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Public knowledge on karst and protected areas: A case study of Tara National Park, Serbia

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Abstract

The aim of this paper is to present the results of our research on the knowledge and awareness of visitors and residents about karst and protected areas (PAs). The research was carried out in the Tara National Park (NP) in western Serbia, which includes karst landscapes. By conducting surveys with visitors, local population, and National Park employees, as well as interviews with local key persons, NP key persons and external experts, we got a deeper understanding of the issues related to knowledge on karst and PAs. We also investigated whether local people or visitors knew the values of karst landscapes in general and how they were informed or learned about the Tara NP. In addition, we also analysed the content of these topics in school curricula and textbooks in Serbia. We concluded that the awareness about the researched topics is unsatisfactory at present thus it should be raised to a higher level, both in the case of local people and in the case of visitors. One of the most significant ways to improve the current level is through formal, non-formal, and informal education.

Keywords: karst, protected areas, knowledge, education, questionnaire, Tara National Park, Serbia

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Introduction

Karst areas are usually considered to have harsh living conditions due to scarcity of arable land, low level of terrain possibility, general lack of surface waters, and uneven spatial and temporal availability of groundwaters (Cvijić, J. 1925). For all these reasons, population density is relatively low and depopulation processes are intensive on karsts of almost the whole Europe (Habič, P. 1993; Ciglič, R. *et al*. 2012; Telbisz, T. *et al*. 2015, 2019, 2020; Lukić-Tanović, M. *et al*. 2019) as well as in Asia (e.g. Han, Z. and Song, W. 2019, 2020). However, for prehistoric people karst caves were significant shelters or temporary habitats and sacred locations, which altogether subsequently provided priceless data on human evolution to the present scientists (e.g. Mihailović, D. *et al*. 2022). Historically, many karst areas, as being relatively isolated from major communication directions, had been inhabited as people's refuges from conquerors (De Waele, J. 2009; Day, M. 2010). In former communist countries, in times of forced industrialisation, emigration from villages had a particularly high extent in karst (Cocean, P. 2001). In recent times,

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karst depopulation generally continues, but there are also several opposite examples – scarce and therefore worth mentioning, such as in the Moravian Karst in the Czech Republic (Vaishar, A. *et al*. 2018). However, in developing countries, especially in Asia, population growth poses certain risks on karst areas (Tuyet, D. 2001; Wang, L.C. *et al.* 2004). People who live on karst are usually aware of both its advantages and limitations – their main resource is knowledge on their environment.

On the other hand, the general global population increase has led to the overuse of natural resources, making them endangered and triggering the need for their protection (Eagles, P.F.J. and McCool, S.F. 2002). At the same time, the importance of the human dimension of conservation is emphasised, in order to create productive policies and achieve effective results and actions (Gössling, S. 2002; Sandbrook, C. *et al.* 2013; Bennett, N.J. *et al.* 2017). Necessary legal instruments are being enacted, defining the criteria and categories of PAs. The sensitivity of karst is very high in terms of possible groundwater pollution. The capacity of self-purification of this system is extremely low. This requires high ecological awareness and strict protection rules. To be protected, an area needs to be studied in detail by scientists and nature conservation professionals. In other words, it is the knowledge that triggers the actions and increases the awareness of the significance of these areas. Subsequently, this leads us to evaluate the role of education in understanding our environment *(Figure 1).* The loop of knowledge indicates that the process continues.

The importance of knowledge and education process was considered by many experts in different fields of science and from numerous aspects. The key role of formal education in relation to other forms of education (non-formal and informal) in the context of natural disasters was pointed out by many authors (Wisner, B. 2006; Komac, B. *et al*. 2010; Ćalić, J. *et al*. 2015). All the arguments in favour of formal education discussed in the mentioned papers are valid in general (majority of the

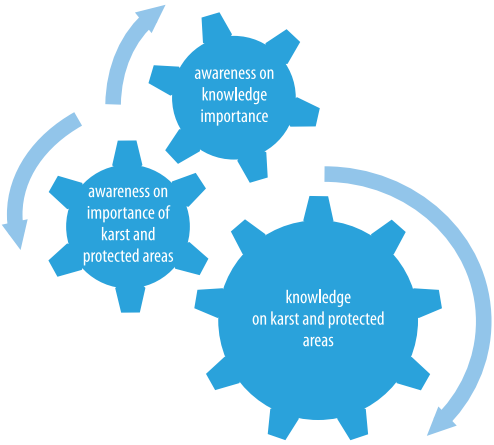

Fig. 1. The driving mechanism of knowledge related to karst and protected areas

population acquire this type of education, it is the easiest way to organise knowledge transfer, the learning process requires sufficient time, the content is reliable). The important place and role of other forms of education is not disputable. There are examples that the efforts related to the education of the visitors of the PAs effectively alter visitors' behaviour in a positive direction (Marion, J.L. and Reid, S.E. 2007).

In the system presented in *Figure 2*, relations between the selected components are

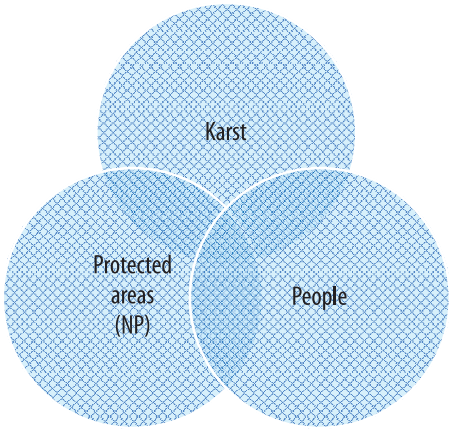

Fig. 2. Selected components of the nature-human system

complex and can be observed from many aspects. In this paper, we deal only with a part of these relations in the context of the process presented in *Figure 1*.

