eco.mont

Journal on Protected Mountain Areas Research and Management

Vol. 12 No. 2 – July 2020

eco.mont – Journal on Protected Mountain Areas Research and Management
is published by Austrian Academy of Sciences Press and *innsbruck* university press

Content

Published by:

ÖAW AUSTRIAN ACADEMY OF SCIENCES

IGF

universität innsbruck

Publisher:

AUSTRIAN ACADEMY OF SCIENCES PRESS

innsbruck university press
peer reviewed

Initiated by:

ISCAR

alparc

ISSN 2073-106X print version
ISSN 2073-1558 online version: http://epub.oeaw.ac.at/eco.mont

eco.mont – Volume 12, Number 2, July 2020
ISSN 2073-106X print version – ISSN 2073-1558 online version: http://epub.oeaw.ac.at/eco.mont
https://dx.doi.org/10.1553/eco.mont-12-2s3

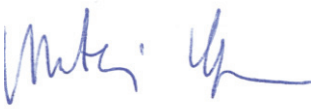
Epidemics as a challenge for managers of protected areas

I am writing this editorial during the Covid-19 pandemic, when the authorities in most countries have restricted the movement of their inhabitants. In Slovenia, people are not allowed to leave the territory of their own municipalities without good reason, but they are allowed to engage in leisure activities outdoors within the territory. With such restrictions in place, we have become especially aware of the importance of nature, and in particular of the protected areas near our homes where we can stroll and admire the spring. I am very fortunate: a walk of just 10 minutes from my home takes me to a landscape park which lies practically in the centre of the Slovenian capital. However, while enthusiastic statements about protected areas are common, some townspeople and nature conservationists tend to forget about the locals who had little opportunity to take part in decision making and for whom the protection of nature involves a restriction in their activities. In this issue of *eco.mont*, this topic is discussed in depth by Mosè Cometta in an article on the failure of the initiative to declare the Adula Park in Switzerland a national park. The park *was perceived as a project that threatened the local way of life*. A similar conflict occurred in Slovenia in 1924 at the declaration of the country's very first protected area, in the Triglav Lakes Valley, when local farmers lost their right to graze livestock there.

Three articles in this issue discuss the management of Biosphere Reserves. The article by Valerie Braun and co-authors describes how management in the Austrian BRs implements the three complementary functions: conservation, sustainable development and logistical support. Günter Köck and co-authors describe the outcome of a UNESCO-Expert meeting held in Škocjan (Slovenia) and emphasize the importance of science in underpinning the management of protected areas. In their article on the Italian Julian Alps Biosphere Reserve, Stefano Santi and co-authors state that "*The Julian Alps are characterized by three main aspects: extremely high biodiversity, an extraordinary cultural mix, and communities with a high level of resilience who, over time, have never ceased to fight proudly to preserve and protect their territory and culture.*" Estela Inés Farías-Torbidoni and Demir Barić, in *The economic impact of tourism on protected natural areas*, talk about how much revenue visitors bring in for local populations. Based on their findings, managers of protected areas will be able to direct visitors appropriately so that conservation goals and the economic expectations of local residents are met.

During the current pandemic, tourist flows have virtually stopped, and as a result protected areas have remained without visitors. As the purpose of protected areas is to preserve nature, their managers should be pleased that the degradation of nature has decreased during this period. However, they cannot fulfil their other purpose – that is, enabling people to visit and experience nature. This time without visitors can be used to think about how to organize visits as sustainably as possible, both while pandemic restriction measures are in force and after they have been lifted. As social distancing will have to be maintained for some time, some visitors may be more likely to leave the marked trails. In recent days, I have often noticed this kind of behaviour in the Ljubljana area. Vera Kopp and Joy Coppes in their article *Why do people leave marked trails?* analyse the factors that influence precisely this type of visitor behaviour. Will our behaviour in the wild in crisis situations also change for the long term?

In *Herpetofauna diversity in the middle of the Southern Carpathians*, Severus-Daniel Covaciu-Marcov and his colleagues find that hydroelectric power plants pose the greatest threat to biodiversity. With a focus on the Tiroler Lech, one of the last near-natural Alpine river valleys in Austria, Marlene Salchner presents a LIFE project that is concerned with the preservation or restoration of wild river habitats and their typical biodiversity. We can see a conflict between renewable energy production and nature conservation in many mountain areas. As environmentalists, are we, on a personal level, also willing to give up long, energy-consuming journeys and thus reduce the pressure to build new energy facilities? Currently, our travel to remote national parks in other countries and other continents is limited. We can embrace this restriction as an opportunity to visit nearby protected areas that we may not yet know. For the managers of protected areas, this time is an opportunity to direct visitors to sustainable journeys to protected areas and a respectful attitude towards natural and cultural heritage. In times of crisis, we change our habits. Hopefully, the pandemic will be an opportunity to improve our behaviour for the long term.



Matej Gabrovec
Anton Melik Geographical Institute, Research Centre of the Slovenian Academy of Sciences and Arts, Ljubljana

eco.mont – Volume 12, Number 2, July 2020
ISSN 2073-106X print version – ISSN 2073-1558 online version: http://epub.oeaw.ac.at/eco.mont
https://dx.doi.org/10.1553/eco.mont-12-2s4

Protected Areas and Territorial Tensions: The Ticinese Case of Adula Park

Mosè Cometta

Keywords: protected areas, cultural hegemony, consensus, Adula Park, Switzerland

Abstract

This study examines the role of socio-spatial structures and their perception in negotiations concerning Protected Areas (PAs). It focuses on tensions among institutions and various groups of local people with regards to the creation of one particular PA. By bridging the gap between studies on PAs and others on critical urban issues, this paper offers a new perspective for the constitution of PAs. A critical analysis of the content of newspaper articles, editorials and readers' letters regarding Adula Park (Switzerland) was conducted. A radical discursive difference between supporters and detractors of the Park emerged. As predicted, the findings show the importance of including broader socio-spatial elements in PA negotiations. Future research should further enhance the analysis of PAs in terms of urban territorial policies.

Profile

Protected area

proposed Adula Park

Mountain range

Alps

Country

Switzerland

Introduction

The aim of this paper is to analyse the failure to establish one particular protected area (PA), in order to better frame bottom-up processes. The public debate that led to the rejection of the Swiss Adula Park in a vote in November 2016 was analysed. (For details regarding PA implementation in Switzerland, see Michel & Bruggman 2019). The analysis revealed an important discursive asynchrony between institutions and detractors, deepening the ideas proposed by Michel & Bruggman (2019) and Michel (2017, 2019).

The paper takes an interdisciplinary perspective, focusing on the interaction between PAs and society (Hammer et al. 2012). The research is based on three theoretical corpora: on the production of space, cultural hegemony, and bottom-up processes in PAs.

The notion of the production of space (Lefebvre 2001) is at the core of urban studies. Contemporary spatial forms can be understood as ranging from the urban (in which density and diversity are concentrated) to the infra-urban (e.g. mountainous and secluded areas) (Lévy 1994) – which means that centre–periphery dynamics are crucial in contemporary social analysis (Lefebvre 2015). The theory of planetary urbanization (Brenner & Schmid 2011) indicates that any activity that reinforces urban structures can be read as urbanization. PAs, then, represent a form of urbanization of wilderness (e.g. Gómez-Pompa & Kaus 1992) while playing a major role in environmental policies (Bruner et al. 2001). Harvey (2008, 2016) has shown how capitalist structure is linked to the cycle of destruction and reconstruction of urban spaces. Contradictions within the process of capital accumulation are crucial as urban determinants (Jaret 1983). Furthermore, in an urban society these factors increase competition between places (cities, regions etc.) (Harvey 2010: 295), nurturing a global competitive trend to attract particular industries, become international tourist centres etc. The transition from an insular (Elden 2013; Schmitt 2006) to a networked territorial paradigm (Dematteis & Governa 2001; Marull et al. 2015) is another key aspect: spatial planning increasingly transcends institutional boundaries in order to promote connections between different territories and foster competitiveness.

The study of cultural hegemony (Gramsci 1975; Mouffe 2005, 2013a, b) reveals how society is divided into different groups struggling to establish hegemonic discourses. Institutional discourses are particularly important, since they also have performative effects (Weisser 2014). The description of institutional projects (e.g. the founding of a PA) is not politically neutral. The importance of discourses – particularly on the concept of justice (Chan & Satterfield 2013) – has also been recognized in studies of PAs.

In studies on PAs, there is broad agreement on the need for bottom-up and participatory policies (Oestreicher et al. 2009; Hiwasaki, 2005). These policies should help to acknowledge and preserve the particularities of the local management of nature (Hayes 2006). PAs are always a negotiation between top-down and bottom-up initiatives (Fraser et al. 2006; Gaymer et al. 2014; Jones 2012), and so they need multi-level governance to be effective (Mauerhofer 2011). Finally, the multiplicity of expectations related to PAs (Mose & Weixlbaumer 2006; Michel 2017) and the consequent tensions (Bay-Larsen et al. 2006) reinforce the consensus around the need to operate in bottom-up ways (Weixlbaumer et al. 2015).

The concept of a neoliberal paradigm of nature conservation (Büscher & Arsel 2012a, b) provides a link between these three theoretical perspectives: it shows how PAs are one of the territorial materializations of the neoliberal discourse. In this frame, PAs serve not only to protect nature, but also to promote regional development – e.g. to foster tourism (Good-

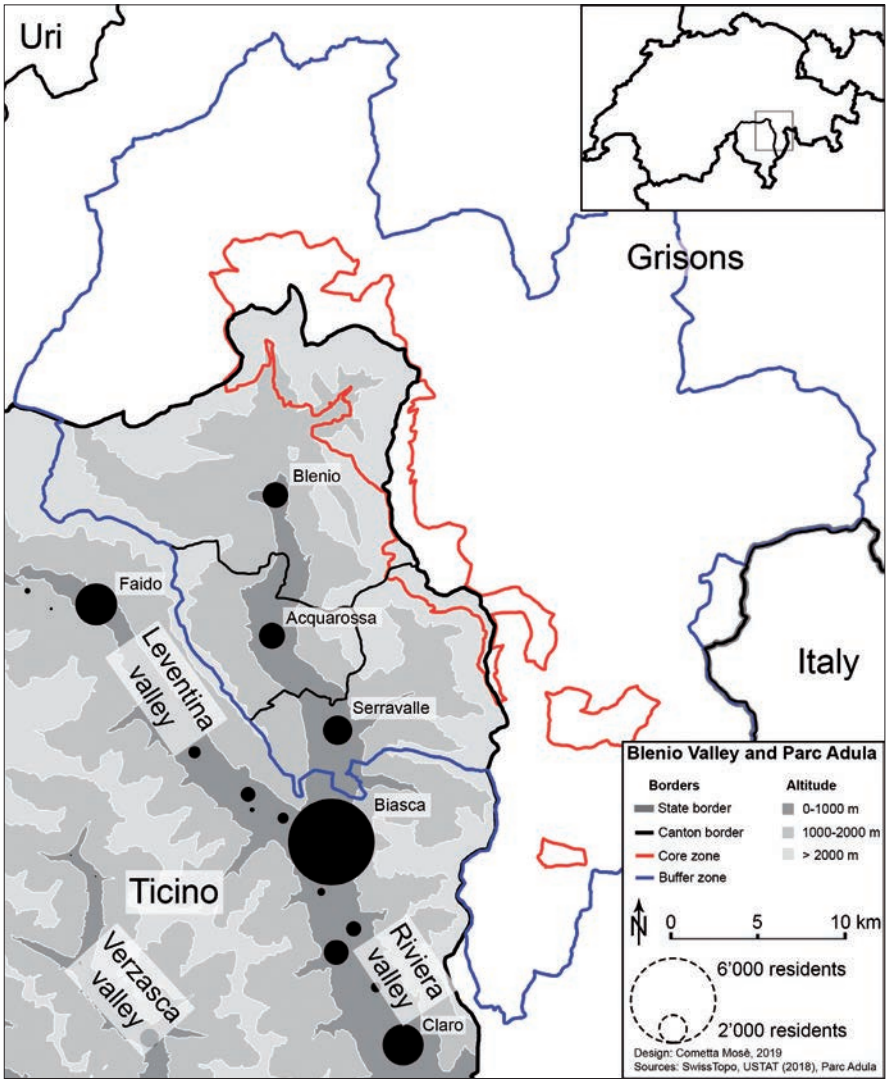


Figure 1 – Proposed perimeter of Adula Park and Ticino population details..

win 2002). This is possible thanks to the inclusion of anthropic goals in the management of PAs (Oldekop et al. 2015).

Study Area

The proposed Adula Park (Mount Adula's central peak is located at 46° 29'N, 9° 2'E) would have been the second largest National Park in Switzerland. In contrast to the Engadin Park, it would also have guaranteed protection of anthropic interests (in a buffer zone comprising most of the territory involved in the project). The project followed a bottom-up, participatory process but was rejected in a vote at commune level. This study has focused on the Ticino part of the Park, that is the sparsely populated Blenio Valley (Figure 1), with its 5 714 residents in 2015 (USTAT 2018c).

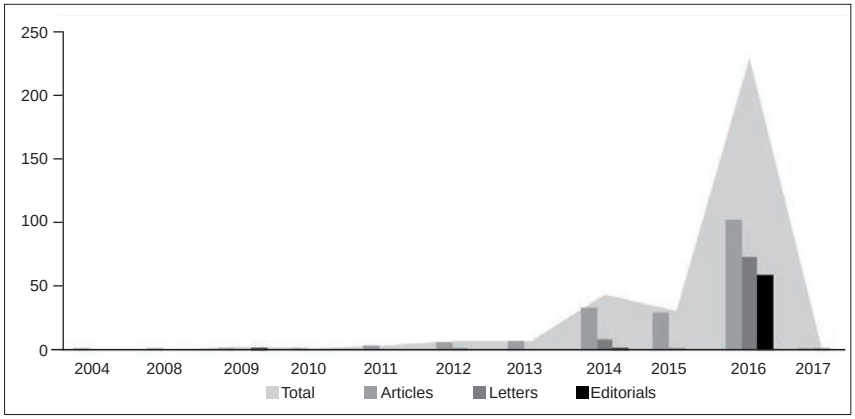
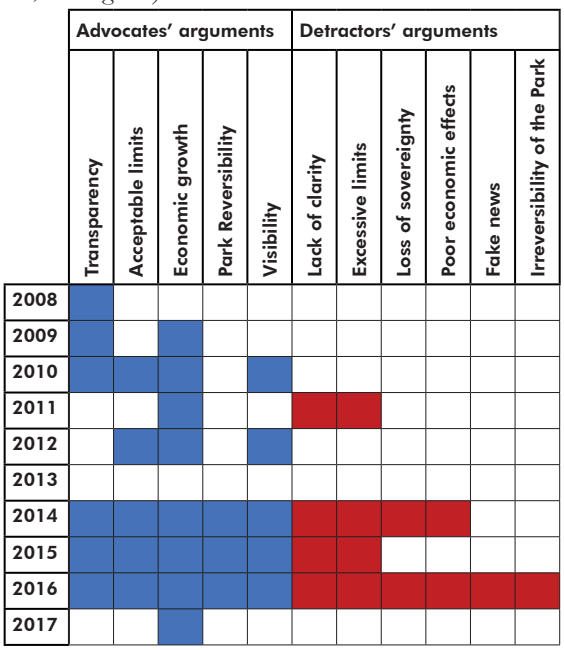


Figure 2 – Number of newspaper texts analysed, based on year of publication.

Table 1 – Expressions of opinion about the Park (blue: positive; red: negative) in the media debate.



Methodology

334 newspaper articles and readers' letters from *Corriere del Ticino* (CdT) and *laRegione* (lR) – the major newspapers in Ticino – were studied using Atlas.Ti software. These items were published between 01.01.2004 and 31.12.2017 (Figure 2). Quotations from the letters were translated into English. Data was collected and analysed in 2018.

Critical analysis (Foucault 2015; Hajer 2003) and content analysis (Mucchielli 1996) perspectives were mobilized to gain an understanding of the motivations that led to the results of the vote. As previously shown by Kohlbacher (2006) and Wodak & Reisigl (2016), the combination of qualitative and critical discursive analyses brought together both problem-oriented and theory-guided approaches.

Results

Analysis of the media debate – especially regarding readers' letters – shows a clear difference between supporters and opponents of the Park where the focus of their arguments is concerned. The former described the Park positively, highlighting the visibility that the Park would offer to the region, as well as the economic growth it would drive. Supporters also focused on the transparency and reversibility of the project, and the idea that the delimitation of the core zone was fair and acceptable. The opponents' arguments, which only started to emerge during 2014 (Table 1), focused on negative criticism of the process involved in the Park's creation, perceived as obscure, irreversible and excessively limiting to human freedom, including in the buffer zone. The Park was also seen as economically pointless and politically dangerous for the sovereignty of local communities. Critics of the project also denounced what they perceived to be acts of state-financed propaganda by the organizers.

Economic growth, centred on the development of tourism guaranteed by the visibility of the National Park label, was one of the strong arguments of the Park's supporters. Adula Park was perceived by its advocates to be the last hope for the economic development of the valley. *"If we want to keep this Valley alive and ensure that it does not become only a dormitory zone with a weak tourism sector, few services and scarcely any attractions, we must embrace this challenge and try"* (Rigozzi & Vitali, CdT, 03.10.2016: 29), claimed two Blenio legislative assembly members. Economic growth was closely linked to visibility. Accordingly, the Mayor of Blenio stated that "*it is not enough to design and build tourism infrastructures if we do not create the attractor element that will make our region known and attractive on a Swiss, European and international level, [as a place] which can be visited as part of the largest Swiss national park: the Adula Park*" (Truaisch, CdT, 30.09.2016: 42).

Economic growth is seen as an agent of development that upholds freedom. According to the supporters, the Park would impose a small loss of freedom to hike, which would be generously compensated for by the socio-economic outcomes. *"What is freedom? Freedom 'is many things'. Freedom is, for example, 'being able to' go hiking in the mountains [...]. Freedom, however, is also being able to carry out a work activity at home to decently maintain a family. Today, many young people 'are no longer free' to work in the valley. The park would give them and all of us more possibilities"* (Bricalli, CdT, 24.11.2016: 37).

In addition to the idea that the restrictions that the project would impose were reasonable, many supporters stated that even the core zone was still basically accessible. *"There will be few new constraints, and they will only touch the core zone, which includes 142 km² over a total area of 1250 km², and is, for the most part, situated above 3000 metres. Huts, cottages and mountain pastures will be able to continue their activities even in the core areas of the park. If it is true that you will not be allowed to leave the paths, it is equally true that in the core zone alone we will have 60 km of paths, 157 summer itineraries and 113 winter trails that will allow us to frequent the mountains, both in summer and during the winter"* (Lechleitner, lR, 16.11.2016: 27).

Concerns about restrictions were depicted as irrational. The project was seen as bottom-up and transparent: *"The intentions of the park [were] highlighted in a transparent way over the years and explained to the population during the numerous public meetings, as well as [being] available during the three months of public consultation of the 'Charta'"* (Galli, CdT, 06.06.2016: 45). No hidden goal was associated with the Park. Furthermore, supporters claimed that opponents of the project were moved by personal interest and misinformation. *"Public debates* [organized by the promoters to present the project to the population before the vote] *highlighted the juxtaposition of opinions […] from among those who feel satisfied with the existing*

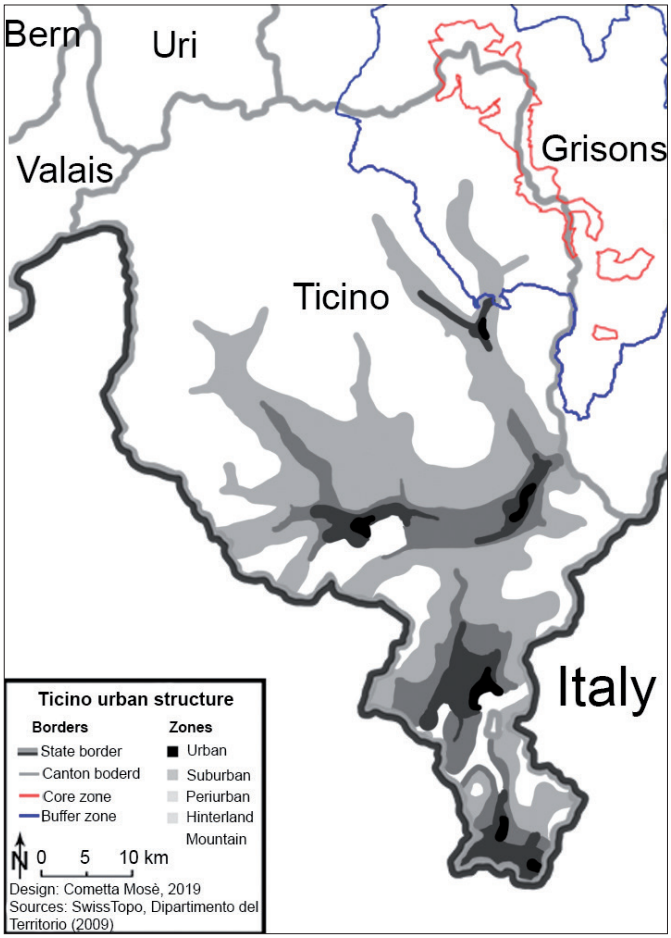


Figure 3 – Urban structure of Ticino.

situation (lucky them) – they fight for the defence of personal or categorical interests – and […] those who have instead taken the trouble to investigate the contents of an idea which has allowed the Park to financially support about twenty bottom-up projects since its preliminary phase" (Baggi, lR, 29.10.2016: 30).

As previously stated, detractors had been challenging Adula Park on another discursive level. Their arguments were more broadly linked to scepticism and lack of confidence. *"We have been told that nothing will change in the buffer zone. One wonders then why they want this area. […] One wonders why in Zernez, in the Engadine, they did not want to add a new buffer zone to their National Park. […] It is certain that the Engadinese understood that the introduction of a buffer zone would have involved only restrictions"* (Devittori, CdT, 05.10.2016: 37). Despite the claims of both the Park's promoters and the authorities, opponents feared top-down impositions on their way of life. They were particularly sensitive to the topic of the presence of large predators – a concern which manifests the difficult balance between conservation and anthropocentric interests. *"The Blenio Valley will become an experimental laboratory. While in Switzerland and in Europe we are moving towards reducing the presence of the wolf, for the Blenio Valley they hope for a massive presence of the predator to increase tourism"* (Bini, lR, 08.10.2016: 30). Although the wolf and bear populations are managed by the federal government and not by the Park organization, opponents feared the decisional power of the Park. From this perspective, accepting the Park would mean a clear loss of sovereignty. *"If the project is accepted, what will happen when the interests of the park come into conflict with our individual and collective interests? How much freedom will we still have to develop our projects?"* (Boggini, CdT, 14.10.2016: 45). Regarding development of the region, opponents wanted to initiate certain projects, *"but chosen by us and not driven by Bernese bureaucrats or even from Brussels"* (Devittori, CdT, 03.11.2016: 36).

The Park was seen as an imposed, top-down, project, as something imagined from far away, that disregarded local practices and traditional lifestyles. Despite all the efforts of inclusion by the promoters, Adula Park was perceived as a project that threatened the local way of life. Doubts were cast on the reversibility of the project (which would have been guaranteed by confirmatory votes every 10 years). *"If you vote yes, you won't be able to leave. This is certain and is not a far-fetched opinion. Nobody has informed us in detail and fully about what it means to be in a park forever"* (Devittori, CdT, 25.10.2016: 34). Thus, supporters, institutions and the Adula Park organization were criticized for pushing an obscure project without telling people the truth. *"Reasons for rejecting Adula Park are certainly more solid than the undemonstrated promises, the myriad press releases released by the promoters, and an abstract concept without any certainty"* (Fraschina, CdT, 13.10.2016: 37), claimed a right-wing Blenio legislative assembly member. Moreover, depict-

ing supporters in a negative manner was a strategy of the opposition. *"I say no to this name and its symbols, to which many have adhered with an attitude close to fanaticism"* (Dalberti-Bassi, CdT, 19.11.2016: 37). The whole epistemic value of the project was undermined by affirming head-on opposition to science itself. *"Every time we come up with research, we create new constraints and restrictions that are unlikely to have a positive impact on the region"* (Zanini, CdT, 03.10.2016: 28), said a right-wing cantonal MP.

Discussion

The differences between the arguments put forward by supporters and opponents of the Park, focusing on radically different concerns, are quite clear, and a constructive debate was therefore impossible. As shown by Michel (2019), underlying concepts of justice are at stake. This paper confirms Michel's findings, and further extends them to the Italian-speaking part of the Park. I propose, however, to add another layer of analysis: that of the territorial fabric (i. e. including both urban and infra-urban areas).

To understand Ticino's rejection of the Adula Park project, one needs first to be aware of the evolution of territorial policies in this Canton. Swiss territorial policies were founded on the principle of *decentralized centralization* (Salomon Cavin 2004, 2005). In this political frame, every region should receive public aid in order to develop (Schmid et al. 2006). The Blenio valley, like all other peripheral regions of Switzerland, benefited from financial help that provided important communal and regional autonomy. Because of the increase in global urban competition during the 90s (Harvey 2010) and a neoliberal turn in institutional governance (Ceschi 1998), this kind of policy was gradually abandoned. To avoid the risk that the entire Canton would become nothing more than an outlying residential area of Milan, the new cantonal masterplan (RCT 2009) stated that a more efficient allocation of economic resources was needed. This goal was pursued based on the principle of *functional specialization*, which divided the Canton into *urban* (urban to peri-urban) and *infra-urban* (hinterland and mountains) zones (Figure 3). Subsequently, every region was forced to plan its development in accordance with broader cantonal goals. The Canton's competitiveness was at stake.

While according to the plan, urban parts of the Canton were to aim to increase their links to the nearby Italian towns of Como and Varese, infra-urban areas were to seek to collaborate with other alpine Cantons and to focus on agriculture, tourism and nature conservation. Adula Park was the key project for ensuring these results in the Blenio valley. The institutional perspective on the creation of the Park was thus clearly linked to large-scale neoliberal urban analysis (Harvey 2008): on the one hand, the arguments in favour of the Park were focused in particular on economic development (the so-called neoliberal paradigm for PAs (Büscher & Arsel 2012a, b)). On the other hand, spatial planning criteria for promoting Adula Park from an institutional point of view were concentrated mainly on regional development and competitiveness – a structuring idea of the neoliberal paradigm (Foucault 2008). Since the integration of the Blenio valley in the broader urban network was mediated by the Park as a means of increasing tourism, we can understand the Park as a project of urbanization.

A better understanding of the urban setting of Ticino also leads to a deeper understanding of the disputes between supporters and detractors of the Park. Supporters never discussed Ticino's broader urban situation. Even among the most critical of the Park's supporters, the new urban setting was perceived as a fact and not a situation to be debated. Thus, they indirectly accepted the new institutional perspective. Conversely, detractors disputed indirectly the political shift between the two cantonal masterplans, depicting the valley's autonomy (founded on *decentralized centralization* policies) as legitimate, and the need to coordinate local development at cantonal level (following *functional specialization* policies) as an undemocratic submission of peripheral communities to bureaucrats' interests. From their point of view, the Park was a political instrument of both central powers and ecological organizations to override local sovereignty. Promises of financial development linked to the PA's creation (Job et al. 2006) were not sufficient to overcome the fear of losing sovereignty (Backhaus et al. 2018: 54).

Where the supporters wanted to discuss the concrete regulations of the Park, the opponents made more general criticisms, showing discontent because of the perceived abandonment and submission of the valleys. Furthermore, the arguments mobilized show radically different understandings of freedom. For the Park's supporters, freedom was the possibility of living in an economically prosperous environment; for its opponents, it was seen merely as the absence of imposed rules. For the former group, the region's central social problems were the poverty and peripherality which forced people to look for work outside the valley or emigrate. For the latter, conversely, the main problem was the increasingly invasive role of state goals in the valley's way of life. These differences seem to indicate a lack of acceptance by the detractors of the transition of the Blenio from a rural (autonomous) area to an infra-urban (interconnected) one (Lévy 1994): a dispute concerning hegemonic discourse (Gramsci 1975).

Conclusion

By helping to better connect the populations of peripheral regions to the urban network, PAs can tackle exclusion. However, for this to happen, all territorial policies must be inclusive. Suspicions of being subjected to a central control are linked to the sense of unease brought on by urban transformations. The opponents of Adula Park prevailed because of the gen-

eral anxiety felt by those in the peripheral area about submitting to external interests. I suggest that these difficulties cannot be solved within the process of creating a PA. More inclusive and participative spatial planning is needed at cantonal and federal levels. If the Park project remains an isolated example of a bottom-up approach within the broader top-down territorial policy, it will be rejected not so much for its content as for what it represents.

However, the aim of more inclusive policies is not to eliminate contrasting positions and establish a monolithic, universal consensus. Conflicts between different visions are at the heart of democracy and cannot be eliminated (Mouffe 2013a). Inclusive policies should, however, help to manage them in a more constructive way. Better governance would limit tensions, allowing problems to be addressed in a more rational way. With less concern about the loss of local sovereignty, opponents might have entered into the debate on the Park with more pertinent arguments, helping to improve the project.

I suggest that a fundamental problem that prevents the constructive management of tensions is the complete asynchrony between the discourses employed. If supporters and detractors argue on two radically different discursive levels, no debate can take place. To reduce this discursive asynchrony, educational measures are probably needed. For spatial planning to be participatory, people need to be properly informed and to understand the problems and challenges facing the community. In times of fake news and widespread epistemic dispute around the values of science, it is important to regain a minimum cultural common ground to render possible a constructive public debate on the creation of PAs. As stated by Michel, *"conservation and regional development projects have both to follow and to communicate a clear set of values (or worths) and adjust these to local citizens' plural senses of justice"* (2019: 30).

This paper follows the consensus found in the literature on the need for bottom-up policies in PA creation and management, but it also suggests that for those processes to be effective we need to integrate broader bottom-up spatial planning and a stronger shared culture. PA promoters cannot be left alone to address the demands for greater participation in wider territorial policies. Public authorities, if they are really interested in establishing Parks as a way of including peripheral areas in urban networks, must help the Parks' promoters. Without achieving this first, PAs in rural and traditionally autonomous regions will run the risk of being seen by locals as urban, top-down impositions, despite the Park's aims not simply to protect the area's cultural and natural richness but also to promote economic development and social stability.

Acknowledgement

This work was supported by the Swiss National Science Foundation under Grant POLAP1-172054/1.

References

Backhaus, N., L. Plegerb, A. von Atzigen, O. Bosello, O. Graefe, M. Hunziker, F. Sager & D. Siegrist 2018. *Parc Adula. Gründe und Hintergründe der Ablehnung in den Gemeindeabstimmungen*. Zürich. [In German]

Bay-Larsen, I., R. Bjøru, R., Eilertsen & G.E. Fedreheim 2006. Integrated Conservation Processes – A Tool for Reducing Conflicts in Area Conservation Processes. In: Siegrist, D. et al. (eds.), *Exploring the Nature of Management*. University of Applied Sciences Rapperswil, Switzerland: 124–128.

Bruner, A.G., R.E. Gullison, R.E. Rice, G.A.B. da Fonseca 2001. Effectiveness of Parks in Protecting Tropical Biodiversity. *Science* 291: 125–128.

Büscher, B. & M. Arsel 2012a. Introduction: neoliberal conservation, uneven geographical development and the dynamics of contemporary capitalism. *Tijdschrift voor Economische en Sociale Geografie* 103 (2): 129–135.

Büscher, B. & M. Arsel 2012b. Nature™ Inc.: Changes and Continuities in Neoliberal Conservation and Market-based Environmental Policy. *Development and Change* 43 (1): 53–78.

Ceschi, R. 1998. *Storia del Cantone Ticino*, Bellinzona.

Chan, K.M.A. & T. Satterfield 2013. Justice, Equity and Biodiversity. In: Levin, S. (ed.), *Encyclopedia of Biodiversity*: 434–441. New Jersey.

Dematteis, G. & F. Governa 2001. Urban Form and Governance: The New Multi-centred Urban Patterns. In: Andersson, H. et al. (eds.), *Change and Stability in Urban Europe*: 27–44. London.

Elden, S. 2013. *The birth of territory*. London.

Foucault, M. 2008. *The birth of Biopolitics*. New York.

Foucault, M. 2015. La volonté de savoir. In: Œuvres: 617-738. Paris. [In French]

Fraser, E.D.G., A.J. Dougill, W.E. Mabee, M. Reed & P. McAlpine 2006. Bottom up and top down: Analysis of participatory processes for sustainability indicator identification as a pathway to community empowerment and sustainable environmental management. *Journal of Environmental Management* 78: 114–127.

Gaymer, C.F., A.V. Stadel, N.C. Ban, P.F. Cárcamo, J. Ierna & L.M. Lieberknecht 2014. Merging top-down and bottom-up approaches in marine protected areas planning. *Aquatic Conservation: Marine and Freshwater Ecosystems* 24: 128–144.

Goodwin, H. 2002. Local Community Involvement in Tourism around National Parks: Opportunities and Constraints. *Current Issues in Tourism* 5 (3-4): 338–360.

Gómez-Pompa, A. & A. Kaus 1992. Taming the Wilderness Myth. *Bioscience* 42(4): 271-279.

Gramsci, A. 1975. *Quaderni del carcere*. Torino.

Hajer, M.A. 2003. Discourse Analysis. In: *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process*. Oxford.

Hammer, T., I. Mose, T. Schreurer, D. Siegrist & N. Weixlbaumer 2012. Societal research perspectives on protected areas in Europe. *eco.mont* 4(1): 5–12.

Harvey, D. 2008. The right to the city. *New Left Review* 53: 23–40.

Harvey, D. 2010. *Justice, Nature and the Geography of Difference*. Oxford.

Harvey, D. 2016. *Il capitalismo contro il diritto alla città*. Verona. [In Italian]

Hayes, T.M. 2006, Parks, People, and Forest Protection. *World Development* 34: 2064–2075.

Hiwasaki, L. 2005. Toward Sustainable Management of National Parks in Japan. *Environmental Management* 35 (6): 753–764.

Jaret, C. 1983. Recent neo-Marxism Urban Analysis. *Annual Review of Sociology* 9: 499–525.

Job, H., D. Metzler & M. Woltering 2006. Large Scale Protected Areas + Tourism = Regional Development? In: Siegrist, D. et al. (eds.), *Exploring the Nature of Management*. University of Applied Sciences Rapperswil, Switzerland: 140–144.

Jones, P.J.S. 2012. Marine protected areas in the UK: challenges. *Environmental Conservation* 39(3): 248–258.

Kohlbacher, F. 2006. The Use of Qualitative Content Analysis in Case Study Research. *Forum: Qualitative Socia Research* 7(1).

Lefebvre, H. 2001. *Du rural à l'urbain*. Paris. [In French]

Lefebvre, H. 2015. *Le droit à la ville*. Paris. [In French]

Lévy, J. 1994. *L'espace légitime*. Paris. [In French]

Marull, J., C. Font & R. Boix 2015. Modelling urban networks at mega-regional scale: Are increasingly complex urban systems sustainable? *Land Use Policy* 43: 15–27.

Mauerhofer, V. 2011. A bottom-up 'Convention-Check' to improve top-down global protected area governance. *Land Use Policy* 28: 877–886.

Michel, A.H. 2017. 'What is a national park for?' – Principles of worth in a Swiss national park project. In: *6th Symposium for Research in Protected Areas*: 425–427. Vienna.

Michel, A.H. 2019. How conceptions of equity and justice shape national park negotiations: The case of Parc Adula, Switzerland. *eco.mont* 11(1): 25–31.

Michel, A.H. & A. Bruggman 2019. Conflicting Discourses: Understanding the Rejection of a Swiss National Park Project Using Data Analysis Triangulation. *Mountain Research and Development* 39 (1). doi: 10.1659/MRD-JOURNAL-D-18-00081.1

Mose, I. & N. Weixlbaumer 2006. Protected Areas as a Tool for Regional Development? In: Siegrist, D. et al. (eds.), *Exploring the Nature of Management*. University of Applied Sciences Rapperswil, Switzerland: 149–154.

