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Front cover photography: Bojan Erhartič loved mountains and also visited the Altai mountains lying on the contact between Kazakhstan, Mongolia, China and Russia (photograph: Bojan Erhartič).
Fotografija na naslovnici: Bojan Erhartič je ljubil gore in je obiskal tudi gorovje Altaj, ki leži med Kazahstanom, Mongolijo, Kitajsko in Rusijo (fotografija: Bojan Erhartič).

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GEOMORPHOLOGY AND WINE: THE CASE OF MALVASIA IN THE VIPAVA VALLEY, (SLOVENIA)

GEOMORFOLOGIJA IN VINO: PRIMER SORTE MALVAZIJA V VIPAVSKI DOLINI

Petra Jamšek Rupnik, Franc Čuš, Andrej Šmuc

PRIMOŽ RUPNIK

Vineyards spreading across the slopes of the Vipava valley.
Vinogradi se razprostirajo prek pobočij Vipavske doline.

Geomorphology and wine: the case of Malvasia in the Vipava valley, Slovenia

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ABSTRACT: The concept of terroir incorporates interaction between geogenic and anthropogenic parameters and defines the typicity and quality of wine in a particular geographic area. Geomorphology represents one of the most important geogenic parameters of terroir. In 2008 we produced two wines from two different sites located within the same vineyard in the Vipava valley (Slovenia). Despite identical vine-growing and winemaking techniques, the two sites yielded grapes and wines of different quality. Both sites are identical in terms of macroclimate and bedrock, thus the differences are related to soil composition, drainage and microclimate, all directly linked to different geomorphic positions.

KEY WORDS: terroir, geomorphology, soil, drainage, microclimate, wine, Malvasia, Vipava valley, Slovenia

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1 Introduction

Geomorphological characteristics of wine-producing areas represent an important part of winemaking. They are included in the concept of **terroir**, which incorporates the interaction between geogenic and anthropogenic parameters and defines the typicity and quality of wine (e.g. Wilson 1998; Meinert 2004; Hugget 2006). Beside geomorphology, geogenic parameters of terroir include bedrock, hydrogeological and pedogenic characteristics, and climate. Anthropogenic parameters of terroir include specific vine-growing and winemaking techniques. Despite the fact that geogenic factors of terroir affect grape yield, vine vigour, and fruit quality (e.g. Trought et al. 2008), the relative importance of individual factors remains controversial due to their interaction and variability in time (e.g. Wilson 1998; Meinert 2004).

Vineyards in Slovenia extend over approximately 16,000 ha with an average annual production of ~70 million litres of wine, ~8 million litres being exported and ~9 million imported (Zagorc et al. 2014). Wine consumption amounts to 39 L per capita, placing Slovenia among the top five European wine consumers (Čuš et al. 2007). Therefore, winemaking is an important part of the Slovenian economy, the focus of research, however, has been mainly on grapevine varieties, training systems, cultivation techniques, etc., while physical elements of terroir have been neglected.

The present study examines the importance of geomorphic factors and attempts to define the spatial scale on which they influence the wine.We performed interdisciplinary research on the Malvasia (*Vitis vinifera* L.) terroir in the Vipava valley (Figure 1) that included all fundamental geogenic and anthropogenic

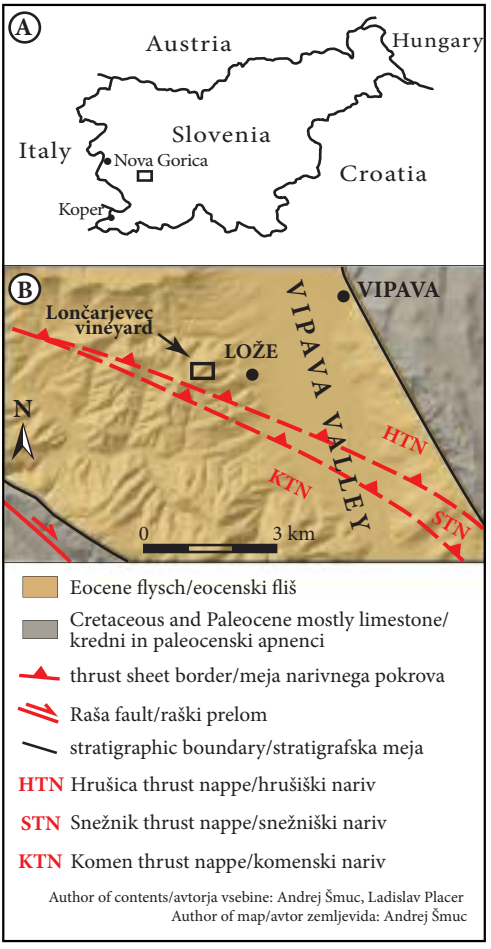

Figure 1: (A) Location of the studied area. (B) Generalized tectonic map of the Vipava valley (modified after Placer 1981) with location of the studied vineyard.

aspects of terroir. To separate the role of geomorphology, other geogenic and anthropogenic factors had to be the same. The selected Lončarjevec vineyard (Figures 2 and 3) was the perfect candidate: a) the vineyard bedrock is uniform; b) the vineyard is small enough to ensure the same macroclimate; and c) the investigated Malvasia was planted in the same year in two distinct topographic localities within the same vineyard, hereafter reffered as the Upper Malvasia (UM) planted on a terraced slope and the Lower Malvasia (LM) planted in the valley bottom, though both are of the same variety. With identical vine-growing and winemaking techniques two wines were produced from the two vineyard sites in 2008, allowing a direct comparison with differences in terroir.

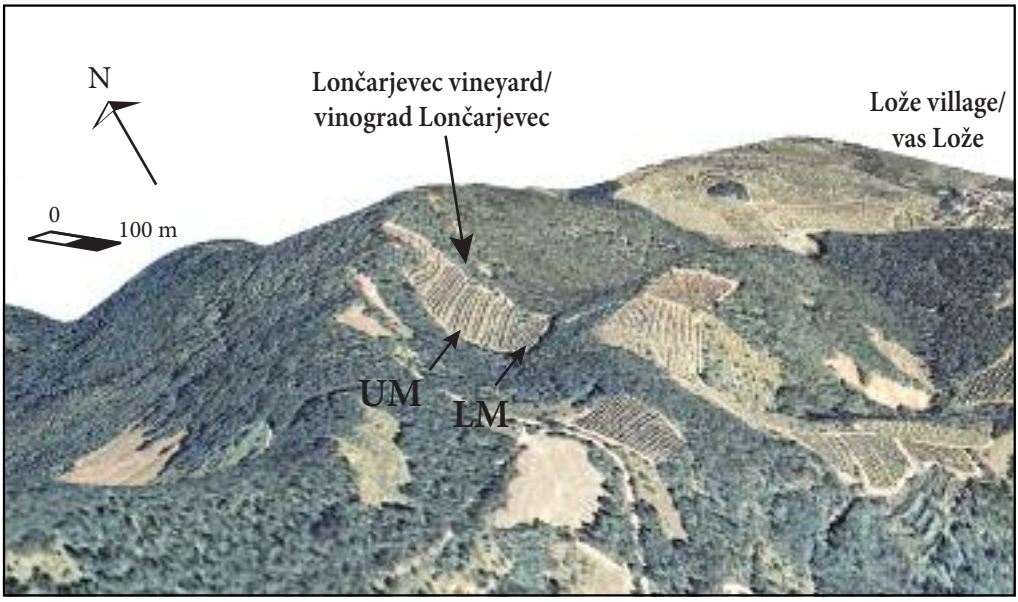

Figure 2: Orthophoto image of the study area (recorded in 2006) over the DEM 5 m resolution (The Surveying and mapping authority of the Republic of Slovenia 2014).

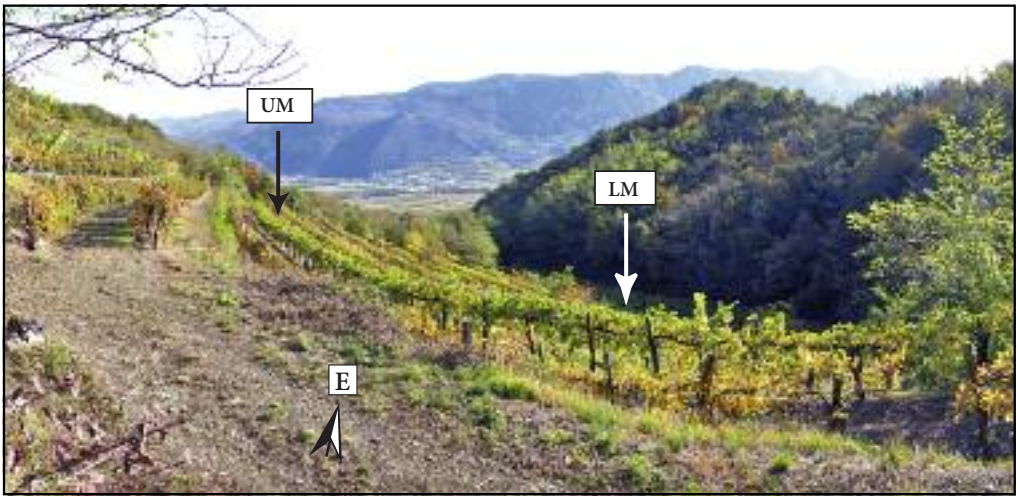

Figure 3: Lončarjevec vineyard with marked UM and LM sites.

2 Materials and methods

2.1 Bedrock

Detailed geological mapping of the vineyard at 1 : 5,000 scale was done in order to define the bedrock conditions.

2.2 Soil

Soil samples were collected according to the methodology described in ISO 10381-1,2,4 (2002/2003) in April 2009, eight months after the last tilling, from two studied rows in the vineyard and from two depths: 0–20 cm, and 20–40 cm. Two representative soil samples for each site (0–20 cm and 20–40 cm sample) were made up of a composite of five subsamples taken at even distances across the row, ~20 cm away from the vines. After a week of air-drying at 25 °C, the samples were disaggregated, sieved to 2 mm to remove parts of the substratum (skeleton), and then ground in a mechanical agate grinder to a fine powder < 63 µm. The mineralogical composition was identified via X-ray diffractometry (XRD, Philips, PW 1820) on unoriented powder mounts (Cu Kα / Ni 40 kV, 30 mA) with the X'Pert HighScore software program. Elemental composition of soil samples was analysed in a certified commercial Canadian laboratory (Acme Analytical Laboratories, Ltd.) after extraction for 1 h with 2-2-2- HCl–HNO_3–H_2O at 95 °C by inductively coupled plasma mass spectrometry (ICP-MS). The accuracy and precision of the soil analyses were assessed by using international reference material such as the Canadian Certified Reference Material Project (CCRMP) SO-1 (soil) and United States Geological Survey (USGS) G-1 (granite).

2.3 Climate

Climatic data were obtained from the nearest automatic meteorological station, located in the Bilje village, 25 km westward from the studied area. Monthly and daily temperature and precipitation data are available from ARSO (2015).

2.4 Grapes and wine

Five healthy and normally grown vines were randomly selected in each of the vineyard sites to examine the grape yield and grape quality. The grape yield was estimated by weighing grape clusters of each vine. Samples of 100 randomly selected grapes were collected from 10 grape clusters per vine taken from all sides of each grape cluster. All grapes were weighed and pressed manually. Pressed juice was left to settle and then the sugar content was measured by digital refractometer as well as the total acidity (g/L of tartaric acid) and pH value (OIV 2012).

60 vines from each vineyard site were harvested on 19 September 2008 to produce two wines. Grape processing and vinification were the same for both wines. Grapes (~200 kg/site) were destemmed, crushed, and pressed. Must (~140 L/site) was poured into stainless steel tanks and potassium metabisulphite was added (0.1 g/L). The must (~120 L/site) was decanted after 36 h, and then rehydrated dry yeasts (*Saccharomyces bayanus*) were added (0.2 g/L; Enologica Vason). Yeast nutriment (0.2 g/L) was added the next day (V ACTIV, Enologica Vason). Alcoholic fermentation lasted for four days at a temperature of 15–18 °C. Seven days after the fermentation was completed, the wine was decanted (~110 L/site) and 0.1 g of potassium metabisulphite per litre was added. Alcohol level, total acidity, residual sugar, and pH value of the wines were measured one month after the completed fermentation using the reference methods by the OIV (2012).

3 Results

3.1 Geological setting

The bedrock of the vineyard and its surroundings consists of Eocene flysch with intercalated calciturbidite beds (Figure 4). The vineyard itself is underlain only by siliciclastic flysch represented by an alternation of sandstones, siltstones and marls. Intercalated 1–20 m thick carbonate beds (carbonate breccias and calcarenites) form the edges of the vineyard.

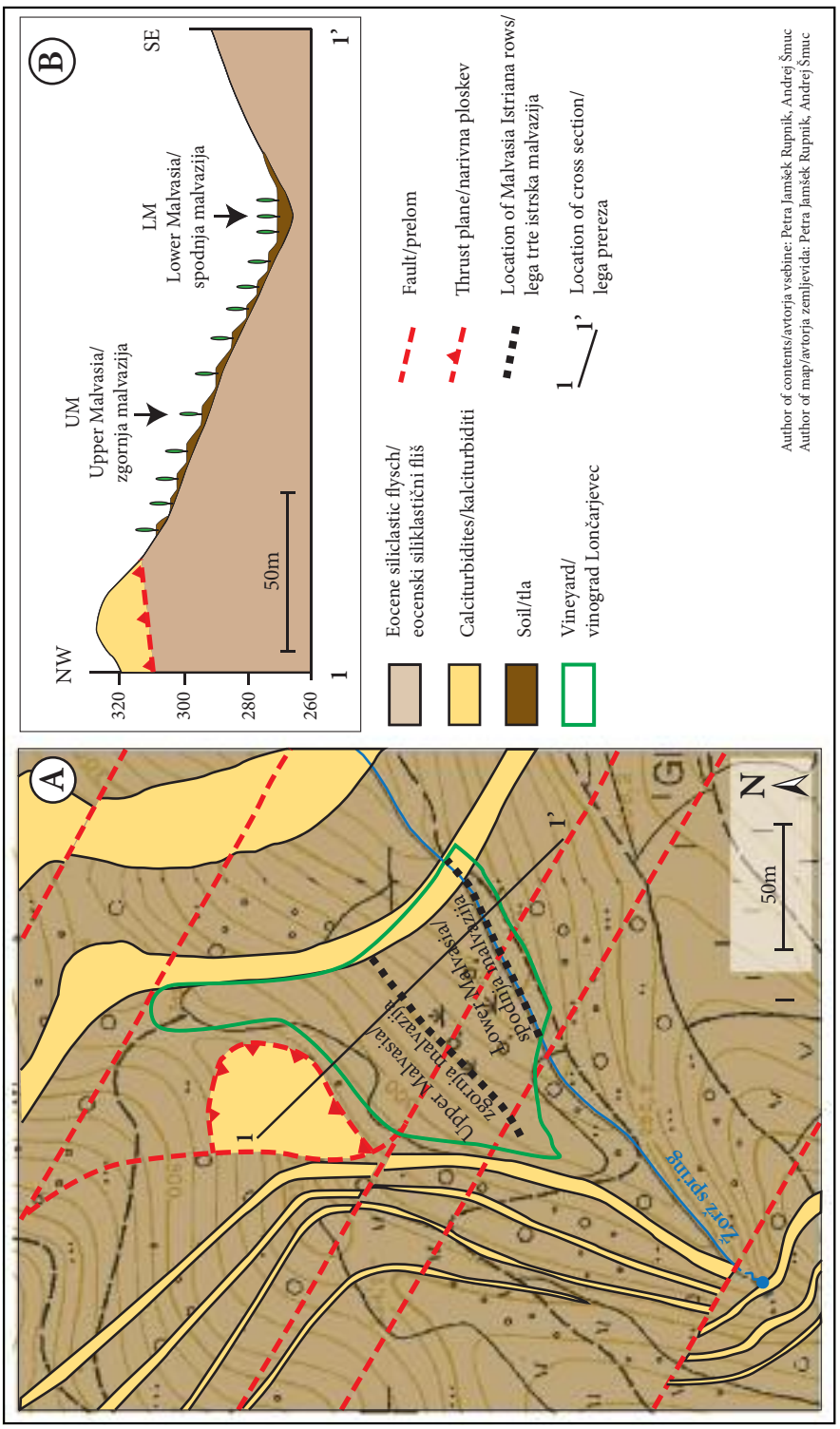

Figure 4: Geological map (A) and profile (B) of the Lončarjevec vineyard.

3.2 Geomorphology

The development of the present landforms of and around the vineyard resulted mainly from Neogene-to-recent thrust and strike-slip tectonics, evolution of the fluvial-drainage network, differential erosional processes due to lithological differences in Eocene flysch succession (carbonate rocks being more resistant to weathering, cf. Komac and Zorn 2008) and subsequent slope processes (cf. Zorn 2009; Popit et al. 2014). The vineyard lays on a southeastern slope (Figures 4, and 5); the upper part is on a steep slope (~ 50% inclination) stretching between altitude of 270–310 m, while the lower part is on a flat valley bottom at 270 m altitude. The slope is terraced to individual terraces 3.5–4.0 m wide and UM is located on the 6th terrace from the bottom. UM has south-east exposure, LM on the other hand is located on a relatively flat surface.

3.3 Hydrogeological properties

The siliciclastic flysch has low permeability with hydraulic conductivity in the range of 1.10^{-6} to 1.10^{-7} m/s (e.g. Janža and Prestor 2002), while intercalated thick carbonate beds have fracture water conductivity with hydraulic permeability several orders of magnitude higher than flysch (e.g. Verbovšek 2008). Areas with flysch bedrock are characterized by a dense network of small and usually non-perennial watercourses draining water from the surface and subsurface. The intercalated carbonate beds in these areas can form smaller aquifers. Within the vineyard the water is drained on the surface or subsurface from the slopes towards the valley bottom where also a few weak springs occur on the carbonate/flysch contact. At the valley bottom waters merge into the Žorž spring (Figure 4) with a torrent character.

Hydrological properties differ within the vineyard. Slope of the vineyard has a relatively fast surface and subsurface drainage and is therefore drier, while the valley bottom is usually wetter due to slower drainage and larger quantities of received waters.

3.4 Pedological properties

The soil of the vineyard was derived from Eocene flysch mainly by direct organic and weathering breakdown and slope redeposition. Fine grained loamy clay vitisol is regularly tilled and homogenized, with a neutral pH (7.0) and cation-exchange capacity at 20–35 milliequivalent of hydrogen per 100 g of dry soil.

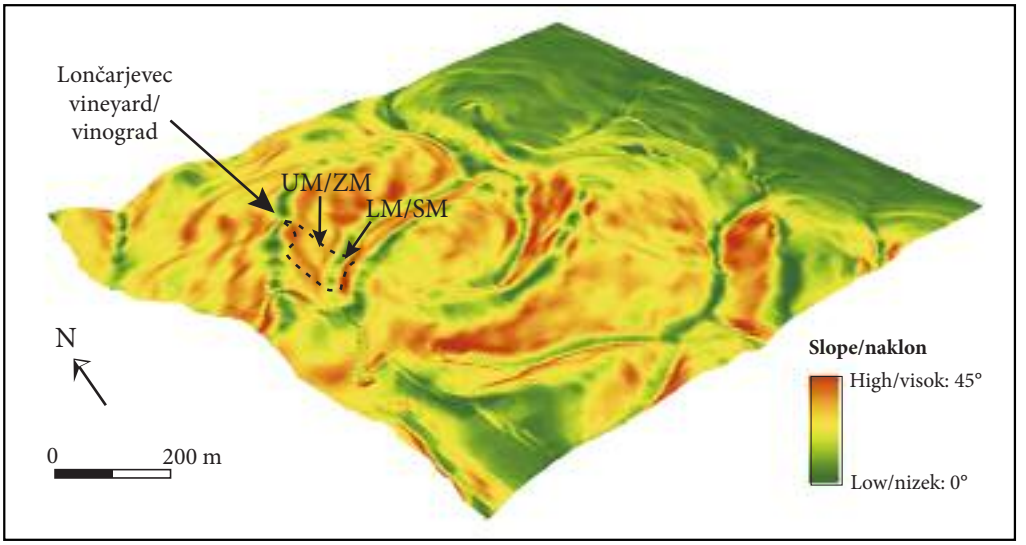

Figure 5: Slope map derived from 5 m resolution DEM (The Surveying and mapping authority of the Republic of Slovenia).

The soil thickness in the vineyard varies; on a slope it is from 20 cm on the inner side to up to 2 m on the outer side of the terrace, while at the valley bottom it is 2–5 m thick.

X-ray diffraction of soils show the overall mineralogy is comparable within the vineyard; however some differences occur (Table 1). The LM soils contain more abundant clay minerals of montmorillonite and clinoclore, whereas the UM subsurface soils contain calcite.

Table 1: Identified minerals in UM and LM soils.

Site	Soil depth [cm]	Quartz	Muscovite Illite	Albite	Clay minerals		Calcite
					Montmorillonite	Clinochlore	
LM	0–20	✓	✓	✓	✓	✓	×
	20–40	✓	✓	✓	✓	✓	×
UM	0–20	✓	✓	✓	×	×	×
	20–40	✓	✓	✓	×	✓	✓

Soil geochemistry show the content of major elements is again quite similar for both sites, with some differences (Table 2); the UM soil is enriched in MgO and CaO and has lower P_2O_5 content than LM. These results show good concordance with mineralogical study that identified carbonate in the UM soil.

Table 2: Major element concentrations in UM and LM soils (values are in %).

Site	Soil depth [cm]	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	MnO	LOI
LM	0–40	58.5	14.8	6.2	1.4	1.2	0.9	2.8	0.7	0.19	0.18	13.0
UM	0–40	60.3	15.8	6.7	1.7	1.7	0.9	2.8	0.8	0.13	0.21	8.9

3.5 Climatic characteristics

The Vipava valley has a specific transitional climate that represents a mixture of Mediterranean and continental climate influence. The mild climate of the valley is often interrupted by a strong northeasterly wind

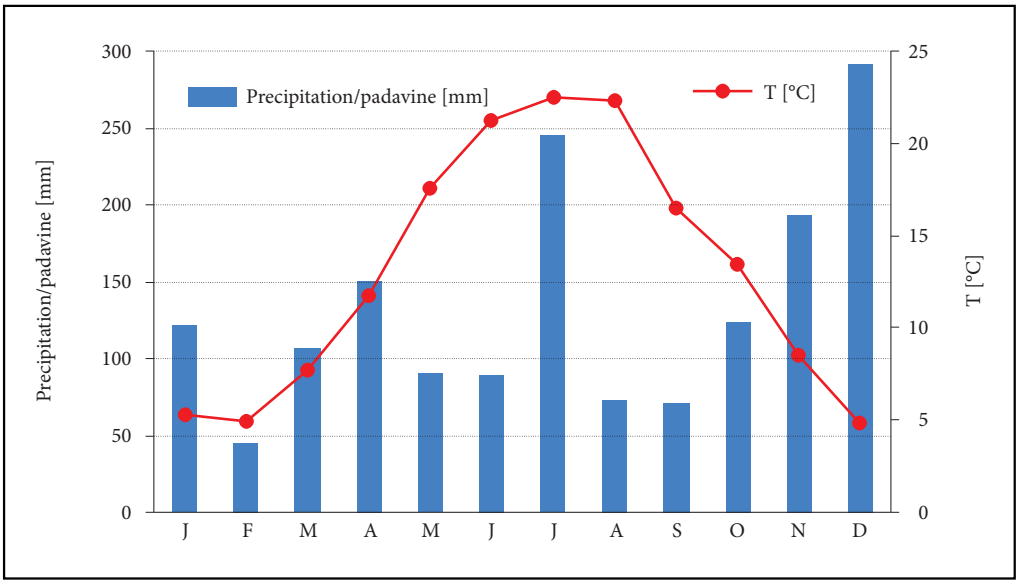

Figure 6: Average air temperature (lines) and monthly sum of precipitation in 2008 (ARSO data source 2015).

Bora that can reach a speed of 200 km/h (e.g. Mihevc 1997). The annual rainfall in the area is between 1,400 and 1,700 mm (ARSO 2015). The majority of rainfall is in spring and autumn, while winter snow is rare. The second part of July and August is usually the drier season, with uneven distribution of short-lasting and torrential rain followed by longer periods with minimal rainfall, higher temperatures, and wind. During 2008 the annual precipitation was 1,601 mm, 110 % of the 1961–1990 average, and the average annual air temperature was 13 °C (Figure 6, ARSO 2015). During the winter the daily average temperatures dropped below 0 °C for six days, while daily average temperatures in summer reached up to 27 °C (ARSO 2015). The area received 2,136 h/yr of solar radiance, 101% of the 1961–1990 average (ARSO 2015).

Microclimates of the vineyard differ. The UM site enjoys strong solar radiance but is more exposed to the Bora wind. The LM site receives less solar radiance and is more prone to frost but less exposed to the Bora wind.

3.6 Anthropogenic parameters

The Lončarjevec vineyard is planted with 3,500 vines, of which 800 belong to the Malvasia variety, planted in April 1993, with a cordon training system *Casarsa*. Vine spacing is 2.2 m and row spacing is 3.0 m. Rows trend in NE–SW direction. The plant material and rootstock (Selection Oppenheim 4) for both localities is the same and originates from the Vrhpolje nursery at Vipava.

3.7 Grapes and wine

Results of analyses of yield and quality parameters of grapes and wines are shown in Table 3.

Table 3: Yield and quality parameters of grapes and wines.

	Parameters	UM	LM	Statistical significance (%)
Yield	No. of grape clusters per vine	19.4 ± 3.1	18.4 ± 4.8	70.8
	Weight of 10 random grape clusters per vine [g]	1,886 ± 241	1,970 ± 258	61.2
	Total weight of grapes per vine [g]	3,600 ± 400	3,700 ± 1,400	88.6
	Weight of 100 random grape berries per vine [g]	256.9 ± 10	262.5 ± 10.1	40.4
Grape quality	Sugar content [Öe]	83 ± 8	77 ± 3	18.2
	Total acidity [g/L]	10.3 ± 1.4	12.0 ± 1.5	10.4
	pH	3.20 ± 0.10	3.09 ± 0.03	9.3
Wine quality	Alcohol [vol. %]	10.9	10.4	
	Residual sugar [g/L]	0.9	1.2	
	Total acidity [g/L]	10.3	11.3	
	pH	3.22	3.10	

LM, and UM vines yielded similar number, and total weight of grape clusters per vine, but the average weight of 100 grape berries was higher on the LM site (Figure 7). Differences however were not statistically significant.

The average sugar content and pH was higher and the total acidity lower in the UM grapes (Figure 8). Only differences in total acidity and pH value are statistically significant with 10.4% and 9.3%, respectively.

The UM wine had higher alcohol content and pH and lower common acidity. The significance of the differences cannot be assesed however, since one wine was produced from each site.

4 Discussion

Despite very similar geologic, pedogenic, and macroclimate conditions, the quality of the UM and LM grapes differed, particularly in terms of total acidity and pH. The total acidity in wine influence the sensorial perception of acidity. Although the winemaking was done in only one sample per each site, the differences in total acidity and pH value in the wines confirmed the differences detected in the grape juice.

In a particular year, a must's total acidity depend mainly on geology, soil and climate, including soil humidity and permeability, rainfall patterns and temperature. The UM and LM sites have identical macroclimate and bedrock, significant differences in the wines are therefore related to different soil composition (1), drainage (2), and microclimate (3), which are directly linked to geomorphic positions of the sites.

1. The UM soil depth (20 cm to 2 m) allowed thorough tilling and better soil nutrients homogenization which could explain a slightly higher CaO and MgO content compared to the LM soil. In up to 5 m deep LM soil, tilling did not reach deeper horizons and did not recycle the CaO and MgO from deeper parts.

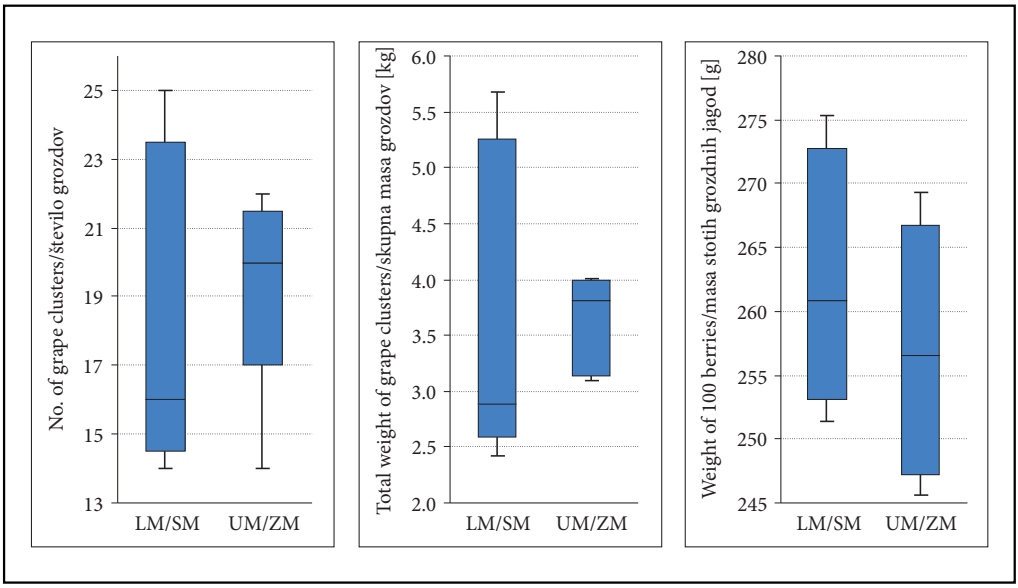

Figure 7: Whisker plots of grape yield parameters.

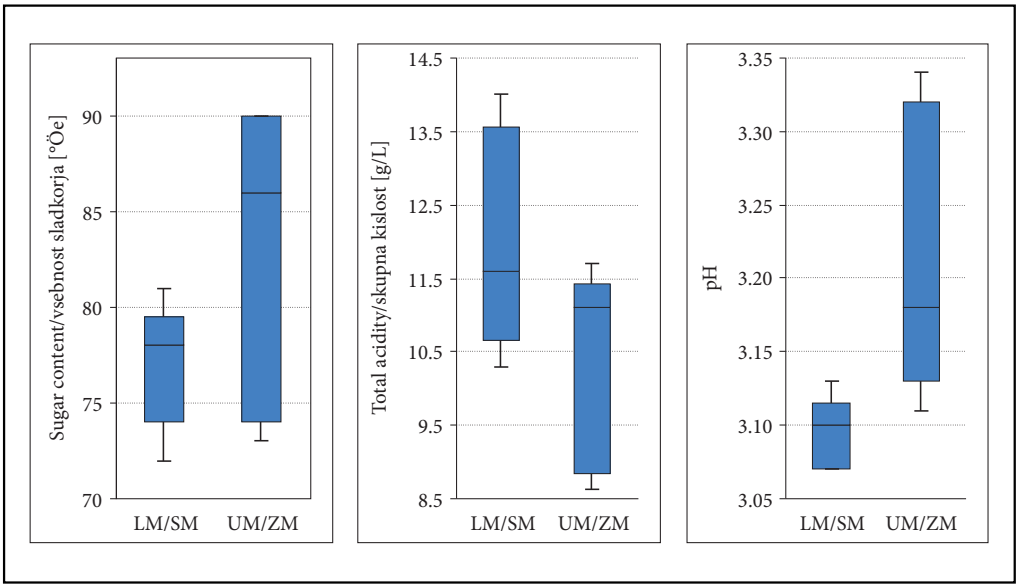

Figure 8: Whisker plots of grape quality parameters.

2. The steeper UM site allows far better drainage. This is partly a result of the mineralogical differences; the UM soils have lower clay minerals content because they are washed into lower soil parts and transported downslope, accumulating in the LM soils. Clays have higher water retention capacity and retard water drainage. Since a mild to moderate water deficit has a positive effect on the fruit and wine phenolic composition and the wine sensory characteristics (e.g. Zsofi et al. 2011) good drainage is essential.
3. Slope and its aspect influence the solar radiation load (Huggett 2006). The UM site enjoys stronger solar radiance, has stronger evapotranspiration rate and is less prone to frost. Higher clay minerals content in the LM soils also contributed to the faster heat loss affecting the acidity of the grapes and wines (cf. Huggett 2006).

5 Conclusion

In 2008 we produced two wines of Malvasia from two different sites within the same vineyard in the Vipava valley, one on the terraced slope and another in the valley bottom. With identical vine growing, and wine-making techniques the two sites yielded grapes and wines of different quality. Since the studied vineyard has uniform bedrock and the same macroclimate, significant differences in the grapes and wines are due to different soil composition, drainage and microclimate, which are directly linked to different geomorphic positions. Geomorphic position of not only the vineyard but also the vines within it influences wine quality.

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IZVLEČEK: Koncept terroirja združuje interakcijo geogenih in antropogenih parametrov, ki vplivajo na tipičnost in kakovost vina na določenem geografskem območju. Eden najpomembnejših geogenih parametrov terroirja so geomorfološke značilnosti vinograda. Iz dveh različnih leg v istem vinogradu v Vipavski dolini smo leta 2008 pridelali dve vini. Kljub enakim vinogradniškim in vinarskim tehnikam pridelave sta bili kakovost grozdja in vina iz obeh leg različni. Legi zaznamujeta enaka makroklima in geološka podlaga, torej so razlike, ki smo jih zaznali v grozdju in vinu, odvisne predvsem od sestave tal, drenaže in mikroklime. Ti parametri so neposredno povezani z različno geomorfno pozicijo raziskovanih leg.

KLJUČNE BESEDE: terroir, geomorfologija, tla, drenaža, mikroklima, vino, malvazija, Vipavska dolina, Slovenija

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1 Uvod

Geomorfološke značilnosti vinorodnih območij imajo pomemben vpliv na kakovost grozdja in vina. Vključene so v koncept terroirja, ki združuje interakcijo geogenih in antropogenih parametrov, ki vplivajo na tipičnost in kakovost vina (npr. Wilson 1998; Meinert 2004; Hugget 2006). Poleg geomorfologije geogeni parametri terroirja obsegajo še geološko podlago, hidrogeološke, pedološke ter podnebne značilnosti območja. Antropogeni parametri terroirja vključujejo način obdelave vinograda in proces pridelave vina. Geogeni faktorji terroirja pomembno vplivajo na uspevanje, rodnost trsov in kakovost grozdja (npr. Trought s sodelavci 2008), vendar njihov relativni pomen ostaja sporen zaradi interakcij in časovne variabilnosti (npr. Wilson 1998; Meinert 2004).

Vinogradi se v Sloveniji razprostirajo na približno 16.000 ha, povprečna letna pridelava vina znaša ~70 milijonov litrov, ~8 milijonov litrov je izvoženih in ~9 milijonov uvoženih (Zagorc s sodelavci 2014). Letna poraba vina znaša 39 litrov na prebivalca, kar Slovenijo postavlja med pet največjih potrošnikov vina v Evropi (Čuš s sodelavci 2007). Pridelava vina je zato pomemben del slovenske ekonomske dejavnosti. Raziskave so bile doslej bile usmerjene predvsem na sorte trsov, gojitvene oblike, načine obdelave, medtem ko so bili zapostavljeni fizični elementi terroirja.

Naše delo raziskuje pomembnost geomorfnih dejavnikov in skuša ugotoviti, na kakšnem prostorskem merilu le-ti vplivajo na kakovost vina. Interdisciplinarne raziskave smo usmerili na primer terroirja malvazije (*Vitis vinifera* L.) v Vipavski dolini (slika 1), vključujoč vse temeljne geogene in antropogene vidike terroirja. Da bi vlogo geomorfologije lahko ločili od ostalih dejavnikov, smo morali zagotoviti enake ostale geogene in antropogene razmere. Izbrani vinograd Lončarjevec (sliki 2 in 3) je bil v tem oziru idealen: a) geološka podlaga vinograda je enotna; b) vinograd je dovolj majhen za zagotavljanje enake makroklime in c) preiskovana sorta malvazija je bila v istem letu posajena na dveh različnih topografskih legah znotraj istega vinograda: na terasiranem pobočju (v nadaljevanju imenovano Zgornja malvazija – UM/ZM) ter na dnu doline (Spodnja malvazija – LM/SM); v obeh primerih gre za isto sorto. Z enakimi vinogradniškimi in vinarskimi tehnikami je bilo v letu 2008 iz vsake lege pridelano vino, kar je omogočilo neposredno primerjavo z razlikami v terroirju.

Slika 1: (A) Lokacija obravnavanega območja. (B) Generalizirana tektonska karta Vipavske doline (po Placer 1981) z lokacijo obravnavanega vinograda.
Glej angleški del prispevka.

Slika 2: Ortofoto obravnavanega območja (posnet v letu 2006) prek DMR z ločljivostjo 5 m (Geodetska uprava Republika Slovenije).
Glej angleški del prispevka.

Slika 3: Vinograd Lončarjevec z označenima legama ZM in SM.
Glej angleški del prispevka.

2 Materiali in metode dela

2.1 Geološka podlaga

Geološke razmere smo raziskali z detajlnim geološkim kartiranjem vinograda in njegove okolice v merilu 1 : 5.000.

2.2 Tla

Prst oziroma tla smo vzorčili aprila 2009, osem mesecev po zadnjem rigolanju, po metodologiji opisani v ISO 10381-1,2,4 (2002/2003). Vzorce smo pobrali iz dveh obravnavanih leg oziroma vrst trsov in iz dveh globin: 0–20 cm in 20–40 cm. Iz vsake lege smo izdelali po dva reprezentativna vzorca (0–20 cm in 20–40 cm), sestavljena iz petih pod-vzorcev, ki smo jih odvzeli enakomerno po vrsti trsov in v oddaljenosti ~20 cm od trsov. Po enotedenskem sušenju na 25 °C smo vzorce presejali skozi sito z 2 mm odprtinami, s čemer so bili odstranjeni večji delci matične podlage (skelet), in nato drobili v ahatski terilnici na zrnavost finega prahu < 63 µm. Mineraloško sestavo smo določili z rentgensko difrakcijo (XRD, Philips, PW 1820) na neorientiranih vzorcih (Cu Kα / Ni 40 kV, 30 mA) in z uporabo programa X'Pert HighScore. Elementna

sestava vzorcev je bila izmerjena v akreditiranem kanadskem laboratoriju Acme (Acme Analytical Laboratories, Ltd.) in sicer s postopkom enournega izluževanja z 2-2-2- HCl–HNO_3–H_2O pri temperaturi 95 °C ter visokoločljivostnim ICP-MS (masni spektrometer z induktivno sklopljeno plazmo). Natančnost in točnost analiz je bila ocenjena z uporabo mednarodnih referenčnih materialov, kot sta CCRMP SO-1 (zemlja) in USGS G-1 (granit).

2.3 Podnebje

Klimatske podatke smo pridobili iz najbližje avtomatske vremenske postaje v vasi Bilje, 25 km zahodno od obravnavanega območja. Podatki o mesečnih in dnevnih temperaturah in padavinah so dostopni prek ARSO (2015).

2.4 Grozdje in vino

Količino (rodnost) in kakovost pridelka smo izmerili na petih naključno izbranih zdravih in normalno razvitih trsih na vsaki od leg v vinogradu. Rodnost trsov smo ocenili s tehtanjem grozdja na vsakem trsu. Vzorec stotih naključno izbranih grozdnih jagod smo odvzeli iz desetih grozdov in iz vseh delov grozda. Jagode smo stehtali in ročno stisnili. Po bistrenju grozdnega soka s samousedanjem smo izmerili koncentracijo sladkorja, skupnih kislin (g/l vinske kisline) in pH (OIV 2012).

Na vsaki od obravnavanih leg smo 19. septembra 2008 potrgali grozdje iz 60 trsov in ga predelali v vino. Predelava grozdja in proces pridelave vina sta bila za obe vini enaka. Grozdje (~200 kg/lego) smo pecljali, drozgali in stisnili. Mošt (~140 l/lego) smo shranili v nerjavečo posodo in mu dodali kalijev metabisultif (0,1 g/l). Po 36 urah smo mošt pretočili (~120 l/lego) in mu dodali rehidrirane suhe kvasovke *Saccharomyces bayanus* (0,2 g/l; Enologica Vason). Naslednji dan smo dodali hrano za kvasovke (0,2 g/l; V ACTIV, Enologica Vason). Alkoholna fermentacija je trajala štiri dni pri temperaturi 15–18 °C. Sedem dni po zaključeni alkoholni fermentaciji smo vino pretočili (~110 l/lego) in mu dodali 0,1 g kalijevega metabisulfita na liter vina. Alkoholno stopnjo, koncentracijo skupnih kislin, reducirajočih sladkorjev in pH v obeh vinih smo izmerili mesec dni po zaključeni alkoholni fermentaciji po referenčnih metodah OIV (2012).

3 Rezultati

3.1 Geološka podlaga

Podlago vinograda in okolice gradi eocenski fliš z vmesnimi plastmi karbonatnih turbiditov (slika 4). Vinograd leži samo na siliciklastičnem flišu, ki ga sestavlja menjavanje peščenjakov, meljevcev in laporovcev. Od 1 do 20 m debele karbonatne plasti (karbonatne breče in kalkareniti) pa tvorijo robove vinograda.

Slika 4: Geološka karta (A) in profil (B) vinograda Lončarjevec.
Glej angleški del prispevka.

3.2 Geomorfologija

Današnje površje vinograda in njegove okolice je posledica neogenske–recentne narivne in zmične tektonike, razvoja rečne drenažne mreže, različnih erozijskih procesov zaradi litoloških razlik v eocenskem flišnem zaporedju (karbonatne kamnine so odpornejše proti preperevanju, cf. Komac in Zorn 2008) in sledečih pobočnih procesov (cf. Zorn 2009; Popit s sod. 2014). Vinograd leži na jugovzhodnem pobočju (sliki 4 in 5); zgornji del je na strmem pobočju z naklonom ~50 % na nadmorski višini 270–310 m, medtem ko je spodnji del v ravnem dolinskem dnu na nadmorski višini 270 m. Pobočje je terasirano na posamezne terase s širino 3,5–4,0 m in ZM leži na šesti terasi od spodaj navzgor. ZM ima jugovzhodno ekspozicijo, SM pa je na razmeroma ravnem površju.

Slika 5: Zemljevid naklonov površja izdelan iz DMR z ločljivostjo 5 m (Geodetska uprava Republika Slovenije).
Glej angleški del prispevka.

3.3 Hidrogeološke lastnosti

Siliciklastičen fliš je slabo vodoprepusten, njegov koeficient vodoprepustnosti je reda velikosti $1 \cdot 10^{-6}$ do $1 \cdot 10^{-7}$ m/s (npr. Janža in Prestor 2002), medtem ko imajo vmesne karbonatne plasti razvito razpoklinsko poroznost z nekaj razredov višjim koeficientom vodoprepustnosti kot fliš (npr. Verbovšek 2008). Za flišno pokrajino je značilna gosta hidrografska mreža majhnih in običajno nestalnih vodotokov, ki drenirajo vodo s površja in preperinskega sloja. Vmesne karbonatne plasti v teh območjih lahko tvorijo manjše vodonosnike. Znotraj vinograda se voda drenira po površju in pod preperinskim slojem s pobočja proti dnu doline, kjer se pojavlja nekaj šibkih izvirov na stiku karbonatnih in flišnih kamnin. Na dnu doline se voda združi v Žoržev potok (slika 4), ki ima hudourniški značaj.

Hidrološke značilnosti znotraj vinograda so raznolike. Pobočje vinograda ima relativno hitro drenažo površja in preperinskega sloja ter je zato bolj suho, medtem ko je dno doline običajno bolj vlažno zaradi počasnejše drenaže in večje količine prejete vode.

3.4 Pedološke lastnosti

Tla v vinogradu so nastala iz eocenskih flišev predvsem z organskim in mehanskim preperevanjem ter pobočnimi premiki preperine. Drobnozrnati ilovnato-glinasti vitisol je redno rigolan in homogeniziran, ima nevtralen pH (7.0) in izmenjalno kapaciteto 20–35 miliekvivalentov hidrogena na 100 g suhih tal. Debelina tal je znotraj vinograda različna; na pobočju so debela od 20 cm na notranji strani do 2 m na zunanji strani teras, na dnu doline pa 2–5 m.

Rentgenska difrakcija vzorcev tal kaže, da je mineraloška sestava tal znotraj vinograda podobna, vendar se pojavlja nekaj razlik (preglednica 1). Tla SM vsebujejo več glinenih mineralov montmorillonita in klinoklora v primerjavi s ZM, ki vsebuje v spodnjem horizontu tudi kalcit.

Preglednica 1: Minerali v tleh ZM in SM.

lokacija	globinski vzorec tal [cm]	kremen	muskovit/illit	albit	glineni minerali		kalcit
					montmorillonit	klinoklor	
SM	0–20	✓	✓	✓	✓	✓	×
	20–40	✓	✓	✓	✓	✓	×
ZM	0–20	✓	✓	✓	×	×	×
	20–40	✓	✓	✓	×	✓	✓

Tudi geokemične raziskave tal kažejo, da je vsebnost glavnih elementov precej podobna na obeh legah, a z nekaj razlikami (preglednica 2): tla ZM so obogatena z MgO in CaO ter imajo manj P_2O_5 kot tla SM. Ti rezultati so skladni z ugotovitvijo mineraloške analize, ki kaže na vsebnost karbonatov v tleh ZM.

Preglednica 2: Koncentracije glavnih elementov v tleh ZM in SM (vrednosti v %).

lokacija	globinski vzorec tal [cm]	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	MnO	LOI
SM	0–40	58,5	14,8	6,2	1,4	1,2	0,9	2,8	0,7	0,19	0,18	13,0
ZM	0–40	60,3	15,8	6,7	1,7	1,7	0,9	2,8	0,8	0,13	0,21	8,9

3.5 Podnebne značilnosti

Vipavska dolina ima svojevrstno prehodno podnebje, ki predstavlja mešanico mediteranskih in celinskih vplivov. Sicer zmerno podnebje v dolini pogosto prekinja močan severovzhodni veter, imenovan burja, ki lahko doseže hitrost 200 km/h (npr. Mihevc 1997). Letna količina padavin v Vipavski dolini je med 1400 in 1700 mm (ARSO 2015). Glavnina padavin je jeseni in spomladi, snežne padavine so redke. V drugi polovici julija in v avgustu je običajno suho obdobje z neenakomerno razporejenimi kratkotrajnimi plohami

in nalivi, ki jim sledijo daljša obdobja z malo padavinami, višjimi temperaturami in vetrom. Leta 2008 je količina padavin znašala 1601 mm, tj. 110 % povprečja v obdobju 1961–1990, povprečna letna temperatura zraka je bila 13 °C (slika 6; ARSO 2015). Pozimi se je povprečna dnevna temperatura spustila pod 0 °C za šest dni, poleti pa je dnevno povprečje doseglo do 27 °C (ARSO 2015). Sončno obsevanje je trajalo 2136 h/leto, kar je 101 % povprečja v obdobju 1961–1990 (ARSO 2015).

Znotraj vinograda se mikroklima razlikuje. Lega ZM je deležna več sončnega obsevanja, a je bolj izpostavljena burji. Lega SM je deležna manj sončnega obsevanja in je bolj podvržena zmrzali, a je manj izpostavljena burji.

Slika 6: Povprečna temperatura zraka (linije) in mesečna količina padavin v letu 2008 (vir podatkov: ARSO 2015).
Glej angleški del prispevka.

3.6 Antropogeni parametri

Vinograd Lončarjevec je zasajen s 3500 trsi, od tega je 800 trsov sorte malvazija, sajenih aprila 1993, na kordonski gojitveni obliki Casarsa. Medtrsna razdalja je 2,2 m in medvrstna razdalja je 3,0 m. Vrste potekajo v smeri severovzhod–jugozahod. Sadilni material, cepiči in podlaga trsov (selekcija Oppenheim 4) sta enaka na obeh legah. Poreklo sadilnega materiala je trsnica Vrhpolje pri Vipavi.

3.7 Grozdje in vino

Rezultati analiz rodnosti trsov in kakovosti grozdja in vina so prikazani v preglednici 3.

Preglednica 3: Parametri rodnosti trsov in kakovosti grozdja in vin.

	parametri	ZM	SM	statistična značilnost (%)
rodnost trsov	število grozdov na trs	19,4 ± 3,1	18,4 ± 4,8	70,8
	masa 10 naključnih grozdov na trsu [g]	1886 ± 241	1970 ± 258	61,2
	skupna masa grozdja na trs [g]	3600 ± 400	3700 ± 1.400	88,6
	masa 100 naključnih jagod na trsu [g]	256,9 ± 10	262,5 ± 10.1	40,4
kakovost grozdja	sladkor [öe]	83 ± 8	77 ± 3	18,2
	skupna kislina [g/l]	10,3 ± 1,4	12,0 ± 1,5	10,4
	pH	3,20 ± 0,10	3,09 ± 0,03	9,3
kakovost vina	alkohol [vol. %]	10,9	10,4	
	reducirajoči sladkor [g/l]	0,9	1,2	
	skupna kislina [g/l]	10,3	11,3	
	pH	3,22	3,10	

Trsi SM in ZM so imeli primerljivo število grozdov na trs in primerljivo skupno maso grozdja na trs (slika 7). Povprečna masa 100 jagod je bila večja na legi SM (slika 7). Razlike sicer niso bile statistično značilne.

Slika 7: Whisker diagrami za parametre rodnosti trsov.
Glej angleški del prispevka.

Povprečna koncentracija sladkorja in pH je bila višja, skupna kislina pa nižja v grozdju ZM (slika 8). Samo razlike v skupni kislini in vrednosti pH so statistično značilne na ravni zaupanja 10,4 % oziroma 9,3 %.

Slika 8: Whisker diagrami za parameter kakovosti grozdja.
Glej angleški del prispevka.

Vino ZM je imelo več alkohola, višji pH in nižjo skupno kislino. Statistične značilnosti razlik sicer ni moč oceniti, ker je bilo iz vsake lege pridelano le eno vino.

4 Razprava

Kljub zelo podobnim geološkim, pedološkim in makroklimatskim pogojem se je kakovost grozdja na legah ZM in SM razlikovala, predvsem v vsebnosti skupnih kislin in pH v prsti/tleh. Skupna kislina v vinu vpliva na senzorično zaznavanje kislosti. Čeprav je bila vinifikacija izvedena na samo enem vzorcu za vsako lego, razlike v skupni kislini in vrednosti pH v vinih potrjujejo razlike ugotovljene v grozdnem soku.

V določenem letu je skupna kislina v moštu odvisna predvsem od geologije, tal in podnebja, vključujoč vlažnost in prepustnost tal, vzorce padavin in temperaturo. Glede na to, da imata legi ZM in SM identično makroklimo in geološko podlago, so značilne razlike v vinih pogojene z različno sestavo tal (1), drenažo (2) in mikroklimo (3), kar je neposredno povezano z geomorfno pozicijo obeh leg.

1. Globina tal ZM (20 cm do 2 m) dovoljuje temeljito rigolanje in homogenizacijo hranil v tleh, s čimer lahko pojasnimo nekoliko višjo vsebnost CaO in MgO v primerjavi s tlemi SM. V do 5 m debelih tleh SM rigolanje ni doseglo globljih horizontov, zato CaO in MgO nista bila reciklirana iz globljih delov.
2. Lega ZM na strmem pobočju dovoljuje precej boljšo drenažo. To je deloma tudi rezultat mineraloških razlik; tla ZM imajo nižjo vsebnost glinenih mineralov, saj se le-ti izpirajo v globlje horizonte tal, premeščajo po pobočju navzdol in akumulirajo v tleh SM. Gline imajo večjo sposobnost zadrževanja vode in zavirajo odvodnjavanje. Ker ima blago do srednje pomanjkanje vode pozitiven efekt na vsebnost kislin v grozdju in vinu ter na senzorične značilnosti vina (npr. Zsofi s sodelavci 2011), je dobra drenaža bistvena za boljšo kakovost vina.
3. Pobočje s svojim naklonom vpliva na delež prejetega sončnega obsevanja (Huggett 2006). Lega ZM prejme več sončnega obsevanja, ima višjo stopnjo evapotranspiracije in je manj podvržena zmrzali. Višja vsebnost glinenih mineralov v tleh SM prispeva tudi k hitrejši izgubi toplote, kar se odraža v vsebnosti kislin v grozdju in vinu (cf. Huggett 2006).

5 Sklep

Leta 2008 smo pridelali dve vini sorte malvazija iz dveh različnih leg znotraj istega vinograda v Vipavski dolini, ki sta na terasiranem pobočju in na dnu manjše doline. Z enakimi vinogradniškimi in vinarskimi tehnikami pridelave sta bili kakovost grozdja in vina iz obeh leg različni. Glede na to, da sta geološka podlaga in makroklima v obravnavanem vinogradu enotni, so značilne razlike v grozdju in vinu rezultat različne sestave tal, drenaže in mikroklime. Omenjeni parametri so v neposredni zvezi z različno geomorfno lego trsov. Geomorfna pozicija vinograda in tudi posameznih trsov vinske trte znotraj posameznega vinograda torej vplivata na kakovost vina.

6 Literatura

Glej angleški del prispevka.

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TRANSFERABILITY OF A PREDICTIVE *ROBINIA PSEUDACACIA* DISTRIBUTION MODEL IN NORTHEAST SLOVENIA

PRENOSLJIVOST NAPOVEDNEGA MODELA RAZŠIRJENOSTI VRSTE *ROBINIA PSEUDACACIA* V SEVEROVZHODNI SLOVENIJI

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Robinia pseudacacia in the Prekmurje region.
Robinija v Prekmurju.

Transferability of a predictive *Robinia pseudacacia* distribution model in northeast Slovenia

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ABSTRACT: The main goal of this study is to assess the transferability of a species distribution model (SDM) for *Robinia pseudacacia* (black locust) to two testing sites in the Prekmurje region in northeast Slovenia. The predictive performance of the SDM at the testing sites was measured by 1) visual evaluation, 2) confusion matrix, 3) true positive rate (TPR), 4) the maximum of the true skill statistics (TSS) over possible cutoffs, and 5) paired-sample ANOVA. We show that the model adequately predicted potential distribution of the species in the region, which ensures that extension of the prediction at this scale will be a reliable base for nature conservation decisions. This also serves as a positive example for within-region transfer and extension of SDMs.

KEY WORDS: geography, invasive species, landscape features, species distribution model, transferability, Prekmurje

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1 Introduction

Slovenia is among the European countries with best-preserved nature and the highest biological and landscape diversity (Ciglič 2009; Ciglič and Perko 2013; Ciglič and Oštir 2014). This is reflected by the size of Slovenian territory that is protected: 52% of the country lies within ecologically important areas and approximately 35% within Natura 2000 sites (Žvikart 2010). However, Slovenia is also subject to many pressures, one of them being biological invasions. Over the past decade, the cover of invasive species has been increasing. So far, thirty to sixty plant species in Slovenia are considered invasive (Jogan 2000), and *Robinia pseudacacia* (black locust) is one of the species with the potentially greatest negative influence on the biodiversity of natural habitats in Slovenia (Zelnik 2012).

Biological invasions are considered to be the second greatest reason for the loss of biodiversity worldwide (Vitousek et al. 1996). The effects of invasive species on areas invaded are manifold. These species may alter the disturbance regime of the sites they invade (D'Antonio and Vitousek 1992; Hejda and Pyšek 2006), competitively exclude native species and decrease native biodiversity (Walker and Vitousek 1991), alter ecosystem structure (Vitousek et al. 1996; Higgins et al. 1999; D'Antonio and Mack 2001), and lead to enormous economic costs, including decreases in timber growth rates and forest values when forest ecosystems are invaded (Pimentel 2005; Gurevitch et al. 2006). Some ecologists also believe that plant invasions contribute substantially to plant species extinctions (Mooney and Drake 1989; Vitousek 1994; Wilcove et al. 1998). Rodríguez-Labajos et al. (2009) summarized the major socioeconomic driving forces of biological invasions as 1) anthropogenic activities, 2) policies/policy level, and 3) ideology/lifestyle.

Due to their socioeconomic (Pimentel et al. 2001) and environmental effects, biological invasions have increasingly been recognized as a great problem worldwide (Ribeiro et al. 2011). The development of effective strategies to manage and monitor the spatial distribution of invasive species requires data on the habitat preferences of these species and knowledge of how landscape features influence their spatial distribution and establishment. However, detailed data collection is time consuming and logistically demanding (Preuss et al. 2011). Therefore efforts have been made to map invasive species spread in the landscape and to model and predict its spatial distribution into unknown areas (e.g., Liu et al. 2005; Vanderhoof et al. 2009; Ribeiro et al. 2011). Maps of predictive species distributions often rely on statistical models relating observations of species to environmental predictors, and projecting the fitted relationship into geographic space to produce distribution maps (Maggini et al. 2006; Randin et al. 2006; Fukasawa et al. 2009; Sundblad et al. 2009; Guisan et al. 2013; Verbruggen et al. 2013). These distribution maps are becoming a useful tool when dealing with restrictive field data and large spatial and temporal terms (Guisan and Thuiller 2005) and are also a valuable tool for environmental management and conservation (Razpotnik 2007; Barbosa et al. 2009; Sundblad et al. 2009). Despite the recent increase in species distribution models (SDM) in the literature, evidence of the practical utility of these models in real-world conservation management (Guisan et al. 2013), and aspects such as the importance of validation of these models and their transferability to other areas have not been intensively studied (Randin et al. 2006; Sundblad et al. 2009). Guisan et al. (2013) found various examples of the practical use of SDMs to guide decisions in various conservation fields, such as 1) managing biological invasions, 2) identifying and protecting critical habitats, 3) regional conservation planning, and 4) informing the translocation of threatened or captive-bred populations. The use of SDMs for conservation purposes is limited by the availability of suitable data, skilled staff, and modelling tools (Guisan et al. 2013). Its utility for applications in biological invasions by predicting areas of potential occupancy in order to target its control also depends on their transferability between regions (Verbruggen et al. 2013). Transferability of the models refers to the case when a model is applied to an area outside the site it was trained on. Preferably the range of the predictor variables (environmental variables) should be the same, or wider, at the training site than at the sites the model is applied to (Peterson et al. 2007; Sundblad et al. 2009).