The NKFIH project K124497 deals exactly with karst areas which are under protection. The aim of the project is to identify and analyse national parks (NPs), while the main aim of this paper is to show the high significance of public knowledge about these areas. The case study used in this paper for the analysis was Tara National Park in western Serbia, covering an area of 250 km², out of which approximately 53 percent is karstic, developed on pure Triassic limestone *(Figure 3)*. The mountainous area is mostly forested, has high biodiversity, but is also rich in geological values (gorges, cliffs, dolines, etc.). We also note that the natural conditions are modified by the Drina-Lim hydropower plant, which is located just next to the NP boundary and is in close hydrological relation with the area of the NP. It is the most important economic stronghold of the area, but the large water reservoir, which stretches into the Drina river canyon also plays a significant role in tourism as well.

Our research includes the following modules: (1) degree of public knowledge on karst and PAs among the local population, NP visitors, NP key persons, NP employees, local key persons, and external experts; and (2) official educational Curricula contents related to karst and PAs.

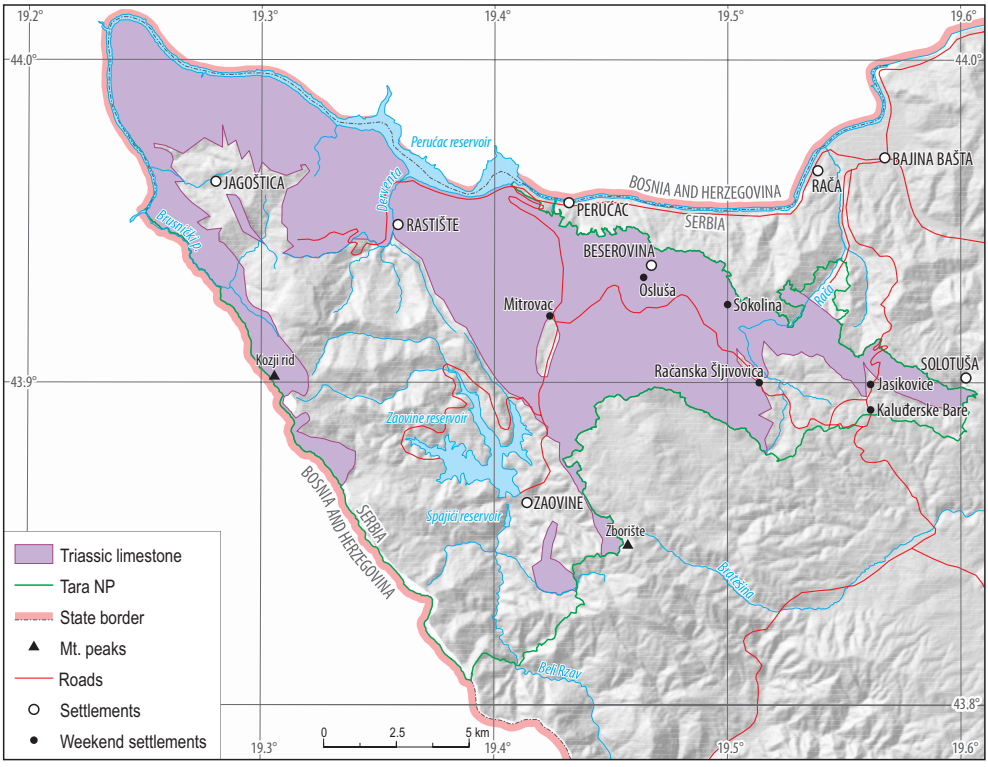

Fig. 3. Karstic areas in the area of the Tara National Park

Methodology

Data and participants

The level of the knowledge on karst and PAs is examined within the survey of 433 participants who were classified into several groups (local population 197, visitors 208, NP employees 28), as well as through interviews conducted with 20 respondents (NP key persons 5, local key persons 10, external experts 5). The sample of local population in relation to the total population number in the Tara NP is hard to estimate since the data on population is published on the level of settlements. There are ten settlements which are totally or partly within the Tara NP borders with 3,630 residents (Population Census, 2011). The real number is smaller, so we assume that we have a sample of 7–10 percent. As reported by the Head of the NP Sector of Presentation and Tourism Information in Tara NP, the number of registered visitors varies between 70,000 and 80,000 a year, and it encompasses those staying in the hotels on the Tara Mt. and the hotels in Bajina Bašta and without those who use private accommodation. As for the locals and visitors, the same sample of participants was used as in the paper of Telbisz, T. *et al*. (2021), given that its size is considered sufficient for the application of different statistical techniques (Pallant, J. 2010).