Mouffe, C. 2005. *The Return of the Political*. London: Verso.

Mouffe, C. 2013a. *Agonistics. Thinking the world politically*. London: Verso.

Mouffe, C. 2013b. *Il conflitto democratico*. Milano-Udine: Mimesis. [In Italian]

Mucchielli, A. 1996. Contenu, analyse de. In: *Dictionnaire des méthodes qualitatives en sciences humaines et sociales*. Paris. [In French]

Oldekop, J.A., G. Holmes, W.E. Harris & K.L. Evans 2015. A global assessment of the social and conservation outcomes of protected areas. *Conservation Biology* 30(1): 133–141.

Oestreicher, J.S., K. Benessaiah, M.C. Ruiz-Jaen, S. Sloan, K. Turner, J. Pelletier, B. Guay, K.E. Clark, D.G. Roche, M. Meiners & C. Potvin 2009. Avoiding deforestation in Panamanian protected areas. *Global Environmental Change* 19: 279–291.

RCT (Republic and Canton of Ticino) 1990. *Progetto di Piano Direttore Cantonale*. Bellinzona. [In Italian]

RCT (Republic and Canton of Ticino) 2009. *Revisione del Piano Direttore Cantonale*. Bellinzona. [In Italian]

Salomon Cavin, J. 2004. La Suisse urbaine : entre ubiquité et absence. *EspacesTemps.net*. [In French]

Salomon Cavin, J. 2005. *La ville, mal-aimée*. Lausanne. [In French]

Schmid, C., R. Diener, J. Herzog, J. Meili & P. de Meuron 2006. *Switzerland. An Urban Portrait*. Basel.

Schmid, C. & N. Brenner 2011. Planetary urbanisation. In: Gandy, M. (ed.) *Urban Constellation*: 10–13. Berlin.

Schmitt, C. 2006. *The Nomos of the Earth in the International Law of the Jus Publicum Europaeum*. New York.

USTAT (Cantonal Bureau of Statistics) 2018. Popolazione residente permanente al 31 dicembre, secondo la classe d'età, dal 2003 al 2017. Avaiable at: https://www3.ti.ch/DFE/DR/USTAT/index.php?fuseaction=dati.regioni&tema=33 (accessed: 27.03.2018).

Weisser, F. 2014. Practices, politics, performativities: Documents in the international negotiations on climate change. *Political Geography* 40: 46–55.

Weixlbaumer, N., D. Siegrist, I. Mose & T. Hammer 2015. Participation and Regional Governance. A Crucial Research Perspective on Protected Areas Policies in Austria and Switzerland. In: Gambino, R. & A. Peano (eds.), *Nature Policies and Landscape Policies*: 207–216.

Wodak, R. & M. Reisigl 2015. The discouse-historical approach. In: Wodak, R. & M. Meyer (eds.), *Methods of Critical Discourse Studies*: 23–61.

Author

Mosè Cometta

doctorate (2019) at the Institute of Geography and Sustainability, University of Lausanne. E-mail: mose.cometta@alumnil.unil.ch; https://orcid.org/0000-0001-8700-2030

eco.mont – Volume 12, Number 2, July 2020
ISSN 2073-106X print version – ISSN 2073-1558 online version: http://epub.oeaw.ac.at/eco.mont
https://dx.doi.org/10.1553/eco.mont-12-2s11

Herpetofauna diversity in the middle of the Southern Carpathians: data from a recent survey (2016–2018) in Cozia National Park (Romania)

Severus-Daniel Covaciu-Marcov, Paula-Vanda Popovici, Alfred-Ştefan Cicort-Lucaciu, István Sas-Kovács, Diana Cupşa & Sára Ferenţi

Keywords: amphibians, reptiles, habitats, altitude, forest type, mountains, differences, past

Abstract

Herpetofauna is of interest in protected areas because of the large number of protected species. We studied the herpetofauna of Cozia National Park (CNP) between 2016 and 2018. CNP is situated in the central part of the Southern Romanian Carpathians. We recorded 10 species of amphibian (*Salamandra salamandra, Triturus cristatus, Lissotriton vulgaris, Bombina variegata, Hyla arborea, Bufo bufo, Bufotes viridis, Pelophylax ridibundus, Rana dalmatina* and *R. temporaria*), and 11 reptile species (*Lacerta agilis*, L. *viridis*, *Podarcis muralis, Darevskia praticola, Zootoca vivipara, Anguis colchica, Natrix natrix, N. tessellata, Coronella austriaca, Zamenis longissimus* and *Vipera ammodytes*). Reptiles dominate in number of species, number of individuals and distribution records. CNP is situated at the northern limit of the distribution range of some of these reptiles, notably *D. praticola* and *V. ammodytes*. Mountain species associated with a colder, moist climate are very rare or even absent. *Zootoca vivipara* is restricted to the highest areas of Mount Cozia, above 1 350 m. Although mountain species are well represented in other Carpathian regions, the warmer, drier climate of CNP and its surroundings has limited their distribution in the area, pushing *Z. vivipara* to higher and higher altitudes. *Lacerta agilis* is syntopic with all the other lizard species. In some areas, as many as four lizard species cohabitate. The distribution of the herpetofauna in CNP has been negatively influenced by past human activity. The dams on the River Olt have favoured species related to large, stagnant bodies of water, in a region where such habitats were naturally missing. In addition, massive deforestation has decreased the abundance of herpetofauna in many areas of CNP.

Profile

Protected area

Cozia National Park

Mountain range

Carpathians

Country

Romania

Introduction

Protected regions at the periphery of the European Union are crucial for conserving species which are rare in the rest of the EU, although in some of these peripherally located countries, like Romania, species richness is still underestimated (see Hoffmann et al. 2018). In Romania, the network of protected areas is dense and compact (Rozylowicz et al. 2019). The total surface of these protected areas has recently been increased, but the management of the network as a whole is far from efficient (see Iojă et al. 2010; Niculae et al. 2017). Many of the country's protected areas, including Cozia National Park (CNP), are situated in the Carpathian Mountains, especially in the Southern Carpathians (Iojă et al. 2010). They also rank highest in the number of protected species (Rozylowicz et al. 2019).

CNP is remarkable for its landscapes and biodiversity (Ploaie 2004; Ploaie & Turnock 2001), and its surroundings (Ploaie & Turnock 1999). Some species of invertebrates (Covaciu-Marcov & Ferenţi 2019) and reptiles (Iftime & Iftime 2006) in CNP extend to higher altitudes than in other areas of the country. Nevertheless, information on amphibians and reptiles in the Park does not cover the region fully or the species composition (Ploaie 2004; Ploaie & Turnock 2001; Iftime & Iftime 2006, 2007, 2017a). A recent publication (Iftime & Iftime 2019), however, provides new distribution records of herpetofauna, as well as a literature review for the area. Herpetofauna is of high importance to conservation because almost all species in Romania are protected (O.U.G. 57/2007) and present in various protected areas (Iojă et al. 2010). In recent years, many studies have been conducted on herpetofauna both in protected regions (Ghira et al. 2012; Cicort-Lucaciu & Muncuş-Nagy 2013; Covaciu-Marcov et al. 2009a, 2014; Iftime & Iftime 2014; Zamfirescu et al. 2016) and elsewhere (Dincă et al. 2013; Gaceu & Josan 2013; Bogdan et al. 2014; Iftime & Iftime 2015, 2017b). There have also been numerous studies on herpetofauna in protected areas of other countries (Tuberville et al. 2005; de Medeiros Magalhães et al. 2015; Kass et al. 2018; Leyte-Manrique et al. 2018). Any information on amphibian and reptile distribution is considered useful for conservation purposes (Iftime & Iftime 2010; Hollanders et al. 2018; Leyte-Manrique et al. 2018).

In this context, we aimed to investigate the herpetofauna of CNP. Our objectives were: 1. to establish the distribution of the herpetofauna in CNP using

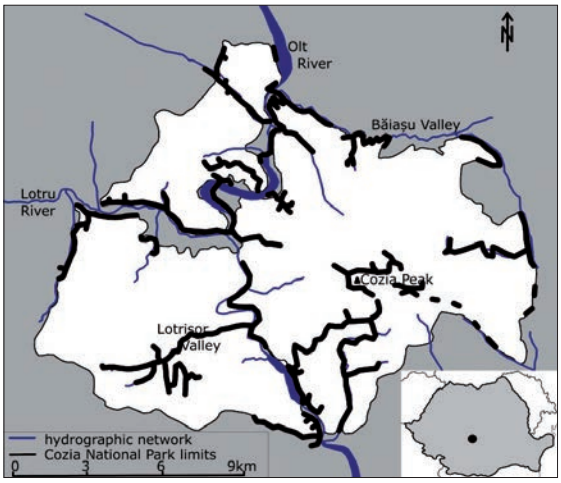


Figure 1 – The research paths taken in CNP (black thick lines – research paths; triangle – Cozia Peak).

distribution maps; 2. to identify the most important areas from an ecological and zoogeographical point of view; 3. to compare the herpetofauna of CNP with that of neighbouring areas.

Material and Methods

Field activities took place between 2016 and 2018, after Iftime & Iftime had completed their own research in the area (see Iftime & Iftime 2019). CNP lies in the central part of the Southern Carpathians, in the Olt River Gorge region. The gorge, situated at altitudes between 300 m and 400 m, cuts through the Southern Carpathians (Tufescu 1986). CNP is situated at the gorge's southern end, having a peak with a maximum altitude of 1668m (Ploaie 2004; Ploaie & Turnock 2001). It was founded in 1990 and is the second oldest National Park in the country (Ploaie 2004). The Park has three distinct regions, each of which belongs to a different mountain massif, separated by the Olt and Lotru rivers (Ploaie 2004). CNP is mostly covered by forests, especially beech, but also oak, hornbeam and a few conifers (Ploaie 2004; Ploaie & Turnock 2001). The Olt and its tributary the Lotru have been modified for hydro-electrical purposes (Rădoane & Rădoane 2005; Cojocar 2014). The region is crossed by forest tracks and numerous tourist routes (Ovreiu et al. 2019) as well as by national roads.

We spent 25 days in the field in CNP. Field trips were usually made over the weekend, from April to September, each generally lasting 2–3 days. Because the herpetofauna species have very different ecological requirements (Fuhn 1960; Fuhn & Vancea 1961), the chances of encountering them depended on the season and weather conditions. The best time for field work was spring, especially May. The herpetofauna inventory was made using direct methods, especially the transect method, various forms of which are recommended in studies of herpetofauna in Romania (see Török et al. 2013). These methods have been used in both Romania (Iftime & Iftime 2006, 2007, 2019; Covaciu-Marcov et al. 2009b; Cicort-Lucaciu & Muncuş-Nagy 2013; Bogdan et al. 2014) and other regions (Lamb et al. 1998, Tuberville et al. 2005; Kass et al. 2018; Ansari 2018; Leyte-Manrique et al. 2018; Slavchev et al. 2019). Animals were usually observed directly, without being captured or handled. A small number of amphibians were captured in some larger aquatic habitats using a net with a long metal handle, as used in similar studies (Covaciu-Marcov et al. 2009a, b; Ghira et al. 2012). They were released immediately after identification. As in other studies, road-killed animals were also identified (Tuberville et al. 2005; Strugariu et al. 2008; Covaciu-Marcov et al. 2009a, b, 2014).

We made dozens of transects (Figure 1) varying in length from several hundred metres to eight kilometres in one direction. Altogether, we walked more than 300 km in CNP. The Cozia Massif is generally accessible, but there are also areas whose accessibility is difficult or very difficult (Ovreiu et al. 2018). Thus, the region studied could not be covered uniformly. The transects generally overlapped with the region's access routes, such as forest tracks or tourist trails. In some cases, we deviated from the access routes and walked for a short distance into the forest. Because of some very inaccessible areas (Ovreiu et al. 2018), there were regions that we could not cross. Nevertheless, we explored large, characteristic areas of CNP, which is generally uniformly covered with forests (Ploaie 2004) over its entire altitudinal range. Thus, we consider that the transects are representative of the region. Transects were walked by 2 or 3 people at a time; one observed and identified the fauna, and the others made notes and took photos. Only a few transects were repeated. Because the transects were walked, they were travelled in both directions. The species distributions were marked on maps. For most species, a point on the map corresponds to one observed individual, although in some cases (notably for lizards) for which the number of observed individuals was too large, some distribution points overlap.

Results

Ten amphibian and 11 reptile species were identified in CNP. The amphibians were: *Salamandra salamandra*, *Triturus cristatus*, *Lissotriton vulgaris*, *Bombina variegata*, *Hyla arborea*, *Bufo bufo*, *Bufotes viridis*, *Pelophylax ridibundus*, *Rana dalmatina* and *R. temporaria*. The reptile species were: *Lacerta agilis, L. viridis, Podarcis muralis, Darevskia praticola*, *Zootoca vivipara, Anguis colchica, Natrix natrix, N. tessellata, Coronella austriaca*, *Zamenis longissimus* and *Vipera ammodytes*. These 21 species were recorded at 904 distribution points. Amphibians were observed at 361 points (39.93% of the distribution records), and reptiles at 543 (60.06% of the distribution records). The most-represented species in CNP was *P. muralis*, recorded at 157 points, followed by *L. vir-*

Table 1 – Herpetofauna distribution points in CNP: percentage abundance of the distribution points, approximate altitudinal range, and distribution in habitat types: 1. natural forest, 2. recovery forest, 3. forest margin, 4. grassy areas (meadows, pastures), 5. mountain streams, 6. small wet areas (riverside coppices with alders, springs with small puddles in open areas), 7. large, artificial, wet areas, 8. rocky areas, 9. abandoned constructions, 10. human settlements.

Species	P [%]	Altitude	1.	2.	3.	4	5.	6.	7.	8.	9.	10.	Total
Salamandra salamandra	8.07	300–800	X	X	-	-	X	X	-	-	X	-	5
Triturus cristatus	0.44	350–750	X	-	-	X	-	X	X	-	-	-	4
Lissotriton vulgaris	0.55	350–1350	X	X	-	X	-	X	X	-	-	-	5
Bombina variegata	13.27	300–1200	X	X	X	X	X	X	-	-	X	X	8
Bufo bufo	5.86	300–1400	X	X	X	X	X	X	X	-	X	X	9
Bufotes viridis	0.22	350	-	-	-	-	-	-	X	-	-	X	2
Hyla arborea	0.55	350	X	-	-	-	-	-	X	-	-	-	2
Rana dalmatina	4.09	350–1200	X	X	X	X	X	X	X	-	X	X	9
Rana temporaria	2.65	350–1350	X	X	-	X	X	X	-	-	-	-	5
Pelophylax ridibundus	4.20	300–500	-	-	-	-	-	X	X	-	-	X	3
Lacerata agilis	7.96	350–1600	-	-	X	X	-	X	-	X	X	-	5
Lacerata viridis	14.82	300–700	-	-	X	X	-	-	-	X	X	X	5
Podarcis muralis	17.36	300–1000	-	-	X	-	-	-	-	X	X	X	4
Darevskiy praticola	2.54	350–850	X	-	X	-	X	X	-	X	-	-	5
Zootoca vivipara	2.21	1350–1650	-	-	X	X	-	X	-	-	-	-	3
Anguis colchica	5.19	300–1500	X	X	X	X	X	-	-	X	X	X	8
Natrix natrix	3.20	300–750	X	X	X	X	X	X	X	X	X	X	10
Natrix tessellata	3.31	300–400	-	-	-	-	-	X	X	-	-	X	3
Coronella austriaca	0.44	300–400	-	-	X	-	-	-	-	-	-	-	1
Zamenis longissimus	2.54	300–500	X	-	X	X	-	X	-	X	-	X	6
Vipera ammodytes	0.44	350–650	X	-	X	-	-	-	-	X	-	-	3
Total			13	8	13	12	8	14	9	8	9	11	-

idis, registered in 134 points. Among the amphibians, *B. variegata* was the most common species, present at 120 distribution points. The rarest herpetofauna species were *B. viridis*, present at only two points, followed by *T. cristatus*, *C. austriaca* and *V. ammodytes*, each recorded at four points (Figures 2–5).

Herpetofauna species are unevenly distributed in CNP (see Figures 2–5). Some are present virtually throughout CNP, like *B. variegata*, *R. dalmatina* or *A. colchica*. Others (*D. praticola* and *Z. vivipara*) are present only in the Cozia Massif area, while yet others are present only in wet areas at low altitudes along the Olt, Lotru and Băiaşu rivers (*P. ridibundus*, *H. arborea*, or *N. tessellata*). Only one species, *N. natrix*, was recorded in all the habitat types of CNP, while *Coronella austriaca* was recorded in just one habitat type, in forest margins (Table 1). The largest number of species was registered in small-sized wet areas, followed by natural forests and forest margins. Except for *Z. vivipara*, all species were present in the low altitude areas of CNP (Table 1), each ascending to different altitudes. *Lacerta agilis* has the widest altitude distribution in the Park (Table 1).

Discussion

In most Romanian regions, amphibian species are more numerous than reptile species (Strugariu et al. 2008; Ghira et al. 2012; Dincă et al. 2013; Cicort-Lucaciu & Muncuş-Nagy 2013; Bogdan et al. 2014; Covaciu-Marcov et al. 2014; Iftime & Iftime 2011, 2013, 2014, 2017b). CNP is exceptional in having more reptile than amphibian species; there are few other such regions in southern Romania (Krecsák et al. 2004; Covaciu-Marcov et al. 2006, 2009a, b; Iftime & Iftime 2008). The number of reptile distribution records is an underestimate, because in the case of lizards occasionally more than one individual was observed per point. Also, in CNP there is a predominance of species which prefer a warmer climate.

Two reptiles, *D. praticola* and *V. ammodytes*, are east-Mediterranean species (Tomović et al. 2014), so Romania is at their northern distribution limit (Sillero et al. 2014). *Darevskia praticola* was not mentioned in the region in the most recent review on reptile distribution in Romania (Cogălniceanu et al. 2013a). Nevertheless, it has been registered in CNP since 2007, where although rare it seems to be present at the highest altitude in the country (Iftime & Iftime 2006). *Darevskia praticola* is well represented in CNP, even if the region lies at the limit of its suitability area (Ćorović et al. 2018). Although it was previously recorded at higher altitudes (Iftime & Iftime 2006), we identified *D. praticola* only below 850 m, near Stânişoara Monastery, alongside the Carpathian scorpion (Covaciu-Marcov & Ferenţi 2019), another species related to a sub-Mediterranean climate (Bunescu 1959).

Darevskia praticola is unevenly distributed in CNP, as previously reported (Iftime & Iftime 2019). It is present only east of the River Olt, on the western side of the Cozia Massif; it was not encountered to the east of the Cozia Massif, either because of the colder climate (Stoenescu et al. 1966) or because of high forest disturbance. This area was heavily deforested in the past (Ploaie 2004; Ploaie & Turnock 2001); the construc-

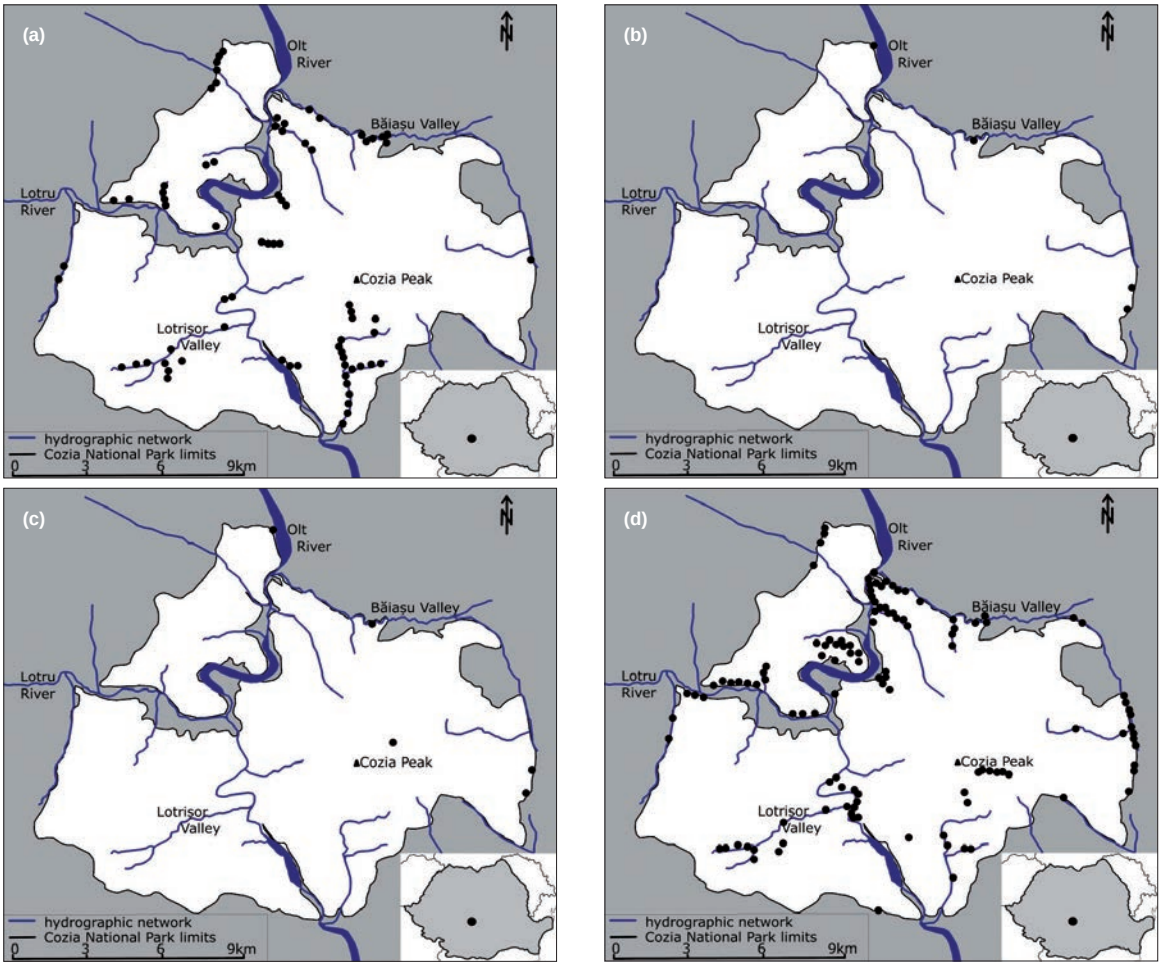


Figure 2 – The distribution (black dots) in CNP of (a) S. salamandra*, (b)* T. cristatus*, (c)* L. vulgaris *and (d)* B. variegata.

tion of a narrow-gauge forest railway served to increase the deforestation by giving access to more areas (Turnock 2005). According to local people, large areas were completely cleared of trees. Today, the eastern CNP is covered by coniferous plantations and dense beech and hornbeam regeneration forests.

The populations of *Darevskia praticola* in CNP seem to be isolated, both from the western ones in the Jiu River Gorge (Covaciu-Marcov et al. 2009a, Sucea 2019) and from the eastern ones in the Curvature Carpathians (Gherghel et al. 2011). This fragmentation is apparent also from the species' absence from the areas surrounding CNP, where it has not been attested (Iftime & Iftime 2011, 2013, 2014; Covaciu-Marcov et al. 2014; Dincă et al. 2013). While the isolation can be explained by deforestation in some areas (Gherghel et al 2011), this forest species has access to continuous habitats in the lower Southern Carpathians, and climatic models also show suitable areas (Ćorović et al. 2018). The Carpathian scorpion has a similar distribution; populations in the Olt River Gorge seem to be isolated from the ones in the Jiu Gorge and the Curvature Carpathians (Bunescu 1959; Gherghel et al. 2016). Although with fewer distribution records, *V. ammodytes* is present in the same areas of CNP as *D. praticola*. The western part of the Cozia Massif is the eastern distribution limit of this species in the Romanian Carpathians (Cogălniceanu et al. 2013a).

CNP is remarkable also because of the scarcity or absence of some mountain species. This is the case of *Mesotriton alpestris* and *Vipera berus*, which have not been recorded in CNP, and *Z. vivipara*, which has a very rare and localized distribution. The absence of the first two species distinguishes the herpetofauna of CNP as a whole from that of the Jiu River Gorge (Covaciu-Marcov et al. 2009a). In the Jiu Gorge, these species are also rare and present only above 1 200 m (Covaciu-Marcov et al. 2009a). Both were intensely searched for in the Cozia Massif, to no avail. Even at an altitude of 1 350 m, where *Z. vivipara* is already present, we identified only *L. vulgaris*, although we expected to find *M. alpestris*, which is commonly present above 800 m in the eastern proximity of CNP, in the Topolog (Dincă et al. 2013) and Vâlsan river basins (Covaciu-Marcov et al. 2014). *Vipera berus* is also present at higher altitudes some dozens of km from CNP (Krecsák et al. 2004; Iftime 2005; Iftime & Iftime 2010; Dincă et al. 2013). It is possible that the presence of the species in the Jiu Gorge is favoured by the proximity of the Parâng Massif, which reaches altitudes of over 2 500 m, and has a colder and more humid climate (Stoenescu et al. 1966). Massifs reaching more than 2 500 m are further

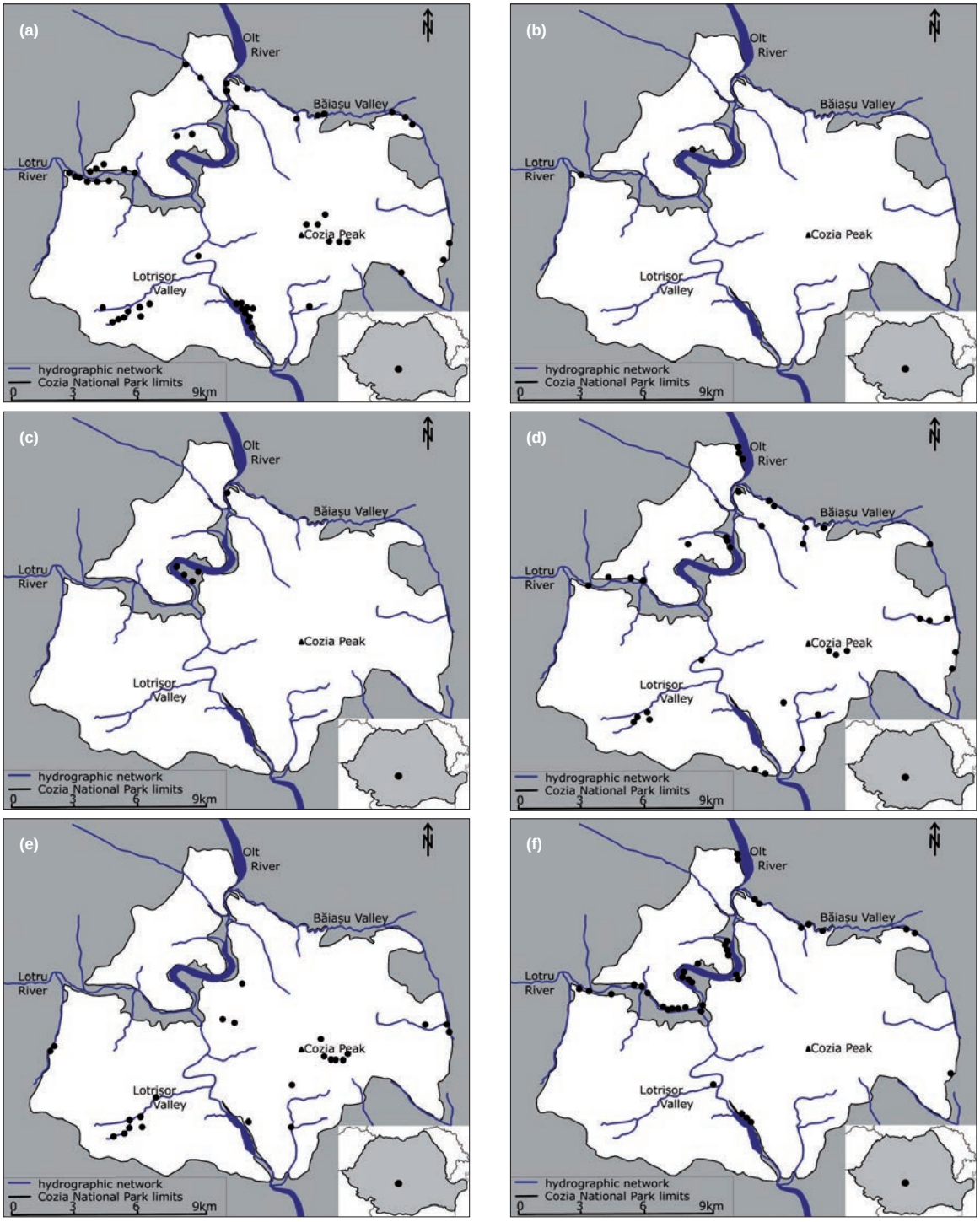


Figure 3 – The distribution (black dots) in CNP of (a) B. bufo*, (b)* B. viridis*, (c)* H. arborea*, (d)* R. dalmatina*, (e)* R. temporaria *and (f)* P. ridibundus

from CNP, and because of this CNP has a warmer, drier climate (Stoenescu et al. 1966).

Zootoca vivipara is present only in the highest areas of the Cozia Massif, where it was recently mentioned (Iftime & Iftime 2019); we found it above 1 350 m. This is among the highest lower-altitudinal limits for the species in Romania; in other regions it is present from 800 m upwards (Iftime & Iftime 2013) and has even been recorded in plains (Covaciu-Marcov et al. 2008). To the west, in the Jiu River Gorge, its presence starts at 1 200 m (Covaciu-Marcov et al. 2009a); in the Jieţ Gorge, it is found above 1 100 m (Iftime & Iftime 2010); to the east, in the Vâlsan river basin, it descends to 800 m (Covaciu-Marcov et al. 2014). *Zootoca vivipara* seems completely isolated in the highest part of the Cozia Massif, over an area of just a few km². The Cozia Massif is delimited to the east and north by the Olt and Băiaş rivers. It is connected to other mountain areas only to the east through a peak of about 750 m, which is below this species' lowest altitudinal

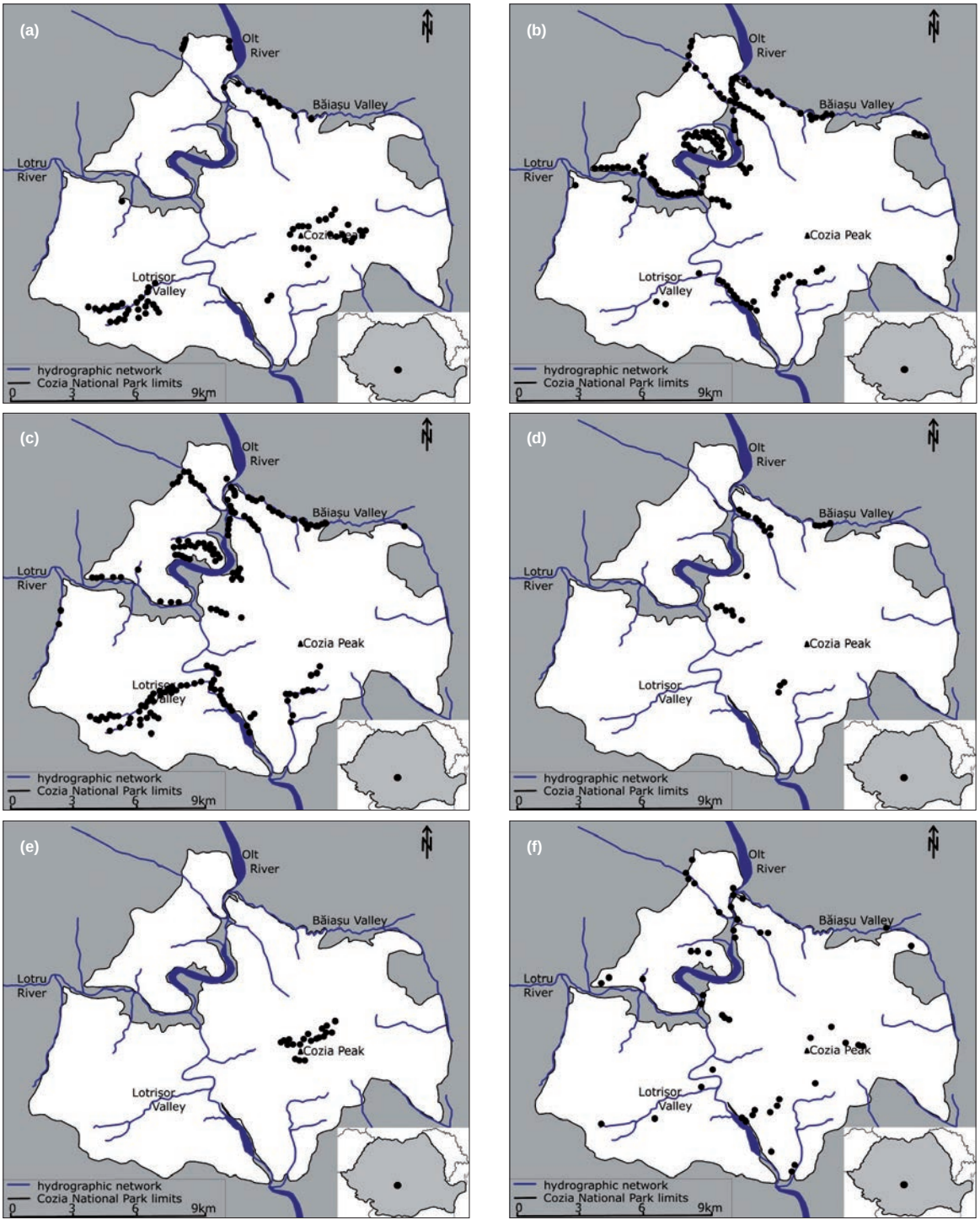


Figure 4 – The distribution (black dots) in CNP of (a) L. agilis*, (b)* L. viridis*, (c)* P. muralis*, (d)* D. praticola*, (e)* Z. vivipara *and (f)* A. colchica.

limit in the area. *Zootoca vivipara* habitats in CNP are similar to those of other populations, such as mountain meadows, and the margins of coniferous forests (Iftime 2005; Covaciu-Marcov et al. 2009a). Even at 1600 m, *Z. vivipara* is present alongside *L. agilis*. The high temperatures around the Cozia Massif (Stoenescu et al. 1966) pushed *Z. vivipara* populations to higher altitudes, isolating them from the ones in the southern Făgăraş Mountains; thus, they are relicts of a former distribution in the area. Any future climate change could cause their disappearance because they would not find any higher suitable habitats this close to the mountain peak. *Zootoca vivipara* from the Cozia Massif probably belongs to the haplogroup recently described in the Făgăraş Mountains (Velekei et al. 2015), which increases its conservation value. Due to its presence at high altitudes, *Z. vivipara* coexists only with *L. agilis*, although near CNP, in the Vâlsan river basin, it is present alongside *P. muralis* (Covaciu-Marcov et al. 2014). *Lacerta agilis* can coexist with all the other lizard spe-

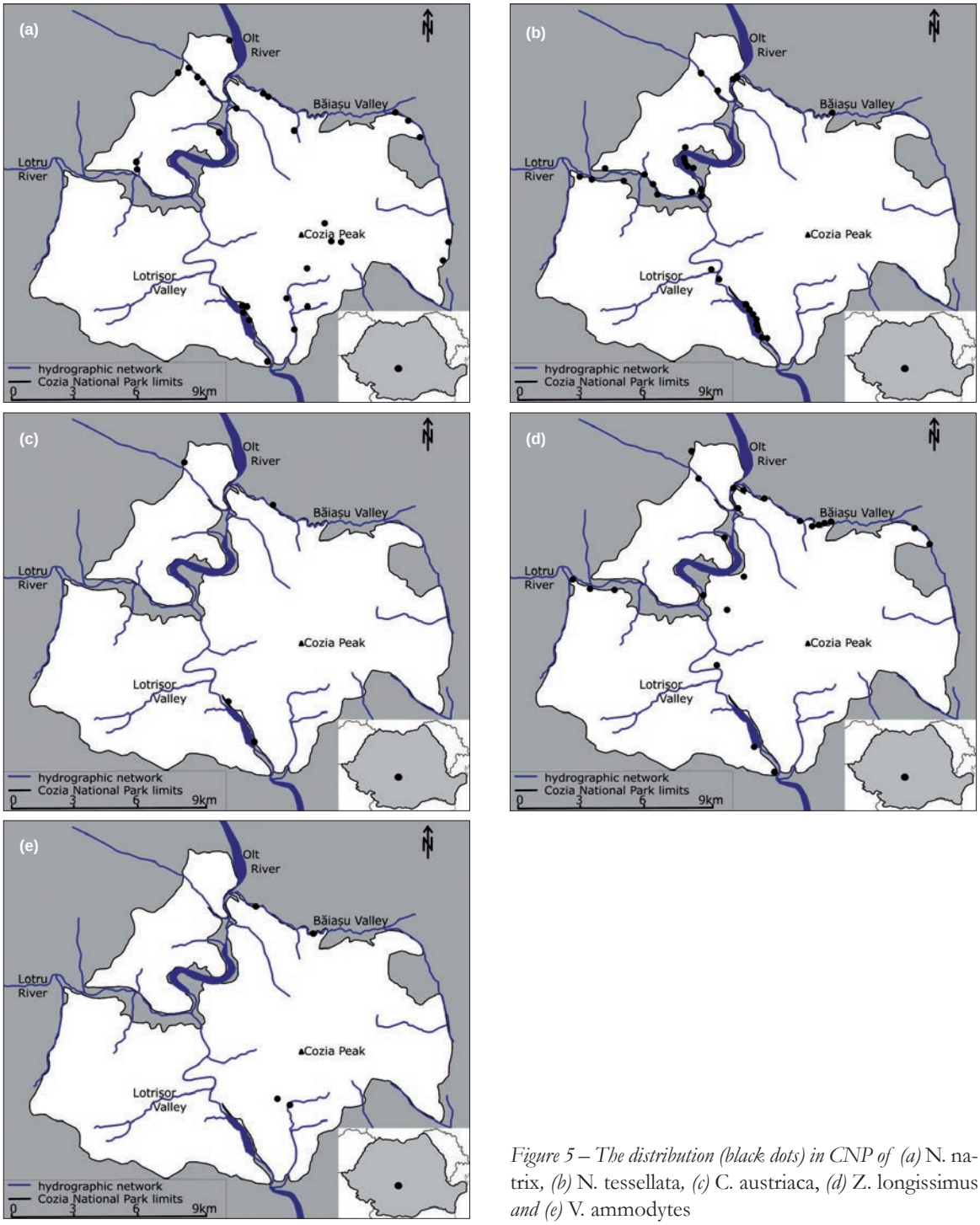


Figure 5 – The distribution (black dots) in CNP of (a) N. natrix*, (b)* N. tessellata*, (c)* C. austriaca, *(d)* Z. longissimus *and (e)* V. ammodytes

cies. In the highest areas of the Cozia Massif, *L. agilis* is syntopic with *Z. vivipara*. It is the only lizard present between 1 000 m and 1 350 m. Below this altitude, it co-occurs with *L. viridis*, *P. muralis* or *D. praticola*. These four lizard species (*L. agilis*, *L. viridis*, *P. muralis* and *D. praticola*) are rarely syntopic (Lotrişoru de Cozia valley). In CNP, *P. muralis* ascends to almost 1 000 m along forest roads and sunny slopes.