The main goal of this study is to examine the transferability of an existing SDM of *R. pseudacacia* (by Ribeiro et al. 2011) to two testing areas within the same region. To model the potential distribution of *R. pseudacacia*, we used a generalized linear model (GLM) in which the presence/absence of *R. pseudacacia* was used as dependent variable and environmental variables as predictors. The results of the model indicated the most important environmental factors for species occurrence: land use, soil type, distance to the road network, and distance to water bodies. The major part of the distribution pattern observed was explained by land use, with meadows and pastures most prone to invasion by *R. pseudacacia*. The distance from water bodies has a negative influence on the species occurrence, according to the model. The distance to the road

network influences *R. pseudacacia* distribution in a non-linear way; closer to roads the probability of finding the species is higher, and this probability decreases when roads are within a distance between 100 and 300 m, while a distance longer than 300 m increases the probability of *R. pseudacacia* occurrence again. Regarding the predictor soil type, fluvisols are significantly less susceptible to *R. pseudacacia* than cambisols, and they also differ in this manner from urban soils.

2 Methods

2.1 Study area

This research was conducted in the northeastern part of Slovenia, in the Prekmurje region. Although agriculture still prevails in this region (Gabrovec and Kladnik 1997; Cunder 2009), around 29% of the landscape is forested, resulting in a high level of fragmentation (Hladnik 2005). According to its topographical features, Prekmurje can be divided into three geographical areas, which are ecologically dissimilar as well; the northern hilly area of Goričko, the central floodplains of the Mura River, known as Ravensko, and the southern lowlands known as Dolinsko (Čarni et al. 2008).

The Mura floodplains, due to their high biological diversity, host habitats of greatest importance for nature protection and are therefore included in the Natura 2000 network (Globevnik and Mikoš 2009; Košir et al. 2013). Sixty-five percent of the floodplains are forested, and ten percent is covered by *R. pseudacacia* (Globevnik and Kaligarič 2005). Along the Mura River well-drained and nutrient-rich soils prevail (Košir et al. 2013), which are most suitable for agriculture (Perko and Orožen Adamič 1998); therefore intensive agriculture is present here (Vovk Korže 2002).

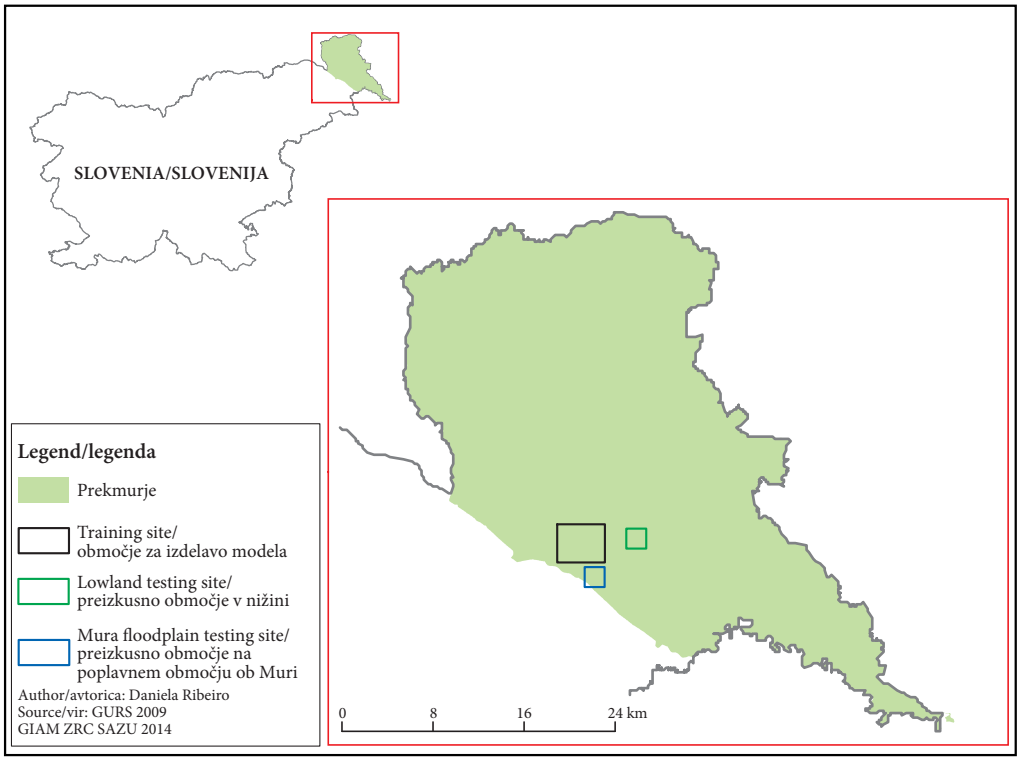

Figure 1: Location of the study area, showing the training and testing sites.

The central part of the lowlands of Prekmurje is occupied by gravelly fields safe from floods; therefore it is densely populated and intensively cultivated. The northern and southern parts are wetter and less populated (Perko and Orožen Adamič 1998). *R. pseudacacia* aggressively regenerates in the lowland area, mainly due to the decrease in groundwater level and openings in stands of forest, which creates ideal conditions for its development (Rudolf and Brus 2006).

In the southern lowland part of the study region, a training site of 12 km^2 was chosen to build the SDM and two testing sites were selected to assess the accuracy and transferability of the *R. pseudacacia* distribution model, one in the lowland and one in the Mura floodplains (see Figure 1). The testing sites measured 4 km^2 and were demarcated outside the area used to build the model (i.e., the training site; for more information, see Ribeiro et al. 2011).

2.2 Data

This study focuses on the introduced and highly invasive species *R. pseudacacia* L. This species was selected due to its abundance in the study region (Wraber 1951; Rudolf and Brus 2006; Kutnar and Kobler 2013; Kutnar and Pisek 2013) and its presence in the country for over a century (Novice 1858). For both testing sites, *R. pseudacacia* occurrence was determined from the visual interpretation of spring orthophotos. Somodi et al. (2012) have shown that orthophotos taken during the flowering period of *R. pseudacacia* provide the best sources for its recognition and thus a potential basis for monitoring. All patches with the species' presence, independent of its size, were digitized in a geographic information system environment.

For application of the model, a grid 10 m wide was generated by regular point generation at the testing sites. We resampled the set of predictor variables shown by Ribeiro et al. (2011) to be relevant for *R. pseudacacia* to these grids of both testing sites, using ArcGIS 9.3. The source of variables that contributed to the model included the following: land use (Zemljiški kataster 2009), soil type (Pedološka karta Slovenije 2007), distance to the road network, and distance to water bodies (Državna topografska karta 2009).

2.3 Predictions and evaluation

The SDM for *R. pseudacacia* built by Ribeiro et al. (2011) using a GLM was applied to the testing sites, enabling assessment of the generality of habitat preferences deduced at the training site and a test of its transferability. The predictive ability of the SDM was tested at the testing sites and contrasted with its performance at the training site.

The predictive performance of the SDM at the testing sites was measured by: 1) visual evaluation, looking at spatial predictions and observed presences of the species, 2) confusion matrices, 3) true positive rate, also called sensitivity (Fielding and Bell 1997), 4) the maximum of the true skill statistics (Allouche et al. 2006) over possible cutoffs, and 5) paired-sample ANOVA. Distributions of TPR at the specific testing sites were compared in an ANOVA-like setting, in which the values of the index at the same cut were treated as paired samples (for details, see Somodi et al. 2012). Tukey contrasts were also applied, which make the procedure equivalent to a Tukey post-test. The confusion matrix records the frequencies of each of the four possible types of outcome of prediction success: 1) true positives, 2) false positives, 3) false negatives, and 4) true negatives. True positives is the number of occurrences in which the presence of the species was correctly identified, false positives is the number of positive predictions in which no presence was observed, false negatives is the number of presences in which the model did not predict occurrences (Fielding and Bell 1997; Somodi et al. 2012), and true negatives is the number of absences that were correctly predicted by the model. False negatives do not only reflect our errors, but also arise because the species is not yet present (and our estimation falls at a point still negative), though the site may be suitable for the species. This is a common problem in habitat suitability modelling, which makes AUC and ROC curves potentially misleading (Lobo et al. 2008). Therefore, we relied on the ratio between true positive cases and all positive cases, in which the presence of the species was correctly identified by the model (TPR). In addition, the maximum of TSS was introduced to replace the traditional maximum Kappa measure because it is free of prevalence bias (Allouche et al. 2006) and was used to cut the probability distribution into a presence/absence binary map.

Finally, the comparison of the TPR curves, emerging from values calculated at regular cuts along the probability gradient from the training and testing sites, was done using a method conceptually corresponding to paired-sample ANOVA. The appropriate way to perform such a test is to use linear mixed models, with site identity as a random variable and the predictor variables as fixed effects (the function used in R was »lme«, »nlme« package; Pinheiro et al. 2014). A Tukey post test was also applied to the mixed model to assess pairwise significance in order to determine which sites differed significantly from one another (for details, see Somodi et al. 2012).

The application of the SDM to the testing sites and the evaluation of its accuracy and transferability were implemented in the R Statistical environment (R Core Development Team 2008). The SDM was exported from the R Statistical environment as tables describing each predictive probability point-by-point and projected in ArcGIS 9.3.

3 Results

The prediction of the SDM for *R. pseudacacia* was first verified by spatial overlapping at the existing locations with predicted values of probability occurrence. There was a good degree of overlap between predicted and observed *R. pseudacacia* at the testing sites (Figures 2 and 3).

The probability of occurrence was assigned to each sampling point. Map colours were selected to reflect major breakpoints at TPR curves (Figure 4). Two major breakpoints (at 0.5 and 0.3) are apparent for the lowland site, and therefore the highest probability classes were defined as 0.5–1 (red) and 0.3–0.5 (orange). Lower probabilities were separated into three equal classes in ascending order: 0.00–0.08 (dark green), 0.08–0.15 (light green), and 0.15–0.30 (yellow).

The predicted distribution for the testing sites beyond the known occurrences of the species indicates that those sites are suitable for invasion.

The prediction resulting from the SDM was a good match with the observed presence of the species at both testing sites (Figures 2 and 3). Substantial observations fall into the predicted category with a higher probability than 0.50. Some of the observed areas that were outside this probability were included in the next category (0.30–0.50) and a few in the remaining categories.

Table 1: Confusion matrix for the Lowland testing site at the probability cut corresponding to the maximum TSS. Predicted presence/absence [1/0] of *R. pseudacacia* crosstabulated with observations.

		Observed *R. pseudacacia*	
		0	1
Predicted *R. pseudacacia*	0	25128	434
	1	4201	1368

Table 2: Confusion matrix for the Mura floodplain testing site at the probability cut corresponding to the maximum TSS. Predicted presence/absence [1/0] of *R. pseudacacia* crosstabulated with observations.

		Observed *R. pseudacacia*	
		0	1
Predicted *R. pseudacacia*	0	14301	230
	1	12160	2330

The results from the confusion matrices indicate that the majority of presences predicted fell into the presences observed (Tables 1 and 2). Nevertheless, as can be seen, these tables present better results for the Mura floodplain than for the Lowland testing site.

The TPR and TSS values at specific probability cuts at the Mura floodplain and Lowland testing sites can be seen in Figures 4 and 5, respectively.

Table 3: Comparison of TPR curves by paired-sample ANOVA with Tukey post test.

	Estimate	Std. Error	*z* value	Significance
Mura: Lowland = 0	0.007	0.003	2.353	$p < 0.1$
Training: Lowland = 0	−0.011	0.003	−3.408	$p < 0.01$
Training: Mura = 0	−0.018	0.003	−5.761	$p < 0.001$

The comparison between the predictions for the training site and the testing sites shows a significant difference, meaning that the testing sites were predicted worse than the training site (Table 3).

The SDM from the training site was successfully used to generate maps of potential distributions at the testing sites. However, as expected, the SDM achieves better predictive results at the training site than at the testing sites.

4 Discussion

We were able to successfully transfer the SDM for *R. pseudacacia* built by Ribeiro et al. (2011) to two testing sites within the same geographical region. A GLM was a reliable method to model the range of potential habitats for the species to new sites; this result is consistent with Randin et al. (2006), who argued that a GLM is a robust modelling method for transferability. However, Araújo et al. (2005) found that a generalized additive model showed better transferability than a GLM.

Generally the SDM adequately predicted the potential distribution of *R. pseudacacia* in the Prekmurje region; however, significant differences appeared regarding its success at the two testing sites. It can at least be inferred that our model performs adequately for a slightly different geographical setting, albeit within one region.

Most studies testing models outside the training area use one testing site only (e.g., Randin et al. 2006; Fukasawa et al. 2009; Sundblad et al. 2009; Preuss et al. 2011) and there are only a few examples using more than one testing site (Zimmermann and Kienast 1999; Wenger and Olden 2012). Our study is also valuable as a contribution to the latter group. Nevertheless its generalizability to other geographic regions may be limited and the extrapolation of its results should be treated with prudence; this should be done with careful examination of the underlying environmental predictors. One of the most important conditions for the practical use of SDMs to guide environmental management decisions is their transferability within and among other regions. As shown by Barbosa et al. (2009), SDMs are best at describing the spatial pattern of species at the site the model was trained in, mainly because different localities may have differences in the ranges of environmental predictors (Randin et al. 2006). Environmental differences between different geographical regions may therefore limit the usefulness of this type of model, and such models may yield unrealistic predictions outside the domain used to build the models (Barbosa et al. 2009). Thus the availability of data can be a limiting factor in the spatial transfer of SDMs. In addition to this limitation, the choices made during the modelling process, such as the modelling technique selected, affect its transferability to other areas, as shown by Araújo et al. (2005) and Randin et al. (2006). It was beyond the scope of our study to assess the robustness of modelling techniques when transferred from one geographical region to another, but we did transfer the model within the same geographical region.

The greatest value of our study is that the predictions of the likelihood of occurrence of the species at non-surveyed sites may warn managers of the potential threat of planting or spontaneous spread, which may support conservation planning. We have shown that the predictive model tested here can reliably be applied for region-wide predictions, which helps raising awareness among the public about this invasive species. This is vital for combating further spread, especially in the study region, where locals predominantly perceive the benefits of the species. The application of a model already constructed for predicting the possible extent of range expansion of *R. pseudacacia* offers an easy tool for managers to mitigate the impact of this invasive species and is an alternative to time-consuming and logistically demanding data collection.

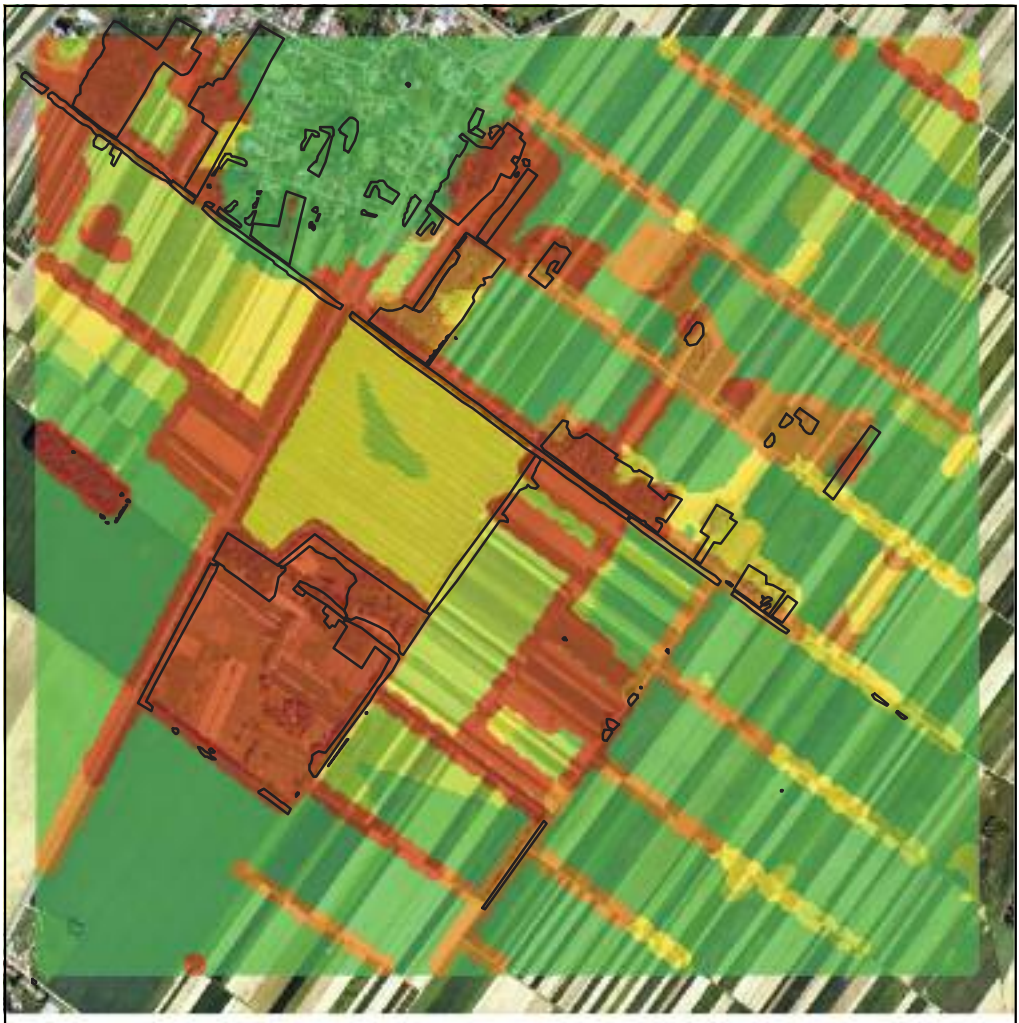

Figure 2: Potential habitat map of *R. pseudacacia* for the lowland testing site.

Figure 3: Potential habitat map of *R. pseudacacia* for the Mura floodplain testing site.

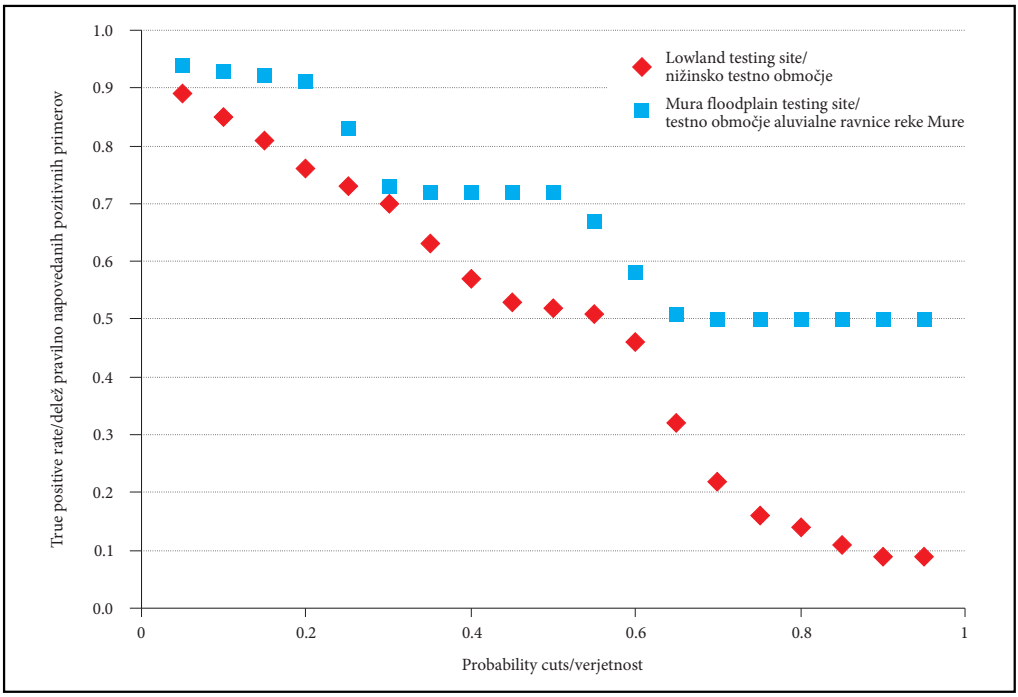

Figure 4: True positive rate measurement of predictive accuracy for the testing sites.

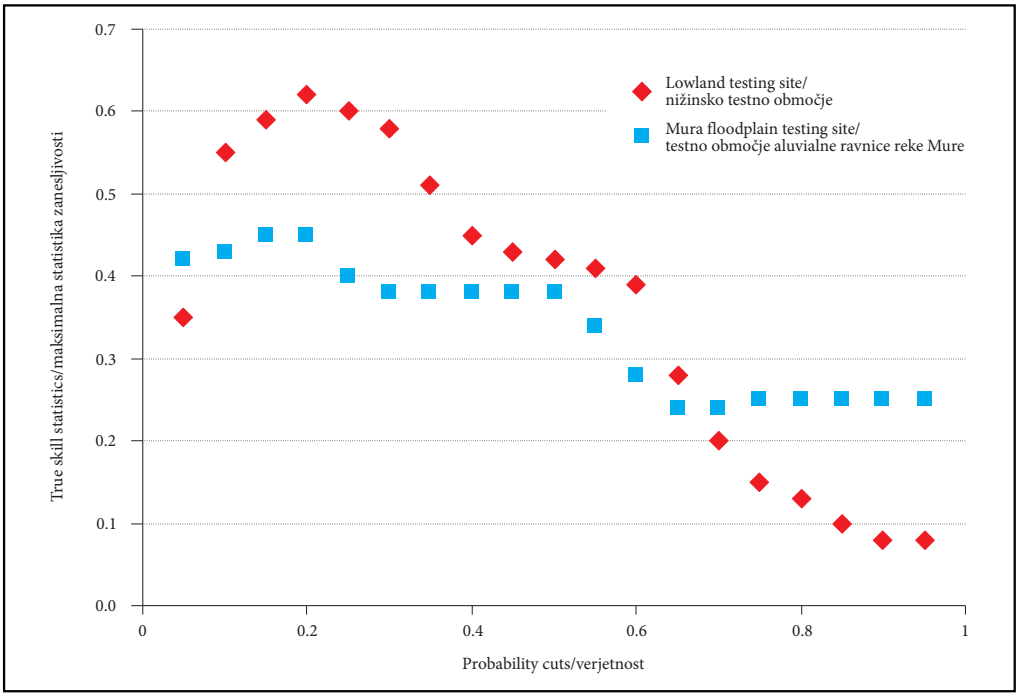

Figure 5: True skill statistics measurement of predictive accuracy for the testing sites.

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Prenosljivost napovednega modela razširjenosti vrste *Robinia pseudacacia* v severovzhodni Sloveniji

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IZVLEČEK: Glavni namen raziskave je oceniti prenosljivost napovednega modela razširjenosti vrste (NMRV) *Robinia pseudacacia* na dve testni območji v Prekmurju v severovzhodni Sloveniji. Napovedno uspešnost NMRV na testnih območjih smo merili z 1) vizualnim ocenjevanjem, 2) matriko razvrstitev, 3) deležem pravilno napovedanih pozitivnih primerov, 4) maksimalno statistiko zanesljivosti (ang. *True Skill Statistics* ali TSS) in 5) analizo variance odvisnih vzorcev. Raziskava kaže, da je model ustrezno napovedal potencialno razširjenost vrste na tem območju, kar pomeni, da bo na podlagi napovedi za celotno regijo mogoče sprejemati zanesljive odločitve na področju ohranjanja narave. Poleg tega gre pri tem za pozitivni primer prenosa in razširitve NMRV znotraj iste regije.

KLJUČNE BESEDE: geografija, invazivne vrste, pokrajinske značilnosti, model razširjenosti vrste, prenosljivost, Prekmurje

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1 Uvod

Slovenija spada med evropske države z najbolje ohranjeno naravo in najvišjo stopnjo biološke in pokrajinske pestrosti (Ciglič 2009; Ciglič in Perko 2013; Ciglič in Oštir 2014). To je vidno tudi v površini zavarovanega slovenskega ozemlja: 52 % dežele leži na ekološko pomembnih območjih in približno 35 % njene površine pokrivajo območja Nature 2000 (Žvikart 2010). Slovenija pa je podvržena tudi mnogim obremenitvam, med drugim tudi biološkim invazijam. V zadnjem desetletju se pokritost z invazivnimi rastlinskimi vrstami povečuje. Doslej so v Sloveniji potrdili trideset do šestdeset invazivnih rastlinskih vrst (Jogan 2000), robinija (*Robinia pseudacacia*) pa je ena izmed vrst s potencialno največjim negativnim vplivom na biotsko raznovrstnost slovenskih naravnih habitatov (Zelnik 2012).

Biološke invazije v svetu veljajo za drugi najpomembnejši razlog za izgubo biotske raznovrstnosti (Vitousek s sod. 1996). Invazivne vrste imajo za območja, na katera se razširijo, raznolike posledice. Spremenijo lahko režim motenj na območjih, kamor se razširijo (D'Antonio in Vitousek 1992; Hejda in Pyšek 2006), izrinejo avtohtone vrste in zmanjšajo avtohtono biotsko raznovrstnost (Walker in Vitousek 1991), spremenijo strukturo ekosistema (Vitousek s sod. 1996; Higgins s sod. 1999; D'Antonio in Mack 2001) in povzročijo ogromne ekonomske stroške, vključno z zmanjšanjem prirastka lesa in vrednosti gozda v primeru širjenja v gozdne ekosisteme (Pimentel 2005; Gurevitch s sod. 2006). Nekateri ekologi menijo, da invazivne rastlinske vrste pomembno prispevajo k izginevanju rastlinskih vrst (Mooney in Drake 1989; Vitousek 1994; Wilcove s sod. 1998). Rodríguez-Labajos s sodelavci (2009) so glavne družbenoekonomske gonilne sile bioloških invazij razdelili v tri skupine: 1) antropogeni dejavniki, 2) politična raven in 3) nazor/življenjski slog.

Zaradi svojih družbenoekonomskih (Pimentel s sod. 2001) in okoljskih posledic biološke invazije postajajo vse večji problem na svetovni ravni (Ribeiro s sod. 2011). Za oblikovanje učinkovitih strategij upravljanja in spremljanja prostorske razširjenosti invazivnih vrst potrebujemo podatke o tem, v katere habitate se te vrste raje naseljujejo, poleg tega pa moramo vedeti tudi, kako pokrajinske značilnosti vplivajo na prostorsko razširjenost in uveljavitev teh vrst. Zbiranje podrobnih podatkov pa je dolgotrajno in logistično izredno zahtevno (Preuss s sod. 2011), zato poskušajo raziskovalci izdelati karte razširjenosti invazivnih vrst v pokrajini ter modelirati in napovedati njihovo širjenje na druga območja (npr. Liu s sod. 2005; Vanderhoof s sod. 2009; Ribeiro s sod. 2011). Napovedne karte razširjenosti vrst pogosto temeljijo na statističnih modelih, ki prisotnost vrst povezujejo z okoljskimi napovednimi dejavniki (prediktorji) ter izračunano razmerje projicirajo v geografski prostor in tako oblikujejo karte razširjenosti (Maggini s sod. 2006; Randin s sod. 2006; Fukasawa s sod. 2009; Sundblad s sod. 2009; Guisan s sod. 2013; Verbruggen s sod. 2013). Te karte postajajo uporabno orodje v primerih, ko imamo opravka z omejenimi terenskimi podatki ter obsežnimi prostorskimi in časovnimi zahtevami (Guisan in Thuiller 2005). Poleg tega so dragoceno orodje na področju upravljanja in ohranjanja okolja (Razpotnik 2007; Barbosa s sod. 2009; Sundblad s sod. 2009). Kljub temu da je v literaturi v zadnjem času viden porast obravnave modelov razširjenosti vrst (NMRV) in primeri njihove praktične uporabe pri dejanskem ohranjanju narave še niso bili preučeni v zadostni meri (Guisan s sod. 2013). Prav tako niso bili raziskani različni drugi vidiki, kot sta pomen validacije teh modelov in njihova prenosljivost na druga območja (Randin s sod. 2006; Sundblad s sod. 2009). Guisan s sod. (2013) so našli različne primere praktične uporabe NMRV, ki lahko usmerjajo odločitve na različnih področjih ohranjanja, kot so 1) upravljanje bioloških invazij, 2) določanje in varovanje ogroženih habitatov, 3) regionalno načrtovanje programov zaščite in 4) prenos ogroženih populacij ali populacij, gojenih v ujetništvu. Uporabo NMRV za namene ohranjanja vrst omejuje razpoložljivost ustreznih podatkov, ustrezno usposobljenega osebja in orodij za modeliranje (Guisan s sod. 2013). Pri obravnavi bioloških invazij lahko te modele uporabimo za napovedovanje območij morebitne prisotnosti invazivnih vrst za namene nadzorovanja njihove širitve, vendar je uporabnost modelov v tem pogledu odvisna tudi od njihove prenosljivosti med regijami (Verbruggen s sod. 2013). O prenosljivosti govorimo, ko model uporabimo zunaj območja, na katerem smo ga prvotno razvili (t. i. učnega območja). Če je le mogoče, mora biti razpon napovedne (okoljske) spremenljivke na učnem območju enake ali širše kot na območjih, na katera je model prenesen (Peterson s sod. 2007; Sundblad s sod. 2009).

Glavni cilj te raziskave je preučiti prenosljivost obstoječega modela razširjenosti robinije (*Robinia pseudacacia)* (Ribeiro s sod. 2011) na dve testni območji v isti regiji. Za modeliranje potencialne razširjenosti robinije smo uporabili generalizirani linearni model (GLM), pri katerem smo za odvisno spremenljivko uporabili prisotnost/odsotnost robinije, napovedne dejavnike pa smo uporabili kot okoljske spremenljivke. Model je pokazal najpomembnejše okoljske dejavnike, ki vplivajo na pojavnost vrst: raba tal, vrsta prsti,

oddaljenost od cestnega omrežja in oddaljenost od vodotokov. Na vzorec razširjenosti najbolj vpliva raba tal, pri čemer so invazijam robinije bolj izpostavljeni travniki in pašniki. Oddaljenost od vodotokov negativno vpliva na pojavnost vrste, oddaljenost od cestnega omrežja pa na razširjenost vrste vpliva nelinearno. V bližini cest je verjetnost, da bomo našli robinijo, večja, pri čemer se na oddaljenosti 100–300 m od ceste ta verjetnost zniža, na oddaljenosti več kot 300 m pa se spet poviša. Z vidika prsti robinja veliko bolje uspeva na rjavih prsteh (kambisolih) kot na obrečnih prsteh (fluvisolih), ki se v tem pogledu tudi razlikujejo od prsti oziroma tal na urbanih površinah.

2 Metode

2.1 Območje raziskave

Raziskava je potekala v Prekmurju na severovzhodu Slovenije. Čeprav v tej regiji še vedno prevladuje kmetijstvo (Gabrovec in Kladnik 1997; Cunder 2009), je okrog 29 % pokrajine prekrite z gozdom, zaradi česar je za to območje značilna visoka stopnja razdrobljenosti pokrajine (Hladnik 2005). Z vidika topografskih značilnosti lahko Prekmurje razdelimo v tri ekološko različna geografska območja: severno hribovito območje Goričkega, osrednjo aluvialno ravnico reke Mure, poznano pod imenom Ravensko, in južno nižavje, poznano pod imenom Dolinsko (Čarni s sod. 2008).

Zaradi visoke stopnje biotske raznovrstnosti so habitati na aluvialnih ravnicah reke Mure izredno pomembna naravovarstvena območja, ki so vključena v mrežo Natura 2000 (Globevnik in Mikoš 2009; Košir s sod. 2013). 65 % aluvialnih ravnic prekriva gozd, 10 % pa jih prerašča robinija (Globevnik in Kaligarič 2005).Vzdolž Mure prevladujejo rodovitna tla, ki dobro prepuščajo vodo (Košir s sod. 2013) in so najprimernejša za kmetijstvo (Perko in Orožen Adamič 1998); za to območje je zato značilno intenzivno kmetijstvo (Vovk Korže 2002). Osrednji del prekmurske nižine sestavljajo prodnata polja, ki jih rečne poplave ne ogrožajo, zato so gosto poseljena in intenzivno obdelana. Severni in južni del sta bolj mokrotna in manj poseljena (Perko in Orožen Adamič 1998). Robinija se zelo agresivno pomlajuje v nižinskem svetu, kar je v veliki meri posledica vpliva nižanja podtalnice in velike presvetljenosti gozdnih sestojev, ki ustvarjata idealne pogoje za njen razvoj (Rudolf in Brus 2006).

V južnem nižinskem delu obravnavane regije smo izbrali učno območje velikosti 12 km^2, na katerem smo razvili NMRV, in dve testni območji, na katerih smo ocenili točnost in prenosljivost modela razširjenosti robinije, in sicer enega v nižinskem delu in enega na aluvialni ravnici reke Mure (glej sliko 1). Testni območji sta obsegali 4 km^2 in sta ležali izven območja, ki smo ga uporabili za oblikovanje modela (za več informacij glej Ribeiro s sod. 2011).

Slika 1: Lokacija območja raziskave z učnim območjem in dvema testnima območjema.
Glej angleški del prispevka.

2.2 Podatki

Raziskava obravnava robinijo, ki je v ta prostor prinesena in močno invazivna. Izbrali smo jo zato, ker jo lahko v preučevani regiji najdemo na velikih površinah (Wraber 1951; Rudolf in Brus 2006; Kutnar in Kobler 2013; Kutnar in Pisek 2013) in ker je v Sloveniji prisotna že več kot stoletje (Novice 1858). Prisotnost robinije na obeh testnih območjih smo določili z vizualno interpretacijo spomladanskih ortoposnetkov. Somodi s sodelavci (2012) so ugotovili, da na ortoposnetkih, narejenimi v obdobju cvetenja robinije, najlaže prepoznamo in morebiti tudi spremljamo prisotnost te vrste. Vse zaplate, poraščene s to vrsto, smo digitalizirali v geografskem informacijskem sistemu ne glede na njihovo velikost.

Nato smo na testnih območjih oblikovali pravilno mrežo točk, tako da so bile posamezne celice široke 10 m. Napovedne spremenljivke, za katere je Ribeiro s sodelavci (2011) dokazala, da so primerne za obravnavo robinije, smo z uporabo ArcGIS 9.3 prenesli na mrežo na obeh testnih območjih. Spremenljivke, ki smo jih uporabili v modelu, so bile raba tal (Zemljiški kataster 2009), vrsta prsti (Pedološka karta Slovenije 2007), oddaljenost od cestnega omrežja in oddaljenost od vodotokov (Državna topografska karta 2009).

2.3 Napovedi in ocena

Na testnih območjih smo uporabili model razširjenosti vrste, ki ga je za robinijo razvila Ribeiro s sodelavci (2011) z uporabo generaliziranega linearnega modela. Na podlagi tega smo lahko ocenili, v kakšni meri lahko posplošimo ugotovitve z učnega območja glede tega, v katere habitate se vrsta raje naseljuje, in testirali prenosljivost modela. Na testnih območjih smo preverili napovedno uspešnost modela in jo primerjali z uspešnostjo na učnem območju.

Napovedno uspešnost NMRV na testnih območjih smo merili z: 1) vizualnim ocenjevanjem, tako da smo na podlagi prostorskih napovedi opazovali dejansko prisotnost vrste; 2) matrikami razvrstitev; 3) deležem pravilno napovedanih pozitivnih primerov (ang. *true positive rate* ali TPR) oziroma stopnjo občutljivosti (Fielding in Bell 1997); 4) maksimalno statistiko zanesljivosti (ang. *True Skill Statistics* ali TSS; Allouche s sod. 2006) in 5) analizo variance odvisnih vzorcev. Porazdelitvi TPR na obravnavanih testnih območjih smo primerjali v okolju, podobnim tistemu pri analizi variance (ANOVA), pri čemer smo vrednosti indeksa na istem pragu obravnavali kot odvisne vzorce (za več informacij glej Somodi s sod. 2012). Uporabili smo tudi Tukeyjevo primerjavo, zaradi česar je postopek enakovreden Tukeyjevemu *post hoc* preizkusu. Z matriko razvrstitev določimo pogostost vsake izmed štirih vrst rezultatov napovedne uspešnosti:

- pravilno napovedanih pozitivnih primerov,
- napačno napovedanih pozitivnih primerov,
- napačno napovedanih negativnih primerov in
- pravilno napovedanih negativnih primerov.

Pravilno napovedani pozitivni primeri se nanašajo na število primerov, v katerih je bila prisotnost vrste pravilno napovedana, napačno napovedani pozitivni primeri se nanašajo na število pozitivnih napovedi, pri katerih ni bilo ugotovljene prisotnosti, napačno napovedani negativni primeri na število primerov prisotnosti, pri katerih model prisotnosti ni napovedal (Fielding in Bell 1997; Somodi s sod. 2012), in pravilno napovedani negativni primeri se nanašajo na število neprisotnosti, ki jih je model pravilno napovedal. Napačno napovedani negativni primeri ne odražajo samo naših napak, saj vrsta na tem območju sploh še ni prisotna (pa tudi svojo oceno smo podali v času, ko še ni bila prisotna), a to še ne pomeni, da območje za vrsto ni primerno. To je pri modeliranju ustreznosti habitatov pogosta težava, zaradi česar sta lahko krivulji AUC in ROC zavajajoči (Lobo s sod. 2008). Zato smo se oprli na razmerje med številom pravilno napovedanih pozitivnih primerov in številom vseh pozitivnih primerov, v katerih je model pravilno ugotovil prisotnost vrste (TPR). Poleg tega smo namesto klasičnega maksimalnega koeficienta kapa raje uporabili maksimalno statistiko zanesljivosti TSS, saj ni podvržena pristranskosti zaradi (drugačne) razširjenosti (Allouche s sod. 2006); na podlagi TSS smo verjetnost razširjenosti vrste pretvorili v binarni zemljevid prisotnosti/odsotnosti.

Na koncu smo primerjali krivulje TPR, ki smo jih oblikovali na podlagi vrednosti, izračunanih v rednih presledkih vzdolž gradienta verjetnosti na učnem območju in testnih območjih; primerjali smo jih z uporabo metode, ki je po svoji zasnovi podobna analizi variance odvisnih vzorcev. Tovrstni test je najbolje izvesti z uporabo linearnih mešanih modelov, pri čemer je identiteta območja naključna spremenljivka, napovedne spremenljivke pa so stalni (fiksni) učinki (v statističnem programu R smo uporabili funkcijo »lme« v paketu »nlme«; Pinheiro s sod. 2014). Da bi ocenili statistično pomembnost v parih, smo pri mešanem modelu uporabili tudi Tukeyjev post hoc preizkus in tako določili območja, ki so se med seboj pomembno razlikovala (za več informacij glej Somodi s sod. 2012).

Prenos NMRV na testna območja ter oceno njegove točnosti in prenosljivosti smo izvedli v statističnem programu R (R Core Development Team 2008). Rezultate modeliranja smo iz programa R izvozili v obliki preglednic, v katerih je bila opisana napovedna verjetnost vsake točke, in rezultate projicirali v programu ArcGIS 9.3.

3 Rezultati

Rezultate NMRV za robinijo smo najprej preverili s prostorskim prekrivanjem obstoječih prisotnosti z napovedanimi prisotnostmi. Napovedana in dejanska prisotnost robinije na testnih območjih sta se v precejšnji meri ujemali (sliki 2 in 3).

Vsaki vzorčni točki smo pripisali verjetnost pojavnosti vrste. Glavne prelomne točke (točke, na katerih se pojavnost vrste poveča ali zmanjša) na krivuljah TPR smo na karti označili z različnimi barvami (slika 4). Za nižinsko območje smo ugotovili dve prelomni točki (pri vrednostih 0,5 in 0,3), na podlagi česar smo

določili razreda največje verjetnosti: 0,5–1 (označeno rdeče) in 0,3–0,5 (označeno oranžno). Nižje verjetnosti smo v naraščajočem zaporedju razdelili v tri enakovredne razrede: 0,00–0,08 (temno zeleno), 0,08–0,15 (svetlo zeleno) in 0,15–0,30 (rumeno).

Napovedana razširjenost na testnih območjih, ki je bila večja od dejanske prisotnosti vrste, kaže na to, da sta ti dve območji primerni za invazijo.

Slika 2: Zemljevid potencialnih habitatov robinije na nižinskem testnem območju.
Glej angleški del prispevka.

NMRV se je dobro ujemala z dejansko prisotnostjo vrste na obeh testnih območjih (sliki 2 in 3). Obsežna območja dejanske prisotnosti vrste spadajo v napovedani razred z verjetnostjo nad 0,50. Nekatera druga območja dejanske prisotnosti, ki so bila izven tega razreda verjetnosti, smo vključili v naslednji razred (0,30–0,50), nekaj pa tudi v ostale razrede.

Slika 3: Zemljevid potencialnih habitatov robinije na testnem območju aluvialne ravnice reke Mure.
Glej angleški del prispevka.

Preglednica 1: Matrika za nižinsko testno območje ob pretvorbi v maksimalni TSS. Razvrstitev dejanskih in napovedanih prisotnosti/odsotnosti [1/0] robinije.

		dejanska prisotnost robinije	
		0	1
napovedana prisotnost robinije	0	25128	434
	1	4201	1368

Preglednica 2: Matrika za testno območje aluvialne ravnice reke Mure ob pretvorbi v maksimalni TSS. Razvrstitev dejanskih in napovedanih prisotnosti/odsotnosti [1/0] robinije.

		dejanska prisotnost robinije	
		0	1
napovedana prisotnost robinije	0	14301	230
	1	12160	2330

Rezultati matrike razvrstitev kažejo, da se je večina napovedanih prisotnosti ujemala z dejanskimi (preglednici 1 in 2). Kljub temu je iz preglednic razvidno, da so bili rezultati boljši na testnem območju aluvialne ravnice reke Mure.

Slika 4: Merjenje TPR za določitev napovedne točnosti na testnih območjih.
Glej angleški del prispevka.

Slika 5: Merjenje TSS za določitev napovedne točnosti na testnih območjih.
Glej angleški del prispevka.

Vrednosti TPR in TSS na izbranih prelomnih točkah na obeh testnih območjih so predstavljene na slikah 4 in 5.

Preglednica 3: Primerjava krivulj TPR z analizo variance parnih vzorcev in Tukeyjevim post hoc preizkusom.

	cena	st. napaka	*z*-vrednost	pomembnost
Mura: nižina = 0	0,007	0,003	2,353	$p < 0,1$
učno območje: nižina = 0	–0,011	0,003	–3,408	$p < 0,01$
učno območje: nura = 0	–0,018	0,003	–5,761	$p < 0,001$

Primerjava napovedi za učno območje in napovedi za testni območji razkrije pomembne razlike: napovedi za testni območji so bile slabše od tistih za učno območje (preglednica 3).

Z modelom razširjenosti vrste, ki smo ga oblikovali na učnem območju, smo uspešno izdelali zemljevide potencialne razširjenosti na testnih območjih. Kot pričakovano pa model dosega boljše napovedne rezultate na učnem območju kot na testnih območjih.

4 Razprava

Model razširjenosti robinije, ki ga je razvila Ribeiro s sodelavci (2011), smo uspešno prenesli na testni območji v isti geografski regiji. GLM se je izkazal za zanesljivo metodo modeliranja potencialnih habitatov vrste na novih območjih; rezultat se ujema z ugotovitvijo Randina s sodelavci (2006), da je GLM zanesljiva metoda modeliranja prenosljivosti. V nasprotju s tem je Araújo s sodelavci (2005) ugotovil, da je generalizirani aditivni model (GAM) bolje prenosljiv kot GLM.

Na splošno je NMRV zadovoljivo napovedal potencialno razširjenost robinije v Prekmurju, vendar pa so se pomembne razlike pokazale glede njegove uspešnosti na obeh testnih območjih. Kljub temu lahko zaključimo, da se model lahko zadovoljivo uporablja tudi na malce drugačnem geografskem območju, četudi znotraj iste regije.

V večini raziskav, v katerih so raziskovalci modele preskušali zunaj učnega območja, je uporabljeno samo eno testno območje (npr. Randin s sod. 2006; Fukasawa s sod. 2009; Sundblad s sod. 2009; Preuss s sod. 2011); raziskav, v katerih je bilo uporabljeno več kot eno testno območje, pa je zelo malo (Zimmermann in Kienast 1999; Wenger in Olden 2012). Naša raziskava tako pomembno prispeva k zbirki tovrstnih raziskav. Kljub temu jo lahko na druge geografske regije posplošimo le do določene mere, pa tudi pri prenosu njenih rezultatov moramo biti previdni; skrbno moramo namreč preučiti osnovne okoljske napovedne dejavnike (prediktorje). Eden najpomembnejših pogojev praktične uporabe modelov razširjenosti vrst, na podlagi katerih lahko sprejemamo odločitve s področja upravljanja okolja, je njihova prenosljivost znotraj iste regije in med različnimi regijami. Kot je ugotovil Barbosa s sodelavci (2009), ti modeli najbolje opišejo prostorski vzorec razširjenosti vrste na območju, na katerem je bil model razvit, in sicer predvsem zato, ker lahko med različnimi območji obstajajo razlike v obsegu okoljskih napovednih dejavnikov (Randin s sod. 2006). Okoljske razlike med različnimi geografskimi regijami lahko zato omejujejo uporabnost tovrstnih modelov, poleg tega pa lahko ti modeli dajejo nerealne napovedi zunaj območja, na katerem so bili prvotno razviti (Barbosa s sod. 2009). Razpoložljivost podatkov je lahko pri prostorskem prenosu teh modelov omejitveni dejavnik. Poleg te omejitve na prenosljivost na druga območja vplivajo tudi izbire med samim postopkom modeliranja, kot je recimo izbira tehnike modeliranja; to sta potrdila tudi Araújo s sodelavci (2005) ter Randin s sodelavci (2006). Ocena zanesljivosti tehnik modeliranja pri prenosu modela z ene geografske regije na drugo je presegala okvire naše raziskave; uspelo pa nam je model prenesti znotraj iste geografske regije.

Največja vrednost raziskave leži v dejstvu, da lahko napovedi verjetnosti pojava obravnavane vrste na neraziskanih območjih upravljavce opozorijo na morebitne nevarnosti zasaditve te vrste oziroma njenega spontanega razraščanja, kar jim lahko pomaga pri načrtovanju zaščitnih ukrepov. Pokazali smo, da lahko napovedni model, ki smo ga testirali v tej raziskavi, zanesljivo uporabimo za oblikovanje napovedi znotraj iste regije in osveščanje javnosti o tej invazivni rastlinski vrsti. To je ključnega pomena za preprečevanje njene nadaljnje širitve, še zlasti na obravnavanem območju, kjer domačini večinoma še vedno zaznavajo zgolj njene koristi. Že izdelani model napovedi morebitnega obsega razširitve robinije je preprosto orodje, s katerim lahko upravljavci omilijo posledice te invazivne rastlinske vrste, in rešitev, ki je učinkovitejša od dolgotrajnega in logistično zahtevnega postopka zbiranja podatkov.

5 Literatura

Glej angleški del prispevka.

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ANISOTROPIC SPACES IN ROMANIA: A CASE STUDY OF THE TIMIŞ-CERNA CORRIDOR

Remus Crețan, Sebastian Jucu, Maria Antoni

SEBASTIAN JUCU

General view of Băile Herculane and the Cerna Valley.

Anisotropic spaces in Romania: a case study of the Timiş-Cerna Corridor

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ABSTRACT: This paper presents a critical discussion of Romania's south-west, analyzing the proposal that the Timiş-Cerna Corridor should be systemically considered anisotropic. The aim of our paper is to test the possible anisotropic matrix system by using a methods approach based on interpreting human and material mobilities in the area. We use the theoretical framework of regional geography in a systemic context and specifically the concept of anisotropy defined as a territorial anomaly in homogenous and polarized regions, in order to reveal the social and physical relations in which anisotropy is embedded. Our results show that the Timiş-Cerna Corridor is an anisotropic area fitting the structural system of this specific type of space as the dynamics of flows inside the axis are asymmetrical, generating disparities, while transit flows are predominant.

KEY WORDS: geography, anisotropic spaces, human flows, material flows, the Timiş-Cerna corridor, Romania

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1 Introduction

Located in south-western Romania, the Timiș-Cerna Corridor is a geomorphological discontinuity (Ielenicz 1998) which separates two major Carpathian ranges (the Retezat–Godeanu Mountains of the central Carpathians in the east and the Banat Mountains in the west), connecting the Timiș Plain in the north and the Danube in the south. It links two economic development areas, the West and the South-West Regions, extending over three counties: Timiș, Caraș-Severin and Mehedinți. The Corridor is a complex area containing a network of multiple geographical features. It has an elongated form up to the valleys of the Timiș and Cerna rivers, notable for its serial succession of polarizing centers. It evolved from the concentration of habitats and economic activities alongside major transport routes.

Through its specific position in Romania's functional landscape, the Timiș-Cerna Corridor has been posited as 'a regional space with typical anisotropic features' (Boțan and Ilovan 2006). Thus this study follows a concept of region typology, the anisotropic region, and the way in which Timiș-Cerna Corridor fits the specific elements for this type of space. The question we have set is whether this corridor is anisotropic. The purpose of the study is to identify specific geographical elements which work together for the functionality of the axis and to test its anisotropy from a mobility perspective.

2 Theoretical framework

A wide-ranging scholarly literature has been written on the background definitions of a region (Blache 1908; Haggett 1990; Paasi 1991; Claval 1993) as well as its structure and functionality (Dauphiné 1997; Ianoș 2000).

The concept of anisotropic spaces was introduced into geographical sciences by Dauphiné (1979, 127, an anisotropic region being »*a territorial anomaly of the homogeneous and polarized regions*«. Dauphiné's perception of anisotropic regions was developed from analysing the alongated represention of the Lorraine region, France, which is structured by the hydrographic axis of Moselle, in which roads, railways and urban networks are intermingled. The concept of anisotropy is used not only in seismology and physics (Helbig 1994), but also in geography. Important contributions to this concept were brought into Romanian literature by Cocean (2010, 107), who defined the concept as »*elongated spatial entities (strip, axis, corridor), characterized by the existence of several successive polarizing centers united in a series*.« Thus, one of the most important features of the anisotropic region is its structural and functional asymmetry.

According to Dauphiné (1979), the main element in an anisotropic space is the central privileged axis along which the completely regional entity is organized, other elements being of lesser importance. The presence of the development axis is crucial in anisotropic regions, with a significant role for the complex material, energy and information flows to and from the surrounding regions.

The structure of an anisotropic area is characterized by its configuration along a major axis marked by complex overlapping energy, material and information flows. The region has to be polarized not by a single center but by small polarizing centers partially influencing the region. The material, energy and information flows in such regions are always asymmetrical (functional asymmetry), resulting in uneven functionalities, hierarchies and functional disparities (Dauphiné 1979). Their origin is in the concentration of habitats and activities along the rivers and the main transport routes, and in the morphological corridors and elongated depressions (Cocean 2010).

Anisotropic spaces function as definite territorial systems with positive feed-back circuits. Consequently they form irreversible spatial structures (Dauphiné 1979). The energy, material and information flows are generated both inside and outside the region by the large polarizing centers situated along the axis. Such a space integrates the features of the homogenous and polarized areas, while the longitudinal orientation dominates (Cocean 2010). The polarizing areas of the centers in a regional system have a partial isotropy.

An anisotropic region may be temporary. It may evolve, intensifying its flows and crystallizing its specificity, or it may regress under the impact of certain centrifugal forces, collapsing to an inferior category of anisotropic area, or fragmenting while attaching to other territorial systems. Thus, local places and regions can be (re)created and reproduced as part of regional transformation of the society (Paasi 1991). Focusing on the intensity of the nucleation phenomenon inside a studied anisotropy (Dauphiné 1979), one can state that, according to its evolution, it could determine an endogenous nucleation type (Cocean 2010). This is due to the impact of univocal or bi-univocal transit processes in areas with reduced or strong lateral contribution.

On the other hand, high transit (of passengers and materials) could be another characteristic of an anisotropic space. As Tim Cresswell (2014) states, geographers studying mobilities must think how things move and what are the meanings given to those movements. Intensification of flows of people, materials and information are included in a wide web of socio-economic scales and are widely supported by an intricate network of technologies and actors (Urry 2007). 'Mobile lives' (Elliott and Urry 2010) are key elements in understanding anisotropy, as specific forms of capital has recently generated 'new mobilities paradigm' (Urry 2007; Sheller and Urry 2006) which require a systemic analysis.

3 Contextualizing the Timiş-Cerna anisotropy

The various characteristics of the Romanian landscape, including its positioning in concentric levels, and the abrupt contact of the major landforms and valley corridors with at least one route for transport and the seashore, are favorable for the identification of territorial units with anisotropic features displaying a certain geographical specificity (Cocean 2010). As such, Boţan and Ilovan (2006) revealed several anisotropic regions in Romania, the Timiş-Cerna Corridor being considered one of those with anisotropic features (Figure 1). Within some of these regions the so-called 'double anisotropy phenomenon' is developed.

The geographical space of the studied area represents an important axis for material, energy and information flows as well as a specific space with an array of internal relations. Through its specificities, this space is unique (Ianoş 2000), its major role being the possession, at regional and national level, of upstream and downstream areal connections through different flow categories. The corridor's functionality is determined by the characteristics of the major structures, by its overlaps on a divided graben in three sectors, with two narrower sectors towards the extremities and a central one with a wider extension. The evolution of this space is influenced by natural laws with geographical relations altered by human action. This impact is obvious on the axis but also in various places on the mountain slopes.

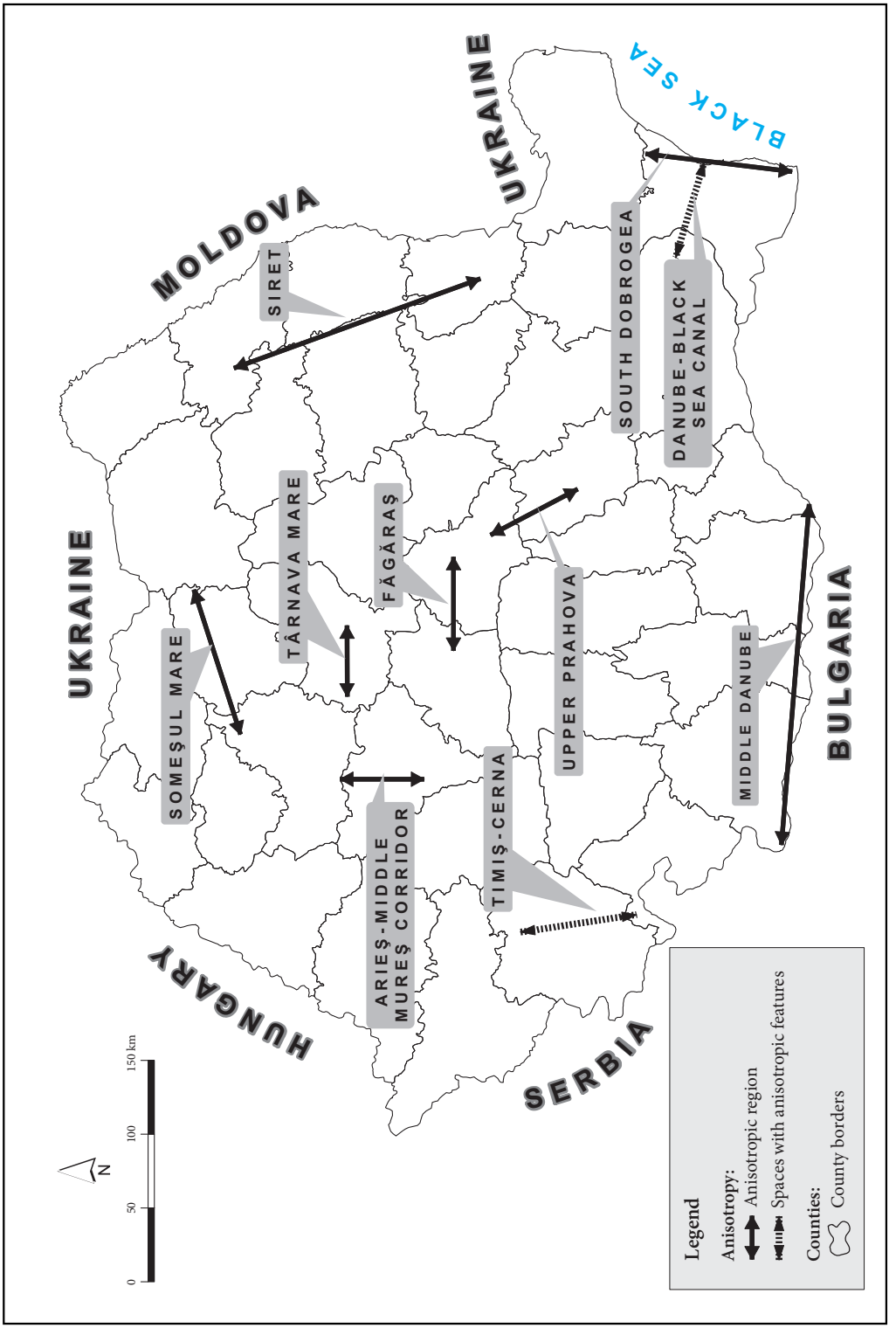
The corridor comprises a development axis which spreads along the Timiş River continuing southwards to the Cerna river (Figure 2). Hence, there is a main axis comprising two individual contiguous axes, one an extension of the other, in a longitudinal north–south direction. One example is the Timiş Valley axis, with Caransebeş as a polarizing urban center, several rural centers (Buchin, Bucoşniţa, Slatina Timiş, Armeniş, Teregova), plus the Cerna river axis, with a series of sequential polarizing rural centers (Luncaviţa, Domaşnea, Cornea, Bolvaşniţa, Mehadia, Topleţ). In the southern extremity is the town of Orşova. Along the main axis, there are two secondary axes with a perpendicular orientation, the Mehadica river axis, with the rural centers Mehadica, Lăpuşnicel and Iablaniţa, and the Sebeş river axis, with the rural center Turnu Ruieni.