We applied a broad range of modes in the survey procedures, such as self-administrated questionnaire filling (locals at their homes, visitors in visitor centres, and NP employees in the building of the Public Enterprise (PE) Tara NP), face-to-face questioning (locals at their homes), and online surveys set on the Tara NP website, and also sent to appropriate organisations, institutions, and personal contacts (visitors). The surveys were completely anonymous. The questionnaires comprised open-ended and close-ended questions with multiple-choice answers. The questions were grouped into three segments related to: (a) knowledge on karst, (b) PAs, and (c) the importance of knowledge and education. Each group of respondents, including those interviewed, was asked about these mentioned issues. Interviews with NP key persons were done in the building of the PE Tara NP and with the local key persons and external experts in their offices. In this paper, we have analysed only selected questions and answers related to our topic. They are presented in *Table 1.*

In terms of missing data, only a small number of respondents chose not to answer certain questions. In the tourist group the mean value of missing data was 1.9 percent with a maximum of 7.7 percent in the case of the question on the meaning of the word "karst". In the NP employees group, the mean value of missing data was 5.0 percent with a maximum of 7.1 percent (i.e. 2 of 28 answers).

Curricula and school textbooks analyses were a way to determine whether there is enough content about karst and PAs and whether that content has the appropriate quality and is purposeful (Regulations on the Plans and Curricula, 2018–2021).

Research procedure

After data collection, we examined whether there was a problem in the education system and we proposed measures to solve the existing problems. The conceptual framework and methodological procedure of the research are presented in *Figure 4.*

The descriptive statistics and bivariate analysis (t-tests and ANOVA) were performed using SPSS 20.0 for Windows to recognise factors that affect the particular outcome. In the case when the type of data did not meet the assumptions on which the classic ANOVA is based, Welch's ANOVA was used instead. The interpretation of the effect size was made according to Cohen, J.W. (1988).

Results and discussion

Demographic characteristics

The demographic characteristics of the respondents show that the gender structure

*Table 1. Selected questions and answers related to the current analysis, thematically grouped**

	Questions	L	V	NP e	L kp	NP kp	E
Karst	Do you know the meaning of the word „karst"(„krš", „kras")?		+				
	What do you think the values of this landscape are? (analysed answers: viewpoints, cliffs)		+	+	+	+	+
	Did you visit some viewpoints?		+		+	+	+
	Why did you personally choose this site? (analysed answer: to visit viewpoints)		+				
Protected areas	What is the level of nature protection of the area?	+					
	Was it important to you that Tara is a National Park? (analysed answers: not at all / slightly / yes, very important)		+				
	Are there any advantages thanks to the national park for local people? If yes, what are these advantages?	+			+	+	+
	Are there any drawbacks (restrictions) due to the Tara National Park for local people? If yes, what are these restrictions?	+			+	+	+
	Was there any economic change due to the declaration of Tara National Park?	+			+	+	+
	Do you think of Tara National Park as a part of our national heritage that we can be proud of?	+		+	+	+	+
Importance of knowledge and education	How did you get information about Tara National Park? (analysed answers: school studies / books)?		+				
	If there are children in the family: do they „meet" the national park by school programs?	+					
	How much are you satisfied with the following possibilities on Tara? (analysed answers: visitor information, inscriptions, sights, brochures)		+				
	How much are educational trails important to you? (analysed answers: not at all / slightly / yes, very important)		+		+	+	+
	What kind of tourist development would you think important for Tara NP? (analysed answers: creation of new education trails and tourist paths, building of new viewpoints)		+		+	+	+
	According to you, how important should the following tasks be in the Tara NP? (1-5 scale; 1 = not important; 5 = the most important) (analysed answers: preservation of the geological values: viewpoints, cliffs; scientific research; education)	+	+	+	+	+	+

*Except from the full questionnaire list. *Codes:* L = survey with the local population; V = survey with visitors; NP e = survey with NP employees; L kp = interviews with local key persons; NP kp = interviews with NP key persons; E = interviews with external experts.

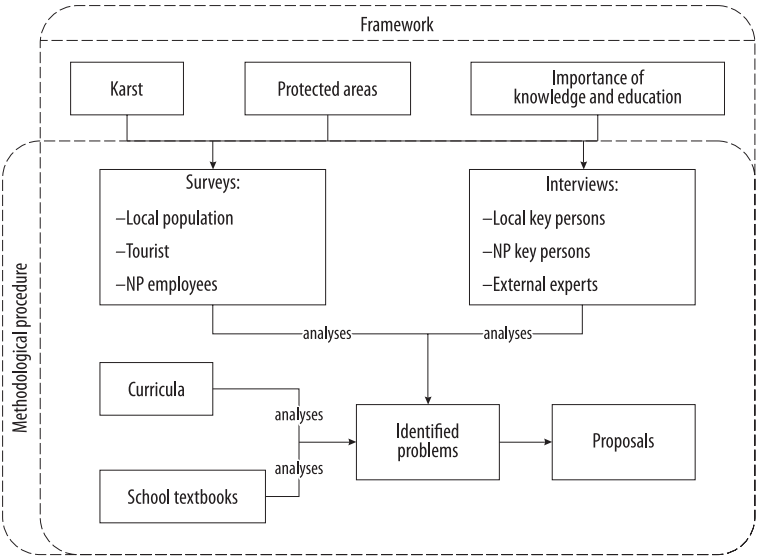

Fig. 4. Conceptual framework and methodological procedure

is balanced; respondents were 14 years and above, while the age structure is normally distributed with the most frequent age group of 31–50. Considering the education level, among the local population, participants with secondary school predominate, while among visitors, NP employees, local key persons, NP key persons, and external experts those with higher education predominate.