CNP's herpetofauna is dominated by forest and rock-loving species, which is to be expected since forests occupy most of the park (Ploaie 2004; Ploaie & Turnock 2001). The rarest amphibian is *B. viridis*, which was recorded at only two points, inside and near human settlements. Despite having been mentioned upstream of CNP (Fuhn 1960; Krecsák et al. 2004), *B. viridis* probably benefits from human settlements in the area because it is a steppe species (Fuhn 1960) with few natural habitats in the Park. It was recently reidentified in the region, but also in or near human settlements (Iftime & Iftime 2019). *Coronella austriaca* and *V. ammodytes* are the rarest reptiles. *C. austriaca* is a difficult species to observe (Hartel et al. 2009). *V. ammodytes* is at the limit of its distribution range and requires particularly rare habitats and conditions

(Ghira 2016). The presence of both species in the area has been noted in various publications (see a review in Iftime & Iftime 2019). Some rarely mentioned species, such as *V. ammodytes* (see in Iftime & Iftime 2019), were recorded by us at more distribution points.

Because increasing sampling effort leads to evidence of greater species richness (Băncilă et al. 2014), new field studies could lead to new distribution records of the known species or even of species that we did not encounter. It is also possible that some species were not accurately represented in our maps, as we may have missed their peak activity due to differences in species ecology (Fuhn 1960, Fuhn & Vancea 1961) and weather conditions. Furthermore, not all regions of CNP were covered in the same amount of detail: Mount Narăţ, for example, was less well covered. In 2018, the region was affected by strong winds that toppled trees and rendered some tourist routes inaccessible. Despite these methodological shortcomings, it can be seen that the herpetofauna of CNP is richer than that of many areas in the Southern Carpathians (Iftime 2005; Iftime & Iftime 2010, 2013, 2014; Covaciu-Marcov et al. 2014; Dincă et al. 2013), but poorer than in some hotspots, like the Jiu River Gorge (Covaciu-Marcov et al. 2009a): most mountain species associated with colder climate are absent from CNP, which is an oasis for warmer-climate species. Nevertheless, there are similarities between the herpetofauna of CNP and that of other regions in the Southern Carpathians. Newts are rare in CNP, as they are in the Jiu River Gorge, Danube Gorge and Jieţ valley (Covaciu-Marcov et al. 2009a, b; Iftime & Iftime 2010), where the steep slopes provide very few suitable breeding habitats (Covaciu-Marcov et al. 2009a, b; Iftime & Iftime 2010). Newts in CNP are present either in partially artificial wet areas near the river Olt, or in ponds formed as a result of landslides in the eastern CNP. Only *L. vulgaris* is present in small ponds in the peak area of the Cozia Massif.

Earlier human activities, such as the hydro-electrical works and heavy deforestation, have had an impact on the herpetofauna of CNP. Nowadays, the Olt is a succession of dams, in both the gorge and downstream sections (Rădoane & Rădoane 2005). Its tributary, the Lotru, has suffered the most modifications of this type in the country (Cojocar 2014). *P. ridibundus* and *Natrix tessellata* are probably favoured by the dams, which form stagnant bodies of water in an area naturally devoid of such habitats. Because of the lack of historical data, we cannot know how much has been lost due to the dams. The dams are also the reason why the railway was moved; thus, new tunnels were made, and some old ones were abandoned (Turnock 2006; Bellu 2010). Two abandoned tunnels were flooded, but one is above the water level and is used by some amphibians. More than 50 m inside this particular tunnel, we identified *B. variegata* individuals, and even one *B. bufo*. *Bombina variegata* was recently recorded in caves (Russo et al. 2018) and had already been sighted in abandoned tunnels (Covaciu-Marcov et al. 2017a). This confirms that abandoned railroad tunnels may be used by amphibians even in natural areas (Covaciu-Marcov et al. 2017a).

Other structures left behind by human activity, however, have negative effects on herpetofauna, like the vertical pipes open at ground level in which some amphibians get trapped. Massive deforestation has shaped the appearance of today's forests in CNP, and in the Southern Carpathian region, between the Olt and the Jiu, there were many sawmills (Turnock 2006). The effects of this activity are still apparent: many forests, especially in the eastern CNP, are regenerated forests or plantations. Herpetofauna is poorer in these areas, and similar cases have already been recorded (Covaciu-Marcov et al. 2009a). Deforestation continues, but on a smaller scale and in the already affected regions.

Nowadays, human impact in CNP is reduced and at a constant level. However, it could increase in the future because of plans for a highway to pass through its northern area, in the Băiaşu valley (Anonymous 2018). Băiaşu Gorge is an area with a rich herpetofauna, which should be taken into consideration when constructing the highway. As in other regions of Romania (Ciolan et al. 2017; Covaciu-Marcov et al. 2017b), road traffic already has a negative impact on the herpetofauna of CNP, as numerous individuals are killed, even on roads with little traffic. The richest herpetofauna in CNP is to be found in the southern and western parts of the Cozia Massif, in its higher area, and in the Băiaşu, Lotrişor, Călineşti and Beţel valleys. These areas should be kept free of human interventions, especially in the natural primary forests, where deforestation should be prohibited (see Schrödl 2019). The eastern areas could be included in restoration programmes, replacing coniferous plantations with native forests. As long as the human impact is maintained within its current limits, the future of CNP's herpetofauna seems secure.

Acknowledgments

This study was carried out in collaboration with the Cozia National Park Administration. We would like to thank to Diana L. Delibaltov (Google, Mountain View, CA, USA) for revising the language of the manuscript.

References

Anonymous 2018. *Acord de Mediu pentru proiectul Autostrada Sibiu – Piteşti.* ANPM Bucureşti. [In Romanian].

Ansari, N.A. 2018. Enumeration of Herpetofaunal assemblage of Surajpur Wetland, National Capital Region (India). *Amphibian & Reptile Conservation* 12(2): 90–97.

Băncilă, R.I., D. Cogălniceanu, R. Plăiaşu, M. Tudor, C. Cazacu & T. Hartel 2014. Comparative per-

formance of incidence-based estimators of species richness in temperate zone herpetofauna inventories. *Ecological Indicators* 45: 219–226.

Bellu, R. 2010. *Romania, mica monografie a tunelurilor de cale ferata (1856–2009)*. Tipografia Filaret S.A., Bucureşti. [In Romanian].

Bogdan, H.V., I. Sas-Kovács & S.D. Covaciu-Marcov 2014. Herpetofaunistic diversity in Lipova Hills, western Romania: Actual and past causes. *Biharean Biologist* 8(1): 48–52.

Bunescu, A. 1959. Contribuţii la studiul răspândirii geografice a unor animale mediterannene din R.P.R. Nota I. Artropode. *Probleme de Geografie* 6: 87–107. [In Romanian].

Cicort-Lucaciu, A.Ş. & K. Muncuş-Nagy 2013. Some data about the herpetofauna of two natural protected areas from Transylvania, Romania and their surroundings. *Herpetologica Romanica* 7: 1–21.

Ciolan, E., A-Ş. Cicort-Lucaciu, I. Sas-Kovács, S. Ferenţi & S.-D. Covaciu-Marcov 2017. Wooded area, forest road-killed animals: Intensity and seasonal differences of road mortality on a small, newly upgraded road in western Romania. *Transportation Research Part D: Transport and Environment* 55: 12–20.

Cogălniceanu, D., L. Rozylowicz, P. Székely, C. Samoilă, F. Stănescu, M. Tudor, D. Székely & R. Iosif 2013a. Diversity and distribution of reptiles in Romania. *ZooKeys* 341: 49–76.

Cogălniceanu, D., P. Székely, C. Samoilă, R. Iosif, M. Tudor, R. Plăiaşu, F. Stănescu & L. Rozylowicz 2013b. Diversity and distribution of amphibians in Romania. *ZooKeys* 296: 35–57.

Cojocar, M. 2014. Representative dams in Romania. *Hidrotehnica* 59(12): 3–23.

Covaciu-Marcov, S.-D. & S. Ferenţi 2019. An endemic species in a protected area: *Euscorpius carpathicus* (L., 1767) in the Cozia National Park, Romania (Scorpiones: Euscorpiidae). *Euscorpius* 279: 1–6.

Covaciu-Marcov, S.-D., I. Ghira, A.-Ş. Cicort-Lucaciu, I. Sas, A. Strugariu & H.V. Bogdan 2006. Contributions to knowledge regarding the geographical distribution of the herpetofauna of Dobrudja, Romania. *North-Western Journal of Zoology* 2(2): 88–125.

Covaciu-Marcov, S.-D., A.-Ş. Cicort-Lucaciu, S. Ferenţi & A. David 2008. The distribution of lowland *Zootoca vivipara* populations in North-Western Romania. *North-Western Journal of Zoology* 4(1): 72–78.

Covaciu-Marcov, S.-D., A.-Ş. Cicort-Lucaciu, F. Dobre, S. Ferenţi, M. Birceanu, R. Mihuţ & A. Strugariu 2009a. The herpetofauna of the Jiului Gorge National Park, Romania. *North-Western Journal of Zoology* 5 (Supplement 1): S1–S78.

Covaciu-Marcov, S.-D., A.-Ş. Cicort-Lucaciu, O. Gaceu, I. Sas, S. Ferenţi & H. V. Bogdan 2009b. The herpetofauna of the south-western part of Mehedinţi County, Romania. *North-Western Journal of Zoology* 5(1): 142–164.

Covaciu-Marcov, S.-D., A.-Ş. Cicort-Lucaciu, I.C. Telcean, A. Pal & I. Sas-Kovács 2014. Some notes on the herpetofauna from Vâlsan River natural protected area, Romania. *Carpathian Journal of Earth and Environmental Sciences* 9(3): 171–176.

Covaciu-Marcov, S.-D., S. Ferenţi, I. Urák, É.-H. Sas-Kovács, A.-Ş. Cicort-Lucaciu & I. Sas-Kovács 2017a. After the last train passes: data on the fauna from abandoned railway tunnels in Romania. *Annales Zoologici Fennici* 54: 335–346.

Covaciu-Marcov, S.-D., A. Puskás, A.N. Pop, M. Ţârţ & S. Ferenţi 2017b. Road-killed Amphibian and Reptiles on a Local Road in a Protected Area in Western Romania. *Acta Zoologica Bulgarica* 69(1): 115–120.

Ćorović, J., M. Popović, D. Cogălniceanu, M.A. Carretero & J. Crnobrnja-Isailović 2018. Distribution of the meadow lizard in Europe and its realized ecological niche model. *Journal of Natural History* 52(29-30): 1909–1925.

de Medeiros Magalhães, F., D.O. Laranjeiras, T.B. Costa, F.A. Juncá, D.O. Mesquita, D.L. Röhr, W.P. da Silva, G.H.C. Vieira & A.A. Garda 2015. Herpetofauna of protected areas in the Caatinga IV: Chapada Diamantina National Park, Bahia, Brazil. *Herpetology Notes* 8: 243–261.

Dincă, P.C., A. Strugariu, A. Iftime, O. Iftime, O. Zamfirescu & Z. Zamfirescu 2013. Herpetofauna from the upper Topolog River basin (Romania). *Analele* Ştiinţifice *ale Universităţii „Alexandru Ioan Cuza" din Iaşi, s. Biologie animală* 59: 61–68.

Fuhn, I. 1960. *"Fauna R.P.R.", vol. XIV, Fascicola I, Amphibia.* Editura Academiei R.P.R., Bucharest. [In Romanian].

Fuhn, I. & Ş. Vancea 1961. *"Fauna R.P.R.", vol. XIV, Fascicola II, Reptilia*. Editura Academiei R. P. R., Bucharest. [In Romanian].

Gaceu, O. & I. Josan 2013. Note on the occurrence of *Darevskia pontica* (Reptilia) north of Mureş River, in Metaliferi Mountains, western Romania. *North-Western Journal of Zoology* 9(2): 450–452.

Gherghel, I., A. Strugariu, T. Sahlean & A. Stefanescu 2011. New Romanian distribution record for *Darevskia praticola pontica* (Lantz and Cyrén, 1919) at its north-western range limit. *Herpetozoa* 23(3/4): 91–93.

Gherghel, I., A. Sotek, M. Papeş, A. Strugariu & L. Fusu 2016. Ecology and biogeography of the endemic scorpion *Euscorpius carpathicus* (Scorpiones: Euscorpiidae): a multiscale analysis. *Journal of Arachnology* 44: 88–91.

Ghira, I. 2016. *Ecologia, etologia, şi distribuţia geografică a viperei cu corn (Vipera ammodytes ammodytes L., 1758) în România*. Presa Universitară Clujeană, Cluj-Napoca. [In Romanian].

Ghira, I., S.-D. Covaciu-Marcov, A.-Ş. Cicort-Lucaciu & I. Sas 2012. Notes upon the herpetofauna of the Cefa Nature Park, (Crişana, Romania). *Transylvanian Review of Systematical and Ecological Research* 13: 171–176.

Hartel, T., K. Öllerer, L. Farczády, C.I. Moga & R. Băncilă 2009. Using species detectability to infer distribution, habitat use and absence of a cryptic species:

the smooth snake (*Coronella austriaca*) in Saxon Transylvania. *Biologia Acta Scientiarum Transylvanica* 17(1): 61–76.

Hollanders, M., F. Serrano, T. Leerschool & W. Beukema 2018. New and recent herpetological records from Soria, Spain. *Boletín de la Asociación Herpetológica Española* 29(1): 105–109.

Hoffmann, S., C. Beierkuhnlein, R. Field, A. Provenzale & A. Chiarucci 2018. Uniqueness of Protected Areas for Conservation Strategies in the European Union. *Scientific Reports* 8: 6445.

Iftime, A. 2005. Notes on the amphibians and reptiles in the region of Vidraru Dam Lake (Southern cline of Făgăraş Massif, Romania). *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»* 48: 317–326.

Iftime, A. & O. Iftime 2006. Preliminary data on the herpetofauna of the Cozia Massif (Romania). 1. Reptiles. *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»* 49: 331–340.

Iftime, A. & O. Iftime 2007. Preliminary data on the herpetofauna of the Cozia Massif (Romania). 2. Amphibians. *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»* 50: 259–271.

Iftime, A. & O. Iftime 2008. Observations on the herpetofauna of the Giurgiu County, Romania. *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»* 51: 209-218.

Iftime, A. & O. Iftime 2010. Contributions to the knowledge of the herpetofauna of the eastern Jiu and upper Lotru drainage basins (Southern Carpathians, Romania). *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»* 53: 273–286.

Iftime, A. & O. Iftime 2011. Note on the herpetofauna of the Vâlcan Mountains and their foothills (Southern Carpathians, Romania). *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»* 54(2): 533–521.

Iftime, A. & O. Iftime 2013. Observations on the herpetofauna of the Buila-Vânturariţa Massif (Southern Carpathians, Romania). *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»* 56(1): 93–101.

Iftime, A. & O. Iftime 2014. Note on the amphibians and reptiles on the „Nordul Gorjului de Est" site of community interest and adjacent areas (Southern Carpathians, Romania). *North-Western Journal of Zoology* 10 (Supplement 1): S44–S50.

Iftime, A. & O. Iftime 2015. Contributions to the Knowledge on the Amphibians and Reptiles of Teleorman County (Southern Romania). *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»* 58(1-2): 63–71.

Iftime, A. & O. Iftime 2017a. Data on the Populations of *Bombina variegata* (Amphibia: Anura: Bombinatoridae) from Cozia National Park and its Surrounding Areas (Vâlcea County, Romania). *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»*, 60(1): 389–399.

Iftime, A. & O. Iftime 2017b. Contributions to the Knowledge on the Amphibians and Reptiles of Ialomiţa County (South-Eastern Romania). *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»* 60(2): 505–516.

Iftime. A. & O. Iftime 2019. New herpetological records from Cozia National Park and its surrounding areas (Vâlcea County, Romania). *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»* 62(2): 221–233.

Iojă, C.I., M. Pătroescu, L. Rozylowicz, V.D. Popescu, M. Vergheleţ, M.I. Zotta & M. Felciuc 2010. The efficacy of Romania's protected areas network in conserving biodiversity. *Biological Conservation* 143: 2468–2476.

Kass, C., N.A. Kass, M.A. Velasco, M.D. Juri, J.D. Williams & F.P. Kacoliris 2018. Inventory of the herpetofauna of Talampaya National Park, a World Heritage Site in Argentina. *Neotropical Biology and Conservation* 13(3): 202–211.

Krecsák, L., T. Sike & T. Sos 2004. Distribution of the herpetofauna in the Lotrioara River basin, Sibiu District, Romania. *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»* 47: 285–295.

Lamb, T., R.W. Gaul Jr, M.L. Tripp, J.M. Horton & B.W. Grant 1998. A Herpetofaunal Inventory of the lower Roanoke River Floodplain. *The Journal of the Elisha Mitchell Scientific Society* 114(2): 43–55.

Leyte-Manrique, A., C. Berriozabal-Islas, V. Mata-Silva & J.P. Morales-Castorena 2018. Herpetofaunal diversity in Área Natural Protegida Las Musas, Guanajuato, Mexico. *Mesoamerican Herpetology* 5(1): 122–136.

Niculae, M.I., S. Avram, G.O. Vânău & M. Pătroescu 2017. Effectiveness of Natura 2000 network in Romanian Alpine Biogeographical Region: an assessment based on forest landscape connectivity. *Annales of Forest Research* 60(1): 19–32.

Ovreiu, A.B., I.A. Bărsoianu, L. Comănescu & A. Nedelea 2018. Assessing the accessibility of relief for tourism activities. Case study – Cozia Massif (Southern Carpathians, Romania). *GeoJournal of Tourism and Geosites* 22(2): 509–523.

Ovreiu, A.B., I.A. Bărsoianu, L. Comănescu & A. Nedelea 2019. Capitalizing of the geotourism potential and its impact on relief. Case study – Cozia Massif, Romania). *GeoJournal of Tourism and Geosites* 24(1): 212–236.

Ploaie, G. 2004. *Parcul Naţional Cozia*. Editura Almarom, Râmnicu Vâlcea. [In Romanian].

Ploaie, G. & D. Turnock 1999. Conservation and rural change in Valcea County. *GeoJournal* 46: 289–303.

Ploaie, G. & D. Turnock 2001. Public perception of environment in the mountains of Vâlcea County. *GeoJournal* 54: 683–701.

Rădoane, M. & N. Rădoane 2005. Dams, sediment sources and reservoirs silting in Romania. *Geomorphology* 71: 112–125.

Rozylowicz, L., A. Nita, S. Manolache, V.D. Popescu & T. Hartel 2019. Navigating protected areas net-

works for improving diffusion of conservation practices. *Journal of Environmental Management* 230: 413–421.

Russo, V.G., L.F. Russo, L. Coppari & T. Notomista 2018. First record of *Bombina variegata* (Linnaeus, 1758) in a cave environment. *Herpetology Notes* 11: 967–969.

Schrödl, M. 2019. A scientist's warning: Stop neglecting biodiversity in climate change! *Spixiana* 42(1): 1–5.

Sillero, N., J. Campos, A. Bonardi, C. Corti, R. Creemers, P.-A. Crochet, J. Crnobrnja Isailović, M. Denoël, G.F. Ficetola, J. Gonçalves, S. Kuamin, P. Lymberakis, P. de Pous, A. Rodríguez, R. Sindaco, J. Speybroeck, B. Toxopeus, D.R. Vieites & M. Vences 2014. Updated distribution and biogeography of amphibians and reptiles of Europe. *Amphibia-Reptilia* 35: 1–31.

Slavchev, M.L., G.S. Popgeorgiev & N.D. Tzankov 2019. Species Diversity of Amphibians and Reptiles in Relation to Habitat Diversity at a Natura 2000 Area in NW Bulgaria. *Acta Zoologica Bulgarica* 71(3): 377–384.

Stoenescu, Ş.M., A. Şchiop, I. Dica, E. Popescu, E. Patrichi & E. Ţepeş 1966. *Atlasul climatologic al R. S. R., Bucureşti.* [In Romanian]

Strugariu, A., S.R. Zamfirescu, A. Nicoară, I. Gherghel, I. Sas, C.M. Puşcaşu & T. Bugeac 2008. Preliminary data regarding the distribution and status of the herpetofauna in Iaşi County (Romania). *North-Western Journal of Zoology* 4 (Supplement 1): S1–S23.

Sucea, F.-N. 2019. The Second Record of a Rare Lizard Species, *Darevskia praticola* (Eversmann, 1834), in the Jiu Gorge National Park, Romania. *Ecologia Balkanica* 11(1): 239–241.

Tomović, L., R. Ajtić, K. Ljubisavljević, A. Urošević, D. Jović, I. Krizmanić, N. Labus, S. Đorđević, M. Kalezić, T. Vukov & G. Džukić 2014. Reptiles in Serbia – Distribution and Diversity Patterns. *Bulletin of the Natural History Museum* 7: 129–158.

Török, Z., O. Ghira, I. Sas & S. Zamfirescu 2013. *Ghid sintetic de monitorizare a speciilor comunitare de reptile şi amfibieni din România.* Editura Centrul de Informare Tehnologică Delta Dunării, Tulcea. [In Romanian].

Tuberville, T.D., J.D. Willson, M.E. Dorcas & J. Whitfield Gibbons 2005. Herpetofaunal Species Richness of Southeastern National Parks. *Southeastern Naturalist* 4(3): 537–569.

Tufescu, V. 1986. *Harta R. S. România.* Editura Didactică şi Pedagogică, Bucureşti. [In Romanian].

Turnock, D. 2005. Romania's Railway Development 1950–1989: Changing Priorities for Socialist Construction. *Geographica Pannonica* 9: 32–43.

Turnock, D. 2006. The Romanian Carpathians under communism: the changing significance of a mountain region. *Review of Historical Geography and Toponomastics* 1(2): 157–206.

Velekei, B., F. Lakatos, S.-D. Covaciu-Marcov, I. Sas-Kovács & M. Puky 2015. New *Zootoca vivipara* (Lichtenstein, 1823) haplogroup in the Carpathians. *North-Western Journal of Zoology* 11(2): 363–365.

Zamfirescu, Ş.R., A. Strugariu, P.C. Dincă & I. Gherghel 2016. An updated distribution of the herpetofauna from the Natura 2000 Site Rarău-Giumalău (ROSCI0212), Romania. *Memoirs of the Scientific Sections of the Romanian Academy* 39: 16–35.

***** O.U.G. nr. 57 / 2007 privind regimul ariilor naturale protejate, conservarea habitatelor naturale, a florei şi faunei sălbatice. [In Romanian, Romanian law].

Authors

Severus-Daniel Covaciu-Marcov[1] – corresponding author

is a herpetologist and associate professor at the University of Oradea, Faculty of Informatics and Sciences, Department of Biology. His work focuses on biogeography, faunistics, the ecology of herpetofauna, and some invertebrate groups. E-mail: severcovaciu1@gmail.com

Paula-Vanda Popovici[1]

is an MS student at the University of Oradea, Faculty of Informatics and Sciences, Department of Biology, with an interest in the negative effects of human activity on wildlife.

Alfred-Ştefan Cicort-Lucaciu[1]

is a senior lecturer at the University of Oradea, Faculty of Informatics and Sciences, Department of Biology. He studies various aspects of conservation biology, faunistics and the ecology of newts especially, but also other animal groups.

István Sas-Kovács[1]

is a senior lecturer at the University of Oradea, Faculty of Informatics and Sciences, Department of Biology, studying herpetology. His main focus is on amphibians, especially their ecology and biology.

Diana Cupşa[1]

is a professor at the University of Oradea, Faculty of Informatics and Sciences, Department of Biology. Her main research domain is freshwater ecology, with a special focus on functional and conservation aspects.

Sára Ferenţi[1]

is an assistant at the University of Oradea, Faculty of Informatics and Sciences, Department of Biology, whose main research interests are in the ecology, biology and biogeography of terrestrial isopods and herpetofauna.

[1]University of Oradea, Faculty of Informatics and Sciences, Department of Biology; 1, Universităţii, Oradea 410087, Romania.

eco.mont – Volume 12, Number 2, July 2020
ISSN 2073-106X print version – ISSN 2073-1558 online version: http://epub.oeaw.ac.at/eco.mont
https://dx.doi.org/10.1553/eco.mont-12-2s22

The economic impact of tourism on protected natural areas: examining the influence of physical activity intensity on visitors' spending levels

Estela Inés Farías-Torbidoni & Demir Barić

Keywords: economic impact, physical activity intensity, MET, visitors' profile, hierarchical multiple regression

Abstract

In addition to being important tourism attractions that boost local economic development, protected areas also promote healthy habits through engagement in a variety of physical activities (PA). However, little is known about the extent to which PA intensity influences visitors' spending. Drawing on results from 500 questionnaires collected from visitors in the Alt Pirineu Natural Park, Spain, this study assesses the influence of PA intensity on spending after controlling for sociodemographic, visit, motivational and opinion descriptors to assess the connection between these two factors. Hierarchical regression analysis revealed that PA intensity had a marginal but potentially significant effect on respondents' expenditure during their visits. When looked at separately, the results indicated that trip and motivational descriptors explained the highest degree of variation in visitor spending. More research is necessary to confirm whether these findings are applicable broadly.

Profile

Protected area

Alt Pirineu Natural Park

Mountain range

Pyrenees

Country

Spain

Introduction

In addition to preserving biodiversity, protected natural areas (PNAs) are increasingly recognized as a driving force for economic regional development and the sociological prosperity of many adjacent local communities (Hammer et al.; 2012; Mayer et al. 2010; Mayer & Job 2014; McDonald & Wilks 1986; Lintzmeyer & Siegrist 2008; Pröbstl-Haider & Haider 2014; Reinius & Fredman 2007; Schirpke et al. 2018). They are also seen as promoting healthy lifestyles by offering engagement in a variety of physical activities (PA) (Bedimo-Rung et al. 2005; Cohen et al. 2014; Europarc-España 2013; Lemieux et al. 2012; Maller et al.2010; Stolton & Dudley 2010).

Attracting more than eight billion visits per year worldwide, terrestrial protected areas are an important factor in the growth of nature-based tourism globally (UNEF-WCMC & UICN). Among others, Eagles et al. (2000) show for the USA and Canada that nature-based tourists in national parks create an important economic impact for the park's peripheral regions. In the European context, it is estimated that visitors to Natura 2000 sites in the EU generate around EUR 50–85 billion / year (European Commission, 2013). In particular, a study on the economic impact of tourist spending in the six German national parks revealed spending ranging from 525 million to 1.9 million euros, depending on the national park (Mayer et al., 2010).

Several studies have shown that physical activity carried out in protected areas is generally of a higher level than exercise done at home, with correspondingly greater physical, psychological, spiritual and social benefits (Bird 2004; Giles-Corti et al. 2005; Godbey 2009; Godbey & Mowen 2010; Oftedal & Schneider 2013; Romgosa et al. 2015; Romagosa 2018). Furthermore, some studies examining characteristics of visitors to PNAs have demonstrated that the types of PA available in a PNA are a key pull factor for the decision to visit the area. Studies have also shown that differences in PA intensity may reflect varieties in visitors' sociodemographic profiles, behavioural characteristics, preferences and motivations (Arnberger et al. 2019; Barić et al. 2016a; Cordente-Rodríguez 2014; Broyles et al. 2011; Farías-Torbidoni 2011; Galloway 2002; Mowen et al. 2012) and, indeed, how much they are willing to spend (Schirpke et al. 2018). According to Jette et al. (1990), PA intensity is defined by its MET value, which is the ratio of an individual's working metabolic rate relative to their resting metabolic rate. MET is used to express the intensity and energy expenditure of activities in a way that allows comparisons among different physical activities. MET values are well documented in the Compendium of Physical Activities and include 4 basic PA intensities: sedentary, ≤ 1.5 METs; light intensity, 1.6 to 2.9 METs; moderate intensity, 3.0 to 5.9 METs; and vigorous intensity, ≥ 6 METs (Ainsworth et al. 2011).

However, in theoretical terms, PNAs and their managers experience various dilemmas in managing their territories and in constructing their development models, which are two increasingly recognized challenges (Leung et al. 2019). Finding a balance between protecting the ecological integrity of ecosystems and satisfying the necessities of growing tourism and recreation demand is increasingly complicated, especially in PNAs with limited financial and human resources. Knowledge of the possible relationship between PA intensity and visitors' levels of spending can provide valuable input data for developing effective and creative management measures to satisfy the increasing and varied demands placed on these kinds of area.

The main objectives of this exploratory research are therefore the following, organized in order of application:

1. analyse how much visitors spend per visit, including on accommodation, food and drink, and local products and services;
2. group visitors by reported physical activities, using corresponding MET values;
3. assess the influence of PA intensity on spending levels after controlling for sociodemographic, trip, motivational and opinion descriptors.

Literature review: economic impact of tourism and PA in PNAs

According to Watson et al. (2007), economic impact is defined as the net change in economic activity associated with an industry, event or policy in an existing regional economy. A variety of methods, ranging from pure guesswork to complex mathematical models, are used to estimate tourism's economic impacts (Job 2008; Mayer & Job 2014). Studies vary extensively in quality and accuracy, as well as in which aspects of tourism are included (Stynes 1997). According to Stynes (1999), the economic impact of visitor spending is typically estimated by the variation of three basic components: number of tourists, average spending per visitor and multiplier. However, in the case of PNAs, the simple consideration of the money visitors spend on food, accommodation and services during their visit to an area could be useful first to assess and then to track the economic impact of visitors on the region (Eagles 2002; Mayer et al. 2010; Carlsen & Wood 2004). Moreover, it is interesting to highlight the three advantages that Alegre and Pou (2004) noted with respect to microeconomic studies. Although macro- and microeconomic studies serve different purposes, these authors contend that microeconomics studies allow little deviation from theoretical economic consumer models, avoid bias when the analysis is based on aggregated data, and acknowledge the diversity and heterogeneity of consumer behaviours that are ignored in studies using highly aggregated data.

Previous research in the field of tourism impact in PNAs encompasses three main topics: i) the role of the PNA in tourism development and visitor affinity (Mayer et al. 2010; Pröbstl-Haider & Haider 2014; Reinius & Fredman 2007); ii) the amount of money that a PNA could generate in the region (Eagles 2002; Person et al. 2000; Zambrano-Monserrate et al. 2018); iii) the relationship between key visitor characteristics and visitors' spending levels (Flix & Loomis 1997; Fredman 2008; Hierpe & Kim 2007 McDonald & Wilks 1986).

Regarding the last topic, several authors have argued that differences in spending could vary according to the profile, needs and preferences of visitors (Mayer & Voght 2016; Mika et al. 2016; Stynes 1999; Wanga & Davidson 2010; Watson et al. 2007). Moreover, although they do not address economic impact directly, a number of visitor segmentation studies by specific PNAs have demonstrated that PA and its intensity greatly influence specific behavioural characteristics (i. e., type of accommodation, length of stay or party size) and are often responsible for the level of spending (Farías-Torbidoni & Monserrat 2014; Farías-Torbidoni et al. 2018; Mayer et al. 2010). For example, Barić et al. (2016b) and Farías-Torbidoni et al. (2005) demonstrated that visitors who were more physically dedicated and active preferred to stay longer at the chosen destination and visited it repeatedly. Their findings corroborated significantly those of Schirpke et al. (2018), who examined the profiles of visitors to ten Nature 2000 sites in Italy and found that higher-intensity activity visitors such as cyclists (M = 68.77 €) and mountaineers (M = 58.91 €) spent significantly more money per day compared to those who were engaged in lower-intensity PA such as hiking (M = 46.48 €) and picking mushrooms (M = 38.75 €). Including travel costs, this corresponds to a 10.70 € difference in visitors' average daily spend (48.56 €).

Research methodology

Study area

This study was carried out in the largest natural park in Catalonia, Spain, located in the Pyrenees. The Alt Pirineu Natural Park was established by the Catalan government in 2003. The definition and management of this protected natural area, which covers 69 850 ha (172 600 acres), is the responsibility of the Catalonia Region Government and is equivalent to the IUCN Protected Area Category V – Landscapes / Seascapes (Dudley 2008). It stretches over the administrative areas of Pallars Sobirà and Alt Urgell, and includes the highest peak in the Catalan Pyrenees. For managerial purposes, the park is divided into 5 zones and valleys: Valls d'Àneu, Vall de Cardós, Vall Ferrera, Vall de Santa Magdalena and Massís de l'Orri, four of which attract particularly high numbers of visitors. The number of park visits is 314 000 per year (data from the latest visitor report, Farías-Torbidoni & Morera 2017).