The main direction of the natural processes is longitudinal, with vectors of running waters and river deposits. The transversal direction is created by the processes resulting in mountain slopes. This axis has a bi-univocal character presenting an ambivalent open loading and downloading aspect. Its extremities form a reception funnel concentrating the flows inside the axis (Cocean 2010). The main dynamic factor is due to »the transit, characterized by a movement of flows in both directions« (Ianoş 2000), appearing as a classical specific entity to tectonic corridors. An asymmetrical space is evident on both axis sides, with an inferior role in the structural matrix of the space. This asymmetry results from the morphology of the region, separating the Carpathian ranges.

Structurally, the Timiş–Cerna area is based on the hydrographic network and communication routes. The Corridor develops along two rivers (Timiş and Cerna) as well two major transport routes, an international railway and a European road. The Timiş river has the most important role in this area, connecting the geographical units of the northern extremity of the region and collecting waters from the entire area. It receives tributaries symmetrically from the Semenic and Ţarcu Mountains. Cerna, the second river, contributes to the formation of the Corridor.

Transport routes of the area are important, especially the M1 Bucharest–Timişoara–Belgrade (M 900) railway in a 79 km stretch between Orşova and Caransebeş. Routes also include two short forest railways in the Hideg Valley and the Long River Valley, connecting to the main line at Teregova and Armeniş. From the main network, a secondary railway separates, connecting the flows towards Reşiţa. The E70 European

Figure 1: Proposal for anisotropic regions in Romania. ►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FĂGĂRAŞ
ARIEŞ-MIDDLE MUREŞ CORRIDOR
TIMIŞ-CERNA
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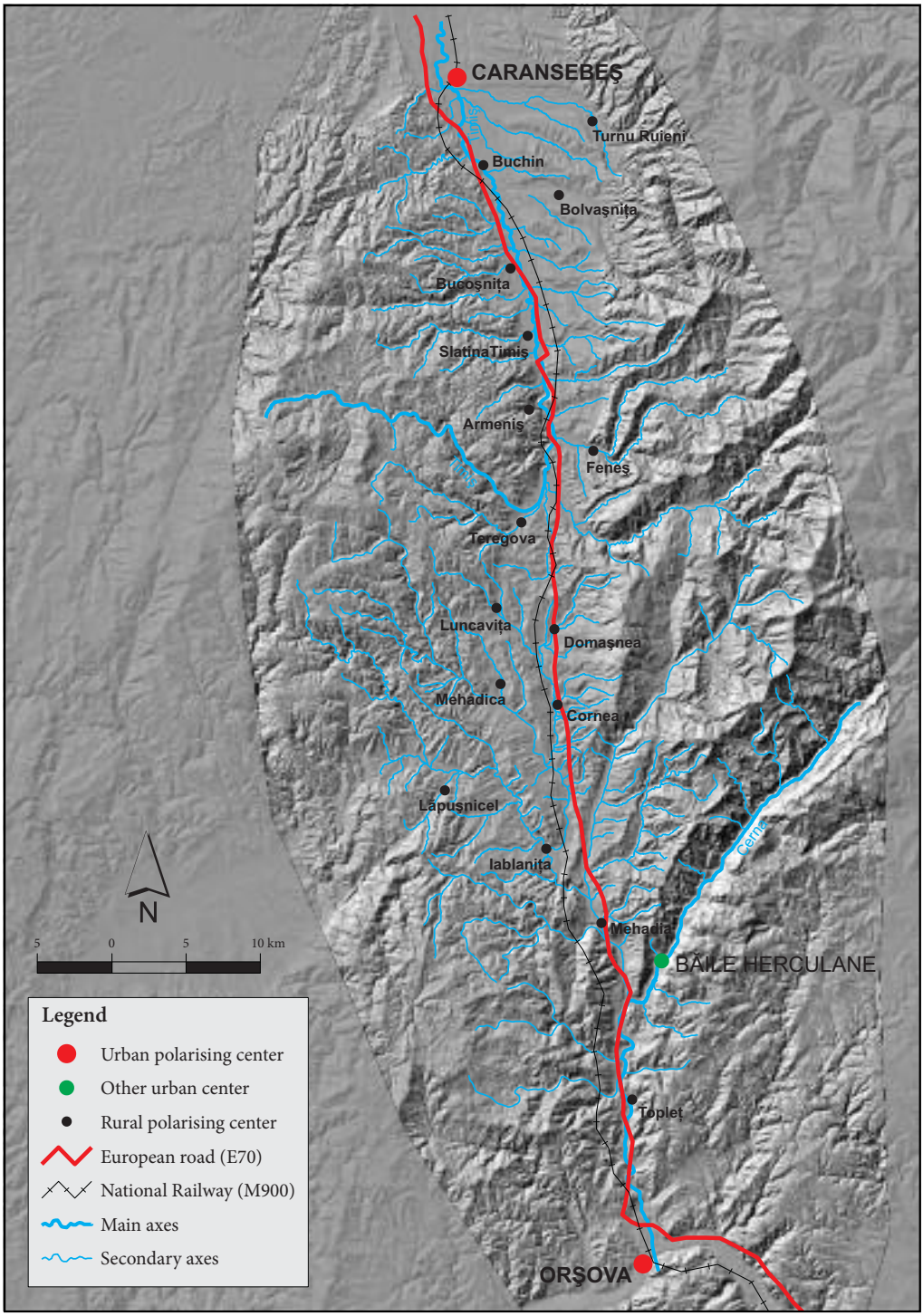

Figure 2: The anisotropic axis Timiş-Cerna.

Road, between Orşova and Caransebeş, crosses the Corridor for 90 km. It overlaps the old Roman road which linked Direna to other Roman provinces and which in the Middle Ages linked the craft and trade centers of Banat and Oltenia. The National Road DN6 crosses the same route with many links between the local urban and rural sites.

Human occupancy in the Timiş–Cerna axis dates from the Roman period, when this axis was well populated, as proven by the castrae from Dierna, Aquae (Băile Herculane) and Meedia (Mehadia), which were compulsory transit points to Sarmizegetusa Ulpia Traiana, as access routes also to Ad Pannonius (Cornea and Teregova) and Praetorium (Plugova). Many settlements appeared in the 16th and the 17th centuries, the present settlement network becoming distinct in the 20th century. The present rural system comprises 15 communes and 52 villages attracted by two urban poles, Caransebeş in the north and Orşova in the south. A number of ethnicities have lived together for centuries in this area: Romanians, Germans, Serbians, Czechs, Hungarians, Gypsies, Jews and Ukrainians (Creţan 2006). Different identities have contributed to a common heritage and cultural diversity, as region-specific structures of expectations are influenced by how people contextualize the meanings in personal life histories (Paasi 1991).

4 Methods and data sources

The anisotropy of the Corridor was tested using the perspective of human and material flows, with a specific set of data and methods. For identifying human mobilities, we followed a three methods approach: the population dynamics for each town and commune, the tourist flows, and the railway transportation flows. In the first instance, data from the Population Census of Romania (2011) helped us understand the local and regional dynamics of population. Data from Asociaţia Naţională a Agenţiilor de Turism Caraş-Severin (2012) were very useful in showing the origin and destination of tourists in the studied area during 2011. For the third approach, the railways ticketing offices of SNTFC – Călători SA offered data on passenger flows (SNTFC 2012) and we followed the method of Estimated Passenger Flows (Myojo 2006). We considered a sample of flows counting using the OD (Origin and Destination) pairs in each partitioned period of a day, during April 4–10, 2012. We made the following steps: select a pair of OD from OD data gathered from ticket offices; search all paths from those traveling the OD selected; calculate the number of passengers on the paths searched during each period; store the number of passengers calculated; repeat the procedures for each unit of the day until all pairs have been finished; calculate the total number of domestic and transit passengers that pass each link daily; and identify the nodes in the network in order to see spatial discontinuities.

We were then interested to see the intensity of material flows, rather than their expression in weight or their environmental impact. SNTFM-CFR (2012) provided data on raw materials mobility. A classical material mobility account on the flows of solid materials was made. Following the Material Flows Analysis (MFA), largely used in fields including regional and transport studies (Brunner and Rechberger 2005), the group of materials was divided into three main subgroups: minerals (metal ores and non-metallic minerals like stones, clays, etc.), fossil energy carriers (coal, gas, oil), and biomass (forestry, agriculture and fishery). Then we selected inner material flows and transit material flows in order to see which one is dominant. General passenger and material flows were then represented in a choreme, as data handling and representation are relevant in regional analysis (Field 2010).

5 Discussing the functionalities of the Timiş-Cerna anisotropy

Following the theoretical line of nucleation phenomena in anisotropic areas (Dauphiné 1979; Cocean 2010), we have identified two categories of mobilities (flows) – human and material – with both longitudinal and transverse manifestation.

Human flows are very useful in revealing anisotropy, as mobilities 'upset established orders' (Cresswell 2014). We find that population dynamics, represented by the different internal and external centers, are endowed with various rankings and influences both upstream, downstream and laterally. There are passenger flows with an extreme ordering, with loss of material and energy because of migration to other areas of Romania or to other countries, a situation similar to the central Transylvania area (Conţiu 2010). This is the case in

southern Timiş-Cerna, with the external town Drobeta-Turnu Severin and even the distant capital Bucharest attracting segments of the active population. The internal urban centers attract population from the rural settlements regardless of their distance. The demographic flows show the movement of people from their native village to the communes, and the displacement of later generations to urban centres. Moreover, the natural population is decreasing continually, simply due to a low birth rate (9.2/1000 persons).

The urban centers Orşova and Caransebeş polarize the region by their location and hierarchical position in the Romania urban system.The towns in rank I are allochthonous, while the inner towns of the Corridor are of rank II (Table 1).

Table 1: Towns with polarization function inside and outside the Timiş-Cerna area (Population census of Romania 2011).

Number	Town	Rank in the anisotropic area	Number of inhabitants
1.	Lugoj (allochthone)	I	44,590
2.	Drobeta–Turnu Severin (allochthone)	I	106,237
3.	Caransebeş	II	28,456
4.	Orşova	II	12,726
5.	Băile Herculane	II	5,966

The communes (rank III) sequentially polarize the rural centers of the axis. The most important polaizing communes are Teregova, Domaşnea and Mehadia. In this line, as Kladnik and Ravbar (2003) demonstrated, the division of the countryside is very important in a regional development context.

Another factor in analyzing anisotropy relates to passenger flows. Following the railway estimated passenger flows method (Myojo 2006), we found that the OD pair totally belonging to the corridor (Caransebeş–Orşova/Orşova-Caransebeş) has a very high proportion of daily transit passengers (Table 2). This is due to including transit railway connections (Timişoara–Bucharest/Bucharest–Timişoara) in our study.

Table 2: Caracteristics of the OD railway pairs, including daily passenger values (SNTFC–CFR–Călători SA 2012).

Number	Origin-Destination Pairs	Daily travelling trains (No.)	Average number of daily passengers	Average number of daily transit passengers	%
1.	Caransebeş–Orşova;	8	2433	1933	79.4
	Orşova–Caransebeş	8	2112	1906	78.3
2.	Caransebeş–Reşiţa;	6	592	–	–
	Reşiţa–Caransebeş	6	466	–	–
3.	Caransebeş–Timişoara;	7	2311	–	–
	Timişoara–Caransebeş	7	2322	–	–
4.	Orşova–Bucharest;	6	2476	1655	86.7
	Bucharest–Orşova	6	2557	1986	77.7

Polarization is partial inside the corridor, as in Buchin and Topleţ; thus, a pseudo-isotropic phenomenon is generated. Teregova, Domaşnea and Mehadia are core polarizing rural nodes. They have an urbanization trend – a reality reflected in the higher proportion of passengers attracted at rural level. Both traditionally attracted railway commuters from neighboring villages. The rank III settlements assume the role of pseudo-isotropy confluences, mediating the process of connection between the access railways. Moreover, the atrophic feature includes polarizing centers in competition known as spatial aggregation nuclei (Cocean 2010). Correlating our results with the statistics offered by the Population Census of Romania (2011), we discover that some of the former industrial communes in the communist period (such as Topleţ, Armeniş and Buchin) now have a dominant female labor force, with men preferring to commute to work in Orşova, Băile Herculane and Caransebeş. After calculating the total number of domestic passengers who use each railway link daily, we conclude that the three autochtonous towns held almost 80% of the internal valley corridor's railway destination flows.

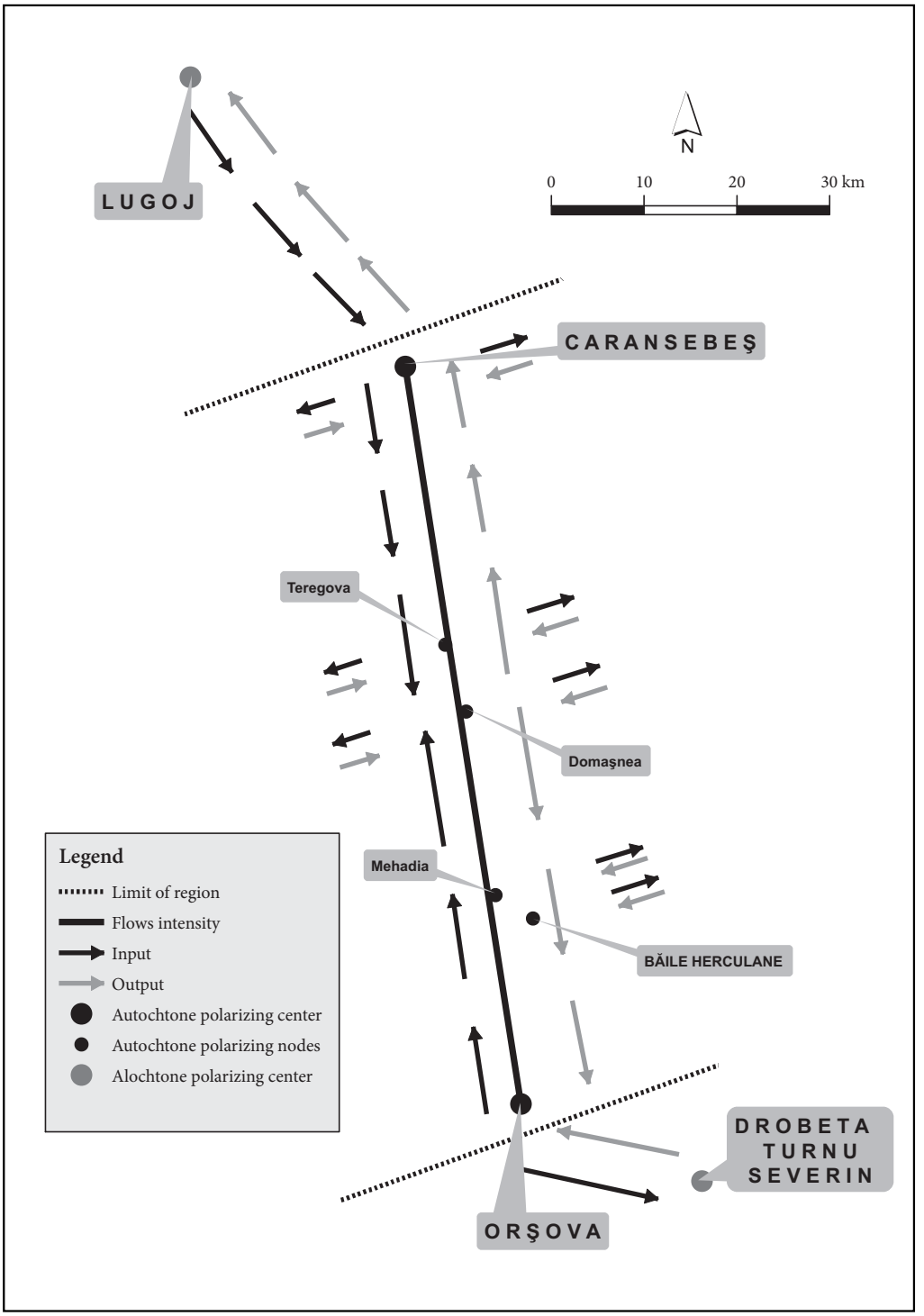

Figure 3: Flow orientation and intensity in the Timiş-Cerna Corridor.

Touristic flows are figured by Orşova, a port on the Danube connecting Eastern Europe and the Black Sea, and mainly by the resort of Băile Herculane, an important tourist town, with a random positioning from the development axis on its eastern side of the Cerna river. The resort attracts 84% of the tourist flows in the Timiș-Cerna Corridor (ANAT 2012). Only a quarter of the tourists are autochtonous and few (16%) are registered as foreign tourist flows.

Material flows consist of minerals (21%), fossil energy carriers (35%), and biomass (44%). Brown coal is extracted in the south of the Domaşnea–Mehadia Depression and transported along and outside the corridor. The exploitation of construction rocks, granite and, feldspars is notable on both sides of the axis (Linc 2001, 55). Agricultural products (as a main biomass subcategory) are also important in these flows (27%). Industrial products are mainly represented by wood processing (cellulose and paper) and the food industries at Caransebeş. They are distributed to several big cities of the Banat and southern Romania. In general, most of the industrial products are destined for other areas of Romania (Figure 3).

The final findings of the study refer to accounting the proportion of transit flows. It is notable that about 80% of the total railway passenger flows are created by transit flows. About 25% of these transit flows result from goods transportation inside the area and 75% feature transit through the corridor. Due to this allochthonous polarization, a large part of material and energy entries in this system do not remain within the Timiș-Cerna Corridor. Consequently, an important characteristic of the Timiș-Cerna space is transition.

Analyzing the choreme of matrix structure in the Corridor, both its extremities reveal the presence of two urban centers, providing important interfluent and continuous demographic and material flows in the Corridor. Lugoj municipality is in the northern part and Drobeta-Turnu Severin in the southern sector. The polarization provided by the urban allochthonous centers (Figure 4) is a common characteristic for the majority of anisotropic regions in Romania.

6 Conclusion

This contribution analyzed the functional features of the Timiș-Cerna area considering anisotropy as a key concept in spatial polarization. It is an anisotropic area fitting the structural matrix of this specific type of space. This argument is based on two main findings: from a spatial perspective it develops along the main privileged axis up to Timiș-Cerna; the axis supports complex and overlapped human and material mobilities (flows).

As a developing axis it is influenced by several centers, each polarizing the area differently according to its ranking in the Romanian urban system hierarchy. The inner flow dynamics, on which functional inequalities, hierarchies, functional disparities and uneven fluxes are based, are asymmetrical. This shows how physical mobility has fundamentally transformed a regional society, and has spanned new modes of social and material interaction (Urry 2007). Mobile lives (Elliott and Urry 2010) and 'new mobilites paradigm' (Sheller and Urry 2006) based on different flow dynamics are core elements of spatial interpretation for anisotropic areas.

The entire regional functions determine irreversible spatial structures, confirming Dauphiné's theory (1979), the dynamics of the mobilities in the axis being conducted from both within and outside. The Timiș-Cerna Corridor clearly combines the characteristics of homogenous areas with those of polarized areas. Nodes appear within, due to the polarization of different ranking centers. Where polarization is partial, a local scale pseudo-isotropic phenomenon appears.

7 Acknowledgements

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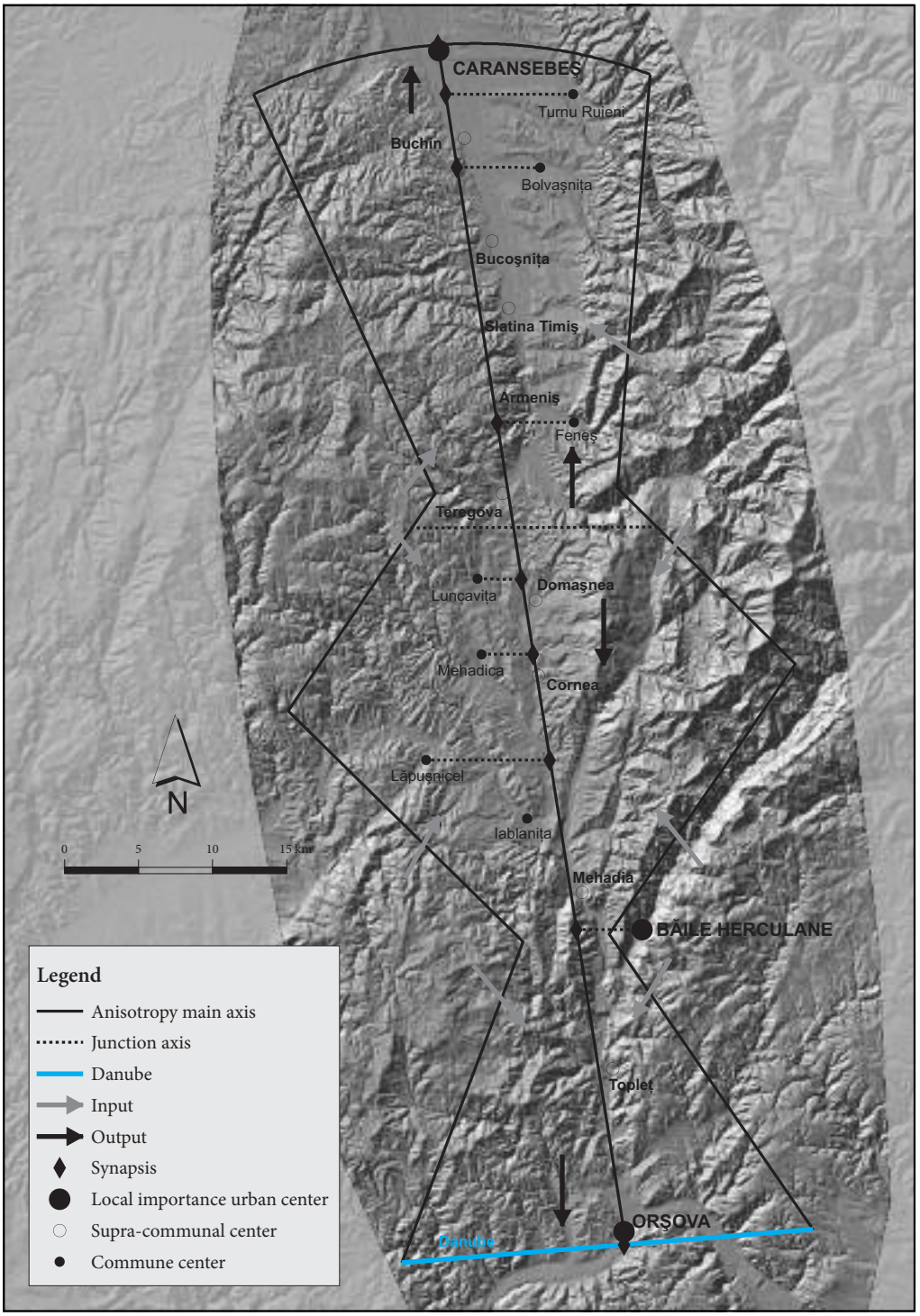

Figure 4: Chorema of matrix structure in the Timiş-Cerna Corridor.

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MEASURING URBAN QUALITY OF LIFE: CASE STUDY OF LJUBLJANA

MERJENJE KAKOVOSTI ŽIVLJENJA V MESTU: PRIMER LJUBLJANE

Jernej Tiran

BOJAN ERHARTIČ

Ljubljana is the economic, traffic, cultural, and educational centre of Slovenia and it boasts a high level of residential quality of its inhabitants.
Ljubljana je gospodarsko, prometno, kulturno in izobraževalno središče Slovenije in se ponaša z visoko kakovostjo bivanja tamkajšnjega prebivalstva.

Measuring urban quality of life: case study of Ljubljana

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ABSTRACT: Quality of urban life is a useful concept for studying the quality of residential environment and its effect on quality of life. The article is based on the data analysis of the survey research Quality of Life in Ljubljana (2010). Using structural equation modelling and hierarchical multiple linear regression analysis, the effect of residential quality on quality of life was determined and compared to the effects of selected domains of life. The results depend heavily on the operationalization of quality of life and on the selected independent variables in the model. Structural equation modelling confirmed the hypothesis about the effect of residential quality on quality of life, wherein satisfaction with the dwelling has a significantly greater effect on it than satisfaction with the neighbourhood and with living in the city. The hierarchical regression analysis results show that the quality of life for Ljubljana residents is most affected by their own estimation of social-economic factors, especially economic well-being, family life, and social life.

KEY WORDS: geography, quality of life, urban quality of life, residential quality, multivariate statistics, city, Ljubljana

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1 Introduction

Quality of life is a multidimensional construct that cannot be unambiguously defined (Diener and Suh 1997); it overlaps with other welfare concepts such as human development, social quality, level of living, and others (Mandič 2005). In the broadest sense of the term, it includes »objective« as well as »subjective« elements and is defined by some authors as »*the extent to which the objective human needs are fulfilled in relation to personal or group perceptions of subjective well-being*« (Costanza et al. 2007, 269). Numerous researches on quality of life have been done in the fields of geography, urbanism, and other spatial sciences, which usually differ from other sciences by their use of a referential spatial frame and study the effect that geographical environment has on quality of life (for example, Cutter 1985; Krevs 2002; Pacione 2003).

Consequently to the increasingly larger number of spatially oriented researches on quality of life in urban areas, the term »quality of urban life« has been established, defined by Marans and Stimson (2011, 1) as »*the satisfaction that a person receives from surrounding human and physical conditions, conditions that are scale-dependent and can affect the behaviour of individual people, groups such as households and economic units such as firms*«. The term's meaning is very close to quality of residential environment, or to elements in the vicinity of the dwelling that are significant for satisfying people's needs and enable them to perform their activities (Drozg 1994); it is perhaps even closer to that than to some (older) perceptions of quality of life that refer predominantly to individuals and their estimations of life as a whole (for example, Diener and Suh 1997). Quality of urban life can thus be understood as a research scope that encompasses studying residential environment, quality of life as a whole, and their reciprocal effects.

Ljubljana is the political, cultural, economic, employment, and educational centre of Slovenia; at the national level, it boasts a very high level of living for its inhabitants, especially with the high income, good accessibility to education, services, and supplies, its numerous options for spending free time (Krevs 2002; Uršič, Dekker and Filipovič Hrast 2014), and its housing conditions (Filipović and Mandič 2007). The same is true of the Ljubljana Urban Region: it has the highest level of well-being in Slovenia (Šprah, Novak and Fridl 2014). On the other hand, Ljubljana is more prone to vulnerability and environmental pollution due to a bigger concentration of different activities (for example, Špes, Cigale and Lampič 2002; Breg, Kladnik and Smrekar 2007; Plut 2007; Ogrin 2008). Many studies indicate that Ljubljana's central position and its dominance over other cities in Slovenia are increasing (for example, Ravbar, Bole and Nared 2005; Kozina 2010; Bole 2011; Pečar 2011). It is interesting to note here that a number of studies (for example, Hočevar et al. 2004; Kos 2013) show that a large share of Ljubljana's residents have been expressing a relatively strong aversion towards living in more densely inhabited areas and their negative perception of characteristics that are completely commonplace in urban environments (a higher noise level, heterogeneous population structure, interaction with different social groups, etc.). Some research indicates that this can lead to an increased social-geographical differentiation and the continuation of migration flows to surrounding areas (Rebernik 2002; Uršič 2010).

This research attempts to verify the hypothesis that Ljubljana residents' satisfaction with their residential environment has an important effect on their estimation of quality of life as a whole. This assumption is not uncommon in scientific literature, but it has seldom been empirically tested (for example, Davis and Fine-Davis 1991; McCrea, Stimson and Western 2005; Marans and Kweon 2011). The second objective is to determine what kind of effect residential quality has on quality of life compared to other domains of life. The municipal spatial plan of the Municipality of Ljubljana (MOL) states that one of the goals of spatial development is to raise the quality of life and residential quality (Odlok o občinskem … 2010). The research therefore indirectly tries to answer the question of how much and in what way the city authorities and the urban planners can improve the residential conditions, thus contributing to a greater quality of life of the inhabitants.

2 Methodology

The presented results are based on the data analysis of the survey research Quality of life in Ljubljana (Kos et al. 2010), which was carried out in June 2010 to take a multidimensional measurement of the MOL inhabitants' subjective perception of quality of life. The sample of surveyed adult inhabitants was chosen at random, spatially stratified, and subsequently socially-demographically weighted. Its size (N = 1124) and

representativeness makes it suitable for different analyses and enables the results to be generalized onto the entire population of Ljubljana.

When defining quality of urban life, the distinction was made between residential quality and quality of life (as a whole), which, in addition to residential environment, also encompasses other domains of life, such as work, social relations, health, and others (McCrea et al. 2011).

The decision on the variables was tied largely to the questions of the survey research. Similarly to other authors (for example, Marans and Rodgers 1975; Campbell, Converse and Rodgers 1976; Pacione 2003; McCrea, Stimson and Western 2005), this research defined **residential quality** as **a general satisfaction with the residential environment at different spatial levels**:

- the dwelling,
- the near-by surroundings (neighbourhood), and
- the wider residential environment (city).

The first two levels related to the survey questions on satisfaction with the dwelling and the neighbourhood, which were measured on a 5-point ordinal scale (with 1 – very unsatisfied to 5 – very satisfied); the level of satisfaction with living in the city was measured with the approximation, or the question »Has the quality of life in Ljubljana generally increased or decreased in the past three years?« (1 – extremely decreased to 5 – extremely increased).

The quality of life was determined in two ways, depending on the implemented statistical method:

- **as a latent variable, represented by a satisfaction with different domains of life**: social life, family life, employment, health, and economic well-being, measured with a 5-point ordinal scale (1 – very unsatisfied to 5 – very satisfied). Rahman, Mittelhammer, and Wandschneider (2004) and Marans and Kweon (2011) defined quality of life in a similar way, but with a larger number of measured variables;
- **as a general life satisfaction**, which has been widely established in different international and longitudinal research due to its reliability and validity (Larsen, Diener and Emmons 1985). The problems that arise in using a variable of an ordinal nature as the dependent variable (for example, Lu 1999) and the findings of some researches that warn about the relatively weak reliability of life satisfaction results when measured with a single question (Krueger and Schkade 2008) prompted this research to determine general life satisfaction with two variables, measured with questions on happiness (»How happy are you in general?«; 1 – very unhappy to 5 – very happy) and on satisfaction with life (»How satisfied have you been with life lately?«; 1 – very unsatisfied to 5 – very satisfied) on a 5-point ordinal scale.

Table 1: Mean satisfaction scores of the analysed variables.

Variable	Average
Family life	3.81
Happiness in general *	3.81
Near-by environment (neighbourhood)	3.75
Health	3.68
Dwelling	3.65
Social life	3.61
Life in general	3.60
Employment	3.43
Economic well-being	3.32
Quality of life in Ljubljana in the past three years *	3.25

* Due to the differing nature of the posed question, the mean score is not directly comparable to the others.

The survey data was then analysed using the selected linear multivariate statistical methods: structural equation modelling and multiple regression analysis, which have been implemented in similar research several times before (for example, Ha and Weber 1994; McCrea, Stimson, and Western 2005; McCrea, Shyy and Stimson 2006; Marans and Kweon 2011; Türkoğlu et al. 2011).

2.1 Structural equation modelling

Structural equation modelling (SEM) is a statistical method that combines factor analysis elements and path analysis. SEM is used to determine whether hypothetical relations that have been based on previous

scientific findings or logical conclusions are correct or not. SEM consists of two parts: measurement models that illustrate the relations between the latent variables and their indicators and of the structural model that shows the causal relations between the exogenous (explanatory) and endogenous (dependent) factors (Hair 1998; Diamantopoulos and Siguaw 2000; Milfelner, Mumel and Snoj 2006). As the relations between the phenomena and the processes in the landscape and society are complex, using SEM can be more efficient than other multivariate methods.

SEM was used to confirm or reject the created multiple indicators and multiple causes model (MIMIC), which is based on our research hypothesis. The exogenous variables included all three residential quality variables, while the endogenous variable was the latent variable of quality of life, which was expressed by satisfaction with different domains of life (Figure 1). The global adequacy of the model was assessed with the selected fit indices with the maximum likelihood estimation. SEM was carried out using the SPSS 22.0 programme pack and its AMOS 22.0 programme.

2.2 Multiple regression analysis

In order to estimate the effect of residential quality on the quality of life and to compare its effect with other domains of life, the hierarchical regression analysis was executed. In the first step, all three independent variables representing satisfaction with residential environment were included in the regression model; the second step involved adding all the independent variables that represent satisfaction with selected domains of life. All these variables should, in accordance with the bottom-up spillover effect (Campbell, Converse and Rodgers 1976; Cummins 1996), affect general life satisfaction, whose factor score was used as the dependent variable in the regression. The analysis was carried out using the SPSS 22.0 programme pack.

3 Results

3.1 Structural equation modelling

The results visible in Figure 1 show the correlation coefficients between the independent variables, the share of the latent variable's explained variance, the standardized regression coefficients, and the variance shares of individual measured variables, explained with a common factor. The Chi-squared is statistically

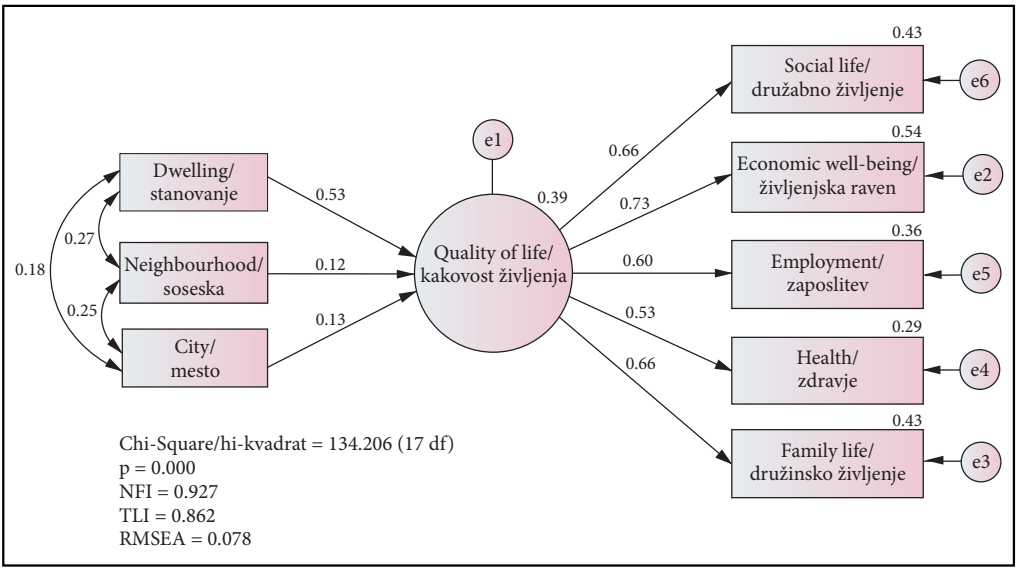

Figure 1: Structural modelling results of the relation between the residential quality and quality of life.

significant, but its sensitivity to the sample size required that the entire model fit had to be assessed using some other measurements, such as the Tucker-Lewis Index (TLI) and the Normed Fit Index (NFI), using a scale between zero and one, while their value of 0.9 was the limit for the model fit. The TLI and NFI indices provided differing results, so the fit of the entire model was verified again with the RMSEA index, claimed to be the most informative fit index. Its value was within the 0.05–0.08 interval, which points to an acceptable model fit, therefore adequately fitting to the empirical data.

The high values of the standardized regression coefficients in the measurement model (over 0.5) indicate that satisfaction with selected domains of life is actually illustrated by a general dimension (quality of life). The model shows that satisfaction with the dwelling, satisfaction with the neighbourhood, and the estimation of quality of urban life, which correlate slightly with each other, have a statistically significant, but differing influence on the quality of life of Ljubljana's population. Satisfaction with the dwelling influences it the most, which is expressed by the highest value of the standardized regression coefficient ($\beta = 0.53$). All three levels of residential quality combined account for as much as 39% of the quality of life variance; thus, the SEM results support the hypothesis stated in the introduction.

3.2 (Hierarchical) multiple regression analysis

The results of the first of both regression analyses (Table 2) reflect a positive and statistically significant effect of residential quality on quality of life, wherein the prevailing effect of satisfaction with the dwelling is again greater ($\beta = 0.23$) compared to satisfaction with the neighbourhood ($\beta = 0.13$), and with living in Ljubljana ($\beta = 0.13$).

The results of the second, hierarchical regression analysis (Table 3), which included all three levels of residential quality in the first step and the other domains of life in the second step, however, significantly relativize the meaning of residential quality for quality of life as a whole. After the second step, the value

Table 2: Regression model results of the effect of residential quality on quality of life.

	B	SE B	β
Constant	−1.82	0.16	
Dwelling	0.24	0.03	0.23**
Neighbourhood	0.15	0.03	0.13**
City	0.12	0.03	0.13**
Adjusted $R^2 = 0.12$**			
N = 1035			
*p ≤ 0.05, **p ≤ 0.01			

B = multiple regression coefficient, SE B = standard error of the multiple regression coefficient, β = standardised multiple regression coefficient

Table 3: Hierarchical regression model results on the effect of residential quality and other domains of life on quality of life.

	B	SE B	β
Constant	−3.278	0.16	
Dwelling	−0.10	0.03	−0.10**
Neighbourhood	0.05	0.03	0.05
City	0.04	0.03	0.04
Economic well-being	0.30	0.04	0.29**
Family life	0.25	0.03	0.25**
Health	0.11	0.03	0.10**
Social life	0.22	0.04	0.20**
Employment	0.06	0.03	0.07*
Adjusted $R^2 = 0.44$**			
Δ adjusted $R^2 = 0.32$**			
N = 849			
*p ≤ 0.05, **p ≤ 0.01			

of the R^2 determination coefficient, which represents the share of the dependent variable's explained variance, increased significantly (from 0.12 to 0.44). The values of the standardized regression coefficients of the residential quality variables were not statistically significant, with the exception of satisfaction with the dwelling, which, surprisingly, expresses a negative value ($\beta = -0.10$). General life satisfaction is most affected by socio-economic variables, especially economic well-being ($\beta = 0.29$), family life ($\beta = 0.25$), and social life ($\beta = 0.20$).

4 Discussion

Judging by the structural equation modelling results, satisfaction with residential environment has a very big influence on the Ljubljana population's quality of life, because the share of the quality of life variance, which can be explained with residential quality, is quite high and much larger compared to data from other research that is based on a similar methodology. Marans and Kweon (2011) used a very similar research model, but could account for only 21% of the quality of life variance for the population of Detroit; McCrea, Stimson and Western (2005) could account for 23% of the quality of life variance for the population of Brisbane.

The results of SEM and the first of both regression analyses also draw attention to the greater meaning of satisfaction with the dwelling as one of the dimensions of quality of life compared to satisfaction with the neighbourhood and with living in the city, which corresponds to the findings of other similar studies (Sirgy and Cornwell 2002; McCrea, Stimson and Western 2005; Filipović 2008; Marans and Kweon 2011; Türkoğlu et al. 2011). As Mandič (1999) states, the dwelling fulfils many needs in the life of an individual: in addition to its fundamental function as a shelter, it covers needs regarding privacy, location, assets, social contact, partner relationships, and others. Similarly, Schmeidler (2008, 35) states that the dwelling is one of the most important factors for quality of life: it affects every side of mental and social health and has a beneficial effect on inner peace, family life, and achievements in career and education.

The hierarchical regression analysis results lead to the conclusion that different »subjective« social and economic factors have a significantly greater effect on general life satisfaction of Ljubljana residents compared to residential quality. Similar results were confirmed in the case of other urban areas by Craik and Zube (1976), van Praag, Frijters and Ferrer-i-Carbonell (2003), McCrea, Stimson and Western (2005), and Marans and Kweon (2011). These results inadvertently reveal that »materialistic« values are prevalent among the inhabitants of Ljubljana, which is a characteristic of post-socialist countries (Inglehart and Welzel 2005). The relatively small significance of residential quality as one of the dimensions of quality of life can be interpreted as a consequence of the present axiomatic truth about the residential environment of the survey respondents (Volker 2011). It can be assumed that the relatively good quality of residential environment in Ljubljana, which is expressed by its large share of green areas, low crime rate, and good access to supplies, education, and employment, is regarded among the inhabitants as a form of axiomatic truth that is not discussed, but is rather considered a basic living standard. The discussion on the quality of life in Ljubljana apparently only becomes relevant when it comes to analysing the accessibility to material goods.

According to this analysis, satisfaction with the dwelling even has a negative effect on the quality of life as a whole, which is undoubtedly a surprizing and unexpected finding. This is the consequence of the partial correlation with the other variables in the regression model: despite their positive and statistically significant relation, satisfaction with the dwelling has only an indirect effect on the quality of life, through the satisfaction with other domains of life. One of the possible interpretations of the regression coefficient's negative value is that some people with a greater quality of life have higher expectations about their apartment, so they are less pleased with it, while people with a lower quality of life seek consolation precisely in their apartment (Jansen 2014). According to Saunders (1990; cf. Mandič 1999, 189), this gives them a sense of fulfilment and life purpose, which helps them overcome the feeling of alienation they may experience in the external world.

5 Conclusion

Based on the data from the survey research Quality of life in Ljubljana (2010), the selected multivariate statistical methods could only partly confirm the central research hypothesis that the inhabitants' satisfaction with residential environment attributes to their estimation of quality of life as a whole. The final

results are quite reliant on the definition of quality of life and on incorporating independent variables into the model. Structural equation modelling and the first of the two regression analyses have confirmed the effect of residential quality on quality of life, wherein satisfaction with the dwelling has a significantly higher explanation power than satisfaction with the neighbourhood and with living in the city. The significance of satisfaction with the residential environment for the quality of life of Ljubljana's inhabitants is considerably relativized by the results of the hierarchical regression analysis, which show that the estimation of individual social-economic domains of life (especially the material position of the survey respondents) has an expressly greater influence on general life satisfaction compared to the estimation of residential quality.

The research also has some limitations. As it was bound to the questions in the survey, the key term definitions had to be simplified, which reduced the complexity of the studied problem to a degree. Despite this, the study results instil a doubt that the city authorities and urban planners' efforts to manage spatial development and improve the living conditions has had a significant effect on the Ljubljana inhabitants' quality of life. Saying this, we do not believe this lessens their potential responsibility in spatial interventions. Most social-economic factors of quality of life are namely indirectly linked to the quality of residential environment, which in turn has an important effect on the inhabitants' wish to move to another, better quality location. In light of this, the most effort should be placed in renewing the existing building fund and constructing new, quality apartments; this will attribute to stopping the processes of social-geographical differentiation and migration flows from Ljubljana into its surroundings and consequently to a greater quality of family and social life of the city's inhabitants.

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Merjenje kakovosti življenja v mestu: primer Ljubljane

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IZVLEČEK: Kakovost življenja v mestu je uporaben koncept za preučevanje kakovosti bivalnega okolja in njenega vpliva na kakovost življenja. Prispevek temelji na analizi podatkov anketne raziskave Kakovost življenja v Ljubljani (2010). Z modeliranjem strukturnih enačb in hierarhično multiplo linearno regresijsko analizo smo ugotavljali vpliv kakovosti bivanja na kakovost življenja in ga primerjali z vplivom izbranih življenjskih področij. Rezultati so precej odvisni od operacionalizacije kakovosti življenja in od izbora neodvisnih spremenljivk v model. Z modeliranjem strukturnih enačb smo potrdili domnevo o vplivu kakovosti bivanja na kakovost življenja, pri čemer ima zadovoljstvo s stanovanjem nanj bistveno večji vpliv v primerjavi z zadovoljstvom s sosesko in z bivanjem v mestu. Rezultati hierarhične regresijske analize kažejo, da na kakovost življenja prebivalcev Ljubljane v največji meri vpliva njihovo vrednotenje družbeno-ekonomskih dejavnikov, zlasti življenjske ravni, družinskega in družabnega življenja.

KLJUČNE BESEDE: geografija, kakovost življenja, kakovost življenja v mestu, kakovost bivanja, mesto, Ljubljana, multivariatna statistika

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1 Uvod

Kakovost življenja je večrazsežnostni konstrukt, ki ga ni mogoče enoznačno opredeliti (Diener in Suh 1997) in se prekriva z ostalimi blaginjskimi koncepti, kot so človekov razvoj, družbena kakovost, življenjska raven in podobno (Mandič 2005). V najširšem pomenu besede vključuje tako »objektivne« kot »subjektivne« elemente in jo nekateri avtorji opredeljujejo kot »*raven, do katere so zadovoljene objektivne človekove potrebe v razmerju do osebnega ali skupinskega dojemanja subjektivnega blagostanja*« (Costanza s sod. 2007, 269). Številne raziskave na temo kakovosti življenja zasledimo v geografiji, urbanizmu in drugih prostorskih vedah, ki se od ostalih običajno razlikujejo po uporabi referenčnega prostorskega okvira in po preučevanju vpliva geografskega okolja na kakovost življenja (na primer Cutter 1985; Krevs 2002; Pacione 2003).

Kot posledica vedno večjega števila prostorsko naravnanih raziskav kakovosti življenja v urbanih območjih se je v literaturi sčasoma uveljavil pojem »kakovost življenja v mestu«, ki ga Marans in Stimson (2011, 1) opredeljujeta kot »*zadovoljstvo, ki ga človek prejme od fizičnega in družbenega okolja oziroma od razmer v njiju, ki lahko vplivajo na vedenje posameznikov in skupin, kot so gospodinjstva in podjetja*«. Pojem je vsebinsko zelo blizu kakovosti bivalnega okolja oziroma elementov v okolici stanovanja, ki so pomembni za zadovoljevanje človekovih potreb in opravljanje njegovih dejavnosti (Drozg 1994), morda celo bližje kot nekaterim (starejšim) pojmovanjem kakovosti življenja, ki se pretežno nanašajo na posameznike in na njihovo oceno življenja kot celote (na primer Diener in Suh 1997). Kakovost življenja v mestu tako lahko razumemo kot raziskovalni okvir, ki obsega preučevanje bivalnega okolja, kakovosti življenja kot celote in njunih medsebojnih vplivov.

Ljubljana se kot politično, kulturno, gospodarsko, zaposlitveno in izobraževalno središče Slovenije v slovenskem merilu ponaša z zelo visoko življenjsko ravnjo tamkajšnjega prebivalstva, še posebej z visokimi dohodki, dobro dostopnostjo do izobraževanja, storitev in oskrbe, možnostmi za preživljanje prostega časa (Krevs 2002; Uršič, Dekker in Filipovič Hrast 2014) in stanovanjskimi razmerami (Filipović in Mandič 2007). Podobno velja tudi za Ljubljansko urbano regijo, za katero je v Sloveniji značilna najvišja raven blaginje (Šprah, Novak in Fridl 2014). Za Ljubljano sta po drugi strani kot posledica zgostitve različnih dejavnosti značilni večja ranljivost in onesnaženost okolja (na primer Špes, Cigale in Lampič 2002; Breg, Kladnik in Smrekar 2007; Plut 2007; Ogrin 2008). Številne raziskave kažejo, da se središčni položaj Ljubljane in prevlada nad ostalimi slovenskimi mesti krepita (na primer Ravbar, Bole in Nared 2005; Kozina 2010; Bole 2011; Pečar 2011). Ob tem je zanimivo, da vrsta raziskav (na primer Hočevar s sod. 2004; Kos 2013), kaže, da je za Ljubljano že dalj časa značilen razmeroma močan odpor velikega deleža prebivalcev do življenja v bolj gosto naseljenih območjih in negativno vrednotenje značilnosti, ki so v urbanih okoljih sicer nekaj povsem običajnega (višja stopnja hrupa, raznovrstna sestava prebivalstva, interakcije z različnimi družbenimi skupinami in podobno). Nekatere raziskave nakazujejo, da to lahko vodi v povečano socialnogeografsko diferenciacijo in nadaljevanje selitvenih gibanj v okolico (Rebernik 2002; Uršič 2010).

V raziskavi smo želeli preveriti domnevo, da zadovoljstvo prebivalcev Ljubljane s svojim bivalnim okoljem pomembno vpliva na njihovo oceno kakovosti življenja kot celote. Gre za domnevo, ki jo v literaturi zasledimo dokaj pogosto, a je bila redko empirično preverjena (na primer Davis in Fine-Davis 1991; McCrea, Stimson in Western 2005; Marans in Kweon 2011). Obenem nas je zanimalo, kolikšen je vpliv kakovosti bivanja na kakovost življenja v primerjavi z drugimi življenjskimi področji. V občinskem prostorskem načrtu Mestne občine Ljubljana (MOL) je namreč zapisano, da je eden od ciljev prostorskega razvoja tudi dvig kakovosti življenja in bivanja v mestu (Odlok o občinskem … 2010). Tako smo v raziskavi posredno skušali odgovoriti tudi na vprašanje, koliko in na kakšen način mestne oblasti in urbanistični načrtovalci z izboljšanjem bivalnih razmer lahko pripomorejo k večji kakovosti življenja prebivalcev.

2 Metodologija

Rezultati prispevka temeljijo na analizi podatkov anketne raziskave Kakovost življenja v Ljubljani (Kos s sod. 2010), s katero so junija 2010 večdimenzionalno izmerili subjektivno dojemanje kakovosti življenja prebivalk in prebivalcev MOL. Vzorec anketiranih polnoletnih prebivalk in prebivalcev je bil naključno izbran, prostorsko stratificiran in naknadno socialno-demografsko usklajen. Zaradi svoje velikosti (N = 1124) ter reprezentativnosti je primeren za različne analize in omogoča posploševanje rezultatov na celotno populacijo prebivalcev Ljubljane.

Pri opredelitvi kakovost življenja v mestu smo smiselno razlikovali med kakovostjo bivanja in kakovostjo življenja (kot celoto), ki poleg bivalnega okolja zajema tudi druga življenjska področja, kot so delo, družbeni odnosi, zdravje in podobno (McCrea s sod. 2011).

Pri določitvi spremenljivk smo bili precej vezani na vprašanja anketne raziskave. **Kakovost bivanja** smo, podobno kot drugi avtorji (na primer Marans in Rodgers 1975; Campbell, Converse in Rodgers 1976; Pacione 2003; McCrea, Stimson in Western 2005), opredelili kot **splošno zadovoljstvo z bivalnim okoljem na različnih prostorskih ravneh**:

- s stanovanjem,
- z ožjo okolico stanovanja (sosesko) in
- s širšim bivalnim okoljem (mestom).

Za prvi dve smo povzeli anketni vprašanji o zadovoljstvu s stanovanjem in stanovanjskim okoljem (sosesko), merjenima na 5-stopenjski ordinalni lestvici (od 1 – zelo nezadovoljen do 5 – zelo zadovoljen), medtem ko smo za zadovoljstvo z bivanjem v mestu uporabili približek oziroma vprašanje »Ali se je v zadnjih treh letih kakovost življenja v Ljubljani na splošno izboljšala ali poslabšala?« (od 1 – zelo poslabšala do 5 – zelo izboljšala).

Kakovost življenja smo opredelili na dva načina, odvisno od uporabljene statistične metode:

- **kot latentno spremenljivko, ki jo ponazarja zadovoljstvo z različnimi življenjskimi področji**: družabnim življenjem, družinskim življenjem, zaposlitvijo, zdravjem in življenjsko ravnjo, merjeno na 5-stopenjski ordinalni lestvici (od 1 – zelo nezadovoljen do 5 – zelo zadovoljen). Podobno, le z večjim številom merjenih spremenljivk, so kakovost življenja opredelili Rahman, Mittelhammer in Wandschneider (2004) ter Marans in Kweon (2011);
- **kot splošno zadovoljstvo z življenjem**, ki se je zaradi svoje solidne zanesljivosti in veljavnosti (Larsen, Diener in Emmons 1985) na široko uveljavilo v različnih mednarodnih in longitudinalnih raziskavah. Zaradi problematičnosti uporabe spremenljivke ordinalnega značaja kot odvisne spremenljivke (na primer Lu 1999) in spoznanj nekaterih raziskav, ki opozarjajo na dokaj šibko zanesljivost meritev zadovoljstva z življenjem z enim samim vprašanjem (Krueger in Schkade 2008) smo splošno zadovoljstvo z življenjem opredelili z dvema spremenljivkama, merjenima s vprašanjema o sreči (»Kako srečni ste na splošno?«; od 1 – zelo nesrečen do 5 – zelo srečen) in zadovoljstvom z življenjem (»Kako ste zadovoljni z življenjem zadnje čase?«; od 1 – zelo nezadovoljen do 5 – zelo zadovoljen) na 5-stopenjski ordinalni lestvici.

Preglednica 1: Povprečne vrednosti zadovoljstva analiziranih spremenljivk.

spremenljivka	povprečje
družinsko življenje	3,81
sreča na splošno*	3,81
stanovanjsko okolje (soseska)	3,75
zdravje	3,68
stanovanje	3,65
družabno življenje	3,61
življenje na splošno	3,60
zaposlitev	3,43
življenjska raven	3,32
kakovost življenja v Ljubljani v zadnjih treh letih*	3,25

* zaradi drugače zastavljenega vprašanja povprečje ni neposredno primerljivo z ostalimi.

Podatke anketne raziskave smo nato analizirali z izbranima linearnima multivariatnima statističnima metodama: modeliranjem strukturnih enačb in multiplo regresijsko analizo, ki sta bili že večkrat uporabljeni v tovrstnih raziskavah (na primer Ha in Weber 1994; McCrea, Stimson in Western 2005; McCrea, Shyy in Stimson 2006; Marans in Kweon 2011; Türkoğlu s sod. 2011).

2.1 Modeliranje strukturnih enačb

Modeliranje strukturnih enačb (ang. *structural equation modelling* – SEM) je statistična metoda, ki združuje elemente faktorske analize in analize poti. S SEM ugotavljamo, ali hipotetične povezave, ki so bile postavljene

na podlagi preteklih znanstvenih dognanj ali logičnega sklepanja, držijo ali ne. SEM sestoji iz dveh delov: merskih modelov, ki prikazujejo povezave med latentnimi spremenljivkami in njihovimi indikatorji, in strukturnega modela, ki ponazarja vzročne povezave med eksogenimi (pojasnjevalnimi) in endogenimi (odvisnimi) dejavniki (Hair 1998; Diamantopoulos in Siguaw 2000; Milfelner, Mumel in Snoj 2006). Ker so povezave med pojavi in procesi v pokrajini in družbi kompleksne, je uporaba SEM učinkovitejša od ostalih multivariatnih metod.

S SEM smo želeli potrditi oziroma zavreči postavljeni MIMIC model (ang. *multiple indicators and multiple causes*), ki temelji na naši raziskovalni domnevi. Vanj smo kot eksogene spremenljivke vključili vse tri spremenljivke kakovosti bivanja, kot endogeno spremenljivko pa latentno spremenljivko kakovosti življenja, ki naj bi jo ponazarjalo zadovoljstvo z različnimi življenjskimi področji (slika 1). Globalno ustreznost modela smo na podlagi metode največjega verjetja ocenili z izbranimi indeksi ustreznosti. SEM smo izvedli s programskim paketom SPSS 22.0 oziroma njegovim dodatkom AMOS 22.0.

2.2 Multipla regresijska analiza

Da bi ocenili vpliv kakovosti bivanja na kakovost življenja in njegov vpliv primerjali z ostalimi življenjskimi področji, smo izvedli še hierarhično regresijsko analizo. V prvem koraku smo v regresijski model vključili vse tri neodvisne spremenljivke, ki ponazarjajo zadovoljstvo z bivalnim okoljem, v drugem pa smo mu dodali neodvisne spremenljivke, ki ponazarjajo zadovoljstvo z izbranimi življenjskimi področji. Vse te spremenljivke naj bi v skladu z učinkom prelitja od spodaj navzgor (Campbell, Converse in Rodgers 1976; Cummins 1996) vplivale na splošno zadovoljstvo z življenjem, katerega faktorsko vrednost smo v regresiji uporabili kot odvisno spremenljivko. Analizo smo izvedli s programskim paketom SPSS 22.0.

3 Rezultati

3.1 Modeliranje strukturnih enačb

Iz slike 1, ki prikazuje rezultate, lahko razberemo korelacijske koeficiente med neodvisnimi spremenljivkami, delež pojasnjene variance latentne spremenljivke, standardizirane regresijske koeficiente in deleže varianc posameznih merjenih spremenljivk, pojasnjenih s skupnim faktorjem. Hi-kvadrat je sicer statistično značilen, a smo zaradi njegove občutljivosti na velikost vzorca celotno ustreznost modela preverili še z nekaterimi drugimi merili, kot sta Tucker-Lewisov indeks (TLI) in indeks NFI (ang. *normed fit index*), s skalo med nič in ena, medtem ko je njuna vrednost 0,9 meja ustreznosti modela. Ker sta indeksa TLI in NFI dala različne rezultate, smo ustreznost celotnega modela preverili še z indeksom RMSEA, ki velja za najbolj informativni indeks ustreznosti. Njegova vrednost je znotraj intervala 0,05–0,08, kar kaže na še sprejemljivo ustreznost modela, ki se torej zadovoljivo prilega empiričnim podatkom.