All of the local people reported live in the settlements of Bajina Bašta and Užice municipality. Tara NP extends on the area of these two municipalities. NP employees and key persons, as well as local key persons reported in this survey, reside exclusively in the settlements of Bajna Bašta municipality. The majority of visitors are from Serbia (93.0%), while foreigners (3.5%) came from Croatia, Russia, and North America, and 3.5 percent of the respondents did not provide that information. Considering visitors from Serbia, half of them are from Belgrade (the capital), 10.0 percent are residents from the municipalities of Bajina Bašta and Užice, while the rest (one-third of the respondents) are from the other parts of Serbia.

Knowledge on karst

This issue was examined by asking the visitors several questions. First, the meaning of the words "karst", "krš" or "kras" was asked. These are the various terms used in Serbia for the same phenomenon. The results show that almost 70 percent of respondents answered that they knew the meaning of that word, but analysing the related open-ended answers, it is concluded that about 40 percent of the respondents gave a very general answer, and a quarter of them gave a partly correct answer, another quarter gave a largely correct description, and only 10 percent of them gave the perfect answer (for details, see Telbisz, T. *et al*. 2021). Although the local people was not asked about karst terminology, the external expert who is a retired scientific researcher in geography, told an interesting story about how well the local people know the area they live in. Namely, there is a saying among the villagers that cattle are grazed on "white stone" (limestone), but watered on "black stone" (serpentinite and diabase). It clearly demonstrates that although local peo-

ple do not necessarily know how limestone is dissolved, but they do know that streams flow only on the black rocks. This example indicates that functional knowledge is important. Another question for visitors and NP employees was if they see viewpoints and cliffs as the values of the landscape. In *Figure 5*, it can be seen that a pretty large number of visitors (76.4% of them) see viewpoints as a value, and 43.8 percent see cliffs as a value of this landscape. NP employees (82.0%) also marked viewpoints as a value and 43.0 percent of them also see cliffs as a value. In addition, respondents were asked if they visited viewpoints during their staying in Tara NP. 82.3 percent of visitors and 100 percent of NP key persons, local key persons and experts answered positively, while one-third of visitors chose Tara to visit viewpoints.

As for the geological values, the external experts confirmed in the interviews that karsts were "useful" terrains during wars because caves, gorges and canyons were suitable for hiding. They also agreed that such terrains are harsh for life and that depopulation is an inevitable process today. On the contrary, there are nature-lovers who promote sustainable development and life on the karst. These opinions are often related to hiking, which is in turn supported by projects such as "Via Dinarica" (www.viadinarica.com).

In the questionnaires, all of the respondents were asked to rate the importance of the preservation of the geological values

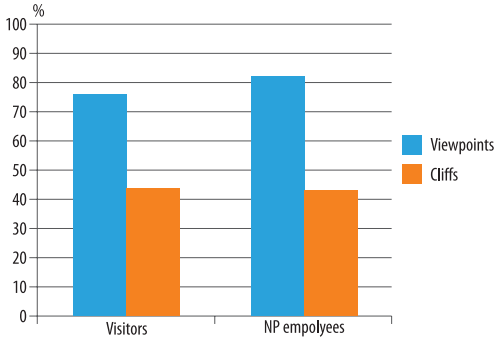

Fig. 5. Viewpoints and cliffs as a value of landscape in Tara National Park

(viewpoints, cliffs) on a 5-point Likert-type rating scale (1 = 'not important at all', 2 = 'not important', 3 = 'neutral', 4 = 'important', 5 = 'most important'). In each group of respondents, the geological values were rated as 'most important' with the highest frequency, which means that people in each group are aware of the geological values and see them as an important task in the Tara NP management. In order to illustrate the different perceptions of biological and geological values, the president of the "Tara" Mountain Club pointed out that although the bear is an excellent trademark for Tara NP, it is also a problem in certain situations because bears sometimes cause damage, while the viewpoints "do not ask for anything". He also outlined that the small rock protruding from the Drina River with the hut on it, captured and made famous as a National Geographic photo, is also a geological value.

Welch's ANOVA was used to compare the average results of the observed attitudes in specific independent categories of respondents. Statistically significant differences in attitudes about the preservation of geological values were identified among investigated groups, with a small effect size registered. Post hoc procedure, using the Games-Howell test, revealed differences in the opinions of visitors and the local population, with the former valuing the priorities of the NP significantly higher than the latter *(Table 2).*

We also examined the influence of socio-demographic factors on the respondents' opinions. The total sample was subject to t-tests and one-way analysis of variance (ANOVA) in order to examine the relationship between socio-demographic variables (gender, age, education) and the opinion on development priorities of NP in the future.

In the case of gender and age, no statistically significant differences in attitudes were found among members of different groups. However, when it comes to the level of education, the series of t-tests confirmed that those with a higher level of education consider the protection of geological values more important compared to the respondents with

*Table 2. Differences in the attitudes on the importance of the preservation of the geological values**

Variables		Average value	Values	Significance (p)	Effect size (est. ω^2)
Group of respondents	Visitors	4.68	F-value 3.68	0.018	0.03
	Local population	4.34			
	NP employees	4.62			
	NP key persons	4.80			
	Local key persons	4.44			
	External experts	4.60			
Level of education	Primary/secondary	4.35	t-value -3.18	0.002	0.02
	Higher education	4.62			

*Importance values on a 5-point Likert-type rating scale. p = probability of occurrence ($p < 0.05$)

a lower level of education. However, the obtained effect size is small.

