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Transnational Ecological Networks in Central Europe

A Compilation of Results and Outputs from the EU Central Europe TransEcoNet Project

Elmar Csaplovics/Anke Hahn/Christopher Marrs/
Stephan Schöps (Hrsg.)

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Foreword

In Central Europe protected areas, such as national parks or biosphere reserves, are often isolated patches of nature conservation. They are surrounded by less protected and/or unprotected areas. Frequently these surrounding areas are intensively used for agriculture, transport infrastructure, industrial sites and human settlements. For animal and plant species the intensive use of landscapes can create barriers which can reduce genetic exchange, posing a threat to biodiversity. To provide animals and plants with possibilities for migration, dispersal and forage and to conserve biodiversity in the long run, valuable natural landscapes need to be spatially connected by ecological networks.

Central Europe's rural border regions are particularly characterised by a diverse mosaic of protected and non-protected areas, though the non-protected areas can still be ecologically valuable nonetheless. Nowadays with the political and economic integration of Europe these former remote landscapes are affected by rapid changes and borderlands are facing the challenge of finding a balance between economic development on the one hand, and protection of their valuable natural and cultural heritage on the other.

The idea of the project TransEcoNet (Transnational Ecological Networks in Central Europe) has been to analyse border areas in Central Europe regarding the spatial coherence of ecological networks, the status of biodiversity and ecosystem services and land use development past and present. In addition to spatio-ecological analyses socio-cultural topics such as awareness of ecological networks and general regional ecological values have also been considered. In this publication the scope of project work and the most relevant results are presented.

The individual chapters cover an inventory of ecological networks in Central Europe, an analysis of the history of these ecological networks, the assessment of their biodiversity and ecosystem services in selected regions as well as strategies for raising awareness for ecology as such and for ecological networks in particular. The articles within the chapters have varying spatial foci and also cover regional and local elements.

The TransEcoNet project has been funded by the Central Europe 2007-2013 Programme and involved 15 partners from Austria, the Czech Republic, Germany, Hungary, Poland and Slovenia.

The results of the project presented in this publication are trans-disciplinary and connect the work of experts coming from remote sensing, nature conservation and environmental education, landscape ecology and conservation biology, regional and spatial planning, as well as cultural history and architecture.

Contents

Editorial

Professor Elmar Csaplovics, Technische Universität Dresden.

> „Man braucht jetzt ein Visum für jedes Land extra!“ sagte mein Vetter Joseph Branco. „Zeit meines Lebens hab' ich so was nicht gesehn. Jedes Jahr hab ich überall verkaufen können: in Böhmen, Mähren, Schlesien, Galizien“ – und er zählte alle alten, verlorenen Kronländer auf. „Und jetzt ist alles verboten. Und dabei hab' ich einen Paß. Mit Photographie.“ Er zog seinen Paß aus der Rocktasche und hielt ihn hoch und zeigte ihn der ganzen Runde.“ „Dies ist nur ein Maronibrater“, sagte Chojnicki, „aber sehn Sie her: es ist ein geradezu symbolischer Beruf. Symbolisch für die alte Monarchie. Dieser Herr hat seine Kastanien überall verkauft, in der halben europäischen Welt, kann man sagen. Überall, wo immer man seine gebratenen Maroni gegessen hat, war Österreich, regierte Franz Joseph. Jetzt gibt's keine Maroni mehr ohne Visum. Welch eine Welt!“
>
> Joseph Roth (1938) Die Kapuzinergruft. De Gemeenschap, Bilthoven, Kapitel 30
>
> [“Now a separate visa is needed for each country! “ said my cousin Joseph Branco. ”All my life I have not seen the like of it. Every year I could sell everywhere: in Bohemia, Moravia, Silesia, and Galicia“– and he recounted the old lost Crown lands. ”And now everything is forbidden, yet I have a passport, with photograph“. He drew out his passport from the trouser pocket and held it high and showed it to the whole table. ”This is only a chestnut roaster“, said Chojnicki,”but look here: it is almost a symbolic profession, symbolic for the old monarchy. This gentleman has sold his chestnuts everywhere, in half of the European world, so to say. Everywhere, where his roasted chestnuts have been consumed, was Austria, and reigned by Franz Joseph. Now there are no chestnuts without visa. What a world! “]

> Dass die politische Entwicklung so hinter der wirtschaftlichen herhinkt, ist ein rechtschaffenes Unglück. In Südosteuropa aber hat dieser Widerspruch besonders katastrophale Folgen: denn hier bestand schon einmal die Wirtschaftseinheit der österreichisch-ungarischen Monarchie. Ihre Zerstörung als Rückwärtsbewegung zu bezeichnen, hat man dann das Recht, wenn man gleichzeitig betont, dass die Zerschlagung der politischen Einheit ein Fortschritt war.
>
> Max Herb (1938) Südosteuropa – Form und Forderung. Editions Nouvelles Internationales, Paris, p.19
>
> [That the political lags behind the economic development to such an extent, is verily a misfortune. In South Eastern Europe this contradiction has exceptionally catastrophic consequences: because there existed already the economic union of the Austro-Hungarian Empire. Describing its destruction as a step backwards is justifiable as long as at the same timeit is stressed that the destruction of its political structure was progress.]

Europe’s territories undergo a continuous process of transformation. At the end of the 20th century, which was shaped by severe political and economic deteriorations, an era of common interest and common visions seemed to dawn. Borders were overcome, at least political borders, in terms of ‘freedom of movement‘ in the countries of Western, Southern and increasingly also in Central Europe, the latter being integrated step by step under the umbrella of the European Union.

After an era of more or less obstructive state borders, of unscalable border walls, electrified fences and minefields dividing Europe into two following World War II and plenty of border crossing regulations between countries in general, it has become possible to travel from the Adriatic coast of Slovenia to the easternmost fringes of Slovakia without being forced to show up at border inspection points. This freedom however means more than some kind of civil liberty which is increasingly misunderstood as a *carte blanche* for 'anything goes' for everybody at any time and at any place. By contrast, freedom implies a new dimension of making use of that liberty responsibly. The European citizen should understand that taking long-term advantage of that freedom requires acceptance that though or because individuals have gained a wealth of 'democratic' rights they have at the same time to fulfil respective obligations in support of peaceful and solidary coexistence at regional, national and European levels. Crossing political borders without restrictions allows for the stepping at will from one region to the other, each characterised by its very specific cultural traditions, languages and socio-economic as well as socio-ecological ways of interaction between people and resources and its specific attitudes and folklore.

After 20 years of experiences of a 'Europe without borders' it has become obvious that based on the fact that this specific 'Europe' represents only a privileged part of the European territory and the term 'open/closed borders' embraces a surprising variety of different types of 'borders', the political border is but one of many. When political borders disappeared new types of borders gained influence. The assumption that a 'Europe without borders' will, at the same time, foster cross-border understanding and solidarity is not at all self-evident. Borders of language, of different levels of economic wealth, of ethnicity became more important and replaced the 'trivial' border-line marked by fences, or at least by border stones and warning signs. Above all it is a matter of fact that the formerly closed Central European state borders were only shifted to the east. The new (old) 'hard' borders now exist between the European Union and the neighbouring non-member states such as Belarus, Ukraine and Serbia, while the borders between the Soviet satellite states and the Soviet Union itself have been 'hard' borders before 1989 and remain so to this day. Additionally mental borders emerge and fade in space and time depending on oscillations of political and economic developments and changes. Xenophobia wafts here and there, fuelled by ill-fated movements, fear and agitation. The Europe of the early 21st century is far off from a unified, at least solidary federation of (former) nation states.

> The human being needs borders, searches for them, always creating new ones. They are the markers of identity formation, or more precisely: border as question of identity and identity as question of border.
>
> Benjamin Grilj (2012) Border – Attempt of a Phenomenology, in Csaplovics E (ed) Lost Landscapes - Reflections from Central European Border Regions. Murska Sobota, p.94

Funding programmes such as EU-INTERREG are therefore all the more indispensable and a means to support the development, implementation and establishment of cross-border and transboundary initiatives of enhancing common understanding, cooperation and coexistence at the European level. They bring together actors in different fields of interest, from economy and society to cultural affairs and environmental protection. These programmes stimulate understanding and common action for balancing heterogeneous interests and the establishment and maintenance of platforms of

communication and networking and, importantly, promote tolerance, mutual respect and friendship (without borders).

Dealing with the 'natural world' makes things easier when talking of and dealing with borders. Nature as such does not recognise (state) borders or boundaries except those which are imposed by climatic, geological and ecological characteristics.

> Étudiées pour elles-memes et en elle-memes, montagnes, rivières et forets livrent peu à peu lentement leurs secrets. Des limites? Souvent, sans doute. Dans la mesure où elles sont réellement des obstacles. Mais des traits d'union aussi, de centres d'expansion et de rayonnement, des petits mondes attirants doués de valeur propre, liant entre eux étroitement des hommes des pays mitoyens. En tout cas, des limites „nécessaires", jamais!
>
> Lucien Febvre (1922) La Terre et l'Évolution Humaine. Introduction Géographique à l'Histoire. La Renaissance du Livre, Paris, p.366
>
> [When studying mountain ranges, river landscapes and forests as such they disclose their secrets step by step and slowly. Are there limits? Often, no doubt. Given that they represent real obstacles. But they are also links, centres of expansion and of presence, little worlds, attractive and gifted due to their very own values, closely interlinking people of separated countries. In any case, they are never "necessary" limits!]