Visoke vrednosti standardiziranih regresijskih koeficientov v merskem delu modela (nad 0,5) kažejo, da zadovoljstvo z izbranimi življenjskimi področji dejansko ponazarja skupna razsežnost (kakovost življenja). Model kaže, da imajo zadovoljstvo s stanovanjem, zadovoljstvo s sosesko in ocena kakovosti bivanja v mestu, ki med sabo sicer rahlo korelirajo, statistično značilen, a različno velik vpliv na kakovost življenja prebivalcev Ljubljane. Največji vpliv nanjo ima zadovoljstvo s stanovanjem, kar ponazarja največja vrednost standardiziranega regresijskega koeficienta ($\beta = 0{,}53$). Vse tri ravni kakovosti bivanja skupaj pojasnijo visokih 39 % variance kakovosti življenja, s čimer rezultati SEM potrjujejo v uvodu postavljeno domnevo.

Slika 1: Rezultati strukturnega modeliranja odnosa med vrednotenjem kakovosti bivanja in kakovosti življenja.
Glej angleški del prispevka.

3.2 (Hierarhična) multipla regresijska analiza

Rezultati prve od obeh regresijskih analiz (preglednica 2) odsevajo pozitiven in statistično značilen vpliv kakovosti bivanja na kakovost življenja, pri čemer se ponovno nakazuje večji vpliv zadovoljstva s stanovanjem ($\beta = 0{,}23$) v primerjavi z zadovoljstvom s sosesko ($\beta = 0{,}13$) in bivanjem v mestu ($\beta = 0{,}13$).

Rezultati druge, hierarhične regresijske analize (preglednica 3), v katero smo v prvem koraku vključili vse tri ravni kakovosti bivanja, v drugem koraku pa ostala izbrana življenjska področja, pa precej relativizirajo pomen kakovosti bivanja za kakovost življenja kot celoto. Po drugem koraku se je vrednost determinacijskega koeficienta R^2, ki ponazarja delež pojasnjene variance odvisne spremenljivke, namreč občutno povečala (iz 0,12 na 0,44). Vrednosti standardiziranih regresijskih koeficientov spremenljivk kakovosti bivanja razen zadovoljstva s stanovanjem, ki ima, presenetljivo, celo negativno vrednost (β = –0,10), niso statistično značilne. Na splošno zadovoljstvo z življenjem v največji meri vplivajo spremenljivke, ki sodijo v sklop družbeno-ekonomskih dejavnikov, kar še posebej velja za življenjsko raven (β = 0,29), družinsko življenje (β = 0,25) in družabno življenje (β = 0,20).

Preglednica 2: Rezultati regresijskega modela vpliva kakovosti bivanja na kakovost življenja.

	B	SE B	β
konstanta	–1,82	0,16	
stanovanje	0,24	0,03	0,23**
soseska	0,15	0,03	0,13**
mesto	0,12	0,03	0,13**
prilagojen $R^2 = 0,12$**			
N = 1035			
*p ≤ 0,05, **p ≤ 0,01			

B = multipli regresijski koeficient, SE B = standardna napaka multiplega regresijskega koeficienta, β = standardizirani multipli regresijski koeficient

Preglednica 3: Rezultati hierarhičnega regresijskega modela vpliva kakovosti bivanja in ostalih življenjskih področij na kakovost življenja.

	B	SE B	β
konstanta	–3,278	0,16	
stanovanje	–0,10	0,03	–0,10**
soseska	0,05	0,03	0,05
mesto	0,04	0,03	0,04
življenjska raven	0,30	0,04	0,29**
družinsko življenje	0,25	0,03	0,25**
zdravje	0,11	0,03	0,10**
družabno življenje	0,22	0,04	0,20**
zaposlitev	0,06	0,03	0,07*
prilagojen $R^2 = 0,44$**			
Δ prilagojen $R^2 = 0,32$**			
N = 849			
*p ≤ 0,05, **p ≤ 0,01			

4 Razprava

Sodeč po rezultatih modeliranja strukturnih enačb ima zadovoljstvo z bivalnim okoljem zelo velik vpliv na kakovost življenja prebivalcev Ljubljane, saj je delež variance kakovosti življenja, ki jo lahko pojasnimo s kakovostjo bivanja, precej visok in mnogo večji v primerjavi s podatki iz drugih znanih raziskav, ki temeljijo na podobni metodologiji. Marans in Kweon (2011) sta z zelo podobnim raziskovalnim modelom uspela pojasniti le 21 % variance kakovosti življenja prebivalcev Detroita, McCrea, Stimson in Western (2005) pa 23 % variance kakovosti življenja prebivalcev Brisbana.

Rezultati SEM in prve od obeh regresijskih analiz opozarjajo tudi na večji pomen zadovoljstva s stanovanjem kot ene od razsežnosti kakovosti življenja v primerjavi z zadovoljstvom s sosesko in bivanjem v mestu, kar se ujema z ugotovitvami drugih podobnih raziskav (Sirgy in Cornwell 2002; McCrea, Stimson in Western 2005; Filipović 2008; Marans in Kweon 2011; Türkoğlu s sod. 2011). Po Mandičevi (1999) stanovanje zadovoljuje številne potrebe v posameznikovem življenju; poleg temeljne, zavetiščne funkcije tudi potrebe v zvezi z zasebnostjo, lokacijo, premoženjem, družabnimi stiki, partnerskimi odnosi in podobno.

Podobno tudi Schmeidler (2008, 35) navaja, da je stanovanje ena od najpomembnejših dejavnikov kakovosti življenja; vpliva namreč na vse plati duševnega in socialnega zdravja in spodbudno vpliva na duševni mir, družinsko življenje in na dosežke v poklicni poti ter izobraževanju.

Rezultati hierarhične regresijske analize pa nas napeljujejo k spoznanju, da imajo različni »subjektivni« družbeni in ekonomski dejavniki v primerjavi s kakovostjo bivanja bistveno večji vpliv na splošno zadovoljstvo z življenjem prebivalcev Ljubljane. Podobno so na primeru drugih mest in območij ugotovili tudi Craik in Zube (1976), van Praag, Frijters in Ferrer-i-Carbonell (2003), McCrea, Stimson in Western (2005) ter Marans in Kweon (2011). Ti rezultati nehote razkrivajo, da med prebivalci Ljubljane prevladujejo »materialistične« vrednotne usmeritve, kar je značilnost postsocialističnih držav (Inglehart in Welzel 2005). Relativno majhen pomen kakovosti bivanja kot ene od razsežnosti kakovosti življenja si lahko razlagamo tudi kot posledico prisotnosti aksiomatske resnice glede bivalnega okolja pri anketirancih (Volker 2011). Tako lahko domnevamo, da je relativno dobra kakovost bivalnega okolja v Ljubljani, ki se med drugim kaže v veliki količini zelenih površin, nizki stopnji kriminalitete ter dobri dostopnosti do oskrbe, izobraževanja in delovnih mest, pri prebivalcih dojeta kot oblika aksiomatske resnice, o kateri se ne razpravlja, temveč je privzeta kot osnovni bivalni standard. Razprava o kakovosti življenja v Ljubljani se očitno prične šele pri analizi dostopa do materialnih dobrin.

Zadovoljstvo s stanovanjem ima po tej analizi celo negativno smer vpliva na kakovost življenja kot celoto, kar je nedvomno presenetljiva in nepričakovana ugotovitev. To je posledica parcialne korelacije z ostalimi spremenljivkami v regresijskem modelu; zadovoljstvo s stanovanjem na kakovost življenja kljub pozitivni in statistično značilni povezanosti med njima vpliva zgolj posredno, preko zadovoljstva z ostalimi življenjskimi področji. Ena od možnih interpretacij negativne smeri regresijskega koeficienta je, da imajo nekateri ljudje z višjo kakovostjo življenja večja pričakovanja glede svojega stanovanja, zato so z njim manj zadovoljni, ljudje z manjšo kakovostjo življenja pa svojo uteho iščejo ravno v stanovanju (Jansen 2014). To jim po Saundersu (1990; v: Mandič 1999, 189) daje občutek izpolnitve in življenjskega smisla, kar jim pomaga premagovati občutek odtujenosti, ki ga lahko doživljajo v zunanjem svetu.

5 Sklep

Na podlagi podatkov anketne raziskave Kakovost življenja v Ljubljani (2010) smo z izbranima multivariatnima statističnima metodama le delno potrdili osrednjo raziskovalno domnevo, da zadovoljstvo prebivalcev z bivalnim okoljem pripomore k njihovi oceni kakovosti življenja kot celote. Izkazalo se je, da so dobljeni rezultati precej odvisni od opredelitve kakovosti življenja in vključitve neodvisnih spremenljivk v model. Modeliranje strukturnih enačb in prva od obeh regresijskih analiz sta potrdili vpliv kakovosti bivanja na kakovost življenja, pri čemer ima zadovoljstvo s stanovanjem precej večjo pojasnjevalno moč od zadovoljstva s sosesko in mestom. Pomen zadovoljstva z bivalnim okoljem za kakovost življenja prebivalcev Ljubljane pa v precejšnji meri relativizirajo rezultati hierarhične regresijske analize, ki kažejo, da ima ocena posameznih družbeno-ekonomskih življenjskih področij (zlasti materialni položaj anketirancev) v primerjavi z oceno kakovosti bivanja izrazito močnejši vpliv na splošno zadovoljstvo z življenjem.

Pričujoča raziskava ima tudi nekatere pomanjkljivosti. Ker smo bili vezani na vprašanja anketne raziskave, smo morali poenostaviti opredelitev ključnih pojmov ter s tem nekoliko oklestiti kompleksnost obravnavanega problema. Kljub temu se nam na podlagi dobljenih rezultatov poraja dvom, da mestne oblasti in urbanistični načrtovalci z usmerjanjem prostorskega razvoja in s skrbjo za izboljševanje bivalnih razmer bistveno vplivajo na kakovost življenja prebivalcev Ljubljane. Hkrati menimo, da to ne zmanjšuje njihove potencialne odgovornosti pri posegih v prostor. Večina družbeno-ekonomskih dejavnikov kakovosti življenja je namreč posredno vezana tudi na kakovost bivalnega okolja, ta pa navsezadnje pomembno vpliva na željo prebivalcev po selitvi na drugo, bolj kakovostno lokacijo. V tej luči velja največ truda vložiti v prenovo obstoječega stavbnega fonda in gradnjo novih, kakovostnih stanovanj, ki bosta pripomogli k zaustavitvi procesov socialnogeografske diferenciacije in selitvenih gibanj iz Ljubljane v okolico, posledično pa tudi k večji kakovosti družinskega in družabnega življenja njenih prebivalcev.

6 Literatura

Glej angleški del prispevka.

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CHARACTERISTICS OF SPATIAL DISTRIBUTION OF CREATIVE INDUSTRIES IN LJUBLJANA AND THE LJUBLJANA REGION

ZNAČILNOSTI PROSTORSKE PORAZDELITVE KREATIVNIH DEJAVNOSTI V LJUBLJANI IN LJUBLJANSKI REGIJI

Matjaž Uršič

DAVID BOLE

Creative industries are increasingly seen as a replacement of jobs lost in traditional industrial and service sectors.
Kreativne dejavnosti so nadomestilo izgubljenih delovnih mest v tradicionalnih industrijskih in storitvenih sektorjih .

Characteristics of spatial distribution of creative industries in Ljubljana and the Ljubljana region

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ABSTRACT: This article analyzes the key features of the spatial distribution of creative industries in Ljubljana and the Ljubljana urban region. Special attention is devoted to analyzing factors that influence the concentration of individual branches of creative industries in specific locations. GIS tools were applied to evaluate factors that influence the distribution of creative activities. Simultaneously, the concept of central places is used to analyze variations of spatial clustering of creative enterprises. Data for the analysis were collected from the Slovenian Business Register (AJPES) and the Real Estate Register (GURS). The mapping of creative economies identifies patterns of concentration and reveals some locational disadvantages that have arisen due to the absence of clear development strategies regarding creative economies in Slovenia.

KEYWORDS: spatial distribution, creative industries, Ljubljana, Ljubljana urban region, central places

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1 Introduction

Due to global structural changes in trade and industrial production, creative industries are becoming an increasingly important segment of urban economies (Bairoch 1998; Landry and Bianchini 1995; Scott 2000). Creative industries, often referred to as the creative economies, are increasingly seen as a valuable tool for diversifying the local economic base and replacing jobs lost in traditional industrial and service sectors (Hesmondhalgh 2002; Howkins 2001). With the transition to the knowledge society, creativity obtained the status of utmost importance, and simultaneously the share of employees in creative industries is increasing (Bole 2008; Ravbar 2011). According to the United Nations (2010), creative economies in Europe are rising 12% faster than other forms of economies and currently provide around five million jobs in the European Union. According to the Institute for Economic Research (Murovec and Kavaš 2012), 39,193 individuals are currently employed in creative activities in Slovenia, with approximately 42% of all creative enterprises located in the Ljubljana urban region. It follows that urban areas are increasingly improving their locational advantages and creating an environment of micro-locations that have certain advantages for creative businesses and attract a highly skilled workforce (Ravbar, Bole and Nared 2005).

Advantages of individual locations for creative industries are reflected through various factors, ranging from the amount of rent for business premises, transport links, access to customers, and lifestyle orientations of employees, to the extent of social networks and proximity to socio-cultural activities and leisure. This article uses the term »*mapping of creative enterprises*« (Higgs and Cunningham 2008; Lazzeretti, Boix and Capone 2008) for analyzing the positioning of creative industries to evaluate some of the factors that affect the concentration of creative industries at specific locations in Ljubljana and the Ljubljana urban region. The largest part of the creative sector is located in Ljubljana, which acts as a key node of the wider economic system that covers the entire country. Despite this important or leading economic role in the country, Ljubljana still does not have a profiled or appropriately designed orientation of development of creative industries at the local, regional, and national levels. Existing documents such as the Green Paper on Cultural and Creative Industries (EU 2010), the Strategy for the Development of Culture in the Municipality of Ljubljana 2012–2015 (2012), the Regional Development Program of the Ljubljana Urban Region 2007–2013 (2007), and the Recommendations of the Ninth Development Group for the Creative Industries to Increase the Competitiveness of Slovenia (2008) at present only interfere with the development of individual branches of the creative industries, and a comprehensive strategy is not fully formed. It is assumed that strategic ambiguities lead to the formation of specific patterns of spatial distribution of creative industries that are not optimal in terms of socio-economic development. This article analyzes data to highlight some of the locational disadvantages that arise from incompleteness in strategic development and inhibit the rapid development of creative industries in Ljubljana and the Ljubljana urban region.

2 The concept of central places and spatial distribution of creative industries

When searching for affordable living and working conditions, innovative businesses and creative individuals apply the system of progressive elimination, or tapering of the most negative elements, and pursue the most suitable options that meet their development needs. In doing so, they rely on cost-benefit analysis and decide on a suitable location only when they feel satisfied with the majority of conditions that minimize unnecessary costs (Giddens 1984). Potential users of a site for creative industries rigorously assess all possible costs and do not only pay attention to the economic price for renting or purchasing the premises. For example, the cost of access to the market (consumers), transport accessibility, mental/emotional effort required to operate at the location, level of cultural heterogeneity, respect for diversity, openness of local culture, type of values, traditions, and so on are all elements evaluated by potential users. For potential users, each of these elements may represent a significant cost or inappropriate effort – or, on the other hand, comfort or relief – which may significantly affect its work and either discourage or attract it to the location. These are push/pull factors (Gottlieb 1994; Pareja et al. 2009) in attracting creative groups (Table 1).

Any suitable location for developing creative industries comprises a number of pull factors that successfully attract specific groups of people and companies. In doing so, it is important to emphasize that specific pull factors heavily depend on spatial planning strategies and incentives from the environment.

In environments or situations with spontaneous, unplanned development of creative industries, pull factors are formed on the basis of free market conditions. In such circumstances, creative activities accumulate along the lines of central places (Burger and Meijers 2012; Christaller 1966; Cigale 2002; Kokole 1971; Logan and Molotch 1987), which are characterized by the accumulation of resources and potentials at sites that have a lot of economic power and appropriate concentration of population. The oncept of central places is based on theories of urban systems and in a simplified form assumes that certain locations that have the advantage of exceptional natural accumulation of resources (people, institutions, and infrastructures) also more successfully cluster economic activities and services (Jaklič, Cotič Svetina and Zagoršek 2004; Nered 2005). Characteristics of central places are based on providing physical access to resources of sufficient size (population, consumers, and transport infrastructure) that maintain existing monopolistic relations in the urban system (Table 1).

Table 1: Characteristics of central places and dynamic networks of places (adapted from Batten 1995; Borja and Castells 1996; Hočevar 2000).

Category	Characteristics of central places	Characteristics of dynamic networks of places
Urban economy	Emphasis on size, scale (population, economy)	Emphasis on quality, flexibility (market, economy)
Regional relations	Monopoly, one-directional gravity	Dispersion, multiple centrality centrifugality, multi-way flows
Transportation policies	Emphasis on physical transport costs and mobility costs	Importance of information cost and exchange of information cost
Urban planning	Long term, limited, static planning	Long-term, dynamic, fragmented, and strategic planning
Urban cultures	Homogeneity	Heterogeneity
Integration	Vertical relationships, centrality	Horizontal relationships, nodality (networks)

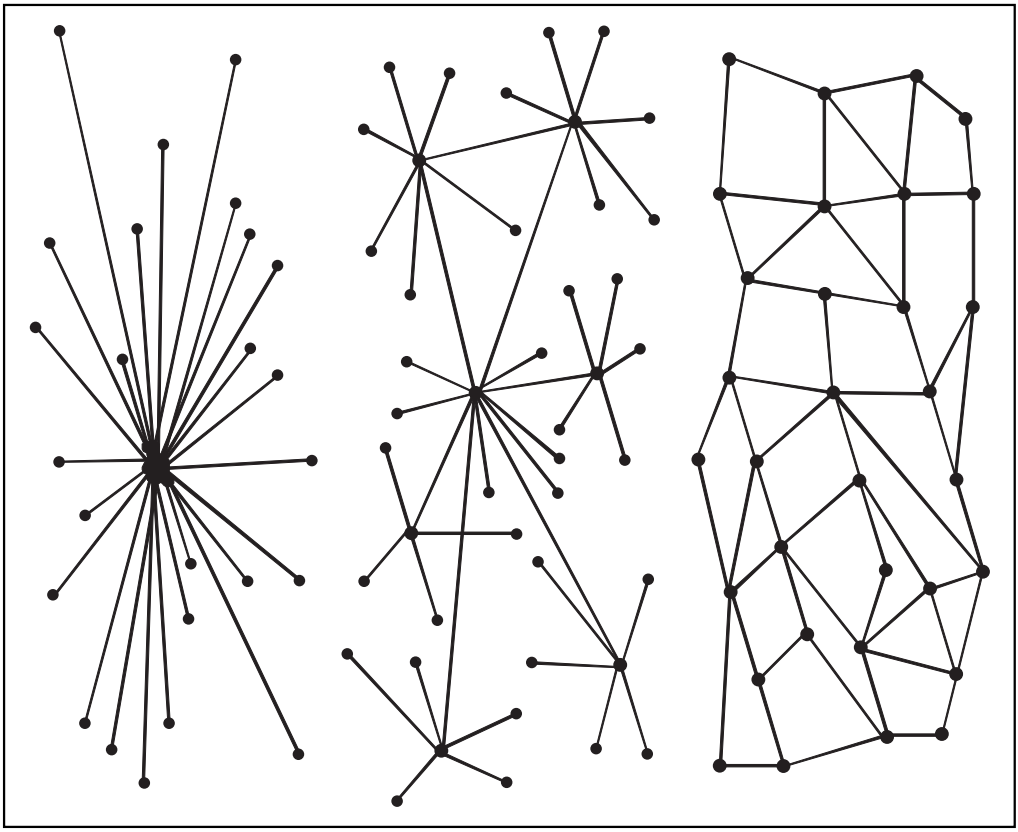


Figure 1: Schematic representation of centralization (first pattern), decentralization (second pattern), and distribution (third pattern).

Clusters of economic activities and services also supply the surrounding areas and are thus central places in the wider region. In some cases, the advantages of central places attract a greater number of people, allowing them to offer more specialized services and consequently develop faster. Differences in the speed of development presuppose that various central places have different strengths or ranges of influence. Spatial centrality refers to the degree to which the central location serves and supplies the surrounding areas. The theory of central places fundamentally presupposes a hierarchical spatial arrangement, in which either the central settlement or more distant central settlements with subcenters control a wider area (see the first and second patterns in Figure 1) and prevent more balanced development of different locations in the same area (the third pattern in Figure 1). From this perspective, the concept of central places has often been criticized as flawed (see, e.g., Batten 1995; Eaton and Lipsey 1982; Preston 1983) and does not sufficiently explain the new, more dynamic, networked, multi-central models of functional distribution (see also Table 1). The influence and centrality of local spaces in the postmodern global economy may rapidly change location and reduce the importance of proximity and direct physical accessibility of services or a large population (Mlinar 1994; Soja 2000).

The theory of central places can explain the clustering of creative industries in cases in which there exists a spontaneous, unplanned concentration of economies and services on the basis of absolute population size and combination of various infrastructure and government institutions. The distribution of creative industries in Ljubljana and the Ljubljana urban region follows a typical hierarchical distribution of spontaneous accumulation of services and businesses based on the concept of central places. Creative industries are heavily concentrated in the city center, and smaller subcenters occasionally arise on the outskirts. In this respect, proximity is a decisive factor in the choice of location for creative industries. The size of the aggregated population and geographical placement of infrastructure in the historical and administrative center of the region provides access to a larger market (Kozina 2010). In the following section, the mapping method – which is used as an important analytical tool by a number of international development agencies (DCMS 2010; CCN 2010) and provides insight into the locational patterns of creative businesses – is used to present and analyze the key features of spontaneous hierarchical spatial distribution of creative industries in Ljubljana and the Ljubljana urban region.

3 Methodology and research process

Mapping creative industries in the Ljubljana urban region is based on the Slovenian Business Register (AJPES) and the Slovenian Real Estate Register (GURS). It should be noted that the AJPES database does not allow accurate insight into the activities of employees and companies. These shortcomings were overcome in the study by combining data from different sources that made it possible to obtain credible insight into the current situation in the field. The key findings in the research were therefore obtained not only through data from AJPES records, but primarily through the use of a grounded theory approach (Glasser, 1998; Holt-Jensen 1988). After an analysis and comparison of multi-layer data, an inductive path was used to identify key trends, which may explain details reflected in the cartographic analysis of the locations of creative industries in Ljubljana and the Ljubljana urban region.

The cartographic analysis included data from specific categories of economic activities (see Figure 1 and Annex 1), which were in line with the existing European NACE classification (see SKD, Standard Classification of Activities in the Republic of Slovenia, and NACE Rev. 2 2008) and have been previously identified as part of creative industries. ArcGIS software was used for mapping. Key creative industries included in the analysis were determined after a review of various definitions of creative and cultural industries (DCMS 2001; Eurostat 2007, 2010; KKIPS 2011), from which thirty-two categories of activities from the SKD classification (2008) were extracted.

The thirty-two categories of activities were then divided into eleven groups of creative industries, which were used for cartographic analysis of Ljubljana. The groups of creative industries are 1) advertising, 2) architecture, 3) art and antiques, 4) design, 5) video, film, and photography, 6) software, 7) visual and performing arts, and music, 8) arts creation, 9) publishing, 10) TV and radio, and 11) cultural institutions.

These groups cover specific characteristics of the local creative industries and include categories that are treated as separate groups in other countries (e.g., music). In this respect, creative industries are very flexible, multifaceted, and a broad concept that many authors interpret in a number of ways (DCMS 2001; Evans 2009; Fleming 2011; Florida 2002, 2005; Krätke 2010; Montgomery 2003; Peck 2005; Simmie 2006).

Uniform categorization of creative industries is therefore not clearly defined and is adapted to the specific local context. In this study, the classified categories were divided on the basis of access to data and range of information from previous studies related to creative industries in Ljubljana and the Ljubljana urban region (Bunker 2010; IER 2012; IPoP 2011, 2012; MOL 2002; Second Chance 2011).

The cartographic analysis of creative industries based on the Standard Classification of Activities (2008) and AJPES database has certain shortcomings because it focuses on companies that primarily belong to general creative industries and thereby excludes a specific set of creative individuals that also work in creative fields but are employed in small sections of businesses that are not primarily defined as part of the creative industries (e.g., marketing and design departments of manufacturing companies, architects in construction companies, etc.). The statistics also exclude creative individuals and companies engaged in »border areas« of creative industries that do highly creative work associated with research and experimentation (e.g., institutes, companies involved in transport, environmental protection, etc.) but are statistically not included in the creative sector. The database is also deficient in recording the number of employees in creative businesses because it divides them into several classes (micro, small, medium, and large units) and does not provide accurate information on the concentration of creative individuals. The analysis therefore includes all creative businesses, irrespective of the number of employees. Consequently, whenever any specificities in the concentration of creative businesses were detected, they were specially marked in subsequent phases of cartographic analysis. A certain lack of accurate data on creative enterprises is understandable because of the unique characteristics of creative individuals: a highly mobile workforce with a dynamic working attitude and lifestyle orientations that require a high degree of social crosslinking (Clark 2004). Nevertheless, the analysis of combined creative industries made on the basis of SKD classification still allows credible insight into key sectors and the scope of certain branches of creative industries in the Ljubljana urban region (Table 2).

Table 2: Number and share of combined creative industries in the Ljubljana urban region based on the selection from the NACE classifications (Source: AJPES 2011; GURS 2011; IPoP 2012; SURS 2011; Žaucer et al.2012).

Creative industry	No. of firms (Ljubljana urban region)	Share (%) of creative industries (Ljubljana urban region)
Advertising	543	9.00
Architecture	879	14.50
Art and antiques	31	0.50
Design	392	6.50
Video, film and photography	477	7.90
Software	798	13.20
Visual and performing arts, music	515	8.50
Arts creation	1,682	27.80
Publishing	385	6.40
Radio and TV	130	2.10
Cultural institutions	228	3.80
Total	6,060	100.00

In order to improve the quality of information derived from the SKD classification (2008), the data in the study were further filtered at the level of local communities. Particular attention was paid to detecting and verifying the locations of the strongest creative centers or clusters, which are groups of mutually complementary, heterogeneous companies linked through production, consumers, suppliers, and other relationships to promote the circulation of information and economic growth in a particular area (see Landry 2000; Perrons 2004; Porter 1990; van Heur 2009).

4 Mapping analysis of creative businesses

4.1 Locational characteristics of creative industries in Ljubljana

The maps show the key densifications of creative industries in Municipality of Ljubljana. In the legend to Figure 2, the size of the dots represents the number of business units covered in the SKD classifications (2008).

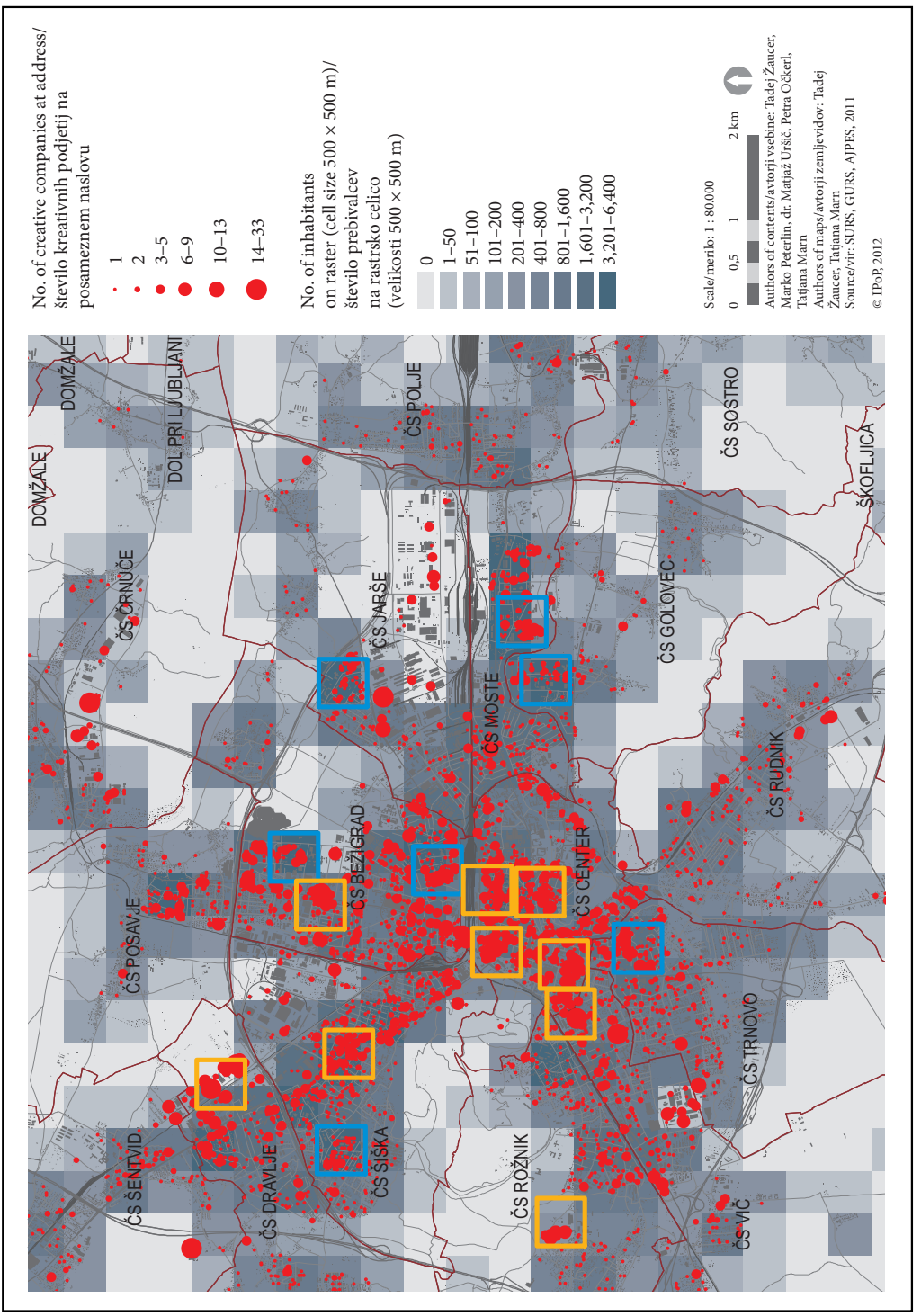


Figure 2: Distribution of enterprises from creative industries in the Municipality of Ljubljana.

Stronger concentrations of businesses in creative industries particularly stand out in areas around the city center – Rome Street (*Rimska cesta*), Mirje (Tobačna), Ajdovščina, Tabor, and Trubar Street (*Trubarjeva cesta*) – and along the city's arterial roads; for example, Vienna Street (*Dunajska cesta*) near the Mercator office building and the southern part of Bežigrad, and parts of Šiška along Klagenfurt Street (*Celovška cesta*). These areas are marked with yellow squares in Figure 2.

To a lesser extent, some individual areas or hotspots are noticeable outside the city center, created on the basis of various business opportunities (e.g., the Brdo Technology Park and the Stegne Industrial Zone). On the map areas of residential neighborhoods (e.g. Trnovo, Župančičeva Jama, and Fužine) are also noticeable where there are smaller concentrations of companies from creative industries. These are mostly groups of self-employed people (e.g., freelance journalists, artists, etc.) that are registered at addresses where business owners live. It should be noted that the figures do not say much about the activities of these companies. Only a detailed field analysis could assess their actual potential for development in the context of creative enterprises. These areas are therefore marked with blue squares in Figure 2.

The city center represents an extremely strong concentration of creative industries in the Municipality of Ljubljana and the total number of creative firms in this location far exceeds other parts of the city (see Figure 2). The colored background in Figure 3 shows the below-average (negative) or above-average proportion of firms in creative industries among all companies in the area. In particular branches of the creative industries, a stronger concentration is observed in specific urban areas. In the case of software production, peripheral locations such as Trzin, Domžale, and some outlying districts of Ljubljana (e.g. Črnuče, Dravlje, and Vič) stand out in the proportion of creative businesses, which may be explained by the lesser importance of micro-location for the development of these industries and the possibility of telecommuting (Toffler 1980). In contrast, the proportion of firms engaged in architecture is highest in the city center and areas adjacent to the city center (e.g., the Trnovo district). There are also differences in the structure of creative businesses between areas, with some locations being more attractive to core creative industries than culture-related industries. Such an example is the Municipality of Trzin, which is a strong business zone characterized by a high proportion of firms in computer software, complemented by architecture, design, and video, and relatively low shares of artistic creation, the visual and performing arts, and publishing.

4.2 Characteristics of creative industry locations in the Ljubljana urban region

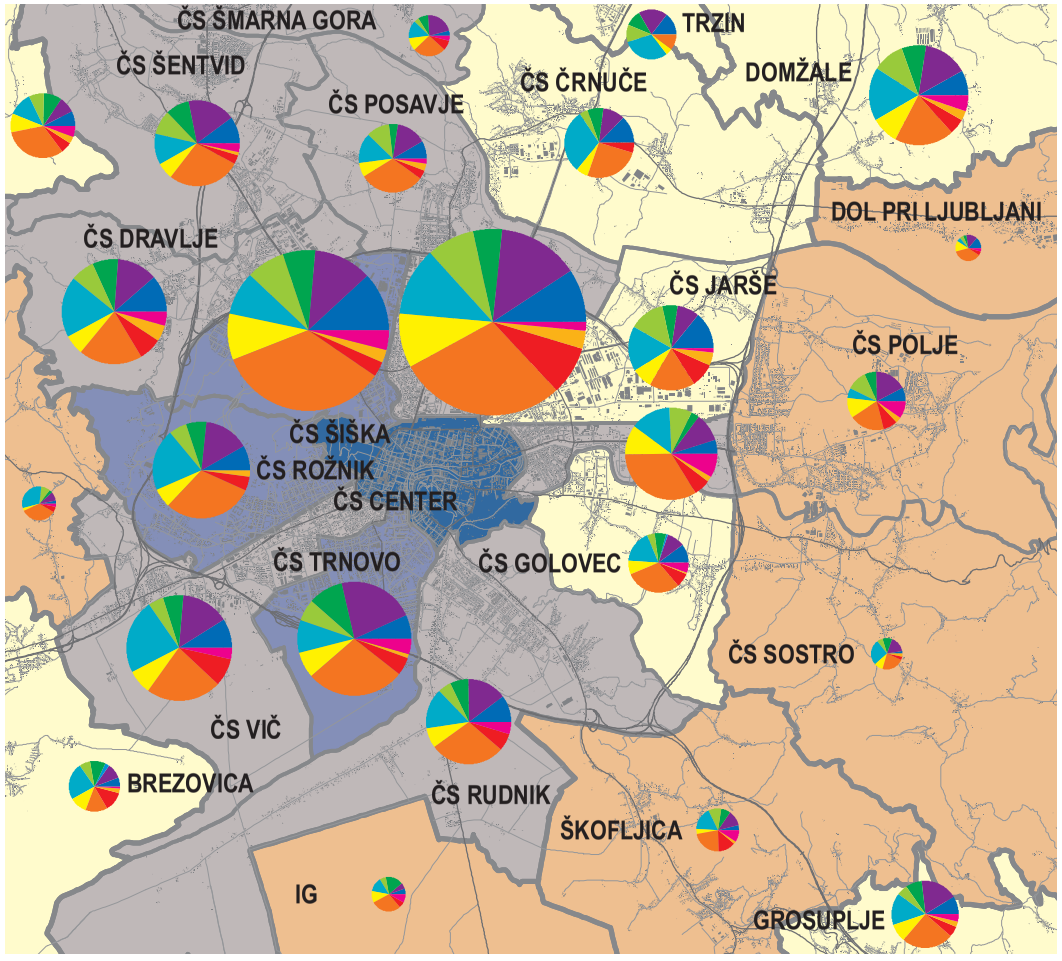
At the level of the Ljubljana urban region, the city of Ljubljana is a prominent center of creative industries in relation to smaller municipalities (e.g. Domžale, Kamnik, Grosuplje, and Vrhnika). The proportion of businesses in creative industries is much higher within the districts of Municipality of Ljubljana than in other municipalities in the Ljubljana urban region (Figure 4 and Annex 2).

In particular, compared to other municipalities in the Ljubljana urban region, the Municipality of Ljubljana stands out not only for its large share and number of creative enterprises, but also for an exceptional concentration of such businesses. The concentration of creative businesses in the Ljubljana urban region is shown in Figure 5, where the number of firms from creative industries is correlated and normalized by the number of residents in municipalities and city districts.

5 Conclusion

The mapping analysis of businesses shows that Ljubljana, as a large demographic agglomeration in the region, has a strong concentration of creative industries. From this perspective, the distribution of creative activities in the Municipality of Ljubljana and the Ljubljana urban region approaches the idea of »central places« and follows a typical hierarchical layout, in which the number of firms decreases proportionally from the city center towards the periphery or subcenters. In the case of Ljubljana and the Ljubljana urban region, the clustering of creative industries is largely dependent on the population size and number of transport links. Other factors, such as the cost of renting office space and general attractiveness of micro-locations, also influence clustering. A minimum number of creative industries is notable only in slightly more densely

Figure 3: Percentage of companies from various branches of creative industries in the Municipality of Ljubljana and the proportion of firms in creative industries based on the total number of companies in the Municipality of Ljubljana. ►



Standard deviation of creative companies (%)/
standardna deviacija kreativnih podjetij (%)

- < –1,5
- –1,5––0,50
- –0,50–0,50
- 0,50–1,5
- 1,5–2,5
- > 2,5

Size of this circle corresponds to 290 creative companies/
velikost tega kroga sovpada z 290 kreativnimi podjetji

- advertising/oglaševanje
- architecture/arhitektura
- design/dizajn
- video, film, photo/ video, filmska in foto produkcija
- software/računalniško programiranje
- visual, perf., music/glasbena in vizualna produkcija
- arts creation/umetniška produkcija
- publishing/založništvo
- radio & TV/radijska in televizijska produkcija
- institutions of cultural production/ institucije na področju kulture in umetnosti

Scale/merilo: 1 : 125.000

0 1 2 4 km

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Authors of maps/avtorji zemljevidov: Tadej Žaucer, Tatjana Marn
Source/vir: SURS, GURS, AJPES, 2011

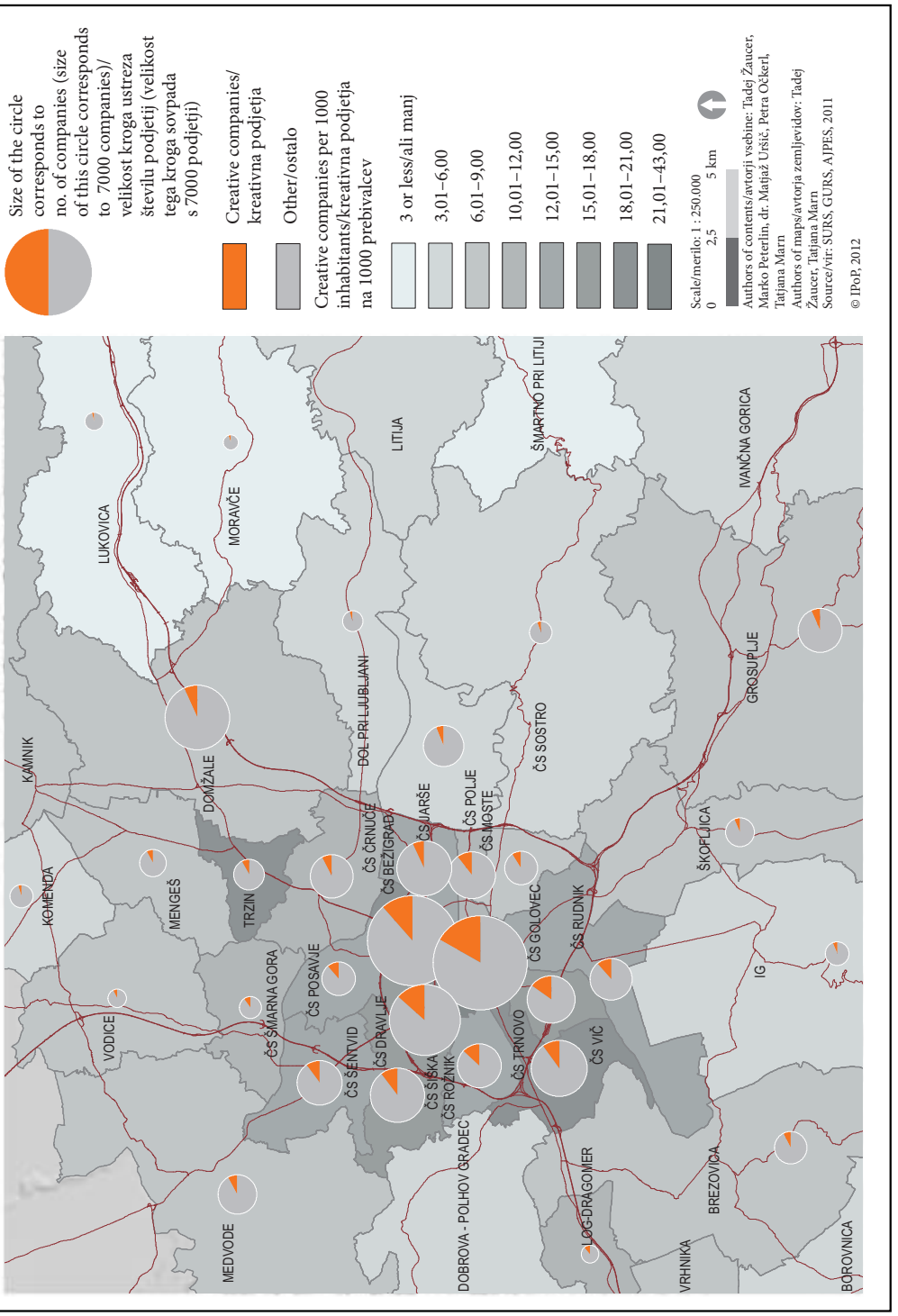

Figure 4: Overall proportion of firms in creative industries in relation to the total number of firms by municipalities in the Ljubljana urban region.

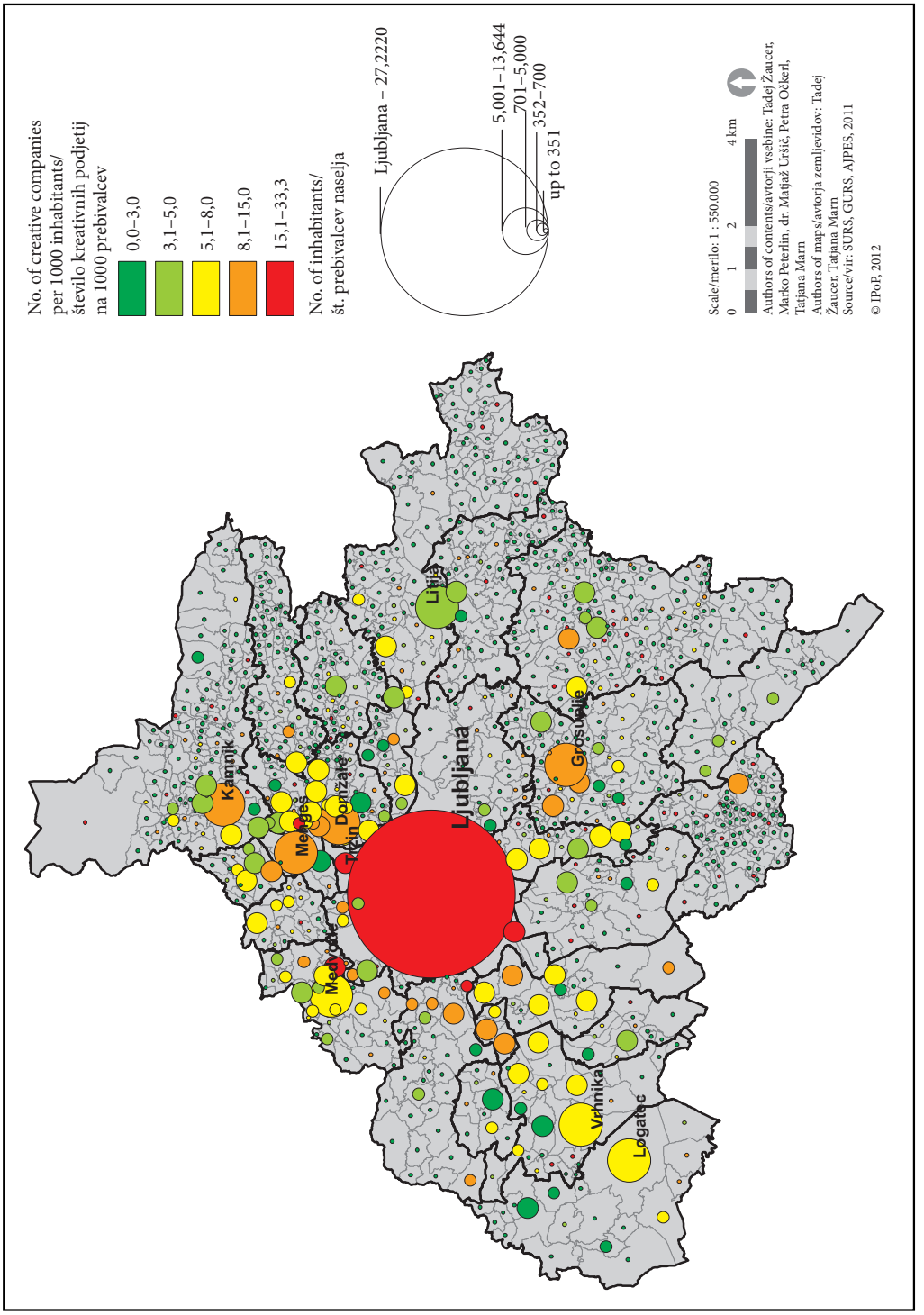

Figure 5: Concentration of business in creative industries correlated with the number of people in the Ljubljana urban region.

populated subcenters along the main roads. The best ratio between the population and creative enterprises is in Trzin, which is also well connected through transport, and the lowest ratio is characteristic for more distant subcenters such as Litija, Logatec, and Vrhnika.

Hierarchical or uneven spatial distribution of companies in creative industries decreases the functional heterogeneity of creative industries. In such circumstances, the ones that perform best are industries with quick access to a large market and hinterland from which they draw the necessary human resources. Only sectors of creative industries that are able to spontaneously respond to the needs of major business and commercial companies are successful, whereas specialized branches of creative industries are developing very slowly (e.g. radio and television, software, film and photography, design, art, and the antiques market). This situation could be described as the entropic dimension of the socioeconomic system (see Kirn 2008), in which the energy or actors and companies associated with the development of creative industries accumulate in specific locations, but at the risk that, after a certain period of time, potentially successful creative industries will lose their initial drive or even cease operations due to a poor economic base, lack of incentives from the environment, or the inability to upgrade their activities because of limited spatial, social, or human resources.

Over-dependence of creative industries on the market creates hierarchization at the level of choice of locations and types of creative industries in Ljubljana and the Ljubljana urban region. The effects of this hierarchy are reflected in low spatial and functional diversification of creative industries. Such spontaneous or incrementalistic development does not promote creative industries in a global context, but only responds to the current situation in the locally confined (regional) market. Further development of creative industries should therefore be based on strategies that facilitate access to adequate resources (financial incentives, services, and facilities) and infrastructures for specialized sectors of creative industries, which are present in the form of small nucleuses outside the city center and offer the greatest potential for further creative clustering and urban regeneration. Increasing access to the basic resources needed to develop certain types of creative industries would also increase the chances for a developmental breakthrough and business expansion.

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Značilnosti prostorske porazdelitve kreativnih dejavnosti v Ljubljani in Ljubljanski regiji

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IZVLEČEK: Članek analizira ključne značilnosti prostorske porazdelitve kreativnih dejavnosti v Ljubljani in Ljubljanski urbani regiji. Posebna pozornost je namenjena analizi vzrokov zgoščevanja posameznih vej kreativnih dejavnosti na specifičnih lokacijah. Pri ovrednotenju dejavnikov, ki vplivajo na razporeditev kreativnih dejavnosti, se opiramo na uporabo GIS orodij. Pri tem so prek koncepta centralnih krajev analizirani načini prostorskega grozdenja kreativnih podjetij. Podatki za analizo so zajeti iz Poslovnega registra Slovenije (AJPES) in Registra nepremičnin in hišnih številk ter teritorialnih enot (GURS). Metoda t. i. »kartiranja« (mapping) kreativnih ekonomij identificira vzorce zgoščevanja kreativnih dejavnosti in razkriva nekatere lokacijske pomanjkljivosti, ki so nastale ob odsotnosti jasnih razvojnih strategij kreativnih ekonomij v Sloveniji.

KLJUČNE BESEDE: prostorska porazdelitev, kreativne dejavnosti, Ljubljana, Ljubljanska urbana regija, centralni kraji

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1 Uvod

Zaradi globalnih strukturnih sprememb na področju trgovine in industrijske produkcije postajajo kreativne dejavnosti vse pomembnejši segment mestnih ekonomij (Bairoch 1998; Landry in Bianchini 1995; Scott 2000). Kreativne dejavnosti, pogosto poimenovane tudi kreativne ekonomije in kreativne industrije so vedno bolj obravnavane kot dragoceno orodje za diverzifikacijo lokalne gospodarske osnove in nadomestilo izgubljenih delovnih mest v tradicionalnih industrijskih in storitvenih sektorjih (Hesmondhalgh 2002; Howkins 2001). Kreativnost pridobiva s prehodom v družbo znanja izreden pomen, pri čemer se povečuje tudi delež zaposlenih v kreativnih panogah (Bole 2008; Ravbar 2011). Po podatkih Združenih narodov (2010) kreativne ekonomije v Evropi naraščajo 12 odstotkov hitreje od ostalih oblik ekonomij in trenutno zagotavljajo približno pet milijonov zaposlitev Evropski uniji. Po podatkih Inštituta za ekonomske raziskave (Murovec in Kavaš 2012) je v Sloveniji v kreativnih dejavnostih trenutno zaposlenih 39.193 posameznikov, pri čemer približno 42 % vseh kreativnih podjetij leži v Ljubljanski urbani regiji. Iz navedenega izhaja, da urbana območja vedno bolj stremijo k izpopolnjevanju svojih lokacijskih prednosti in ustvarjanju okolja oziroma mikrolokacij, ki imajo določene prednosti za kreativna podjetja ter privabljajo visokokvalificirano delovno silo (Ravbar, Bole in Nared 2005).

Prednosti posameznih lokacij za kreativne dejavnosti se zrcalijo skozi različne dejavnike, ki segajo od višine najemnin poslovnih prostorov, prometnih povezav, dostopa do strank, življenjsko-stilskih orientacij zaposlenih do obsega socialnih omrežij ter bližine družbeno-kulturnih in prostočasovnih dejavnosti. V članku bomo prek t. i. »kartiranja kreativnih podjetij« (Higgs in Cunningham 2008; Lazzeretti, Boix in Capone 2008) ali analize pozicioniranja kreativnih dejavnosti ovrednotili nekatere dejavnike, ki vplivajo na zgoščevanje kreativnih dejavnosti na posameznih lokacijah v Ljubljani in mestni regiji. Velika večina kreativnega sektorja je v Ljubljani, ki deluje kot ključno vozlišče širšega ekonomskega sistema, ki pokriva celotno državo. Kljub tej pomembni, vodilni gospodarski vlogi v državi, Ljubljana še vedno nima profiliranih oziroma ustrezno izoblikovanih usmeritev razvoja kreativnih industrij na lokalnem, regionalnem in državnem nivoju. Obstoječi dokumenti, kot so na primer Zelena knjiga – Izkoriščanje potenciala kulturnih in ustvarjalnih industrij (EU 2010), Strategija razvoja kulture v Mestni občini Ljubljana 2012–2015 (2012), Regionalni razvojni program Ljubljanske urbane regije 2007–2013 (2007), Priporočila 9. razvojne skupine za kreativne industrije za povečanje konkurenčnosti Slovenije (2008), zaenkrat posegajo v razvoj zgolj posameznih vej kreativnih dejavnosti, medtem ko celostna strategija na tem področju ni popolnoma izoblikovana. Pri tem predpostavljamo, da strateške nedorečenosti vodijo v oblikovanje specifičnih vzorcev prostorske razporeditve kreativnih dejavnosti, ki niso najbolj optimalne z vidika družbeno-ekonomskega razvoja. V članku bomo na podlagi analiziranih podatkov skušali izpostaviti nekatere izmed teh lokacijskih pomanjkljivosti, ki izhajajo iz strateško-razvojnih nedorečenosti in zavirajo hitrejši razvoj kreativnih dejavnosti v Ljubljani in ljubljanski regiji.

2 Koncept centralnih krajev in prostorska porazdelitev kreativnih dejavnosti

Kreativna podjetja in ustvarjalni posamezniki pri iskanju ugodnih bivalnih in delovnih pogojev uporabljajo sistem postopnega izločanja (angl. *tappering*) najbolj negativnih elementov in stremljenju k izbiri najprimernejših možnosti za zadovoljitev razvojnih potreb. Pri tem se opirajo na analizo koristi in stroškov ter se odločijo za izbiro lokacije šele takrat, ko se jim zazdi, da je zadovoljeno večini pogojev in so minimalizirani nepotrebni stroški (Giddens 1984). Potencialni uporabniki lokacije za kreativne industrije pri tem strogo ocenjujejo vse mogoče stroške in ne le ekonomske cene najema/nakupa prostorov. Za potencialne uporabnike strošek lahko na primer predstavlja tudi dostop do trga (potrošnikov), prometna dostopnost, psihični/emocionalni napor, ki je potreben za delovanje na lokaciji, ali pa stopnja kulturne heterogenosti, upoštevanje in spoštovanje različnosti, zaprtosti/odprtosti lokalne kulture, vrednot, tradicije in tako dalje. Vsak izmed naštetih elementov lahko za potencialne uporabnike lokacije predstavlja pomemben strošek, napor/ugodje, olajšavo, ki lahko bistveno vpliva na njegovo delo in ga bodisi odvrača od lokacijo bodisi privlači. Gre za t. i. dejavnike odbijanja/privlačnosti (ang. *push/pull factors*; Gottlieb 1994; Pareja in ostali 2009) pri privabljanju kreativnih skupin (preglednica 1).

Vsaka primerna lokacija za razvoj kreativnih dejavnosti vsebuje neko število privlačnostnih dejavnikov, s katerimi uspešno privablja specifične skupine ljudi in podjetij. Pri tem poudarjamo, da so posamezni dejavniki privlačnosti močno odvisni od strategij prostorskega načrtovanja in spodbud iz okolja. V okolju oziroma v razmerah, kjer prihaja do spontanega, nenačrtovanega razvoja kreativnih dejavnosti, se privlačnostni dejavniki izoblikujejo na podlagi prostih tržnih razmer. V takih okoliščinah se kreativne dejavnosti kopičijo po vzoru centralnih krajev (Burger in Meijers 2012; Christaller 1966; Cigale 2002; Kokole 1971; Logan in Molotch 1987), za katere je značilno kopičenje resursov in potencialov zgolj na lokacijah, ki imajo veliko ekonomsko moč in ustrezno število prebivalstva. Koncept centralnih krajev izhaja iz teorij urbanih sistemov in v poenostavljeni obliki predpostavlja, da na določenih lokacijah, ki imajo prednost izredne fizične akumulacije resursov (prebivalstva, institucij, infrastruktur), prihaja tudi do grozdenja ekonomskih dejavnosti in storitev (Jaklič, Cotič Svetina in Zagoršek; Nered 2005). Značilnosti centralnih krajev temeljijo na zagotavljanju fizičnega dostopa do dovolj velikih resursov (prebivalstva, potrošnikov, prometne infrastrukture), s katerimi se ohranjajo obstoječa monopolna razmerja v urbanem sistemu (preglednica 1).

