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Graphic: BUND – Project Office Green Belt

Proceedings of the 1st GreenNet Conference:
The Green Belt as a European Ecological Network
- strengths and gaps



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The Green Belt as a European Ecological Network – strengths and gaps

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INTRODUCTION

These are the proceedings of the 1st scientific conference of the Central Europe project: “GreenNet – Promoting the Ecological Network in the European Green Belt”.

	GreenNet - scientific conferences	
1.	The Green Belt as a European Ecological Network – strengths and gaps	2012
2.	Landscape policies and instruments in the partner countries – a benchmark	2013
3.	Good examples of landscape action and successful measures	2014

The 1st scientific conference focused on the European Green Belt as an Ecological Network.

The European Green Belt developed from the wasteland of the former death strip along the iron curtain through Europe over decades to a green life line in most areas with a rich and unique biodiversity and cultural heritage. This is a success story. So why is there a project GreenNet? The idea of the GreenNet-project results from the former GREENBELT-project (Interreg III B CADSES). GREENBELT highlighted the ecological most valuable areas. As one result it was recognized, that the gaps in the Green Belt cover more than 50%. These gaps are not protected and are subject to negative effects. Consequently the emphasis of GreenNet lays on developing and re-establishing an Ecological Network, bridging these gaps.

An Ecological Network is the aim, but what exactly is meant by an Ecological Network and how do we reach it? What does it include or exclude? During GreenNet project meetings and contacts with stakeholders and interested persons it became obvious, that there are different understandings of “Ecological Networks” and how to start work in the pilot regions. The expression “Babylonian confusion“ was used in this context. A clear definition could help also to work out a methodology for and start working in the pilot regions. So what is it all about: The Ecological Network and of course the GreenNet project: “Promoting the Ecological Network in the European Green Belt”? Is it about pure nature protection? Is it also about sustainable regional development and cultural heritage? Is it about marketing and public relations? Is it about participation? And in which way do we integrate successfully all stakeholders and landowners? How far in the best case will bring us participation? Shouldn’t it also be about a large scale European and national landscape policy and spatial policy (top-down-approach)? And don’t we all use and need the ecosystem services or common benefits of Ecological Networks? Doesn’t it affect all of us, our civil society and our future?

It is an honour for us to present you the Proceedings: “The Green Belt as a European Ecological Network – strengths and gaps” from all over Europe and beyond which will not only give answers to most of the above raised questions but also show their justification. As the theoretical definition (compare for example the articles from Jongman and Zhang) and the practical approach (compare for example the articles from Raderbauer et. al. and de Boer/Bressers) of Ecological Networks changed from a single target to a multifunctional approach in the last decades and years.

Besides the importance of land use for biodiversity the articles point out a lot of synergies from Ecological Networks with other fields, for example water management, agriculture, cultural heritage, Natura 2000 and sustainable regional development, society and political issues.

Further the articles will give valuable impulses to several of the following 11 GreenNet core outputs:

	GreenNet - core outputs	due by
1	Media contacts and partnerships, IP coordination	31.10.2011
2	Common transnational methodology to be applied in all pilot areas	31.01.2012
3	Transnational analysis (of safeguarding processes and instruments)	31.05.2012
4	Web based database with integrated GIS tool (local, regional, inter-and transnational level)	30.09.2012
5	Spatial hotspots (1 defined set of 2-3 spatial hotspots in the 5 pilot areas)	31.01.2013
6	Development of tools for dissemination of results	30.11.2013
7	Development of tools for safeguarding ecological networks	30.11.2013
8	Transnational management and protection strategy	31.03.2014
9	Target oriented lobbying	31.03.2014
10	Policy makers (ongoing lobbying activities)	31.03.2014
11	World heritage promotion (ongoing lobbying activities)	31.03.2014

Summarizing the panel discussion at the end of the conference, the speeches, articles and own thinking, there can be drawn following conclusions:

The **European Green Belt as an Ecological Network has an - unique throughout the world - natural and cultural heritage with an emotional human and political history, meaning and power.** It symbolizes also, that something bad can turn into something good.

Still it's a narrow strip for an Ecological Network and the gaps in the Green Belt cover already more than 50%. Will it be possible to bridge the gaps and safeguard and develop the European Green Belt and other Ecological Networks?

This is a huge task. Therefore the **multifunctional approach of Ecological Network development** with emphasis on synergies and win-win situations offers an enormous **chance** to raise acceptance, to go in the public, the civil society, involve the stakeholders, the affected policies. This offers also potential for a more sustainable land use and development in general for a long term benefit of society and future.

On the other hand it seems an almost impossible **challenge** to develop and secure Ecological Networks under today's given policy circumstances: therefore ecological specialist knowledge (with a global and a local point of view) should be combined with openness, interest and continuous learning about other fields of knowledge. This more technical knowledge then again should be enriched with a social and political vision and knowledge, communication and action (with a global and a local point of view). Once again all this knowledge and these abilities need to be rounded up with a high human personal development to moderate, participate, integrate, accompany and lead successfully in a positive way.

Let's take the chance.

ECOLOGICAL NETWORKS: A SOCIETY APPROACH FOR BIODIVERSITY CONSERVATION

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ABSTRACT

The decline of nature in the last century has led to a major decline in biodiversity. One answer lies in the ecological network systems that have mitigated partly the decline of biodiversity and natural depletion. This paper discusses the development of the ecological networks at European level and the actual challenges for the future. The need for habitat connectivity systems is determined by species-specific factors, the landscape and land use. I conclude that the challenges for the future realization of ecological networks in Europe require three parallel initiatives: develop a better ecological knowledge, create political and social consensus and work on cooperation between policy sectors. Better ecological knowledge is the easiest element of this; much harder is it to develop consensus and cooperation as here social and political interests compete.

1 INTRODUCTION

In a large part of Europe structured development of urban and rural areas, landscape management, water management, road planning, agricultural development and conservation of natural areas have taken place for over hundred years. The main objective was to organise an efficient land use, which could fulfil all required functions in the most efficient way within a country.

“Environment” comprises in its broadest sense the totality of all factors that are of importance for living species and living communities. It refers to the social and psychological environment of man. It is necessary to take natural resources and their mutual relations in consideration in landscape planning. This implies also a close relationship between the use of natural resources, environmental management and spatial and landscape planning. Environmental conservation and environmental management include not only technical environmental protection such as air and water purification, but also the conservation of functional ecological systems and their variety in spatial forms in their totality. Environmental and landscape planning for safeguarding and development of natural resources are priority issues for national and regional authorities. The objective of spatial planning is to organise functions and space in such a way that it shows the best mutual relationship or, to develop human and natural potentials in a spatial framework in such a way, that all can develop as well as possible [1].

Although the objectives of nature conservation were agreed by society, it was the industrialisation in agriculture, the changes in landscape structure, the development of transport infrastructure and the development of larger conurbations that made nature and biodiversity deteriorate further. The declining quality of nature, the declining size of natural areas and the fragmentation were the pressures that caused the decline of biodiversity in both west and Eastern Europe [2, 3].

In this paper we deal with ecological network approaches that developed in Europe in the last forty years aiming for biodiversity conservation. The role of connectivity and connectedness in the modern fragmented European landscape is discussed. This leads to the

conclusion that these features should be included in conservation strategies in the structure of ecological networks. As in ecological networks biodiversity conservation is moving outside the reserved areas and claims conservation measures in the wider countryside involvement of other land users and their consent and understanding is essential. Therefore, implementation in relation to the spatial scale of ecological networks and the differences between countries in planning are shortly elaborated as well as the role of stakeholders. A logical consequence is the inclusion of public support.

2 CONNECTIVITY AND CONNECTEDNESS

Many species disperse through our landscapes and need islands and corridors to do so. Migration is a species or population's periodic movement typically of relatively long distance from one area to another to avoid unfavourable seasons or conditions [4]. Migration is a specification of dispersal, while it is targeted and has a direction. Routes for species migration consist of zones that are accessible for the species to move from one site to another and back. Migration routes can be manifold, from single wooded banks to small-scale landscapes and from river shores to whole rivers and coastlines. Migrating species are vulnerable in their lifecycle. They are not all year available to signal the importance of a site as a temporary habitat. European storks (*Ciconia ciconia*) for instance breed in large parts of Europe and they winter in Africa, migrating 10,000 km each season [5].

In the past many species have adapted to the cultural landscapes of Europe, because they were accessible and not hostile. Large areas with good living conditions that are always inhabited are defined as core areas for populations. In good reproductive years species will move from these areas into other – even marginal - sites [6]. Reduction in quality and size of the breeding area will cause a reduction of the populations that can survive and an increased risk of extinction, because of reduced dispersal between habitats, causing less exchange of genetic information and less colonisation of empty habitats.

Increasing traffic and intensifying agriculture made the European cultural landscape more difficult to cross for natural species. Forests and hedgerows disappeared in intensively used agricultural land, forests became uniform production forests, streams have been straightened and dammed and the road-network became asphalted, denser and more intensively used. Last but not least many large and important wetlands have been drained.

Plants and animals both disperse by wind, water or with help of other species or by own movements. Dispersal is essential in population survival and the functioning of biotopes. However, dispersal and migration can only function if there are sites to disperse from and to and means for dispersal. On the one hand animal species will leave a population if living conditions cannot support all individuals and on the other hand species will fill in gaps in populations or sites that are empty. Fluctuations in populations can cause changes in species abundance and species composition of a site. Birth, death, immigration and emigration are the main processes to regulate fluctuations at the population level and these depend on habitat quality, habitat size and connectivity and corridors.

Corridors may be continuous, linear [7] or interrupted as stepping stones [8]. The main functional aspect of in the landscape of importance for dispersal and migration and in this way in the persistence of populations is connectivity and connectedness [9]. Connectivity is a functional landscape parameter indicating the processes by which sub-populations of organisms are interconnected into a functional demographic unit. Connectedness refers to the structural links between elements of the spatial structure of a landscape. Structural parameters can be different from functional parameters. For some species connectivity is measured in the

single distance between sites, for other species it also has to include the structure of the landscape. The connectedness through hedgerows or streams includes the possibility of corridors and barriers.

Due to differences in need of migration corridors can be manifold, from single wooded banks to small-scale landscapes and from river shores to whole rivers and coastlines. For fish it means that rivers are not blocked by dams and of good water quality. For mammals and amphibians it means that routes are available and that man-made barriers can be crossed. These groups migrate over distances from several metres to hundreds of kilometres. For small mammals ecological corridors can be hedgerows, streams and all kind of other natural features that offer shelter.

3 THE STRUCTURE OF ECOLOGICAL NETWORKS

Ecological networks can be defined as systems of areas of high biodiversity value and their interconnections that make a fragmented natural system coherent to support more biological diversity than in non-connected form. An ecological network is composed of core areas, usually protected by buffer zones and connected through ecological corridors [10]. Core areas have mostly been identified by traditional nature conservation policies as National Parks or nature reserves. The fact that we acknowledge that species make use of landscapes makes it unavoidable that we integrate nature conservation in general land use policy and spatial planning. In this way ecological corridors and buffer zones are becoming key elements in nature conservation strategy, but also highly discussed elements as they are the landscape elements where several functions coincide and that might be conflicting with other land use functions.

The emphasis in ecological network planning is shifting from nature protection towards sustainable development for a region as a whole by integrating biodiversity issues. The observed change in thinking originates from the discourse in the international policy arena of the Convention on Biological Diversity, the World Summit on Sustainable Development and the Millennium Development Goals (MDGs), which perceive environment rather as making a contribution to sustainable development than as an intrinsic value to be protected from use. Following this, the CBD agreed to the Aichi targets, that also include the by 2020, at the latest, biodiversity values have been integrated into national and local development [11]. Implementation of these international agendas is increasingly guided by the ecosystem services approach. This approach can be regarded as a strategy for the management of land, water and living resources that promotes conservation and sustainable use of the services that biodiversity offers to society [12]

At the heart of the approach is the awareness that, without the effective and sustainable management of ecosystems, there can be no economic development that generates sustainable human and social welfare. Equally, without engagement of various sectors of economy and society in the management of ecosystems, there can be no effective biodiversity conservation. This shift in emphasis runs parallel with changing paradigms in protected area management that have moved from “strictly nature oriented” to “nature and people oriented” [13].

A consequence of perceiving an ecological network as a means towards sustainable development is the increasing number and diversity of stakeholders and land use interests that need to be incorporated in the design and management process. It is evident that the institutionalisation of such an approach change will greatly benefit from the overall support by stakeholders. Or as Bennett [14] puts it: *“No programme of the breath and ambition of an ecological network can achieve results without the active support of local communities and*

key stakeholders". In the USA and in several European countries Greenway Planning is emphasising social interests such as outdoor recreation with biodiversity conservation, building on the tradition of Greenbelt Planning and Parkway Planning (<http://www.aevv-egwa.org>) [15].

Connectivity and connectedness come together in the concept of ecological corridors. Ecological corridors can be defined functionally to indicate connectivity and as physical structures to indicate connectedness. They can be defined as functional connections enabling dispersal and migration of species that could be subject to local extinction (Bouwma et al 2002). As physical structures they also can be defined as various landscape structures, other than core areas, in size and shape varying from wide to narrow and from meandering to straight structures, which represent links that permeate the landscape, maintaining or re-establishing natural connectivity (Jongman 2004). Corridors can be classified into three or four classes according to the shape that they have: linear, stepping stone and landscape corridors (Figure 1).

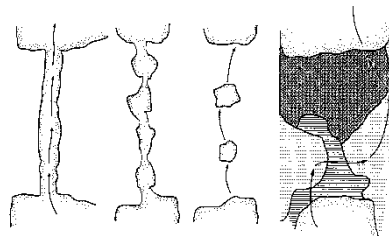


Figure 1: Different shapes of corridors: line corridors, line corridors with nodes, stepping stone corridor and landscape corridor [16]

As physical structures within an ecological network ecological corridors are multifunctional landscape structures. In Europe ecological corridors are often the result of human intervention in nature: hedgerows, stonewalls, landscapes with small forests, canals and rivers. Others such as coastlines and watercourses are predominantly natural. The nature of ecological corridors and their efficiency in interconnecting remnants and in permeating the landscape depend on the habitat site they originate from and the land use mosaic within which they are embedded in and of which they consist. Their density and spatial arrangement change according to the type of land use. Their connectivity function varies from high to low depending on their spatial arrangement, internal structure and management.

Ecological corridors are multifunctional in both ecological and societal sense, because they are not the core areas of a nature conservation system but function in the wider landscape. They can also be part of 'greenways' that exist in many parts of Europe, sometimes under different names [17,18]. They can be as wide as a watershed or as narrow as a trail.

Corridors, if designed wrongly, also can have negative influence such as the breaking of isolation that is needed for certain species, exposing populations to more competitive species, the possibility of spreading of diseases, exotic species, and weeds, disrupting local adaptations, facilitating spread of fire and abiotic disturbances and disruption of local adaptations [19]. Beier and Noss [20] stipulate that based on empirical research ecological corridors to maintain biodiversity are valuable conservation tools. Not maintaining or re-establishing ecological corridors would mean that mankind neglects the last remnants of natural connectivity and in this way could harm its own nature conservation objectives. Moreover, nowadays practice shows that transport by man are much more important for

spreading species and diseases as showed the foot and mouth disease outbreaks in Europe in 2001 and 2007.

Finally a network can be hampered by all kind of barriers. Natural barriers do exist at all levels and are important to prevent problems with invasive species. Mountains and rivers can be barriers for mammals and agricultural roads can already be barriers for insects and spiders [21]. Designing corridors is important to overcome modern barriers for nature such as roads, open agricultural landscapes and dams. (Figure 2).



Figure 2: Fish ladder in one of the headwaters of the Tweed (Scotland) for migration of Salmon
(Photo Rob Jongman)

4 HIERARCHY OF ECOLOGICAL NETWORKS

Ecological networks are effectively implemented at the landscape level; they reflect the complexity of pattern and processes in the landscape. This means that between the Pan European Ecological Network (PEEN) [22] and its local application several levels of planning can be identified with applications for different purposes. Four levels can be identified [23]:

1. mega-scale: very large natural core areas ($>10000 \text{ km}^2$),
2. macro-scale: large natural core areas ($>1000 \text{ km}^2$) connected with wide corridors or stepping stone elements (width $>10 \text{ km}$);
3. meso-scale: medium size core areas ($10\text{-}1000 \text{ km}^2$) and connecting corridors between these areas (width $0,1\text{-}10 \text{ km}$);
4. micro-scale: habitats, woodlots, wetlands, grassland patches, ponds ($<10 \text{ km}^2$) and connecting corridors (width $<0,1 \text{ km}$).

Mega-scale ecological networks can be considered at global level. The Human Footprint Map [24] can serve as a base for determining global ecological networks. The macro-scale of ecological networks is represented by macro-regional-level plans such as PEEN maps [25], the wildlands project [26], or national-level projects within larger countries such as Russia [27]. Most of the projects at this level are used as guiding principles or visions for the future. This macro level can be defined as the (sub) continental level.

Landscape-level ecological networks are designed and implemented in a wide spatial scale range, from macro- and meso- to micro-scale projects. At the meso- scale most significant planning of ecological networks has been carried out. Likewise, the most detailed analysis and implementation schemes have been established at micro-scale (Figure 3, 4). The challenge of the ecological network approach is to integrate ecological principles, biodiversity, and landscape conservation requirements into spatial planning as well as into implementation.

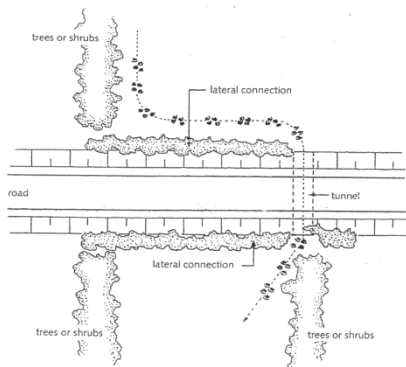


Figure 3 Design of a road crossing and landscape structure for a badger (*Meles meles*) [28]



Figure 4 Badger tunnel realised in a road project (Photo Rob Jongman)

5 ECOLOGICAL NETWORKS ACROSS BORDERS

Important processes in European landscapes are homogenisation and fragmentation of traditional landscapes [29]. The European landscape is fragmenting and many species in the small-scale cultural landscapes of Europe are especially sensitive to land use change and changes in landscape structure. The recognition of the existence of fluxes of matter and minerals, population dynamics and genetic exchange on the one hand and compensation of land use that is not compatible with it on the other are the main considerations as arguments for development of ecological networks. Especially administrative borders (national, regional) can be a cause for fragmentation, because plans and priorities are set within administrative borders and mostly not across. Ecological networks require landscape planning across borders.

The responsibility for landscape and spatial planning is organised rather differently over Europe and therefore the development of ecological networks is different. In many cases functions and tasks are divided over several ministries and many other agencies depending on the state organisation. Different views are being developed depending on institutionalisation, scientific tradition and history.

In Germany and Austria landscape planning plays a decisive role as a tool for structuring and maintaining the diversity of the rural areas: its multifunctionality. In other countries nature conservation and landscape planning are strongly integrated (Czech Republic, Slovak Republic) because of the recognition of the relation between them in their cultural landscapes. In countries in southern Europe the need for planning was felt less strongly or at least the execution of planning ideas was less strict. Partly this is due to a lack of vertical co-ordination between municipalities, provinces, regions and the national level.

In all Europe habitats were becoming increasingly fragmented due to economic development. The concept of ecological networks is the translation of landscape ecological knowledge on fragmentation processes and its consequences for populations of natural species. It tries to mitigate the decline of natural species in fragmented landscapes and to overcome the fact that for many natural species the existing nature reserves and National Parks are too small. The concept has become implicit in a variety of international conventions (Ramsar convention, Bern Convention), European directives (Habitats and Birds Directives) and related EU policy implementation (Natura 2000). It has become operational in national and European strategies of developing national and regional ecological networks, and in the Pan European Ecological Network – PEEN, that is the core of the Pan European Biological and Landscape Diversity Strategy – (PEBLDS) [30].

6 ECOLOGICAL NETWORKS AND ITS STAKEHOLDERS

Plans for the further development of ecological networks are ambitious. The 5th Ministerial Conference “Environment of Europe” concluded that “*by 2008, all core areas of the Pan-European Ecological Network will be adequately conserved and the Pan European Ecological Network will give guidance to all major national, regional and international land use and planning policies as well as to the operations of relevant economic and financial sectors*”. It is obvious that these targets have not been met and that they will not be met without the active cooperation of relevant land use sectors such as agriculture and forestry, and local and regional planning authorities. These targets can only be realised in partnerships between the conservation sector (government and NGO) and the various stakeholders involved. In 2007 at least the vision and the collective ideas have been realised and implementation is an on-going process [31].

The implementation of ecological networks can only be carried out if the cooperation between neighbouring countries and between sectors is realized. This is the biggest challenge, because it required engagement of the whole society and especially politicians. That's not easy, because it asks for long-term commitment. It is possible, as experience shows in the last ten years in the Netherlands, but also vulnerable, as the political changes haven't demonstrated in the Netherlands in the last two years.

7 CONCLUSION

Two important principles have to be united. The approach, and the resulting ecological network, must allow integration of environmental issues with socio-economic functions of the landscape and the acceptance of the landowners and consumers of the landscape. The approach taken must also provide an identifiable product on which the varied skills, knowledge and attitudes of stakeholders can focus. This means that not only the top down planning approach is important, but that realisation and implementation depend on the bottom up approach of involving stakeholders, both from the field of biodiversity conservation and other sectors of society.

We need visionary people, who are able to use of the opportunities at the right moment, push the development and are able to work on the relationship between the European and the national ecological network systems. This is necessary if in the future nature has to cope with climate change and fits into an economically evolving Europe.

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GREEN BELT EUROPE – STRUCTURE OF THE INITIATIVE AND SIGNIFICANCE FOR A PAN EUROPEAN ECOLOGICAL NETWORK

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ABSTRACT

In the remoteness of the Iron Curtain a “Green Belt” of valuable pristine landscapes developed through Europe from the Barents to the Black Sea. Today the Green Belt Europe connects a large number of valuable areas in the sense of European nature conservation; it is a cross section of all European biogeographical regions and could be developed as part of a European Green Infrastructure and backbone of a Pan-European ecological network. Furthermore the Green Belt is an outstanding memorial landscape of European relevancy with a great potential for trans-boundary cooperation, sustainable regional development, the support of understanding among nations and the merging of Europe. The initiative Green Belt is a geopolitical challenge and change; it connects 24 European countries and stakeholders from the local to the international level from governmental and non-governmental organizations.

1 INTRODUCTION – FROM DEATH ZONE TO LIFE LINE

‘Nature knows no boundaries’ is an often stated truism, but absolutely pertinent in Europe with its densely packed political borders which frequently follow natural features such as mountain ranges or river systems. Regarding the European Green Belt, nature does not only know no boundaries, nature is uniting across borders: people, organizations and states, large pristine areas through the continent, animal and plant populations as well as Europe’s history and future.

Along the former Iron Curtain, which separated the continent in East and West for nearly 40 years, an outstanding ecological network and living memorial landscape developed. Despite its brutal inhumanity, the Iron Curtain granted nature a pause for breath along more than 12,500 kilometres from the Barents Sea at the Russian-Norwegian border, along the Baltic Coast, through Central Europe and the Balkans to the Black Sea.

A lack of conventional land use and agriculture as well as the absence of most human-made disturbances along large parts of the Iron Curtain and also in its surrounding led to the conservation and development of large pristine areas and a connected system of various nature related habitats and landscapes. In the former Eastern Bloc countries the utilization of border land was mostly prohibited [1], in some areas villages at the border were raised to the ground and people were forcefully settled down in the inland, whereas on the western side remote border areas were less attractive for investors, sparsely populated and no major infrastructure was needed.



Figure 1: The Green Belt Europe connects 24 European countries and a great number of pristine and nature related landscapes like the Thaya valley (trans-boundary national park Czech Republic, Austria). Map: BUND-Project Office Green Belt; Picture: Christian Übl.

2 BACKGROUND OF THE INITIATIVE

Unwittingly the Iron Curtain supported the conservation and development of valuable habitats and therefore served as a retreat for many endangered species. The richness of nature related habitats became obvious long before its fall. Years before the breakdown of the Iron Curtain, conservationists in several areas of Europe draw their attention to the flourishing nature and wildlife proliferated undisturbed. Therefore the establishing of the European Green Belt initiative was more or less a merging of different existing regional initiatives to a European one.

In the year 2002 BUND (Friends of the Earth Germany) firstly suggested the creation of a Green Belt all along the former Iron Curtain. It succeeded to bring together the different approaches by implementing first conferences on the European Green Belt supported and organised by the German Federal Agency for Nature Conservation (BfN) and the World Conservation Union (IUCN) in 2003 and 2004 [1]. The three main origins of the European Green Belt initiative are - from north to south - the activities along the Fennoscandian Green Belt, the German Green Belt and along the Green Belt in the Balkans.

2.1 Fennoscandian Green Belt

Already in 1970 satellite pictures showed a dark green belt of old-growth forest on the Finnish-Russian border. Nature conservation cooperation between Finland and the Soviet Union started in the 1970s when a scientific-technical cooperation agreement was signed [2]. Furthermore a joint Finnish-Russian working group on nature conservation was founded, which led to the successive establishment of a series of twin parks along the border in the mid-1980s. An inventory project on border forests conducted from 1992 to 1994 showed the ecological value of this border area with regards to ecosystems and species in the boreal forest zone and led to the idea of establishing a network of separate protected areas on each side of the border. In this connection it was firstly discussed to develop a Fennoscandian Green Belt covering also the border of Norway and Russia [2]. Core of this Fennoscandian Green Belt

are the large and many nature reserves along the border (see figure 2). The concept of the Fennoscandian Green Belt includes also a joint environment policy in the border area [3].

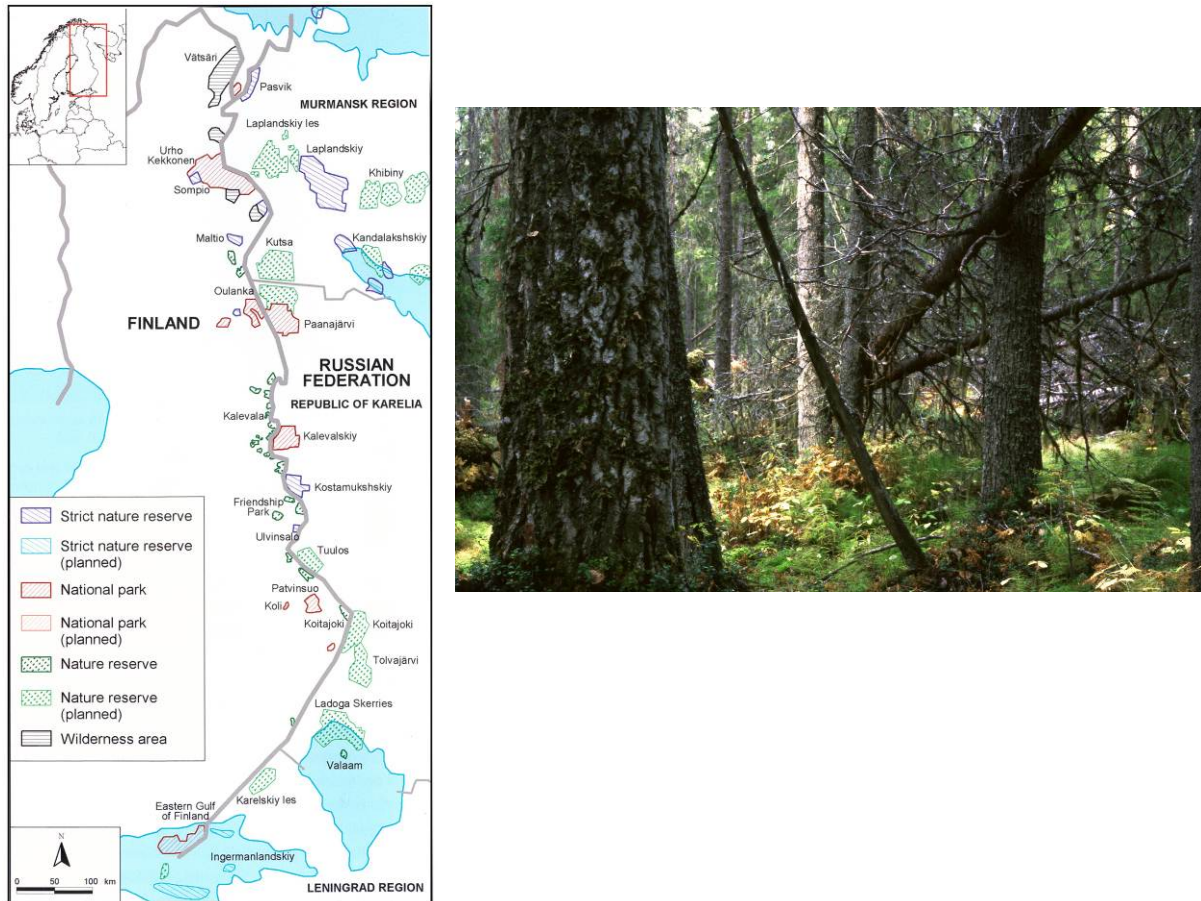


Figure 2: Existing and planned nature reserves along the Fennoscandian Green Belt [4] (map left). E. g. the Kalevalskiy national park (right) in Russia is one of the last European primeval forests and retreat for species like Wolf (*Canis lupus*), Brown Bear (*Ursus arctos*), Eurasian Eagle-Owl (*Bubo bubo*) and Three-toed Woodpecker (*Picoides tridactylus*). Picture: Riitta Nykänen.

The Fennoscandian Green Belt is a mosaic of forests, bogs and lakes; it covers a wide range of ecosystems from the Arctic tundra on the Barents Sea coast to mixed broad-leaf forests covering the islands in the Gulf of Finland. The largest part is northern coniferous forest, known as the boreal zone. The area comprises also last tracts of old-growth taiga in the European part of the continent and highly interesting geological structures and relief as part of the ancient Baltic crystalline shield. The Fennoscandian Green Belt contains the last large massifs of old-growth taiga typical for Fennoscandia, which mainly consist of dry pine forests [5].

Because of the large pristine areas and forests, the Green Belt of Fennoscandia serves as a retreat for several large and endangered carnivores like Wolverine (*Gulo gulo*), the Eurasian Lynx (*Lynx lynx*), Wolf (*Canis lupus*) and Brown Bear (*Ursus arctos*). Large carnivores are an indicator group of animals which has been carefully studied for decades and shows the high value of the Fennoscandian Green Belt [4].

2.2 Green Belt Germany

The border fortifications of the Iron Curtain were most strongly expressed in the former divided Germany. The GDR (German Democratic Republic) used 3,000 kilometres of fences, 200 kilometres of walls, 800 kilometres of anti-vehicle ditches, 1,800 kilometres of patrol routes 850 watchtowers, 1.2 million tons of concrete and 700,000 tons of iron, land mines and spring guns to “secure” their border to West-Germany.

First observations of the border areas, only possible from the western site, from 1975 on and a systematic ornithological survey in 1979 on a stretch of 140 kilometres along the inner-German border conducted by young conservationists of Bund Naturschutz (BN), the Bavarian branch of BUND, showed the richness of biodiversity. The ornithological survey covered the immediate border zone to Thuringia (GDR) and large areas of adjacent farmlands in Bavaria for comparison [6]. 90% of the recorded, highly endangered bird species like Whinchat (*Saxicola rubetra*), Red-Backed Shrike (*Lanius collurio*), European Nightjar (*Caprimulgus europaeus*) and Woodlark (*Lullula arborea*) preferred to breed inside the border strip [7]. Since then, it was clear, that the inhuman border line had developed to a last retreat for species avoiding intensively used agrarian areas. Further activities followed, e. g. first land purchases at the western side of the border by BN and attempts to get in contact with conservationists from the eastern side [8].

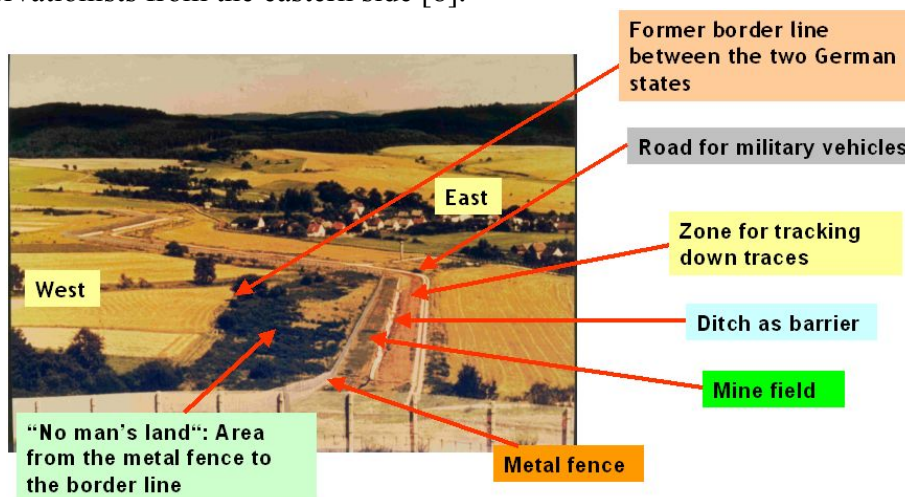


Figure 3: Structural components in the former border zone between the two German states. The Core area of the Green Belt Germany is the former “no mans land”, the upstream territory of the GDR lying west to the metal fence. Here, habitats could develop nearly undisturbed for decades. Picture: Bundesarchiv/BUND-Project Office Green Belt.

The Iron Curtain fell in 1989. One month after the Berlin Wall was officially opened; BUND organized the first meeting of nature conservationists from East and West Germany. The approximately 400 participations of the meeting passed a resolution that requested priority protection as a “Green Belt” – an ecological backbone of Central Europe - for the border strip between the Federal Republic of Germany (FRG) and the German Democratic Republic (GDR) [6]. Thus, the Green Belt Germany-project was born. Right from the start, it was not only Germany’s first nationwide nature conservation project but also a living memorial to recent German history. The first years of the Green Belt in Germany were marked by a positive interest by the media, environment politicians, who took up the idea, and committed nature conservation authorities in the new states (the former GDR-countries), who

designated nature reserves along the former Iron Curtain. But these times were also characterized by rapid intervention and destruction of valuable areas. E. g. habitats that had been unused for decades were ploughed up in a few days mostly by Western farmers. Not until 2001 a decisive breakthrough came when the German Federal Agency for Nature Conservation (BfN) together with BUND carried out a habitat survey of the entire former inner-German border line.

The results proved that the Green Belt is of high value for German nature conservation. The survey identified 109 different habitat types along the 1,393 kilometres long and 17,656 hectares wide central Green Belt Germany between the former borderline of FRG and GDR and the road for military vehicles (see figure 3). 60% of the Green Belt Germany consists of streams, rivers and inland waters, various types of forest, extensively exploited mesophilic grassland, unused fallow land and species-rich moist and wet grasslands. Half of the area consists of endangered habitat types of the Red List for Germany, e.g. xerophilic grassland, moors and wetlands, semi-natural riparian zones and alluvial forests. At the same time, 85 % of the area and 80 % of the length may be regarded as intact [9].