Europe is increasingly shaped by 'industrialised' landscapes and a steadily decreasing amount of traditional cultural, semi-natural and 'wilderness' landscapes. Borders in traditional cultural landscapes were shaped by interactions of humans with the environment in a more or less ecologically balanced way, such as extensive grazing, small-scale agriculture and selective silviculture. Borders in disturbed environments were and are however largely created by more aggressive forms of human impact, i.e. by agro- and sylvo-industrial exploitation, drainage of wetlands, urbanisation and fragmentation due to expansion of traffic networks. Secondary effects such as spread of invasive species and deterioration of soils and groundwater due to discharge of pollutants, fertilisers and pesticides also have an impact as do oscillations of local and regional climate. *Natura* in its various manifestations serves as a mirror of the complexity of external (environmental) impacts and effects in a holistic sense of understanding. Vegetation explicitly behaves as a more or less immediate responsive matter to external drivers, be they of 'natural' or artificial/human origin.

Vegetation in its ecological complexity and the patterns of interaction between flora and fauna provide a protective shield against environmental impacts of different kinds as long as biodiversity, density and vitality of vegetation cover remain distinctive and resilient. Networks of vegetation of high ecological value, thus ecological networks, provide a precondition for the preservation and long-term maintenance of highly valuable Europe-wide green infrastructure. They interlink different eco-climatic zones, ecological regions and biotopes of varying scales and by that create a network of ecologically and 'aesthetically' outstanding landscapes as a backbone of a 'Green Europe'. Ecological networks are therefore an indispensable means for sound protection and management of natural resources and of ecological services and green infrastructure.

Transnational Ecological Networks (TransEcoNet) is grounded on a platform of actors coming from transdisciplinary fields of interest, from regional planning and socio-ecological development to landscape ecology as well as from nature conservation to geoinformatics, at different institutional levels, from universities to NGOs in nature

conservation and to regional agencies. It is located in six different (in terms of e.g. eco-climatic, socio-economic and political characteristics) regions and in six different countries of Central Europe.

Borders are subtle entities depending on the causes and reasons of their evolution and of their mimicry as well as on their manifestation in space and time. Ecological networks overcome, depending on time as a crucial factor, any kind of disturbance which is often represented by a boundary-type structure, be it the result of political or economic impact. Sound documentation and qualitative and quantitative analysis (of strengths, weaknesses, opportunities and threats) as well as valorisation of the benefits of ecological networks are key elements in combatting environmental deterioration as a fatal by-product of the „immobilité fulgurante“ [racing standstill, A/N] of current political structures found in contemporary societies.

> Mythomanie d'une quantification encouragée par le développement constant de l'informatique et de ses effets d'entraînement sur les exigences d'une communication où la rapidité du résultat prime sur sa qualité.
>
> Paul Virilio (2007) L'université du désastre. Galilée, Paris, p.25
>
> [This mythomania of quantification which is encouraged by the continuous development of informatics and of its practical impact on the requirements of a communication where the speed of achieving a result dominates over its quality.]

Participative approaches to raising awareness, to re-establishing eroded regional identities (in marginalised border regions),valorising the qualities of ecological network structures for the benefit of the respective local/regional population, reinventing traditional ways of cultivation, of crafts based on local resources, of new (old) ways of intercommunication at local to transnational levels, i.e. in the local and regional, the cross border and also the European dimension, have become the driving force for networking based on common socio-ecological and socio-ethical values. In a second step, common interest in sound development of the protective management of heritage of cultural and semi-natural landscapes as well as of remaining patches of wilderness landscapes all over (Central) Europe can be established.

TransEcoNet in our understanding is thus both a means for creating responsible approaches to the conservation, the ecologically-balanced development/ management and to the valorisation of the ecological qualities of landscapes rich in biodiversity via a Europe-wide network approach as well as a strong and efficient catalyst to stimulate the creation and development of local and regional interest and participation. As a consequence the benefits of ecological network approaches are passed over to the communities concerned and a process of networking between 'nature and people' is communicated and established. To this end *TransEcoNet* plays a significant part in contributing to the continuous further development of (European) fora of ecology-minded individuals and of respective interest groups towards an expansion and maintenance of strong ties of urgently needed intercommunication and solidary action in 'ecological networking' from local to European levels.

I The Importance of Transnational Ecological Networks in Central Europe

The TransEcoNet Project - Background, objectives, actors and regions

Stephan Schöps, Technische Universität Dresden

In Central Europe protected areas, such as national parks or biosphere reserves, are often isolated patches of nature conservation. They are surrounded by less protected or unprotected areas. Frequently these surrounding areas are intensively used for agriculture, transport infrastructure, industrial sites and human settlements. For animal and plant species this intense usage of landscapes creates barriers which can prevent genetic exchange, posing a threat to biodiversity. To provide animals and plants with possibilities for migration, dispersal and forage and to conserve biodiversity in the long run, naturally valuable landscapes need to be spatially connected by ecological networks.

Central Europe's rural border regions are particularly characterised by an interesting mosaic of sometimes protected and sometimes non-protected areas but still ecologically valuable landscapes nonetheless. However, these former remote landscapes are nowadays facing rapid changes. With the political and economic integration of Europe, border areas are facing the challenge of finding a balance between economic development on the one hand, and protection of their valuable natural and cultural heritage on the other.

The idea of TransEcoNet is to analyse border areas in Central Europe regarding the spatial coherence of ecological networks, the status of biodiversity and ecosystem services and land use development past and present. Besides the spatial-ecological analyses socio-cultural topics such as awareness of ecological networks and general regional ecological values are considered. The following issues were the guiding questions when developing the TransEcoNet project:

- How strongly are Central European protected areas connected to each other? Where are gaps in the ecological networks?
- How did transboundary landscapes develop in the past centuries, particularly regarding land-use?
- How are cross-border landscapes structured in terms of ecological functionality, biodiversity and ecosystem services?
- How can awareness of transnational ecological networks be raised and contributions to their maintenance achieved?

The results of the project are trans-disciplinary and experts from remote sensing, nature conservation and environmental education, landscape ecology and conservation biology, regional and spatial planning, as well as cultural history and architecture worked together during the project to analyse the history of land-use,

biodiversity and socio-cultural values of Central European transnational ecological networks.

Objectives and work packages

The TransEcoNet partners elaborated strategies on how to develop and manage transnational ecological networks in Central Europe regarding future land use and biodiversity conservation. In particular, the focus was on less or unprotected landscapes in-between protected areas. As a result recommendations for sustainable land-use management in these areas were given. The recommendations are addressed at planning authorities at European, national and regional level as well as at rural development agencies and protected area administrations.

The results should contribute to an enhanced connectivity of Central European ecosystems towards a close-knit pan-European ecological network. Additionally, by means of a number of transnational and local workshops, excursions, exhibitions and film screenings, TransEcoNet strengthened people's awareness of ecological networks and the natural and cultural heritage of trans-boundary landscapes.

The project's activities and outputs were implemented within four thematic work packages which are illustrated in the following table:

Tab 1: TransEcoNet work packages

Inventory of Ecological Networks	*History of Ecological Networks*
Analysis of trans-boundary connectivity Identification of potential habitat corridors and gaps Review of the legal and political framework **Outputs**: Studies, surveys and geodata, recommendations for safeguarding ecological networks	Assessment of land use and vegetation cover change from the end of the 18th century Inventory of natural and cultural heritage in trans-boundary areas **Outputs**: Time series of historical maps, collection of historic material such as postcards and pictures, books and films visualising landscape change
Ecosystem Services and Biodiversity	*Raising Awareness*
Assessment of landscape functionality and Ecosystem services in ecological networks Determination of landscape-related protection values and threats **Outputs**: Studies and geodata, scenarios of landscape development, strategies on how to maintain ecological networks	Landscape perception: surveys of oral history Visualisation of landscape change Communication of ecological networks to the public **Outputs**: Studies, documentary films, interactive visualisation tools, case studies, events, excursions

Project partners

Six Central European countries are involved in the TransEcoNet project. The 16 partners participating in the project come from various backgrounds: Ten of them come from research and six come from national parks and nature protection or regional development agencies.
The following table provides an overview of the partner consortium:

Tab. 2: TransEcoNet project partners

PP no.	*Institution*	*Country*
1 (LP)	Technische Universität (TU) Dresden, Department of Geosciences, Chair of Remote Sensing	Germany
2	Leibniz Institute of Ecological Urban and Regional Development, Dresden	Germany
3	The Saxon Regional Conservation Foundation, National Park Saxon Switzerland Information Centre, Bad Schandau	Germany
4	Technische Universität Wien, Institute of Photogrammetry and Remote Sensing	Austria
5	University of Vienna, Department of Conservation Biology, Vegetation and Landscape Ecology	Austria
6	Austrian League for Nature Conservation Burgenland, Eisenstadt	Austria
7	University of Jan Evangelista Purkyně in Ústí nad Labem	Czech Republic
8	Karkonosze National Park, Jelenia Góra	Poland
9	University of West Hungary, Sopron	Hungary
10	Geodetic Institute of Slovenia, Ljubljana	Slovenia
11	Vienna University of Technology, Institute of History of Art, Building Archaeology and Restoration	Austria
12	The Silva Tarouca Research Institute for Landscape and Ornament Gardening, Brno	Czech Republic
13	Public Benefit Corporation Bohemian Switzerland, Krásná Lípa	Czech Republic
14	University of Nova Gorica, Laboratory of Environmental Science	Slovenia
15	Regional Development Agency Mura, Murska Sobota	Slovenia
16	Provincial Administration Burgenland, Dep. 5/III Nature Protection (Biological Station Neusiedler See), Illmitz (until December 2010)	Austria

Project regions

At the beginning of the project four project regions were defined. They are located in border areas of seven Central European countries within or between the wide-ranging

ecological networks of the Alps, the Carpathians and the European Green Belt. They are also exemplary for other landscapes of Central Europe. The regions chosen contain protected and non-protected areas. Within each trans-boundary project region the project partners worked in individually specified investigation areas according to their research intentions. The four project regions are embedded in an overarching investigation area (in Fig. 1) which provided the basis for the overall inventory of a transnational network of protected areas.