Preglednica 1: Značilnosti centralnih krajev in dinamičnih omrežij krajev (prirejeno po Batten 1995; Borja in Castells 1996; Hočevar 2000).

	značilnosti centralnih krajev	značilnosti dinamičnih omrežij krajev
urbana ekonomija	poudarek na velikosti, obsegu (prebivalstva, ekonomij)	poudarek na kvaliteti, fleksibilnosti (trga, ekonomij)
regionalni odnosi	monopol, enosmerna gravitacija	razpršenost, večjedrnost, centrifugalnost, večsmerni tokovi
transportne usmeritve	poudarek na fizičnem transportu in stroških mobilnosti	pomen informacijskih stroškov in izmenjave informacij
urbano načrtovanje	dolgoročno, zamejeno, statično načrtovanje	dolgoročno-dinamično-fragmentirano in strateško načrtovanje
urbane kulture	homogenost	heterogenost
povezovanje	vertikalna razmerja, centralnost (središčnost)	horizontalna razmerja, vozliščnost (omrežje)

Grozdi dejavnosti s svojo ponudbo in servisi oskrbujejo tudi okoliška območja in so na ta način centralni kraji širše regije. V določenih primernih lahko centralni kraji zaradi svojih lokacijskih prednosti privabljajo večje število ljudi, ponujajo več specializiranih servisov in se posledično hitreje razvijajo. Razlike v hitrosti razvoja predpostavljajo tudi različno moč oziroma obseg vplivnih območij centralnih krajev. S prostorsko centralnostjo označujemo stopnjo, do katere centralna lokacija služi in oskrbuje okoliška območja. Teorija centralnih krajev v temelju predpostavlja hierarhično prostorsko ureditev, kjer bodisi centralno naselje bodisi več medsebojno primerno oddaljenih centralnih naselij s subcentri obvladuje širše območje (shemi a in b na sliki 1) ter preprečuje bolj uravnotežen razvoj različnih lokacij v istem območju (shema c na sliki 1). S tega vidika so koncept centralnih krajev pogosto kritizirali (glej npr. Batten 1995; Eaton in Lipsey 1982; Preston 1983) kot pomanjkljiv in naj bi v nezadostni meri pojasnjeval nove, bolj dinamične, mrežne, multijedrne modele razporeditve funkcij in krajevnih pomembnosti (glej tudi preglednico 1), ki v postmodernih globalnih ekonomijah lahko zelo hitro menjajo lokacije ter zmanjšujejo pomen neposredne dostopnosti oziroma fizične bližine servisov in storitev ter velikega števila prebivalstva (Mlinar 1994; Soja 2000).

Slika 1: Shematski prikaz centralizacije (prva shema), decentralizacije (druga shema) in distribucije (tretja shema).
Glej angleški del prispevka.

S teorijo centralnih krajev lahko pojasnimo grozdenje kreativnih dejavnosti v primerih, kjer prihaja do spontanega, nenačrtovanega zgoščevanja dejavnosti na osnovi absolutne velikosti populacije ter prepleta različnih infrastruktur in državnih institucij. Razporeditev kreativnih dejavnosti v Ljubljani in ljubljanski regiji sledi tipični hierarhični razporeditvi spontane akumulacije storitev in podjetij, ki temelji na konceptu centralnih krajev. Kreativne dejavnosti se močno zgoščajo v središčih mest, na obrobju pa občasno nastajajo manjši subcentri. Kot prednostni dejavnik izbire lokacije za kreativne dejavnosti v tem pogledu izstopa bližina čim večjega tržišča oziroma velikost agregirane populacije ter geografska umestitev v infrastrukturno, historično, upravno središče regije (Kozina 2010). Z metodo kartiranja, ki ga kot pomemben pripomoček uporablja vrsta mednarodnih razvojnih agencij (DCMS 2010; CCN 2010) in daje vpogled v vzorce lociranja kreativnih podjetij in s tem povezane prostorske koncentracije, bodo v nadaljevanju prikazane in analizirane ključne značilnosti spontane hierarhične prostorske razporeditve kreativnih dejavnosti v Ljubljani in ljubljanski regiji.

3 Metodologija in raziskovalni proces

Kartiranje kreativnih industrij v Ljubljanski urbani regiji temelji na podatkih Poslovnega registra Slovenije (AJPES) in Registra nepremičnin in hišnih številk ter teritorialnih enot (GURS). Pri tem moramo omeniti pomanjkljivosti, ki izhajajo iz baze AJPES, saj ne omogoča natančnega vpogleda v aktivnosti zaposlenih in podjetja. Navedene pomanjkljivosti smo v raziskavi premostili s kombiniranjem podatkov iz različnih virov in na ta način pridobiti verodostojen vpogled v obstoječo situacijo na terenu. Do ključnih ugotovitev smo torej v raziskavi prišli ne le prek podatkov iz evidenc AJPES-a, temveč predvsem z uporabo temeljne analize (ang. *grounded theory*; Glasser 1998; Holt-Jensen 1988), kjer smo na podlagi analize in primerjave večplastnih podatkov po induktivni poti prešli k splošni obravnavi in identifikaciji ključnih trendov, s katerimi lahko pojasnjujemo posebnosti, ki odsevajo v kartografski analizi lokacij kreativnih dejavnosti v Ljubljani in Ljubljanski urbani regiji.

V kartografsko analizo so bili zajeti podatki iz specifičnih kategorij gospodarskih dejavnosti (glej prilogo 1), ki so bile usklajene z veljavno evropsko klasifikacijo NACE (glej SKD – standardna klasifikacija dejavnosti v RS in NACE Rev. 2 2008) in smo jih predhodno opredelili kot del kreativnih dejavnosti. Za izdelavo zemljevidov smo uporabili program ArcGIS. Ključne kreativne dejavnosti, ki so bile vključene v analizo, smo določili po pregledu različnih definicij kreativnih in kulturnih industrij (DCMS 2001; Eurostat 2007, 2010; KKIPS 2011), na podlagi katerih smo izluščili 32 kategorij dejavnosti iz klasifikacije SKD (2008).

Nadalje smo 32 kategorij dejavnosti razdelili v enajst skupin kreativnih dejavnosti, ki smo jih uporabili za potrebe kartografske analize v Ljubljani. Skupine kreativnih dejavnosti obsegajo 1) oglaševanje, 2)arhitekturo, 3) prodajo umetnin in starin, 4) oblikovanje, 5)video, film in fotografijo, 6) računalniško programiranje, 7) vizualne in scenske umetnosti, glasbo, 8) umetniško ustvarjanje, 9) založništvo, 10) radijsko in TV-dejavnost ter 11) kulturne ustanove.

Navedene skupine pokrivajo krajevne specifične značilnosti kreativnih dejavnosti in vključujejo tudi kategorije, ki jih v drugih državah obravnavajo kot samostojne skupine (npr. glasba). Kreativne dejavnosti so v tem pogledu zelo fleksibilen, večplasten in širok koncept, ki ga različni akterji različno opredeljujejo (DCMS 2001; Evans 2009; Fleming 2011; Florida 2002, 2005; Krätke 2010; Montgomery 2003; Peck 2005; Simmie 2006). Enotna porazdelitev kreativnih dejavnosti zato ni jasno določena in je prirejena specifičnemu lokalnemu kontekstu. V raziskavi smo klasificirane kategorije razdelili na podlagi dostopa do podatkov in nabora informacij iz predhodnih raziskav, ki se navezujejo na kreativne dejavnosti v Ljubljani in Ljubljanski urbani regiji (Bunker 2010; IER 2012; Ipop 2011, 2012; MOL 2002; Second Chance 2011).

Navedena kartografska analiza kreativnih dejavnosti, ki izhaja iz standardne klasifikacije dejavnosti (2008) in črpa podatke iz baze AJPES, ima določene pomanjkljivosti, saj se osredotoča na podjetja, ki prvenstveno spadajo med kreativne industrije, in s tem izloča določen del kreativnih posameznikov, ki delajo na kreativnih področjih, vendar so zaposleni v manjših oddelkih podjetjih, ki se prvenstveno ne ukvarjajo s kreativnimi industrijami (npr. marketinški in oblikovalski oddelki proizvodnih podjetij, arhitekti v gradbenih podjetjih ipd.). V statistiko prav tako niso zajeti kreativni posamezniki in podjetja, ki se ukvarjajo z »mejnimi področji« kreativnih industrij in delajo na visoko kreativnih delovnih mestih, ki so povezana z raziskovalnim in eksperimentalnim delom (npr. inštituti, podjetja s področja prometa, varovanja okolja ipd.), vendar prvenstveno statistično niso zajeta v kreativni sektor. Baza je pomanjkljiva tudi pri beleženju števila zaposlenih v kreativnih podjetjih, saj pozna delitev v več razredov (mikro, majhne, srednje in velike enote) in ne poda točne informacije o koncentraciji kreativnih posameznikov. V analizo smo zato zajeli vsa kreativna podjetja, ne glede na število zaposlenih pri čemer smo v nadaljnjih fazah oziroma pri kartografskem prikazu posebej označevali območja, kjer so bile zaznane posebnosti pri koncentraciji kreativnih podjetij. Določen manko natančnih podatkov o kreativnih podjetjih je razumljiv, saj gre za težje »ujemljivo« – visoko mobilno delovno silo z dinamičnim načinom dela ter življenjsko-stilskimi orientacijami, ki zahtevajo visoko stopnjo družbene omreženosti (Clark 2004). Analizirani deleži v kombiniranih panogah kreativnih industrij, izdelani na podlagi SKD kljub temu omogočajo relativno verodostojen vpogled v ključne sektorje ter obseg določenih vej kreativnih dejavnosti na območju Ljubljanske urbane regije (preglednica 2).

V raziskavi smo za izboljšanje kakovosti zbranih informacij, ki izhajajo iz klasifikacij SKD (2008), podatke še dodatno filtrirali na ravni četrtnih skupnosti, pri čemer smo posebno pozornost namenili zaznavi in preverjanju lokacij močnejših kreativnih jeder oziroma grozdov, ki so skupine medsebojno dopolnjujočih, heterogenih podjetij, povezanih prek proizvodnje, potrošnika, dobavitelja in drugih razmerij, s katerimi spodbujajo kroženje informacij in ekonomsko rast na določenem območju (glej npr. Landry 2000; Perrons 2004; Porter 1990; van Heur 2009).

Preglednica 2: Število in deleži v kombiniranih panogah kreativnih dejavnosti na območju Ljubljanske urbane regije glede na izbor iz klasifikacij SKD (Vir: Ajpes 2011; Ipop 2012; Gurs 2011; Surs 2011; Žaucer in ostali 2012).

	število podjetij (Ljubljanska urbana regija)	delež v kreativnih industrijah (%) (Ljubljanska urbana regija)
A oglaševanje	543	9,00
B arhitektura	879	14,50
C prodaja umetnin in starin	31	0,50
D oblikovanje design	392	6,50
E video, film in fotografija	477	7,90
F računalniško programiranje	798	13,20
G vizualne in uprizoritvene umetnosti, glasba	515	8,50
H umetniško ustvarjanje	1682	27,80
I založništvo	385	6,40
J radio in TV	130	2,10
K kulturne ustanove	228	3,80
VSOTA	6060	100,00

4 Analiza kartiranja kreativnih podjetij

4.1 Značilnosti lokacij kreativnih dejavnosti v Ljubljani

Na kartah so prikazane ključne zgostitve kreativnih dejavnosti na območju Mestne občine Ljubljana. V legendi na sliki 2 velikost pike predstavlja število poslovnih enot, ki so bile zajete prek klasifikacij SKD (2008). Močnejše zgostitve podjetij v kreativnih dejavnostih izstopajo zlasti na območjih v mestnem središču (Rimska ulica, Mirje (Tobačna), Ajdovščina, Tabor, Trubarjeva ulica) in ob mestnih vpadnicah (Dunajska cesta v bližini poslovne stavbe Mercator in južni del Bežigrada, del Šiške ob Celovški cesti). Ta območja so na sliki 2 označena z rumenimi kvadrati.

Slika 2: Porazdelitev podjetij s področja kreativnih dejavnosti v Mestni občini Ljubljana.
Glej angleški del prispevka.

V manjši meri so opazna še posamezna območja oziroma žarišča zunaj centra, ki so nastala na podlagi različnih poslovnih priložnosti (npr. Tehnološki park Brdo, industrijska cona Stegne). Na karti so opazna tudi nekatera območja stanovanjskih sosesk (npr. Trnovo, Župančičeva jama, Fužine), kjer prihaja do manjših koncentracij podjetij v kreativnih dejavnostih. Gre pretežno za skupine samozaposlenih v dejavnostih (npr. samostojni novinar, kultura), ki so registrirane na naslovnih, kjer lastniki podjetij stanujejo. Pri tem velja poudariti, da podatki ne povedo veliko o aktivnostih teh podjetij. Šele s podrobno terensko analizo bi lahko ocenili njihov dejanski razvojni potencial v kontekstu kreativnih podjetij. Ta območja so zato na sliki 2 označena z modrimi kvadrati.

Mestno središče predstavlja izredno močno koncentracijo kreativnih dejavnosti v MOL in po skupnem številu kreativnih podjetij močno presega ostale dele mesta (glej prilogo 2). Na sliki 3 je s pomočjo barvnih podlag prikazan podpovprečni (negativen) ali nadpovprečni delež podjetij s področja kreativnih industrij med vsemi podjetji na območju. Pri posameznih kreativnih panogah opažamo močnejše zgoščevanje v specifičnih mestnih predelih. V primeru proizvodnje računalniške programske opreme obrobne lokacije kot so Trzin, Domžale ter obrobne ljubljanske četrti (Črnuče, Dravlje, Vič) precej bolj izstopajo glede na delež kreativnih podjetij, kar lahko pojasnjujemo z manjšim pomenom mikrolokacije za razvoj tovrstnih dejavnosti in možnostjo »dela na daljavo« (Toffler 1980). V nasprotju s tem je delež podjetij, ki se ukvarjajo z arhitekturno panogo najvišji v mestnem središču in območjih, ki mejijo na mestno središče (npr. četrtna skupnost Trnovo). Med posameznimi območji prihaja tudi do razlik v strukturi kreativnih podjetij, pri čemer so nekatere lokacije privlačnejše za jedrne kreativne industrije kot pa za t. i. kulturne industrije. Tako je na primer za Trzin, kjer je močna poslovna cona, značilen visok delež podjetij s področja računalniškega

programiranja, ki ga dopolnjujejo panoge arhitekture, oblikovanja, videa ter relativno nizki deleži podjetij umetniškega ustvarjanja, vizualnih in scenskih umetnosti, založništva.

Slika 3: Delež podjetij po posameznih panogah kreativnih dejavnosti v MOL in delež podjetij v kreativnih dejavnostih glede na skupno število podjetij v MOL.
Glej angleški del prispevka.

4.2 Značilnosti lokacij kreativnih dejavnosti v Ljubljanski urbani regiji

Na ravni Ljubljanske urbane regije predstavlja mesto Ljubljana v razmerju do manjših občin (npr. Domžale, Kamnik, Grosuplje, Vrhnika) izrazit center kreativnih dejavnosti. Delež podjetij v panogah kreativnih dejavnosti v četrtnih skupnostih MOL močno presega deleže v drugih občinah Ljubljanske urbane regije (slika 4 in priloga 2).

Slika 4: Skupni delež podjetij v panogah kreativnih dejavnosti glede na število vseh podjetij po občinah v Ljubljanski urbani regiji.
Glej angleški del prispevka.

Posebej poudarjamo, da MOL v primerjavi z ostalimi občinami Ljubljanske urbane regije ne izstopa le po velikem deležu in akumulaciji kreativnih podjetij, temveč tudi izjemni zgoščenosti tovrstnih poslovnih subjektov. Zgoščenost kreativnih podjetij v Ljubljanski urbani regiji je prikazana na sliki 5, kjer je število subjektov kreativnih industrij korelirano oziroma normalizirano s številom prebivalcev v občinah in četrtnih skupnostih.

Slika 5: Zgoščenost poslovnih subjektov s področja kreativnih dejavnosti glede na korelacijo s številom prebivalstva v Ljubljanski urbani regiji.
Glej angleški del prispevka.

5 Sklep

Analiza kartiranja poslovnih subjektov s področja kreativnih dejavnosti kaže, da se Ljubljana kot velika prebivalstvena aglomeracija v Ljubljanski urbani regiji ujema z izrazito močno koncentracijo kreativnih industrij. S tega vidika se razporeditev kreativnih dejavnosti v MOL in Ljubljanski urbani regiji približuje ideji »centralnih krajev« in tipični hierarhični razporeditvi, kjer se število podjetij sorazmerno zmanjšuje iz mestnega središča proti periferiji oziroma subcentrom. Grozdenje kreativnih dejavnosti je v primeru Ljubljane in Ljubljanske urbane regije izrazito odvisno od števila prebivalstva in prometnih povezav, pri čemer sodelujejo tudi ostali dejavniki, kot so stroški najema poslovnega prostora in splošna privlačnost mikrolokacije. Določeno manjše število kreativnih dejavnosti je tako opazno le še v nekoliko gosteje naseljenih subcentrih ob prometnicah. Najboljše razmerje med številom prebivalstva in kreativnih podjetij je značilno za Trzin, ki je tudi dobro prometno omrežen, najnižje razmerje pa za bolj odmaknjene subcentre, kot so Litija, Logatec, Vrhnika.

Hierarhična oziroma neenakomerna prostorska razporeditev podjetij s področja kreativnih dejavnosti vpliva na manjšo funkcionalno heterogenost kreativnih industrij, saj so najuspešnejše tiste panoge, ki imajo hiter dostop do velikega trga in zaledja, iz katerega črpajo potrebne človeške resurse. Pri tem so uspešne le tiste panoge kreativnih industrij, ki so se sposobne spontano odzivati na potrebe večjih poslovnih in gospodarskih družb, medtem ko se specializirane panoge kreativnih industrij razvijajo zelo počasi (npr. radio in televizija, programska oprema, film in fotografija, oblikovanje, trg umetnin in starin). Gre za t. i. entropično razsežnost družbeno-ekonomskega sistema (glej Kirn 2008), kjer se energije oziroma akterji in podjetja, povezana z razvojem kreativnih industrij zbirajo, akumulirajo na določenih lokacijah, vendar ob tem obstaja nevarnost, da se bodo po določenem časovnem obdobju zaradi slabe ekonomske podlage, premajhnih spodbud iz okolja ali nezmožnosti nadgradnje svojih dejavnosti zaradi omejenih prostorskih, socialnih, človeških resursov, ti potenciali oziroma zametki potencialno uspešnih kreativnih industrij razpršili ali celo prenehali z dejavnostmi.

Prevelika odvisnost kreativnih industrij od tržnih zakonitosti sproža hierarhizacijo na nivoju izbire lokacij in vrste kreativnih dejavnosti v Ljubljani in Ljubljanski urbani regiji. Učinki hierarhizacije se odražajo v nizki prostorski in funkcijski diverzifikaciji kreativnih industrij, kar je posledica spontanega oziroma

inkrementalističnega razvoja, ki ne spodbuja kreativnih industrij v globalnem kontekstu, temveč se zgolj odziva na trenutne razmere na lokalno zamejenem (regionalnem) trgu. Nadaljnji razvoj kreativnih dejavnosti bi zato moral temeljiti na strategijah omogočanja lažjega dostopa do ustreznih resursov (finančnih spodbud, servisov, prostorov) in infrastruktur za specializirane panoge kreativnih industrij, ki so v obliki manjših jeder že razporejene zunaj mestnega središča in predstavljajo največji potencial za nadaljnje kreativno grozdenje in urbano regeneracijo. S povečevanjem dostopa do osnovnih resursov, ki so potrebni za zagon določenih vrst kreativnih dejavnosti, bi se povečale tudi njihove možnosti za razvojni preboj in širjenje dejavnosti.

6 Literatura

Glej angleški del prispevka.

Annex 1: The thirty-two categories of activities according to the 2008 Standard Classification of Activities included in the analysis of creative industries.
Priloga 1: 32 kategorij dejavnosti po standardni klasifikaciji dejavnosti 2008, ki so bile uvrščene v analizo kreativnih dejavnosti.

category / kategorija	Standard Classification of Activities code / šifra standardne klasifikacije dejavnosti 2008	Standard Classification of Activities code / šifra standardne klasifikacije dejavnosti 2002	opis	English description
I	G47.610	47.610	trgovina na drobno v specializiranih prodajalnah s knjigami	Retail sale of books in specialized stores
I	G47.621	47.621	trgovina na drobno v specializiranih prodajalnah s časopisi in revijami	Retail sale of newspapers in specialized stores
I	G47.630	47.630	trgovina na drobno v specializiranih prodajalnah z glasbenimi in video zapisi	Retail sale of music and video recordings in specialized stores
C	G47.782	47.782	trgovina na drobno v specializiranih prodajalnah z umetniškimi izdelki	Retail sale services of commercial art galleries
I	J58.110	58.110	izdajanje knjig	Book publishing
I	J58.130	58.130	izdajanje časopisov	Publishing newspapers
I	J58.140	58.140	izdajanje revij in druge periodike	Publishing journals and other periodicals
F	J58.210	58.210	izdajanje računalniških iger	Publishing computer games
F	J58.290	58.290	drugo izdajanje programja	Other software publishing
E	J59.110	59.110	produkcija filmov, video filmov, televizijskih oddaj	Motion picture, video and television program production activities
E	J59.120	59.120	post produkcijske dejavnosti pri izdelavi filmov, video filmov, televizijskih oddaj	Motion picture, video and television program post-production activities
E	J59.130	59.130	distribucija filmov, video filmov, televizijskih oddaj	Motion picture, video and television program distribution activities
E	J59.140	59.140	kinematografska dejavnost	Motion picture projection activities
G	J59.200	59.200	snemanje in izdajanje zvočnih zapisov in muzikalij	Sound recording and music publishing activities
J	J60.100	60.100	radijska dejavnost	Radio broadcasting
J	J60.200	60.200	televizijska dejavnost	Television programming and broadcasting activities
F	J62.010	62.010	računalniško programiranje	Computer programming activities
I	J63.910	63.910	dejavnost tiskovnih agencij	News agency activities
B	M71.111	71.111	arhitekturno projektiranje	Architectural planning
B	M71.112	71.112	krajinsko arhitekturno, urbanistično in drugo projektiranje	Landscape architecture, urban and other planning
A	M73.110	73.110	dejavnost oglaševalskih agencij	Advertising agencies
D	M74.100	74.100	oblikovanje, aranžerstvo, dekoraterstvo	Specialized design activities
E	M74.200	74.200	fotografska dejavnost	Photographic activities
K	P85.520	85.520	izobraževanje, izpopolnjevanje in usposabljanje na področju kulture in umetnosti	Cultural education

category / kategorija	Standard Classification of Activities code / šifra standardne klasifikacije dejavnosti 2008	Standard Classification of Activities code / šifra standardne klasifikacije dejavnosti 2002	opis	English description
G	R90.010	90.010	umetniško uprizarjanje	Performing arts
G	R90.020	90.020	spremljajoče dejavnosti za umetniško uprizarjanje	Support activities to performing arts
H	R90.030	90.030	umetniško ustvarjanje	Artistic creation
G	R90.040	90.040	obratovanje objektov za kulturne prireditve	Operation of arts facilities
K	R91.011	91.011	dejavnost knjižnic	Library activities
K	R91.012	91.012	dejavnost arhivov	Archive activities
K	R91.020	91.020	dejavnost muzejev	Museum activities
K	R91.030	91.030	varstvo kulturne dediščine	Operation of historical sites and buildings and similar visitor attractions

Annex 2: Number of companies by categories of creative industries in municipalities and city districts.
Priloga 2: Število podjetij po sklopih kreativnih dejavnosti po občinah in četrtnih skupnostih.

Municipality, district / Občina, Četrtna skupnost	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*Total/ skupaj*
Borovnica	0	1	0	1	0	4	4	3	2	1	1	**17**
Brezovica	4	7	2	7	5	17	8	9	9	2	1	**71**
Dobrepolje	2	0	0	1	1	2	0	0	0	0	1	**7**
Dobrova–Polhov Gradec	1	3	0	1	3	11	1	11	2	0	1	**34**
Dol pri Ljubljani	3	3	0	1	1	1	3	8	1	0	1	**22**
Domžale	19	33	2	18	24	40	21	43	12	8	12	**232**
Grosuplje	10	21	0	9	6	18	10	29	6	3	4	**116**
Horjul	1	1	0	0	0	2	0	0	1	0	1	**6**
Ig	2	2	0	6	2	5	4	10	2	0	3	**36**
Ivančna Gorica	4	7	0	4	6	18	4	18	3	2	2	**68**
Kamnik	14	25	0	14	23	30	16	33	9	1	7	**172**
Komenda	2	2	1	0	4	1	1	13	0	2	0	**26**
Litija	3	10	0	4	2	7	13	8	1	5	4	**57**
Logatec	4	9	0	3	6	3	8	23	2	1	4	**63**
Log-Dragomer	5	4	1	5	3	3	1	11	2	1	1	**37**
Lukovica	1	2	0	0	1	3	0	7	2	0	0	**16**
Medvode	8	9	0	10	8	13	10	34	6	4	6	**108**
Mengeš	7	8	0	1	3	9	4	15	4	1	1	**53**
Moravče	0	1	0	4	1	3	0	4	1	0	1	**15**
Škofljica	2	6	0	4	5	9	2	12	7	1	5	**53**
Šmartno pri Litiji	1	1	0	0	1	3	1	4	0	1	2	**14**
Trzin	10	13	0	6	6	21	3	5	0	0	0	**64**
Velike Lašče	1	2	0	2	0	6	8	6	1	1	1	**28**
Vodice	3	3	0	2	2	6	2	5	0	2	4	**29**
Vrhnika	12	15	0	8	6	17	5	23	5	1	5	**97**
***Bežigrad**	65	99	6	34	56	82	66	199	59	22	10	**698**
***Center**	86	192	13	49	89	38	98	361	91	9	42	**1068**
***Črnuče**	16	14	0	10	5	36	7	32	6	0	0	**126**
***Dravlje**	29	32	0	20	19	47	15	50	15	13	11	**251**
***Golovec**	10	9	1	6	4	17	7	29	7	1	5	**96**
***Jarše**	26	16	0	10	30	30	15	31	17	10	3	**188**
***Moste**	10	20	1	6	16	29	21	68	12	4	17	**204**
***Polje**	7	16	0	6	10	5	10	18	7	3	9	**91**
***Posavje**	10	17	1	5	13	17	8	36	5	4	3	**119**
***Rožnik**	18	33	1	15	13	38	14	68	10	5	2	**217**
***Rudnik**	16	27	0	12	9	26	13	50	12	1	8	**174**
***Sostro**	1	5	0	3	2	8	3	7	1	1	0	**31**
***Šentvid**	19	34	1	17	18	23	11	49	6	2	6	**186**
***Šiška**	61	64	1	35	42	47	50	186	15	14	20	**535**
***Šmarna gora**	2	11	0	4	2	7	5	13	4	0	2	**50**
***Trnovo**	20	65	0	29	18	27	22	82	15	3	13	**294**
***Vič**	23	38	0	16	12	59	20	60	22	2	9	**261**
Ljubljana	**419**	**692**	**25**	**277**	**358**	**536**	**385**	**1339**	**304**	**94**	**160**	**4589**
TOTAL/SKUPAJ	**538**	**880**	**31**	**388**	**477**	**788**	**514**	**1673**	**382**	**131**	**228**	**6030**

* četrtna skupnost/district

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KNOWLEDGE OF SUSTAINABLE DEVELOPMENT AMONG GEOGRAPHY STUDENTS IN SLOVENIA

POZNAVANJE TRAJNOSTNEGA RAZVOJA MED ŠTUDENTI GEOGRAFIJE V SLOVENIJI

Gregor Kovačič, Valentina Brečko Grubar

GREGOR KOVAČIČ

Waste separation is also an integral part of sustainable practices.
Tudi ločevanje odpadkov je sestavni del trajnostnega ravnanja.

Knowledge of sustainable development among geography students in Slovenia

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ABSTRACT: The paper presents the results of the survey conducted among geography students of the three public universities in Slovenia regarding their knowledge of sustainable development and the ways of gaining this knowledge. On the basis of 160 questionnaires, distributed mainly among the first-level students, we concluded that the students assess their knowledge of sustainable development as very good. However, they lack knowledge about social aspects of sustainable development. They gained most of their respective knowledge through formal education. The knowledge of sustainable development improves in the course of study years on the first level and particularly on the second level. This fact and the answers regarding connectedness of study programmes with the topic of sustainable development (also the courses mentioned by the students) show that sustainable development is well integrated into geography study programmes.

KEY WORDS: geography, sustainable development, knowledge of sustainable development, survey, education, universities, Slovenia

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1 Introduction

Sustainable development (hereafter SD) as a paradigm of an urgent change in the world management, both in economy and in social and environmental spheres, should also be integrated into education. At universities in particular, far greater attention should be paid to sustainability, especially in view of the fact that education is provided to persons who will to a great extent become the holders of leading and managing positions and conveyors of knowledge, i.e. teachers. Already in the Tbilisi Declaration of the remote year 1977, the necessity was recognized that the ethical, social, cultural and economic aspects should be integrated into university curricula as »environmental education«. Resultantly, in the following decades, education about the environment was enhanced, especially instruction about the negative consequences of human interventions into natural environment, excessive utilization of natural resources and the already critical burdening of the environment. With the Agenda 21, we were acquainted more thoroughly with the ideas and contents of sustainable development and we realized how urgent was the need to upgrade education with the knowledge required for sustainable development. The United Nations Economic Commission for Europe, which is part of the United Nations Educational, Scientific, and Cultural Organization (UNESCO), prepared the Education for Sustainable Development Strategy and declared the period 2005–2014 as the Decade of Education for Sustainable Development (Internet 1; Internet 2; Internet 3). As envisaged, sustainability as a strategy and a paradigm should have already become an integral part of the curricula at all levels of education, research and learning, but unfortunately we are still quite remote from this objective, as has been established by A. Mlinar (2011). Though in general geography is not the mother discipline of the sustainability science, with environmental sciences and technologies being the most important ones (Nučič 2012), mainly thanks to the publications of Plut (1998; 2005; 2006; 2008; 2010), the scholarly branch of geography has recognized its scientific potentials, offered by its vast scope, openness and interdisciplinary-linking nature, for being integrated to a larger extent into the education for sustainable development.

In order to establish the extent to which the study of sustainable development has been integrated into geography study programmes, a research was launched among geography students at our public universities. In our research of 2011, done at the University of Primorska, we already detected differences in the knowledge, comprehension and learning among students in different study programmes (Kovačič and Brečko Grubar 2012), while in the continued research we tried to discover whether or not differences existed also among the students of different study programmes of geography. The results have shown that the students still relate SD most closely to environment, the use of natural resources, and nature protection, less closely to economy, and least of all to the social sphere (Kovačič and Brečko Grubar 2012). Also some foreign studies have shown much the same situation (Summers, Corney and Childs 2004; Kagawa 2007; Blum 2010; Catenazzo et al. 2010; Incekara and Tuna 2011; Michalos et al. 2011; Michalos et al. 2012). We can anticipate that from the education *about* SD we are gradually advancing to the education *for* SD, while we cannot hope to reach very soon the education *as* sustainability – if we summarize the differentiation made by Sterling, as quoted in Mlinar (2011). Education for sustainability helps students to understand and value sustainability as well as to get integrated in the changes necessary for sustainability; but when education has become sustainability, an overall view will be required, as well as systematic consideration, dialogue, active citizenship, interculturality, empathy, and, above all, interdisciplinarity (Mlinar 2011). Thus, required for sustainable education are long-term cultural changes and a different concept of society. In view of the well-reasoned interconnection between interdisciplinarity and sustainability (Jones, Selby and Sterling 2010), geography certainly plays an important role, thanks to its all-embracing view; namely, in addition to environmental sciences as the leading ones in the domain of sustainability, geography is supposed to influence significantly the perception of sustainability and education as sustainability.

2 Methods

The research is based on a survey conducted among geography students at the three Slovenian public universities in the study year 2011/2012. Included in the survey were students of the university first-level one-strand and two-strand study programmes of geography, and the second-level master's study programme of geography at the Faculty of Arts, University of Ljubljana (hereafter UL), students of the university first-level two-strand study programme of geography and second-level two-strand study programme of geography

at the Faculty of Arts, University of Maribor (hereafter UM), and the university first-level one-strand study programme of geography and the second-level master's programme of geography at the *Faculty of Humanities, University of Primorska* (hereafter UP). The total number of students included in the survey was 160, or 33.3% of geography students population at the first- and second levels in Slovenia; 94.4% of respondents were students at the first level and mere 5.6% were students at the second level, who represent 32.0% of the post-graduate geography students at the second level in Slovenia. The sample of the investigated students at both levels of study is adequate and considered to be representative. The research included 63 students (39.6%) of the first, 32 students (20.1%) of the second and 44 students (27.7%) of the third year of the undergraduate studies. Of the respondents at the UL, 12 were fourth-year students (7.5%) of the previous, i.e. pre-Bologna, programme. As to the gender, 114 of the respondents were females (71.3%) and 46 males (28.7%). The survey at the UL included 92 students of geography study programmes, or 29.1 % of the population, 68 of whom were females (73.9%); at the UM, 24 students (22.4% of the population) were included in the survey, 18 of whom were females (75.0%); and the survey at the UP included 44 students (62.9% of the population), 28 of whom were females (63.6%).

The online survey, which was devised after different foreign models (Summers, Corney and Childs 2004; Catenazzo et al. 2010; Eyuboglu, Oslu and Oz 2010; Michalos et al. 2011; Michalos et al. 2012), consisted of 40 questions; however, published in the current paper are only the results of descriptive statistics related to the knowledge and understanding of SD, statements about the sources of knowledge about SD, and those about connectedness of study programs with the SD contents. For comparison we also made use of the results of a similar research performed by the UP ($n = 238$) among the students of the three faculties in the year 2011 (Kovačič and Brečko Grubar 2012).

Differences in frequencies of responses to individual questions by geography students from individual universities as well as differences in frequencies of responses to individual questions by geography students in individual academic years were analysed by means of Pearson chi squared statistics at the significance level $\alpha = 0{,}01$, and put down alongside were also the computed *p*-values (Košmelj 2007). By means of the analysis of adjusted standardized residuals in individual cells we tried to establish locations of the highest statistical deviations within the studied contingency tables, also in those cases when the computed statistics for the entire table have not shown significant differences in responses. The values of adjusted residuals higher than 2 represent a statistically significant difference ($\alpha < 0.05$), and the values higher than 3 are already a considerable deviation ($\alpha < 0.01$) (Agresti 2007; Internet 4; Internet 5).

However, we are well aware of the fact that different compulsory and elective courses that were taught while the survey was being conducted, especially those whose contents are related to SD, certainly influenced significantly the demonstrated students' knowledge about SD and their assessments of connectedness of individual courses with the SD contents, yet these influences cannot be properly evaluated.

3 Knowledge about the sustainable development contents

A gross half (53.1%) of the respondents believe that their knowledge about SD is good, and 34.4% believe that their knowledge is poor. There was no option of answering »medium« to this question. The results are comparable to those of the UP students (good = 57%; poor = 31%) (Kovačič and Brečko Grubar 2012). The percentage of those geography students who assessed their knowledge of SD as very poor is really low, 4.4%, while 8.1% of the students believe that they have a very good knowledge of SD. The chi-square statistics show ($p = 0.0321$) that there is no statistically significant relationship between the knowledge of sustainable development and the students of geography from individual universities. Slightly lower than the average is the percentage of geography students at the UL with their responses of »poor« knowledge of SD (26.1%), and slightly higher is the percentage of those who believe that their SD knowledge is very good (12.0%). At one of the universities in Istanbul, merely 12% of the respondents ($n = 60$) ticked off the answer confirming that they were acquainted with the SD contents, but only 7% were able to explain it (Eyubolglu, Oslu and Oz 2010). A research among post-graduate students at the Oxford University ($n = 61$) showed that 62% of the respondents (but 80% of geographers) assessed their own knowledge of SD as good or very good. The percentage of responses by Slovenian geography students in equal value categories is by one percent lower and the same statement applies to the UP student respondents in the year 2011 (Summers, Corney and Childs 2004; Kovačič and Brečko Grubar 2012).

The chi-square statistics show (p = 0.0000) that the notion of one's own knowledge about SD among Slovenian geography students is closely related to the year of study. In the contingency table of the year of study and one's own notion about SD, the students of the first year statistically significantly deviate with their high percentage of responses in the categories »very poor« (adjusted residual = +3.3) and »poor« (adjusted residual = +5.9), and with a low percentage of responses in the category »good« (adjusted residual = –5.6). The students of the third year stand out by their low percentage of responses in the category »poor« (4.5%; adjusted residual = –4.9) and the high percentage in the category »good« (81.8%; adjusted residual = +4.5).

Table 1 shows the percentage of correct answers of Slovenian students of geography to the statements about the knowledge of SD. The chi-square statistics show that the percentage of correct answers to individual statements is not statistically significantly related to the year of study. This is somewhat surprising, since the SD contents are included in the courses syllabi of all study programmes of geography in Slovenia and it could be expected that the percentage of correct answers would be higher in advanced years (see below, chapter 4.1). Except for the second statement, where the majority of answers were incorrect, correct answers prevail (77.5%–98.8%), which also corresponds with the assessments by the respondents about their own knowledge of the SD contents. As has already been established by the research done among the UP students in 2011 (Kovačič and Brečko Grubar 2012), the lowest number of correct answers occurred with the questions related to the social sphere in SD (statements 2, 3, 4, 7 and 13). Geography students proved to be the worst at answering the question about the connection of gender equality with SD, where the percentage of correct answers is only 35.0%, which is by 10% lesser if compared to the answers of

Table 1: Percentages (%) of correct answers to the statements on the knowledge about sustainable development.

Statement (n = 160)	UL	UM	UP	TOTAL
1. Economic development, social development and environmental protection are all comprised/included in sustainable development.	97.8	100.0	100.0	98.8
2. Education for sustainable development includes education in the culture of peace and gender equality.	37.0	41.7	27.3	35.0
3. Sustainable development equally incorporates the needs of the future (our children) and the present needs.	95.7	95.8	88.6	93.8
4. Social justice is not an integral part of sustainable development.	82.6	75.0	68.2	77.5
5. Sustainable use means the use of goods and services in a way that minimizes the use of natural resources and poisonous substances and reduces wastes	94.6	91.7	93.2	93.8
6. Reduction of material-energy flows is not of great significance for sustainable development.	95.7	95.8	86.4	93.1
7. Sustainable development surpasses anthropocentrism and involves ethical treating of animals.	87.0	83.3	70.5	81.9
8. Sustainable development seeks to establish balance between the human and economic welfare and the cultural tradition and natural resources.	96.7	100.0	86.4	94.4
9. We are not able to slow down the climate changes.	84.6	79.2	79.5	82.4
10. Social responsibility of companies is irrelevant for sustainable development.	95.7	91.7	93.2	94.4
11. Sustainable development anticipates a change in consumers' mentality and the transition from satisfying desires to meeting actual needs.	95.7	83.3	90.9	92.5
12. Preservation of biodiversity is essential for effective operation of ecosystems.	96.7	100.0	100.0	98.1
13. Education for sustainable development supports cultural diversity and respect of human rights.	84.8	79.2	68.2	79.4
14. The use of non-renewable resources should not exceed the use of sustainable renewable substitutes.	92.3	87.5	93.2	91.8
15. Environmental carrying capacity of the environment (capacity of self-purification, neutralization of burdening/pollutions and regeneration) is irrelevant for sustainable development.	89.1	91.7	93.2	90.6

the UP students in 2011 (Kovačič and Brečko Grubar 2012). It is interesting that the percentage of male geography students who answered correctly the question about gender equality as part of SD (43%) is higher than the percentage of answers given by female students (32%), while the research in Manitoba (Michalos et al. 2011) shows that females are better than their male colleagues at recognizing the social sphere as part of SD. This is somewhat consistent with the finding that the sustainability science focuses around the environmental sciences, and much less goes to the economic and social research fields (Nučič 2012). With Slovenian geography students, relationship between sexes and the percentage of correct answers to the statements about SD are not statistically significant, except for the 3rd statement, where the percentage of correct answers by males is 87% (adjusted residual = –2.3) and by females 96.5% (adjusted residual = +2.3).

There is no major statistically significant relationship in the percentage of correct answers and the students of geography from individual universities, except for the UP students of geography, whose answers to the statements 6, 7, 8, and 13 statistically significantly deviate (adjusted residuals from –2.1 to –2.7) with a lower percentage of correct answers in comparison with the other two universities. And the UM students of geography deviate negatively with a slightly lower percentage of correct answers to the statement 11 (83.3%).

4 Sources of knowledge about sustainable development

The following two questions were related to the education about SD and the principal sources of knowledge which influenced the students' insight into SD. The answers show that 61.9% of geography students of the three universities have already received some education about SD, while 38.1% have not, and positive answers were more frequent with male students (67.4%) than with female ones (59.6%). We can conclude from the results obtained that the SD contents are not adequately included in Slovenian geography study programs. However, the analysis of these (see below – chapter 4.1.) shows just the opposite: the courses related to SD are well involved. The result obtained from the answers can partly be explained by the fact that students do not recognize the SD contents within individual courses or that several of such courses are elective and the respondents just did not choose them. The percentage of geography students who have already been taught about SD is slightly lower than the percentage of the UP respondents (71%) of 2011 (Kovačič and Brečko Grubar 2012). The results of the research done among the Istanbul students show that only 3% of the respondents received some education about SD (Eyuboglu, Oslu and Oz 2010). The analysis of the data from our research shows that the percentage of geography students who have already been taught about SD increases from the start of undergraduate studies to the completion of postgraduate studies (first year – first level = 30.2%, second year – first level = 71.9%, third and fourth years – first level = 86.0%, and second level altogether = 100%).This means that the SD contents are adequately included in the study programs. However, disquieting is the information that only 52.3 % of the UP geography students state that they have already been taught about SD; the respective percentage at the UL amounts to 65.2%, and at the UM to 66.7%. The UP geography students statistically significantly deviate (adjusted residual = + 3.7) also in the total number of answers saying »very poor« and »poor« in response to the question about connectedness of study contents with SD, which amounts to 31.8% in comparison with 10.8% with the UL geography students and 16.6% with the UM students.

Answers to the question concerning the source of their knowledge about SD, where several options were offered to students (several answers possible), are shown in Table 2.

For Slovenian students of geography, »formal education« (19.6%) is the most important source of knowledge about SD; this option was ticked off by as many as 81.8% of those who had already received some education about SD (n = 99). This testifies that the SD contents are adequately integrated both in the formal education at the undergraduate and postgraduate study programmes of geography in Slovenia and in the curricula of secondary schools. The latter fact can be deduced from the answers by the first-year geography students. The importance of formal education for acquiring knowledge about SD in the undergraduate and postgraduate study programmes of geography is also manifest in the increasing percentage of answers in this category from the beginning of study at the undergraduate level (11.7%) to the postgraduate study (17.9%). The research performed among the students of several faculties of the UP (Kovačič and Brečko Grubar 2012) gave a similar result: formal education is the most important source of knowledge about SD (21.4%). At the Oxford University, 56% of the postgraduate respondents acquired knowledge

about SD within the framework of formal education, while the percentage of geographers alone, who were taught about SD, is much higher (81%) (Summers, Corney and Childs 2004). The survey conducted among postgraduate students of geography at the Faculty of Humanities, University of Primorska (n = 10) showed that this percentage amounted to 100% (Kovačič and Brečko Grubar 2012). Of the student respondents in Manitoba only 14% stated that they had already been taught about SD within the framework of formal education (Michalos et al. 2011).

The computed chi-square test shows that there is no statistically significant relationship between the answers and geography study programmes of the three Slovenian universities ($p = 0.5498$). However, the residual analysis by individual cells of contingency table 2 shows that the UP students of geography with only 12.3% of answers in the category »formal education« statistically significantly deviate in the negative direction (adjusted residual = –3.6), which agrees with the above presented high percentage (31.8%) of the UP students of geography who believe that their study programme is poorly or very poorly related to SD. In contrast to geography students of the other two universities, where the answer »formal education« takes the first place of all offered options (UL = 22.2%, and UM = 21.5%), this answer takes only the fourth place with geography students at the UP (Table 2). The results of residual analysis show that the UL geography students statistically significantly deviate in the negative direction with only 9.9% of the answers to the option »social background« (adjusted residual = –3.1), while for the same option the UP geography students deviate into the positive direction with 17.9% (adjusted residual = +3.3).

The lowest percentage of answers by geography students from the three universities occurs within the category »informal education« (4.6–7.4%), which encompasses students' activities in various courses, societies, workshops and round tables outside the regular study process. This percentage is slightly higher than the average with the UP students (4.2%) (Kovačič and Brečko Grubar), but in general it shows the lack of students' interest for gaining SD knowledge outside the formal forms of education and mass media. Through active participation various forms of informal education are a very suitable way of promotion of the SD guidelines, and young educated people should be the propelling power in this direction; however, the results show that this is not the case. Therefore, the role of teachers is very important at all levels of education, and at faculties in particular; it is teachers that should encourage zeal in the students for creating a better future by means of informing the public about the pressing necessity for the society to live and act in accordance with the SD principles. To achieve this goal, teachers should have adequate knowledge and skills to inspire young people to recognize that we are all responsible for space, if we want to preserve it for future generations (Fridl, Urbanc and Pipan 2009; Urbanc and Fridl 2012). It is a miscalculation to rely merely on the self-initiative of the young in their assuming the responsibility. The importance of educating the young about SD, so that its global aims could be reached, is also underlined in some researches (Wade 1999; Catenazzo et al. 2010).

The answers of Slovenian geography students concerning the remaining individual categories of knowledge sources are rather equally distributed (10.4–13.3%) (Table 2). Slightly surprisingly, with its 12.8% »professional and scientific literature« is ranking third, immediately after »documentary programs (TV & radio shows)«, which is about gross 2% more than the result obtained from the UP students in 2011 (Kovačič and Brečko Grubar 2012). The results of the same study show that the UP students gain 51.6% of information

Table 2: Percentage (%) of selected options on obtaining individual types of information related to sustainable development (multiple choice question). The first of the two figures shows the percentage of all respondents who chose the respective answer, and the second figure shows the percentage of choices of individual answers in relation to all chosen answers.

Answer (n = 99)	UL	UM	UP	SUM
Formal education	90.0 / 22.2	87.5 / 21.5	56.5 / 12.3	81.8 / 19.6
Informal education (courses, round tables, societies, talks, etc.)	30.0 / 7.4	18.8 / 4.6	26.1 / 5.7	27.3 / 6.5
Social background (friends, family, etc.)	40.0 / 9.9	56.3 / 13.8	82.6 / 17.9	52.5 / 12.6
Informative TV and radio programmes	48.3 / 11.9	37.5 / 9.2	60.9 / 13.2	49.5 / 11.8
Documentary TV and radio programmes	50.0 / 12.3	50.0 / 12.3	73.9 / 16.0	55.6 / 13.3
Newspapers and magazines	36.7 / 9.1	56.3 / 13.8	52.2 / 11.3	43.4 / 10.4
Professional and scientific literature (books, articles in journals)	58.3 / 14.4	50.0 / 12.3	43.5 / 9.4	53.5 / 12.8
Web pages, forums, actions, etc.	50.0 / 12.3	43.8 / 10.8	56.5 / 12.3	50.5 / 12.1
Other	1.7 / 0.4	6.3 / 1.5	8.7 / 1.9	4.0 / 1.0

and knowledge about SD from diverse mass media (TV, radio, newspaper, internet, etc.; this percentage is slightly higher than that of Slovenian geography students in general (47.7%), and both of them reveal the importance of mass media in the education about SD. Informative and documentary programs on TV and radio cover one quarter of the answers, therefore they should be utilized more efficiently for the purpose of education about SD and its promotion (Table 2).

4.1 Connectedness of sustainable development contents with geography study programmes

The computed chi-square test shows that the answers by geography students as to connectedness of their study programmes with the SD contents significantly differ between the three universities ($p = 0.0066$). Sticking out with the total of 60.9% of »strong« and »very strong« answers are the UL geography students, who gained most of their SD knowledge through formal education (22.2%; Table 2). With the UM geography students the total percentage of »strong« and »very strong« answers amounts to 33.3% and with the UP students 29.5%. The latter statistically significantly deviate with the highest total percentage of »very poor« and »poor« answers (31.8%). A half of the UM geography students believe that their study programme is moderately connected with the SD contents; of equal opinion at the UP are 38.6% of the students, and 27.2% at the UL (Table 3). Of the 160 respondents of the three universities only one declared that his study programme was not related to the SD contents.

Table 3: Connectedness of the contents of Slovenian geography study programmes with SD.

Answer (n = 160)	UL (%)	UM (%)	UP (%)	SUM (%)
No	1.1	0	0	0.6
Very poor	5.4	8.3	4.5	5.6
Poor	5.4	8.3	27.3	11.9
Moderate	27.2	50.0	38.6	33.8
Strong	42.4	25.0	22.7	34.4
Very strong	18.5	8.3	6.8	13.8

A comparison of the total percentage of »strong« and »very strong« answers by all respondents and the answers to the question about connectedness of study contents with SD in individual years of study shows that the SD contents are adequately integrated in geography study programmes. This indicates that academic geography education properly follows the generally set goals of education in the field of SD. Statistically significant deviation in the negative direction is typical for the first-year students (adjusted residual = –3.3). This is also reflected in the explicit difference in the total percentage of the »strong« and »very strong« answers given by the students of the first year (25.3%) and by those of the second year of study (62.6%) at the first level. Equal percentage occurs with the students of the third and fourth years (62.5%), while with the postgraduate students it amounts to 75.0%. Students' assessment of connectedness of study programmes and the SD contents is in accord with the opinion about their knowledge about SD which increases through the years from the beginning to the completion of their study (see chapter 3).

In order to establish connectedness of Slovenian geography study programmes with the SD contents we asked the students to name up to five courses in the order of the amount of SD contents included in them. Connectedness of a course with the SD contents was first established only on the basis of its name; we did not examine the syllabi contents of the quoted courses. Because of the insufficient number of the respondents at the second level of geography, the analysis was done for the programme of the first level only. Included in further analyses were only the first three named courses which, according to the opinion of the respondents, deal with the SD themes (Table 4).

From the names of courses in the one-strand and two-strand first level study programmes of geography at the UL we could conclude that most strongly connected with the SD contents are the following courses: Geography of Sustainable Development, Ecological Geography and Protection of Geographical Space. The last-mentioned one is a course that remains from the old (pre-Bologna) study programme of geography. However, the analysis of the stated titles of the courses shows that the UL geography students most often

named as their first three selections the following ones: Hydrogeography (16.7%), followed by Geography of Sustainable Development (13.7%) and Ecological Geography (11.6%). The eight courses quoted in Table 4 represent together 75.5% of all course titles named by the UL geography students. Since the course Protection of Geographical Space was named only by the students of the old programme, the percentage of this choice is proportionally low (4.7%). The UL students of geography most often named Geography of Sustainable Development (35.2%) as their first selection among the courses; Ecological Geography came as the second (23.1%), and Human Ecology (17.9%) as the third selected course.

Table 4: Selection percentage (%) for individual courses in first-level geography study programmes which, according to students, deal with the SD themes.

University and course	Course type	Year	Percentage of answers
UNIVERSITY OF LJUBLJANA			
Hydrogeography	Compulsory	2	16.7
Geography of Sustainable Development	Elective	1–3	13.7
Ecological Geography	Compulsory	3	11.6
Pedo- and Biogeography (only one-strand study)	Compulsory	2	8.6
Tourism and Traffic Geography (only one-strand study)	Compulsory	2	8.2
Human Ecology	Elective	1–3	6.4
Climatogeography (only one-strand study)	Compulsory	1	5.6
Protection of Geographical Space (pre-Bologna programme)	Compulsory	4	4.7
UNIVERSITY OF MARIBOR			
Sustainable Water Resources Management	Elective	1	31.7
Soil Protection	Elective	2	16.7
Hydrogeography	Compulsory	1	15.0
Geography of Slovenian Regions	Compulsory	3	6.7
Ecological Geography	Compulsory	3	5.0
UNIVERSITY OF PRIMORSKA			
Introduction to Social Geography	Compulsory	1	23.3
Introduction to Physical Geography	Compulsory	1	13.3
Landscape and Human Ecology	Elective	2–3	10.0
World Regional Geography	Compulsory	1	10.0
Applied Geography in Regional Development	Elective	2–3	7.8
Geography of Settlement and Population	Compulsory	2	5.5
Economic and Social Geography	Compulsory	3	4.5

For three of the five most often named courses in the two-strand first-level study programme of geography at the UM we can conclude from their very names that their contents are connected with SD (Sustainable Water Resources Management, Soil Protection, and Ecological Geography). Given in the first year of the above-mentioned programme is also the elective course Anthropogenic Climate Changes, whose content is connected with SD, but only a very low number of students named it. From among the first three selected courses, Sustainable Water Resources Management was most often named (31.7%) by the UM geography students, next comes Soil Protection (16.7%), and the third is Hydrogeography (15.0%). The five courses from Table 4 together account for 75.1% of the courses named by the UM geography students. As their first selection they most often named Sustainable Water Resources Management (66.7%), as the second Hydrogeography and Soil Protection (23.8% each), as the third one again Soil protection (33.3%).

In the UP one-strand first-level study programme of geography only the name of the elective course Landscape and Human Ecology indicates connectedness with the SD contents. However, the analysis of choices by the students of the said programme shows that the SD contents are also included in the general geographical courses. The most frequently named course was Introduction to Human Geography (23.3%), thus ranking first, next comes Introduction to Physical Geography (13.3%), ranking third with 10.0% are World Regional Geography and Landscape and Human Ecology. The seven courses quoted in Table 4 together account for 74.3% of the choices by the UP geography students. Most often named as their first selection were Landscape and Human Geography and Introduction to Physical Geography (18.9% each), second comes Introduction to Social Geography (30.3%) and the third was World Regional Geography (20%).

5 Conclusion

More than a half of the respondents believe that they have good knowledge about SD and a gross third of them assess their own knowledge as poor. Those who assess their knowledge as »very good« or »very poor« are few, and differences between the students of different Slovenian universities are negligible. Slightly higher is the percentage of good knowledge with the UL students, which corresponds with the high percentage (60.9%) of students who believe in »strong« or »very strong« connectedness of the SD contents with their study programmes. It is beyond doubt that students in the higher years of the first level and students of the second level of study assess their own knowledge as much better than do the students of lower years. Surprisingly, percentages of correct and incorrect answers to statements with which we tested the knowledge about SD did not show any statistically significant relationship between the answers' correctness and the years of study; neither did they show any statistical significant relationship the students of different universities. This can be explained by the fact that certain SD contents, especially those from the sphere of »public welfare«, are not at all or only to a lesser extent included in the study programmes, and students do not learn about them even in a long-term education. A slightly lower percentage of correct answers was observed with the UP geography students, who assessed their SD knowledge as poor already at the beginning.

The percentage of geography students included in the survey who have previously gained knowledge about SD surpasses 60% and increases with the students of higher years (3rd year, first level = 86%). The differences also agree with the conclusion that the percentage of students who have already some previous SD knowledge, and the percentage of students who believe that their study programmes are strongly or very strongly connected with SD both increase from the beginning to the completion of the study. A comparison between the students of different universities shows that the UP geography students statistically significantly deviate, due to their minor percentage of affirmative answers; they also assess connectedness of study programmes with SD as poorer. This was further confirmed by their answers to the question concerning the way of acquiring their knowledge, where they ascribed minor importance to formal education. Nonetheless, formal education plays an important role in acquiring knowledge about SD with the majority of the respondents. Examination of the curricula of study programmes has shown that there are quite significant differences between study programmes as to the inclusion of the SD contents, judging merely from the names of the courses. At the UL and UM, there is the compulsory course Ecological Geography, which is related to SD, while at the UP there is no such compulsory course, and among the elective courses, there are two at the UL and UM, while the UP has only one. More illuminating are the courses named by the students since we have established that some general basic geographical courses are more often than expected the source of knowledge about SD.

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Poznavanje trajnostnega razvoja med študenti geografije v Sloveniji

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IZVLEČEK: Prispevek predstavlja rezultate raziskave o poznavanju in poteh pridobivanja znanja o trajnostnem razvoju študentov geografije na vseh treh javnih univerzah v Sloveniji. Na podlagi 160 anket, izvedenih večinoma med študenti prve stopnje študija, smo ugotovili, da študenti visoko vrednotijo svoje poznavanje trajnostnega razvoja, da slabše poznajo njegovo družbeno-kulturno polje in da so znanje pridobili večinoma s formalnim izobraževanjem. Boljše poznavanje pri študentih višjih letnikov in študentih druge stopnje, odgovori anketiranih o povezanosti študijskega programa z vsebinami trajnostnega razvoja ter njihove navedbe predmetov, kjer so o njem največ izvedeli, kažejo, da je trajnostni razvoj dobro vključen v študijske programe geografije.

KLJUČNE BESEDE: geografija, trajnostni razvoj, poznavanje trajnostnega razvoja, anketiranje, izobraževanje, univerze, Slovenija

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1 Uvod

Trajnostni razvoj (v nadaljevanju TR) kot paradigma o nujni spremembi upravljanja sveta na ekonomskem, družbeno-kulturnem in okoljskem področju bi moral biti prisoten tudi v izobraževanju. Na univerzah bi morali trajnosti posvetiti več pozornosti. V Tbilisijski izjavi iz leta 1977 je bila izražena potreba, da se etični, družbeni, kulturni in gospodarski vidiki vključijo v univerzitetni prostor kot »okoljsko izobraževanje«. Posledično se je v naslednjih desetletjih okrepilo izobraževanje o okolju, zlasti o negativnih posledicah človekovih poseganj v naravno okolje, o čezmerni izrabi naravnih virov in že kritičnem obremenjevanju okolja. V večji meri je družba »osvojila« pojme in vsebine trajnostnega razvoja ter spoznala potrebo po nadgraditvi izobraževanja za trajnostni razvoj z Agendo 21. Ekonomska komisija Organizacije združenih narodov za Evropo, ki deluje v okviru Organizacije združenih narodov za izobraževanje, znanost in kulturo, je oblikovala Strategijo izobraževanja za trajnostni razvoj in obdobje 2005–2014 razglasila za desetletje izobraževanja za trajnostni razvoj (internet 1; internet 2; internet 3). Tako bi po pričakovanjih trajnost kot strategija in paradigma morala postati del učnih programov na vseh ravneh izobraževanja in raziskovanja, vendar smo žal od tega še precej oddaljeni, kot ugotavlja Mlinar (2011). Geografija ni matična disciplina znanosti o trajnostnosti, saj prednjačijo okoljske znanosti in tehnologije (Nučič 2012). Vendar smo v Sloveniji predvsem po zaslugi objav Pluta (1998; 2005; 2006; 2008; 2010) spoznali njene priložnosti, da se s svojo širino, odprtostjo in povezovalno interdisciplinarnostjo v večji meri vključi v izobraževanje za TR.