Analysing the Plans and Curricula for the primary and secondary schools, we found that in the primary school, which lasts eight years in Serbia (ages 7–15), through the subject of geography, the pupils learn about karst and the relief of the Earth within two topics: in "Relief formation by water" (dissolving rocks) and "Man and relief" (positive and negative influences) during the fifth year. Later in the seventh and eighth years, they learn about karst areas on the examples of regional and national geography. In secondary schools, there are the same topics and pupils expand their knowledge on karst landforms. In the first year of the gymnasium there is a topic on the geomorphological and hydrological characteristics of karst, while in the third year, national karst areas are presented. In vocational secondary schools, pupils learn national geography only in the first year.

The content of the Geography textbooks is determined by the Curricula. In Geography textbooks, considering a relatively large number of publishers and authors, the karst topic is treated at very different detail levels. Thus, as for the many other subjects, the role of the teacher is crucial (Kovačević-Majkić, J. *et al.* 2014; Ćalić, J. *et al*. 2015). The formal handicap of geography teaching is that there is only one class per week in the 5th year of primary school.

We conclude that even if the topic of karst is represented in curricula, the visitors' knowledge on karst is unsatisfactory. Since the visitors are mostly from Serbia, they studied according to the mentioned Plans and Curricula. On the other hand, the knowledge of the local population is functional because it is based on both education and experience. The solution may be to improve teaching in terms of enhanced practical learning for those who do not live on karst terrains and also more classes to learn about karst because the process of learning implies iterations. An example of the non-formal education on karst is the brochure published within the initiative International Year of Caves and Karst – Serbia (Ćalić, J. 2021). In the centre of Tara NP at Mitrovac, there is one of the most visited resorts for school children that is suitable for education in the nature. In addition, the NP also organises the *Junior Ranger Camp*, where children can get to know the life in the NP, which is the best way to learn.

Knowledge on protected areas

The local people were asked about the level of nature protection of the area they live in. We expected a large number of answers to be correct, which was justified because almost 92 percent of respondents answered that they knew that it is a NP. Eight percent of respondents gave an incorrect answer, including three people with higher education. Since the Tara NP was proclaimed in 1981, it was not expected that they do not know that fact.

The local people were asked to comment on the advantages and drawbacks related to the NP. The numbers of those who see advantages and those who do not see advantages are almost equal (47% versus 53%, respectively). Of those who see advantages, only 6 percent answered this way because they consider the protection of nature as an advantage. Such a small percentage indicates that there is a low level of awareness about the importance of nature protection. The majority of the local population considers tourism development as the main advantage related to the NP, but this topic is discussed in a different paper. When it comes to drawbacks, almost 2/3 of respondents do not see them, and 1/3 mostly state different types of restrictions as drawbacks. One answer in a negative context was *"everything is protected"*. In addition, one-third of the local population feels that there has been an economic change due to the declaration of the NP, but they mentioned it both positively and negatively. Only one answer emphasised the fact that the area of forests has enlarged since the foundation of the NP.

All respondents except visitors were asked whether it is important for them *that "the NP is part of our national heritage and we can be proud of it"*. Of the local population 58 percent answered *"yes"*, 32 percent answered *"partially"* and 10 percent answered *"no"*. This can be partly explained by the fact that there is an opinion among some locals that the establishment and existence of NP Tara do not have any essential influence on the life of the local population. This is in accordance with the previously mentioned fact that 53 percent of locals do not see any advantages of the NP. The process of depopulation and the decrease of agricultural activities and grazing would happen even if the NP were not there. Details on stakeholders' attitudes toward Tara NP were elaborated by Brankov, J. *et al*. (2022). Of NP employees, 89 percent responded positively, 11 percent answered *"partially"*, and none responded negatively. Among the interviewees each person spoke positively, which can be explained by their higher education and subsequently higher awareness on the importance of nature protection *(Figure 6)*. Head of the Sector of Planning, Design, Protection, and Arrangement in Tara NP, reminded that one of the most successful telecommunication companies in Serbia is successfully conducting an advertising campaign using the name of the Serbian spruce (*Picea Omorika*) for one of its service packages. This example demonstrates that *Omorika* is related to positive attitudes, thus, it is used for marketing (within the "business sphere"). Another positive example was mentioned by the Assistant Director for the General and Legal Affairs in Tara NP, who points out that on the billboards at the border crossings to

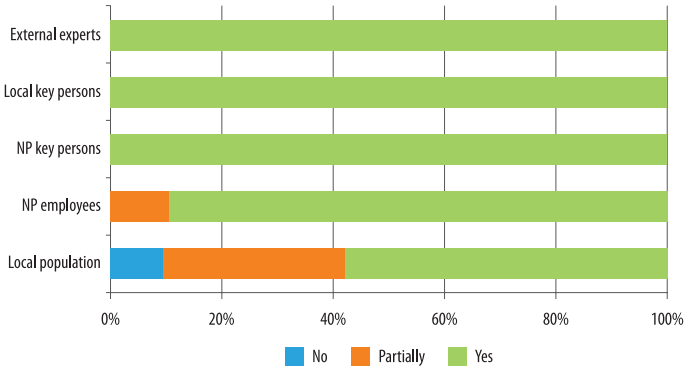

Fig. 6. The respondents' answers to the question "Do you think of NP as a part of our national heritage that we can be proud of?"