The *Northern Project Region* includes parts of Germany, the Czech Republic and Poland. It comprises of a huge number of protected areas and biodiversity hot spots reaching from the Ore Mountains in the west over the Elbe Sandstone Mountains extending further to the Lusatian Mountains which continue the mountain range eastwards up to the Jizera mountains and to the Giant Mountains. Further protected areas like the Gór Stołowych National Park and its adjacent landscapes Broumovsko and the Orlické Mountains are situated more to the southeast and are integrated in the Northern Project Region as well.

The *Central Project Region North* includes the border areas of Poland, the Czech Republic, Slovakia and Austria. North of the Danube floodplains the Lower Morava River forms the border between the Czech Republic, Slovakia and Austria. It is one of the largest tributaries of the middle Danube. Together with the floodplain of the River Dyje, which is located on the border between the Czech Republic and Austria, it forms one of the best preserved floodplains in Central Europe with high biodiversity and a well-preserved complex of highly diverse wetlands. To the east of the Central Project Region North the White Carpathians and Beskid Mountains form the western mountain range of the Carpathian Mountains. They are situated on the border between Poland, the Czech Republic and Slovakia and are part of the Slovak-Moravian Carpathians.

The border areas of Austria, Slovakia and Hungary form the *Central Project Region South*. The transnational ecological network from the northeast where the Danube floodplains follow the Slovak-Hungarian border over the natural landscapes surrounding the biodiversity hot spot and the transboundary Neusiedler See-Seewinkel/Fertö-Hanság National Park to the protected landscape areas in the southwest in the Austrian Burgenland stood as the focus of the project partners involved.

The TransEcoNet *Southern Project Region* incorporates landscapes along the border areas of Austria, Hungary, Slovenia and Croatia which also partly belong to the European Green Belt. Amongst others, these are the valleys of the rivers Raab, Pinka and Strem in Austria, the Goričko landscape park and the floodplain of the Mura River in Slovenia, the Őrség National Park in Hungary and to the south the Kozjanski Park on the border to Croatia.

This publication presents the main results achieved in the project. The book is structured into four chapters representing each of the project's work packages. The first chapter contains articles covering the inventory of ecological networks. The project partners investigated and assessed gaps – unprotected but ecologically valuable areas – which were detected in the Central European ecological network. Regional studies were carried out in the Free State of Saxony (Germany) and in Moravia (Czech Republic). In addition, possible strategies for a sustainable management are given for closing a detected gap area on the border between Germany and the Czech Republic. Organisational frameworks and transnational initiatives striving for the maintenance and enhancement of ecological networks in Central Europe were analysed. Green infrastructure elements such as the European Green Belt or the system of river

corridors in the Austrian-Hungarian-Slovakian border area have been investigated regarding their biodiversity value and landscape structures.

The contributions in the second chapter are tracing back the history of ecological networks. Historical maps can provide important information about land use and change in vegetation cover. The project partners involved employed maps from the end of the 18th century until the present to find out more details about the development of landscapes which are part of the current ecological networks. They analysed the continuity of land cover and land use changes in selected trans-boundary regions. Digitised historical maps were also used as a source for 3D-computer visualisations of landscape change which some partners elaborated upon.

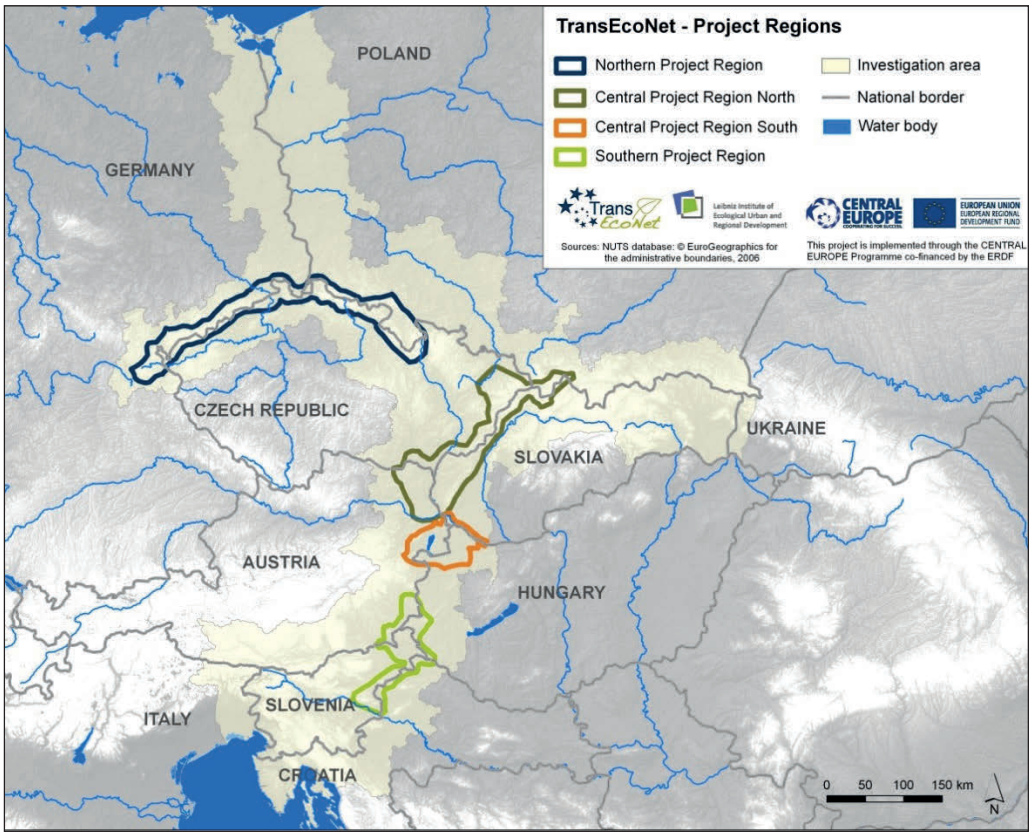

Fig. 1: TransEcoNet project regions

The functionality of landscapes and the ecosystem services that they provide to society, such as fresh water or food is the main topic of the third chapter. The question dealt with is how to determine and assess landscape functionality and landscape/ecosystem services. One contribution highlights the way in which airborne laser scanning can provide important data for biodiversity assessment. Another article focuses on the state of landscape services in three trans-boundary areas.

Finally, the fifth chapter is helping to establish a bridge between the project and the public by communicating, in a number of ways, its results and the natural and cultural heritage of ecological networks. Altogether five articles reflect on how people perceive landscape change and how several trans-boundary landscapes were assessed

regarding their interactions with the built heritage and with the people living in those landscapes. The use of interactive tools which aim at raising awareness for landscape change within environmental educationis presented.

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II Inventory of Transnational Ecological Networks in Central Europe

This chapter contains articles covering the inventory of ecological networks. The project partners investigated and assessed gaps – unprotected but ecologically valuable areas – which were detected in the Central European ecological network. Regional studies were carried out in the Free State of Saxony (Germany) and in Moravia (Czech Republic). In addition possible strategies for a sustainable management are given for closing a detected gap area on the border between Germany and the Czech Republic. Organisational frameworks and transnational initiatives striving for the maintenance and enhancement of ecological networks in Central Europe were analysed. Green infrastructure elements such as the European Green Belt or the system of river corridors in the Austrian-Hungarian-Slovakian border area have been investigated regarding their biodiversity value and landscape structures.

Articles

Detecting Gaps in the Ecological Network - Transnational Assessment and Regional Studies in Saxony (Germany) and Moravia (Czech Republic)

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Keywords: ecological networks, gap analysis, transnational assessment, regional studies, Saxony, Moravia

Abstract

This chapter deals with the identification of gaps in transnational ecological networks. First, the methodology is introduced, followed by results from the overall transnational assessment and by two case studies from Saxony (Germany) and Moravia (Czech Republic). The analyses are based on spatial data and were performed in a Geographical Information System (GIS). After collecting and harmonising national as well as European data sets of protected areas, all areas were classified according to the international standard provided by the categories of the International Union for Conservation of Nature (IUCN). Following these basic data preparation steps, a gap analysis was performed, where the gaps were defined as unprotected areas with high natural value. The methodology is based on an unspecified species approach and on the detection of potential habitat corridors. The aim was to include valuable areas into the ecological network through the enlargement of protected areas and the protection of stepping stones and therefore to improve the connectivity of protected sites to each other. The performed analysis illustrates a method of how to connect protected areas across borders with each other. Often protected areas are too small to allow for the persistence of viable populations of species and connecting networks of protected sites may increase species' persistence. The need to recover endangered species and rare habitat types has driven the demand for habitat connectivity. One of the solutions is to maintain and restore habitats that will provide connections between protected areas. For that reason the gap analysis focuses on connecting protected areas via potential suitable habitat corridors and potential corridors of protected areas.