V raziskavi smo želeli ugotoviti, v kolikšni meri študenti geografije slovenskih javnih univerz poznajo vsebine TR. Že v raziskavi, ki je na Univerzi na Primorskem potekala leta 2011, smo namreč ugotovili razlike v poznavanju, razumevanju in učenju pri študentih različnih študijskih programov (Kovačič in Brečko Grubar 2012), v nadaljevanju pa smo želeli ugotoviti, ali so razlike med študenti geografije treh univerz. TR še vedno najbolj povezujejo z okoljem, rabo naravnih virov, varovanjem narave, v manjši meri z gospodarstvom in najmanjši z družbeno-kulturnim področjem (Kovačič in Brečko Grubar 2012), kar dokazujejo tudi nekatere raziskave v tujini (Summers, Corney in Childs 2004; Kagawa 2007; Blum 2010; Catenazzo s sod. 2010; Incekara in Tuna 2011; Michalos s sod. 2011; Michalos s sod. 2012). Predvidevamo, da od izobraževanja o TR postopno prehajamo k izobraževanju za TR, izobraževanja kot trajnostnosti (Sterling v Mlinar 2011) pa še ne bomo dosegli prav kmalu. Izobraževanje za trajnostnost pomaga študentom pri razumevanju, vrednotenju trajnostnosti ter pri vključevanju v spremembe za trajnostnost, ko pa postane izobraževanje trajnost, so potrebni celostni pogled, sistemsko razmišljanje, dialog, aktivno državljanstvo, medkulturnost, empatija in predvsem interdisciplinarnost (Mlinar 2011). Za trajnostno izobraževanje so torej potrebni dolgoročne kulturne spremembe in drugačen koncept družbe. Glede na utemeljeno povezanost interdisciplinarnosti in trajnostnosti (Jones, Selby in Sterling 2010), ima geografija s svojim celostnim pogledom nedvomno pomembno vlogo, saj naj bi pomembno vplivala na zaznavanje trajnostnosti in izobraževanje za trajnostnost.

2 Metode

Raziskava temelji na anketiranju študentov geografije na treh javnih slovenskih univerzah v študijskem letu 2011/2012. V anketo so bili vključeni študenti univerzitetnega študijskega programa prve in druge stopnje Geografija na Filozofski fakulteti Univerze v Ljubljani (v nadaljevanju UL), Filozofski fakulteti Univerze v Mariboru (v nadaljevanju UM) ter na Fakulteti za humanistične študije Univerze na Primorskem (v nadaljevanju UP). Skupaj je bilo anketiranih 160 ali 33,3 % populacije študentov geografije prve in druge stopnje v Sloveniji; 94,4 % anketiranih je bilo študentov prve stopnje in zgolj 5,6 % študentov druge stopnje, ki pa vendar predstavljajo 32,0 % populacije študentov geografije druge stopnje v Sloveniji. Reprezentativnost preučevanega vzorca za obe stopnji študija je ustrezna. Anketiranih je bilo 63 študentov prvih (39,6 %), 32 študentov drugih (20,1 %) in 44 študentov tretjih letnikov (27,7 %) dodiplomskih programov. Med anketiranimi na UL je bilo še 12 študentov četrtega letnika starega programa (7,5 %). Med anketiranimi je bilo 114 študentk (71,3 %) in 46 študentov (28,7 %). Na UL je bilo na programih geografije anketiranih 92 študentov ali 29,1 % populacije, od tega 68 deklet (73,9 %), na UM je bilo anketiranih 24 študentov ali 22,4 % populacije, od tega 18 deklet (75,0 %), in na UP 44 študentov ali 62,9 % populacije, od tega 28 deklet (63,6 %).

Spletna anketa, ki je bila zasnovana po različnih zgledih iz tujine (Summers, Corney in Childs 2004; Catenazzo s sod. 2010; Eyuboglu, Oslu in Oz 2010; Michalos s sod. 2011; Michalos s sod. 2012), je obsegala 40 vprašanj. V prispevku objavljamo zgolj rezultate statistike na vprašanja o poznavanju in razumevanju TR, navedbah virov pridobivanja znanja o TR ter povezanosti študijskih programov z vsebinami TR. Za primerjavo smo uporabili rezultate podobne raziskave, opravljene med študenti treh fakultet UP (n = 238) leta 2011 (Kovačič in Brečko Grubar 2012).

Razlike med frekvencami odgovorov študentov geografije na posameznih univerzah in razlike med frekvencami odgovorov študentov geografije v posameznih letnikih na posamezna vprašanja smo preučili s pomočjo Pearsonove χ^2 statistike pri stopnji značilnosti $\alpha = 0{,}01$ in dopisali *p*-vrednosti (Košmelj 2007). S pomočjo prilagojenih ostankov v posameznih celicah smo ugotavljali največja statistična odstopanja znotraj preučevanih kontingenčnih preglednic, tudi v primerih, ko izračun χ^2 statistike za celotno preglednico ni pokazal bistvenih razlik v odgovorih. Vrednosti prilagojenega ostanka, višje od 2, pomenijo statistično značilno razliko ($\alpha < 0{,}05$), vrednosti, višje od 3, pa kažejo na močno odstopanje od pričakovanih vrednosti ($\alpha < 0{,}01$) (Agresti 2007; internet 4; internet 5).

Zavedamo se, da je izvajanje različnih obveznih in izbirnih predmetov v času anketiranja, še posebej tistih, ki so vsebinsko zelo povezani s TR, zagotovo zelo vplivalo na izkazano znanje študentov o TR in njihovo opredeljevanje do povezanosti posameznih predmetov z vsebinami TR, vendar teh vplivov ni možno ustrezno ovrednotiti.

3 Poznavanje vsebin trajnostnega razvoja

Približno polovica (53,1 %) študentov geografije v Sloveniji meni, da je njihova predstava o TR dobra, 34,4 % pa, da je slaba. Možnosti odgovora »srednje« vprašanje ni vsebovalo. Rezultati so primerljivi s študenti UP (dobra = 57 %, slaba = 31 %) (Kovačič in Brečko Grubar 2012). Med študenti geografi je zelo majhen delež tistih, ki so svoje poznavanje TR ocenili kot zelo slabo (4,4 %), 8,1 % pa jih meni, da imajo zelo dobro predstavo o TR. Statistika χ^2 testa kaže ($p = 0{,}0321$), da med študenti geografije na posameznih univerzah in poznavanjem vsebin trajnostnega razvoja ni statistično značilne povezanosti. Na UL z nekoliko manjšim deležem izstopajo odgovori »slaba« predstava o TR (26,1 %) in odgovori, da je predstava o TR »zelo dobra« (12,0 %). Na eni od univerz v Carigradu je zgolj 12 % anketiranih (n = 60) označilo, da pozna vsebino TR, razložiti pa jo jih je znalo samo 7 % (Eyubolglu, Oslu in Oz 2010). Raziskava med podiplomskimi študenti na Oxfordski univerzi (n = 61) je pokazala, da 62 % anketiranih (geografi 80 %) svoje poznavanje TR ocenjuje kot dobro oziroma zelo dobro. V enakih vrednostnih kategorijah je delež odgovorov študentov geografije v Sloveniji odstotek manjši, enako pa velja tudi za anketirane študente UP v letu 2011 (Summers, Corney in Childs 2004; Kovačič in Brečko Grubar 2012).

Statistika χ^2 pokaže ($p = 0{,}0000$), da je predstava o lastnem poznavanju TR študentov geografije zelo povezana z letnikom študija. V kontingenčni preglednici med letniki študija in lastni predstavi o TR študenti prvih letnikov močno odstopajo z velikim deležem odgovorov v kategorijah »zelo slaba« (prilagojen ostanek = + 3,3) in »slaba« (prilagojen ostanek = + 5,9), z majhnim deležem odgovorov pa v kategoriji »dobra« (prilagojen ostanek = –5,6). Študenti tretjih letnikov izstopajo z majhnim deležem odgovorov v kategoriji »slaba« (4,5 %; prilagojen ostanek = –4,9) in velikim deležem v kategoriji »dobra« (81,8 %; prilagojen ostanek = + 4,5).

Preglednica 1 prikazuje delež pravilnih odgovorov študentov geografije v Sloveniji na trditve o poznavanju TR. Statistika χ^2 kaže, da delež pravilnih odgovorov pri posamezni trditvi ni statistično značilno povezan z letnikom študija, kar je nekoliko presenetljivo, saj so te vsebine vključene v učne načrte predmetov vseh programov geografije v Sloveniji in bi pri višjih letnikih pričakovali večji delež pravilnih odgovorov (poglavje 4.1). Z izjemo druge trditve, kjer je bila večina odgovorov nepravilnih, prevladujejo pravilni odgovori (77,5 do 98,8 %), kar je skladno tudi z lastnimi ocenami anketiranih študentov o poznavanju vsebin TR. Tako kot je pokazala že raziskava med študenti UP leta 2011 (Kovačič in Brečko Grubar 2012), je najmanj pravilnih odgovorov pri vprašanjih, povezanih s družbeno-kulturnim področjem TR (trditve 2, 3, 4, 7 in 13). Študenti geografije so se najslabše izkazali pri vprašanju povezanosti enakosti spolov in TR, kjer je bil delež pravilnih odgovorov zgolj 35,0 %, kar je v primerjavi z odgovori študentov UP v letu 2011 (Kovačič in Brečko Grubar 2012) 10 % manj. Zanimivo je, da je delež moških študentov geografije, ki so pravilno odgovorili na vprašanje o enakosti spolov kot delu TR (43 %) večji od deleža žensk (32 %), v raziskavi

v ameriški zvezni državi Manitobi (Michalos s sod. 2011) pa se je pokazalo, da ženske v primerjavi z moškimi družbeno-kulturno področje bolje prepoznavajo kot del TR. To je skladno z ugotovitvijo, da se znanost o trajnostnosti prevladujoče osredotoča na okoljske znanosti, veliko manj pa sega na področja ekonomije in družbenih ved (Nučič 2012). Pri študentih geografije v Sloveniji povezanost med spolom in deležem pravilnih odgovorov na trditve o TR ni statistično značilna, z izjemo 3. trditve, kjer je delež pravilnih odgovorov pri moških 87,0 % (prilagojeni ostanek = –2,3), pri ženskah pa 96,5 % (prilagojeni ostanek = + 2,3).

Med študenti geografije na posameznih univerzah in deležem pravilnih odgovorov ni statistično značilne povezave, z izjemo študentov geografije na UP, ki v primerjavi z drugima dvema univerzama pri trditvah 6, 7, 8 in 13 statistično značilno odstopajo (prilagojeni ostanki od –2,1 do –2,7) z manjšim deležem pravilnih odgovorov. Z nekoliko manjšim deležem pravilnih odgovorov pri 11. trditvi (83,3 %) v negativno smer izstopajo študenti geografije na UM.

Preglednica 1: Deleži (%) pravilnih odgovorov na trditve o poznavanju trajnostnega razvoja.

trditev (n = 160)	UL	UM	UP	skupaj
1. Trajnostni razvoj vključuje tako gospodarski razvoj, družbeno-kulturni razvoj kot varstvo okolja.	97,8	100,0	100,0	98,8
2. Učenje za trajnostni razvoj vključuje učenje kulture miru in enakosti spolov.	37,0	41,7	27,3	35,0
3. Trajnostni razvoj enako zajema potrebe v prihodnosti (naših otrok) kot današnje potrebe.	95,7	95,8	88,6	93,8
4. Socialna pravičnost ni sestavina trajnostnega razvoja.	82,6	75,0	68,2	77,5
5. Trajnostna poraba vključuje uporabo dobrin in storitev na način, ki zmanjšuje na minimum uporabo naravnih virov in strupenih snovi ter zmanjšuje odpadke.	94,6	91,7	93,2	93,8
6. Zmanjšanje snovno-energijskih tokov za trajnostni razvoj ni bistvenega pomena.	95,7	95,8	86,4	93,1
7. Trajnostni razvoj presega antropocentrizem in vključuje etično ravnanje do živali.	87,0	83,3	70,5	81,9
8. Trajnostni razvoj skuša uravnotežiti človeško in gospodarsko blagostanje s kulturno tradicijo in naravnimi viri.	96,7	100,0	86,4	94,4
9. Podnebnih sprememb ne moremo upočasniti.	84,6	79,2	79,5	82,4
10. Družbena odgovornost podjetij je za trajnostni razvoj nepomembna.	95,7	91,7	93,2	94,4
11. Trajnostni razvoj predvideva spremembo potrošniške miselnosti ter prehod od zagotavljanja želja k zagotavljanju dejanskih potreb.	95,7	83,3	90,9	92,5
12. Ohranjanje biološke raznovrstnosti je ključno za učinkovito delovanje ekosistemov.	96,7	100,0	100,0	98,1
13. Izobraževanje za trajnostni razvoj podpira kulturno različnost in spoštovanje človekovih pravic.	84,8	79,2	68,2	79,4
14. Uporaba neobnovljivih virov ne sme presegati uporabe sonaravnih obnovljivih nadomestkov.	92,3	87,5	93,2	91,8
15. Nosilna sposobnost okolja (sposobnost samočiščenja, nevtralizacije obremenitev in regeneracije) je nepomembna za trajnostni razvoj.	89,1	91,7	93,2	90,6

4 Viri znanja o trajnostnem razvoju

Naslednji vprašanji sta bili povezani z učenjem o TR in poglavitnimi viri znanja, ki so vplivali na poznavanje TR. Odgovori kažejo, da se je 61,9 % študentov geografije treh univerz že učilo o TR, 38,1 % pa ne; več pritrdilnih odgovorov je bilo pri študentih (67,4 %) kot študentkah (59,6 %). Iz rezultatov bi lahko sklepali, da vsebine TR niso ustrezno zastopane v študijskih programih geografije v Sloveniji. Vendar njihova analiza (poglavje 4.1) pokaže ravno nasprotno, torej, da je zastopanost predmetov, povezanih s TR, dobra.

Takšen rezultat si lahko delno razložimo s študentskim neprepoznavanjem vsebin TR znotraj posameznih predmetov ali pa s tem, da je več predmetov izbirnih in jih anketirani študenti niso izbrali. Delež vseh študentov geografije, ki so se že učili o TR, je nekoliko manjši od deleža anketiranih študentov UP (71,0 %) leta 2011 (Kovačič in Brečko Grubar 2012). Rezultati raziskave med študenti v Carigradu kažejo, da se je o TR učilo zgolj 3 % vprašanih (Eyuboglu, Oslu in Oz 2010). Analiza podatkov naše raziskave razkriva, da delež študentov geografije, ki so se že učili o TR, narašča od začetka dodiplomskega do zaključka podiplomskega študija (prvi letnik prve stopnje = 30,2 %, drugi letnik prve stopnje = 71,9 %, tretji in četrti letnik prve stopnje = 86,0 % in druga stopnja skupaj = 100,0 %), kar pomeni, da so vsebine TR ustrezno zastopane v študijskih programih. Zaskrbljujoč je podatek, da je le 52,3 % študentov geografije na UP navedlo, da so se že učili o TR, na UL je ta delež 65,2 % in na UM 66,7 %. Študenti geografije na UP statistično močno odstopajo (prilagojen ostanek = + 3,7) tudi pri skupnem deležu odgovorov »zelo malo« in »malo« na vprašanje o povezanosti študijskih vsebin s TR, ki je kar 31,8 %, v primerjavi s študenti geografije na UL (10,8 %) in UM (16,6 %).

Odgovore na vprašanje, kje so pridobili znanje o TR, pri čemer so študenti izbirali med ponujenimi možnostmi (možnih več odgovorov), prikazuje preglednica 2.

Preglednica 2: Deleži (%) navedb pridobivanja posameznih vrst informacij o trajnostnem razvoju (možnih več odgovorov). Prvo število je delež vseh anketiranih, ki so izbrali odgovor, drugo pa delež navedb posameznega odgovora od vseh navedenih odgovorov.

odgovor (n = 99)	UL	UM	UP	skupaj
formalno izobraževanje	90,0/22,2	87,5/21,5	56,5/12,3	81,8/19,6
neformalno izobraževanje (tečaji, okrogle mize, društva, krožki . . .)	30,0/7,4	18,8/4,6	26,1/5,7	27,3/6,5
okolica (prijatelji, družina . . .)	40,0/9,9	56,3/13,8	82,6/17,9	52,5/12,6
informativni programi TV, radio	48,3/11,9	37,5/9,2	60,9/13,2	49,5/11,8
dokumentarni programi TV, radio	50,0/12,3	50,0/12,3	73,9/16,0	55,6/13,3
časopisje in revije	36,7/9,1	56,3/13,8	52,2/11,3	43,4/10,4
strokovna in znanstvena literatura (knjige, članki v revijah)	58,3/14,4	50,0/12,3	43,5/9,4	53,5/12,8
spletne strani, forumi, akcije . . .	50,0/12,3	43,8/10,8	56,5/12,3	50,5/12,1
drugo	1,7/0,4	6,3/1,5	8,7/1,9	4,0/1,0

Najpomembnejši vir znanja o TR je »formalno izobraževanje« (19,6 %), ki ga je navedlo kar 81,8 % vseh, ki so se že učili o TR (n = 99). To kaže, da so vsebine TR ustrezno vključene tako v formalno izobraževanje na dodiplomskih in podiplomskih programih geografije kot tudi na srednjih šolah. Slednje je mogoče sklepati iz odgovorov študentov prvih letnikov. Pomen formalnega izobraževanja na študijskih programih geografije pri pridobivanju znanj o TR se kaže tudi v naraščanju deleža odgovorov v tej kategoriji od začetka študija na dodiplomski ravni (11,7 %) do podiplomskega študija (17,9 %). Raziskava, opravljena med študenti več fakultet UP (Kovačič in Brečko Grubar 2012), je prav tako pokazala, da je najpomembnejši vir znanja o TR formalno izobraževanje (21,4 %). Na Oxfordski univerzi se je 56 % anketiranih podiplomskih študentov o TR učilo v okviru formalnega izobraževanja, pri čemer je delež geografov, ki so se učili o TR, še veliko večji (81 %) (Summers, Corney in Childs 2004). Anketa med podiplomskimi študenti geografije na UP (n = 10) je pokazala, da je ta delež 100 % (Kovačič in Brečko Grubar 2012). Med anketiranimi dijaki v Manitobi pa jih je samo 14 % navedlo, da so se o TR že učili v okviru formalnega izobraževanja (Michalos s sod. 2011).

Izračun χ^2 testa kaže, da med viri znanja o TR in domicilnostjo študentov geografije ni ($p = 0{,}5498$), vendar pa analiza ostankov posameznih celic kontingenčne preglednice 2 pokaže, da z zgolj 12,3 % vseh odgovorov v kategoriji »formalno izobraževanje« v negativno stran močno odstopajo študenti geografije na UP (prilagojen ostanek = –3,6), kar je skladno z že zgoraj omenjenim velikim deležem (31,8 %) študentov geografije na UP, ki menijo, da je njihov program malo ali zelo malo povezan s TR. Drugače od študentov geografije na ostalih dveh univerzah, pri katerih je med ponujenimi na prvem mestu odgovor »formalno izobraževanje« (UL = 22,2 % in UM = 21,5 %), ta pri študentih geografije na UP zaseda šele četrto mesto (preglednica 2). Rezultati analize ostankov pokažejo, da v negativno stran s samo 9,9 % vseh odgovorov pri navedbi »okolica« močno odstopajo študenti geografije na UL (prilagojen ostanek = –3,1), v pozitivno stran pri isti navedbi pa s 17,9 % študenti geografije na UP (prilagojen ostanek = + 3,3).

Pri študentih geografije na vseh treh univerzah je najmanjši delež odgovorov v sklopu »neformalno izobraževanje« (4,6–7,4 %), ki zajema udejstvovanje študentov na tečajih, krožkih, delavnicah in okroglih

mizah zunaj študijskega procesa. Delež je nekoliko večji od povprečja za študente UP (4,2 %) (Kovačič in Brečko Grubar 2012), vendar pa kaže na nezanimanje študentov za pridobivanje znanja o TR izven formalnih oblik učenja in množičnih medijev. Oblike neformalnega izobraževanja so z aktivno udeležbo sicer zelo primerna oblika promocije smernic TR in mladi izobraženci bi morali biti gonilna sila v tej smeri, vendar rezultati kažejo, da ni tako. Zato je zelo pomembna vloga učiteljev, ki bi v študentih morali spodbuditi vnemo po prizadevanju za ustvarjanje boljše prihodnosti, v smislu informiranja javnosti o nujnosti bivanja in delovanja družbe po načelih TR. Pri tem je pomembno tudi mladim vcepiti zavedanje, da je prostor skupna odgovornost vseh, če ga želimo ohraniti prihodnjim rodovom (Fridl, Urbanc in Pipan 2009; Urbanc in Fridl 2012). Računati zgolj na samoiniciativnost mladih pri prevzemanju te odgovornosti je zgrešeno. Pomen izobraževanja mladih o TR za doseganje njegovih globalnih ciljev izpostavljajo tudi nekatere raziskave (Wade 1999; Catenazzo s sod. 2010).

Preostale kategorije virov znanja so med študenti geografije dokaj enakomerno razporejene (od 10,4 do 13,3 %) (preglednica 2). Nekoliko presenetljivo se na tretje mesto (12,8 %), takoj za »dokumentarnimi programi«, uvršča »strokovna in znanstvena literatura«, kar je za dobra 2 % več, kot smo leta 2011 ugotovili pri študentih UP (Kovačič in Brečko Grubar 2012). Rezultati iste raziskave so pokazali, da študenti UP 51,6 % informacij in znanja o TR pridobijo iz različnih medijev (TV, radio, časopis, svetovni splet …), kar je nekoliko več od celotne populacije študentov geografije v Sloveniji (47,7 %), oboji pa seveda kažejo na velik pomen medijev v izobraževanju o TR. Informativnemu in dokumentarnemu programu TV in radia pripada skupno četrtina vseh odgovorov, zato bi ju veljalo učinkoviteje izkoristiti za izobraževanje o TR in njegovo promocijo (preglednica 2).

4.1 Povezanost vsebin trajnostnega razvoja s študijskimi programi geografije

Preglednica 3: Povezanost vsebin študijskih programov geografije v Sloveniji s TR.

odgovor (n = 160)	UL (%)	UM (%)	UP (%)	skupaj (%)
nikakršna	1,1	0,0	0,0	0,6
zelo majhna	5,4	8,3	4,5	5,6
majhna	5,4	8,3	27,3	11,9
srednja	27,2	50,0	38,6	33,8
velika	42,4	25,0	22,7	34,4
zelo velika	18,5	8,3	6,8	13,8

Odgovori študentov geografije o povezanosti njihovih študijskih programov z vsebinami TR med tremi univerzami se statistično pomembno razlikujejo ($p = 0{,}0066$). S skupno 60,9 % odgovorov »velika« in »zelo velika« izstopajo študenti geografije na UL, ki so največ znanja o TR pridobili s formalnim izobraževanjem (22,2 %; preglednica 3). Pri študentih geografije na UM je skupni delež odgovorov »velika« in »zelo velika« 33,3 %, na UP pa 29,5 %. Slednji pomembno odstopajo z največjim skupnim deležem odgovorov »zelo majhna« in »majhna« (31,8 %). Polovica študentov geografije na UM meni, da je njihov program srednje povezan z vsebinami TR, na UP jih je enakega mnenja 38,6 % in na UL 27,2 %. Med vsemi anketiranimi je zgolj eden navedel, da njegov študijski program ni prav nič povezan z vsebinami TR.

Primerjava skupnega deleža odgovorov »velika« in »zelo velika« vseh anketiranih študentov ter odgovorov na vprašanje o povezanosti študijskih vsebin s TR po letnikih študija pokaže, da so vsebine TR ustrezno vključene v programe geografije, povezanost je statistično značilna. Visokošolsko izobraževanje ustrezno sledi splošno zastavljenim ciljem izobraževanja na področju TR. Močno odstopanje v negativno stran je značilno za študente prvega letnika (prilagojeni ostanek = –3,3). To se odseva tudi v izraziti razliki skupnega deleža odgovorov »velika« in »zelo velika« med študenti prvega (25,3 %) in drugega letnika študija (62,6 %) na prvi stopnji. Enak delež je pri študentih tretjega in četrtega letnika (62,5 %), pri študentih podiplomskega študija pa je le-ta 75,0 %. Ocena študentov o povezanosti študijskih programov z vsebinami TR se ujema z mnenjem glede poznavanja TR, ki narašča od začetka do zaključka študija (poglavje 3).

Z namenom ugotavljanja povezanosti programov geografije z vsebinami TR smo študente zaprosili za navedbo do pet študijskih predmetov, ki si sledijo glede na zastopanost vsebin o TR. Na povezanost predmeta z vsebino TR smo sklepali le na podlagi navedbe predmeta, učnih načrtov nismo pregledovali. Zaradi premajhnega števila anektiranih študentov druge stopnje geografije smo analizo opravili le za programe

prve stopnje. V nadaljnjo analizo smo vključili samo prve tri navedene predmete, ki po mnenju anketiranih obravnavajo teme TR (preglednica 4).

Iz navedenih imen predmetov enopredmetnega in dvopredmetnega prvostopenjskega programa Geografija na UL bi lahko sklepali, da so z vsebinami TR najbolj povezani predmeti Geografija sonaravnega razvoja, Ekološka geografija in Varstvo geografskega okolja. Slednji je predmet starega (predbolonjskega) programa Geografija. Vendar je analiza navedb predmetov pokazala, da so študenti geografije na UL kot prve tri možnosti največkrat navedli Hidrogeografijo (16,7 %), šele nato sledita Geografija sonaravnega razvoja (13,7 %) in Ekološka geografija (11,6 %). Osem navedenih predmetov v preglednici 4 predstavlja skupno 75,5 % vseh navedb predmetov študentov geografije na UL. Ker so predmet Varstvo geografskega okolja navajali zgolj študenti starega programa, je delež teh navedb temu primerno majhen (4,7 %). Študenti geografije na UL so kot prvoizbrani predmet največkrat navedli Geografijo sonaravnega razvoja (35,2 %), kot drugoizbranega Ekološko geografijo (23,1 %) in kot tretjeizbranega Humano ekologijo (17,9 %).

Preglednica 4: Deleži (%) navedb posameznih predmetov programov geografije 1. stopnje, ki po mnenju študentov obravnavajo teme, povezane s TR.

univerza in predmet	tip predmeta	letnik	delež navedb
UNIVERZA V LJUBLJANI			
Hidrogeografija	obvezni	2	16,7
Geografija sonaravnega razvoja	izbirni	1–3	13,7
Ekološka geografija	obvezni	3	11,6
Pedo- in biogeografija (samo enopredmetni študij)	obvezni	2	8,6
Geografija turizma in prometa (samo enopredmetni študij)	obvezni	2	8,2
Humana ekologija	izbirni	1–3	6,4
Klimatogeografija (samo enopredmetni študij)	obvezni	1	5,6
Varstvo geografskega okolja (stari program)	obvezni	4	4,7
UNIVERZA V MARIBORU			
Sonaravno urejanje voda	izbirni	1	31,7
Varovanje prsti	izbirni	2	16,7
Hidrogeografija	obvezni	1	15,0
Geografija slovenskih pokrajin	obvezni	3	6,7
Ekološka geografija	obvezni	3	5,0
UNIVERZA NA PRIMORSKEM			
Uvod v družbeno geografijo	obvezni	1	23,3
Uvod v fizično geografijo	obvezni	1	13,3
Pokrajinska in humana ekologija	izbirni	2–3	10,0
Regionalna geografija sveta	obvezni	1	10,0
Uporabna geografija v regionalnem razvoju	izbirni	2–3	7,8
Geografija poselitve in prebivalstva	obvezni	2	5,5
Ekonomska in socialna geografija	obvezni	3	4,5

Za tri od petih predmetov na dvopredmetnem prvostopenjskem programu Geografija na UM, ki so jih študenti največkrat navedli, lahko že iz njihovih imen sklepamo na povezanost vsebin s TR (Sonaravno urejanje voda, Varovanje prsti in Ekološka geografija). Na omenjenem programu se kot izbirni predmet 1. letnika predava tudi predmet Antropogene klimatske spremembe, ki je vsebinsko povezan s TR, vendar ga je navedlo zelo majhno število študentov. Med prvimi tremi možnostmi so študenti geografije na UM največkrat navedli Sonaravno urejanje voda (31,7 %), sledi Varovanje prsti (16,7 %), na tretjem mestu je Hidrogeografija (15,0 %). Pet navedenih predmetov v preglednici 4 predstavlja skupno 75,1 % od vseh navedb predmetov študentov geografije na UM. Kot prvo izbiro so največkrat navedli Sonaravno urejanje voda (66,7 %), kot drugo Hidrogeografijo in Varovanje prsti (oba 23,8 %), kot tretjo pa Varovanje prsti (33,3 %).

Na enopredmetnem prvostopenjskem programu Geografija na UP z imenom le izbirni predmet Pokrajinska in humana ekologija nakazuje na povezanost z vsebinami TR, kakor pa kaže analiza navedb študentov omenjenega programa, so vsebine TR vključene tudi v splošne geografske predmete. Na prvo mesto se z največ navedbami uvršča Uvod v družbeno geografijo (23,3 %), sledi Uvod v fizično geografijo (13,3 %), na tretjem mestu sta z 10,0 % deležem Regionalna geografija sveta ter Pokrajinska in humana ekologija. Sedem navedenih predmetov v preglednici 4 predstavlja skupno 74,3 % od vseh navedb študentov geografije na

UP. Kot prvo izbiro so študenti največkrat navedli Pokrajinsko in humano ekologijo ter Uvod v fizično geografijo (oba po 18,9 %), kot drugo Uvod v družbeno geografijo (30,3 %) in kot tretjo Regionalno geografijo sveta (20 %).

5 Sklep

Več kot polovica anketiranih študentov geografije v Sloveniji meni, da dobro poznajo TR, dobra tretjina jih svoje poznavanje ocenjuje kot slabo. Tistih, ki svoje poznavanje ocenjujejo kot »zelo dobro« ali »zelo slabo«, je malo, med študenti posameznih univerz pa so razlike zanemarljive. Nekoliko večji je delež dobrega poznavanja pri študentih UL, kar je skladno z velikim deležem (60,9 %) študentov, ki menijo, da so vsebine TR »veliko« ali »zelo veliko« povezane z njihovimi študijskimi programi. Nedvoumna je ugotovitev, da študenti višjih letnikov prve stopnje in študenti druge stopnje študija veliko boljše ocenjujejo lastno poznavanje od študentov nižjih letnikov. Deleži pravilnih in nepravilnih odgovorov pri trditvah, s katerimi smo preverjali poznavanje TR, presenetljivo niso pokazali statistično značilne povezanosti med pravilnimi odgovori in letniki študija, kakor tudi ne z domicilnostjo anketiranih študentov. Določene vsebine TR, zlasti z družbeno-kulturnega polja, namreč niso ali so le v manjši meri zastopane v študijskih programih in jih študenti ne spoznajo niti v dalj časa trajajočem izobraževanju. Nekoliko manjši delež pravilnih odgovorov je bil zaznan pri študentih geografije UP, ki so svoje poznavanje TR že v začetku ocenili slabše.

Delež anketiranih študentov geografije, ki so se že učili o TR, presega 60 % in se pri študentih višjih letnikov povečuje (3. letnik 1. stopnje 86 %). Razlike so skladne tudi z ugotovitvijo, da delež študentov, ki so se že učili o TR, in delež študentov, ki menijo, da so njihovi študijski programi močno ali zelo močno povezani s TR, naraščata od začetka do zaključka študija. Z manjšim deležem pritrdilnih odgovorov so statistično pomembno odstopali študenti geografije na UP, ki tudi slabše ocenjujejo povezanost študijskih programov s TR. To so potrdili tudi z odgovori na vprašanje o načinu pridobivanja znanja, kjer so manjši pomen pripisali formalnemu izobraževanju. Sicer ima pri večini anketiranih študentov geografije formalno izobraževanje pomembno vlogo v spoznavanju TR. Pri pregledovanju predmetnikov študijskih programov smo ugotovili, da so med študijskimi programi univerz precejšnje razlike v zastopanosti vsebin TR, če bi sklepali iz imen predmetov. Bolj »zgovorne« so navedbe nazivov predmetov pri študentih, kjer smo ugotovili, da so bili nekateri splošnogeografski temeljni predmeti bolj pogosto vir znanja o TR, kot smo pričakovali.

6 Literatura

Glej angleški del prispevka.

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1 Introduction

This special issue of *Acta Geographica Slovenica* is dedicated to geographer Bojan Erhartič at the ZRC SAZU Anton Melik Geographical Institute, who died in a plane crash in mid-October 2013 while carrying out fieldwork and photographing Slovenian landscapes clad in wonderful autumn colors. He was only thirty-three years old.

In less than ten years of conducting geomorphology and nature conservation research, his devoted work firmly established him in the Slovenian professional community. He was also gaining an increasing international profile, which is clearly confirmed by a letter from Eric Fouache from the Sorbonne, the chair of the International Association of Geomorphologists, who, among other things, wrote the following upon Bojan's death: »*Our colleague Bojan Erhartič was a pioneer in studying geomorphological values in Slovenia and was developing research on Slovenian geomorphological heritage and geotourism, while also taking part in the development of the Slovenian geomorphological school.*«

2 Background

Because geography takes an extremely broad view of physical space, it can contribute significantly to a comprehensive and multidisciplinary natural and cultural heritage protection system. According to UNESCO, which seeks to preserve the greatest achievements of nature and humankind worldwide, »*heritage is our legacy from the past, what we live with today, and what we pass on to future generations. Our cultural and natural heritage are both irreplaceable sources of life and inspiration*« (Internet 1).

Areas with exceptional or rare features, or areas with a great diversity of features, are also relevant to heritage. Both of these qualities are also criteria for determining the significance of surface geomorphological natural values. A great diversity of terrain and features – which is typical of Slovenia, for instance (Ciglič and Perko 2013) – results from the fact that, under the impact of many factors, the Earth's surface is transformed by various geomorphological processes that create extremely diverse landforms and landscapes (Migoń 2010). In order to interpret geomorphological processes correctly, it is necessary to understand rock structure, the origin, development, and movements of the Earth's layers, and the impacts of external processes (Reynard 2004). This means that a complex geographical research approach can be used to detect and evaluate geomorphological heritage from various points of view (e.g., scientific value, diversity, and aesthetics). The correct evaluation of geomorphological heritage includes selecting the most important values, and this forms the basis for its management. An important part of management entails activities such as education, awareness raising, and interpretation (Erhartič 2010; 2012).

Just as it is unnecessary to protect all landforms (Komac, Zorn and Erhartič 2011), it is also not practical to seek to protect heritage as a whole. Therefore the most important or valuable parts of heritage should be defined and protected through appropriate measures. This is also supported by the fact that the impacts and pressures of human activity, especially those on geodiversity and geomorphological heritage, are increasing. The need arises for more extensive knowledge of conserving nonliving nature, at both the scholarly and management levels. In this regard, Bojan Erhartič's work should be highlighted because he was the first Slovenian researcher to tackle the demanding task of comprehensively evaluating geomorphological heritage. Even though this type of natural heritage in particular is the very foundation of a landscape's tourism attraction, it is often neglected because it is difficult to evaluate its significance, let alone bridge the gap between evaluation and its significance for management.

Even though only little heritage is included on the UNESCO World Heritage List, ten generally applicable and completely clear criteria are used for assessing outstanding universal value. Two of them also include geomorphological forms: »*contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance*« and »*is an outstanding example representing major stages of Earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features*« (Operational Guidelines … 2015).

The evaluation of beauty is one of the greatest challenges, also in connection with the criteria mentioned above. Even though many philosophers have asked »*What is beautiful*?« and Lothian (1999) suggests that one receives as many answers to this question as there are philosophers – or, in other words, that this is about the subjective ability to experience beauty (Šmid Hribar 2011) – certain principles are nonetheless

apparent regarding the beauty of a specific landscape. However, philosophers establish differences in perceiving landscape beauty between different population groups according to age, education, and cultural environment (Kaplan and Herbert 1987). Over the past decades, they have also established that beauty affects many economic and social outcomes (Florida, Mellander and Stolarick 2011).

With regard to heritage protection, one must also not ignore awareness raising because it is key for people to recognize heritage as something that needs to be protected and that cannot be preserved for future generations if people do not have an appropriate attitude toward it. This may involve heritage at the local, national, European, or global levels; the paths may vary greatly, but the goal is the same everywhere.

Heritage interpretation is a more recent phenomenon in heritage studies and is one of the most suitable and established forms of informing and raising the awareness of visitors and local people. The goal of modern and comprehensive landscape interpretation, which goes beyond interpreting natural and cultural heritage, is to make people more familiar with a specific topic in a comprehensive way in order to help them understand the landscape. This encourages them to engage in further explorations and critical thinking (Wearing et al. 2008). Protected areas' mission is not only to protect, but also to enable people to experience a specific area's nature, cultural heritage, and intangible values. Arranging and presenting protected areas for visitors are important goals, operational purposes, and hence important tasks in managing these types of areas. However, the presence of visitors often causes disturbances that go against the desired goal to protect unique and diverse natural or cultural landscapes; therefore, it is important to keep careful watch over the visits to these areas (Baldauf et al. 2011) and use them to raise people's awareness.

3 The articles

The Acta geographica Slovenica journal has a long tradition in human geography (Urbanc, M., Kladnik, D., Perko, D. 2014). With the articles in this special issue (volumes 56-1 and 56-2) we want to present comprehensive and multidisciplinary nature of geographical approach to the study of heritage. Following this introduction the special issue begins with the article »*The contribution of Bojan Erhartič to geography*« (Smrekar, Zorn and Komac 2016) in which the editors concisely present Bojan Erhartič's short but rich research career. His research path is presented chronologically; his affinity for mountains led him to study the environmental impacts of mountain lodges, followed by an interest in mountain landforms and their protection, which he summarized in a volume on the evaluation of the geomorphological heritage in the Triglav Lakes Valley (*Dolina Triglavskih jezer*) in the Julian Alps in Slovenia.

In their article »The role and importance of the landscape park Udin Boršt,« Mateja Šmid Hribar and Mateja Ferk (2016) studied the currency of the Udin Boršt protected landscape area in Slovenia, which was declared a historical and cultural monument in 1985. Using the Swiss method of evaluating landforms (Reynard et al. 2007), they established that the current ordinance should be amended in order to safeguard this area in central Slovenia as part of the joint protection of monuments and nature.

In his essay article »Aspects of geodiversity of Palaeozoic limestones in the Black Mountains of southern France,« Christian Giusti presents the significance of the diversity of rock composition and related geomorphological heritage. This article is interesting because it presents the cultural importance of geomorphological heritage, which is also reflected in Tolkien's imaginary worlds. Hence it is no coincidence that this article is also conceived as a journey »there and back again,« during which the reader follows, observes, and learns about the geomorphological and geological heritage of France's Savoy Alps.

Natural and cultural heritage protection makes no sense without well-informed local residents and visitors because they are the only ones that can successfully maintain the protected areas. Aleš Smrekar, Mateja Šmid Hribar, Jernej Tiran, and Bojan Erhartič (2016) authored the article »A methodological basis for landscape interpretation: The case of the Ljubljana Marsh,« in which they present a methodological basis for landscape interpretation using a form for identifying suitable topics and selecting the right interpretation tools. The application of this form is illustrated using the case of the Ljubljana Marsh in central Slovenia.

In their article »The importance of mountain geomorphosites for environmental education,« Emmanuel Reynard and Paola Coratza (2016) discuss the importance of mountain areas. They highlight mountains as areas with an extensive diversity of unique features that offer great potential for heritage protection. They review six reasons why mountain areas should be covered separately in school programs as sensitive landscapes on which current landscape changes have a strong impact. The paper presents two case studies in the Italian Dolomites and the Swiss Alps.

In their article »Stakeholder conflicts in the Tivoli, Rožnik Hill, and Šiška Hill Protected Landscape Area,« Aleš Smrekar, Mateja Šmid Hribar, and Bojan Erhartič (2016) study what is probably the most popular protected area in Slovenia, less than 1 km from the center of Ljubljana. Conflicts have arisen between various stakeholders in the area, especially visitors and landowners, and therefore the authors suggest several solutions through which this high-quality environment could be preserved by fulfilling a basic requirement: designating a manager.

Bojan Erhartič evaluated the landforms in the Triglav Lakes Valley (Dolina Triglavskih jezer) using the Swiss method (Reynard et al. 2007), as early as 2012, but he was not satisfied with the results section that involved aesthetic evaluation. In their article »The beauty of landforms,« Aleš Smrekar, Katarina Polajnar Horvat, and Bojan Erhartič (2016) therefore used a survey method to examine the most representative landscape features in this same area. They established that water elements (i.e., lakes) were the most attractive to respondents, and that crushed zones were the least attractive.

4 Conclusion

This special edition of *Acta geographica Slovenica* focuses on an emerging topic in geography that brings together geomorphology and environmental protection. The selective perspective on natural heritage used to date and consequently the corresponding operation has proven inadequate. Through his work, our colleague Bojan Erhartič, who left us much too soon, paved the way for us (in geomorphological heritage protection), outlined directions of future research (in heritage interpretation), and also hinted at others (inclusion of aesthetics).

Thus in some way, this special edition rounds off his scholarly creativity; parts of the articles published here, or in some cases the lion's share of them, were created by him. The goal of this special issue is to present the character and work of our esteemed colleague to the reader, which is why the articles must be read together, bearing in mind Bojan's contribution to geography. It is also by design that the journal's cover and some of the articles feature Bojan's photos of natural heritage.

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BOJAN ERHARTIČ'S CONTRIBUTION TO GEOGRAPHY

Aleš Smrekar, Matija Zorn, Blaž Komac

MIHA PAVŠEK

Bojan Erhartič: geomorphologist and conservationist.

Bojan Erhartič's contribution to geography

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ABSTRACT: At the beginning of the twenty-first century, Bojan Erhartič had a strong impact on Slovenian geography because he placed it on the map of countries where geographers deal with geomorphological heritage. He began his research path into the world of natural heritage with the study of geography. After receiving his bachelor's degree, he turned his attention to studying geodiversity, and this led him to issues concerning the evaluation of geomorphological heritage, especially in mountainous areas. Erhartič was among the first in Slovenian geography to deal with the aesthetic evaluation of geomorphological heritage. His interest in the »beauty of nature« stemmed from many years of planned work in (geographical) photography. The Anton Melik Geographical Institute of the Research Center of the Slovenian Academy of Sciences and Arts holds approximately 218,000 of his »geographical« photos, which he took during his many travels in more than forty countries on five continents.

KEY WORDS: geography, research, environmental protection, geomorphological heritage, natural values, in memoriam, Bojan Erhartič

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1 Introduction

Bojana Erhartič's research path into the world of natural heritage began with the study of geography, when he started dealing with mountainous areas and their conservation. At the end of his bachelor's program, he wrote the following in his thesis: »*With the expansion and modernization of the Triglav Lakes Lodge in the mid-1980s, we came to the realization that the impact of mountain lodges on drinking water in the Alps was becoming a serious problem*« (Erhartič 2004, 1). Soon after he graduated, he turned his attention to studying geodiversity, or the diversity of nonliving nature (Erhartič 2007). This led him to questions concerning its scientific value. He especially dedicated himself to evaluating geomorphological heritage and its conservation (Erhartič 2011, 2012), and also to the application of these findings in society (Erhartič and Šmid Hribar 2010). Because of his skills, Erhartič was employed at the Anton Melik Geographical Institute of the Research Center of the Slovenian Academy of Sciences and Arts, where he primarily dealt with nature conservation in various projects. He dedicated himself to natural and cultural heritage in towns (Smrekar, Erhartič and Šmid Hribar 2011b), in the countryside (Smrekar et al. 2014), and especially in the mountains (Erhartič 2012; Zorn et al. 2015; Figure 1).

2 A brief outline of Erhartič's heritage research

During his relatively brief research career, Erhartič published many works on natural and cultural heritage, and his works dedicated to geomorphological heritage stand out in particular. In these, he was primarily oriented toward their evaluation (Erhartič 2010a, 2010b; Erhartič, Komac and Zorn 2012). He also dedicated himself to the analysis of landforms (Erhartič 2007) and geodoversity (Erhartič and Zorn 2012). He was one of the few people to deal with geomorphological heritage from the perspective of geomorphic processes (Komac, Zorn and Erhartič 2011) that either shape it or »destroy« it. Using the examples of rockfalls that considerably reduced the height of Čedca Falls (once the highest in Slovenia) in 2008 (Triglav Čekada and Zorn 2014) and the effects of the 2007 flash floods that destroyed the Franja Partisan Hospital from the Second World War, which is on the European heritage list, he drew attention to the dynamic character of the landscape (Erhartič and Jelenko 2010), which is not always apparent and which in some manner

Figure 1: Erhartič's volume on the Triglav Lakes Valley, in which he evaluated its geomorphological heritage (Erhartič 2012).

also internally conflicts with the idea of nature conservation. In addition, he described the development of people's relationship to heritage in karst studies, with special attention to tourism (Zorn, Erhartič and Komac 2009, 2012). In Slovenia, which is known for its great diversity of natural values (Ciglic & Perko 2013; Erhartič, Zorn and Komac 2013; Perko, Hrvatin and Ciglič 2015), tourism was also initially »research tourism« because it was based on many visits by foreign researchers. This is especially true for the Kras (Karst) Plateau in southwest Slovenia (Smrekar et al. 2007), which is considered the »cradle« of karst studies (Zorn, Erhartič and Komac 2009; Ferk and Zorn 2015).

Erhartič was one of the rare geography researchers in Slovenia that sought to evaluate natural and cultural heritage as a whole. »*In nature everything is connected and equally important, and people perceive both tangible and intangible values in it*« (Erhartič 2012, 34). It is therefore no surprise that, in addition to unspoiled nature, he was also interested in issues of protecting nature and cultural heritage in the countryside and especially in urban areas (Smrekar, Erhartič and Šmid Hribar 2011a; Smrekar et al. 2014). This is also confirmed by his productive participation in projects on plot gardening in Ljubljana (Breg Valjavec et al. 2008), values of Tivoli, Rožnik, and Šiška Hill Nature Park (Smrekar, Erhartič and Šmid Hribar 2011a), and interpretation of heritage in the Ljubljana Marsh Nature Park (Smrekar et al. 2014). In the case of the Tivoli, Rožnik, and Šiška Hill Nature Park, he determined »*that green areas are one of the key factors for pleasant living*« (Smrekar, Erhartič and Šmid Hribar 2011a: 120). In another place he wrote that its »main value [lies] … *in offering a diverse experience of nature and the opportunity for psychological relaxation and recreation in a natural environment*« (Smrekar, Erhartič and Šmid Hribar 2011b, 109). Because he was aware of how man can upset the natural balance, it is no surprise that he saw the »*necessity of … zoning with optimal distribution of activities*« (Smrekar, Erhartič and Šmid Hribar 2011a, 124). In the same publication, he also wrote that in »*recent times … there has been a strong public emphasis on nature conservation aspects of the area, but considerably less on its cultural significance, which needs to be balanced in the future*« (Smrekar, Erhartič and Šmid Hribar 2011a, 109). He concluded the same for the town of Idrija: »*The Idrija area is a nice example of man's adaptation to natural endowments. Nature defines culture, and culture protects nature. This harmony is especially visible in the mix of natural, cultural, and technical heritage*« (Erhartič and Šmid Hribar 2010, 76). Elsewhere he wrote: »*Similarly to nature conservation, in recent years the protection of cul-*

ALEŠ SMREKAR

Figure 2: Erhartič masterfully combined photography and research in his study of heritage.

tural heritage has seen the increasing establishment of the doctrines of comprehensive conservation and active management of protected monuments« (Erhartič 2014, 40).

3 Mountains: the unifying theme of Erhartič's research work

Love for the mountains directed Erhartič's basic research work toward Alpine landscapes (Figure 2). This is where, as a student, he produced his bachelor's thesis, in which he examined the applicability of constructed wetlands at mountain lodges in Triglav National Park (Erhartič 2004). For each mountain lodge he worked out an assessment of the suitability of building a wastewater treatment plant and a proposal for solving the problem using a constructed wetland. Even at that time, he understood the broader context of environmental protection, and he wrote that it is »*necessary to emphasize that wastewater treatment plants are not the optimal solution … Much more important is the adoption of preventive measures*« (Erhartič 2008, 64), such as reducing water use, and thus the quantity of wastewater. He also conducted his doctoral fieldwork in Slovenia's only national park, in its core area: the Triglav Lakes Valley (Erhartič 2012; Figure 1). Posthumously, he contributed to a volume commemorating the ninetieth anniversary of its protection (Zorn et al. 2015). He assessed the geomorphological heritage in the Triglav Lakes Valley, where he stumbled across the problem of subjectivity, which he felt was »*an unavoidable evil, but it is necessary to reduce the impact of subjective judgments as much as possible*« (Erhartič 2012, 172). He took an active role in studying the Triglav Glacier as an indicator of climate change in the southeastern Alps (Erhartič and Polajnar Horvat 2010).

4 Evaluation of natural heritage

For Erhartič, the question of a scholarly approach to evaluating natural heritage was such a great challenge that he dedicated his doctoral research to it (Erhartič 2011, 2012). In it, he studied the geomorphological heritage in the Triglav Lakes Valley and carried out a scientific evaluation of landforms as geomorphological

FRANJO DROLE

Figure 3: For Erhartič (first from the left), the mountain landscape was a point of departure for research.

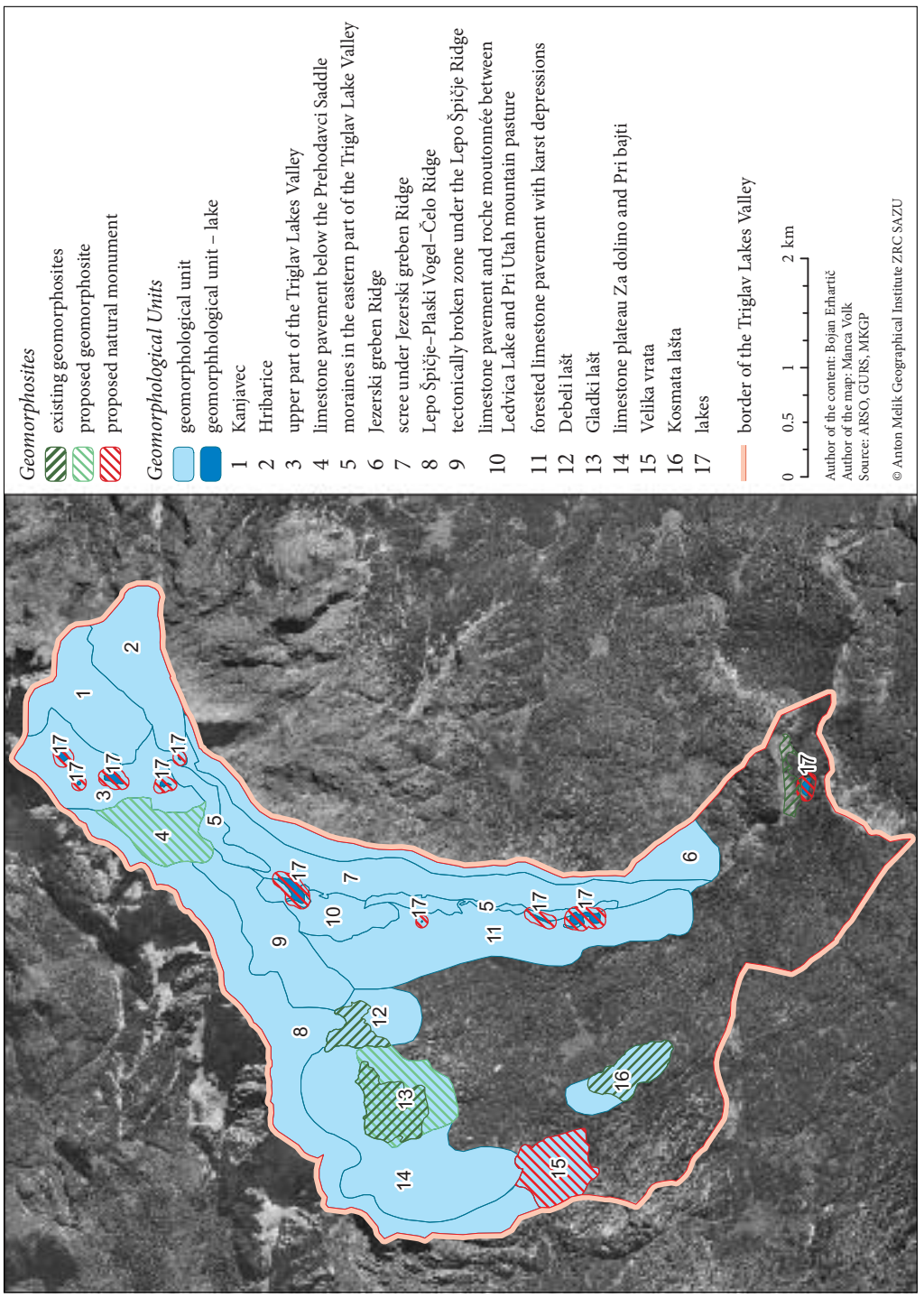

Figure 4: Geomorphological units in the Triglav Lakes Valley and proposals for geomorphological heritage and its protection (Erhartič 2011, 139, 196; Erhartič and Zorn 2012, 60).

heritage. It seems that his participation in the workshop Mapping Geoheritage, which the International Association of Geomorphologists held in Lausanne in 2008 and which focused on the evaluation of geomorphological heritage, was a milestone for his research (Regolini-Bissig and Reynard 2010). This was where, as a doctoral student, he became acquainted with the basics of mapping geomorphological heritage, and especially with the methods of evaluating it.

He evaluated landforms using the Swiss method (Reynard et al. 2007), which for the scientific value takes into account the following criteria: rareness, representativeness, integrity, and paleogeographic value. The method also uses additional values, such as ecological, aesthetic, cultural, and economic values (Erhartič 2011, 2012). The result of such analysis is an assessment of the value of a particular landscape or its parts from the perspective of geomorphological heritage. In the Triglav Lakes Valley, he classified the landforms into seventeen geomorphological units based on their genesis and the processes that (re)shape them (Figure 4). Erhartič was also engaged at the applied level, and in his conclusion he suggested which areas should be given additional protection due to their high research or aesthetic value or due to the rarity of features found there.

His work was also important because it added to the methods used up until then for evaluating landscapes from the perspective of geomorphological heritage (Reynard and Coratza 2016). Such evaluation was started by Panizza in Italy (Panizza and Piacente 1993; Panizza 2001, 2003), and his work was continued in neighboring countries. Thus, in addition to the Italian method, there gradually also appeared Swiss, Spanish (Serrano and Gonzales-Trueba 2005), Portuguese (Pereira, Pereira and Caetano Alves 2007), and other methods (e.g., Coratza and Giusti 2005) for assessing geomorphological heritage. Erhartič's contribution can easily be ranked alongside these and one may also speak about a »Slovenian method« (Table 1; Erhartič 2010).

Erhartič dedicated special attention to natural heritage in the former mining town of Idrija, which is on the UNESCO list of world heritage sites because of its five-hundred-year heritage of mercury mining (Zorn, Nared and Razpotnik Visković 2015). Erhartič's comprehensive treatment of territory in the Municipality of Idrija from the perspective of natural heritage is probably the apex of the application of his expertise (Erhartič and Šmid Hribar 2010; Nared, Erhartič and Razpotnik Visković 2013). His work has broader social significance because he showed that it is possible to use research findings to solve current challenges (Goluža and Erhartič 2014).

Table 1: Geomorphological heritage assessment criteria according to the Slovenian method (Erhartič 2010, 304).

	Short description
Exceptionality	We assess exceptionality within the typological group according to the frequency of appearance, dimensions and other characteristics. Usually the comparison is made within Slovenia, sometimes even wider. We distinguish the absolute and the relative rarity of a feature, exceptional dimensions and extraordinary or unique landforms.
Representativeness	The criterion for representativeness is used for all objects or areas of natural heritage on the basis of which literature offers descriptions of specific natural features, landforms, processes, or for those objects and areas which are characteristic of or are evidently formed representatives of a specific type of natural features.
Complexity	Objects or areas of geomorphological heritage frequently intertwine and together form a new value. This can happen due to a peculiar combination of values within an area or due to the merging of objects into bigger, connected units. The value of such complex areas is bigger than the sum of all individual values, and one individual object as part of a bigger unit is assessed on a higher level.
Ecological aspect	Assessment on the basis of the ecological aspect takes into account ecosystems with higher levels of protection, ecosystems with greater diversity of habitats or species (stable ecosystems), as well as ecosystems that are rare.
Cultural aspect	The cultural aspect is the most subjective one, as it defines our relationship towards our heritage. It is based on the following criteria: expressiveness, symbolic value, diversity and the landscape aspect (the aesthetic relationship of natural heritage towards the surrounding environment).
Exploitation aspect	The exploitation aspect (scientific and educational aspects) was used regarding the protection of the heritage and not for its assessment. The assumption was made that all objects which match at least one of the aforementioned criteria are important for scientific study. The suggestion of intended use – what is acceptable from perspective of natural heritage conservation – derives from the evaluation of the conservation aspect and the accompanied exploitation or function. This intended use can partly or fully match other exploitations of space, or it can exclude them.

