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COMPARISON OF THE SONAR RECORDING METHOD AND THE AERIAL PHOTOGRAPHY METHOD FOR MAPPING SEAGRASS MEADOWS

Mojca Poklar

MOJCA POKLAR

Underwater image of a meadow in Semedela Bay.

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Mojca Poklar[1]

Comparison of the sonar recording method and the aerial photography method for mapping seagrass meadows

ABSTRACT: This article presents a new perspective on the study of the spatial distribution of seagrass meadows, which – due to their sensitivity to coastal hydrodynamics, sediment transport, changes in nutrient content, and disruptions due to human intervention in their environment – are a good indirect indicator of the properties of seawater. Monitoring their extent and characteristics is essential for determining the properties of seawater, but this requires developing a precise methodology that involves acquiring data on the occurrence of seagrass meadows and mapping them. The base data for the survey presented are sonar recording and aerial photography data, which were utilized to create a seabed classification using geographic information systems (GIS). This provided information on the extent and characteristics of the seagrass meadows. Spatial analysis offers a new look at the coastal belt and reveals some new features.

KEYWORDS: geography, Semedela Bay, seagrass meadows, multibeam sonar data, aerial photography, GIS, line transect method, coastal area

Primerjava metode sonarskega snemanja in metode zračne fotografije za namen kartiranja morskih travnikov

POVZETEK: Prispevek prikazuje nov pogled na preučevanje prostorske porazdelitve morskih travnikov, ki so zaradi njihove občutljivosti na obalno hidrodinamiko, transport sedimentov, spremembe vsebnosti hranil in motnje zaradi človekovega poseganja v njihovo okolje, dober posredni pokazatelj lastnosti morske vode. Spremljanje njihovega obsega in lastnosti je namreč bistveno pri ugotavljanju lastnosti morske vode, zahteva pa natančno izdelano metodologijo, ki vključuje pridobivanje podatkov o razširjenosti morskih travnikov in njihovo kartiranje. Izhodišče za izvedeno raziskavo so bili podatki sonarskega snemanja in zračne fotografije, na katerih smo z uporabo geografsko informacijskih sistemov izvedli tipizacijo morskega dna, kjer je bila posebna pozornost posvečena morskim travnikom. S tem smo dobili podatke o obsegu in lastnosti morskih travnikov. Prostorske analize so omogočile nov pogled na obalni pas in razkrile nekatere nove značilnosti.

KLJUČNE BESEDE: geografija, Semedelski zaliv, morski travniki, podatki večsnopnega sonarja, zračna fotografija, GIS, metoda linijskih presekov, obalno območje

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1 Introduction

Seagrass meadows are one of the most important marine ecosystems in the world in terms of the goods they produce and ecosystem services they provide (Telesca et al. 2015). Due to their characteristics and sensitivity to coastal hydrodynamics, sediment transport, changes in nutrient content, and disruption due to human intervention in their environment, seagrasses are important species in determining the quality of a coastal ecosystem (Krause-Jensen et al. 2004; Ralph et al. 2007; McMahon et al. 2013; Peterlin 2013; Vacchi et al. 2014). Despite their importance, they are constantly threatened by numerous human activities that eventually lead to their degradation and rapid loss (Duarte 2002), estimated at a rate of 110 km²/year since 1980 (Waycott et al. 2009). Consequently, seagrass meadows are regularly included in monitoring programs, both for their protection and for their value as a bioindicator (McMahon et al. 2013). To understand the dynamic nature of seagrass meadows and to predict their response to future environmental changes (Unsworth et al. 2014), it is necessary to synoptically monitor the changes in the composition of a meadow, its spatial distribution or cover, and its biomass. Therefore, developing an effective methodology for monitoring meadows is a very topical issue (Comas Gonzales 2015).

This study focuses on mapping seagrass meadows and thus examining their spatial distribution as one of the parameters of monitoring seagrass meadows (Hossain et al. 2014). Because the changes in spatial distribution occur on small (< 1 km²) and large (> 100 km²) spatial scales, traditional field surveys (diver observations, sampling using rakes or scrapers, and other methods) are often inconvenient for mapping large areas (McKenzie 2003; Hossain et al. 2014). With the development of geographic information systems (GIS) and technical improvements in remote sensing techniques (Robbins 1997), indirect methods have become more popular. Due to the ability of remote sensing to detect changes in the spatial distribution of seagrass meadows on larger spatial and time scales, it is among the most important tools in the management of seagrass meadows because of time efficiency, speed of use, large coverage, and reproducibility of observations (Hossain et al. 2014).

On a global scale, mapping seagrass meadows using remote sensing techniques is already well known (Hossain et al. 2014), whereas in Slovenia mapping seagrass meadows is still carried out using only field surveys (Turk et al. 2002; Lipej et al. 2007). Despite the fact that there have been some individual attempts to map the seabed using remote sensing techniques (Berden Zrimec, Poklar and Moškon 2015; Berden Zrimec et al. 2015; Moškon et al. 2015), the traditional approach is still predominant. In order to reduce the constraints imposed by this approach, this study compared the sonar recording method and aerial photography method, and it verified this with the already established line transect method for determining the spatial distribution of seagrass meadows. The aim of this research was to evaluate the selected methods based on the obtained data quality and to determine their suitability and opportunities for use in further research. Of particular interest was the accuracy of both methods, especially aerial photography, for which it was assumed that the significant water turbidity typical for Slovenian waters and for a large part of the northern Adriatic Sea would be a limiting factor.

2 Methods

2.1 Research area

The research area covered Semedela Bay as the southeasternmost part of Koper Bay between Žusterna and the old town of Koper. This is a shallow bay with an average depth of 6 m (Harpha sea 2013), and, despite its strong anthropogenic transformation, its coastline has the characteristics of a depositional coast. Due to its erodible flysch hinterland (Zorn 2009), the Badaševica River carries sediments that are deposited in the sea (Malačič 1994; Orožen Adamič 2002). The area is a unique habitat because it differs from the central part of Koper Bay in its natural characteristics. The mixing of seawater and fresh water varies considerably over the course of the year (Poklar 2016). Due to this variability, the area is suitable for researching the impact of changing water properties on seagrass coverage. Two types of seagrass are found in Semedela Bay: little Neptune grass (*Cymodocea nodosa*) and common eelgrass (*Zostera marina*; Lipej et al. 2006).

2.2 Definition of a seagrass meadow

Because the perimeter of a seagrass meadow, which is the basis of determining its entire area, cannot be absolutely determined, problems may arise in defining it. In measuring phenomena that are not directly measurable, the need for an operational definition arises. This ensures that the understanding of phenomena and the data collection method are unified and repeatable (Adanza 1995). Therefore, for the purpose of this survey, the operational definition of a seagrass meadow and thereby the minimum mapping unit of 0.01 ha were defined. Even though very sparse seagrass may indicate that seagrass appears in a certain area, such areas were excluded from the operational definition of the seagrass meadow. There are several reasons for this: very sparse seagrasses have very little ecological value and also visually do not correspond to the idea of a meadow. In addition, monitoring very sparse seagrass and tracking its changes is very difficult (Virnstein et al. 2000).

2.3 Mapping seagrass meadows using the sonar recording method

Sonar data, which are essential for this survey, were obtained from bathymetric measurements with a Reson SeaBat 8125 multibeam echosounder. Measurements were conducted within seven working days (August 28th, September 26th, October 15th, 17th, 23rd, and 25th, and November 5th, 2013) in the morning in clear to cloudy weather with precipitation with winds from 0.0 m/s (smooth sea level) up to 5.9 m/s (small waves, peaks already breaking; Internet 1; Internet 2). The measurements provided a georeferenced point cloud, which was manually examined in order to avoid incorrect data that occasionally arise due to disturbances in measurements. From processed and systematically organized data, a bathymetric model with a resolution of 0.5 × 0.5 m was created, which served as a basis for mapping seagrass meadows. Based on this mapping, a spatial seabed slope analysis was made. Seagrass meadows are higher than the seabed and it was

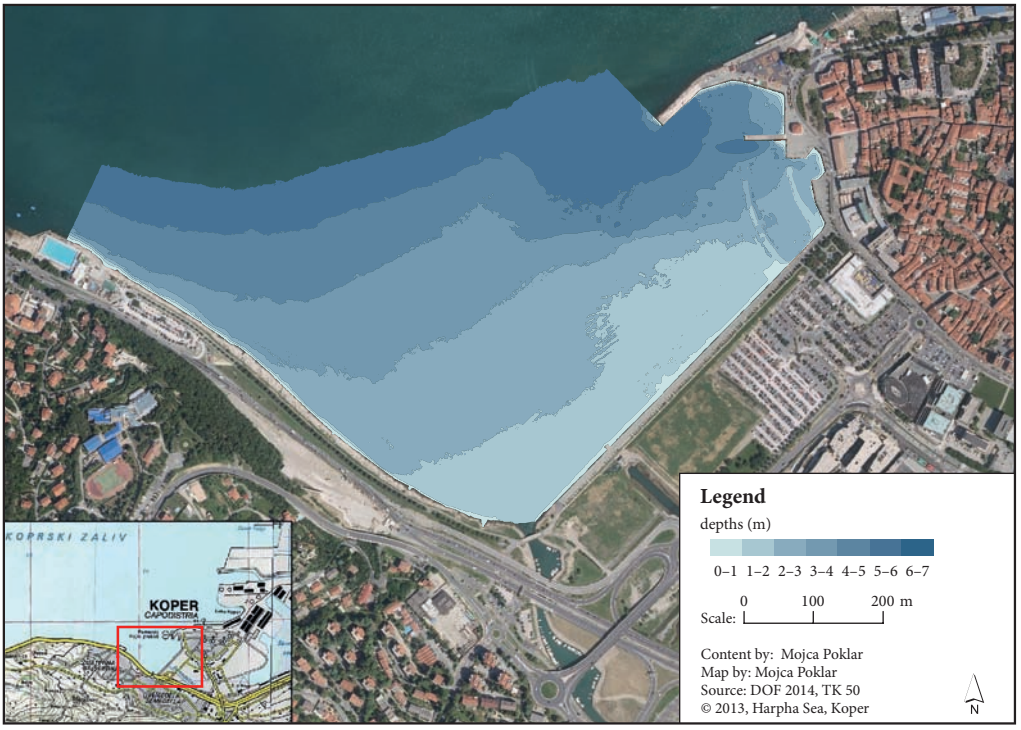

Figure 1: Depths of the Semedela Bay research area (Source: Podatki snemanja morskega dna z večsnopnim sonarjem 2013).

expected that the slopes at the transitions between silt and meadow would be quite high. The resulting layer was examined in detail. Because the area of seagrass meadow occurrence was previously recognized from an orthophoto (Digitalni ortofoto 2012), it was known in advance where they could be expected. In these areas, an attempt was made to identify key patterns or edges of seagrass meadows. A vector layer of seagrass meadows was acquired from the seabed slope raster by exporting all contours of slopes greater than 40°, which was completed and verified with raw sonar data at the end.

2.4 Mapping seagrass meadows using the aerial photography method

Aerial photography was used to obtain aerial photos, which were used to digitize seagrass meadows. This was carried out with a professional camera with automatic triggering in terms of aircraft height and velocity, providing 60% overlap of the photos in the forward direction of the flight. The exact location of the aerial photos was ensured by monitoring the position and orientation of the camera on the aircraft using a GNSS receiver and a gyroscope. Aerial photography was carried out in one working day (September 6th, 2013), in the morning during clear weather.

Prior to the digitization of seagrass meadows, pre-processing of aerial photos was carried out, which included geometric and lighting corrections. Aerial photos were then merged into a unique photo of the entire research area, which was orthorectified and georeferenced, and its contrast was improved.

Data on the spatial distribution and therefore edges of seagrass meadows were obtained through a supervised image classification of the RGB layers of the aerial photo, in combination with its visual interpretation. In the process of a supervised image classification, training samples were first created; these are areas with a known type of seabed, on which the spectral signature of the seabed type was calculated. Training samples were marked interactively using the training sample drawing tools and were determined by manual limitation. Twelve training samples were determined for various seabed types and in various situations (shadows, seagrass meadow density, etc.). For the classification, the maximum likelihood classification method was used because it is the most accurate, although it is a very demanding computing process (Oštir 2006). The quality of the classification was improved by visual interpretation of the entire photograph, for which the edges of seagrass meadows were manually corrected by evaluating the basic elements of visual photo interpretation (tone, shape, size, pattern, texture, shadows, etc.); this is the most subjective part of the method.

2.5 Verification of both methods by comparison with the line transect method and the final map of seagrass meadows

Because the sonar recording and aerial photography methods are indirect remote sensing methods, after their implementation they always require ground truth observations to verify the results already obtained (Komatsu et al. 2003).

They are helpful in interpreting the distinctive characteristics of seagrasses from sonar data or aerial photos, where they also serve as a reference point for verifying the interpretation of photos; for example, to check that no macroalgae or shells were misidentified as seagrass meadows (Krause-Jensen et al. 2004).

Accordingly, to verify the spatial distribution of seagrass meadows obtained by sonar data or aerial photography, and to evaluate the accuracy of selected methods, a field survey was carried out, which involved seabed recordings with an underwater camera. Underwater recordings were made directly from a vessel on predetermined line transects and meadow centroids (Figure 2). Because the line transects were plotted by a computer, the precise geographical position and the angles of the recordings were verified with a GNSS receiver and a gyroscope simultaneously with the recordings. The recorded videos of line transects were then processed and converted into underwater photos or raster data.

The raster data obtained represented the reference state for the verification of sonar and aerial photography data. The first phase compared the mapped edges of seagrass meadows and measured deviations from the reference state. Along five line transects, forty-six control points were randomly selected, on which the seabed type was determined (the analysis was limited to two types: silt and seagrass meadows) and then compared with sonar and aerial photography data. A comparison also included four points that represented the centroids of the seagrass meadows. Based on the comparison, the accuracy of seagrass meadows mapped with each method was assessed using a confusion matrix (Mumby and Green 2000).

Based on the evaluation of the accuracy of two remote sensing methods, the polygon layer of seagrass meadows was established. Where the edges of seagrass meadows were detected by both methods, the edge with the greater accuracy was considered. Where the edges were detected by only one method, the available ones were considered. When checking raster data from the field survey, it did not occur that an edge was not be detected by any method. The result was then mapped using the tools for analysis and spatial display of measured data.

3 Results

The multibeam sonar data and the seabed slope analysis showed that seagrass meadows' edges are clearly visible in most cases because the slope at the transition between the silt and the meadow can range from 0° to 80°. Larger and denser seagrass meadows are well visible (Figure 3), whereas the areas where the meadows are sparse are not. Such areas are difficult to separate from the silt, and so accurate mapping requires a review of raw data (the distance between points was about 10 cm) or the combination of sonar data with data from another method.

The seagrass meadow edges in Semedela Bay mapped from sonar data are shown in Figure 4. Not all the edges are connected. The western edge, which lies in the eastern part of the bay, was not completely visible because of a gradual transition between seagrass and silt. In this area, the seagrass is sparse and lower in growth, making it difficult to determine its edge. The same applies to seagrass meadows around the mouth of the Badaševica River. The sonar recording method made it possible to draw the seagrass meadow edges with a total length of 5,310.10 m.

From aerial photography data (i.e., classified aerial photos), it was determined that the edges between the seagrass meadows and silt were mostly visible. However, there were areas where the photo did not make

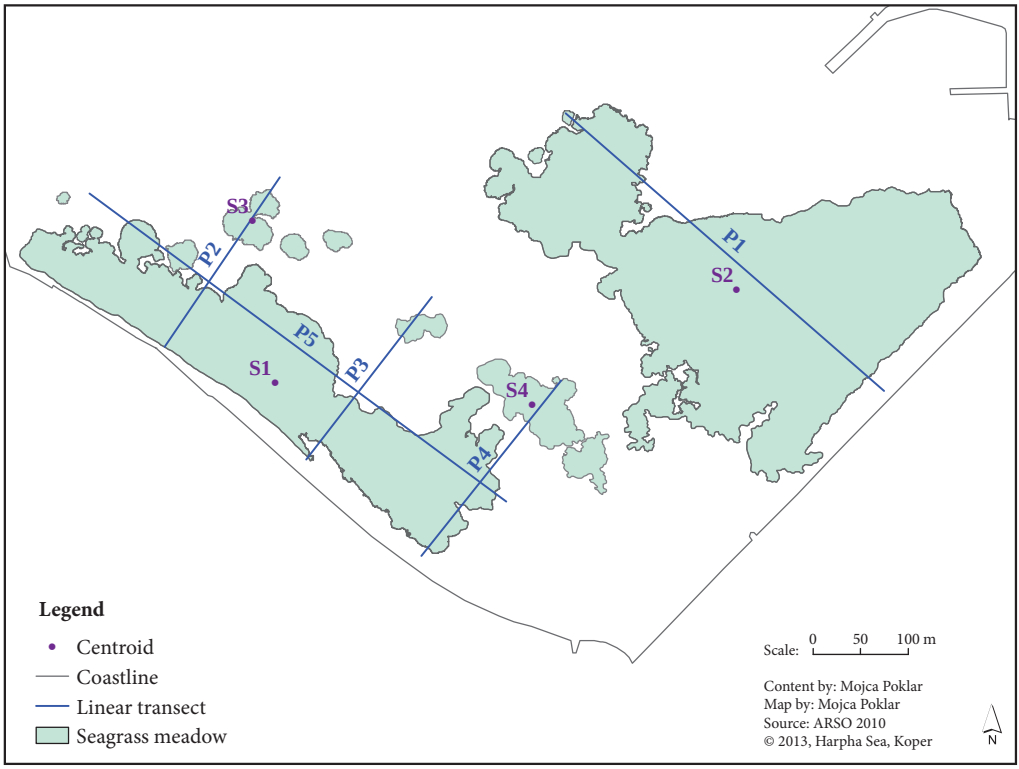

Figure 2: Selected line transects and sampling points (centroids) for verifying seagrass meadow occurrence.

it possible to recognize whether there is a meadow or not. This is especially true for deeper areas, where the lower edge of the meadow is often difficult to determine due to the smaller proportion of light that can penetrate to the seabed or to the meadow. Problems also occurred in areas where the meadow edges were less visible due to reflection of light from the sea surface. The problem was solved by changing the direction of the flight. For the research area, it turned out that the reflection of sunlight from the sea surface is less visible in the aerial photos, which were taken by flying in a north–south direction. Nevertheless, it was not possible to completely solve these problems, and so in the previously described areas the meadow edges were difficult to determine. Figure 5 shows edges of seagrass meadows mapped using the aerial photography method and with a total length of 5,727.30 m.

An overview of the underwater photos of the field survey showed the presence of both types of seabed as predicted with the sonar recording method and aerial photography method (silt and seagrass meadows). In addition, other species were also found in underwater photos; specifically, various macroalgae that appeared closer to the mouth of the Badaševica River and the noble pen shell or fan mussel (*Pinna nobilis*), found on the outer part of the seagrass meadow along the harbor at Koper.

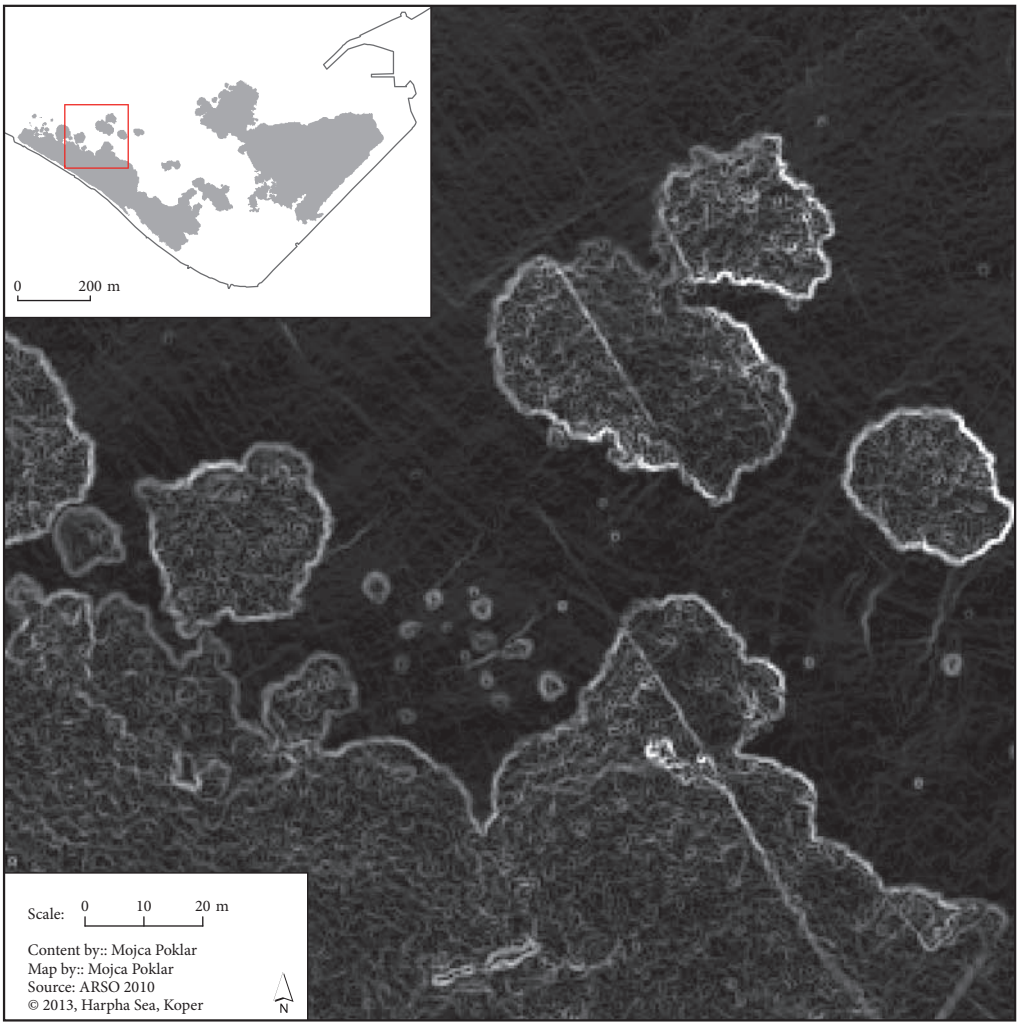

Figure 3: Example of a seagrass meadow on a seabed slope raster.

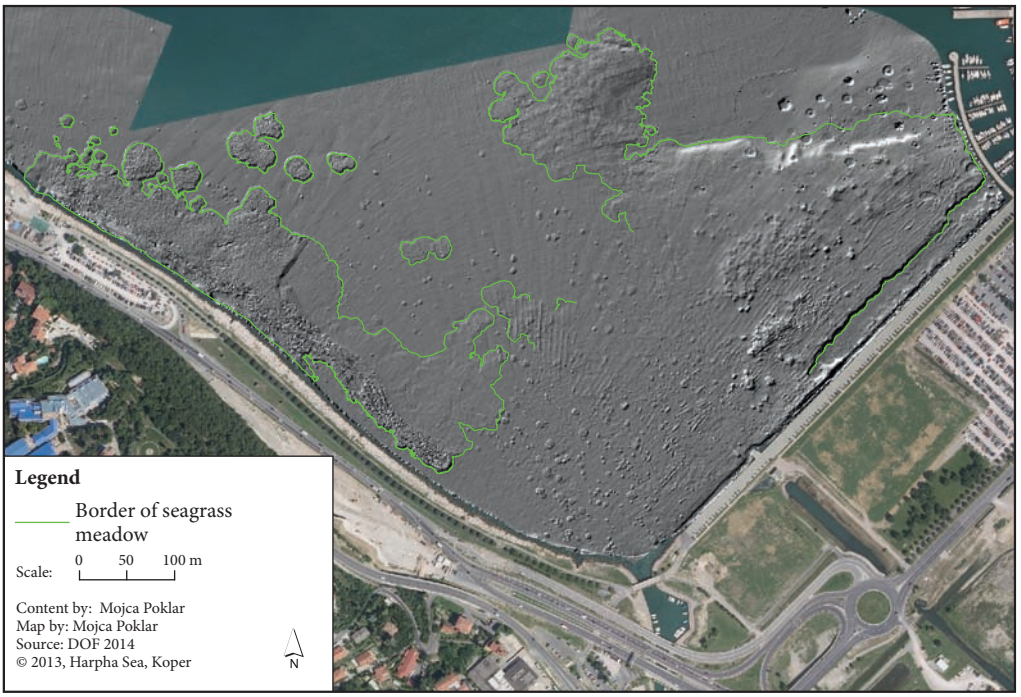

Figure 4: Seagrass meadow edges in Semedela Bay obtained using the sonar recording method.

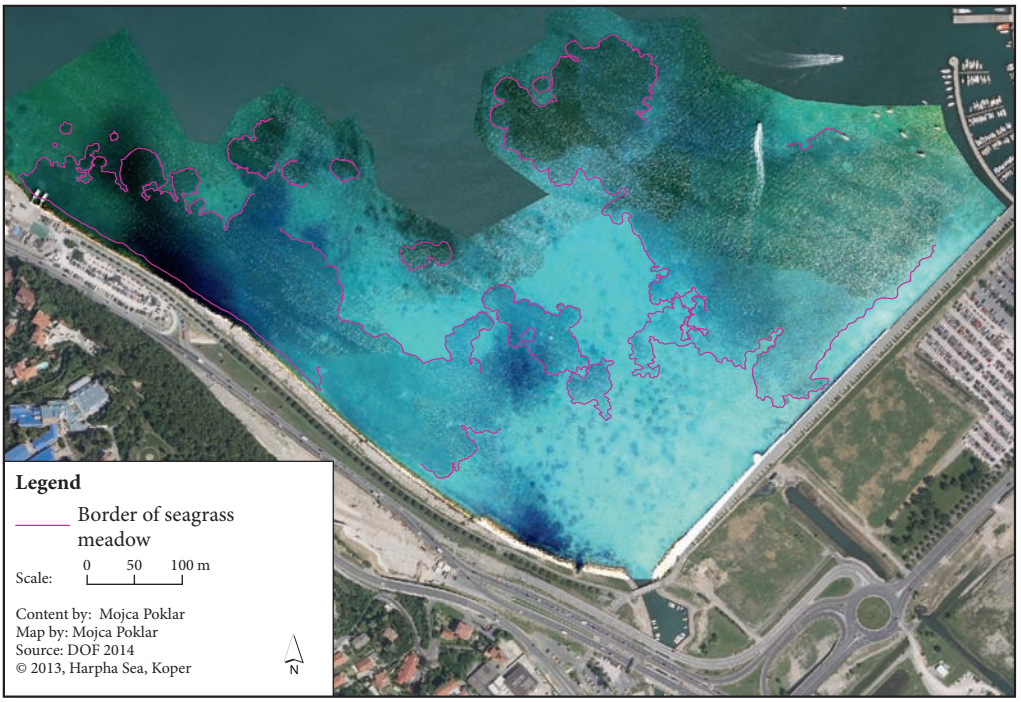

Figure 5: Seagrass meadow edges in Semedela Bay obtained using the aerial photography method.

A comparison of the seagrass meadow edges in underwater photos with meadow edges obtained using the sonar recording method showed deviations of up to 1 m, whereas at the meadow edges obtained through aerial photography deviations of up to 3 m occurred. Considering the position errors – which were estimated between 0.2 and 0.3 m (sonar data), between 0 and 1 m (aerial photography), and between 0.2 and 0.3 m (line transect data) – deviations occur for various reasons. In the case of sonar data, deviations occur in areas of gradual transition between seagrass and silt, whereas at the sharp edges of seagrass meadows the contours are completely coincident (centimeter-level accuracy). Major deviations in aerial photography data can be attributed to errors in georeferencing of aerial photos, as well as the poor visibility of seagrass meadow edges from the aerial photo in areas of greater depth and in areas where light reflected from the sea surface during the shooting.

To assess the classification accuracy of selected methods (Lillesand and Kiefer 1994), two confusion matrices were produced, comparing the predicted data of the sonar recording or aerial photography method with ground truth (reference) data of the field survey.

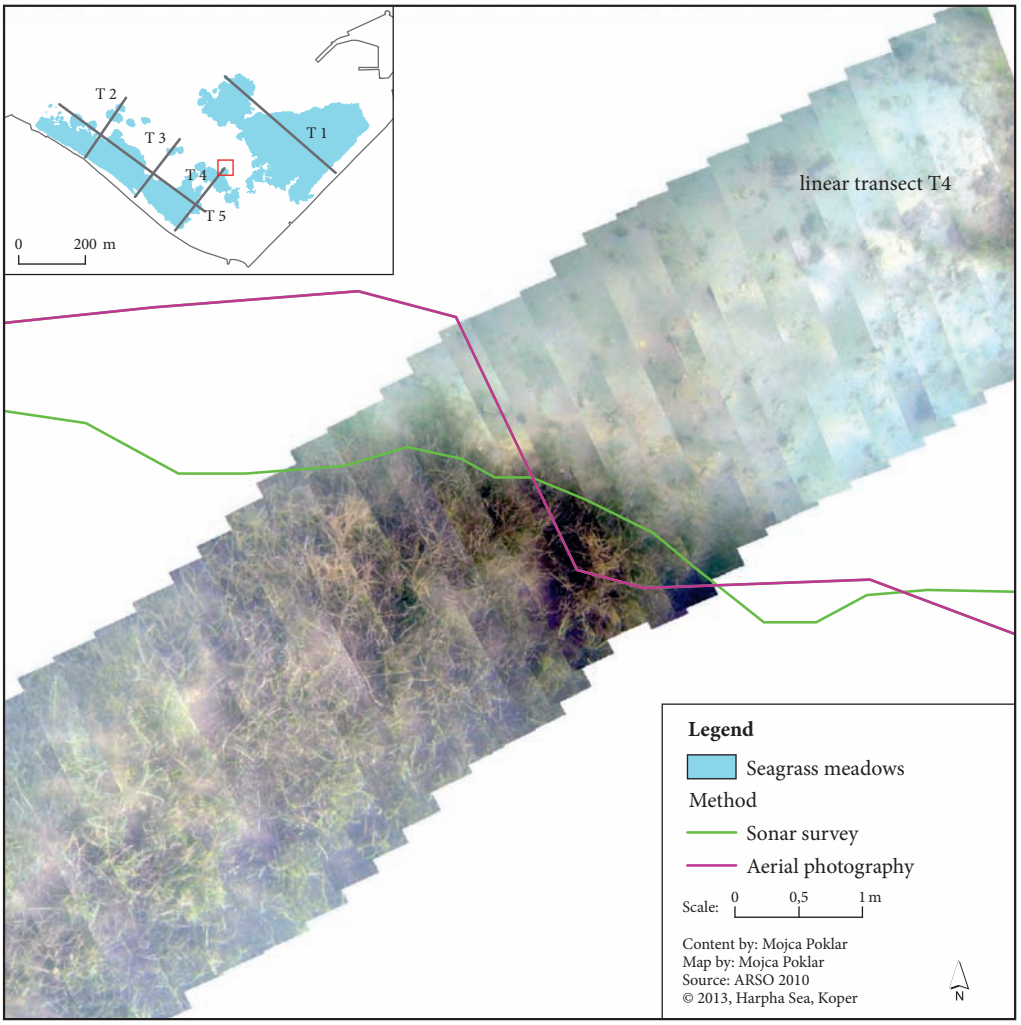

Figure 6: Example of verifying the sonar recording and aerial photography method by using the line transect method, recorded with an underwater camera on line transect T4.

Table 1: Confusion matrix of the a) sonar recording method and b) aerial photography method.

a)

		Reference data		
		Seagrass	Silt	User accuracy
Sonar recording method	Seagrass	30	3	90.9%
	Silt	1	26	96.3%
	Total number of sampling points	31	29	
	Producer accuracy	96.8%	89.7%	Overall accuracy = 93.3%

b)

		Reference data		
		Seagrass	Silt	User accuracy
Aerial photography method	Seagrass	24	13	64.9%
	Silt	7	16	69.6%
	Total number of sampling points	31	29	
	Producer accuracy	77.4%	55.2%	Overall accuracy = 66.6%

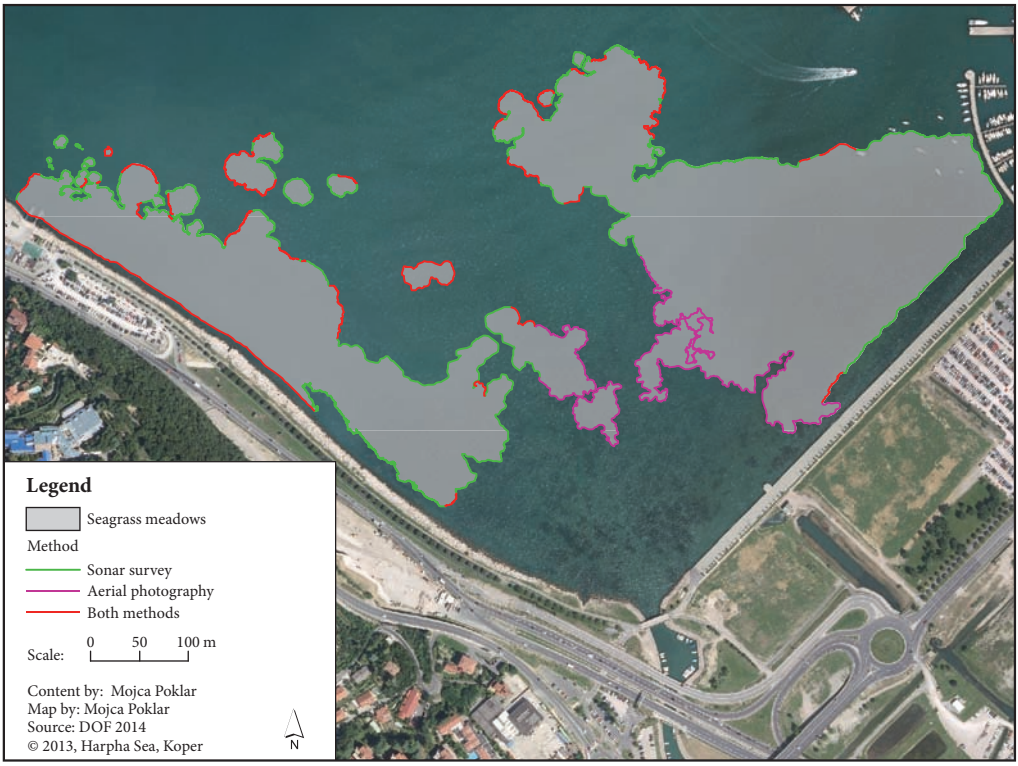

Figure 7: Seagrass meadow edges in Semedela Bay based on the mapping method used, and the final map of the meadows in Semedela Bay in autumn 2013.

Table 1 shows that sampling points labeling seagrass were more correctly classified than those that labeled silt. The difference is small (7.1%) for the sonar recording method, whereas for the aerial photography method it is considerably larger and amounts to 22.2%. In contrast, user accuracy, which serves as a guide to the results' reliability as a prediction tool, shows that in both the sonar recording and aerial photography methods the silt class is more correctly classified (96.3% by sonar recording and 69.6% by aerial photography). Nevertheless, the most noticeable information in Table 1 is the difference between the overall accuracy of the methods by which the seagrass meadows were detected. For the sonar recording the overall accuracy was 93.3%, and for the aerial photography it was 66.6%.

Based on the accuracy of both methods, a spatial data layer of seagrass meadows was created using complete sonar data (because in this case it is more accurate than aerial photography data) supplemented with aerial photography data. Based on the mapping method, a map of seagrass meadows edges was created (Figure 7). Most of the meadow edges (52%) were plotted using the sonar recording method, and the aerial photography method was useful for 24% of the plotted edges. Some edges were detected by both methods, which is shown as an independent category in Figure 7 (24%).

Figure 7, which also shows the spatial distribution of seagrass meadows in Semedela Bay, shows that seagrass meadows are distributed along the coast and in the inner part of the bay. There are two major seagrass meadows as well as a number of minor ones, constituting »islands,« separated from major meadows. Seagrass meadows were not detected at depths exceeding 5 m, where light conditions do not allow the growth of seagrass, and directly along the coast, especially at the mouth of the Badaševica River. In the past, the Badaševica deposited contaminated and nutrient-rich water in the bay, which contributed to the extremely depleted vegetation at its mouth. Because both *Cymodocea nodosa* and *Zostera marina* are sensitive to elevated levels of nutrients in the water column (Lipej et al. 2006; Orfanidis et al. 2007), this could be the main reason for the lower coverage of the seabed with seagrass in the area. Lower coverage of the seabed with seagrass directly along the Semedela promenade in the eastern part of the bay can be attributed to the renovation of the promenade in 2010. The renovation works also consisted of deepening the seabed, which led to physical damage to the seabed and associated vegetation.

4 Discussion

Measurements of the spatial distribution of seagrass meadows with the methods presented for Semedela Bay provided some key findings regarding their characteristics. The first relates to the timeframe for making the measurements. The aerial photography method is faster in comparison to the sonar recording method because photographing the entire research area was carried out in one day, whereas sonar measurements lasted several days.

Another characteristic investigated was the spatial and temporal dependence of the method. It was determined that the sonar recording method, in contrast to the aerial photography method, is a spatially and time-independent method because the data capture with a multibeam sonar is independent of water transparency and sunlight, and with accurate GNSS and INS receivers it is possible to perform quality measurements in the undulating sea. In contrast, the use of the aerial photography method in the Slovenian sea is limited due to high water turbidity. It turned out that the greatest problems arise in the bays (the sea currents are not so strong, the influence of waves is greater than in the open sea, and siltation is prominent), where the largest share of seagrass meadows is located. In addition to increased water turbidity, the problem also lies in the refraction and reflection of light on sea surface, which makes it necessary to capture photos at the best time of the day and under the best environmental conditions.

The greatest weakness of the aerial photography method is certainly its subjectivity in determining the distribution of seagrass meadows. In order to determine seagrass meadows from aerial photos, an image classification was made, partially also with a manual capture of the edges of seagrass meadows, where it was necessary to visually evaluate the basic elements of photo interpretation (such as tone, color, contrast, texture, shadows, etc.), which each individual can recognize differently.

Because the multibeam sonar spreads beams at ± 60° steering angles (Fridl, Kolega and Žerjal 2008), the method is useful for flat and for more morphologically diverse seabeds, and in addition it is also possible to measure the height of seagrass and its biomass above the seabed. However, if one is only interested in information on the occurrence of a meadow in a certain area or if the required precision of the mapped

meadows is low, the aerial photography method is more appropriate from a user perspective. This is especially true when analyzing already existing aerial or satellite images (in this case, one must take into account the lower resolution and thus the lower quality of such images), which, in contrast to the methods described, are more accessible.

In addition to these characteristics of both methods, their accuracy was of primary interest. Considering position errors – which were estimated between 0.2 and 0.3 m (sonar data), 0 and 1 m (aerial photography), and 0.2 and 0.3 m (line transect data) – the overall accuracy of the sonar data was 93.3%, whereas the overall accuracy of the aerial photos was only 63.3%. Considering that accuracy of classification over 90% is good, and that over 80% is satisfactory (Oštir 2006), the sonar recording method was good in this research case, whereas the aerial photography method did not yield the most accurate results. In this study, sonar recording is a more reliable method of data acquisition on the spatial distribution of seagrass meadows. Of course, this does not apply to less turbid waters and thus to more accurate visibility of seagrass meadows, where the aerial photography method can achieve the same accuracy as the sonar recording method. In the case at hand, this was noticeable in determining the edges of seagrass meadows in the area from the mouth of the Badaševica River to the inner part of the bay. In that area, seagrass meadows were poorly visible on sonar data due to the aforementioned gradual transition between sparse seagrass and silt, whereas they were clearly visible in aerial photos due to shallow water (0 to 2 m in depth) and thus increased light penetration through the water column to the seabed.

5 Conclusion

The purpose of this study was to show that the use of modern remote sensing technologies and GIS techniques makes it possible to obtain new and more useful results in mapping seagrass meadows, yielding better knowledge of the ecological status of the sea and a better understanding of the processes in its coastal area. Comparison of the sonar recording and aerial photography methods with the already established line transect method for determining the spatial distribution of seagrass meadows in part of the Slovenian sea showed that both methods allow efficient mapping of seagrass meadows, but they differ significantly in certain characteristics. The sonar recording method proved to be more accurate, more objective, and, in contrast to the aerial photography method, spatially and temporally independent, which is a consequence of the higher water turbidity typical of the Slovenian sea. In terms of affordability, both methods are expensive because high-precision data require high-priced equipment.

If the required precision of the mapped seagrass meadows is low or one is only interested in the occurrence of seagrass meadows in a certain area, the aerial photography method is more appropriate from a user perspective because already existing aerial or satellite images are much easier to access.

However, the choice of methodology primarily depends on the purpose of research/mapping, and then on the environmental conditions, where the water transparency or turbidity, bathymetry and morphology of the bay, weather conditions, and available resources must be taken into account. It should also be noted that the remote sensing methods used alone are not enough. Regardless of the choice of the mapping method, after applying it ground truth observations are always required in order to verify the results obtained and to explain the characteristics of seagrass recognized by remote sensing images or sonar measurements.

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SOCIAL IMPACTS OF MUSIC FESTIVALS: A COMPARATIVE STUDY OF SZIGET (HUNGARY) AND EXIT (SERBIA)

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DRAŽEN ŽIGIĆ, EXIT PHOTO TEAM

The main stage of the Exit festival, 2017.

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Social impacts of music festivals: A comparative study of Sziget (Hungary) and Exit (Serbia)

ABSTRACT: Music festivals are often seen as a key driver of the city's economies. Therefore, there is an increasing interest in the impacts associated with them. The aim of this research is to examine residents' perceptions of the social impacts of two European music festivals, Sziget (Budapest, Hungary) and Exit (Novi Sad, Serbia), applying the modified *Festival Social Impact Attitude Scale* and to compare the results using *Importance–Performance Analysis*. Similarities and differences in perceptions of social impacts of two festivals are discussed with the proposition of priorities for destinations. The findings contribute to a deeper understanding of residents' attitudes toward the impacts of festivals and can be utilized by local authorities to increase the positive and reduce the negative impacts of the festival.

KEYWORDS: social impact, music festival, residents' perception, Serbia, Hungary

Družbeni vplivi glasbenih festivalov: Primerjalna študija festivalov Sziget na Madžarskem in Exit v Srbiji

POVZETEK: Glasbeni festivali pogosto veljajo za glavna gonila mestnega gospodarstva, zato se raziskovalci čedalje bolj zanimajo za vplive, povezane z njimi. Cilj te raziskave je na podlagi prilagojene različice ocenjevalne lestvice družbenih vplivov festivalov (angl. *Festival Social Impact Attitude Scale*) preučiti stališča prebivalcev glede družbenih vplivov dveh evropskih glasbenih festivalov – Szigeta v Budimpešti in Exita v Novem Sadu – ter primerjati rezultate z uporabo analize pomembnosti in uspešnosti (angl. *importance-performance analysis*). Avtorji predstavijo podobnosti in razlike v stališčih glede družbenih vplivov obeh festivalov ter predlagajo prednostne naloge za obe mesti. Izsledki raziskave omogočajo boljše razumevanje odnosov prebivalcev do vplivov festivalov, lokalne oblasti pa jih lahko uporabijo za izboljšanje pozitivnih in zmanjšanje negativnih vplivov festivalov.

KLJUČNE BESEDE: družbeni vpliv, glasbeni festival, stališča prebivalcev, Srbija, Madžarska

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1 Introduction

The organization of festivals is one of the fastest-growing segments of the tourism industry (Getz 2010; Lashua, Spracklen and Long 2014; Kim, Duncan and Chung 2015; Bagiran and Kurgun 2016; Getz and Page 2016). Consequently, there is an increasing interest in research on the theme of festivals, specifically in terms of measuring the impacts of festivals on host communities. Getz and Page (2016) highlight that event tourism, and festivals as part of it, are primarily driven by the economic benefits (Dwyer, Forsyth and Spurr 2006; Herrero et al. 2006; Dwyer, Jago and Forsyth 2016), and so much research has been devoted to economic impacts, while other outcomes were neglected for many years. In addition, local authorities and festival organizers focus on the economic benefits of the event, and there is no doubt that they are important, but the social impacts may have an even more profound effect on the local community (Delamere 2001). Recently a fair amount of research (Delamere 2001; Delamere, Wankel and Hintch 2001; Fredline, Jago and Deery 2003; Small and Edwards 2003; Small, Edwards and Sheridan 2005; Small 2007; Rollins and Delamere 2007; Woosnam, Van Winkle and An 2013; Dragićević et al. 2015; Bagiran and Kurgan 2016; Woosnam et al. 2016; Pavluković, Armenski and Alcantara-Pilar 2017) has been conducted concerning the social impacts of festivals. However, Pavluković, Armenski, and Alcantara-Pilar (2017) highlighted that there was a lack of studies comparing the social impacts of similar events between host destinations. Moreover, in many countries, especially in emerging ones, such in the case of Serbia and Hungary, social impacts of events, and specifically festivals, are empirically still underresearched (except the work of Pavluković, Armenski and Alcantara-Pilar 2017).

One of the first scales used to measure residents' perception of social impacts of festivals was the Festival Social Impact Attitude Scale (FSIAS), developed by Delamere (2001) and Delamere, Wankel and Hintch (2001). While FSIAS was firstly used on small community festivals, there was a need to further validate it by testing it in other community types and with different types of festivals (Delamere 2001).

Therefore, the objective of this study is to assess the local residents' perceptions of the social impacts of two large-scale and worldwide popular music festivals, Sziget (Budapest, Hungary) and Exit (Novi Sad, Serbia), using the modified FSIAS. Exploratory factor analysis was carried out in order to determine the underlying factor structure of modified FSIAS. In addition, Importance-Performance Analysis (IPA) was employed to compare the results and to examine the implications of the findings for both festivals' management and destinations that can assist them to develop a focused action agenda to achieve and maintain festivals' sustainability and community support.

As these two festivals take place annually in summer months, attract similar music performers and visitors, they are often seen as competitors. Moreover, the festivals are held in Europe, in neighboring countries that have some similar political and economic settings – post-communist countries that experienced a transition to a market-based economy (Stankov and Dragićević 2015). In this context, the comparative study is of importance.

2 Literature review

2.1 Social impact of festivals

»*Festivals are emerging as growing and vibrant sector of the tourism and leisure industries and are seen to have significant economic, sociocultural, and political impacts on the destination area and host groups*« (Arcodia and Whitford 2007, 1). According to Getz (2008) festivals produce various outcomes and managers cannot concentrate only on event profitability as a measure of success. Instead, social and environmental impacts of an event should be equally considered (Small et al. 2005; Wood 2005; Reid 2007; Kim and Petrick 2005; Delamere et al. 2001; Fredline, Jago and Deery 2003). However, there are difficulties involved in distinguishing between social, cultural, environmental and economic impacts of the events all of which can have political repercussions (Getz and Page 2016) and affect the quality of life of the host community. Park (2007) defines social impacts as positive or negative changes in social and cultural conditions directly or indirectly resulting from an activity, project, or program. For the purpose of this paper, social impacts are defined as any impacts that potentially affect the quality of life for local residents (Fredline, Jago and Deery 2003). Similarly, Sharpley and Stone (2012) pointed out that the social impacts of events refer to effects on people's life.

There have been significant efforts to create measurement scales in order to assess how residents perceive the social impacts of events. Delamere, Wankel and Hintch (2001), Fredline, Jago and Deery (2003),

and Small and Edwards (2003) developed the most commonly used scales. Fredline, Jago and Deery (2003) developed a scale similar to FSIAS to measure the social impacts of a variety of medium to large-scale events. Small and Edwards (2003) created the Social Impact Perception (SIP) scale with 35 items across six factors which are comparable with factors presented by Delamere (2001) and Fredline, Jago and Deery (2003).

Delamere, Wankel and Hintch (2001) developed FSIAS to be used for the measurement and interpretation of residents' perceptions of the social impacts of community-based festivals. Through exploratory factor analysis and removal of cross loading and low loading items (from 70 to 47 items), two main factors of the scale were determined: social benefits (comprising 21 items – positive impacts) and social costs (26 items – negative impacts) of festivals. Delamere (2001) further refined FSIAS and verified the two-factor scale across 25 items. The social benefits factor comprised items relating to community image, identity, wellbeing, experiencing new things, opportunities to develop new skills. The second factor (social costs) explained a range of items related to overcrowding, traffic, litter, noise and disruption and intrusion into the lives of local residents.

Recently, there has been an increase in the utilization of FSIAS in different community settings and types of festivals. Bagiran and Kurgan (2016) applied original FSIAS in their research on the residents' perceptions of the Foca Rock Festival in Izmir, Turkey. They confirmed the two-dimensional nature of FSIAS (social benefits and social costs) with 35 items in total. Similarly, Woosnam, Van Winkle and An (2013) confirmed the factor structure of the FSIAS utilizing the context of a cultural heritage festival in rural Texas. They found that residents' perceptions of impacts differed across the length of residency and annual household income. Dragićević et al. (2015) assessed Maribor residents' attitudes towards the social impacts of the European capital of culture, using modified FSIAS. They found that residents perceived more positive than negative impacts of the event.

Woosnam et al. (2016) examined perceived social impacts of the annual harvest festival in the rural town of Morden, Manitoba (Canada) on the community as well as the underlying structures of motivations to attend the festival among residents and visitors through modified FSIAS and a newly developed festival–attending motivation scale. Their modified FSIAS had a four-factor structure: social costs (comprised of the same items as in original FSIAS), community benefits, individual benefits (the same as factor social benefits in original FSIAS) and new factor labeled new opportunities. In addition, this was the first study to consider motivations as a predictor of perceived impacts. Pavluković, Armenski and Alcantara-Pilar (2017) utilized modified FSIAS to identify the underlying dimensions of social impacts of two large-scale music festivals, Exit (Serbia) and Sziget (Hungary), and to explore moderation effect of Hofstede's national cultural dimensions on residents' perceptions of impacts of these festivals on their communities. Results reveal the six-factor substructure of FSIAS that represents two main, positive and negative, dimensions of social impacts of large–scale music festivals. In addition, they found that national culture significantly influenced residents' perception of the impacts of the festival on their community.

All the above–mentioned studies call for further testing and modification of FSIAS in order to contribute to the academic literature on the social impacts of the events and on a practical basis to improve the management of festivals. Therefore, this research is of importance.

2.2 Importance–Performance Analysis

Importance-Performance Analysis (IPA) introduced by Martilla and James (1977) is a widely used technique for developing management strategies. IPA identifies attributes for which, given their importance, a product or service underperforms or over-performs. It combines measures of attribute importance and performance into a two–dimensional grid in order to facilitate data interpretation and attain practical recommendations (Dwyer et al. 2016).

Figure 1 illustrates the IPA grid. The Y-axis shows the perceived importance of specific attributes while the X-axis reflects the performance when compared with these attributes. The four quadrants are labeled as follows: Concentrate here, Keep up the good work, Low priority and Possible overkill. In the Concentrate here quadrant, attributes are considered to be very important, but of low performance, meaning that improvement efforts should be concentrated here. In the quadrant labeled Keep up the good work very important attributes with high levels of performance in relation to these activities are concentrated. In the Low priority quadrant, attributes have both low importance and low performance and therefore should not be of management concern. Possible overkill quadrant gathers attributes of low importance and of relatively high performance meaning managers should consider their efforts on these attributes as being overexploited

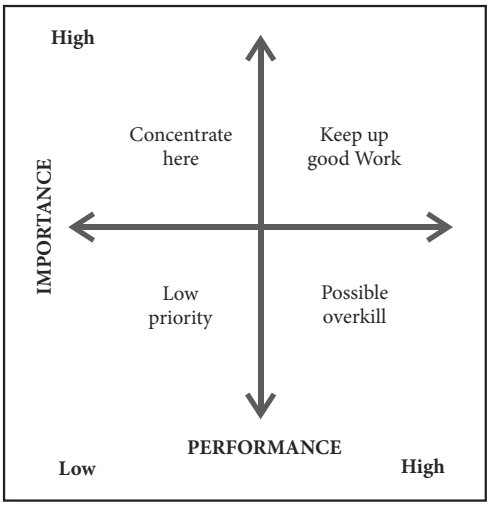

Figure 1: Importance–performance grid (Dwyer et al. 2016).

(Chu and Choi 2000). The standard four quadrants matrix helps stakeholders/managers to identify the areas for improvement and actions for minimizing the gap between importance and performance.

Importance-Performance Analysis has increasingly been applied in tourism contexts, including the hotel industry (Beldona and Cobanoglu 2007; Chu and Choi 2000), travel markets (Murdy and Pike 2012), leisure and recreation (Deng 2007; Chen 2014), tourism destination competitiveness (Dwyer et al. 2013; Dwyer et al. 2015; Dwyer et al. 2016), festival quality and attractiveness (Kim, Ahn and Wick 2014; Choi 2015), transportation (Huang, Wu and Hsu 2006).

3 Methods

3.1 Study site

Exit festival is a summer music festival held annually since 2000 in the city of Novi Sad, Serbia. It started as a student movement fighting for democracy in Serbia, but already in 2001, it became one of the most important music festivals in Europe. The four-day festival takes place on the first weekend of July. It was ranked top 10 best major festivals at European Festival Awards from 2009 to 2013, one of the 10 Best Overseas Festivals at UK Festival Award 2014 and Best Summer Music Festival in Europe for 2016 by travel portal »European Best Destinations« in cooperation with the European Commission. More than 2.5 million people from over 60 countries around the world have visited the festival so far (Internet 1; Pavluković, Armenski and Alcantara-Pilar 2017).

From a student event in 1993 Sziget Festival has become one of the largest summer music events in Europe, held every August in Budapest, Hungary. This seven days festival has had more than 500,000 visitors from over 100 countries in 2016. It was ranked one of the five best festivals in Europe by The Independent in 2011 and is a two–time winner at the European Festivals Awards in the category Best Major European Festival in 2012 and 2015 (Internet 2).