Figure 4: In intensively used agricultural areas like Germany, the Green Belt is irreplaceable as ecological network and often last retreat for endangered species like the Whinchat (*Saxicola rubetra*). Green Belt between Thuringia and Hesse near the village Obersuhl (left). Pictures: Klaus Leidorf and BN-Archive.

The Green Belt Germany is a backbone of a nationwide ecological network. There are 150 nature conservation areas along the Green Belt, most created after 1989, and further 125 conservation areas in the vicinity. If the 150 conservation areas directly to the Green Belt are included, the ecological network increases 12.5 times to 2,232 square kilometres [10], which is nearly the size of the German federal state Saarland. In the long run, it is the aim to protect and develop not only the partly narrow central German Green Belt as ‘backbone’ of the ecological network but also adjacent conservation and nature-related areas as ‘ribs’ to both sides.

2.3 Balkan Green Belt

In South-Eastern Europe the Iron Curtain separated several countries, not just the two political blocs. Yugoslavia was not part of the Eastern Bloc and people were allowed to travel. The border between the former Yugoslavia and Greece was heavily controlled and

only a few border crossings were open. Albania closed its borders and was isolated from the rest of Europe since the early 1970s. This special situation led to the fact, that on the Balkan Peninsula the Green Belt follows not only the borders of the Eastern Bloc, but also those of Albania and former Yugoslavia forming a “Y” from the Danube to the Mediterranean and the Black Sea. As in other parts of the Green Belt these borders largely preserved nature from human activities [11]. After the collapse of communism also on the Balkan Peninsula, the European Nature Heritage Fund (EuroNatur) began building support among governmental and non-governmental organizations in the early 1990s, with the aim of protecting transboundary areas of high ecological value [1].

From the Pannonian Plain to the Mediterranean and Black Sea coast, the Balkan Green Belt forms an extremely heterogeneous, but mostly natural corridor. Alluvial wetlands, steppe areas, mountains, lakes and nature related cultural landscapes form a unique mosaic of valuable habitats. Along the Balkan Green Belt different valuable habitats are connected, for example in the centre of the Balkan Peninsula, mountain national parks are linked with the protected Lakes Prespa and Ohrid (Albania, FYR Macedonia, Greece). On the coast, marine habitats such as beaches and lagoons are interrelated with the freshwater ecosystem of Lake Skadar (Montenegro, Albania) or the alluvial wetlands of the Evros-Meric River (Greece, Bulgaria, Turkey). Although many wetlands are situated at the border, the biggest part of the Balkan Green Belt is formed by mountain chain and forest complexes. No large towns or industrial zones are located along the formerly strictly controlled border. The range offers excellent opportunities for the establishment of large-scale protected areas [11].

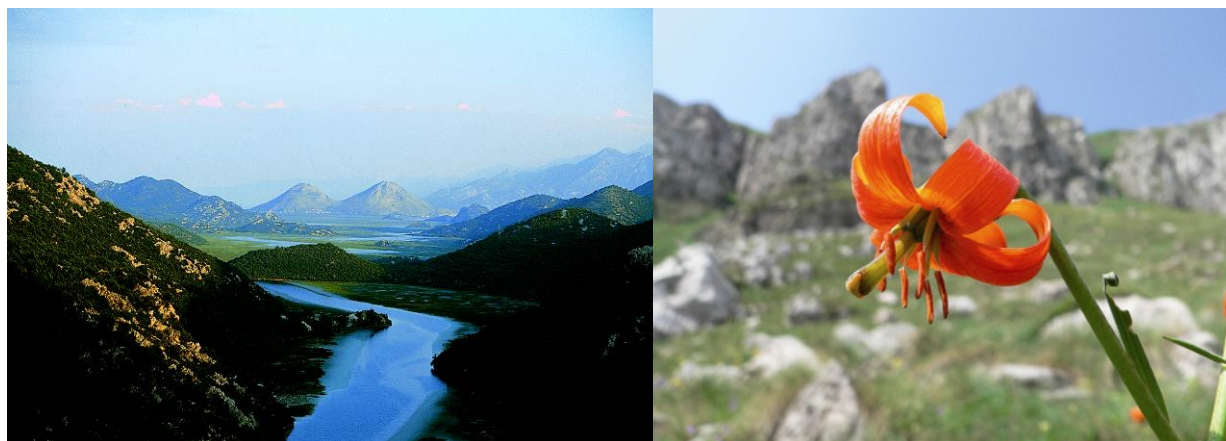


Figure 5: Lake Skutari (Motenegro, Albania) is one of the last not regulated lakes in Europe and situated along the Balkan Green Belt (left). The Chalcedonian Lily (*Lilium chalcedonicum*) in the Jablanica Mountains (Albania, FYR Macedonia) is one of the many endemic species along the Balkan Green Belt. Pictures: EuroNatur.

The Balkan Green Belt is part of an extensive connected habitat system and forms an important ecological corridor. It is a retreat for numerous rare species like Dalmatian Pelican (*Pelecanus crispus*), Imperial Eagle (*Aquila heliaca*) and Balkan Lynx (*Lynx lynx balcanicus*) [12].

3 TRANS-BOUNDARY NETWORK AND COOPERATION

During the international conference “Perspectives of the Green Belt” in Bonn (Germany) conducted by the German Federal Agency for Nature Conservation (BfN) in July

2003, the vision of a Green Belt through Europe was officially discussed for the first time. A very big step for the Green Belt Europe was the international conference in Hungary in September 2004. The World Conservation Union (IUCN) and BfN jointly organised a conference that took place in the trans-boundary protected area of the Fertő-Hanság National Park in Hungary. Over 70 participants from 17 countries attended the conference. The two main outcomes of this conference were a common structure for the coordination of the Initiative and a Programme of Work (PoW).

Today a huge number of associations, groups and authorities in 24 countries are working within the European Green Belt initiative. Currently there are three distinct areas of activity: The Fennoscandian Green Belt, with Norway, Finland, the Russian Federation and the Baltic countries Estonia, Latvia and Lithuania. The Green Belt Central Europe; running through Poland, Germany, Czech Republic, Austria, Slovakia, Hungary, Slovenia, Croatia and Italy. The Balkan Green Belt; running along the barrier that separated the Balkan countries - Serbia, Montenegro, Kosovo, FYR Macedonia, Romania, Bulgaria, Albania, Greece, Turkey -, ending at the Black Sea. The three main regions are attended by Regional Coordinators: The Association of Zapovedniks and National Parks in Northwest Russia for Fennoscandia, BUND for Central Europe and EuroNatur for the Balkan region. IUCN took over the patronage of the initiative. Furthermore, in every country so called National Focal Points, mainly from ministries, are persons in charge.

The European Green Belt connects 15 EU-countries, three candidate countries, four potential candidates and with Russia and Norway two non EU countries, the initiative is an outstanding chance of geopolitical, ecopolitical and cultural relevancy for the EU. The initiative offers outstanding possibilities for trans-border cooperation between states and regions as well as for the establishment of sustainable regional development, especially through ecotourism, considering the outstanding connection of nature, culture and history as a unique selling proposition and competitive advantage particularly of structurally weak areas along the Green Belt. The great potential of this initiative for the historical documentation and clarification of the Cold War as well as for the merging of old and new EU-member states, candidate countries, potential EU-candidates and non-EU-countries is obvious.

In addition to the numerous local trans-boundary nature conservation, environmental education and nature-tourism projects along the Green Belt, there are currently two EU-funded projects covering large parts of the European Green Belt. The Baltic Green Belt project (January 2009 - January 2012, www.balticgreenbelt.net) with 22 partners (13 partners and 9 associated partners) from Germany, Poland, Russia, Lithuania, Latvia, Estonia and Sweden (Coalition Clean Baltic) supported within the Baltic Sea Region Programme and the project GreenNet (April 2011 - March 2014, www.greenet-project.eu) with 22 Project partners (thereof 11 associated partners) from Czech Republic, Germany, Austria, Slovakia, Slovenia and Italy, supported within the Central Europe Programme.

4 CHANCE AND CHALLENGE FOR EUROPEAN NATURE CONSERVATION

The outstanding importance of the Green Belt Europe for the European ecological network is apparent because of the conspicuous accumulation of large scale nature reserves along the 12,500 kilometre of the former Iron Curtain: 39 national parks are situated directly along the Green Belt, 16 thereof are trans-boundary national parks. More than 3,200 nature protected areas can be found within a 25 kilometres buffer on either side of the Green Belt [13]. Furthermore, this ecological network connects all European biogeographical regions

[14]. The European Green Belt is a retreat for many endangered and rare habitats as well as animals and plants and a very important corridor for the migration of endangered large mammals. Therefor it represents a unique European nature heritage.

The implementation of the Green Belt Europe as one of the largest European and trans-boundary ecological networks is one of the main challenges of European nature conservation in the next decades. The existing nature reserves and pristine landscapes should be conserved as core areas and the landscapes next to and between these areas must be developed as stepping stones for species. In this way, the European Green Belt contributes to the implementation of the Convention on Biological Diversity (CBD) and Natura 2000 (EU Habitats Directive 92/43/EWG). Furthermore the European Green Belt will contribute to the implementation of the six main aims of the EU-Biodiversity Strategy for 2020 [15].



Figure 6: The European Green Belt is in some parts the last retreat and indispensable migration corridor for big mammals like Brown Bear (*Ursus arctos*) and European Lynx (*Lynx lynx*). Pictures: Hofrichter and GEO-Biodiversity Day 2003.

The importance of the Green Belt in combination with other large scale ecological networks, like the Alpine-Carpathian network or the ecological network along the Rhine river, is described within the study of the Leibniz Institute for ecological spatial planning [16] and the report by EEB (European Environmental Bureau) [17]. The mentioned large scale ecological networks do not only support trans-boundary cooperation, anyhow they are a chance to halt the loss of biodiversity at least in parts.

5 CONCLUSIONS

The further protection and development of the Green Belt Europe as Pan-European ecological network and historical heritage is a big challenge for the next decades. Therefore the EU is asked to support the Green Belt, referring to target 2 of the EU-Strategy on Biological Diversity [15]. To achieve these objectives, further trans-boundary projects have to be supported by the European countries as well as by the EU also including EU-candidates and non EU-countries. Regarding the EU-level, this requires a special priority to preserve and support the ecosystem function of the European Green Belt in currently implemented and future infrastructure projects; as well as the trans-boundary harmonization of conservation area management, the closing of gaps within the ecological network and the establishment of additional trans-boundary protected areas as core areas and buffer zones. Also an adaption of the EU-subsidy policy is urgently necessary; e.g. the comprehensive coordination and restriction of biomass production and industrial agriculture, which currently endangers the

ecological network of the Green Belt and its unique landscapes. Instead, a support of ecological land use and sustainable regional development along the Green Belt is needed.

Above its uncountable value for nature conservation, the European Green Belt is also a European cultural heritage of invaluable asset. It is both a commemorative landscape and a living monument for the overcoming of the Iron Curtain and the Cold War just as it is a symbol for the overcoming of the separation of Europe. Therefore the long-term objective is to nominate the European Green Belt as UNESCO (natural and cultural) World Heritage.

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THE GERMAN GREEN BELT AS BACKBONE OF THE NATIONAL ECOLOGICAL NETWORK

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ABSTRACT

Since 2002 there is a legal obligation in Germany to implement a national ecological network on at least 10 % of the national territory. Already in 2001 a working group consisting of experts from the German Federal States (Bundesländer) and the German Federal Agency for Nature Conservation started to develop criteria to identify the core areas and corridors of this network. In three scientific studies these criteria have been applied to identify these components based on available field data covering the entire German territory. The area of the German Green Belt had been mapped during 2001 and 2002. Based on these results it can clearly be shown that the Green Belt fulfills the defined criteria for being a 'site of national importance for the ecological network' and that in some parts it is the only remaining natural structure in the countryside. Therefore the German Green Belt is an important backbone of the national ecological network.

1 INTRODUCTION

Since 2002 there is a legal obligation in Germany to implement an ecological network on at least 10 % of the national territory (Article 20 of the National Nature Conservation Act of 2009). Article 21 states that the objectives of this network are the general protection of all indigenous species and their habitats as well as the conservation of ecological interactions and exchange processes in the landscape. It shall also contribute to the coherence of the Natura 2000 network in Germany. Furthermore the components of this network have to be legally protected. Already in 2001 a working group consisting of experts from the German Federal Agency for Nature Conservation (BfN) and the respective institutions of the German Federal States (Bundesländer) was implemented to develop common criteria for the identification of components of a national ecological network and to design guidelines for the implementation of this network [1]. Main criteria for the identification of 'sites of national importance for the ecological network' are the quality of areas (inter alia: size), the natural characteristics, the integrity of consisting habitat complexes, the degree of fragmentation as well as the occurrence of target species [2, 3].

The German Green Belt is considered to be a major component of the national ecological network. But can this hypothesis be verified or is it just wishful thinking by nature conservationists involved and engaged in the protection of the Green Belt? In the first part of this paper a brief overview will be given on existing data on the national ecological network as well as the implementation of the legal obligations resulting from the German nature conservation law. In the second part the possible function of the Green Belt as part of the German national ecological network will be analyzed using available information and the common criteria developed for the implementation of the national ecological network.

2 RESULTS

2.1 National Implementation of an ecological network

Based on the criteria mentioned above core areas of national relevance have been identified by Fuchs et al. in 2007 [4].

Main results of this study were maps on the core areas of a national ecological network of open landscape habitats, forest habitats and rivers. In total 21,321 km² amounting for 6.2 % of the total national territory can be considered ecological network areas of national relevance (Fig. 1). This study also offers an overview on areas with a deficit of core areas on a national scale.



Figure 1: Core areas with national relevance for an ecological network in Germany (Status: July 2010 [5, modified])

Additionally search areas for ecological corridors for wet and dry open landscape habitats as well as forest habitats have been determined by means of a GIS based method (HABITAT-NET) [6, 7]. Search areas for ecological corridors were identified by a modified least distance method using all suitable mapped biotopes and avoiding urbanized areas. This method allows for a cartographical presentation of significant spatial-functional relations on a landscape scale. Although these search areas cannot be used for a precise planning of

ecological corridors they can nevertheless serve as major planning aids in identifying these corridors.

In a final step national ecological corridors of moist/wet as well as of dry/nutrient poor open landscape habitats were subsequently derived from these search areas. In this process the potential for respective habitat restoration and development was accounted for by using a simplified map of the potential natural vegetation [5 based on data from 8]. Thus corridors were derived that connect the major core areas of the respective habitat complexes. These corridors represent an abstract visualization of the major axes of ecological connectivity in Germany (see Fig. 2 for open landscape habitats).



Figure 2: National ecological network of moist/wet as well as dry/nutrient poor open landscape habitats (Status: July 2010 [5, modified])

2.2 The German Green Belt as part of the national ecological network

Over the last decades a strip of mostly valuable habitats has developed in the area of the former ‘Iron Curtain’, which formed the inhumane border between East and West in Europe. This Green Belt harbours a lot of endangered species and ecosystems. The German part of the

Green Belt has a total length of 1,393 km and covers an area of some 177 km². It spans from the Baltic Sea to the Saxon-Bavarian-Czech border triangle. On its way it touches nine federal states, 38 administrative districts and two independent cities. The Green Belt covers all major landscape types in Germany except the alpine region. Due to its integrity and linear character it connects many large natural landscapes. In some regions the Green Belt forms the last remaining natural or near natural structure of any relevance within the countryside (Fig. 3).



Figure 3: Core areas with national relevance for an ecological network in Germany. Detail from figure 1 showing the German Green Belt along the Border between Lower Saxony and Saxony-Anhalt. Red arrows indicate areas in which the Green Belt is the only structure of national importance for the national ecological network. Legend see figure 1 (Status: July 2010 [5, modified])

It often represents the most important retreat for endangered species in these landscapes. Different habitat types occur tightly interweaved within the Green Belt. This results in its high diversity in structure and species. Over 600 animal and plant species from the Red Data Book have made their homes in the Green Belt [9]. The Green Belt also connects many large areas of high nature conservational value that serve as core areas in a national ecological network (Fig. 1). A habitat mapping project carried out in 2001 demonstrated that about 85 % of the area of the German Green Belt had not yet been degraded at that time. Only around 11 % of the Green Belt had until then been converted into intensively used arable land and grassland. Another 2.4 % had been destroyed by traffic infrastructure, buildings and settlements [9].

Just looking at these results and its general shape and extend the Green Belt can already be expected to fulfil the function as a backbone for an ecological network of national and European importance.

But does the Green Belt also fulfil the general criteria defined by Burkhardt et al. [1]? For the identification of ‘sites of national importance for the ecological network’ three criteria have been defined. They are very pragmatic and based on the knowledge of nation-wide available data like the results of the habitat mapping projects of the German Federal States (Bundesländer) or distribution maps of target species. A detailed analysis of species habitat requirements is not used in this process [1]. Each criterion has three categories: ‘national importance’, ‘supra-regional importance¹’ and ‘regional importance²’.

¹ importance for one federal state

The most important criterion is ‘quality of sites’. Although there are already some gaps in the Green Belt we considered it a single site in this paper. The first sub-criterion is ‘surface area’. To be in ‘very good condition’ a valuable forest site has to exceed 50 km² and in the case of open ecosystems including mixed open and forested habitats it has to exceed 10 km². In most parts the Green Belt features a mixed landscape character. The Green Belt is nearly 18 times larger than the required minimum size and therefore meets this benchmark. Even if the gaps already existing are taken into account, the Green Belt still meets the size criterion. This remains also true if the Green Belt would merely consist of forests: it would still be more than three times larger as the specified minimum area benchmark.

The remaining sub-criteria are more difficult to apply because they are not defined quantitatively. But since applying the sub-criterion ‘surface area’ already results in a ‘very good condition’, the Green Belt only has to be in ‘good condition’ for the fourth sub criterion ‘coherence’ (for details see [1], pp 26-29.). To meet this category a site has to have large unfragmented core areas or the disturbing structures have to be of low overall impact. Looking at the results from mapping projects [10] and aerial pictures, which are available in our agency for the entire area of the Green Belt and in three time cuts, it is obvious that it falls into this category. Therefore applying the ‘quality’ criterion the Green Belt can be considered a site of ‘national importance’ for the ecological network.

The second criterion is ‘spatial position in the landscape’. To fulfil this criterion a site has to be part of an obvious corridor of national importance. The Green Belt itself forms a corridor of nearly 1.400 km. Additionally it is very well connected to corridors of the national ecological network of moist/wet and dry/nutrient poor open landscape habitats (Fig. 2). Therefore it is indisputable fulfilling this criterion, too.

The third criterion is the ‘occurrence of (viable populations of) target species for habitat connectivity’. This criterion is a supplemental one, which only applies if a site is of minor importance according to criteria one or two. Although the Green Belt already fulfills the requirements for a site of national importance for a national ecological network applying criteria one and two, we will nevertheless have a brief look at the Green Belt situation of target species. At least the following target species have already been reported for the Green Belt: beaver (*Castor fiber*) e.g. Elbe floodplains, lynx (*Lynx lynx*) e.g. Harz Mountains, European otter (*Lutra lutra*) several smaller rivers, different bat species, stork (*Ciconia ciconia*) e.g. Elbe marshes, red kite (*Milvus milvus*) several parts of the Green Belt. That means, that the Green Belt easily also fulfils this supplemental criterion.

3 CONCLUSIONS

In total the German Green Belt meets the criteria for being considered a ‘site of national importance’ for the national ecological network. Additionally it is itself shaped as a corridor which crosses Germany from north to south for nearly 1.400 km and is well connected especially to the corridors of national importance of moist/wet and dry/nutrient poor open landscape habitats. In addition to those remaining big rivers valleys still functioning as part of the ecological network (Elbe, Oder, Danube) the Green Belt is one of the largest and most important backbones of the national network. On the other hand there are already some major gaps in the Green Belt. To preserve its function there is a strong requirement to limit further destructions and to raise the quality of the habitats as far as necessary. Furthermore efforts

² importance for parts of a federal state resp. a county

should be undertaken to close the existing gaps again. Wherever this is not possible, bypass solutions should be discussed.

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THE GREEN BELT IN THURINGIA – A VISIONARY IDEA

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THE GREEN BELT IN THURINGIA – A VISIONARY IDEA

The Green Belt in Thuringia follows the historically significant course of the former border between East and West Germany. Totalling 763 km, the stretch of the Green Belt in Thuringia is the longest in Germany. By comparison, 112 km of the Green Belt pass through Lower Saxony, 270 km through Hessen and 381 km through Bavaria.

The key to the success of the Green Belt lies in convincing people of its worth. Broad acceptance among local residents is crucial to realising the project objectives. It was important to communicate to former landowners and farmers in Thuringia, Bavaria, Hessen and Lower Saxony, who in the past were subject to severe restrictions that the restructuring measures are a positive developmental initiative and not a further expropriation of their property.

MISSION STATEMENT FOR THE THURINGIAN SECTION OF THE GREEN BELT

The government of the Free State of Thuringia recognizes its vital role and began developing a Mission Statement for the Thuringian section of the Green Belt as far back as 1998. Working together with relevant stakeholders and parties involved in the project, the Thuringian authorities formulated a set of clearly defined objectives as a basis for a shared policy that takes into account the many different interests.

The Mission Statement for the Thuringian Green Belt declares that:

- Nature within the Green Belt must have utmost priority. This unique natural habitat must be preserved and its on-going development ensured.
- The Green Belt preserves a part of German history, making it visible and accessible for future generations.
- The economic potential of the Green Belt will be made available for tourism and local recreation.
- The complicated land ownership structures must be clarified and reorganized as quickly as possible.
- In consultation with local residents, a consensus should be reached for the future sustainable use of this area.

The Green Belt must also communicate to future generations how a dividing line through a country has become a unique space that is able to connect people and nature.

CLARIFYING PROPERTY RIGHTS

An important step towards realising the development strategies was the clarification of land ownership rights, which was particularly complicated by the former partitioning of Germany. Almost all land parcels in the Green Belt were the property of the Federal Republic of Germany following the laws passed after the reunification of Germany. To prevent undesirable developments within the Green Belt, the then Thuringian Ministry for Agriculture, Forestry, Environment and Nature Conservation in cooperation with the Federal Assets Office and other concerned parties set out recommended guidelines for the future use and leasing of land.

This was recognised as an interim solution for regulating land use until final resolution of the land ownership situation. The law governing property in the border region also regulated the sale of properties to their former owners or legal heirs. Thuringia was the first federal state to take over responsibility for nationally significant natural heritage sites in the Green Belt from the German state, following an agreement signed on 9 November 2008. The Free State of Thuringia is in turn committed to continuing the work already undertaken to maintain the Green Belt as a historical memorial and to develop its natural potential. In addition, the Federal Forestry Agency has been commissioned to undertake work over a period of 8 years totalling some 380,000 € for personnel costs, material costs not included.

The land formerly owned by the German state – 3800 hectares of the 6400 hectares of the Green Belt – has been transferred to the Stiftung Naturschutz Thüringen (Thuringian Nature Conservation Trust). Together with agricultural and forestry enterprises, the Trust ensures that this land remains accessible and can be experienced while simultaneously safeguarding long-term nature conservation aims.

RECONCILING CONSERVATION WITH LAND USE - MODERN ORGANISATIONAL CONCEPTS

Since the reunification of Germany, the former border region has become much more attractive. The special charm of the landscape has given rise to many different demands by different user groups, and to increasing conflicts of interest. To avoid risking losing the irreplaceable value of the landscape, valid land use claims have to be reconciled with the aims of nature conservation.

To implement the project aims, new approaches were adopted. Local work groups were established to deal with the problems in their areas. Specific development strategies were devised for each section of the Green Belt to ensure that the strategies are carried out on an ongoing basis. Work measures were coordinated by three regional work groups under the direction of the Authorities for Rural Development and Land Management in Gotha, Meiningen and Gera. The work groups consisted of representatives from the relevant authorities and interest groups. Land owners, agricultural and forestry enterprises, local tourism agencies as well as interested citizens worked together to find balanced approaches for individual sections of the Green Belt along the former border.

The work groups were charged with the following tasks:

- Consultation and professional assistance in the realisation of local projects.
- Coordinating the interests of landowners and land users.
- Resolving conflicts of land use interests.

- Support in the declaration and designation of protected natural reserves.
- Assistance in the clarification of land ownership questions.
- Implementation of land development and land use measures.
- Promotion of sustainable land use and ongoing management.
- Assistance in the realisation of environmentally-friendly tourism initiatives.
- Coordination of public funding and financing models.
- Public relations.

A project group entitled The Green Belt Thuringia was set up within the Thuringian Ministry for Agriculture, Forestry, Environment and Nature Conservation to coordinate the activities of the overall project.

THE MAIN PILLARS OF THE PROJECT

LAND DEVELOPMENT

Fundamental contributions towards reconciling ecological and agricultural interests as well as reorganising land ownership and land use aspects were achieved through the implementation of specific land development measures. This process was supported through agricultural structural development plans, land consolidation procedures and village revitalisation initiatives. The aim was to resolve land use conflicts and to develop land management and development concepts together with all the parties involved.



Dankmarshäuser Rhäden
– the flood plains of the
Werra river
(Wartburg County)

All land usage conflicts concerning nature conservation, agriculture and local administrations were easily resolved through a simplified land reallocation process.

ENVIRONMENTALLY PROTECTED AREAS

The most valuable sections of the Green Belt were declared by the Government of Thuringia as environmentally protected areas in the form of nature reserves, landscape conservation areas or areas of outstanding natural beauty with the aim of securing their long-term existence as natural habitats.

The most valuable sections of the Green Belt cover 30% of the total area:

- 1330 hectares of nature reserves
- 580 hectares of Natura 2000
- 19 hectares of protected natural landmarks

These are the key sections of larger protected areas.

DEVELOPMENT OF NATURAL HABITATS AND BIOTOPES

Through a series of specific measures for improving the quality of biotopes, the Free State of Thuringia has supported the free and sustainable development of natural habitats. The objective was to create a network of biotopes that can also incorporate relevant areas that adjoin the Green Belt. A key factor in this approach is the use of sustainable and extensive farming and agricultural methods.

The Free State of Thuringia has successfully secured national funding for the Green Belt, for example for a “Habitat Type Inventory of the German Green Belt” and the “Experience Green Belt” pilot development programme in the Thüringer Wald-Thüringer Schiefergebirge region. In addition, the Green Belt has been incorporated into two large-scale nature conservation projects, the “Eichsfeld-Werratal Green Belt” and “Rodachtal – Lange Berge – Steinachtal Green Belt”, each covering a stretch of 130 km.

The Green Belt has also been the site of mitigation measures that compensate for environmental impacts caused by other development projects, for example for the expansion of the A38 motorway.

PUBLIC RELATIONS AND EDUCATIONAL WORK

The future of the Green Belt can only be preserved when all concerned work together towards its development. Raising public awareness is therefore an especially important and effective means of pursuing this aim.

The progress of the project was documented and publicised in the media mainly in the local and regional papers as well as through special events and campaigns. Both the historical meaning as well as natural importance of the Green Belt needs to be communicated to a wider audience and to the younger generation in particular.

The concept included educational activities both in schools as well as for the general public. New and attractive initiatives for were devised for the Green Belt that complement and augment the existing environmental education programmes in Thuringia.



Pupils at the border museum Teistungen
(Eichsfeld County)

FINAL REMARKS

The declaration of the Green Belt as a National Nature Monument (a new category introduced as part of the new Federal Nature Conservation Act, BNatschG) is not currently envisaged by the Government of Thuringia. A final decision will follow pending the results of an F&E research and development project commissioned by the Federal Agency for Nature

Conservation (BfN) on the topic of “National Nature Monuments”. The F&E project will examine the role of the new category alongside the existing nature protection categories and will elaborate classification criteria for the Federal Nature Conservation Act (BNatschG) taking into account the international criteria used by the International Union for the Conservation of Nature (IUCN).

Although what has been achieved falls short of what would be ideal, the efforts undertaken by the Free State of Thuringia have been considerable. The TMLFUN has supported over 70 individual projects ranging from guided walks along the former border and school projects to grazing concepts for maintaining valuable open pastureland. In light of the complex conditions, more would not have been possible in the circumstances. The Green Belt will continue to be a central aspect of the Thuringian Ministry for Agriculture, Forestry, Environment and Nature Conservation’s efforts to maintain and promote the growing importance of interlinked networks of natural habitats.

The Green Belt must also communicate to future generations how a dividing line through a country has become a unique space that is able to connect people and nature.

MONITORING BIODIVERSITY OF THE THURINGIAN GREEN BELT

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ABSTRACT

In 2010 and 2011, the Foundation for Nature Conservation Thuringia initiated a monitoring programme on its property within the Thuringian Green Belt. The aim of this monitoring programme is to document the distribution of threatened species and habitats, to describe changes in habitat distribution, to evaluate management measures and to preserve and enhance the biodiversity of the Thuringian Green Belt. Until now, the biotope types of the Inner German Green Belt were systematically surveyed but detailed information on species and threatened species is lacking. Therefore, this monitoring programme includes a systematic investigation at the species level.

The concept of the monitoring programme includes a spatially explicit and comprehensive survey of biotopes (land use types and valuable biotopes for nature conservation) in 30 selected monitoring areas, a survey of characteristic and threatened plants and a standardised zoological survey of breeding birds, butterflies and grasshoppers. The main results of the first monitoring period are presented. The influence of extensive land use (e.g. grazing and mowing) on overall species richness (threatened and not threatened), occurrence of red list species (plants and animals), and biotope types is analysed. The diversity of characteristic plant species and its dependence on land use types is investigated. Threats for the biodiversity of the Thuringian Green Belt are detected (e.g. intensification of land use; succession and shrub encroachment; invasive plants), and proposals for management measures are given. The monitoring programme is the first comprehensive monitoring programme for the Green Belt in Germany. It enables the Foundation for Nature Conservation Thuringia to develop and improve management measures on a sound basis and to evaluate their success.

1 INTRODUCTION

1.1 Motivation

In 2010 and 2011, the Foundation for Nature Conservation Thuringia (Stiftung Naturschutz Thüringen, Erfurt) initiated a monitoring programme on its freehold (about 3600-3800 ha) in the Thuringian Green Belt. The aim of this monitoring programme is to document the distribution of threatened species and habitats, to describe changes in habitat distribution, to evaluate management measures and to preserve and enhance the biodiversity of the Thuringian Green Belt. Due to its former military use, the characteristic biotopes of the Green Belt are those of open land. Recent land use changes in the area are manifold, and range from partly illegal construction of buildings to intensification of agricultural use (meadows transformed to arable land) to abandonment of land use with succession to forests.

To date, the biotope types of the Inner German Green Belt were systematically surveyed [1], but a systematic investigation of species and threatened species of the Thuringian Green Belt is lacking. Many local surveys (e.g. the Saxonian Green Belt) and campaigns (e.g. 5th GEO-day of biodiversity 2003, 7 sites) revealed that the Green Belt is populated by a large number of threatened species. The monitoring programme described here represents the first systematic investigation at the species level of the Thuringian Green Belt. The central aim of the project was to create a feasible concept for long-term monitoring of the Thuringian Green

Belt. The following text presents this concept and the results of the first survey rounds in the years 2010 and 2011.

1.2 Concept Outline

The monitoring programme covers 30 monitoring areas. This number was chosen to assure validity and representativeness on the one hand, and to meet long-term funding possibilities on the other hand. The final number of 30 areas is the result of a power analysis based on preliminary results in 2010. Power analysis is a statistical method to identify the minimum required sample size to obtain meaningful results.

The monitoring consists of a spatially explicit and comprehensive survey of biotopes (land use types and valuable biotopes for nature conservation, according to Article 30 of Federal German Nature Conservation Law and the manual for the Thuringian biotope mapping [2]). All areas of minor conservational value were noted as land use types solely. For all valuable biotopes, a detailed documentation is given (biotope structure, land use, threats, shrub cover, management proposals). A detailed evaluation (with 3 levels: excellent, good or poor conditions) of the parameters habitat structure, plant species composition, and impairments is given, and then summed up for a comprehensive evaluation of each biotope. Additionally, a comprehensive list of characteristic and threatened plants (species lists including an estimate of abundance) is compiled for each valuable biotope. The evaluation scheme was developed with reference to the evaluation scheme for habitat types of the Habitats Directive [3].

Furthermore, three animal groups are investigated. A survey of breeding birds is done according to the German standard method for territorial bird mapping [4] with 5 survey dates. The survey of butterflies and grasshoppers follows the German standard of butterfly monitoring: 500 m long transect of 10 reaches, counting individuals at 4 survey dates (see [5]). Zoological surveys were done in 7 selected monitoring areas. The number of 7 sites again are a compromise between costs for field work, accuracy and limited funding. For each species, the reproduction status is assessed. The evaluation is based only on confirmed and probably reproducing species. The areas of valuable biotopes as well as land use types of minor conservational value were mapped and digitized in a scale of 1:2500 on aerial photographs using GIS (ArcGIS 9.3), detailed information on valuable biotopes were documented in a database. One monitoring area can consist of up to 20 land use types and valuable biotopes.

1.3 Selection of monitoring areas

The selection of monitoring areas followed several aims. Every natural geographic unit should be represented with at least one area, and large natural geographic units with at least two areas. Main biotope types should be represented in all the natural geographic units in which they are common. Thirdly, it was aspired to represent different elevations of the Thuringian Green Belt. Therefore, the 30 monitoring areas are scattered along the Thuringian Green Belt (see Figure 1).

Within this framework, the monitoring areas should not represent the „best“ or „most valuable“ sections of the Green Belt per natural geographic unit, but were chosen to give reliable information of the actual state habitats and biotopes within the Green Belt. Therefore, strongly degraded open land areas were included as monitoring sites, but areas of the Green Belt completely covered by forests were not surveyed. The monitoring areas (2010 and 2011)

are on average 900 m long (from 480 to 1680 m length) and cover the complete width of the former inner-german border strip. The mean area per monitoring site is 8.0 hectares, leading to a total area of 239.6 ha [6].