1 Introduction

Protected areas such as national parks, nature parks and biosphere reserves are often isolated areas. Often they are separated by insufficiently protected and unprotected landscapes, traffic corridors as well as settlements. It is often the case that animal and plant species have less space for migration, dispersion, forage and reproduction at their disposal than necessary. To preserve both natural and cultural heritage in the long run, the TransEcoNet project is striving for a better connection of protected landscapes with those that are weakly protected and unprotected, in particular across national borders.

Ecological networks and corridors represent one of the most widely applied concepts in contemporary approaches to nature conservation. The basic idea is to link ecosystems of one type into a spatially coherent system through flows of organisms, and to consider also the interactions with the matrix in which they are embedded (OPDAM et al., 2006).

A gap analysis is a method to identify biodiversity (i.e. species, ecosystems and ecological processes) not adequately conserved within a protected area network. Within this study, gaps are defined as areas with high natural value (oligotroph and selected mesohemerobe land use types) according to the definition of Dudley and Parish (2006). The aim is to spatially detect and to embed valuable areas into the ecological network through the enlargement of protected areas as well as the protection of stepping stones and therefore improving connectivity. With many of the relevant areas being less productive areas, in terms of farming it should be easier to de-intensify agricultural land use in these areas and to incorporate them into the ecological network as a crucial part of increasing connectivity.

Often protected areas are too small to allow for the persistence of viable populations of species. Connecting networks of protected areas may increase species' persistence; therefore the need to recover endangered species and rare habitat types has driven the demand for habitat connectivity. One solution is to maintain and restore habitats that will provide connections between protected areas (HILTY et al., 2006). For this reason our gap analysis focuses on connecting protected areas via potential habitat corridors and potential corridors of protected areas. Corridors are understood as any space, which is identifiable by the species using it and that facilitates the movement of animals and/or plants over time between two or more patches of otherwise disjunctive habitats (LIDICKER, 1999).

2 Identification of the gaps in the transnational ecological networks

2.1 Material and methods

The gap analysis is usually applied to fairly large areas. It should allow decisions about conservation with the best available information and on the basis of ecological rather than political boundaries (DUDLEY and PARISH, 2006). Dudley and Parish define six key steps in a protected area gap analysis:

Our gap analysis followed these key steps (Fig. 2), but we used easily accessible data on ecosystems (CORINE 2000 land cover data set (EUROPEAN ENVIRONMENT AGENCY (EEA), 2002) (classified through a hemeroby index which we used as a proxy for unavailable data on ecosystems, specifically biodiversity) as well as worldwide accessible species data (IUCN, 2009). We combined a corridor/habitat approach (identification of existing and potential habitat corridors) with a species number approach (occurrence of threatened species – mammals, birds, reptiles and amphibians) for the prioritisation process (NEUBERT et al., 2010, BIANCHIN and NEUBERT, 2012).

In the first step we identified three different potential habitat corridor types (wetlands, woodlands and open landscape areas of natural and semi-natural vegetation) and potential corridors for protected areas (EEA, 2010). The corridors were identified with an unspecified species approach using CORINE 2000 land cover data (EEA, 2002)

considering different land use types (ecosystems) and using a specific buffer procedure. For all buffers (wetlands, woodlands, open landscape areas and protected areas) we used a buffer distance of 2,000 metres (Fig. 3).

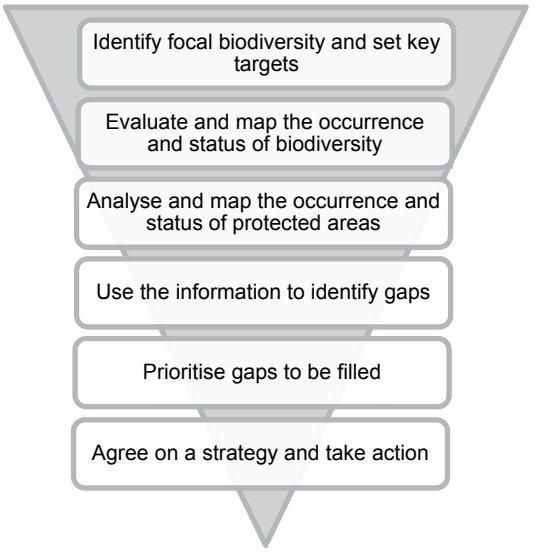

Fig. 1: Key steps in a protected area gap analysis (DUDLEY and PARISH, 2006)

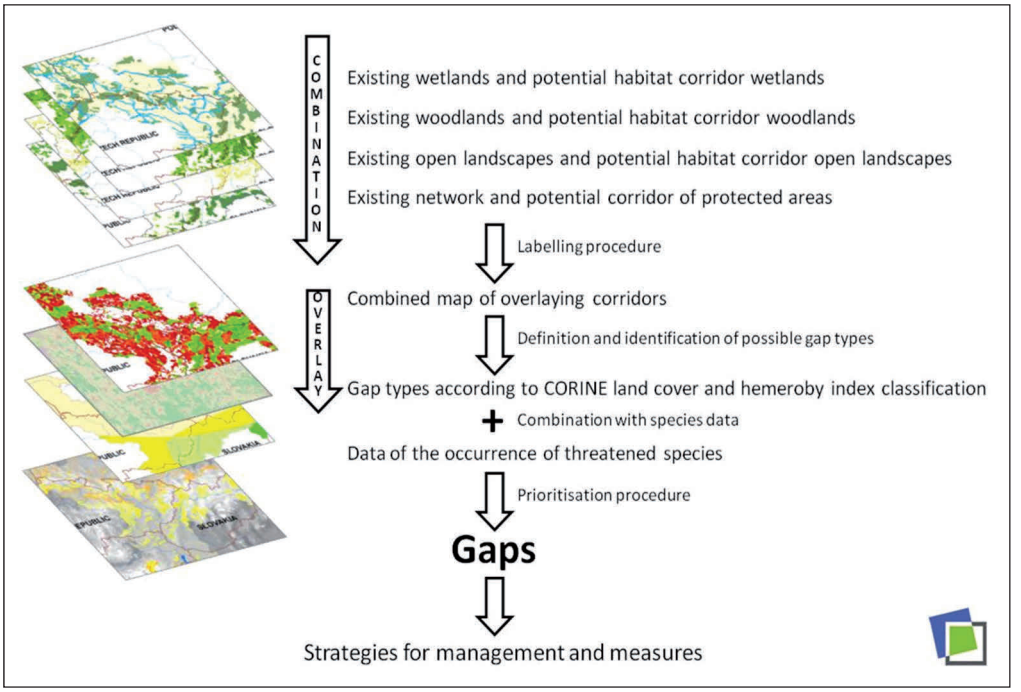

Fig. 2: Methodology of the gap analysis (BIANCHIN and NEUBERT, 2012)

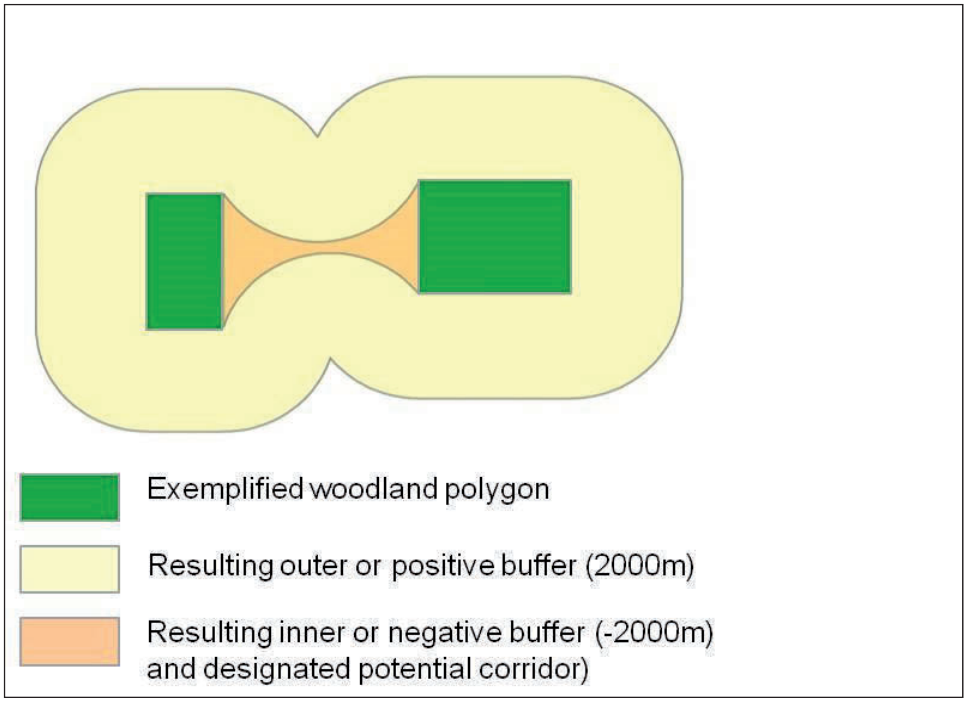

Fig. 3: Scheme of the buffering procedure exemplified for the designation of woodland corridors (according to HAENEL, 2007)

This distance has been selected according to PAN (2006) and Bastian and Schreiber (1999) because a large number of species are able to bridge distances between habitats smaller than 4,000m (i.e. 2 x 2,000m). Thereafter the three possible ecological corridors and the potential corridor of protected areas have been combined and labelled with attributes according to Tab. 1.