Figure 1 shows the 6 main entrances considered in the fieldwork. One of the park's most important features for this study is that it has an extensive provision of trails and managed areas for outdoor activities such as hiking, mountain biking, snow activities, and off-road activities. There are 3 different snow areas and more than 170 trails (permitting off-road driving) and paths inside the park, 94 of which are signposted. Thus, this area is representative of PNAs in Spain generally and of other countries in Europe. Detailed descriptions of the main characteristics of the entrances are provided in Table 1.

Data collection

Fieldwork was conducted from June 2017 to December 2017. The sampling days were one weekend day monthly during the entire period and one weekday

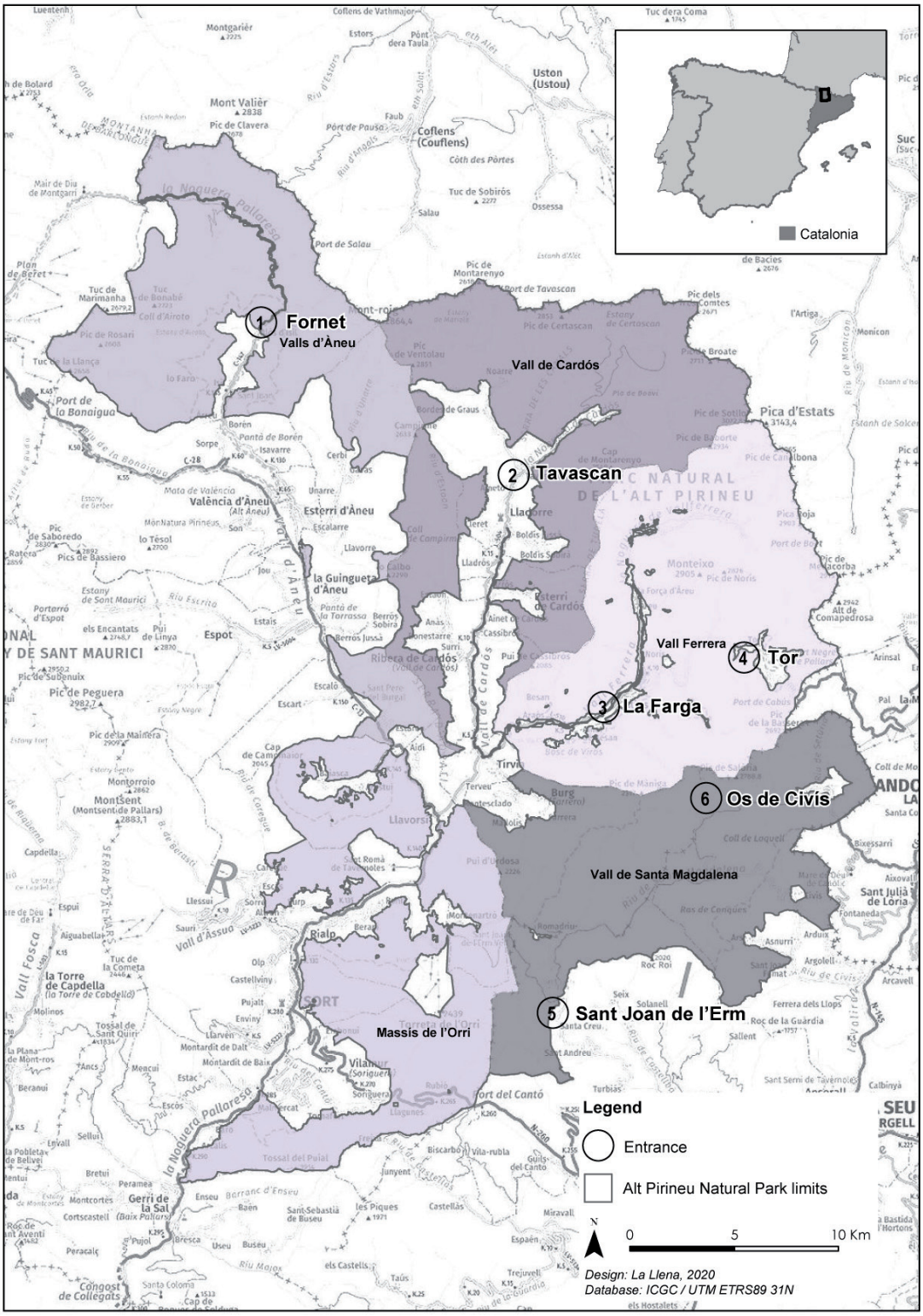


Figure 1 – Alt Pirineu Natural Park. The different shades of grey distinguish the Park's main valleys.

each month during the summer season (i.e., from 1 July to 31 August), resulting in 54 fieldwork days in total for the 6 entrances combined. In total, 706 questionnaires were collected through on-site structured interviews, carried out at each of the 6 entrances, of which 500 were considered usable as 206 respondents were permanent residents within the park borders and were therefore excluded. Table 2 shows the total sampling days at each entrance and the total number of questionnaires finally considered in the study.

Data were collected from 10 a.m. until sunset. Respondents were approached on their way out of the Park through the main entrances because most of the questions referred to the experience they had just had (e.g., place visited, activity practised, length of visit, etc.).

Table 1 – The six main entrances of Alt Pirineu Natural Park[a].

Main entrances	Fornet	Tavascan	La Farga	Tor	Sant Joan	Os Civís
Physical activity areas						
Path: low difficulty		1	2		3	1
Path: intermediate	1	2	2		1	2
Path: high difficulty	1	5	4	1	1	3
Specific MTB trails	1			1	3	1
Cross-Park routes	2	3	3			1
Iconic peaks	3	3	5	2	1	1
Others PA areas*	1					
Winter activity areas		2			2	
Total	9	16	16	4	11	9
Supporting areas						
Parking areas	1	3	4		1	1
Information points	1	1			1	1
Picnic areas	1	2	1		2	1
Shelters		2	1		1	
Signposts	1	1	1		1	1
Viewpoints		2	1	1	1	1
Total	4	11	8	1	7	5
Recreational and physical activities						
Hiking	Yes	Yes	Yes	Yes	Yes	Yes
Picking mushrooms					Yes	
Mountaineering	Yes	Yes	Yes	Yes	Yes	Yes
Mountain biking	Yes	Yes	Yes	Yes	Yes	Yes
Fishing	Yes					
Off-road driving	Yes			Yes	Yes	Yes
Downhill skiing		Yes				
Snow activities**		Yes			Yes	
Total	6	6	4	5	7	4

[a] The list of PAs and supporting areas is based on the sectorial maps included on the official web page, http://parcsnaturals.gencat.cat/es/alt-pirineu/visiteu-nos/guia-visita/planol/

* For instance, rivers for fishing

** Snowshoeing, snow mountaineering, cross-country skiing.

The survey was conducted with the assistance of 12 people trained in field survey techniques. The response rate was 95%, and the representativeness of the whole sample included an error of ±5%.

Survey Instrument

The survey consisted of four sections. In the first section, questions were devoted to basic sociodemographic and trip characteristics (e.g., place of residence, age, frequency of visiting). Five age groups were included: 18–25 years, 26–36 years, 37–47 years, 48–58 years, and older than 58. In the second section, visitors were asked to select from a predefined list the one recreational activity perceived as the most important for their visit. When the type of activity selected had some associated element of doubt (for instance, slow or brisk walking), the interviewer continued with complementary questions related to the itinerary followed and time spent on the visit, finally allowing the respondent's foremost activity to be identified correctly. The list of activities was developed in accordance with park regulations and observations made by the main author of the present study. The activities were then related to those listed in the Compendium of PA (Ainsworth et al. 2011). Activities in the study area included: activities at the entrances (such as picnics), vehicle touring, recreational hiking (slow walking), hiking (brisk walking), picking mushrooms (a variation of slow walking), off-road motocross, snow activities (snowshoeing, cross-country skiing, downhill skiing, snow mountaineering), mountaineering (scaling a peak), mountain biking, and trail running. In the third section, individuals were asked to rate the importance of 12 motivation statements, drawn from Farías-Torbidoni (2011), for their visit. The statements were operationalized on a five-point Likert scale, ranging from 1 (very unimportant) to 5 (very important). The fourth section aimed to assess how much visitors spent during their visit. Here, three open-ended questions were asked to gather information on how much individuals spent (in euros) on accommodation, food and drink, and services / products available in the area.

Table 2 – Distribution of questionnaires administered at the main entrances.

Entrance	Total fieldwork days	Number of questionnaires	Visitors who spent money during their visit to the park
Fornet	9	115	79
Tavascan	9	204	172
La Farga	9	112	77
Tor	9	53	40
Sant Joan de l'Erm	9	147	90
Os de Civís	9	75	42
Total	54	706	500

Data analysis

The data collected were transformed and coded using the Statistical Package for the Social Sciences 18.0 (SPSS). Descriptive statistics including frequencies, mean values and standard deviations were applied to assess the basic sample information. An updated version of the Compendium of Physical Activities' Relative Metabolic Intensity (MET) consumption values (Ainsworth et al. 2011) was used to identify respondents' PA intensity (light, moderate or vigorous). To uncover the underlying dimensions, 12 motivational statements were factor-analysed using principal component analysis (PCA) with Varimax rotation. Reliability was established using the Cronbach alpha internal consistency measure, with values between 0.70 and 0.79 regarded as adequate, values from 0.60 to 0.69 as moderate, and values less than 0.60 as minimal. Convergent validity was assessed through a minimum adequate factor loading of 0.50 (Hair et al. 2006). The following equation was used to calculate the average value of individual spending during the visit:

Table 3 – Descriptive analysis: Visitor sociodemographics and travel characteristics (n = 500).

Sample characteristics	M	SD	%
Sociodemographics			
Place of residence			
Barcelona			54.6
Lleida			16
Tarragona			58
Girona			3
Other provinces			7.2
Foreign countries			8.4
Gender			
Male			67.2
Female			32.8
Age			
18–25			4.7
26–36			21.5
37–47			34.4
48–58			24.4
Over 58			15
Age	46	12.36	
Education level			
No university degree			46.4
University degree			53.6
Trip characteristics			
Park entrance points			
Fornet			15.8
Tavascan			34.4
La Farga			15.4
Tor			8
Saint Joan de l'Erm			18
Os de Civís			8.4
Number of visits in last 2 years	3	6.71	
Visit duration (days)	3.5	5.57	
Spending on accommodation (in €)	238.9	403.02	
Spending on food (in €)	81.3	151.83	
Spending on services and products (in €)	12.6	33.95	
Total spending per visit (in €)	111	149.16	
Total spending per day (in €)	31.7	49.72	

Total Sp = Sp_1 + Sp_2 + Sp_3

Sp_1 – Spending on accommodation

Sp_2 – Spending on food and drink

Sp_3 – Spending on services and products

A one-way analysis of variance (ANOVA) with a post-hoc Tukey procedure was performed to explore the differences in visitor spending as related to entrance points to the park. After controlling for the effects of sociodemographic, travel and motivational characteristics, a four-step hierarchical multiple regression analysis was run to examine the relationship between the independent variable, PA intensity in which visitors participated (METs), and the dependent variable (individual expenditure during the visit). All polytomous independent variables were previously re-coded as dummy variables. Assumptions for normality, singularity and multicollinearity were checked (Cohen et al. 2003). The assumption of normality was assessed by examining the skewness (1.96) and kurtosis values (2.56) and visual observation of the Q-Q plot. Log transformation was performed to reduce a positive skew of dependent variables. The assumption of singularity was assessed by conducting a Pearson correlation analysis to uncover the possible existence of correlations between the independent variable above 0.7. The tolerance (values less than 0.10) and variation inflation factor (VIF; values above 10) were assessed to avoid multicollinearity among the predictor variables.

Results

Descriptive analysis

The total sample showed that more than two-thirds of the visitors were from Catalonia, of whom the majority were residents of the city of Barcelona (54.6%). Male respondents (67.2%) were twice as numerous as female respondents (32.8%). This proportion is not exceptional if we take into consideration the latest results obtained in the national context (Farías et al. 2018; Luque-Gil et al. 2018; Romagosa 2018) or indeed the European context (Shirpke et al. 2018). This kind of area is visited more by men than by women. Most visitors were in the age range of 37–58 years (56.8%); 21.5% were 26 to 36; and 15% were aged over 58. Only 4.7% were aged 18 to 25. The mean age was 46. More than half of the respondents had a university degree (53.6%). Tavascan was the most frequent entrance point (34.4%), followed by Sant Joan de l'Erm (18%). On average, respondents had visited the park three times in the last two years, usually staying three and a half days. 111 euros per visit was the (average) total spend registered by visitors, including accommodation, food, drink, services and products, corresponding to 31 euros per day. (See Table 3.)

Visitor spending according to entrance point

A one-way between-groups analysis of variance (ANOVA) showed statistically significant differences in spending with regards to the entrance points: F (5.494) = 6.148, $p < 0.001$ (Table 4). Subsequently, post-hoc comparisons using the Tukey HSD test indicated that the mean spending for Tavascan ($M = 147.39$, $SD = 187.05$) differed from the mean for Saint and Os de Civís at a significance level of $p < 0.001$. Visitors who entered the park through La Farga spent significantly more money than those who entered through Sant Joan de l'Erm ($p < 0.01$).

Grouping procedure

Using the updated version of the Compendium of Physical Activities' Relative Metabolic Intensity (MET) consumption values (Ainsworth et al. 2000), respondent-reported activities were classified into three distinct PA intensity groups (Table 5). The first group accounted for 21.6% of the sample and comprised those visitors who participated in activities with metabolic consumption between 1.5 and 3 METs (e.g., light PA intensity). The second (largest) group included 57.8% of respondents, who carried out mod-

Table 4 – ANOVA results: Visitors' spending with respect to entrance points (n = 500).

Entrance points	n	M	SD	F5.494
a) Fornet	79	116.75	123.05	6.148*
b) Tavascan	172	147.39[e,f]	187.05	
c) La Farga	77	130[a]	192.20	
d) Tor	40	105.27	97.37	
e) Saint Joan de l'Erm	90	53.5[b,c]	48.97	
f) Os de Civís	42	59.5[b]	65	

*Note: $p < 0.001$; post-hoc significant differences (Tukey HSD) are shown as indexes.
For example, spending by visitors who entered via Tavascan (listed as letter b) differed significantly only from those visitors who entered via Saint Joan de l'Erm (listed as e) and Os de Civís (listed as b). Spending by those who entered via Fornet did not differ significantly from that of other visitor groups.

Table 5 – Grouping procedure according to the PA Compendium and corresponding MET consumption [a] (n = 500).

Reported activities	Total sample		Code	MET	Grouping category
	N	%			
Activities at the entrance	92	18.4	09100	1.8	Light (21.6%)
Vehicle touring	16	3.2	09105	2	
Recreational hiking (slow walking)	129	25.8	17090	3.3	Moderate (57.8%)
Hiking (brisk walking)	130	26	17082	5.3	
Picking mushrooms	1	0.2	08246	3.5	
Off-road motocross	9	1.8	15470	4	
Snow activities	20	4.0	19190	5.3	
Mountaineering	49	9.8	17040	7.3	Vigorous (17.6%)
Mountain bike	37	7.4	01009	8.5	
Trail running	2	0.4	12140	9	
Unclear answers	15	3	--	--	--

erate PA intensity, in the range 3–6 METs. The third group (17.3%) included those individuals who were engaged in vigorous recreational activities with METs above 6. Those respondents who did not report their recreational activities (i. e., other; 1.7%) were excluded from the grouping procedure.

Visitors' motivations: factor analysis

A principal component analysis (PCA) with Varimax rotation was performed on 12 motivational variables to reveal underlying motivation factors. First, a series of basic measures was inspected to justify empirically whether the set of variables fitted the proposed statistical technique. Following convention, only items with no cross-loadings and with loadings of 0.50 or greater were retained for further analyses (Hair et al. 2006). Using this criterion, the initial list was shortened to nine items (Table 6). The Bartlett test of sphericity was then carried out on the remaining items; the value reached a statistical significance of $p < 0.001$, and the Kaiser-Meyer-Olkin value was 0.45. Therefore, the data revealed a reasonable fit for the proposed statistical procedure for factor analysis. Three factors, all of which had eigenvalues equal to or greater than 1.0, explained 62.69% of the total variance. The first factor, labelled *Physical activities*, contained four corresponding variables and yielded a reliability coefficient of 0.740. The second, *Nature,* comprised three items and produced a reliability coefficient of 0.635. The third, *Novelty*, reflected two variables and had an α value of 0.627. Factor two, *Nature,* was the most important motivation dimension, with a grand mean of 4.65.

Hierarchical regression analysis

After controlling for the effects of series of sociodemographic, travel and motivational characteristics, a four-step hierarchical multiple regression analysis was run to examine the influence of PA intensity, classified within MET values, on individual spending during the visit, x.

Prior to the regression analysis, a bivariate correlation analysis was conducted, as shown in Table 7. Seven out of the ten independent variables correlated significantly with the dependent variable. Among them, only age and frequency had negative associations. Correlations between independent variables were predominately weak and did not exceed 0.4. Additional preliminary analyses confirmed no violation of the assumptions of normality and multicollinearity. Four sociodemographic predictors (place of residence, gender, age and education level) were entered at the first

Table 6 – Motivation for visiting the park: Descriptive statistics, principal component analysis and factor loadings.

Principal components	M	SD	Item loading	Eigenvalue	Explained variance	Reliability coefficient
Factor 1: Physical activities	3.03	1.35		3.222	35.76	0.74
To do physical activities			0.86			
To practise some specific PA or sport			0.86			
To improve health			0.55			
To visit specific trails			0.52			
Factor 2: Nature	4.65	0.65		1.35	14.94	0.63
To relax and disconnect			0.77			
To enjoy the scenery			0.70			
To be close to nature			0.70			
Factor 3: Novelty	3.79	1.13		1.01	11.95	0.63
To enjoy new experiences			0.83			
To explore new places			0.80			

Table 7 – Correlations among dependent and independent variables.

	Individual spending per visit[a]	1	2	3	4	5	6	7	8	9
1. Place of residence	0.123**									
2. Gender (Ref: Female)	0.025	0.047								
3. Age	−0.223***	−0.097*	0.071							
4. Education level	0.064	0.078*	0.146**	0.096*						
5. Number of visits in the last 2 years	−0.142**	−0.087*	−0.041	0.047	−0.025					
6. Visit duration (days)	0.416***	0.079*	0.068	−0.109**	0.055	0.064				
7. Physical activities	0.162***	0.056	−0.005	0.005	0.187***	0.047	0.055			
8. Nature	0.05	0.237***	0.053	0.015	0.083*	−0.013	−0.136**	0.122**		
9. Novelty	0.162***	0.138***	0.037	0.082*	0.032	−0.190***	−0.023	0.107**	0.311***	
10. METs	0.197***	0.069	−0.005	−0.002	0.245***	0.005	0.131**	0.313***	0.186***	0.148***

Significance level (two-sided): *p < 0.05; **p < 0.01; ***p < 0.001
Note: [a] Dependent variable

step and accounted for statistically significant variance in the dependent variable ($R^2 = 0.066$, F change $(3.462) = 8.226$, $p < 0.001$). Addition of travel descriptors at step two (i.e., number of visits in the last two years and visit duration), led to a statistically significant increase in the R^2 of 0.170, F $(1.460) = 51.321$, $p < 0.001$. Three motivational dimensions (*Physical activity*, *Nature* and *Novelty*) entered at step three resulted in a statistically significant increment in R^2 of 0.039, F $(2.457) = 8.310$, $p < 0.001$. Finally, by adding the physical activity intensity in the fourth step, the final model reflected a weak but statistically significant change in R^2 of 0.006, F $(1.456) = 3.909$, $p < 0.05$. The full model comprising all predictor variables was statistically significant, $R^2 = 0.282$, F $(10.465) = 17.947$, $p < 0.001$. Here, statistically significant influences of the predictor variables on individual expenditure during the visit were found for age ($\beta = -0.182$, $p < 0.001$), frequency of visits ($\beta = -0.138$, $p < 0.001$), visit duration ($\beta = 0.393$, $p < 0.001$), motivational dimensions *Physical activity* ($\beta = 0.101$, $p < 0.05$), *Novelty* ($\beta = 0.123$, $p < 0.01$), and intensity of physical activities (MET; $\beta = 0.086$, $p < 0.05$).

Discussion of findings and implications

This study is the first attempt to analyse a comprehensive dataset on the microeconomic impact of tourism in a PNA in Spain as linked to visitors' behaviour. Where the three main goals of this research are con-

Table 8 – Hierarchical regression analysis for variables predicting total spending per individual during their visit.

Independent variable	Model 1			Model 2			Model 3			Model 4		
	B	SE B	β	B	SE B	β	B	SE B	β	B	SE B	β
Place of residence (Ref: City of Barcelona)	0.088	0.042	0.094*	0.054	0.039	0.058	0.023	0.039	0.024	0.024	0.039	0.026
Gender (Ref: Female)	0.025	0.045	0.025	−0.007	0.041	−0.007	−0.007	0.040	−0.007	−0.002	0.040	−0.002
Age(Year of birth)	−0.008	0.002	−0.223**	−0.006	0.002	−0.171***	−0.007	0.002	−0.184***	−0.007	0.002	−0.182***
Education level (Ref: University degree)	0.069	0.043	0.074	0.047	0.039	0.051	0.023	0.038	0.024	0.007	0.039	0.008
Number of visits in the last 2 years				−0.011	0.003	−0.154***	−0.010	0.003	−0.137***	−0.010	0.003	−0.138***
Visit duration (days)				0.033	0.003	0.401***	0.034	0.003	0.404***	0.033	0.003	0.393***
Physical activities							0.042	0.014	0.122***	0.035	0.015	0.101*
Nature							0.031	0.032	0.043	0.022	0.032	0.031
Novelty							0.055	0.018	0.130***	0.052	0.018	0.123**
METs										0.066	0.033	0.086*
R^2		0.066			0.237			0.276			0.282	
F		8.226***			23.789***			19.383***			17.947***	
ΔR^2		0.066			0.170			0.039			0.006	
ΔF		8.226***			51.321***			8.310***			3.909*	

*p < 0.05; **p < 0.01; ***p < 0.001
NOTE: B = Beta of unstandardized coefficients; β = Beta of standardized coefficient; R^2 = Variation in the dependent variable explained by the independent variables; ΔR^2 = R square change; F-distribution (F-test); ΔF – F-test change

cerned – to analyse how much visitors spent, to group visitors according to PA intensity, and to assess the contribution of PA intensity to the level of spending – the results obtained provide an information base for detailed discussion.

Visitor spending

Although there were difficulties in finding specific studies that help to put our data in context, the mean daily spending identified in our study serves as a first national reference. Namely, we found that the mean daily and total spends per person for Alt Pirineu Natural Park visitors are similar to the national averages for tourists in Spain; visitors to this park spend 31.7€ per day (national average: 33€) and 111€ per trip (national average: 125€). Despite the different approach used, the present results corroborate some of the findings of the studies referred to earlier. For example, the daily average spend established in our study was very similar to that observed in the study by Shirpke et al. (2018): if we exclude the travel costs in the Italian study, we find a difference of 20% between visitors of Natura sites in both countries (Spain: 31.7€ *versus* Italy: 37.86€). Another important finding was the significant differences between the various entrances regarding spending. Results indicated that visitors who entered the park through Tavascan or La Farga spent significantly more than those who entered through Saint Joan or Os de Civis, which is probably related to the main characteristics of the different entrances. Namely, Tavascan and La Farga offer more opportunities for engagement in various PAs and are characterized by a wider range of supporting areas. In this case, we do not have any specific references with which to compare these results, but they could also be connected with the differences identified by Schirpe et al. in the 10 Natura sites, which ranged from 15.92€ (Grigna) to 71.72€ (Fogosa). However, more data are needed to be able to establish connections between the characteristics of each site/entrance and spending levels.

PA segmentation

Although the results of the segmentation approach do not provide empirical evidence in relation to the issue, this new approach would be easily transferable if we consider that recreational activities are a common data type collected in studies related to the identification of visitor profiles in this type of area. Some examples of the approach are to be found in Farías-Torbidoni et al. (2018), Mowen et al. (2012) and Walden-Schreiner et al. (2014), who demonstrated that a metabolic equivalent approach could be used to categorize the recreational and physical activities performed by visitors to PNAs. For instance, while Mowen et al. (2012), who sampled visitors to 6 parks in Pennsylvania (USA), found similar results (almost 60% of the sample reported participation in moderate-intensity PA), Walden-Schreiner et al. (2014), who examined visitors in the high-use meadows in Yosemite National Park (USA), found that only 44% of visitors participated in moderate-intensity PA during their visit. However, the potential of this approach in connection to promoting health-enhancing physical activity (HEPA) in PNAs has been argued intensively (Farías-Torbidoni et al. 2018), not least because these kinds of data provide a good example of how existing monitoring programmes may be adapted to incorporate indicators relevant to PA evaluation point.

Contribution of PA intensity on spending levels

Although the final model of hierarchical multiple regression analysis explained a notable 28.2% of total variance, PA intensity itself made marginal but still significant contributions to visitor spending after controlling for other descriptors ($\Delta R^2 = 0.006$). These findings undoubtedly highlight the notion that they should be perceived holistically and should take into consideration other visitor characteristics. Namely, the findings have shown that increasing age was negatively associated with likelihood of expenditure. In other words, they revealed that the younger population is willing to spend more money while visiting the area. In addition, the results clearly showed that individuals who stayed longer were more motivated by internal factors, such as PA and new experiences, and were more likely to spend more money during their visit. These results are not surprising and agree with the findings of other studies in the field, which also found a positive association between visitor age (younger to middle-aged), engagement in activities with higher intensity (e.g. mountain biking, rock climbing, intensive hiking), and motivations and variables that reflect spending during the visit (Barić et al. 2016a; Cordente-Rodriguez et al. 2014; Fredman 2008). For instance, Barić et al. (2016a) found that, compared to general visitors, rock climbers, who were younger and more interested in experiences related to personal achievement, preferred to stay longer and overnight in local accommodation in surrounding villages, which indirectly implied greater spending. Freedman (2008) uncovered similar associations. Examining visitor spending in mountain regions, he found that individuals who stayed longer and participated in higher intensity PA (e.g. downhill skiing) were more likely to spend more at the destination than those who stayed for shorter times and engaged in lower-intensity PAs (e.g. snowmobiling). It is therefore reasonable to assume that the positive association between PA intensity and spending found in this study greatly depends on a range of other behavioural characteristics. However, care should be taken in making these assumptions as there is little empirical evidence about the moderating effects of sociodemographic, trip and motivational descriptors on the association between PA intensity and total spending.

Overall, the present findings have important implications and could be of great importance to park managers, local tourism operators and decision makers in

formulating more transparent, accurate and effective planning strategies and wider marketing programmes. In short, this study provides holistic insights into the associations between the influence of PA intensity on total spending, considering other relevant characteristics, and may aid managers to better understand visitors' behavioural patterns, perceiving them not as an undifferentiated group but more as mutually related and dependent units who are open to changes according to managerial needs. Managers could use this information to set site-specific strategies for improving particular physical and social conditions in parks, widening the range of recreational opportunities for visitors, and stimulating them to stay longer and spend more money. Moreover, these findings might aid park managers in developing clearer links between inputs (i. e., facilities and services provided) and outcomes (visitor spending), which could pave the way for more rational recreation and tourism strategies.

Conclusion and limitations

Earlier studies have analysed and discussed the importance of the economic impact of tourism in PNAs and the contribution of these areas to the promotion of PA and health. However, the relationship between these two factors has not been examined empirically. This is the contribution of the present study.

First of all, the results obtained in terms of visitor spending not only serve as a first national benchmark, but also allow us to corroborate the findings of earlier studies at both national (Spain) and regional (Europe) levels. Furthermore, the results obtained indicate, if inconclusively, a possible connection between park facilities (PA and supporting areas) and visitor spending levels.

Second, because recreational activities are a common data type collected in any study related to identifying the profiles of visitors to protected areas, the segmentation approach is readily transferable (although its results do not provide empirical knowledge).

Finally, although the contribution of PA intensity to the level of expenditure is not conclusive, the results obtained here show a statistically significant influence of predictor variables on individual spending. We found that age, visit duration, the motivational dimensions of *Physical activity* and *Novelty,* and PA intensity are good predictors of how much a visitor will spend. This indicates that, by increasing PA intensities, managers and local officials could increase visitor spending and open up a new approach to expand the roles of PNAs in society. Although the results of this study regarding the relationship between the two benefits (i. e. the economic and the health impacts) are not conclusive, they do offer a line of work for future research, which could create a further segmentation of PA intensities based on market tourism theories. Such data could help inform policy decisions, aiding managers to direct and support increasing PA intensity and take more appropriate decisions to increase the economic impact on the region.

Acknowledgements

This project has been possible thanks to the Alt Pirineu Natural Park, the Ministry of Territory and Sustainability, Government of Catalunya, and to the National Institute of Physical Education of Catalonia (INEFC).

References

Ainsworth, B.E., W.L. Haskell, M.C. Whitt et al. 2000. Compendium of physical activities: an update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise* 32(9): 498–516.

Ainsworth, B.E., W.L. Haskell, S.D. Herrmann et al. 2011. Compendium of physical activities: a second update of codes and MET values. *Medicine and Science in Sports and Exercise* 43(8): 1575–1581.

Alegre, J. & L Pou 2004. Micro-economic determinants of the probability of tourism consumption. Tourism Economics 10(2): 125–144.

Arnberger, A., R. Eder, B. Allex et al. 2019. National park affinity segments of overnight tourists differ in satisfaction with, attitudes towards, and specialization in, national parks: Results from the Bavarian Forest National Park. *Journal for nature conservation* 47: 93–102.

Barić, D., P. Anić & A.M. Bedoya 2016a. Segmenting protected area visitors by activities: a case study in Paklenica National Park, Croatia. *European Journal of Tourism Research* 13: 103.

Barić, D., P. Anić & A.M. Bedoya 2016b. Combining benefit-sought segmentation and service quality gap analysis: case study of Paklenica National Park, Croatia. *Tourism: An Interdisciplinary Journal* 64(1): 7–25.

Bedimo-Rung, A.L., A.J. Mowen & D.A. Cohen 2005. The significance of parks to physical activity and public health: a conceptual model. *American Journal of Preventive Medicine* 28(2): 159–168.

Bird, W. 2004. *Natural fit. Can green space and biodiversity increase levels of physical activity?* London: Faculty of Public Health.

Broyles, S.T., A.J. Mowen, K.P. Theall, J. Gustat & A.L. Rung 2011. Integrating social capital into a park-use and active-living framework. *American Journal of Preventive Medicine* 40(5): 522–529.

Carlson, J. & D. Wood 2004. *Assessing of the economic value of recreation and tourism in western Australia's national parks, marine parks and forests. Technical report.* Cooperative Research Centre for Sustainable Tourism III.

Cohen, D.A., R. Sturm, B. Han & T. Marsh 2014. *Quantifying the contribution of public parks to physical activity and health: introducing SOPARC.* Santa Monica, CA: RAND Corporation.

Cohen, P, S.G. West & L.S. Aiken 2003. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences.* Mahwah, NJ.

Cordente-Rodríguez, M., J.A. Mondéjar-Jiménez & J.J. Villanueva-Álvaro 2014. Sustainability of nature: the power of the type of visitors. *Environmental Engineering & Management Journal (EEMJ)* 13(10): 2437–2447.

Dudley, N. 2008. *Guidelines for Applying Protected Area Management Categories.* Gland, Switzerland: IUCN.

Eagles, P.F.J 2002. Trends in park tourism: economics, finance and management. *Journal of Sustainable Tourism* 10(2): 132–153.

Eagles, P.F.J., D. McLean & M.J. Stabler 2000. Estimating the tourism volume and value in parks and protected areas in Canada and the USA. *George Wright Forum* 17(3): 62–82.

EUROPARC-España (2013) *Salud y Areas Protegidas en España. Identificación de los Beneficios de las Areas Protegidas Sobre la Salud y el Bienestar Social. Aplicación de Casos Prácticos en la Sociedad.* Madrid, Spain. [In Spanish]

European Commission 2013. *Economic Benefits of the Natura 2000 Network, European Commission.* Luxembourg.

Farías-Torbidoni, E.I., H.R. Grau & C. Camps 2005. Trail preferences and visitor characteristics in Aigüestortes i Estany de Sant Maurici National park, Spain. *Mountain Research and Development* 25(1): 51–59.

Farías-Torbidoni, E.I 2011. Managing for recreational experience opportunities: the case of hikers in protected areas in Catalonia, Spain. *Environmental Management* 47(3): 482–496.

Farías-Torbidoni, E.I. & S. Monserrat 2014. Los visitantes del parc natural de l'alt pirineu y la práctica de actividades recreativo-deportivas. Una propuesta de segmentación. *Pirineos.* DOI: 10.3989/Pirineos.2014.169005. [In Spanish]

Farías-Torbidoni E.I., D. Barić & P. Anić 2018. Willingness to engage in physically challenging activities as a visitor-segmentation criterion: the case of five protected areas in Catalonia. *eco.mont – Journal on protected mountain area research and management* 10(1): 15–23.

Farías-Torbidoni, E.I. & S. Morrera 2017. *Estudi de afluencia, freqüentacio´ i caracteritzacio´ dels visitants al Parc Natural de l'Alt Pirineu. 2011–2017*. Barcelona, Spain: Generalitat de Catalunya. Departament de Medi Natural i Sostenibilitat. [In Spanish]

Fix, P. & J. Loomis 1997. The economic benefits of mountain biking at one of its meccas: an application of the travel cost method to mountain biking in Moab, Utah. *Journal of Leisure Research* 29(3): 342–353.

Galloway, G 2002. Psychographic segmentation of park visitor markets: evidence for the utility of sensation seeking. *Tourism Management* 23(6): 581–596.

Giles-Corti, B., M.H. Broomhall, M. Knuiman, C. Collins, K. Douglas. K. Ng, A. Lange & RJ. Donovan RJ.2005. Increasing walking. How important is distance to, attractiveness, and size of public open space? *American Journal of Preventive Medicine* 28: 169–176.

Godbey, G. 2009. *Outdoor recreation, health, and wellness. Understanding and enhancing the relationship.* Discussion paper. Washington DC.

Godbey, G. & A. Mowen 2010. *The benefits of physical activity provided by park and recreation services: The scientific evidence.* Ashburn: National Recreation and Park Association.

Fredman, P 2008. Determinants of visitor expenditures in mountain tourism. *Tourism Economics* 14(2): 297–311.

Hair, J., Black, B. Babin, B. Anderson & R. Tatham 2006. *Multivariate Data Analysis*. 6th ed. Upper Saddle River, NJ.

Hammer, T. & D. Siegrist 2008. Protected Areas in the Alps – The Success Factors of Sustainable Tourism and the Challenge for Regional Policy. *GAIA* 17/S1: 152–160

Hammer, T., I. Mose, T. Scheurer & D. Siegrist 2012. Societal research perspectives on protected areas in Europe. *eco.mont – Journal on protected mountain area research and management* 4(1): 5–12.

Hjerpe, E. & Y. Kim 2007. Regional economic impacts of Grand Canyon river runners. *Journal of Environmental Management* 85: 137–149.

Jette, M., K. Sidney & G. Blümchen 1990. Metabolic equivalents (METS) in exercise testing, exercise prescription, and evaluation of functional capacity. *Clinical Cardiology* 13(8): 555–565.

Job, H. 2008. Estimating the regional economic impact of tourist to national parks. *Gaia* 17 (S1): 134–142.

Lemieux, C.J., P.F. Eagles, D.S. Slocombe et al. 2012. Human health and well-being motivations and benefits associated with protected area experiences: an opportunity for transforming policy and management in Canada. *Parks* 18(1): 71–85.

Lintzmeyer, F. & D. Siegrist 2008. Key Success Factors for Nature-based tourism in Protected Areas of the Alps. In: Siegrist, D., C. Clivaz, M. Hunziker & S. Iten (eds.), *Visitor Management in Nature-based Tourism. Strategies and Success Factors for Pars and and Recreational Areas.* Series of the Institute for Landscape and Open Space, HSR University of Applied Sciences Rapperswil: 93–106.