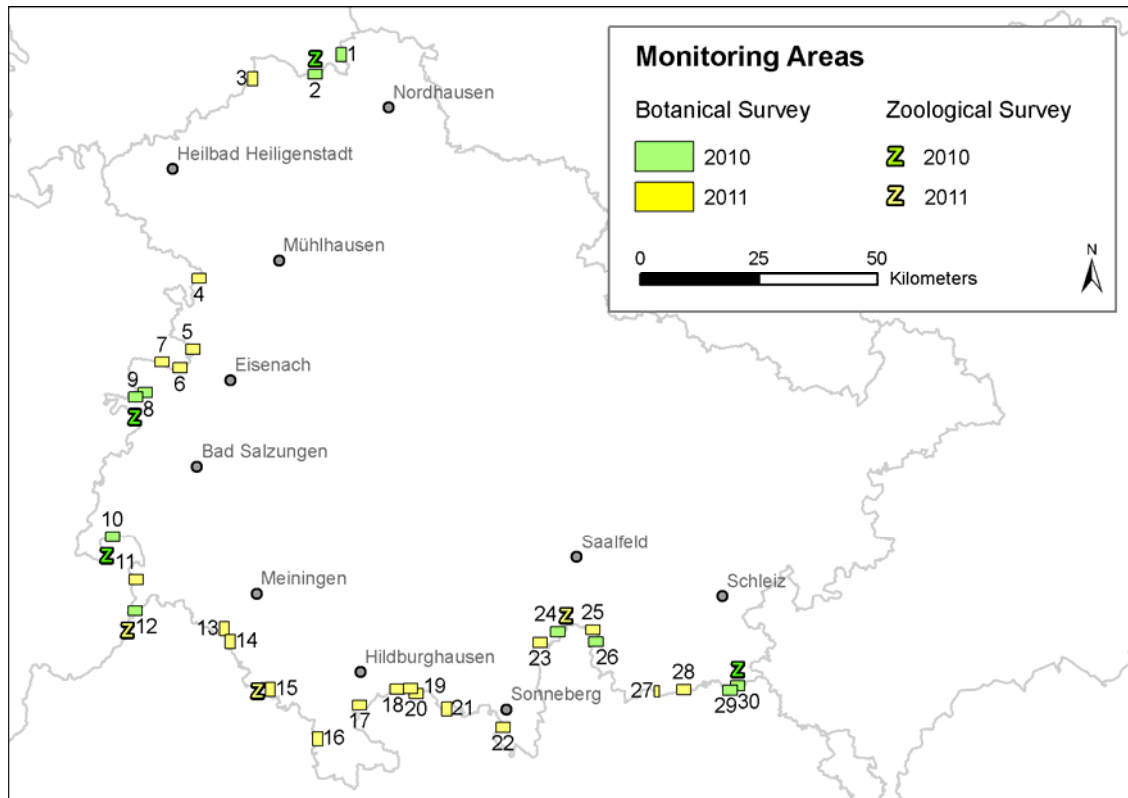


Figure 1: Overview monitoring areas (status as of September 2011)

2 RESULTS OF THE MONITORING SURVEYS IN 2010 AND 2011

2.1 Vegetation and biotope types

2.1.1 Overview on biotope types

The total monitoring area of 239.6 ha is predominantly covered by 122 ha of grassland, about 43 ha of forest and 19 ha of tall herb stands, followed by pioneer stages of young forests (12.5 ha). Large areas are covered by biotope types protected by law (Art. 30 German Federal Nature Conservation Law). Regarding only those biotope types of high conservational value, there is a total of 90.2 ha of protected grassland types: fresh to dry mesophilic grasslands (45.7 ha), calcareous dry grasslands (30.5 ha), and montane meadows (9.4 ha). Dwarf shrubs and broom heaths cover 10.6 ha.

In total about 47.7 % of the investigated area are of high conservational value and protected by law, the largest part consisting of protected biotopes of open land. The proportion of valuable biotope types in the different monitoring areas display large variations (extremes from 4.6 % (Monitoring-ID 22) to 97.3 % (Monitoring-ID 18, see

Figure 3).

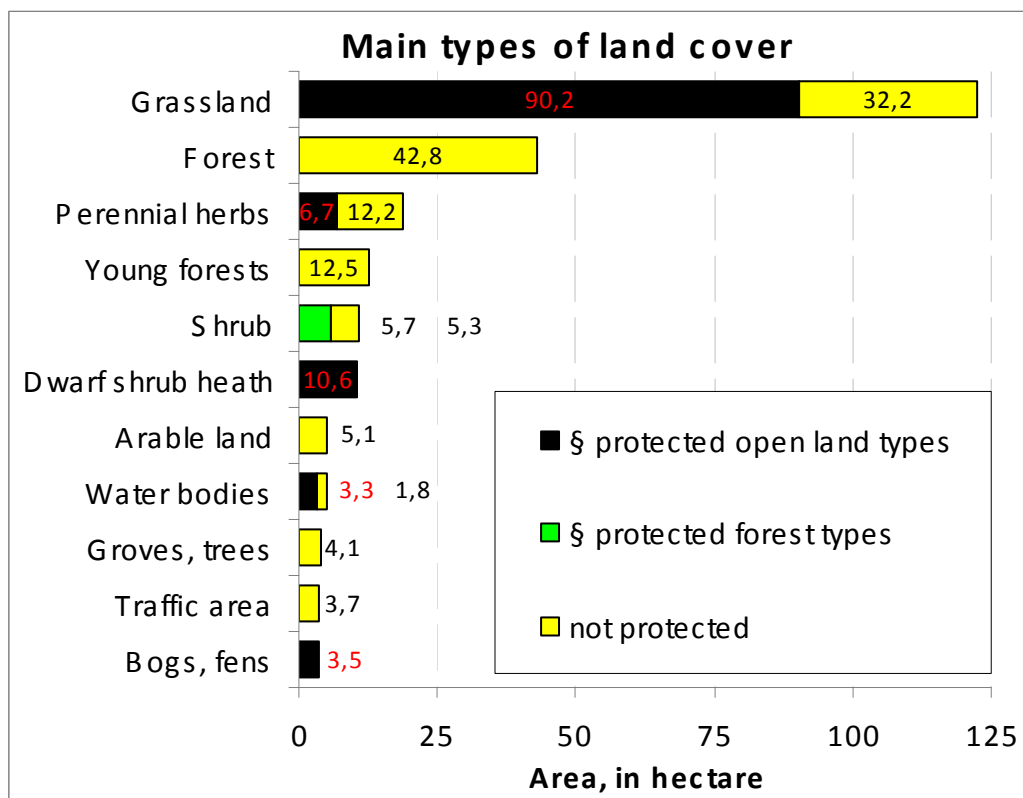


Figure 2: Land use types with and without legal protection

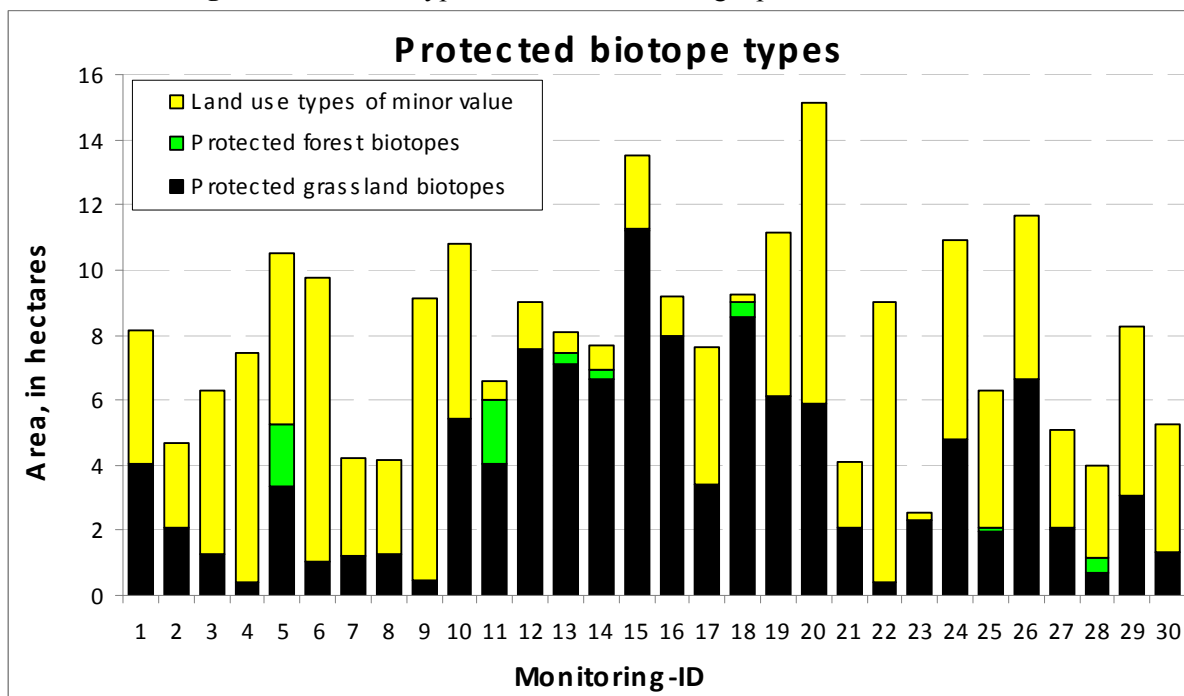


Figure 3: Legal status of biotope and land-use types at the individual monitoring areas

2.1.2 Threats

For each valuable biotope type, threats were recorded and rated from A (minor or no threat) to C (critical threat, threat endangering the continuance of biotope). Threats were present at 119 ha of valuable biotopes. The major part of threats (69 ha) was rated as medium threat (B), 22.3 ha were evaluated as suffering critical threats (C), with urgent need for management measures. About 27.7 ha had no or only minor threats (A).

Shrub encroachment (on total of 78.9 ha) and eutrophication (on a total of 47.3 ha), followed by ruderalisation (31.0 ha) and presence of nitrophilic plant species (18.5 ha), abandonment of traditional extensive use (9.6 ha), invasion by non-native plant species (5.6 ha), as well as altered ground water levels (5.2 ha) were the most frequent threats. Shrub encroachment and eutrophication mostly were rated as moderate impairments (B), but abandonment of extensive land use (like grazing or mowing of grassland) were often recorded as severe threats (C).

2.1.3 Shrub encroachment

As succession and shrub encroachment were considered as main overall threat for many valuable biotope types, the shrub cover was mapped using an 8-level scale (from “0”: zero or not noteworthy, to “7”: shrub cover 60 - 67 %). Areas with more than 67 % shrub cover are per definition not open land biotope types according [2] and were hence not surveyed in detail. 40.3 % of all biotope areas were free of shrub encroachment (level 0). These are mainly mown meadows. The level of shrub encroachment differs strongly between different biotope types (see **Table 1**). Critical stages of succession (level 4-7) are frequent at dry basophilic, nutrient-poor grasslands, at species rich ruderal stands, or at mesophilic grasslands. A total of 24 ha is under modest shrub encroachment (up to level 3), mainly at semi-dry nutrient poor grasslands, meadows, and dwarf shrub heaths.

Table 1: Critical succession stages for different biotope types

Biotope type (with area in hectare)	Code	0 %	1 % to 30 %	31 % to 67 %
Sedge swamps	3213	0.00	0.27	0.00
Common reed bed in land habitat	3230	1.42	1.81	0.00
Semi-dry nutrient poor grassland, basiphilic	4211	15.91	12.50	2.05
Mountain meadows	4221	9.36	0.00	0.00
Mesophilic to semi-dry grassland (meadows)	4222	33.86	10.42	1.41
Mesophilic to moist grassland (meadows)	4223	1.93	1.14	0.00
Species-rich wet grassland, eutrophic	4230	3.85	0.53	0.00
Species-rich wet grassland, nutrient poor	4240	0.24	0.06	0.00
Moist tall herbaceous fringes	4721	5.24	0.00	0.00
Species-rich ruderal sites, dry and thermophilous	4732	0.00	0.00	1.46
Dwarf shrub heath	5610	6.44	4.14	0.00

2.1.4 Management and land use recommendations

For each of the valuable biotope types, proposals for management action were given. A first management recommendation was noted during field work, and then all management

proposals were combined to a comprehensive proposal for the total monitoring area. For the valuable biotope types, the main recommendation was “continuity of current land use” (mainly traditional grazing, or mowing) on a total of 83.3 ha, followed by the removal of threats (very often clearing of shrubbery; on a total of 47.0 ha). The reintroduction of extensive land use (e.g. grazing or mowing) were recommended on 22.6 ha and the extensification of current land use was recommended for about 4.3 ha, see following table.

Table 2: Management proposals given for valuable biotope types

Management recommendations	Urgency 1 (within 1-2 years)	Urgency 2 (within 3-5 years)	Urgency 3 (>6 years)	Sum
maintaining current land use or management	80.0	3.2		83.3
Reintroduction of extensive land use	10.6	12.0		22.6
No management action necessary	9.4		1.4	10.7
Extensification of land use	4.3			4.3
Removal of impairments	21.4	25.1	0.5	47.0
Sum (ha)	125.7	40.3	1.9	167.9

2.1.5 Plant species inventory

The species lists containing both characteristic and threatened species was used to evaluate plant species inventories from A (very good species inventory, including a broad number of biotope-typical species as well as rare species) to C (species inventory lacking typical species, rare species missing). 15.9 ha of valuable biotope types were rated as of outstanding value (A), further 79.6 ha were rated as in good conditions (B). The remaining 30.4 ha were rated as in moderate to poor conditions (C).

On average 1.9 rare species occur per monitoring area (regarding the Thuringian Red List (2011) [7], Red List Germany (1996) [8] and species protected by law). In total 10 endangered plant species of the Red List Thuringia (2011) were recorded at the monitoring areas (numbers in brackets gives number of monitoring sites): *Arnica montana* (1), *Barbarea stricta* (1), *Carex flava* (1), *Lathyrus nissolia* (4), *Melampyrum cristatum* (3), *Petrorhagia prolifera* (1), *Stachys germanica* (1), *Tephrosieris helenitis ssp. helenitis* (1), *Trifolium spadiceum* (2), and *Vaccinium uliginosum ssp. uliginosum* (1). Additionally, 31 plant species are categorised as “vulnerable” according the Red List Thuringia (2011).

2.1.6 Plant species richness

The average number of characteristic species was 20.3 species per monitoring area, with a standard variance of 12.7 species (median 18). The values range from 1 characteristic plant species (on MID 9) to 56 species (MID 15). The areas with highest numbers of rare species (i.e. plant species of the Red List Thuringia 2011, of Germany 1996 or protected plants by nature conservation law) are four oligotrophic grassland monitoring areas (2 of them with 9, 2 with 5 rare plant species). On average two rare plant species occur per monitoring area (1.3 species with reference only to the Red List of Thuringia). *Melampyrum arvense* (occurring at 15 biotopes) and the orchid *Gymnadenia conopsea* (10 biotopes) were most frequent.

Centaureum erythraea and *Thalictrum aquilegifolium* were found at 5 sites. The majority of threatened or legally protected plant species were only found once or twice.

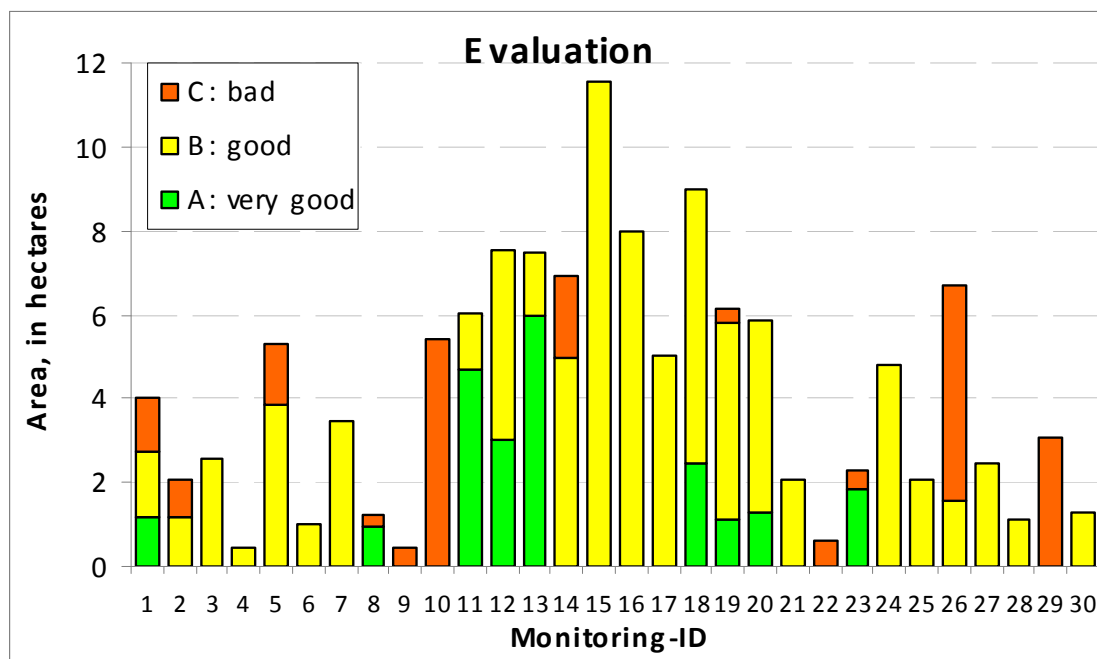


Figure 4: Evaluation of the ecological conditions of the monitoring areas.

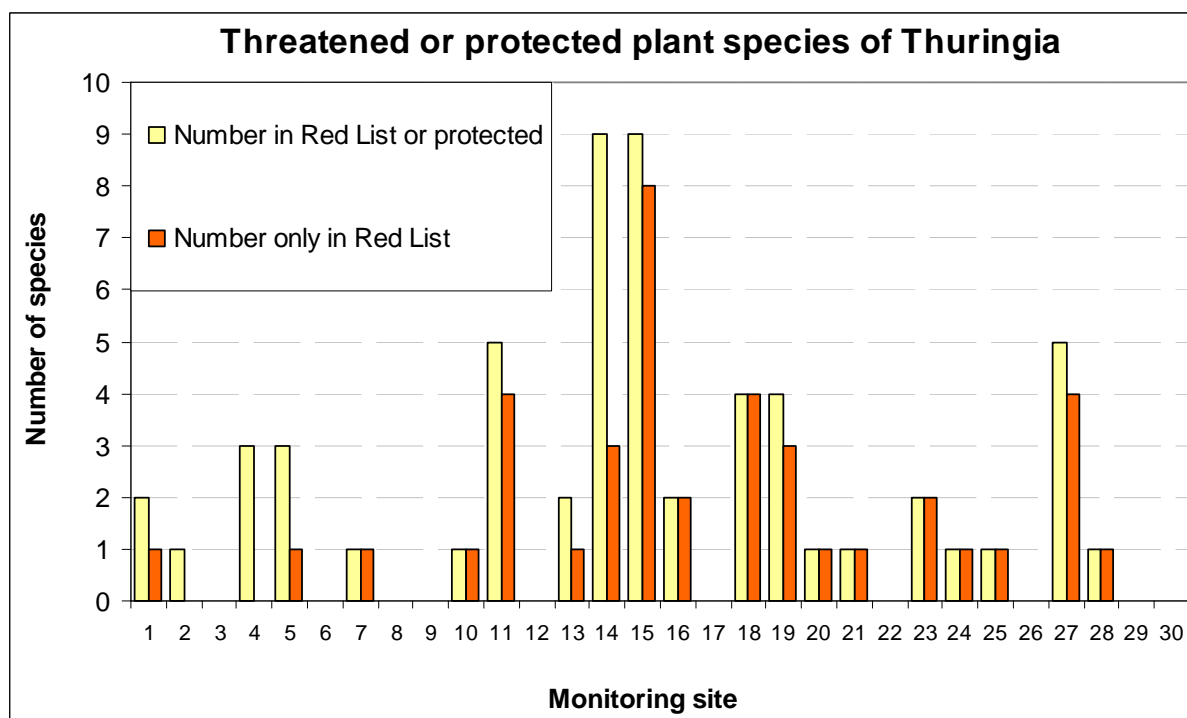


Figure 5: Threatened and protected plant species of the monitoring areas

2.2 Animal species

2.2.1 Grasshoppers and locusts

At the seven areas of the Green Belt surveyed in 2010 and 2011 a total of 21 grasshopper species were detected. The site with most species (15 species) was the dry grassland of the monitoring area ID 15. The area with least species was the area ID 30 (moist tall herbaceous fringe), see table 3. Three threatened species of the Red List Thuringia (2011) were detected, namely *Conocephalus discolor*, *Stethophyma grossum* and *Polysarcus denticauda*. According the German Red List [9], two threatened grasshoppers were detected (*Stenobothrus lineatus*: near threatened; and *Polysarcus denticauda*: endangered).

2.2.2 Butterflies

60 butterflies and four *Zygaenidae* species were observed in the seven monitoring areas of 2010 and 2011. The area ID 15 (oligotrophic semi-dry grassland, grazed by sheep) had the highest species number with 47 species. As for grasshoppers, the wet tall herb stands at ID 30 (cool and shady valley) was poorest in species number. 12 butterfly- and *Zygaenidae*-species of the Red List Thuringia were detected. One of this species is listed as critically endangered (Glanville Fritillary - *Melitaea cinxia*), one species is endangered (Large Tortoiseshell - *Nymphalis polychloros*), and 10 species are listed as vulnerable. A considerable larger number of threatened species of the Red List Germany (1998) [10] was surveyed, as many nearly threatened species of the Red List Germany could be found on the monitoring areas (see table 3). Two of the butterflies are endangered, 12 are vulnerable and 19 are nearly threatened, according [10].

2.2.3 Birds

Bird species were evaluated by territorial mapping (according to [11]) and the creation of territorial maps in ArcGIS9.3. The method defines a territory (confirmed or probably breeding) if a species showed at least at two survey dates territorial behaviour, or proof of juveniles, or feed carrying adults. In total 57 bird species were observed at the monitoring sites. The monitoring area with the highest number of bird species is ID 15 (grazed oligotrophic grassland, 33 breeding birds), the site with least species are the scrubby fractions of dry grassland ID 2 (20 species). In total 18 bird species of the Red List Thuringia [7], the Red List Germany [11] or the Birds Directive were detected (see table 3). Monitoring areas without valuable bird species did not occur (in average 4.6 valuable bird species per monitoring area occurred, minimum 2 species, maximum 11 species), which shows the high ornithological value of the monitoring sites and the high importance of the Green Belt.

Table 3: Species richness of grasshoppers, butterflies, and birds
Numbers of species according Red List of Thuringia; in brackets (G:) according Red List of Germany

ID	Land use	Number of grasshopper species	Red List Grass-hoppers	Number of butterfly species	Red List butterfly species	Bird species	Red List birds
2	No use	11	(G: 1)	43	4 (G:18)	20	2 (G: 5)
9	No use	9		21	2 (G: 5)	22	1 (G: 4)
10	Cattle grazing	10		33	2 (G:12)	24	0 (G: 2)
12	Cattle grazing	7		30	2 (G:10)	26	3 (G: 4)
15	Sheep grazing	15	2 (G: 2)	47	7 (G:24)	33	6 (G: 11)
24	Goat grazing	9		26	3 (G: 10)	23	3 (G: 4)
30	No use	8		19	1 (G: 4)	25	1 (G: 2)

3 DISCUSSION

3.1 Threatened plant species and land use types

At the monitoring sites there is a clear dependence between the land use type and the occurrence of threatened species, see **Table 4**. Generally, most endangered species occur in biotopes grazed by cattle or sheep (51 occurrences of threatened species). A high number of rare species can also be found in biotopes without current use or management (39 occurrences), less species are found in biotopes that are mown or cleared (6 and 3 occurrences). The high number of endangered species occurring in unused biotopes is however misleading, as missing land use is only favourable to a certain extent of shrub encroachment. Habitats with higher amounts of shrub cover (level 5 and onwards, i.e. 40 % shrub cover) were mostly not mapped as valuable biotopes, and threatened species are seldom. It is hence very likely that rare plant species actually occurring at unused biotopes disappear in the future if succession to young forests continues.

Table 4: Number of rare plant species by land use type and shrub cover

Degree of shrub cover	Grazing	No usage	Mowing	Post clearing	Sum
0: 0 or not noteworthy	8	6	3		17
1: up to 10 %	29	6	3	3	41
2: up to 20 %	8	8			16
3: up to 30 %	4	13			17
4: up to 40 %	1	6			7
5: up to 50 %					
6: up to 60 %	1				1
7: up to 67 %					
Sum	51	39	6	3	99

For 20 out of the total number of 41 rare species the database BIOLFLOR [12] lists grazing and mowing tolerances (each from 1: no tolerance to 9: completely tolerant). A value

of 4 for grazing tolerance is defined as species adapted to regular (1-2 times a year), extensive grazing [13]. The value of 3 for mowing is defined as sensitive to mowing – species able to support mowing only at autumn. The majority of rare species recorded at the monitoring sites is adapted to grazing rather than to mowing (see Table 5). A slight cover with shrubs and trees (coverage up to level 4, up to 40 % cover) does not affect the amount of threatened species (see Figure 6).

Table 5: Mowing and grazing tolerance of threatened plant species

	Mowing tolerance	Grazing tolerance
Mean	3.3	4.1
Minimum	2	2
Maximum	5	8
Species number	20	20

3.2 Threatened animal species

For grasshoppers the highest number of species (total number and number of rare species) was found at grazed areas, especially monitoring site ID 15. We also found high numbers at one unused semi-dry grassland (ID 2) with strong shrub encroachment. For butterflies the numbers of species was lowest at unused areas (ID 9 and ID 30), the highest species richness was found at a grazed area (ID 15). This monitoring site also showed the highest number of rare species. Regarding birds, the highest species numbers was also found at the grazed area ID 15 (total species number as well as number of rare species). The area with the lowest species number was found at unused areas (ID 2 and ID 9).

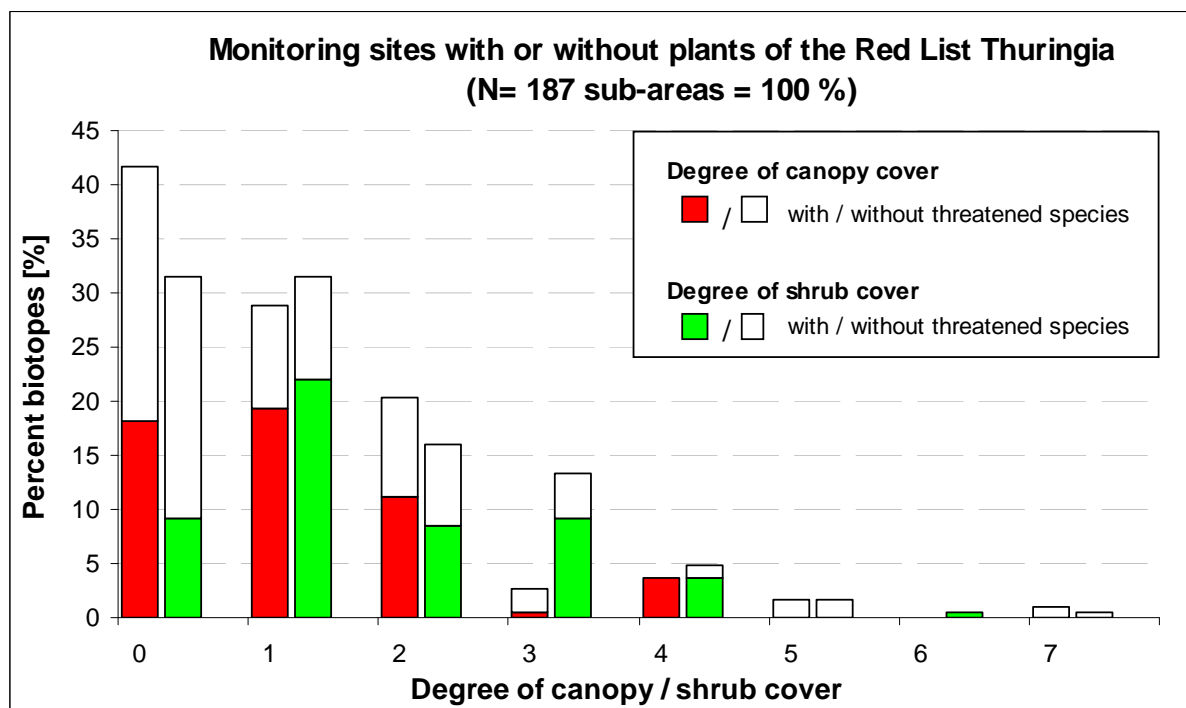


Figure 6: Proportions of biotope areas with rare species vs. shrub or canopy cover

3.3 Shrub cover and threatened species

Missing land use does not lead to loss of rare plant or animal species in the short run. With on-going succession to dense shrub stands and young forests the populations of rare species (i.e. plants of the Red List, or protected by law) will decline and get lost. The 39 occurrences of rare plant species we found at unused sites (see table 4) will get lost in the long run if no land use or land management will be established. The same is true for rare animal species, where grazed areas (like ID15) showed the highest numbers of threatened species as well as highest total species numbers.

Regarding plant and animal species, grazed areas show the highest species numbers, and the amount of rare species is also very high. Unused areas showed low to medium species numbers (and only very seldom unused areas reached high numbers), and rare species were found less frequent. We therefore recommend extensive grazing as best land use type, producing a high species richness and supporting many rare plant and animal species. A low shrub or canopy cover (about up to 30-40 %) seems not to harm the occurrence of most threatened plants or animals. Missing land use and increasing shrub and canopy cover above this extent decreases the conservational value in the long term. Our recommendation is to enable grazing (or mowing), and to tolerate a low shrub cover level at the Thuringian Green Belt.

4. CONCLUSION

The conservation of large areas of highly valuable biotopes is a big challenge. In the case of the property of the Foundation for Nature Conservation Thuringia at the Green Belt the major difficulty is to substitute the former military use of large areas for low-cost land use forms and at the same time conserving the valuable biotopes and habitats. Our results show that an overall of more than 50 % of the monitored area is covered by biotope types of high conservation value. Out of these valuable biotopes, only 7 % are critically endangered by abandonment and shrub encroachment, albeit increased shrub cover to a less severe extent is among the most frequent threats within the monitoring sites. Regarding plant species inventory, most of the biotopes (76 %) were considered as of exceptional high or good species richness. The zoological monitoring also showed high numbers of rare bird, butterfly and grasshopper species.

The surveyors recommended to maintain the current land use (extensively mowing or grazing) for a majority of sites. In total, large parts of the monitored areas are in good conditions. Extensive grazing is favourable for threatened plant species as well as for bird, butterfly and grasshopper species. This land use type should be promoted or newly established wherever feasible. Shrub and tree covers up to about 30 % seem not to cause species or biotope loss, hence could be tolerated to a certain extent.

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ENERGY WOOD USE AS A MEASURE OF LANDSCAPE MANAGEMENT – AN APPROACH TO PRESERVATION OF BIODIVERSITY IN THE GREEN BELT?

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ABSTRACT

The compound research project “Energy wood and biodiversity – the use of energy wood as an approach to conservation and development of habitats of national significance” may be an approach as an agent to enhance or to save biodiversity of habitats and species. Redevelopment and support of open habitats such as dry grassland, heather and others should be achieved as project aims to push places of high biodiversity in the culture landscape with different management methods.

INTRODUCTION GREEN BELT

The green belt along the inner German boundary dividing western and eastern parts of Germany has a long history of nature development. We can't forget the role of political and military separation causing a lack of agricultural and forestry use for a long time. Nearly nothing of the former biotopes remained in this stripe of 50 to 200 meters width. But this was also a chance to develop nearly undisturbed in phase of beginning secondary succession process for fauna and flora. After ending the separation a monitoring action of fauna and flora showed a very high level of biodiversity in biotopes, succession stages and species.

Because the lack of military use, cleaning the area of mines, metal fences and so on the succession was reset to an early stage and has begun to start again [1]. In the following time the biodiversity was growing up because the mosaic of biotopes gives place for a lot of open land and also forest species. The green belt developed to a very complex habitat mosaic. Therefore some parts of the greenbelt were protected as conservation areas for nature. A lot of organizations and persons supported the idea to develop the former boundary as part of biotope network [2]. So the Federal republic of Germany gave a big part of the area to the federal states and nature foundations got the possibility to develop these areas. But the success of this process seems to be endangered by a formal protection without any regulation of succession development. It would be possible to save natural dynamic processes with the result of undisturbed woodland over a long time but only connected with a loss of biodiversity.

In the analyses of faunal change in Thuringian butterflies as inhabitants of open biotopes, it was deplored that the existence conditions for this insect group have become worse and worse in the green belt [3].

1 PROJECT ENERGIE WOOD AND BIODIVERSITY

The compound research project “Energy wood and biodiversity – the use of energy wood as an approach to conservation and development of habitats of national significance” may be an approach as an agent to enhance or to save biodiversity of habitats and species.

The start of the project was in autumn 2009 and it will end in December 2012 [4]. What about the initial situation? We will stop the species decrease caused by wood succession and lack of land use. On the other hand we have the possibility of energetic use of wood from landscape conservation. It seems to be a simple approach to solve our diversity problem – we can use energy from renewable sources and reduce the costs of landscape management connected with existing aims in stopping loss of biodiversity. But it is not that easy as it looks like.

We cannot use forest technology for wood harvesting clear of difficulties, for example too big exposure or too wet soil. We don't have enough experience to estimate the amount of existing biomass and the required logistics from harvesting place to energy wood consumer. Further we have acceptance problems with conservationists in such a radical solution. What about the effects of harvesting technique on soil, biotopes and species? Which kind of use follows on harvesting wood to save the state of the biotope? What kind of land use has to follow: grazing, mowing, destroying greensward by harrow? Will it be efficient enough? In the background there is a lot of work in coordination with land owners, land users, forest authorities, nature conservation authorities and so on. And at last we have in the green belt and other protection areas problems with mines and other munitions. Therefore the aims of the project are integrated in efforts for development and test of a presentable form of using harvest of energy wood as one firmed method of nature conservancy connected with local solutions for energetic use and increased income from this kind of landscape management.

We ourselves are working in the subproject 5 (see figure 1) and try to create ideas for managing habitats after harvesting shrubs and trees as energy wood. We cooperate with the colleagues from Anhalt University of Applied Sciences which investigate reaction of flora and vegetation.

In more than 40 selected areas (4 of them in the green belt) in Thuringia and Brandenburg we investigate fauna and flora before and after harvesting energy wood. Therefore we developed concrete aims for each investigation area. In these areas plots for vegetation records and transects for animal observation were defined. Depending of the size of area and habitat type indicator groups of animals were chosen to estimate technology effects and effectiveness of measures including following land use in the sense of conservational ideas. The groups of animals are birds (in bigger areas), butterflies (moths in single plots), locusts, crickets and additionally in some plots snakes and lizards.

If you calculate the necessary number of investigations to reach very good information and on the other hand the minimal number of personal (a half stead, supposed by occasionally helping students) you have to search for a compromise in the amount and type of investigations. We evaluated available data sources, literature and observe now only special indicator species (restricted to a special biotope type). Their presence or absence, their reaction to the changed environment, their colonization or recolonization of transects, their reaction to disturbances from harvesting technique (for example soil devastation) are indicators for success of measures. The derivation of recommendations for further land use to save biodiversity follows.