Tab. 1: Attribute assignment for the combination of the potential habitat corridors and the potential corridor of protected areas

Existing network and potential corridors of protected areas	**Potential habitat corridors**		
	Single corridor	**Overlay of two corridors**	**Overlay of three corridors**
Outside the corridor of protected areas	**1**	**2**	**3**
Within the corridor of protected areas	**11**	**22**	**33**

For the determination of gaps all land use classes from the CORINE 2000 land cover data set with an oligohemerobe hemeroby index (close to natural) and two selected land use classes with an mesohemerobe hemeroby index (semi-natural) according to Steinhardt et al. (1999) where chosen. Two mesohemerobe land use classes (231 and 243) were included as they concern valuable areas with specific species assemblage such as mountain meadows and open landscapes of complex structured fields and hedgerows.

After this selection procedure the determined potential gaps were combined with the available data of the occurrence of threatened species (IUCN, 2009). Shape files and metadata can be downloaded

- for amphibians at: http://www.iucnredlist.org/initiatives/amphibians/description/download-gis-data;
- for reptiles at: http://www.iucnredlist.org/spatial-data/REPTILES.zip;
- for birds at: contact BirdLife International http://www.birdlife.org/index.html;
- for mammals at: http://www.iucnredlist.org/initiatives/mammals/description/download-gis-data.

Thereafter, according to the European Red List of amphibians (TEMPLE and COX, 2009), reptiles (COX and TEMPLE, 2009), birds (BIRD LIFE INTERNATIONAL, 2010) and mammals (TEMPLE and TERRY, 2007) the designated gaps were prioritised. Only species belonging to the threatened categories 'critically', 'endangered' or 'vulnerable' were considered and used for prioritisation.

Tab. 2 shows the prioritisation process which is an important part of the gap analysis. In total five different prioritisation classes were defined (lowest priority, low priority, medium priority, high priority and highest priority) according to the type of gap and the number of occurrences of threatened species. The assessment is based on a simple addition method, which means the gap with the highest rank (gap within the overlay of three corridors within the corridor of the ecological network of protected areas) and the highest number of threatened species have the highest priority (very high priority). However, the location inside or outside of the potential corridor of protected areas was of a higher importance than the number of overlaying corridors.

Tab. 2: Prioritisation process of the gap analysis

Type of gaps listed by rank	**Category of threatened species occurrence**		
	High	**Medium**	**Low**
Gap within the overlay of three corridors within the corridor of the ecological network of protected areas (PA)	Highest priority	High priority	High priority
Gap within the overlay of two corridors within the corridor of the ecological network of PA	High priority	High priority	Medium priority
Gap within single corridor within the corridor of the ecological network of PA	High priority	Medium priority	Medium priority
Gap within the overlay of three corridors outside protected areas and outside the corridor of ecological network of PA	Medium priority	Medium priority	Low priority
Gap within the overlay of two corridors outside protected areas and outside the corridor of ecological network of PA	Medium priority	Low priority	Low priority
Gap within single corridor outside protected areas and outside the corridor of ecological network of PA	Low priority	Low priority	Lowest priority

2.2 Results and conclusions

The results of the gap analysis (Fig. 4) show that most gaps have a low priority (70.1%). Most of the hotspot gaps (high to highest priority) are located in the southern part of the investigation area.

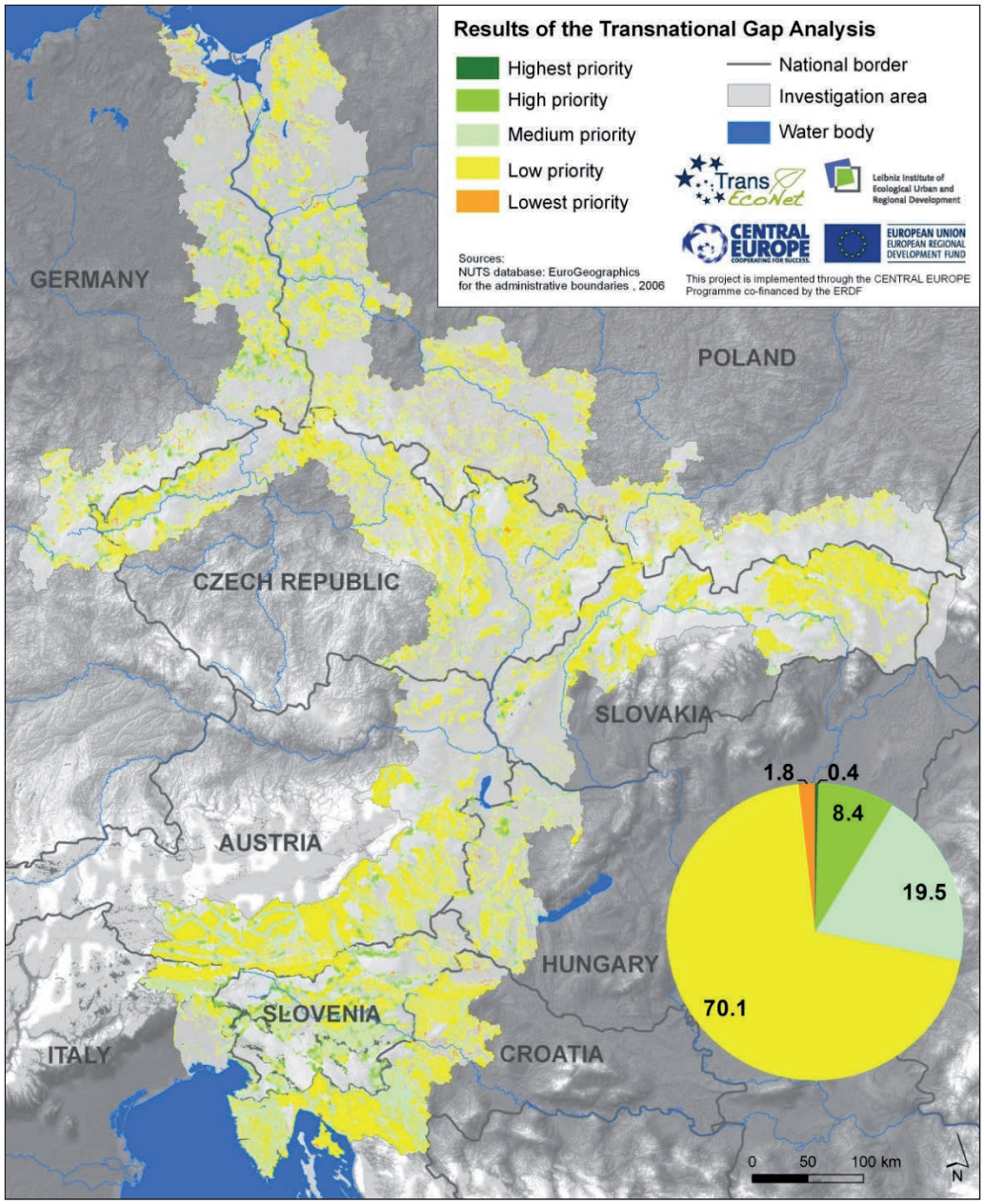

Fig. 4: Transnational gap analysis and priority level

After the identification and characterisation of the gaps the most urgent actions would be the implementation of necessary measures to prevent the deterioration of these areas of high biodiversity value outside protected areas (resp. within the gaps identified). One of the biggest threats could be the intensification of land use and the development of buildings and transport infrastructure. For that purpose the identified areas need to be included into regional and national development plans as well as into planning procedures about ecological networks to preserve their biodiversity value and connective function.

Furthermore, the protection and strengthening of the existing network of protected areas is of highest importance. Land use that threatens the biodiversity value in these areas should be prohibited and the areas should be extended and should be protected by a higher legal status as well as protected further by surrounding buffer zones of less intensive land use.

Involving all key stakeholders from an early stage (WHITE et al., 2005) as well as coordinating the management strategies across borders is an important goal. In the Project Region North the first meeting with responsible authorities (Saxon State Ministry of the Environment and Agriculture, Saxon State Office for Environment, Agriculture and Geology, Czech Agency for Nature Conservation and Landscape Protection, Czech Ministry of Agriculture) was held and the need for a detailed gap analysis on a small scale was addressed. More detailed gap analyses were then realised for Saxony (Germany) and for parts of Moravia (Czech Republic).

3 Regional case study Saxony (Germany)

3.1 Introduction

With the help of GIS-based methods the spatial preconditions for the realisation of a habitat network are examined for Saxony, focussing specifically on Red List threatened vertebrate species in Saxony.

Statistical analysis shows that about 44% of Saxony is already under protection. The potential ecological network of protected areas, which was constructed in this regional case study, covers a total of 67% of Saxony. By implementing appropriate management measures, parts of these areas could be focal regions for the migration and genetic dispersal of threatened vertebrate species in Saxony and adjacent regions. So-called gaps could then be enhanced to serve as stepping stones between protected areas and improve the overall connectivity within the landscape.

In Saxony three different landscape units can be distinguished. The Lower Lusatian Heathland containing lakes and heath land covers about 20% of the area and is the northernmost landscape unit. The Saxon Loess Landscape accounts for almost half of the territory of Saxony and is intensively used by agriculture. Only about 31% of its area is under protection which is below the Saxony average. Approximately 31% of Saxony belongs to the southernmost landscape unit, which is the highland and low mountain ranges. In this landscape unit 60% of the area protected.