3.2 Research instrument, sampling and data collection

To achieve the objective of the study, a two-step procedure was conducted. First, in order to adopt original FSIAS to the research setting of large–scale music festivals, five academics from Serbia and Hungary who have research experience in tourism and event management were asked to discuss on FSIAS. Based on this discussion, the original scale was refined to suit specific cases of Exit and Sziget festivals. Namely, 20 original items from FSIAS were kept and 11 new items were proposed. The final scale consists of 31 items with good internal consistency ($\alpha = 0.88$).

Second, by using the refined scale, the main survey was conducted among residents of Novi Sad and Budapest, host destinations of Exit and Sziget, in summer months June–September 2014, when festivals are held. The questionnaire used was composed of three sections. The first part included background information of participants. The second part consisted of 31 items – social impacts, for which local residents of Novi Sad/Budapest were asked to evaluate the perceived importance of the impacts when organizing any festival in their community on a five-point Likert scale ranging from 1 (least important) to 5 (most important). In the third part residents evaluated the same 31 items in respect of actual festival performance using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was prepared in two languages: Hungarian (for respondents from Budapest) and Serbian(for respondents from Novi Sad). It was created using *Google Docs* and distributed electronically. In total 505 usable questionnaires were obtained (301 from Novi Sad and 204 from Budapest). Some authors believe that the assessment will be good only if the sample contains a minimum of 51 units (Bagozzi 1981; Barrett and Kline 1981), while others think that 150–300 observations will be sufficient (Pallant 2011). According to MacCallum et al. (2001), a sample size between 100 and 200 is acceptable. Therefore, the sample size used in this study is adequate for the analyses conducted. The data was processed with the statistical package *SPSS 2.0*.

4 Results

4.1 Respondents' profile

The respondents characteristics are shown in detail in Table 1. In both subsamples, females, younger residents (less than 31) and those who attended the festival evidently show higher interest to take part in the research.

Table 1: Respondents' characteristics.

City/Festival	Novi Sad/EXIT		Budapest/SZIGET	
Characteristics	Absolute frequencies	(%)	Absolute frequencies	(%)
Gender				
Female	200	66.4	120	58.8
Male	101	33.6	84	41.2
Age				
Less than 31	167	55.5	111	54.4
Between 31–41	92	30.5	56	27.5
More than 41	42	14.0	37	18.1
Years of residence in the cities				
Less than 10 years	76	25.3	68	33.3
Between 10 and 20 years	78	25.9	42	20.6
More than 20 years	147	48.8	94	46.1
Level of Education				
High school	70	23.2	50	24.5
2–years higher education	31	10.3	59	28.9
Graduate studies	133	44.2	54	26.5
Post graduate studies	67	22.3	41	20.1
Attendance at the festival				
Yes	216	71.8	147	72.1
No	85	28.2	57	27.9
Number of times attending the festival				
Never	85	28.2	57	27.9
Once	34	11.3	27	13.3
Two times	27	9.0	32	15.7
Three times	25	8.3	19	9.3
More than three times	130	43.2	69	33.8
Total	**301**	**100.0**	**204**	**100.0**

4.2 Exploratory factor analysis

To explore dimensions of modified FSIAS exploratory factor analysis was carried out, using the principal component method and Oblimin rotation. The Kaiser–Meyer–Olkin (KMO) overall measure of sampling adequacy (KMO = 0.927) and Barlett's test of sphericity (p = 0.000) suggested that the data were suitable for factor analysis. In this study, all factors with an eigenvalue greater than 1 and with factor loadings of more than 0.5 were retained. The results of the factor analysis suggested a two-factor solution, which explained 46.35% of the total variance. The results produced a clean factor structure with relatively higher loadings on the appropriate factors. Most variables were loaded heavily on one factor and this reflected that there was minimal overlap among factors and that all factors were independently structured. Cronbach's α values for each factor were greater than recommended 0.7 (DeVellis 2003), suggesting that the scale used in the survey has considerable reliability (Nunnally 1978).

Table 2: Results of exploratory factor analysis for modified FSIAS.

Factors	Variance explained	Eigen value	Parallel analysis 95 percentile of random Eigenvalues	Cronbach's alfa	Number of items
F1 Social benefits – Positive impacts	32.35	10.027	1.538	0.937	22
F2 Social costs – Negative impacts	14	4.342	1.472	0.863	9

The factors are labeled as in the original FSIAS scale (Delamere 2001): first factor »social benefits«, as it involves 22 items referring to positive impacts of a music festival on the local community, and second factor »social costs« consists of nine items – negative impacts of a festival on the local community. In the following sections, we will discuss each of the items – social impacts of two festivals across two dimensions of scale, positive and negative.

4.3 IPA results

Table 3 shows the mean values of social impacts of music festivals on local communities in relation to importance and performance. For almost each of the impacts, the respondents rated importance relatively highly and consistently higher than performance. In addition, t-test of paired samples was employed in order to test the difference between each festival impact performance and importance mean. Almost all importance and performance means for both festivals were found to be significantly different ($p < 0.05$) (see Table 3). Interestingly, for both groups of respondents, there is no statistically significant difference in evaluating the importance and performance of impact labeled P3. In addition, this social impact of both festivals demonstrates strong performance. Further, the data were transferred to the IPA grid presentation in order to provide easier interpretation and discussion of the results and comparison of the festivals.

Figure 2 and Figure 3 are constructed using data means (the mean scores of importance and performance across all 31 social impacts) as the intersection point of the x (performance) and y (importance) axes. For easier interpretation, positive impacts are labeled P1–P22 and negative impacts N1–N9 (see Table 3).

Almost all of the negative impacts (except two) of Exit festival are located in Low priority or Possible overkill quadrants, while most of the positive impacts are in Keep up good work and Concentrate here area, meaning that respondents from Novi Sad are more focused on positive impacts of the festival. This is consistent with the literature in general, which emphasizes that local communities are more aware of festival benefits to the community. In the case of the Sziget festival, the benefits and costs are more dispersed among quadrants, and we assume a higher level of tourism development and event industry.

Table 3: Descriptive statistics of the importance and performance of social impacts of festivals and t-test paired samples.

Impacts		EXIT				SZIGET			
		I	P	t	p*	I	P	t	p*
P1	Festival enhances image of the community	4.59	4.40	−3.828	0.000	3.64	3.57	−0.729	0.467
P2	Community identity is enhanced through festival	4.47	3.89	−8.825	0.000	3.41	2.87	−6.512	0.000
P3	Hosting festival improves promotion of the city internationally	4.66	4.73	1.803	0.072	4.42	4.44	0.291	0.771
P4	Festival enables local community to present itself to others (visitors) as special and unique	4.38	4.09	−4.430	0.000	3.78	3.64	−1.601	0.111
P5	Festival acts as a showcase for new ideas for the locals	4.46	3.76	−11.116	0.000	4.00	3.36	−7.246	0.000
P6	Festival contributes to sense of community well-being	4.24	2.89	−19.271	0.000	4.00	3.11	−6.166	0.000
P7	Community feels a sense of pride due to hosting festival	4.37	3.75	−10.224	0.000	3.70	3.50	−7.367	0.000
P8	Festival has ongoing positive cultural impact on community	4.41	3.81	−11.594	0.000	4.18	3.51	−6.462	0.000
P9	Festival improves the quality of life in community	4.57	3.03	−16.970	0.000	4.13	2.57	−11.810	0.000
P10	Festival provides residents with opportunity to learn new things	4.33	3.58	−9.936	0.000	3.64	3.05	−6.498	0.000
P11	The local community has a chance to meet festival performers	4.30	3.04	−8.325	0.000	3.75	3.11	−3.911	0.000
P12	Local community is exposed to a variety of cultural experiences through festival	3.69	3.92	−6.576	0.000	3.50	3.65	−3.136	0.002
P13	Local community gains positive recognition as a result of festival	4.35	3.70	−7.847	0.000	3.96	3.26	−9.043	0.000
P14	Festival provides new job opportunities for residents	4.45	3.63	−11.702	0.000	4.41	3.72	−7.725	0.000
P15	Due to hosting the festival, residents have the opportunity for additional income	4.53	4.31	−4.230	0.000	4.52	3.75	−9.022	0.000
P16	Festival is of great importance for exploring the local culture by visitors	4.60	3.95	−10.365	0.000	4.13	3.13	−9.593	0.000
P17	There is high security level of festival visitors	4.81	3.60	−18.475	0.000	3.36	3.58	2.214	0.028
P18	There is high security level of residents during the festival	4.82	3.55	−19.135	0.000	4.48	3.38	−12.415	0.000
P19	Festival visitors behave properly	4.70	3.28	−20.716	0.000	4.49	3.15	−15.091	0.000
P20	Festival program is rich and diverse	4.71	3.83	−13.407	0.000	4.63	3.79	−10.347	0.000
P21	Local community is involved in the organisation of the festival	4.32	3.21	−15.327	0.000	3.46	2.79	−7.153	0.000
P22	Local community attitudes toward organization of the festival are acknowledged	4.28	2.79	−18.731	0.000	3.98	2.78	−12.354	0.000
N1	Festival leads to disruption in normal routine of residents	3.95	3.18	−7.911	0.000	3.85	3.27	−5.586	0.000
N2	Community facilities are overused	3.38	3.45	0.720	0.472	3.57	3.39	−1.796	0.074
N3	The influx of festival visitors reduced privacy in community	3.56	2.61	−11.142	0.000	3.99	3.18	−9.479	0.000
N4	Community is overcrowded during festival	3.08	3.68	6.266	0.000	3.34	3.11	−2.131	0.034
N5	Local traffic increases to unacceptable levels	3.52	3.01	−5.865	0.000	3.48	2.90	−5.837	0.000
N6	Noise levels increase to an unacceptable level	3.33	3.71	4.599	0.000	3.77	2.84	−9.136	0.000
N7	Litter increases to unacceptable levels	4.52	3.44	−12.915	0.000	4.10	2.99	−11.935	0.000
N8	Prices of products and services increases	4.16	3.69	−5.404	0.000	4.14	3.11	−9.644	0.000
N9	Crime in community increases	4.78	2.59	−28.928	0.000	4.59	2.25	−24.708	0.000
Mean value of whole scale (for all items)		**4.23**	**3.55**			**3.95**	**3.25**		

*Note: I –mean value of Importance, P –mean value of Performance, *p < 0.05*

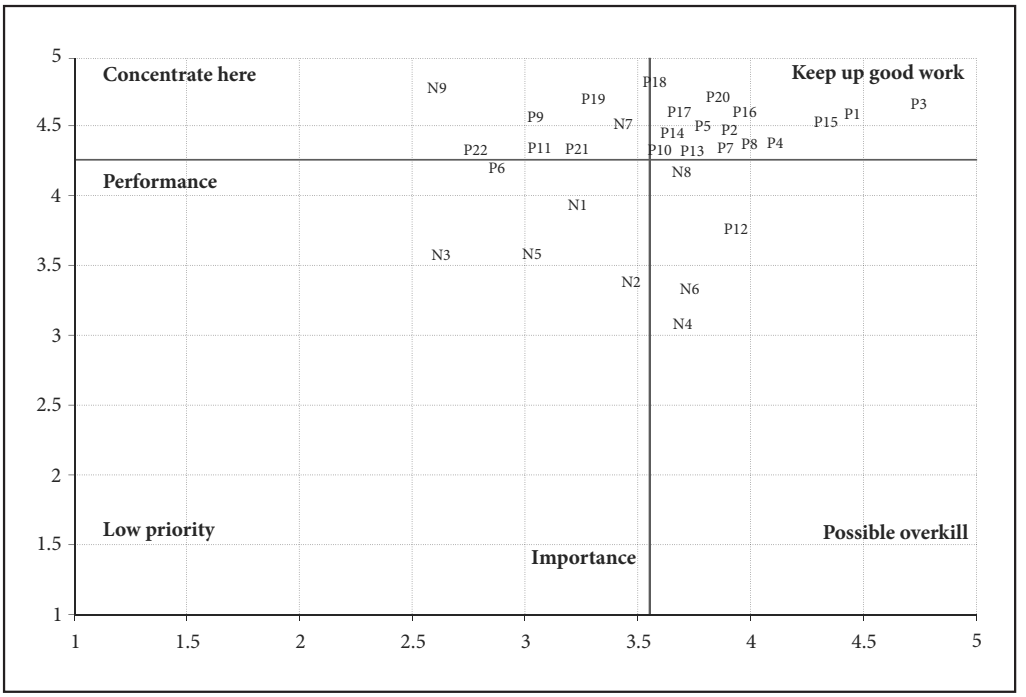

Figure 2: IPA grid for the Exit festival.

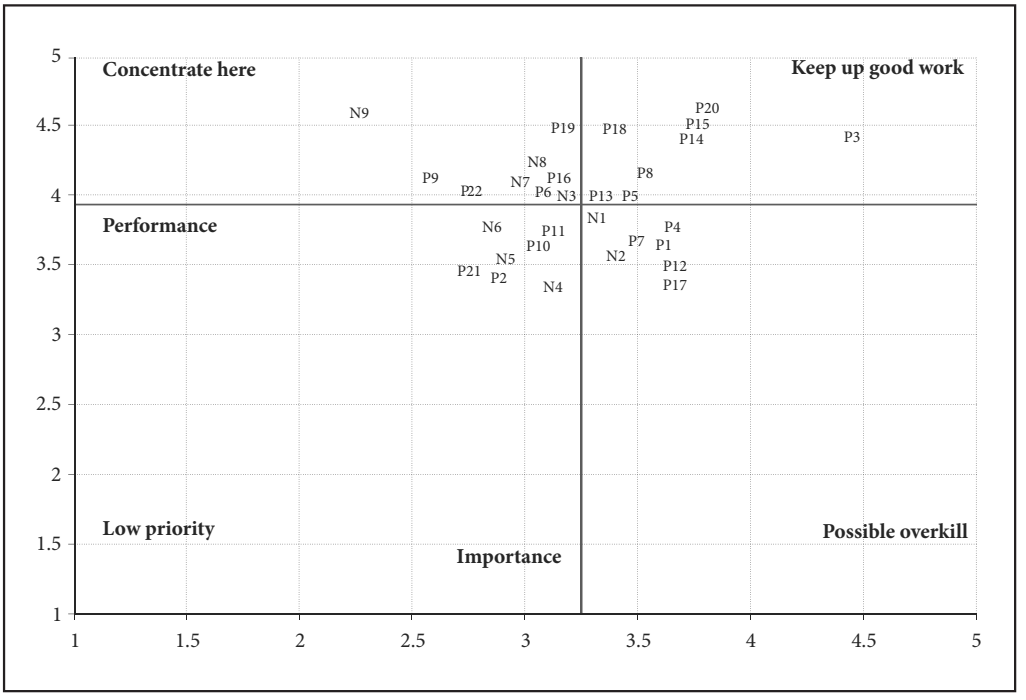

Figure 3: IPA grid for Sziget festival.

5 Discussion

5.1 Social impacts of Exit and Sziget in common

In this section, the social impacts of Exit and Sziget, which are located in the same IPA quadrants (see Table 4), will be discussed in order to highlight festivals' similarities. Both sets of respondents from Novi Sad and Budapest nominated eight positive impacts of festivals as combining relatively high importance and performance.

Table 4: Social impacts of Exit and Sziget located in the same IPA quadrants.

IPA Quadrant	Impact of festival
Keep up the good work	P3 Hosting festival improves the promotion of the city internationally
	P5 Festival acts as a showcase for new ideas for the local community
	P8 Festival has an ongoing positive cultural impact on the community
	P13 Local community gains positive recognition as a result of the festival
	P14 Festival provides new job opportunities for residents
	P15 Due to hosting the festival, residents have the opportunity for additional income
	P18 There is the high-security level of residents during the festival
	P20 Festival program is rich and diverse
Concentrate here	P9 Festival improves the quality of life in the community
	P19 Festival visitors behave properly
	P22 Local community attitudes toward the organization of the festival are acknowledged
	N7 Litter increases to unacceptable levels during festival
	N9 Crime in community increases during the festival
Low priority	N5 Local traffic increases to unacceptable levels
Possible overkill	P12 Local community is exposed to a variety of cultural experiences through the festival

That festival program is rich and diverse and adds entertainment opportunities for the community is consistent with recent awards both festivals got an increased number of visitors. In this field, festival organizers should keep up the good work. Respondents in both destinations affirmed the importance of residents' safety during the festival, which was expected as safety risks are associated with outdoor music festivals. Research suggests that safety and security are fundamental requirements for tourism destination competitiveness (Dwyer and Kim 2003) as well as for festivals' sustainability. It seems that so far Exit and Sziget have performed well with respect to residents' safety and should continue in the same manner.

Affirmation by both sets of respondents that Exit and Sziget festivals provide new jobs and additional income opportunities is consistent with research literature emphasizing the capacity of festivals to generate increased revenues and job opportunities for locals (Dwyer, Forsyth and Spurr 2006). This is specifically important for countries like Serbia and Hungary where average wages are among the lowest in Europe (Stankov and Dragićević 2015; OECD 2016).

That hosting festival improves the promotion of the city internationally was another benefit of festivals. Both festivals have been attracting an increasing number of people from different parts of Europe as well as from other continents in the past decade (Nagy and Nagy 2013). Namely, the number of foreign visitors in both, Novi Sad and Budapest increased in July and August, months when festivals are held. Both festivals emerged from small local events to multicultural European music festivals. In addition, the impact of festivals on the promotion of cities and consequently tourism development is well documented in the literature on festivals (Getz 2008; Montgomery 2007).

Findings that local communities gain positive recognition as a result of festivals and that both festivals have an ongoing positive cultural impact on host communities are consistent with research literature (Bowdin et al. 2006; Gursoy, Kim and Uysal 2004).

Five impacts of festivals fall into Concentrate here category for both Exit and Sziget. It seems that both festivals management together with local authorities should focus on decreasing crime rates during festivals, solving environmental issues (increased garbage in public areas) and controlling the behavior of festival visitors. The literature emphasizes that the delinquent behavior of festival visitors in the long-term impacts residents' support for the festival and the image of destination (Deery and Jago 2010), as well as the quality of life in the community. Residents' attitudes toward festivals are of great importance as the local community is directly involved in creating an experience for visitors and furthermore, their support for the event will probably affect the festival sustainability (Gursoy and Kendall 2006). Festivals' management and local authorities should acknowledge that there could not be a successful festival unless the community is involved in it (Mason 2015).

Both sets of respondents accorded low-priority to traffic jams during the festival. Since Exit and Sziget last a few days, the residents of both cities may not think that festivals can create any major traffic problems in a few days period. Local residents are willing to accept short-term irritation (such as traffic and parking problems) as they are aware of numerous benefits that festivals generate (Deery and Jago 2010).

5.2 Differences in social impacts priorities of Exit and Sziget

There are a large number of benefits and costs of Exit and Sziget festivals valued differently by the two sets of respondents. We herein focus on Keep up the good work and Concentrate here categories since these have important implications for the action agenda of festival management and tourism leaders in each destination.

Respondents from Novi Sad consider that Exit is performing well in respect of several impacts of relatively high importance. They identified high performance in the enhancement of community image, which is consistent with literature that emphasizes the role of the festival in improving the place's image (Getz 2008; Van den Berg 2012). In contrast, respondents from Budapest placed this impact in a Possible overkill quadrant, which was expected as Budapest has already created an image as a travel and event destination.

In addition, respondents from Novi Sad allocated several benefits of the festival (enhancement of community identity, sense of pride, opportunity to learn new things, the high-security level of festival visitors) to Keep up good work quadrant while respondents from Budapest placed them into Possible overkill and Low priority quadrant.

These differences could be due to slightly different tourism development stages of hosting destinations. Budapest is the most populous city in Hungary, with about 1.7 million inhabitants and more than 3 million tourists in 2017, while Novi Sad is a smaller community with about 300,000 residents and 130,000 tourists in 2014. According to Pizam (1978), tourism concentration on a destination area leads to negative attitudes toward tourists and tourism in general. The differences in population and in the number of tourists in Budapest and Novi Sad could affect both communities' attitudes towards benefits of festivals, meaning residents of Novi Sad perceived more benefits of festivals than residents of Budapest. Respondents from Budapest think more efforts should be made towards presenting the local culture to the festival visitors.

Respondents from Novi Sad indicated two impacts of the festival that deserve priority: the local community should be involved in the organization of the festival and should have a chance to meet festival performers. However, these are low priorities for respondents from Budapest. In the case of Serbia, these results are not surprising as younger respondents with less than 31 years old make more than half of the sample in this research, and they are usually willing to socialize and meet new people, specifically festival performers, which bring excitement to their everyday life and create positive memories related to festival.

Interestingly, the respondents from Novi Sad affirmed that Exit festival management and local authorities should concentrate on involving the local community in the festival organization and should acknowledge community's attitudes, which is consistent with general opinion in the research literature (Arcodia and Whitford 2007; Gursoy and Kendall 2006; Mason 2015). Both festivals' management should concentrate on collaboration with community and consultation before, during and after the festival, in order to provide community well-being and its support for the festival in long terms (Arcodia and Whitford 2007).

Respondents from Budapest emphasized as priority area the festival's contribution to the sense of community well-being. However, respondents from Novi Sad regard it as a low priority, which is not in accordance

with the positive impacts of the Exit festival located in Keep up good work quadrant that altogether contribute to community well–being. In addition, it is inconsistent with the growing evidence in the literature that festivals have public good aspect beyond generating revenue (Getz and Page 2016).

Respondents from Hungary indicated two negative impacts of the festival, which should be in the focus of local authorities. The research literature indicates that like any other type of tourism development, festivals generate an increase in prices of goods and services and overcrowding in streets and public places, which affects residents' privacy (Gursoy, Jurowski and Uysal 2002; Tosun 2002). For the Exit festival, these impacts are located in Low priority and Possible overkill category. A number of researchers who examined the link between the perception of negative impacts and the support for tourism development reported that there was a negative relationship between negative impacts and residents' perceptions of tourism development (Gursoy, Jurowski and Uysal 2002; Tosun 2002).

6 Conclusion

This study has presented and discussed the social impacts of two famous European music festivals Exit and Sziget on their communities using modified FSIAS and IPA. So far, there was a lack of studies comparing the social impacts of similar events between host destinations with an exception to the work of Pavluković, Armenski and Alcantara-Pilar (2017). Moreover, this study was conducted in response to recent calls for further testing and modification of FSIAS in different settings.

The paper has theoretical and practical contributions. First, it expands the body of knowledge on the social impacts of festivals. Then, it validates the usage of FSIAS in a novel context of large-scale festivals in urban communities. The scale can still produce reliable results even if slightly modified and utilized in different environments. The results of exploratory factor analysis show the acceptable and meaningful two-factor structure of modified FSIAS, as in Delamere et al. (2001) original FSIAS. In addition, this study seeks to encourage the use of IPA in geography, specifically urban and social, as this technique is widely used in a tourism context. Also, within urban social geography, considerable effort has been directed to assessing the quality of life and urban environmental quality (Pacione 2003). Given the importance of social impacts of festivals on the quality of every-day life for local residents and on the urban space, this paper contributes to the body of knowledge in urban social geography field.

The results have practical implications for festival/urban destination management in each community. Namely, the paper discussed similarities and differences between two festivals proposing the priorities for each festival/destination management implied by IPA results. Strong areas of both festivals were determined as well as those that should be improved by festivals' management and local authorities in order to maximize benefits and minimize the costs of hosting the festival. In addition, low priority or possible overkill points are defined and should not be ignored as they can largely influence both community wellbeing and the sustainability of the festival itself. It is the social impact in Concentrate here quadrant that deserves special emphasis by festival organizers.

As with any research, limitations exist that need to be discussed. Although two countries have a common history of being communist countries, differences exist in their level of economic and tourism development, and in the transition to a market-based economy, which affects the respondents' perceptions of festival impacts. Cultural differences also exist and may well impact on the study results (see Pavluković, Armenski and Alcantara-Pilar 2017).

Although it was not the purpose of this study to examine whether sociodemographic variables and previous attendance at the festival affect residents' perceptions of social impacts, a description of survey samples from Novi Sad and Budapest may potentially shed light on the findings. For instance, more than 50% of the respondents in both samples are females and younger (under the age of 31), and more than 70% of the respondents in both samples attended the festival. Perhaps such a high level of the respondents who attended the festival, and specifically younger respondents who are usually in favor of music festivals, affect the perception of positive and negative impacts of the festival. Therefore, future research would need to examine this speculation. In addition, Small (2007) and Woosnam, Van Winkle and An (2013) note that within any given community residents will perceive the same impact in different ways based on their personal background whether it is from previous festival participation, sociodemographic and socio-economic classification.

Since most of the researchers use the quantitative approach in examining perceptions of social impacts of festivals, further research orientations could be towards a qualitative approach (e.g. interviews with the representative stakeholders and/or focus groups).

As perceptions of the impacts of the festival are not static and the festival itself changes, it would be interesting to see how perceptions of festival impacts change over time in a longitudinal study. To the authors' knowledge, this has rarely been done by researchers and festival organizers, although it can provide valuable information for the festival and destination management.

Despite the abovementioned limitations of the work, findings from this study support the use of FSIAS and make a significant contribution to understanding residents' attitudes toward the social impacts of large-scale music festivals.

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THE EFFECTS OF INTENSIVE LOGGING ON THE CAPACITY OF KARST DOLINES TO PROVIDE POTENTIAL MICROREFUGIA FOR COOL-ADAPTED PLANTS

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ZOLTÁN BÁTORI

Snow cover in the bottom of a large doline in the Mecsek Mountains, in the spring of 2018 (11th March, 2018).

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The effects of intensive logging on the capacity of karst dolines to provide potential microrefugia for cool-adapted plants

ABSTRACT: Dolines are local depressions of karst surfaces. They can be considered potential microrefugia for various species. We investigated the plant species composition and vegetation pattern of two medium-sized dolines in Hungary before and 10 years after logging, and analysed how different species groups (oak forest species, beech and ravine forest species and disturbance-tolerant species) were affected. The cover and number of oak forest species and disturbance-tolerant species increased, while the cover and number of beech and ravine forest species decreased within dolines due to logging. Therefore, their species composition and vegetation pattern have changed substantially, and dolines have partially lost their capacity to act as safe havens for plant species adapted to cooler conditions.

KEY WORDS: biology, geography, climate change, logging, cool-adapted plants, karst area, vegetation pattern, Hungary

Vpliv intenzivne sečnje na sposobnost kraških vrtač za zagotavljanje potencialnih mikrozatočišč za hladnoljubne rastline

POVZETEK: Vrtače so kraške kotanje na kraškem površju, ki lahko zagotavljajo mikrozatočišča različnim vrstam. Preučili smo vrstno sestavo in razporeditev vegetacije v dveh srednje velikih vrtačah na Madžarskem pred sečnjo gozda in deset let po njej ter analizirali vpliv sečnje na različne skupine rastlinskih vrst (vrste v hrastovih gozdovih, vrste v bukovih gozdovih in vrste v gozdovih plemenitih listavcev ter vrste, ki so odporne na različne motnje). Pokrovnost in število vrst v hrastovih gozdovih ter vrst, odpornih na motnje se je povečalo, pokrovnost in število vrst v bukovih gozdovih ter v gozdovih plemenitih listavcev pa se je zaradi sečnje lesa v vrtačah zmanjšalo. Zato sta se močno spremenili vrstna sestava in razporeditev vegetacije v teh gozdovih, vrtače pa so delno izgubile funkcijo varnih zatočišč za hladnoljubne rastlinske vrste.

KLJUČNE BESEDE: biologija, geografija, podnebne spremembe, sečnja, hladnoljubne rastline, kraški svet, razporeditev vegetacije, Madžarska

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1 Introduction

Stable habitats buffered from climate changes are known as refugia (Ashcroft 2010; Keppel et al. 2012). Microrefugia are small sites with locally favourable environmental conditions (e.g., microclimate and soil moisture) amidst unfavourable regional environments (Rull 2009; Gentili et al. 2015). Therefore, they facilitate the *in situ* persistence of species. Convergent environments (e.g., basins, ravines and valleys) may act as microrefugia (Dobrowski 2010; Bátori et al. 2014a), since their topographic complexity provides a diversity of microclimates (Whiteman et al. 2004), allowing species to track suitable conditions with minimal movement. In Europe, dolines (local depressions of karst surfaces) may also constitute microrefugia (Bátori et al. 2009), as cold-air pooling occurs within them and north-facing slopes receive less insolation than surrounding areas (Bárány-Kevei 1999). For instance, dolines in Central and Southeastern Europe are known to maintain relict populations of boreal and high-mountain plant species (Ritter Beck von Mannagetta 1906; Horvat 1953; Kobal et al. 2015). Therefore, they have the capacity to harbour many plant and animal taxa that are rare or absent in the surrounding areas (Modrić Surina and Surina 2010; Kemencei et al. 2014; Raschmanová et al. 2015; Růžička et al. 2016; Bátori et al. 2019a). This capacity depends on small- and large-scale environmental factors (Keppel et al. 2015), such as macroclimate, depth/diameter ratio, slope aspect and vegetation cover (Bátori et al. 2012; 2017). Although dolines act as key habitats for various taxa, the effects of human activity on their species-holding capacity have rarely been assessed and raise further questions.

Expansive economic growth and urbanization pose a serious threat to karst landforms (Breg Valjavec, Zorn and Čarni 2018; Bátori et al. 2019b). For instance, many dolines have been filled up with construction waste and rock debris in Slovenia during the expansion of settlements and highway constructions (Breg 2007; Kovačič and Ravbar 2013). Consequently, the shape and depth of these dolines have changed markedly (Cernatič-Gregorič and Zega 2010; Breg Valjavec 2014; Breg Valjavec, Ribeiro and Čarni 2017) and many of them have lost their capacity to act as safe havens for biodiversity in changing climate. In Crete, road construction, overgrazing and nutrient addition by sheep are the main threats to the endemic plant species of dolines (Egli 1991; Iatroú and Fournaraki 2006). Human-induced changes in forest cover also have the potential to negatively influence the species diversity of karst depressions (Bárány-Kevei 2011).

Deforestation is a serious threat to the biological diversity of karst surfaces (Calò and Parise 2006). Species respond to changes in light, nutrient, soil moisture and temperature individualistically (Stewart 2010), however, when changes are strong and fast, functionally similar species may respond similarly (Birks and Ammann 2000). Microhabitat changes induced by logging are especially pronounced in dolines (Lehmann 1970), where environmental conditions vary considerably from slope to slope and from top to bottom (Whiteman et al. 2004; Bátori et al. 2011). Previous studies revealed that the diurnal fluctuations in temperature, humidity and wind speed are less extreme in forested dolines than in non-forested ones (Lehmann 1970). To better understand the impact of logging on the species-holding capacity of karst dolines, we need to document the changes in species composition and vegetation pattern over time.

The western part of the Mecsek Mountains (Hungary) has typical karst landform features, such as dolines, with funnel-shaped geometry and unique microclimate (Bátori et al. 2011). Our previous studies showed that larger dolines have the capacity to enable the persistence of cool-adapted plant species and diverse forest types that are absent from the surrounding plateau (Bátori et al. 2012; 2014a; 2014b; 2017). Intensive logging began about 10 years ago in this region, and mature forest cover has been reduced to approximately 30–40 percent of its original extent in some dolines. In the present study, we investigated the changes in the species-holding capacity of karst dolines induced by logging. Specifically, we studied the plant species composition and vegetation pattern in two dolines in the Mecsek Mountains before and after logging, and compared the focal species groups to each other.

2 Methods

2.1 Study area

The study area is a limestone karst landscape of about 30 km^2 in the western part of the Mecsek Mountains (Figure 1), located at an altitude between 250–500 m. The climate is continental with sub-Mediterranean influences: moderately warm (mean annual temperature is 9.5 °C) and moderately humid (mean annual

precipitation is 740 mm) (Dövényi 2010). The number of dolines is about 2200 (Hoyk 1999). Beech and oak-hornbeam forests cover the slopes of dolines and the major part of the plateaus between dolines, while ravine forests cover the bottom of larger dolines (Bátori et al. 2012).

2.2 Vegetation resurvey

Two medium-sized dolines were selected (doline 1: WGS 46.13359 N, 18.16589 E; doline 2: WGS 46.13131 N, 18.17164 E) with a funnel-shaped geometry. Dolines were about 70 m in diameter and about 14 m deep. Both dolines were sampled before logging (about 110 years old forests, in 2007) and 10 years after logging (in 2017), using the same method. The cover of mature trees within dolines has been reduced to approximately 30–40 percent of its original extent (Figure 1). Because the greatest differences in species composition were expected between the north- and south-facing slopes (Bátori et al. 2012), we established a transect with north-to-south orientation across the dolines, traversing the deepest points. Transects began and ended on doline rims. Each transect consisted of 1 m × 1 m plots spaced at 2-m intervals. We recorded the cover of all herbs, shrubs and tree saplings in all plots. A total of 114 plots were surveyed. Nomenclature follows The Plant List (2018).

2.3 Species grouping

We classified all plant species according to their habitat preference (Horváth et al. 1995). Three larger functional groups (cf. Troiani et al. 2016) were established:

- »oak forest species« (i.e. typical species of turkey oak–sessile oak forests and drier oak-hornbeam forests),
- »beech and ravine forest species« and
- »disturbance-tolerant species« (i.e. ruderals).

All three functional groups were analysed using both the cover and presence/absence data of species. Since beech and ravine forest species are the best indicators of cool microhabitats in our study area, this functional group was considered to be particularly relevant to detect changes in the species-holding capacity of dolines.

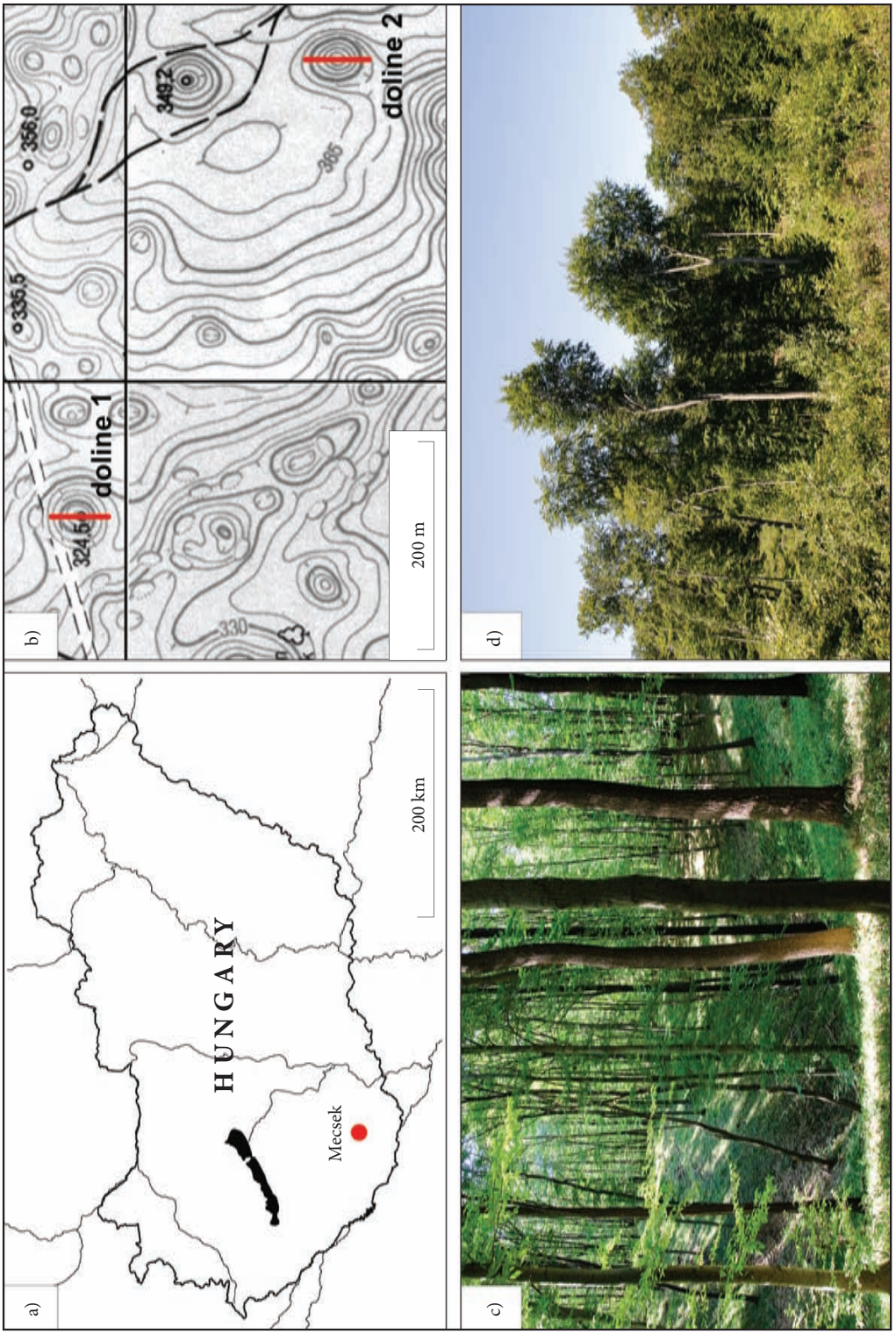
2.4 Data analyses

We used permutational multivariate analysis of variance (PERMANOVA) to test the effect of logging on plant assemblages. We used the raw cover data of species for each sampling plot in the source matrices. We applied the Bray–Curtis index, and performed 5,000 permutations. PERMANOVAs were calculated in R statistical environment (R Core Team 2018) using the *adonis* function of the »vegan« package (Oksanen et al. 2018). We prepared non-metric multidimensional scaling (NMDS) ordinations (cover values and Bray–Curtis index) to visually illustrate differences in vegetation pattern.

The diagnostic species of the dolines before and after logging were determined by calculating the phi (Φ) coefficient of association between species and habitat (Chytrý et al. 2002). Species with $\Phi > 0.1$ were considered diagnostic. Non-diagnostic species were excluded with Fisher's exact test ($p < 0.05$). Calculations were done with the *JUICE 7.0.25* program (Tichý 2002).

We used linear mixed-effect models (LMMs) with Gaussian error term for the comparison of the cover of functional groups, and generalized linear mixed-effects models (GLMMs) with Poisson error term for the comparison of the species numbers of functional groups. All analyses were carried out in R (R Core Team 2018). In the models, the management types (unlogged and logged) were included as fixed factors, the cover and number of species as dependent variables, and the location (i.e. doline 1 and 2) as random factor. LMMs were performed using the *lme* function from the »nlme« package (Pinheiro et al. 2018), while GLMMs were performed using the *glmer* function from the »lme4« package (Bates, Maechler and Bolker 2013).

Figure 1: Location of the study site (a) and studied dolines (b) in the Mecsek Mountains (Hungary). Dolines were sampled before logging (c) and 10 years after logging (d). Red lines indicate the position of transects. ►


a)
HUNGARY
Mecsek
200 km
b)
356.0
335.5
324.5
doline 1
349.2
doline 2
330
365
200 m
c)
d)

3 Results

A total of 72 vascular plant species were recorded in the plots. Five diagnostic species (one oak forest species and four beech and ravine forest species) were identified before logging and 15 (six oak forest species, three beech and ravine forest species, and six disturbance-tolerant species) after logging (Table 1). NMDS ordinations (stress factor: 0.24 and 0.22, respectively) showed that the compositional pattern of the vegetation changed significantly (PERMANOVA: $F = 6.8$ and 7.8, respectively, $p < 0.001$) after logging (Figure 2).

The cover and number of oak forest species (e.g., common bugle (*Ajuga reptans*), fragrant hellebore (*Helleborus odorus*) and butcher's broom (*Ruscus aculeatus*)) and disturbance-tolerant species (e.g., deadly nightshade (*Atropa belladonna*), American burnweed (*Erechtites hieracifolia*) and Japanese hedgeparsley (*Torilis japonica*)) were higher after logging ($p < 0.001$ and $p < 0.05$, respectively), while the cover and number of beech and ravine forest species (e.g., enchanter's nightshade (*Circaea lutetiana*), common lungwort (*Pulmonaria officinalis*) and spineless butcher's broom (*Ruscus hypoglossum*)) were higher before logging ($p < 0.001$ and $p = 0.06$, respectively) (Figure 3).

4 Discussion

Karst depressions provide suitable microhabitats for a variety of species, but human-activity may influence their species-holding capacity. To our knowledge, this is the first study to report evidence of a decrease in species-holding capacity within forested dolines confirmed with repeated sampling. We have shown that 10 years after logging (30–40 percent of the original forests remained intact) the vegetation pattern and species composition changed substantially within dolines, and they have partially lost their capacity to act as safe havens for a number of plant species adapted to cooler conditions.

As previous studies have shown, cool and humid dolines in Eurasia have the capacity to support animal and plant populations outside their main distribution ranges (Raschmanová et al. 2015; Bátori et al. 2017; Su et al. 2017), and microclimate is a significant predictor of the species diversity within them (Růžička et al. 2016). Although microclimatic differences between the slopes of forested dolines are less pronounced

Table 1: Diagnostic species of the dolines before and after logging ($p < 0.05$). Species are listed by decreasing values of the phi (Φ) coefficient of association between species and habitat. Letters in parenthesis indicate functional groups: (a) oak forest species, (b) beech and ravine forest species and (c) disturbance-tolerant species.

Before logging	
Ivy – *Hedera helix* (a)	0.47
Yellow archangel – *Lamium galeobdolon* s.l. (b)	0.37
Wood speedwell – *Veronica montana* (b)	0.33
Woodruff – *Galium odoratum* (b)	0.28
Dog's mercury – *Mercurialis perennis* (b)	0.28
After logging	
Hairy blackberry – *Rubus hirtus* agg. (c)	0.42
Stinging nettle – *Urtica dioica* (c)	0.42
European hornbeam – *Carpinus betulus* (b)	0.35
Wood small-reed – *Calamagrostis epigejos* (c)	0.34
Wood sedge – *Carex sylvatica* (b)	0.27
Annual fleabane – *Stenactis annua* (c)	0.24
Hairy St Johns-wort – *Hypericum hirsutum* (c)	0.23
Turkey oak – *Quercus cerris* (a)	0.23
Lady fern – *Athyrium filix-femina* (b)	0.21
Wall lettuce – *Lactuca muralis* (a)	0.21
Goat willow – *Salix caprea* (c)	0.21
Silver linden – *Tilia tomentosa* (a)	0.21
Germander speedwell – *Veronica chamaedrys* (a)	0.21
Wood melick – *Melica uniflora* (a)	0.20
Sessile oak – *Quercus petraea* (a)	0.19

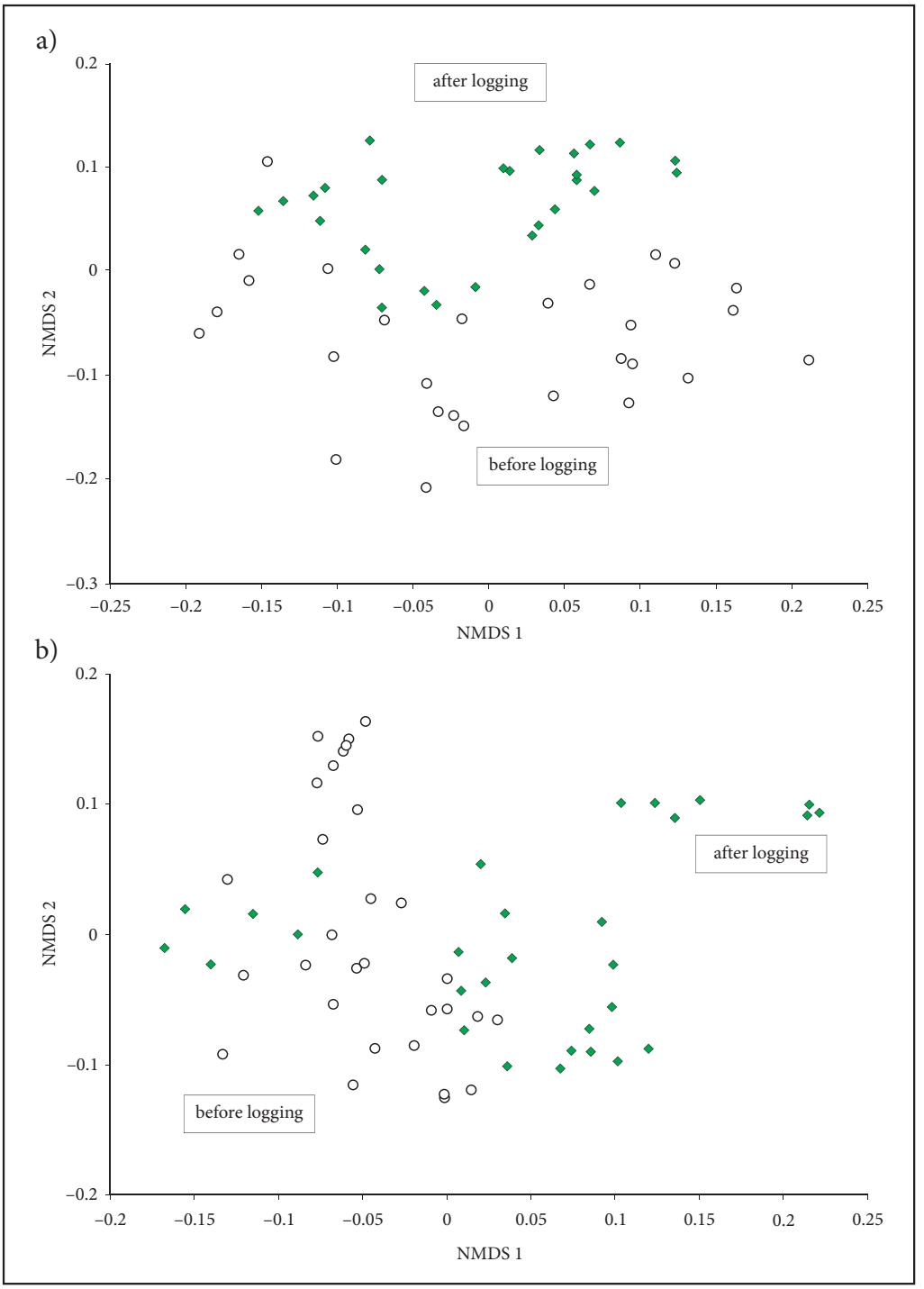


Figure 2: Non-metric multidimensional scaling (NMDS) ordination (cover values and Bray–Curtis index) diagrams of doline 1 (a) and doline 2 (b) before and after logging (stress factor: 0.24 and 0.22, respectively).

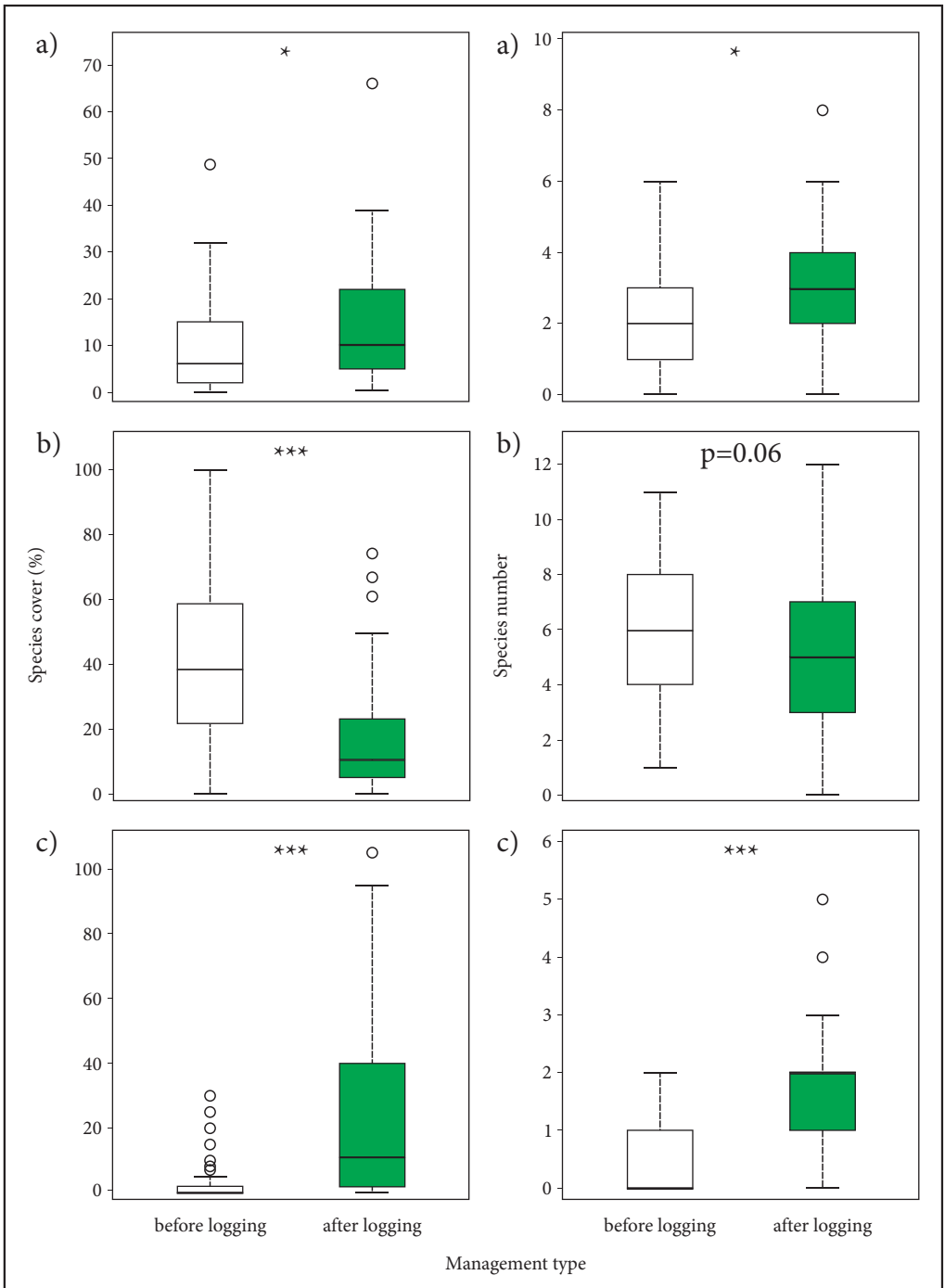


Figure 3: Cover and species number of the different functional groups (a: oak forest species; b: beech and ravine forest species and c: disturbance-tolerant species) in the dolines of the Mecsek Mountains (Hungary) before (white boxes) and after (green boxes) logging. Significant differences are indicated by asterisks (*$p < 0.05$; ***$p < 0.001$).

(Bátori et al. 2011; 2014b), dolines in the Mecsek Mountains introduce great variation in species composition and many plant species can be found within them that are rare or totally absent from the surrounding karst plateaus (Bátori et al. 2012).

In general, changes in vegetation cover should affect the surface albedo (i.e. the amount of reflected solar radiation), wind pattern, soil hydrology, soil nutrient content, near-surface temperature and humidity, which in turn, should affect the vegetation (Saikh, Varadachari and Ghosh 1998; Guariguata and Ostertag 2001; Berbet and Costa 2003; Lukić et al. 2017; Stančič and Repe 2018). Our results show that intensive logging can cause significant changes in local species abundance and composition, and has a negative effect on the species-holding capacity of dolines (Figures 2 and 3). Dolines contained fewer beech and ravine forest species (e.g., narrow buckler-fern (*Dryopteris carthusiana*), herb Paris (*Paris quadrifolia*) and wood speedwell (*Veronica montana*)) 10 years after logging, and their cover was much lower than before logging. In contrast, the number and cover of oak forest (e.g., field maple (*Acer campestre*), wood melick (*Melica uniflora*) and white violet (*Viola alba*)) and disturbance-tolerant species (e.g., wood small-reed (*Calamagrostis epigejos*), hairy blackberry (*Rubus hirtus* agg.) and stinging nettle (*Urtica dioica*)) increased significantly due to logging. The increase in the number and cover of oak forest species likely resulted from a decrease in albedo and a corresponding increase in absorbed solar radiation, while greater post-disturbance light and nutrient availability, changes in species interactions (such as competition) could increase the number and cover of disturbance-tolerant species. Since different species may recover at different rates during forest regeneration (Dunn 2004), it is unclear how species composition will change in these doline microrefugia in the future.

Extreme heat events are increasing in frequency in Central Europe, and will continue to do so throughout the next few decades (Bartholy et al. 2008). Climate warming affects the local abundance, phenology and distribution of species and alters the interactions between populations (Hegland et al. 2009). The distributions of many plant species in Europe are likely to shift upwards (Geßler et al. 2007; Czúcz, Gálhidy and Mátyás 2011; Hlásny et al. 2011), or species can persist in environmentally stable habitats (Willis, Rudner and Sümegi 2000; McLaughlin et al. 2017), such as dolines (Bátori et al. 2017). A number of studies indicate that forest cover has the potential to mitigate climate warming at local scales and to maintain suitable microclimate, enhancing species persistence (Frey et al. 2016; Keppel et al. 2017). The combined effects of forest cover and topographic complexity may contribute to the long-term persistence of forest species adapted to cooler conditions (beech and ravine forest species) (Figure 3) in the karst region of the Mecsek Mountains, provided that the current management intensity decreases. If this management practice continues, the species-holding capacity of these dolines would further decrease, and many currently widespread plant species may become rare or extinct during forest regeneration in a warming climate.

5 Conclusion

We conclude that intensive logging poses a serious threat on the species-holding capacity of karst depressions. To meet the demands of preservation of cool-adapted species in dolines, it would be necessary to establish more forest reserves on the karst surfaces where no forestry takes place. Alternatively, the maintenance of continuous forest cover in at least larger dolines and their surroundings would be indispensable to facilitate the recolonization or the *in situ* persistence of cool-adapted species under global warming.