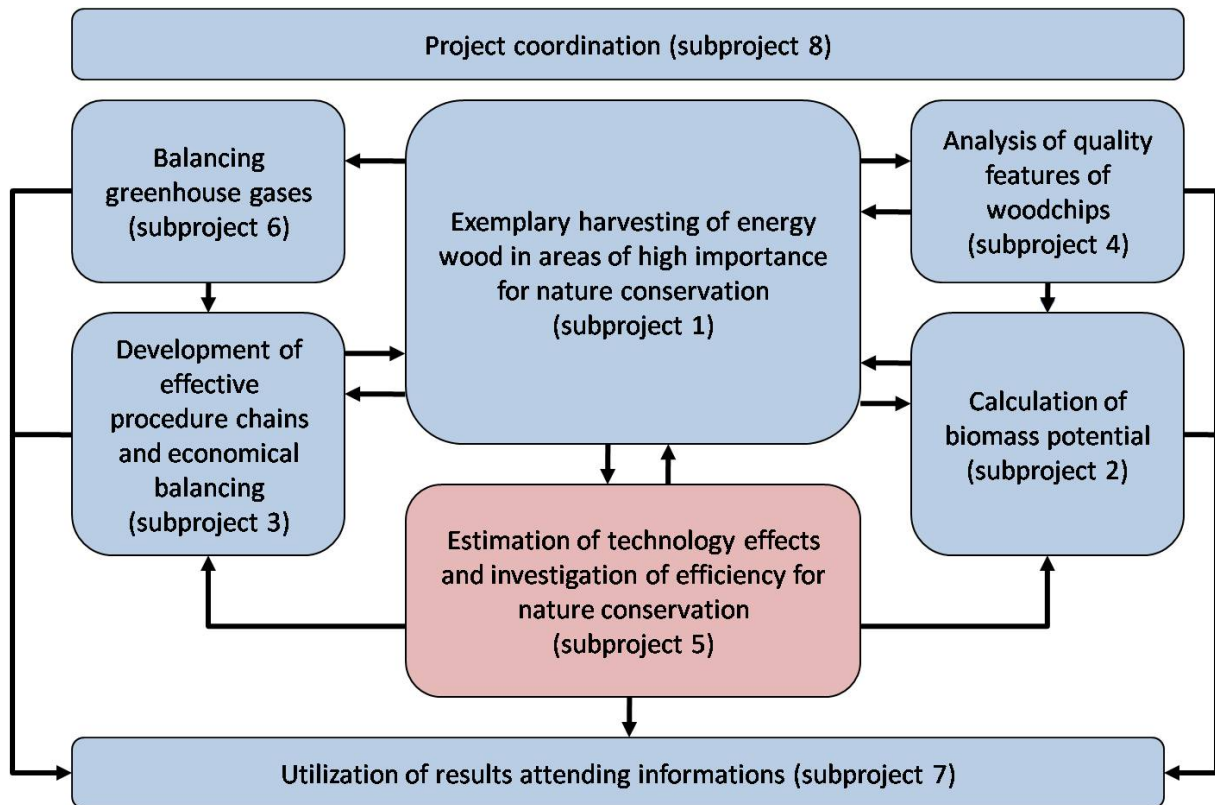


Figure 1: Project scheme

It seems to be a concrete clear concept with some restrictions in time and personal capacity but in practice there are some more difficulties. It is difficult to get continuously data series over the year, comparable between different years depending on the state of literature, empirical knowledge and operational experience, the ability to determine fast moving animals in the field (no automatically traps were used) or laboratory (difficult determination by preparing genitalia slides in insects) and weather conditions. Accurate but flexible time planning, draw up habitat specific lists of (preliminary) indicator species contribute to project success.

3 EXAMPLES AND RESULTS

In the following we will show some concrete examples from the green belt concerning as difficulties in the case of single species and also the connection between area specific aims and measures.

3.1 Species examples and management requirements

The balance between succession processes and landscape management to reach or conserve high biodiversity and or endangered species in open habitats is very difficult. The larvae of *Eriogaster catax* (LINNAEUS, 1775) (protected by habitat directive, FFH-species 1074) are feeding on shrubs of *Prunus spinosa* or *Crataegus* species. *Prunus* and *Crataegus* are widespread but not so *Eriogaster catax*. In Germany recent populations are observed only

in Bavaria, Rhineland-Palatinate and Thuringia, most of them in or nearby the green belt. What are the special problems of this species endangered to be extinct in these countries and in whole Germany? The problem of *Eriogaster catax* is the special arrangement, the species needs habitats between open- and woodland.

In one of our investigation areas – a part of green belt in the locality “Schlechtsarter Schweiz” – a monitoring project of Bavaria and Thuringia shows the situation of *Eriogaster catax* depending of management of the forest structure, the age and the structure of single bushes of *Prunus spinosa*. The caterpillar nests were found only in younger plants not covered by trees or older bushes [5]. Possible management measures are cutting, mowing and grazing in combination. Because there are no traditional forms of land use including these management measures the observed population density is low.

The different forms of harvesting energy wood for purposes of nature conservation in protected areas could be a contribution to upgrade the habitat quality for *Eriogaster catax*. The lumberjacks have to be informed before harvesting about the conclusions concerning preservation of determined shrubs with a concrete age and in concrete location, the concrete localization of occurrence and possible habitat dynamics.

In the same area we observed *Everes argiades* (PALLAS, 1771), a vagrant butterfly species, extinct according to red data list of Thuringia. It requires very distinct habitat conditions comparing with *Eriogaster catax*. The place for egg deposition is characterized by inflorescences of *Trifolium pratense*, *Lotus corniculatus* and *L. uliginosus*, also *Medicago sativa*. These plants are widely distributed. You can find *E. argiades* as an inhabitant of different biotopes but only very local, neighboured with wood formations. What is the reason for observation in this area? Is it migration all over Europe, areal progression or mowing the footpath along the green belt by tourism management? We don't know it exactly but we have good conditions in this area for the species, this part of the green belt is one of the habitats in a mosaic distribution. The neighbourhood of different biotope types in the green belt and their coexistence in the future is one of the guaranties for biodiversity.

3.2 Preservation of biodiversity

The locality "Straufhain" is both a FFH protective area, a national nature reserve and a component of the green belt. The area is surrounded on both sides by wood. At the moment the area is strongly covered by shrubs, the biggest biodiversity could be found along the flagstone path ca. 3 m inside the area. The location aim within the project is to release the grassland from shrubs and trees, so far that there arise a variety of biotope types with open country character and at the most less covered by shrubs. The size of the measure surface amounts to approximately 15 ha. Up to now the area "Straufhain" has turned out as the area with highest faunal species richness in the investigations of their status quo. It is a very good example to indicate how species-rich a place in spite of strong shrub coverage still can be and how much sense it makes to caring such areas permanently.

The animal groups of butterflies, locusts and birds were examined. Eleven mappings were carried out in two years, five in 2010 and six in 2011. The following table 1 gives an overview about the number of species which could be proved within the project examinations before the realization of the measure.

57 butterfly-species were found, these are nearly 50% of the whole butterfly fauna in Thuringia in 1990 [3]. Of the 117 proved animal species 42 species depend on a habitat with open character. We assume that these 42 species will profit of the measure realization. For the

bird species *Locustella naevia* (BODDAERT, 1783) and *Lanius collurio* (LINNAEUS, 1758) an improvement will appear alone by the change of the structure. Some butterflies species will profit only from the measure when the supplies of her food plants could recover, for example *Polyommatus thersites* (CANTENER, 1835) whose larvae feed on *Onobrychis viciifolia*.

Table 1: Numbers of species, status quo at the project area „Straufhain“.

Animal group	Total number of species	Endangered in Thuringia [6]	Endangered in Germany [7]	Protected in Germany [8]	Protected in Europa [9]
Butterflies	57	20	34	25	0
Burnet moths	5	1	4	5	0
Locusts	17	4	2	0	0
Birds	38	5	9	38	5

To ensure the preservation of the species for a long term it is important that also after the wood harvesting by the research project a land use by grazing or mowing quickly follows, as possible already during the next vegetation period. In case of the "Straufhain" a land use by mowing is planned. Thereby the dispersal of *Calamagrostis* should be avoided in the harvested areas. This measure is in conflict with habitat requirements of *Pyrgus armoricanus* (OBERTHUR, 1910) extinct according to red data list of Thuringia in 2001 but observed in Straufhain area and other areas in the green belt. *Potentilla* species (*reptans*, *erecta*, *tabernaemontani* [10]) as foodplant of the *P. armoricanus* larvae are more supported by grazing than by planned mowing.

Therefore there is no simple management scheme for all areas in the project. The idea must be to realize a concept with priorities for the value and preservation of biotopes, their complexes and single strong protected species. We have to search for a concept of harvesting shrubs and trees as “energy wood”, followed by suitable land use to reach a good condition of populations of the most endangered species and their habitats. These concepts depend on regional and local climatic factors, other natural conditions, management possibilities, the ability of nature conservation authorities to cooperate with land owners and land users. One of the modules in this frame is the possibility of harvesting and use of energy wood.

4. CONCLUSIONS

A big chance for the preservation and the support of the biodiversity in Germany has originated based on the former inner German boundary. Biodiversity in the green belt is the result of different land use or misuse in the past. Only extensive land management after the end of German separation leads to a mosaic of natural and seminatural biotopes as the basis of species diversity. The natural development of succession gives us a picture of different wood biotopes suppressing different grassland and heather biotopes.

Using the wood from landscape conservation to get energy from renewable sources should be an option for landscape management. Harvesting energy wood in such areas is one method to get an equilibrium between open and wood biotopes. However it is necessary to know the periods between harvest activities and also the other management measures following the harvest to reach the aims of nature conservation. Natural requirements of biotope and species existence have to be introduced in the management planning.

Agricultural use as extensive grazing or mowing supported by combined programmes between nature conservation and agriculture or forestry may be a help to preserve and develop biodiversity in the green belt.

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THE EUROPEAN NATURA 2000 NETWORK AS A FACTOR FOR RURAL DEVELOPMENT IN THE ORE MOUNTAINS (GERMANY / CZECH REPUBLIC)

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ABSTRACT

In the Ore Mountains (Germany / Czech Republic), there are many NATURA 2000 sites, which constitute in some cases extensive complexes straddling the border between the two countries. The Ore Mountains Green Network EU project identified synergies between nature conservation and rural development, with the three main topics being landscape management, tourism, and environmental education. Starting from a SWOT analysis focusing on the strengths, weaknesses, opportunities and threats concerning these three main topics in a cross-border context, an assessment of potentials showed the wide variety of ecosystem services that such protected areas provide. Based on these results, the opportunities and risks for enhancing synergies between nature conservation and rural development were discussed with relevant stakeholders, and a draft strategy was elaborated, which addresses such key aspects as landscape management, protection of the black grouse, energy questions (biomass, wind turbines), and environmental tourism (esp. Nordic skiing and visitor management).

1 INTRODUCTION

Protected areas, such as national parks, biosphere reserves and NATURA 2000 sites, not only support biodiversity, but also provide a wide range of provisioning, regulating and socio-cultural ecosystem services, and thus enable various forms of economic activity. They can contribute to gains in local income and employment (e.g. benefits from investments in NATURA 2000 sites by local, national and EU sources). They can also be a key tourist attraction generating external purchases of local products and services, as well as helping visitors gain greater awareness of habitats and their function and value. They may contribute to strengthening the sense of place and regional identity which can promote greater civic responsibility, safeguard the cultural and natural heritage, and provide opportunity for environmental education and leisure, health and amenity. Thus, they may improve living conditions and be part of a framework for successful sustainable rural development, e.g. [1], [2], [3], [4].

This applies, too, to the Ore Mountains (*German: Erzgebirge/ Czech: Krušné hory*), which are characterized by outstanding natural assets and a typical cultural landscape on both sides of the border between the German state of Saxony and the Czech region of Northern Bohemia. The ridge of the Ore Mountains, averaging 800-1000 m above sea level, contains many NATURA 2000 sites, including both Special Areas of Conservation under the EU

Habitats Directive and Special Protection Areas under the EU Birds Directive, some of them in extensive complexes, which in some cases straddle the border and form transnational “green networks”. There are numerous characteristic habitat types, such as raised bogs and bog forests that give the impression of pristine nature; however, such “human-made” features as mountain meadows with blooming and fragrant herbs, matgrass meadows, tall subalpine herbaceous vegetation, stone walls, mixed mountain forests and near-natural flowing waters are also valuable and worthy of protection. Several rare and threatened species are among the remarkable flora, such as arnica (*Arnica montana*), ragged pink (*Dianthus seguieri*) and several orchid species, and fauna, including the black grouse (*Tetrao tetrix*) and the corncrake (*Crex crex*). The black grouse, which is threatened with regional extinction, is a species being targeted for nature conservation on the European level. The biggest Central European black grouse population outside the Alps has its habitat in the Ore Mountains on both sides of the German-Czech border.

The cross-border German-Czech project “Green Network Ore Mountains” (time period 2009-2012; <http://www.natura-2000-synergies.net>; project partners: Leibniz Institute of Ecological Urban and Regional Development (IOER), Dresden, Germany, Faculty for Environment of the J. E. Purkyně University, Ústí nad Labem, Czech Republic, the Western Ore Mountains and Central Ore Mountains Associations for Land Care, Germany) funded by the European Union (EFRE Objective 3 / INTERREG IV A), was launched to identify and develop synergies between nature conservation and rural development, especially in the spheres of conservation-friendly agriculture and forestry, rural tourism and environmental education. The project had a special focus on the many NATURA 2000 sites in the Ore Mountains. The core objectives were to reveal the various services and benefits that NATURA 2000 sites along the Ore Mountains ridge zone provide, as well as to elaborate a draft strategy including measures to support rural development at the interface of nature conservation and landscape management.

This paper presents the project design (Fig. 1), the methodological approach and the main results and experiences.

2 METHOD

We started with a SWOT analysis, which shows the strengths, weaknesses, opportunities and threats in the region. Thus, we identified relevant stakeholders (mainly from public authorities and non-governmental organizations) that were actively involved in nature conservation, tourism and environmental education. In particular, we analyzed the main economic, ecological and socio-cultural potentials and services of the NATURA 2000 sites in the ridge zones of the Ore Mountains using a mere descriptive or semi-quantitative approach (expert judgement). We distinguished between the potential or capacity to provide services on the one hand, and the actual use of these services on the other. We also identified the opportunities and risks of utilizing these services in the framework of sustainable rural development [5]. The information used stems from the management plans for the NATURA 2000 sites (SAC) and nature reserves, from government agencies, and from project partners’ personal knowledge. The selected NATURA 2000 sites (24 on the Saxon side and 19 on the Czech side of the Ore Mountains) included in the analyses are representing the typical spectrum of habitat types of the upper Ore Mountains: forests, raised bogs, mountain meadows and small creeks.

In close connection with the identification of potentials and services of NATURA 2000 sites, in-depth investigation into agriculture, rural tourism and environmental education, covering the present situation, stakeholders, and differences between the two countries, were made to enrich the information base. This was a precondition for the next step:

In close cooperation with local and regional stakeholders, e.g. landscape managers, touristic associations, authorities, even mayors, and NGOs, strategies and measures were worked out to enhance the status and the acceptance of nature conservation, especially NATURA 2000, and to show how such areas can be maintained in a favourable state by permanently integrating such economic aspects as product marketing and rural tourism, and through environmental education.

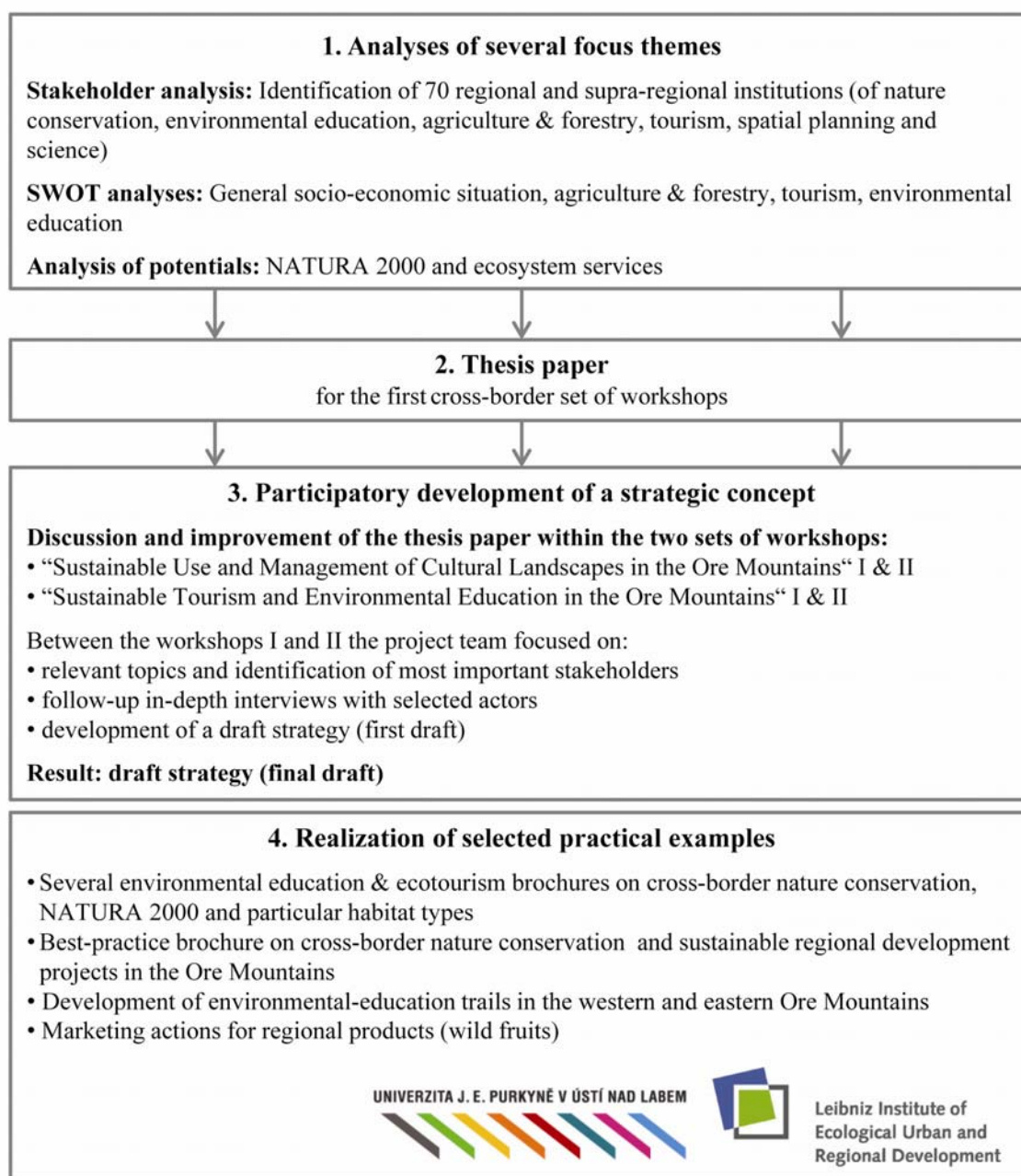


Figure 1: Design of the EU project “Green Network Ore Mountains”

Two series of workshops were conducted with stakeholders as part of the elaboration process. Each of them, one organized on the German side, the other on the Czech side of the study area, consisted of two single workshops, one focusing on landscape management, the other on rural tourism and environmental education. During the first set of workshops in 2010, the results of the SWOT analyses were presented and discussed. The goal was to involve the participants in the identification of the most important problems and challenges at the interface of nature conservation and landscape management, incl. agriculture, tourism and environmental education. In the months that followed, the project partners dealt with the results and questions that were raised in depth, i.e. they tried to find solutions and draft proposals, and they wrote a preliminary joint strategy paper containing the issues concerned.

The draft paper was sent to the stakeholders. One year after the first series of workshops, a second series was organized in 2011 with a similar thematic structure. The same and also additional participants were invited, so as to discuss and improve the draft strategy. Those persons who were interested in this process but could not participate personally in the workshops had the opportunity to send their remarks in writing, e.g. by E-mail. The corrections were made to the final draft of the strategy paper.

A final conference was organized at the end of 2011 to present the strategy paper and other results of the project. After an introductory presentation of essential conditions for successful cross-border cooperation in nature conservation, speakers from several European regions with cross-border complexes of nature protection areas presented their own experiences and offered insight into their regions.

Parallel to the SWOT analyses and the elaboration of the draft strategy, various concrete measures in all three main topics of the project – landscape management, tourism, environmental education – have been carried out by the project partners themselves. As a result, parts of the draft strategy were already implemented during the project period, and valuable experiences could be gained.

The main goal of the draft strategy was to search for methods and approaches to enhance the cross-border cooperation between Saxony and Northern Bohemia, so as to promote long-term sustainable regional development within the entire Ore Mountains ridge zone. The structure of the strategy paper is as follows: introduction (goal of the strategy); present situation (problems and challenges) concerning the main topics; on-going activities; suitable strategies and measures to solve the problems; and possible stakeholders and partners.

3 RESULTS AND DISCUSSION

The analyses of potentials and services showed that the NATURA 2000 sites of the Ore Mountains ridge zone provide a wide range of provisioning, regulation and socio-cultural services. Thus, the benefits from these areas go far beyond the original purpose of maintaining threatened species and habitats. There is also much potential, so far unused, which could be developed, but only with consideration for various restrictions to ensure the goals of nature conservation. There are also local cases of overexploitation, e.g. by tourism: the trampling of sensitive vegetation, and the disturbance of such animals as the black grouse (*Tetrao tetrix*). On the other hand, some valuable areas, such as the mountain meadows, are threatened by land abandonment and insufficient landscape management.

The following services in particular were identified and assigned to particular NATURA 2000 sites and habitat types: among the

- provisioning (economic) services: supply of animal products such as livestock (products: milk, meat, wool), fish and game, supply of plant products (crops, timber, wild fruits/berries, mushrooms), biochemical/ medicinal resources (e.g. spignel *Meum athamanticum* and other herbs), provision of genetic resources (seeds of forest trees, herbs and grasses), drinking water, energy from water power
- regulation (ecological) services: regulation of air quality and local climate (by forests and grassland), water balance regulation (flood mitigation, erosion control, self-purification of waters), habitat services (biodiversity)
- socio-cultural services: aesthetic values (e.g. scenery), ethical values (biodiversity, the integrity of creation), services in the field of recreation, rural tourism and environmental education

Many ecosystem services from all three categories do not depend on particular vegetation structures but on land cover forms. Of course, ecosystem services that are connected with biodiversity to a higher degree, e.g. habitat function and several socio-cultural services, show stronger correlations to the biological characteristics of the ecosystems concerned.

Notwithstanding the very similar natural conditions on both sides of the border, there are distinct differences, e.g. in management planning, but also in the awareness and acceptance of NATURA 2000, the implementation of conservation measures and related environmental education and public relations activities.

The results of these analyses provided the basis for the elucidation and discussion of the opportunities and risks of enhancing synergies between nature conservation and rural development. Together with the stakeholders, e.g. by means of the workshops, we identified several crucial challenges and proposed possible solutions for the following main topics:

1. Relationships between agriculture, landscape management and NATURA 2000

The stakeholders called for the cross-border harmonization of nature conservation policies and goals, the cooperation of authorities and organizations responsible for landscape and biotope management, the exchange of experiences, and to launch common (bilateral) cross-border projects.

2. Maintaining the traditional cultural landscapes of the Ore Mountains and their biodiversity

The maintenance and extension of flowering meadows is desirable, not only for biodiversity but also for scenery and tourism. As detailed analyses have shown, nature-friendly grassland management can cause economic losses for farmers. That means that without appropriate financial support, long-term maintenance of valuable grassland ecosystems in the Ore Mountains cannot be guaranteed. To overcome or reduce the dependency on subsidies, the recovery of hay from mountain meadows as well as herbs and wild fruits (niche markets for local products) could also make a positive contribution, as could the establishment of regional producer groups, the development of markets and marketing, and the creation of brands of quality, especially in the context of broader marketing activities, such as partnership of National Natural Landscapes in Germany.

3. Generation of economic benefits through landscape management (e.g. use of biomass from management measures for energy)

Due to the poor or absent markets for the biomass cut on the mountain meadows (modern cattle breeds need other fodder, richer in protein and calories), the search for alternative purchasers is justified. A possible energy recovery of biomass from landscape management measures raises hope, but there are several obstacles: the rather low content of energy compared to such crops as maize, technological problems in the production of biogas, and logistical problems (long transport distances). Suitable economical and technological framework conditions and alternative value-added chains are needed. These tasks cannot be solved in the short term. Nevertheless, cross-border cooperation may be helpful in future to reduce logistic problems, to concentrate efforts and to develop biomass through landscape management on both sides of the border.

4. Avoiding conflicts with wind turbines along the mountain ridge

The European Union has set the goal of increasing the renewable share of energy consumption in the EU significantly, in order to reduce dependency on imported oil and gas as well as to significantly reduce greenhouse gas emissions [6]. A major part of the renewable energy mix is to be provided by wind energy. From the point of view of investors in the wind energy sector, the Ore Mountains are seen as a very attractive location for wind turbines – much more than was previously the case. Wind turbines may disturb animals (bats and birds) and alter the landscape's visual quality, which can have an effect on its attractiveness for tourists. In order to avoid or reduce conflicts with nature conservation and tourism, we have, together with the stakeholders, defined the following demands: Choice of suitable sites, exclusion of protected areas and aesthetically sensitive areas (e.g. the mountain ridge), intensification of regional planning and cross-border Environmental Impact Assessment, early contact to local stakeholders and planning authorities.

5. Protection of characteristic bird species, especially the black grouse (*Tetrao tetrix*)

The black grouse (*Tetrao tetrix*), a rare and threatened species of fowl with a significant population in the Ore Mountains on the European scale, shows the importance of large cross-border NATURA 2000 habitat complexes. The birds prefer large undisturbed landscapes covered by sparse woods with berry bushes (bilberries/ *Vaccinium myrtillus*) and pioneer shrubs (rowan/ *Sorbus aucuparia*, birch/ *Betula pendula*). The major reasons for the decline of the black grouse populations include the afforestation of clearings and forest meadows with spruce monocultures, the increase in predator populations such as the red fox and the wild boar, and disturbances, e.g. by tourists. Due to the supra-regional importance of this species, the Ore Mountains population must be ensured on a permanent basis, precisely by maintaining and restoring their habitats, resolving conflicts with land users, prioritizing species protection in sensitive areas, and communicating targets, measures and restrictions to the lay public.

6. Promoting environment-friendly sustainable tourism and cross-border cooperative efforts

Due to favourable natural conditions (diversified un-spoilt landscape, large forests, mountain meadows and other elements of the traditional cultural landscape) and cultural and historical elements (mining history, Christmas customs), attractive opportunities and offers,

the Ore Mountains attract many tourists. The stakeholders identified a need for competitive destination management organisations, common marketing strategies, the coordination of offers, the stimulation of bi-/multilingualism on both sides of the border, innovative offers in the sphere of rural tourism, support for local and cross-border public transport, and better cooperation between nature conservation and tourism. For example, the question was discussed whether and how the tourist sector should support nature conservation, e.g. by way of fees for maintaining attractive landscape elements, such as flowering mountain meadows.

7. Environmental education and visitor management in sensitive areas

The initial situation in the Ore Mountains is rather good; many institutions offer environmental education. Challenges include enhancing bilingualism, improving cooperation with the tourism industry to advocate environment-friendly behaviour, and applying new technologies (e.g. smartphones) to generate innovative offers. Unspoilt nature, such as the large forests of the Ore Mountains, mainly in the higher altitudes, affords opportunities for both local and cross-border nature and landscape experiences. The outstanding natural value of the Ore Mountain ridge zone – in general – is a strategic advantage for tourism and environmental education. The requirements of nature conservation must be respected, the more so as disturbance of sensitive species and ecosystems has already been ascertained and could be further aggravated by modern outdoor activities, like geo-caching, snowmobiles, etc. The education of visitors is absolutely necessary and can be combined with visitor management, for example to experience raised bogs. In particular, sites which are ecologically fragile and stressed by various factors, like the core habitats of the black grouse, are unsuitable for tourism. There is a need for sophisticated tourism concepts that take the demands of protected areas as well as the peculiarity and beauty of the landscape into consideration.

8. Environment-friendly winter sports

The ski tracks on the ridge of the Ore Mountains enjoy great popularity. The growing numbers of visitors mean even more stress to flora, fauna and fragile ecosystems. To reduce the threats and to spare sensitive areas from visitors (e.g., conflicts with skiers in raised bogs), the localization of ecologically-compatible bundled ski trails on both sides of the border has been fostered. There is also the particular challenge of environmental education: Recreating a cross-border atlas of ski pistes and trails consisting of several small maps where nature-friendly behaviour is also advocated, might represent an exceptional contribution.

The measures, which the project team had already realized during the course of the project, are also worth mentioning: marketing actions for regional products from protected areas (from wild fruits); a brochure and concept for visitor guidance in NATURA 2000 sites (e.g. the Western Ore Mountains SPA); two brochures about cross-border nature trails in the Eastern part of the Ore Mountains; an information table about the Černý potok creek restoration project realized together with the Agency for Nature Conservation and Landscape Protection of the Czech Republic; the image brochure “Ore Mountains: naturally without borders”; the brochure and internet presentation “Nature borderless: The European network of protected areas: The example of the Bohemian and Saxon Ore Mountains”; and articles in the daily press.

4 CONCLUSIONS

Along the Ore Mountains ridge, NATURA 2000 sites constitute a huge and complex transboundary network of valuable ecosystems, which are not pristine but influenced by long-term economic and other human activities. They provide a broad range of economic, ecological and socio-cultural services, and offer considerable potential for a careful cross-border rural development. The draft strategy, developed together with relevant stakeholders from Germany (Saxony) and the Czech Republic (Northern Bohemia), identified opportunities and also risks and restrictions, while considering NATURA 2000 sites in the context of a sustainable rural development. All human activities have to take into consideration that the biodiversity and visual quality of the Ore Mountains are vulnerable to, and suffer from, land use intensification, the abandonment of extensive land management forms, the excessive afforestation of open areas with spruce monocultures, unsuitable development for tourism, and the establishment of wind turbines at sensitive sites on the mountain ridge.

To conserve the valuable nature of the Ore Mountains, special efforts and effective measures are necessary. The challenge is to link protected areas like NATURA 2000 as core elements of an economically viable but at the same time sustainable development strategy. Yet, for many the NATURA 2000 is a mere catchword or slogan symbolizing a system of scientific terms that cannot be communicated easily to the lay person. Nature conservation would be more successful if it generated pride in such treasures of nature as raised bogs, mountain meadows, rare species and the typical landscape that constitute the natural heritage of the Ore Mountains, and strengthen a sense of identity of the people with their region. A great part of marketing actions for NATURA 2000 in Germany could be initialized by the administration of the Ore Mountains Nature Park, as it covers about two-thirds of the mountain ridge on the German side, and as it is widely accepted and known by tourists and locals.

The project revealed various restraints (short-term economic interests, a dependency on subsidies, the lack of regional marketing structures, deficient awareness of the environment and of the values of nature and the cultural landscape).

The Ore Mountains example also shows that cross-border cooperation is still difficult to manage, due to such simple factors as different languages, historical peculiarities, different political and socio-economic conditions and organizational/ institutional settings, cp. [7]. Nevertheless, involving stakeholders (authorities, organizations) on both sides of the border is the only way to achieve realistic cooperation, because the elaboration of such concepts can be only supported, but not imposed, from outside. For such projects, using existing networks with strong actors is helpful: we suggest linking the development of the draft strategy, such as tourism development strategies, nature conservation strategies, etc., to existing structures. Even close transboundary cooperation between ministries, non-governmental organizations etc., strongly depends on the cooperation of individuals, as much of the cross-border projects are carried out in addition to regular work, and since stakeholders are very often faced with urgent tasks and their interest in long-term strategic goals and concepts is not very great.

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STUDY ON HABITAT NETWORKING IN STYRIA (Austria) / Developed within the framework of NATREG

**BASIC PRINCIPLES FOR THE DEMARCATION OF GREEN ZONES AND ECOLOGICAL CORRIDORS
WITHIN THE REGIONAL DEVELOPMENT PROGRAMM OF THE STYRIAN STATE GOVERNMENT**

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1 INTRODUCTION

Why is the preservation of “Green Networks” so important?

Open spaces, which are of high importance for humans, animals and plants, are endangered because of the continuous growth according to economy, housing, infrastructure and many other sectors. The present project tries to channel the competing claims of utilization of open spaces or to sustain the diverse functions of these areas respectively. Especially the protection of extensive local recreation areas as well as the protection of coherent open spaces in the present and future settlement areas of Styria is vital to facilitate the unobstructed dispersal of fauna and flora.

The project fulfills a further cross-linking function. Through the close collaboration between spatial planning and ecology (nature conservation) an added value for all departments can be generated, which could not be achieved by one discipline on its own.

The present approach of connecting open spaces corresponds to the strategies of the EC which have been published in summer 2010 and propagate the consideration of various relevant disciplines when connecting open spaces. Therefore the innovative approach of the Styrian “Green Network” makes a significant contribution to the European-wide discussion about connecting open spaces.

The present study is part of the European Community co-financed project NATREG (Managing Natural Assets and Protected Areas as Sustainable Regional Development Opportunities – EC co-financing within the program South East Europe). The Spatial Planning Department of Styria takes part in the EU-project and retained an interdisciplinary team of experts. The Styrian result is an expert proposal concerning the demarcation of green zones and living space corridors. In a separate process a

conflict free demarcation and regulation of green zones and ecological corridors is carried out. The statutory basis underlies the directives of the Regional Development Program of the Styrian Government.

2 PROJECT OBJECTIVES

The main objective is the development and implementation of an innovative method to demarcate green zones and habitat corridors. Further, the protection of these areas by means of spatial planning instruments and strong accompanying public relations are core working areas within the present study. By considering the multifunctionality of open spaces, following aims are of high importance:

- safeguard habitats and sanctuaries
- safeguard connection axes and keep them clear in order to facilitate genetic exchange and to provide additional withdrawal areas
- safeguard landscapes with high (local) recreation value and their connections
- keep areas clear where high risk of exposure to the forces of nature is given
- safeguard climatic compensation areas in order to improve the quality of the environment

3 WHY A MULTIFUNCTIONAL APPROACH?

According to the Birds and Habitats Directive, numerous protected zones have been established in the European Union within the past years. For most of the animal and plant species the currently existing conservation areas are getting too small, because of specific species requirements, as reproduction, migration etc. Only to secure isolated sanctuaries is not sufficient enough, it is also necessary to ensure the preservation of biological biodiversity. Thus, a further important step is to establish a continuity of PA's (Protected Areas) in an integrated transnational "Green Network".

Within the scope of a professional cooperation between spatial planning and (wildlife) ecology in the pilot region Styria, the approach of developing and securing green zones and habitat corridors is put into practice. A professional, faultless demarcation of green zones and living space corridors is essential for a funded argumentation within the scope of defining areas in spatial planning.