Serbia is a photograph of the Banjska Stena, the most popular viewpoint of Tara NP. This example presents a case, when a viewpoint image is used to market "itself", also to suggest a positive country image.

Visitors were asked if it is important to them that Tara is a NP. We used three-point response format (1 = 'not at all', 2 = 'slightly', 3 = 'yes, very important'). Among the respondents, 43 percent answered that is important for them that Tara is a NP, 39 percent were neutral, and 18 percent responded that for them, the protected status of the area is not important at all. Nonetheless, a relatively small number of positive answers does not necessarily mean that the protection of the landscape is not important for the respondent, but it may also mean that it is not crucial when it comes to motivations for travel. On the other hand, the interviewees, although mostly consider tourism as a desirable branch of the economy that needs to be developed, also mentioned that a large number of visitors leads to increased waste and greater pollution, higher water consumption, and so on.

Considering nature protection, there is a further conflict when it comes to building facilities. Many respondents are aware of the problem of illegal construction. The necessity of cooperation in the field of nature protection is confirmed by the example of Tara NP. For example, waste disposal is an issue that several institutions are dealing with (the municipality, the NP, and the Drina-Lim hydropower plant). Interviewees from the hydropower plant stated that their institution takes out the garbage two times a week in the tourist season and once a week out of season from certain settlements (Mitrovac, Zaovine, and Perućac). That is 50–60 m^3 of garbage per tour. They also give money for floating waste removal (plastic bottles, other plastic waste, stumps, and branches) from the Drina reservoirs. They constructed a chain system, which removes 8–10 x 10^3 m^3 of waste per year. The waste is transported to a landfill, whereas the stumps and branches are used for pellet production. The hydropower plant also performs anti-erosion works (there are gabion dams that retain erosion material).

As for schools, PAs are included in the curricula within several subjects in primary and secondary schools. An overview of the subject and related topics, which is taught in the upper years of primary school and in secondary school, is presented in *Table 3*. Besides the content presented in *Table 3*, in the lower years of primary school within the subjects

*Table 3. Content related to PAs in Plans and Curricula of primary and secondary schools**

	Subjects	Topics
Primary school	Geography	Biogeography (vulnerability and protection of the species) Natural and cultural heritage Economy (the concept of sustainable development) National geography (examples from Serbia)
	Biology	Life in the ecosystem (the protection of species and environment, endangered species, sustainable development, rare and endangered species in Serbia)
	Nature keepers	"Let's help them to survive" (endangered species) "I save the nature" (natural resources, protected natural values)
	Let's save our planet	Biodiversity and geodiversity (nature protection and PAs)
Secondary school	Biology	Ecological and environmental aspect appears in many topics
	Geography	Biosphere (biodiversity protection) Geoheritage (geoheritage protection, spatial aspect – PAs in Serbia)
	Education for sustainable development	Laws and standards on sustainable development

*After Regulations on the Plans and Curricula in the reference list.

World around us and *Nature and society*, children are also able to develop knowledge and awareness on environmental protection and human-nature relations.

It can be seen that there are horizontal connections between the subjects. Vertical connections are temporal and imply the connection within one subject and through all years.

The contents of the textbooks related to PAs follow the Curricula, but differences depend on the publisher and the authors. It is concluded that relative to the topic of karst, the topic of PAs is more represented.

We can conclude that although the issue of PAs is present in Curricula and school textbooks, the survey results show that the local population has only a partially affirmative attitude towards the Tara NP. Of all the respondent groups, local residents have the most negative and the least number of positive answers to the question related to "Tara NP as part of our national heritage". However, it is difficult to conclude how much the local people care about nature protection. That is a sensitive issue, and certainly, the problems and conflicts that exist between the local population and the NP should be approached carefully because they are also widespread in other types of PAs in Serbia (Jojić Glavonjić, T. *et al*. 2021). Improving attitudes towards nature protection is a process that involves the cooperation of all stakeholders in the area.

The importance of knowledge and education

It is an issue we examined through questions on the source of knowledge and information about the NP, and through the opinion of respondents on the importance of educational trails, viewpoints, as well as research activities and education in general.

The tourist group was asked where they got information about Tara NP. Out of them, 47 percent answered *"in school"*, i.e. through formal education, and 20 percent *"from books"*. The rest stated that TV/radio, internet, and personal contacts were their main source of information *(Figure 7,* a*)*. In order to assess the importance of formal education for PAs, we asked the local population whether their children got to know the NP through school programs. 52 percent gave a positive answer, 36 percent a negative answer, and 12 percent left this question without an answer *(Figure 7,* b*)*. This example also

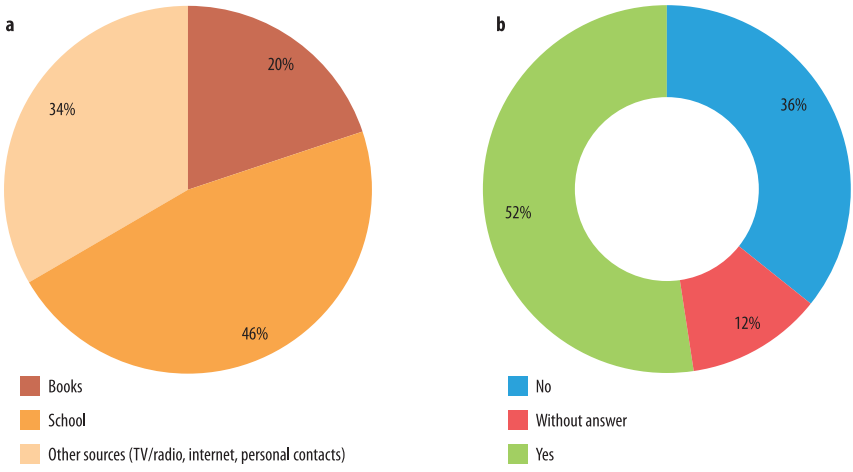

Fig. 7. Sources of information about Tara NP for visitors (a), and answers by the local population to the question "If there are children in the family: Do they »meet« the NP by school programs?" (b)

shows that to the topic of nature protection is less significant for the local population.