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COMMERCIAL SERVICES AND URBAN SPACE RECONVERSION IN ROMANIA (1990–2017)

Radu Săgeată

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»Afi Cotroceni«, the biggest mall in Romania (over 90,000 sqm, commercial surface), was open on Oct. 29, 2009. The structure was built in a former industrial area (Electrical Equipment Plant, Bucharest).

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Commercial services and urban space reconversion in Romania (1990–2017)

ABSTRACT: Concentrating incomes in large cities has encouraged the development of specialist services and the opening of big commercial units. The downfall of ideological barriers east of the former Iron Curtain made global culture combine with endemic sub-cultures, influenced by the living standard. The only limitation of this process appears to be social segregation which restricts demand and creates preferential segments of users. In Romania, financial segregation is directly reflected in the commercial investment made in Bucharest and in the large cities, mostly in the centre and western part of the country. The paper analyses the correlation of financial and commercial services, as well as their location and dispersion strategies at the level of the Romanian urban system.

KEY WORDS: globalization, urban spatial reconversion, services, commercial investments, Romania

Trgovske storitve in ponovna preobrazba mestnega prostora v Romuniji (1990–2017)

POVZETEK: Zgoščanje dohodka v velikih mestih je spodbudilo razvoj specializiranih storitev in odpiranje velikih trgovskih središč. Zaradi padca ideoloških ovir vzhodno od nekdanje železne zavese se je začela globalna kultura mešati z lokalnimi subkulturami, kolikor jim je to dopuščal življenjski standard. Edina slabost tega procesa je socialna segregacija, ki omejuje povpraševanje in ustvarja prednostne segmente uporabnikov. V Romuniji se finančna segregacija neposredno kaže v naložbah v gradnjo trgovskih središč v Bukarešti in večjih mestih, zlasti v osrednjem in zahodnem delu države. V članku avtor analizira povezavo med finančnimi in trgovskimi storitvami ter strategije, povezane z njihovim umeščanjem in razpršenostjo na ravni romunskega urbanega sistema.

KLJUČNE BESEDE: globalizacija, ponovna preobrazba mestnega prostora, storitve, naložbe v trgovska središča, Romunija

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1 Introduction

With the collapse of ideological barriers at the end of the 1980s, deep-going economic mutations took place in the former communist space. In Romania, transition from a central-based economy to a free-competition system, destructured the economy, a new economic structures being put instead. However, corruption and failed privatizations made especially industrial units bankrupt, which eventually were among the first to disappear. A new space-dependency between production and consumption and new spatial poles that concentrated the population's incomes would develop (Ianoş and Heller 2006).

The main aim of the present study is to highlight changes in the urban space organization after the decline of industry and the development of commercial services which have re-balanced the territorial systems disturbed by oversized industrialization under communism. As a result, large rural-urban migration flows got momentum, associated with a fast-growing housing-stock in the city (Goodman and Marshall 2013). This process, which could be labelled »quantitative urbanization«, evolved faster than »qualitative urbanization«, that is, the development of a technical-building and services infrastructure (Novotný 2016).

The issues discussed in this paper highlight the relationships between territorial disparities, purchasing power and the location of financial-banking and commercial investments in Romania. After the industrial sector had collapsed, a services sector developed, these processes being characteristic of the former central-based economies in Central and Eastern Europe after 1989 (Brülhart, Carrère and Robert-Nicoud 2018). Also, the logic behind big commercial investments and the social impact of promoting the services sector through big commercial investments is discussed herein.

Deindustrialization means reducing the share of industry in a country's economy, or in a human community. This is specific to the periods of transition, or of economic crises and affects both the industrial production and people's lives as real wages and the living standard are declining and unemployment is rising (Rita Sedita, De Noni and Pilotti 2017). Transition from an excessively industrialized economy to a free-competition system is marked by globalization, deindustrialization preceding the development of the services sector. The complex relations between deindustrialization and the emergence of the services sector, as well as their impact on urban space organization within the general context of globalization, is a topical issue of major interest for the Central- and East-European countries (Jacoby and Korkut 2015).

The fall of the communist system and the elimination of ideological barriers created the premises for a closer connection among the urban systems in neighbouring countries (McFarlane 2006). Cities acted as polarization nuclei, redirecting human flows in the territory. And yet, urban development could not make up for industrial decline and its demographic, but especially social consequences (Crescenzi, Pietrobelli and Rabellotti 2016). After four decades of forced industrialization associated with hypertrophic development, the Romanian urban system experienced a radical change, basically de-urbanization of the city population and city-life quality, the functional characteristics of cities undergoing essential modifications (Holmén 1997).

Industry, which had been the main factor of urbanization, would be overcome by the services sector, a phenomenon specific mainly to the big cities. Thus, Romania's capital-city and the regional metropolises strengthened their positions of co-ordination in the territory (Ianoş, Pumain and Racine 2000; Bürkner and Totelecan 2018).

Big cities tended to assume the role of cosmopolite cities due to an increasing ethnical diversity, as well as to the development of specialist services and the large-scale assimilation of consumption products of the global culture that go beyond cultural frontiers (Stead, de Vries and Tasan-Kok 2015; Wikström, Jönsson and L'Espoir Decosta 2016). Food and fashion items have the greatest impact on the population. Immigration to Romania of some Arab, Turkish, and Chinese citizens dealing in trade, or having small industrial enterprises, the presence of foreign citizens studying in this country, the staff of diplomatic missions, of multinational companies, or of non-government organizations kept diversifying the services sector. So, Chinese, Lebanese, Italian, or Greek restaurants would open, as did French or German bakeries, African, Indian, Latin-American, or other artisanal shops (van Ham and Tammaru 2016).

The ever-greater concentration of incomes in the country's capital-city, or in large cities, stimulated the development of products and specialist services, profile commercial units cropping up, usually in big commercial centres of the mall and supermarket type. This would explain the importance of these units for spreading the items of the global consumerist culture at local level (Bezin and Moizeau 2017). The limits of this type of localization lie presumably in the growing social segregation through the ever-wider gap

between the population's income and demand, so that access is restricted to some particular segments of users (Picard and Zenou 2018). Hence, new spatial polarizations, directly proportional to social and cultural segregation, and dependent on the capacity of the Romanian urban system to take in globalizing flows. Thus, the growing financial segregation between the urban population, as a result of restructured economic activities, opens up the way to globalizing flows (Demetry, Thurk and Fine 2015). Even if the items of the global consumerist culture are easily penetrating at local level, the population's access to them is still fairly limited. Global culture tends to combine with local culture grafted on poverty and lack of education. In view of it, the quality of urban life is degrading through the development of urban subcultures and the proliferation of organized crime (Cohen 2016). Studying the distribution of banking investments could be a starting-point for looking at the spatial distribution of other types of services, commercial ones, in particular.

2 Data collection and methods

2.1 Data-set

The present research relies on field investigation, bibliographical sources and quantitative analyses. In this way, correlations could be established between the analyzed elements and the statistical prognoses.

Field investigations focused on current land-use practices in certain urban and peri-urban areas and their situation in the 1988-1989 period, the peak of socialist industrialization in Romania (Dumitrescu 2008). The differences found show the changes occurred in the organization of the urban and peri-urban area, as well as in the functional zoning of cities in the post-communist period of deindustrialization.

Preferences in the distribution of commercial investments reveal the extent of socio-economic availability both at country level and in each city. Assessing the situation meant estimating the distribution of financial-banking investments. To this end, the internet sites of the 38 commercial banks in our study-sample were accessed. Investment distribution was compared with the territorial disparities highlighted by the poverty-level indicators reported in official statistics.

Collecting data on the territorial distribution of malls and supermarkets was made by consulting the internet sites of the main big commercial centres. A correlation was established between the territorial distribution of these centers and the financial-banking investments, corresponding to the population's poverty level. Our analyses covered all mall-type commercial investments of rank 0, I and II cities, as well as the stores of the 25 chains of big European retailers located in these cities.

2.2 Research methods

In order to get an insight into the changes of the urban space once industrial zones were turned into commercial and services zones, one should proceed by looking at the impact of the population's financial segregation when commercial investments are made (Mermet 2017). So, the analysis of the spatial distribution of a characteristic sample of 38 commercial banks, which proved to be relatively stable in the Romanian capital market, has been made by a bi-dimensional linear regression model, conceived as a correlation between the logic of financial-banking investment distribution area and commercial investments.

What underlies the dependency of placing investments in the services sector is the perpetuation, in time, of path dependency (Isaksen and Jakobsen 2017).

Once the logic of locating the main big investments was established, a correlation was made between the location of new commercial sites and what had previously existed in those areas. In this way, a few typologies of urban and peri-urban spatial reconversion were outlined in terms of the development of commercial services.

The impact of ethnical minorities on the physiognomy and functional particularities of commercial zones was analyzed as part of the process of large Romanian cities acquiring a cosmopolitan character. This phenomenon is ever more often met in Central and Eastern Europe.

There is a close correlation between the territorial distribution of poverty (i.e. minimum guaranteed income, labour employment rate, purchasing power/inhabitant) (Paugam 1998), and the distribution of

financial-banking and commercial investments. This distribution can be expressed by a bi-dimensional regression equation between the number of banking units and of commercial centres:

$$y = a + bx,$$

where x = number of banking units, y = number of commercial units and a = a point on the axis of commercial units when the number of banking units = 0 and b = regression slope specific to the relation between the two variables.

Bucharest is a hypertrophic city in the Romanian urban system and the correlation between both variables gives a wrong image on territorial distribution. This explains why it is necessary to analyze the urban system with and without Bucharest.

Synthetically, the main methodological steps which define our approach were as follows:

a) Highlighting the main territorial disparities in Romania;
b) Correlating territorial disparities with the purchasing power and the placement of financial-banking and commercial investments;
c) Analyzing the correlation between the territorial distribution of financial-banking and commercial investments using the bilinear regression (with and without Bucharest);
d) Defining the changes occurred within the urban space organization through deindustrialization and tertiarization, the development of commercial services and the establishment of a typology to this effect;
e) Evaluating the impact of big commercial investments on Romania's cities.

3 Results and discussion

3.1 Territorial disparities in Romania: General remarks

In order to better understand the logic behind locating new commercial investments in Romania, one should first look at the main characteristics of the urban system and the major territorial disparities in this country.

The Romanian urban system (Figure 1) contains 320 towns (Mitrică, Grigorescu and Urucu 2016). A four-rank hierarchy of towns had in view the economic and demographic polarization grade in the territory and the social-urbanism level.

The first three ranks (0, I and II) include 93 urban centres (29% of all of Romania's towns) with 8.6 million inhabitants (68.5%) of the urban population and ca. 43% of Romania's total population. These are best representative for the urban system in this country.

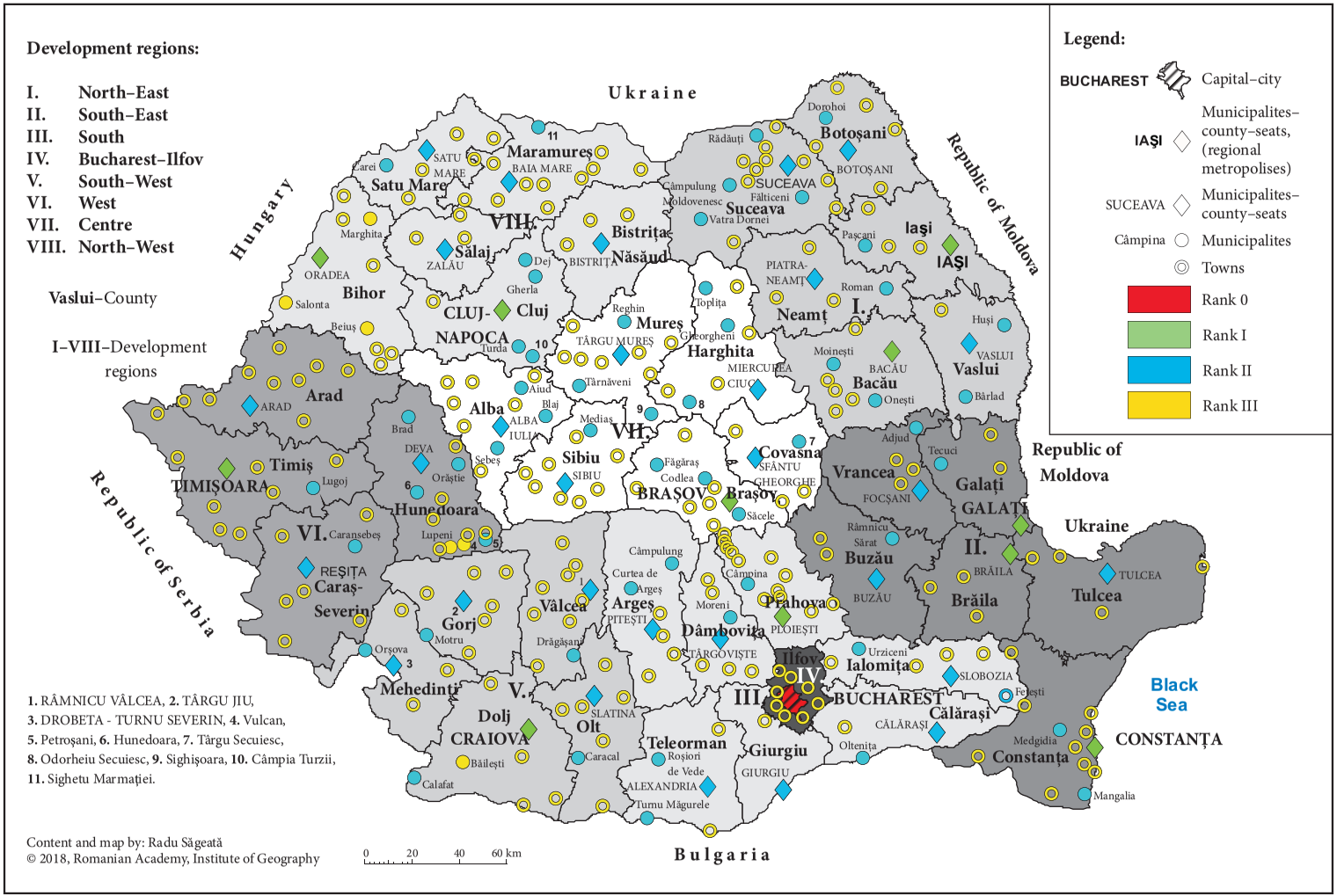
The poverty rate of the population is decisive for the purchasing power and the location of financial-banking and commercial investments.

Territorial disparities show two poverty polarization areas:

1) in the east (Moldavia), extreme poverty (lack of means of daily subsistence) in the counties of Vaslui and Botoşani;
2) in the south, extreme poverty in Ialomiţa, Giurgiu and Teleorman counties.

According to statistical data (2014), most poverty-prone people, running the risk of social exclusion, live in the South-East development region (53.4% / total population), North-East (48.9%) and South-West (45.6%). These territorial disparities are confirmed by the following analyzed indicators: percentage of population receiving a minimum guaranteed income, labour employment level, and purchasing power/inhabitant In Romania, 1.1% of the population benefits from a guaranteed minimum (31.85 Euro/person) from the State budget; on average, most socially-assisted people live in the east (Vaslui County – 2.7%) and south (Teleorman and Mehedinţi counties – 2.4% each; Buzău and Dolj counties – 2.2% each). Labour employment level in Romania: 59.8% of the total active population (15–64-year olds) in 2016, minimum values being recorded again in the eastern and southern counties. Disparities are also shown by the purchasing power index: the poorest counties lying in the east and south (Vaslui: 3,054 Euro/inhabitant) (Figure 2).

Figure 1:The urban system in Romania. ► p. 54
Figure 2: Purchasing power and banking unit density in Romania (2016). ► p. 55


Development regions:
I. North–East
II. South–East
III. South
IV. Bucharest–Ilfov
V. South–West
VI. West
VII. Centre
VIII. North–West
Vaslui–County
I–VIII–Development regions
Legend:
BUCHAREST Capital–city
IAŞI Municipalites–county–seats, (regional metropolises)
SUCEAVA Municipalites–county–seats
Câmpina Municipalites
Towns
Rank 0
Rank I
Rank II
Rank III
Ukraine
Hungary
Republic of Moldova
Republic of Serbia
Bulgaria
Black Sea
Botoşani
Maramureş
Satu Mare
Suceava
Bistriţa
Năsăud
Sălaj
Iaşi
Bihor
Cluj
Mureş
Harghita
Neamţ
Vaslui
Arad
Alba
Sibiu
Covasna
Bacău
Timiş
Hunedoara
Vrancea
Galaţi
Caraş-Severin
Gorj
Vâlcea
Argeş
Prahova
Buzău
Brăila
Tulcea
Mehedinţi
Dolj
Olt
Dâmboviţa
Ilfov
Ialomiţa
Teleorman
Giurgiu
Călăraşi
Constanţa
1. RÂMNICU VÂLCEA, 2. TÂRGU JIU,
3. DROBETA - TURNU SEVERIN, 4. Vulcan,
5. Petroşani, 6. Hunedoara, 7. Târgu Secuiesc,
8. Odorheiu Secuiesc, 9. Sighişoara, 10. Câmpia Turzii,
11. Sighetu Marmaţiei.
Content and map by: Radu Săgeată
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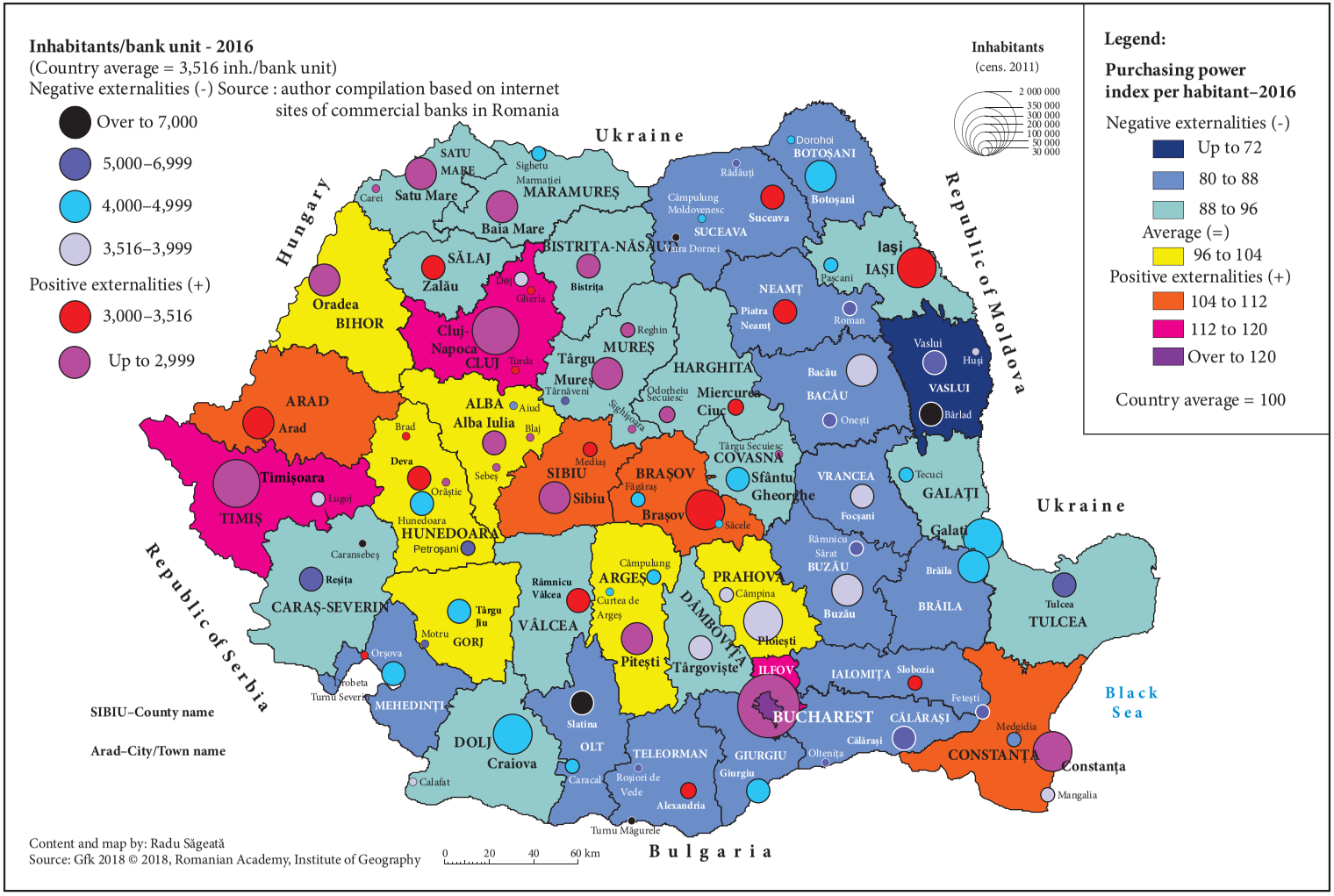
0 20 40 60 km


Inhabitants/bank unit - 2016
(Country average = 3,516 inh./bank unit)
Negative externalities (-) Source : author compilation based on internet sites of commercial banks in Romania
Over to 7,000
5,000–6,999
4,000–4,999
3,516–3,999
Positive externalities (+)
3,000–3,516
Up to 2,999
Inhabitants
(cens. 2011)
2 000 000
350 000
300 000
200 000
100 000
50 000
30 000
Legend:
Purchasing power index per habitant–2016
Negative externalities (-)
Up to 72
80 to 88
88 to 96
Average (=)
96 to 104
Positive externalities (+)
104 to 112
112 to 120
Over to 120
Country average = 100
Ukraine
Hungary
Republic of Moldova
Republic of Serbia
Bulgaria
Black Sea
SATU MARE
Satu Mare
Baia Mare
MARAMUREŞ
SĂLAJ
Zalău
BISTRIŢA-NĂSĂUD
Bistriţa
SUCEAVA
Suceava
BOTOŞANI
Botoşani
IAŞI
NEAMŢ
Piatra Neamţ
Roman
Oradea
BIHOR
Cluj-Napoca
CLUJ
MUREŞ
Târgu Mureş
HARGHITA
Miercurea Ciuc
BACĂU
Bacău
VASLUI
ARAD
Arad
ALBA
Alba Iulia
Aiud
SIBIU
Sibiu
BRAŞOV
Braşov
COVASNA
Sfântu Gheorghe
VRANCEA
Focşani
GALAŢI
Galaţi
Timişoara
TIMIŞ
HUNEDOARA
Petroşani
Deva
CARAŞ-SEVERIN
Reşiţa
GORJ
Târgu Jiu
VÂLCEA
Râmnicu Vâlcea
ARGEŞ
Piteşti
Târgovişte
PRAHOVA
Ploieşti
BUZĂU
Buzău
BRĂILA
Brăila
TULCEA
Tulcea
DÂMBOVIŢA
ILFOV
BUCHAREST
IALOMIŢA
CĂLĂRAŞI
Călăraşi
CONSTANŢA
Constanţa
Medgidia
Slobozia
Feteşti
MEHEDINŢI
Orşova
Drobeta Turnu Severin
DOLJ
Craiova
Calafat
OLT
Slatina
Caracal
TELEORMAN
Roşiori de Vede
Alexandria
GIURGIU
Giurgiu
Turnu Măgurele
Oltenita
Mangalia
SIBIU–County name
Arad–City/Town name
Content and map by: Radu Săgeată
Source: Gfk 2018 © 2018, Romanian Academy, Institute of Geography
0 20 40 60 km

3.2 Purchasing power, financial-banking and commercial investments

The logic of making financial-banking and commercial investments lies at the base of the territorial disparities of the population's purchasing power.

An analysis of the 38 commercial banks reveals their clear-cut concentration in the urban area, with one exception (*CEC Bank*). Another characteristic feature of the Romanian banking system is the pyramidal distribution of banking units, most of them located in Bucharest (19% of all) and in rank I and II cities, regional and county polarization nuclei, which also have the best services coverage/inhabitant. Small, especially one-industry towns, or towns situated in high-poverty areas and occupational dependency, with little financial-banking investments, make the population dependent on the services offered only by certain banks, which implicitly have the regional monopole. The best coverage of banking services units (positive externalities) is in Bucharest, as well as in some large cities from the west of Romania, and in Constanţa (a Black Sea port and tourist city). Here, there is a good correlation between income distribution and people's purchasing power. At the other end of the spectrum (negative externalities) stand the poor countries in the east (especially Vaslui and Botoşani) and in the south-east (Călăraşi, Ialomiţa, Giurgiu and Teleorman) (Mitrică et al. 2017).

There is an obvious path-dependency between the territorial distribution of the purchasing power and of banking services, visible in the population density/banking unit. Positive anomalies recorded some cities in which the industrial decline could be compensated for by tourism (e.g. Constanţa, Piatra Neamţ), enabling the employment of the industry-released labour surplus, or by some cities that have a good geographical position versus the big communication axes (e.g. Suceava). At the other end of the spectrum one finds negative anomalies which largely affect the iron-and-steel industry centres (Galaţi, Hunedoara, Reşiţa, Călăraşi and Târgovişte) and the mining ones (Petroşani and Motru), in which the process of economic reconversion, generated unemployment and a low purchasing power, or towns located in the neighbourhood of some regional metropolis (Săcele), where the labour force is taken in by the city (Braşov) (Figure 2).

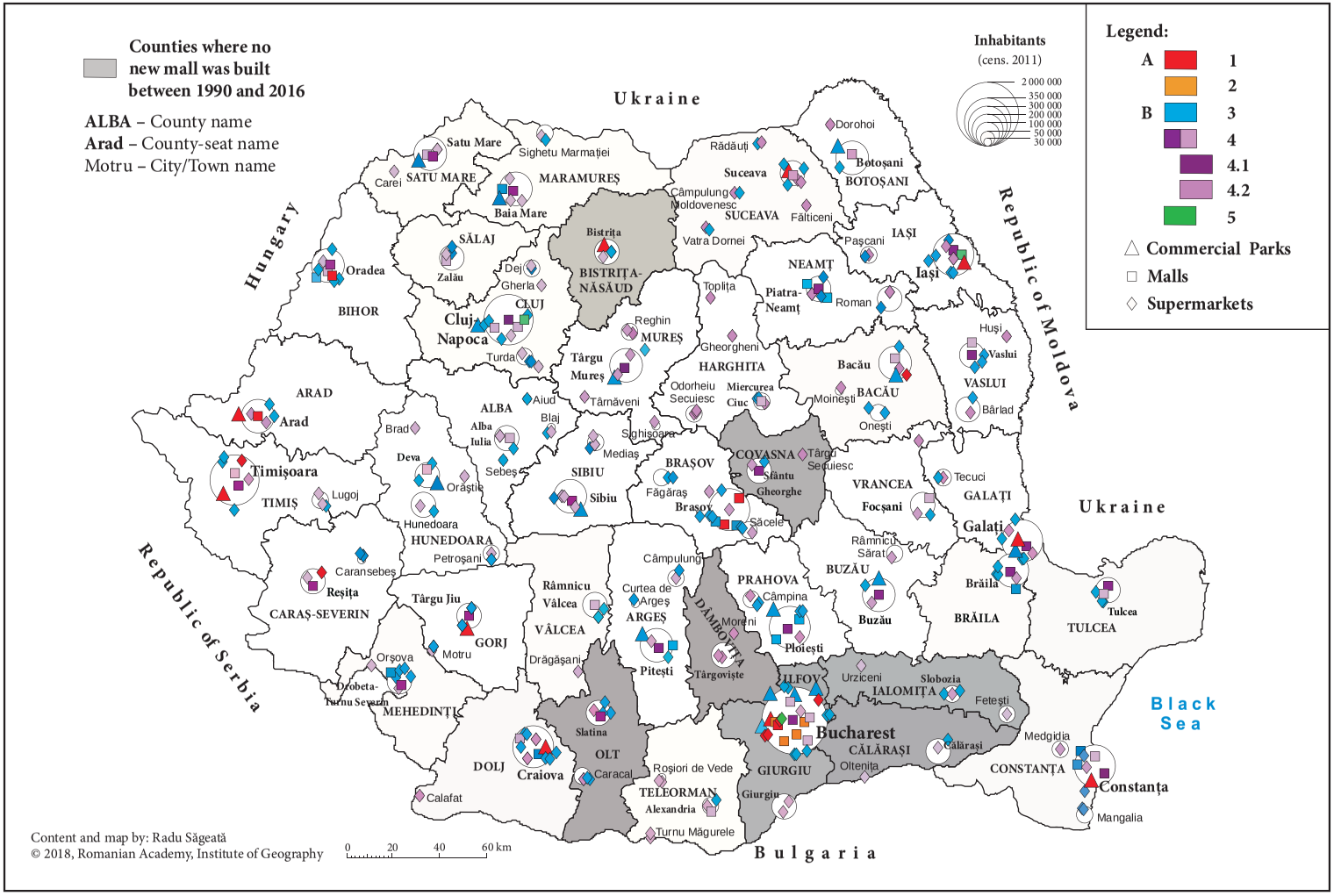
The same pyramidal distribution of financial investments holds also for commercial units, the extent of investments being directly proportional to town-size. Big commercial units are frequently opened in large regional polarization cities with a positive economic dynamic, offering a fairly competitive financial market that ensures profitability. Commercial investments made in towns situated at the lower end of the urban hierarchy (under 30,000 inhabitatnts) are mostly of the small supermarket type, because making big commercial investments in such towns is not profitable. In the territory of Romania, the east/west financial segregation is the direct reflection of commercial services, too; big commercial investments are attracted mainly by Bucharest, Constanţa and the large cities in Banat and Transylvania (Timişoara, Arad, Oradea and Cluj-Napoca).

Analyzing this regression equation for the 93 urban-rank centres 0, I and II, yielded a 0.85 correlation coefficient which confirms the close correlation among these variables. This strong correlation is the result of the high hypertrophic character of the Capital-city (H index is 5.8) within the Romanian urban system. If Bucharest were excluded, this coefficient would be equal to 0.67, which shows a weaker, yet significant, correlation (R^2=0.45).

3.3 The spatial impact of commercial investments on urban areas

The first malls in Romania were opened by changing the destination of some buildings designed (in the years of the centralized economy) to host big food stores. In the second stage, the policy of centralized industrialization focussed on the building of large agro-food and public food units within industrial areas, or on their boundary with dwelling quarters to enable the workers' rapid access to these services and thus reduce meals-and-shopping breaks. In 1990, these constructions were abandoned; later on, they would be taken over by foreign investors who turned them into mall-type centres (all in Bucharest). Since urban development policies had in view developing industrial and residential areas (to take in industry-employed migration flows), locating big commercial and services units inside these areas to make up for a shortage of commercial and services facilities. Investments proved profitable and contributed to diminishing people's migration from the city-centre to the periphery (Shertzer, Twinam and Walsh 2018).

Figure 3: Typology of localizing commercial investments in Romania. ►


Counties where no new mall was built between 1990 and 2016
ALBA – County name
Arad – County-seat name
Motru – City/Town name
Inhabitants
(cens. 2011)
2 000 000
350 000
300 000
200 000
100 000
50 000
30 000
Legend:
A
1
2
B
3
4
4.1
4.2
5
Commercial Parks
Malls
Supermarkets
Ukraine
Hungary
Republic of Moldova
Republic of Serbia
Bulgaria
Black Sea
Satu Mare
Sighetu Marmației
Carei
SATU MARE
MARAMUREȘ
Baia Mare
Rădăuți
Suceava
Dorohoi
Botoșani
BOTOȘANI
Câmpulung Moldovenesc
SUCEAVA
Fălticeni
Vatra Dornei
Pașcani
IAȘI
Iași
SĂLAJ
Zalău
Bistrița
BISTRIȚA-NĂSĂUD
NEAMȚ
Piatra-Neamț
Roman
Oradea
BIHOR
Dej
Gherla
CLUJ
Cluj-Napoca
Turda
Reghin
MUREȘ
Târgu Mureș
Topliță
Gheorgheni
HARGHITA
Odorheiu Secuiesc
Miercurea Ciuc
Târnăveni
Aiud
ALBA
Blaj
Sighișoara
Mediaș
SIBIU
Sibiu
Moinești
BACĂU
Bacău
Onești
Huși
Vaslui
VASLUI
Bârlad
ARAD
Arad
Brad
Alba Iulia
Deva
Orăștie
Sebeș
Lugoj
Timișoara
TIMIȘ
Hunedoara
HUNEDOARA
Petroșani
Caransebeș
Reșița
CARAȘ-SEVERIN
Târgu Jiu
GORJ
Motru
Orșova
Drobeta-Turnu Severin
MEHEDINȚI
Râmnicu Vâlcea
VÂLCEA
Drăgășani
Curtea de Argeș
ARGEȘ
Pitești
Câmpulung
PRAHOVA
Câmpina
Moreni
Ploiești
DÂMBOVIȚA
Târgoviște
COVASNA
Târgu Secuiesc
Sfântu Gheorghe
BRAȘOV
Făgăraș
Brașov
Săcele
VRANCEA
Focșani
Tecuci
GALAȚI
Galați
Râmnicu Sărat
BUZĂU
Buzău
Urziceni
Slobozia
IALOMIȚA
Fetești
Călărași
Bucharest
CĂLĂRAȘI
Oltenița
GIURGIU
Giurgiu
Slatina
OLT
Caracal
DOLJ
Craiova
Calafat
Roșiori de Vede
TELEORMAN
Alexandria
Turnu Măgurele
BRĂILA
Brăila
Buzău
TULCEA
Tulcea
Medgidia
CONSTANȚA
Constanța
Mangalia
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0 20 40 60 km

Other big commercial investments were placed on farmland on the outskirts of cities, or on the terrains of some former industrial units (that had been demolished), using the available rail-and-road facilities (Mirea 2011). Here are some examples of former industrial zones turned commercial: in Bucharest (*Mioriţa* milk factory, *Electric Machine Plant*, *Semănătoarea*), Craiova (*Electroputere*), Timişoara (former slaughterhouse), Braşov (former rubber items and agricultural equipment factories), etc.

There are many other situations of big investments localized on the territory of some communes that lie in the proximity of large cities, where land price is lower. The advantages offered by easy access account for the development of peri-urban commercial parks: in the proximity of Bucharest, on the motorways to Ploieşti, to Piteşti and to Urziceni; near Sibiu, on the motorway to Bucharest; close to Ploieşti, on the highway to Braşov; Constanţa (to Mangalia); Braşov (to Ploieşti and Bucharest); Galaţi (to Brăila); Piteşti (on the motorway to Bucharest), etc.

Another tendency is to update the big commercial units, built before 1989 in county-seats, and turn them into malls. For example, the big universal store *Unirea* in Bucharest, updated and turned into mall-type centre. In some 1st and 2nd-rank cities, they built commercial units in the central parts of the city, or of big residential areas (Figure 3).

Some commercial complexes are located in the proximity of large student camps. In Bucharest, a typical example is *Carrefour Orhideea* sited in the close vicinity of the Regie-Grozăveşti student camp; similar examples in Cluj-Napoca and Iaşi. The same location pattern holds for entertainment services complementary to the shopping ones.

3.4 The social impact of commercial investments. The Romanian city from traditional to cosmopolitan

Whether located on the outskirts of large cities, or within their central sections, of great demographic concentration, the impact of big commercial investments is worth considering. The »mall« concept transcends a strictly commercial function, it being associated with luxury and fashionable; one goes to the mall to see new trends, to socialize, to become acquainted with a certain segment of the population (Skivko 2016). So, financial segregation goes hand-in-hand with social segregation, both being embodied in commercial segregation, and the best way of expressing it is going to the mall. No wonder, therefore, that in some big commercial centers, commercial facilities are associated with social and business facilities (in Timişoara, Bucharest, etc.).

Apart from fashion garments, cosmetics, or electric items, malls have fast-food restaurants, coffee-bars, cinemas, casinos, entertainment areas, destined to disseminate global consumer products within the Romanian urban society. Looking at the number of visitors going to these places, the social function of malls is quite obvious. At the same time, the global character of this commercial type is reflected in the countries these products originate from, they being sold by over 90% of the commercial network in Romania.

Incomes are concentrated in Bucharest and in the large cities; this determined specialist goods and services to be concentrated in big commercial complexes. Their location appears to be connected with ever-greater social segregation, tending to delimit the areas where such goods and services can be distributed, that is, areas in which a certain type of users can be found. Thus, a new kind of urban-rural polarization emerged, directly proportional to social and cultural segregation, which depends on the Romanian urban system's capacity to take in globalizing flows.

The deep-going financial disparities among the urban population, caused by industrial restructuring, filter the penetration of globalizing flows. On the other hand, the global consumerist culture, combined with endemic poverty-induced lack of culture, is a fertile ground for the resurgence of urban subcultures and organized crime. This phenomenon is increasingly affecting Romania's towns, and especially the large cities (Ban 2014).

4 Conclusion

Developing the commercial services sector has become one of the main characteristics of the Romanian economy after 1989, in line with evolution trends in the global economy. Changes in the urban functional zone have been made as commercial and services areas kept replacing the industrial ones.

The density of modern commercial areas goes hand-in-hand with the financial-banking investments, and is directly proportional to the population's state of well-being. In Romania, the commercial area outside Capital-city is 2,43 million m^2 (density: 184 m^2 / 1,000 inh.) and of 1.19 million m^2 in Bucharest City (651 m^2 / 1,000 inh.) (C&W Echinox 2018).

Big commercial investments have been made on the site of former industrial units that had been demolished (Cercleux, Peptenatu and Merciu 2015), or on some former production spaces, former farm lands located on the outskirts of large cities, or in peri-urban zones (using existing road access), in some residential areas short of services facilities, or in the proximity of some student camps.

The global economic and financial crisis had a serious impact on commercial investments in Romania, the investment-market becoming saturated as people's purchasing power dropped. Some projects were abandoned for lack of investors (e.g. in Craiova, Buzău, Constanța and Bucharest), others were turned into office-rooms, or residential areas.

Globalization, through big investments in commercial and agreement areas has materialized in that over 90% are held by international store chains in Romania's commercial structure. This country is among the European states with the fastest economic dynamics in this field.

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APPLICATION OF A MASS MOVEMENT SUSCEPTIBILITY MODEL IN THE HETEROGENEOUS MIOCENE CLASTIC SUCCESSIONS OF THE SLOVENJ GRADEC BASIN, NORTHEAST SLOVENIA

Kristina Ivančič, Jernej Jež, Blaž Milanič, Špela Kumelj, Andrej Šmuc

KRISTINA IVANČIČ

The hilly landscape between Slovenj Gradec and Velenje consists of soft sedimentary rock, which is susceptible to landslide formation.

DOI: https://doi.org/10.3986/AGS.7040
UDC: 551.435.62:528.94(497.413)
COBISS: 1.01

Kristina Ivančič[1], Jernej Jež[1], Blaž Milanič[1], Špela Kumelj[1], Andrej Šmuc[2]

Application of a mass movement susceptibility model in the heterogeneous Miocene clastic successions of the Slovenj Gradec Basin, northeast Slovenia

ABSTRACT: In Slovenia, mass movements are not only a threat to the population, but also a major environmental and social science challenge. Lithologically heterogeneous areas have been found to be problematic, and the Miocene Slovenj Gradec basin (in northeast Slovenia) is one such area. For this area, we developed landslide and rockfall susceptibility maps based on detailed geological research combined with statistical modeling schemes. Crucial factors include lithological composition, land use, geological structural elements, slope curvature, aspect and inclination, and bed dipping. The approach taken in the development of mass movement susceptibility maps presented here is transferable to other areas defined by heterogeneous lithology. Such maps could prove useful spatial planning, forestry, environmental protection, landscape architecture, and other fields.

KEY WORDS: Miocene, landslides, rockfalls, mass movement process modeling, heterogeneous lithology, Slovenia

Model nevarnosti za pobočne procese na primeru heterogenih miocenskih zaporedij klastičnih kamnin v slovenjgraški kotlini v severovzhodni Sloveniji

POVZETEK: V Sloveniji pobočni procesi ogrožajo prebivalstvo, hkrati pa so tudi velik okoljski in družboslovni izziv. S tega vidika so se za problematična izkazala litološko heterogena območja, med katerimi je tudi miocenska slovenjgraška kotlina v severovzhodni Sloveniji. Za to območje so avtorji na podlagi podrobnih geoloških raziskav v kombinaciji s shemami statističnega modeliranja oblikovali zemljevide nevarnosti za zemeljske plazove in skalne podore. Glavni dejavniki, ki vplivajo na oblikovanje tovrstnih procesov, so litološka sestava, raba tal, geološke strukturne prvine, ukrivljenost pobočja, ekspozicija, naklon in usmerjenost kamninskih plasti. Predstavljeni pristop k oblikovanju zemljevidov nevarnosti za pobočne procese je prenosljiv na druga litološko heterogena območja. Tovrstni zemljevidi bi bili lahko uporabni za področja, kot so prostorsko načrtovanje, gozdarstvo, okoljevarstvo in krajinska arhitektura.

KLJUČNE BESEDE: miocen, zemeljski plazovi, skalni podori, modeliranje pobočnih procesov, litološka heterogenost, Slovenija

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1 Introduction

Mass movements are a very common geological phenomenon in Slovenia (Mikoš, Brilly and Ribičič 2004; Zorn and Komac 2008; Mikoš and Majes 2010; Zorn, Komac and Kumelj 2012). Their occurrence is related to diverse geological and tectonic structures, relief, and land use. They have caused considerable damage and occasionally threatened or even claimed human lives (Mikoš 2000/2001). In recent decades, geological phenomena including landslides, debris flows, and rockfalls have been intensively investigated in Slovenia (Mikoš et al. 2006; Mikoš, Fazarinc and Majes 2007; Zorn and Komac 2002, 2007, 2008, 2011; Jemec Auflič et al. 2017). Preventive measures have been identified as an important basis for avoiding damage and loss caused by mass movements and helping solve socioeconomic challenges. Among these measures, landslide susceptibility maps are a useful tool for minimizing potential hazard (Komac and Jež 2018) in terms of appropriate spatial planning based on the results of the investigations. Many susceptibility models for landslide zonation (Carrara et al. 1991, 1995; Guzzetti et al. 1999, 2006; Zorn and Komac 2007; Rossi et al. 2010; Petschko et al. 2014) and rockfall susceptibility zonation (Pannatier et al. 2009; Shirzadi et al. 2012; Böhme, Derron and Jaboyedoff 2014) have been used around the world. The methodology used in our research was developed as part of research projects at the Geological Survey of Slovenia (Bavec, Budkovič and Komac 2005; Komac and Jež 2018). It was developed using a linear model of weighted spatial factors tested by a univariate chi-square (χ^2) statistical method, which has already been utilized by several authors (Stančič and Veljanovski 1998, 2000a, 2000b; Veljanovski 1999; Komac 2005b). Initially, the methodology was used at smaller scales at the national level (Komac and Ribičič 2006), and later it was also applied to larger scales; that is, at the municipal and local levels. In order to verify the transferability of the methodology to other environments (also outside of Slovenia), it was tested on the example of the Municipality of Zvornik (Republika Srpska, Bosnia and Herzegovina), where it proved successful (Kumelj et al. 2014). The method was previously used for landslide and rockfall susceptibility zonation in the wider study area at a scale of 1:25,000. It turned out that approximately 70% of the area of the municipalities of Slovenj Gradec and Velenje are exposed to a medium, high, and very high occurrence of mass movement (Bavec et al. 2012a; 2012b).

In preparing the geological modeling input data, the most problematic areas were found to be areas with lithologically heterogeneous sequences. In such areas, rocks with different geomechanical properties alternate frequently within very short distances. Such rocks include Miocene and Permian–Carboniferous clastic sedimentary successions, which are most commonly found in central and northeastern Slovenia (Figure 1A). According to the Landslide Susceptibility Map of Slovenia, these are the most exposed hazardous landslide areas (Figure 1B). The problem of common occurrences of landslides in Neogene rocks in the wider Pannonian Basin was also addressed by Tošić et al. (2014).

This paper describes a possible approach in geologically diverse areas where detailed geological mapping and detailed geological profile logging constitute the main analytical tools. They provide more precise geological input data required for the model. The main purpose is to improve maps so that they are precise for large scales (e.g., 1:5,000), on which the susceptibility zonation for a specific location can be seen. The area between Podgorje (in the Municipality of Slovenj Gradec) and Gaberke was appropriate for our research because it is lithologically and morphologically heterogeneous with different land-use characteristics. The approach can be transferred to other areas with similar rock successions.

2 Study area

The investigated area is located between Podgorje (in the Municipality of Slovenj Gradec) and Gaberke in northeastern Slovenia, and it covers 11 km² (Figures 1A, 2). The area studied is part of the Alpine macroregion and corresponds to the Eastern Karawanks, the Velenje and Konjice Hills, and the Strojna, Kozjak, and Pohorje mountains (Perko 1998). Paleogeographically, the investigated area is part of the Slovenj Gradec Basin and consists of alternating Miocene clastic sedimentary rocks.

The terrain in the study area is morphologically diverse. Only 3.6% of the study area has a slope less than 5°. In areas with steeper slopes, landslides could occur. A slope steeper than 38° is found in 17.3% of the area and rockfalls can occur (Komac 2005a). Rarely, conglomerate and sandstone beds can even form overhanging walls. The highest point of the area reaches 825 m, and the lowest is at 425 m. The morphological diversity of the area is conditioned by the geological diversity there and, consequently, a branched

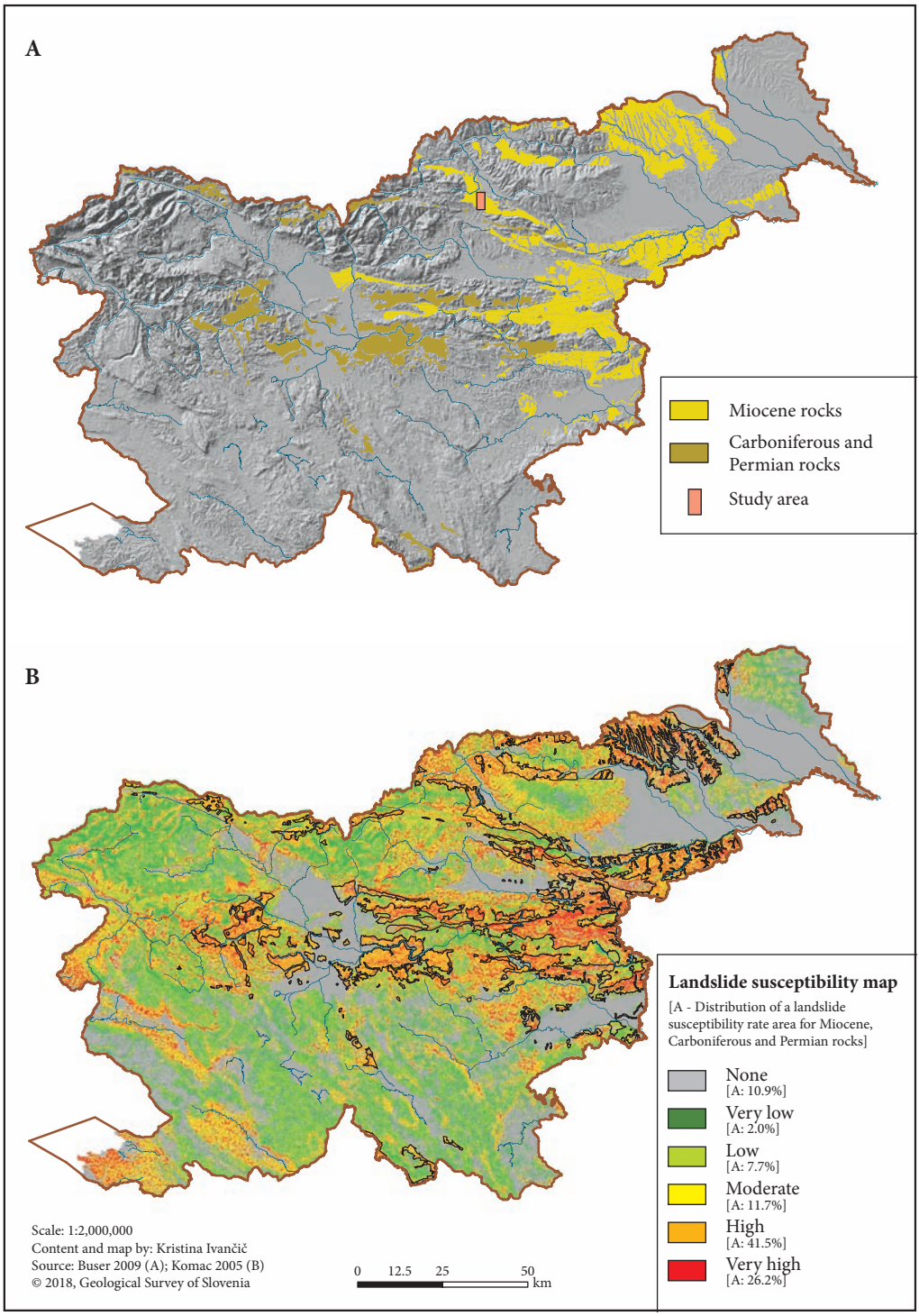


Figure 1: A) Areas with Miocene and Permian–Carboniferous clastic rocks, B) landslide susceptibility map of Slovenia (Komac and Ribičič 2006).

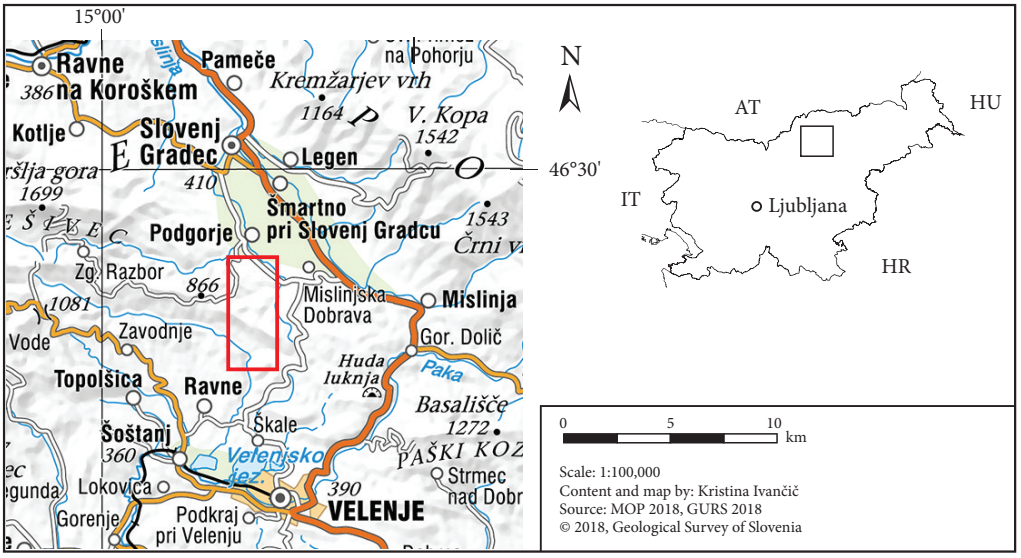


Figure 2: Topographic map with the location of the investigated area (red).

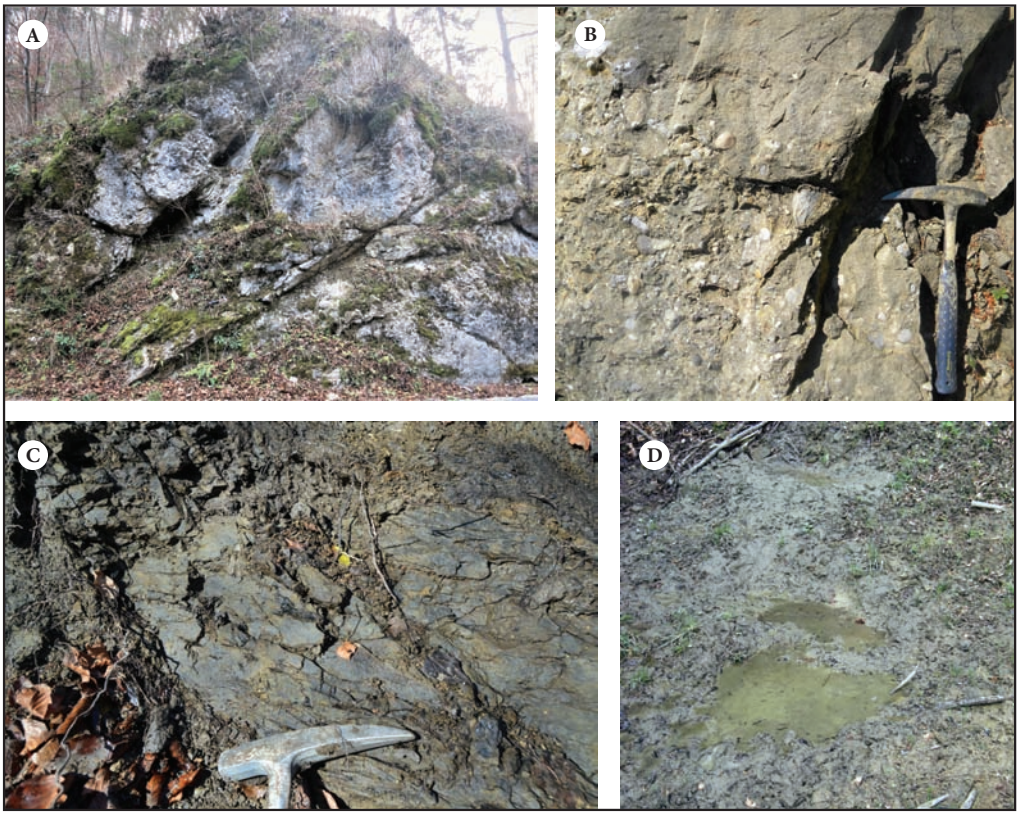


Figure 3: A) Cracks in conglomerate layers, B) alternation of conglomerate and sandstone layers, C) characteristic shaly marlstone, a consequence of weathering, D) water retention on impermeable claystone.

river system of the torrent type. The main valleys and ridges formed in a northwest–southeast direction and are partly conditioned by the tectonic structure present there.