The basis is the multifunctionality of open spaces. Apart from ecological corridor and habitat functions, open space also fulfils numerous positive functions for humans regarding social welfare and recreation. Between these functions, numerous synergies exist and the additional value of these areas should be highlighted in the results of this project. Besides the already mentioned functions of open spaces, the productive function (e.g. agricultural or forest areas) is of high importance. In Styria these areas are already under protection by means of the so called "agricultural priority zones" of the spatial planning instruments. The approach of protected agricultural areas against urban sprawl forms the basis for a country-wide protection of landscape-ecologically valuable areas. If operating as important wildlife corridor, intensively used agricultural land is included into the results. A separate process is used to declare certain areas as "ecological corridors" or "agriculturally used zones" in spatial planning.

Therefore, intensive production areas are not considered in the subsequently presented method.

The focus of the Styrian Nature Conservation Act lies on the protection of areas and species, but lack the consideration of living space corridors. Further, planning regulations for the entire federal state, respectively for areas between protected zones, are hardly to define.

One basic principle of spatial planning in Styria is to establish a balance between interests of settlement development and the utilization of open space. Spatial planning, as an interdisciplinary matter, supports nature conservation by securing ecologically important structures between protected areas (cross-linking requirements) and by implementing area management. Within the scope of the Regional Development Programs (REPRO-“Regionales Entwicklungsprogramm”), priority zones for different utilization (e.g. green zones) are to be defined.

The subsequently drafted method requires a strong co-operation between experts in spatial planning and ecology.

4 GENERAL AIMS AND FUNCTIONS OF THE “GREEN NETWORK”

Despite the efforts of establishing protected areas, biodiversity is continuously declining in the European countries. The main reasons are the destruction of natural habitats and the deterioration of cultural landscapes combined with the fragmentation of vital areas for fauna and flora. These phenomena become obvious mainly outside of protected areas. Areas without a special protection status which are farmed, used or urbanized, are of major importance and have to be connected (Federal Agency for Nature Conservation, 2010).

The connection between high-valued physical regions needs to be secured. This challenge needs a common vision and can only be implemented successfully when different actors/stakeholders and disciplines pursue a common European-wide aim together, using coherent strategy.

The main aims of the “Green Network” are

- Protect habitats and biocoenosis (ecosystems)
- Safeguard native fauna and flora (e.g. protection of a reproductive population)
- Safeguard, restore and develop the ecological functions in and between protected areas, as well as between protected and other areas of outstanding natural beauty.

The “Green Network” consists of core areas, corridors and connecting elements (stepping-stone biotopes). The defined aim of the Styrian approach fits in the interdisciplinary methodological approach. It is obvious that green zones and living space corridors, that have to be secured, fulfill multiple functions. Thus the overall focus is set on following main functions:

- **Ecological function** (protection of natural and cultural landscapes)
- **Connecting function** of corridors
- **Recreational function** (local recreation close to urban settlement areas)
- **Common benefit** (social welfare- and protective function, such as climate effective areas, retention areas to protect settlements e.g.).

According to the multifunctional approach of the presented “Styrian approach”, the following aims have been defined:

- Maintenance and safeguard of ecosystem functions for protected areas, ecological core areas, corridors and stepping-stone biotopes:
 - a. in terms of exchange between population to avoid inbreeding
 - b. in terms of genetic exchange and
 - c. as additional retreat area
- Definition of zones with recreational function and the connection between them (main focus on the central region and urban areas):
 - d. Safeguard landscapes with high recreational value
 - e. Establish and ensure „recreational qualities“ and thereby maintain the area's character
 - f. Establish and ensure connections between landscapes with high recreational value and settlement areas
- Definition and protection of areas with protective and common benefit function
 - g. Protection of settlements against natural hazards
 - h. Assurance of climatological compensation-areas and enhancement of environmental quality (particularly in rehabilitation zones according to the Immission Control Act).

WORKFLOW OF THE STYRIAN APPROACH

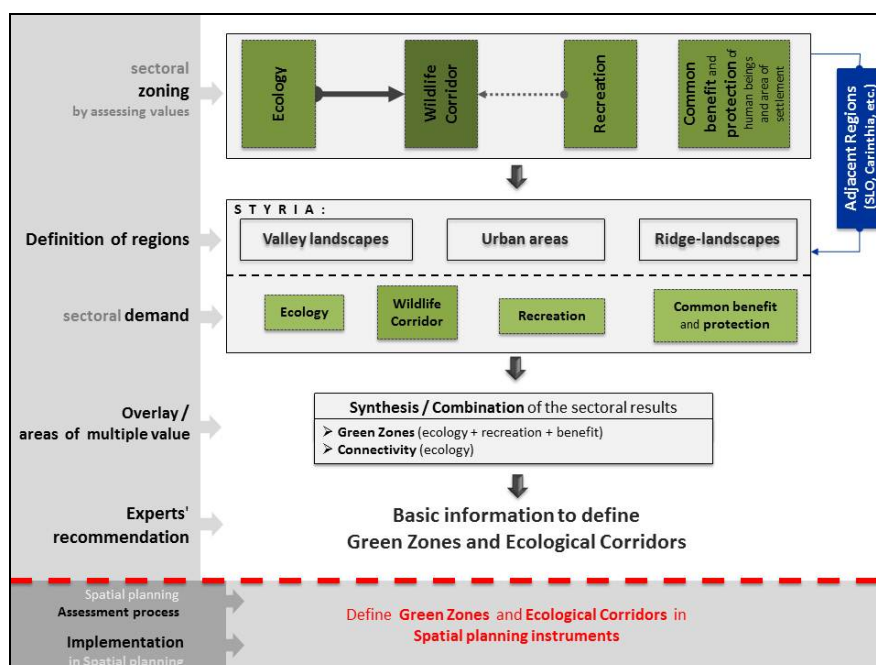


Fig.: Workflow of the Styrian approach

The proposal of the expert for the demarcation of green zones and living corridors is based on the following four working steps:

- 1) Sectoral zoning: in the four sectors of ecology, networking, recreation, protection and welfare functions a method corresponding to the respective professional standards and the quality areas is analyzed. Connecting routes as sectoral value maps and important habitat corridors are shown.
- 2) Partial space separation: caused by the different natural and socio-economic conditions, Styria has a very different settlement and land use structure. In Upper Styria, the settlement area is limited throughout the valley. In the hilly Eastern and Western Styria more urban sprawl trends are possible. Around the urban centers there is an increasing pressure on the remaining open spaces.
- 3) Sectoral green zone requirement: a cross table is elicited and presented by a combination of sectoral value cards .
- 4) During the synthesis the four partial results were combined and produce a first technical proposal for the delimitation of green zones and habitat corridors. The technical draft has been enhanced as part of a consultation process with the knowledge of regional experts. The aim of the regional expert workshop was to upgrade the separation carried out in advance with the regional expertise and to pass on the project idea and results to the regions.

As a result of the project NATREG Styria, there is an expert proposal for the demarcation of green zones and habitat corridors. The actual spatial planning process for consideration of binding demarcation and regulation of green zones and habitat corridors occurs during the making of the Regional Development Program (REPRO).

5 PROCESSING PRINCIPLES

Definition of regions

Depending on geomorphology and utilization, each country offers a wide range of various landscapes such as mountains, hilly areas, highlands, coastal areas, wetlands etc. The very diverse utilization in permanent settlement areas entails a high consumption of area. Especially, zones in inner-alpine valleys and around congested areas stay under high anthropogenic utilization pressure. Thereby, natural mitigation of wildlife is strongly affected and can even be inhibited to some extent. In the previously defined regions quite heterogeneous utilization-intensities are registered.

Based on the geomorphological conditions and the anthropogenic utilization, Styria is divided into two major geographic regions, the alpine Upper Styria and the non-alpine ridges of the so called Eastern and Western Styria.

In Upper Styria, settlement is mainly located in the valleys. The ownership structure is more spacious than in the cultural landscapes of Western and Eastern Styria. Inner alpine valleys offer a wide net of main traffic infrastructure demonstrating strong barriers for fauna and flora. Anthropogenic caused fragmentation is concentrated in these inner alpine valley landscapes. Higher reaches, on the other hand, offer a high ecological potential with lower anthropogenic influences.

Within the hilly landscapes of Eastern- and Western Styria, anthropogenic utilization is distributed quite differently, e.g. settlement areas predominantly develop in valleys as well as on hills. The diverse mosaic of landscapes in this area is based on the different land utilization structures (specialized cultivation of different crops: vineyards, fruit-growing, crop-farming,

grassland, settlement areas, etc.), the small-scale structure of plots and the prevailing ownership structures. In these sub-regions, it is especially difficult to safeguard areas that have been influenced by human activities only to a low degree. Favorable settlement areas are situated in valleys as well as on the top of the hills. Due to anthropogenic utilization, Eastern- and Western Styria is divided into small sections and show a high degree of fragmentation. The road network is close-meshed and settlement densities are higher than in Upper Styria.

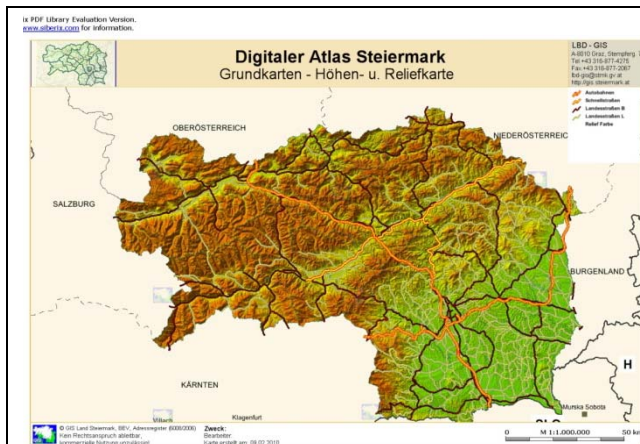


Figure: Altitudinal and relief map of Styria

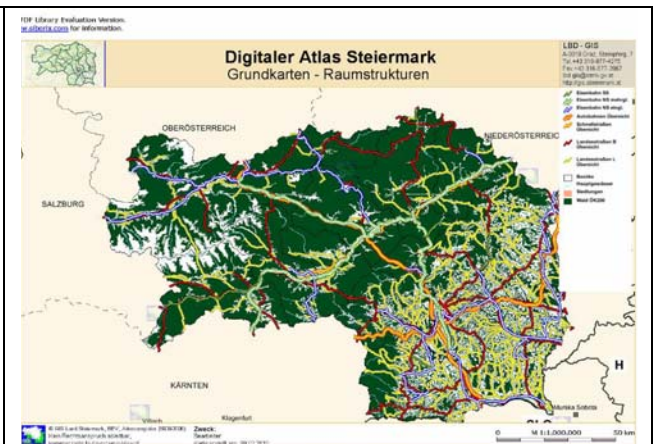
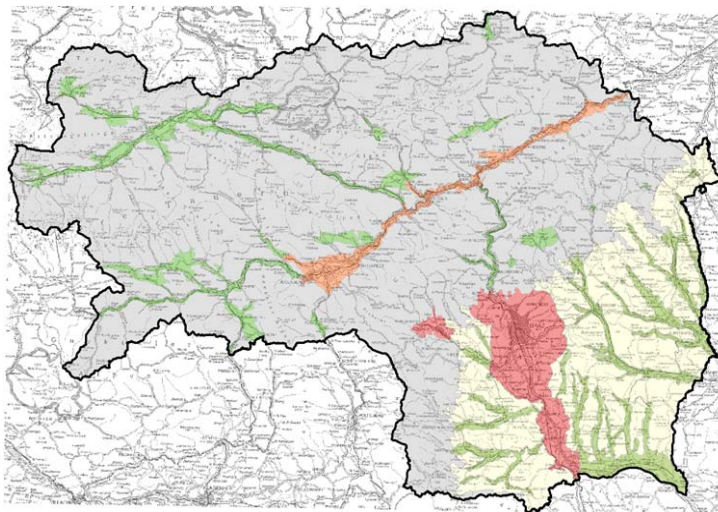


Figure: Spatial structures of Styria

The comparison of the two major geographic regions of Styria (Upper Styria; Eastern and Western Styria) shows the degree of regional differences and the necessity to define connecting areas.

For different regions indicators and criteria, which are necessary to distinguish sectoral green zones, are assessed in a miscellaneous way. Furthermore, the method to demarcate habitat corridors has to be adjusted according to the conditions of the respective region.

Concerning these aspects, a classification of the number of regions is conducted. Independent from administrative restrictions, these regions represent connected landscape units. The definition of homogenous landscape areas is necessary to answer the dominant, spatial related question of connecting habitats. This allows the adjustment of the validation of selected assessment indicators according to the particular (sub) region.



- Alpine area (grey)
- Alpine urban zones (orange)
- Central urban zone (red)
- Alpine – and non-alpine valleys (green)
- Ridges / Hills (yellow)

Figure: Styrian regions

Sectoral Processing

The principles and objectives are based in the Styrian Spatial Planning Act (STROG 2010) as analysis and definition of green zones and habitat corridors.

The high-quality areas in the four sectors are determined by GIS analysis. The presentation of the sectoral results are shown in sectoral value cards (e.g. a map of the ecological value).

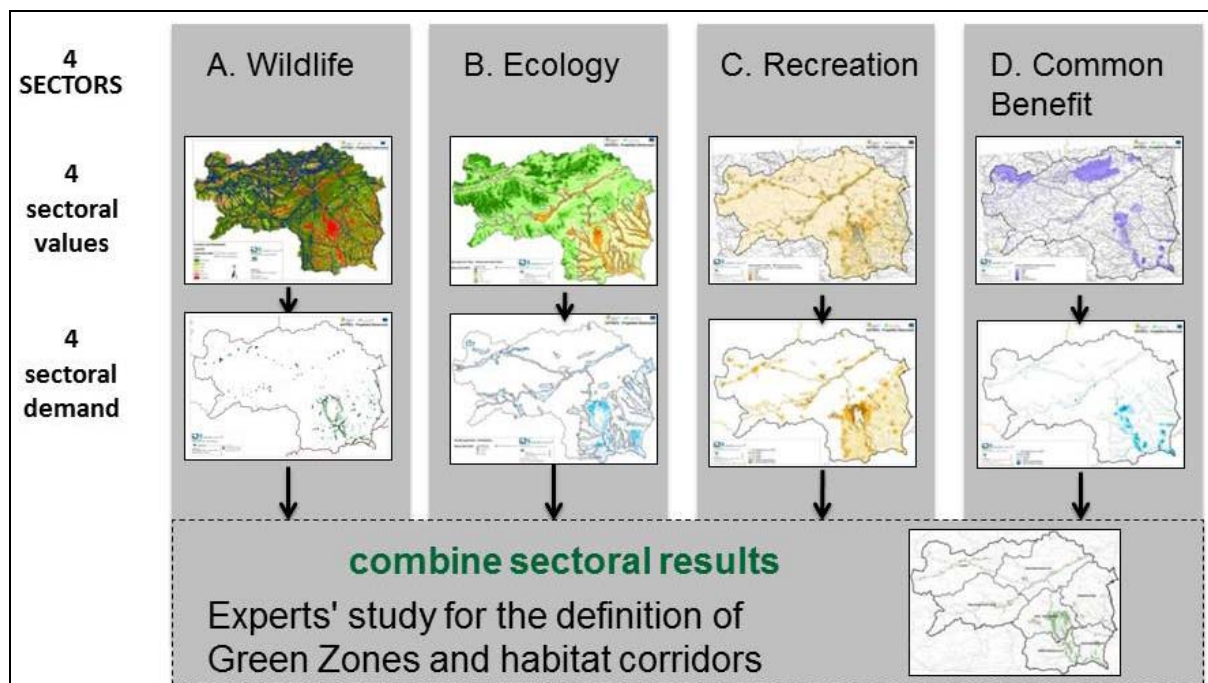


Figure: Sectoral results

To demarcate the green zones and habitat corridors, it is necessary to upgrade or devalue the identified ranges of values according to the pressure of utilization. This is done by

means of a crosstable in which the sectoral values are set in spatial relationship to the subspaces, and thus report a sectoral green zone requirement.

GIS-modeling

The model was designed in that way that it can be used with input data of different scales, since the required input data are available in different levels of quality. The quality of the result based on the homogeneity and quality of data input. The larger the scale of the input data and more current and interdisciplinary input data is available, the more accurate are the results, the maximum required output scale should not be exceeded. The result of the Styrian part of the project is mapped as a grid 100x100m with the focus on an issue scale of 1:50,000.

6 SYNTHESIS OF SECTORAL RESULTS

Considering the diverse sub-regions of Styria, each of the four sectors has a “sectoral green zone demand”. The results are illustrated in a 100x100 m raster map with consistent coding.

By using raster analysis and reclassifications of sectoral results, a synthesis raster with a comprehensive overall appraisal is compiled. By using a comprehensive coding – similar to the Austrian Forest Development Plan – sectoral values can be identified for each raster cell, respective subspace, of the overall result.

The technical basis for the determination of green zones and living space corridors results from the respective subspace which at least contains 1 x 3 respectively 2 x 2 in its coding.

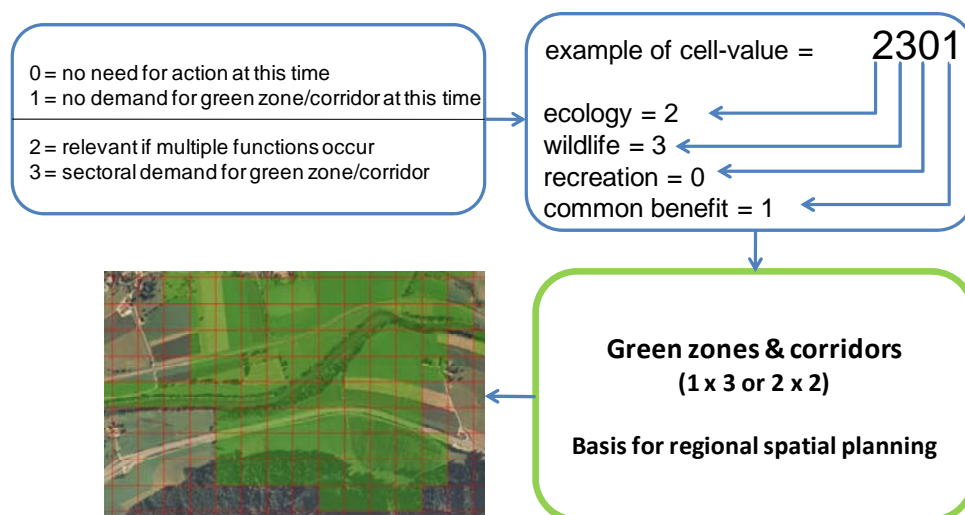


Figure: Synthesis – encoding of sectoral information

Synthesis result

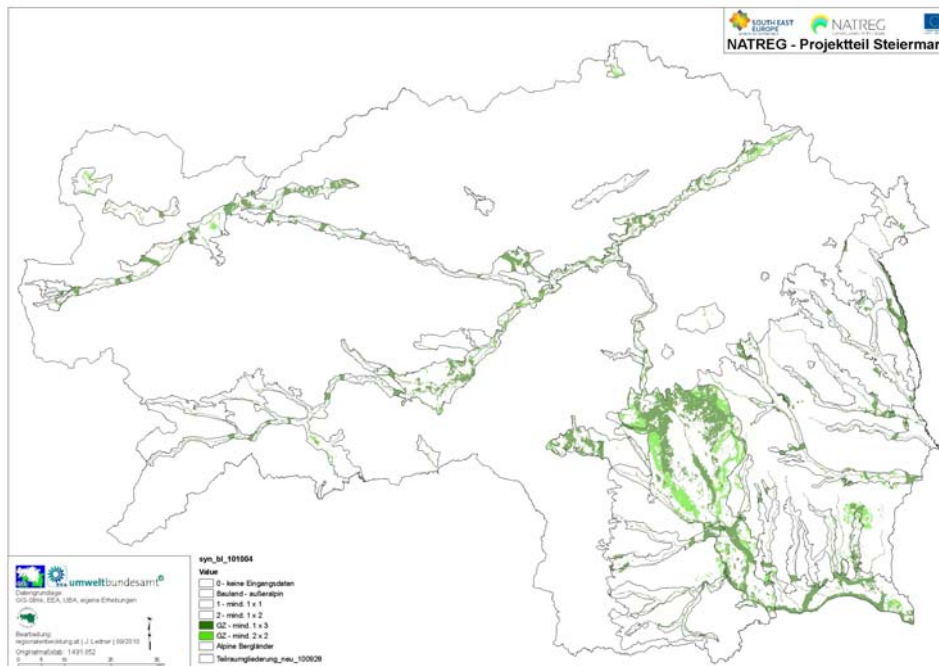


Figure: Synthesis result: multifunctional green zones and living space corridors in Styria

The figure presents the preliminary result of the experts' proposal for demarcating green zones and living space corridors. The graphic shows the high-value and multifunctional green zones and living space corridors in the Styrian regions with high anthropogenic utilization. These areas demonstrate a strong need for protection by means of spatial planning instruments. Extensive high-value regions, as e.g. the alpine regions of Upper Styria, are not part of the results, because those regions show only small-scale anthropogenic fragmentation or settlement structures.

Apart from the last-mentioned, all identified high-value regions need to be kept free from anthropogenic utilization pressure and therewith connected landscape fragmentation, to secure the connection of living spaces and establish the "Green Network" in Styria.

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DETECTING GAPS – GIS-BASED INVENTORY OF ECOLOGICAL NETWORKS IN SELECTED CENTRAL EUROPEAN BORDER REGIONS

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ABSTRACT

Within the project TransEcoNet (Transnational Ecological Networks in Central Europe, <http://www.transeconet.eu/>) the transnational network of ecological important areas in border regions within Central and Eastern Europe is analysed. The area under investigation stretches from the Baltic Sea to the Ukraine and to the Adriatic Sea, covering the NUTS3 regions (Nomenclature of Territorial Units for Statistics, level 3) adjoining selected inner Central European national boundaries. The analyses are based on spatial data and are performed using a Geographical Information System (GIS). After collecting and harmonising national data as well as European data sets of protected areas all areas were classified according to the international standard provided by the categories of IUCN (International Union for Conservation of Nature). Following these basic data preparation steps, a gap analysis was performed. Within the TransEcoNet project gaps were defined as unprotected areas with high natural value (oligotroph and selected mesohemerober land use types). The methodology is based on an unspecified species approach and 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 among each other. The performed analysis shows a way of how to connect protected areas across borders with each other, because they are often too small to allow for the persistence of viable population of species. Connecting networks of protected sites may increase species' persistence; therefore, 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 our gap analysis focuses on connecting protected areas via potential suitable habitat corridors and potential corridors of protected areas. In a further step existing European, national and regional network plans for ecological networks were identified and overlaid with the allocated gaps. The results of the latter analyses are highlighted within this paper.

1 INTRODUCTION

Protected areas such as national parks, nature parks and biosphere reserves are often isolated “islands” for protecting the world's biodiversity. They are separated by weakly protected and unprotected landscapes, traffic corridors as well as settlements. It is often the case that animal and plant species dispose of less space for migration, dispersion and reproduction than necessary. To preserve both natural and cultural heritage in the long run, the TransEcoNet project is thus striving for a better connection of protected landscapes with those that are weakly protected and unprotected 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 [1].

The performed analysis shows a way of how to connect protected areas across borders, because they are often too small to allow for the persistence of viable population of species. Connecting networks of protected sites may increase species' persistence; therefore, 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 [2]. For that reason our gap analysis focuses on connecting protected areas via potential suitable habitat corridors and potential corridors of protected areas. Corridors are understood as any space identifiable by species using it; and any space that facilitates the movement of animals or plants over time between two or more patches of otherwise disjunct habitats [3].

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 we define gaps as areas with high natural value (oligotroph and selected mesohemerober land use types) according to the definition of Dudley and Parish [4]. The aim is to embed valuable areas into the ecological network through the enlargement of protected areas and the protection of stepping stones and therefore to improve the connectivity. Because most of the relevant areas concerns less productive areas it should be easier to extensify these areas and incorporate them into the ecological network as a crucial part for increasing the connectivity.

The gap analysis is usually applied to fairly large areas, because this allows decisions about conservation to be made with the best available information and on the basis of ecological rather than political boundaries [4].

1.1 Study area and database

The project's study area is situated within or rather between the wide-ranging ecological networks of the Alps, Carpathians and the European Green Belt. The investigation area (figure 1) consists of NUTS 3 regions that adjoin the borders between Germany, the Czech Republic, Poland, Slovakia, Ukraine, Austria, Hungary, Slovenia, Italy and Croatia.

Since the database serves as the basis for the analysis, an attempt was made to collect the national databases on protected areas from the relevant countries. For the Natura 2000 sites we used the databases from the European Environment Agency [5] as well as for the countries where we could not obtain a national dataset. In the case of Ukraine, we used the World Database on Protected Areas (WDPA). During the data preparation process, we combined the national, European and WDPA datasets and harmonised them along the borders using GIS methods. Further data from the European Environment Agency (EEA) (CORINE landcover data), the IUCN (species data - mammals, reptiles and amphibians, [6]) and Birdlife International (species data – birds, [7]).

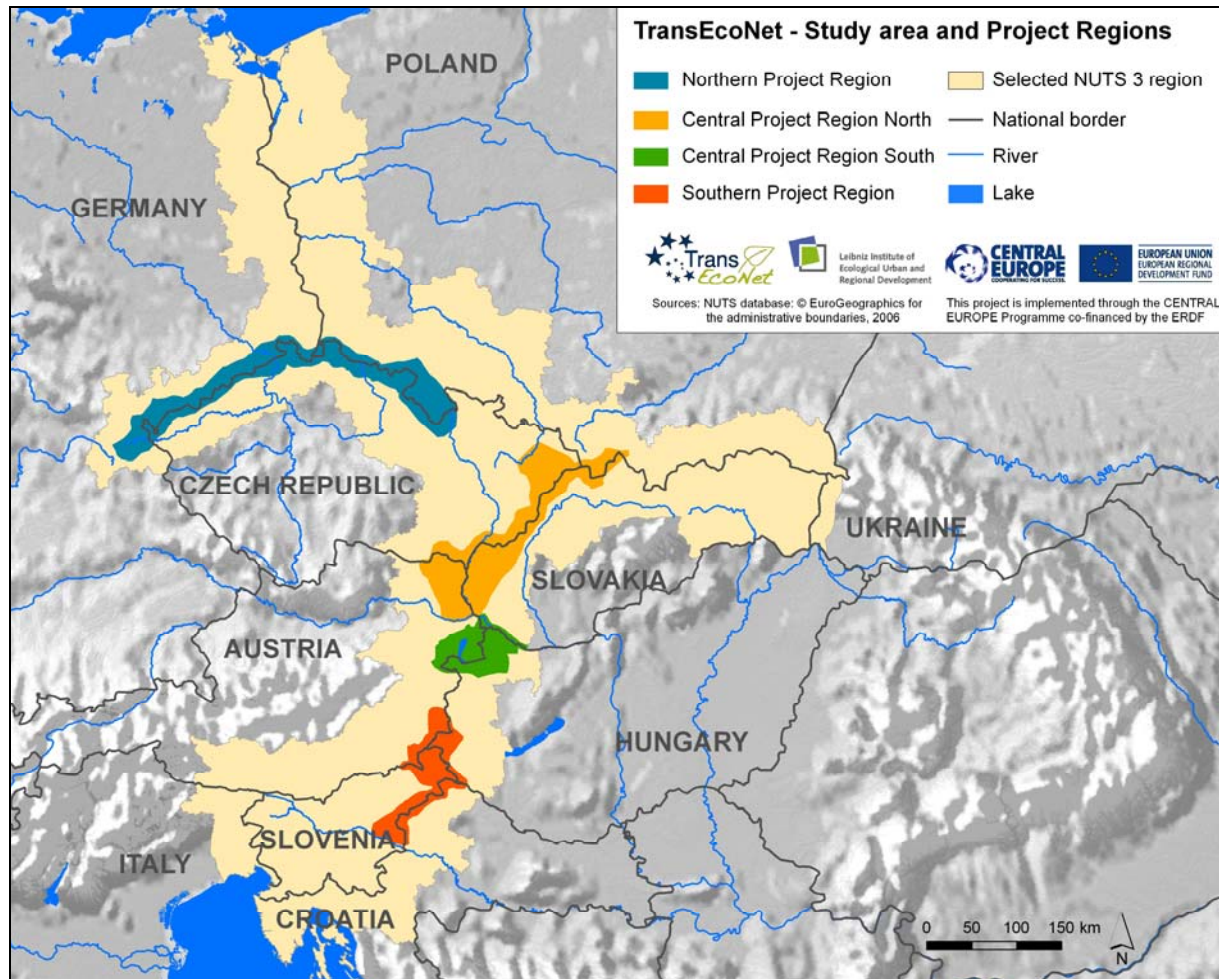


Figure 1: Location of the TransEcoNet study area

2 METHODOLOGY

Dudley and Parish (2006 [4]) define six key steps in a protected area gap analysis. In our gap analysis (figure 2) we followed these key steps but we used easily accessible data on ecosystems (CORINE land cover data set classified through a hemeroby index which we used as a proxy for non-available data on ecosystems respectively biodiversity for the investigation area) as well as worldwide accessible species data (IUCN database). We combined a corridor/habitat approach (identification of existing and potential habitat corridors) with a species occurrence approach (number of threatened species of mammals, birds, reptiles and amphibians) for the prioritisation process [8], [9].

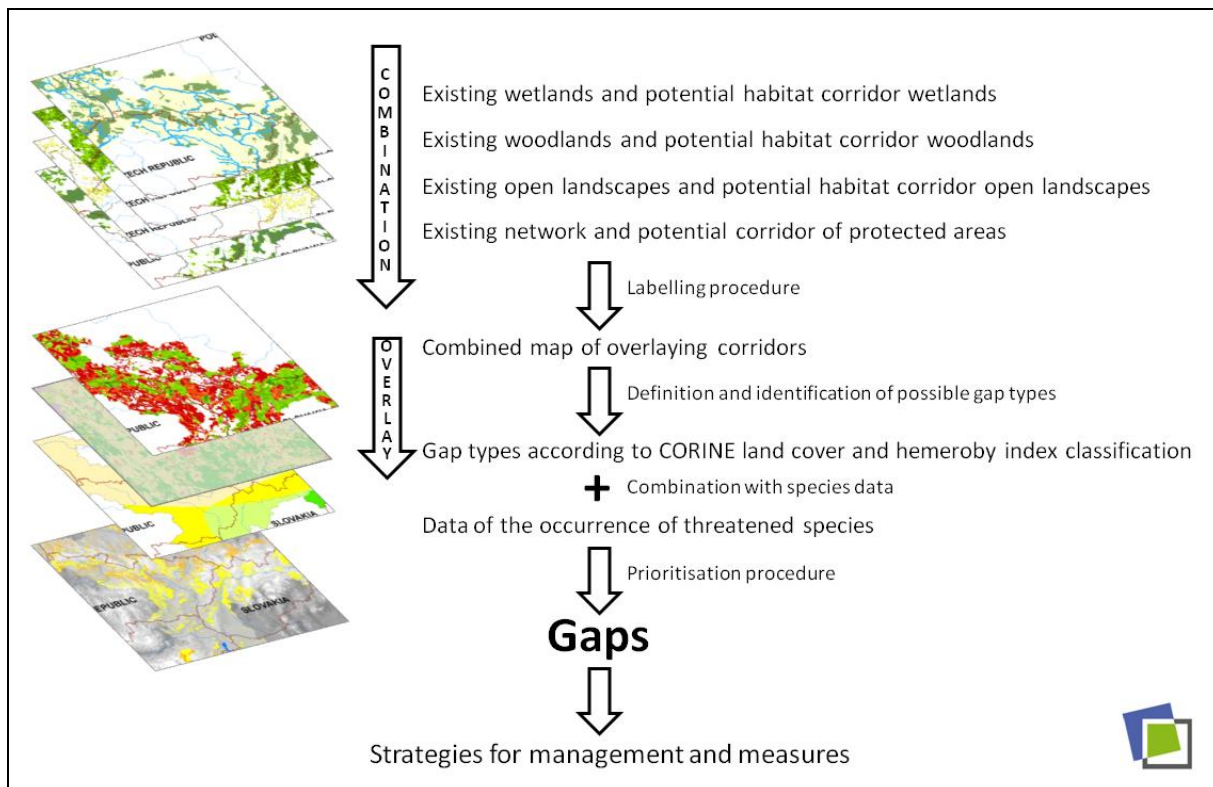


Figure 2: Methodology of the gap analysis [8]

In a further step the gaps were overlaid with existing European, national and regional plans for ecological networks. The following datasets were used for the analysis:

- European biotope corridors:
 - European Ecological Network (EECONET)
 - Pan-European Ecological Network (PEEN)
- National biotope corridors:
 - National Ecological Network (ECONET-POLAND)
 - EECONET Czech Republic
 - Territorial System of Ecological Stability (TSES), Czech Republic
 - Territorial System of Ecological Stability (TSES), Slovakia
 - Habitat network (Habitatnetzwerk), Austria
 - National Ecological Network (Nemzeti Ökológiai Halozat, NOH), Hungary
- Regional biotope corridors:
 - Search areas for biotope corridors in Saxony, Germany

For Slovenia no network plans were considered because the important ecological areas of Slovenia were already included within the network of protected areas.

The gaps and existing plans for biotope corridors and network plans were overlaid and the following five categories were defined:

- TransEcoNet gaps corresponding with European, national and regional network plans
- TransEcoNet gaps not corresponding with European, national and regional network plans (only TransEcoNet gaps localised)

- Corridors only identified by European, national and regional network plans (no TransEcoNet gaps defined)
- Network of protected areas
- Areas with less nature value

3 RESULTS AND DISCUSSION

The overlay of gaps identified by TransEcoNet with existing European, national and regional plans for biotope corridors and network plans is different in every project region because of various statuses of existing networks plans (figure 3 **Fehler! Verweisquelle konnte nicht gefunden werden.**). For example no network plans exist in Slovenia whereas two different network plans are available for the Czech Republic (EECONNECT and TSES). The least corresponding TransEcoNet gaps with existing network plans are situated in the Southern Project Region, only 2.0 %, because of no network plans for Slovenia and in the concerned part of Austria. In all other Project Regions the percentage of gaps which corresponded with existing plans for biotope corridors and network plans is between 6.9 and 9.3 %.

The results of the correlations of the gaps and the existing plans for ecological networks for the examples of transboundary Project Regions Central North and Central South are illustrated in figure 4.