Leung, Y.F., A. Spenceley, G. Hvenegaard & R. Buckley (eds.) 2019. *Gestión del turismo y de los visitantes en areas protegidas: directrices para la sostenibilidad.* Serie Directrices sobre Buenas Prácticas en Áreas Protegidas no. 27, Gland, Suiza: UICN. XII. [In Spanish]

Maller, C., M. Townsend, L. St Leger, C. Henderson-Wilson, A. Pryor, L. Prosser & M. Moore 2010. Healthy Parks, Healthy People: The Health Benefits of Contact with Nature in a Park Context. *The George Wright Forum* 26(2): 51–83.

Mayer, M., M. Müller, M. Woltering J. Arnegger & H. Job 2010. The economic impact of tourism in six German national parks. *Landscape and Urban Planning* 97(2): 73–82.

Mayer, M. & H. Job 2014. The economics of protected areas – a European perspective. *Zeitschrift für Wirtschaftsgeographie* 58(2-3): 73–97.

Mayer, M & L. Vogt 2016. Economic effects of tourism and its influencing factors. An overview fo-

cusing on the spending determinants of visitors. *ZfTW* 8(2): 169-198.

McDonald, G.T., & L.C. Wilks 1986. The regional economic impact of tourism and recreation in national parks. *Environment and Planning B: Planning and Design* 13(3): 349–366.

Mika, M., B. Zawilinska & R. Pawlusinski 2016. Exploring the economic impact of national parks on the local economy. Functional approach in the context of Poland's transition economy. *Human Geographies* 10(1): 5.

Mowen, A.J., N.E. Trauntvein, A.R. Graefe & J.S. Son 2012. The influence of visitor characteristics on state park physical activity levels. *Journal of Park and Recreation Administration* 30(2): 19–40.

Oftedal, A. & I. Schneider 2013. Outdoor recreation availability, physical activity, and health outcomes: County level analysis in Minnesota. *Journal of Park and Recreation Administration* 31: 34–56.

Pearson, L., I. Russell & K. Woodford 2000. *Economic Impact of Noosa National Park on the Sunshine Coast and Noosa Economies*. School of Natural and Rural Systems Management. The University of Queensland.

Pröbstl-Haider, U. & W. Haider 2014. The role of protected areas for destination choice in the European Alps. *Zeitschrift für Wirtschaftsgeographie* 58(2-3): 144–163.

Reinius, S.W & P. Fredman 2007. Protected areas as attractions. *Annals of Tourism Research* 34(4): 839–854.

Romagosa, F., P.F.J. Eagles & C.J. Lemieux 2015. From the inside out to the Outside in: Exploring the Role of Parks and Protected Areas as Providers of Human Health and Well-Being. *Journal of Outdoor Recreation and Tourism* 10: 70–77. doi: 10.1016/j.jort.2015.06.009.

Romagosa, F. 2018. Physical health in green spaces: Visitors' perceptions and activities in protected areas around Barcelona. *Journal of Outdoor and Tourism Recreation* 23: 26–32.

Schirpke, U., R. Scolozzi, R.D. Re, M. Masiero D. Pellegrino & D. Marino 2018. Recreational ecosystem services in protected areas: a survey of visitors to Natura 2000 sites in Italy. *Journal of Outdoor Recreation and Tourism* 21: 39–50.

Stolton, S & N. Dudley 2010. Vital Sites: *The contribution of protected areas to human health*. Arguments for protection series 7.

Stynes, D.J. 1997. Economic Impacts of Tourism. Available at: https://msu.edu/course/prr/840/econimpact/pdf/ecimpvol1.pdf (access 01/03/2020)

Stynes, D.J 1999. *Approaches to estimating the economic impacts of tourism; some examples. Economic impact approaches.* East Lansing, MI: Department of Park, Recreation and Tourism Resources, Michigan State University.

UNEP-WCMC & IUCN 2016. *Update on global statistics.* Cambridge, UK and Gland, Switzerland.

Walden-Schreiner, C., Y.F. Leung & M.F. Floyd 2014. Incorporating physical activity measures into environmental monitoring of national parks: an example from Yosemite. *Journal of Physical Activity and Health* 11(7): 1284–1290.

Wanga, Y. & M.C, Davidson 2010. A review of micro-analyses of tourist expenditure. *Current Issues in Tourism* 13(6): 507–524.

Watson, P., J. Wilson, D. Thilmany & S. Winter 2007. Determining economic contributions and impacts: what is the difference and why do we care. *Journal of Regional Analysis and Policy* 37(2): 140–146.

Authors

Estela Inés Farías-Torbidoni[1,2] – corresponing author

is ssociate professor of Health and Sport Management at the National Institute of Physical Education of Catalonia (INEFC) She has a PhD in Sport Sciences (University of Lleida) and a Master's in Protected Natural Areas (University of Madrid). Her main research areas are sport management, sociology of sport, outdoor activities, and protected natural areas.

Demir Barić[1]

is a Postdoctoral fellow at the National Institute of Physical Education of Catalonia (INEFC), in Lleida. He specializes in visitor monitoring in protected natural areas and has a particular interest in the development of effective visitor management strategies.

[1] National Institute of Physical Education of Catalonia (INEFC). University of Lleida (UdL)
[2] Grup d'Investigació Social i Educativa de l'Activitat Física i l'Esport (GISEAFE). Partida la Caparella sn. 25120 Lleida, Spain

eco.mont – Volume 12, Number 2, July 2020
ISSN 2073-106X print version – ISSN 2073-1558 online version: http://epub.oeaw.ac.at/eco.mont
https://dx.doi.org/10.1553/eco.mont-12-2s33

Why do people leave marked trails? Implications for managing outdoor recreationists

Vera Kopp & Joy Coppes

Keywords: outdoor recreation, wildlife, visitor behaviour, off-trail, visitor management

Abstract

Outdoor winter sports activities are growing in popularity, causing conflicts with sensitive wildlife species. Many studies have shown negative effects of recreational activities on wildlife, with off-trail activities considered to be more detrimental compared to activities performed on marked trails. Small hand-held global positioning devices are readily available, facilitating navigation off marked trails. For adequate visitor management, it is essential to know the motives of visitors to nature areas. The motives of recreationists to leave marked trails are, however, rarely known. Using questionnaires, we studied why people leave trails and analysed the predictors according to the Fietkau-Kessel grid model of environmental behaviour. The main motives for leaving a marked trail were *more fun* compared to staying on marked trails, previous experience of guided tours which left marked trails, and the signs being unclear. High-quality recreation infrastructure significantly reduces the chances of leaving marked trails, and a person with a positive attitude towards wildlife conservation is more likely to stay on the trails. We recommend visitor-steering management that combines attractive recreation infrastructure and clear signposts with methods influencing people's attitudes towards nature conservation and education to foster on-trail activities.

Profile

Protected area

Schauinsland and Feldberg

Mountain range

Black Forest

Country

Germany

Introduction

Nature-based recreation and outdoor activities are increasing worldwide (Eagles et al. 2002; Hennig et al. 2011). Technological advances (e.g. e-bikes, pedelecs, GPS) allow new areas to be used for recreation and activities to be performed during the day or night (e.g. high-powered LED head lamps). Consequently, spatial and temporal recreational use of the landscape has intensified (Hennig et al. 2011). Nature-based recreational activities can, however, conflict with another function of forests – the preservation of natural habitats and biodiversity (Green et al. 2004; Niemelä et al. 2005; Pröbstl et al. 2010) – with recreation even being recognized as a threat for a wide range of species (Ballantyne et al. 2013; BirdLife International 2015). Free-living animals (from now on referred to as wildlife) react in a similar fashion to the presence of humans as to predators (Frid et al. 2002). Human recreationists can affect the behaviour, physiology, survival rate, reproduction rate and population dynamics of wildlife (Larson et al. 2016; Tablado et al. 2015). Off-trail activities (e.g. snowshoeing and ski touring) are a non-predictable threat for wildlife, limiting their possibilities to adapt to human disturbances (Geist 1978; Miller et al. 2001). Wildlife shows greater flushing distances (Baines et al. 2007; Miller et al. 2001) or greater vigilance distances (Taylor et al. 2003) when humans carry out activities away from marked recreational trails compared to on-trail activities. Consequently, to reduce the negative effects of recreation activities, visitor-steering measures should aim at keeping people on the marked trails. Although previous studies show what environmental factors affect *where* people leave marked trails (Coppes et al. 2013), the factors affecting *why* people leave the trails remain unknown. For adequate visitor management, more knowledge of the factors influencing people to leave trails is needed, which can in turn be applied to change visitor behaviour.

In studies focusing on changing behaviour, some of the most commonly discussed influencing factors are: people's attitudes towards a specific topic (Hines et al. 1986); knowledge (of a problem's *content* and of *solution* options) (Kaiser et al. 2003); the possibility to act pro-environmentally (Homburg et al. 1998), and perceived consequences, which means that if people are capable of reflecting on the consequences of their behaviour they are more willing to adjust their behaviour (Kollmuss et al. 2002). These factors are known to influence behaviour in general but have not yet been tested regarding their influence on off-trail behaviour in a wildlife context. We developed a conceptual model and used questionnaires to study (1) people's motives to leave trails, and (2) the factors that influence people's off-trail behaviour. Our results provide a basis for appropriately designed visitor management concepts that facilitate the coexistence of wildlife and recreationists in highly-frequented winter sports regions in Central Europe.

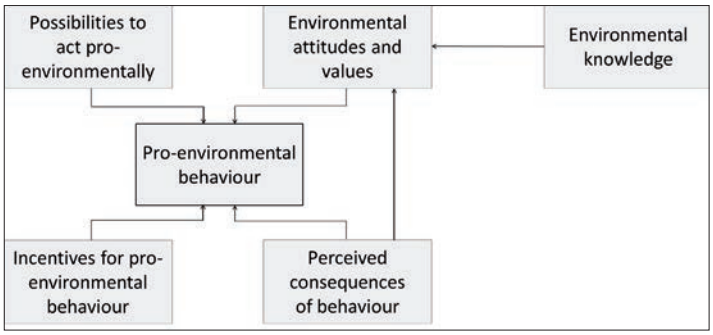


Figure 1 – Model of ecological behaviour by Fietkau et al. 1981 (Kollmuss et al. 2002).

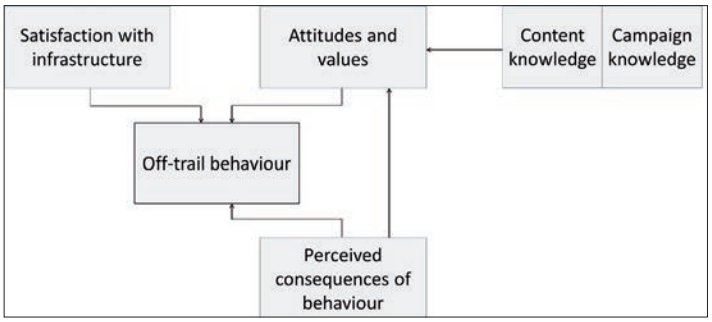


Figure 2 – The conceptual model explaining off-trail behaviour, with the relevant predictors.

Materials and methods

Conceptual model and operationalization

In order to identify influencing predictors for off-trail behaviour, we developed a conceptual model based on the model of ecological behaviour by Fietkau et al. (1981) (Figure 1). This model explains environmental behaviour as being dependent on five predictors.

We modified the Fietkau-Kessel grid model with predictors that are applicable for off-trail behaviour (Figure 2 and Table 1). According to the original model of Fietkau et al. (1981), it is assumed that knowledge about wildlife-related topics correlates positively with attitudes towards wildlife and values placed on it, and thus reduces off-trail behaviour. The predictor *knowledge* was divided into *campaign knowledge* (i. e. knowledge of a campaign addressing the topic of off-trail behaviour) and *content knowledge* (i. e. knowledge of the effects of off-trail behaviour on wildlife) to test whether there was a difference between the types of knowledge that are conveyed. According to Fietkau's original model, the predictor *attitudes and values* is assumed to be positively influenced by the predictor *perceived consequences of behaviour*. This means that people who know about the consequences of their behaviour for wildlife have positive attitudes and values and are less likely to go off-trail. It is further assumed that the predictor *satisfaction with infrastructure* will reduce off-trail behaviour. The predictor *incentives to act pro-environmentally* was excluded as there were no penalties for off-trail behaviour enforced in the study area during the study period, and no rewards for staying on the trails.

For the analysis of the explanatory predictors, two predictors were constructed in the context of knowl-

Table 1 – Description of the predictors tested in the model for influence on off-trail behaviour and sample questions for each from the questionnaire.

Predictors	Description	Sample item for the questionnaire
Campaign knowledge	assumes that people with knowledge about local campaigns and initiatives regarding behavioural rules will stay on-trail	*"Have you ever heard any the following terms?"* Options: wildlife protection zone, stay on-trail, capercaillie action plan, campaign bewusstWild[1]
Content knowledge	assumes that people with knowledge of the consequences of human disturbances will stay on-trail	*"Do you know to what type of disturbance wildlife can adapt better?"* Options: regular disturbances, frequent disturbances, irregular disturbances, rare disturbances
Satisfaction with infrastructure	assumes that people who are satisfied with the infrastructure provided will stay on-trail	*"Please indicate how satisfied you are with the trail offer"* Options: very satisfied, satisfied, partly satisfied, not very satisfied, not satisfied at all, I don´t know
Attitude and values	assumes that people with positive attitudes and values with respect to wildlife will stay on-trail	*"If my favourite route is closed due to wildlife protection measures, I would be annoyed"* Options: I totally agree, I agree, I partly agree, I don't agree at all, I don't know
Perceived consequences of behaviour	assumes that people who know about the possible consequences of their behaviour for wildlife will stay on-trail	*"Wildlife is used to winter sports activities and thus does not feel threatened"* Options: I totally agree, I agree, I partly agree, I don't agree at all, I don't know

[1] bewusstWild is a campaign that offers information on how to behave in wildlife-friendly manner (e. g. to stay on-trail) during outdoor activities (www.bewusstwild.de).

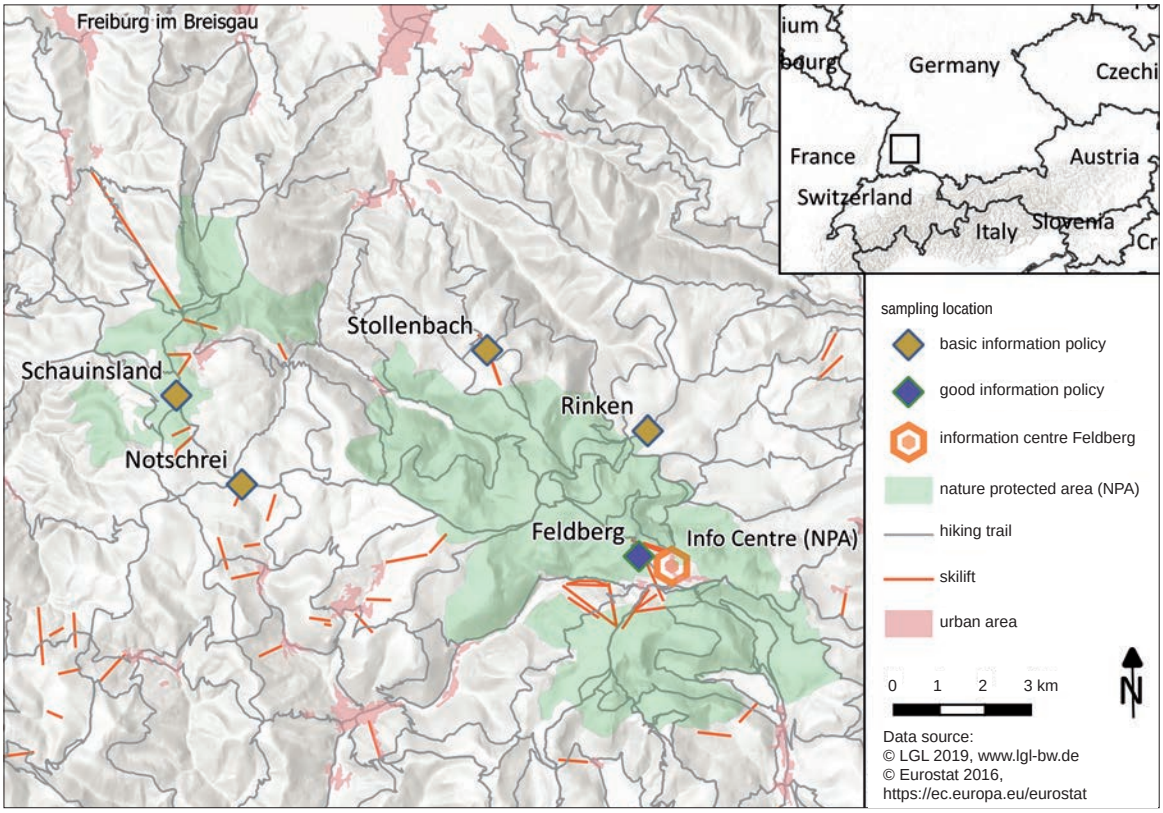


Figure 3 – Study area showing the two PAs Schauinsland *and* Feldberg *and the five questionnaire sites according to their information policies* basic *and* good.

edge. *Content knowledge* was created by calculating the sum score of the appropriate answers of the knowledge item. The predictor *campaign knowledge* was calculated as the sum of the knowledge items of initiatives and campaigns. The predictors *satisfaction with infrastructure*, *attitude and values* and *perceived consequences of behaviour* were also assessed. A confirmatory factor analysis showed that two predictors can be distinguished (Tucker-Lewis-Index (TLI) = 0.970, Comparative Fit Index (CFI) = 0.976, Root Mean Square Error of Approximation (RMSEA) = 0.059): *pro-wildlife attitudes* and *satisfaction with trails* (Table 2). Cronbach's α for the reliability of the new predictors was determined as 0.703 and 0.966 respectively. These values indicate the correlation of a variable with a predictor. The positive values indicate that both factors correlate positively with the variables. Factor loading '0' means that factor and variable are stochastically independent; '1' means complete correlation. Both predictors combined explained almost 35% of the variance of all variables in the model.

The first predictor, *pro-wildlife attitudes*, consists of 7 items ranging from attitude and values items to perceived consequences of behaviour items. This means that the originally distinct predictors of the conceptual model *attitude and values* and *perceived consequences of behaviour* could not be considered separately but belong together. The second predictor, *satisfaction with trail*, implied all four original items which refer to being satisfied: comprehensibility, variety and number of trails,

Table 2 – Results of factor loadings for the items of the predictors pro-wildlife attitude *and* satisfaction with trails.

Items	Pro-wildlife attitude	Satisfaction with trails
Alternative routes		0.962
Number of trails		0.947
Variety of trails		0.942
Clarity of trail signs		0.920
I consider it important to create sufficient habitat for wildlife	0.670	
I consider it reasonable to close trails during winter in order to protect wildlife	0.645	
I feel uncomfortable at the thought that my winter sport activity might disturb wildlife	0.619	
The media should report more on the effects of winter sports on wildlife	0.593	
I consider it reasonable to designate wildlife protection areas in order to provide wildlife refuges	0.576	
I feel satisfied, knowing that my personal restrictions help survival of wildlife	0.568	
In forests, it is important to stay quiet calm in order not to disturb wildlife	0.533	

and alternative routes. The predictor *off-trail* was calculated as the sum score of the items *I have already been off-trail during one of my tours* vs. *I have never been off-trail during one of my tours* and considered as a dependent variable.

Study area

The study area is located in the Southern Black Forest, a lower mountain range in South-Western Germany (Figure 3). The area is a destination for outdoor recreation all year around but is known especially for its various winter sports activities, such as backcountry skiing, snowshoeing and winter hiking, making it one of the most important generators of income for the region (Gebhardt 2016). Off-trail activities such as ski touring and snowshoeing have gained in popularity in recent years. At the same time, the area is home to a threatened subpopulation of capercaillie (*Tetrao urogallus*) (Coppes et al. 2019) and is close to the Southern Black Forest red deer (*Cervus elaphus*) management area (Suchant et al. 2008). Both species are highly susceptible to irregular disturbances by humans (Reimoser 2012; Thiel 2007) and known to adapt their behaviour according to human presence and recreational infrastructure (Coppes et al. 2017a; Coppes et al. 2017b). The occurrence of these species plays an important role in determining the approval or rejection of applications for licences for new recreational activities in the study area.

Local legislation generally allows leaving marked trails in the forests; only in the designated protected areas (PAs) *Schauinsland* and *Feldberg* is it prohibited to go off-trail. Although nature-protection legislation is the same for *Feldberg* and *Schauinsland*, the areas differ regarding their information policies. The PA *Schauinsland* is relatively small and people can easily cross the border into it when visiting non-protected areas. Here, the information policy gives basic information signs on-site, limited waymarking of trails, and no additional information on how winter sports are affecting wildlife. The Feldberg area has an extensive information policy: there is an information centre, and signs and rangers inform people on-site. Additionally, information regarding environment- and wildlife-friendly behaviour is provided, which can also be found on the information centre's website (www.naz-feldberg.de). Consequently, we divided our study area into sites with basic information policy (Schauinsland, Notschrei, Rinken, Stollenbach), and a site with good information policy (Feldberg) (Figure 3).

Questionnaire and survey

Based on a pre-tested questionnaire, a survey was designed according to the standards of Kirchhoff et al. (2010). In the winter of 2014, the questionnaires were handed personally to recreationists (winter hikers, snowshoe walkers and backcountry skiers) to be filled out when they returned from their tours to five different carparks and end-points of marked winter-hiking and snowshoe trails. The survey took place during randomly selected days in January and February, with an emphasis on weekends when people were likely to be more relaxed and therefore more open to participate. The survey consisted of qualitative and quantitative questions which were based on a bipolar Likert scale ranging from 1 to 5.

We asked people directly whether they had been off-trail either during their visit that day or ever before. We also asked for satisfaction with infrastructure, attitudes towards and values placed on wildlife, knowledge of wildlife-related topics, and whether people perceived the consequences of their behaviour, and used open questions to ask for people's motives in leaving trails.

Statistical analysis

Descriptive statistics were used to determine visitor characteristics (quantitative questions) and to describe visitor motivations (qualitative questions) for leaving marked trails. In order to identify the predictors which influence off-trail behaviour and describe the relationships between the predictors, we developed a predictive model. Here, the variable *Off-trail* was considered as a dichotomous variable (*I had already been off-trail during one of my tours* vs. *I have never been off-trail during one of my tours*). This was regarded as a dependent variable, and potential behaviour predictors were tested for their influence on off-trail behaviour. A two-step approach was chosen, consisting of factor analysis, and logistic and linear regression. Next, the correlations between the calculated predictors and the dependent variable were calculated using a regression model. Analyses were conducted using IBM SPSS Statistics 22. The significance level chosen was $p \leq 0.05$.

Results

Visitor Characteristics

A total of 190 people who practised winter hiking, snowshoeing or ski touring participated in the survey (43% females, 57% males). Most practised snowshoeing (60%), followed by winter hiking (50%) and cross-country skiing (22%). Almost a third (31%) practised either two or three of the activities. Most people lived in Baden-Württemberg (81%); others were from other parts of Germany (11%); the remainder were from neighbouring countries (8%). The majority of the people questioned had planned their tour in advance (60%), mainly based on recommendations by friends (22%), the internet (15%), or using maps (7%). Others planned on site by means of flyers (6%), information signs (3%) and guide books (3%), or by consulting local people (3%). Those who had not planned their tour in advance gave their reasons as good local knowledge (22%), participation in a guided tour (9%), orientation using the on-site signage (7%), or having no idea where to go for information (2%).

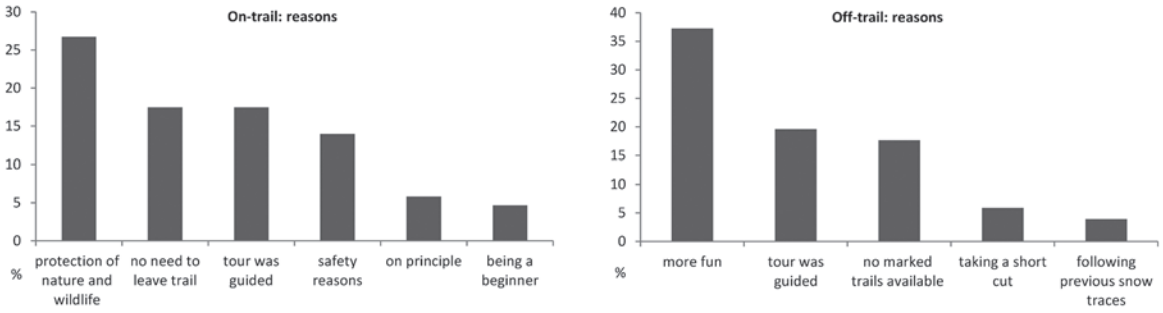


Figure 4 – Percentage of people giving reasons to stay on designated trails (left) and to go off-trail (right).

Motivation for leaving marked trails

The response rate regarding going *off-trail* was very high (98%). Most recreationists declared that they had not left the trails during their visit (65%). The main reasons given were *protection of nature and wildlife* (27%), *no need to leave trails* (17%), and *participation in a guided tour* (17%) (Figure 4). More than a third of the people (35%) stated that they had left their trail. The main raisons for going off-trail were that it was *more fun* (37%), *participation in a guided tour* (20%), and *unclear signage* (18%) (Figure 4). Of those who went off-trail, 8% ventured into open landscapes, 10% made their way along forest edges, and 4% left the trails for a combination of forest edges, forest and open landscapes. 13% of respondents did not give information about where they left the trails.

Off-trail behaviour: prediction model

According to logistic regression analysis, satisfaction with infrastructure was a significant predictor for going off-trail. The more recreationists were dissatisfied with infrastructure, the more they decided to go off-trail ($p = 0.013$). If they were dissatisfied with the recreational trails available, the probability of leaving the designated trails increased by the predictor 1.24 (24%). Second, *campaign knowledge* showed a significant negative correlation with going off-trail. The more *campaign knowledge* recreationists had, the less they decided to go off-trail ($p = 0.026$). The linear regression predicting *knowing about wildlife campaigns* and *content knowledge* showed that the more recreationists thought and felt *pro-wildlife*, the more they knew about wildlife campaigns ($p = 0.001$), and consequently they stayed on-trail more often (Figure 5). The predictor *content knowledge* did not influence off-trail behaviour, either directly or indirectly (Figure 5).

Recreationists were more likely to go off-trail when information policy was only basic (63% left trails), but were more likely to stay on-trail if a good information policy was in place (49% left trails) ($p = 0.047$). The prediction models for both information policy areas were the same, except for the predictor *satisfaction with trails*: the predictor significantly ($p = 0.031$) affected off-trail behaviour when basic information policy was given, but not ($p = 0.212$) in the area with a good information policy.

Discussion

Exposing underlying motives and reasons as well as predictors for off-trail behaviour, this study is the first to show why winter recreationists leave marked trails. By applying the conceptual model and combining it with questionnaires, we reveal clear management options to reduce the off-trail behaviour of outdoor recreationists. So far, off-trail behaviour has been assessed either in a spatial context, i. e. *where* people leave trails (Coppes et al. 2013), or in the context of the reactions of wildlife to off-trail activities (Mainini et al. 1993; Miller et al. 2001; Taylor et al. 2003). These studies reveal the importance of visitor-steering and management to keep visitors on the marked trails. For

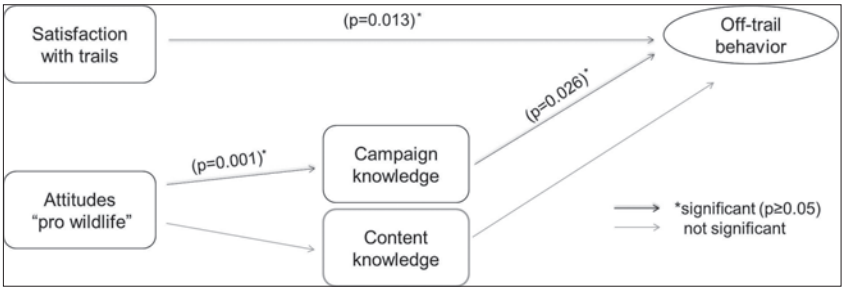


Figure 5 – Prediction model explaining off-trail behaviour of winter recreationists. The arrows indicate a significant correlation between the factors and off-trail behaviour. The pale dashed arrows indicate factors which did not affect off-trail behaviour significantly. The factors affecting off-trail behaviour significantly were satisfaction with infrastructure and pro-wildlife attitude via campaign knowledge. The factor content knowledge was not significant for off-trail behaviour.

effective management, however, knowledge of how to influence visitor behaviour is crucial. Previous studies that assess predictors influencing recreationists' behaviour focus on responsible behaviour in general (e.g. Kil et al. 2014; Klöckner 2013; Kollmuss et al. 2002), the acceptance of steering measures (Arnberger et al. 2012; Immoos et al. 2015; Sterl et al. 2010; Zeidenitz et al. 2007), or the attitude of recreationists towards management measures (Sterl et al. 2010). However, these studies fail to test and address how to influence visitor behaviour using management measures. Although it has been suggested that public relations and communication measures can be effective to minimize conflicts between the needs of wildlife and those of recreationists (Graf et al. 2018), these proposals have not been substantiated by scientific results. Our results offer management options based on a scientific methodology.

Respondents said they left a trail to go into open landscape or move along forest edges, while a few went into the forest. This result is in line with Coppes & Braunisch (2013), who showed that with an increase of canopy cover, the probability of people going off-trail decreases. An important motive for staying on-trail and for going off-trail was participation in a guided tour. Hence, we recommend that tour guides should be given further training in informing the public regarding wildlife-friendly behaviour during winter sports activities. Although we cannot show that the motivation for going off-trail is a predictor for leaving marked trails, our results indicate that the motivation to do so might differ from the *typical* recreation motivations. In their responses to the qualitative questions regarding off-trail behaviour, respondents did not name escape, recreation, nature experience or solitude (Arnberger et al. 2010), or fitness, adventure / thrill or saving costs (Zeidenitz et al. 2007) as motives for off-trail behaviour. We recommend future research to assess whether there are specific recreation motivations that trigger off-trail activities. Respondents also gave *unclear signage* as one of the main reasons they left trails. Here, local management should ensure that information is adequate and readily understandable, and implement a standardized information policy using consistent signs which are visible also during snowfall.

The results of the prediction model revealed that people who are satisfied with the infrastructure provided are less likely to go off-trail. This result is in line with the findings of other authors (Freuler et al. 2007; Kollmuss et al. 2002) who showed that appropriate infrastructure can positively steer people, as it helps visitors to put their positive attitudes into practice. As the trail offer is different between summer and winter in the study area, Coppes and Braunisch (2013) found that recreationists left trails in winter, to continue on (closed) summer infrastructure. This behaviour was more pronounced where summer-trail signs were present, indicating the significance of signage and infrastructure for visitor steering.

We found that recreationists are more likely to go off-trail when information policy is only basic. This result is supported by Freuler et al. (2007), who show that the level of information provided strongly influences behaviour. With regard to the prediction model, we were able to show that people who are dissatisfied with trails (model predictor: *satisfaction with trails*) are more likely to leave trails in the basic information policy area than in the good information policy area. This result confirms the findings of Immoos et al. (2015), who state that simple waymarking is not sufficient to steer visitor behaviour as required: good information already during the planning phase of a visit or at its starting point triggers people to behave in the hoped-for way.

Although attitudes towards wildlife and related steering measures were positive overall, respondents still left trails. As implementing visitor-steering efforts is shown to be compatible with attitudes (Freuler et al. 2007), there is a discrepancy between attitudes and behaviour. This phenomenon has been addressed by several authors (e.g. Freuler et al. 2007; Homburg et al. 1998; Kollmuss et al. 1998) who state that, although people are generally willing to behave in a manner that respects the environment and are emotional about this topic, in fact their behaviour shows little conformity with these attitudes. Nevertheless, attitudes are considered to play an important role in fostering pro-environment behaviour (Bamberg et al. 2007; Hines et al. 1986). This is in line with the present results, which indicate a strong relationship between (campaign) knowledge and attitudes.

Our results indicate that the predictive power of knowledge depends on the type of knowledge. The knowledge predictor was divided into *content knowledge* and *campaign knowledge*, in line with other authors (e.g. Kaiser et al. 2003). A pro-wildlife attitude was a significant predictor for campaign knowledge. Thus it can be concluded that if people already have the appropriate attitudes, as the respondents did, providing information via campaigns will have a positive effect on off-trail behaviour (Manning 2003; Marion et al. 2007; Zeidenitz et al. 2007). This supports the results of Freuler et al. (2007) that the gap between attitudes and behaviour can be reduced if recreationists are provided with appropriate information, good arguments and appeals for them to act responsibly. The positive effects of campaign knowledge on behaviour were also shown by Immoos et al. (2014). As demonstrated by earlier studies (Kollmuss et al. 2002), content knowledge is not significant in predicting off-trail behaviour. It can be deduced that procedural knowledge, which explains how to behave (transferred by campaigns), is more effective in changing behaviour than providing simple content knowledge.

Conclusion

We identified satisfaction with infrastructure as the strongest predictor for not leaving trails, especially

in areas with basic information policies. The results further show that a positive attitude towards wildlife implies a better knowledge of wildlife campaigns and consequently encourages people to stay on-trail. Furthermore, we show that an extensive information policy can play an important role in visitor-steering in nature areas. Our findings suggest measures which could be included in visitor management in nature areas. Future studies should assess how to effectively communicate knowledge to the target groups. As our results indicate that most people planned their tour in advance, not relying simply on on-site information sources, the effectiveness of off-site communication measures (e.g. information in magazines, on websites or apps) should be tested. The role of subjective norms (the attitudes of the individual's social group, friends and relatives, or of tour guides) could also be studied to optimize communication measures. We show how the use of a qualitative social science approach can reveal new insights which are important for reducing human-wildlife conflicts.

Acknowledgements

We are grateful to all the respondents who agreed to participate in our study. We would also like to thank everyone supporting the data collection and are grateful to Prof. Dr. Janina Strohmer for help with the statistical analysis.

Declaration of interests and funding details

The authors declare that they have no competing interests. This work was supported by the Ministry of Rural Affairs and Consumer Protection Baden-Württemberg. The funding organization played no role in the study design, data collection, analysis or interpretation of the results.

References

Arnberger, A., R. Eder, B. Allex, P. Sterl & R.C. Burns 2010. Exploring relationships between visitor motives, satisfaction, recreation quality and attitudes towards rotected area management in the Gesaeuse National Park, Austria. In: Gossen, M., B. Eilands & R. van Marwijk (eds.), *Recreation and tourism in a changing world:* 63–64.

Arnberger, A., R. Eder, B. Allex, P. Sterl & R.C. Burns 2012. Relationships between national-park affinity and attitudes towards protected area management of visitors to the Gesaeuse National Park, Austria. *Forest Policy and Economics* 19: 48–55.

Baines, D. & M. Richardson 2007. An experimental assessment of the potential effects of human disturbance on Black Grouse *Tetrao tetrix* in the North Pennines, England. *Ibis* 149: 56–64.

Ballantyne, M. & C.M. Pickering 2013. Tourism and recreation: a common threat to IUCN red-listed vascular plants in Europe. *Biodiversity and Conservation* 22: 3027–3044.

Bamberg, S. & G. Möser 2007. Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology* 27: 14–25.

BirdLife International 2015. *European red list of birds.* Luxembourg: Office for official publications of the European communities. doi: 10.2779/975810

Coppes, J. & V. Braunisch 2013. Managing visitors in nature areas: where do they leave the trails? A spatial model. *Wildlife Biology* 19: 1–11.

Coppes, J., F. Burghardt, R. Hagen, R. Suchant & V. Braunisch 2017a. Human recreation as a determinant of temporal habitat use patterns in red deer (*Cervus elaphus*). *PLoS One* 12.

Coppes, J., J. Ehrlacher, G. Müller, K. Roth, K. Schroth, M. Förschler, V. Braunisch & R. Suchant 2019. Dramatic decline of the Capercaillie *Tetrao urogallus* population in the Black Forest. *Vogelwarte* 57: 115–122.