The investigated area is faulted and folded. Faults and fault zones are more frequent in the southern part of the area. They belong to the Periadriatic fault zone, which separates tonalite from clastic sedimentary rocks. Smaller-scale faults are present in other parts of the study area. In the entire investigated area, the rocks are fractured. The most prominent fractures are in the southern part of the area, occurring mainly in conglomerate (Figure 3A) and sandstone, and they are subordinate in siltstone.

In the area there are also two synclines and an anticline with a northwest–southeast axis orientation. The folding has resulted in variable dip of the beds, which ranges from 310–30/20–60 to 190–225/30–50.

3 Methods

Landslide and rockfall susceptibility models were developed for the area between Podgorje and Gaberke. The study is based on two primary types of data collection and processing schemes: a) geological mapping and sedimentological analyses, and b) the preparation of input data and statistical modelling.

3.1 Geological methods

Detailed geological mapping of rock outcrops was performed at a scale of 1:5,000 in order to obtain a detailed lithological map with geomechanical properties. In addition, tectonically fractured rocks, the location of faults and fault zones, and bed dip were evidenced, and a special focus was placed on existing landslides. Seven lithological sections present in different parts of the Slovenj Gradec Basin succession were recorded at a scale of 1:100 in order to precisely determine the type and properties of rocks (Figure 4A).

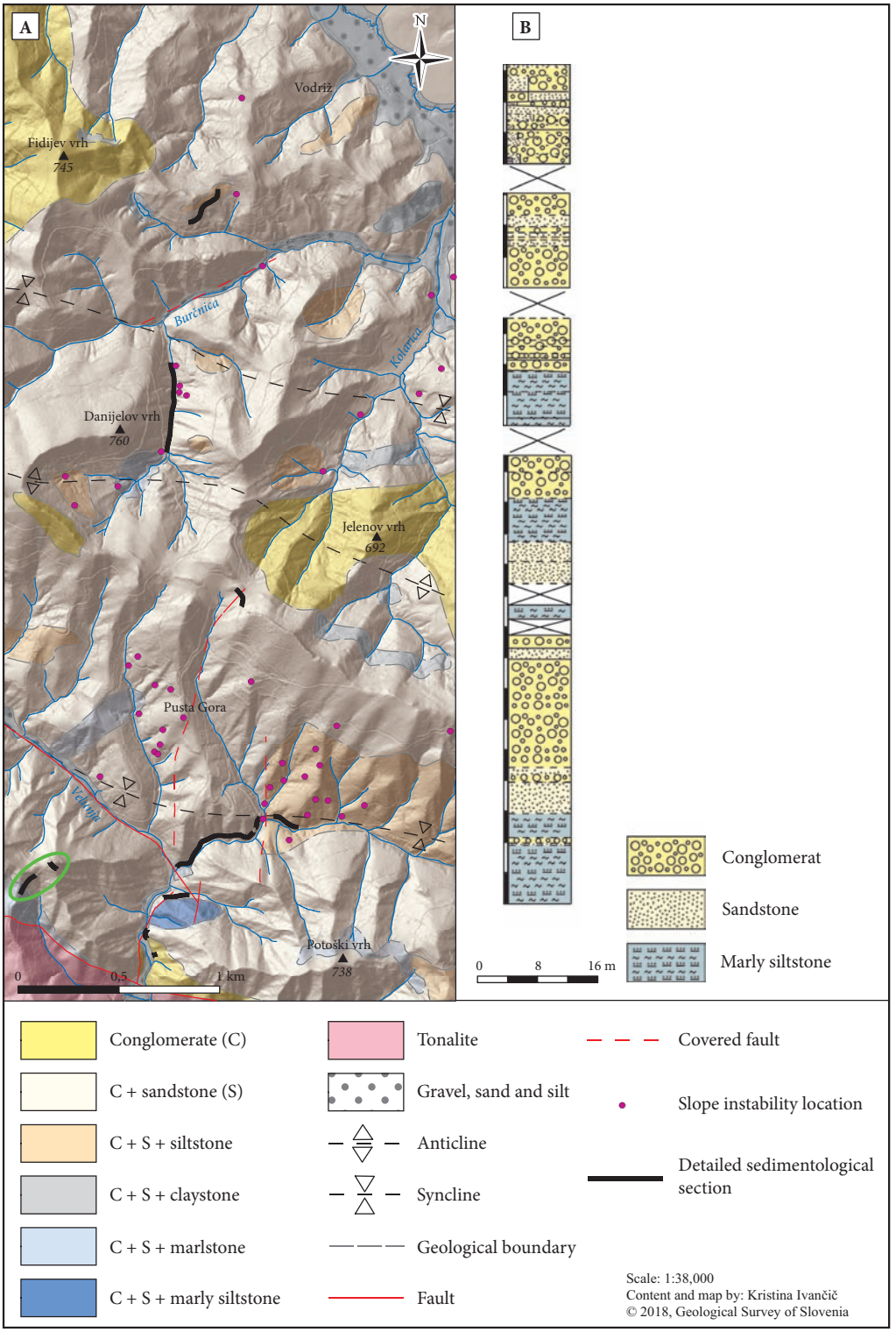
The lithological units were reclassified into six susceptibility categories according to landslide and rockfall susceptibility (Bavec, Budkovič and Komac 2005; Komac and Jež 2018), where Category 1 shows areas with no occurrence (area under 5°) and Category 6 shows areas that are very prone to mass movement event occurrence.

3.2 Input data and statistical modeling

Two existing conceptual models (a methodology for estimation of geohazard induced by mass movements; Komac 2003a, 2005a; Bavec, Budkovič and Komac 2005) were used to determine landslide and rockfall susceptibility rates. The method is explained in Komac (2003a, 2003b, 2005a) and Komac and Ribičič (2006). It was developed using a linear model of weighted spatial factors. Univariate statistical methods (the chi-square method) were used to test the influences of individual spatial factors on landsliding, and multivariate statistical methods were used to test the importance of individual factors in landslide occurrence. Komac (2005a) developed 3,142 models for landslide susceptibility and 7,674 for rockfall susceptibility using the Monte Carlo method. For the landslide model, lithological data are combined linearly with the synchronicity of the bed dips and the slope aspect, applying a weighting ratio of 0.8 for the lithological composition and 0.2 for the dip of the beds. In addition, land-use factors, distances from structural elements and fault zones, slope aspect, and curvature were all included. Precondition spatial-temporal factors for landslide occurrence are lithology 0.3, slope inclination 0.25, landcover type 0.25, slope curvature 0.1, distance to structural elements 0.05, and slope aspect 0.05 (Figure 5A). For the rockfall model, lithological composition and fault zone parameters were weighted as follows: 0.5 for slope inclination, 0.35 synchronicity of dip of beds, and 0.15 for slope aspect weight (Figure 5B).

In general, the methodology of both models at a scale of 1:25,000 is based on four consecutive phases (Bavec, Budkovič and Komac 2005; Komac 2005a; Komac and Jež 2018): 1) synthesis of the existing cartographic archival geological data and verification fieldwork examinations in the phase map of geological hazards due to slope mass movements; 2) the production of a probability statistical model of geological

Figure 4: A) Lithological map of the investigated area with structural elements (faults). The red circle marks the location of the Gaberke section; B) the Gaberke section, where frequent alternation of different rock types with different geomechanical properties can be observed. ►


A
N
Vodriž
Fidijev vrh
745
Burčnica
Kolarica
Danijelov vrh
760
Jelenov vrh
692
Pusta Gora
Velunja
Potoški vrh
738
0
0,5
1 km
B
0
8
16 m
Conglomerat
Sandstone
Marly siltstone
Conglomerate (C)
C + sandstone (S)
C + S + siltstone
C + S + claystone
C + S + marlstone
C + S + marly siltstone
Tonalite
Gravel, sand and silt
Anticline
Syncline
Geological boundary
Fault
Covered fault
Slope instability location
Detailed sedimentological section
Scale: 1:38,000
Content and map by: Kristina Ivančič
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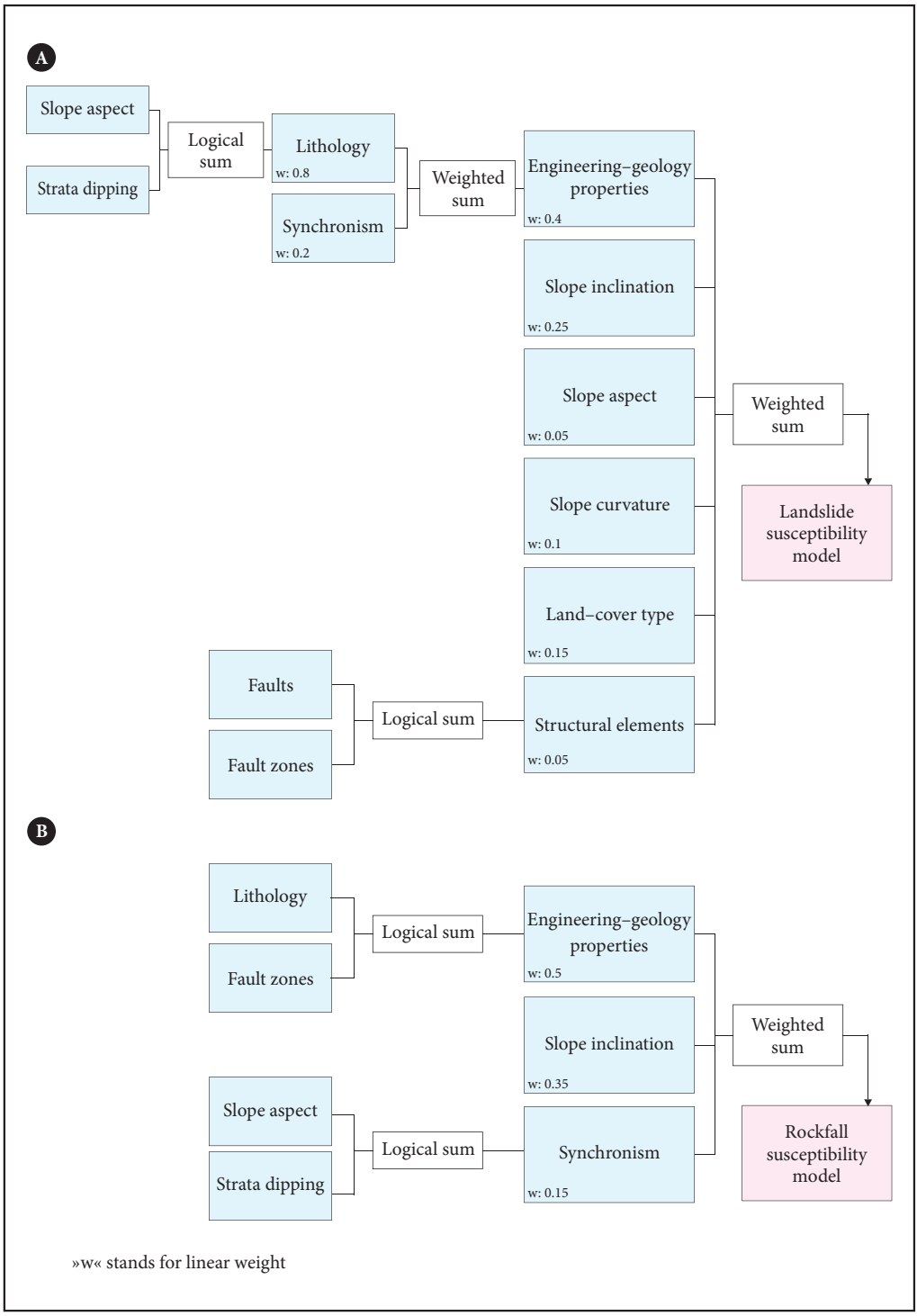


Figure 5: A) Input parameters for the landslide susceptibility model, B) input parameters for the rockfall susceptibility model.

hazards due to slope mass movements; 3) production of maps of geological hazards due to processes of slope mass movement based on the synthesis of Phase Map 1 and Probability Model 2 by exclusion of the most problematic areas, and 4) detailed mapping of more problematic areas at a scale of 1:5,000 or 1:10,000 and production of a detailed geological hazards map due to slope mass movements for these areas. In this paper, the modeling is based exclusively on new geological data, and therefore Phase 1 related to archival geological data is not included. The methodology starts with the process of Phase 4.

Data on slope inclination, aspect, and curvature were derived from the digital relief model produced on the basis of LiDAR data at a spatial resolution of 1 m (MOP 2018). Areas under 5° for landslides and areas under 38° for rockfall are considered areas where the probability of landslide or rockfall is essentially zero, and they were therefore not included in the model (cf. Komac 2005a).

The values of the calculated models were classified into six landslide and rockfall susceptibility categories and were arranged according to changes in the distribution of frequency occurrence (Natural Breaks – Jenks; natural boundary method). Class breaks are identified that best group similar values and that maximize the differences between classes. The features are divided into classes whose boundaries are set where there are relatively large differences in the data values (Esri 2006).

All landslides in the area studied from the national database (Komac and Hribernik 2015) were verified in the field, and new landslides identified during fieldwork were added to the database. This served as a basis for model validation. If the input parameters were identified as incorrect in the field (e.g., lithology or land use), we modified them accordingly in the model and ran a new one.

4 Results

4.1 Lithological map

The investigated area is composed of tonalite and alternation of conglomerate, sandstone, siltstone, marlstone, and claystone (Figure 4A). Tonalite is not part of the clastic sedimentary succession, and it is therefore not involved in our research. Conglomerate and sandstone predominate and were found throughout the entire investigated area. They frequently occur together, meaning that layers of sandstone alternate with conglomerate layers (Figure 3B). In general, more coarse-grained lithologies predominate in the northern part of the investigated area, whereas fine-grained intercalations and packages are more common in its southern part.

4.2 Detailed description of lithological units

Based on detailed fieldwork (Ivančič et al. 2018), all lithological units were defined and their geomechanical properties were evaluated. The frequent alternation of different lithological units could be well observed in the Gaberke section, where conglomerates, sandstone, and silty marlstone occur (Figure 4B).

Fine- to coarse-grained conglomerate is grain-supported, thin- to thick-bedded, or massive in places. The conglomerate is very well to poorly lithified, and sometimes fractured. It is present throughout the entire investigated area, and it is common in hilltops and ridges.

Fine- to coarse-grained sandstone is well to poorly lithified. The grains are bonded with carbonate and quartz cement, with a carbonate matrix. Sandstone was found throughout the investigated area, mostly in combination with conglomerate layers.

Siltstone occurs locally throughout the entire mapped area. It is laminated and bedded, and contains plant remains (Figure 3C). Although silty layers are usually present only in thin layers between sandstone and conglomerate beds, locally successions can be up to 32 m thick.

Marlstone and silty marlstone are frequently found on the southern part of the map, occurring in combination with conglomerate and sandstone. Marlstone is laminated and usually shaly, which contributes to its rapid weathering and poor geomechanical characteristics.

Claystone is mostly found in the northern part of the investigated area, occurring as thin layers in combination with conglomerate and sandstone. Retained water on the surface suggests impermeability of the unit (Figure 3D).

4.3 Model

The values of the final model (between 0 and 1) were classified into six landslide or rockfall susceptibility classes. The method determines the boundaries between groups of data that exhibit relatively large differences between pairs of adjacent values. The classes are not equally distributed (Figures 8 and 9).

4.3.1 Landslide susceptibility model

The landslide susceptibility model indicates that 19.9% of the investigated area exhibits a very high probability of landslide occurrence. A moderately high probability is exhibited by 22.7% of the area, and 44.3% has a relatively low to a very low probability of landslide occurrence. The greatest landslide hazard areas are Plešivec (Figure 6) and Vodriž (Figure 7). The areas coincide with the real state of nature. The very high landslide susceptibility class that characterizes the Plešivec area coincides with already identified landslide hazard areas. These relatively vast unstable areas are mainly limited to meadows and pastures, whereas in forests they are not common. Generally speaking, those more susceptible areas coincide with fine-grained sedimentary rocks (Figure 4A), such as siltstone, marlstone, and claystone. These locations are presented in Figure 8.

4.3.2 Rockfall susceptibility model

The rockfall susceptibility model indicates that 22.1% of the investigated area belongs to the class of very high susceptibility, and 28.6% of the area to moderate susceptibility. Locations where rockfall occurrence has been documented are rare. The highest possibility for their occurrence is on the northwest part, the central part, and the southwest part of the investigated area (Figure 9). The area is mostly composed of a conglomerate, subordinate sandstone. It is bound to vertical walls in places. The result presented by the model coincides with the real situation in nature. The locations of the susceptible areas are marked in Figure 9.

5 Discussion

With this approach, the mass movement susceptibility models of the rockfall and landslides proved to be very precise and gave a very good approximation of the natural state. This was proved by verification. The areas of highest landslides and rockfall susceptibility coincide with the actual state of nature even in the study area between Podogrje and Gaberke, where the lithology frequently alternates. Very high and high landslide susceptibility in the study area turns out to be on the meadows and pastures with siltstone, marlstone, or claystone as bedrock. Landslides from the national database and new landslides are located in the high and very high susceptibility areas. Moreover, new landslides were determined during the verification process. They are located in areas of high and very high probability for landslide occurrence. The model did not specify the correct landslide susceptibility zonation in the case of locally changed land use or in the case of newly changed land use that is not included in the modeling process. One specific landslide occurs in the area of deforestation (Figure 7C). In this case, the bedrock is composed of alternating sandstone and conglomerate. Rockfalls in the study area are subjected to the lithology of conglomerate with rare sandstone layers.

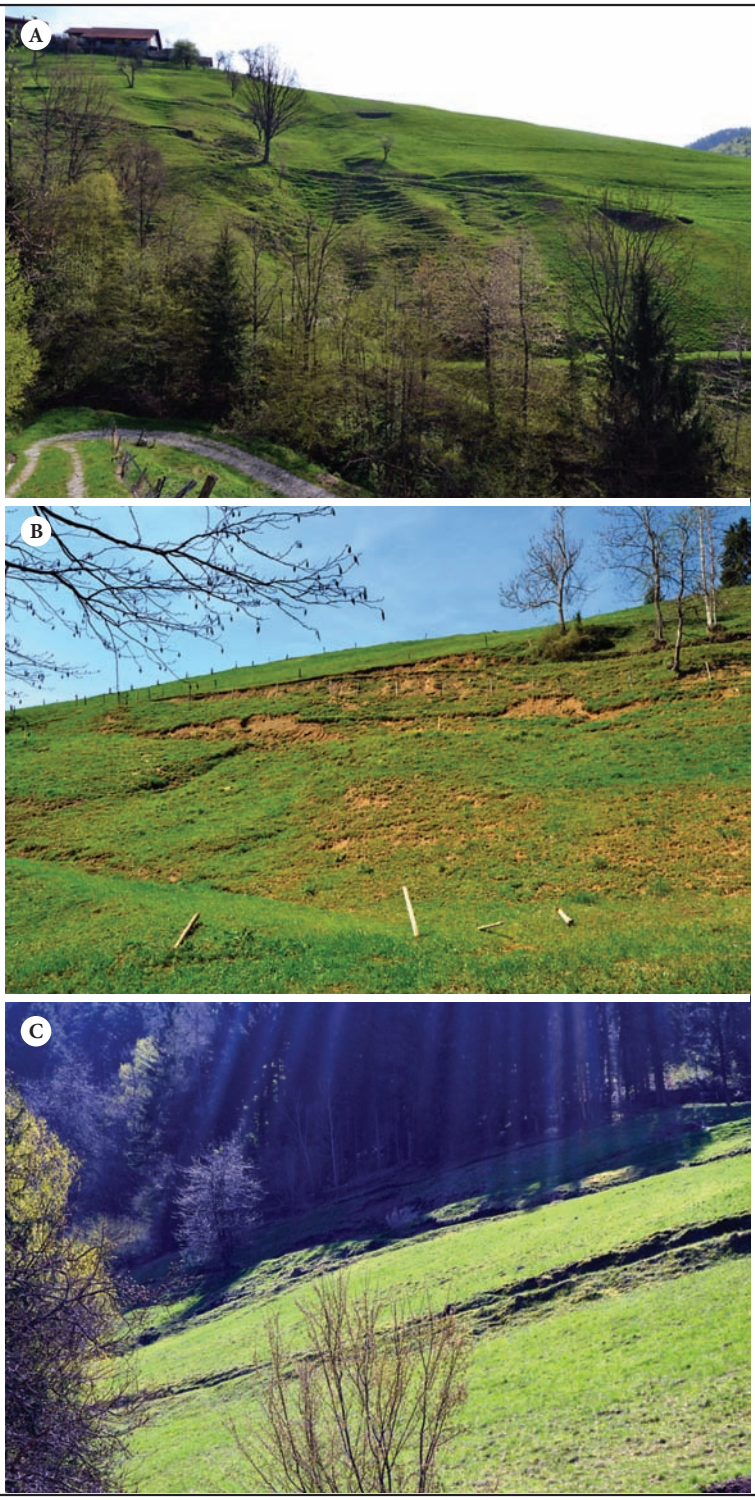
Many different models were used in the past (Carrara et al. 1991, 1995; Guzzetti et al. 1999, 2006; Zorn and Komac 2004, 2007; Rossi et al. 2010; Reichenbach et al. 2018) to produce mass movement susceptibility zonation. Such models usually do not precisely define susceptibility to slope mass movements in lithological heterogeneous areas. The problem of heterogeneous lithology has already been discussed

Figure 6: Examples of larger labile areas in the Plešivec region. A) The area below the Količnik farm, B) the area near the Grah farmhouse, C) the area at the Grabnar farm. The locations of areas 6A to 6C are also indicated in Figure 8. ► p. 71

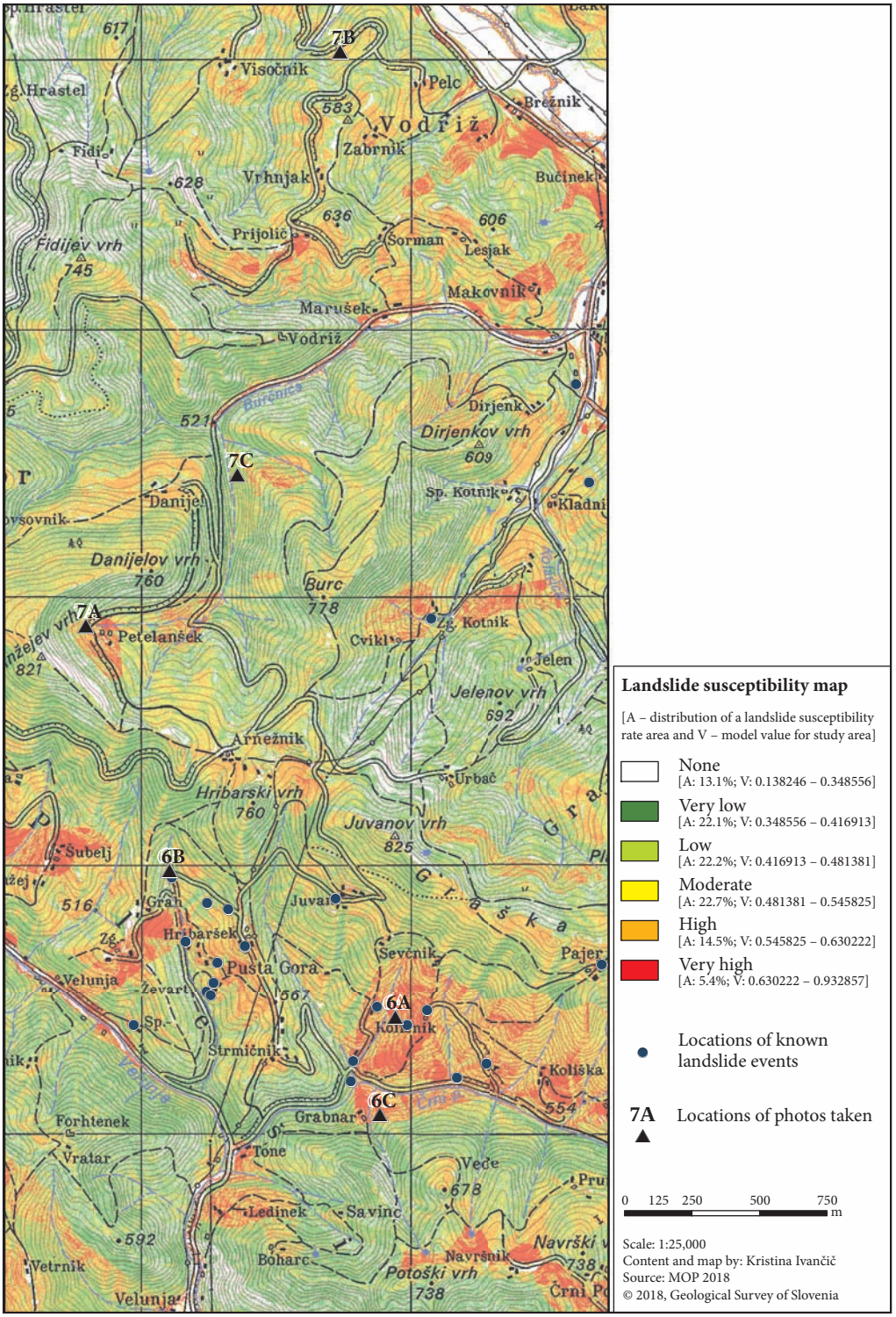
Figure 7: Examples of individual landslides in the investigated area. A) Landslide at the Petelanšek farm, B) cleanup of the landslide along the road toward the Pelc farm, C) newly formed landslide on the freshly deforested section along Vodriž Creek, with marked main scarp. The locations of areas 7A to 7C are also indicated in Figure 8. ► p. 72

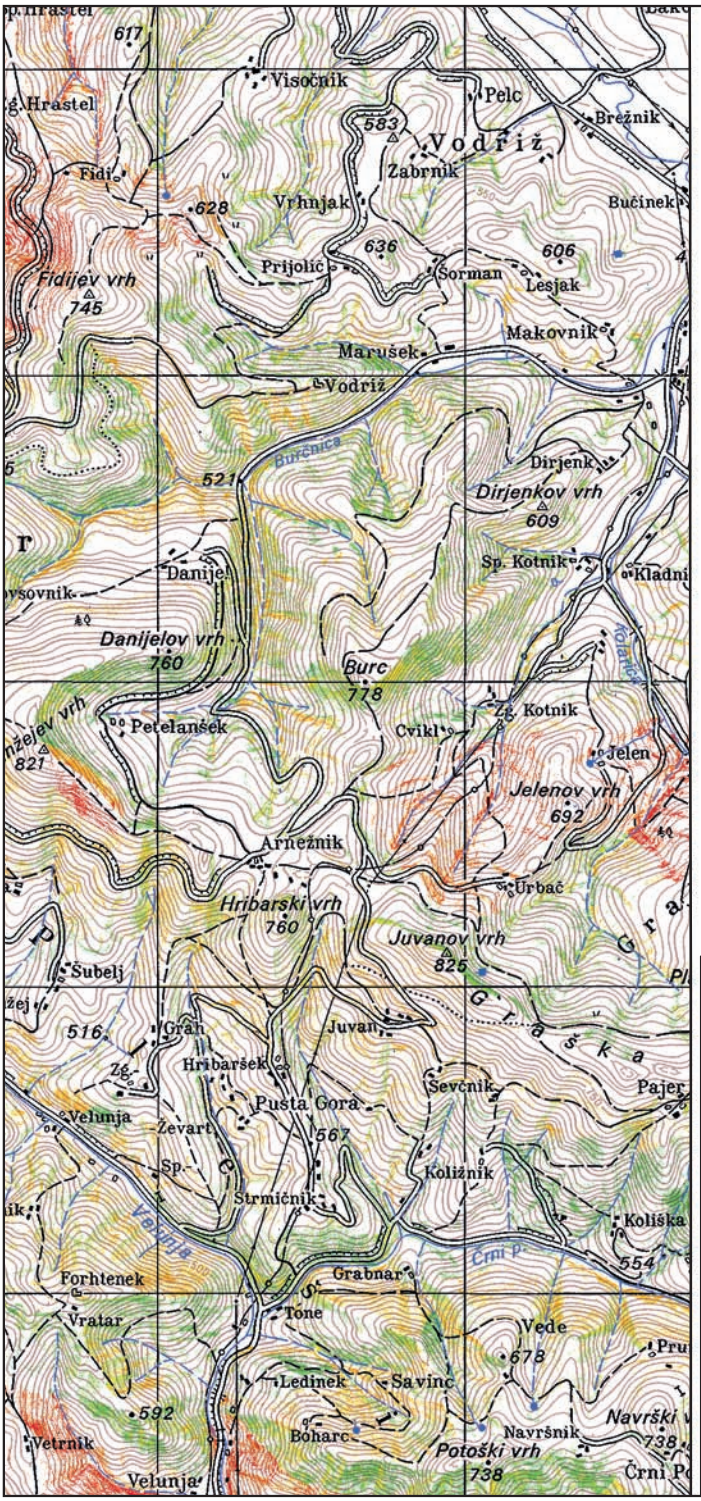
Figure 8: Landslide susceptibility map of the investigated area. Points 6A, 6B, 6C, 7A, 7B, and 7C mark the locations of the photos in Figures 6 and 7. ► p. 73

Figure 9: Rockfall susceptibility map of the investigated area. ► p. 74


A
B
C


A
B
C


7B
7C
7A
6B
6A
6C
Visočnik
Pelc
Brežnik
Vodriž
Zabrnik
Vrhnjak
Bučinek
Fidi
Prijolič
Sorman
Lesjak
Fidijev vrh
745
Makovnik
Marušek
Vodriž
Dirjenk
Dirjenkov vrh
609
Danije
Sp. Kotnik
Kladni
Danijelov vrh
760
Burc
778
Petelanšek
Cvikl
Kotnik
Jelen
Jelenov vrh
692
Arnežnik
Urbač
Hribarski vrh
760
Juvanov vrh
825
Subelj
Grah
Juvan
Hribaršek
Pusta Gora
Ševčnik
Pajer
Velunja
Zevart
Sp.
Strmičnik
Koniček
Koliška
Forhtenek
Grabnar
Vratar
Tone
Veče
678
Ledinek
Savinc
592
Vetrnik
Bohare
Navršnik
Potoški vrh
738
Velunja
Črni
Navrški
Landslide susceptibility map
[A – distribution of a landslide susceptibility rate area and V – model value for study area]
None
[A: 13.1%; V: 0.138246 – 0.348556]
Very low
[A: 22.1%; V: 0.348556 – 0.416913]
Low
[A: 22.2%; V: 0.416913 – 0.481381]
Moderate
[A: 22.7%; V: 0.481381 – 0.545825]
High
[A: 14.5%; V: 0.545825 – 0.630222]
Very high
[A: 5.4%; V: 0.630222 – 0.932857]
Locations of known landslide events
7A Locations of photos taken
0 125 250 500 750 m
Scale: 1:25,000
Content and map by: Kristina Ivančič
Source: MOP 2018
© 2018, Geological Survey of Slovenia



Rockfall susceptibility map

[A – distribution of a rockfall susceptibility rate area and V – model value for study area]

- None [A: 5.27%; V: 0.333929 – 0.521429]
- Very low [A: 18.9%; V: 0.521429 – 0.601191]
- Low [A: 25%; V: 0.601191 – 0.657143]
- Moderate [A: 28.6%; V: 0.657143 – 0.71756]
- High [A: 16.2%; V: 0.71756 – 0.796726]
- Very high [A: 5.9%; V: 0.796726 – 0.928571]

0 125 250 500 750 m

Scale: 1:25,000
Content and map by: Kristina Ivančič
Source: MOP 2018
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(Lee et al. 2008; Zorn and Komac 2009; Blahut, Van Westen and Sterlacchini 2010; Petschko et al. 2014). The greatest difference in our model is in its input factors, which are more precisely defined for slope (curvature, inclination, and aspect) and strata (dipping and aspect). Moreover, detailed mapping improves the input data of lithology and tectonic elements, and therefore the final landslide and rockfall susceptibility zonation is more detailed and usable at larger scales (e.g., 1:5,000). The model provides accuracy with respect to the worst-scale input parameter, but nevertheless more accurate data (such as LiDAR) show characteristic features that must be taken into account when interpreting the results. Geological maps at smaller scales (e.g., 1:100,000 or 1:25,000) usually do not sufficiently separate or differentiate lithologically heterogeneous units. Consequently, such maps are of limited use for mass movement susceptibility modeling.

The quality of the final predictions of the formation of slope mass movements primarily depends on the quality of the input geological data, and therefore it is necessary to combine the existing methodology of the modeling (Komac, Kumelj and Krajnik 2012; Bavec et al. 2012a, 2012b) with classic techniques of geological research (e.g., geological mapping and detailed recording of lithological sections). Only in this way can we obtain quality data, which, in combination with the geomorphological parameters of the terrain, make a significant contribution to the production of a useful final model of susceptibility to slope mass movements.

Today publicly available relief data (i.e., LiDAR data susceptibility) are significantly more accurate than that used by existing lithological maps, and this therefore contributes to more detailed geological fieldwork. In addition, current land-use data are also very important in the modeling process. Statistical data indicate that shallow landslides frequently occur in areas used as meadows, pastures, orchards, and vineyards (Komac 2005a). Certain factors related to changes in land use, such as deforestation and the cultivation of pastures and orchards, play a major role in the destabilization of labile areas (Fidej et al. 2018). Consequently, agricultural areas located in hazardous areas are often affected. Examples of such phenomena were also observed and documented in the investigated area. Determining the weighting ratio of the impact of the individual land use class (forest, vineyard, etc.) proves a particular challenge within the basic input factor: land use.

In addition to activities related to agriculture and forestry, the data in the model are indispensable in all spatial planning processes in the environment. Regional and local spatial planning and land use should be adjusted according to such models. It is worth mentioning that the models indicate source areas of potential mass movements, not their transport paths or deposition areas. As a rule, landslide deposition areas are generally not far from the landslide source, with the exception of cases in which large quantities of water are present, and the material can be converted into a mass (debris) flow. In the case of rockfalls, the material (blocks) may be deposited far from the source site (Zorn 2002).

6 Conclusion

Existing geological and pedological maps are not sufficiently accurate to produce quality detailed models, making it necessary to include precise field mapping and other basic geological research in the process. This is absolutely suggested in lithologically heterogeneous areas. A good example of this is the study area between Podgorje and Gaberke, where more than 40% of the area exhibits a very high, high, or moderate probability of landslide occurrence.

Alongside lithology, land use as model input factor (e.g., meadows and pastures, and deforestation) was found to be very important in the modeling process. In addition, changes in land use may play a major role in the destabilization of labile areas.

The susceptibility models presented here are sufficiently accurate and have been verified by checking known slope movement events in the investigated area. The approach used is transferable and comparable at all susceptibility levels, and it can be used in lithologically heterogeneous areas for large-scale maps (1:5,000).

The results can be used for spatial planning in the environment. By considering such models, the most hazard-prone areas can be avoided or can be dealt with in a geotechnically professional manner.

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MEASUREMENTS OF TECTONIC MICRO-DISPLACEMENTS WITHIN THE IDRIJA FAULT ZONE IN THE UČJA VALLEY (W SLOVENIA)

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Introductory figure caption: Left: A crack in the Idrija fault inner fault zone in the Učja valley on which the TM 71 extensometer is installed. Right: Outcrop of another fault plane located 50 m to the east with clear striations indicating subhorizontal movements.

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Measurements of tectonic micro-displacements within the Idrija fault zone in the Učja valley (W Slovenia)

ABSTRACT: A recent slip-rate of an active fault is a very important seismotectonic parameter, but not easy to determine. Idrija fault, 120 km long, is a prominent geomorphologic feature with large seismogenic potential, still needed to be researched. Measurements of tectonic micro-displacements can provide insight into its recent activity. The Učja valley extends transversally to the Idrija fault and was therefore selected for the installation of TM 71 extensometer. Measurements on the crack within its inner fault zone are conducted from the year 2004. In 14 years of observations a systematic horizontal displacements with average rate of 0.21 mm/year and subordinate vertical displacements of 0.06 mm/year were established, proving the activity of this fault. An overview of methods of displacement measurements related to active faults and of newer interdisciplinary investigations of the Idrija fault is given. Displacement rates are beside for geodynamic interpretations important for improvement of seismotectonic models and thus for better seismic hazard assessment.

KEY WORDS: tectonics, geodynamics, fault, extensometer, Idrija fault, Učja, Slovenia

Meritve tektonskih mikro-premikov v prelomni coni Idrijskega preloma v dolini Učje (Z Slovenija)

POVZETEK: Recentna hitrost premikov ob aktivnem prelomu je zelo pomemben seizmotektonski parameter, ki pa ga ni lahko določiti. Idrijski prelom je z dolžino 120 km pomembna geomorfološka struktura z velikim seizmogenim potencialom, ki pa ga je treba še raziskati. Meritve mikro-premikov lahko nudijo vpogled v recentno aktivnost preloma. Dolina Učje poteka prečno na Idrijski prelom, zaradi česar je bila izbrana za namestitev ekstenziometra TM 71. Meritve na razpoki v notranji prelomni coni potekajo od leta 2004. V 14 letih opazovanj je bilo ugotovljeno sistematično vodoravno zmikanje s povprečno hitrostjo 0,21 mm/leto in podrejeni vertikalni premiki s hitrostjo 0,06 mm/leto, kar dokazuje aktivnost tega preloma. Podan je pregled različnih metod raziskovanja recentnih premikov ob aktivnih prelomih ter novejših interdisciplinarnih raziskav Idrijskega preloma. Ocene hitrosti premikov so poleg geodinamskih interpretacij pomembne predvsem za izboljšanje seizmotektonskih modelov in s tem boljše ocenjevanje potresne nevarnosti.

KLJUČNE BESEDE: tektonika, geodinamika, prelom, ekstenziometer, Idrijski prelom, Učja, Slovenija

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1 Introduction

A recent slip-rate of an active fault is among the most important seismotectonic parameters needed for realistic earthquake hazard assessment. However, it is not easy to determine it and interdisciplinary approach is needed for a reliable estimate. The methods applied so far on the Idrija fault or its vicinity can be grouped into a) geodetic (Kogoj9 2000; Rižnar, Koler and Bavec 2007; Weber et al. 2010), geological (Čar 2010), b) tectonic geomorphology (Moulin et al. 2014), c) paleoseismology (Bavec et al. 2013), d) outcrops dating methods (Moulin et al. 2016) and e) seismological (Bajc et al. 2001; Živčić et al. 2011). Measurements of tectonic micro-displacements using extensometer represent an additional method (Stemberk, Košťak and Vilimek 2003), which can contribute to the solution of the problem. Such measurements were enabled through invention of a crack-gauge instrument (Košťak 1991), which is installed on the crack which separates two tectonic blocks.

In Slovenia seven TM 71 extensometers were installed between 2004 and 2010 at or near the active faults, three of them on the surface (Idrija, Kneža and Raša faults) and four inside karst caves (two in Postojna cave, in Polog cave and in Kostanjevica cave) (Gosar et al. 2007, Gosar et al. 2011). Until 2011 the highest rates with stable sense of movements were observed on the Idrija fault (average horizontal displacement rate of 0.24 mm/year). The observed displacement rates (mainly horizontal) at all other locations were much smaller (from 0.006 to 0.05 mm/year). Only on the Raša fault more significant short-term vertical displacement rate of 0.16 mm/year was observed, at all other locations the rates were an order of magnitude smaller (Gosar et al. 2011). The fact that the monitoring on the Idrija fault showed with the leap the highest displacement rates in Slovenia, additional eight years of monitoring till 2019 and significance of the Idrija fault for earthquake hazard assessment and tectonic geomorphology, motivated a study dedicated only to the measuring site in the Učja valley which is presented in this paper.

Idrija fault is because of its length and prominent expression in topography one of the most important faults in Slovenia (Fig. 1) and it is supposed that it has a large seismogenic potential (Atanackov et al. 2014; 2016). However, its recent tectonic activity is not definitely proved yet by seismological monitoring or geodetic observations, but there are several indications for its activity from geological mapping, tectonic geomorphology, dating of outcrops and paleoseismological studies.

To get additional insight into the activity of the Idrija fault, we installed in 2004 the TM 71 extensometer on a crack within the inner fault cone which is exposed in the Učja valley (Figures 2 and 3). This location was selected as the best, because elsewhere along its trace there are no suitable outcrops. After 14 years of measurements, we provide the results of observed trends and displacement rates. First, an overview of interdisciplinary investigations of the Idrija fault is given. It is followed by description of different methods for displacement measurements and tectonic slip-rate estimates. The fault zone exposed in the Učja valley is described together with the selection of the location for the installation of extensometer. Observed microtectonic displacements are evaluated and some possible interpretations indicated.

2 Idrija fault and measurements of tectonic displacements

2.1 Geology and geomorphology of the Idrija fault

The Idrija fault is geomorphologically the most prominently expressed fault in W Slovenia and is clearly visible on satellite and aerial images or digital elevation models (Figure 1). Active tectonic movements are the only geological force which can influence the landscape in such a way. They can be studied by tectonic geomorphology methods or direct measurements along faults. The Idrija fault can be traced in the length of 120 km from Friuli (Italy) on the NW (Figure 1) to Gorski Kotar in Croatia on the SE (Buser 1986). Its average strike direction is 310°, and the dip 85° (Atanackov et al. 2014; 2016). In the southern part there are several karst poljes of the Ljubljanica river system distributed along the fault. In the northern part the fault extends along the Idrijca, Kanomljica and Soča river valleys (Figure 1). The history of its investigations is very long (Čar and Gosar 2011), also due to the importance of the Idrija Hg ore deposits, because in the geological history part of the ore body (Ljubevč) was displaced along the fault for approximately 2.5 km to its present position. Based on this fact and considering the supposed age of the fault of 10–12 million years, Placer (1971) estimated that the average slip-rate through the whole period was from 0.25

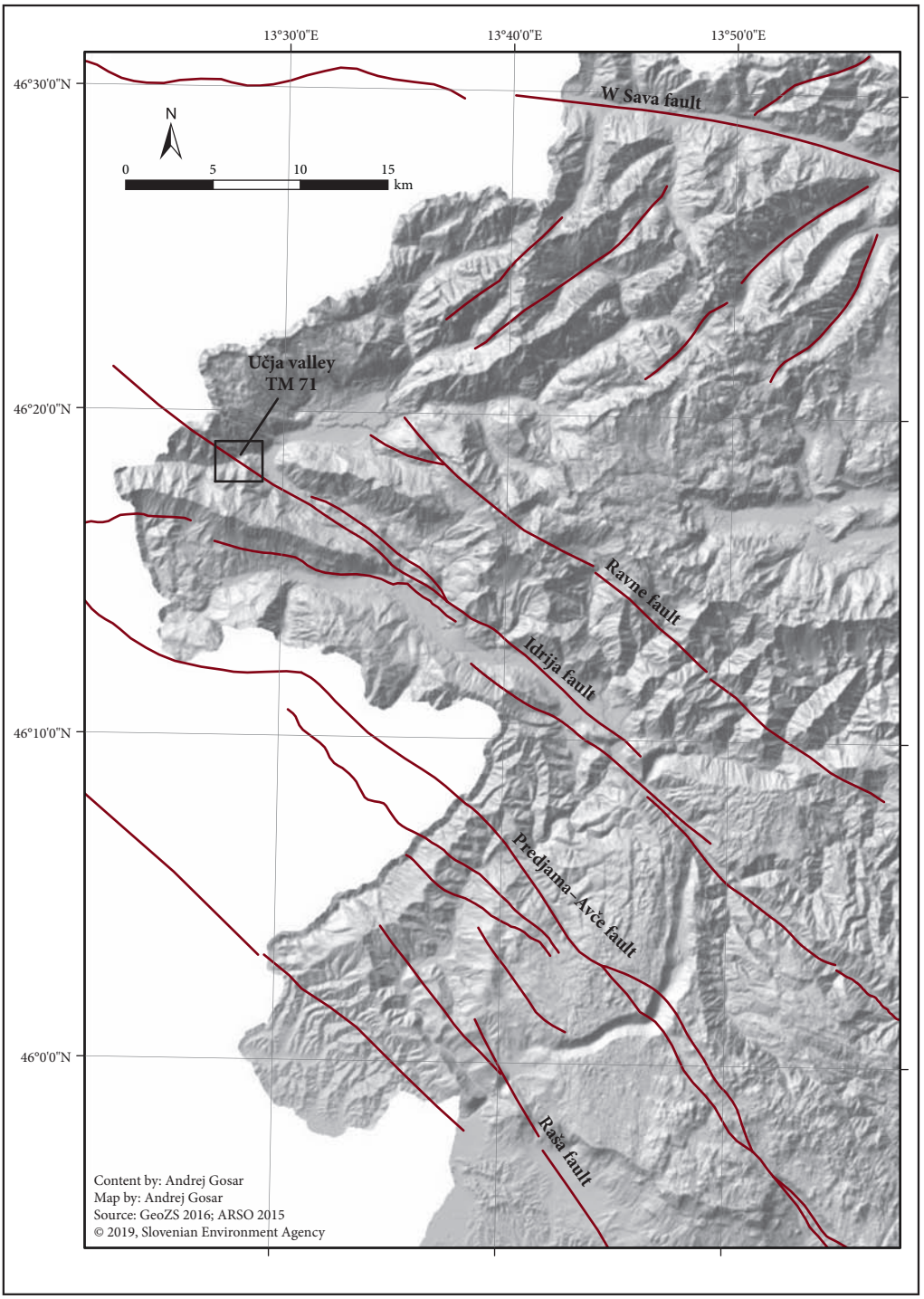

Figure 1: Map of active tectonic faults in NW Slovenia (after Atanackov et al. 2014; 2016) on shaded LiDAR 1 m resolution digital elevation model (ARSO 2015) with the location of TM 71 extensometer on the Idrija fault in the Učja valley. The rectangle indicates a detailed map shown in Figure 2.

to 0.16 mm/year, and the slip was oblique with vertical displacement of 480 m (Placer 1982). Newer investigations also shown oblique displacement, which is the result of two separated tectonic phases (Čar 2010). In middle Miocene, 12 million years ago, the area was under strong extensional forces and normal faults were developed in NW–SE direction dipping towards the NE. Along the Idrija fault the NE block was lowered for up to 480 m (Čar and Gosar 2011). Later the stress regime has changed to compression in approx. N–S direction and the fault was reactivated as a dextral strike-slip (Čar 2010). Related to this change some new fault traces were developed. Due to this fact the whole fault zone is rather complex. In a newer study Placer, Vrabec and Celarc (2010) made an estimate that the apparent displacement along the Idrija fault in Tolmin area is around 10 km. Because the Idrija fault runs mostly along river valleys and karst fields, there are very few outcrops suitable for detailed tectonic analyses.

The best exposure of the whole fault zone is in the Učja valley at the far NW end of the fault (Figures 1 and 2), because it extends in a transverse direction to the fault and at the location of the fault zone it forms a small canyon (Čar and Pišljar 1993). In this canyon the structures of outer and inner fault zones are very good visible (Figure 2). The direct evidence of Quaternary to recent deformation in this area was described by Vrabec (2012). He found an outcrop of poorly sorted Quaternary breccia, which is dissected by several NW–SE oriented subvertical faults and associated fractures. Activity of the fault is further indicated by dextral offsets of the Učja river coinciding with the strands of the Idrija fault zone.

Using the tectonic geomorphology (e.g. Žibret and Žibret 2014) and detailed LiDAR digital elevation model, recent kinematics of the Idrija fault was studied by Moulin et al. (2014). Later they applied also the dating methods based on the exposure of outcrops to cosmic rays (isotope ^{36}Cl) and estimated the average slip rate along the fault on 1.15 mm/year for late Pleistocene onwards (Moulin et al. 2016). In the frame of seismotectonic parameterisation of active faults in Slovenia, Atanackov et al. (2016) estimated the recent slip rate on 1 mm/year.

It is assumed that the Idrija fault is seismically active, although the number of earthquakes detected so far in its vicinity is rather low (Živčić et al. 2011; Vičič et al. 2019). However, the fact that seismic stations were in the past located at relatively large distances, contributes to the large extent to the uncertainty of determinations. For the Idrija earthquake in 1511 with estimated magnitude of 6.8, it is supposed that it occurred in the wider area of the Idrija fault. However, the exact location of this event is still subject of investigations (Fitzko et al. 2005). Recently, the most important investigations of this subject are paleoseismological (Bavec et al. 2013). In the 20th century in a wider area of the Idrija fault two strong earthquakes happened, the Cerknica one in 1926 and the 1998 in Krn Mountains (Živčić et al. 2011).

2.2 Measurements of tectonic displacements

Estimates on recent slip-rates are very important to understand active tectonics and tectonic geomorphology, as well as for earthquake hazard assessments. In the regions with moderate rates of deformations, including Slovenia, to measure recent slip-rates is not an easy task, especially if strong faults are characterised by rather wide fault zones. To accomplish the task the methods of terrestrial and satellite geodesy are used. In the past several repeated levelling measurements were conducted along various infrastructure. They usually measured only vertical deformations, but horizontal displacements can be measured as well. In the western Slovenia vertical deformations were measured along the profile from Sečovlje to Bled (Rižnar, Koler and Bavec 2007) indicating faster uplift of the Julian Alps north of the Idrija fault with respect to the territory south of it. For detailed analysis of the activity of individual faults, geodetic measurements should be performed at locations where structural geological setting is well known and the fault zone is preferable not too wide. On the Idrija fault it was appraised that for terrestrial measurements a suitable transect is between Dolenja Trebuša and Kanomeljsko Razpotje (Čar and Gosar 2011). For this purpose a network of four points was deployed in the Kanomljica valley already in 1985, but only initial measurements were conducted (Kogoj 2000). For geodetic monitoring of active fault zones Placer and Koler (2007) proposed deployment of geodetic networks of points in both blocks outside the fault zones and long-term measurements.

Some investigations which include repeated GNSS measurements were also conducted (Weber et al. 2010; Serpelloni et al. 2016) in W Slovenia. They provided velocity vectors for wider area indicating general movements in the north direction for 2–3 mm/years. However, the density of measuring points was in general too low to enable assessment of displacements along individual faults. Besides GNSS measurements, for detection of vertical movements of the surface Synthetic Aperture Radar method of persistent scatterers

(InSAR PS) is also used. This method was applied also in the Julian Alps, but not evaluated for tectonic deformations (Žibret, Komac and Jemec Auflič 2012).

With respect to the scale of measurement, on the other end, compared to satellite geodesy, are micro-displacement measurements on individual fault planes or cracks inside the fault zones (Stemberk, Košťak and Vilimek 2003), which are described in this paper. By their application we can prove the activity of a fault plane and thus activity of the fault, but we cannot assess the total deformation across the whole fault zone.

3 The Idrija fault zone in the Učja valley

In the Učja valley the Idrija fault zone is approximately 750 m wide (Figure 2). In the frame of COST project *3D monitoring of active tectonic structures* it was geologically mapped by Igor Rižnar. The wider area is built mainly of upper Triassic Dachstein limestone. Slightly to the north, there is the main thrust of Kanin Mountains, along which the Dachstein limestone is overthrusted to the south on Cretaceous flysch (Buser 1986). To the SW of the main fault plane in the Učja valley there is a smaller area of Jurassic limestone, and in the canyon floor in some places Cretaceous flysch outcrops. The inner fault zone is approximately 260 m wide and comprises of two border faults, the main and side fault planes (Figure 2). Along the main fault plane we didn't find any suitable crack for micro-displacement measurements. On the other hand, the side fault plane which runs 70 m to the east across 50 m high canyon wall, represents a prominent crack (Figure 3a), which was found as the most appropriate for the installation of extensometer. Down the river to the east, there is another well exposed fault plane with striations which indicate subhorizontal movements (Figure 3b). However, the access to this narrow part of the canyon with equipment needed for the installation was not possible.

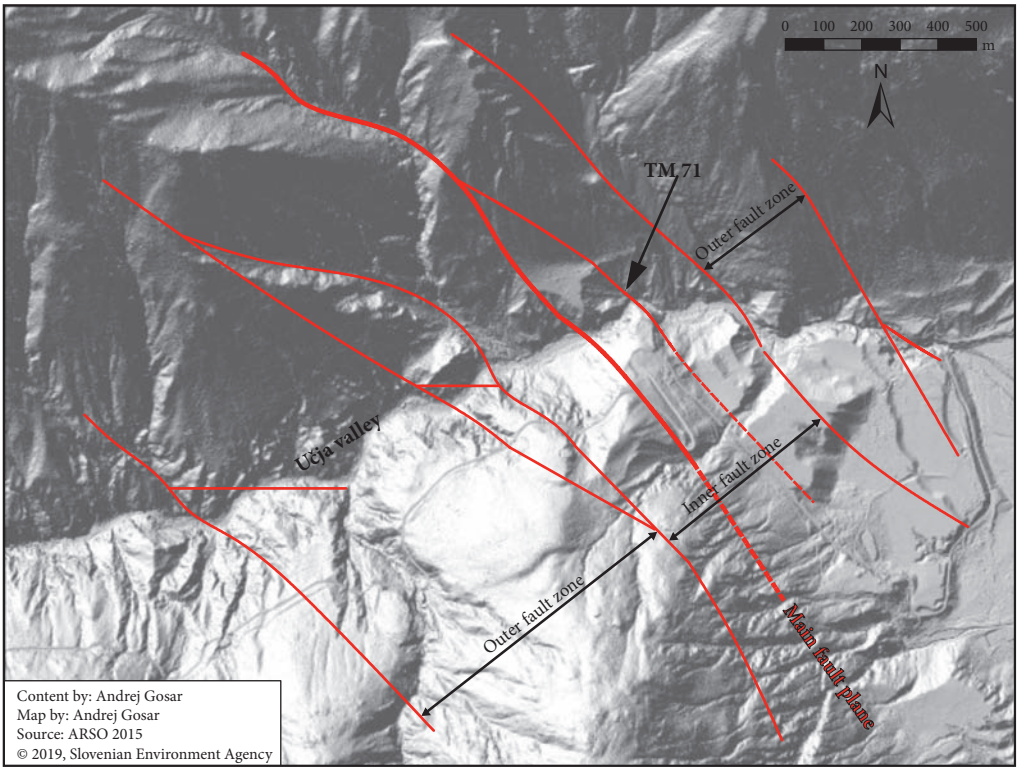

Figure 2: Detailed map of outer and inner fault zones of the Idrija fault in the Učja valley on shaded LiDAR 1 m resolution digital elevation model (ARSO 2015) with the location of TM 71 extensometer.