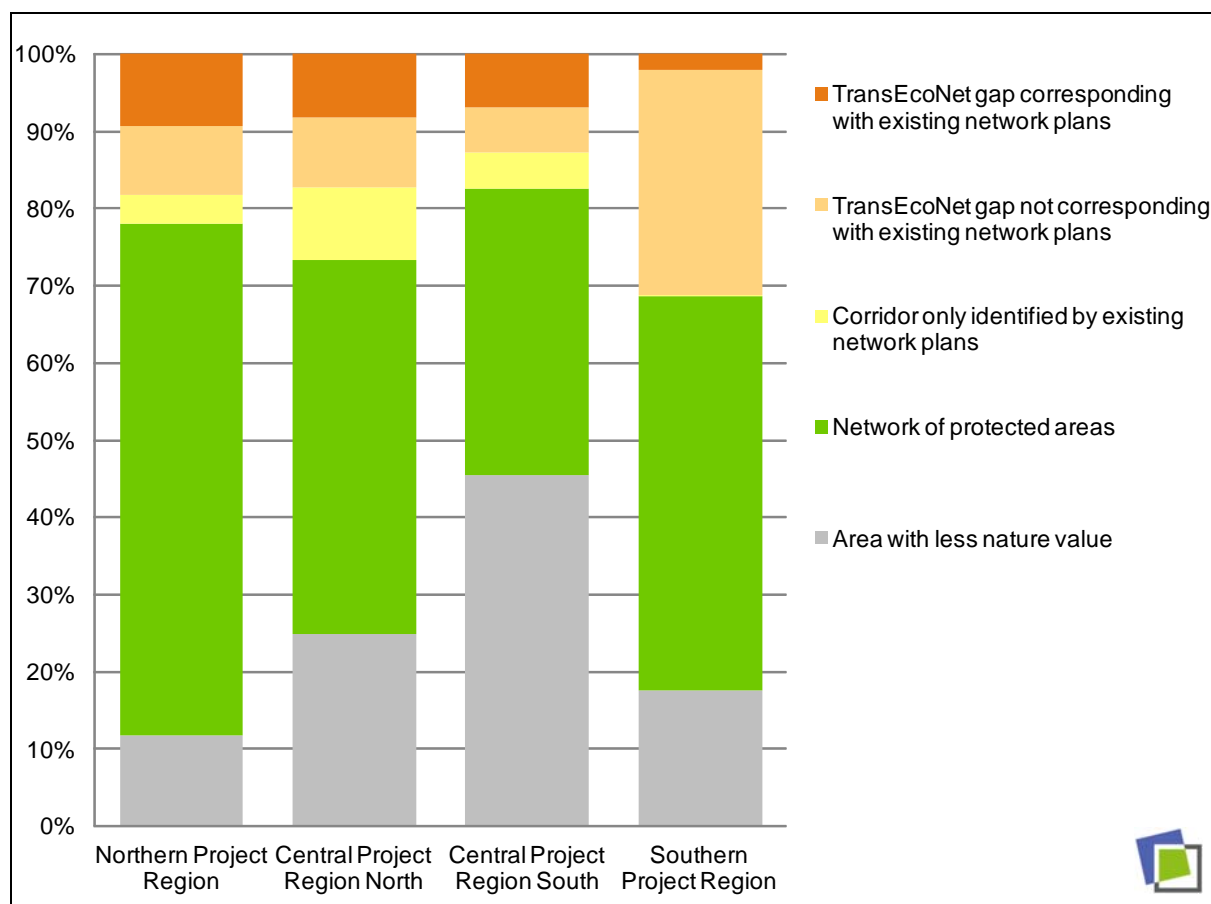


Figure 3: Statistic results of the overlay of gaps identified by TransEcoNet with European, national and regional network plans (interlinked system of biotopes) for all four Project Regions

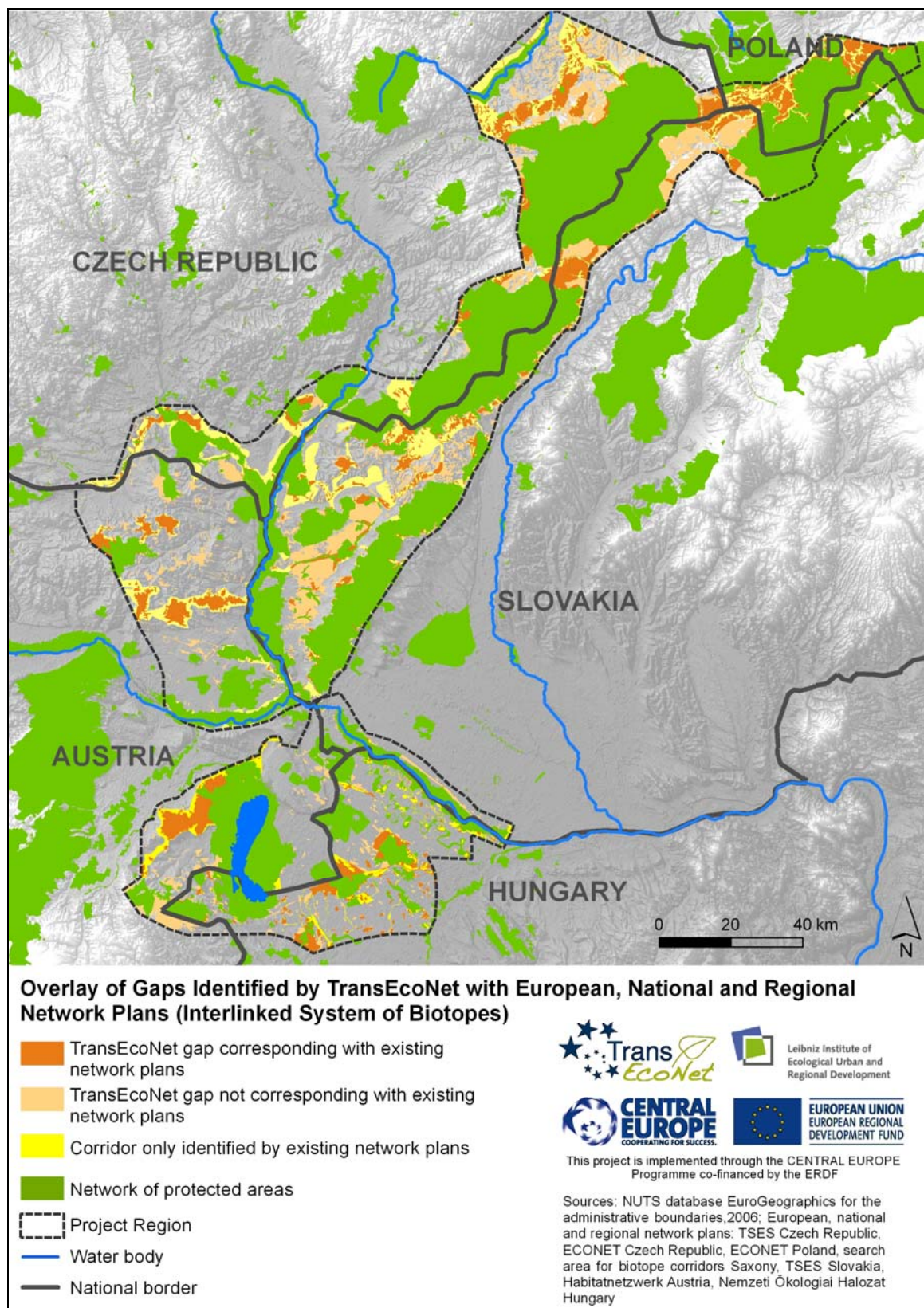


Figure 4: Map of the overlay of gaps identified by TransEcoNet with European, national and regional network plans (interlinked system of biotopes) for the Central Project Region North and South

4 CONCLUSIONS

The results of the gap analysis were overlaid with existing plans for ecological networks to illustrate the correlation between our methodology based on free and easily accessible data on a large European scale and other methods used in Central Europe (TSES, EECONET, NOH, biotope corridors of Saxony) to distinguish ecological networks. The analyses indicate the weaknesses of the current situation as well as the potentials for further development of the network of protected areas as the backbone of ecological networks. To face the still existing challenges of preserving and extending the ecological network the implementation of joint transnational strategies like the Convention on Biological Diversity (CBD) or Natura 2000 need to be strengthened and supported by cross-border cooperation. Taking these actions may allow closing some of the gaps within the green networks.

It also gives an overview of areas with high nature value which are currently not adequately protected within the European protected area network. To ensure the preservation of these valuable areas the elimination or prohibition of land use intensification of should be one of the foremost strategies. Other important strategies are the de-intensification of land use, forests conversion and the preservation, maintenance and replanting of landscape structures such as hedges, tree rows, small woodlands, individual trees, dry stone walls, rock fragment piles, mixed orchards, and wetlands.

The cross-border cooperation and the harmonised transboundary database for the ten countries involved is one of the achievements of the project. The results of the analysis offer an overview of the large scale cross-border connectivity of the protected area network in Central European countries. This provides the basis for the development of common plans and strategies for ecological networks and biotope corridors across national borders as well as further analyses. Thus, the goal of linking habitats as demanded by the CBD programme can be supported, especially across national boundaries.

The results presented here represent only a subset of the overall results achieved during the investigation of the ecological network of Central and Eastern Europe within the TransEcoNet project. Further results can be found in various publications, e.g. [8], [9], [10].

ACKNOWLEDGMENTS

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ECOLOGICAL NETWORKS: POTENTIAL OF AGRICULTURAL LANDSCAPES

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ABSTRACT

Agricultural landscapes are important biodiversity areas, and ecological networks can significantly contribute to biodiversity in these areas. The promotion of ecological networks and corridors are perceived as efficient nature protection policy instruments in Europe and all around the world. However, the number of researches is limited with regards to designing ecological networks in agricultural landscapes. Assessment of general site characteristics is vital in this endeavor, as they can influence the kinds of species that use the network, as well as the long term viability of corridors and the communities that depend on them. The purpose of this study is to investigate the structure of agricultural landscapes in the Big Meander (Soke) Plain, Turkey. Initial findings from site observations and GIS works are presented in this paper. Major habitats include Dilek Peninsula, Big Meander Delta, Bafa Lake, Azap Lake and their surroundings. Big Meander traverses the Soke Plain and forms the most important ecological corridor in the agricultural landscape. Other natural corridor types are remnant meander parts and seasonal creeks. Whilst narrow strips of mainly herbaceous vegetation are left between agricultural plots, hedgerows and windbreak corridors are rare. Infrastructure corridors such as roads, drainage and irrigation canals provide some opportunities for green network formation in the study area. Enhancement of these corridors may propose important opportunities for establishing an ecological network in the study area.

1 INTRODUCTION

The importance of ecological networks in sustainable resource planning and management is increasing. Agricultural landscapes could be an indispensable element of ecological networks due to their ecological, economic and social values. Agricultural landscapes are important biodiversity areas, and ecological networks can significantly contribute to the biodiversity in these areas. The promotion of ecological networks and corridors are perceived as efficient nature protection policy instruments in Europe and all around the world. Great numbers of initiatives has been taken in this regard (The Pan-European Biological and Landscape Diversity Strategy, Pan-European Ecological Network – PEEN, the EU Habitats Directive, the Birds Directive, and the EU Biodiversity Action Plan for Agriculture). On the contrary, the number of initiations and scientific research is limited in Turkey. Also, no research exists on ecological networks in agricultural areas in the nation. Turkey's institutional environment lacks legislations related to the protection of biodiversity in agricultural landscapes. These areas, without any conservation status, are not considered potential areas for biodiversity and nature protection. Agricultural landscapes are not manifested in the legislation of related agencies as tools for the protection of biodiversity.

The purpose of this study is to investigate the structure of agricultural landscapes from an ecological network planning point of view. Specifically, the goal of this case study of Big Meander (Soke) Plain is to identify possible core areas and corridors based on geomorphology, cultural and natural disturbance regime, and protection status. Assessment of general site characteristics is vital in establishing networks in agricultural landscapes, as they can influence the kinds of species that use the network, as well as the long term viability of corridors and the communities that depend on them. Located in the Aydin Province, the study area, Soke Plain, is one of the prominent agricultural areas of Turkey (Figure 1).

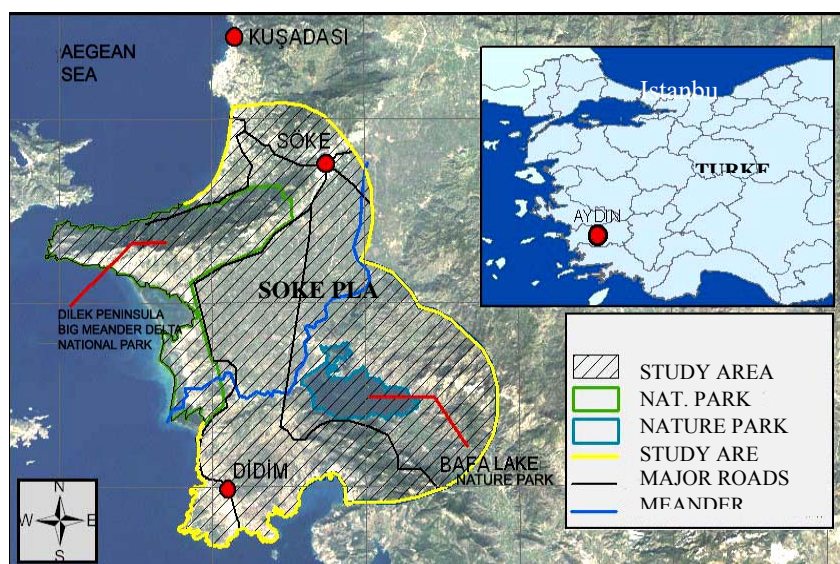


Figure 1: Study area

Soke Plain lays in between two important legally protected areas, Dilek Peninsula-Big Meander Delta (DYBMD) National Park and Bafa Lake Nature Park. Accordingly, the establishment of an ecological network in the agricultural landscape can contribute to the sustainable protection of the neighboring ecologically important areas.

2 MAIN CHARACTERISTICS

Study area contains mountainous, hilly, and flat physiographic formations (Figure 2). The conglomerations of alluvial sediments brought by hydrological flows and surface run off has filled the Menderes graben and formed the Big Meander Delta and Soke plain where the topography ranges between 1m. at the delta, to 8-10 m. in inner areas of the Soke plain. Two mountain series make contrast to the plain: Samsun Mountains on the north, and Menteşe Mountains on the south. Numbers of legally protected areas are located on the north, south and west of the study area. These areas are internationally recognized for their high biodiversity, and constitute core areas of this study.

2.1 Core areas

Potential core areas of the study include Dilek Peninsula, Big Meander Delta, Bafa Lake and Azap Lake.

Dilek Dagi Mountain stretches towards the Aegean Sea and rises to 1237 m. There exist significant temperature differences between the south and north sides of the peninsula. This means that plants belonging to no less than four different regions are to be found in close proximity here. As well as typical Aegean vegetation there are many plants normally more at home in the Mediterranean, Marmara and Black Sea regions. Red pine, Phoenician juniper, sumac, a variety of wild pear, myrtle, cornelian cherry, oak, chestnut, linden, ash, and many more species coexist here. The area was declared as a national park in 1966. The national park covers an area of 10985 ha. and is a European Flora Biogenetic Reserve.

The Big Meander Delta, south of the peninsula, is a vast wetland of international importance for wildlife. With its marshes and lagoons, the Menderes Delta is said to have taken 23 million years to form. In the delta, flamingos and 208 others species of birds are to be seen at different times of year. Of these, 76 species breed here. The delta's Karine, Kocagöl and Kabahayit lagoons are divided from the sea by narrow sand banks. Fresh and salt water mingle in the lagoons, which therefore exhibit extraordinary biological diversity. Due to its high biodiversity the area is declared as a national park in 1994. Covering an area of 16690 ha., The delta of Big Meander River has international importance and protected by international agreements due to its endemic species and biologic richness.

Bafa Lake was one of the busiest bays of the Aegean Sea (Gulf of Lade) in the 7th century B.C. The sediments brought by the Big Meander River slowly separated the bay from the Aegean sea by the 1st century A.C. The lake is 6721.5 ha. and its altitude is 2m above sea level (maximum 25m depth). The lake is primarily fed by the floods from the Big Meander River. In 1994, the lake and its surrounding was declared as a nature park (12281 ha.). Bafa Lake Nature Park consists of 325 plant species belonging to 80 families. Among these, 16 of them are endemics. In terms of the fauna, 295 vertebrate species are in the protected species list of various international treaties. The area is rich in bird species due to its location on the major bird routes: 260 water bird species are detected in the park [1]. The area is a wintering site for Great crested grebe, Black neck grebe, Dalmatian pelican, Pochard, and Eurasian coot [2]. The Dalmatian pelican that is represented by only 2000 individuals all around the world has the world's third largest colony in the adjacent Big Meander River corridor and utilizes Bafa Lake for food. Azap Lake is an important wetland. Bird species coming to Big Meander and Bafa Lake area also utilizes this lake. The lake does not have any protection status and is becoming smaller in area year by year.

2.2 Corridor types

There exist three types of corridors in the study area: natural corridors, semi natural corridors and infrastructure corridors. Big Meander traverses the Soke Plain and forms the most important ecological corridor in the agricultural landscape. Other natural corridor types include remnant meander parts and seasonal creeks (Figure 3). The Big Meander River rises in west central Turkey near Usak before flowing west through the Big Meander graben until reaching the Aegean Sea (548km). Its depth equals its breadth in most parts. Meanders are most often formed in alluvial materials (stream-deposited sediments) and thus freely adjust their shapes and shift downstream according to the slope of the alluvial valley.



Figure 2: Vegetation characteristics along Big Meander corridor (left); meanders (center); and small creeks (right)

Semi natural corridors mainly include narrow uncultivated strips between agricultural plots (Figure 2). Vegetation in these corridors is mostly herbaceous. Unlike examples from other countries in Europe and America, the agricultural landscape lacks in hedgerows and planted windbreaks in the Soke Plain. The rare occurrence of such corridors displays a discontinuous structure.



Figure 3: Semi natural corridors with herbaceous plants (left); discontinuous hedgerows (center), planted windbreaks (right)

Infrastructure corridors pass through substantial amount of landscapes, therefore those corridors such as roads, drainage and irrigation canals provide considerable opportunities for green network formation in the study area (Figure 3). Road corridors can be divided into major road corridors and dirt road corridors. Canals can be divided into irrigation and drainage canals. Each infrastructure corridor has its own vegetation characteristics and structure, hence adapted by different animal species at some certain degree.



Figure 4: Infrastructure corridors, an irrigation canal (left); a drainage canal (center) and a road corridor (right)

Analysis done in the GIS and remote sensing environment showed that all together natural, semi natural and infrastructure corridors constitute approximately 30 percent of the Soke Plain. This percentage is higher than most of agricultural cases in Turkey and Europe, and is really promising for establishing ecological networks, if ecological integrity of these corridors are improved.

2.3 Land use change and major disturbances

A major study on detecting landscape change in the study area between 1993 and 2005 showed fragmentation and its consequences in the study area [3]. Major drivers of the landscape change was urbanization, agriculture, grazing, fire, and clearing of original vegetation for heating and timber. The legally protected areas (core areas) were less affected by these impacts due to their protection status.

Nevertheless, there are many issues threatening the ecological integrity in the core habitats of the study area. For instance, Dilek Peninsula National Park faces significant challenges such as fire, water pollution, over grazing and hunting, exceeding visitor capacity during summer months. Big Meander River and its delta are suffering mainly from pollution, resource overuse for irrigation, hunting, and agricultural intensification. The dynamics of the aquatic systems of Bafa Lake has been altered significantly by the construction of a levee, canal and regulators since 1985. Pollution in the lake has been caused by the unregulated disposal of both domestic and industrial waste [4]. Moreover, residuals from agricultural fertilizers and pesticides upstream in the Soke Plain are threatening the fish and bird populations [5].

Significant amount of the Soke Plain which is also a flood plain is at the delta level. In the soils of the delta, salt moves towards the surface and eventually accumulates on the top layer due to evapotranspiration and capillary action during hot summer months. Therefore, soil salinity and the agricultural practices to cope with it play a major role in ecosystem integrity. In order to wash off the salt from soil, farmers flood their fields before cotton cultivation. Even though flooded fields attract a variety of birds and reptiles, water drains into the drainage canals with all the salt and chemicals accumulated in the soil. Subsequently, the number and amount of species utilizing drainage canals are less than that of irrigation canals. In addition to contamination of soil and water by pesticides and fertilizers, the area suffers from waste dump into water corridors and canals. Clearance of vegetation along road corridors and other infrastructure corridors also affect ecological quality.

3 DISCUSSION AND CONCLUSIONS

Sustainable agriculture, as defined by FAO, means agriculture that conserves land, water, and plant and animal genetic resources, does not degrade the environment, and is economically viable and socially acceptable [6]. Among the most serious constraints in achieving sustainable agriculture are: shortages of arable land, degradation of land resources, water shortages and pollution, disappearing genetic diversity, climatic change, and loss of agricultural land due to urbanization [7]. However, the sustainable agriculture efforts remained limited only to reforestation, planting hedgerows of native species, reducing the application of chemicals, and restoring riparian corridors at the scale of the individual farm. Hilty et al. (2005) emphasized the need for enhancing large scale agricultural landscapes for biodiversity conservation. The importance of mitigating fragmentation at larger scale agricultural landscapes has been recognized in Europe at the end of 1990's. Thus, European environmental and agricultural policies now address connectivity through ecological networks, and green infrastructure [8].

In the ecological networks sense, corridors are important tools for enhancing connectivity, and hence maintaining viable populations of biota in fragmented landscapes. What surrounds a potential corridor is as important as the properties of the corridor itself [9]. In agricultural landscapes many opportunities exist as corridors. For example, fencerows, unmanaged ditches, creeks, and shelterbelts can serve as de facto corridors. Many studies suggested that many vegetation structures in agricultural landscapes can act as movement corridors and even provide habitat for some generalist species [10], [11]. On the other hand, these linear elements can be problematic by inhibiting movement of some species and boosting exotic species and predators. Similarly, roadside corridors can have both positive and negative effects on connectivity for native species [12]. Even though all of these de facto corridors most probably facilitate generalist species and result in loss of some species and mortality, still the enhancement of these corridors may propose important opportunities for some species in heavily impacted landscapes where setting aside or restoring larger corridors is not feasible.

One of the most important landscape elements for biodiversity is the riparian corridor. Conserving these areas can provide multiple benefits such as protecting in stream biota by controlling erosion regulating stream temperature. Riparian corridors can also serve for the terrestrial species. Buffer zones around these corridors shelter many amphibians and reptiles [13]. Therefore, maintaining vibrant riparian corridors is a good conservation approach along with creating viable landscape context.

Turkish agricultural areas are generally ecologically unfriendly because of intensive farming. As in the case of other countries, the advancements in technology have led to intensive agricultural production which aims to increase crop yield through the use of improved crop varieties, fertilizers and, irrigation, and mechanization. Intensive agriculture was triggered even further by subsidies and other governmental support measures. As a result, the structure of agricultural landscapes was simplified due to mono type crop production and the removal of native vegetation in and around the farm to increase cultivation area. Agricultural policies should promote more environmentally friendly practices and maintain balance between economic and environmental gains especially in areas with high ecological value such as Big Meander basin.

Agricultural landscapes are discreet mosaic of different types of patches and corridors, therefore to achieve and maintain connectivity it is necessary to evaluate the composition and configuration of these elements. Legal framework pertaining to protection and conservation

should recognize the need for different management categories related to the network elements. Social and cultural composition should also be taken into consideration. There is a need to create closer relationships with stakeholders. Involvement of all the institutions and society is essential for the development of green corridors

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RESEARCHERS DESPERATELY SEEK STABLE 50-YEAR-OLD LANDSCAPES WITH PATCHES AND LONG, WIDE CORRIDORS

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ABSTRACT

Conservation corridors are intended to promote enough demographic and genetic exchange to sustain plants and animals in the linked natural landscapes after the surrounding matrix has been converted for urban or agricultural use. Unfortunately, rather than assessing demography or gene flow, most research on corridor effectiveness has documented species' presence and movement along relatively short (≤ 150 m) corridors in landscapes where the matrix is not dominated by human land uses, which provides only limited evidence as to whether conservation corridors work. We describe a research project to determine if conservation corridors work, and to determine what conditions (such as width, constrictions, or land use) are associated with successful corridors. Because true conservation corridors are too young for genetic and demographic effects to be evaluated, we will study "de facto" conservation corridors - i.e., corridors that exist as a quirk of how the landscape was developed, that are ≥ 500 m long, and embedded in a human-dominated matrix. In each landscape, we will collect DNA samples in patches connected by corridors, isolated patches, and sampling locations within an intact natural area. A corridor will be deemed successful if genetic distances between connected patches are smaller than genetic distances between isolated patches and similar to genetic distances between sampling sites in intact habitat. Focal species will vary among landscapes and may include any reptile, amphibian, mammal, flightless arthropod, or sedentary bird associated with the patches and corridors, but not the matrix. In each landscape, the configuration of patches and corridors must have been stable for at least 20-50 years, so that genetic structure likely reflects landscape pattern. We ask readers to suggest appropriate landscapes at: www.docorridorswork.org.

INTRODUCTION

Human activities such as urbanization and roads have disrupted movement and gene flow for plants, reptiles, mammals, sedentary birds, and arthropods [1, 2]. Indeed, human-caused habitat fragmentation is a leading threat to biodiversity [3]. As plant and animal populations become smaller and more isolated they become more susceptible to stochastic events and reduced genetic diversity via drift and inbreeding [4]. Conservation corridors and increased reserve size are the primary conservation interventions to counteract habitat fragmentation. Conservation corridors are also the most frequently cited recommendation to conserve the ability of species and ecosystems to adapt to climate change [5].

Because corridors are such a promising conservation intervention, conservation corridors are being designed and implemented in many parts of the world. For example, one of us (PB) has helped develop high-resolution plans, each of which is being implemented by government agencies and nongovernmental organizations, to conserve nine corridors in Bhutan [6], 11 corridors in coastal southern California (www.scwildlands.org), 16 corridors in Arizona (www.corridordesign.org/arizona), 22 corridors in the deserts of south-eastern

California, and 14 corridors in northern California (in progress). Each corridor ($N = 72$) is a swath of natural land 500 m to 80 km long identified for conservation so that it can support gene flow and demographic interactions between a pair of natural landscape blocks after “build-out” – i.e., after lands adjacent to the corridor and the natural landscape blocks have been converted to urban, agricultural, or industrial uses that are incompatible with wildlife movement.

Despite the large body of research confirming that corridors promote wildlife movement [summarized by 7, 8], there is no strong evidence that these 72 corridors will promote demographic and genetic movement of plants and animals as intended. Evidence is lacking because these conservation corridors differ from the corridors studied by most ecologists in three critical ways, namely spatial extent, landscape context, and the response variables considered.

First, almost all corridor research has concerned corridors ≤ 150 m long, but conservation corridors are much longer. Second, in most ecological studies, a corridor is any narrow swath of land connecting two habitat patches where the patches and corridor share a land cover dissimilar from the surrounding matrix [e.g. 9]. This definition depends only on structural layout of the focal land cover type, regardless of adjacent land uses. In contrast, each conservation corridor is a swath of natural land that is (or eventually may be) embedded in urban, agricultural, or industrial landscapes. Although most conservation corridors are designated for conservation while the matrix is still in a relatively natural state, they are explicitly predicted to be useful for species conservation after build-out.

With respect to response variables, almost all studies of corridor utility document only whether focal species were present in or moved through the corridor [7, 8]. Although presence and movement are necessary for corridor utility, these responses do not demonstrate that the corridor enhances demographic stability, gene flow, or recolonizations – which are ultimately the intended outcome of conservation corridors [10]. Genetic relatedness (reflecting effective connectivity among patches; [11] and long-term patch occupancy (reflecting demographic rescue and recolonization; [12]) are better response variables for assessing the effectiveness of conservation corridors. Thus, most corridor studies have not been conducted in a landscape context, at a spatial extent, or using response variables truly capable of assessing the utility of conservation corridors [8, 13, but see 14].

In this paper, we describe a study design to assess the utility of conservation corridors and identify conditions associated with successful conservation corridors. Our goal is to solicit readers to suggest appropriate landscapes for this study.

AN IDEAL STUDY DESIGN

Because corridors are intended to promote demographic persistence and gene flow, the two most appropriate response variables are probability of occupancy and genetic similarity. If a conservation corridor works, then the patches connected by corridors should have higher probability of occupancy than isolated patches. Inglis & Underwood [15] describe a study design to evaluate corridor effectiveness on the basis of patch occupancy. Although occupancy is a valid response variable, it has drawbacks. For the size of patches typically connected by conservation corridors, it may take a century or more to reach equilibrium among extirpation, demographic rescue, and recolonization. We therefore propose to use genetic similarity between populations in patches connected or not connected by corridors as the response variable. If a conservation corridor works, then genetic similarity between the

patches connected by corridors should be higher than between isolated patches and about the same as between sampling sites in intact habitat (Figures 1 & 2). Although genetic divergence takes several to many generations [16], most populations exhibit genetic effects of isolation and fragmentation long before demographic stochasticity and extinction occur [17]. Moreover, genetic similarity is a better response variable than movement of individual animals because some movements simply do not result in reproduction or gene flow [1]. In contrast, genetic data reflect functional connectivity. Furthermore, gene flow among patches can occur in the absence of any movement by an individual animal between patches, such as when gene flow occurs incrementally across multiple generations.

The best design would be a Before/After–Control/Impact (BACI) design [18]. This design would start by documenting genetic distances among focal populations inhabiting intact natural landscapes before fragmentation has occurred on the basis of samples collected in pairs of sampling sites that will become isolated patches, pairs of sampling sites that will become patches connected by corridors, and pairs of sampling sites that will remain part of a large area of natural land (Figure 1).

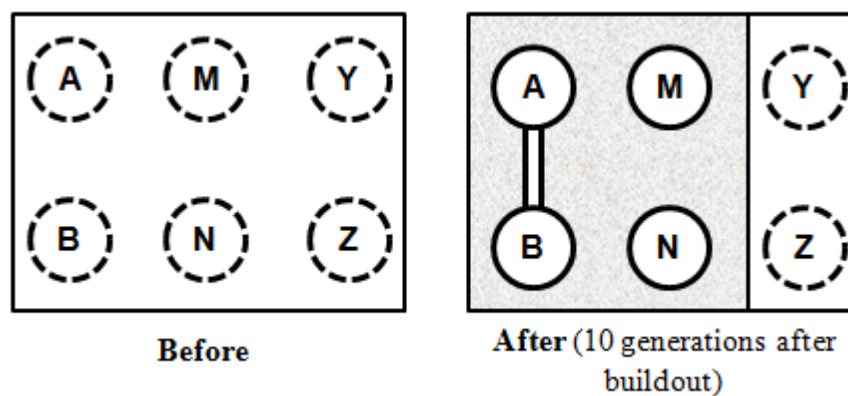


Figure 1: The spatial layout of an ideal design for the study of corridor effectiveness. White background and polygons indicate natural land cover; stippling indicates land converted to urban, agricultural, or industrial uses incompatible with movement by the focal species. A & B are sampling sites located in what will become patches connected by a corridor. M & N provide Reference Condition 1, namely a pair of sampling sites that become isolated patches. Y & Z provide Reference Condition 2, namely sampling sites that remain within a large expanse of natural land cover. The mapped distances AB, MN, and YZ are about equal. Note: In BACI parlance, the corridor [the conservation intervention] is the *impact* site and the other two conditions are *controls*; such terminology can be counterintuitive in a conservation context.

Then the natural landscapes are fragmented, and the researcher waits 10-20 generations (time required increases with effective population sizes in the patches) for genetic patterns to respond to the new landscape configuration. Finally, genetic samples are again collected and analysed. Three possible outcomes of this design are illustrated in Figure 2.

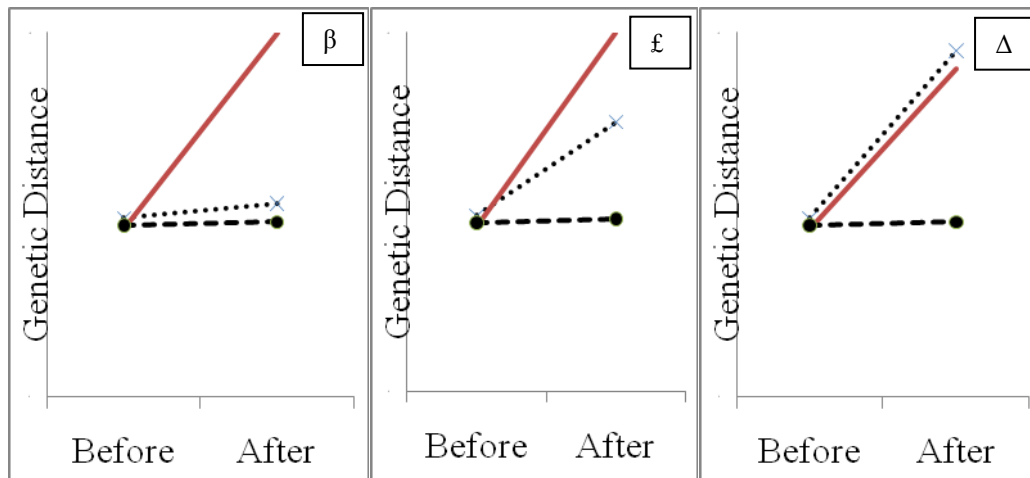


Figure 2: Possible outcomes of the study design illustrated in Figure 1. The dotted line indicates genetic distances between patches A and B, the solid line indicates genetic distances between patches M and N, and the dashed line indicates genetic distances between Y and Z. Figure 2 β : results supporting the conclusion that the corridor worked. Genetic distances between all pairs of patches were similar before build-out, but over time the genetic distance between isolated patches increased while the genetic distances between patches connected by corridors remained low and similar to genetic distance between sampling locales in intact habitat. Figure 2 ϵ : Results suggesting a partially successful corridor. The corridor promoted more gene flow than occurred between isolated patches, but less gene flow than occurred across intact habitat. Figure 2 Δ : an outcome consistent with failure of the corridor. The patches linked by a corridor became as genetically dissimilar as isolated patches while gene flow was maintained between sampling locales in intact habitat.

We believe that this study should be conducted and we advocate that conservation scientists and management agencies collect DNA samples from appropriate species in a variety of landscapes, and store the samples for future analysis. Appropriate sampling sites can be identified most reliably in areas where large-scale conservation plans, such as Habitat Conservation Plans or other large-extent, ecosystem-based conservation plans [19, 20], are being initiated. Unfortunately, it will take between 30-100 years for data from this design to be useful for conservation planning because the fully controlled BACI design requires protecting swaths of land as conservation corridors, waiting 10-30 years for build-out to destroy most of the remaining habitat, and waiting an additional 20-50+ years (10-20 generations) for genetic consequences of isolation and corridors to manifest.

MODIFYING THE STUDY DESIGN FOR FASTER RESULTS

To get information without waiting several decades, we propose to use a space for time substitution by identifying and studying landscapes containing corridors that resemble conservation corridors (even if they were not designed as such) that have been stable for 20-50 years. We call these “de facto” conservation corridors to distinguish them from corridors explicitly designed as conservation interventions. This design is the same as illustrated in Figures 1 & 2, except that it lacks any genetic samples prior to build-out. A crucial assumption is that contemporary gene flow among sampling locales within intact habitat is similar to the gene flow that occurred between all pairs of patches in the landscape before humans altered it. In other words, the landscape prior to major human disturbance resembled

the landscape in the Before panel of Figure 1, such that pre-disturbance genetic distances probably were similar between all pairs of sampling sites.