Coppes, J., J. Ehrlacher, D. Thiel, R. Suchant & V. Braunisch 2017b. Outdoor recreation causes effective habitat reduction in capercaillie *Tetrao urogallus*: a major threat for geographically restricted populations. *Journal of Avian Biology* 48(12): 1583–1594.

Eagles, P.F.J., S.F. McCool & C.D.A. Haynes 2002. *Sustainable Tourism in Protected Areas: Guidelines for Planning and Management.* IUCN Gland, Switzerland and Cambridge, UK.

Fietkau, H.-J. & H. Kessel 1981. *Umweltlernen.* Königstein/Ts. [In German]

Freuler, B. & M. Hunziker 2007. Recreation activities in protected areas: bridging the gap between the attitudes and behaviour of snowshoe walkers. *Forest Snow and Landscape Research* 81: 191–206.

Frid, A. & L. Dill 2002. Human-caused Disturbance Stimuli as a Form of Predation Risk. *Conservation Ecology* 6(1): 11. Available at: http://www.consecol.org/vol6/iss1/art11 (accessed 06/03/2020)

Gebhardt, H. 2016. *Fremdenverkehrsgebiete.* Landeszentrale für politische Bildung: Landeskunde Baden-Württemberg. Available at: http://www.landeskunde-baden-wuerttemberg.de/3383.html [In German]

Geist, V. 1978. Behaviour. In: Schmidt, J.L. & D.L. Gilbert (eds.), *Big game of North America: ecology and management:* 283–296.

Graf, R.F., C. Signer, M. Reifler-Bächtiger, M. Wyttenbach, B. Sigrist & R. Rupf 2018. Wildtier und Mensch im Naherholungsraum. *Swiss Academies Factsheets* 13(2). Available at: https://naturwissenschaften.ch/uuid/684b6e6c-f28d-55c6-b786-6cc4e0ec4adb?r=20190807115818_1565139634_e48acf1a-cf10-560c-b13a-a67081dadef9 (access 06/03/2020) [In German]

Green, R. & M. Giese 2004. Negative effects of wildlife tourism on wildlife. In: Higginbottom, K. (ed.), *Wildlife tourism: impacts, management and planning:* 81–98

Hennig, S. & M. Künzl 2011. Applying Integrated Nature Conservation Management: Visitor Management and Monitoring of Winter Recreation Activities Focusing Grouse Species in Berchtesgaden National Park. In: Zhelezov, G. (ed.), *Sustainable Development in Mountain Regions:* 239–253.

Hines, J.M., H.R. Hungerford & A.N. Tomera 1986. Analysis and Synthesis of Research and Responsible Environmental Behaviour: A Meta-Analysis. *The Journal of Environmental Education* 18: 1–8.

Homburg, A. & E. Matthies 1998. U*mweltpsychologie.* Weinheim/München. [In German]

Immoos, U. & M. Hunziker 2014. Wirkung von Lenkungsmaßnahmen auf das Verhalten von Freizeitaktiven. *Naturschutz und Landschaftsplanung* 46: 5–9. [In German]

Immoos, U. & M. Hunziker 2015. The effect of communicative and on-site measures on the behaviour of winter sports participants within protected mountain areas – results of a field experiment. *eco.mont – Journal on protected mountain areas research and management* 7(1): 17–25.

Kaiser, F.G. & U. Fuhrer 2003. Ecological Behavior's Dependency on Different Forms of Knowledge. *Applied Psychology: An International Review* 52: 598–613.

Kil, N., S.M. Holland & T.V. Stein 2014. Structural relationships between environmental attitudes, recreation motivations, and environmentally responsible behaviors. *Journal of Outdoor Recreation and Tourism* 7-8: 16–25.

Kirchhoff, S., S. Kuhnt, P. Lipp & S. Schlawin 2010. *Der Fragebogen Datenbasis, Konstruktion und Auswertung.* Wiesbaden. [In German]

Klöckner, C.A. 2013. A comprehensive model of the psychology of environmental behaviour – A meta-analysis. *Global Environmental Change* 23: 1028–1038.

Kollmuss, A. & J. Agyeman 2002. Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research* 8: 239–260.

Larson, C.L., S.E. Reed, A.M. Merenlender & K.R. Crooks 2016. Effects of Recreation on Animals Revealed as Widespread through a Global Systematic Review. *PLOS ONE* 11: e0167259.

Mainini, B., P. Neuhaus & P. Ingold 1993. Behaviour of marmots *Marmota marmota* under the influence of different hiking activities. *Biological Conservation* 64: 161–164.

Manning, R.E. 2003. Emerging Principles for Using Information/Education in Wilderness Management. *International Journal of Wilderness* 9: 20–28.

Marion, J.L. & S.E. Reid 2007. Minimising Visitor Impacts to Protected Areas: The Efficacy of Low Impact Education Programmes. *Journal of Sustainable Tourism* 15: 5–27.

Miller, C.K., S.G. Miller & R.L. Knight 2001. Wildlife Responses to Pedestrians and Dogs. *Wildlife Society Bulletin* 29: 124–132.

Niemelä, J., J. Young, D. Alard, M. Askasibar, K. Henle, R. Johnson, M. Kurttila, T.-B. Larsson, S. Matouch, P. Nowicki, R. Paiva, L. Portoghesi, R. Smulders, A. Stevenson, U. Tartes & A. Watt 2005. Identifying, managing and monitoring conflicts between forest biodiversity conservation and other human interests in Europe. *Forest Policy and Economics* 7: 877–890.

Pröbstl, U., V. Wirth, B. Elands & S. Bell 2010. *Management of recreation and nature based tourism in European forests.* Berlin.

Reimoser, S. 2012. Influence of Anthropogenic Disturbances on Activity, Behavior and Heart Rate of Roe Deer (*Capreolus capreolus*) and Red Deer (*Cervus elaphus*), in context of their daily and Yearly Patterns. In: Cahler A.A. & J.P. Marsten (eds.), *Deer: Habitat, Behaviour and Conservation:* 1–96.

Sterl, P., R. Eder & A. Arnberger 2010. Exploring factors influencing the attitude of ski tourers towards the ski touring management measures of the Gesäuse National Park. *eco.mont – Journal on protected mountain areas research and management* 2(1): 31–38.

Suchant, R. & K.L. Gerecke 2008. *Rotwild im Südschwarzwald: Konzeption eines integrativen Rotwild-Managements. Projektgruppe Rotwild.* Freiburg, Germany. [In German]

Tablado, Z. & L. Jenni 2015. Determinants of uncertainty in wildlife responses to human disturbance. *Biological Reviews. Cambridge Philosophical Society* 92: 216–233. doi: 10.1111/brv.12224

Taylor, A.R. & R.L. Knight 2003. Wildlife Responses to Recreation and Associated Visitor Perceptions. *Ecological Applications* 13: 951–963.

Thiel, D. 2007. *Behavioral and Physiological Effects in Capercaillie (*Tetrao urogallus*) Caused by Human Disturbance.* Ph.D. Thesis, University of Zurich.

Zeidenitz, C., H.J. Mosler & M. Hunziker 2007. Outdoor recreation: from analysing motivations to furthering ecologically responsible behaviour. *Forest Snow and Landscape Research* 81: 175–190.

Authors

Vera Kopp

works as a research assistant in the Wildlife and Disturbances research group, which studies the impact of human activities on wildlife. She is currently coordinating a project on human activities in wildlife habitats. Wildlife and Disturbance, Department of Wildlife Ecology, Forest Research Institute of Baden-Württemberg, Germany. E-mail: vera.kopp@forst.bwl.de

Joy Coppes

leads the Forest Bird Research Group, which monitors and studies forest birds. The main research subjects of recent years have been the effects of climate change, anthropogenic disturbance and wind turbines on capercaillie. Forest Birds, Department of Wildlife Ecology, Forest Research Institute of Baden-Württemberg, Germany.

eco.mont – Volume 12, Number 2, July 2020
ISSN 2073-106X print version – ISSN 2073-1558 online version: http://epub.oeaw.ac.at/eco.mont
https://dx.doi.org/10.1553/eco.mont-12-2s41

LIFE Lech – Dynamic River System Lech

Marlene Salchner

Keywords: LIFE Project, Natura 2000 area, Tiroler Lech Nature Park, wild river, natural dynamic of the river

Abstract

Two at one stroke – the LIFE Lech project combines species and flood protection. The project, which will run for 5 years and is financed with EU subsidies, focuses on large gravel banks and wild river habitats. River engineering measures are being implemented to promote these habitats. Rare and endangered plant and animal species are also being helped with targeted species protection measures. This work is accompanied by an extensive monitoring programme and a wide range of public relations projects.

Profile

Protected area

Tiroler Lech Nature Park

Mountain range

Alps, Austria

Introduction

Following earlier LIFE projects, the European Commission has again approved a LIFE project in the Lech Valley. More than 6 million euros are available until 2021 for the revitalization of the Lech. 60% of this comes from EU LIFE funding. The LIFE Lech project aims to link species protection and flood prevention in the best possible ways. It is particularly concerned with the preservation or restoration of wild river habitats and their typical biodiversity. Between 2016 and 2021, 12 river revitalization measures will be implemented on the Tiroler Lech. At suitable locations, bank protection structures and stone groynes that are no longer needed will be removed so that the Lech can deposit stones there again, and gravel and sandbanks can form, thus creating habitats for rare and endangered animal and plant species, such as the Stone Crayfish (*Austropotamobius torrentium*), Dwarf Bulrush (*Typha minima*) or the German Tamarisk (*Myricaria germanica*), which need special support in the Tiroler Lech Nature Park. To ensure their survival, the LIFE Project focuses on special species protection measures.

The Tiroler Lech Nature Park

The unique wild river landscape on the Tiroler Lech (see Figure 1), together with its tributaries, is one of the last near-natural Alpine river valleys in Austria, and the last wild river landscape in the northern Alpine region. The Tiroler Lech Nature Park in its entirety is a Natura 2000 area and a nature reserve. In 2004 the area received the label *Nature Park* from the federal government of Tyrol.

Many protected areas in Tyrol are located in the mountains, away from inhabited areas. The Tiroler Lech Nature Park is different: the Lech together with its small tributaries forms the largest continuous protected area in the valley area of Tyrol. This extensive valley location is a special feature, because the areas of economic activity and permanent human settlements along the Tiroler Lech border directly on the areas that are important for natural history.

Figure 1 – The river Lech © Mario Posch

The heart of the Tiroler Lech Nature Park

The Tiroler Lech is the last near-natural river in the Northern Alps. Large sand and gravel banks, wide alluvial forest areas and shimmering, light turquoise-blue water give the Tiroler Lech its special beauty. The Lech flows through Tyrol for approximately 60 km. Characteristic is the river's braiding which creates islands of sand and gravel, and the wide riverbed, which is over 100 m wide in some places. The interaction of water, scree, stones, gravel and sand, the gradient of the riverbed and the speed of the water play decisive roles in the constant remodelling of the wild river. The Lech has two faces – wild or tame, thundering through the valley or gently branching, with much or little water. All this brings about constant changes. This dynamic is characteristic of a wild river.

Figure 2 – Top: before restoration, bottom: after restoration. © Baubezirksamt Reutte

Building with consequences

The large-scale hydraulic engineering began at the beginning of the 20th century, after a catastrophic event in 1910 devastated large parts of the valley floor and destroyed property. The cause of this catastrophe was not least the unplanned clearing of the protection forests.

Large stretches of the Lech were channelled according to the state of the art and knowledge of the time: transverse structures (groynes) were built, behind which gravel accumulated. Longitudinal structures were then built along the river, between the groynes. In this way, the river was channelled, its flow increased in speed, and sediment was removed from the riverbed, which thus became deeper. Over time, the engineering of the river created land that became used for agriculture and settlement (Figure 2).

These hydraulic structures, built by several generations of Lechtalers during the winter months for a meagre additional income, still characterize the landscape of the Tiroler Lech in some sections today.

In addition, around 1960, bedload barriers were built into the Streim, Schwarzwasser and Hornbach valleys to retain the stones in these tributaries.

Not without consequences! The Lech's riverbed deepened further and the groundwater level lowered. The plant and animal specialists of the wild river landscape and the adjacent habitats, which depend on regular flooding, were and still are affected by this.

During the following decades, hydraulic engineers realized that the Lech needed the bedload (rock material) from the tributaries to line and stabilize its riverbed with. The bedload barriers erected earlier therefore proved to be more of a curse than a blessing. From 2001 to 2007, the Natura 2000 area of the Tiroler Lech was already the scene of a LIFE project (Tiroler Lech – Wild river landscape of the Tiroler Lech 2020, LIFE00 NAT/A/007053), in which the first positive steps were taken to redynamize the river and the surrounding habitats (Figure 2).

The LIFE Lech Project

Extensive gravel banks and intact wild river sections characterize the Tiroler Lech where it forms the border with Germany. Such ecosystems are among the most threatened landscape types in Central Europe. Preserving the natural dynamics of the river and its adjacent riparian forests (Figure 3) with their typical plant and animal species is the overall objective of the LIFE Lech project. Special attention is paid to the dynamically formed gravel bank areas and pioneer sites (Figure 4).

In order to restore or improve the natural dynamics of the river, river engineering works will be implemented. The highly specialized and endangered wild river species are promoted and cared for in the best possible way by means of monitoring and species protection measures. The focus of LIFE Lech activities is on the Flora-Fauna Habitats (FFH):

- 3230 – Alpine rivers with riparian woodland of *Myricaria germanica*,
- 7240 – Alpine pioneer formations of the Caricion bicolorisatrofuscae
- 91E0* – alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae).

Other target species are the Common Sandpiper (*Actitis hypoleucos*), Little Ringed Plover (*Charadrius dubius*), Bilek's Azure Maiden (*Coenagrion hylas*), European Bullhead (*Cottus gobio*), Stone Crayfish (*Austropotamobius torrentium*) and Northern Crested Newt (*Triturus cristatus*), see Figure 5.

Infobox – Nature Park

Area: 41.38 km²
Length: 65 km
Protection categories: Natura 2000 site, nature reserve, protected landscape area, natural monument
Nature park region:
- 24 communities from Steeg to Vils
- Last wild river landscape of the Northern Alps
- Power of river to constantly remodel its course and sand/gravel banks
- Wide riverbed with sand and gravel banks
- Rare and endangered animal and plant species

All these measures are accompanied by extensive public relations activities.

River engineering measures

Within the framework of the LIFE Lech project, 12 river engineering measures and various species protection measures are being implemented on the upper reaches of the Tiroler Lech and where the river borders German territory. The measures are particularly suitable for the restoration of dynamic gravel areas and pioneer sites. To restore the natural dynamics of the river, river barriers are removed, the riverbed is widened, tributaries are created, and cross-bracings are shortened (Figure 7). This creates habitats for highly specialized species adapted to the wild river. At the same time, the deepening of the riverbed ceases and the groundwater level is stabilized or raised. This benefits the floodplains, the species that live there, and ultimately mankind in the form of better flood protection.

Example: Revitalization near Stanzach-Vorderhornbach

The Lech was closely regulated near Stanzach-Vorderhornbach (Figure 2), causing the river to dig a deeper and deeper bed. Now, the old longitudinal structures and groynes have been removed, the riverside path moved inland to a safe distance, and the Lech can shape its own banks again. When water levels are high, the river has more space again, and the further deepening of the riverbed has been stopped.

Example: Revitalization near Stockach

Downstream from the bridge over the Lech at Stockach, widening the river now provides more space, which benefits nature and local people: the characteristic flora and fauna of the Lech find new habitats; people find recreation on easily accessible banks; the nearby residential and industrial areas are protected by the higher discharge capacity and additional flood barriers.

Species protection measures

The modifications along the river are designed to promote habitats for numerous specialized and endangered animal and plant species, such as the German Tamarisk (*Myricaria germanica*), Little Ringed Plover (*Charadrius dubius*), *Bryodemella tuberculata* – a species of a grasshopper typical of Northern Alpine regions, or European Bullhead (*Cottus gobio*).

On the basis of a study of environmental variants, the LIFE Project also implements specific conservation measures for particularly endangered species, such as the Dwarf Bulrush (*Typha minima*) (Figure 6). This particular species prefers to colonize periodically flooded banks of slow-flowing stretches of the river with sandy-silty subsoil where marsh plants grow. Without the constant modifications to the river's braiding and the displacement of soil, the competition-weak and light-loving Dwarf Bulrush would be quickly displaced by taller species such as willows. In the past, there were large populations of Dwarf Bulrush in the river systems in the Alps and Alpine foothills. Dramatic declines of the species due to habitat loss caused by

Figure 3 – Riparian forest © Francesca Wolf

Figure 4 – Dynamically formed gravel bank and pioneer sites with Myricaria germanica. *© Anette Kestler*

Infobox – LIFE Lech

Project name: LIFE Lech – Dynamic River System Lech
Project number: LIFE15 NAT/AT/000167
Project period: 1 September 2016 – 31 December 2021
Project area:
- Natura 2000 site Tiroler Lech
- Natura 2000 site Falkenstein, Alatsee, Faulenbacher & Lechtal
- Natura 2000 area Ammergebirge with Kienberg, Schwarzberg and Falkenstein

Budget: € 6 093 220
EU funding: 60% (€ 3 655 932)
Project Management:
- Federal Water Engineering Administration Tyrol, Building District Office Reutte, Austria

Project partner:
- Office of the Tyrolean Provincial Government, Department of Environmental Protection, Austria
- Water Management Office Kempten, Germany

Figure 5 – Top: Charadrius dubius © *Felix Lassacher, middle:* Bryodemella tuberculata © *Anton Vorauer, bottom:* Cottus gobio © *die-nATurknipser*

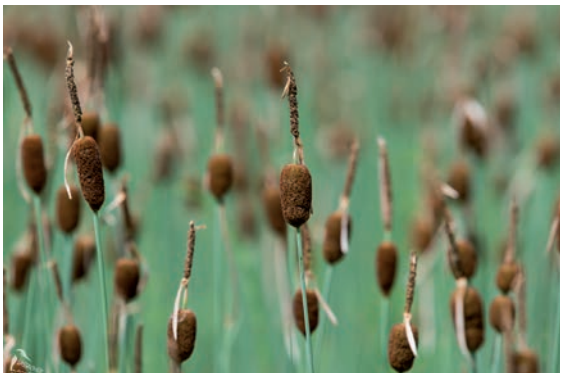


Figure 6 – Typha minima © *Felix Lassacher*

river regulation have been recorded over the last 100 years. Today it is acutely threatened with extinction in the Alpine countries. Isolated remaining populations can still be found on the Tiroler Lech. Austria therefore bears a special responsibility for the conservation of the Dwarf Bulrush in Europe. Within the framework of the LIFE Lech project, young plants of the Dwarf Bulrush cultivated at the University of Innsbruck are being planted in suitable locations.

The Natterjack Toad (*Epidalea calamita*) is the rarest amphibian in Austria. On the Tiroler Lech, it inhabits biotopes with little or no vegetation that provide sufficient hiding places and small, very shallow pools (for spawning). In order to promote and secure its survival, new spawning grounds are being created for the Natterjack Toad.

The Scarce Heath (*Coenonympha hero*) is another focus of the project. This protected butterfly can also be found in the Tiroler Lech Nature Park, in sparse woods or pipe grass meadows. In order to support its population, two hectares of forest in Musau, for example, are to be converted into pasture. This could enable a genetic exchange between previously isolated populations and create a large, coherent habitat for the endangered species.

Monitoring

The success of the revitalization measures is monitored by *repeated observation*, in the context of which inanimate environmental factors, such as the development of the riverbed, are examined. Other biotic environmental factors, such as the populations of protected species and habitats, are also observed. The first monitoring studies were carried out at the beginning of the project and will be repeated at the end to document changes.

Public Relations

A major concern of the LIFE Lech project is to inform the local population and interested people. For this purpose, a project homepage (www.life-lech.at) was designed, the *River Experience Guide, Tiroler Lech Nature Park* was republished, and a folder *LIFE Lech – Dynamic River System Lech – Actions for a Wild River Landscape* (LIFE Lech – Dynamic River System 2020) was created. The media will be kept up to date on the latest developments and events of the LIFE Lech project. Interested parties can obtain information about the project on the spot at the visitor centre (*Naturparkhaus Klimmbrücke*), or during excursions. Action days, such as the launch event for the LIFE Lech project or the Riverfest, promote communication and exchange with local people. For all river construction measures, LIFE information boards on site provide details of the project and the objectives of the measures being implemented. From June 2021, a new visitor facility on the Lech in Forchach will provide information about the project. A touring exhibition is currently travelling round Tyrol and has already been a guest in many places, including the seat of the federal government in Innsbruck. Short videos are currently being produced that capture the intentions and results of the LIFE Lech project in attractive and readily comprehensible images.

Expected results

The LIFE Lech project aims to promote the river's habitats with their specialized species. To this end, it is expected that around 4.3 ha of forest will be returned to a dynamic river habitat with gravel banks. Along the 12 river-revitalization sections, a total of approximately 11 km of non-reinforced riverbanks will be created. In addition, about 32 ha of dynamically changing river habitats (FFH Appendix I, Habitats 3220, 3230, 3240) are to be developed. They should contribute to the long-term survival of the unique, highly specialized populations of the Common Sandpiper, Little Ringed Plover and *Bryodemella tuberculata* grasshopper. For other particularly endangered and protected species, such as the Northern Crested Newt, European Tree Frog (*Hyla arborea*), Natterjack Toad, Bilek's Azure Maiden, Stone Crayfish, Bullhead or Dwarf Bulrush, two habitats each are to be improved or newly created.

References – further readings

Braun, V., G. Bendler, A. Haller & K. Heinrich 2018. Timelines of Tension: Trajectories of Protected-Area Creation in the Austrian Alps. *Journal of Alpine Research* 106-4. doi: 10.4000/rga.4711

Land Tirol 2020. Archiv Wasserwirtschaft. Available at: www.tirol.gv.at/verkehr/baubezirksaemter/bba-reutte/archiv-wasserwirtschaft/ (accessed 06/03/2020) [In German]

LIFE Lech – Dynamic River System Lech 2020. Available at: www.life-lech.at (accessed 06/03/2020)

LIFE Lech – Dynamic River System 2016. Projektbeschreibung. [In German]

LIFE Nature and Biodiversity 2016. Technical application forms.

Naturpark Tiroler Lech 2017. *Das Naturmagazin „grenzenlose Natur"* 5. [In German]

Naturpark Tiroler Lech 2018. *Das Naturmagazin „grenzenlose Natur"* 7. [In German]

Naturpark Tiroler Lech 2019. *Das Naturmagazin „grenzenlose Natur"* 8. [In German]

Naturpark Tiroler Lech 2019. *Fluss-Erlebnisführer Naturpark Tiroler Lech.* Amt der Tiroler Landesregierung. [In German]

Naturpark Tiroler Lech 2020. *Wanderausstellung LIFE Lech.* Amt der Tiroler Landesregierung. [In German]

Tiroler Lech – Wild river landscape of the Tiroler Lech. Available at: www.naturpark-tiroler-lech.at/fileadmin/PDF/Lifeprojekt_Der_Fluss_der_Zeit.pdf (accessed 06/03/2020)

Author

Marlene Salchner

is managing director of the Tiroler Lech Nature Park association. www.naturpark-tiroler-lech.at

MIT UNTERSTÜTZUNG VON BUND, LAND UND EUROPÄISCHER UNION

Bundesministerium Landwirtschaft, Regionen und Tourismus

NATURA 2000

LAND TIROL

Life

Wasserwirtschaftsamt Kempten

NATURPARK TIROLER LECH

LifeLech Dynamic River System Lech

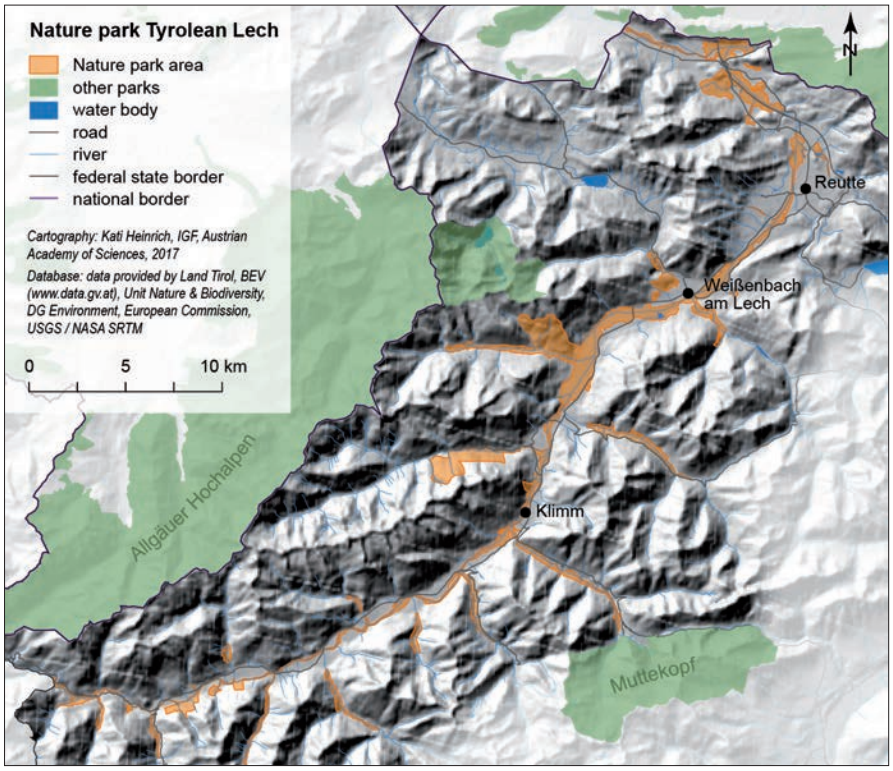


Figure 7 – Tiroler Lech Nature Park (Braun et al. 2018).

eco.mont – Volume 12, Number 2, July 2020
ISSN 2073-106X print version – ISSN 2073-1558 online version: http://epub.oeaw.ac.at/eco.mont
https://dx.doi.org/10.1553/eco.mont-12-2s46

The Italian Julian Alps – A new Biosphere Reserve for a sustainable future

Stefano Santi, Paola Cigalotto & Alessandro Benzoni

Keywords: biosphere reserve, cultural heritage, protected area, transboundary

Abstract

In June 2019 UNESCO established the new Italian Julian Alps Biosphere Reserve (BR) in the frame of the MAB programme. It includes the entire territory of 11 mountain municipalities in the Friuli Venezia Giulia region. The recognition is based on the special biodiversity of the area, its original historical and cultural characteristics, and the possibility of creating a new transboundary BR with the Slovenian Julian Alps. Ongoing projects dedicated to nature preservation, awareness raising on environmental topics, the promotion of typical local products and the involvement of the local community were also judged positively. The BR is seen by local administrators and stakeholders as an opportunity to develop actions for sustainability with regard to the protection and enhancement of the extraordinary environmental richness, and to give young people the opportunity to live in the area. For this reason, the Management Committee will be supported in its activity by a Youth Advisory Board.

Profile

Protected area

Italian Julian Alps

Biosphere Reserve

Mountain range

Alps, Italy

Figure 1 – Venzone and the river Tagliamento. © MoviTex

Introduction

On 19 June 2019, the area comprising 11 municipalities in the far north-eastern part of Italy was named the Italian Julian Alps Biosphere Reserve (BR) within the framework of UNESCO's MAB programme, becoming the 19th BR in Italy, and marking the end of a process which had begun in 2011 and developed over 8 long years of meetings and discussions involving many different stakeholders.

The Italian Julian Alps BR covers about 715 km² and includes the municipalities of Artegna, Chiusaforte, Dogna, Gemona del Friuli, Lusevera, Moggio Udinese, Montenars, Resia, Resiutta, Taipana and Venzone in the Autonomous Region of Friuli Venezia Giulia (see Figure 1 & 2). The BR is situated close to Austria, and for several kilometres it shares a border with Slovenia. About 22000 people live in the area.

Within the space of a few kilometres, the elevation profile passes from approximately 150 m above sea level on the Osoppo – Gemona Plain to 2754 m on Mount Jof di Montasio. The rainfall pattern in the BR is one of the most abundant in Europe, often reaching annual averages in the Musi Mountains of 2800–3000 mm. The area includes two important watersheds, belonging to two great rivers in the south-eastern part of the Alpine arc: the Tagliamento and Isonzo-Soča, which both flow into the Northern Adriatic Sea and act as primary ecological corridors linking the Alpine arc and the sea.

The recognition of the area as a BR has its origins in the extraordinary natural, landscape and cultural characteristics of the region, but the history, territorial management model, existing projects, and involvement of the younger generations all played their part. Also important was the strong pre-existing link with the neighbouring Julijske Alpe MAB BR in Slovenia, and it is hoped that in the not too distant future this will lead to the creation of just one transboundary BR in the Julian Alps. This perspective was also highly appreciated by the International Co-ordinating Council of the Man and the Biosphere Programme.

A peculiar characteristic of the region is the key role it plays as a link between different landscapes, ecosystems and cultures. These overlappings and intertwinings have contributed to the creation of a *plural* environment, the specificity and uniqueness of which combine with the differences that are also found here: above all, this is a transitional territory between the Latin and Slavic worlds; it is also a strategic hub between the mountainous Alpine and Prealpine environments and the great plain context. The succession of elevations present different landscapes and habitats associated with particular climatic characteristics, and specific ways of life: from glaciers to Alpine land-

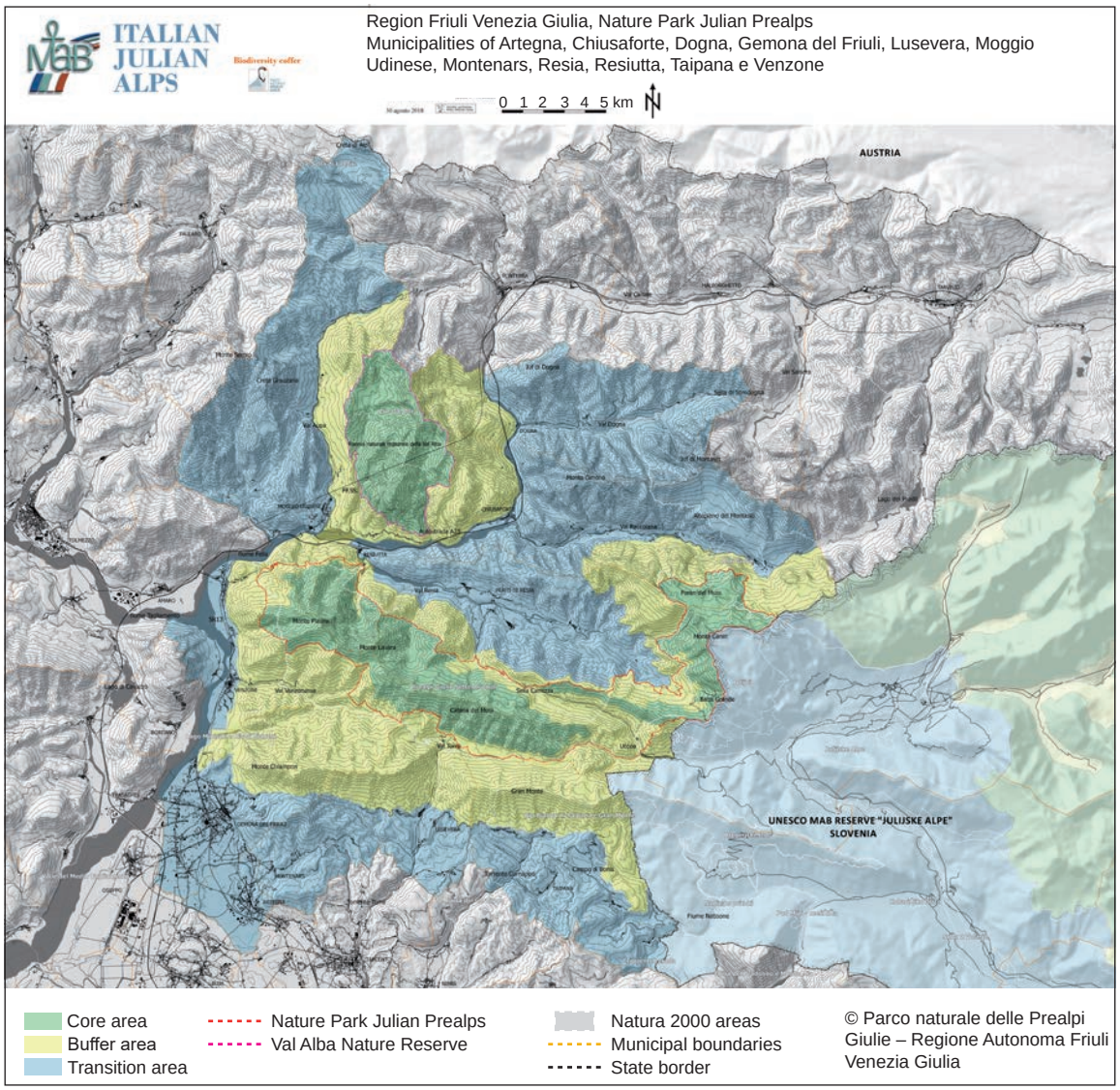


Figure 2 – Zonation map of the Italian Julian Alps Biosphere Reserve

scapes dotted with *Malgas* (mountain farms) and cottages, wooded slopes scattered with pastures, to larger settlements on the plains.

The Julian Alps are characterized by three main aspects: extremely high biodiversity, an extraordinary cultural mix, and communities with a high level of resilience who, over time, have never ceased to fight proudly to preserve and protect their territory and culture.

A wealth of biodiversity

The specific biological nature of the BR is determined by several factors: its biogeographic location, elevation gradient and abundant rainfall are particularly relevant. The richness of nature in the area has been confirmed by several studies (Genero et al. 1998; Mainardis 2001; Museo Friulano di Storia Naturale 2004; Gobbo & Poldini 2005), and constant monitoring activities.

From a natural-environmental point of view, the conservation of landscapes, ecosystems, species and genetic variability is guaranteed by the presence, within the area's boundaries, of several officially-managed protected areas, as well as a high density of sites belonging to the Natura 2000 Network.

The peculiar biogeographical and bioclimatic characteristics are directly reflected in the chorological spectrum of the area, in which there is a prevalence of Eurosibiric elements (*Cypripedium calceolus* L., *Malva sylvestris* L. subsp. *sylvestris*), while there are also others of a Mediterranean-Mountain corotype (*Genista radiata* (L.) Scop., *Gentiana clusii* E.P. Perrier & Songeon subsp. *clusii*) alongside strictly Alpine species (*Eryngium alpinum* L., *Luzula alpina* Hoppe), which are also well-represented.

Within the area, there are numerous rare and endemic floristic species (*Campanula zoysii* Wulfen., *Physoplexis comosa* (L.) Schur.) as well as fauna species (*Austropotamobius pallipes* Lereboullet, *Rosalia alpina* L.,

Figure 3 – Canin Massif © Archivio PNPG – Marco Di Lenardo

Figure 4 – Saint Ann in Carnizza © Archivio PNPG – Marco Di Lenardo

Bombina variegata L., *Gyps fulvus* L., *Ursus arctos* L.) which are recognized as of Community (EU) Importance. The BR also includes rare pure habitats (4070 Bushes with *Pinus mugo* and *Rhododendron hirsutum*; 9530* Mediterranean pine forests with endemic black pines), the conservation of which is associated with anthropogenic practices, mainly mowing and grazing.

There are several plant species listed in Annex II of the Habitats Directive; 23% of the bird species found here figure in the Birds Directive 79/409/EEC; over 50% of the invertebrate species belong to the Habitats Directive 92/43/EEC; moreover, there are a significant number of species of fish, amphibians, reptiles and mammals.