3.2 Material and methods

For this regional case study detailed land use and biotope type data from the Free State of Saxony from 2005 (BTLNK, 2005) as well as point data of the occurrence of

threatened Red List vertebrates in Saxony (LfULG, 2008; RAU et al., 1999) was used. For the identification of protected areas data from the German Federal Agency for Nature Conservation from 2010 was employed.

To elaborate the potential ecological network of protected areas a 2,000m outer and inner buffer was applied for the corridor construction. The three different potential habitat corridor networks were created by applying a 500m buffer distance. This was possible due to the detailed input data that shows biotopes relatively close to each other.

After overlaying all four potential corridors the gaps could be identified. The selection procedure followed the same scheme as described in the section above. In the next step the gaps were overlaid with occurrence data of vertebrate species from the Red List of Saxony. The locations of recorded threatened species occurrences were buffered with group-specific activity ranges. As an example, for the group of threatened amphibians an activity range of 150m was used and used as a buffer distance. Thereafter, gaps of a special habitat type (e. g. gaps in the woodland) were overlaid with buffers of species that also occur naturally in this habitat.

Finally, the gaps were prioritised. As described in the section above, for this procedure five priority classes were assigned to the gaps. Furthermore, hot spot analysis, nearest neighbour analysis and fragmentation analysis were also carried out in order to obtain more details about the location, effective accessibility and other characteristics of the gaps.

3.3 Results

In total, gaps are covering about one fifth of the territory of Saxony. The vast majority of gaps (95.5% of the total gap area, Fig. 5) correspond to the habitat type woodland or open landscape. This reflects the need to advance specifically the poorly represented wetland gaps by integrating them into the habitat network. Moreover, gaps of very high or high priority (so called ‘hot spots’), gaps within wildlife corridors of national and international importance as well as gaps which are also core areas of the ecological network system designated by the state and regional planning agencies, should be recognised as important parts of the future habitat network.

As another result, relatively high numbers of threatened species occurrences per gap can be found in the old mining areas south of Leipzig and near Hoyerswerda in the northeast of Saxony. However, there is also about 37% of the gap area in which Red List species occurrences that were neither registered yet within these gaps nor within a close buffer distance.

Most gaps with high or very high priority are situated in the northernmost landscape unit of Saxony, which therefore can be characterized as a ‘hot spots’ for threatened species (see Fig. 5). In the case study of Saxony approximately 1% of the gap area corresponds to very high priority gaps and about 16% of the gap area corresponds to gaps with high priority.

Good requisites for the realisation of a habitat network in Saxony are, on the one hand, short distances between the gaps and, on the other hand, that the vast majority (approximately two thirds) of the gaps are located either adjacent to a protected area, or at least not more than one kilometre from the nearest protected area. The identified

potential corridors should however also be checked against dissecting linear barriers or filters, such as roads or railways.

To close the gaps in the protected area network of Saxony implementation-oriented measures and sufficient human, institutional and social capacities (see also DUDLEY and PARISH, 2006) will be needed.

Since the methodologies of the gap analysis in the transnational assessment and in the regional case study within Saxony are similar, the comparability of the results of both assessments was also tested. The question to be answered was, if the results would resemble each other despite of different spatial scales and input data.

For the GIS-based comparability analysis the area that belongs to both the Free State of Saxony and to the project region north of TransEcoNet, served as the study area. Fig. 6 shows that the locations and the priorities of gaps are similar in the two different assessments. Of course a more detailed statistical analysis also shows differences in the exact relative distributions and square dimensions of the gap priority classes. However, if a gap area was assigned to a low priority class within the transnational assessment there is a clear tendency that this gap area has also a relatively low priority within the regional assessment. The same is valid for gaps with high priority. In conclusion, the TransEcoNet methodology of the gap analysis can also be applied on a smaller spatial scale without showing big differences in the final results. The tendencies that were indicated on a larger spatial scale are not blurred, but can be further defined with the help of more detailed input data.

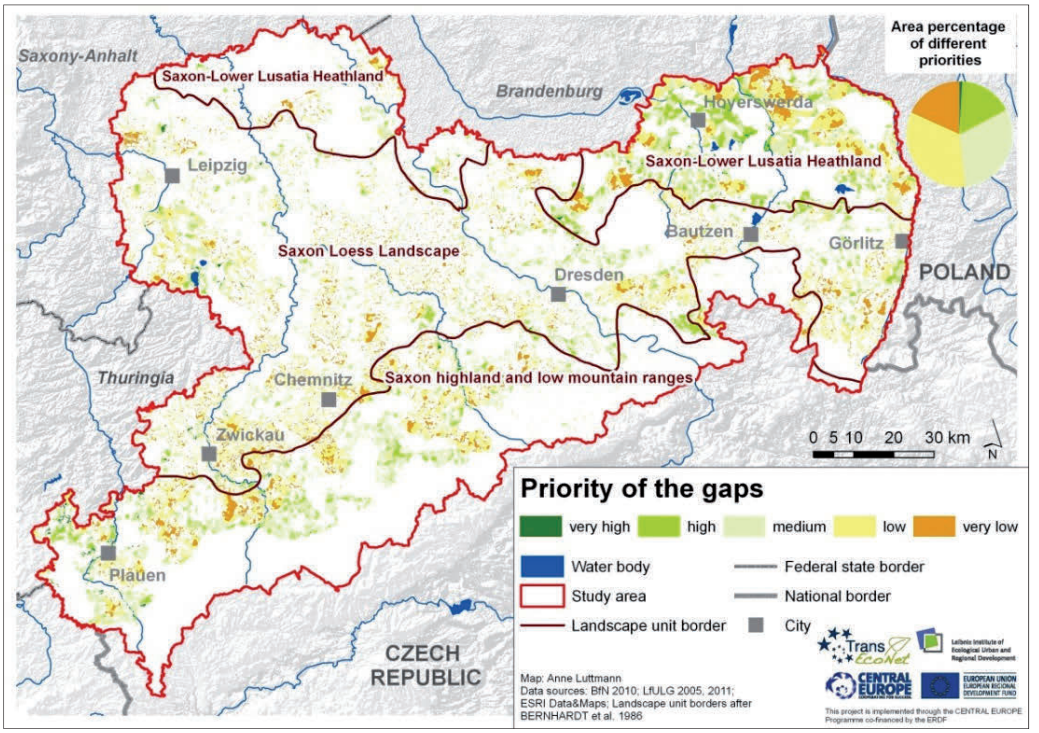

Fig. 5: Regional gap analysis in Saxony (Germany)

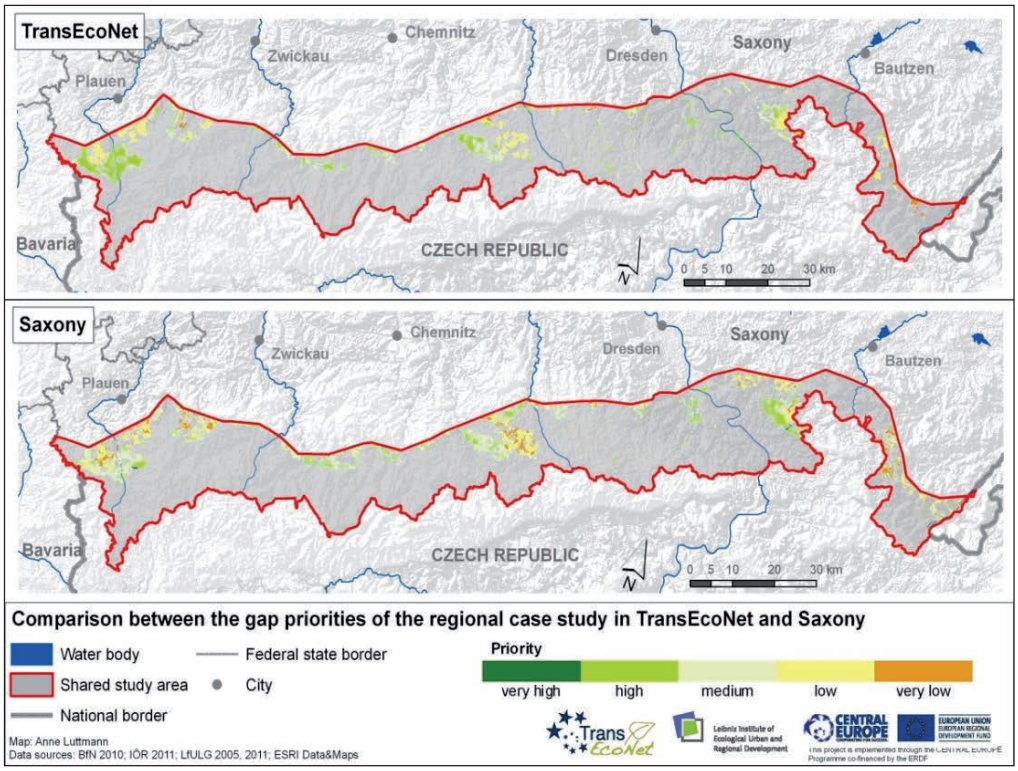

Fig. 6: Comparison between the priority results of the regional case study (Saxony) and the transnational assessment (TransEcoNet)

4 Regional case study Moravia (Czech Republic)

4.1 Introduction

In this section, results of the gap analysis in three focal regions in Moravia, Czech Republic, are presented. It focuses on a coarser scale than the previous case study from Saxony and it also incorporates possibilities of closing the gaps within the Czech Territorial System of Ecological Stability (TSES).