4 Methods

4.1 Extensometer TM 71

TM 71 is a mechanic extensometer (Figure 4) aimed for installations on cracks to monitor relative micro-displacements of two tectonic blocks separated by the crack. It operates on the principle of Moire optical effect. Displacements are measured through interference pattern (Košťak 1977; Košťak 1991), formed by two optical grids engraved in two glass plates which undergo a relative shift. The instrument measures deformations in three dimensions as displacement vectors in two perpendicular planes (horizontal and vertical) and angular deviation (rotation). The accuracy of the instrument is 0.05–0.0125 mm for displacements and greater than $3.2x10^{-4}$ rad (0.018°) for angular deviation (Stemberk, Košťak and Vilimek 2003; Stemberk, Košťak and Cacon et al. 2010). The main advantage of TM 71 is that it has no electric components and is thus very robust for operation in difficult outdoor conditions. Therefore, it is very suitable for long-term monitoring. A disadvantage is that it requires manual readings at regular intervals. However, this problem was recently solved for temperature stable and protected environments (for instance karst

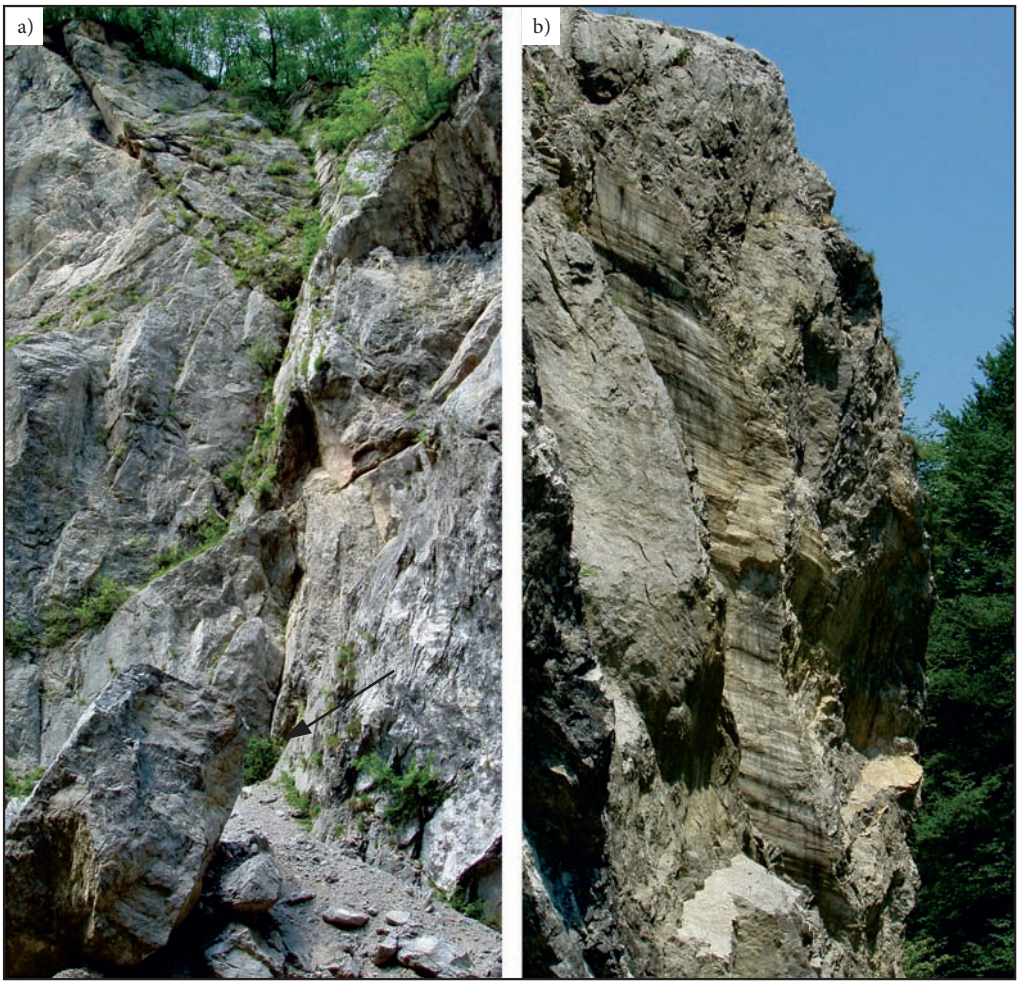

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Figure 3: a) A crack in the Idrija fault inner fault zone in the Učja valley. Arrow indicates the location of the TM 71 extensometer. b) Outcrop of another fault plane located 50 m to the east with clear striations indicating subhorizontal movements (after Gosar 2007).

caves) by automated shooting images of interference pattern in selected intervals (Briestensky et al. 2010; Šebela et al. 2009). Instrument readings are always corrected for temperature variations. Today almost 300 instruments are installed in the whole world. Beside measurements of tectonic displacements, it is used also in engineering geology for monitoring stability of rock blocks or landsliding.

4.2 Measurements of tectonic micro-displacements in the Učja valley

After detailed survey of the fault zone we selected, as the most suitable for installation of the TM 71, a prominent crack in the initial part of the canyon, which cut 50 m high south oriented face (Figure 3a). The crack extends across the whole face, and the installation was realised at the foot of it, above a large scree cone (Figures 3a and 5). In this area seismically triggered rockfalls occurred during the 1976 Friuli earthquake (Čar and Pišljar 1993) and also during the 1998 earthquake in the Krn Mountains (Gosar 2012; 2019c). Installation of TM 71 was performed in November 2004 (Šebela et al. 2005; Gosar et al. 2007). Quite a challenge was already a transport of heavy drilling equipment into the canyon and across the river. Taking into account configuration of the crack, a still rod is anchored in the western block in two points and in the eastern block in one point (Figure 5). To guarantee a sustainable installation without exposure to damage, it was important that the instrument is located under the small overhang in the wall (Figure 3a) which protects it from falling rocks and ice. The instrument is protected with a metal case (Figure 5a).

5 Results

The extensometer TM 71 records displacements for already 14 years. This is long enough period that it is possible to deduce on representativity of long-term displacements. The results of the first six years of measurements (end of 2004–2010) were already published in Gosar et al. 2011), but additional eight years

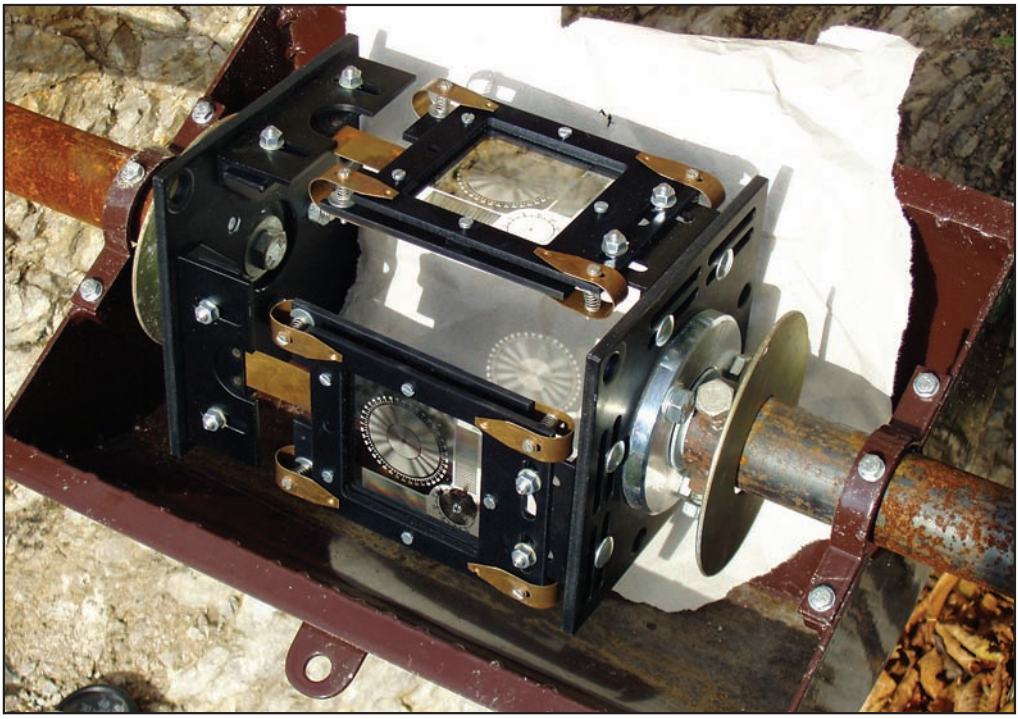

Figure 4: The TM 71 extensometer which measures tectonic micro-displacements in three directions.

(2011–2018) of measurements allows much more firm interpretations and conclusions. The results (Figure 6) shows especially systematic trend of horizontal displacements (y-axis) and relatively smaller displacements in vertical direction (z-axis). This observation is in agreement with the fact that Idrija fault is today mainly a strike-slip fault with minor vertical component of slip (Čar and Gosar 2011). This was so far known from geological observations only. Other source of information on the sense of displacements could be seismological data. However during the last decades of detailed seismological monitoring in Slovenia and Friuli, there were no really strong earthquakes on the Idrija fault which will allow computation of focal mechanisms or detailed analysis of a coseismic slip along the fault plane (Živčić et al. 2011; Gosar 2019b). Such analyses were performed for the 1998 and 2004 earthquakes in the Krn Mountains, where focal mechanisms show on almost pure dextral slip along the Ravne fault with only minor vertical component (Bajc et al. 2001; Živčić et al. 2011; Gosar 2019a). Since Ravne and Idrija faults are parallel and both exposed to the same stress regime (compression in N–S direction), we can deduce that also along the Idrija fault recent displacements are predominantly dextral strike-slip. However, this is not necessarily valid for all cracks within the wide fault zone (e.g. Twiss and Moores 1992). In fact measurements with TM 71 on the crack which is parallel to the main fault plane shows predominantly left-lateral strike-slip with minor vertical component. Although such a result is a surprise, a thorough discussion on possible causes at this moment is not possible. This would perhaps become possible, if detailed geodetic measurements in a dense net of points would be performed for several years. Such a survey should include a measuring points that are definitely located in a stabile blocks far outside from the fault zone, as well as within the blocks separated by individual fault planes within the outer and inner fault zones. Local permutations of the stress direction within complex fault zones are always possible, and they can result in unequal sense of movements of individual blocks also due to rotation of blocks (Twiss and Moores 1992). Therefore, in spite the whole Idrija fault clearly expresses right-lateral strike-slip movements, a displacement on a crack inside the fault zone composed of several blocks and fault planes can show opposite sense. Large scale neotectonic rotations of rigid blocks in the Adria-Eurasia collision strike-slip zones in W Slovenia were recently revealed from paleomagnetic data of Pliocene-Quaternary cave sediments (Vrabec et al. 2018). However, this large scale observation cannot be directly transferred to the local scale situation within the complex fault zone.

Average displacement rate of left-lateral slip in the first ten years (2004–2014) is 0.21 mm/years (Figure 6). In the first ten months after installation the velocity was even much higher (y = +0.54 mm/year) (Gosar et al. 2011). It was followed with anomalous reading at the beginning of 2006. Although there are no direct proofs, this outlier is most probably a result of an outer mechanical influence on the instrument, which can be a falling rock or ice. This explanation is likely, because outlying reading was later completely recovered. In the first 2.5 years the average displacement rate was 0.31 mm/year, and in the first six years 0.24 mm/year (Gosar et al. 2011). This can be an indication of gradually diminishing of displacement rate

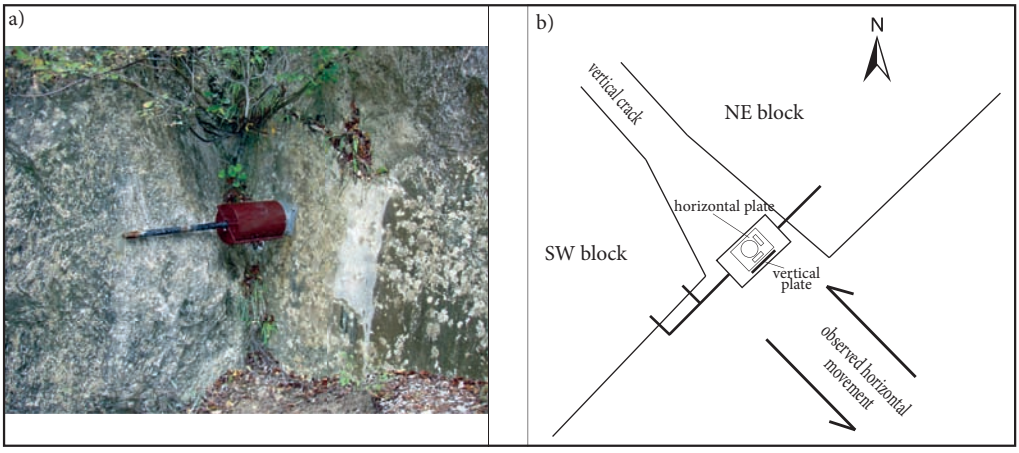

Figure 5: a) Installation of the TM 71 extensometer on a crack in the Idrija fault zone in the Učja valley. b) Schematic presentation of the installation with observed horizontal displacements (Figure 5b after Gosar 2007).

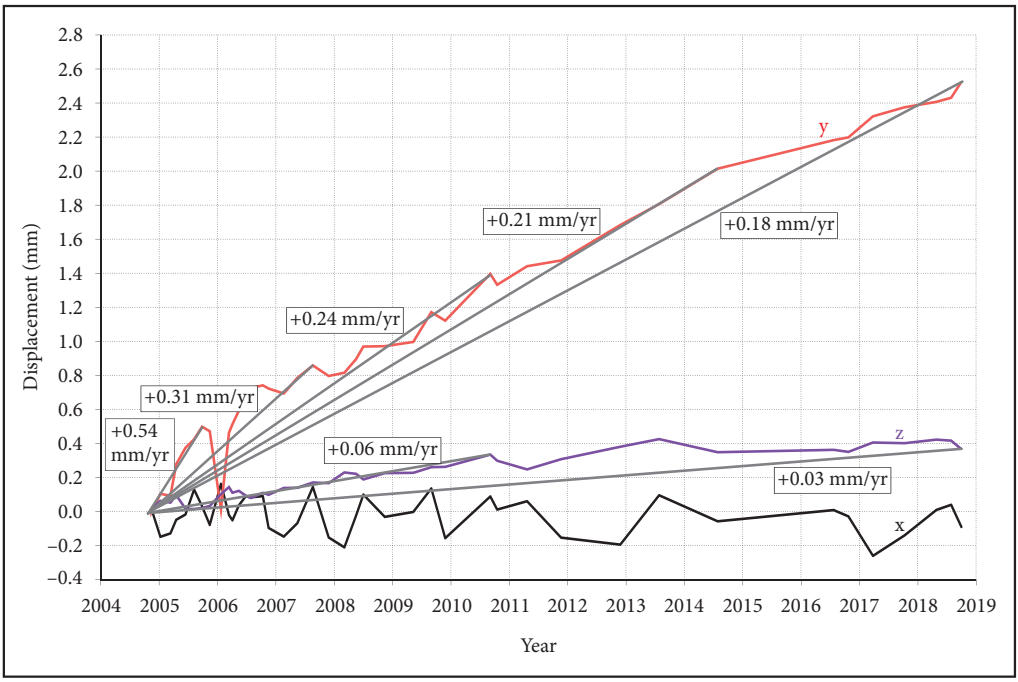

Figure 6: Displacements observed with TM 71 on the Idrija fault; +x indicates closing of the crack, +y indicates left-lateral displacement, +z indicates lowering of the SW block.

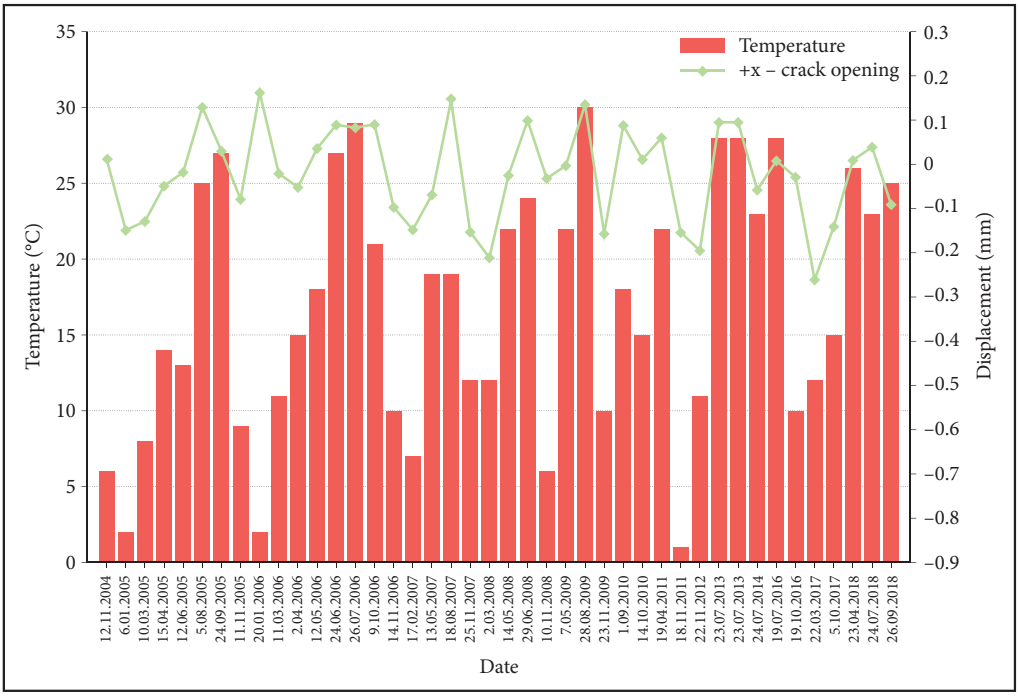

Figure 7: Correlation between temperature variations and opening (-x extension) or closing (+x compression) of the crack on the Idrija fault.

with time. Possible reasons for this are not known. However, on 12 July, 2004 a strong earthquake with moment magnitude of 5.2 occurred in the Krn Mountains (Gosar 2019b) at the distance of 10–12 km from Učja, only five months before installation of TM 71. It is well known that large earthquakes cause a static stress change on neighbouring faults. Therefore also the Krn Mountains earthquake definitely had an influence also on the Idrija fault which runs only 8 km to the SW. Coulomb static stress change for 1998 and 2004 earthquakes was computed by Ganas, Gosar and Drakatos (2008) and shows slight unloading in the part of the Idrija fault near Žaga. Although this can be only a hypothesis, the stress change can have an influence on the slip-rate with diminishes with time after the earthquake. Moreover, after the year 2004 up to now there were no other strong earthquakes in the area which exceed magnitude 3.5 (Gosar 2019b). In the last years a smaller displacement rate of 0.08 mm/year was measured with TM 71 from mid-2014 up to the end of 2018. Taking into account the whole 14-years of observation, the average horizontal displacement rate was 0.18 mm/year.

On the vertical axis (z-axis) during first six years of observations very stable positive displacement rates were established +0.06 mm/year (Gosar et al. 2011), which means relative subsidence of the SW block with respect to the NE block (Figure 6). After 2010 this rate has diminished and for the whole 14-years period it is only +0.03 mm/year. For the Idrija fault prevailing strike-slip tectonics, subordinated vertical component was expected also from geological data.

The horizontal x-axis extends in transverse direction to the crack and reflects opening or closure of the crack. As expected it shows only seasonal variations, which are in general well correlated with measured temperatures at the time of taking readings (Figures 6 and 7). Positive values (compression) corresponds to higher temperatures in summer months and negative values (extension) to lower temperatures in winter months. Observed displacements do not exceed 0.2 mm.

Angular deformations (rotations) in both measuring planes are small (Figure 8). In the *xz* plane they reach maximum of +0.4 π/200 and in the *xy* plane maximum of -0.2 π/200. The largest deformations in the *xz* plane were in years 2007, 2009 in 2011, but they were later mostly recovered and there is no systematic trend over the whole period of observation. On the *xy* plane there is only a slight trend to negative values over the whole period.

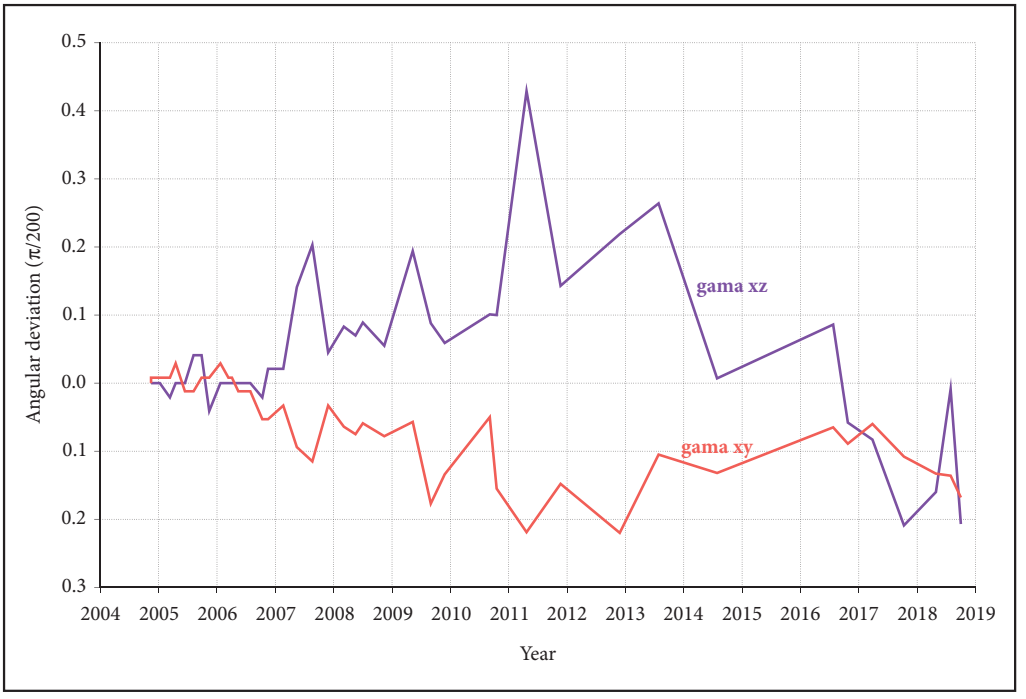

Figure 8: Angular deviations observed with TM 71 on the Idrija fault in two planes.

6 Discussion of results and conclusions

Displacement measurements with TM 71 extensometer on the crack in the inner fault zone of the Idrija fault proved that this is an active fault. This is a very important result, because no direct geodetic (Kogoj 2000) or seismological (Živčić et al. 2011) proofs of its recent activity are available so far, although it was deduced from the geologic (Čar 2010), tectonic geomorphological (Cunningham et al. 2006; Moulin et al. 2016) and paleoseismological (Bavec et al. 2013) investigations that Idrija fault is an active fault.

Among all supposed active faults monitored with TM 71 extensometers in Slovenia (Gosar et al. 2011) the observed horizontal displacement rates on the Idrija fault are with the leap the highest (average rate of 0.21 mm/year) and with the most stable and consistent trend. The measured displacement rates on the Raša, Kneža, Predjama-Avče (Figure 1) and Brežice faults (from 0.006 to 0.05 mm/year) are for one order of magnitude smaller. Only measuring location on the Raša fault showed for 2.5 years a higher vertical displacement rate (0.16 mm/years), but later the sense of the movements has changed and the long-term average displacement trend is 0.06 mm/year (Gosar et al. 2011), which is the same as measured in the whole 14-years period on the Idrija fault, but the trend on the later was stable and the sense of movements consistent in the whole period.

During the whole period the displacement trends on the Idrija fault were consistent, however the slip-rate diminishes with time. This can be only hypothetically related to the static stress changes on the Idrija fault after the strong 2004 earthquake (Ganas, Gosar and Drakatos 2008). Prevailing are left-lateral horizontal displacements with average rate of 0.21 mm/year, and subordinated vertical displacements with the rate of 0.06 mm/year. For observed left-lateral displacements within dextral strike-slip fault we can only guess that they are caused by local permutation of the stress field within a complex and very wide fault zone or by rotations of the blocks. Measured displacement rates can be compared with long-term displacements estimated from the geological data, which are from 0.25 to 0.16 mm/year (Placer 1971). Based on tectonic geomorphology and cosmic rays exposure dating, the slip-rate of the Idrija fault for post late Pleistocene period is assessed on 1.15 mm/year (Moulin et al. 2016). In the frame of seismotectonic parameterisation of active faults Atanackov et al. (2014) estimated the recent slip-rate on 1 mm/year. GNSS measurements performed in W Slovenia revealed general movements of the territory in the north direction with velocity of 2–3 mm/year (Weber et al. 2010; Serpelloni et al. 2016). Deformations related to this movements are distributed over numerous faults of Dinaric direction which prevail in the W Slovenia (Moulin et al. 2016). In a recent study on the present-day kinematic behaviour of active faults in the Eastern Alps in Austria using TM 71 extensometers (Baroň et al. 2019), it was found that annual displacement rates of the monitored faults were mostly about an order of magnitude smaller than the rates of the entire crustal wedges revealed from GNSS measurements. This is consistent with our observations on the Idrija fault.

Comparison of deformation rates on various faults is very important for earthquake hazard assessment, especially in the W Slovenia, where active Dinaric strike-slip faults prevail. The most intriguing above all is the Idrija fault, due to rather low recent seismic activity in the last decades of instrumentally seismological monitoring (Živčić et al. 2011). This fact rises a question which of Dinaric faults could be a seismogenic sources of the strongest known historical or paleoseismological earthquakes in the region, for instance the Idrija 1511 earthquake (Fitzko et al. 2005), because these earthquakes to large extent control the seismic hazard in W Slovenia. Results of TM 71 measurements on the Idrija and Raša faults and in vicinity of the Predjama-Avče fault in the Postojna cave revealed that observed deformations are much higher on the Idrija fault, although the seismic activity in the last decades was higher in the vicinity of the Raša and Predjama-Avče faults especially with several earthquake swarms or aftershock sequences in the Ilirska Bistrica, Pivka-Knežak and Vipava valley areas (Vičič et al. 2019).

Although investigations on the active tectonics of the Dinaric fault system have been more intensive in the last decade and comprises tectonic geomorphology, paleoseismology, satellite geodesy, seismology, micro-displacement measurements etc., they still do not provide sufficient data for reliable estimates on recent slip-rates of the Idrija fault. Therefore, it would be very important to supplement them with systematic and long-term geodetic measurements in a well designed and dense network of measuring points installed on stable outcrops on both tectonic blocks separated by the fault, outside of its highly fractured fault zone (Placer and Koler 2007). Realistic data on recent rates of tectonic deformations along the Idrija fault and other Dinaric faults in the W Slovenia are beside geodynamic interpretations very important for improvement of seismotectonic models and thus for better seismic hazard assessment in this earthquakes prone area.

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ECONOMIC RESILIENCE OF THE COMMAND AND CONTROL FUNCTION OF CITIES IN CENTRAL AND EASTERN EUROPE

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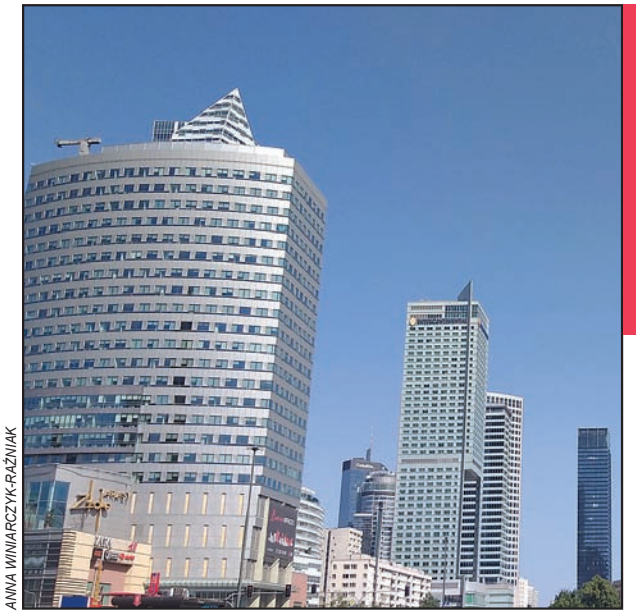

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Economic resilience of the command and control function of cities in Central and Eastern Europe

ABSTRACT: The authors propose a new approach to the analysis of cities in a time of potential major crisis in a dominant sector consisting of the largest firms generating the command and control function of a city. This purpose is served by the creation of the Central and Eastern European Economic Centre Index (CEEECI), which reflects the potential of each studied city and its development and/or fields of economic specialisation of its largest companies capable of generating regional command and control (C&C) functions of cities. Research has shown that the C&C functions of cities such as Warsaw, Prague, and Budapest are the most resistant to economic crisis of the dominant sector. More than half of the analysed cities are economically dominated by the consumer business and transportation and manufacturing sectors.

KEY WORDS: cities, economic resilience, headquarters, regional command and control function, Central and Eastern Europe

Ekonomska odpornost funkcije vodenja in upravljanja srednje- in vzhodnoevropskih mest

POVZETEK: Avtorji v članku predlagajo nov pristop k analizi mest med morebitno veliko gospodarsko krizo vodilnega sektorja, v katerem največje gospodarske družbe opravljajo funkcijo vodenja in upravljanja mesta. V ta namen avtorji oblikujejo indeks srednje- in vzhodnoevropskih gospodarskih središč, ki izraža potencial posameznega proučevanega mesta in njegov razvoj in/ali področja gospodarske specializacije njegovih največjih gospodarskih družb, ki lahko opravljajo regionalno funkcijo vodenja in upravljanja mest. Raziskava je pokazala, da so funkcije vodenja in upravljanja mest, kot so Varšava, Praga in Budimpešta, najbolj odporne na gospodarsko krizo vodilnega sektorja. Glavni gospodarski sektorji v več kot polovici analiziranih mest so sektor izdelkov za široko rabo, prevozništvo in proizvodni sektor.

KLJUČNE BESEDE: mesta, ekonomska odpornost, sedež, regionalna funkcija vodenja in upravljanja, Srednja in Vzhodna Evropa

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1 Introduction

The concept of a command and control function appears in many research publications and descriptions of the economic strength of cities and their international connectivities. One seminal paper on this subject is that of Hall (1966) who created the *world city* concept. Friedmann (1986, 70–77) argues that one measure of a world city is its control function in the global economy: »…*The global control functions of world cities are directly reflected in the structure and dynamics of their production sectors and employment*…«. He also notes that *world cities* invite foreign capital (Friedmann 1986, 73) by functioning as open systems, thus attracting investment and yielding additional command and control functions in the world economy. Sassen (1991) describes New York, London, and Tokyo as the most critical cities in the world economy due to their accumulation of world economic control functions. Beaverstock, Smith and Taylor (1999) analysed the international connectivities of cities via the largest companies in the services sector, accounting sector, advertising sector, banking sector, and the field of law, but connectivities may also be examined for other sectors including global media firms, maritime-producer services, and non-governmental organisations (Derudder and Taylor 2018). It appears at this point in time that New York and London are the most highly linked cities via what is known as the NY-LON city-dyad concept (Taylor et al. 2014). Command and Control Function (C&C) is determined on the basis of location of the headquarters of the main multinational companies. The C&C functions in city research are strongly linked to the notion of cities as command and control centres of the world economy (Csomós 2013; Csomós and Derudder 2014). The command and control (C&C) function may also contribute to the prestige of a city (Alderson and Beckfield 2004). It seems that research on the corporate headquarters of the largest firms shows a particular strength of cities in terms of their command and control role in the global economy; however, this is not the only measure of the global rank of a city (Taylor 2004).

Other studies on the number of corporate headquarters per city and corporate financial results as factors in the economic strength of cities as well as their impact on other parts of the world include the following: Heenan (1977), Friedmann and Wolff (1982), Taylor et al. (2009), Huang, Leung and Shen (2013), Raźniak, Dorocki and Winiarczyk-Raźniak (2018b), Csomós (2017), Derudder et al. (2018), Śleszyński (2018), Raźniak, Dorocki and Winiarczyk-Raźniak (2019). Since the 1970s transnational corporations have become increasingly important in the world economy and many have relocated their principal office or corporate headquarters to new locations in Asia (Csomós and Derudder 2014). This may be due to the fact that geographical diversification of investments is one of the key issues considered by investors eager to reduce their level of risk (Bacsosz 2019). It is noteworthy that companies located in Central and Eastern Europe are starting to play an increasingly significant role in the world economy (Raźniak and Winiarczyk-Raźniak 2015).

Existing conceptualisations of the city, e.g. world city (Internet 3), global city (Sassen 1991), city command and control function (Csomós 2013) do not assess the resilience of these functions to periodic crises in the world economy. While cities may be very important in the world, they may not be ready to counter economic recession events that may strongly affect a given key function of their economy. It may be argued that a city characterised by a strong command and control function is not necessarily prepared for a major crisis event. The command and control function of cities dominated by a single sector or company is prone to economic collapse in the event that the dominant sector or company faces problems. On the other hand, the C&C function of cities basing their growth on multiple successful companies or sectors is better able to offset losses at selected companies or structural problems in some sectors by the successful performance of other companies or entire sectors of the command and control function (Raźniak, Dorocki and Winiarczyk-Raźniak 2017).

Cities are complex, adaptive systems of people, economics, and the natural environment driven by key processes sustaining them and determining their ability to resist crisis events (Hooling 2001). This means that a city's resistability may be defined in terms of the flexibility of its communities and economies, which are able to predict, prepare for, and respond to disruptions in their functioning (Barnett 2001; Foster 2007).

We argue that a given city's command and control function stability can be measured in terms of its ability to resist economic crisis of the dominant sector represented by leading corporations (Raźniak, Dorocki and Winiarczyk-Raźniak 2017). This paper assesses this level of resistance to crisis for key economic sectors and key corporate employers in the studied cities. Crisis is defined by the authors in this case as a decline in the financial performance of firms in a given sector, which causes them to become excluded from the

list of the 500 largest firms in Central and Eastern Europe. This type of decline forces a sector to lose its dominant economic position and effectively its ability to play a regional command and control role in its parent city.

In current world economy the increasingly important question is the following: »How will these cities change when/if these principal functions are lost (Raźniak, Dorocki and Winiarczyk-Raźniak 2017)?« It is not only important for a city to rank high in a good economic situation, but also in an economic crisis that may affect its main functions. This prompts the following question: »What will happen to the city command and control functions in case of economic recession?« The authors use the concept of the city command and control function to determine the resilience of the cities to possible future economic crises that can affect a city's overall rank in the world economy.

2 Research data and methods

The study analyses the largest companies in Eastern Europe and compares their performance over the period 2008–2015 based on data obtained from the *Deloitte* company (Internet 1), which has been compiling sales revenue data on the top 500 companies headquartered in Central and Eastern Europe since 2008.

According to Anh, Thuy and Khanh (2018) an economic crisis may be triggered by a budget deficit, international currency reserves or increases in national debt. In a purely financial sense, a crisis may be defined by a depreciation of local currency against the U.S. dollar of at least 30%, and this decline is higher than 10 percentage points relative to previous years (Delbianco, Fioriti and Tohmé 2019). Corporate performance suffers over the course of a financial crisis, as does corporate management quality, with executives attempting to maximise their own compensation packages at the expense of company financial performance (Cornett et. al. 2009).

In this research crisis is defined as a decline in financial performance among companies in the most profitable sector present in a city, which results in a substantial loss of market status of the sector's companies that generate the command and control function of a city. This type of analysis is served by the creation of an World Economic Center Index that illustrates the rank of a city in terms of the value of the largest corporate headquarters by sector as well as the stability of this rank upon sudden removal of the most important sector. This index is calculated using basic statistics including standardisation via the standard deviation value and the weighted average. These methods represent the basis for descriptive statistics and are used in the calculation of most statistical indices employed in socioeconomic studies (Benos, Karagiannis amd Karkalakos 2015). This method is designed to produce information on the command and control potential of a city, but also on its path of economic development or economic specialisation of the companies creating this function. In addition, it may be assumed that strong company resistance to economic crisis is linked with a city's high degree of international connectivity, as financial losses generated by a company at one location may be offset by profits generated an another location in the globalised world (Raźniak, Dorocki and Winiarczyk-Raźniak 2017).

Deloitte's Central Europe Top 500 List + 50 banking and 50 insurance companies (banking and insurance companies are in the same reports but not in the main Top 500 list) (Raźniak, Dorocki and Winiarczyk-Raźniak 2018a) is not representative of the studied region, as it could be affected by a potential overrepresentation of the banking and insurance sectors. In addition, sales revenue is not the only factor that describes the rank of a company. In light of this issue, Deloitte Central Europe Top 500 Reports were used to create a customised list of the most important 500 companies in Central and Eastern Europe. Deloitte Central Europe Top 500 Report (Internet 2) is based on standardised financial data, and it was used to create a New Eastern Europe Top 500 list of major companies. Sales revenue was standardised along with net profit for all 600 Deloitte companies by calculating the share for each individual company where the maximum relative value is 100. Next, an average value (Equation 1) was calculated for this set of revenue and profit values (x_{top}) (Shiller 1991).

$$x_{top} = \frac{\left(\frac{x}{x_{max}}100\right)+\left(\frac{y}{y_{max}}100\right)}{2} \quad (1),$$

where x is the sales revenue and y is the net profit.

The x_{top} value was used to assign a rank to each company on the list. The first 500 companies were then selected for further analysis. Further analysis focused on selecting only cities with corporate headquarters representing three or more sectors of the economy in any given year.

The studied companies were divided into nine sectors used by Deloitte in its research work (Internet 1): banking, consumer business and transportation, energy and resources, insurance, life sciences and health care, manufacturing, the public sector, real estate, technology media and telecommunications. The geographic location of each company was determined based on the location of its headquarters. Companies were assigned to specific major metropolitan areas.

Based on Raźniak, Dorocki and Winiarczyk-Raźniak (2018a) it is assumed that regional as well as local command and control functions are generated in Eastern European cities by companies on the New Eastern Europe Top 500 List created by the authors. The benefits of the presence of these companies presumably go to their parent cities. Based on New Eastern Europe Top 500 List Central and Eastern European Economic Center Index (CEEECI) was created, which assesses cities in terms of the value of corporate headquarters by sector and stability in cases where one or more sectors are excluded. This approach yields information not only on the potential of a given city, but also on its economic evolution and/or specialisation. Cities with at least three economic sectors were included in the analysis. Cities featuring only two sectors were excluded in light of the substantial decline of the command and control function in the event of crisis in one of the sectors.

The rank of the studied cities was compared by calculating standardised values based on mean normalised revenue and net profit (x) for each studied sector of the economy (z) in the calculation of the comprehensive potential index (CPI) for each studied city (Equations 2 and 3):

$$z = \frac{x - \frac{\sum_{i=1}^{N} x_i}{N}}{\sqrt{\frac{\sum_{i=1}^{N} (x_i - \overline{x_i})^2}{N}}} \tag{2}$$

$$CPI = \sum_{i=1}^{N} z_{s_i} \tag{3}$$

where x = revenue plus net profit for each sector of the economy, s – is the sectors of the economy and N – is the number of cities per sector of the economy.

One goal of the research was to verify which sector of the economy impacts a city's economic potential the most. This purpose was served by subtracting the value of individual sectors from the total standardised value calculated for 2009, 2012 and 2015. The objective was to observe how the sum of standardised values (z') changes for a given city, assuming that the initial value constitutes 100% (Equation 4). Cities characterised by a high range following sector subtraction tend to specialise in one area of the economy and tend to remain underdeveloped in other areas of the economy. On the other hand, cities with low range tend to have both, advanced and multifaceted economies. The paper analyses cities with three or more sectors.

$$z' = \frac{CPI - z_s}{CPI} \tag{4}$$

Then a stability index (SI; Equation 5) was constructed using standardised values CPI and variances in values resulting from the subtraction of the selected individual sectors of the economy (z') from all studied sectors. The value of the index was then divided by the standard deviation (SD) of values resulting from the subtraction of selected sectors (z') [4]. This index also illustrates how financial crisis in a city's main economic sector impacts the city's overall economy.

$$SI = \frac{CPI}{SD_z} \tag{5}$$

The final step consisted of the construction of a Comprehensive Development Index for cities based on sectors (CEEECI). The index includes the degree of stability, number of sectors, and the number of corporate headquarters (Equation 6). The weights of the variables used to construct the CEEECI were calculated using principal component analysis (PCA), which included the stability index (SI), number of sectors

of the economy (S) and the number of headquarters (HQ). Data for 2008, 2012 and 2015 were analysed separately and the value of the CEEECI was calculated only based on the first principal component.

$$CEEECI = \frac{SI * w_{(SI)} + S * w_{(S)} + HQ * w_{(HQ)}}{\sum w} \quad (6)$$

where HQ is the number of headquarters, S is the number of sectors of the economy and SI is the stability index.

Calculations cannot be performed for a mean sector value of zero. Normalisation was performed only in relation to a normal distribution without checking for data asymmetry and assuming that a normal distribution will suffice. This must be considered in data analysis and normalisation must not be used for data that is strongly skewed.

Similar methods of constructing economic indicators with the use of standardized values, weighted averages, principal component analysis, and mixed models were discussed by Morrison (1967), and Marino and Tebala (2016). However, the method used in this paper was created by its authors, and it is used also by the authors of other publications (Dorocki, Raźniak and Winiarczyk-Raźniak 2018 and 2019; Raźniak et al. 2019).

3 Ranking of Eastern European cities based on the CEEECI

A total of 500 companies had their headquarters in 125 cities in 2008, 124 in 2012, and 156 in 2015. The number of cities declined by one (–0.8%) during the global economic crisis in 2008. A significant diversification of headquarters locations was noted in the period 2012–2015, and the number of cities increased 25.8%. An opposite trend was observed in the case of the location of the largest world corporations (Internet 2).

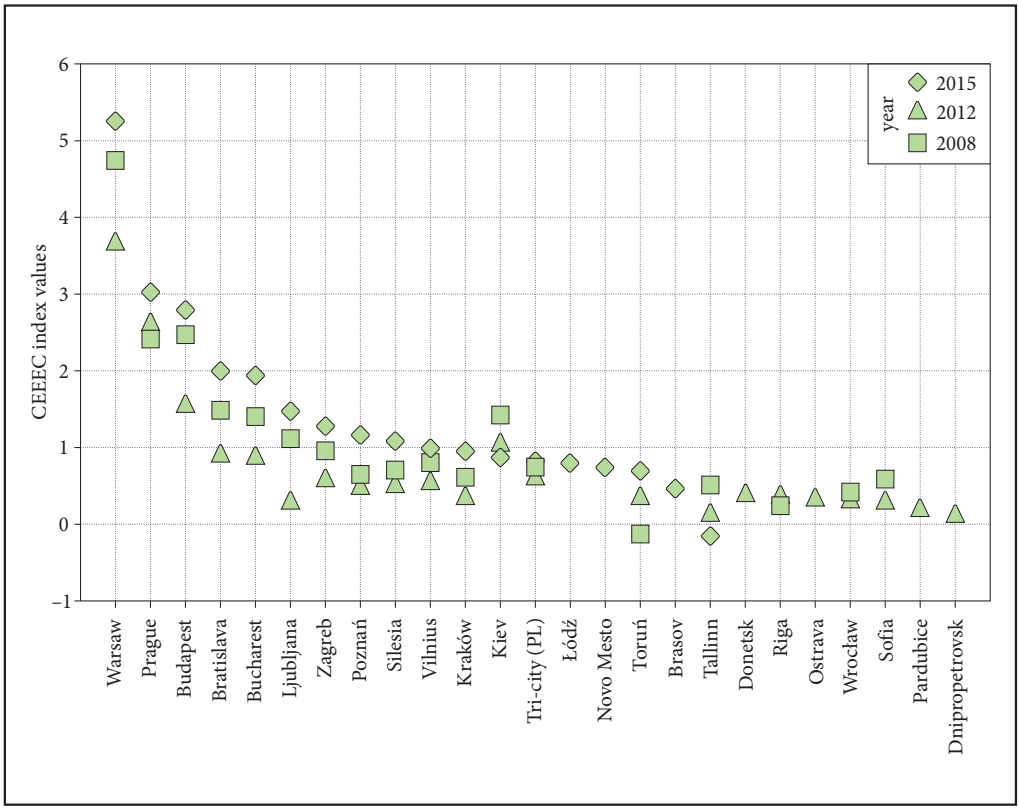

Figure 1: CEEECI values for 2008, 2012 and 2015 based on Deloitte's Central Europe Top 500 Reports.

The number of cities with the largest corporations increased 7.9% in the period 2008–2012 and then declined 5.4% in the period 2012–2015. Hence, a spatial deconcentration is observed for the largest corporations in Central and Eastern Europe, while a spatial concentration is observed on a world scale.

The highest CEEECI values in 2008 were noted for Warsaw (4.7 points), Budapest (2.5 points), and Prague (2.4 points; Figure 1). Warsaw had the highest CEEECI in subsequent years. Resistance to crisis in the main sector of Budapest's economy declined in 2012 and 2015 leading to a decline to third rank, behind Prague. Other capitals were also characterised by rather high CEEECI values in 2015: Bratislava (1.99), Bucharest (1.94), Ljubljana (1.46). On the other hand, Kiev's resistance to crisis significantly declined. The reason for this may be the current state of war between Russia and Ukraine, influencing the economy (Charap and Colton 2017; Feklyunina and Romanova 2017).

Its CEEECI in 2008 was 1.42, while in 2015 it was almost 40% less. The lowest values (less than 0.5) for CEEECI cities in the study period were those of Pardubice, Brasov, and Tallinn. The largest increases were observed for smaller cities such as Łódź (240%), Novo Mesto (189%), Poznań (176%), Pardubice (158%), and Kraków (153%). However, only Poznań exceeded a value of one in 2015. Several cities were classified as CEEECI cities in one or two years of the study period: Riga, Wrocław, Sofia in 2008 and 2012; Donetsk, Ostrava, Pardubice, Dnepropetrovsk in 2012. It may be argued that these cities were not affected by the global economic crisis of 2008, as they had lost their rank after 2012 (Figure 1).

In 2015 a total of 18 Central and Eastern European economic centres were identified and divided into four categories based on their ability to resist an economic crisis. Three cities were given the *top* CEEECI ranking. Six cities were ranked *major*. Seven cities were ranked *midsize*. Two cities were ranked *minor*. The Romania and Slovenia feature two cities each. Another seven countries in Eastern Europe feature only one top-ranked economic centre each. Finally, no ranked economic centres were noted in Albania, Bosnia

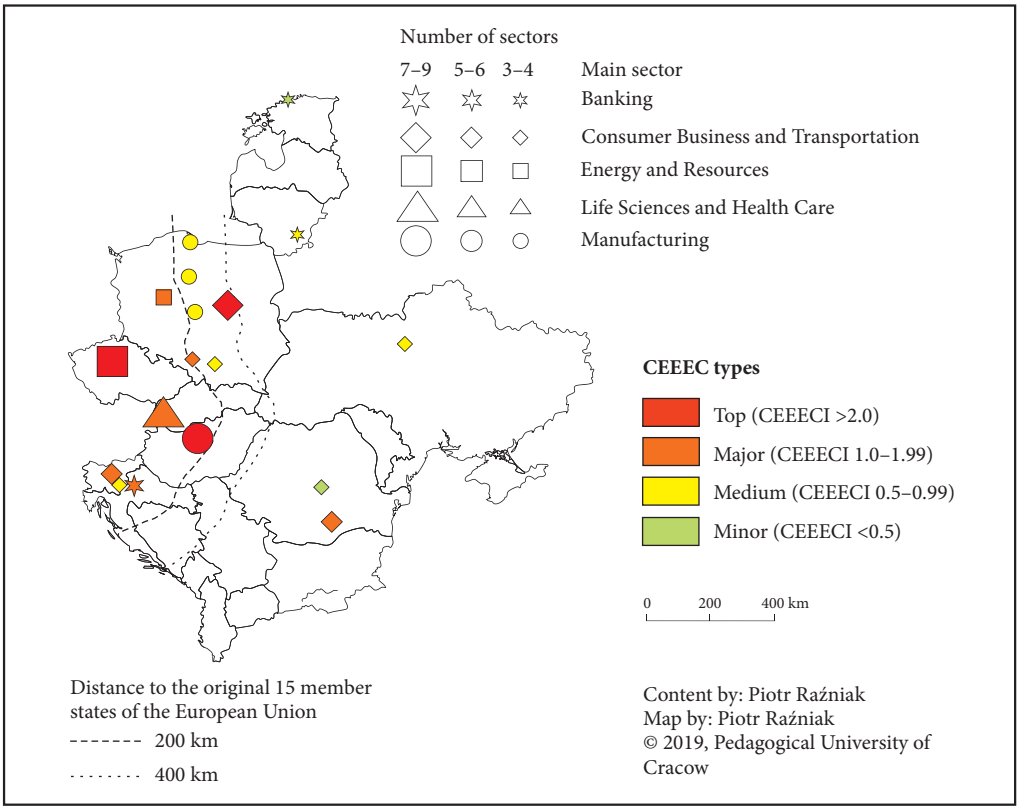

Figure 2: Central and Eastern European economic centres in 2015 based on Deloitte's Central Europe Top 500 Reports (author: Anna Winiarczyk-Raźniak).

and Herzegovina, Montenegro, Moldova, Northern Macedonia, and Serbia (Figure 2). All of the above six countries are characterised by small geographic area, small population, low total GDP, and low GDP per capita (Internet 2). Most of these countries became independent only in the 1990s following the dissolution of the much larger Socialist Federal Republic of Yugoslavia. Warsaw, Prague, and Budapest are now the three most significant Central and Eastern European Economic Centres, and are classified in the *top* category due to their economic dominance in the region and very strong resistance to economic crisis. At the same time, only Prague is home to all nine of the studied sectors (Warsaw and Budapest are home to eight). These three top CEEECI cities differ in terms of their dominant economic sector. In Warsaw, it is consumer business and transportation, while in Prague energy and resources, and lastly in Budapest it is manufacturing. Cities such as Bratislava, Bucharest, Ljubljana, Zagreb, Poznań and the Katowice were classified in the *major* category due to their strong ability to resist economic crisis (Figure 2). The only non-capitals in this group (Poznań and Katowice) are located in Poland, but they are »balanced« regional centres (Páthy 2017). The region continues to develop in an economic sense as well as in the sense of its residents' well-being (Egri and Tánczos 2018) and home to a number of robust foreign corporations (Nazarczuk and Umiński 2018).

However, each of the three cities is dominated by a different sector of the economy except Zagreb and Poznań (consumer business and transportation). Hence, it may be argued that the rank of these six cities may change in different directions in the event of crisis in a particular sector. The strength of Polish cities (7 cities) is apparent in this study, with 38.9% of CEEECI cities located in Poland. Polish cities are not strongly differentiated by main sector and are classified mostly as *major* and *medium* type. Three Polish cities are dominated by the life sciences and another three are dominated by consumer business and transportation. Cities described as *minor*-type usually feature three or four sectors. In the event of crisis in a dominant sector, *midsize*-type cities are likely to decline substantially in economic terms (Figure 2).

The most frequently encountered sector in Central and Eastern European economic centres is the consumer business and transportation sector – eight cities (44.4%). This is especially the case in countries that used to be part of the Soviet Union until the early 1990s including Lithuania, Latvia, Estonia, and Ukraine. Manufacturing is dominant (22.2%) in four key urban regions – usually old industrial regions such as the Tri-city (Gdańsk, Gdynia and Sopot) and Łódź in Poland. However, Eastern European companies in this sector are not important players on the global scene (Krätke 2014). In summary, Central and Eastern European Economic Centres are dominated by consumer business, transportation, and manufacturing (66,7%). The next key sector is banking (3 cities; Figure 2).

4 Discussion

The largest companies in Central and Eastern Europe became concentrated in a larger number of cities in the period 2008–2015 (Internet 1). This is the opposite trend to what is now observed in the world economy, with fewer cities hosting the largest corporations around the world (Internet 2). This may be the result of the opening of some offices of foreign corporations headquartered in Eastern Europe in order to limit operating costs and invest more profits in the home country. What is important is that this occurred several years after the global economic crisis of 2008.

Economic stability of the command and control function of cities in time of crisis was analysed in terms of the effects of structural change on the economy. The smallest differences in the level of economic development based on sector specialisation and corporate financial performance were noted in Prague, Warsaw, Ljubljana, Vilnius, Zagreb, and Poland's Tri-city. However, the latter four cities were characterised by low standardised values, which is why the difference in values triggered by the loss of a major sector of the economy was quite small. A high degree of specialisation and a close link with a single sector were observed in the case of Donetsk, Bucharest, Kiev, and Bratislava.

Two thirds of the analysed cities are economically dominated by consumer business and transportation and manufacturing. A crisis in any of these key sectors could trigger a decline in the city command and control function. Consequently, the cities of Warsaw, Prague, and Budapest may be called the leading Central and Eastern European Economic Centres. The three cities are highly resistant to crisis and have significant international connectivities. At the same time, these three cities possess an adequate amount

of potential to play a meaningful role in the world economy. However, Prague outpaced Budapest in 2012 and 2015 compared with 2008.