The area has been studied by botanists since the early 20th century. Publications include Crichiutti (1906), Poldini (1991), and Simonetti & Mainardis (1997). The plant landscape is extremely varied and complex as the BR stretches from the typically Prealpine elevations to those of an Alpine nature (see Figure 5), including almost all the transition zones between the two bioclimatic areas consisting of the Esalpic and Mesalpic bands. The management plans for the Natura 2000 areas have confirmed the presence of an extraordinary floristic variety (see Regione Autonoma Friuli Venezia Giulia 2018).

The area is also characterized by a wide variety of habitats that provide suitable sites for the reproduction, nutrition and growth of fauna whose biodiversity is just as rich as that of the flora, ranging from large carnivores to invertebrates. The fundamental role of the entire area as an Alpine corridor is proven by the way large carnivores, including brown bears, pass frequently from the Slovenian Julian Alps to those on the Italian side. Just as important is the autumnal migration of the avifauna monitored at the bird-ringing station in Malga Confin (Venzone).

The significance of these phenomena has been attested by various projects, and by the recognition of the region as an Alpine pilot area for ecological connectivity, carried out in collaboration with the equivalent authority on the Slovenian side, and conferred by the Secretariat of the Alpine Convention.

Land of water and rocks

The BR represents perhaps the largest water basin in the Friuli Venezia Giulia region and in this part of the Alps: at one end, there is the region's only glacier, situated on Mount Canin, and at the other, on the Campo di Osoppo plains, between Gemona and Artegna, is the largest underground freshwater reservoir, which supplies the Central Friuli area. In the mountain and pre-Alpine areas, the karstic soil, which absorbs surface water, has led since ancient times to the invention of techniques to collect and manage water (cisterns, fountains, springs), as it is a scarce resource. Similarly, on the plain, a large portion of arid, gravelly soil led to the creation of an ancient system of canals to supply the fields, mills and manufacturing activities.

On the south-western edge of the BR flows the unspoilt Tagliamento river. Water has shaped this territory profoundly, partly because of the richness of the geology in the area, which includes significant *geosites* (Cucchi et al. 2009). The Karst morphology extends to the Foran dal Mus plateau, at the foot of Mount Canin, where it is at its richest. Here all types of surface and underground Karst phenomena can be found. Particularly impressive is the area near Col delle Erbe, where hundreds of the caves are located, including the Gortani Abyss, which is over 900 m deep. The Grotta Nuova in Villanova extends for 8 020 m and is open to visitors and for excursions.

Cultural diversity: one land, many voices

The territory of the BR is an age-old crossroads where different cultures and populations have met, as proven by the presence of a multitude of dialects and languages, varied settlement patterns, and the variety of agricultural and artistic practices. Cultural diversity is considered of paramount importance on an interna-

tional scale: here, the interplay between the *Latin world* and the *Slavic world* takes on forms that still have to be examined in detail, although they were already the subject of anthropological studies in the 19th century. In particular, research would be welcome regarding the Resia Valley, in the heart of the BR, from ethnographical, linguistic and musicalogical points of view (Adaïewsky 1883 in Guzzi 2012). The area is particularly interesting linguistically, because the ancient Resian language is still used here.

The overlapping of cultures can be seen in the castles, wayside stones, architecture of the settlements and other physical features in those places in particular which saw flows of international migrants from north to south and from east to west passing through them. In Roman times, Roman power came up against Noricum (a territory corresponding to most of modern-day Austria and part of Slovenia); the customs station in Resiutta constituted a point of transition between these two worlds. Later, the Abbey in Moggio Udinese, built in the 11th century, was the Patriarchate of Aquileia, in the Alpine area of which it became a fief with the right to vote in the Friuli General Parliament. In turn, the two medieval centres of Venzone and Gemona del Friuli bear witness to the flows of people who transited through this area from north to south and back again, and still do so today, as they are key points of contact between the mountains and the plain (Floramo 2017).

Resilience and capacity of adaptation

A feature of the communities in the area that is by no means secondary is their capacities of resilience and adaptation, seen in their ability to adapt to the succession of wars, changing administrative boundaries, the different powers and forms of government, and extreme weather conditions. The resilience shown in the local communities' response to the 1976 earthquake, which had its epicentre in this very territory, causing devastating damage, appears to be of great importance both today and for the future. Reconstruction after the earthquake was a true example of a bottom-up process: local communities played an important role both in promoting a reconstruction process that respected local identities and in the definition of an emergency management system, mostly carried out on a voluntary basis, which led the way on a global level. The Italian Civil Protection Service was founded here (see link below: Tiere Motus museum).

Since the effects of global warning have become evident, particular – urgent – efforts need to be made to allow nature and man to co-exist in this area, and further research needs to be carried out. The melting of icecaps, the decreasing reliability of snow, and extreme weather conditions form a scenario of global reference that has repercussions also in the Julian Alps and imposes modifications in local management and development strategies.

Figure 5 – Julian Alps poppies © Elena Mattiussi

The biosphere reserve's main goal

The main goal of the BR is to drive and lead local people towards a future of sustainability, in the belief that only a path based on environmental wealth can provide those who wish to remain in this area with the concrete possibility of doing so. This goal is strongly shared by local administrations, Ecomuseums, NGOs and private associations representing local communities that actively participated in the application process to become a BR. The objective of establishing a BR is to promote a vision which will achieve sustainable development anchored to the values of the territory, and in line with the themes developed by the Alpine Convention: *quality of life in the Alpine area, tourism and production zones, agriculture, animal husbandry and forestry, energy self-sufficiency and the Alpine ecological network.*

A host of projcets to be developed

Within the boundaries of the BR, a variety of activities have been established in order to achieve sustainable development. Many activities are carried out both by the municipal authorities and by the widespread network of associations and local players, including the Ecomuseum of Waters and the Resia Valley Ecomuseum (see links below).

Among the many projects developed, some are particularly worthy of note as they have greater significance and relevance in relation to the 2016–2025 Lima Action Plan, the 2015–2025 MAB Strategy, and the 2030 Agenda for Sustainable Development. These projects include:

- preserving biodiversity thanks to the monitoring and active management activities carried out in the area, and thanks to EU funding;
- reducing the impact of CO_2 emissions through the calculation of the carbon footprint in the Gemona del Friuli area;
- reinforcing local identity through the creation of Parish maps by the Ecomuseums;

Figure 6 – The local Fiorina bean (top), mountain cheese (middle) and Resia garlic (bottom). © Paolo Da Pozzo

- implementing responsible consumption and production in agriculture, including the conservation and valorization of prestigious local products (pumpkins, garlic, bread, flour, truffles ...) which have led to the recognition of three Slow Food presidia (Resia Garlic, *Pan di Sorc* – corn bread, and *Latteria Turnaria* cheese) (ERSA 2008) (Figure 6);
- implementing sustainable tourism through a wide selection of outdoor activities, including cycling tours, developed especially around the international Alpe Adria cycle route, and an extensive footpath network for walking and hiking (see Figure 3);
- activities promoting health, well-being and healthy lifestyles by means of the *Sportland* intermunicipal project, managed by *Gemona – the city of well-being*.

This brief list should be enough to help us understand the direction in which this territory is going. In the near future, these projects will be both carried forward and enhanced. Others identified in the Management Plan / Action Plan will be launched. In particular, the process to establish the MAB cross-border BR in the Julian Alps will be initiated, in agreement with the Slovenian authorities.

Participatory management for an active biosphere reserve

With the aim of constantly involving the local stakeholders, the management of the BR will be as participatory as possible. The Management Committee will decide the guidelines to be followed in order to reach the BR goals. The Committee consists of 17 members, 11 of whom are the Mayors of the municipalities involved. The Julian Prealps Regional Nature Park will perform a coordination function for the entire BR and its activities. The Management Committee will be joined by three advisory bodies:

1. the Committee for Associations and Economic Categories;
2. the Youth Advisory Board;
3. the Technical-Scientific Committee.

Their role will be to support the Management Committee in pursuing the aims of the BR and to ensure co-operation between its communities, associations and stakeholder groups. More specifically, the Technical-Scientific Committee will have 5 representatives coming both from the Universities and the Natural History Museums of Udine and Trieste, as well as the domain of culture. Its task will be to provide opinions and formulate proposals on issues of the greatest technical and scientific interest, taking into account the objectives relating to the establishment of the BR. It will also verify the coherence of the actions undertaken in the light of these objectives alongside the general guidelines of the MAB programme.

What appears to be even more strategic for the future is the involvement of the young residents so that they become the driving force behind the BR. The Youth Advisory Board of the BR, open to all residents aged between 16 and 30, was established for this very purpose. It will have a consultative and propositional function in the decision-making processes regarding the BR and will foster the active participation of young people in the initiatives. It will not only encourage relations between young people in the municipalities of the BR but will also actively participate in the drafting of projects involving young people in relation to BRs.

The role of the younger generations will be part of the great challenge to achieve the success of the entire initiative: the involvement of the local communities. The challenge is to ensure that every inhabitant feels ownership of the BR, and has the power to change the trends taking place in this part of the Alps. Only

in this way will the BR be seen as offering a future, based on its exceptional natural and cultural heritage, to those who want to live there.

References

Crichiutti, G. 1906. Elenco di piante raccolte per la prima volta in Valle di Raccolana e nel gruppo del monte Canin con cenno sulla distribuzione delle piante arboree. *Atti della Accademia Scientifica Veneto-Trentino-Istriana* 3(1-2): 104–121. Padova. [In Italian]

Cucchi, F., F. Finocchiaro & G. Muscio 2009. *Geositi del Friuli Venezia Giulia*, Arti Grafiche Friulane – Udine

ERSA 2008. *Cibario del Friuli Venezia Giulia - Atlante dei Prodotti della Tradizione*, Editoriale Ergon s.r.l. (GO) [In Italian]

Floramo, A. 2017, *Forse non tutti sanno che in Friuli*… Roma. [In Italian]

Genero, F. 1998. *Piano pluriennale di gestione della fauna del Parco naturale delle Prealpi Giulie.* Ente parco naturale delle Prealpi Giulie – Resia. [In Italian]

Gobbo, G. & L. Poldini 2005 *La diversità floristica del Parco naturale delle Prealpi Giulie*, Ente parco naturale delle Prealpi Giulie – Resia. [In Italian]

Guzzi, F. 2012. *Un voyage a Resia. Il manoscritto di Ella Adaiewsky del 1883 e la nascita dell'etnomusicologia in Europa.* [In Italian]

Julian Prealps Nature Park Authority 2018. *Italian Julian Alps, a biodiversity coffer – Biosphere reserve nomination form.*

Mainardis, G. 2001 *Atlante illustrato della Flora del Parco delle Prealpi Giulie*. Ente parco naturale delle Prealpi Giulie – Resia. [In Italian]

Museo Friulane di Storia Naturale 2004. *Monitoraggio di invertebrati bioindicatori di pascoli e faggete*. Ente parco naturale delle Prealpi Giulie – Resia. [In Italian]

Poldini, L. 1991. *Atlante corologico delle piante vascolari nel Friuli – Venezia Giulia. Inventario floristico regionale*. Regione Autonoma Friuli – Venezia Giulia – Direzione Regionale Foreste e Parchi, Università di Trieste. [In Italian]

Regione Autonoma Friuli Venezia Giulia 2018. *La rete europea Natura 2000 per la tutela della biodiversità.* Available at: http://www.regione.fvg.it/rafvg/cms/RAFVG/ambiente-territorio/tutela-ambiente-gestione-risorse-naturali/FOGLIA203/FOGLIA132/ [In Italian]

Simonetti, G. & G. Mainardis 1997 *Carta della vegetazione delle Prealpi Giulie nord-occidentali tra il fiume Tagliamento ed il gruppo del Monte Canin*. Arti Grafiche Friulane – Tavagnacco (Ud). [In Italian]

Links

Ecomuseo delle Acque del Gemonese: http://www.ecomuseodelleacque.it/ecomuseo-en

Tiere Motus museum in Venzone: http://www.tier-emotus.it/en

Val Resia Ecomuseum: http://www.tarvisiano.org/Ecomuseums/Val-Resia-Ecomuseum

Authors

Stefano Santi[1] – corresponding author

has been Director of the Julian Prealps Regional Nature Park since 2004 and has been examining environmental issues and questions of sustainable development for about 30 years. He graduated in agricultural sciences from the University of Udine, after which he worked as an agronomist and taught for a number of years in high schools. He is currently a member of the Europarc (the European Parks Federation) cross-border protected areas steering committee and working group and verifier of the European Charter for Sustainable Tourism. E-mail: stefano.santi@parcoprealpigiulie.it

Paola Cigalotto[2]

is an architect and urban planner, and was an Adjunct professor with teaching and research responsibilities in the Department of Engineering and Architecture, University of Trieste (2001–2019). The author of General City Plans, Town plans, Masterplans, papers and books about urban planning and architecture, she has received several awards for her work on sustainable design and planning. E-mail: paola.cigalotto@gmail.com

Alessandro Benzoni[1]

is head of the administrative office of the Julian Prealps Nature Park. He graduated in law from the University of Trieste and has been President of the Italian Alpine Club, Tolmezzo section, since 2015. He deals with environmental issues both professionally and in his leisure time. He is a lover of mountains in all their aspects, and practises mountaineering, climbing and ski mountaineering.

[1] Ente parco naturale delle Prealpi Giulie, Piazza del Tiglio 3, 33010 Resia, Italy, info@parcoprealpigiulie.it
[2] Architecture, landscape and urban planning, Via della Prefettura 8. 33100 Udine, Italy.

eco.mont – Volume 12, Number 2, July 2020
ISSN 2073-106X print version – ISSN 2073-1558 online version: http://epub.oeaw.ac.at/eco.mont
https://dx.doi.org/10.1553/eco.mont-12-2s52

Conservation, development and logistical support: How are these three functions incorporated in Austrian Biosphere Reserves?

Valerie Braun, Christian Diry, Heinrich Mayer, Anna Weber & Günter Köck

Keywords: Seville Strategy, conservation, sustainable develoment, logistical support

Abstract

There are four UNESCO biosphere reserves (BRs) in Austria representing different bio-geographical regions. As members of the World Network of Biosphere Reserves (WNBR), they function according to the Seville Strategy of 1996 and are intended to fulfil three complementary functions: conservation, sustainable development and logistical support. This article aims to give an overview of the manifold initiatives taking place in Austrian BRs which reflect the complexity of the landscapes and the people living there.

Figure 1 – Carinthian part of BR Salzburger Lungau and Kärntner Nockberge © BR Nockberge Franz Gerdl

Introduction

UNESCO's Man and the Biosphere Programme (MAB) aims to preserve characteristic habitats of cultural landscapes and their biodiversity while achieving sustainable regional development from an economic and socio-cultural perspective and facilitating environmental and sustainable development education. On-site managers responsible for Austrian BRs pursue these goals in regions which include both protected areas and other spatial entities which are not conventional protected areas (see Reed & Price 2019). This requires participatory governance, that is involving local people in decisions concerning the BR (Pütz & Job 2016), and combining different types of knowledge, e.g. local and traditional as well as scientific knowledge, to promote the integration of natural and social sciences (Kjellqvist et al. 2019). The existing Austrian BRs have been implemented according to the *Seville Strategy for BRs* and *MAB Statutory Framework of the World Network of BRs* (UNESCO 1996), known as the Seville Strategy, a document which names the three connected functions of BRs: conservation, development and logistical support. This conservation and development concept was intended to facilitate the protection of valuable natural and cultural landscapes while also meeting the requirements of the people living in those landscapes (Köck & Arnberger 2017). In this article we present various projects in Austrian BRs in which these three objectives are implemented.

Development of the MAB programme in Austria

In Austria, the MAB National Committee (MAB-NC) was established as early as 1973 (Köck & Grabherr 2014). It represents the national network of BRs in Austria and is the link to the MAB Secretariat at UNESCO Headquarters in Paris. The international guidelines of the Seville Strategy of 1996, the Madrid Action Plan 2008–2013 and the MAB Strategy 2015–2025 were incorporated into the Austrian criteria published by the Austrian MAB-NC in 2006, which were revised in 2015. Until 2014, Austria had a total of seven BRs. However, the MAB-NC decided to remove four of them from the World Network of Biosphere Reserves because of their non-compliance with its Statutory Framework (Köck & Arnberger 2019). In 2000, the first BR established to function according to the Seville Strategy was BR Grosses Walsertal (BRGW), followed in 2005 by Wienerwald (BRWW), and in 2012 by Salzburger Lungau and Kärntner Nockberge (BRSL&KN). In 2019, BR Unteres Murtal was approved as Austria's contribution to the 5-country transboundary BR (Austria, Slovenia, Croatia, Hungary, Serbia) along the Mura-Drava-Danube corridor.

Study areas

The four Austrian BRs cover different bio-geographical regions and vary in size, number of inhabitants, altitude, history and demography (see Table 1). Additionally, the planning and management processes in the BRs differ according to the size of the BR, and to the stakeholders and municipalities involved (see Jungmeier et al. 2011). The BRs have three, or sometimes four, defined areas: the core zone, which serves conventional nature conservation in a way similar to

Table 1 – Main characteristics of the Austrian BRs (Braun et al. in print; Austrian National Committee of the Man and the Biosphere Programme 2018). ca – core area; ba – buffer area; ta – transition area

Biosphere reserve	Classification of natural areas	Area [ha]	Inhabitants	Municipalities involved	Range [m]	Natural environment character
Großes Walsertal	Northern Alps	ca: 4010 ba: 2824 ta: 12366	3400	6	580 to 2704	- alpine cultural landscapes - meadows with high biodiversity - alpine grasslands, ravine forests, wetlands
Wienerwald	Pannonian plains and hills / Central Alps	ca: 5442 ba: 32571 ta: 66991	855000	51 in Lower Austria; 7 districts of Vienna	160 to 893	- sub-Mediterranean beech forests - pine forests with endemic Austrian pine (*Pinus nigra*), and downy oak forests (*Quercus pubescens*) - extensive meadows and pastures - traditionally managed semi-natural dry grasslands - old-growth vineyards and orchards, fields (cereals, potatoes) - dense system of rivers and watercourses - small landscape elements
Salzburger Lungau & Kärntner Nockberge	Central Alps	ca: 8192 ba: 55235 ta: 86173	34000	15 in Salzburg; 4 in Carinthia	600 to 3078	- alpine agricultural landscape - alpine meadows, bog complexes, deciduous forest (up to approx. 1400 m), arable fields, coniferous forest (up to the tree line at 1950 m), dwarf shrubs and lichen at high altitudes - traditionally managed alpine pastures - characteristic plants: *Pinus cembra*, *Valeriana celtica* ssp. *norica* - mountain lakes and mountain streams
Untere Mur	South-eastern Alpine foreland	ca: 200 ba: 1891 ta: 11089	10099	4	198 to 289	- river landscape with adjacent riparian forests - soft and hard floodplain forests, depending on the water regime - agricultural landscape units with corn, soybeans, millet and cereals, and crops such as pumpkin, wine or fruit

national parks; buffer zones, in which ecologically sustainable activities are permitted, and transition areas, in which the local population lives (Biosphärenpark Österreich 2020). BRGW also has a fourth area, the regeneration area, which may be revitalized in the future.

Presentation of the BRs' 3 functions

Selected examples of projects show how the three functions are incorporated by Austrian BRs. Since BR Unteres Murtal was established only in 2019, only one BR-specific activity has been implemented there.

Function 1: conservation

Ecosystem processes that take place in nature contribute to economic growth, and to the health and wellbeing of the local population. One focus of BRs is on ecosystems that are either unaffected by human intervention, or which exist only because of human-nature interactions.

In BRWW, the conservation function is most evident in the 37 core areas, which are exclusively forests representing the natural vegetation (see also Köck et al. 2009). These core areas are under strict nature conservation regulations in order to allow the primeval forest to grow without human intervention. In the core and buffer areas, a monitoring programme collects basic data of the natural environment (see also Drozdowski & Mrkvicka 2014). Throughout BRWW, there are many initiatives involving landowners and volunteers. These include the *Biosphere Volunteers* project, in which volunteers remove vegetation to reduce the impact of shrub encroachment and thereby preserve dry grasslands; a fruit tree campaign, which funds owners of agricultural land to plant heritage varieties and to increase meadow orchards which are rich in biodiversty; other BR projects aim to restore habitats of endangered animals such as the Corn Crake (*Crex crex*), the Ural Owl (*Strix uralensis*),

The federal government granted support for costs and loss of income resulting from compliance with nature conservation requirements (AMA 2015). The project itself ended in 2018 but its continuation is enshrined in BRGW's mission statement.

Function 2: development

In BRs, the protection of biodiversity together with economic, social and cultural aspects should ensure sustainable regional development. Sustainable regional development requires the conservation of natural resources for economic use and development. In addition to the UNESCO guidelines, a BR needs inhabitants with ideas to support the BR management (Diry 2014). A good example integrating municipalities, stakeholders and the public is the project *Future Concept*, which created a *roadmap* for BRWW for the next 10 years. The issues identified by the participants are nature conservation activities, regional development, education and public relations (Biosphärenpark Wienerwald Management GmbH 2013).

A wide range of initiatives have recently been developed in BRs to encourage the sustainable production, processing and marketing of regional food. The involvement of suppliers of regional products and services and cooperation with local companies are important for the BR regions (see Mose & Weixlbaumer 2019). The Carinthian part of BRSL&NK established a quality seal to promote local and innovative products and to guarantee landscape protection (Biosphärenpark Nockberge 2019). The BRGW management also creates incentives for sustainable agriculture by supporting farmers to become BR partner companies. It then helps to sell the products in the BR shop – which also offers products from BRWW and BRSL&KN

Figure 2 – Biosphere Reserve Wiener Wald © BPWW / L. Lammerhuber

– or via local supermarkets. The *Walserstolz*, *Bergholz* and *Alchemilla* initiatives sustainably produce cheese, furniture and herbs respectively. But not all initiatives are implemented as successfully. The online platform *Walser Kostbarkeiten*, which was initiated by the BRGW management to promote regional products, was insufficiently supported by consumers and producers, probably due to the prior existence of other well-functioning networks. The regional planning association is currently working on a regional strategy to strengthen the circular economy in the BRGW by evaluating existing networks. The aim is to establish alternative models to increase the consumption of regional products.

In 2005, the BRWW started a farming project with the aim of preserving meadows and pastures through cooperation between farmers, butchers and catering businesses. The predominantly part-time farms were able to produce high-quality meat while respecting the interests of nature conservation. Small-scale farming could be maintained through the secured sales of agricultural products. Unfortunately, after a successful start, the project alone could not meet the high from butchers and catering businesses.

Ecotourism aims to deliver sustainable development through nature conservation and regional development (Hoppstadius & Dahlsträm 2015; Weixlbaumer et al. in press). According to the Austrian criteria for BRs, nature-oriented tourism and gentle leisure use are possible in the core areas, provided they are compatible with the protection goals. The BRs in Austria face various challenges, in particular due to their location: BRGW is situated in a remote area, whereas BRWW is close to Vienna, the largest city in Austria. How visitors are managed therefore differs between the BRs. In BRWW, for example, the platform for mountain biking serves as a communication tool between various interest groups (see Köck & Brenner 2015). The platform's aim is the development of the existing trails in BRWW to create a contemporary, nature-compatible, legal mountain bike network based on attractive sustainable routes and contractual solutions.

In 2018, with the participation of the local population, BRGW developed a revised mission statement which describes two important topics of sustainable tourism for the area: deceleration and climate change. The Grosses Walsertal also has a ski resort in Faschina, which wants to promote the ski industry further, and is considering an alliance with Damüls in the Bregenzerwald outside the BRGW. The Regional Development Plan 2019, which was drawn up with the participation of the BR, recognizes that the BR's mission statement is binding but that an association between the two ski areas, combining the different touristic concepts, should also be possible (REGIO Großes Walsertal 2019). There are also alliances between the tourism association Alpenregion Bludenz and the BRGW management, who defined criteria for BR partners in the tourism industry, such as restaurants and hotels, to promote the BR concept.

One of the main economic sectors in the Carinthian part of BRSL&KN is tourism. Together with landowners and representatives from tourism, the BR management of the Carinthian part of BRSL&KN initiated a visitor guidance project for sensitive habitats of various animal species, including red deer (Cervidae), chamois (*Rupicapra rupicapra*), capercaillie (*Tetrao urogallus*), black grouse (*Lyrurus tetrix*), ptarmigan (*Lagopus* sp.), and the stone hen (*Alectoris graeca*). Additionally, suitable routes to be used for recreation were drawn up. The aim of the project is to develop a framework to guide leisure and tourism activities in this part of BRSL&KN while avoiding disturbing wildlife (see Besucherlenkung im Biosphärenpark Nockberge 2019). A further example of tourist infrastructure is the Nockalm Road, a route running through the core area of the Carinthian part of BRSL&KN. As around 200 000 people use the road in the months from May to October, discussions about air and noise pollution are frequent.

One aspect of sustainable development is clean energy. The Austrian MAB-NC published a position paper for the use of renewable energies in Austrian BRs. BRGW has already made efforts in this respect and is an eco-electricity export region with both small hydropower plants and a photovoltaic plant. It belongs to the e5 network of energy-efficient municipalities and is the only e5 *region* in Austria. The seven schools in the valleys have been awarded the eco label and are energy efficient. Another aspect is mobility within the regions. In the Carinthian part of BRSL&KN, a call-and-collect, demand-focused taxi service has been established as a green alternative to the car for locals and guests (Nockmobil 2020).

Function 3: logistical support

Education for sustainable development is one of the major goals of BRs. It covers global interrelations and challenges such as climate change, conservation of biological and cultural diversity, global justice, and

the complex economic, ecological and social causes of these problems. Forward-looking thinking, interdisciplinary knowledge, independent action and participation in decision-making processes are the design and action skills that are taught (Braun et al. in press).

Educational work in schools also reaches parents and grandparents alike and offers a good introduction to education for sustainable development and energy management, as well as specific, fundamental, BR-related content. The Carinthian part of BRSL&KN developed an ambitious school project that comprises three steps: i) BR rangers visit schools with the mobile exhibition *Smart Fox on Tour* to explore flora, fauna and the geological features of the region; ii) programmes for school trips, hiking days and project weeks; iii) schools are designated as BR schools in which the topic of BRs is included in the timetable. The Carinthian part of BRSL&KN claims only limited success in involving the local population and those responsible in the municipalities in the further development of the BR. Greater involvement would, of course, contribute a great deal to the creation of an understanding of, and an identity and enthusiasm for, the BR. The school project could help to involve more people in the BR idea. BRWW's management also engages with schools through other initiatives, e.g. the *Biosphere Reserve Game*, to deepen understanding of BRs and of sustainable development. In addition, the BRWW management offers its partners in agriculture, education and tourism a varied educational programme. Another interesting project is *Enjoy Diversity*, which involved students from culinary schools as multipliers for the concept of BRs. Young students from BRWW and BRGW were asked to document the value of biodiversity in their immediate environment through the use of edible wild plants in cooking. The recipes were published in a cookery book and promoted in various restaurants to reach as many people as possible (Köck et al. 2013, 2019). In June 2019, RIVER'SCOOL was established in the Unteres Murtal BR, a cross-border network of outdoor learning centres for school classes, local stakeholders and tourists along the Mura, Drava and Danube rivers. RIVER'SCOOL not only communicates the natural values of the river landscape, but also addresses the problems and challenges of protecting the so-called *Amazon of Europe*.

Ensuring that biodiversity becomes a mainstream topic in education and learning is one of the priorities of BRs (UNESCO 2017). This is reflected in many projects within Austria's BRs. BRGW's management encouraged municipalities to sow seeds from species-rich meadows in community areas and held workshops on how to maintain these areas. Given the low acceptance rate among some residents, since these seeds included not only flowering plants but also grasses, the BR's management attempted to communicate the importance of the project through channels like the BR journal *talschafft* with articles such as "*Not everything has to be tidy!*". The original project has come to an end

Figure 3 – Biosphere Reserve Großes Walsertal © Monika Bischof

but will be continued with: i) workshops for people with private gardens; ii) schools where flowering boxes should teach pupils about biodiversity, protection of insects, and the provision of food sources; iii) decimation of invasive neophytes during a day of action involving assigning volunteers in each community. The largest outdoor research event in Austria is the Geo-Biodiversity Day, in which BRWW and BRSL&KN regularly participate. Scientists volunteer for a 24-hour species search. The outcomes add to the research data and are published as an information booklet. Within the Slovenian-Austrian Interreg programme, the Balance for Nature and People (BANAP) project seeks to maintain biodiversity in a time of climate change, and to create a handbook and an action plan on the topic (Interreg Slowenien-Österreich 2020).

BRs stand for the harmonized management and conservation of biological and cultural diversity, and for economic and social development based on local community efforts and sound science (Schaaf & Clamote Rodrigues 2016). In order to achieve this goal, MAB Austria, funded by the Federal Ministry of Education, Science and Research, finances scientific projects within the country's BRs.

In response to UNESCO's MAB Strategy and the Lima Action Plan, BRs are supposed to build partnerships with universities and other research institutions to establish research, training and practical learning opportunities. BRGW and the Carinthian part of BRSL&KN have successfully established formal cooperation agreements with Austrian Universities, for example between Alpen-Adria University in Klagenfurt and the Carinthian part of BRSL&KN, which together created the SCiENCE_LINKnockberge project. The project's aim is long-term, systematic bridge-building between excellent international research and the living reality of the BR region.

Conclusion

Austrian BRs are living laboratories for sustainable regional development. They try to involve local residents in projects, but sometimes compromises have to be made in relation to objectives. Being embedded in an international network and national guidelines certainly help BRs to navigate the complexities of their tasks, but each region has to act according to its specific characteristics.

References

AMA 2015. Naturschutz (WF). Available at: https://www.ama.at/getattachment/aab18096-61cb-45f6-b048-a99161f9b5d2/MEB_Oepul2015_Naturschutz_4-0.pdf (access 30/03/2020) [In German]

Drozdowski, I. & A. Mrkvicka 2014. Der Wienerwald ist UNESCO-Biosphärenpark – eine Modellregion für Nachhaltigkeit. W*issenschaftliche Mitteilungen aus dem Niederösterreichischen Landesmuseum* 25: 9–40. [In German]

Austrian National Committee of the Man and the Biosphere Programme 2018. *The biosphere reserve Unteres Murtal / Lower Mura Valley Nomination Form.*

Besucherlenkung im Biosphärenpark Nockberge 2019. Besucherlenkung im Biosphärenpark Nockberge. Wildökologische Grundlagenerhebung. Available at: https://www.biosphaerenparknockberge.at/forschung-bildung/wild%C3%B6kologische-grundlagenerhebung/ [In German]

Biosphärenpark Nockberge 2019. Biosphärenpark Partner. Available at: https://www.biosphaerenparknockberge.at/biosph%C3%A4renpark/biosph%C3%A4renpark-partner/ (access 25/03/2020) [In German]

Biosphärenpark Österreich 2020. The concept. Available at: http://www.biosphaerenparks.at/index.php/en/the-concept (access 27/03/2020) [In German]

Biosphärenpark Wienerwald Management GmbH 2013. Tätigkeitsbericht 2012. Available at: https://www.yumpu.com/de/document/read/23387371/bpww-tatigkeitsbericht-2012-biospharenpark-wienerwald (access 27/03/2020) [In German]

Biosphärenpark Wienerwald Management GmbH 2015. Weinbaulandschaften im Wienerwald. Available at: https://www.bpww.at/sites/default/files/download_files/BPWW-WBL-DRUCK-Homepage_SMALL.pdf (access 23/03/2020) [In German]

Braun, V., A. Humer-Gruber, K. Heinrich & H. Job in press. Synopsis der Biosphere Reserves in Deutschland, Österreich und der Schweiz. In: Borsdorf, A., M. Jungmeier, V. Braun & K. Heinrich, *UNESCO-Biosphere Reserves als Modellregionen einer nachhaltigen Entwicklung*: 33–60 [In German]

Diry, C. 2014. Lebensregion Biosphärenpark Wienerwald. UNESCO für nachhaltige Entwicklung. Vortrag. Available at: https://www.univie.ac.at/zoobot/wordpress/wp-content/uploads/2014/12/1-Biosph%C3%A4renpark-WW-141119-1-Ch-Diry.pdf (accessed 09/04/2020) [In German]

Hoppstadius, F. & M. Dahlstrom 2015: Processes of Sustainable Development: Ecotourism in Biosphere Reserves. *Journal of Environmental and Tourism Analyses* 3(1): 5–25.

Interreg Slowenien-Österreich 2020. BANAP Balance for Nature and People 2020. Available at: http://www.si-at.eu/de2/banap/ (accessed 30/03/2020)

Jungmeier, M. I. Paul-Horn, D. Zoller, F. Borsdorf, K. Grasenick, S. Lange & B. Reutz-Hornsteiner 2011. Biosphere reserves as a long-term intervention in a region – strategies, processes, topics and principles of different participative planning and management regimes of biosphere reserves. *eco.mont* 3(1): 29–36.

Kjellqvist, T., R. Rodela & K. Lehtilä 2019. UNESCO Biosphere Reserves – Supporting Biocultural Diversity, Sustainability and Society. In: Reed, M.G. & M. Price (eds.) 2019. *UNESCO Biosphere Reserves – Supporting Biocultural Diversity, Sustainability and Society*. London: 102–113.

Köck, G., G. Koch & C. Diry 2009. The UNESCO Biosphere Reserve "Biosphärenpark Wienerwald" (Vienna Woods) – a Long History of Conservation. *eco.mont* 1(1): 51–56.

Köck, G., M. Umhack & C. Diry 2013. The Austrian Biosphere Reserves. A (connoisseur's) world beyond the cookery book. *eco.mont* 5(2): 59–63.

Köck, G. & G. Grabherr 2014. 40 years of the UNESCO Man and the Biosphere Programme in Austria – a success story of ecologic basic research evolving into a flagship of transdisciplinarity. *eco.mont* 6(1): 57–62.

Köck, G. & H. Brenner 2015. Appropriate behaviour in the forests of Wienerwald Biosphere Reserve. *eco.mont* 7(2): 78–82.

Köck, G. & A. Arnberger 2017. The Austrian Biosphere Reserves in the light of changing MAB strategies. *eco.mont* 9(Special issue): 85–92.

Köck, G. 2019. Vielfalt genießen – Die österreichischen Biosphärenparks als Modellregionen für regionalen Genuss. In: Mose, I. & N. Weixlbaumer (eds.), *Geographie des Essens – Perzeption und Rezeption von Schutzgebieten im Spiegel kulinarischer regionaler Produkte.* Wahrnehmungsgeographische Studien 28: 139–181. [In German]

Mose, I. & N. Weixlbaumer 2019. *Geographie des Essens – Perzeption und Rezeption von Schutzgebieten im Spiegel kulinarischer regionaler Produkte.* Wahrnehmungsgeographische Studien 28. [In German]

Pütz, M. & H. Job 2016. Governance und Regionalentwicklung in Großschutzgebieten, diskutiert am Beispiel der Schweiz und Österreichs. *Raumforschung und Raumordnung* 74: 569–583. [In German]

Reed, M.G. & M. Price (eds.) 2019. UNESCO Biosphere Reserves – Supporting Biocultural Diversity, Sustainability and Society. London

UNESCO 1996. *The Seville Strategy for Biosphere Reserves.*

REGIO Großes Walsertal 2019. *Ziele und Maßnahmen (Teil 2). Regionales Räumliches Entwicklungskonzept. Biosphärenpark Großes Walsertal.* Available at: https://biosphaerenpark.riskommunal.net/system/web/GetDocument.ashx?fileid=982234 [In German] (access 30/03/2020)

Schaaf, T. & D. Clamote Rodrigues 2016. *Managing MIDAS: Harmonising the management of Multi-Internationally Designated Areas: Ramsar Sites, World Heritage sites, Biosphere Reserves and UNESCO Global Geoparks*. Gland, Switzerland.