TSES is a network of both existing and potential natural as well as modified but near natural ecosystems that a have higher ecological stability and thus contribute to keeping the natural balance. The goals of this system are to preserve and support the development of the natural gene-pool, to secure a positive influence on the surrounding ecologically less stable parts of the landscape, to support multifunctional utilization of the landscape and to preserve important landscape phenomena (BUČEK and LACINA, 1995). Through applying functions three constituents can be distinguished: bio-centres, bio-corridors and interactive elements. For the scale of TSES four levels were determined: local, regional, supra-regional and provincial.

4.2 Material and methods

4.2.1 Focal regions

Three focal regions were selected along the state border with Slovakia and Austria (Fig. 7). These regions represent different types of the Moravian landscape.

The focal region of Lower Dyje River (428.9km^2) is situated in South Moravia. It is an example of an intensively used agricultural region with specialisation on wine, cereal and fruit production. It includes the vast floodplain of the Dyje River and the surrounding undulating terrain of hills and uplands with elevations between 160m and 550m above sea level (a.s.l.). It has limestones, sandstones, claystones and quaternary sediments, dry, warm climate, termophilous fauna and flora typical for hilly parts and alluvial forests in the floodplain. Protected parts in terms of NATURA 2000 sites and small special protected areas (Act 114/1992 Coll.), i.e. areas with stricter protection, cover 31% of the region. Parts of the region also belong to a protected landscape area (in the centre), biosphere reserve and UNESCO world heritage (in the east).

The focal region Bílé Karpaty (746.5km^2) is situated in south-eastern Moravia. It is an example of a mountainous agricultural and recreational region with elevations between 170m and 970m (a.s.l.), flysh formations, mild climate, beech forests and herb-rich meadows. The whole region has the status of a protected landscape area and biosphere reserve of which 28% are under stricter protection.

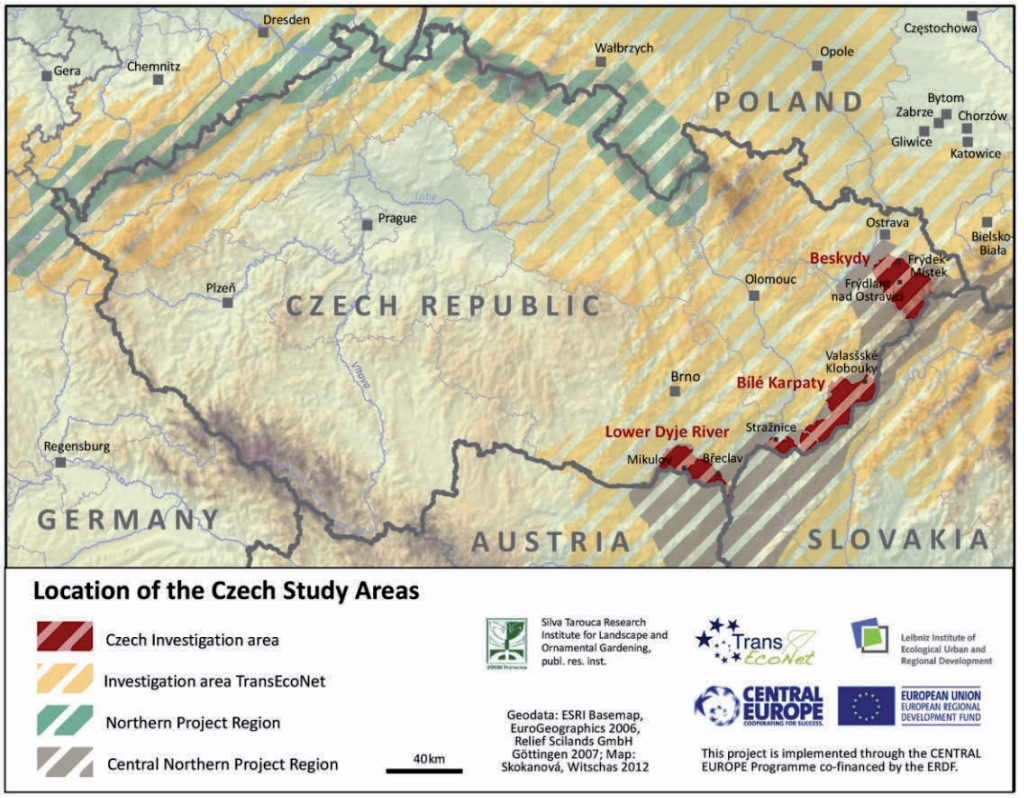

Fig. 7: Location of focal regions in Moravia

The third focal region, Beskydy (674.5km^2), is situated in north-eastern Moravia. Two different parts can be distinguished here – the northern industrial plain with elevations between 260m and 890m (a.s.l) and the southern recreational mountain range with elevations between 425m and 1,324m (a.s.l). Correspondingly, quaternary sediments, mild climate and floodplain forests are typical for the northern plain, while flysh formations, cold climate, beech forests with fir and spruce forests are typical for the southern mountain range. 55% of the focal region is covered either by NATURA 2000 sites or small special protected areas. A protected landscape area can also be found in the southern part of the region.

4.2.2 Methods

The gap analysis is based on the methodology described in section 2.1 (Fig. 2). For data on ecosystems CORINE 2006 data was used. The input data on protected areas consisted of the national data set for small special protected areas from 2009 and the European NATURA 2000 network also from 2009. The prioritisation process was somewhat simplified as it included a number of species regardless of their habitat priorities.

Gaps below 1ha were excluded from the further analysis as they were more likely a result of sliver polygons due to positional errors of the input data than actual gaps.

To find out if the establishment of TSES helps in closing identified gaps results from the gap analysis were overlaid with TSES data. This enabled further analyses, e.g. which priority gaps and gaps of which size can be closed by TSES.

For the analysis TSES data from regional and supra-regional levels from the year 2008 was used. Only bio-centres and bio-corridors were considered. Since original data for bio-corridors were in the form of linear elements, they were buffered with 10m (for regional bio-corridors) and 20m (for supra-regional bio-corridors).

4.3 Results

Most gaps and also the biggest gaps were identified in Bílé Karpaty, while the lowest number and small gaps was typical of the Lower Dyje River (Tab. 3).

Tab. 3: Number of identified gaps, their area (km^2) and their share of the total area (%) of the focal regions

	Lower Dyje River	**Bílé Karpaty**	**Beskydy**
Number	16	369	302
Area [km^2]	68.04	400.49	180.83
Area [%]	15.9	53.7	26.8

In the Lower Dyje River gaps were identified in the south, northeast, northwest and west along the borders of the focal region (Fig. 8a). Gaps in Bílé Karpaty are situated mainly in the north-eastern part, but some gaps were also identified in the southwest (Fig. 8c). Due to the fact that the southern, mountainous part of Beskydy is covered by protected areas, gaps in this focal region concentrated in the northern part (Fig. 8b).