5 Aesthetics and interpreting nature

Erhartič was among the first to deal with the aesthetic evaluation of geomorphological heritage in Slovenian geography (Smrekar and Erhartič 2015; see also Smrekar, Polajnar Horvat and Erhartič 2016 in this special issue), or the issue of beauty as a criterion for classifying landforms among natural values. He took issue with aesthetic evaluation, because, as an old Slovenian proverb says, Vsake oči imajo svojega malarja (essentially, 'to each his own'; Erhartič 2012). Later he carried out an extensive survey on the beauty of landscape forms and determined that »*people are most attracted to landforms with a water element; one can speak about collective patterns of perceiving nature's beauty*« (Smrekar and Erhartič 2015, 123).

Erhartič's interest in the »beauty of nature« proceeded from his many years of planned work in (geographical) photography. His colleagues recall how precisely he planned his trips, which were often oriented toward learning about and documenting natural and especially geomorphological heritage. Thus it is not surprising that, due to his outstanding familiarity with various landscapes around the world and their natural and cultural characteristics, he was distinguished by exceptional knowledge and breadth, patience, and photographic talent. This is reflected in his photos, which grace many of the publications by the Anton Melik Geographical Institute of the Research Center of the Slovenian Academy of Sciences and Arts and beyond, and also in his travel lectures, in which he emphasized a comprehensive experience of the landscape, including with music. The Anton Melik Geographical Institute of the Research Center of the Slovenian Academy of Sciences and Arts holds nearly 218,000 of his »geographical« photos (Figure 2), which he took on his many trips to more than forty countries on five continents.

In the conclusions to his doctoral dissertation, he indicated what his next challenges would be: »*visitor education and interpretation of geomorphological heritage*« (Erhartič 2008). Soon afterwards, he was offered the opportunity to create an interpretation of the landscape along the Iška River in the Ljubljana Marsh Nature Park (Figure 5; Smrekar et al. 2013, 2014; see also Smrekar et al. 2016 in this special issue). He was aware that one of the key tasks is »*to enrich experience and ensure visitors' satisfaction*«, whereby he did not forget that it is necessary to inform people »*without significant negative impacts on the environment*« (Smrekar et al. 2014, 121, 123).

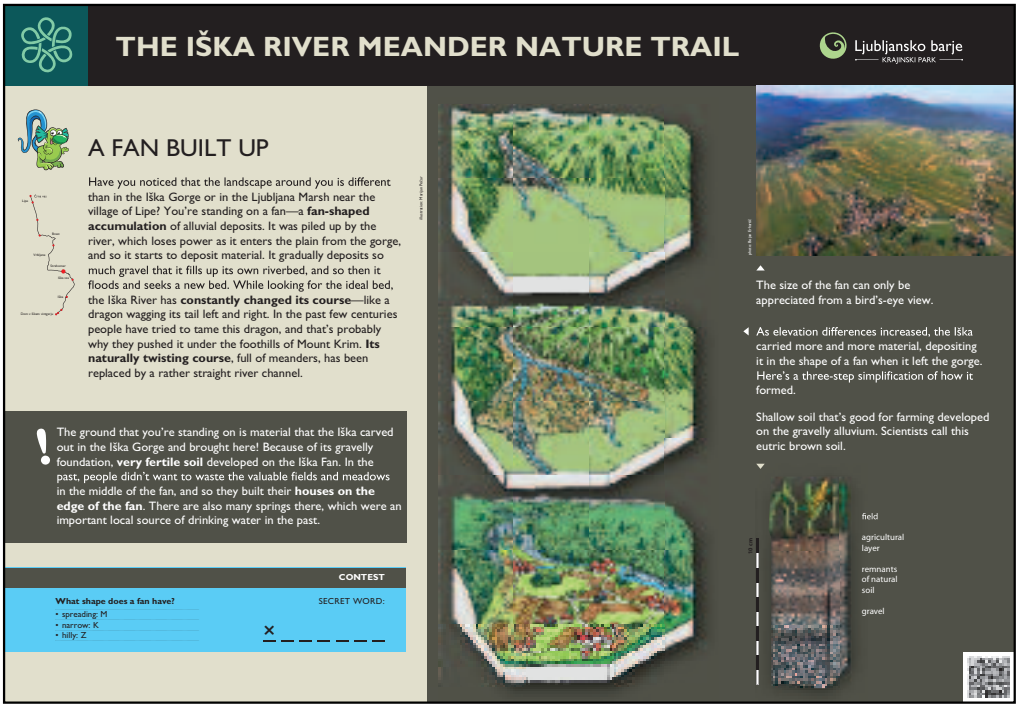

Figure 5: Interpretation of natural heritage on the nature trail along the Iška River: the example of a fan (Smrekar et al. 2013).

6 Conclusion

This volume of the journal *Acta geographica Slovenica* is dedicated to the geographer Bojan Erhartič (Figure 6). In just a few years at the beginning of the twenty-first century, Erhartič had a strong impact on Slovenian geography. His greatest contribution was to place it on the map of countries where geographers deal with geomorphological heritage. He drew attention to the fact that it is necessary to understand natural values at multiple levels, especially at the intrinsic level, which encompasses understanding their genesis and transformation through geomorphic processes. Through his work in photography, he emphasized the importance of cultural and aesthetic elements. He made a lasting contribution to the socioeconomic, educational, and functional aspects of geomorphological heritage. His contribution to environmental protection also cannot be overlooked. He specifically drew attention to the long-term significance of nature conservation: »*In the preservation of natural heritage it is essential to recognize that we are not protecting against nature, but against man, for man. We are preserving nature, which is in a state of dynamic equilibrium and gradual change. Man should not interfere in these processes and, if life and property are threatened, he should only guide them!*« (Erhartič and Jelenko 2010, 26). This thought was reflected not only in his research, but also in his private life.

Bojan Erhartič summed up his relationship to geography, protection of nature and the environment, and man's place in the landscape with the following thought (Smrekar et al. 2014, 119):

> »*An important mission of protecting the environment is also making it possible to experience the heritage that has been preserved. Protected areas are suitable for learning, education, recreation, and »soft« tourism. Visits to such areas should be planned, guided, and supervised, because the sensitivity of landscapes means that visits may disturb them, which is contrary to the primary goals of protecting and safeguarding unique and diverse landscapes.*«

MIHA PAVŠEK

Figure 6: Erhartič (foreground) had a sense of humor that endeared him to his colleagues.

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THE ROLE AND IMPORTANCE OF THE LANDSCAPE PARK UDIN BORŠT

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MIRKO KUNŠIČ

Northwest part of the Landscape park Udin Boršt with the settlemet Duplje.

The role and importance of the landscape park Udin Boršt

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ABSTRACT: Udin Boršt is an isolated conglomerate terrace in Gorenjska region, Slovenia. A number of surface karst features and caves developed here due to the predominance of carbonate gravel. It is one of the last contiguous areas of lowland forest in Gorenjska region, and a popular recreation location for the people living nearby. Due to its karst surface and the forest it offered shelter to the locals in turbulent times. Its role during the period when bandits (*rokovnjači*) was common and during the Second World War is still preserved in folk memory. Due to its natural and cultural heritage, the area was protected as a Memorial park in 1985, but the legislation has become outdated and needs to be amended and updated. This article presents new findings on the geomorphological and intangible cultural heritage that need to be incorporated in the amended legislation.

KEY WORDS: geography, conglomerate karst, isolated karst, eogenetic karst, shallow karst, geomorphological heritage, cultural heritage, landscape park, Udin Boršt

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1 Introduction

The Udin Boršt (Duke's forest) is an isolated conglomerate glacial terrace rising up to 50 m above the gravel plain Gorenjske Dobrave (Woodland of Upper Carniola) and measuring approximately 15 km^2. It is one of the last contiguous areas of lowland forest in Gorenjska region (Upper Carniola), which makes it increasingly popular among both locals and visitors.

A morphologically heterogeneous landscape developed due to the geological characteristics of the conglomerate rock (Grad and Ferjančič 1976; Žlebnik 1978). The wide range of landforms creates an area with a high degree of geodiversity. The assessment of the geodiversity of Udin Boršt was conducted by the methodological approach suggested by Bojan Erhartič to whom we dedicate this paper. Furthermore, the natural features turned Udin Boršt into an important shelter for locals during foreign invasions. In order to commemorate the importance of this area, especially during the Second World War, and its natural and cultural heritage, the Udin Boršt was protected as a Memorial park in 1985 (Odlok o razglasitvi … 1985).

This study focuses on the modern role of the Udin Boršt and whether it complies with the criteria and values based on which it was protected. Because the monument protection ordinance is outdated and must be redefined due to the newly established Municipality of Naklo, the importance of protecting the Udin Boršt is analysed from the viewpoint of new functions and findings.

2 Methods

The research included a detailed study of literature and legislation on nature and cultural protection, and a field inspection of natural and cultural heritage. In order to obtain numerical data on the Udin Boršt geomorphological heritage (Panizza 2001), a quantitative Swiss method (Reynard et al. 2007) was used to evaluate the landforms. This method is based on simplified evaluation criteria divided by importance, which renders the procedure more transparent and makes the results suitable for the academic, professional, and nature protection community (Erhartič 2010). The conglomerate karst of the Udin Boršt was treated as a homogenous geomorphological landscape unit, which was compared to all of Slovenia. The criteria used include (1) scientific value: assessment of rareness, representativeness, integrity, and paleogeographic value, and (2) additional values: assessment of ecological value (ecological impact and protected sites), aesthetic value (view points, and contrast), cultural value (religious importance, historical importance, artistic and literary importance, and geo-historical importance), and economic value (qualitative and quantitative). The assessment of additional values also included a planning value. A five-point scale was used for the evaluation; the scale was adapted in such a way that at the same time the results also show individual shares (100% being the highest theoretical score). Each criterion was ascribed a value between 0 (no value) and 100 (extremely high value) and the following scores: 0, 25, 50, 75, and 100.

The social and recreational role of the Udin Boršt was evaluated using a quantitative method; that is, two chronicles published by the local Cultural and tourism society Pod krivo jelko Duplje (hereinafter: CTS Pod Krivo jelko Duplje; *Pod Krivo jelko* means under the bent fir tree) (Kronika KTD Pod krivo jelko Duplje 1997–2009; Kronika KTD Pod krivo jelko Duplje 2009–2012) and the visitors' book (Vpisna knjiga 2012). Entries for the 2003–2012 were taken into account, and visits in 2012 were analysed in greater detail in order to determine the number of places and countries the visitors come from.

3 Geomorphological heritage of the conglomerate karst of Udin Boršt

During Quaternary the Sava river and its tributaries deposited large amounts of gravel and finer sediments in central Gorenjska region that formed the conglomerate rocks (Grad and Ferjančič 1976). From the genetic viewpoint, the conglomerate of Udin Boršt is in the stage of early diagenesis or eogenetic stage (Lipar and Ferk 2011; Ferk and Lipar 2012). The poorly cemented conglomerates initiate dynamic processes and fast development of the geomorphological system that results in a great number and variety of geomorphological features.

Surface and subsurface karst features developed in the western and central part of the Udin Boršt, and a fluvial geomorphological system developed in its eastern part. Dolines predominate among surface geomorphological karst features. They are usually up to 10 m deep and tens of meters in diameter. The largest

among them are 20 to 30 m deep, and can measure as much as 100 m in diameter. The dolines are filled with fine-grained sediments that are relatively flattened. Suffosion depressions are smaller than dolines. These are funnel-shaped holes in unconsolidated regolith or alogenic detritus covering the conglomerate that form when the sediments are washed into the underlying karstified bedrock. They are up to 5 m wide and 5 m deep. In some places, erosion gullies formed on the slopes of suffosion depressions. The water that occasionally runs through them sinks to the underground at the lowest point of the depressions. North of Strahinj a 500 m long blind valley is formed, stretching in the north-south direction. Its uppermost part begins with several steep gullies that join into an increasingly wider valley. In its lower part, the bottom of the blind valley expands into a 40 m wide plain enclosed by steep slopes. At the edge of the plain several ponors are formed through which the intermittent brook sinks into the karst underground. The water percolates through the voids in the conglomerate to the underground water table, whereby it dissolves the rock, widens the flow channels, and forms caves. Udin Boršt has an autogenic recharge entirely through precipitation water, and the water flows diffusely to numerous karst springs on the edges of the terrace. At some springs, pocket valleys (Lipar and Ferk 2015) formed in the upstream ends. The two longest ones are near Duplje, where the Dupeljščica River springs from Arneš Cave, and near Strahinj, where the Lebinica River springs from Velika Lebinca Cave.

4 Historical aspects

Except for the rare forts dating back to the Iron age and the defence posts from classical antiquity, there is no other evidence of this area being settled. The first villages were established around the twelfth and thirteenth centuries in the area where the forest meets the fertile plain (Fister 1970). This was also when people began clearing the forest that covered the area north of Kranj.

The Slovenian name *Udin Boršt* means 'Duke's forest' and the forest was most likely named after Archduke Karl V. (1564–1590), who controlled and managed it (Kranjc 2005). According to Kos (1960, 65), »a *boršt* is primarily the kind of forest that was excluded or banned from general use.« In the Middle Ages, the forest was only accessible to the castle lords, who used it for hunting. Others could only take wood from it if the duke so allowed. Logging, gathering leaf litter, and picking berries was also strictly limited. Comparing the land use on the Josephinian military map from the second half of the eighteenth century with present-day land use (Figure 1) shows that the area of the Udin Boršt has hardly changed; the only exception is the part in the extreme south that is crossed by the freeway section from Naklo to Kranj. However, the composition of trees has changed significantly: the former oak and hornbeam forest have been replaced by pine (*Pinus silvestris*) and spruce (*Picea abies*) (Mulec and Pipan 2005).

The Udin Boršt played an important protective role in the lives of the locals; its caves in particular offered them shelter several times. Valvasor (1689) mentions a large cave in Duplje (most likely Arneš Cave) where the locals hid from the Ottomans and other attackers. In this regard, Vrhovnik (1885) wrote that even at the end of the nineteenth century the Boltar farm in Duplje still had an iron gate that was believed to have been used to close the entrance to Arneš Cave. Caves were also important hiding places from 1825 to 1853, when bandits (*rokovnjači*) lived in the Udin Boršt. These were young men that did not want to serve in the military and preferred to hide in the forest. Sometimes they were also joined by women. They gathered and got married by the Bent Fir tree (*pri Krivi jelki*), where they also held fests called *finfranje* (Bohinjec 1998). During the Second World War in Yugoslavia, the Udin Boršt was one of the centres of the partisan movement in Gorenjska Region.

5 Social and recreational role

The social and recreational role of the Udin Boršt is becoming increasingly important. Several tourism and cultural societies are active in this area, which also include the Udin Boršt in their programs. The CTS Pod krivo jelko Duplje is based in the settlement Duplje. Because the original Bent fir tree where bandits

Figure 1: The Udin Boršt and its surrounding settlements on the Josephinian military map from the second half of the eighteenth century and in the present. ►

Viri: (levo) Rajšp 1998, (desno) GURS 2011.
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used to gather was felled by snow more than a century ago, the two oldest Duplje residents planted a substitute one in 1998 at the society's initiative (Šmid Hribar 2009). The society holds an annual torch-lit night walk on the first Saturday in January. Participants gather by the fir, where they are greeted by boiled potatoes, lard, tea, and mulled wine. The society also holds a bandits' fest in May, which is also when a »Bandits' run« takes place. The »Duplje orienteering route« and the »Bent fir tree loop trail« in the Udin Boršt were also set up as part of the society's activities (Kuhar and Šmid 2002); in 2012, this loop grew into the »Conglomerate karst land hiking trail« (Pešpot … 2013).

An important role is also played by the Udin Boršt conservation society, which was established in 2007 to prevent the construction of a regional waste-processing centre in Tenetiše. Members of the Kokrica tourism society set up the »Mammoth land trail«, part of which runs past the place called Little mills (*Mlinčki*) in the southern part of the Udin Boršt, where toy mills are set up along the creek. A walk along the »Three bells trail« has been held in Sebenje every Friday since 2012. The Centre for sustainable rural development Kranj is also becoming an important stakeholder, contributing to the area's development through various projects. In 2012, it set up an »bandit camp with bark tents« near the Bent fir tree, where people can stay the night.

In addition to the locals, people from Kranj and other places in Gorenjska region often visit the Udin Boršt. There are many organizations and active individuals operating in this area, but so far they are fairly unconnected.

6 Results and discussion: the potential of the Udin Boršt' natural and cultural heritage

The formal protection that was applied in 1985 points to the unique relationship that the locals had to this area in the past, without which it is likely that the forest would have been cleared significantly more and the area degraded more. However, despite being protected, this area has not received a manager or a management plan in these twenty-eight years. The Udin Boršt memorial park is included in the following two heritage registers (Figure 2):

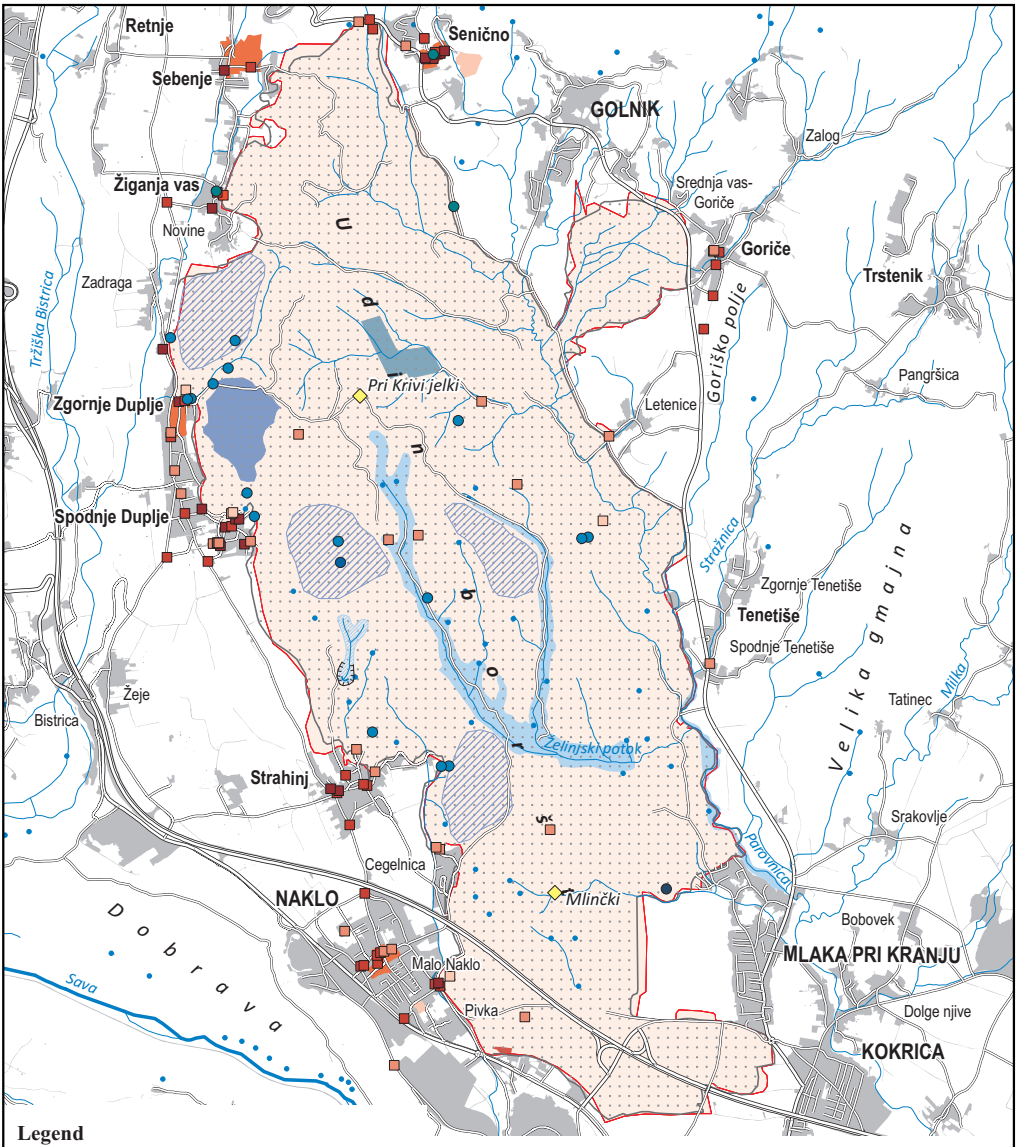
- In line with the cultural protection legislation, it is inscribed in the Register of immovable cultural heritage (Register nepremične kulturne … 2014) as a cultural landscape that has the status of a cultural monument of local importance;
- In accordance with nature protection legislation, it belongs to landscape parks (Širša zavarovana območja 2014), and at the same time the isolated karst terrace of the Udin Boršt is inscribed in the Register of natural values as a »surface geomorphological value, subsurface geomorphological value, hydrological value, and geological value of national importance« (Pravilnik o določitvi … 2004).

The 1985 protection ordinance is outdated. In 1994, the new municipality of Naklo was established in this area, but an additional reason for amending the ordinance is also that, despite the fact that The institute of the Republic of Slovenia for nature conservation classifies Udin Boršt under landscape parks, it is currently formally protected only as a memorial park. The new ordinance will have to incorporate new findings in the field of geomorphology and findings connected with the increasingly important social and recreational role of the area, and its intangible heritage, clearly highlighting the purposes and goals of the protection.

Because there is a clear interconnection between natural and cultural heritage in this area, it is recommended that the Udin Boršt be safeguarded as part of the *joint protection of monuments and nature* in line with Article 15 of the Cultural heritage protection act (2008). Article 60 of this same act requires preparation of a detailed management plan. The new ordinance will have to define the activities allowed in this area, the manager, and his or her responsibilities and tasks, and highlight individual smaller natural and cultural heritage units. The premises of the management plan could be based on the findings of this article. Figure 2 shows the current natural and cultural heritage of the Udin Boršt.

The exceptional opportunity to establish an outdoor laboratory is among the most important scientific prospects for this area. Thanks to the many years of protection, the area's living and non-living nature

Figure 2: Natural and cultural heritage of the Udin Boršt. ►



Legend

Natural heritage

- Protected landscape area
- Hidrological heritage/ Proposed Hidrological heritage
- Geomorphological heritage/ Proposed Geomorphological heritage
- Heritage ecosystems
- Heritage trees
- Geomorphological, Geological heritage
- Subterranean geomorphological heritage
- Cave

Cultural heritage

- Cultural landscape
- Archeological heritage
- Settlement heritage
- Other
- Archeological heritage
- Memorial heritage
- Garden arhitectural heritage
- Religious arhitectural heritage
- Religious-secular arhitectural heritage

- Cliff
- Geathering place
- Ponor
- Spring

0 0,5 1 km

Authors of content: Mateja Ferk, Mateja Šmid Hribar; Author of the map: Manca Volk Bahun
Source: Register of immovable cultural heritage (Rkd), Ministry for culture 2013 (on 6.7.2013), Register of natural values Slovenian Environment Agency 2012.
Map source: GURS 2013; © Anton Melik Geographical Institute ZRC SAZU 2013

has been preserved well, and at the same time its easy accessibility makes it possible to carry out research and familiarize interested groups with environmental processes in the Udin Boršt. The most important factors for effective protection include education, raising awareness, and participation of locals and visitors in these activities (Polajnar 2008; Smrekar et al. 2011).

6.1 Natural and geomorphological heritage of the Udin Boršt

Due to its conglomerate bedrock, a combination of karst and fluvial geomorphological system, and diverse terrain with specific vegetation, the Udin Boršt is an area with a high degree of geodiversity and an important part of geomorphological heritage (Erhartič 2010). The environmental protection significance is increased by the homogeneity of the spatial unit and the density and diversity of its geomorphological features; in the case of Udin Boršt, it would make sense to connect and protect it as a geopark. The karst of Udin Boršt can be defined several ways based on various criteria: as conglomerate or isolated karst (Habič 1981), shallow karst (Žlebnik 1978), or eogenetic karst (Lipar and Ferk 2011; Ferk and Lipar 2012).

Table 1: Quantitative evaluation of the Udin Boršt' geomorphological heritage (Erhartič 2010).

Criterion			Score	Average	Average
Scientific value		Assessment of rareness	75	75	75
		Representativeness	50		
		Integrity	75		
		Paleogeographic value	100		
Additional values	Assessment of ecological value	Ecological impact	75	75	58.75
		Protected sites	75		
	Esthetic value	View points	50	37.5	
		Contrast	25		
	Cultural value	Religious importance	0	43.75	
		Historical importance	75		
		Artistic, literary importance	50		
		Geohistorical importance	50		
	Economic value	Qualitative	50	37.5	
		Quantitative	25		
	Planning value	Accessibility	100	100	
Total average			58.33	61.46	66.88

The Udin Boršt has a high average scientific value (75%) because (1) conglomerate karst is rare in Slovenia, especially in the eogenetic stage of diagenesis; (2) it has many features comparable to classic karst in terms of size; (3) the slightly elevated conglomerate terrace can easily be distinguished from the surrounding area, representing a distinct landscape unit; and (4) it is a richly layered and excellently preserved assembly of information on the palaeoenvironment. The high average ecological value (75%) is the result of the many years of protection and the unsuitability of the karst land for agricultural use, which is why the lowland forest with diverse undergrowth has been preserved. The low average esthetic value (37.5%) is due to forest vegetation, which makes it more difficult to identify the landforms, and the relatively level landscape that reduces visual diversity. The average cultural value (43.75%) reflects the many centuries of people's connection with the forest, which was often used as a shelter in times of foreign invasions, and the importance of the Udin Boršt' conglomerate karst, based on which eogenetic karst features in continental sediments were defined for the first time (Lipar and Ferk 2011). The low average economic value (37.5%) results from the fact that the Udin Boršt s' tourism and scientific potential has been underexploited. Accessibility was given the highest score (100%) because there is a freeway interchange nearby, and the woods are crisscrossed by roads and contain many well-marked hiking trails. The categories evaluated differ from one another and the authors are aware that they cannot be put on the same level; nonetheless, the sum of all the average scores (scientific and added value) was used to calculate a theoretical total score of the Udin Boršt' geomorphological heritage (67%) in order to be able to compare it with the scores of other geomorphological heritage sites in the future.

6.2 Cultural heritage

In terms of cultural heritage, the Udin Boršt has already been recognized as a cultural landscape in the past; in addition, the Udin Boršt memorial park contains several archaeological sites and examples of memorial heritage. Architectural and settlement heritage can be found on its edges in the surrounding villages that are inseparably connected with the forest. This is also reflected in rich oral tradition, which is part of intangible heritage. In addition, for several years now the Udin Boršt has been a popular venue for various events (Table 2). In recent years, the Little mills and Bent fir tree meeting points have become the main places for socializing (Figure 3).

Table 2: Events held in the Udin Boršt.

Event	Location	Date	Organizer
The Udin Boršt friendship and memory walk (from Kokrica)	Kapnik monument	April 27th (since 1986)	Kokrica Sports Society
Bandits' fest (*finfranje*)	Bent fir tree	Third Saturday in May (since 1998)	CTS Pod Krivo jelko Duplje
Torch-lit walk	From various settlements in the area to the Bent Fir tree	First Saturday in January (since 2002)	CTS Pod Krivo jelko Duplje
Various walks during Lifelong Learning Week	Various locations in the Udin Boršt	May (since 2004)	CTS Pod Krivo jelko Duplje
Mammoth land walk	From Kokrica past the Little Mills area	September (since 2008)	Kokrica Tourism Society
The Udin Boršt Friendship and memory walk (from Križe)	Kapnik monument	April 27th (since 2009)	Tržič independence war veterans organization, Slovenian partisan veterans league, Tržič municipal Slovenian officers association
Three bells walk	Along the forest trails between Žiganja Vas, Novaki, and Sebenje	Once a year for large groups, otherwise every Friday at 6:00 pm, or 5:00 pm in winter (since 2012)	Sebenje local community and Križe primary school

MATEJA ŠMID HRIBAR

Figure 3: The Bent Fir tree meeting point in the Udin boršt (left) and decorated Bent Fir tree.

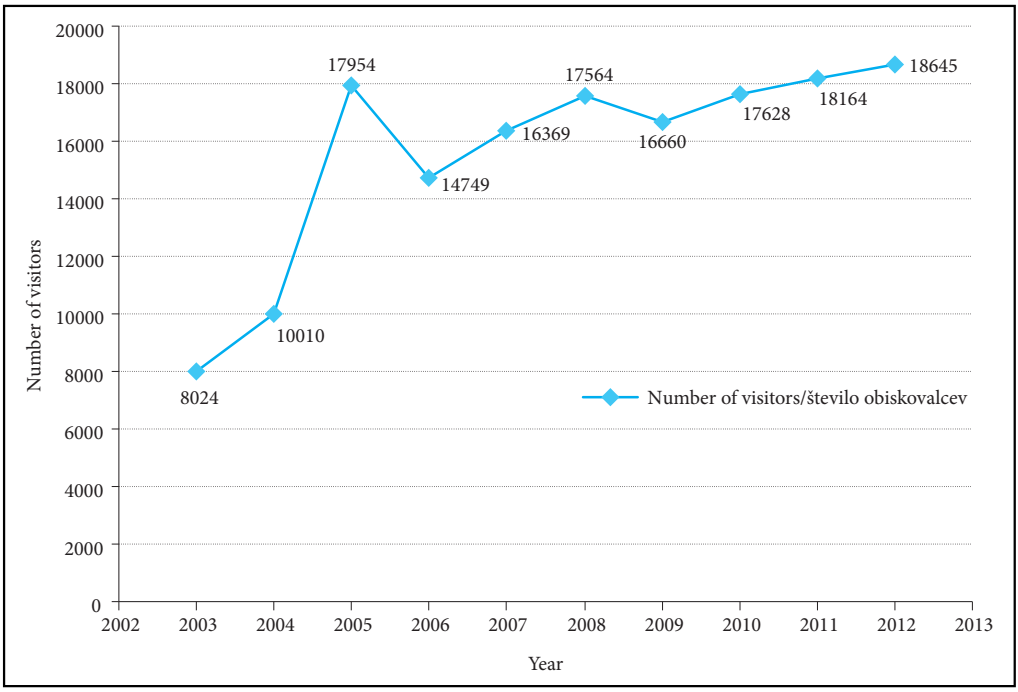


Figure 4: Number of visitors from 2003 to 2012 entered in the Bent fir tree visitors' book (source: Kronika KTD Pod Krivo jelko Duplje 1997–2009; Kronika KTD Pod Krivo jelko Duplje 2009–2012).

Since 2003, visitors have been entering their names in the visitors' book, kept inside a box in the shelter at the Bent Fir tree. Their number has been growing constantly since 2003 (the only exception was 2006; Figure 4). According to the visitors' book (2012), 18,645 people visited the area in 2012; they came from ninety-one places, not only in Slovenia, but also Croatia, Bosnia and Herzegovina, Serbia, Italy, Switzerland, Germany, the Netherlands, Belgium, Canada, and Nicaragua (i.e., ten countries outside Slovenia). On January 1st, 2012 alone, 145 people from thirteen different places visited the Bent fir tree area. Some even celebrate New year's eve there (Vpisna knjiga 2012). Students from the nearby primary schools also visit the Udin Boršt several times a year. They are greeted by »bandits« in the clearing in front of the Bent fir tree.

According to the findings and the UNESCO cultural and natural heritage evaluation criteria (Operational guidelines … 2013; The Asia … 1995), it can be concluded that the area has local significance because of:

- Its unique cultural tradition (the 1998 reprint of the story *Pod krivo jelko* [Under the bent fir tree], which revived interest in the bandits);
- Its direct connection with events or living tradition (oral tradition passed on from one generation to another by people in the nearby villages indirectly influenced the establishment of the CTS Pod Krivo jelko Duplje; the clearing with the new Bent fir tree is visited by more than 18,000 people a year; building the bandit bark tents in the forest; Second World War memorials); and
- The important testimony of the Earth's history and geological processes with regard to the development of landforms (eogenetic karst).

No less important to the wider society is the social and recreational role of the largest contiguous lowland forest in Gorenjska region, which is a popular area for socializing and relaxing.

7 Conclusion

The Udin Boršt combines aspects of natural and cultural heritage. The evaluation of the Udin Boršt' geomorphological heritage evaluated according to geomorphosite assesment proposed by Erhartič (2010) shows

that this area has high scientific and ecological value. The most important but still insufficiently used prospective of this area include its scientific and research potential, with an exceptional opportunity to establish an outdoor laboratory. Direct exchange of researchers' and locals' experience could have an important impact on the development of the surrounding settlements. Aspects of intangible cultural heritage are also strongly present in the Udin Boršt. According to the findings described and the nature- and cultural protection legislation, the outdated ordinance on protecting the Udin Boršt will have to be amended and the area should be safeguarded as part of joint protection of monuments and nature.

Due to its significant geomorphological heritage, the area could also be declared a geopark in order to appropriately protect its karst landscape and forest and to use it for educational purposes. Its future management will have to take into account and connect all the roles described for the Udin Boršt. Especially the different dynamics of natural and man-made processes (Urbanc 2009) and principles within the landscape should be considered. Various stakeholders distributed across three municipalities will have to be persuaded to act together. In order to activate the development potential, effective management needs to be put in place, in which cooperation between local stakeholders and connecting various heritage and other values into a comprehensive range of tourism products is of key importance (Šmid Hribar and Ledinek Lozej 2013).

Finally, future land-use planning in this area will also have to bear in mind the recreational and social role of the forest, which is also indicated by the number of visitors between 2003 and 2012.

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ASPECTS OF GEODIVERSITY OF PALAEOZOIC LIMESTONES IN THE BLACK MOUNTAINS OF SOUTHERN FRANCE

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The sun rising on the Cambrian limestone massif of Dent de Saint Jean, Brusque, Aveyron.

Aspects of geodiversity of Palaeozoic limestones in the Black Mountains of southern France

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ABSTRACT: In the southern Massif Central (France), where the scenery resembles that of Middle-earth, the geodiversity of carbonate formations (limestones and dolomites), mainly of Paleozoic age, can be observed in the nested scales of the geotopes, geofacies, and geosystems.

KEYWORDS: geography, geology, geomorphology, geodiversity, Black Mountains (*Montagne Noire*), Tolkien, France

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1 Introduction

In one of the best-known works of the twentieth century literature, *The Lord of the Rings*, the action of each of the six books of this long story unfolds through the stunning landscapes of Middle-earth, which are underpinned by great geodiversity (Gray 2013). One of the most important sites of Tolkien's world, Rivendell, Imladris, the »last homely house east of the sea« (Rivendell illustration … 2014), is located in a hidden trough alongside a narrow valley flanked by high limestone walls dotted with waterfalls, a landform feature whose model is clearly the Lauterbrunnen Valley, as the writer himself stated in a letter to his son Michael (Tolkien 1981, 306). As noted by Marie Barnfield (1996), »*not only the similarity between Tolkien's painting of Rivendell and the Lauterbrunnen Valley, but also: i) that Tolkien had visited Lauterbrunnen in 1911, ii) that he had come down into the valley by an unusual route that exactly mirrors the rather perverse route his characters insist on taking into Rivendell, iii) that Lauterbrunnen essentially means the same as Greyflood & Hoarwell, and iv) that Tolkien mirrored the sound of the name Lauterbrunnen itself in the English and Elvish names for the Rivendell river: i.e. Loudwater & Bruinen.*« All over the Alps and Jura Mountains (Figure 1), more or less similar landforms associated with outcrops of limestone rocks are to be found, such as the Arve Valley between Sallanches and Cluses in the Savoy Alps, the Mesdì Valley (Ital. *Val de Mesdì*) in the Dolomites, and the blind valley of Baume-les-Messieurs in the Jura Mountains, which inspired the illustrator John Howe (2014).

This essay is a tribute to our late distinguished colleague Bojan Erhartič. We had the pleasure of meeting twice in Paris, first at the »Geomorphosites 2009« symposium with several papers on geomorphosites in Slovenia (as first author) on natural heritage and on karst geotourism, and second in August 2013 at the Eighth International Conference on geomorphology, during which Bojan participated on the field-trip to the Seine Valley (Figure 2). Because he was from Slovenia, Bojan had a keen interest in the study of karst systems and the magnificence of limestone landscapes in the Alps and the Jura Mountains.

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Figure 1: Alternative possible landscapes for Tolkien's Rivendell in Middle-earth, from top left, clockwise: 1) the Lauterbrunnen Valley nearly a century ago by Giorgio Sommer (Lauterbrunnen . . . 2014); 2) the Arve Valley north of Sallanches, 2008; 3) the blind valley of Baume-les-Messieurs, 2014; 4) the Mesdì Valley, 2009).

Figure 2: Bojan Erhartič in Giverny, August 29th, 2013. In the group photo, Bojan stands in the last row, second from right (blue T-shirt), near Emmanuel Reynard.

The following pages are dedicated to the memory of Bojan in two parts. The first part is devoted to some general ideas (such as those that Bilbo Baggins, had he been a geomorphologist, would have had in Elrond's house after a long journey), and the second part deals with a bit of geology, landscape features, and karst surficial landforms of various Paleozoic limestones in the Black Mountains (*Montagne Noire*) of southern France.

2 The Black Mountains: »There and back again«

In metropolitan France, the southern Massif Central is the contrasted area that lies between Toulouse in the west and Montpellier southward, straddling the two administrative regions of Midi-Pyrénées and Languedoc-Roussillon, to be merged as one of the fourteen new super-regions after the territorial reform law passed by the National Assembly in July 2014. Regarding landform development, the main property of the country is that of a large plateau, itself part of a larger unit formerly known as Franc's Massif Central (Baulig 1928; Martonne 1942), where most of the rivers flow through deeply entrenched valleys, sometimes taking the appearance of gorges like the Tarn both upstream from Millau and immediately west of the city, where the stunning viaduct designed by the architect Norman Foster stands. Sometimes a hilly landscape with a higher elevation locally looks out over the plateau, as in the Palanges Massif and Lévezou Mountains (Fr. *Monts du Lévezou*) west of Millau (Aveyron), in the Lacaune Mountains (Fr. *Monts de Lacaune*) east of Castres (Tarn), in the Espinouse Mountains northwest of Béziers (Hérault) or in the Black Mountains north of Carcassonne (Aude). In fact, the highest summits are, the well-named Montgrand (literally, 'big mountain', 1,269 m) south of Lacaune (at 1,270 m, Mount Rascas, Fr. *Puech de Rascas*) is a manmade platform built for military use nearby), followed by Nore Peak (Fr. *Pic de Nore*, 1,211 m), an asymmetric mid-size mountain with round features between Castres and Carcassonne. In the eastern part of the Lacaune Mountains south of Sylvanès Abbey, a particularly picturesque landscape of ridges and valleys despite the presence of increasingly more wind turbines impacting the scenery, a few summits stand near 1,100 meters such as Merdelou (1,110 m) and Croix de Marcou (1,093 m).

The geologists Dufrénoy and Élie de Beaumont (1841), who created the first geological map of France, extended the compound name of the Black Mountains (*Montagne Noire*) to all the pre-Jurassic areas of the southern Massif Central, including granites, migmatized gneiss and mica-schist, as well as sedimentary formations of Lower Palaeozoic age and low metamorphic grade. This is explained by Jules Bergeron (1887), the creator of the first detailed 1 : 80,000 geological map:

Le massif montagneux qui s'étend de Castelnaudary à Lodève porte les différents noms de montagne Noire, d'Espinouse, de Saumail et de Caroux; mais il présente, au point de vue de sa constitution géologique, une unité telle qu'on ne peut y faire les distinctions admises en géographie, et l'on est en droit de le désigner tout entier sous le nom de Montagne Noire, qui est celui de la plus grande chaîne« (The mountain range that extends from Castelnaudary to Lodève bears the various names of the Black Mountains, Espinouse Mountains, Saumail Mountains, and Caroux Mountains, but from the point of view of its geological formation it represents a unit such that we cannot make distinctions on a geographical basis, and it is appropriate to designate all of it as the Black Mountains, which is its largest chain.)

Despite the reservations expressed by the geomorphologist Henri Baulig (Beckinsale and Chorley 1991; Derruau 1999), and that geographers disagree with the excessive extension geologists give the name of the Black Mountains when they apply it to the entire southwest part of the Massif Central, including the Agout Plateau, the Lacaune Mountains, and the Southern Segala (Baulig 1928), this use has persisted to today (Thoral 1935; Gèze 1949; Arthaud 1970; Faure *et al.* 2009). Therefore, the term Black Mountains is used in a broad sense at the regional scale for a geological massif comprised of an Axial Zone sandwiched between the Northern Side and the Southern Side (Figure 3), and in a narrow sense the Black Mountains is the term used at the local scale for the geographical tract of land that overlooks the Thoré Valley in the vicinity of Mazamet (Figure 4).

With regard to the geological literature, the publication of the Castres sheet in 2013 completed the publication of the detailed 1 : 50,000 geological map, which began in the early 1970s, and which is summarized by the 1 : 250,000 Montpellier sheet (Berger et al. 2001; Alabouvette et al. 2003). Concerning the pre-Permian basement, Demange (1975, 1998, 1999) sought to find the model proposed in the Eastern Pyrenees by Fonteilles and Guitard (1977) in the Black Mountains. However, the Ordovician age (Roger et al. 2004; Cocherie et al. 2005) of orthogneiss of the Axial Zone has since invalidated the hypothesis of several »Precambrian orthogneissic cores« involved in thrust nappes of Penninic style (Laumonier et al. 2004; Charles et al. 2009; Roger et al. 2015). Consequently, recent works (e.g., Faure et al. 2009, 2010) prefer to go back to former structural maps such as those published by François Arthaud (1970) or even by Bernard Gèze (1949).

With regard to the geomorphological literature, since the pioneering essay by Abbé Jean-Louis Giraud-Soulavie in 1781 (Baulig 1928; Chorley et al. 1964), numerous works concerning the southern Massif Central have been devoted to the development of its landforms, with special emphasis on the strong contrast between remnants of paleoplains in the sense of Ollier (1991) and deeply incised valleys (Giusti 2002), as exemplified by the emblematic Espinouse–Caroux Plateau overlooking the Orb–Jaur Valley (Figure 5). Obviously, the explanation of landforms such as paleoplains deals with long-term geomorphology; that is, »the study of landforms that are of mostly pre-Quaternary, Cenozoic, Mesozoic or even Palaeozoic age, … with the lowering of a land surface to the base level (mostly sea level), leaving a new land surface« (Ebert 2009). There is a long history of long-term geomorphological studies in the southern Massif Central, which, on the one hand, offers any geoscientist (geographer, geologist, or geomorphologist) a large amount of significant data and observations but, on the other hand, adds to the difficulty because the proposed interpretations are not of equivalent value and often contradict one another. Moreover, for works published before 1980, there is also the difficulty of correspondence between current science and the former scientific framework. To take just one example, the definitions of the Miocene, Pliocene, and Quaternary have changed substantially since Baulig's thesis in 1928 about the effects of Neogene eustatic variations throughout the Mediterranean basin (Beckinsale and Chorley 1991; Klein 1999), and so any citation of older publications have to be carefully contextualized. However, any work, regardless of the date of publication, refers to local observations (paleontological sites, geological outcrops, sections of soils, and geomorphological point of views) that may still have some value as long as they have been carefully checked (including in the field, if this is even possible) and interpreted according to scientific criteria and standards currently in use. However, another point must be now emphasized, which is the scope of the conclusions in relation to the size of the area studied. The most frequent situation is that of local studies attempting to generalize their findings to the southern Massif Central as a whole. This would be justified if the bedrock (solid) were of homogeneous composition and structure, which is not the case at all. This approach systematically leads to inconsistencies because local results are difficult to generalize to all of the southern Massif Central. Even a careful study such as the one by Ambert (1994), focusing on a transect from Millau (Causses, Aveyron) in the north to Montpellier (Bas-Languedoc, Hérault) in the south, leads to conclusions that are not really convincing at the regional scale. Incidentally, over-specialization is another limitation; for example, when karst specialists consider it unnecessary to study the nearby crystalline massifs, or, conversely, when bedrock specialists set aside the Causses geomorphology. However, at a larger regional scale, both morphostructural units function as open systems and sub-systems involved in a common history they share geomorphologically speaking. This is precisely what makes the works by Baulig (1928) and Le Griel (1988) interesting: these two major works, sixty years apart, integrated the regional scale into an overall analysis of the Massif Central and its neighboring regions (Giusti 2002, 2012).

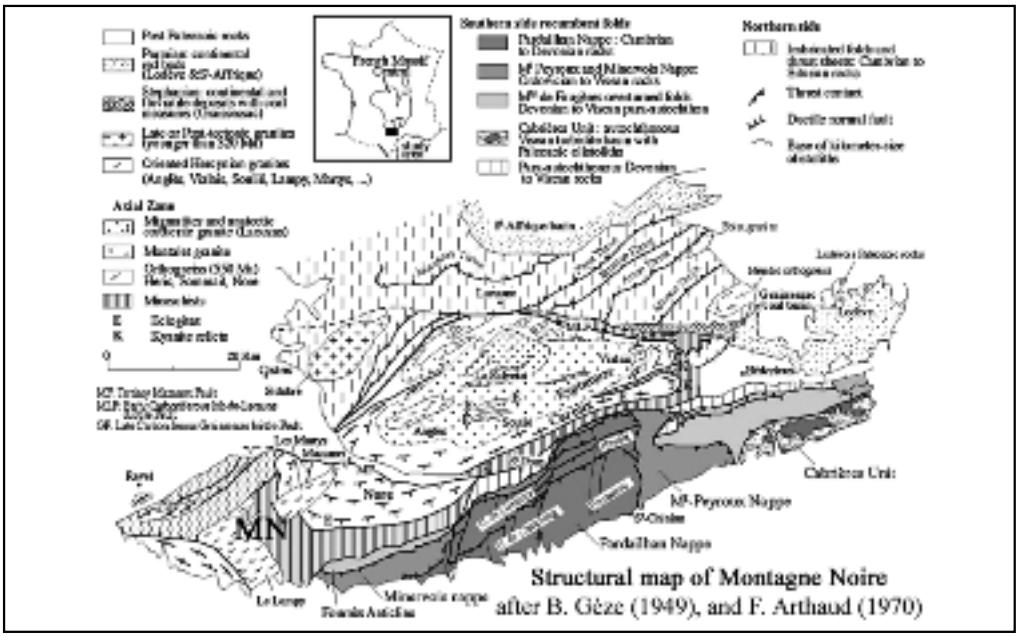

Figure 3: The Black Mountains in the broad sense as a geological massif (Faure et al. 2010: 656), modified to show the emplacement of the Black Mountains in Figure 4.

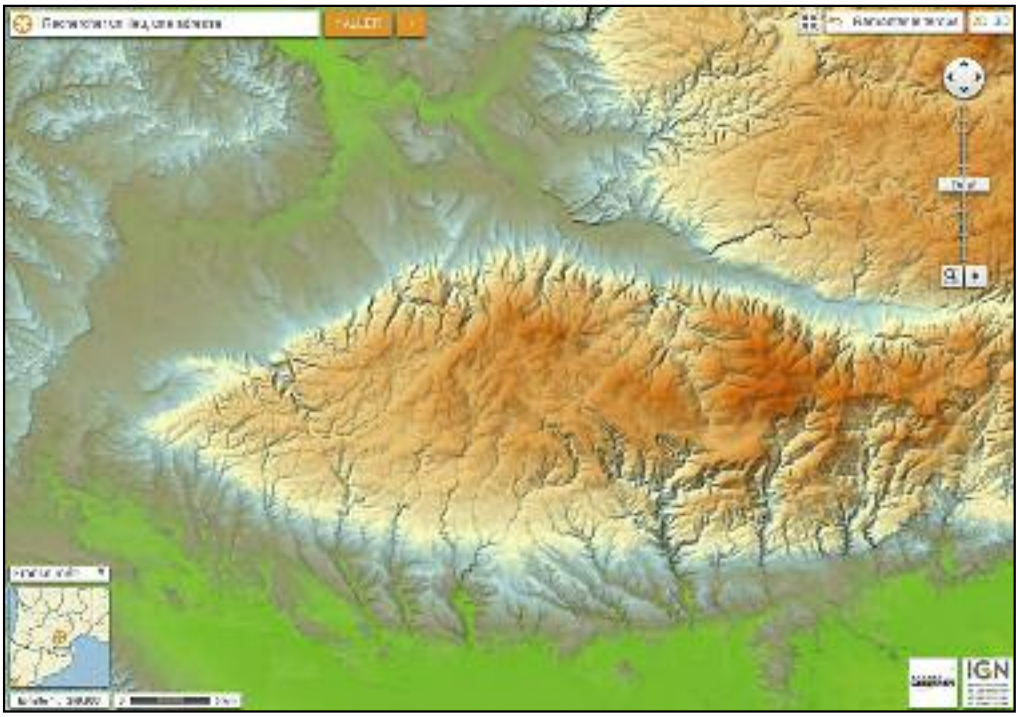

Figure 4: The Black Mountains in the narrow sense as a geographical massif (DEM from IGN, Géoportail . . . 2014).

3 Palaeozoic limestones in the Black Mountains: from outcrop to landscape, extensive geodiversity

In the impressive karst study *Grottes et Karsts de France* (Caves and Karst in France, Audra 2010), thirteen references are devoted to the karst phenomena and landscapes of the garrigues, Grands Causses Plateaus, and Black Mountains, with an interesting text about karst systems of the Minervois (Bès 2010) in the south-west part of the Southern Side (Figure 3). Unfortunately, nothing is said about the geo(morpho)logy of other calcareous outcrops of the mountains of Pardailhan, Faugères, or Cabrières (also on the Southern Side) or, moreover, about the small limestone plateaus (Fr. *causses*) linked to the large outcrops of Cambrian limestones on the Northern Side of the Black Mountains, mainly in the areas of Marcou and Mélagues (Aveyron), or in Dourgne and Sorèze near Revel (Tarn; e.g., Gazelle 1979; Favory and Gazelle 1982). In the Black Mountains considered as a geological massif (Figure 3), carbonate sedimentary rocks such as limestones or dolomites are well represented in the lower part of the Cambrian system, in all of the Devonian system, and in places in the Lower Carboniferous sub-system (Tournaisian). It must be pointed out that Carboniferous marine sedimentary deposits of the »Klippen of Cabrières« unit are known of many geologists worldwide due to the presence of a Global Boundary Stratotype Section and Point (GSSP) located at the »La Serre« section, where the base of the Carboniferous System, Mississippian Sub-System, and Tournaisian Stage are defined (Gray 2013; GSSP for Tournaisian … 2014). Two other GSSPs are located nearby: the Coumiac Quarry (Figure 6), the base of the Famennian Stage (GSSP for Famennian … 2014) and the Mount Suque Pass (Fr. *Col du Puech de la Suque*), the base of the Frasnian Stage and Upper Devonian Sub-System (GSSP for Frasnian … 2014).

The second edition of Gray's textbook (2013) proposes a new and more comprehensive definition of »geodiversity« as »the natural range (diversity) of geological (rocks, minerals, fossils), geomorphological (landforms, topography, physical processes), soil and hydrological features. It includes their assemblages,

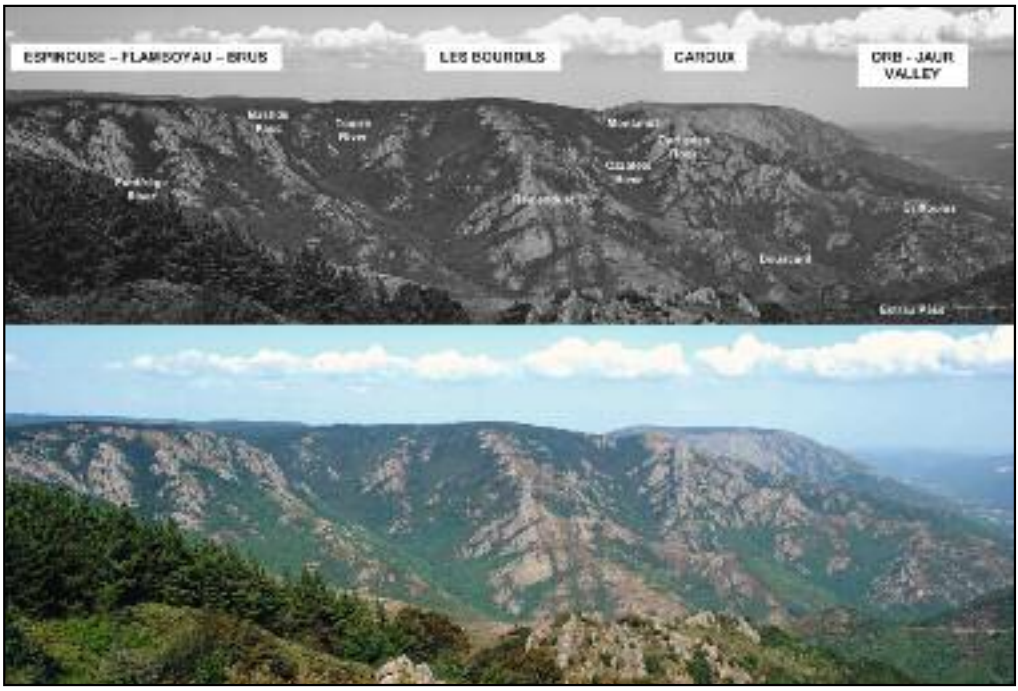

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Figure 5: The Espinouse–Caroux Plateau seen from Somail, looking eastward, 2009. Note the contrast between the faint sub-horizontal relief of the highland plateau and the strong sub-vertical southward dip of the Axial Zone gneisses (as exemplified in Ramandure, Montahut, and the Ourliades Rocks).

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Figure 6: The Upper Coumiac Quarry, near Cessenon-sur-Orb (Hérault), 2006. Pelagic calcilutites, mostly red tinted and well-bedded. The GSSP between the Frasnian and Famennian Stages (Devonian) is adjacent to the southeastern border of the quarry that was mined for a red nodular limestone exported all over the world (e.g., for the White House in Washington, or the French tourism office (Fr. *Maison de la France*) in Rio de Janeiro). This series corresponds to the Famennian Biological Crisis responsible for one of the most severe mass extinctions in Earth's history.

structures, systems and contributions to landscape.« The second part of this helpful definition confirms the belief that it is appropriate to use the nested concepts of geotope, geofacies, and geosystem as defined nearly half a century ago by the geographer Toulouse Bertrand (1968), which can easily be applied to geomorphological objects and processes that affect them (Giusti et al. 2010; Giusti et al. 2013).

2.1 At the scale of a single outcrop: the geotope

Of course, it would be quite easy to start this section with some famous examples of quarries of ornamental stones, such as those of Caunes-Minervois north of Carcassonne, which provided the red marble of Languedoc used for the Grand Trianon (or »Marble Trianon«) in Versailles (Gèze 1979; Lorenz and Féraud 2004), or the Marbres de France quarries near Saint-Pons-de-Thomières (Marbres … 2014). However, it is more interesting here to mention three outcrops of rather small extension, but that are interesting pieces of great significance though still poorly connected (at least two of them) into the geological jigsaw puzzle of the Black Mountains as part of the patchwork of the Variscan belt (Faure et al. 2009, 2010).