Given the political history of Central and Eastern Europe and its links to globalisation, it remains a unique region where many companies operating in this part of the world are in fact just regional offices of leading corporations. Śleszyński (2015) argues that strategic decisions regarding their key functions are made outside of Central and Eastern Europe, and argues that the largest companies, even those whose headquarters are located in a foreign country, may generate the command and control functions of a given country's economy.

Despite being listed in the Deloitte Central Europe Top 500 Report, many companies in the study area do not fully perform the command and control function in their home cities. However, regional offices located in the Central and Eastern Europe may have some decision power at the local and regional level. Regional managers thus may perform a limited regional or local command and control function, but not higher-level functions that remain reserved for main offices located outside of the study area. For example, the decision to close a plant or regional office made outside of the studied region may strongly affect the stability of a city's regional command and control function. Hence, it is important to study cities not only in terms of the financial results of key corporations, but also in terms of the ability of the command and control function to remain stable in times of economic crisis in a principal sector generating this function.

It may be argued that, for a city, important is not only the magnitude of the C&C function, but also its ability to weather a crisis. This is important, as the economy of a city and its C&C function are not only affected by economic processes, but also by historial problems and ongoing warfare in some cases.

5 Conclusion

In a global world, it appears that a city's global rank in a period of economic growth is not the only important issue. What is also important is its global rank in periods of economic recession, which may affect its primary functions. The methodology presented in the paper answers the following question: »What would happen if something goes wrong in the realm of a city's C&C function?« Similar research needs to be performed as part of other urban conceptual models such as the concept of the *world city*. Standard forecasts are not sufficient (Neal, Derudder and Taylor 2019); instead what is needed is analysis on what would happen to intercity connectivities in the event that the number of linkages between a given city and its main connectivity partner city would strongly decrease. Would it continue to be connected as well as before? Would it continue to be a world city?

Research has shown that cities can resist economic crisis in their command and control function better if they are home to a larger number of economic sectors and follow a more sustainable path of economic development. In order to increase the attractiveness of a city to global investors, it would be helpful to help streamline city management practices by reducing redundancies between local governments and the national government, and increasing the effectiveness of the local job market. These steps would reduce differences between cities (Wolman et al. 1992) and may also help cities weather any potential crisis that may occur. Alderson and Beckfield (2004) speak of a certain type of prestige associated with a city's command and control function. Cities in the studied region could attempt to build their brand as cities performing a regional command and control function resistant to economic crisis in a main sector of their local economy. A strong local or regional brand would then help them to trigger a virtuous cycle of brand recognition and continuous foreign direct investment.

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MANAGEMENT OF SMALL RETENTION PONDS AND THEIR IMPACT ON FLOOD HAZARD PREVENTION IN THE SLOVENSKE GORICE HILLS

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Retention pond at the former Benedictine monastery at Jareninski Dvor.

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Management of small retention ponds and their impact on flood hazard prevention in the Slovenske Gorice Hills

ABSTRACT: One of the methods of water resource management is to construct small retention ponds. Within the framework of the »*Possible ecological control of flood hazard in the hilly regions of Hungary and Slovenia*» project the management of small ponds and their impact on flood prevention were studied in selected catchments. Data on pond management were gathered from interviews with pond owners. In a pilot study, we conducted an inventarisation and classification of all retention ponds. Primarily they were constructed for more specific use: fishing, irrigation, watering livestock. These functions have been gradually replaced by leisure-time activities, aesthetics, and tourism. Spring, stream and rainfall-fed ponds prevail in the pilot area and reduce the flood risk. Due to the increased variability of precipitation patterns ponds are also becoming an important measure to limit drought consequences at a local level.

KEY WORDS: hydrogeography, natural hazards, floods, water management, dams, detention ponds, Slovenia

Upravljanje malih vodnih zadrževalnikov in njihov vpliv na poplavno varnost Slovenskih goric

POVZETEK: Eden od načinov gospodarjenja z vodnimi viri je izgradnja majhnih zadrževalnih ribnikov. V okviru projekta »*Primerni ekološki ukrepi na področju poplavne nevarnosti v hribovitem območju Madžarske in Slovenije*« smo preučili upravljanje majhnih ribnikov in njihov vpliv na preprečevanje poplav v izbranih porečjih. Podatke o upravljanju ribnika smo zbrali s pomočjo intervjujev z lastniki ribnikov. V pilotni študiji smo izvedli inventarizacijo in razvrščanje zadrževalnih ribnikov. V glavnem so bili zgrajeni za namensko uporabo, kot je ribolov, namakanje, napajanje živine. Te funkcije so postopoma nadomestile prosti čas, estetika in turizem. Na pilotnem območju prevladujejo zadrževalniki, ki jih polnijo izviri, vodotoki in padavine, in zmanjšujejo poplavno ogroženost. Zaradi večje variabilnosti padavin postajajo ribniki na lokalni ravni tudi pomemben ukrep za omejevanje posledic suše.

KLJUČNE BESEDE: hidrogeografija, naravne nesreče, poplave, upravljanje voda, pregrade, vodna zajetja, Slovenija

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1 Introduction

In the past, water management focused on building and managing water supply infrastructure. This approach brought into use large-scale centralized water storage infrastructure systems for irrigation, sewage, and energy production which were also used for flood control. According to the data of the World Commission on Dams (World register … 2020) there were more than 50,000 dams globally in 2019. In Slovenia, there are 47 large dams (Komac and Zorn 2016). This so-called hard path water management has improved human water security worldwide. However, the diminishing capacity of the hard path to solve emerging water problems led water managers to seek new approaches. Soft path solutions focus on institutional reforms, small-scale interventions, the introduction of water-efficient technologies, and the management of agricultural, industrial, and residential water use. They can better address future water scarcity where hard path approaches have not been successful (Wutich et al. 2014). Retention ponds on fluvial systems are a useful soft path approach and contribute to water resource management by influencing water discharge and sediment transport dynamics (Verstraeten and Poesen 2001; Koskiaho 2003), and water chemistry (Fairchild and Velinsky 2009).

Retention ponds can be divided by their size into two categories. Large ponds or reservoirs are flood retention dams, flood control dams, water retention objects, and sediment traps, while small retention ponds are fishing ponds, watering holes, and pools. The dams of large retention ponds are mostly of concrete or combined construction, while small retention ponds involve simpler earthworks (Steinman and Banovec 2008; Table 1). In Slovenia, large ponds were mostly built for energy production, drinking and technological water storage, flood and drought management, and irrigation for food production (Širca 2010). Small retention ponds, on the other hand, provide water for irrigation and support secondary uses, such as fishing and tourism. With large retention ponds, the detention time is from one to several years, while it lasts from one to several days in the small ones.

In Slovenia, water infrastructure management is beyond individual interests and is a public utility service concessed by the Slovenian Environment Agency. However, the List of the existing water infrastructure excludes sediment retention objects, their inflow and outflow channels, and irrigation and drainage systems, while only the barriers and dams are included (Seznam obstoječe … 2006). The Waters Act (Zakon o vodah 2002) lists 40 dams as water infrastructure (Globevnik 2012) while the Rules to determine water infrastructure (Pravilnik o določitvi … 2005) declare the formal status of water infrastructure, especially related to maintenance. Water infrastructure is part of geodetic data and governed in the EU by the INSPIRE Directive (Infrastructure for … 2017).

In Slovenia, the water infrastructure is governed by the National water management program, water management plans, remediation programs, and other water management programs. The National water management program determines water management policy, as well as the goals, directives, and priorities

Table 1: Types of water ponds according to the construction and type of distribution of water pressure (Steinman and Banovec 2008).

First level division (building material)	Second level division	Third level division
concrete	gravity	full
		relieved
	pillar	with reinforced part
		with arches
	arch	cylindrical
		equilateral
		domed
earth	earth fill	homogeneous
		layered
	rock fill	folded
		metalled
		layered
combined	/	/

for water use, protection, and management. At the catchment level, the period 2016–2021 is regulated by the Adriatic Sea Watershed Management Plan (Načrt upravljanja voda na vodnem območju Jadranskega … 2016; Uredba o načrtih upravljanja 2016) and the Danube River Catchment Management Plan (Načrt upravljanja voda na vodnem območju Donave … 2016; Uredba o načrtih upravljanja 2016).

Water infrastructure objects are documented in the Water Register, the official record of the Slovenian Water Agency (E-vode 2019). It encompasses 55 databases on water, including hydrology, water typology, water areas, nature protection areas and flood hazard maps (Pravilnik o vodnem … 2017). Although new data regarding hydrology and use of the water areas are available they lack coherence as they were created through desktop work, without any field research (Barborič et al. 2017). Significant differences were indicated between the official documentation on water infrastructure and the actual state in nature (Sodnik, Kogovšek and Mikoš 2014). This especially applies to small water infrastructure objects, such as ponds.

Two regulations on retention ponds exist in Slovenia, but they originally support the management of large retention ponds and they are only applied to hydroelectricity dams. These are the Rules on the technical monitoring of high water dams (Pravilnik o tehničnem … 1966) and the Rules on the monitoring of seismicity in the area of large dams (Pravilnik o opazovanju … 1999). The Instructions for preparing risk assessments for dam barrier failures (Lenart, Rajar and Širca 2017) were never passed in the Republic of Slovenia, so today's practice is based on an almost half-a-century-old Yugoslav regulation (Uputstvo … 1975). At the European level, the core document regulating retention ponds is the Manifesto on Dams and Reservoirs (Manifesto … 2015), while the Kyoto Protocol (World declaration … 2012) governs the issue at global level.

In general, the situation is rather bad as regards the comprehensive approach to planning, construction, operation and safety rules for water dams in Slovenia. The rules are scattered across construction and other legislation, we lack orderliness and even a comprehensive overview of the situation (Širca, Ravnikar Turk and Zadnik 2010). Large retention ponds (hydroelectricity dams are excluded) are poorly maintained and not regularly examined. Past constant changes and scattered organization of retention pond management caused bad management practices. Archival data were often lost and sometimes even the construction data are missing (Širca, Ravnikar Turk and Zadnik 2010). Many so-called sediment trap objects are not regularly cleaned and no longer retain sediments (Papež 2010), leading to erosion (Kračun 2010) and increasing flash flood hazard (Komac and Zorn 2011). Since their construction, the barriers have not been adjusted to the current hydrological, climate, and land use conditions (Zemeljske … 2016), exposing the regions to combined and cascade disasters (Komac 2015).

Therefore, the hazard in the Slovenske Gorice Hills should not be ignored although the region has lower dams than other regions in Slovenia. Their less cohesive building material and structure need to be considered. As even large retention facilities face several worrying issues, it is even more challenging to enforce legislation for small retention ponds (Širca 2010). Furthermore, incomplete records on small retention ponds and bodies of water are an important, even pressing issue, urgently calling for their comprehensive analysis and management. The management of large dams faces numerous issues and has been put to the agendas of different national and international organizations. Small retention pond management, on the other hand, encounters several challenges that have not been properly addressed yet. An important issue is the rapid filling of the ponds with sediment which increases maintenance costs (Verstraeten and Poesen 1999; 2000). Also, the improved accessibility of water in the last century for people and their livestock decreased the need for ponds in rural areas, consequently they are increasingly abandoned (Mioduszewski 2012).

The project entitled *Possible ecological control of flood hazard in the hilly regions of Hungary and Slovenia* is one of the attempts to address this question in the Pannonian Basin. It studies the suitability of ecological measures for decreasing floods hazard in the hilly regions of Eastern Slovenia. Namely, while sustainable reduction of flood risk can be achieved by large scale spatial planning and land use adaptation in the downstream river valleys, water retention areas in small basins can effectively lower the frequency of floods (Hooijer et al. 2004; Richert et al. 2011; Kijowska-Strugała and Bucała-Hrabia 2019). It has been established that small retention ponds are especially effective in peak flow reduction on a local scale (Chrétien et al. 2016). Furthermore, studies have shown they have a beneficial impact on limiting erosion (Verstraeten and Poesen 1999; Koskiaho 2003), as well as improving runoff quality (Chrétien et al. 2016) and are an added ecological value of the environment (Mioduszewski 2012).

In the research, we focused on ponds that are defined as small artificial structures to retain freshwater. We investigated the management of such ponds in the Pesnica River catchment (part of Slovenske Gorice

Hills). The detailed analysis of the retention ponds in two representative lower-ranked catchments – Jarenina and Vukovje creeks consisted of spatial analysis and in-depth interviews. The aim of the paper is to present a comprehensive assessment of management practices of small ponds, and their impact on flood prevention in the Slovenske Gorice Hills.

2 Hydrological features of the Slovenske Gorice Hills

The Slovenske Gorice Hills are a hilly region in north-east Slovenia (Perko 1998). The area is located in the west of the Pannonian Basin between the Drava River to the south and the Mura River to the north. The hills are composed of Neogene marine sediments: mostly clays, sandy marl, sandstone, and conglomerates, with local outcrops of limestone (Belec 1998; Kert 1998). According to the calculations using a version of the Gavrilović equation according to Pintar, Mikoš and Verbovšek (1986), the annual sediment production in Slovenske Gorice Hills is 1031.6 m^3/km^2 or 16.5 t/ha and the annual sediment yield is 639.7 m^3/km^2 or 10.2 t/ha (Hrvatin et al. 2019). Water flows quickly from the impermeable bedrock to the lowlands and the Slovenske Gorice Hills have a dense stream network (2.1 km/km^2). Relatively high precipitation and high temperatures contribute to high evapotranspiration during summer when many small watercourses dry up. Specific runoff and discharge coefficients are below average in the area (Kolbezen 1998; Frantar 2008a; 2008b). In recent years, a smaller share of snow precipitation has increased water runoff during winter (Žiberna 2017). The share of forest below the Slovenian average covering about a third of the area (Kert 1998) decreases water retention in source areas. However, in the last hundred years, the landscape has changed considerably: the share of forests has increased, replacing orchards and vineyards on steep slopes (Ciglič and Nagy 2019; Deriaz et al. 2019). In addition, modernization of agriculture led to terrace abandonment in viticulture (Pipan and Kokalj 2017). Small amount of precipitation, high evapotranspiration, quick runoff, and poor retention capacity increase the frequency of droughts (Frantar 2008a; 2008b; Kozjek, Dolinar and Skok 2017; Žiberna 2017).

The valley floors had often been flooded before the regulation of watercourses in the second half of the 20th century. These measures have decreased flood hazard in the valleys but as the streams have been changed by man, water runs off faster. Water discharge varies significantly; it rises during downpours and snowmelts and lowers during droughts when the streams even desiccate (Kert 1998). Torrential floods are common and occur during local downpours in summer and autumn (Trobec 2016). As noted elsewhere (Frantar and Hrvatin 2005; Kovačič 2016; Hrvatin and Zorn 2017), the precipitation trend in the period 1961–2016 is positive in the autumn and winter months (Žiberna 2017). The increase of precipitation during the colder months with limited evapotranspiration poses a threat to flood security and increases the importance of maintaining small retention ponds for the future.

Due to significant variability of precipitation and water discharge, the area of the Slovenske Gorice Hills is subject to high uncertainty of water supply management: on one hand, it receives short-lived, heavy downpours and torrential floods with a quick water discharge, while on the other hand, long periods with very scarce and low amounts of precipitation occur leading to water shortages. This is why innovative management practices are needed in order to increase water retention during droughts and prevent high water runoff. One of the measures for water retention in the periods of drought and for preventing runoff during the period of more abundant precipitation is ensuring proper land use (for example, by afforestation) and water infrastructure management. The latter involves riverbanks maintenance and excavating or building small and large water retention ponds.

2.1 The Pesnica River Valley

The Pesnica River Valley is located in the central part of the Slovenske Gorice Hills. It runs from the northwest to the southeast collecting most of the waters in the area. The catchment is of asymmetrical shape with the left, north-eastern bank more hydrologically developed. The valley floor is a few 100 m wide above Zgornja Kungota, and its width extends to about 3 km in the lower reaches near Ptuj. The valley was developed in Miocene clastic sediments, mainly sandstone and marl. The flat valley bottom is filled with fluvial deposits and was shaped by the river's frequent floods in a wetland environment. In the past, a very low

stream gradient –1.7‰ (Kobold 2012) caused the meandering of the river. This can be clearly observed on the Josephine Military Map (e.g. Zorn 2007) or on the map of the Franciscean Cadastre (Natek 1992; Gabrovec, Bičík and Komac 2019; Kladnik et al. 2019). The meandering river channel was channelized in the 1960s in order to support agriculture. Of its approximately 69 km course (65 km on the Slovenian territory), about 50 km were regulated. In order to prevent flash floods about 90 km of the tributaries were also regulated (Juvan et al. 1997). In total, 13% of the stream network surface has been meliorated (Leitinger 2012) and only the headwaters of some small tributaries and small narrow valleys remained undisturbed. With channelization the wetland was converted to farmland, on the other hand, channelization increases flood hazard (Lóczy, Kis and Schweitzer 2009; Lóczy and Dezső 2013). The flood hazard prevention measures in the Pesnica River Valley included the building of several large retention ponds. The largest retention pond along the Pesnica River is the Pernica accumulation lake (Figure 1). It consists of two parts; the Pernica 1 and Pernica 2 retention ponds, divided by a dam and a floodgate. The Jarenina and Vukovje creeks flow into the Pernica 1 retention pond. The Pesnica River contributes water into the Pernica 2 retention pond. Also the Pristava retention pond lies on the Pesnica River, while all other retention ponds are located on its tributaries (Figure 2).

Figure 1: Pernica accumulation lake in 2006 and 2016.

2.2 Spatial analysis of the Jarenina Creek and Vukovje Creek catchments

The catchments of Jarenina and Vukovje Creeks are similar by their average elevation (306 m and 318 m, respectively) which is about 50 m higher than the average elevation of the Slovenske Gorice Hills. The valley floors lie at an altitude of 250 m, while the highest peaks of the hills exceed 400 m in the north-western part of the Jarenina Creek catchment. Slope gradients, which were calculated with a 5 m resolution, range between 13° and 14°, with a maximum of about 50°. Landslide susceptibility level on a scale from 0 to 5 (after the landslide index method; Zorn and Komac 2008) is around 3, while areas with the highest possible level of landslide susceptibility (scale level 5) can be found in both catchments.

According to the Slovenian Environment Agency, the average temperature was –1.1 °C in January and 20.1 °C in July in the period from 1981 to 2010. The area gets about 980 mm of precipitation on average, with just under 4200 MJ/m^2 of insolation. Annual snow cover spans from 42 to 56 days. The average evapotranspiration is just over 630 mm and, on average, about 350 mm of water drains from the area. The net groundwater recharge is about 80 mm on average but it can vary significantly. The variation coefficient of groundwater recharge is 82% in the Jarenina Creek catchment and 52% in the Vukovje Creek catchment. Parts of the pilot area experience soil water shortage (over 80%) up to 20 days or more. Both catchments have watercourses of the first, second, and third order (Figure 6).

Land use is similar in both catchments. About one-third of the area is covered by meadows, followed by forests and arable fields. The percentage of the forested area is lower in the Jarenina Creek catchment than in the Vukovje Creek catchment, while the percentage of arable land is somewhat higher. The fourth category is built-up areas, while other areas include vineyards, permanent crops, and overgrown areas. There are only a few tenths of a percent of water surfaces and wetlands.

The catchments considered have identical natural geographical features. However, it was confirmed that the Jarenina Creek catchment has been more reshaped by human activity. This is confirmed by the higher share of built-up areas and agricultural land use. However, today there is more forest than in the first half of the 19th century and fewer fields and vineyards (Deriaz et al. 2019; Gabrovec and Kumer 2019).

3 Methods

We selected seven small retention ponds in the Pesnica River catchment to conduct detailed analyses using geoinformation tools and structured interviews with the water pond owners (Figure 2). A structured interview (Šmid Hribar and Ledinek Lozej 2013; Pipan and Kokalj 2017) is a technique for the systematic gathering of verbal information. It was used to record opinions and determine the interviewee's position (Nared 2007) on the selected examples of anthropogenic bodies of water in order to analyze their common features. We studied these examples to determine the main characteristics of the management system of small retention ponds, their versatility, and challenges. The interviews were structured with the following sequence of questions:

- Who is the landowner?
- Who manages the water body?
- What year was the pond established?
- What was it primarily used for?
- What is its current purpose?
- What is the depth of the water?
- What is the speed of sediment accumulation and how often does it have to be removed?
- Do the pond banks have to be maintained?
- Has the pond ever been (over)flooded?

The results enabled us to evaluate the sustainability of the ponds from the management perspective (i.e. maintenance efforts, the quantity of sediment input, primary purpose, frequency of flooding).

Based on field observations and the information gained from the interviews, a pilot study was designed to map and classify all the retention ponds in the catchments of the two Pesnica River tributaries: the Jarenina and Vukovje Creeks which both contribute to the Pernica 1 retention pond (Figures 1 and 2).

All the retention ponds in the pilot area were mapped in the geographic information system and a pond inventory was created. The collected data included:

- Catchment name;
- Location (coordinates);

- ID number and name of the pond;
- Pond surface area (m^2);
- Description of the hinterland – inflow;
- Description of the area of the water reservoir – outflow.

We calculated the percentage of small retention ponds that are constructed on the main watercourse and influence water discharge and sediment yield and a percentage of ponds that work with a bypass channel.

4 Results and discussion

4.1 Interviews with the pond owners

The structured interviews with the owners of the small retention ponds served as an insight into the common challenges regarding their management observed in previous studies: from legislation issues (Širca 2010) to costs related to maintenance (Verstraeten and Poesen 1999; 2000; 2001) and the motivation to maintain or abandon the ponds (Mioduszewski 2012). The results show that in the Pesnica River catchment the ponds are usually privately owned and the owners manage them by themselves. Although they are responsible for the operative as well as financial aspects of management they mostly lack experience with any possible authorities responsible for water-related topics. Understandably, since also the review of legislation about small retention ponds in Slovenia showed there are no specific and clear laws and rules (they apply only for large retention ponds). In most cases, the uncertainties and confusion of the legislation do not create problems for individual landowners to establish private ponds. In only one case, the interviewee reported an issue with acquiring a permit to remove sediments from his retention pond in the Vukovje Creek catchment. Consequently, the pond was abandoned and is currently empty.

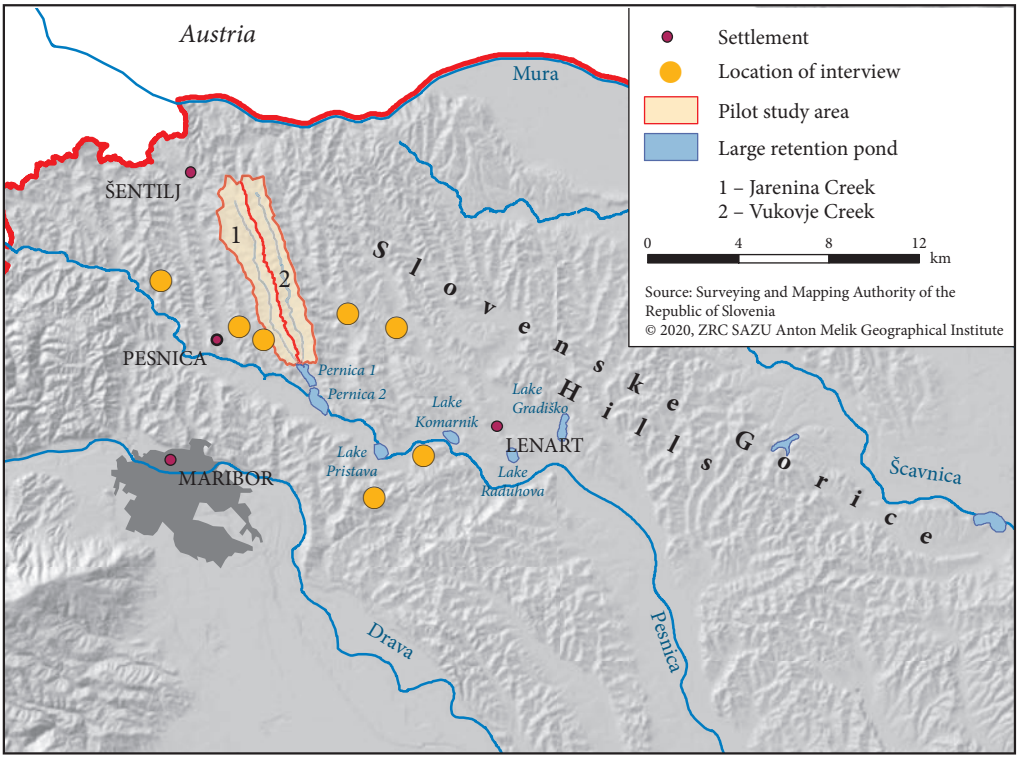

Figure 2: Location of small retention ponds included in the interviews with the pond owners and the pilot study area.

Based on their primary function when they were created and also their current function the ponds can be divided into two main groups: fishing ponds (commercial and non-commercial) and irrigation ponds. Some retention ponds have existed for hundreds of years. They were made for aesthetic reasons and for fish farming near castles (e.g. Hrastovec Castle; Figure 3), countryside mansions (e.g. former Rittersberg in Spodnji Jakobski Dol), or monasteries (e.g. the Benedictine Monastery at Jareninski Dvor; Figure 4). They can be distinguished from most other ponds by their larger size, which is a consequence also of the favorable environmental conditions: they were created in natural stream valleys, at large natural springs, and in lower basins with permanently high groundwater levels. Through time and the changes in ownership, their function was adapted to the owners' needs. However, the ornamental and fishing ponds have mostly preserved their original function to this day.

Decades ago, fish cultivation was an additional source of income for farmers in the Slovenske Gorice Hills. Nowadays, the financial impact is minimal, leading many of the owners to abandon the fishing ponds. According to the interviewees, the lower income from fish sales in the past decade is most likely a consequence of the dominating low-priced products by major manufacturers on the market. Their observations are in line with the findings at the European Union level where the economic performance of fish farming was linked to the heavy global competition but also to market requirements for the constant supply and quality with guaranteed environmentally-friendly production chains (Review of the EU … 2009). Competing with such requirements is impossible for individual, non-aligned farmers. Further factors negatively influencing aquaculture development are water user conflicts and increasingly complex regulations (Review of the EU … 2009). Consequently, commercial fish farming will become economically beneficial only if it is integrated into national strategic development plans, providing the farmers with economic stimulations and legal advice, and connecting them into local production chains (Adámek, Mosser and Hauber 2019).

The other group of retention ponds is intended for irrigation to maximize or stabilize crop yields. They were constructed in the 1990s when state subventions were made available. The irrigation water is used in orchards, vineyards and private gardens. The interviews revealed that the pond maintenance costs for the owners are comparable with the gains of irrigation. Therefore, the owners are looking for additional possibilities to use the existing ponds, otherwise, the ponds will be abandoned. Consequently, the trend of retention pond use is shifting towards an increasingly multi-functional role: irrigation, watering livestock, tourism with non-commercial sports fishing, and the aesthetic function is gaining in importance. Also, other research has shown that public awareness of the benefits of multi-functional ponds encourages local people to properly maintain them (Oda et al. 2019). Due to increased climate variability and

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Figure 3: The tradition of fishing in the castle ponds at Hrastovec Castle has been maintained for several centuries.

change in precipitation patterns (see chapter 2) the need for irrigation ponds will most likely increase in the future. Furthermore, small on-farm ponds are a more sustainable water source, compared to large scale groundwater extraction for irrigation (Sanfo et al. 2017; Vico, Tamburino and Rigby 2020).

Usually, retention ponds are constructed in areas of local springs and streams. Consequently, constructing them requires simply digging out or deepening a small basin in the valley floor, with minimal construction of barriers or dams. Simple dams are constructed by piling up clay sediment and fortified in places with wooden stakes. Some interviewed pond owners stated the ponds were constructed many decades ago by previous landowners. In such cases, the knowledge about motivation and reasons for constructing the ponds at a specific location in a specific way is lost.

The bedrock of the Slovenske Gorice Hills is prone to quick weathering and erosion. Furthermore, despite the fact that these shallow retention ponds are no more than 5 m deep, they do not need to be frequently cleaned as the accumulation of sediment is still slow. The owners remove the sediment from the ponds only once in every 10 to 30 years. There are several reasons for that, demonstrating the deep understanding and knowledge of local people about their environment:

- The retention ponds are usually located in areas with low inclination slopes, where the torrential character of the watercourses is decreased.
- Low sediment accumulation occurs also because the retention ponds were generally created above the main watercourses and are not subject to flooding.
- Many ponds are built on springs or small tributaries transporting low amounts of bedload.
- When the ponds are built next to the streams, to minimize pond sedimentation, the main watercourse is commonly diverted to bypass the pond (Figure 5). The inundation of ponds is controlled by water channeled from the main watercourse which transports significantly less bedload material. In this way, the owners avoided possible damage during floods and high sediment flow along the main streams.

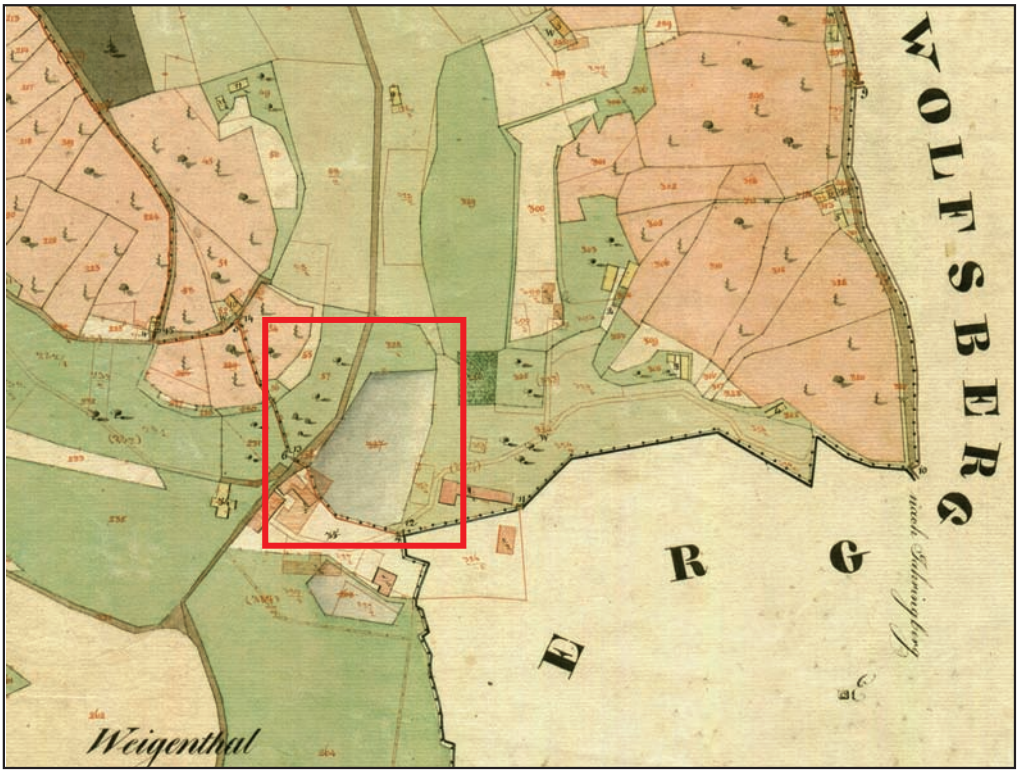

Figure 4: Fishing pond (marked with red rectangle) at the Benedictine Monastery at Jareninski Dvor as shown on the Franciscean Cadastre from the early 19th century (Franciscejski kataster 1824).

These adaptation methods helping the owners to more efficiently manage and maintain the ponds, influence also the effect of the ponds as possible natural ecological measures for preventing floods. For this reason, we analyzed the percentage of retention ponds in the pilot areas that are located directly on the stream network and the number of ponds that are physically separated from the watercourses and only filled with groundwater or precipitation (chapter 4.2).

Since the issue of pond sedimentation was frequently already limited by creating specific resilient pond types, some interviewed pond owners reported the removal of aquatic weeds from the retention ponds as the most time and cost consuming management issue. Overgrowth by vegetation causes problems because it alters the ecological conditions in the ponds very quickly by inducing eutrophication, overgrowth of the surface with algae, leading to low visibility and low oxygen level (Vanacker et al. 2016). Such changes in water properties are harmful to fish populations and, consequently, need to be avoided especially in fishing ponds (Vanacker et al. 2016; Adámek, Mosser and Hauber 2019). This is why the vegetation in the retention ponds, and especially on their banks, has to be regularly removed every few years (Figure 5).

4.2 Pond inventarisation in the catchments of Jarenina and Vukovje Creeks

A total of 41 artificial structures to retain freshwater (i.e. retention ponds) were detected during field mapping in the Jarenina Creek and Vukovje Creek catchments (Figure 6, Table 2). The identified ponds cover a total area of 15,014.73 m^2 and the average pond size is 366.21 m^2. Despite the comparable size of both catchments, there are significantly fewer ponds in the Jarenina Creek catchment (15 ponds) than in the Vukovje Creek catchment (26 ponds). However, the largest pond of all (JC1 – 5,125 m^2) and the average pond size in the Jarenina Creek catchment (642.81 m^2) considerably exceed the ponds in the Vukovje Creek catchment (average size is 206.64 m^2). Also, the total area of ponds in the Jarenina Creek catchment (9,642.10 m^2) is larger than in the Vukovje Creek catchment (5,372.63 m^2).

MATEJA FERK

Figure 5: Vegetation is removed from the banks of the retention ponds every few years. White arrow is indicating the location of the diversion channel which diverts the excess water and bedload around the pond.

Ponds differ according to the material and method of construction, their source of water, and the way in which water can be drained from the pond (Fish pond … 2005). Additionally, the possible influence of ponds to decrease flood hazard was evaluated.

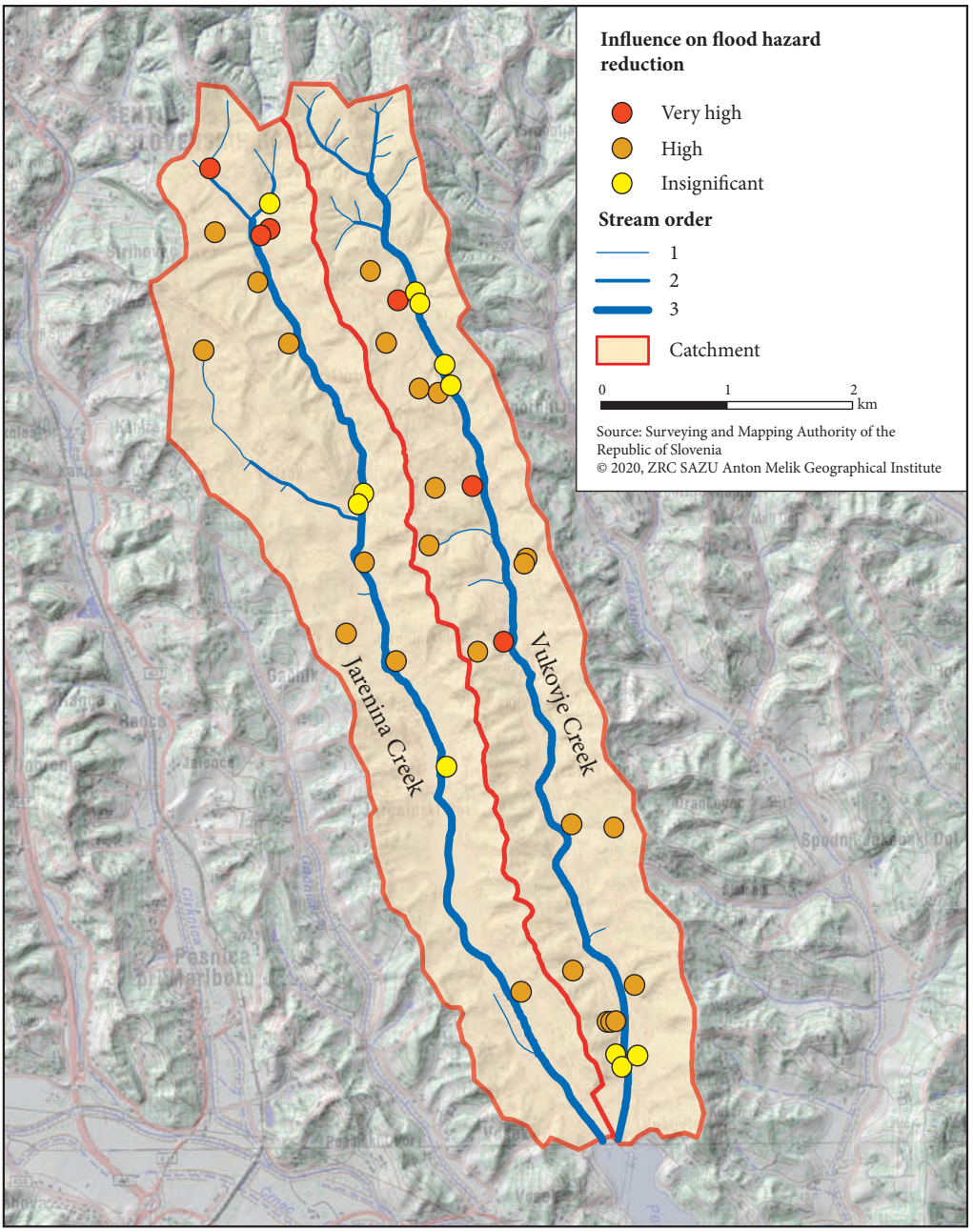

Figure 6: The catchment of Jarenina and Vukovje creeks with the location of small retention ponds classified according to their influence on flood hazard reduction. The figure is showing also the drainage basin network with the order classification (Strahler 1957). The data on the stream network was acquired from the Surveying and Mapping Authority of the Republic of Slovenia.

All identified ponds in both catchments were built using local natural material (i.e. gravel, sand, clay, soil, and wood) and can be defined as simple earthen ponds. No concrete or metal constructions were used. According to the construction methods, the ponds are either dug-out ponds or cut-and-fill ponds (Table 3). The **dug-out ponds** (also sunken ponds) are constructed in flat areas by excavating bedrock material to form a hole in the ground (Fish pond … 2005). The excavated material can be used to additionally strengthen or rise pond walls above the surrounding surface. In both catchments 15 ponds (37%) are dug-out ponds: 5 ponds (33,3%) in the Jarenina Creek catchment, and 10 ponds (38,5%) in the Vukovje Creek catchment. The **cut-and-fill ponds** (also barrage ponds) are constructed on slopes by the excavation of the bedrock material and using it to embank the pond on the downslope side (Fish pond … 2005). In this way, a barrier or dam is built to retain the water. In both catchments, 26 ponds (63%) are cut-and-fill ponds: 10 ponds (66,6%) in the Jarenina Creek catchment, and 16 ponds (61,5%) in the Vukovje Creek catchment.

According to the source of water recharge, the ponds can be fed by groundwater or surface water (Fish pond … 2005). The groundwater can flow to the pond as seepage from the matrix porosity of the bedrock (the level of water will vary with the groundwater-table) or from a spring in or close to the pond (the level of water will vary according to the wet/dry seasons). The surface water can be supplied by rainfall or from surface run-off (e.g. surface stream) both dependent on the wet/dry seasonality. All identified ponds are fed by a combination of water sources (e.g. rainfall and seepage affect all ponds). However, for analytical reasons, the main source of water for each pond was considered in the study (Table 3).

The most common source of water in all identified ponds is groundwater (73%): 67% of ponds in the Jarenina Creek catchment and 77% of ponds in the Vukovje Creek catchment. Approximately two-thirds of the groundwater and 46% of all the water in both catchments comes from springs. Only three ponds in each catchment are supplied by surface water coming from a stream (15% of all water supply). 12% of the ponds are mainly supplied by rainfall. Like it was discussed through the interviews with pond owners (see chapter 4.1), also the pond inventarisation confirmed that the pond location (from the aspect of water supply) is well adjusted to the environmental conditions of the Slovenske Gorice Hills. Ponds fed by seepage and spring water transport an insignificant amount of bedload and need less maintenance. From the aspect of sustainability, ponds fed by groundwater (seepage or springs) have a lower amplitude of water-table variability and are less affected by precipitation seasonality. In rural areas, the reliability of the water sources was especially important before the construction of the water distribution system and remained important for livestock and plantation farmers until the present. Moreover, the importance of sustainable small ponds is increasing due to the current climate variability (Sanfo et al. 2017; Vico, Tamburino and Rigby 2020).

Another method (used also by some interviewed pond owners) to prevent flooding and/or filling of ponds with bedload transported by streams is to construct diversion channels to divert excess water and bedload around the pond (Fish pond … 2005). Out of 6 ponds fed by a surface stream, 4 ponds (2 in each

Table 2: Pond inventory of Jarenina (JC) and Vukovje Creek (VC) catchments showing the area of the identified ponds.

ID	area (m^2)	ID	area (m^2)	ID	area (m^2)
JC1	5125.00	VC1	929.00	VC16	312.00
JC2	801.00	VC2	117.00	VC17	346.00
JC3	1103.00	VC3	91.20	VC18	113.00
JC4	125.00	VC4	301.00	VC19	204.00
JC5	39.00	VC5	64.90	VC20	440.00
JC6	31.40	VC6	120.00	VC21	263.00
JC7	250.00	VC7	33.00	VC22	138.00
JC8	837.00	VC8	6.23	VC23	118.00
JC9	271.00	VC9	150.00	VC24	83.80
JC10	557.00	VC10	129.00	VC25	141.00
JC11	109.00	VC11	267.00	VC26	532.00
JC12	98.40	VC12	54.50		
JC13	88.60	VC13	166.00		
JC14	124.00	VC14	106.00		
JC15	82.70	VC15	147.00		

Table 3: Pond classification by construction method, water supply, and water outlet. The table shows the ID values of identified ponds in the Jarenina Creek catchment (JC1, JC2,. . .JC15) and Vukovje Creek catchment (VC1, VC2,. . . VC26).

	POND TYPE BY CONSTRUCTION METHOD	WATER SUPPLY				WATER OUTLET			
		GROUNDWATER		SURFACE WATER					
		Seepage	Spring	Rainfall	Surface stream	Surface channel	Underground channel	Pumped	Undrainable
Jarenina Creek catchment (ID: JC)	DUG-OUT POND	8, 9, 13	/	5, 12	/	/	8, 9	5, 12	13
	CUT-AND-FILL POND	2	6, 7, 10, 11, 14, 15	/	1, 3, 4	3, 4, 14, 15	1, 2, 6, 7, 10, 11	/	/
Vukovje Creek catchment (ID: VC)	DUG-OUT POND	4, 5, 6, 9, 24, 25, 26	/	2, 8, 13	/	6	4, 9, 26	2, 8, 13	5, 24, 25
	CUT-AND-FILL POND	/	1, 7, 11, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23	/	3, 10, 14	3, 14, 19	1, 7, 10, 11, 12, 15, 16, 17, 20, 21, 22, 23	18	/

catchment; JC 3 and JC4, and VC 3 and VC14) have a diversion channel. Both ponds in the Vukovje Creek catchment are currently out of operation (surrounded by meadows and partly overgrown by bush). We assume they are several decades old and that the diversion channels played a greater role in the past when they were used as watering holes for livestock. Both ponds in the Jarenina Creek catchment were built in the last two decades and have currently an aesthetic and tourism function. The diversion channels for both ponds are regularly cleaned and maintained. Land use changes (afforestation reflecting the changes in farming economy) altered the function of the majority of ponds. Their maintenance strongly depends on the awareness of pond owners of the possible benefits of multi-functional ponds: irrigation, tourism, and aesthetics.

Considering the supply of water, the surface stream-fed ponds have the most direct impact on water and sediment discharge (Koskiaho 2003; Muendo et al. 2014; Chrétien et al. 2016) by slowing down the run-off and consequently on flood reduction. This effect is lessened by the diversion channels, especially for the bedload which can be transported around the ponds. For water retention in the source area of the catchments also rainfall and spring-fed ponds are important as both types are correlated to precipitation patterns; some excess water is stored in the source area during peak flows decreasing fast drainage towards lower valleys (Koskiaho 2003; Chrétien et al. 2016). Stream, rainfall, and spring-fed ponds are becoming more and more important also for limiting on the impacts of drought at individual and local levels due to increased variability of precipitation patterns (Oda et al. 2019; Vico, Tamburino and Rigby 2020). Ponds fed through seepage do not influence water discharge (i.e. movement of groundwater). Moreover, during floods, these ponds can be completely submerged and are not impacting the extent of floods or sediment transport. On the other hand, because they are excavated below the water-table they represent vulnerable locations for chemical or biological contamination of the groundwater (Lóczy and Dezső 2013).

For sustainable management of ponds also the outlet of water is important which can be drainable or undrainable (Table 3). Drainable outlets can be driven by gravitation (surface streams and underground channels) or the water can be mechanically pumped from the pond. Gravitational outlets are typical for cut-and-fill ponds supplied by springs and surface streams. Mostly they have controlled outlets because they were built by embankment (e.g. barrier or dam) through which a surface or underground channel enables the drainage of excess water. In the Jarenina Creek catchment 12 out of 15 ponds have a controlled surface (4 ponds) or an underground (8 ponds) outlet channel. In the Vukovje Creek catchment, 19 out of 26 ponds have a controlled surface (4 ponds) or an underground (15 ponds) outlet channel. These types of outlets directly influence drainage downstream (e.g. discharge, bedload and suspended sediment, as well as water quality). Therefore, their proper management reduces flood and drought risks. All ponds fed by rainfall (5 ponds in both catchments) were excavated on higher ground above the valley floor but have no surface or underground outlet. However, they can be emptied by pumping out water, if needed. Of a special type are ponds fed by seepage, which are deepened below the surrounding surface and cannot be drained (watertable dictates the water level of the pond). As mentioned before, they have the lowest impact on flood reduction but are the most vulnerable point for water pollution, e.g with increased nutrient presence (Ilić and Panjan 2018).

5 Conclusion

The paper discusses small water ponds in north-eastern Slovenia on the example of the Slovenske Gorice Hills. The main conclusion is that small retention ponds, unlike large ponds, are not included in the regional, national and international legislation and the management is left to the landowners. Poor and uncoordinated management strategies and low investments contribute to the state of the water ponds and further minimize their possible use in flood protection. We also noted that the long-term landscape changes, especially land use changes, considerably alter the functioning of the small ponds as an important part of the hydrological system. In the last decades, afforestation, related to the changes in the farming economy, lowered the sediment input and shifted the prevailing use of water ponds from commercial fishing, irrigation and watering livestock to other functions, such as tourism, non-commercial fishing, and aesthetics.

More than half of the retention ponds in the catchments of Jarenina and Vukovje creeks are supplied by groundwater (through seepage or springs) which increases the sustainability of ponds because less effort is needed to maintain them (low sedimentation rates, reliable source of water). Only 15% of the ponds are supplied by surface streams and 12% by rainfall. The ponds constructed on surface streams largely impact

the water discharge and sediment transport and reduce the flood hazard. However, their maintenance is more demanding than that of other pond types. To cope with sediment infilling and avoid peak flow damages to ponds, diversion channels were built on two-thirds of such ponds, diverting the majority of bedload and excess water around the ponds. This technique lowers the maintenance efforts and increases pond sustainability, however, it lowers the pond impact on flood hazard reduction.

For water retention in the source area of the catchments both rainfall and spring-fed ponds are important as both types are correlated to precipitation patterns; some excess water is stored in the source area during peak flows decreasing fast drainage towards lower valley sections. Stream, rainfall, and spring-fed ponds are due to increased variability of precipitation patterns becoming more and more important also for limiting drought consequences at an individual and local level. Ponds fed by seepage have an egligible impact on flood risk reduction . Nevertheless, they are vulnerable locations for chemical or biological contamination of the groundwater because they are deepened below the local water-table level.

Since the owners' investments to maintain the retention ponds are relatively high compared to their economic benefits, the owners often choose to abandon retention ponds. Although retention ponds do not prevent floods, their future abandonment would destabilize the hydrological and agriculture system and increase flood risk and drought impact in the area.

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SEDIMENT PRODUCTION IN FLYSCH BADLANDS: A CASE STUDY FROM SLOVENIAN ISTRIA

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Measuring the catchment areas of erosion plots in the Strane Badlands in the Rokava River headwaters, April 28th, 2008.

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Sediment production in flysch badlands: A case study from Slovenian Istria

ABSTRACT: This article deals with the results of seven years of measurements of sediment release from the flysch badlands in the Rokava River headwaters. Measurements of sediment production were carried out in erosion plots, and measurements of cliff (or rockwall) retreat using erosion pins. Selected meteorological time series from the Portorož Airport meteorological station were included in the analysis. The calculation showed that from 2008 to 2015 (149 measurements) sediment production was 36 kg/m² per year and the flysch cliff retreated by 146 mm or 21 mm per year. The amount of sediment produced is moderately positively correlated with the number of days between successive measurements ($r = 0.51$), with a recorded daily transition of air temperature over/below 0 °C ($r = 0.56$) and slightly more weakly correlated with the precipitation amount ($r = 0.45$). On the other hand, the amount of sediment produced has a low negative correlation with average air temperature ($r = -0.29$) and average minimum air temperature ($r = -0.30$). However, no statistically significant correlation was calculated between the amount of sediment produced and average wind speed.

KEY WORDS: geomorphology, geomorphic processes, erosion processes, sediment production, cliff retreat, geography, Slovenian Istria, Slovenia

Sproščanje gradiva na erozijskih žariščih v flišu v slovenski Istri

POVZETEK: Prispevek obravnava sedemletne meritve sproščanja fliša z erozijskega žarišča Strane v povirju Rokave. Meritve sproščanja kamninskega gradiva smo opravljali s pomočjo erozijskih polj, meritve umikanja flišne stene pa tudi s pomočjo erozijskih žebljičev. V analizo smo vključili podatke izbranih meteoroloških časovnih vrst s postaje Portorož – letališče. Izračuni kažejo, da je bila v obdobju 2008–2015 (149 meritev) intenzivnost sproščanja fliša 36 kg/m²/leto, stena pa se je umaknila za 146 mm oziroma 21 mm/leto. Količina sproščenega gradiva je zmerno pozitivno povezana s številom dni med meritvami (r = 0,51) ter številom dni s prehodom temperature zraka preko/pod 0 °C med dvema meritvama (r = 0,56), manj z višino padavin (r = 0,45), medtem ko s povprečno dnevno temperaturo (r = –0,29) in povprečno minimalno temperaturo zraka (r = –0,30) kaže nizko negativno povezanost. S povprečno hitrostjo vetra količina ne kaže statistično značilne povezanosti.

KLJUČNE BESEDE: geomorfologija, geomorfni procesi, erozijski procesi, sproščanje gradiva, umikanje pobočij, geografija, slovenska Istra, Slovenja

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1 Introduction

Studying erosion in its broadest sense – that is, all exogenous processes of rock and eluvium removal and transportation (Kladnik et al. 2005) – is difficult because these processes are usually slow and most landforms take a long time to develop (Howard and Kerby 1983). Direct observation and measurement or erosion prediction models (erosion models; Stroosnijder 2005, cf. Zorn 2008b) can be used at different time and spatial scales (Turowski and Cook 2017). However, the production and calibration of erosion models, which allow faster acquisition and interpretation of erosion data for larger areas, also require data obtained through direct measurement in the natural environment or laboratories (Stroosnijder 2005). Direct measurement methods are technically complex and time consuming, and the results obtained are difficult to extrapolate to longer time periods and larger spatial units (Zorn 2008b). Due to their complexity, measurements are usually possible only in erosion plots of various sizes, and the results are difficult to extrapolate to larger areas (for more, see Zorn 2008b). Due to greater storage capacity, the amount of sediment produced usually decreases with increasing size of the study area (Nadal-Romero et al. 2011). Erosion process measurements are rare in Slovenia (Zorn 2015). Measurements in flysch badlands were performed by Zorn (2008a; 2009) and in dolomite badlands by Komac (2003) and Švigelj (2015). There have been a few studies examining the intensity of soil erosion on various types of farmland; the findings are published in Komac and Zorn (2005; 2007), Zorn and Komac (2005), and Zorn (2008a).

Extremely well suited for studying geomorphic systems at small spatial and time scales (Wainwright and Brazier 2011) are badlands, where geomorphic processes are intense and landform changes are rapid, allowing effective use of direct observation and measurement methods (Campbell 1997; Gulam et al. 2014). General overviews of badlands and badland-forming processes have been provided by various authors (e.g., Scheidegger et al. 1968; Bryan and Yair 1982; Howard 1994; 1997; 2009; Campbell 1997; Saunders and Young 1983; Torri et al. 2000; Gallart et al. 2002; Harvey 2004).

Badlands can be defined as landforms with or without sparse vegetation, with steep slopes, a dense network of erosion rills and gullies, and few or no eluvial deposits produced in loose or poorly consolidated, impermeable, or poorly permeable rocks, usually with a significant share of clay (Gulam et al. 2014). In badlands, rocks are directly exposed to weathering processes, the effects of raindrops, runoff, and wind erosion (Zorn 2008a; 2009; 2012). This results in the formation of taluses under steep rockfaces (Jurak and Fabić 2000; Zorn 2009; 2012). Badland formation is influenced by various factors, with geological and climate factors being the predominant ones (Bryan and Yair 1982; Gulam et al. 2014). An important factor for their preservation is the absence of vegetation or sparse vegetation cover, which is also disappearing in some places due to human impact (Harvey 2004; Nadal-Romero and Regüés 2010; Gulam et al. 2014). In some areas, the abandonment of farming on steep slopes and afforestation have resulted in a significant (i.e., 70–85%) decrease in the area of badlands (Ciccacci et al. 2008; Staut and Mikoš 2008).