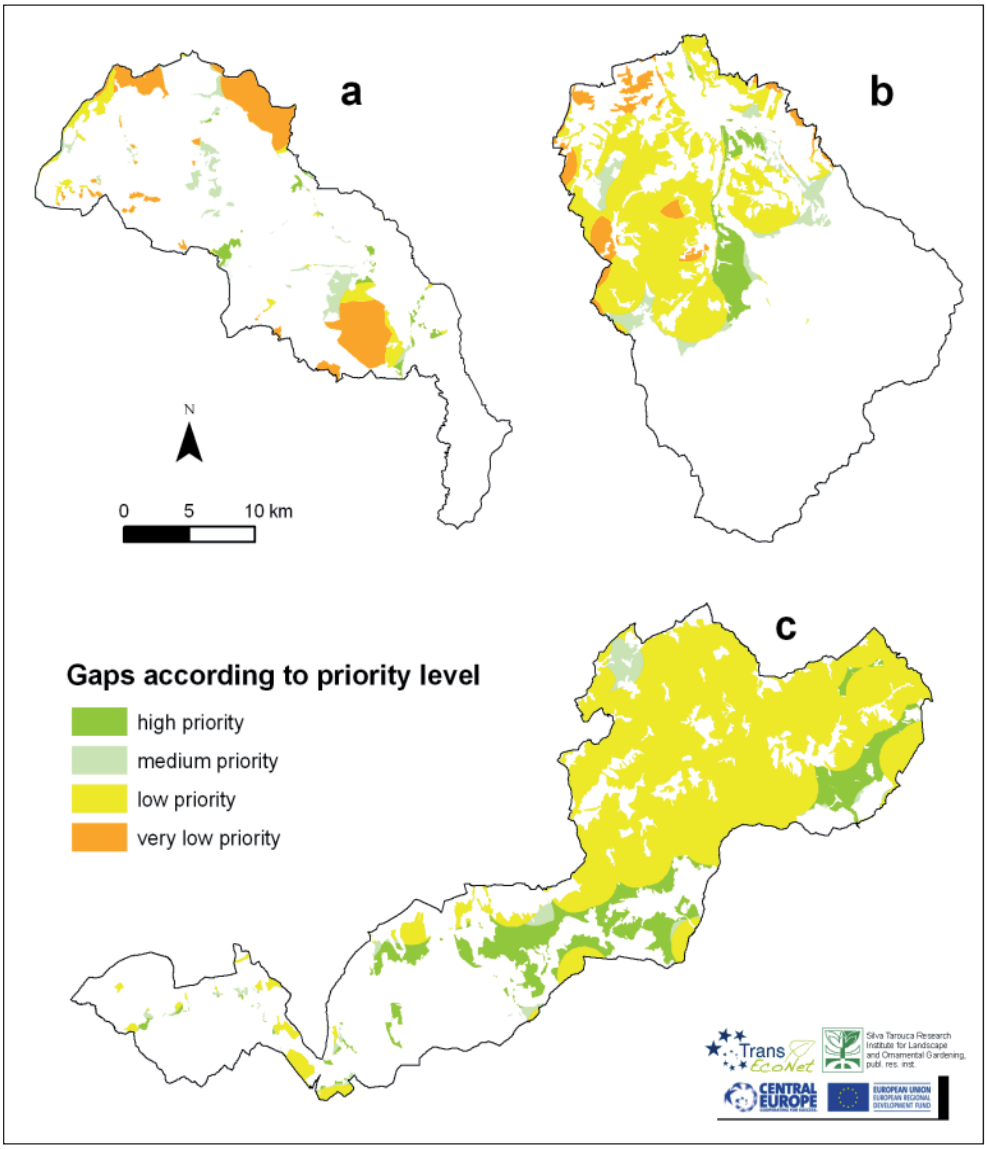

Fig. 8: Identified gaps according to priority in the Lower Dyje River (a), Beskydy (b) and Bílé Karpaty (c)

In the Lower Dyje River and Bílé Karpaty the majority of gaps belonged to open landscape although woodland gaps covered larger areas than open landscape gaps. The situation was the opposite in Beskydy, where the majority of gaps belonged to woodland but open landscape gaps covered larger areas. Wetland gaps played a significant role only in the Lower Dyje River, especially in the northern part of the region.

Gaps smaller than 5km^2 were dominant in all focal regions, gaps larger than 20km^2 occurred only in Bílé Karpaty. As for the priority levels, gaps with very low priority were found only in the Lower Dyje River, where they covered the largest area of the identified gaps, and in Beskydy (Fig. 8).

Low priority gaps dominated both in their number and spatial extent in Bílé Karpaty and Beskydy. Many high priority gaps were identified in Bílé Karpaty (Tab. 4) but they were usually smaller than 5km^2. Gaps with medium to high priority were situated predominantly near the already existing protected areas.

Tab. 4: Number and area (%) of gaps according to their priority in the focal regions

	Lower Dyje River		**Bílé Karpaty**		**Beskydy**	
Priority	Number	Area [%]	Number	Area [%]	Number	Area [%]
Very low	25	60,2	-	-	37	11,1
Low	42	17,3	195	80,9	153	70,8
Medium	55	16,1	48	3,3	79	9,0
High	38	6,4	126	15,8	33	9,1

The comparison of the results from the gap analysis on regional scale with the results from the gap analysis on transnational scale reveals an increase in the number of identified gaps in all focal regions. The extra gaps identified on regional scale were found in the central and eastern part of the Lower Dyje River and in the northern part of Beskydy. As for Bílé Karpaty, the transnational approach did not identify any gaps in this focal region due to its complete protection as a protected landscape area.

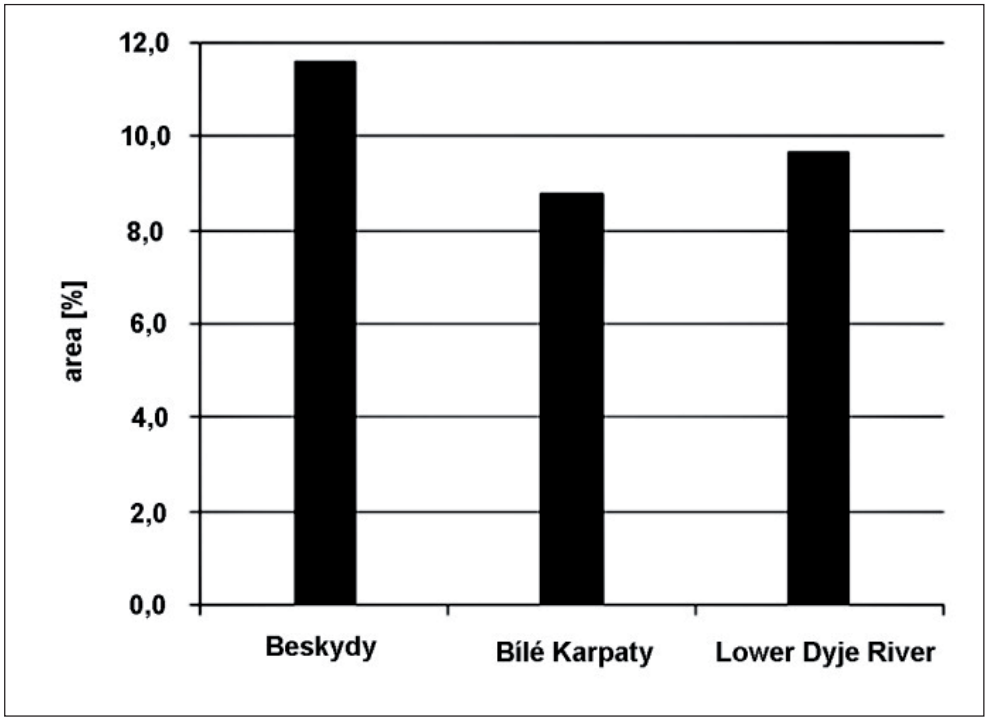

Fig. 9: Area [%] of the gaps covered by TSES elements in the focal regions

Analyses of interactions between gaps and TSES elements show that TSES can close between 9 and 12% of the gaps (Fig. 9).

The highest proportion of gaps that can be closed by TSES was recorded for Beskydy. The identified gaps were predominantly smaller than 5km^2, belonged to open landscape and had a low to medium priority. Gaps identified in Bílé Karpaty were also smaller than 5km^2 but they belonged mainly to woodland. In the Lower Dyje River gaps belonged predominantly to the open landscape, but both woodland and wetland gaps were also significantly covered by TSES elements. Again, TSES elements closed mainly very small gaps which had either medium or low priority.

4.4 Conclusions

The results show that gaps in the ecological networks were identified mainly in the less intensively used landscapes in the north-eastern part of Bílé Karpaty and in the northern part of Beskydy. These findings are not so surprising, especially in the case of Bílé Karpaty with a high proportion of forests and meadows. In the case of Beskydy even though the northern part can be characterized as industrial plain, industry is mainly situated in two big towns while the rest of the plain concentrates on less intensive agriculture. The small number of gaps identified in the Lower Dyje River reflects the high intensity of agriculture corresponding to a smaller occurrence of more favourable ecosystems which could be included into ecological networks. This is the case in particular for the western part of the focal region.

Despite the high presence of ecosystems in Bílé Karpaty and Beskydy, identified as being less altered by human activities, ecological networks are not that widespread in the concerned parts of the regions. However, it does not necessarily mean that all identified gaps should be protected. The prioritisation process used in the gap analysis helps to identify gaps which could be considered for a more detailed analysis (particularly analysis of protected species occurrence) whether they are suitable for the inclusion into ecological networks or not. Medium to high priority gaps that were identified in all three regions were in nearly all cases adjacent to already existing ecological networks. As such they indicate that the easiest way to close gaps is to enlarge these ecological networks.

The establishment of TSES, at least on regional and supra-regional level, can also help in closing gaps even though such closed gaps would mainly concern low to medium priority levels and would cover only up to 12% of the identified gaps.

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Ecological Networks as an Organisational Framework? Transnational Initiatives in Central European Border Areas

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Keywords: actors, policy-making, cooperation, institutions, biodiversity, green infrastructure, Central Europe

Abstract

The article below addresses the questions, in which European and national institutional contexts is cooperation on ecological networks taking place in Central Europe? Moreover, it elaborates which transnational cooperation initiatives did exist between 2000 and 2009 and what can be done to improve the current practice. Methods used include document analysis, internet research, mail inquiries as well as semi-structured interviews with key actors. As result, four large umbrella organisations and 24 individual projects and initiatives were found – most of them are located in the Alps and the Carpathians, but none were found in the Bohemian Massif nor in the Pannonian Plain. It is argued that transnational institutions and strong NGOs – besides funding opportunities – are crucial factors enabling transnational ecological network projects and should therefore be strengthened.

1 The challenge of transnational cooperation

In Central Europe with its many sovereign states and its high proportion of terrestrial borders, ecological networks will be of limited efficacy if conceived and implemented only at the national level. Thus, the case for transboundary and transnational cooperation is self-evident in this part of the world. However, up to now there has been no comprehensive survey of transnational cooperation initiatives aimed at establishing ecological networks in Central Europe (for Germany's external borders see LEIBENATH et al., 2010).
Considering the above factors we want to answer the following questions:

1. Under which European and national institutional contexts is cooperation on ecological networks taking place in Central Europe? – For this reason we analyse current European and national approaches to ecological networks and the related legislation.
2. Which transnational, supra-local cooperation initiatives did exist in the study area between 2000 and 2009? – This question implies the objective of giving a comprehensive overview of respective cooperation initiatives which shall be further characterized with regard to a number of criteria. The outcome is an inventory (or synopsis) of transboundary, supra-local cooperation initiatives in the Central Europe Programme area.