So far, only two or three published studies have used this design. Mech & Hallett [21], studied red-backed voles in a matrix of 20-year old clear-cuts in Oregon. The genetic distance between the patches connected by corridors was lower than that between isolated patches (leading them to conclude that the corridors worked) but higher than between sampling areas in intact habitat; suggesting that corridors provided only limited connectivity, as in Figure 2f. Horskins et al. [22] studied two woodland rodents in an 85-year-old landscape containing one corridor in a pasture matrix. The genetic distance between populations in the connected patches was similar to the distances between completely isolated patches, and much greater than the genetic distance between sampling locales within nearby intact woodland as in Figure 2Δ. They concluded that the corridor failed. Banks et al. [23] evaluated the extent to which exotic pine plantations restricted dispersal of a small marsupial between remnant patches of native forest in Australia. The genetic dissimilarity between isolated patches was greater than genetic dissimilarity between individuals sampled at similar distances within a linear “corridor” (which differed from conservation corridors in that there were no terminal patches) or between individuals sampled at similar distances in continuous native forest. They concluded that the corridors likely facilitated natural levels of gene flow.

These three studies demonstrate that some corridors may facilitate gene flow, whereas others do not. Unfortunately, each study contained only one landscape, so we cannot infer why the corridors in each landscape succeeded or failed. We speculate that the corridor through the Australian pasture failed because it was too narrow (50-300 m wide along its 4.5-km length). Strong inference about the effect of corridor width or other features requires replicating this study design across many landscapes that vary with respect to these features. We propose to do just that.

DESPERATELY SEEKING STABLE, 50-YEAR-OLD LANDSCAPES WITH PATCHES AND LONG, WIDE CORRIDORS

It is the authors’ good fortune to live in the south-western U.S.A., an area with many large and intact natural landscapes; a place where fragmentation has occurred too recently for genetic response to be manifest. We need help from readers and colleagues to identify appropriate study systems, where each study system consists of a landscape and focal species. Interested persons can provide information at www.docorridorswork.org. We encourage readers to direct potential informants to the website. Small honoraria are available for informants who provide leads to study systems that become part of our study. Each study system should meet all seven of the following criteria:

Historically continuous habitat.--Prior to human alteration of the landscape, the natural cover types used by the focal species must have been widespread and relatively continuous, as in the “Before” panel of Figure 1. In other words, we will not study landscapes in which the patches are naturally isolated, such as a group of naturally disconnected marshes.

Focal species restricted to natural matrix and dependent on corridors for connectivity.--There must be at least one mammal, reptile, amphibian, sedentary bird, or flightless arthropod that is expected to occur in natural patches, but probably cannot disperse through habitat in the matrix. Although bats and flying birds have been shown to travel along linear habitat features, most of them are not suitable focal species because they can maintain demographic and genetic flows without corridors. Focal species will differ among landscapes, and we

anticipate that each landscape will eventually have multiple focal species. Estimated effective population sizes (typically 10% to 20% of census population sizes – [24]) in the isolated patches must be low enough for genetic divergence to have occurred during the period of landscape stability since build-out.

At least one corridor and one reference condition in the landscape.--The landscape must contain at least one corridor and at least one type of reference condition (Figure 1). Reference condition 1 consists of habitat patches/blocks separated by approximately the same Euclidean distance as the connected patches, but completely isolated by human-altered matrix for at least 10-20 generations for the focal species. The second reference condition is an intact habitat block large enough to allow researchers to obtain genetic samples at locations spaced at approximately the same Euclidean distance from each other as the connected patches. Ideally a landscape would have both types of reference landscapes. In addition, the land cover in the corridors must be similar to that of the patches and large natural landscape blocks.

Corridor >0.5 km long.--Pairs of patches must be separated by distances > 0.5 km, with similar distance between pairs of isolated patches, pairs connected by corridors, and pairs of sampling locales within intact habitat. Each of the previously mentioned 72 conservation corridors is ≥ 500 m long.

Corridor > 100 m wide.--The corridor must be >100 m wide (except for short constrictions such as a highway crossing structure). Conservation practitioners never recommend narrower corridors as a conservation intervention [25, 26].

Landscape stable for ≥ 20 -50 years.--The configuration of patches, corridors, and matrix must have been relatively stable, except for natural disturbances, for at least 20 to 50 years. This duration makes it likely that genetic pattern reflects landscape pattern. Although genetic equilibrium is probably never reached for any population in a human-altered landscape, genetic distances approach equilibrium values quickly after demographic perturbations [27, 28]. More specifically, genetic divergence should be evident after 10 generations of the focal species for effective population sizes < 50 per patch and after 20 generations for larger effective population sizes [11, 16, 24].

Matrix dominated by urban, agricultural, or industrial forestry uses.--The matrix should be dominated by urban, industrial, agricultural, or industrial forestry land uses. Secondarily, we will consider landscapes in which the matrix is dominated by semi-natural pasture or forests where logging is constrained by ecological goals, but only if there is strong evidence that the human-caused alteration presents a strong barrier to movement of the focal species.

OTHER CONSIDERATIONS

A large sample of study systems probably will include some corridors that work, and others that do not. To determine what factors are associated with success or failure of a corridor, we will select study systems that vary with respect to 5 landscape variables: corridor length, mean corridor width, severity of constrictions in the corridor, type of matrix (high-density urban, rural residential, intensive agricultural, pasture), and degree of human disturbance (including recreation, artificial night lighting, and vehicle traffic) in the corridor. Because traits of the focal species can also affect observed genetic patterns, our analyses will include additional covariates for traits such as species mobility or edge sensitivity. Strong inferences about five landscape variables and two species variables will require at least 50 – preferably 100 – replicate study systems.

Perhaps the greatest risk is that all or almost all corridors that meet our criteria will be narrow (e.g., 100 to 500 m wide) or will have severe bottlenecks (e.g., small highway crossing structures) such that very few corridors support gene flow. In other words, Earth may not contain enough successful “de facto” conservation corridors to identify minimum width or other traits of successful corridors. Nonetheless, simply knowing that the minimum width must be greater than 500 m would conclusively rule out narrow corridors as a credible conservation strategy. If only a few broad corridors are in the sample, and they all succeeded, the results might not be statistically significant, but they would be biologically relevant and persuasive.

To date, we have identified 38 landscapes that contain “de facto” corridors and at least one reference condition and so at first glance appear to meet our criteria. Most of these landscapes are located in North America, but we are hoping to expand coverage throughout Europe, Asia, Africa, and South America. We anticipate that Europe will contain many suitable study sites, because in contrast to the more rapidly changing landscapes of North and South America, the landscape of Europe has been built out and stable for decades.

Conservation scientists need to know what factors are associated with successful wildlife corridors so that they can design and implement effective conservation corridors. Land managers need to know what land uses and management practices are compatible with effective corridors. Ecologists need to know how corridor width, internal characteristics of corridors, characteristics of the matrix in which corridors are embedded, and traits of focal species affect corridor utility. We are asking for your help in identifying suitable study sites for our analysis and we look forward to engaging and working with many colleagues in a rigorous, global study to address these issues.

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RIVER RENATURALIZATION AS A STRATEGY FOR ECOLOGICAL NETWORKS

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ABSTRACT

Rivers in the Netherlands often form linkages between cities. These linkages also provide an opportunity to create natural linkage zones that connect nature and green spaces. This article portrays the collaborative and cooperative strategies which are being used by water managers, nature managers and provincial governments to accomplish significant ecological network development alongside projects aimed at river renaturalization. These strategies provide an approach with which to address the complex and dynamic implementation setting in which such projects need to be realized.

1 INTRODUCTION

In the Netherlands, there are three policy sets which we consider to directly support the greenbelt approach. Firstly, there is the set of policies in place for the protection of the remaining open space located between the larger cities in the west of the country which is referred to as the Green Heart. Secondly, policies exist to contain urban sprawl all over the country and endeavouring to maintain the rural nature of the countryside. And thirdly there are the policies which are connected to the EU Nature policies which enable the connection of existing yet fragmented nature areas. All three policy spheres are currently under pressure by debates on their value in comparison to development, decentralization and budget cuts. Nevertheless, their impact on Dutch land use has been remarkable. With respect to all three policies it holds that the sheer density of the Dutch population and its economic activities makes them both particularly necessary and especially hard to implement.

In this article we concentrate on the policies related to the EU nature policies, and more specifically on the implementation strategies that are used to enable using rivers and river banks for their potential to serve as ecological linkage zones. We concentrate on the renaturalization of the Regge River, a 50 kilometer tributary river in the Dutch Vecht River basin. With the exception of the River Rhine, the Vecht River is by far the largest cross-boundary river between Germany and The Netherlands. In the next section we provide some background on the relevant Dutch policy context, followed by a description of the Regge River case and a specific project as an example. In closing, the management strategies that we have identified are presented.

2 GREENBELT POLICIES IN THE NETHERLANDS

In the early 1900's the majority of the "wild" nature in the Netherlands consisted of raised bogs and heathlands. Over the next seventy years, these areas were generally destroyed through land developments which involved the implementation of ditches, dykes, fields, tree paths, etc. in order to support the increasing demand for agricultural, residential and industrial lands. Forested land cover area did increase over this period, however it was mainly through

the increase use of planted production forests and did not by far compensate for the area lost to development. Government led land consolidation programs led to extreme disruption of small scale landscapes in the countryside and a further fragmentation of remaining nature areas. In the same period a vast majority of all river streams has being straightened.

Beginning in the 1970's a major shift occurred in the environmental, nature and spatial policy spheres of the Netherlands. Previously strong agricultural powers and related planning models began to shift in favour of more protection for nature. This resulted in stronger policies to protect the "Green Heart" of the Randstad metropolitan area which has a population of 7 million and contains Amsterdam, Rotterdam, The Hague and many more closely linked cities. Similar policies began being used to fight urban sprawl all over the country, creating hard boundaries between the built-up and "rural" areas and in essence, the development of local greenbelts began. It is mainly for this reason that much of the Netherlands appears quite rural, even in areas that are in close proximity to cities and towns. Apart from the influence of these policies, natural greenbelts are under construction in many areas in the Netherlands. In the late eighties, Dutch nature protection NGOs realized that their work was only slowing down continuous incremental intrusions into nature areas. They then proposed a more offensive strategy which was based on re-linking the fragmented nature areas through the introduction of new natural connection zones. In recent years, European nature, environment and water policies are increasingly shaping developments in the Dutch countryside. Dutch targets for the quality of water, nature, soil and air are largely determined by agreements and guidelines drawn up in EU and other international contexts.

The attainment of the goals set out in the EU Natura 2000 directive in a densely populated and fragmented country such as the Netherlands, can be extremely costly. Unused or inexpensive lands are not often available to be set aside for these purposes. Improving the value of nature and biodiversity thus requires that every opportunity needs to be taken in a strategic and efficient manner.

This can be done through enabling and supporting multifunctional land use, combining various "greenbelt-like" functions wherever possible and especially in areas that form connections to other natural areas. In this article we concentrate on rivers and their surrounding floodplains as the natural candidates for ecological linkages. Their renaturalization is important for optimizing the value of the land and is as well in line with the development of a climate resilient and natural water system which can deal with increasing irregularities in rainfall and move towards achieving the WFD quality criteria. At the national level, the National Ecological Network (EHS – Ecologische Hoofd Structuur) has been designed to contain all current and desired natural areas and pathways that are seen as necessary to protect and to create in order to meet the EU requirements. The new conservative cabinet which came into power in 2010 has decided to make deep cuts in nature protection and development budgets. The further implementation of this 20 year old policy has thus become much more difficult.

Through research conducted on stream restoration projects in the Netherlands, it became clear that the development of the National Ecological Network was being accomplished in some parts through the partnering of activities aimed at increasing flood protection, water quality and recreational opportunities. This article portrays the collaborative and cooperative strategies which are being used by water managers, nature managers and provincial governments to accomplish significant ecological network development alongside projects aimed at river renaturalization

3 REGGE RIVER RENATURALIZATION AS A LEARNING CASE

In the periods 1848-1879, 1894-1913 and 1925-1935 the Regge River suffered from piecemeal canalization efforts. Over the years the Regge was in this manner changed from a meandering river into a water course that was confined by narrow shores. In the context of the Water Framework Directive all waters contained within this watershed have consequently been labeled as ‘strongly modified’. This is the starting context for the Regge Renaturalization Project. In 1998 the Waterboard of Regge and Dinkel, the Rural Areas Agency (Dienst Landelijk Gebied – DLG) and the Province of Overijssel worked together to develop the Regge Vision. The Regge Vision endeavours to renaturalize the 50 kilometer river through a series of projects involving different stakeholders situated at various spots along the Regge. Within the area covered, the Waterboard has the responsibility for managing surface water quality and quantity, the DLG manages land development projects for various environmental, water, economic, spatial, sectorial and social policies in the rural areas, and the area also contains portions of the planned national and provincial ecological networks. Within the project area, there are thus various levels of government, different nature organizations, farmers, companies and citizens which are involved. In the ideal scenario, all partners can work together within this project through their similar and overlapping goals in order to increase to the fullest extent they can, the synergic multifunctionality of the area under study.

Given the large scale of the project, it was realized early on by the Regge Vision developers that spending too much time in the planning stages would be seriously detrimental to the achievement of their overall goals if this time was spent with the idea of developing a perfect plan to meet all of the goals for the entire area. They chose to adopt an opportunistic approach at the beginning of the project. This means that instead of starting projects in a predetermined and methodical manner, they would either wait to see what projects would emerge from opportunities or develop projects on their own and then work to include as many aspects of the vision as possible. They left ample room in the Regge Vision for coincidences and opportunities to determine where they would focus their short term project efforts.

Renaturalization cases have qualities that are characterised here as ‘boundary spanning projects’ [1]. Complexity arises from the fact that not only the context consists of many policies and actors, but also the projects themselves need to be multifunctional in order to overcome their numerous hurdles, for instance in gathering sufficient funding and legal approval. Consequently the governance regime involved develops as a result of the specific activity (stream restoration) as well as the policies and rules regarding the many additional activities. The multiplicity of actors and “their” policies involved in polycentric regulation regimes can sometimes pose problems of legitimacy and accountability [2][3]. This extension of the scope of the governance regime is here conceptualised as the development of an “inter-regime”.

It often results in that the projects have a multi-level nature. Classic decentralization concepts (including European ‘subsidiarity’) search for the “right” level of regime: the lowest one that is apt for addressing the problem. Multi-level governance is based on the acknowledgement that all levels and scales influence a given situation simultaneously (not necessarily to the same extent) and that all levels influence each other. Upper governance scales can have direct impacts on local governance regimes [4]. This does not only occur in either a top down or bottom up fashion, but in both ways and can also skip some steps in between [5]: 14-17. Though the projects studied are local by nature, abundant relations with

upper levels (including EU and world climate change arrangements) and lower levels (kitchen table conversations with individual citizens) are at centre stage.

Inevitably projects of the size and ambitiousness of the Regge River renaturalization are “complex”, but moreover they are also dynamic. The period through which they are implemented is sufficiently long to allow ample room for actors to negotiate and work with other actors towards accomplishing their goals, but also long enough to try to continuously modify the context under which these actions take place. As such, analysis of the process needs to reckon with the fact that not only the process, but also its contexts evolve and are made to evolve. Water and nature restoration projects channel the attention to the analysis of multi-policy implementation in complex and dynamic social interaction processes. In our research we have used the “Contextual Interaction Theory” as a tool to analyse these processes [6]: 57-95. In this theory the motivation, cognitions and resources of the actors involved are seen as the ultimate drivers of the (inter)action in the process, and are in turn influenced by various layers of contexts. Given the fact that the processes operate in a complex and dynamic, and thus unpredictable and uncertain environment, strict project management strategies are a recipe for failure. To be able to succeed in integrating multiple legitimate and desired uses, multiple actors’ consent, sectorial policy schemes, funding rules, time frames and scale issues, the members of project teams need to be skilled “boundary spanners” [7] and able to see, use and sometimes create “windows of opportunity”.

The Dutch nature organizations, the Provincial government and often the local Municipalities have goals that are mostly in synergy with those of the Waterboard. Generally inhabitants and especially landowners have goals that are often more difficult to reconcile. Recurring partners in the Regge projects include a few relevant Municipalities, and the nature organizations Landscape Overijssel and Nature Monuments. After having accomplished many projects along the Regge, the Waterboard is now discussing with all of the other partners where the gaps are and how they can plan to fill these in and which parties can do what. The ecological linkage zone policies of both the national and provincial authorities have been very helpful as a co-driver for changes, since it involves ultimately the whole of the Regge. But for this to work clever strategies have to be applied by the Waterboard, both externally to deal with the opportunities and constraints of the relevant policies and actors and internally, to make their own organization apt for such adaptive implementation.

4 THE TATUMS EXAMPLE

To illustrate the observed strategies in the concise format of this article we highlight one of earliest Regge projects which taught the practitioners important lessons on how to achieve implementation success under complex and dynamic situations: namely by not fighting against them, but by working with them in an adaptive manner. In the Tatum project an arm of the Regge has been more or less restored through the re-establishment of meanders to improve buffering capacity. However, the meanders will not enter into full use as part of the stream until the planned project on the other side of the river achieves the necessary progress.

Tatums did not originate as a Regge restoration project. At the start, in line with the older perspectives on water management, it had the goals of improving water quality through the sanitation of polluted river bed soils and by doing so also increasing the river capacity by making it deeper. During its development, it was included as a Regge restoration project and was able to teach the project members a number of valuable lessons. The first problem encountered was that a sand deposit site was needed to temporarily store the sludge from the river bed. At first, no sites seemed to be available for this use. Following discussions with

some neighbours, they made a deal with an adjacent farmer who was unsatisfied with his lands and wanted to move to another Province to have more space to expand. The Waterboard had initially planned on having to contribute a fair renting price for the use of the grounds to store their sludge. This new opportunity however enabled them to pool their available funds with that of a nature development fund to purchase the complete farm and use the grounds for a few years as storage.



Figure 1, Tatum project, directly after completion (Source: Photo Holland)

Following their period of use of this land, a portion of it was exchanged for land near the Regge that could be used directly for the project. In addition to this, the state agency that buys lands on behalf of Dutch governments (DLG), was in possession of a farmhouse and a few sheds in the area. These were considered (too) expensive to keep and thus they wanted to re-sell them as soon as possible. The Waterboard staff discovered that a local inhabitant wanted to start a goat farm and was interested in these lands and buildings since the stable was far better for that purpose than his own was. This man's old farm house near the Regge was then taken by someone for whom it was a better place to keep young cattle. Further, that farmer's old place was then taken by someone who trades and renovates motors from all over the world. These dynamics all started with the first buy out and led to people being relocated to areas where their surroundings were more appropriate for their individual interests and activities. The only thing that the project manager had to do was to keep closely in touch with what people in the area had as interests. Such interests are not seen as potential obstacles to be dealt with in a defensive manner, but as potential opportunities. That was a lesson well taken.

The Municipality and Landscape Overijssel cooperated in adding a bicycle path complete with a bridge over the Regge in the area. The path attracted many more recreational visitors, and the bridge also allowed a more convenient connection of two small villages

across the Regge, contributing to the “basis” of good will among the nearby inhabitants, which then viewed the project with more interest and mildness. The increased numbers of visitors made one of the nearby farmers decide to start a tea-house with a tin museum which now provides the major source of income, and attracts coach buses full of senior citizens. The project team involves the tea house in occasional presentations of the project and stimulates cooperation between the new activities, e.g. having visitors of the tea-house visiting the goat farm as well. The farmer with young cattle now has them grazing in the Regge plain meadows in accordance with Landscape Overijssel’s guidelines. When the pastures became too large for his cattle, he arranged for a colleague to fill the capacity. This chain reaction did not only enable the Waterboard and Landscape Overijssel to get all the grounds they needed, but also diversified the rural economy with recreation facilities, special goat farming, enabling cattle to graze as maintenance for the nature (instead of maximizing production), and providing space for a small workplace.

5 STRATEGIES FOR CREATING GREENBELT LINKAGES IN DENSE AREAS

An important principle illustrated above is that by including actors outside of those with a clear geographical, judiciary or financial link, implementation can develop incrementally and become responsive to a great variety of local circumstances. Expressed more strongly: without such an adaptive approach it is unlikely that progress would have occurred at all.

An essential feature observed in all of the Regge projects is the coupling of several goals stemming from various policies and stakeholder’s interests. This can in fact be very productive because competing claims for land use need not always be mutually exclusive. Collecting the multiple policies, multiple institutional arenas, actor constellations and other governance contexts into the “inter-regime”, allows for a better understanding of the experienced influence of the external context.

When the goals are similar, overlapping, mutually reinforcing or even unrelated, important synergies can be discovered. For instance, Landscape Overijssel accepts that the main priorities of the project are often related to water, landscape and recreation development, and are confident that nature development will follow as a result of improvements in the other three. It is accepted by the organisations involved that the development of these synergistic projects can also require some trade off and compromises. This is not seen as a competing concern since the resulting package as a whole can end up providing more than what would otherwise have been possible due to the existence of unanticipated (yet often experienced) hurdles throughout the implementation process. All actors involved, such as the Waterboard, Landscape Overijssel, the Province and the municipalities have learned that rooting your organization too heavily in the beginning to your own goals strongly hinders your ability to participate fully in the process.

A wealth of strategies have been used in the Regge projects to prepare and modify the direct context of the process, including the institutional arena, the actor constellation and the characteristics (motivation, cognitions and resources) of the actors involved, to increase the likelihood of productive processes. These strategies have been used in various, multiple and indirect ways. Proactive, responsive and reactive use of such strategies was also discerned. Here we list a number which we saw to be used in several situations:

1) Openness to synergies with other policies' and actors' goals and interests

The wealth of combinations of goals and interests that are observed in these projects is presented as a strategy as such. Openness to synergies helps make the most efficient use of public money from various sources and of scarce space in a dense country. It also increases the likelihood of achieving actor constellations with supportive characteristics for project progression.

2) The management of relations: Learning to build trust

This strategy relates to building relationships and trust with relevant actors before the project begins. Various institutional arenas for the process exist because there are different legal and voluntary possibilities for framing e.g. river renaturalization sub-projects. Sometimes it's better to refrain from institutional settings that provide legal coercion options, because they are hard to use and can cause widespread resistance. Choosing a voluntary approach can be seen as a strategy to improve the likelihood of development of sufficient trust and commitment. Trust is also of key importance in the relationships between the members of project teams. Learning from past projects plays an important role: who to ask (or not), how to build trust, how to build informal contact. Likewise, good cooperation can be presented as a positive example to support the development of relationships desired in the future. More generally, conceding on some issues can be used as a calculated risk to help build a level of shared trust that will have future returns.

3) Blurring the boundaries of the process phases

In many examples we saw the early involvement of some actors that would otherwise typically appear in later phases of the process. Landowners in the area and neighbouring citizens were asked very early on in the process what wishes they had for the development of the area. The early involvement of Landscape Overijssel (or other nature organizations that would end up managing the project area) was also seen to have been helpful in a number of projects. The traditional distinctions between the various phases of the process are deliberately blurred through this process. While this can increase complexity when performed in an extreme manner, it can also prevent situations in which the later involvement of new actors blocks the process or leads to other unpleasant surprises. One way to reduce the additional complexity is by dividing the project into smaller geographical sub-projects. This is exactly what was observed to have happened in the Regge renaturalization process.

4) Knowing your context

Getting acquainted with local knowledge can improve the projects as it is generally very useful to be aware of existing opportunities. Proactive information gathering can result in acquiring information on municipal plans, which when received early enough can in turn enable cooperation on further studies that can be used to help inform decision makers. Chances to create goodwill in ways that can be included into the project without much difficulty are also made more likely. Through thoughtful and early communication it is possible to understand the motivations of the people involved and can make it possible to influence them.

5) Strengthening your position in advance

Purchasing land in the time preceding project development in order to possess the resource position of a private landowner in the area is also often used as a strategy. Sometimes this is a

matter of stepping into a “window of opportunity” at the right time such as when a farmer decides to quit farming and is willing to sell the land. In several ways this kind of resource can be put into use during later phases of the process; the land itself can be used for the project, although it can also be exchanged for other lands which are needed for the project. Buying land in anticipation of future project needs is a substantial investment, yet it has the benefit of avoiding both resistance and possible price pressures compared to buying land at the time a project needs to be realized at a particular spot.

6) Seizing opportunities when they arise: Surfing the waves

There are good examples of advantageously using timing: opportunities that would support the broader renaturalization vision were taken as soon as they occurred. Actions that would enable the project to move forward with quick wins were taken in order to build momentum, leaving issues related to tougher areas for a later time when more resources would be available. The Waterboard also found that on a number of occasions it was not optimal to start a project on its own, but to wait and to latch onto an existing initiative or when a new Area Development project started. In this case another actor, the Municipality for example, would become the main director of the process. This can have disadvantages under adversarial conditions, but has mainly advantages for the Waterboard when the goals are in accordance with one another.

7) Direct personal communication

It was very important to have as much direct personal communication with stakeholders as possible. Often talking with farmers and neighbours is the only way to overcome clashes of fundamentally different “readings of reality”. Open consultation was also key when dealing with institutional stakeholders. Creativity was important in order to be able to support each other’s interests and enable the creation of an upward spiral which would eventually result in the development of other valuable resources, such as trust. Consequently it is not just a matter of communicating, but also of being open and moreover really trying to advance others’ interests whenever they are or can be made sufficiently compatible with one’s own.

6 DISCUSSION AND CONCLUSION

This article outlined how practitioners in the Regge River Valley who are working on establishing and protecting natural linkages zones along rivers deal with the complex and dynamic settings they have to work in. On the basis of a larger research project in which numerous subprojects of Regge river restoration in the Netherlands were analyzed with the help of Contextual Interaction Theory [6], we identified seven strategies that were used quite regularly. These strategies do not seem to be very surprising given the perspective that “flexible governance regimes” and “adaptive management” form a prudent way forward in a web of dynamic and complex interdependencies. They are however still not seen to be commonly understood by actors that still strive for the formal certainty of linear project planning, even when actual project realization can be less, not more certain this way. An implication of this is that both practitioners and their organizations can benefit from developing capacities that typically were not taught in their professional training but are essential for successful “boundary spanning”.

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REVIEW AND GAPS: EUROPEAN ECOLOGICAL NETWORKS IN THE PAST 40 YEARS

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ABSTRACT

In the process of 40 years, ecological networks as a single target conservation strategy have evolved into a multi-objective comprehensive strategy that includes social, cultural and many other aspects. Ecological networks have significant potential to change the shape and layout of lands without losing their conservation function. This article summarizes the development of European ecological networks during the past 40 years. Concepts and definitions are clarified. The evolutionary process is presented as three distinct periods and the characteristics of each of these periods are identified. Following the literature review, gaps within theoretical considerations and practical activities are explored. Based on this review and gap analysis the status quo of network development is assessed and suggestions provided for the construction of ecological networks in the future.

Keywords: Ecological Network, Green Belt, Literature review, Europe

1 INTRODUCTION

Rapid urbanization has brought great land transformations that lead to fragmentation and serious ecological damage. These processes resulted in large numbers of species to decline or become extinct, additionally, these processes are posing direct threats to humans and to their environment. Hence, while the original intention of devising ecological networks is to protect the world's biodiversity, mainly as a response to fragmentation of land, the compensation for restrictions and intensification of land use are now also important aims.

Without including early examples of 'Green Belts' the development of ecological networks in Europe has a history of nearly 40 years. Supported by advancements in ecological theory and computer technology (e.g. GIS), the designing of ecological networks originated from a single target programme and has now developed into a multi-objective strategy, one that integrates with land management, environmental protection, sustainable development and spatial planning. The green belt and ecological network construction throughout the European continent is one of the largest strategy of mutual cooperation that involves ecologists, biologists, landscape planner, and other professionals.

This article attempts to sum up the development process of ecological networks in the past 40 years. Its starting points are four main questions, (1) what is an ecological network? (2) How did the concept of ecological networks develop and what effects has it had so far? (3)

What is the fundamental theory, and what are current research bottlenecks? (4) What are the gaps in practice?

2 CONCEPTS AND DEFINITIONS

2.1 Definitions

A great many literatures exist that discusses ecological networks. One definition that is widely accepted and quoted is one proposed by Bennett: ‘Ecological network is regarded as a coherent system of natural and/or semi-natural landscape elements that is configured and managed with the objective of maintaining or restoring ecological functions as a means to conserve biodiversity while also providing appropriate opportunities for the sustainable use of natural resources’ [1]. Similar to this definition, Jongman defined ecological networks ‘as systems of nature reserves and their interconnections that make a fragmented natural system coherent, so as to support more biological diversity than in its non-connected form’ [2]. Whether single purpose [3] or multipurpose, in both instances of the definitions emphasize the need for a ‘system’ and for the network to have a ‘coherence’ that is based on ecological processes. Similarly, a definition from conservation biology simply and straightforward includes ‘a set of ecosystems of one type, linked into a spatially coherent system through flows of organisms, and interacting with the landscape matrix in which it is embedded’ [4].

2.2 Concept of the structural model

Despite slight variations that may be detected when comparing the visions that are expressed in these definitions, it can easily be recognized that there are very similar elements included in to any of the ecological networks. Thus, there is a very definite operational model. This is a structural model composed of (a) core areas, (b) ecological corridors, (c) buffer zones. Some models also refer to (d) restoration areas. By and large, this operational model not only allows for implementing aims related to save guarding biodiversity, but also allows for a certain degree of human use and management of the landscape.

2.3 Related Concepts

In addition to the ‘ecological network’ structural model other concepts exist, such as ecological corridor concepts, green infrastructure models, ecological infrastructure models, and also the concept of ‘greenways’. Being only slightly different from the basic ecological network, the so called ‘ecological corridors’ may be considered as being one component of the ecological network model. The ‘green infrastructure’ model focuses mainly on the so called ‘ecological services’. And the ‘greenway’ concept constitutes a connectivity framework in its own right, one that is based on linear landscape structures to be developed and managed for multipurpose use; these may, include nature conservation, aesthetic benefits, recreational and cultural purposes. The greenway is designed to be mainly a linear landscape. But obviously, the greenway discourses have certainly inspired the development of ecological corridors (the crucial element of any ecological network) in European nature conservation [5].

3 THE HISTORY OF ECOLOGICAL NETWORKS: THREE PERIODS

Historic predecessors to ecological networks include landscape axis and avenue designs in Europe (1700s-1930s), the early concepts of arranging for cities to have ‘green belts, and also the idea of the ‘Parkway’ in North America (1920s-1960s). Concepts to develop greenways and greenway network exist, among other places, in the United States (1960s-present). All of these efforts provide the background for modern designs for urban open space systems, and also for nature conservation and sustainable spatial planning. Based on these concepts and approaches, it took nearly 300 years for the modern idea of the ‘ecological network’ to be developed (1970s-present).

Based on the theories and practices published in the relevant literature, the development of the ‘ecological network’ concept may be divided into three periods. The first period is the initial period of spontaneous initiatives. The second period is the development with a clear concept and specific organizations. The third period is the further implementation and extension of ecological networks.

3.1 The first period: singular and spontaneous initiatives (around 1970s-1980s)

While exploring the beginning of the ecological network idea most of the literature points at five countries: Lithuania, Estonia, former Czechoslovakia, Denmark and The Netherlands. Pioneers of thinking about ecological network are from these countries. Hence, during this period, ecological network efforts originated more or less spontaneously as singular events. Aims are varied and mainly focus on nature conservation at regional or national scales. Nature conservation is mainly concerned with crucial species and with habitats to be in their natural state. The concept of ecological networks has, during this time, not been generally accepted as a planning and management strategy.

Early in the 1970s studies have been carried out that are based on the so called ‘island biography’ concept. On this basis, plans were made in Lithuania and Estonia to combat isolation effects that resulted from landscape fragmentation. In the beginning of the 1980s ecological network planning started in former Czechoslovakia. In the same period the concept of nature corridors was introduced as a relevant part of Danish regional plans and in 1984 the concept of ecological networks was worked out as a national plan [6]. At the European level, the Diploma Sites network (1965, the network of Biogenetic Reserves (1976) and EECONET had been discussed [3].

3.2 The second period: clear concept and specific organizations (around 1990s-2000s)

The end of the Cold War and establishing the European Community provides the political background during this period. Better academic exchange was now possible, such as about nature conservation in European countries. Projects were started that were based on transboundary cooperation and on international protection protocols (such as Natura 2000). It

was also the beginning for several major organizations, like EURPARC, IUCN (the world conservation Union), WWF and many others.

The initial concept for a European ecological network was EECONET. As a conservation model it was first published by Bennett in the year of 1991. At this period, project cooperation and protecting protocols involved more countries to participate in the construction of ecological networks. Ecological networks as a concept and strategy for conservation have been clarified, and began to be spread more widely. Certain conservation models have been proposed, pilot projects have been conducted and the focus increasingly was on the preservation of semi-natural landscapes [3]. However, the theory and practice of ecological network were still in their exploratory period.

In 1992, the European Union issued the Directive which focuses on the conservation of natural habitats and wild fauna and flora (92/43/EEC), also known as the ‘Habitats Directive’ or the ‘Fauna-Flora-Habitats (FFH) Directive’. It was adopted as an implementation instrument of the 1979 Bern Convention on the Conservation of European Wildlife and Natural Habitats. Together with the Birds Directive (79/409/EEC), it constitutes the main legal framework for nature conservation in the European Union. Its aim is to contribute to the conservation of natural habitats and wild fauna and flora in the European territory (European Commission 2003).

In 1995, at the conference of European Environment Ministers, in Bulgaria, 54 European countries endorsed the initiative to establish a ‘Pan-European Ecological Network’ within the next twenty years.

3.3 The third period: further implementation and extension (around 2000-present)

Increasing urbanization, the deterioration of urban living environment and the emphasizing of spatial structures and functions in landscape ecology lead to the extension of the ecological network strategy. Primarily, during this period, ecological networks are not only concerned with biological or ecological protection. The idea expanded to include webs of linkages for several different aims e.g. ecological, social, political, cultural aims [1]. Additionally ecological networks were now widely integrated into spatial planning. They were also included into sustainable urban development [4].

Simultaneously, based on the Natura 2000 from the previous decade, European countries began to gradually implement the idea at national and local scales. Especially, 34 transboundary cooperation projects were identified within establishing ecological networks across Germany’s external borders in the period 2003-2005 [7].

The three most important developments in this period pertain to the establishment of the Pan-European Ecological Network, the European Green Belt and the ecological network within the realm of the Alpine Convention.