Badlands are being studied across the globe (e.g., Schumm 1956; 1962; Liu et al. 1985; Feoli et al. 2002; Boardman et al. 2003; Eriksson et al. 2003; Curry and Morris 2004; Poesen et al. 2006; Achten et al. 2008; Maerker et al. 2008; Joshi et al. 2009), including the Mediterranean (e.g., De Ploey 1974; Yair et al. 1980; Alexander 1982; Imeson et al. 1982; Rendell 1982; Wise et al. 1982; Clotet et al. 1988; Benito et al. 1992; 1993; Torri et al. 1994; Wainwright 1994; Poesen and Hooke 1997; Sirvent et al. 1997; Clarke and Rendell 2000; 2006; Nogueras et al. 2000; Cantón et al. 2001; Gallart et al. 2002; Wainwright and Thornes 2003; Regüés and Gallart 2004; Díaz-Hernández and Juliá 2006; Piccaretta et al. 2006; Nadal-Romero et al. 2007; 2008; 2011; Ciccacci et al. 2008; Miščević et al. 2009; Nadal-Romero and Regüés 2010; Martínez-Murillo et al. 2013). They are also typical of the flysch areas in Istria (southwest Slovenia and northwest Croatia), which have been studied by various researchers (e.g., Jurak and Fabić 2000; Jurak et al. 2002; 2003; Petkovšek 2002; Petkovšek and Mikoš 2003; Staut and Mikoš 2008; Zorn 2007; 2008a; 2008c; 2009; 2010; 2012; Zorn and Mikoš 2008; Zorn and Komac 2011; Gulam et al. 2014; 2018). They usually cover up to ten hectares and are small compared to others elsewhere around the globe, which can cover up to several dozen square kilometers (Bryan et al. 1987; Howard 1994). However, in Istria they are very common. Gulam, Pollak, and Podolszki (2014) inventoried 5,568 badlands with a total area of 10.7 km² in the flysch areas of Croatian Istria. In Istria, sediment release in badlands can be up to eight hundred times greater than in areas covered with vegetation (Jurak and Fabić 2000). The percentage of badlands in individual Istrian watersheds can reach up to 12% (Gulam et al. 2014). A simplified model of the formation and development of a badland on flysch rocks is presented in Gulam (2012) and Gulam, Pollak and Podolszki (2014).

This article presents the analysis results of measurements of sediment release from the cliff in the flysch in the Strane Badlands in the Rokava headwaters in Slovenian Istria, conducted between 2008 and 2015. Some results for the period from 2008 to 2012 have already been published in Zorn et al. (2017). The analysis included selected meteorological variables, and their correlation with or impact on sediment production was established using data retrieved from the Portorož Airport meteorological station.

2 Geographical location of the test site, methods, and materials

The Strane Badlands are located on the left, shady side of the Rokava Valley, above one of the left meanders of the Rokava (or Pinjevec) River, 1.5 km south of Marezige and 300 m west of Rokavci (Figure 1). Like the entire Dragonja Basin, which the Rokava River is part of, the badlands extend in an east–west direction. The area is made of Eocene flysch, with alternating layers of siliciclastic sediment and carbonate-siliciclastic turbidites of sandstone and marl (Placer et al. 2004). The flysch areas in Istria are also characterized by calciturbidites 1.5 meters or more thick (megalayers), but there are none in these badlands. The barren flysch marlstone is highly non-resistant to exogenous processes (Vivoda Prodan and Arbanas 2016; Vivoda Prodan et al. 2017), which is also the case in the badlands studied, where the marlstone is fractured to a depth of 5 to 10 cm (Zorn 2008a).

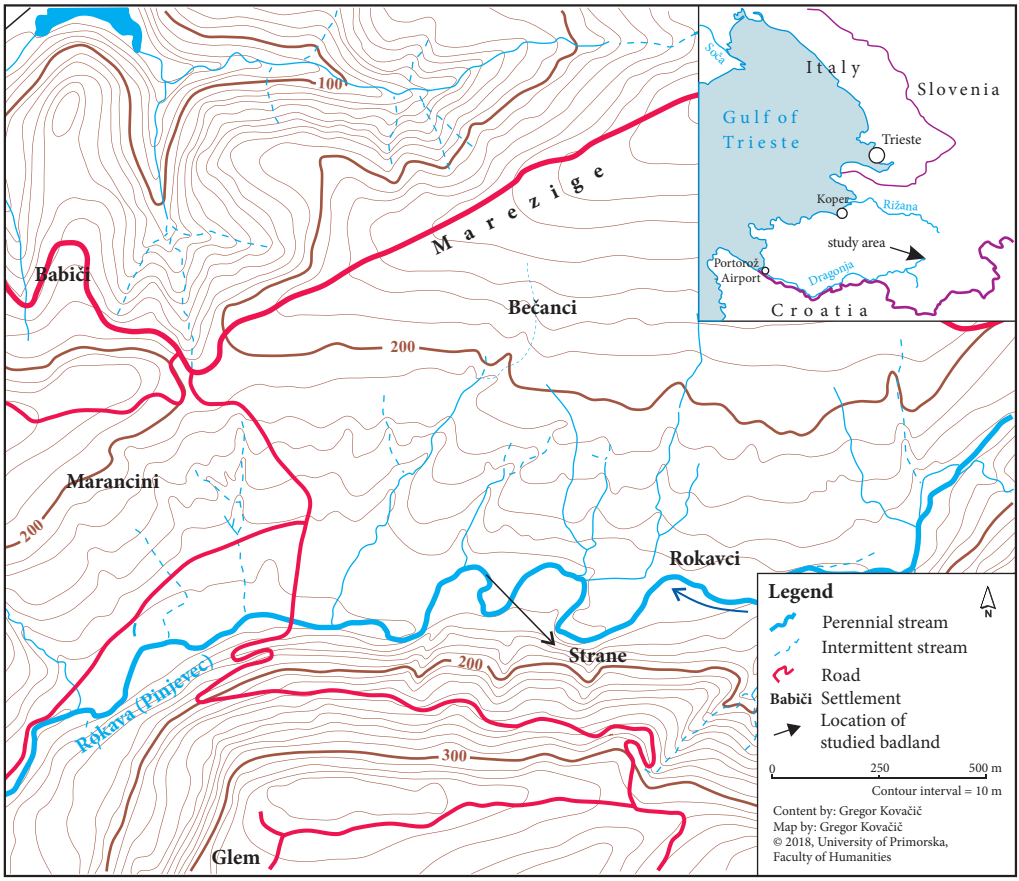

Figure 1: Location of the Strane Badlands in the Rokava headwaters.

Over the past twenty years, the Dragonja Basin has frequently been the subject of studies examining geomorphic processes, especially using various erosion models, whereas direct measurements of geomorphic processes have been less common (Globevnik et al. 1998; Globevnik 2001; Petkovšek 2002; Petkovšek and Mikoš 2003; 2004; Staut 2004; Keesstra 2006; 2007; Keesstra et al. 2005; 2009; Staut and Mikoš 2008; Zorn 2008a; 2009; 2012).

The study area has a transitional climate between the coastal and mainland temperate Mediterranean climates, with annual precipitation between 1,100 and 1,200 mm (Ogrin and Plut 2009). The total area of the central part of the badlands composed of a flysch cliff and a largely overgrown talus beneath it covers approximately 0.8 hectares, and the wider area of more intense erosion and denudation processes covers approximately 1.8 hectares. The highest part of the cliff edge is at an elevation of approximately 203 to 210 m, and the Rokava riverbed is at an elevation of 150 m. The badlands lie above the outer edge of the meander and are thickly overgrown, which is why the Rokava River washes away material from its lower parts only when precipitation is very intense (Zorn 2008a), keeping the badlands active. The contact between the running water and the talus is key to preserving the badlands (Gulam et al. 2014).

On March 19th, 2008, four semi-open erosion plots for measuring the amount of sediment released from the flysch cliff were set up at approximately the same micro-locations as used by Zorn, who performed the measurements from 2005 to 2006. The plots lay at an elevation of 198 to 203 m and were delimited on the upper side by the edge of the badlands and were open on the sides. They had a northeast orientation. The erosion plot barriers were made of wood and plastic (Figure 2) and were placed approximately 2.0 to 2.5 m from the wall. The plastic edges of individual erosion plots, which were placed on the slope to prevent the material produced from mixing with the older material on the talus, were set approximately 0.5 m from the wall. To prevent material from slipping past the barriers, wooden slats were placed on the sides of the plots. The catchment areas of individual erosion plots that followed one another in a north–south

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Figure 2: Location of erosion plots in the Strane Badlands (March 19th, 2008).

direction measured 9.63 m² for the first plot, 8.38 m² for the second, 4.13 m² for the third, and 2.61 m² for the fourth, or a total of 24.74 m² altogether, which was twice as much as with Zorn's measurements (2008a; 2009). The inclinations of the plot barriers ranged from 32° to 55°, which is more than the natural angle of repose of loose material, and the inclination of the erosion plots ranged between 80° and 90°. The slope above the edge of the cliff is less steep and it is overgrown with mixed forest consisting of Austrian pine and downy oak.

In the badlands studied, the sediment release from the flysch cliff was measured by weighing the sediment accumulated behind the erosion plot barriers (Figure 3). A digital hanging scale (with a precision of 10 g) was used to measure both the total mass of the sediment and the masses of three different grain sizes of sediments (up to 13, 13 to 25, and over 25 mm; Figure 4). This article presents the results for the total mass of sediment produced in individual erosion plots. The analysis took account of the total mass of dry material. The ratio between the wet and dry material was defined in the laboratory; with the same volume of material, the mass of wet material is 7% greater. In parallel, direct cliff retreat was measured using erosion pins placed in the cliff's marlstone and sandstone (the measurements are conducted every six months, Figure 5). When a pin falls from the cliff, it has to be replaced. Occasionally the pins in the lower part of the cliff or the upper part of the talus are covered by debris. During the measurements, the measurement plots were damaged several times, which to some extent affected the results.

The rate of cliff retreat and the amount of sediment produced per area were calculated using the data on the size of the catchment areas in the rockfaces above the erosion plots and the flysch mass (1,712.04 kg/m³) that Zorn (2008a) had used in his calculations.

This article presents the results of 149 measurements conducted at various intervals between March 19th, 2008 and February 17th, 2015 (a total of 2,527 days). The measurement data were correlated with the data of selected meteorological variables measured and processed at the Portorož Airport meteorological station just over 14 km west of the badlands studied at an approximately 180 m lower elevation (Table 2, Figure 1). Data on the mass of the sediment accumulated in the erosion plots between two successive measurements were correlated with data on the average air temperature, average minimum air temperature,

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Figure 3: Material accumulated behind the barrier of an erosion plot (June 6th, 2012).

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Figure 4: Weighing the accumulated sediment with a hanging scale, October 23rd, 2017.

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Figure 5: Erosion pins for direct measurements of flysch cliff retreat, April 28th, 2008.

average wind speed, total precipitation and average daily precipitation, and the total and average number of days with a recorded transition of air temperature over/below 0 °C calculated for the periods between the two successive measurements. The information on changes in temperature is important for studying the effect of frost weathering on the production of flysch sediment during the cold half of the year. This effect on the amount of the sediment produced in badlands has been demonstrated by various authors (Zorn 2008a; 2012; Regüés et al. 1995; 2000). The direction and strength of correlation between various pairs of variables were analyzed using the Pearson correlation coefficient ($p < 0.05$).

From October 20th, 2010 to November 13th, 2012 (742 days), air temperature was measured at one-hour intervals above the badland talus (facing east) and on the slope above the edge of the badlands (facing north). A regression analysis between the average and minimum daily air temperatures measured at the Portorož Airport station and the data obtained in this study showed exceptionally high correlation ($r^2 = 0.98–0.99$). Regression functions were used to calculate the average and minimum daily air temperatures in the badlands, which were included in the aforementioned analysis of correlation between the mass of sediment produced and the values of meteorological variables.

3 Results and discussion

3.1 Weather conditions: comparison with long-term average values

The typical air temperatures in the badlands were as follows: the average air temperature was 12.88 °C, the absolute minimum air temperature was −9.5 °C (February 14th, 2012), and the absolute maximum air temperature was 38.3 °C (July 2nd, 2012). Over the seven-year period of measurements, there were 335 days with a recorded transition of air temperature over/below 0 °C, which is 36% more than what was measured at the Portorož Airport station. These changes in temperature are only typical of the cold half of the year (from October to March). The average number of days with a recorded transition of air temperature over/below 0 °C per day for 149 observation periods was 0.11 and in the cold half of the year it was 0.36. During the measurement period, the annual precipitation at the Portorož Airport station was 1,027 mm, which is 6% more than between 1981 and 2010 (Agencija … 2017). Due to higher annual precipitation in Istria's interior, another 100 to 200 mm can be added to the total annual precipitation in the measurement area. Compared to the period from 1981 to 2010, the following months were wetter in the period studied: July (59% more precipitation), February (41% more), and November and May (both with 15% more precipitation). The average August precipitation amounted to only 66% of the long-term average, and the average precipitation in October only 74%. Average daily precipitation was 2.7 mm. The average annual and daily precipitation are not direct indicators of the erosive force of precipitation (which was not measured), but in general erosivity is greater during the wet part of the year (Petkovšek 2002; Zorn 2008a). Precipitation intensity affects the rate of transfer of the already weathered material down the slope. In turn, the wetness or saturation of the rock affects mechanical weathering by wetting and drying, which is typical of fine-grained sedimentary rock, including flysch marl. The average wind speed during the period studied was 2% higher than from 1981 to 2010. The windier months included February, March, December, and October, with 12%, 7%, 5%, and 4% higher average wind speeds, respectively. The greatest downward deviations were recorded in April (6%) and July (2%). Through wetting and drying, wind is an important factor in flysch weathering, and it also triggers the release of weathered material down the slope.

3.2 Sediment production

Over the course of seven years, just over 5,733 kg of sediment was weighed in the four erosion plots, of which 66.7% had a grain size up to 13 mm, 24% had a grain size between 13 and 25 mm, and 9.2% had a grain size larger than 25 mm (Table 1). Flysch mostly weathers into smaller-grained material, which is a result of the fine-grained composition of sandstone and marl. Occasionally larger pieces of sandstone with a typical oblique rectangular prism shape accumulated in the erosion plots. The largest share of the finest-grained material was recorded in Plot 4 (74%) and the smallest share was recorded in Plot 3 (60%), which can be explained by the different flysch composition in the catchment areas, where there were no thick sandstone layers above Plot 4. In contrast, the largest share of the coarsest-grained material was weighed in Plot 3 (11%) and the smallest in Plot 4 (9%).

The largest share in the total mass of the sediment in the badlands came from Plot 1 (2,072 kg or 36%) and the smallest from Plot 4 (824 kg or 14%; Table 1). Sediment production ranged from 213 kg/m² (Plot 2) to 316 (Plot 4) kg/m², with an average of 250 kg/m². Over the seven years, the annual average sediment production was 36 kg/m²/year (ranging from 31 to 46 kg/m²/year). Over the course of two years, Zorn (2008a, 2009, 2010, 2012) calculated sediment production twice as high, ranging from 58 to 122 kg/m²/year for an individual erosion plot (an average of 80 kg/m²/year). This difference may reflect different weather conditions between the two periods observed and/or a different frequency of field measurements, which were performed weekly from 2005 to 2006 and every two to seventy-four days (or on average every seventeen

Table 1: Selected indicators of values measured and calculated in the Strane Badlands in the Rokava headwaters between March 19th, 2008 and February 17th, 2015.

Indicator	Plot 1	Plot 2	Plot 3	Plot 4	Total (Σ sum, x̄ mean)
Catchment area (m²)	9.63	8.38	4.13	2.61	Σ = 24.75
Accumulated sediment mass (kg)	2,072.71	1,781.62	1,054.50	824.33	Σ = 5,733.16
Accumulated sediment mass (%)	36.15	31.08	18.39	14.38	Σ = 100
Calculated flysch cliff retreat, period (mm)	125.67	124.24	149.18	184.80	x̄ = 145.88
Calculated flysch cliff retreat, annual (mm)	18.16	17.95	21.56	26.71	x̄ = 21.30
Sediment production (kg/m²)	215.14	212.70	255.41	316.39	x̄ = 249.91
Sediment production (kg/year)	299.52	257.46	152.38	119.12	x̄ = 207.12
Sediment production (kg/m²/year)	31.09	30.74	36.91	45.72	x̄ = 36.11
Sediment production (t/ha)	2,151.4	2,127	2,554.1	3,164	x̄ = 2,499
Sediment %, grain size < 13 mm	69.11	64.04	60.35	74.25	x̄ = 66.71
Sediment %, grain size 13–25 mm	21.64	27.27	28.38	17.90	x̄ = 24.05
Sediment %, grain size > 25 mm	9.26	8.69	11.27	7.85	x̄ = 9.24

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Figure 6: Damage to a barrier of erosion Plot 2 caused by sandstone breaking off, October 12th, 2017.

days) from 2008 to 2015. Hence, it is possible that the measurements performed after longer breaks do not cover all the material produced because it may have managed to slip past the barriers due to the erosion plots being overfilled. The same applies to measurements performed after the erosion plots had been damaged (Figure 6). Sediment production is inversely proportional to the size of the erosion plots' catchment areas (Table 1), which may again be the result of sediment slipping past the barriers in erosion Plots 1 and 2. The annual amount of sediment accumulated in erosion plots ranged from 119 (Plot 4) to 300 kg/year (Plot 1), with an average of 207 kg/year.

Data on slope retreat across the globe were collected by Young (1969, 1974), Saunders and Young (1983), and Young and Saunders (1986), who report a predominant retreat of up to 1 mm/year. Poesen and Hooke (1997) report significantly higher values for the Mediterranean, ranging from 0.05 to 30 mm/year, and more recent research even reports retreats of up to 65 mm/year (Gulam et al. 2018) and surface lowering of up to 75 mm/year (Ciccacci et al. 2008). It makes sense to compare the results of this study with the results obtained in flysch badlands because the rate of cliff retreat depends strongly on the lithological characteristics of badlands (Bryan and Yair 1982; Gulam et al. 2014). The flysch cliff in the badlands studied retreated 18 to 27 mm/year or 21 mm/year on average. This is half as much as Zorn calculated for individual erosion plots (2008a, 2009, 2010, 2012) – that is, 35–50 mm. Gulam et al. (2018) calculated an annual flysch cliff retreat of 27–33 mm using profilometers and a retreat of up to 65 mm/year using photogrammetry. Jurak et al. (2003) used the same method to calculate a retreat of 21 mm/year, Ogrin (1992) determined a retreat of 20 mm/year using dendrochronology, and Petkovšek (2002) and Petkovšek and Mikoš (2003) reported a retreat of 40 to 50 mm/year. Erosion pins were used to measure a cliff retreat of 19.4 to 41.6 mm/year or 31 mm/year on average. Marl retreats 3 mm/year faster than sandstone. The retreat measured using the erosion pins was larger than the calculated retreats. The differences arise from the measurement method, but partly they can also be explained by material slipping past the erosion plot barriers. The different rates of flysch cliff retreats in the badlands in Istria (Petkovšek 2002; Jurak et al. 2003; Zorn 2008a, 2009, 2010, 2012; Gulam et al. 2018) and a comparison with the results of this study show that sediment production strongly depends not only on lithological characteristics, but also on terrain and climate characteristics.

3.3 Correlation between sediment production and meteorological variables

The sediment masses measured in the erosion plots show high significant positive correlations with meteorological variables (0.70–0.83). In addition, they show moderate significant correlations with the number of days between measurements ($r = 0.43–0.70$), which indicates that sediment production on the cliff is not the same throughout the year. The seasonal aspect of erosion processes and the predominant effect of frost weathering during the cold half of the year and rain erosion during the warm half of the year were reported by Regüés et al. (1995; 2000), Regüés and Gallart (2004), Nadal-Romero and Regüés (2010), and Zorn (2008; 2012). The Pearson correlation coefficient between the total amount of sediment measured in all four plots and the duration of the intervals between measurements was 0.51. The strongest correlation with this indicator was established for Plot 4 (Table 2).

The average air temperature at the measurement site shows a low negative correlation with the amount of sediment produced ($r = -0.29$), and approximately the same values were established for the correlation between the amount of sediment produced and the average minimum air temperature at individual plots ($r = -0.12$ to -0.40), which is comparable to Zorn's (2008a; 2012) findings ($r = -0.31$). The fact that frost weathering is an important process affecting flysch release in badlands is proven by the moderate positive significant correlation of the amount of sediment produced with the number of days with a recorded transition of air temperature below/over 0 °C ($r = 0.59$) and the average number of days with a recorded transition of air temperature below/over 0 °C ($r = 0.54$, Table 2). The same was established by Zorn (2008a; 2012), who established a weak significant positive correlation between the number of days with temperatures below freezing and the amount of sediment produced ($r = 0.25$). The measurements for this study were performed on the shady slope, for which Nadal-Romero et al. (2007) determined that alternation between freezing and thawing is a key factor in weathering and sediment production.

The total precipitation between measurements shows low to moderate significant positive correlations with the sediment mass measured in the erosion plots ($r = 0.35–0.67$). Again, the strongest correlation with this indicator was established for Plot 4; the correlation with the total mass of the sediment accumulated was 0.45, which is completely comparable with the 0.43 reported by Zorn (2008a, 2012). Zorn established

insignificant positive correlations between the total mass of sediment produced and precipitation indicators ($r = 0.21–0.26$) and a weak positive correlation with the precipitation erosion indicator ($r = 0.35$). The results of this study show no statistically significant correlation between the mass of the sediment accumulated in the erosion plots and the average daily precipitation ($r = 0.04–0.16$). Based on an extensive database on erosion plots in the Mediterranean, Nadal-Romero et al. (2011) report no clear correlations between the amount of sediment produced and temperatures or precipitation, whereas the results of this and Zorn's studies (2008a, 2008b, 2012) show the opposite.

Zorn (2008a; 2012) calculated a low significant positive correlation ($r = 0.34$) between the average wind speed at the Koper meteorological station and the mass of sediment produced, and a moderate significant positive correlation with maximum gusts ($r = 0.42$). The results of this study do not show a statistically significant correlation between the average wind speed at the Portorož Airport meteorological station and the mass of the sediment accumulated ($r = 0.06–0.14$). The Pearson correlation coefficient between the total amount of sediment in all four plots and the average wind speed is 0.11 (Table 2).

In thist study, the amount of sediment produced shows a moderate positive correlation with the number of days between two consecutive measurements with a recorded transition of air temperature over/below 0 °C ($r = 0.59$) and a weaker correlation with the precipitation ($r = 0.45$). In addition, it shows a low negative correlation with the average daily temperature ($r = –0.29$) and the average minimum air temperature ($r = –0.30$). The findings of the study show the important impact of frost weathering on flysch sediment production. A correlation between the mass of sediment produced and the average wind speed was not confirmed.

Table 2: Pearson correlation coefficients between the mass of sediment accumulated in the erosion plots and selected meteorological variables ($n = 149$ measurements; statistical significance is tested for $p < 0.05$; *statistically insignificant).

Meteorological variable	Plot 1	Plot 2	Plot 3	Plot 4	Total
Strane: average air temperature	–0.24	–0.39	–0.23	–0.12*	–0.29
Strane: average minimum air temperature	–0.25	–0.40	–0.23	–0.12*	–0.30
Strane: days with air temp. transition over/below 0 °C	0.56	0.60	0.53	0.41	0.59
Strane: avg. days with air temp. transition over/below 0 °C	0.51	0.60	0.41	0.36	0.54
Portorož Airport: average wind speed	0.10*	0.14*	0.06*	0.09*	0.11*
Portorož Airport: precipitation	0.39	0.35	0.43	0.67	0.45
Portorož Airport: average daily precipitation	0.13*	0.04*	0.14*	0.16*	0.11*
Days between measurements	0.45	0.43	0.47	0.70	0.51

4 Conclusion

The results of the seven-year measurements of weathered flysch sediment released from the rockface in the Strane Badlands of the Rokava headwaters in Slovenian Istria showed that on average 36 kg of sediment per m² is produced a year, which is comparable with the results obtained in other Istrian badlands (e.g., Jurak and Fabić 2000; Jurak et al. 2002; Petkovšek 2002; Jurak et al. 2003; Petkovšek and Mikoš 2003; Staut and Mikoš 2008; Zorn 2007; 2008a; 2008b; 2008c; 2009; 2012; Zorn and Mikoš 2008; Zorn and Komac 2011; Gulam et al. 2014, 2018). The cliff retreats at a rate of 21 mm per year.

In the future, research measuring flysch sediment production should be expanded with continuous measurements of selected meteorological parameters at this site, which would allow easier study of the impact of individual climate elements on sediment production during the year and more reliable conclusions about their impact on the rate of erosion-denudation processes. It would make sense to supplement direct measurements with other methods, such as terrestrial photogrammetry. In measuring the direct retreat of the cliff, the pins could be replaced by more accurate profilometers, such as reported by Gulam et al. (2018). Attention should also be directed to dissolved weathering products and fine-grained suspended particles that disappear with water through the weathered material and do not accumulate behind the erosion plot barriers.

Studying geomorphological processes in badlands is important for gaining basic insights into the development of terrain. Because erosion-denudation processes take place relatively quickly in flysch badlands, they can also serve as a good case study for exploring changes in the intensity of geomorphological processes

during this period of increasingly evident planetary climate and environmental change, in view of which the importance of studying them is bound to increase. The findings of this study have undoubtedly shown that slope processes in badlands are very effective in shaping flysch slopes.

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IMMIGRANT INTEGRATION REGIMES IN EUROPE: INCORPORATING THE WESTERN BALKAN COUNTRIES

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LIBERO, PHOTO: COMMISSION FOR REFUGEES AND MIGRATION, SERBIA

Ensuring timely policy responses to integration is important.

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Immigrant integration regimes in Europe: Incorporating the Western Balkan countries

ABSTRACT: This article discusses immigrant integration policies in Europe. We analyzed data from the 2015 Migration Integration Policy Index to identify similar immigrant integration regimes in Europe according to policy priorities related to immigrants' socioeconomic rights. The results of a latent class analysis demonstrated that there are two immigrant integration policy regimes among the EU 28, Albania, Bosnia and Herzegovina, Montenegro, Macedonia, and Serbia, with variation between the old EU member states since 1995 (without Greece) and Estonia versus the new EU member states since 2004 (without Estonia), Greece, and the Western Balkan countries. Based on our classification, we conclude that there is a trend of convergence in integration policy regimes in Europe, in which the effects of spatial/geographical and temporal dimensions are manifested.

KEY WORDS: immigration, integration policy, Migrant Integration Policy Index, latent class analysis, Europe

Režimi integracije priseljencev v Evropi: vključevanje držav Zahodnega Balkana

POVZETEK: V članku avtorja obravnavata evropsko politiko vključevanja priseljencev v večinsko družbo. Na podlagi analize podatkov Indeksa politike vključevanja migrantov (MIPEX) za leto 2015 in ob hkratnem upoštevanju prednostnih nalog, ki se nanašajo na družbenogospodarske pravice priseljencev, ugotavljata, kateri režimi vključevanja priseljencev v Evropi so si med seboj podobni. Rezultati analize latentnih razredov so pokazali, da se v 28 državah članicah EU, Albaniji, Bosni in Hercegovini, Črni gori, Severni Makedoniji in Srbiji uporabljata dva režima politike vključevanja priseljencev, pri čemer so opazne razlike med starejšimi državami EU (članicami od leta 1995, a brez Grčije) in Estonijo ter novejšimi članicami (od leta 2004, brez Estonije), Grčijo in državami Zahodnega Balkana. Na podlagi izdelane klasifikacije avtorja ugotavljata, da postajajo evropski režimi integracijske politike med seboj čedalje bolj podobni, navedeno pa ima opazne prostorske oziroma geografske in časovne posledice.

KLJUČNE BESEDE: priseljevanje, integracijska politika, indeks politike vključevanja migrantov, analiza latentnih razredov, Evropa

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1 Introduction

In Europe today, there has been an increasing focus on immigration-related issues by both scholars and policymakers. A literature review suggests that in the academic world much attention has been given to the discussion of immigration and integration policies across countries (Bjerre et al. 2014; de Haas, Natter and Vezzoli 2015). However, most studies have focused on northwestern Europe, with its long immigration and integration experience, the EU, or OECD countries (Joppke 2007; Garibay and Cuyper 2013; Gregurović and Župarić-Iljić 2018), whereas this topic remains under-researched in the non-EU countries and particularly in the Western Balkans. Therefore, tackling migration and developing immigration and integration policies in European countries that are not immigrant destinations is challenging.

Migration cuts across disciplines, whereas migrants cross geographically and socially constructed borders and boundaries. As Hardwick (2008) and Josipovič and Repolusk (2003) emphasize, it is important to consider the spatial perspective of migration when theorizing about assimilation. The social and political challenges of immigration make immigrant integration a very important policy domain for governments. European countries formulated national immigrant integration policies in the past primarily in countries in northwestern Europe, whereas the institutional framework for migration is relatively new in eastern Europe. Several national models of integration for the countries of northwestern Europe were distinguished in migration literature according to government policy principles and responses to immigration and integration: the assimilationist model, the multicultural model, and the differential exclusionist model (Brubaker 1992; Castles 1995).

These models have been questioned and criticized by researchers for various reasons. Critical discussions suggest that the typology of national immigrant integration models does not recognize the dynamic character of integration policies. It, therefore, under-recognizes the temporality of categories of integration regimes (Meuleman and Reeskens 2008; Finotelli and Michalowski 2012). Entzinger and Biezefeld (2003) emphasize the limitations of focusing on a limited number of dimensions in the most commonly used typologies. Other shortcomings of the typologies refer to the validity of indicators as well as to ignoring the potential immigration-integration policy nexus (Boucher and Gest 2014).

Contemporary Europeanization, as Knill and Lehmkuhl (2002) define it, and globalization processes influence migration management (Appave and Laczko 2011). Therefore, efforts toward the Europeanization of integration policies have been evident in the last decade (Parkes 2008). Since 2004, the European Union has been developing the legal framework and principles of a coherent policy for integrating immigrants (Council … 2004, 2008). The documents create a common understanding of integration as a precondition for harmonization of immigrant integration legislation (Martiniello 2006; Lozano et al. 2014). Integration is defined as a »dynamic, two-way process of mutual accommodation by all immigrants and residents of Member States« (Council … 2004). Although the EU supports national policies with policy funds, coordination and exchange of knowledge among the integration policies is a responsibility of EU countries. Previous research has identified the transformation of national integration models and convergence in integration policies and practices across the EU (Joppke 2007; Penninx and Garcés-Mascareñas 2015), as well as convergence in integration models (Doomernik and Bruquetas-Callejo 2015).

Researchers, policymakers, and decision-makers are increasingly preoccupied with immigration and integration policies across countries. Various databases of migration policies and adopted legislation have been created that cover a number of policy fields, countries, and timespans. These databases offer many opportunities to researchers and policymakers for comparative analysis or evaluation of integration policies across countries. The immigrant integration indicators are part of the International Migration Policy and Law Analysis (IMPALA) database (Beine et al. 2016) tracking immigration policies. They are also part of the Determinants of International Migration (DEMIG) database tracking migration policy changes (de Haas, Natter and Vezzoli 2018). The Barcelona Centre for International Affairs (CIDOB) and the Migration Policy Group (MPG) have produced the Migrant Integration Policy Index (MIPEX). This index covers thirty-eight countries and eight policy areas (labor market, family reunion, education, political participation, long term residence, access to nationality, anti-discrimination, and health) relevant for immigrant integration for 2004–2014 (Huddleston et al. 2015). The data are limited to EU countries, Australia, Canada, Iceland, Japan, South Korea, New Zealand, Norway, Switzerland, Turkey, and the United States. Data for the Western Balkans are not included. The MIPEX data are available for Bosnia and Herzegovina, North

Macedonia, and Serbia (2013 and 2015), whereas Albania and Montenegro were assessed only in 2015. In the Western Balkan countries, immigration and integration issues are relatively new.

Scholars interested in comparing policies for integrating immigrants across countries and classification of integration regimes (Meuleman and Reeskens 2008; Zamfir et al. 2014) frequently refer to MIPEX data. Some researchers combine these data with other indicators; Gregurović and Župarić-Iljić (2018) used the MIPEX overall index together with the OECD indicators of integration. Recently scholars have linked integration policy models with other social phenomena such as the political participation of immigrants (Helbling et al. 2016) or perceptions of economic and cultural threats (Callens and Meuleman 2016). However, only the EU countries were studied.

Considering the diversity of European societies, there is a need to study and analyze integration models of countries that have not been studied so far. This is particularly important for countries that according to Melegh et al. (2014) are still characterized by major emigration flows and could transform into »countries of immigration.« There is also a need to enhance the understanding of different typologies of integration regimes that represent the integration of immigrants.

Understanding the concept of integration of immigrants is very important given its complex nature involving multiple processes. There is an increasing number of thoughts about alternative approaches to the concept of integration (Grzymala-Kazlowska and Phillmore 2018) due to the era of super-diversity as a new demographic reality (Vertovec 2007). However, regarding the data referred to in this article, immigrant integration is understood as an opportunity for gaining equal socio-economic rights.

This article identifies similar clusters of immigrant integration regimes in Europe according to policy priorities related to immigrants' socioeconomic rights. Based on the research gap identified in previous literature, this article answers two main research questions. First, it examines how many different types of integration regimes can be distinguished in Europe when the Western Balkan countries are taken into account. Second, it looks at what the differences are between clusters of immigrant integration regimes and which ones do better in integrating migrants based on the policy areas discussed.

2 Data and methods

The data used in this paper are from the 2015 Migration Integration Policy Index (MIPEX) database for thirty-three countries, collected in 2014. The index represents the integration policy by the indicators based on qualitative expert evaluation of existing national laws and policies. The MIPEX database covers eight policy areas relevant to the integration of immigrants. Every policy area presents diverse components and policy dimensions that are related to policy indicators. Thus, the policy area scores are based on the average scores of policy dimensions that favor the integration of immigrants (Huddleston 2016).

The aim of our analysis was the construction of an exclusive and exhaustive typology of integration policy regimes among the EU 28, Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia. Because the integration regime is represented by eight categorical policy indicators, our analysis requires a model that will reveal the latent classification of these regimes into clusters based on similar patterns of values for each indicator. In other words, this model would reveal a discrete latent variable that will indicate the membership of each country in one of the regime types in such a manner that countries belonging to different types will exhibit substantial differences in the majority of MIPEX indicators. This model was constructed using polytomous latent class analysis, which estimates the conditional probability of each country belonging to one of the different regimes (latent classes) given the values of polytomous categorical variables based on the MIPEX indicators. This procedure requires the specification of the number of classes, and so the analysis proceeds by estimating several models, whereby each model has one class more than the previous one. The maximum number of estimated classes depends on the number of countries analyzed (sample size), the total number of variables observed, and the number of levels of categorical variables observed. The model with the best fit to the empirical data was chosen as the most suitable typology. This also means that the model output results in a conditional probability distribution in which for each country there is a high probability of membership in one of the classes and a low probability of membership in any other class, which satisfies our goal of creating a typology that is straightforward and exclusive.

Our analysis included data that consist of scores for eight policy areas on migrant integration, with thirty-three observations for each policy area. For each policy area score, the minimum value is 0 and the

maximum is 100, with each value being one categorical level of policy area variable. Therefore, given the sample size, the reduction of categories (data recoding) was necessary in order to perform polytomous latent class analysis. We reduced the number of categories of each policy area to three so that the new values are as follows: 1 if the original value of the score was less than the first tercile, 2 if the original value of the score was between the first and second tercile, and 3 if the original value of the score was higher than the second tercile, as shown in Table 1.

The analysis was performed using *R* statistical software and the *poLCA* package (Drew and Lewis 2011).

3 Results

As noted above, the total number of estimated parameters in the latent class model is a function of the number of variables, the number of categories for each variable, and the number of latent classes specified by the model.

A model that consists of seven policy areas, three categories for each policy area, and two latent classes has twenty-nine estimated parameters. Given our sample size of thirty-three, the model with eight policy areas could handle only one class, which is not suitable for our research goals (for a further reference

Table 1: Policy area indicator values for thirty-three European countries.

Country	I1 (labor market)	I2 (family reunion)	I3 (education)	I4 (political participation)	I5 (permanent residence)	I6 (access to nationality)	I7 (anti-discrimination)	I8 (health)
Albania	2	3	1	2	2	3	2	3
Austria	3	1	3	2	2	1	1	3
Belgium	3	3	3	3	3	3	3	2
Bosnia and Herzegovina	2	1	1	1	3	2	2	2
Bulgaria	2	2	1	1	3	1	3	2
Croatia	2	3	1	1	3	1	2	3
Cyprus	1	1	2	2	1	2	1	2
Czech Republic	2	2	2	2	1	2	1	3
Denmark	3	1	3	3	3	2	1	2
Estonia	3	3	3	2	3	1	1	1
Finland	3	3	3	3	3	3	3	2
France	2	1	2	3	1	3	3	2
Germany	3	2	3	3	2	3	2	2
Greece	2	1	2	2	2	1	2	3
Hungary	1	2	1	2	3	1	3	3
Ireland	1	1	2	3	1	3	2	2
Italy	3	3	2	3	3	2	2	1
Latvia	1	2	1	1	2	1	1	2
Lithuania	2	1	1	1	1	1	1	2
Luxembourg	1	2	3	3	2	3	1	3
Malta	1	1	1	2	1	1	1	2
Montenegro	2	1	2	1	2	2	3	2
Netherlands	3	2	3	2	2	3	2	2
North Macedonia	1	2	1	1	1	2	3	2
Poland	1	2	1	1	3	2	1	1
Portugal	3	3	3	3	3	3	3	3
Romania	2	3	1	1	2	1	3	3
Serbia	2	2	2	1	1	2	2	3
Slovakia	1	2	2	1	2	1	2	1
Slovenia	1	3	2	2	2	2	2	1
Spain	3	3	2	3	3	2	1	3
Sweden	3	3	3	3	3	3	3	1
United Kingdom	2	1	3	2	1	3	3	3

regarding the relationship between model parameters, number of classes, sample size, and degrees of freedom in a latent class model, see Hagenaars and McCutcheon 2002). Therefore, we decided to exclude the data for the policy area health, which was most recently included in the MIPEX database (in 2015). With seven remaining policy areas (I1–I7), the model can be estimated for one or two classes, but not for three or more. We constructed two models: Model A with seven policy areas, three categories per policy area and one class; and Model B with seven policy areas, three categories per policy area, and two classes in order for classes to encompass different integration regimes of countries.

Given the data restrictions imposed on the estimated models, our analysis focused on the distinction between Model A, which classifies all countries into the same type, therefore disregarding the concept of different integration regime types, and Model B, which classifies countries into two different integration regime types.

As shown in Table 2, Model B (two classes) has lower values for both AIC (the Akaike Information Criterion) and BIC (the Bayesian Information Criterion), and also higher relative entropy, and so it has

Table 2: Model comparison.

Model	Number of classes	Degrees of freedom	Number of estimated parameters	Log-likelihood	Akaike Information Criterion	Bayesian Information Criterion	Relative entropy
A	1	19	14	−253.33	534.64	555.60	0.8804
B	2	4	33	−221.8322	501.66	545.06	0.8953

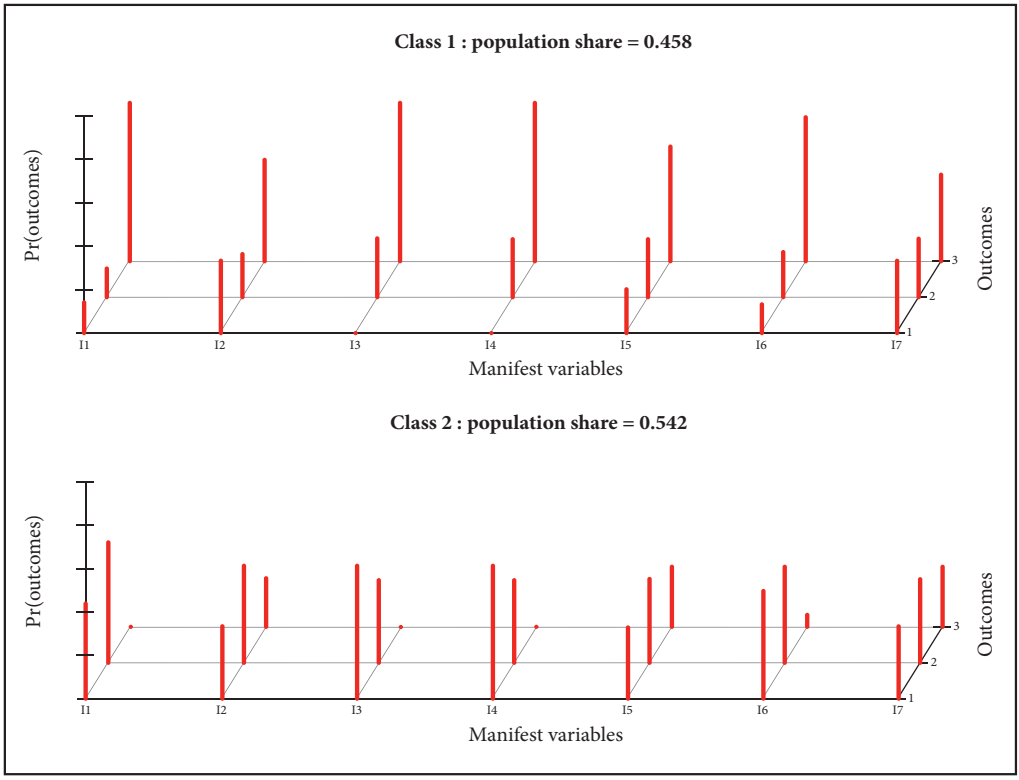

Figure 1: Conditional probabilities of outcomes given class membership (Model B). Note: I1 = labor market, I2 = family reunion, I3 = education, I4 = political participation, I5 = permanent residence, I6 = access to nationality, I7 = anti-discrimination

a better fit to empirical data and the distribution of policy area score values compared to the model with one class (Nylund, Asparouhov and Muthén 2007). In other words, the classification of countries into two classes has a higher fit than the classification of all countries into one class.

The results of the latent class analysis (Figure 1) show that for Model B 45.8% of the countries analyzed belong to Class 1, and 54.2% of countries belong to Class 2. In Model B, Class 2 includes countries for which the distribution of the outcomes of the variables (policy areas) has a high probability of each of the seven variables (policy areas) having the lowest or median score (1 or 2), and a very small probability of them having the highest score (3). There are higher probabilities for the countries grouped in Class 2 to have the highest value for variables I2, I5, and I7 (family reunion, permanent residence, and anti-discrimination), whereas for the others the countries from this class do not have the highest value. On the other hand, countries belonging to Class 1 have high probabilities of each variable's value being the highest one. In summary, Class 2 consists of the countries where one can expect low or medium levels of integration policy in the majority of areas, whereas Class 1 contains countries for which one can expect the highest scores for integration policy. The most striking differences between the two classes are in regard to areas I1, I3, I4, and I6 (labor market, education, political participation, and access to nationality), and these policy areas may serve as clear demarcation lines between countries belonging to the highest tier of integration standards and others.

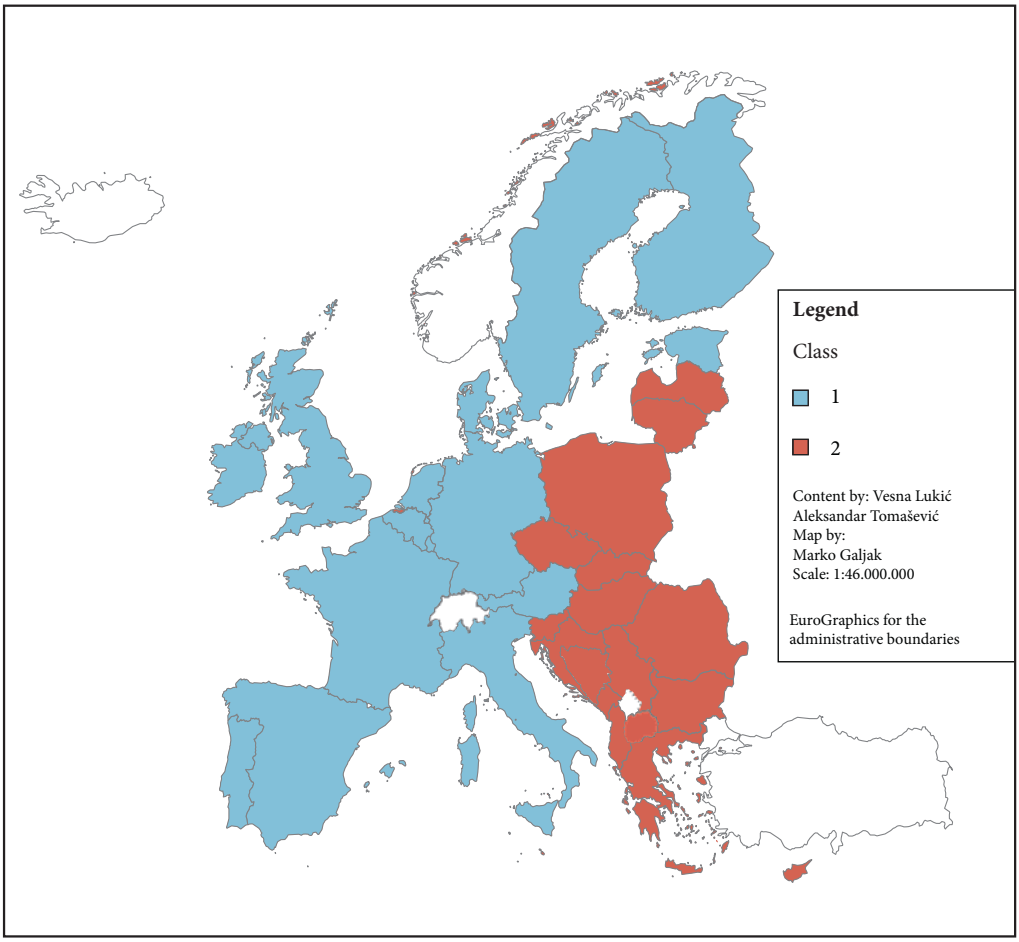

Figure 2: Integration regimes according to latent class prevalence membership for the EU 28 and Western Balkan countries.

Table 3: The latent class membership for EU 28 and Western Balkan countries.

Class 1	Class 2
Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherland, Portugal, Spain, Sweden, United Kingdom	Albania, Bosnia and Hercegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Greece, Hungary, Latvia, Lithuania, North Macedonia, Malta, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia

In terms of latent class prevalence membership (Table 3), we identified two different types of integration regimes in Europe when the Western Balkan countries are included. Class 1 includes EU countries since 1995 (the EU 15) without Greece and with Estonia, and Class 2 includes EU countries since 2004 (EU 13) with Greece and without Estonia but with the Western Balkan countries. As shown in Figure 2, a clear pattern of class division across Europe can be seen.

We find high probabilities for the countries in Class 2 of having achieved high standards regarding immigrants' equal rights and opportunities in the areas of family reunion, permanent residence, and anti-discrimination (I2, I5, and I7). However, the EU 13 (with the exception of Estonia) and the Western Balkan countries will need to make further efforts in developing integration policies in other areas relevant for integration of immigrants in the host society such as the labor market (I1), education (I3), political participation (I4), and access to nationality (I6). According to Huddleston (2016), political participation is seen as an area of weakness for integration policy in all Western Balkan countries and most new countries of immigration, such as the Czech Republic and Greece. The highest probability for the EU 13 (except Estonia) and the Western Balkan countries for achieving standards of integration equivalent to those in the EU 15 countries is in anti-discrimination (I7). The differences between the two classes of immigrant integration regimes point to convergence in integration policies and practices in Europe. The new EU member states and Western Balkan countries need more time to create and implement laws and polices in order to achieve comprehensive high standards defined by the EU regarding immigrants' equal rights and opportunities.

4 Discussion

The validity of traditional national models of integration is currently being questioned and reviewed due to the transformation of national integration policies affected by the process of Europeanization and diverse recent migration challenges (Joppke 2007; Choquet 2017). Calling for more international and comparative migration research (Bommes and Thränhardt 2010) considers paradigms of migration research to be »national paradigms« shaped with states' reactions toward international migration and its social effects identified in national models. In this sense, Pajnik (2007) advocates thinking of migration from a transnational citizenship perspective.

Various immigration experiences of countries, the share of immigrants in the national population, and diverse international migration patterns are reflected in policies and measures of importance for integrating immigrants. The comparison and evaluation of different countries' migration policies make it possible to monitor the best integration practices. Based on the overall score on the 2015 MIPEX Index without health (index value 45) for the Western Balkan countries, immigrant integration policies in those countries are barely halfway favorable for social integration (Huddleston 2016). Although this value is in line with the MIPEX index value (42) for the new EU member states (2004–2013), there is room for improvement compared to the EU 15 countries (61), which do better in providing rights that may produce better integration outcomes. Our results point to two classes of integration regimes for the EU 28 and Western Balkan countries, with a clear distinction between the EU 15 countries on one hand and the EU 13 and Western Balkan countries on the other. The exceptions are Greece and Estonia, which, regarding their EU membership group, do worse and better in the governance of integrating immigrants, respectively. Lower scores in some policy areas in Greece in comparison to Estonia show that targeted support in Greece is missing. Limited funds for integration are not in line with a large number of asylum seekers and illegal arrivals of immigrants. Looking at targeted support in education and the labor market, there is more responsiveness to immigrants' specific needs in Estonia, which has a small number of immigrants per year (Huddleston et al. 2015). High

standards in anti-discrimination in Greece (Huddleston et al. 2015) are in line with the probability values of the class it belongs to.

The Western Balkan countries are continuously harmonizing their legislation relevant to migration with EU standards. However, according to the MIPEX report for the countries of the Western Balkan (Huddleston 2016), indicators of targeted support for immigrants in the labor market and in education express that those measures are completely nonexistent. There are no proper immigrant integration policies for immigrants' participation in political life, consultative bodies, and implementation policies. Nevertheless, customizing different services for a small number of immigrants is not easily feasible. Likewise, the creation of targeted measures to support the integration of immigrants in certain sectors, such as the labor market, education, or political participation, depends on the financial capacity of the state and additional funds for these purposes. For EU member states, financial resources for integration measures are available through EU funds, whereas other countries face more challenges in this regard. Doomernik and Bruquetas-Callejo (2015) point out that integration measures in central Europe largely depend on EU funds.

Comparing our classification with the results obtained by Meuleman and Reeskens (2008) as well as with the results obtained by Zamfir et al. (2014) for twenty-seven EU countries, based on the 2007 and 2010 MIPEX data, respectively, we find that the outcomes are not consistent when the Western Balkan countries are incorporated into the classification of integration regimes. An important difference is that, based on the same policy areas – except for Meuleman and Reeskens (2008), who did not cover education – Meuleman and Reeskens (2008) and Zamfir et al. (2014) classified integration regimes into one class more (i.e., three). Latent Class 2 from our analysis is similar to latent Class 2 of Meuleman and Reeskens (2008), which encompassed all eastern European countries plus Austria, Denmark, Greece, and Malta, which were considered to have exclusionist integration policies, characterized by difficult access to nationality and political participation. In this regard, Denmark has made significant progress since 2007, whereas progress in integration policy in Austria is related to labor market mobility as the major political priority for new integration policies (Huddleston et al. 2015). In our classification, based on the 2014 MIPEX data, Austria and Denmark are in Class 1, pointing to the improved legal environment of immigrant integration. According to our research findings, differences and inequalities in the governance of immigrant integration between the old and the new EU member states are more visible when a broader territory is covered.

In the course of the analysis of the MIPEX data, as Lukić (2018) points out, it should be borne in mind that these data point only to the legal and political framework of immigrant integration, and not to more complex integration policy implementation and effectiveness. According to Czaika and de Haas (2013), the complexity of perception of the effectiveness of immigration policies might be the outcome of the unclear boundary between migration/integration policy as well as between migration policy and other public policies. Indeed, the intertwining of different areas within the institutional framework significantly affects the integration of immigrants. Given the diverse integration experience and immigration patterns between countries, the appropriateness of comparing integration policies through MIPEX has recently been questioned (Gregurović and Župarić-Iljić 2018). Nonetheless, MIPEX is the most comprehensive database and the most widely used tool for measuring immigrant integration policies.

5 Conclusion

This article examined immigrant integration regimes in Europe according to policy priorities related to immigrants' socioeconomic rights. A latent class analysis showed that a model with two classes has a better fit to the MIPEX data than a baseline model in which no distinction between classes is made. Due to the data and method limitations, no further models could be tested.

The results of the latent class analysis demonstrate that two distinct types of integration regimes can be distinguished across the EU 28 and the Western Balkan countries. There are clear differences between the EU 15 group of countries versus the EU 13 and Western Balkan countries group regarding integration regimes. The countries in the first group have achieved high standards in policy areas relevant to integrating immigrants. Furthermore, in the Western European countries variations in immigrant integration-related legislation and policy instruments produced by historical and national contexts are decreasing. The countries from the more numerous second group are lagging in developing integration policies and targeted measures for supporting the integration of immigrants. This is in line with the long-term process of integrating

immigrants into the countries' societies, whereas creating targeted measures for supporting the integration of immigrants is not easy to achieve in countries with a small number of immigrants and limited financial means.

Continued comparative analysis of national policies toward the integration of immigrants can shed light on how particular countries manage to incorporate immigrants in various social spheres while making changes in those policies at the same time. The outcomes provide inputs for policies aiming at best practices in immigrant integration. Monitoring differences within a broader geographical and social setting makes it possible to better understand the strengths and weaknesses of integration regimes. The main conclusion is that there is convergence in integration regimes where the temporal dimension of migration policy development and the geographical dimension are visible.

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COMMUNITY DEVELOPMENT: LOCAL IMMIGRATION PARTNERSHIPS IN CANADA AND IMPLICATIONS FOR SLOVENIA

Mitja Durnik

MITJA DURNIK

Maple leaf, the Canadian national symbol.