Considering the opinion about the importance of educational trails, 58 percent of visitors rated them as *"very important"* and 40 percent as *"slightly important"*. In another question related to satisfaction with tourist information, about 70 percent stated they were *"satisfied"* or *"perfectly satisfied"*. Furthermore, the majority of visitors would support the development of new educational trails (88%) and viewpoints (82%). These opinions match with the aims of the NP authorities, who, with the "Tara" Mountain Club arranged and marked 290 km of walking trails in the recent years (President of the "Tara" Mountain Club and Head of the NP Sector of Presentation and Tourism Information in Tara NP). Keeping in mind the above-mentioned difficulties of life on karst and depopulation, the maintenance of these trails is a more serious challenge than their creation. This is confirmed by the example of the path leading towards the Lađevac spring from the Rača Monastery that is endangered by a landslide, as reported by the Prior of the Rača Monastery and the Head of the NP Sector of Presentation and Tourism Information in Tara NP.

A high percent of affirmative attitudes towards education trails and visitor information indicate that there is a good basis for improving knowledge on karst and nature protection. As most of the respondents are adults who are no longer involved in school education, the solution for increasing knowledge is in non-formal and informal education. In fact, the educational activities offered by Tara NP are comprehensive. Education trails and exhibitions in visitor centres are the dominant informative and interpretation tools (techniques) in a sense set by Puczkó, L. and Rátz, T. (2000). As Tara NP was previously oriented to biodiversity protection, the content of educational trails and exhibitions mainly present biology-related information, but there are also parts with geo contents. Writing about geotourism as a new aspect of tourism on Tara Mountain, Banjac, N. and Rundić, Lj. (2006) pointed out that geotouristic paths are one of the directions in which geotourism can be developed. They also proposed a first potential geotouristic path. In Telbisz, T. *et al*. (2021), new thematic educational paths for Tara NP are also suggested *(Photo 1)*.

The PE NP specifies the set of goals and leads the protection and development program of the NP through various activities

Photo 1. Examples of the visitors' information: info-board along an education path (left), visitor`s centre in Bajina Bašta (right). (Photos taken by the authors.)

defined by the Law on NP (Law on National Parks, 2015, 2018), such as the implementation of protection zones, management of forests, hunting and fishing, the controlling of the construction works (by permits), monitoring of flora and fauna, the promotion of the NP and its resources. One set of activities refers to the interaction with the local population, education and conducting scientific research and participation in international projects. In this regard, all of the respondents were asked to rate the importance of scientific research and education *(Figure 8).* We used a five-point Likert-type rating scale from 1 = 'not important at all', to 5 = 'most important'. In each group of respondents, education was rated as *"most important (5)"* with the highest frequency, but considering the scientific research, the exception was the group of the local population where the answer *"important (4)"* predominated (last row in *Figure 8* – local people *L-Sci*).

Like in the case of geological values, Welch's ANOVA was used to compare the average results of the observed attitudes on the importance of scientific research *(Table 4)* and education *(Table 5)* among specific independent categories of respondents. In both cases, statistically significant differences between the examined groups were confirmed, with a small effect size for the education variable and medium effect size for the scientific research variable. The post hoc procedure confirmed that the opinions of visitors and the local population differ significantly on the importance of scientific research and that the visitors attribute higher priority to scientific research than local residents (see *Table 4*). When it comes to the importance of education, it was found that local key persons value this priority much higher than the members of the local population (see *Table 5*).

Regarding the influence of socio-demographic factors on the opinions of the respondents, neither gender nor age proved to be a predictor of the opinions in any of these two analysed priorities. In contrast, the level of education proved to be a significant predictor of attitudes on the importance of scientific research, with the series of t-tests confirming that those with a higher level of education gave higher marks to this priority compared to the respondents with a lower level of education. The calculated effect size is small (see *Table 4*). No statistical significance was found between the level of education of the respondents and the opinion on the importance of education as a priority.

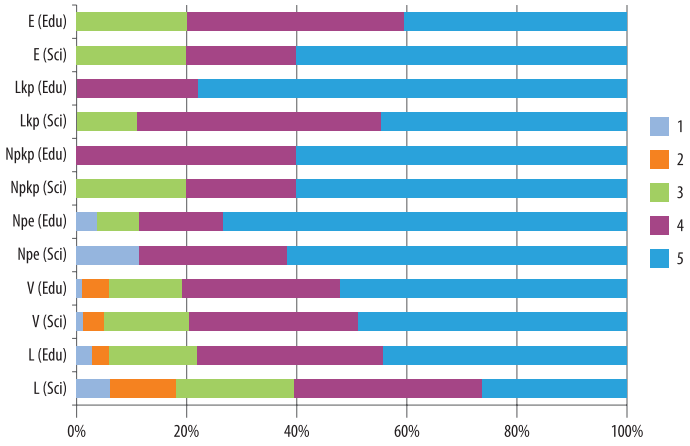

Fig. 8. Evaluation of the importance of scientific research (Sci) and education (Edu) as a NP task by local people (L), visitors (V), NP employees (NP e), local key persons (L kp), NP key persons (NP kp), and external experts (E). 1 = not important at all, 5 = most important.