2.1.1 The diverse values of the Le Bessou geotope

From Saint-Gervais-sur-Mare (Hérault), Road D 922 rises towards Lacaune (Tarn), crossing the pass at La Croix de Mounis (808 m). In the climb, about 1.5 km past Le Péras near the locality of Le Bessou, the section of the road exhibits a coarse conglomeratic outcrop of Upper Carboniferous age (Stephanian, h5 on the 1 : 50,000 geological map) that lies unconformably on a light grey massive dolostone formation of Lower Cambrian age (k2 on the 1 : 50,000 geological map), formerly known as »Calcaires à Archéocyathes« (Figure 7,

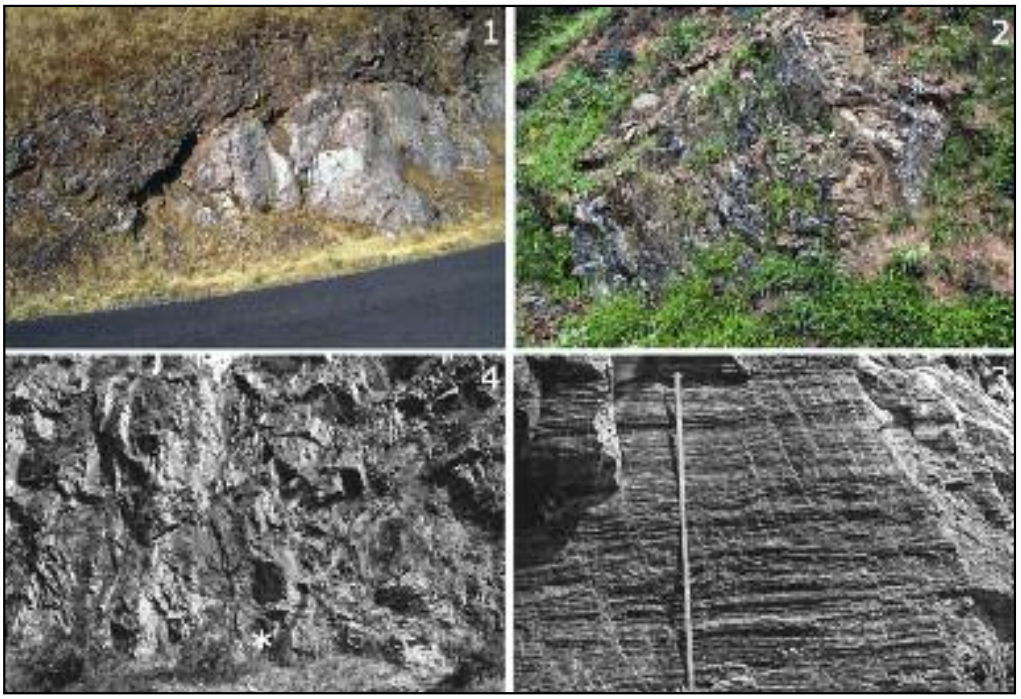

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Figure 7: Some interesting geotopes in the Black Mountains. From top left, clockwise: 1) Stephanian conglomerates of the Graissessac Basin lying unconformably on the Lower Cambrian dolostones of the Mélagues Unit near Le Bessou, west of Saint-Gervais-sur-Mare (Hérault), 2003; 2) Silurian Orthoceras limestones of the Murasson Unit near Mas de Barthès, southwest of Camarès (Aveyron), 2011; 3–4) Dolomite (Proterozoic? Cambrian? Devonian?) of the eastern Axial Zone near La Billière, north of Lamalou-les-Bains (Hérault), 1981, partial view (3, below right, bar scale: 1 m) and general view (4, below left, with * showing the position of photo 3).

top left). The dark Stephanian conglomerates contains numerous heterometric fragments of sandstones (Lower Cambrian, k1 on the 1 : 50,000 geological map) and dolostones (Lower Cambrian, k2). Therefore, the geotope of Le Bessou has a dual heritage value, first as a site of geological interest (geosite) and second as a site of geomorphological interest (geomorphosite). Like anywhere else in the Massif Central, the local Stephanian deposits are part of an intramontane coal basin (Graissessac) that is coeval with a D5 event associated with a late orogenic extensional tectonic regime accommodated by NNE–SSW stretching (Faure et al. 2009). Concerning the block of Cambrian limestone k2, it could be an autochthonous outcrop, but it has also been interpreted more likely as an olistolith fallen in the intramontane basin during the Late Carboniferous sedimentation (Becq-Giraudon 1984): from the geomorphological perspective, the carbonate formation k2 of Lower Cambrian age was not karstified much before fossilization by the deposits of the Upper Carboniferous, as a careful examination of the unconformable local contact reveals. The other value of this geotope is to provide an excellent view of the Orque Cliff (Fr. *Falaise d'Orque*) with the Marcou Mountains (Fr. *Montagne de Marcou*) in the distance (Figure 10), so it can be defined as a geospot because the outcrop here is coupled with a major view of panorama-type (Giusti et al. 2013).

2.1.2 The paleogeographic value of the Mas de Barthès geotope

A long and winding road provides access in the twenty kilometers from Camarès (Aveyron) to Lacaune (Tarn), passing through the Bataillole Pass (Fr. *Pas de la Bataillole*). Just west of the pass, facing Mas de Barthès, the section of the road exhibits an outcrop of Silurian limestones (Figure 7, top right), which connects with the large Silurian area of Murasson (Aveyron), known since the end of the nineteenth century (Bergeron 1883). Thereafter, a detailed geological survey of the local Silurian was carried out by Marcel

Thoral (1935), whose work was subsequently clarified by André Centène (1975, 1977) through the study of Conodonts, and by Jean-Pierre Prian (1980) for lithostratigraphy and geological mapping (the *boutonnières* of Le Cros, Laime's river, and the Rance Valley west and north of Mounes). It must be recalled that the Silurian of Murasson (NS of the Black Mountains) is very different from that of the Laurens–Cabrières area on the Southern Side (Chaubet 1937), a fact not really astonishing given the great complexity of the western peri-Gondwana margin paleogeography (see the position of the Maures–Black Mountains block on the reconstructions by Stampfli et al. 2013) and the intensity of tectonics in the outer zone of the Variscan Belt (Faure et al. 2014).

2.1.3 The enigmatic value of the La Billière and Castanet-le-Haut geotopes

More or less thick layers of limestone or dolomite may be interspersed throughout the mass of azoic metamorphic schists of low grade known as Schistes X, which envelop the magmatic and high-grade metamorphic

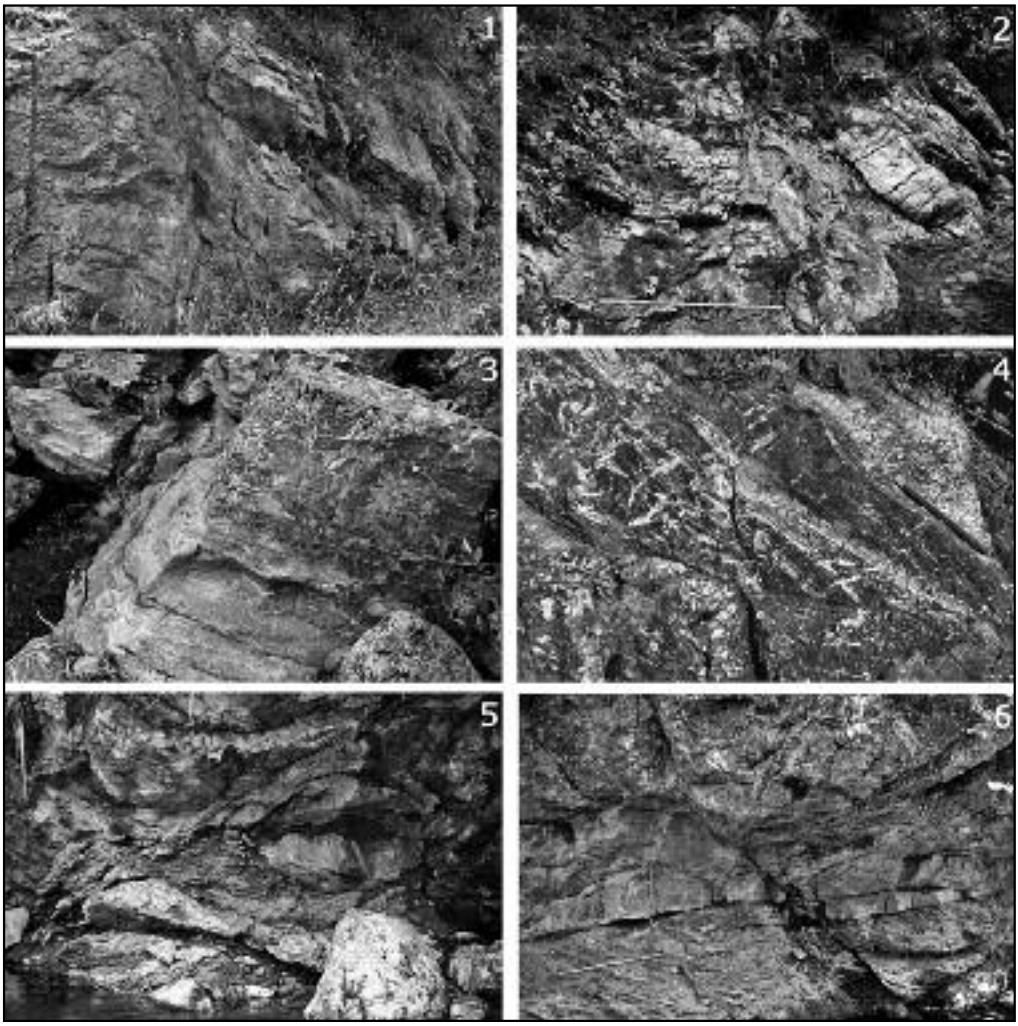

Figure 8: A disconnected geosite: limestone outcrops of the Upper Mare Valley near Castanet-le-Haut (Hérault). 1) At the entrance of the village, along the D22e12 (43° 40′ 01″ N 2° 58′ 25″ E); 2) Same location, below the D22e12 (43° 40′ 02″ N 2° 58′ 26″ E); 3) The Mare, west of the village (43° 40′ 02″ N 2° 58′ 07″ E); 4) On the road to Pabo, D22e11, east of the village (43° 40′ 05″ N 2° 58′ 54″ E); 5) In the village, along Capials Creek (43° 40′ 07″ N 2° 58′ 18″E); west of the village, along the Mare (43° 40′ 10″ N 2° 57′ 40″ E). All photos were taken in 1982.

rocks (granites, migmatites, gneiss, micaschists, etc.) that form the Axial Zone. One of the most notable examples is situated in the Saint-Gervais Mountains (Fr. *Monts de Saint-Gervais*) area north of Lamalou-les-Bains (Hérault, 34), in an abandoned quarry near La Billière (Figure 7, below). The local Schistes X series was first divided into three main groups X1, X2, and X3 (Ellenberger and Latouche 1967), in the third edition of the 1 : 80,000 Bédarieux geologic map (Gèze 1971), then in nine formations numbered x_3 to x_{11} (Ellenberger and Santarelli 1974) on the new 1 : 50,000 Bédarieux geologic map (Bogdanoff et al. 1984). On the former, the La Billière dolomite is noted X^2_C, and it appears on the latter as a strata included in the x_9 formation, labeled *Schistes du Barry*). However, the lithostratigraphic continuity of the »Schistes X« as a single monocline was later challenged by Michel Demange, who divides it into four superposed independent tectonic units (the autochthonous Axial Zone, the discontinuous Madalèze unit of epimetamorphic grade, the Cabausse unit of andalusite-staurolite grade, and the Haute-Mare unit of low-grade metamorphism) separated by mylonitic thrust planes (Demange and Herrera Urbina 1989). Because the limestones of Devonian age are generally quite rich in fossils (crinoids), it is possible and even likely that the La Billière geotope corresponds to a tectonic unit (klippe) of Cambrian dolomites (Berger et al. 2001). However, an older age (Upper Proterozoic?) cannot be excluded (Gèze 1949), especially because the Cambrian of the Avene unit could be quite older than that of the Mélagues unit (Devaere et al. 2014), just north of the Upper Carboniferous Graissessac Basin.

Even more puzzling are several tiny outcrops of calcareous formations to be observed here and there in the Upper Mare Valley, mainly around Castanet-le-Haut (Hérault, 34), between the Axial Zone and the southern limit of the Upper Carboniferous Graissessac Basin (Figure 8). Some are included in the »Schistes X« (Figures 8.1 to 8.4), and others are only fragments pinched in the schists just at the base of the *blaviérites* (rhyolitic tuffs and breccias), a formation of volcanic origin with strong deformation (Figures 8.5 and 8.6). These outcrops are very difficult to date and to interpret because, in addition to the absence of fossils, they are all situated along a steep north-dipping fault zone, with successive intervention of folding and thrusting of southward tectonic vergence, a dextral shear zone, and vertical uplift (e.g. Demange 1993; Malavieille 2010).

2.2 At the scale of a group of outcrops: the geofacies

To illustrate a single outcrop (geotope), one photo is generally enough, perhaps two if a close-up is required (e.g., Figures 7.3 and 7.4). In contrast, for a group of outcrops, it is necessary to offer at least a pair of twinned pictures, sometimes more, with a large panoramic view and part of it as an example in the case of a very homogeneous geofacies. If, as frequently happens, the geofacies is heterogeneous, the panoramic view has to be supplemented by pictures as detailed as required. Both situations are exemplified by a comparison of two sites.

2.2.1 A heterogeneous geofacies: the *Roque Redonde* olistolith

The Cabrières Unit is currently interpreted as an olistostrome about 20 kilometers long from Laurens in the west to Villeneuvette in the east, well exposed at the southeastern part of the Devonian to Visean overturned folds of the Faugères Mountains (Fr. *Monts de Faugères*) para-autochthonous area (Faure et al. 2010). This very complex unit, first described and mapped by Jules Bergeron (1899) and Bernard Gèze (1949), exhibits large-scale olistoliths of Carboniferous and Devonian limestones, Silurian volcanites and Ordovician turbidites, forming a wildflysch sequence deposited during the Visean and Early Namurian stages at the front of the advancing nappes of the Southern Side (Engel et al. 1978, 1980; Feist and Galtier 1984). On the geologic map (Figure 9, top left), the Visean wildflysch corresponds to two very distinct lithological facies because huge blocks of shallow-water limestones formerly known as *Productus giganteus* reefs (Fr. *récifs à Productus giganteus*; h2b, purple-grey) are packed in a thick formation mainly composed of silty shales and greywacke-turbidites (h2b, medium grey). The reef limestone olistoliths are more or less hidden by a sparse oak coppice, as shown by the rocky hills of *Roque de Castel Viel* (sparsely wooded) and *Roque de Loup* (more wooded; Figure 9, top right). Most often, outcrops of light gray limestone are highly visible and clearly identifiable in the landscape as for the mountain *Roc Murviel* (Figure 9, bottom left), where rain seeps through the Visean limestone so that only lean soils and sparse vegetation may develop. The ovoid mountain *Roque Redonde* (Figure 9, bottom right) is a small asymmetric massif that emerges from the thick mass of the flysch and rising about a hundred meters above the floor of the Peyne Valley, which

was probably cut just after the shaping of many partial erosion planes at the end of the Neogene Period (Giusti 2002). Although the weak material of the wildflysch is frequently truncated by an erosion surface known as a *glacis d'érosion* bearing vineyards today, the adjacent uplands are often made of limestone with a local relief of 100 to 150 meters. During the Proto-Historic Period, those hills could be easily defended: this is why ancient habitats of the Bronze Age and Iron Age might be found here and there on the top (Bagan and Beugnon 2014).

2.2.2 A homogeneous geofacies: the *Roc d'Orque* escarpment

A heterogeneous geofacies leads back to outcrops and multiple geotopes because of the constant modifications of geological features of the topography, and so it is possible to show that, conversely, a homogeneous geofacies leads to the landscape dimension. In the author's opinion, the geotope of Le Bessou (Figure 7.1) should also be named a »geospot« because, looking towards the northeast, one can observe a panoramic view whose main feature is an escarpment 50 to 100 meters high (Figure 10, top), culminating at the hill *Roc d'Orque* (Figure 10, bottom left). According to the geologic map and recent works (Bogdanoff et al. 1984; Devaere et al. 2013, 2014), the escarpment is made up of a solid dolomitic package (k2) referred to the Lastours Formation (Minervois Nappe, Southern Side) conformably lying on a siliciclastic group (k1) correlated with the Marcory Formation (Pardailhan Nappe, Southern Side; Figure 3). The upper part of the siliciclastic group (k1) contains carbonate beds and lenses cropping out along the base of the dolomitic cliff (k2), with a faunal assemblage that suggests that these beds may be a lateral equivalent of the mixed (carbonate-siliciclastic) Pardailhan Formation of the Southern Side (Devaere et al. 2013, 2014). Both Lower Cambrian sedimentary layers form the Le Fau–Albes syncline (Figure 10, middle), so that the homogeneous geofacies nearly two kilometers long on the left bank of the Orque Valley is made up of a dolomitic

Figure 9: Geofacies of the Visean wildflysch near Vailhan (Hérault). 1 : 15,000 geologic map (top left, from the 1 : 50,000 Pézenas geologic map; Berger *et al.* 1981) showing the emplacement of the hill *Roque de Castel Viel* (1a, 235 m) and the hill *Roque de Loup* (1b, 206 m; top right), then the mountain *Roc de Murviel* (2,286 m; bottom left), both seen from the top of the hill *Grand Glauzy* (229 m, A*), and of the mountain *Roque Redonde* (3,203 m; bottom right) southward from Vailhan (point 178 m, B*). Note that local relief is less than 150 meters. All photos were taken in 2008.

escarpment in its upper part and a siliciclastic slope in its lower part (Figure 10, bottom left), both corresponding to the normal limb of an asymmetric syncline. The deepening of the lower part of the Orque Valley postdate the formation (probably at the end of the Neogene Period) of several partial planes of erosion (Giusti 2002), here represented by Le Péras strath terraces (a, b, and c, Figure 10, bottom right). In the end it must be pointed out that the Orque Valley is not a symmetrical one because the right slope is very different from the left slope, where the *Roc d'Orque* dolomitic pillar (geotope) and escarpment (geofacies) are part of a larger geosystem as a whole.

2.3 At the scale of a landscape: the geosystem

The dolomitic heart of the Le Fau–Albès syncline is an unsung paradise for karst studies (e.g., Albès Cave), as well as for fans of canyoning (e.g., Albès Canyon). If, instead of examining landforms from one or two

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Figure 10: Geofacies of the Lower Cambrian k1–k2 of the Le Fau-Albès syncline in the Mélagues Unit, west of Saint-Geniès-de-Varensal (Hérault). Below the panoramic view (top) taken from the Le Bessou geotope (Figure 7.1), 1 : 15,000 geologic map (center left, from the 1 : 50,000 Bédarieux geologic map; Bogdanoff *et al.* 1984) and topographic map (center right) at the same scale showing the emplacement of the hill *Roc d'Orque* (10.4, 846 m; below left) and Rec de Rose Falls (10.5*, dry during summer) with the right slope of the Orque Valley near Le Péras. All photos were taken in 2009, except lower right, 2003.

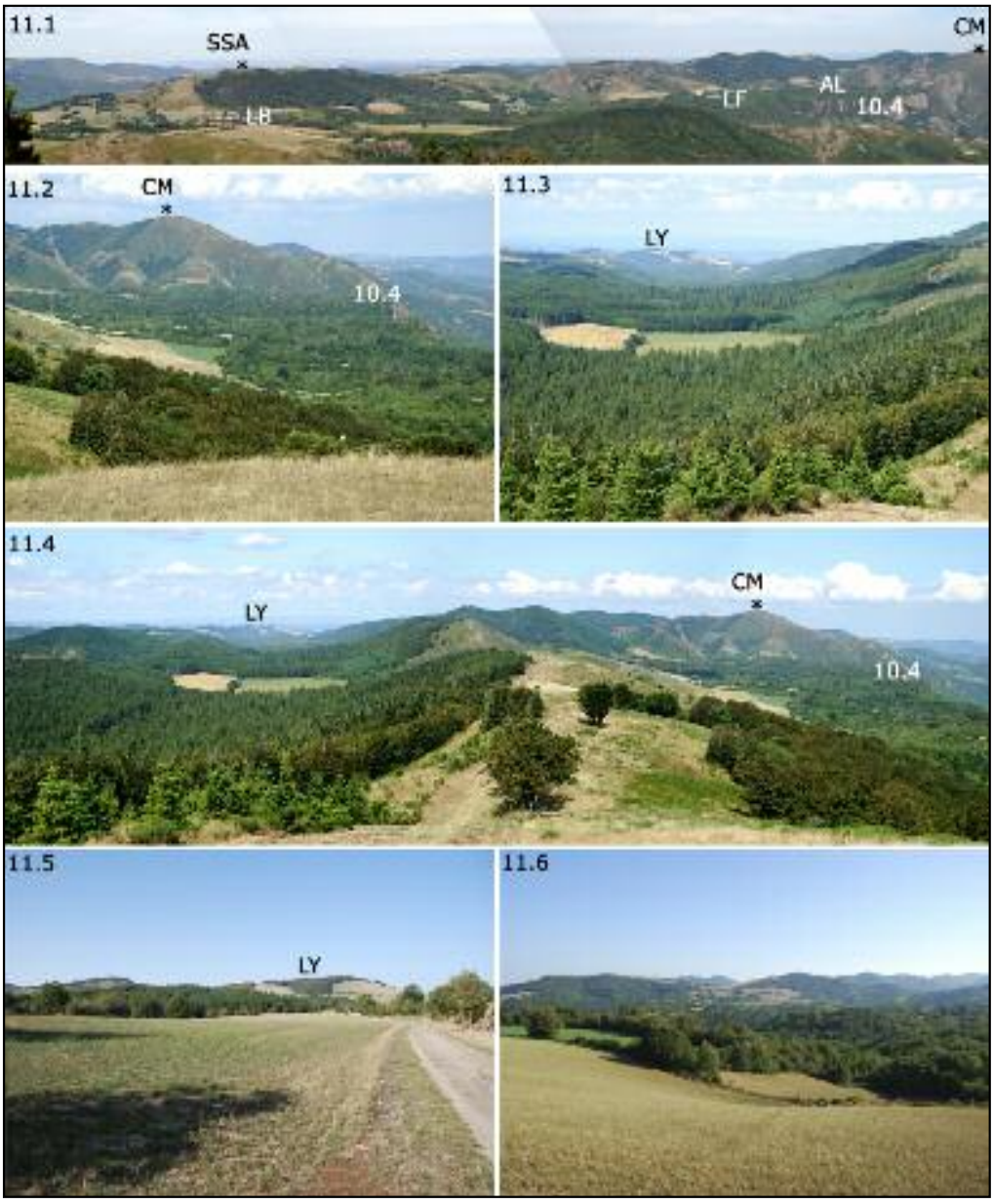

Figure 11: Geosystem of the Marcou Mountains (Fr. *Monts de Marcou*) in the Mélagues Unit (Eastern Monts de Lacaune Mountains, Aveyron and Hérault). CM: Croix de Marcou. LY: Liaury. SSA: Signal de Saint-Amans. AL: Albès. LB: La Baraquette. LF: Le Fau. 11.1: Panoramic view from the Espinouse (2009), and showing the entire extension of the dolomitic heart (k2) of the Le Fau–Albès syncline from La Baraquette in the west. Rounded summits such as the Signal de Saint-Amans (SSA* 1,008 m) or the Croix de Marcou (CM* 1,093 m) are associated with the siliciclastic formation (k1), which forms ridges rising 150 to 250 meters above the local relief of elongated and subhorizontal troughs related to the dolomitic formation (k2). 11.2 and 11.3: Separate views of the geofacies of Causse d'Albès (left) and Causse de Saint-Pierre-des-Cats with Liaury in the distance (right), both pictures were taken from the SSA (2009). 11.4: Also from SSA (2009), a panoramic view showing the geosystem of linear valleys associated with the dolostones (k2) of Le Fau–Albès syncline and Saint-Pierre-des-Cats monocline, and intervening round ridges related to the sandstones (k1) of the Mélagues anticline (SSA) and Marcou thrust (CM). 11.5 and 11.6: Separate views of a planar landform in the dolostones south of Liaury (left, taken from Cayourtes) and geofacies of the Albès syncline in the Bobes area (right, taken from Liaury; both in 2007).

viewpoints only (Figure 10), one coordinates a series of observations from multiple viewpoints forming a network, such as in the case of disconnected geomorphosites proposed by Reynard (2009), it becomes possible to move from the geofacies to the perception of the entire geosystem, as shown in the case study of the Marcou Mountains (Fr. *Monts de Marcou*; Figure 11). Incidentally, the implementation of such a photo composition requires a good knowledge of the field, acquired after several observation missions and benchmarking. The main summits are associated with Lower Cambrian sandstone (k1). Large karst landforms that are quite frequently more or less flat are reported on the topographic map using the term *causse* 'limestone plateau' (Figure 10, center right). They can be observed 150 to 250 meters below the siliciclastic culminating ridges, and are probably related to a phase of local planation that occurred in the highlands during the Neogene (Miocene?). It has been shown that, in the lowlands, those partial planes of erosion are extended by a regional palaeosurface (Giusti 2002). The current landscape is the result of further excavation of the valleys during the Neogene Period and Pleistocene Epoch, although another phase of partial planation with formation of strath terraces could occur at the very end of the Neogene. In short, the Espinouse–Caroux paleoplain is probably a planation surface of regional extension quite well preserved on the magmatic and metamorphic rocks of the Axial Zone (Figure 5), whereas phases of local planation in the Marcou Mountains (Fr. *Monts de Marcou*) are documented by possible Miocene (Figure 11) and Late Neogene (Figure 10) partial planes of erosion.

3 Conclusion

To conclude, this geosystem, which combines the geofacies of dolomitic synclinal valleys on the one hand and the geofacies of sandstone anticlinal ridges on the other, was finely described by the eminent geographer and geomorphologist Henri Baulig (1928, 292) nearly a century ago: »Les calcaires, moins résistants, donnent des sillons au sol rouge, avec des buis, de beaux hêtres, du froment, du maïs, des grottes et de fortes sources; les schistes et psammites forment au contraire des crêtes étroites, aux sols minces et grisâtres, portant des châtaigniers, des hêtres rabougris, de maigres cultures de seigle et de sarrazin« (Limestones, which are less resistant, create valleys with red soil with boxwood, beautiful beech trees, wheat, corn, caves and powerful springs; in contrast, shale and psammites create narrow ridges with thin grayish soils supporting chestnut, stunted beech, and meager crops of rye and buckwheat). Today, these crops are in decline, except for corn, there are still herds of sheep, and numerous wind turbines dot the terrain, impacting the landscape. But the Misty Mountains, the River Bruinen, and the Glittering Caves are still there.

The wind's in the treetop, the wind's in the heather;
The stars are in blossom, the moon is in flower,
And bright are the windows of Night in her tower.
– J. R. R. Tolkien, *The Hobbit*

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Guidelines for Contributing Authors in Acta Geographica Slovenica – Geografski Zbornik

1 Aims and scopes

Acta geographica Slovenica – *Geografski zbornik* is the main Slovenian geographical scientific journal published by the Anton Melik Geographical Institute of the Research Centre of the Slovenian Academy of Sciences and Arts.

The journal is aimed at presentation of scientific articles from the fields of physical, human and regional geography. Review scientific articles are published, e.g. review and synthesis of already published articles on specific topic, and original research articles, e.g. first publication of original scientific results that allows repetition of the study and examination of results.

The journal was first published in 1952, and fourteen issues appeared periodically until 1976. Granted more permanent government funding, it has been published annually since 1976. From 2003, it is published twice a year. The journal is subsequently published in print and on the Internet in both Slovenian and English since 1994 (http://ags.zrc-sazu.si/). Each year, it is distributed in exchange for 200 scientific journals from around the world. The articles on the internet are read in more than 100 countries.

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Acta geographica Slovenica publishes articles in Slovenian and English. If one of the authors is from Slovenia the article has to be in English and Slovenian. The articles of the authors from abroad and the articles of special issues are only published in English. The articles in Slovenian have to be translated to English after a positive peer-review. If the article is translated by the editorial board the cost for authors is 500 €. If the authors provide a professional translation of the article it has to be lectored; the cost of lectoring for authors is 200 €. Slovenian articles are lectored by the editorial board. The articles that are submitted for publication in English need to be lectored after a positive peer-review. Lectoring is organized by the editorial board; the cost for authors is 200 €.

2 Article components

The articles published in the scientific journal *Acta geographica Slovenica* – Geografski zbornik should be arranged according to the IMRAD scheme: Introduction, Method, Results and Discussion. The articles must contain the following elements:

- article's main title in both English and Slovenian;
- abstract (up to 800 characters including spaces);
- up to eight key words;
- article in English (up to 20,000 characters including spaces) and identical article in Slovenian;
- reference list.

Text of the article should be equal in Slovenian and English.

The titles of chapters and subchapters in the article should be marked with ordinal numbers (for example, 1 Introduction, 1.1 Methodology, 1.2 Terminology). The division of an article into chapters is obligatory, but authors should use subchapters sparingly. It is recommended that the article includes Introduction, Conclusion and References chapters. The titles should be short and comprehensible. Authors should avoid using footnotes and endnotes.

3 Quoting

When quoting from source material, authors should state the author's last name and the year, separate individual sources with semicolons, order the quotes according to year, and separate the page information from

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The References' units should be listed according to the alphabetical order of the authors' second names. If there are more units from the same author in the same year, letters should be added to the citation (for example 1999a in 1999b).

Every unit consists of three sentences. In the first Author's name, publishing year and article's title are listed in front of the colon while the title is listed after it. The surnames of the authors and the initials of their names are separated by commas. The subtitle is separated from the title by a comma.

If the unit is an article, the name and number of the journal is indicated in the second sentence. If the unit is a monograph, there is no second sentence. The name of the publisher and number of pages are not listed. If the unit is not printed the type (e.g. diploma thesis) should be listed in the second sentence, separated from information of the institution by a comma. Laws should be qouted by a title, publication name and its number (e.g. Official gazette 56-2), separated from the publication year in the last part of the quotation.

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1) for articles in journals:
   - Melik, A. 1955a: Kraška polja Slovenije v pleistocenu. Dela Inštituta za geografijo 3.
   - Melik, A. 1955b: Nekaj glacioloških opažanj iz Zgornje Doline. Geografski zbornik 5.
   - Perko, D. 2002: Določanje vodoravne in navpične razgibanosti površja z digitalnim modelom višin. Geografski vestnik 74-2.
   - Fridl, J., Urbanc, M., Pipan, P. 2009: The importance of teachers' perception of space in education. Acta geographica Slovenica 49-2. DOI: http://dx.doi.org/10.3986/AGS49205
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   - Mihevc, B. 1998: Slovenija na starejših zemljevidih. Geografski atlas Slovenije. Ljubljana.
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   - Perko, D., Orožen Adamič, M. 1998: Slovenija – pokrajine in ljudje. Ljubljana.
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   - Šifrer, M. 1997: Površje v Sloveniji. Elaborat, Geografski inštitut Antona Melika ZRC SAZU. Ljubljana.
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   - Digitalni model višin 12,5. Geodetska uprava Republike Slovenije. Ljubljana, 2005.
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   - Franciscejski kataster za Kranjsko, k. o. Sv. Agata, list A02. 1823–1869. Arhiv Republike Slovenije. Ljubljana.
   - Buser, S. 1986a: Osnovna geološka karta SFRJ 1 : 100.000, list Tolmin in Videm (Udine). Zvezni geološki zavod. Beograd.
   - Buser, S. 1986b: Osnovna geološka karta SFRJ 1 : 100.000, tolmač lista Tolmin in Videm (Udine). Zvezni geološki zavod. Beograd.

6) for internet sources with known authors and/or titles:
- Vilhar, U. 2010: Fenološka opazovanja v okviru Intenzivnega spremljanja stanja gozdnih ekosistemov. Internet: http://www.gozdis.si/impsi/delavnice/Fenoloska%20opazovanja_Vilhar.pdf (19. 2. 2012).
- eGradiva, 2010. Internet: http://www.egradiva.si/ (11. 2. 2012).

7) for internet sources with unknown authors, titles or institutions:
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The laws are cited as follows (name of the law, number of the official gazzette, place of publishing), for example:
- Zakon o kmetijskih zemljiščih. Uradni list Republike Slovenije 59/1996. Ljubljana.
- Zakon o varstvu pred naravnimi in drugimi nesrečami. Uradni list Republike Slovenije 64/1994, 33/2000, 87/2001, 41/2004, 28/2006 in 51/2006. Ljubljana.

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Authors should submit photographs and other graphic materials in a form suitable for scanning or in digital raster form with a resolution of 300 dpi, preferably in TIFF or JPG format formats in the printing size. If authors cannot deliver articles or graphic supplements prepared using the specified programs, they should consult the editorial board in advance: rok.ciglic@zrc-sazu.si.

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Author of map/avtorica zemljevida: Jerneja Fridl
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11 Acta geographica Slovenica Editorial review form

Acta geographica Slovenica editorial review form

1 The paper is an original scientific one – the paper follows the standard IMRAD scheme and is original and the first presentation of research results with the focus on methods, theoretical aspects or case study.)
Yes
No

2 The paper's content is suitable for publishing in the AGS journal – the paper is from the field of geography or related fields of interest, the presented topic is interesting and well presented. In case of negative answer add comments below.)
Yes
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5 The style and formatting of the paper is according to the AGS guidelines – the paper is prepared in plain text, no other text formatting is used than bold and italic. See the Guidelines of AGS journal for details.)
Yes
No

6 Notes regarding style and formatting.

7 Citing in the paper is according to the AGS guidelines and style, including DOI identificators.
Yes
No

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No, the author did not cite previously published papers on similar topic.

9 Scientific language of the paper is appropriate and understandable.
Yes
No

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- Supplementary files are correct.
- Supplementary files are not appropriate and need a major correction.
- Some supplementary files need corrections.

11 Describe the possible deficiencies of the supplementary files:

12 DECISION OF THE RESPONSIBLE EDITOR*
The paper is accepted for further processing and may be sent to the reviewer.
The paper is accepted for further processing but needs technical improvements (see notes).
The paper is accepted for further processing but its content needs additional improvements (see notes).
The paper is not accepted for publication because:
- It is more suitable for a specialized journal.
- Does not fit the aims and scopes of the AGS journal.
- Is not an original scientific paper.
- The presentation of the results is poor.
- The paper is of very low quality.
- The paper has already been published elsewhere.
- Other (see comments below).
- Other reasons for rejection of the paper.

12 Acta geographica Slovenica review form

1 RELEVANCE

1a) Are the findings original and the paper is therefore a significant one?*
yes
no
partly

1b) Is the paper suitable for the subject focus of the AGS journal?*
yes
no

2 SIGNIFICANCE

2a Does the paper discuss an important problem in geography or related fields?*
yes
no
partly

2b Does it bring relevant results for contemporary geography?*
yes
no
partly

2c What is the level of the novelty of research presented in the paper?*
high
middle
low

3 ORIGINALITY

3a Has the paper been already published or is too similar to work already published?*
yes
no

3b Does the paper discuss a new issue?*
yes
no

3c Are the methods presented sound and adequate?*
yes
no
partly

3d Do the presented data support the conclusions?*
yes
no
partly

4 CLARITY

4a Is the paper clear, logical and understandable?*
yes
no

4b If necessary, add comments and recommendations to improve the clarity of the title, abstract, keywords, introduction, methods or conclusion:*

5 QUALITY

5a Is the paper technically sound? (If no, the author should discuss technical editor [rok.ciglic@zrc-sazu.si] for assistance.)*
yes
no

5b Does the paper take into account relevant current and past research on the topic?*
yes
no
Propose amendments, if no is selected:

5d Is the references list the end of the paper adequate?*
yes
no
Propose amendments, if no is selected:

5e Is the quoting in the text appropriate?*
yes
no
partly
Propose amendments, if no is selected:

5f Which tables are not necessary?

5g Which figures are not necessary?

6 COMMENTS OF THE REVIEWER

Comments of the reviewer on the contents of the paper:
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7 RECOMMENDATION OF THE REVIEWER TO THE EDITOR-IN-CHIEF

My recommendation is:
Please rate the paper from 1 [low] to 100 [high]:
Personal notes of the reviewer to editor-in-chief.

Navodila avtorjem za pripravo člankov v *Acti geographici Slovenici* – Geografskem zborniku

1 Uvod

Acta geographica Slovenica – Geografski zbornik je osrednja slovenska znanstvena revija za geografijo, ki jo izdaja Geografski inštitut Antona Melika Znanstvenoraziskovalnega centra Slovenske akademije znanosti in umetnosti.

Revija je namenjena predstavitvi znanstvenih dosežkov s področja fizične, družbene in regionalne geografije ter sorodnih ved. Objavlja pregledna znanstvena besedila, to je pregled in sintezo že objavljenih najnovejših del o določeni temi, ter izvirna znanstvena besedila, to je prvo objavo originalnih raziskovalnih rezultatov v takšni obliki, da se raziskava lahko ponovi, ugotovitve pa preverijo.

Revija je prvič izšla leta 1952 in je do leta 1976, ko je bila natisnjena štirinajsta številka, izhajala občasno. Leta 1976 je zaradi trajnejše finančne pomoči države začela izhajati redno, od leta 2003 pa izhaja dvakrat letno v tiskani in elektronski obliki na medmrežju. Od leta 1994 izhaja enakovredno v slovenskem in angleškem jeziku (http://ags.zrc-sazu.si). Vsako leto jo razpošljemo v izmenjavo na več kot 200 naslovov po celem svetu. Članke na medmrežju berejo v več kot 100 državah sveta.

Acta geographica Slovenica – Geografski zbornik v objavo sprejema geografske članke iz Slovenije ter Jugovzhodne in Srednje Evrope. Objavljamo tudi članke geografiji sorodnih ved, katerih znanstveno in raziskovalno delo lahko obogati geografske poglede na pokrajino.

Acta geographica Slovenica objavlja članke v slovenskem in angleškem jeziku. Članki, pri katerih je vsaj eden od avtorjev iz Slovenije, morajo imeti tudi slovenski prevod. Članki avtorjev iz tujine in članki posebnih izdaj so objavljeni samo v angleškem jeziku. Članke, ki prispejo v slovenskem jeziku, je po pozitivni recenziji treba prevesti v angleščino. Če za prevod poskrbi uredništvo, je strošek prevoda za avtorje 500 €. Če avtorji sami poskrbijo za profesionalni prevod članka, je treba članek lektorirati, strošek lekture v višini 200 € pa nosijo avtorji. Za lekturo slovenskega dela članka poskrbi uredništvo. Članke, ki prispejo v angleškem jeziku, je po pozitivni recenziji treba nujno lektorirati. Za lekturo poskrbi uredništvo, strošek v višini 200 € pa nosijo avtorji.

2 Sestavine članka

Članki, objavljeni v znanstveni reviji *Acta geographica Slovenica* – Geografski zbornik so urejeni po shemi IMRAD (uvod, metoda, rezultati in razprava; angl.: *Introduction, Method, Results And Discussion*).

Članki, poslani v objavo, morajo imeti naslednje sestavine:

- glavni naslov v slovenskem in angleškem jeziku;
- izvleček dolžine do 800 znakov skupaj s presledki;
- do osem ključnih besed;
- članek v angleškem ali slovenskem jeziku, ki naj skupaj s presledki obsega do 20.000 znakov.
- seznam uporabljenih virov in literature, urejen skladno z navodili.

Besedilo člankov mora biti enakovredno v angleškem in slovenskem jeziku.

Članek naj ima naslove poglavij in naslove podpoglavij označene z vrstilnimi števniki (na primer: 1 Uvod, 1.1 Metodologija, 1.2 Terminologija). Razdelitev članka na poglavja je obvezna, podpoglavja pa naj avtor uporabi le izjemoma. Zaželeno je, da ima članek poglavja Uvod, Sklep in Literatura. Naslovi člankov naj bodo jasni in čim krajši. Avtorji naj se izognejo pisanju opomb pod črto na koncu strani in naj bodo zmerni pri uporabi tujk.

3 Citiranje v članku

Avtor naj pri citiranju med besedilom navede priimek avtorja, letnico ter po potrebi številko strani. Več citatov se loči s podpičjem in razvrsti po letnicah, navedbo strani pa se od priimka avtorja in letnice loči z vejico, na primer: (Melik 1955, 11) ali (Melik, Ilešič in Vrišer 1963, 12; Kokole 1974, 7 in 8). Če ima citirano delo več kot tri avtorje, se citira le prvega avtorja, na primer (Melik s sod. 1956, 217).

Enote v poglavju Viri in literatura naj bodo navedene po abecednem redu priimkov avtorjev, enote istega avtorja pa razvrščene po letnicah. Če je v seznamu več enot istega avtorja iz istega leta, se letnicam dodajo črke (na primer 1999a in 1999b). Zapis vsake citirane enote skladno s slovenskim pravopisom sestavljajo tri je stavki. V prvem stavku sta navedena avtor in letnica izida (če je avtorjev več, so ločeni z vejico, z vejico sta ločena tudi priimek avtorja in začetnica njegovega imena, med začetnico avtorja in letnico ni vejice), sledi dvopičje, za njim pa naslov in morebitni podnaslov, ki sta ločena z vejico. Če je citirana enota članek, se v drugem stavku navede publikacija, v kateri je članek natisnjen, če pa je enota samostojna knjiga, drugega stavka ni. Izdajatelja, založnika in strani se ne navaja. Če enota ni tiskana, se v drugem stavku navede vrsta enote (na primer elaborat, diplomsko, magistrsko ali doktorsko delo), za vejico pa še ustanova, ki hrani to enoto. V tretjem stavku se za tiskane enote navede kraj izdaje, za netiskane pa kraj hranjenja. Pri navajanju literature, ki je vključena v sistem DOI (Digital Object Identifier), je treba na koncu navedbe dodati tudi številko DOI. Številke DOI so dodeljene posameznim člankom serijskih publikacij, prispevkom v monografijah in knjigam. Številko DOI najdete v samih člankih in knjigah, oziroma na spletni strani http://www.crossref.org/guestquery.

Nekaj primerov (ločila so uporabljena skladno s slovenskim pravopisom):

1) za članke v revijah:
   - Melik, A. 1955a: Kraška polja Slovenije v pleistocenu. Dela Inštituta za geografijo 3. Ljubljana.
   - Melik, A. 1955b: Nekaj glacioloških opažanj iz Zgornje Doline. Geografski zbornik 5. Ljubljana.
   - Perko, D. 2002: Določanje vodoravne in navpične razgibanosti površja z digitalnim modelom višin. Geografski vestnik 74-2. Ljubljana.
   - Fridl, J., Urbanc, M., Pipan, P. 2009: The importance of teachers' perception of space in education. Acta geographica Slovenica 49-2. Ljubljana. DOI: 10.3986/AGS49205
2) za poglavja v monografijah ali članke v zbornikih:
   - Lovrenčak, F. 1996: Pedogeografska regionalizacija Spodnjega Podravja s Prlekijo. Spodnje Podravje s Prlekijo, 17. zborovanje slovenskih geografov. Ljubljana.
   - Mihevc, B. 1998: Slovenija na starejših zemljevidih. Geografski atlas Slovenije. Ljubljana.
   - Komac, B., Zorn, M. 2010: Statistično modeliranje plazovitosti v državnem merilu. Od razumevanja do upravljanja, Naravne nesreče 1. Ljubljana.
3) za monografije:
   - Natek, K., Natek, M. 1998: Slovenija, Geografska, zgodovinska, pravna, politična, ekonomska in kulturna podoba Slovenije. Ljubljana.
   - Fridl, J., Kladnik, D., Perko, D., Orožen Adamič, M. (ur.) 1998: Geografski atlas Slovenije. Ljubljana.
   - Perko, D., Orožen Adamič, M. (ur.) 1998: Slovenija – pokrajine in ljudje. Ljubljana.
   - Oštir, K. 2006: Daljinsko zaznavanje. Ljubljana.
4) za elaborate, diplomska, magistrska, doktorska dela ipd.:
   - Richter, D. 1998: Metamorfne kamnine v okolici Velikega Tinja. Diplomsko delo, Pedagoška fakulteta Univerze v Mariboru. Maribor.
   - Šifrer, M. 1997: Površje v Sloveniji. Elaborat, Geografski inštitut Antona Melika ZRC SAZU. Ljubljana.
5) za vire brez avtorjev in kartografske vire:
   - Popis prebivalstva, gospodinjstev, stanovanj in kmečkih gospodarstev v Republiki Sloveniji, 1991 – končni podatki. Zavod Republike Slovenije za statistiko. Ljubljana, 1993.
   - Digitalni model višin 12,5. Geodetska uprava Republike Slovenije. Ljubljana, 2005.
   - Državna topografska karta Republike Slovenije 1 : 25.000, list Brežice. Geodetska uprava Republike Slovenije. Ljubljana, 1998.
   - Franciscejski kataster za Kranjsko, k. o. Sv. Agata, list A02. 1823–1869. Arhiv Republike Slovenije. Ljubljana.
   - Buser, S. 1986a: Osnovna geološka karta SFRJ 1 : 100.000, list Tolmin in Videm (Udine). Zvezni geološki zavod. Beograd.
   - Buser, S. 1986b: Osnovna geološka karta SFRJ 1 : 100.000, tolmač lista Tolmin in Videm (Udine). Zvezni geološki zavod. Beograd.

Avtorji vse pogosteje citirajo vire z medmrežja. Če sta znana avtor in/ali naslov citirane enote, potem se jo navede takole (datum v oklepaju pomeni čas ogleda medmrežne strani):

- Vilhar, U. 2010: Fenološka opazovanja v okviru Intenzivnega spremljanja stanja gozdnih ekosistemov. Medmrežje: http://www.gozdis.si/impsi/delavnice/Fenoloska%20opazovanja_Vilhar.pdf (19. 2. 2010).
- eGradiva, 2010. Medmrežje: http://www.egradiva.si/ (11. 2. 2010).

Če avtor, naslov ali ustanova niso poznani, se navede le:

- Internet: http://giam.zrc-sazu.si/ (22. 7. 2011).

Če se navaja več enot z medmrežja, se doda še številko:

- Internet 1: http://giam.zrc-sazu.si/ (22. 7. 2011).
- Internet 2: http://zgs.zrc-sazu.si/ (22. 7. 2011).

Med besedilom se v prvem primeru navede avtorja, na primer (Vilhar 2010), v drugem primeru pa le medmrežje, na primer (Internet 2).

Zakone se citira v naslednji obliki (ime zakona, številka uradnega lista, kraj izida), na primer:

- Zakon o kmetijskih zemljiščih. Uradni list Republike Slovenije 59/1996. Ljubljana.
- Zakon o varstvu pred naravnimi in drugimi nesrečami. Uradni list Republike Slovenije 64/1994, 33/2000, 87/2001, 41/2004, 28/2006 in 51/2006. Ljubljana.

Če ima zakon dopolnitve, je treba navesti tudi te. Med besedilom se zakon navaja s celim imenom, če gre za krajše ime, ali pa z nekaj prvimi besedami in tremi pikami, če gre za daljše ime. Na primer (Zakon o kmetijskih zemljiščih 1996) ali (Zakon o varstvu … 1994).

V poglavju *Viri in literatura* morajo biti navedena vsa dela, citirana v prispevku, ostalih, necitiranih del pa naj avtor ne navaja.

Avtorji naj upoštevajo tudi navodila za navajanje virov lastnika podatkov ali posrednika, če jih le-ta določa. Primer: Geodetska uprava Republike Slovenije ima navodila za navajanje virov določena v dokumentu »Pogoji uporabe geodetskih podatkov« (http://e-prostor.gov.si/fileadmin/narocanje/pogoji_uporabe_podpisani.pdf).

4 Preglednice in grafične priloge v članku

Priloge morajo prav tako oddati natisnjene v digitalni obliki v ustreznem formatu. Fotografije in druge grafične priloge morajo avtorji, če je le mogoče, oddati v obliki, primerni za skeniranje, sicer pa v digitalni rastrski obliki z ločljivostjo vsaj 300 pik na palec ali 120 pik na cm, najbolje v formatu TIFF ali JPG in končni velikosti slike. Če avtorji ne morejo oddati prispevkov in grafičnih prilog, pripravljenih v omenjenih programih, naj se predhodno posvetujejo z uredništvom (rok.ciglic@zrc-sazu.si).

Vse ***preglednice*** v članku so oštevilčene in imajo svoje naslove. Med številko in naslovom je dvopičje. Naslov konča pika. Primer:
Preglednica 1: Število prebivalcev Ljubljane po posameznih popisih.
Preglednica 2: Spreminjanje povprečne temperature zraka v Ljubljani (Velkavrh 2009).

Vse ***grafične priloge*** – slike (fotografije, zemljevidi, grafi in podobno) v članku so oštevilčene enotno in imajo svoje naslove. Med številko in naslovom je dvopičje. Naslov konča pika. Primera:
Slika 1: Rast števila prebivalcev Ljubljane po posameznih popisih.
Slika 2: Izsek topografske karte v merilu 1 : 25.000, list Kranj.

Avtorji morajo za grafične priloge, za katere nimajo avtorskih pravic, priložiti fotokopijo dovoljenja za objavo, ki so ga pridobili od lastnika avtorskih pravic.

Grafične priloge naj bodo široke točno 134 mm (cela širina strani) ali 64 mm (pol širine, 1 stolpec), visoke pa največ 200 mm. V primeru, da želimo imeti celostransko sliko ali zemljevid, mora biti njuna velikost 134 × 192,3 mm (podnapis h grafični prilogi je enovrstičen) ali 134 × 200 mm (podnapis h grafični prilogi je naveden na sosednji strani).

Slikovno gradivo (zemljevidi, sheme in podobno) naj bo v formatih .ai ali .cdr, fotografije pa v formatih .tif ali .jpg.

Zemljevidi naj bodo izdelani v digitalni obliki. Zaželeno je, da so oddani v vektorski obliki, pripravljeni s programom *Corel Draw* ali *Adobe Illustrator*, zlasti če vsebujejo besedilo. Možno jih je oddati tudi v rastrski obliki z ločljivostjo vsaj 300 pik na palec ali 120 pik na cm, najbolje v formatu TIFF ali JPG in končni velikosti slike.

Pri tistih zemljevidih in shemah, izdelanih s programom ArcGIS, kjer so poleg vektorskih slojev kot podlaga uporabljeni tudi rastrski sloji (na primer .tif reliefa, letalskega ali satelitskega posnetka in podobno), oddajte tri ločene datoteke. V prvi naj bodo samo vektorski sloji z izključeno morebitno prosojnostjo poligonov skupaj z legendo in kolofonom (izvoz v formatu .ai), v drugi samo rastrska podlaga (izvoz v formatu .tif), v tretji, kontrolni datoteki pa vektorski in rastrski sloji skupaj, tako kot naj bi bil videti končni zemljevid v knjigi (izvoz v formatu .jpg). To je nujno, da tudi natisnjeni zemljevid ohrani ustrezno kakovost.

Zemljevidi naj bodo brez naslova, ker je naveden v podnapisu. Za izdelavo zemljevidov uporabite predloge s spletne strani revije.

Pri izbiri in določanju barv za slikovne priloge uporabite zapis CMYK in ne RGB oziroma drugih.

Za legendo zemljevida je potrebno uporabiti tip pisave *Times new roman* velikosti 8 pik, za kolofon pa isto vrsto pisave velikosti 6 pik. V kolofonu naj so po vrsti od zgoraj navzdol v angleškem in slovenskem jeziku navedeni: merilo (grafično ali besedilno), avtor vsebine, avtor zemljevida, vir in ustanova oziroma nosilec avtorskih pravic. Kolofon mora biti v angleškem in slovenskem jeziku razen kjer to zaradi prostorskih omejitev ni možno. Primer:

Scale/merilo: (grafično, besedilno)
Author of contents/avtor vsebine: Drago Perko
Author of map/avtorica zemljevida: Jerneja Fridl
Source/vir: Statistični urad RS, 2002
© Geografski inštitut Antona Melika ZRC SAZU, 2005

Pri zemljevidih in shemah, izdelanih v programih CorelDraw ali Adobe Illustrator, oddajte dve ločeni datoteki; poleg originalnega zapisa (format .cdr ali .ai) dodajte še datoteko, ki prikazuje, kako naj bo videti slika (format .jpg).

Grafikoni naj bodo izdelani s programom *Excel*. Na posameznem listu naj bodo skupaj z grafom tudi podatki, na podlagi katerih je bil izdelan.

Fotografije mora avtor oddati v digitalni rastrski obliki z ločljivostjo vsaj 240 pik na cm oziroma 600 pik na palec, najbolje v formatu .tif ali .jpg, kar pomeni približno 3200 pik na celo širino strani v reviji.

Slike, ki prikazujejo računalniški zaslon, morajo biti narejene pri največji možni ločljivosti zaslona (ločljivost uredimo v: Nadzorna plošča\Vsi elementi nadzorne plošče\Zaslon\Ločljivost zaslona oziroma Control Panel\All Control Panel Items\Display\Screen Resolution). Sliko se nato preprosto naredi s pritiskom tipke print screen, prilepi v izbran grafični program (na primer Slikar, Paint) in shrani kot .tif. Pri tem se slike ne sme povečati ali pomanjšati oziroma ji spremeniti ločljivost. Po želji lahko uporabite tudi ustrezne programe za zajem zaslona in shranite sliko v zapisu .tif.

5 Sprejemanje prispevkov

Za objavo v reviji *Acta geographica Slovenica* sprejemamo le izvirne oziroma nove znanstvne članke. Avtor s podpisom potrdi izjavo o izvirnosti vsebine in podobe članka ter dejstvo, da članek še ni bil posredovan v objavo drugam oziroma drugje še ni bil objavljen.

Avtorji morajo besedilo prispevkov oddati v digitalni obliki prek spletne strani ags.zrc-sazu.si. Prispevki morajo biti izdelani v programu Word.

Zaradi morebitnih sprememb v postopku recenzije in urejanja naj članek najprej oddajo v slovenskem jeziku, po sprejemu za objavo pa še v angleškem. Prevod je strošek avtorja.

Digitalni zapis besedila naj bo povsem enostaven, brez zapletenega oblikovanja, samodejnih naslovov, poravnave desnega roba, deljenja besed, podčrtavanja in podobnega. Avtorji naj označijo le mastni (krepki) in ležeči tisk. Besedilo naj bo v celoti izpisano z malimi črkami (razen velikih začetnic, seveda), brez nepotrebnih krajšav, okrajšav in kratic.

Če besedilo slovnično ali vsebinsko ni ustrezno napisano, ga uredniški odbor avtorju lahko vrne v popravek, zahteva lektoriranje ali članek zavrne. Datum prejetja članka je objavljen za angleškim prevodom izvlečka in ključnih besed.

Avtorji naj prispevke pošiljajo prek sistema OJS na naslovu ags.zrc-sazu.si.

6 Recenziranje člankov

Članke najprej pregleda eden od področnih urednikov. Avtorji člankov so potem običajno pozvani, da članek ustrezno dopolnijo ali popravijo. Sledi recenzentski postopek, ki je praviloma anonimen. Recenzenta prejmeta članek brez navedbe avtorja članka, avtor članka pa prejme recenzijo brez navedbe recenzenta. Če recenzija ne zahteva popravka ali dopolnitve članka, se avtorju članka recenzij ne pošlje. Avtor dovoljuje, da uredništvo prispevek krajša ali drugače prilagodi, da bo primeren za objavo. Na predlog uredništva ali recenzenta se lahko zavrne objavo prispevka.

7 Avtorske pravice

Za avtorsko delo, poslano za objavo v *Acti geographici Slovenici* – Geografskem zborniku, vse moralne avtorske pravice pripadajo avtorju, materialne avtorske pravice reproduciranja in distribuiranja v Republiki Sloveniji in v drugih državah pa avtor brezplačno, enkrat za vselej, za vse primere, za neomejene naklade in za vse medije neizključno prenese na izdajateljico. Avtor dovoljuje objavo članka ali njegovih delov na medmrežju.

Avtor sam poskrbi za profesionalni prevod članka ter obvezno navede ime in priimek prevajalca. Avtorji so dolžni sodelovati v procesu lektoriranja besedila in urejanja članka.

Če obseg avtorskega dela ni skladen z navodili za objavo, avtor dovoljuje izdajatelju, da avtorsko delo po svoji presoji ustrezno prilagodi.

Izdajatelj poskrbi, da se vsi prispevki s pozitivno recenzijo, če so zagotovljena sredstva za tisk, objavijo v *Acti geographici Slovenici* – Geografskem zborniku in na medmrežju, praviloma skladno z vrstnim redom prispetja prispevkov in skladno z enakomerno razporeditvijo prispevkov po temah. Naročeni prispevki se lahko objavijo ne glede na datum prispetja.

Prispevki v reviji *Acta geographica Slovenica* – Geografski zbornik niso honorirani niti niso honorirani recenzenti.

Avtorju pripada 1 brezplačen izvod publikacije.

8 Priprava kontrolnega seznama v sistemu OJS

Kot del postopka oddaje članka morajo avtorji preveriti skladnost članka in navodil. Uredništvo si pridržuje pravico, da avtorjem vrne članek v popravek, če ta ni pripravljen skladno s temi navodili. Avtorji morajo upoštevati naslednja navodila:

1. Članek ni bil predhodno objavljen niti ni v postopku objave v drugi reviji oziroma je to razloženo v komentarju uredniku).
2. Datoteka je shranjena v formatu Microsoft Word.
3. Če so na voljo, so predloženi URL-ji in DOI referenc.
4. Besedilo ima enojne razmike s pisavo velikosti 12 točk; za poudarjanje vsebine uporablja ležeč ali krepki format brez podčrtovanja (razen URL naslovov). V besedilu je s podnapisi označena lega slik, ilustracije in slike pa niso vnesene v besedilo, temveč so oddane v posebnih datotekah (.cdr, .ai za zemljevide in ilustracije; .tif za fotografije). Preglednice so na ustreznih mestih besedilu. Velikost posamezne dodatne datoteke ne sme preseči 50 MB.
5. Besedilo je pripravljeno skladno z oblikovnimi in bibliografskimi merili za pripravo člankov za objavo v reviji *Acta geographica Slovenica*, ki so objavljene v poglavju *About* na spletni strani http://ojs.zrc-sazu.si/ags.
6. Pri oddaji članka so bila upoštevana navodila za zagotavljanje anonimne recenzije članka.
7. Velikost dodatnih datotek ne presega 50 MB.
8. Če je vsaj eden od avtorjev iz Slovenije, se strinjamo, da bomo dali članek na naše stroške prevesti v angleški / slovenski jezik oziroma dali lektorirat angleški del članka (za podrobnosti glej navodila), POTEM ko bo sprejet za objavo.

9 Izjava o zasebnosti

Imena in e-poštni naslovi, vneseni v tej reviji mestu se bodo uporabljali izključno za navedene namene te revije in ne bodo na voljo za kakršne koli druge namene ali za katero koli drugo stranko.

10 Naročanje

Acto geographico Slovenico – Geografski zbornik lahko naročite na naslovu založnika:
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Revijo je mogoče tudi kupiti v knjigarni Azil na Novem trgu 2 v Ljubljani ali si jo sposoditi v knjižnicah (www.cobiss.si).

11 Obrazec za uredniški pregled člankov

Obrazec za uredniški pregled člankov v reviji Acta geographica Slovenica – Geografskem zborniku je zaradi uporabe uredniškega sistema *Open journal system* (OJS) zaenkrat dostopen samo v angleškem jeziku. Glej angleški del navodil.

12 Obrazec za recenzijo člankov

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