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Mitja Durnik[1]

Community development: Local Immigration Partnerships in Canada and implications for Slovenia

ABSTRACT: Canada is perceived as a strongly desired final destination for many refugees and immigrants due to its socio-economic advantages. The author assesses the Canadian praxis of the immigrant settlement from the community development standpoint, with a specific interest to present how successful Canadian immigration policy has been on the local level by using the established Local Immigration Partnerships model. On the other hand, by adopting the so-called restricted model of immigrant integration Slovenia has not developed a consistent model of integration, specifically leaving aside the potential of local areas in resolving these complex issues. The paper is confirming that due to institutionalized multilevel partnership Canada has been more successful in immigrant integration than Slovenia. In both countries, however, integration into the health system has been evidently the most acute problem. In order to obtain more relevant results, a mixed-methods research was used combining interviews and integration indexes. In the majority of integration parameters, Canada shows significantly better results than Slovenia.

KEY WORDS: geography, community, development, immigrants, integration, Canada, Slovenia

Skupnostni razvoj: lokalna priseljenska partnerstva v Kanadi in implikacije za Slovenijo

POVZETEK: Kanada je zaradi svojih socialno-ekonomskih prednosti ciljna država za številne begunce in priseljence. Avtor v članku ocenjuje kanadsko prakso naseljevanja priseljencev s stališča skupnostnega razvoja. V ospredju je predstavitev uspešne kanadske politike priseljevanja in njenega učinka na lokalni ravni z uporabo modela lokalnih integracijskih partnerstev. Nasprotno pa je do sedaj Slovenija uveljavljala t. i. restriktivni model integracije priseljencev, pri čemer ni upoštevala potenciala lokalnih skupnosti pri reševanju te kompleksne problematike. V prispevku smo potrdili, da je Kanada zaradi institucionaliziranega večstopenjskega partnerstva uspešnejša v integraciji priseljencev kot Slovenija. V obeh državah je integracija priseljencev v zdravstveni sistem najbolj akuten problem. Za namen raziskave smo uporabili kombiniran pristop, kjer smo izvedli intervjuje in primerjali nekatere kazalce integracije priseljencev. Kanada glede na večino integracijskih parametrov kaže bistveno boljše rezultate kot Slovenija.

KLJUČNE BESEDE: geografija, skupnost, razvoj, priseljenci, integracija, Kanada, Slovenija

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1 Introduction

Slovenia joined the European Union in 2004 and despite being a member state for over a decade it has still not been recognized as the final country for immigrants, while Canada appears as the decisive goal for newcomers mainly for its rapid economic development. Moreover, comparing both countries, we can also notice different national approaches to integration. Slovenia has been largely following a restrictive approach based on the role of the nation-state (Pajnik 2007), while Canada's borders have remained open to certain immigrant groups specifically needed for its development purposes (having in mind also the historical importance of immigration). In Canada, many multilevel initiatives have emerged offering potential solutions for newcomers' integration. The »welcoming community« approach tried to resolve integration in small cities and rural areas (Gibson, Bucklaschuk and Annis 2017). The federal government has launched a program called Community Partnership Settlement Plan partially responding to the contemporary Syrian refugee crisis.

Immigrants often migrate from highly concentrated ethnic communities to racially mixed places (Murdie and Gosh 2010) inhabiting less expensive areas, while later on, they move to reputable neighborhoods (Waters and Gerstein Pineau 2016). Segovia Gomez (2011) emphasized how crucial the ethnic group's concentration for social inclusion is.

Canadian authors mainly pointed out the relevance of local partnerships in small urban areas (Ma 2017; Tibe Bonifacio and Drolet 2017), the formation of minority neighborhoods in big cities (Hou 2004), or specific integration into the urban history (Anisef and Lanphier 2003). According to the Canadian case study concerning Local Immigration Partnerships (onwards LIPs), there has been an important debate on how rural areas have initiated different strategies of immigrant integration (Ma 2017) than highly populated cities. The urban-rural debate and its relation to development strategies in an important manner determined the concept of regional development in Slovenia (Kozina and Clifton 2019; Vintar Mally 2018; Kozina, Poljak Istenič and Komac 2019).

In the Slovenian context, Botrić (2016) emphasized the insufficient targeted support to immigrants by responsible Slovenian institutions. Medvešek and Bešter (2010) addressed crucial issues of integration such as demography, housing, and health, and Vižintin (2017) explained multicultural integration in relation to educational challenges.

There are three policy fields relevant in our comparative research: (1) labor: how immigrants are integrated in the general labor market; (2) health: access to health care specifically pointing out cultural aspects of the medical treatment; (3) education: focus on integration of children in schools (see Vižintin 2017).

States usually place immigrants into two broad categories. Firstly, labor immigrants leaving homeland on an economic basis, and, secondly, asylum seekers and refugees escaping from war zone areas, where their lives are possibly at risk (Kivisto and Faist 2009).

1.1 Community Development Models

Communities are somehow a result of economic, cultural and social functions. In fact, the concept has been caught up between conventional perception of a community as a place-based structure and the so-called post-place communities having in mind also peoples' social interactions. Geographical view within the first one is often represented as a rural-urban debate regarding modernization in society (Bradshaw 2008).

Rothman (1996 and 2007) has initiated three community development approaches that may interconnect. Planning/policy (social planning) allows planners to use empirically proven data and act as »rationalist« thinkers. It presupposes technocratic top-down activities where governments usually direct policy actions (Chen and Ku 2016). Community capacity development (locality development) builds its efforts on peoples' empowerment within communities and is participatory oriented. Planners try to shape the wide spectrum of different governmental and civic organizations in planning tasks. (Hardcastle, Powers and Wenocur 2011). Social advocacy (social action) is often used by marginal groups trying to radically change power relations regarding decision-makers.

According to the above discussion, the following general hypotheses were examined:

- Due to institutionalized multilevel partnerships, Canada is more successful in integrating immigrants in communities than Slovenia.

Additional sub-hypotheses were formed in order to highlight the comparison between the countries:

- The community capacity development model is importantly connected with a higher national integration policy index.
- Healthcare integration is the most acute problem in Slovenia and Canada.

2 Methods

In the paper, macro (state) policies have been compared using the so-called Migrant Integration Policy Index (onwards Mipex) consisting of 167 different policy indicators joining in different policy as indicated below (index developed by Huddleston et al. 2015). Using Mipex data, we calculated national integration policy in Canada and Slovenia as reflected through governmental decisions on the afore-mentioned policy fields. In general, data are available from 2007 to 2014 for 35 different countries.

Communities' integration capacity research was based on various secondary sources such as reports and experts' analyses concerning community development. Due to major shortcomings of available relevant studies in Slovenia ten semi-structured interviews were conducted with approximately 45-minutes length each, targeting different relevant policy actors like NGOs, policy experts, municipality representatives, and public officials. For measuring Ljubljana municipality's capacity inclusion, the Cities of Migration Diagnostic tool was applied (the MyCOM Diagnostic tool is part of a larger project at Cities of Migration (How inclusive … 2019) supported by the Open Society Foundations and led by the Cities of Migration initiative at Ryerson University's Global Diversity Exchange with international partners). In 2018, by using the MyCOM tool, we asked 55 individuals from the Ljubljana municipality area to fulfill parts of the diagnostic tool (questions related to health, education and economic issues).

3 Building community capacity within Torontonian neighbourhood

In 1998 the provincial Ontario government declared to merge six previously independent municipalities into a single one (Sturdy 2014). Local Immigration Partnerships have been initiated by the federal government to improve the potential of local communities to resolve issues of immigrant integration (Local Immigration Partnerships… 2014).

Toronto has the second largest ratio of foreign-born inhabitants among the biggest world cities (Murdie and Gosh 2010; Anisef and Lanphier 2003). Until 2012, the Torontonian LIP model was based on the neighborhood/community concept. Later on, regional partnerships have been established dividing municipality into four quadrants. Toronto municipality was replaced with funding agencies managing activities »on the ground« (Sturdy 2014). The North Quadrant consisted of Bathurst-Finch, Don Valley, Lawrence Heights, and North York East. In the North York East lived 80,000 residents, 70% of whom were declared as immigrants. Recent newcomers are often highly educated but they would still represent a significant ratio in the unemployment structure. Only 30% were born in Canada. The countries of origin were China and Hong Kong, Iran, India and the Philippines. 44% of all were born in China (The North York East Local immigration Partnership 2013).

A fundamental step in creating local partnerships was the establishment of LIPs Councils, mainly consisting of settlement agencies, municipalities, schools, employment agencies, groups of newcomers, provincial administrative bodies, regional governments, etc. ((Local Immigration Partnerships … 2014). Important tasks of a LIP council are (Pero 2017): (1) creation of a three-year settlement and integration strategy; (2) determination of action plans and implementation strategies; (3) managing regular meetings with partners; (4) education and research. Some of its tasks are delegated to working groups (Pero 2017).

The project team consisted of different experts. Two workers were hired for managing the project, while five animators were carrying out different research activities. Eighteen community organizations became part of the team. Several consultants were identifying the needs and priorities (The North York … 2013).

Community psychical asset mapping demanded to locate geographical distribution of facilities, focus groups (involved more than 200 immigrants) took place with service providers according to different issues. Further activities shaped informant interviews asking management staff from community organizations about their needs. Local service delivery analysis detected the size and financial capabilities of community

organizations. Community consultations extended previous debate specifically building on a future vision of community development. Imagining the community's social and geographic space, newcomers were using maps of community in round tables discussing different obstacles that they found problematic. Then, a service provider meeting applied available information from newcomers' consultations. A special task of the community advisory panel was to redefine and reconstruct priorities and areas of community development orienting to build up a new strategic plan (The North York … 2013).

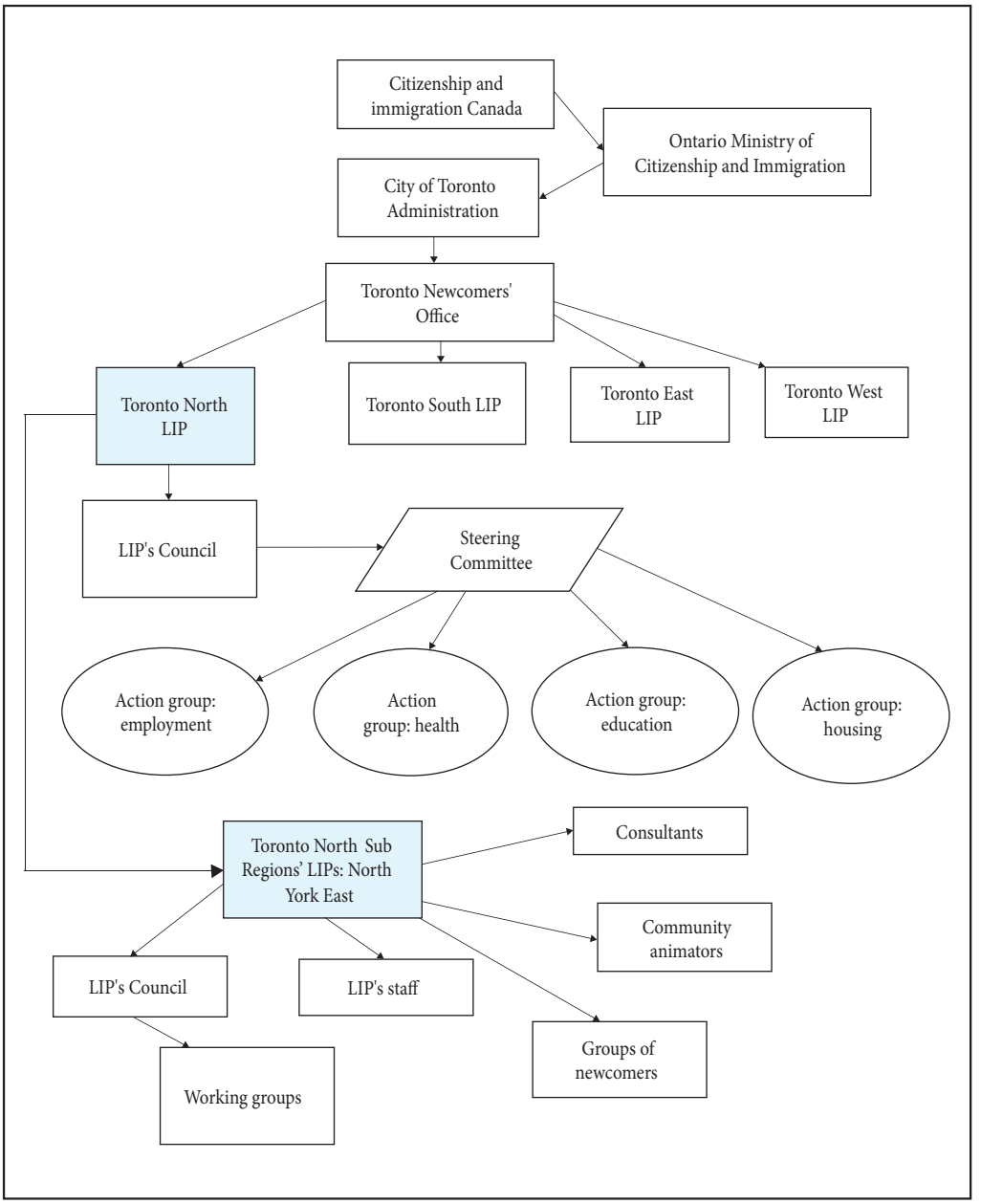

Figure 1: LIP Multilevel Governance Structure focused on sub-regional LIPs in Toronto.

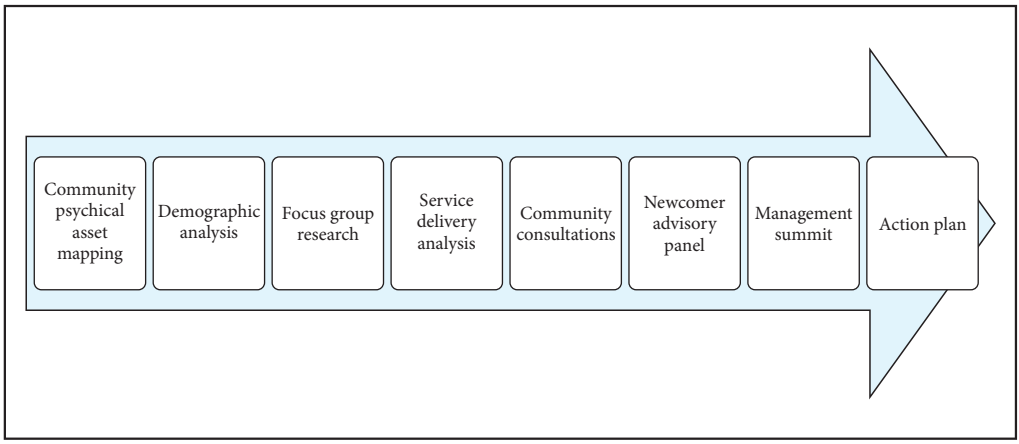

Figure 2: North York East LIP strategic planning process (adapted from The North York . . . 2013).

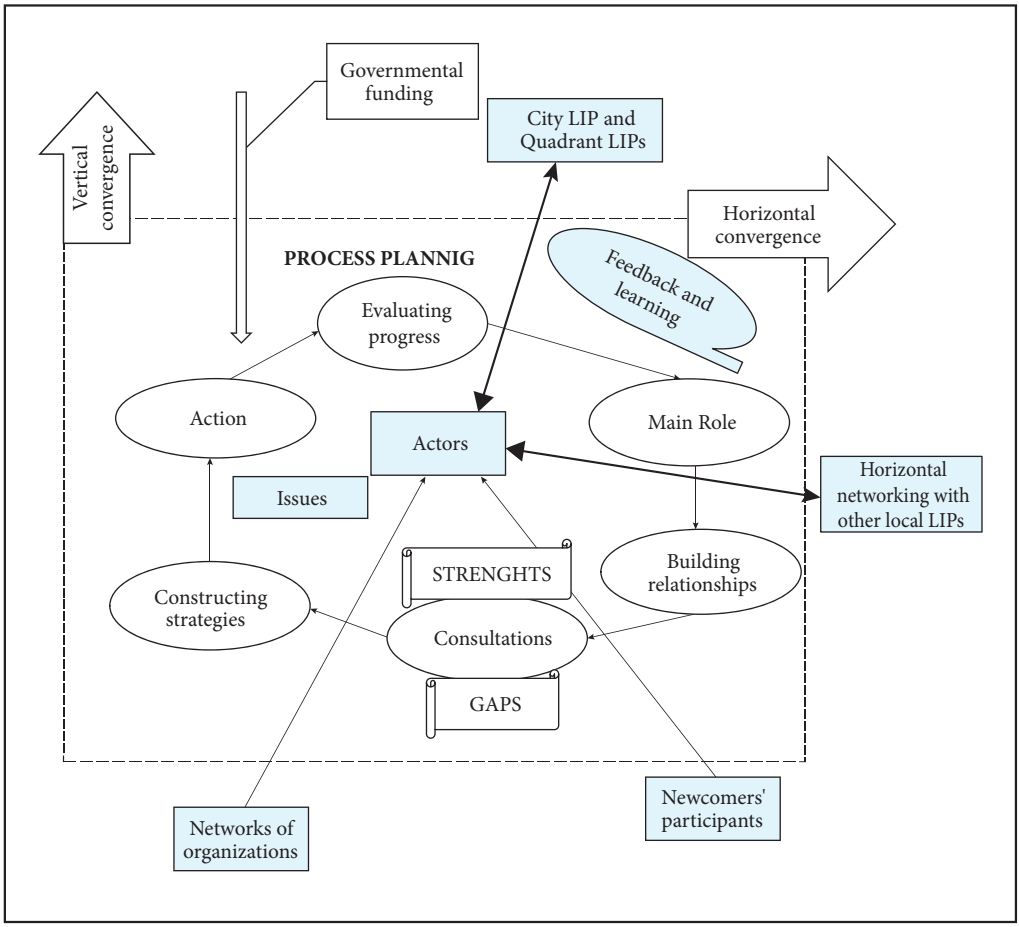

Figure 3: Locality development model as an example of the semi-independent system.

Table 1: North York East Service Analysis (selected categories) (adapted from The North York . . . 2013 and Kobayashi et al. 2012).

Categories	Newcomer & service providers' experience	Area assets & strengths	Service gaps & areas for improvement
Labour and business	• lack of working experience • fewer quality jobs within the community	• employment agencies located within the community • inclusion in co-decision-making	• structural barriers for newcomers' employment • lack of assessment of immigrant skills
Education and youth	• no information about Canadian school culture • financial problems for extra-curriculum activities	• full-day kindergarten schools • preschool training for parents	• limited information in schools • strict eligibility criteria for subsidies
Health	• limitation in access to services • additional fees for some services	• nearby health services • information about services	• communication barriers due to different languages • stigmatization due to mental health problems

4 Social planning in the Slovenian context

Some civil groups organized petitions in favor and against a potential immigrant settlement – particularly, concerning the establishment of accommodation centers (Rijavec and Pevcin 2018). Accordingly, there have been many conflictual relations between municipalities and government concerning major responsibilities although the state formally provided a major share of public services recourses. In reality, the role of municipalities in the integration process has been minimized as much as possible. Combining data given from the Cities of Migration diagnostic tool (measuring inclusion in Ljubljana) and Mipex (detecting integration in Slovenia) the following matrix shows that health issue is the most critical policy in multilevel joint action.

The Ljubljana municipality has supported major national policy initiatives under its jurisdiction. Integration policy has been a continuation of the state policy with some limited cooperation with non-governmental actors and the state (Interviews 2018)

It needs to be highlighted that in terms of the national legislation newcomer workers still face many breaches. Specifically, in the city of Ljubljana, there have been some innovative ideas on how to include political refugees, for instance, to form a kind of a multi-ethnic business (e.g. »Skuhna« restaurant). Despite several successful attempts to start ethnic businesses the question always remains, as to how to continue when public funding is over (Interviews 2018).

Table 2: State capacity of immigrant integration (measuring with Mipex) vs. municipal (city) inclusion policies (measuring with Cities of Migration online diagnostic tool).

	Cities of Migration 2018 (Ljubljana)					
Mipex 2014			Labour	Education	Health	Overall index
(Slovenia)			Intentional	Strategic	Awareness	Intentional
	Labour	Halfway favorable	XXX			
	Education	Slightly unfavorable		XXXX		
	Health	Unfavorable			X	
	Overall index	Halfway favorable				XXX

LEGEND:
Mipex scale: 80–100 – favorable, 60–79 – slightly favorable, 41–59 – halfway favorable, 21–40 – slightly unfavourable, 1–20 – unfavorable, 0 – critically unfavorable.
Cities of Migration scale (arithmetic mean): 80–100% – inclusive, 60–79% – strategic, 40–59% – intentional, 20–39% – awarenes, 0–19% – invisible.
Matrix (level of cooperation): xxxxx highly cooperative, xxxx cooperative, xxx middle cooperative, xx little cooperative, x non-cooperative.
NOTE: Percentages given by respondents were translated into scales (different ones for Mipex and MyCom).

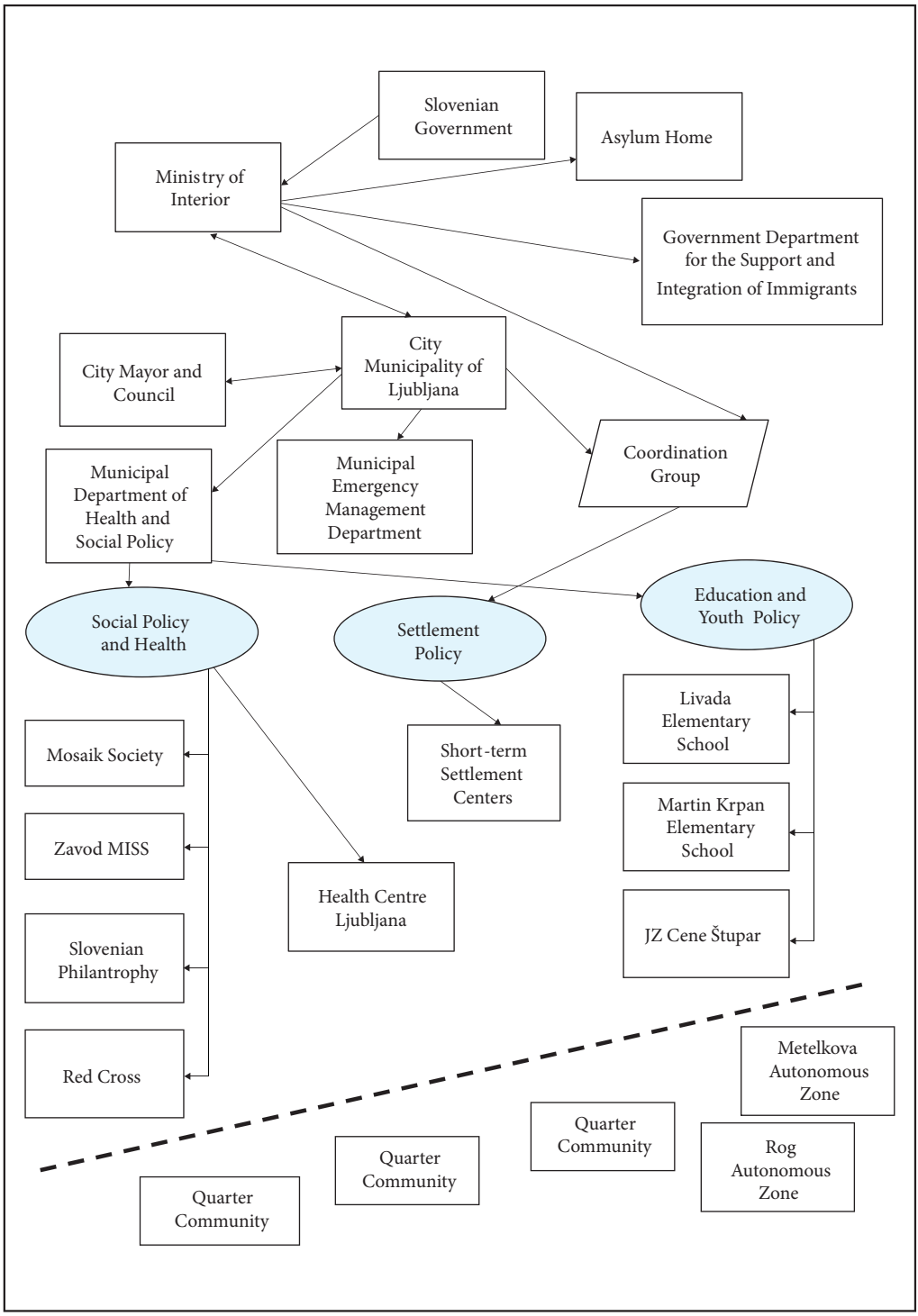

Figure 4: The governance structure of immigrant integration in Slovenia and Ljubljana.

Table 3: Excerpts from interviews (2018) indicating the most acute issues (and positive aspects) of immigrant integration in Ljubljana municipality.

Categories	Newcomer and service providers' experience	Area assets and strengths	Service gaps and areas for improvement
Workplace integration	• Hiring workers through working employment agencies • Limited legal protection	• Employment workshops • Support of employment agency	• Improved target support for the recognition of working skills • Mentoring programs for new entrepreneurs
Education, children and youth	• Language barriers between parents and teachers • Shortage of extra-curriculum activities	• Language training for immigrant children parents • Two-stage model of integration	• Higher financial stimulation for teachers • Developing approaches to understand diversity
Health	• Only emergency treatment for asylum seekers • Out-of-pocket payments for some chronic disease	• Vicinity of some health services • Clinic for individuals without health insurance	• The need for translators • Specific intercultural education for workers

As far as the Slovenian educational system goes, it still does not fully meet multicultural criteria. Some basic policy directives have been accepted at the national level arranging youth integration into the school system. For example, Ljubljana's elementary school Livada has had a prominent history in immigrant children's integration. The municipality also supports a project arranging information and educational activities for immigrant youth (Interviews 2018).

Although the state assured basic healthcare services a systemic approach to the issue was missing. Some very fundamental procedural shortcomings were identified: limited access to doctors and intercultural barriers. Above all, medical personnel often did not recognize the equal health rights for persons holding international protection (Interviews 2018).

5 Comparative multilevel analysis

Canada is still positioned among the countries which have carried out the most notable practices of integration (see figure 5). The Canadian integration policy has not radically changed between 2008 and 2014. Comparatively, according to the Mipex index Slovenia did not achieve the results of most western democratic states.

Following analysis of various LIPs across Ontario, mentoring programs and internships seemed important to immigrants using more effectively their educational credentials (Kobayashi et al. 2012). At the federal level, permanent residents, reunited families and some temporary workers enjoy some of the best labor market opportunities in the developed world (Huddleston et al. 2015). In the case of Slovenia, in some parts of the private sector, non-EU immigrants have often had difficulties to access jobs in this sector (Huddleston et al. 2015). These issues are mostly related to the bureaucratic barriers in the employment process (Interviews 2018).

The overall score of immigrant access to education in Canada is lower than in comparable countries, mostly since only a minority of programs offer immigrants equal access to higher and university education and to vocational training (Huddleston et al. 2015). The LIPs analysis suggested that immigrants would need better coordination of education services (Kobayashi et al. 2012). The Slovenian school system has reacted slowly to the special needs of the newcomers – e.g., there was no specialized center offering expert services (Huddleston et al. 2015). While most interviewees put educational integration very high among other policy groups, Slovenian data show low indexes of integration (Interviews 2018).

Important shortcomings in health integration as an unresponsive healthcare system to immigrants' needs are evident in Canada (Huddleston et al. 2015). Cross-sectional LIPs analysis mainly suggested the removal of systemic barriers approaching mental health services, (Kobayashi et al. 2012). Canada lags behind some countries as Australia, New Zealand, USA or the United Kingdom (Huddleston et al. 2015). Slovenia obviously does almost nothing to integrate and orient newcomer patients into the health system and to address any of their specific health needs (Huddleston et al. 2015). As specifically expressed in Slovenian

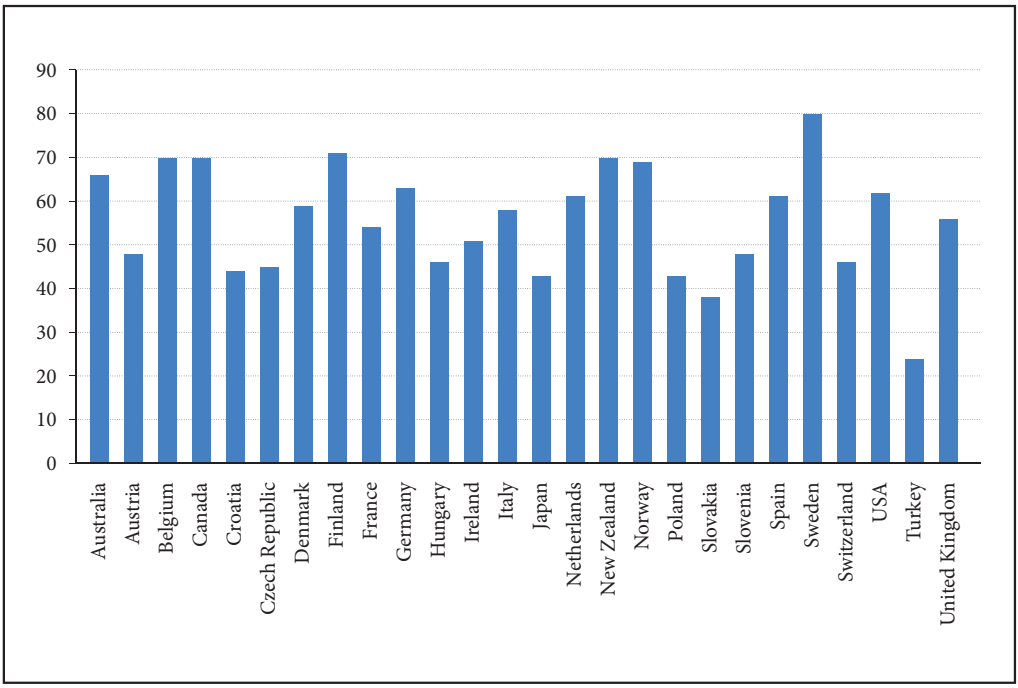

Figure 5: Comparison between countries regarding the Mipex integration policy index in 2014.

Table 4: Parameters measuring labor market integration (calculated Mipex index: source of database: Huddleston et al. 2015).

	Indicators				
	Access to general labor market	Access to general support	Targeted support	Workers' rights	Labor market mobility (overall index)
Canada (2007)	90	58	50	100	75
Canada (2014)	90	83	50	100	81
Slovenia (2007)	30	42	10	50	33
Slovenia (2014)	30	50	20	50	38
EU 25 (2007)	56	55	29	69	52
EU 28 (2014)	61	62	36	71	57

Table 5: Parameters measuring education opportunities (calculated Mipex index: source of database: Huddleston et al. 2015)

	Indicators				
	Access to education	Targeting needs	New opportunities	Intercultural education	Education (overall index)
Canada (2010)	50	80	60	70	65
Canada (2014)	50	80	60	70	65
Slovenia (2007)	N/A	N/A	N/A	N/A	N/A
Slovenia (2014)	33	17	15	40	26
EU 25 (2007)	42	90	80	80	73
EU 28 (2014)	34	47	23	43	37

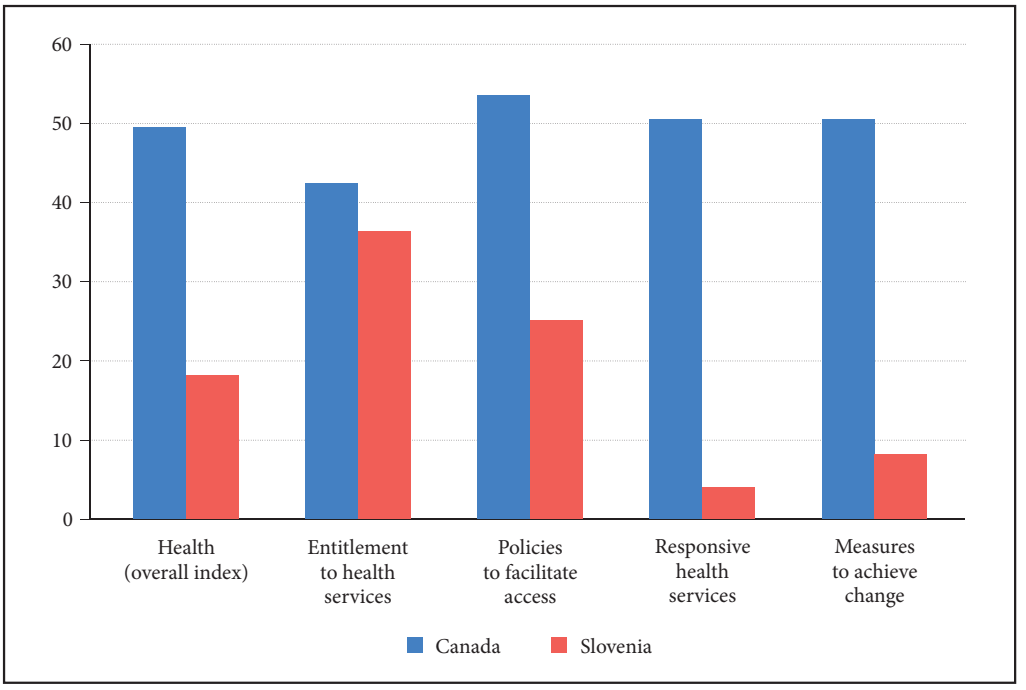

Figure 6: Comparison of health scores (calculated Mipex index: source of database: Huddleston et al. 2015).

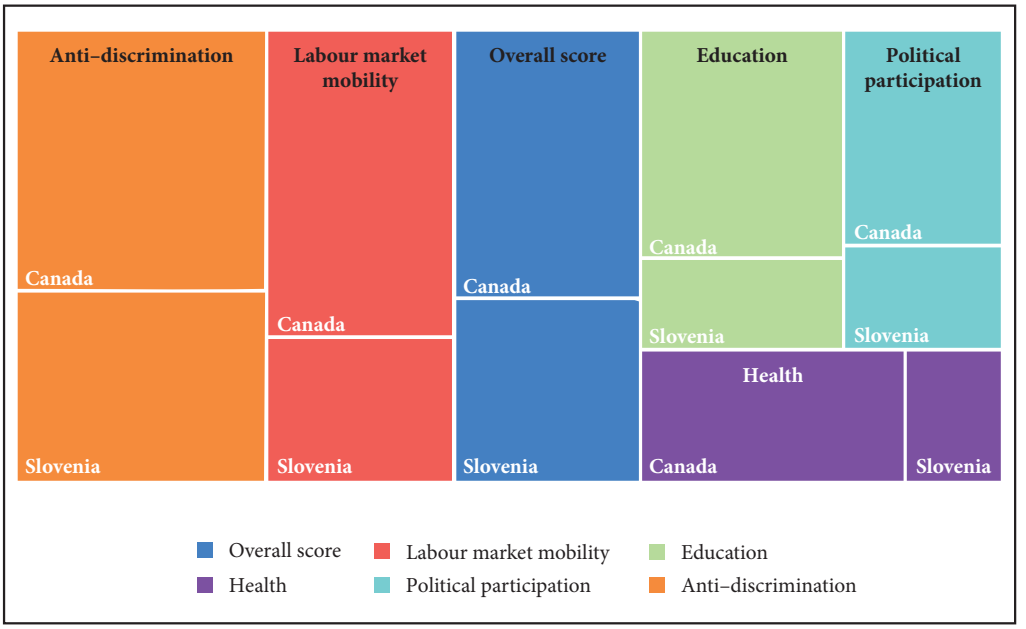

Figure 7: Square area gives comparison of Canada and Slovenia (different policy groups) (calculated Mipex index: source of database: Huddleston et al. 2015). The figure presents the overall calculated Mipex index for Slovenia and Canada by various policy groups. The overall score inside every policy is 100 points as the maximum and shows the ratio between Slovenia and Canada. For example, within section health Canada reaches 80 points, Slovenia only 20 points.

Table 6: Parameters measuring overall scores (calculated Mipex index: source of database: Huddleston et al. 2015).

Country	Year	Overall score
Canada	2014	70
	2013	71
	2012	71
	2011	71
	2010	71
Slovenia	2014	48
	2013	49
	2012	49
	2011	49
	2010	48
EU 28	2014	52
	2013	52

interviews, there has been no organized training of medical personnel and doctors for improving communication with newcomers and understanding their specific cultural needs in medical treatment. In many cases, merely NGOs are those who offer translators and mediators in these activities (Interviews 2018).

The Canadian federal integration policy has largely reflected local characteristics. In Slovenia, incoherent national policy without a long-term vision resulted in individual local social action experiments lacking significant joint effects on all levels of policy-making. Put simply, the shortcoming of serious immigrant integration national program/strategy mainly corresponds with a lower level of the Mipex index.

The final comparison of the overall Mipex index shows that Canadian integration policy on the national level has been far more successful than Slovenian. The general score for years 2014/2015 indicates that the overall EU members' integration policy is more restrictive than in the Canadian case. This may be partially explained also by geopolitical reasons.

6 Conclusion

There are certainly significant correlations between paths of community development and levels of immigrant integration. Canada demonstrates higher integration potential using the so-called capacity development approach allowing local communities to carry out the implementation of integration policies. The Slovenian restrictive national policy without a coherent integration approach is reflected in the conventional social policy planning development model.

Educational policy in Slovenia has been caught between lower Mipex indexes and more positive interviewee opinion. We can agree that the Slovenian educational system quickly corresponds with changes in immigrant integration patterns.

In both countries, healthcare integration is the most acute issue among policy groups compared. We could argue that intercultural barriers represent the most important future challenges for policy-makers.

Inside the Canadian debate, integration provides different social/spatial relations than assimilation. Using integration logic, communities may be integrated based on joint values and are less caught up in ghettoization. Ghettos are usually a result of assimilation processes where community members strongly build their identity on traditional cultural patterns from homeland (Vipond 2017).

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Guidelines for contributing authors in Acta geographica Slovenica

EDITORIAL POLICIES

1 Focus and scope

The Slovenian geographical journal *Acta geographica Slovenica* (print version: ISSN: 1581-6613, digital version: ISSN: 1581-8314) is published by the Anton Melik Geographical Institute of the Slovenian Academy of Sciences and Arts Research Center.

Acta geographica Slovenica publishes original research papers from all fields of geography and related disciplines, and provides a forum for discussing new aspects of theory, methods, issues, and research findings, especially in central and southeast Europe.

We accept original research papers and review papers.

Papers presenting new developments and innovative methods in geography are welcome. Submissions should address current research gaps and explore state-of-the-art issues. Research based on case studies should have the added value of transnational comparison and should be integrated into established or new theoretical and conceptual frameworks.

The target readership is researchers, policymakers, and university students studying or applying geography at various levels.

Submissions are accepted in English or Slovenian.

The journal is indexed in the following bibliographic databases: SCIE (Science Citation Index Expanded), Scopus, JCR (Journal Citation Report, Science Edition), ERIH PLUS, GEOBASE Journals, Current Geographical Publications, EBSCOhost, Geoscience e-Journals, Georef, FRANCIS, SJR (SCImago Journal & Country Rank), OCLC WorldCat, and Google Scholar. The journal's publisher is a member of CrossRef.

2 Types of papers

Unsolicited or invited original research papers and review papers are accepted. Papers and materials or sections of them should not have been previously published or under consideration for publication elsewhere. The papers should cover subjects of current interest within the journal's scope.

3 Special issues

The journal also publishes special issues (thematic supplements). Special issues usually consist of invited papers and present a special topic, with an introduction by the (guest) editors. The introduction briefly presents the topic, summarizes the papers, and provides important implications.

4 Peer-review process

All papers are examined by the editor-in-chief. This includes fact-checking the content, spelling and grammar, writing style, and figures. Papers that appear to be plagiarized, are ghost-written, have been published elsewhere, are outside the scope of journal, or are of little interest to readers of *Acta geographica Slovenica* may be rejected. If the article exceeds the maximum length, the author(s) must correct this before the article is reviewed. The paper is then sent to responsible editors, who check the relevance, significance, originality, clarity, and quality of the paper. If accepted for consideration, the papers are then sent to peer reviewer(s) for double-blind review. Paper are rejected or accepted based on the peer reviews and editorial board's decision.

5 Publication frequency

Acta geographica Slovenica is published three times a year.

6 Open-access policy

This journal provides immediate free open access to its content and supports greater global exchange of knowledge by making research freely available. The papers in *Acta geographica Slovenica* and its predecessors *Acta geographica / Geografski zbornik* and *Geographica Slovenica* are available online free of charge. The author(s) receive a free print copy.

The journal's publication ethics and publication malpractice statement is available online, as well as information on subscriptions and prices for print copies.

AUTHOR GUIDELINES

Before submitting a paper, please read the details on the journal's focus and scope, peer-review process, publication frequency, history, and open-access policy. This information is available in the editorial policies.

1 The papers

Research papers must be prepared using the journal's template and contain the following elements:
- **Title:** this should be clear, short, and simple.
- **Information about author(s):** submit names (without academic titles), institutions, and e-mail addresses through the online submission system.
- **Highlights:** authors must provide 3–5 highlights. This section must not exceed 400 characters, including spaces.
- **Abstract:** introduce the topic clearly so that readers can relate it to other work by presenting the background, why the topic was selected, how it was studied, and what was discovered. It should contain one or two sentences about each section (introduction, methods, results, discussion, and conclusions). The maximum length is 800 characters including spaces.
- **Key words:** include up to seven informative key words. Start with the research field and end with the place and country.
- **Main text:** The main text must not exceed 30,000 characters, including spaces (without the title, affiliation, abstract, key words, highlights, reference list, and tables). Do not use footnotes or endnotes. Divide the paper into sections with short, clear titles marked with numbers without final dots: **1 Section title**. Use only one level of subsections: **1.1 Subsection title**.

Research papers should have the following structure:
- **Introduction:** present the background of the research problem (trends and new perspectives), state of the art (current international discussion in the field), research gap, motivation, aim, and research questions.
- **Methods:** describe the study area, equipment, tools, models, programs, data collection, and analysis, define the variables, and justify the methods.
- **Results:** follow the research questions as presented in the introduction and briefly present the results.
- **Discussion:** interpret the results, generalize from them, and present related broader principles and relationships between the study and previous research. Critically assess the methods and their limitations, and discuss important implications of the results. Clarify unexpected results or lacking correlations.
- **Conclusion:** present the main implications of the findings, your interpretations, and unresolved questions, offering a short take-home message.

Review papers (narratives, best-practice examples, systematic approaches, etc.) should have the following structure:
- **Introduction:** include 1) the background; 2) the problem: trends, new perspectives, gaps, and conflicts; and 3) the motivation/justification.
- **Material and methods:** provide information such as data sources (e.g., bibliographic databases), search terms and search strategies, selection criteria (inclusion/exclusion of studies), the number of studies screened and included, and statistical methods of meta-analysis.

  - **Literature review:** use subheadings to indicate the content of the various subsections. Possible structure: methodological approaches, models or theories, extent of support for a given thesis, studies that agree with one another versus studies that disagree, chronological order, and geographical location.
  - **Conclusions:** provide implications of the findings and your interpretations (separate from facts), identify unresolved questions, summarize, and draw conclusions.
- **Acknowledgement:** use when relevant. In this section authors can specify the contribution of each author.
- **Reference list:** see the guidelines below.

2 Paper submission

2.1 Open journal system

Author(s) must submit their contributions through the *Acta geographica Slovenica* Open Journal System (OJS) using the Word document template.

Enter all necessary information into the OJS. Any addition, deletion, or rearrangement of names of the author(s) in the authorship list should be made and confirmed by all coauthors before the manuscript has been accepted, and is only possible if approved by the journal editor.

To make anonymous peer review possible, the paper text and figures should not include names of author(s).

Do not use contractions or excessive abbreviations. Use plain text, with sparing use of **bold** and *italics*. Do not use auto-formatting, such as section or list numbering and bullets.

If a text is unsatisfactory, the editorial board may return it to the author(s) for professional copyediting or reject the paper. See the section on the peer-review process for details. Author(s) may suggest reviewers when submitting a paper.

2.2 Language

Papers are published in English.

Papers are submitted in English or Slovenian and copyedited/translated after acceptance by a professional chosen by the editorial board.

The translation or copyediting costs are borne by the author(s) (translation €500, copyediting €200) and must be paid before layout editing.

All papers should have English and Slovenian abstracts.

2.3 Supplementary file submission

Supplementary files (figures) can be submitted to the OJS packed in one zip file not exceeding 50 MB.

2.4 Submission date

The journal publishes the submission date of papers. Please contact the editor with any questions.

3 Citations

Examples for citing publications are given below. Using "gray literature" is highly discouraged.

3.1 Citing papers

- de Kerk, G. V., Manuel, A. R. 2008: A comprehensive index for a sustainable society: The SSI – the Sustainable Society Index. Ecological Economics 66-2,3. DOI: https://doi.org/10.1016/j.ecolecon.2008.01.029
- Fridl, J., Urbanc, M., Pipan, P. 2009: The importance of teachers' perception of space in education. Acta geographica Slovenica 49-2. DOI: https://doi.org/10.3986/AGS49205

- Gams, I. 1994a: Types of contact karst. Geografia fisica e dinamica quaternaria 17.
- Gams, I. 1994b: Changes of the Triglav glacier in the 1955-94 period in the light of climatic indicators. Geografski zbornik 34.
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- van Hall, R. L., Cammeraat, L. H., Keesstra, S. D., Zorn, M. 2016: Impact of secondary vegetation succession on soil quality in a humid Mediterranean landscape. Catena, In press. DOI: https://doi.org/10.1016/j.catena.2016.05.021 (25. 11. 2016).

3.2 Citing books

- Cohen, J. 1988: Statistical power analysis for the behavioral sciences. New York.
- Fridl, J., Kladnik, D., Perko, D., Orožen Adamič, M. (eds.) 1998: Geografski atlas Slovenije. Ljubljana.
- Luc, M., Somorowska, U., Szmańda, J. B. (eds.) 2015: Landscape analysis and planning. Heidelberg. DOI: https://doi.org/10.1007/978-3-319-13527-4
- Nared, J., Razpotnik Visković, N. (eds.) 2014: Managing cultural heritage sites in Southeastern Europe. Ljubljana.

3.3 Citing parts of books or proceedings

- Gams, I. 1987: A contribution to the knowledge of the pattern of walls in the Mediterranean karst: a case study on the N. island Hvar, Yugoslavia. Karst and man, Proceedings of the International Symposium on Human Influence in Karst. Ljubljana.
- Hrvatin, M., Perko, D., Komac, B., Zorn, M. 2006: Slovenia. Soil Erosion in Europe. Chichester. DOI: https://doi.org/10.1002/0470859202.ch25
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- Zorn, M., Komac, B. 2013: Land degradation. Encyclopedia of Natural Hazards. Dordrecht. DOI: https://doi.org/10.1007/978-1-4020-4399-4_207

3.4 Citing expert reports, theses, and dissertations

- Breg Valjavec, M. 2012: Geoinformatic methods for the detection of former waste disposal sites in karstic and nonkarstic regions (case study of dolines and gravel pits). Ph.D. thesis, University of Nova Gorica. Nova Gorica.
- Holmes, R. L., Adams, R. K., Fritts, H. C. 1986: Tree-ring chronologies of North America: California, Eastern Oregon and Northern Great Basin with procedures used in the chronology development work including user manual for computer program COFECHA and ARSTAN. Chronology Series 6. University of Arizona, Laboratory of tree-ring research. Tucson.
- Hrvatin, M. 2016: Morfometrične značilnosti površja na različnih kamninah v Sloveniji. Ph.D. thesis, Univerza na Primorskem. Koper.
- Šifrer, M. 1997: Površje v Sloveniji. Elaborat, Geografski inštitut Antona Melika ZRC SAZU. Ljubljana.

3.5 Citing online material with authors and titles

- Bender, O., Borsdorf, A., Heinrich, K. 2010: The interactive alpine information system GALPIS. Challenges for mountain regions, Tackling complexity. Internet: http://www.mountainresearch.at/images/Publikationen/Sonderband/bender-borsdorf-heinrich.pdf (4. 8. 2014).

3.6 Citing online material without authors

- Internet: http://giam.zrc-sazu.si (18. 11. 2016).
- Internet 1: http://giam.zrc-sazu.si/ (22. 7. 2012).
- Internet 2: http://ags.zrc-sazu.si (23. 7. 2012).

3.7 Citing sources without authors

- Popis prebivalstva, gospodinjstev, stanovanj in kmečkih gospodarstev v Republiki Sloveniji, 1991 – končni podatki. Zavod Republike Slovenije za statistiko. Ljubljana, 1993.
- WCED – World commission on environmental and development: Our common future – Brundtland report. Oxford, 1987.

3.8 Citing cartographic sources

- Buser, S. 1986: Osnovna geološka karta SFRJ 1 : 100.000, list Tolmin in Videm (Udine). Savezni geološki zavod. Beograd.
- 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. Arhiv Republike Slovenije. Ljubljana, 1823–1869.
- The vegetation map of forest communities of Slovenia 1 : 400,000. Biološki inštitut Jovana Hadžija ZRC SAZU. Ljubljana, 2002.

3.9 Citing official gazettes

- 1999/847/EC: Council Decision of 9 December 1999 establishing a Community action programme in the field of civil protection. Official Journal 327, 21. 12. 1999.
- 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.

3.10 In-text citations

Please ensure that every reference cited in the text is also in the reference list (and vice versa). In-text citations should state the last name of the author(s) and the year, separate individual citations with semicolons, order the quotes according to year, and separate the page information from the name of the author(s) and year information with a comma; for example: (Melik 1955), (Melik, Ilešič and Vrišer 1963; Kokole 1974, 7–8; Gams 1982a; Gams 1982b).

For sources with more than three authors, list only the first followed by *et al.*: (Melik et al. 1956). Cite page numbers only for direct citations: Perko (2016, 25) states: »Hotspots are …« To cite online material with authors, cite the name: (Zorn 2010). To cite online material without authors, cite only Internet followed by a number: (Internet 2).

3.11 Works cited list

Arrange references alphabetically and then chronologically if necessary. Identify more than one reference by the same author(s) in the same year with the letters *a*, *b*, *c*, etc., after the year of publication: (1999a, 1999b). Use this format for indirect citations: (Gunn 2002, cited in Matei et al. 2014).

Include the Digital Object Identifier (DOI) in the reference if available. Format the DOI as follows: https://doi.org/… (for example: https://doi.org/10.3986/AGS.1812).

4 Tables and figures

Number all tables in the paper uniformly with their own titles. The number and the text are separated by a colon, and the caption ends with a period. Example:

Table 1: Number of inhabitants of Ljubljana.
Table 2: Changes in average air temperature in Ljubljana (Velkavrh 2009).

Tables should contain no formatting and should not be too large; it is recommended that tables not exceed one page.

Upload figures to the OJS as separate supplementary files in digital form. If the graphic supplements prepared cannot be uploaded using these programs, consult the editorial board in advance.

Number all figures (maps, graphs, photographs) in the paper uniformly with their own titles. Example:

Figure 1: Location of measurement points along the glacier.

All graphic materials must be adapted to the journal's format. Illustrations should be exactly 134 mm wide (one page) or 64 mm wide (half page, one column), and the height limit is 200 mm.

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Maps should be made in digital vector form with *Corel Draw, Adobe Illustrator*, or a similar program, especially if they contain text. They can exceptionally be produced in digital raster form with at least 300 dpi resolution, preferably in TIFF or JPG format. For maps made with *CorelDraw* or *Adobe Illustrator*, two separate files should be prepared; the original file (.cdr or .ai format) and an image file (.jpg format).

For maps made with *ArcGIS* with raster layers used next to vector layers (e.g., .tif of relief, airborne or satellite image), three files should be submitted: the first with a vector image without transparency together with a legend and colophon (export in .ai format), the second with a raster background (export in .tif format), and the third with all of the content (vector and raster elements) together showing the final version of the map (export in .jpg format).

Do not print titles on maps; they should appear in a caption.

Save colors in CMYK, not in RGB or other formats.

Use Times New Roman for the legend (size 8) and colophon (size 6). List the author(s), scale, source, and copyright in the colophon. Write the colophon in English (and Slovenian, if applicable). Example:

Scale: 1 : 1,000,000
Content by: Drago Perko
Map by: Jerneja Fridl
Source: Statistical Office of the Republic of Slovenia, 2002
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Graphs should be made in digital form using *Excel* on separate sheets and accompanied by data.

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As part of the submission process, check your submission's compliance with the following items. Submissions may be returned to author(s) that do not follow these guidelines.

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ACTA GEOGRAPHICA SLOVENICA EDITORIAL REVIEW FORM

Acta geographica Slovenica editorial review form

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(The paper is an original and the first presentation of research results with the focus on methods, theoretical aspects or a case study.)*

Yes No

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3 The paper's content is suitable for reviewing in the AGS journal.
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Yes, the author cited previously published papers on a similar topic.

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7 Is the language of the paper appropriate and understandable?*

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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.

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JOURNAL HISTORY

Acta geographica Slovenica (print version: ISSN: 1581-6613, digital version: ISSN: 1581-8314) was founded in 1952. It was originally named *Geografski zbornik / Acta geographica* (ISSN 0373-4498). Altogether 42 volumes were published. In 2002 *Geographica Slovenica* (ISSN 0351-1731, founded in 1971, 35 volumes) was merged with the journal.

Since 2003 (from volume 43 onward) the name of the joint journal has been *Acta geographica Slovenica*. The journal continues the numbering system of the journal *Geografski zbornik / Acta geographica*.

Those interested in the history of the journal are invited to read the paper »The History of *Acta geographica Slovenica* in volume 50-1.«

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