*Table 4. Differences in the attitudes on the importance of the scientific research**

Variables		Average value	Values	Significance (p)	Effect size (est. ω^2)
Group of respondents	Visitors	4.22	F-value 6.28	0.001	0.06
	Local population	3.62			
	NP employees	4.27			
	NP key persons	4.40			
	Local key persons	4.33			
	External experts	4.40			
Level of education	Primary/secondary	3.78	t-value -2.68	0.008	0.02
	Higher education	4.07			

*Importance values on a 5-point Likert-type rating scale. p = probability of occurrence ($p < 0.05$)

*Table 5. Differences in attitudes on the importance of education**

Variables		Average value	F-value	Significance (p)	Effect size (est. ω^2)
Group of respondents	Visitors	4.26	3.44	0.022	0.03
	Local population	4.13			
	NP employees	4.54			
	NP key persons	4.60			
	Local key persons	4.78			
	External experts	4.20			

*Importance values on a 5-point Likert-type rating scale. p = probability of occurrence ($p < 0.05$)

Figure 9 shows a comparison of the answers of all respondents related to all priorities. It is obvious that scientific research and education are also rated as high priorities (with dominant grades 5 and 4), but in comparison to other values of the NP (such as the preservation of the biological, cultural and landscape values), scientific research and education are lower-rated.

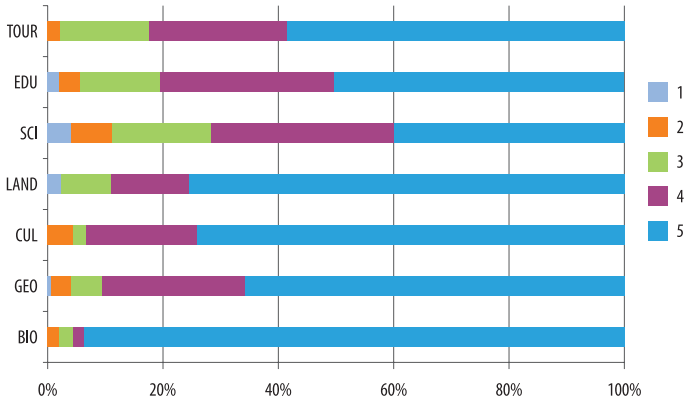

Fig. 9. Evaluation of Tara NP priorities as rated by all respondents. TOUR = tourism, EDU = education, SCI = scientific research, LAND = landscape preservation, CUL = cultural heritage preservation, GEO = geoheritage preservation, BIO = biological preservation. 1 = not important at all, 5 = most important.

Conclusions

All the presented results and facts prove that although the knowledge on karst and PAs is unsatisfactory at present, and the awareness on the importance of the karst and PAs needs to be improved, the belief in the importance of knowledge is strong enough that the process presented in *Figure 1* has a potential to move on. It is claimed that education has a key role in this process.

The results on the issues related to *knowledge on karst* show that visitors have some knowledge on recognising karst landforms, and they estimate their natural values, but it is more difficult for them to give exact definitions or to interpret the karst processes. The local residents have a certain practical knowledge, as they live on karst terrain. As for schools, the karst topic is presented in the Plans and Curricula, as well as in the textbooks, but in order to improve the level of karst knowledge, it is necessary to learn iteratively and in the field.

Considering the results related to *knowledge on PAs* we can conclude that the local people have ambivalent opinions about the importance of the NP status and experience both the advantages and drawbacks of the NP. Only a small per cent of them see the protection of nature as an advantage brought by the NP, which indicates that there is a low level of awareness about the significance of nature protection. One-third of the local people reported different types of restrictions as drawbacks. Considering the NP as a part of the national heritage, the results indicate that this attitude depends on the level of education of the respondents and that those who are highly educated have increased awareness on the importance of nature protection. All interviewees agreed that the protection of nature is important and that mutual cooperation of stakeholders is necessary. The topic of PAs is more represented in the Curricula and school textbooks than the topic of karst. The fact that the local population has only a partially affirmative attitude towards the Tara NP is not satisfactory. The problems and conflicts that exist between the local people and the NP should be approached carefully with gradually improving the attitudes and finding the common goals.

The awareness on the importance of knowledge and education is reflected in the results related to the respondents' opinion on the importance of educational trails and other visitor information. The results showed that about half of the local population remembered that they had learnt about PAs in school textbooks, and half of the visitors had got information about Tara NP during formal education. It means that there is a good basis to improve knowledge about karst and PAs through formal, but also other forms of education such as non-formal and informal education. Although scientific research and education are rated as priorities, these got lower scores in comparison to other values of the NP (the preservation of the biological, cultural, landscapes, and geological values).

This research confirmed that the process of acquiring of knowledge on karst and PAs is alive despite all the existing barriers. Thanks to the potentials of natural resources (in this case, protected karst areas) and people who live there or go for visits, there are reasons to believe that the development of knowledge will contribute to the general development of the area.

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