UNESCO Biosphärenpark-Management Salzburger Lungau 2014. Managementplan / Leitbild. Available at: http://www.lungauerfrauennetzwerk.at/wp-content/uploads/2014/07/LEITBILD_ENDFASSUNG.pdf [In German] (access 01/04/2020)

Weixlbaumer, N., T. Hammer, I. Mose & D. Siegrist in press. Das Biosphere Reserve-Konzept in Deutschland, Osterreich und der Schweiz – Paradigmatische Entwicklung und zukünftige Herausforderungen im Spannungsfeld von Regionalentwicklung und globaler Nachhaltigkeit. In: Borsdorf, A., M. Jungmeier, V. Braun & K. Heinrich, *UNESCO-Biosphere Reserves als Modellregionen einer nachhaltigen Entwicklung*: 99–120. [In German]

Authors

Valerie Braun

has a PhD in eco-physiology of alpine plants and is now co-editor of eco.mont.

Christian Diry

Born 1962 in Vienna. Studied biology (zoology / botany) at the University of Vienna; Master Programme *Management of Protected Areas* University of Klagenfurt, 2009–2011; tour guide, environmental education, Natural History Museum Vienna; national park ranger, Donauauen NP; since 2004 BR Wienerwald management, responsible for education and sustainability. E-mail: cd@bpww.at

Heinrich Mayer

lives and works in the Carinthian part of the BR Salzburg Lungau and Carinthian Nockberge. His main responsibilities include public relations, and national and international cooperation. Furthermore, he is involved in project development and the implementation of these projects in the BR. His hobbies include travelling, movement in nature and much more. E-mail: heinz.mayer@ktn.gv.at.

Anna Weber

has been manager of the BR Großes Walsertal since April 2019. Before that, she worked for 5 years as a biologist for the hydroelectric power company illwerke vkw where she was responsible for the supervision of ecological construction and various environmental issues. She completed her studies in biology at the University of Vienna in 2014.

Günter Köck

is Secretary-General of the Austrian MAB National Committee, former Vice-Chair of the UNESCO MAB Programme, and the Austrian delegate to the European Alliance of Global Change Research Committees, member of the Scientific Board of Hohe Tauern National Park, as well as one of the Austrian delegates to the International Scientific Committee for Alpine Research. In 2009, he became one of the founding editors of eco.mont.

eco.mont – Volume 12, Number 2, July 2020
ISSN 2073-106X print version – ISSN 2073-1558 online version: http://epub.oeaw.ac.at/eco.mont
https://dx.doi.org/10.1553/eco.mont-12-2s58

From a research vision to a state-of-the-art research strategy: UNESCO experts' meeting in the Karst and River Reka Basin Biosphere Reserve

Günter Köck, Darja Kranjc, Irena Lazar & Vanja Debevec

Keywords: UNESCO, MAB Programme, Lima Action Plan, biosphere reserves, research strategy, participatory process

Abstract

UNESCO´s Lima Action Plan (LAP) explicitly calls on biosphere reserves (BRs) to build partnerships with universities and other research institutions to establish research, training and practical learning opportunities. For a BR, a research strategy is an essential framework that provides insights into the work carried out in the area, available data and needs for future research studies. It is the roadmap for adaptive management in a BR. It was therefore a major concern of the Karst and River Reka Basin BR (Škocjan, Slovenia) to develop a research strategy for the greater integration of science and research in the BR in a highly participatory process and with the support of international experts.
Scientists, researchers and BR managers from eight countries shared their knowledge and experiences during a 3-day meeting in Škocjan (Slovenia), 23 to 25 October 2019. The importance of research in BRs, proper data management, involvement of local communities for monitoring and research, partnership and education were presented in case studies.

Profile

Protected area

Karst and River Reka Basin Biosphere Reserve

Mountain range

Dinaric Alps, Slovenia

Figure 1 – Underground canyon in the Škocjan Cave. © Borut Loze, archive of Škocjan Caves Park, Slovenia

Introduction

The Škocjan Caves were declared a UNESCO World Heritage Site in 1986, and in 1999 they were included as the world's first underground wetland biotope in the list of internationally important wetlands of the Ramsar Convention. In order to preserve and study its outstanding geomorphological, geological and hydrological formations, rare and threatened plant and animal species, palaeontological and archaeological sites, ethnological and architectural characteristics and the cultural landscape, and to ensure conditions for appropriate development, the region of the Škocjan Caves was declared the Škocjan *Caves Regional Park* by the Parliament of the Republic of Slovenia in 1996 (Debevec & Kranjc 2019). Since 2004, the area has also been recognized as a UNESCO biosphere reserve, the *Karst and River Reka Basin Biosphere Reserve* (KBR).

Currently, KBR is developing a research strategy that uses a highly participatory process involving high-level BR experts, scientists and local stakeholders. The KBR management prepared a draft research vision for the BR to be discussed and further developed in a UNESCO-MAB Experts Meeting on the occasion of the 15th anniversary of the KBR in Škocjan (Slovenia) in October 2019. Leading experts from Austria, Czech Republic, Italy, the Republic of Korea, Spain, Ghana, the USA and Slovenia were invited to this top-level meeting.

Under the conference theme *Linkage between academic institutions and biosphere reserves: application of traditional knowledge and aiming for sustainable coexistence of people and nature in modern times* participants discussed opportunities and measures for intensifying scientific research in BRs and strengthening cooperation between BR administrations and research institutions. A declared goal of the conference organisers was to create not simply a modern research strategy using a state-of-the-art process for their own BR, but a strategy that could also be used as reference for other members of UNESCO's World Network of Biosphere Reserves (WNBR).

Research strategy for linking Biosphere Reserves and Universities: three steps

The development of the research strategy was in response to the *MAB Strategy 2015–2025* and the *LAP*

2016—2025 (UNESCO 2017). For example, the MAB Strategy states that *"Each BR has an active research programme, based on the principles of sustainability science, which provides the basis of participatory decision-making and management in the BR"* (Strategic Objective 3.3) and *"BRs and national MAB Committees have partnerships with universities and research institutes, to undertake applied research and provide practical learning and training opportunities that support the management and sustainable development of BRs"* (Strategic Lines of Action A.3). Furthermore, Action A.4.1 of the LAP stipulates that BRs should *"Establish partnerships with universities / research institutions to undertake research, especially UNESCO Chairs and Centres"*.

First step: Drafting a research vision

The draft of the KBR's research vision, developed jointly by V. Debevec and D. Kranjc, presented the common vision of cooperation among BR managers, research institutions and a network of Universities. It drew upon:

- the emphasis in the *Seville Strategy* (UNESCO 1996) that BRs will also contribute to the needs of society as a whole, by showing a way to a more sustainable future;
- the statement in the *MAB Strategy 2015–2025* that BRs are models to test and apply interdisciplinary approaches to understanding and managing changes in social and ecological systems, and their interaction, including conflict prevention and the conservation of biodiversity;
- the BRs' characteristic of focusing on a multi-stakeholder approach with particular emphasis on the involvement of local communities in management, and often highly innovative and participative governance systems;
- the conviction that the research strategy of a BR should ultimately help the BR's management to carry out concrete targeted activities towards conservation of biodiversity through its sustainable use, and to foster efficient measures for the protection of cultural and natural heritage.

The authors of the draft research vision aimed to combine two different approaches: the so-called *action-oriented research approach* and the *case study method.*

An *action-oriented research approach* is understood as a participatory process that brings together theory and practice, action and reflection. It is carried out as a research project, which is directed towards a change of common practices or at least entails recommendations for a change in the practices used. In order to obtain results regarding sustainable development and the use of traditional knowledge that will be readily understood, implemented and adopted, local people should be involved in the process from the outset. In this way, the changes will be pursued with greater efficiency (Priola 2016).

In a *case study research approach*, information is sought from various sources. The data gathered takes different forms, such as observations, surveys, interviews and analysis of documents. A *case study research approach* allows a composite, multifaceted investigation of what has proved to be efficient in other contexts (Priola 2016).

In order to follow the action-oriented and case study research approaches, the authors drew up an ambitious draft research vision based on their cooperation with research institutions and their network of universities, in consultation with the KBR's management.

Experts representing a broad spectrum of knowledge and experience in protected areas research and management were invited to help develop the draft research vision further. Researchers were asked to explain individually why it would be important to link / integrate KBR with their individual research fields, while BR managers or related experts were asked to explain why it would be important to link / integrate KBR with science and research in general. During the discussion, the draft was revised and the research vision was finalized:

With effective application-oriented research work of the highest level that helps us protect our natural and cultural heritage, we advance the integration of science and management practices of our BR in order to make it fully functioning and relevant to society. While developing solutions, we integrate novel ideas into the management of our BR, and together create future sustainable ways of living. By exchanging good and bad practices and expertise with our fellow research partners and BR managers, by transmitting knowledge to younger generations and by fostering good mutual relationships, we enable the development of careers. Through our commitment, we wish to become an example of best practice with benefits for all.

Second step: From research opportunities to projects and actions

Following a pre-meeting request by the organisers, participants presented the situation in their own countries/BRs and shared information on international connections between BRs and universities. Their presentations covered:

- educational, public awareness and research projects, expert studies for management activities;
- integration of sustainable development and traditional knowledge, special training courses;
- international cooperation, study programmes.

During the meeting, the experts presented connections between BRs and universities that had resulted in successful projects at national and international levels (Table 1). In the discussions, all experts stated their belief that science, research and monitoring are essential instruments to integrate effectively the three functions of BRs – conservation, logistics and development. Consequently, it is important to link the scientific community with the BR and the local people. To achieve this important aim, participants identified a number of essential activities:

Table 1 – Connections between BRs and Universities in various countries (Agostini 2019, Andrič 2019, Appah-Sampong & Ashong 2019, Bledsoe 2019, Cho 2019, Cupa 2019, Debevec 2019, Fakin Bajec 2019, Köck 2019, Lazar 2019, Roser 2019).

Cooperation Partners	Type of cooperation; actions	Benefits, outcomes (selected)
BR Lower Morava Mendel University Brno (Czech Republic)	- University included in the board of managers and advisory board - practical education of students	- supports the work of the BR by providing scientific data for sound management decisions - University is a perfect Ambassador of the MAB philosophy - several projects carried out
Carinthian part of the BR Salzburger Lungau and Kärntner Nockberge Alpen-Adria University of Klagenfurt (Austria)	- long-term and contractual grounded collaboration, aimed at bridge-building between international research and living reality in the BR region - *research exchange platform* offering a catalogue of more than 50 research questions formulated by the BR - contact point for master / doctoral theses to be carried out in the BR - thematic courses at the University	- practical education of students - the „research exchange platform" supports the BR management to find solutions for its work - Open Access Online Database with more than 360 publications about the region - more than 20 theses finished
BR Großes Walsertal University of Innsbruck (Austria)	- formal cooperation agreement for a strategic partnership aimed at supporting the BR's research and development mandate	- several research projects (e.g. on regional development) carried out
Korean BRs Catholic University of Korea National Institute of Ecology of Korea (Republic of Korea)	- long-term ecological monitoring	- provides data series for assessing trends and mitigating changes - implementation of three core research sites: these so-called "supersites" serve as hubs for integrative multidisciplinary research related to sustainability
BR Karst and River Reka Basin Research Centre of the Slovenian Academy of Sciences and Arts University of Primorska University of Ljubljana University of Nova Gorica (Slovenia)	- network of universities of Škocjan Caves Park established in 2014 - practical education of students - research on paleoecology (long-term changes of vegetation / past environment), and on the cultural heritage and its development potential - supporting collaboration between universities and the corporate sector	- several projects carried out - results useful for planning the protection and management of natural and cultural heritage - integration of research and practical work - involvement of the local community in capacity-building activities
Ghanaian BRs Environmental Protection Agency University of Ghana University of Cape Coast University for Development Studies Kwame Nkrumah University of Science and Technology (Ghana)	- optimization of stakeholder collaboration for BR research in line with the Ghana Action Plan 2018 – 2025, coordinated by EPA, aimed at including local communities and traditional knowledge	- several research projects carried out - training courses for students and tourism sector, - school education
BR Mammoth Cave Area Western Kentucky University (USA)	- Karst field studies in BR - practical education of students	- summer classes for students and industry professionals - natural Resource Condition Assessment for the core area, delivering science-based information for BR managers - programmes for public awareness, education and research of traditional knowledge
Italian BRs Punto 3 srl. Various Universites (Italy)	- collaboration between universities, educational institutions and UNESCO-designated sites	- several projects carried out (e.g. aiming at evaluating natural and cultural values, guidance for sustainable tourism and education activities, biodiversity conservation)
BRs in Spain and the Mediterranean International UNESCO Centre for Mediterranean Biosphere Reserves Barcelona (Spain)	- facilitating linkages between academic institutions and BRs in the Mediterranean - communication, training and environmental education	- several research projects carried out (e.g. on global change, capacity building) - practical education of students; training of researchers

1. It is important to demonstrate and promote that BRs
- are valuable research sites from environmental, cultural-heritage and social perspectives;
- can contribute to research and education at university level;
- are ideal places for transdisciplinary research;
- can play an important role as pioneers and model / test regions, e.g. for state-of-the-art technologies aimed at energy-saving and the production of renewable energies, or adaptations to agricultural strategies that respond to climate change.

2. It is important to explain to people why
- research is important for the BR;
- their cooperation with scientists is most welcome,
- BR science is important for their well-being.

Furthermore, it was stated that it would be helpful if the BR could provide adequate research infrastructure in situ (e.g. accommodation for students, working facilities).

Following the discussion, the experts were asked to highlight their individual research fields or the ones covered in their respective BRs. In order to define actual research topics for BRs or the KBR specifically, individual SWOT analyses of the proposed research

Table 2 – Summary of individual SWOT analyses of integrating individual research fields and science with the BR's roles (in brackets: perspective of the discussion participant – BRM = BR manager; S = scientist, academic institution).

STRENGTHS	WEAKNESSES
- Participatory approach (BRM) - Transdisciplinarity (S) - Interdisciplinarity (S) - Living labs for applied research (S) - A BR is ideal for long-term monitoring (S) - Research infrastructure for national and international collaboration (S) - The objectivity of science can play an important role in resolving disputes (BRM)	- Frequent conflicts of interest between BR/local people and researchers (BRM, S) - Lack of experience of how to integrate different kinds of knowledge (scientific and traditional) (S) - Lack of specialized personnel (S) - Lack of funding (BRM, S) - When the research is interdisciplinary, different approaches and timelines occur, which are difficult to coordinate (S). The integration of common research fields in BRs means having to get out of your own comfort zone (BRM, S) - Lack of historical data and knowledge as a lost opportunity for monitoring and evaluating trends (S) - Transfer of scientific results to plain language and finding a practical outcome (BRM)
OPPORTUNITIES	**THREATS**
- Problem-orientated research supports the BR management, reduces costs and promotes efficiency (BRM) - Dissemination of results to the public (BRM, S) - Opportunity to use traditional knowledge (BRM, S) - Outdoor classes for different audiences (BRM, S) - Transfer of information from parents to children (BRM) - Developing data management plans for BRs (BRM, S) - BR can be a base for initiating dialogues between researchers and BR stakeholders (BRM, S) - Involving local community for long-term monitoring ("Citizen science"; BRM, S)	- Problem-orientated research supports the BR management, reduces costs and promotes efficiency (BRM) - Dissemination of results to the public (BRM, S) - Opportunity to use traditional knowledge (BRM, S) - Outdoor classes for different audiences (BRM, S) - Transfer of information from parents to children (BRM) - Developing data management plans for BRs (BRM, S) - BR can be a base for initiating dialogues between researchers and BR stakeholders (BRM, S) - Involving local community for long-term monitoring ("Citizen science"; BRM, S) - Human-nature conflicts (BRM, S) - Limited finances (S) - Lack of awareness of possibilities in a top-down approach (S) - Lack of capacity (BRM, S) - Lack of coordination between different institutions (BRM, S)

fields and science in general in relation to the BR's roles were then carried out (Table 2).

At the end of the working session, the experts presented a list (based on their individual SWOT analyses) of proposed research topics that it would be interesting for them to carry out with or in the KBR.

Third step: Research priorities for future action plan

A supplementary list of interested research institutions, fields and potential research topics was drawn up at this meeting, complementing the KBR managements' preliminary draft list that included interested members of Škocjan Caves Park University Network.

The next step of the research strategy roadmap will be to define the *research priorities* for the KBR on the basis of the experts' proposed research topics. The research priorities should be defined according to various criteria such as current research needs or knowledge deficits in the BR, the interest of the research institutions / scientists in the submission of a research proposal, and the requirements of international designations, conventions and strategies.

On the basis of the defined research priorities, and using straightforward questions, the BR management will then draw up a research activity plan for each individual research area during individual meetings with interested researchers:

- *What* is the aim of the project?
- What are the *benefits* for the BR management?
- *Who* will do the research?
- *How* will the research be done?
- What is the *timeframe*?
- What are the *costs*?

After the overall research plan has been drawn up, a Call for Research Projects will be issued. Project proposals must be prepared in a standardized form:

- Detailed description of the research topic / problem / subject;
- Review of the literature on the research topic;
- Definition of the research problem;
- Description of the research methodology;
- Detailed elaboration of the research question(s) related to timelines and available funding;
- Outline of the deliverables (e.g. benefits for the BR management and local communities, publications, public awareness).

An agreement concluded between the BR management and the research institutions / scientists will ensure that the institutions / scientists recognise the BR as a project partner and align their research plans so that the research work is carried out in the BR. For example, for research proposals to the Austrian MAB Committee, a Letter of Endorsement signed by the relevant BR management is obligatory for funding (Köck, personal communication). This procedure ensures that the BR management is informed about the research work done in the BR and can make use of the data and results of the project. An appropriate means to establish cooperation between BRs, related stake-

holders and scientists could be to establish scientific councils for BRs (Arpin et al. 2016a, b).

A final step of the research strategy roadmap will be to define a monitoring and evaluation process for the publication of scientific data, implementation of solutions and acceptance by the local community.

Conclusions

With this initiative, the Škocjan Cave Park and KBR started to activate a network of University institutes, communities, technicians and experts who will work together in the near future to develop cooperation with the aim of ensuring increasingly effective links between the scientific sphere and the local communities in the huge worldwide network of UNESCO-recognised sites.

Representatives from BRs, universities and other research institutions expressed the need to encourage dialogue between research institutions and BRs also at international level.

The process of preparing the research strategy gives the BRs and academic institutions a good insight into local needs and possibilities which could be managed effectively thanks to researchers' innovative approaches.

The research vision developed in a highly participatory process will help the KBR to protect its natural and cultural heritage and to create sustainable ways of living. KBR is committed to becoming an example of best-practice with benefits for all.

Furthermore, the process in KBR perfectly supports the development of possible research topics for the UNESCO Chair in *Interpretation and Education for Enhancing Integrated Heritage Approaches*, the establishment of which is planned in cooperation with the Škocjan Caves Park at the Faculty for Humanities of the University of Primorska (Koper).

It is the interlinkages among people, culture and nature that act as triggers for future research studies which will provide scientifically justified actions, data and evaluation of the sustainable development process. BRs as sites of excellence play an important role in the implementation of sustainability science, and thus UNESCO's WNBR will benefit from individual BRs' experiences.

Acknowledgements

We would like to thank Thomas Schaaf (Terra-Sana environmental consulting and temporary lecturer at the University of Freiburg), Thomas Scheurer and Valerie Braun for the critical review of our manuscript.

References

Agostini, A. 2019. Collaborative actions between Universities, educative institutions and UNESCO designated sites: Some experiences developed in Italy. *Experts Meeting "Linkage between academic institutions and biosphere reserves", 23–25 October 2019, Karst and River Reka Basin Biosphere Reserve, Škocjan (Slovenia).*

Andrič, M. 2019. Palynological research: Historical legacies of past (anthropogenic) vegetation changes for the present-day ecosystems: a long-term perspective and link between natural and cultural heritage. *Experts Meeting "Linkage between academic institutions and biosphere reserves", 23–25 October 2019, Karst and River Reka Basin Biosphere Reserve, Škocjan (Slovenia).*

Appah-Sampong, E. & S. Ashong 2019. Optimizing Stakeholders Collaboration for Research in Ghana's Biosphere Reserves – Policy and Institutional Framework. *Experts Meeting "Linkage between academic institutions and biosphere reserves", 23–25 October 2019, Karst and River Reka Basin Biosphere Reserve, Škocjan (Slovenia).*

Arpin, I., G. Ronsin, T. Scheurer, A. Wallner, F. Hobléa, O. Churakova (Sidorova), D. Cremer-Schulte & V. Braun 2016a. The scientific councils of Alpine protected areas: an overview and analysis of their contribution to linking science and management. *eco.mont* 8(2): 5–12.

Arpin, I., A. Wallner, T. Scheurer & V. Braun 2016b. Recommendations for establishing or renewing scientific councils in protected areas. *eco.mont* 8(2): 62–65.

Bledsoe, L. 2019. Mammoth Cave Area Biosphere Reserve & Western Kentucky University: Connecting people to nature through education, research, and community engagement. *Experts Meeting "Linkage between academic institutions and biosphere reserves", 23–25 October 2019, Karst and River Reka Basin Biosphere Reserve, Škocjan (Slovenia).*

Cho, D. 2019. Long-term Ecological Research and Monitoring in Mt. Sorak Biosphere Reserve, Korea. *Experts Meeting "Linkage between academic institutions and biosphere reserves", 23–25 October 2019, Karst and River Reka Basin Biosphere Reserve, Škocjan (Slovenia).*

Čupa, P. 2019. Benefits of cooperation between the Lower Morava Biosphere Reserve and Mendel University in Brno. *Experts Meeting "Linkage between academic institutions and biosphere reserves", 23–25 October 2019, Karst and River Reka Basin Biosphere Reserve, Škocjan (Slovenia).*

Debevec, V. 2019. Network of Universities in Škocjan Caves Park and Karst and Reka River Biosphere Reserve. *Experts Meeting "Linkage between academic institutions and biosphere reserves", 23–25 October 2019, Karst and River Reka Basin Biosphere Reserve, Škocjan (Slovenia).*

Debevec, V. & D. Kranjc 2019. The Karst Biosphere Reserve in Slovenia. *eco.mont* 11(2): 43–49

Fakin Bajec, J. 2019. Establishing an integrative approach in safeguarding and sustainable using of cultural and natural heritage. *Experts Meeting "Linkage between academic institutions and biosphere reserves", 23–25 October 2019, Karst and River Reka Basin Biosphere Reserve, Škocjan (Slovenia).*

Köck, G. 2019. Cooperation between biosphere reserves and research institutions in Austria. *Experts Meeting "Linkage between academic institutions and biosphere*

reserves", 23–25 October 2019, Karst and River Reka Basin Biosphere Reserve, Škocjan (Slovenia).

Kranjc, D. 2019. Linkage between academic institutions and biosphere reserves: Experts meeting. *Research Strategy for the Karst and Reka River Basin Biosphere Reserve: Working session report. Škocjan Caves Park, Slovenia (internal material).*

Lazar, I. 2019. Heritage Education and Students Training at the Faculty of Humanities University of Primorska, Koper. *Experts Meeting "Linkage between academic institutions and biosphere reserves", 23–25 October 2019, Karst and River Reka Basin Biosphere Reserve, Škocjan (Slovenia).*

Priola, C. 2016. '*Research Strategy*' *in Understanding different Research Perspectives*. The Open University: 21–22. Available at: http://www.open.edu/openlearn/money-management/understanding-different-research-perspectives/content-section-0 (accessed 14/04/2020)

Roser, M. 2019. Connecting academia with Biosphere Reserves: challenges and opportunities: Linkages between academic institutions and BRs: application of traditional knowledge and aiming to sustainable coexistence of man and nature in modern times. *Experts Meeting "Linkage between academic institutions and biosphere reserves", 23–25 October 2019, Karst and River Reka Basin Biosphere Reserve, Škocjan (Slovenia).*

UNESCO 1996. The Seville Strategy for Biosphere Reserves and the Statutory Framework of the World Network of Biosphere Reserves. UNESCO, Paris. Available at: https://unesdoc.unesco.org/notice?id=p%3A%3Ausmarcdef_0000103849&posInSet=7&queryId=eac8c808-250a-4b99-86a0-b42cdd621b41 (accessed 14/04/2020)

UNESCO 2017. A New Roadmap for the Man and the Biosphere (MAB) Programme and its World Network of Biosphere Reserves:MAB Strategy (2015-2025), Lima Action Plan (2016–2025), Lima Declaration. UNESCO Paris. Available at: https://unesdoc.unesco.org/notice?id=p%3A%3Ausmarcdef_0000247418&posInSet=5&queryId=c62462dc-9360-406c-ad98-8ecfea3449f1 (accessed 14/04/2020)

Authors

Günter Köck

is Secretary-General of the Austrian MAB National Committee, former Vice-Chair of the UNESCO MAB Programme, and the Austrian delegate to the European Alliance of Global Change Research Committees, member of the Scientific Board of Hohe Tauern National Park, as well as one of the Austrian delegates to the International Scientific Committee for Alpine Research. In 2009 he became one of the founding editors of eco.mont.

Darja Kranjc[1]

is an ethnologist and cultural anthropologist from the Experts Serviceof the Škocjan Caves Park Public Service Agency, Slovenia. She is in charge of the protection, research and development of cultural heritage. She is also the coordinator of the volunteers' Committee for the protection of cultural heritage in the Karst Biosphere Reserve, and of the transboundary Partnership for Karst dry stone walling. Darja is also actively involved in the educational programmes of the Park's networks of schools and universities. E-mail: darja.kranjc@psj.gov.si

Irena Lazar

is an archaeologist at the University of Primorska (Koper, Slovenia). She has a long-standing experience in museum work, Roman archaeology research and ancient glass; she is also active in the field of cultural heritage promotion and preservation. In 2013 she became Dean of the Faculty of Humanities. Univerza na Primorskem, Fakulteta za humanistične študije, Titov trg 5, SI-6000 Koper, Slovenija. E-Mail: irena.lazar@fhs.upr.si

Vanja Debevec[1]

is a biologist (MSc) and works in the Experts Service of the Škocjan Caves Park Public Service Agency, Slovenia. Her work focuses on the conservation of biodiversity, education, participatory approaches in protected areas, and on the coordination of the MAB programme. She is a coordinator of the International Schools network and the Network of Universities of the Karst Biosphere Reserve. She is the focal point in Slovenia for the World Commission on Protected Areas. E-mail: vanja.debevec@psj.gov.si

[1] Park Škocjanske jame, Slovenija, Škocjan 2, 6215 Divača, Slovenia

eco.mont – Volume 12, Number 2, July 2020
ISSN 2073-106X print version – ISSN 2073-1558 online version: http://epub.oeaw.ac.at/eco.mont
https://dx.doi.org/10.1553/eco.mont-12-2s64

Mose, I. & N. Weixlbaumer (eds.) 2019. *Geographie des Essens – Perzeption und Rezeption von Schutzgebieten im Spiegel kulinarischer regionaler Produkte.* Wahrnehmungsgeographische Studien, Band 28. ISBN 978-3-8142-2366-7

The tasks of protected areas such as National Parks, Biosphere Reserves (BRs), World Heritage Sites and Nature Parks include not only nature conservation but also other functions such as agriculture and forestry, local recreation and tourism, environmental education, research and sustainable regional development. Most of today's protected areas within Europe are cultural landscapes that have emerged from thousands of years of diverse human use. BRs and Nature Parks in particular see themselves as model regions for sustainable regional development. Measures aimed at achieving this include promoting small-scale regional producers; integrating soil and water quality, biodiversity and nature conservation into agricultural policy; obliging companies to comply with stricter standards, and promoting the understanding of food as a life-support system. In protected areas, a wide range of initiatives have recently been developed that are committed to the sustainable production, processing and marketing of regional food products.

Geographie des Essens [A Geography of Foods], published by Ingo Mose (University of Oldenburg) and Norbert Weixlbaumer (University of Vienna), provides an insight into the role of protected areas in promoting regional food specialities that are locally and sustainably produced and can become *ambassadors* of territorial protection. The contributions cover Andalusia in Spain, Denmark, Switzerland, and a brief look at France and Germany, but there is a particular focus on Austrian protected areas. Three of the eight contributions cover the Alps; one looks at the mountains of the Sierra Nevada and of Andalusia. Together, then, the contributions show the small-scale diversity of the mountains as economic and living spaces. The example of the European Oyster farming in a Natura 2000 area in Denmark gives an interesting insight into food production from the sea and forms a good counterpoint to the other contributions in this volume.

The contributions provide many examples of foodstuffs and drinks produced in protected areas, including wine and liqueurs, apricots, peaches, the berries of *Sorbus torminalis,* olives, cheese, milk, oysters, fish, meat, pastries and confectionery, and honey. These products are important not only for the tourism industry but also as essential elements for local supply. The distribution and marketing through special labels of some of the products are described. Some labels achieve a certain level of familiarity and market value while others are unsuccessful, as described for Andalusia. The effect on the regional economy of one of these labels is exemplified by the Entlebuch BR in Switzerland.

The idea for a cookery book that involved students from culinary schools as multipliers for the concept of biosphere reserves is illustrated by an example from the Wienerwald BR in Austria. Young students were involved in a competition to demonstrate how edible wild plants can be used in the local kitchen and presented their recipes to an international panel of judges. The recipes were published in a cookery book and promoted in various institutions to reach as many people as possible. *Geographie des Essens* provides many more examples of marketing campaigns, such as the *Caminos naturales* [Nature Trails] in Andalusia: the trails lead through near-natural landscapes, along former train lines, and promote regional products.

The book is an engaging read and offers a wide range of examples of how certain foods from protected areas are produced and promoted. It would certainly be an asset if the book were available in English. Hopefully, this book will motivate more authors to describe the products that other protected areas are able to provide and how they are distributed.

Valerie Braun

Slupetzky, H. 2020. *Das Ödenwinkel- und Riffelkees und die Entstehung von Schutznetzwerken in den Gletschervorfeldern (Stubachtal, Hohe Tauern). Eine Dokumentation über 60 Jahre Forschung.* Salzburger Geographische Arbeiten, Volume 49. Selbstverlag des Fachbereichs Geographie und Geologie der Universität Salzburg. ISBN 3-85283-033-8.2020 [In German]

Highly reputed in scientific circles and well known to the general public, the geographer and glaciologist Heinz Slupetzky of the University of Salzburg recently celebrated his 80th birthday. To mark the occasion, Slupetzky published what is set to become a major contribution to the field of Alpine glaciology.

Although his academic career led him to research and teaching in the Cordilleras of the United States and Canada, the Garhwal Himalayas, and the arctic Franz Josef Land, the main focus of Slupetzky's research was on the Austrian Hohe Tauern, especially the *Großglockner Massif.*

Over an extraordinary timespan of some 60 years, Slupetzky, in enthusiastic and tireless empirical studies, observed, measured and analysed the oscillating glaciers and the changing geomorphology and hydrography of glacier-modelled landscapes. His measurements of the mass balance of the Stubach Sonnblick glacier took place over the second-longest monitoring period in the Austrian Alps and one of the longest monitoring periods worldwide.

In the course of his field observations, Slupetzky discovered a highly interesting glacio-morphological features: linear bands, ridges and networks of rocks and debris on the moraines of the pro-glacial fields. He related these patterns to specific stages of the melting of the glaciers, which are themselves (?) related to specific topography and geological features of

the mountain sites. In linking the dynamic processes of the glacier and the characteristic deposition of debris material, Slupetzky made an innovative contribution to Alpine glacial morphology.

The first part of this 109-page volume presents the glacial history of the Ödenwinkel and Riffel glaciers and the stages of glacier advance and retreat from the 19th century to the present. This chapter includes a treasury of historical sketches, fascinating photographs, and a number of graphs and tables. The second part of the book comprises a series of somewhat loosely connected chapters devoted to glaciological and glaciomorphological features and processes, examining in particular the debris patterns on the 1850, 1900, and 1920 recessional moraines of the Ödenwinkel and Riffel glaciers. The mass balances of the Ödenwinkel glacier, the oscillations of ice accumulation and ablation, and the retreat of the glacier tongue are documented by a series of graphs, models and photographs. Further chapters treat the fluvial and glacio-fluvial features, and erosion and sedimentation processes in the proglacial field. In the concluding chapter, the author gives a personal testimony of his early interest in and fascination with glaciers, his *pioneer days* of glacial studies, his decades-long dedication to empirical research, his rich publication history, and his important public-awareness work. The ample reference list of 132 titles allows the interested reader a further deepening of information.

Although Slupetzky's *vintage scientific oeuvre* – as he calls it – is focused on a small section of the Austrian Alps and on comparatively small glaciers, the importance and value of this attractively presented volume goes beyond a purely local interest and scope. Solidly grounded on decades of extensive and meticulous fieldwork using a variety of scientific approaches and methods, his work documents in an exemplary fashion the climate variations and the dynamics and fluctuations of Alpine glaciers and their effects on morphological and hydrographic features. In this way, the volume makes a most valuable contribution to the wider fields of glacial geomorphology and Alpine studies. It is also a testimony of a geographer who channelled his early fascination with high mountain landscapes into a particularly successful academic career. He paraphrases his dedication to glacier research as a life above, on, within, under, and near glaciers.

Christoph Stadel, Universität Salzburg

Reed, M.G. & M.F. Price (eds.) 2020. *UNESCO Biosphere Reserves – Supporting Biocultural Diversity, Sustainability and Society*. Earthscan, Studies in Natural Resource Management Series, Routledge. Taylor & Francis Group, 342 pages. ISBN 978-1-138-36932-0

The MAB Programme is one of the oldest and most important UNESCO research programmes, dedicated to the relationship between humans and the environment and to the sustainable use of natural resources. Key to the MAB Programme are the so-called UNESCO Biosphere Reserves (BRs). BRs are ecosystems, recognized on the basis of consistent, internationally agreed criteria, where models of sustainable use of the biosphere are being developed, tested and implemented. They serve not only to protect and maintain certain ecosystems, but also to carry out ecological research, environmentally aware land use, and education for sustainable development. At present, the World Network of BRs (WNBR) includes 701 model regions in 124 countries.

Maureen Reed and Martin Price, two recognized experts with many years of expertise in the field of BRs, have now edited a comprehensive book to which more than 60 authors, a who's who of the MAB community so to say, have contributed – a volume which deserves to be seen as a new standard in the field of UNESCO BRs.

Part 1, entitled *Conceptual and practical foundation of the MAB Programme*, outlines the history and development of the MAB Programme and provides a general introduction of UNESCO's BR concept. The second part, entitled *Translations and transitions: the changing practices of biosphere reserves*, describes experiences of the implementation of the biosphere reserve concept throughout the WNBR, and includes a total of 15 case studies from all five UNESCO world regions. The third part, *Lessons for sustainability science and sustainability in practice*, focuses on the thematic lessons learnt from the implementation of sustainability science in BRs.

The thematic coverage of this excellent publication is particularly comprehensive; the work will be of outstanding value not only for professionals dealing with conservation and sustainable development, but also to policy-makers and to University lecturers and students in the field of sustainability science and ecosystem management. I therefore warmly recommend this book not only to BR managers, but to anyone interested in the work of UNESCO BRs as model regions for sustainable development.

Günter Köck

Publishers
eco.mont – Journal on Protected Mountain Areas Research and Management is published by
• Austrian Academy of Sciences Press, Postgasse 7, 1011 Vienna (online version), ISSN 2073-106X
in cooperation with
• *innsbruck* university press (*i*up), Technikerstraße 21a, 6020 Innsbruck (print version), ISSN 2073-1558

Editorial Policy
The geographic focus is on Alpine and other European (or global) protected mountain areas.

Publication Policy
eco.mont – Journal on Protected Mountain Areas Research and Management publishes peer-reviewed research articles by authors who work on protected mountain areas and articles about management approaches within these areas. eco.mont is published twice a year. We only accept previously unpublished articles (including on the internet). Manuscripts submitted for publication are blind peer-reviewed by a member of the editorial board (to ensure a good fit with the mission of the journal and the scientific quality) and independently by a peer (to guarantee the scientific quality). Article processing fee: non-mandatory charges are levied for papers published in eco.mont to help defray production costs. Authors, especially those with institutional and grant support, are urged to take all reasonable steps to pay the charges. The article processing charge is currently EUR 400 per article.

Subscriptions and Back Issues
• electronic: open access
• prints: EUR 50 p.a.

Design
Logo and basic layout of the journal developed by Sigrun Lange
Cover photograph: © Mario Posch