The Pan European Biological and Landscape Diversity Strategy (PEBDLS) was developed, under the auspices of the Council of Europe, in order to achieve effective implementations of the Convention of Biological Diversity (CBD) at European level. A crucial component of the PEBLDS is the development of the Pan European Ecological Network (PEEN), which would be as a guiding vision for coherence in biodiversity conservation. One of the major goals of PEEN is to develop an indicative map of the Pan-

European Ecological Network for the whole of Europe (Council of Europe, 1999). Three sub-projects have been developed: Central and Eastern Europe, completed in 2002; South-Eastern Europe, completed in 2006; and Western Europe, also completed in 2006 [8-9].

The European Green Belt is a project which literally has made use of the former ‘Iron Curtain’. Running from the Barents Sea to the Black Sea it forms a long ‘belt’ with a now predominantly ‘green’ vision. Not only does this project aim at ecological conservation but it also tackles territorial challenges with special geopolitical and cultural relevance [10].

The Alpine Convention is an international agreement between Austria, France, Germany, Italy, Slovenia, Switzerland, the Principality of Liechtenstein, the Principality of Monaco and the European Community. The scope of the Alpine Convention covers the entire Alpine region. This is one of the largest natural regions left in Europe and therefore of particular importance for biodiversity [11].

4 BASIC PRINCIPLES AND RESEARCH BOTTLENECK

4.1 Theories and principles

Originally, the Humanities with a topologically oriented (physical) geography that includes geomorphology, hydrology and climatology have had profound impacts on ‘landscape sciences’ (with German and Scandinavian research influencing, among others, Russian and East European research). Parallel to developments in geography, the new science of ‘landscape ecology’ began (in Europe and North America) to put the focus on issues like landscape heterogeneity and fragmentation, ecotones and edge effects, disturbance and stability, all of which concentrated on (chorological) landscape processes. These insights into processes provided the starting points for models of ecological networks.

Specific attention was paid to landscape connectivity, and models based on ‘island biogeography’ and of ‘metapopulations’ provided the foundational theories. With these theories also introduced the concept of ‘spatial coherence’ as a planning issue for nature conservation and physical planning. This concept was transformed into the strategy for the development of ecological network. To name one publication of many that appeared during this time, Forman’s (1995) classic patch-matrix-corridor model was well received as it provided the basis for the planning of connectivity systems and of linkages which play critical roles in establishing ecological networks [2].

4.2 Theory and knowledge bottlenecks

Core area: bias in selecting areas and focal species

Knowledge about so called ‘focal species’ and the optimal distribution of their habitats are prerequisites for core area planning in particular, and for ecological protection in general [12]. Nearly every attempt to construct an ecological network would encounter these issues that are connected to targeting certain species and to understand the optimal spatial distribution of relevant habitats. In fact, there is still uncertainty about the accuracy and objectivity with which concepts of species related proposals are made, for example by

academic institutions, including concepts of ‘target species’, ‘indicator species’ [13], ‘interesting species’ and ‘focal species’.

At the same time, limited information exist, regarding, the classification and the optimal distribution of habitat, and connectivity planning and implementation of such plans are always confronted with a considerable shortage of knowledge. Although the EUNIS habitat classification and the Annex I of the Habitats Directive [14] have been published these provide only limited guidance for habitat selection.

Corridor: Model and Index of the connectivity

Corridor construction is the backbone of any attempt to develop a green corridor, a green belt and ecological networks [5]. Making linkages and providing for connectivity within the larger network structure [15] is of great importance for the functioning of the system. Hence, corridor planning has become the determining factor of any reasonable network scheme.

A variety models have been proposed in theoretical studies, including dispersal models [15], least-cost modelling [16], cost-distance models, sources-sink models, geographic surface models, movement models of individuals [17], etc. All of these models primarily apply to specific landscape scales. Recently, the topological analysis based on graph theoretical methods [18-19] and artificial neural networks (ANNs) have been discussed. However, there still is no satisfactory and comprehensive theoretical framework to support the concept of landscape connectivity [20] in developing multi-scale ecological networks.

Geospatial Technology and Tools

The validation of large-scale modelling approaches relies on sufficient data and the application of effective analysis tools. GIS-based approaches have always been applied for incorporating connectivity data for ecological network planning [21]. Additionally, visual interpretation of air or satellite imagery, using remote sensing, has also been applied for data extraction and analysis.

More specifically 3D technologies have been explored within geospatial tools. For example, the German institutes of DFR-DFD have applied LiDAR (Light Detection and Ranging) that is based on a Definiens platform as a rapid tool to predict forest habitat types within Natura 2000 networks [22].

Even though such advanced geospatial technologies have been applied in some counties, the degrees and qualities of their application in each country is not harmonized with others. These techniques might, in the future, have the potential to be effectively applied in monitoring ecological networks within Natura 2000 [23].

5 IMPLEMENTATION GAPS

5.1 Connecting national and local network initiatives

Natura 2000 is the conceptual framework for the implementation of the ecological network within Europe. More than 150 different ‘ecological plans’ are currently being conducted at a variety of different scales. Connecting national, regional and local scales is important. Three problems have been encountered and lead to these questions:

(1) How to achieve reasonable transitions from a national protection strategy to concrete local projects; what are the main principles and what is the theoretical model?

(2) How to achieve negotiations and mediations when dealing with local stake holders, especially when aiming at financial compensations for individual land owners [24]?

(3) How to optimally explore community contributions, particularly through involvement social learning and other processes by which the maximum protective effects might be achieved [25]?

5.2 Implementation Assessment

Almost all who are actively involved advocate that tremendous positive effects are achieved by establishing ecological networks. These advocates are active in the fields of nature conservation and ecological and sustainable development. Much money has been invested into network construction. On the other hand, there is a considerable shortcoming of confirmation, through quantitative assessment, on the degree that ecological networks really work. There is a great need to answer the question: to what degree has any ecological network achieved its objective?

It takes some time for the coming out of the ecological network's effects. This might be one of the reasons for the lack of project evaluations. Being a pioneer in the construction of ecological networks, The Netherlands have performed quantitative assessments of the ecological network efficiency. In these evaluations, detailed quantitative assessments are based upon 564 species and 131 different ecosystems. The result of the evaluation indicates that a trade-off must be accepted, at the national level, between ecological improvements and social costs [26]. In the next few decades, with more projects being implemented, it should be a requirement to perform more eco-efficiency assessments, and to use guidelines for this purpose.

5.3 Organisational obligations

Discrepancies exist, in theoretical research and in application, within different countries. To harmonise their efforts is challenge particularly in Europe. The main objective might be to organise the establishing of a unified database, promoting efficient geospatial technologies, and to refer to one common approach [3] [27]. Working among over 100 European-wide agencies still leaves uncounted numbers of gaps to be filled, not only in information systems, but also in the European ecological network itself.

6 CONCLUSION

In the process of 40 years, the development of ecological networks as a single target conservation strategy evolved into a multi-objective comprehensive strategy that now includes social, cultural and other aims. It has a significant advantage over other strategies as it may change the shape and location of land uses without losing their conservation potential.

On the other hand, there is still a great deal of uncertainty in theory and in practice. How to achieve effective approaches and to fill the gap in implementations are some of the

challenges. To connect trans-border projects and national, regional and local efforts are others. While ecological networks have already started to be integrated into official policy and spatial planning it is still necessary to search more actively for sound theoretical foundations and to look for more practical alternatives in the future.

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CULTURAL HERITAGE PILOT PROJECTS AT THE BALTIC GREEN BELT: LESSONS LEARNED AND POTENTIALS FOR FUTURE SUSTAINABLE DEVELOPMENT

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ABSTRACT

The Baltic Green Belt runs along the Baltic Sea coast between the Finnish-Russian border in the north and the town of Lübeck, Germany, in the south. Since 2009, a number of non-governmental, governmental and scientific organisations have been working to establish the vision of the European Green Belt – to create a pan-european ecological network from the Barents to the Black and Adriatic Seas – in this region. The Baltic Green Belt is characterised by a comparatively high number of formally protected areas, a high number of military objects from the times of the Iron Curtain (1945-1991) and a high potential for sustainable tourism development as one form of Green Belt regional development.

Two out of a number of pilot projects for sustainable Green Belt development focused on the use of this cultural heritage, meaning the military objects from the Iron Curtain period. These pilot projects chose different assessment procedures for the cultural heritage of the Baltic Green Belt as well as two different contexts in which they were used for regional development: one was a cultural heritage assessment for spatial planning, the other one was for development of touristic products. The pilot projects were accompanied by research in order to identify valuable lessons learned and to give recommendations for further development of cultural heritage.

Some of the main results were: The cultural heritage of the Green Belt is up to now hardly considered valuable by either decision makers or the general public; however, twenty years after the collapse of the Soviet Union, the willingness to talk about this period is growing, and there is a strong media interest to discuss this period publically; the assessments were carried out and documented very well for their purposes; in the pilot project, the European Green Belt initiative helped to integrate stakeholders from different backgrounds into a constructive dialogue about their region's development.

1 THE BALTIC GREEN BELT

Part of the European Green Belt stretches out for 1.700 kilometers along the southern and eastern Baltic Sea coast between Lübeck, Germany, in the south and the Finnish-Russian border in the north (fig. 1). Unlike the rest of the European Green Belt, which mainly covers terrestrial habitats, this Baltic Green Belt section is characterised as coastal. Until 2009, the

vision of the European Green Belt to create the backbone of an ecological network from the Barents to the Black and Adriatic Seas was virtually unknown in the countries along the Baltic Green Belt (Russia, Estonia, Latvia, Lithuania, Poland) [1]. Since then, it has been the self-assigned task of the Baltic Green Belt project to spread the vision and point out to the chances for sustainable development related to it.

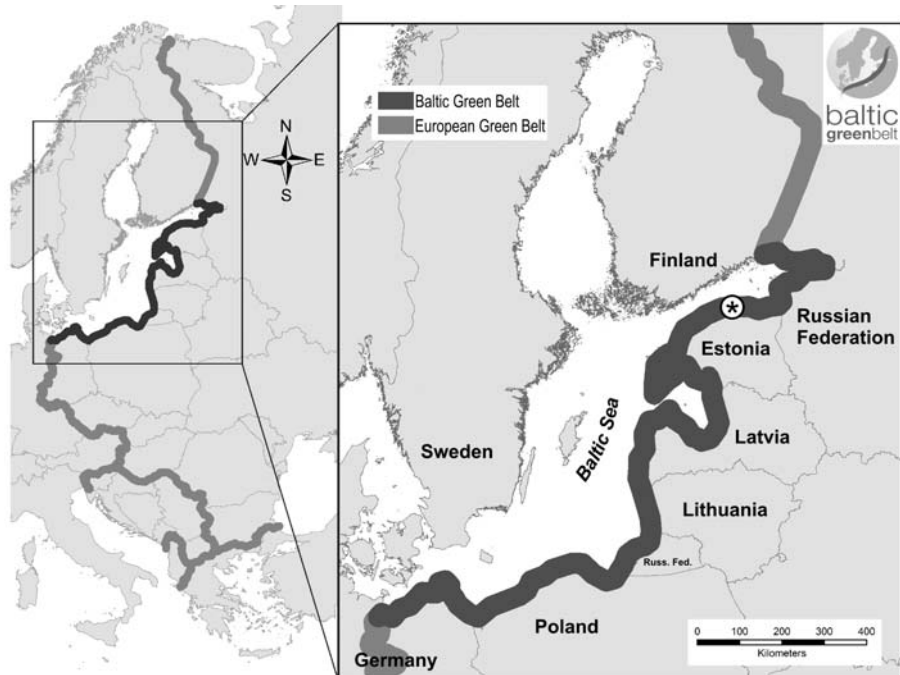


Figure 1: Map of the Baltic Green Belt area within the European Green Belt, * indicates Lahemaa National Park (map: Baltic Green Belt project, 2009)

During Soviet times, large parts of the Baltic Green Belt coastline including several islands were fully or partly closed to the public [2], access was only granted by special permission, coastal fisheries were strictly limited, schools, hospitals and other social infrastructure was closed down. These social incentives urged many people to move further inland. The coasts being outer borders of the Eastern Block between 1945 and 1991, were however, used for military purposes. Numerous relicts of military activities can be found at the coast, especially along the coasts of Estonia and Latvia. Today, while long stretches of the European Green Belt are still remote and partly economically uninteresting, the coastline of the Baltic Sea Region is becoming an important tourism, recreational and residential area[2]. Due to the restrictions during Soviet times, coastal build-up is much less pronounced and the coastlines are much more pristine habitats than at other European coasts[3] – the common feature of all Green Belt regions. Currently, there are more than 500 protected areas within 25 kilometers of the line of mean water level, which can be used as a technical definition of the former Iron Curtain[4]. Based on data for the protection status of the marine[5] and the terrestrial[6] side of the Baltic Green Belt, we can estimate that in each country along the Baltic Green Belt about 30-40 % of the length will be formally protected once the NATURA 2000 designation process has been fully completed [4]. However, resources for further conservation (management planning and implementation) are limited.

In this current situation we cannot expect more large-scale designation of protected areas in the near future. Taking into account the rapid growth of tourism in many parts of the Baltic Green Belt, a pro-active development of sustainable tourism based on the Green Belt heritage seems to be a promising approach to maintain the heritage itself – both natural and cultural. The combination of nature experience and recent history is a unique selling point in tourism marketing for the European Green Belt. However, the cultural heritage – meaning military objects from the period of the Iron Curtain (1945-1991) is not well known in most parts of the Baltic Green Belt. In this article, we present two approaches of assessing and using the cultural Iron Curtain heritage for Green Belt development. Based on expert interviews with main actors as well as external observers, we derive lessons learned during the implementation and in the end conclude some recommendations for future coastal development.

2 CULTURAL HERITAGE BASED ZONING IN LAHEEMA NATIONAL PARK; ESTONIA

The Estonian Green Belt holds an outstandingly high number of cultural heritage objects from Iron Curtain times. One of the major tasks of the Baltic Green Belt project was to systematically inventorise the cultural heritage and make it available for sustainable regional planning. Regional planning in the coastal zone of Estonia is mainly focused as touristic development. The inventory was carried out by the Estonian University of Life Sciences in accordance with existing legal standard procedures in cultural heritage management (full documentation see [2]). Here, we show how the cultural heritage was used for zoning of one of the most important National Parks in Estonia. This zoning ultimately aimed at the long-term harmonic co-existence of intact nature and profitable tourism and land-use and shall thus serve as a good practice example.

2.1 Heritage of Lahemaa National Park

The largest and oldest national park of Estonia* – Lahemaa - was created in 1971. Lahemaa is known for the great number of landscapes characteristic to Estonia.[7] The national park is located in Northern Estonia (fig. 1) bordering the Baltic Sea (the Gulf of Finland), and falls mainly into the administrative territories of two local governments (Kuusalu municipality and Vihula municipality). It comprises, besides mainland and some peninsulas protruding far into the sea, a part of the aquatic area of the Gulf of Finland, including several bays, small bights and inlets. The park protects forest, swamps and coastal ecosystems, natural and heritage landscapes, agricultural land use, balanced environmental use, a specific regional settlement structure, geological monuments (the Baltic klint), and cultural heritage including military objects, farm architecture and folk culture. Lahemaa territory is fully declared as Natura 2000 Bird Protection Area and a Special Area of Conservation and across all its territory.

In the National Park, two main landscape units are distinguished: cultivated and natural landscapes. In the cultivated landscapes, limited economic activities and organized recreational activities are allowed. The natural landscapes comprise on the one hand the areas, which have preserved their natural condition (nearly 70 %) and where human activities are prohibited, and on the other hand natural landscapes of regulated use, where such human activities not causing irreversible changes in the nature, are allowed. Historically, the region's

settlement has been constrained to fishing villages lining the coastline. Today the fishing villages are increasingly transforming into recreational and summer holiday villages.

The National Park is an important tourist destination both at the national and international level as the distance to the capital Tallinn is only approximately 35 to 40 kilometers. Visitation infrastructure, including nature and teaching trails, is already well-developed. Camping and campfire sites for public use have also been set up.[8] The former eras have left marks in the landscape such as numerous preserved landing places, lighthouses, churchyards, old cemeteries and cromlechs, stone fences, manor complexes, etc. Within the Baltic Green Belt project 357 objects of cultural heritage were investigated on the coastline of Lahemaa National Park, most of which were not considered as objects of cultural heritage before[9].

2.2 Problem

Lahemaa National Park is located in the territory of two local governments – Kuusalu municipality* and Vihula municipality. Both municipalities have a valid comprehensive plan[10], which treats the national park as a recreational and tourist area with distinct local holiday sites converging near popular sandy beaches. The local governments aim to develop environmentally friendly tourism. Realising the tourist potential is only possible in collaboration with the national park and its administration.

Upon drafting their comprehensive plans (at the beginning of 2000-s), the local governments on the territory of which the national park is located, have come across several disagreements and dissatisfaction resulting from strict restrictions subject to the (somewhat outdated) protection rules of the national park and the concurrent bureaucracy. Problems are rooted in conflicts between Estonian laws of that time. Rapid changes in society have led to significant changes in legislation, i.e. Estonia joined European Union in 2004, which caused remarkable changes in legislation as well. It has yet been impossible to solve such problems within the planning process.[11] One specific example are strict and for owners quite costly architectural requirements. In Lahemaa most of such problems are caused by requirements to protect rural architecture considered with high cultural value. At the moment 447 buildings all over the Lahemaa National Park territory are protected as National Heritage objects.[12] The inhabitants have expressed the feeling of living in the national park as museum exhibits.

2.3 Objectives and approach

Lahemaa National Park protects the cultural heritage in a very complex manner, which does not occur only by protecting material objects, but includes also intangibles such as preservation of traditional land use, building traditions, settlement structure and toponymy, handicraft skills, heritage landscapes, semi-natural communities etc. In some other, much broader coastal area zoning Lahemaa as a whole would probably qualify as one “protected area”. Traditionally, internal zoning of a protected area aims at determining zones under different protection rules in order to preserve the values of nature. The zones may include e.g. strict nature reserves, natural and maintainable conservation zones and limited management zones. [14]

The purpose of present zoning of Lahemaa National Park was somewhat different than usual: the zoning of the coastal area[15] was laid out to incorporate not only protection but also planning principles. The aim was to focus on cultural landscapes by studying land use

consistency and allocation of protected objects including cultural heritage objects and semi-natural communities. Three different types of areas were distinguished: (1) areas which meet the economic and social needs of modern men, (2) areas where it is possible to practice a so called traditional ways of living (i.e. fishing, farming) and (3) areas where it is possible to combine both (i.e. tourism farms).

The objective of the study is interesting because the framework conditions have substantially changed since the original completion of the comprehensive plans. Several relevant legislative documents have changed, and the national park protection rules are currently being updated. Additionally, more detailed data are available: The inland objects of cultural heritage were investigated after completion of the comprehensive plans, from 2007 to 2009. Coastal objects of cultural heritage were assessed just recently within the Baltic Green Belt project. A literature based analysis about the architectural heritage and settlement structure of Lahemaa has been issued lately. Comparing these new data with the planned land use set by comprehensive plans reveals situational changes, new links, relationships and possibilities. The final goal is to give recommendations for terms of development (use) by zones in a way, which enables to maintain cultural heritage in a more complex manner and more integrated with spatial planning and conservation.

2.4 Activities and outcomes: Zoning

The current, new zoning is regarded as a way to match the coastal area's planning structure with the planning situation. The former is shaped by the opportunities of the society and the needs and intentions of the local community. The latter is shaped by both natural and anthropogenic characteristics of the territory. The current zoning methodology is largely based on a recently completed analysis and database of Lahemaa's historic land use[9]. The project illustrates the traces left in the landscapes by different eras and the effect of historical land use on the development and allotment of today's landscape units. Additionally important input was provided by the Baltic Green Belt database of cultural heritage objects and studies about settlement structure. The zoning in progress follows the traces of consistency in land use. The output of the zoning is an explanatory report and digital map layers (fig. 2).

Upon zoning, three conceptual zones have been regarded. The coastal water zone's baseline is the regular water line and it extends seawards up to the imaginary line connecting the utmost points of the islands, islets and peninsulas, measured from the coast. The coastal sea zone (not displayed in fig 2.) relates to fishing; it extends seawards from the coastal waters. The coastal land zone extends from the regular water line to the inland border of the zoned area (3 kilometres from the regular water line). [17] Within the coastal land zone, smaller subzones can be distinguished, for which specific use recommendations shall be formulated during further work:

- 1) Natural landscape zone
- 2) Secondary forest zone (formerly cultivated landscapes)
- 3) Farmland zone (cultivated landscapes)
- 4) Coastal zone (cultivated landscapes)
- 5) Dispersed settlement zone (cultivated landscapes)

6) Concentrated settlement zone (cultivated landscapes)

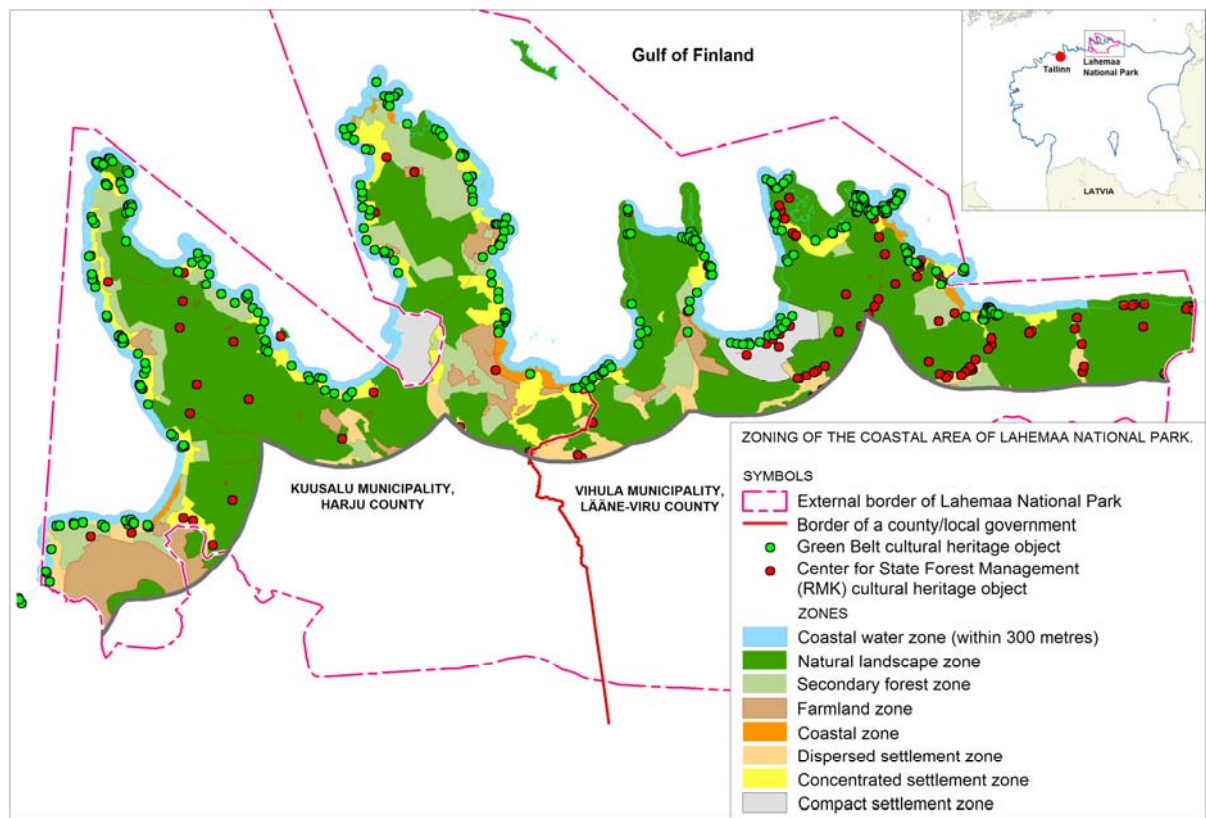


Fig. 2: Zoning of the coastal area of Lahemaa National Park^[16]

7) Compact settlement zone

There are two main criteria for determining the distinguished zones: 1) the land use of the determined zone is as homogeneous as possible and enables to set the terms of use, which would be accepted by the protection rules in the given location, characteristic to the landscape and support the consistency and sustainable use of the latter; 2) the borders of the determined zones are based on as natural and noticeable borders in the landscape as possible, such as rivers, forest division lines, ditches, field edges, but if necessary also roads, power lines, etc. It was also kept in mind that the zoning would support the protection of public interest and local interests, e.g. by guaranteeing the access to the coast, including the shore path would be guaranteed. Presently the protection rules of the national park are under review, which will bring along changes in the zoning. The coastal areas inventory carried out within the Baltic Green Belt project shows several areas on a narrow coastal strip with a very high concentration of cultural heritage objects. This finding can affect the range of the building exclusion zone. Therefore, the coastal area zoning to be drafted highlights the connections between the changing protection regimes, the public recreational areas, bathing sites and hiking trails set with the plan, which are also related to possible changes in the visitation management provisions.

2.5 Lessons learned

The data collected about cultural heritage objects within the Baltic Green Belt project are useful and can be easily integrated into different spatial plans. The cultural heritage objects database simplifies information transmission about Green Belt heritage to several interest groups and stakeholders.

Once cultural and natural heritage has been well investigated and described, its importance is recognised much easier by decision makers in comparison to objects, which are known only to local inhabitants.

The zoning helps the national park administration to get a general overview of the newest information (studies, databases, inventories etc.), draw conclusions and adopt general decisions. Based on zoning information it is possible to find areas and problems, which need immediate action. For more specific information concrete documents or studies can be investigated.

3 MILITARY HERITAGE BASED TOURISM IN LATVIA

Military heritage is abundant at the Latvian coast of the open Baltic Sea, but population density is low. Young people are leaving the villages along the coast due to a lack of economical perspectives. Tourism is a great chance for the region to improve economy, but not everyone is aware that the capital for tourism is intact nature. Therefore, the Latvian Country Tourism Association in cooperation with the Regional Administration the Latvian Nature Conservation Agency developed a pilot project to show how the cultural and natural heritage of the Green Belt can be combined for economically, ecologically and socially sustainable tourism.

3.1 Heritage at the Latvian Green Belt

The Baltic Green Belt in Latvia lies in the historical landscapes of Kurzeme (Baltic Sea coast and western coast of Riga Bay) and Vidzeme (southern and eastern coast of the Riga Bay) and has a total length of 496 kilometers. Biogeographically, the Green Belt of Latvia lies in the Boreal Region defined within the NATURA 2000 process[18]. The boreal region is dominated by forests and wetlands as well as shallow, mainly sandy coasts. Most of the natural coastal areas remained largely undestroyed as large parts were declared as protected areas in the early 1990s. Today, there are two National Parks bordering the Baltic Sea: Slitere National Park and Kemeris National Park and one Biosphere reserve – Ziemeļvidzeme Biosphere reserve. Out of the NATURA2000 territories, 15 (excluding protected marine territories) are located near the coastline. Economic activities are restricted only in certain designated areas of the NATURA2000 territories, and management plans are mostly still under development.

During the Soviet era, military units covered more than 10% of the territory of the Latvian SSR, with army grounds focused on the Baltic Sea shore. To prevent refugees to leave the USSR by boat, a number of restrictions were laid upon a strip of about five kilometers along the Baltic Sea coast. This strip was generally closed to the public, with only parts accessible by special permission during daytime, but beaches were combed daily at 21.00h to detect footprints of refugees in the sand. Only local residents received permits without difficulty. Typical military heritage objects at the Latvian Green Belt are old bunkers, shooting ranges and watch towers, but some more special objects which survived the end of

the Cold War are the radio tower of Irbene, which was used to surveil the whole northern European air traffic, the Karaosta prison in Liepaja, in which caught refugees were kept, and the 30 km long trail of a deconstructed narrow-gauge railway. At the same time, little is known about the Latvian past under Soviet reign as the topic is still sensitive.

3.2 Tourism

With the restored independence in 1991, the Latvian tourism branch began to develop extremely fast, nowadays contributing about 5 % to the GDP, but tourism is focused on the cities. One problem arising in some parts close to Riga is residential sprawl. Seaside land is sold in small parcels to private owners, who neglect traditional architecture and block public access to the sea. On the Baltic Sea coast, tourism is currently little developed, and even the National Parks have few visitors. However, tourism can be expected to increase in the future with more touristic products becoming available and infrastructure improving steadily. Against this background, it is particularly important to further develop local and regional cooperations between stakeholders of nature conservation, tourism, and regional development.

3.3 Objectives and approach

The goal of Latvian activities within the Baltic Green Belt project was to compile information useful for sustainable, nature oriented tourism based on military heritage at the Baltic Green Belt, to give good practice examples and to give guidance to further development while also advertising the new topic and products among the broad public. The main responsibility was with the Latvian Country Tourism Association, Lauku Celotajs, which has more than 1000 partners in tourism, in Latvia, Lithuania and Estonia, including members and accommodation providers and more than 150 of them active in the Baltic Green Belt. The association's activities are focused on environmentally friendly rural tourism product development, promotion, provider training and consultations and networking activities with organisations in Europe.

3.4 Activities and outcomes

The pilot project was carried out in three major phases resulting in a number of exemplary, tangible outcomes for sustainable tourism development:

Assessment phase: In 2009, four stakeholder workshops were carried out to involve entrepreneurs and agencies in the project. In parallel, military heritage sites were assessed following guidelines developed by Lauku Celotajs. A list of suggested objects was presented to the regional nature conservation authority for evaluation of their suitability for touristic development against the background of nature conservation. Additional to general facts, Lauku Celotajs collected contemporary witnesses' stories related to the sites identified. In a public campaign carried out through mass media, Latvians were called to send in their memories. In total, 69 stories were collected and translated.

Development phase: The final list of about 100 military heritage objects was compiled in a multilingual tourism data base (www.countryholidays.lv/military). Based on this information, a tourist map of military heritage as well as brief travel guides for selected tours by bike, boat, canoe or car were compiled together with the local providers.

Dissemination and documentation phase: Dissemination was carried out on different levels targeting international and national professionals from nature tourism (international conference, publications) as well as the broad public (call for personal memories, press conference, press field trips, fairs) with remarkably strong media feedback. For documentation and durability of the approach applied, guidelines for the use and development of military heritage were written and translated to English. The tourist map was downloaded about 2800 times within the first ten months, while the guidelines are downloaded about 150 times per month.

Stakeholder involvement: Special attention was given to involving local and regional stakeholders from economy as well as authorities at different stages (collection of information, development of a joint vision, elaboration of ideas for useful products, test of products, dissemination on the spot).

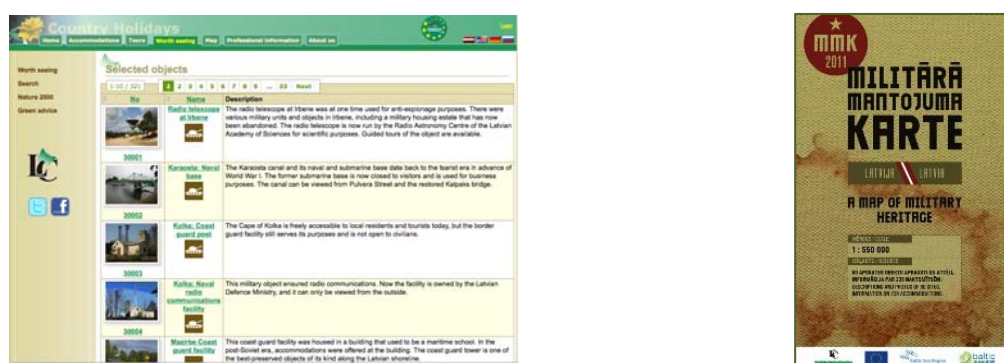


Figure 3: Tourism products for the Latvian Green Belt: military heritage data base www.countryholidays.lv/military (left) and map (right).

3.5 Lessons learned

Soviet heritage is a high potential topic in Latvia, as society has not yet come to terms with this most recent chapter of history. Currently, the public is divided with respect to the topic: There are supporters, but also people who are afraid or ashamed to talk or who consider the collection of contemporary witnesses' stories an unwanted political act. However, many people quite willingly contributed to the collection and thus initiate an active confrontation and debate. In this manner, the project initiated a conversion process, changing the perception of the Soviet from a burden to a cultural history value.

The former military areas do not receive enough attention among decision makers, because there is a lack of knowledge. Even some nature conservationists consider these areas as degraded. Even though the majority of previous borderland is still intact and partly protected, valuable habitats are therefore lost to private landowners. Additionally, this hinders the accessibility for inspection in the light of tourism development.

The transnational potential of military heritage tourism development is not yet exploited. A number of valuable objects currently unused but with high potential for tourism were identified in Latvia. Due to a similar history, heritage and target market, developments in tourism marketing should be carried out at least in trilateral cooperations with Lithuania and Estonia.

The Baltic Green Belt pilot project served as a common topic to stimulate stakeholder communication and joint development of visions; an external organisation was crucial as a moderator for the process.

4 POTENTIALS FOR SUSTAINABLE COASTAL DEVELOPMENT

The two pilot projects presented here chose different assessment procedures for the cultural heritage of the Baltic Green Belt as well as two different contexts in which they were used for regional development: one was a cultural heritage assessment for spatial planning, the other one was development of touristic products. Both individual pilots delivered valuable experience which shows that the European Green Belt initiative offers true potentials for sustainable development of coastal areas:

- The EuGB provides a unique selling point for nature tourism: pristine landscapes in combination with cultural heritage.
- The EuGB can foster regional cooperation and joint identity by involving people into an initiative of pan-european scope.
- The EuGB allows for transnational experience exchange between more than twenty states.

For future sustainable development of the cultural heritage along the coast of the Baltic Green Belt we recommend:

- to adopt the approach of intense but targeted stakeholder involvement for other local projects by providing external moderation as demonstrated in Latvia
- to take over the approach of opening up nature conservation to modern spatial planning needs demonstrated in Estonia
- to assess cultural heritage using a methodology that combines spatial planning and tourism development needs
- to actively inform decision makers about the values of the heritage at the Green Belt – both cultural and natural.
- to maintain and enforce the public discussion about Soviet military heritage by triggering the yet controversial opinions and personal emotions; to use the military heritage topic as a vehicle to inform about the natural value of the Green Belt
- to harmonise and strengthen the principles applied in sustainable tourism development at the Green Belt (ecological, economic and social), e.g. by adopting an existing code of conduct for sensitive regions or by adopting the Agora sustainability check for regional tourism development^[18].
- to formulate measurable goals and establish monitoring mechanisms for any Green Belt project activities, e.g. within revision of the European Green Belt programme of work

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PERCEPTIBILITY OF THE CULTURAL VALUE OF THE GREEN BELT MONUMENT

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ABSTRACT

The nationwide nature conservation project German Green Belt preserves a unique chain of habitats along the former inner German border. However, besides the relevance for nature conservation the socio-political character of the former border line as a living monument of Germany's history should be enhanced in the future. To achieve this aim it is necessary to provide an emotional, experience-driven access to the memorial landscape for the population. An analysis of experienced value of the Green Belt is required to assess the perceptibility of this unique landscape, assisting regional decision makers through the provision of strengths and weaknesses of the perceptibility of the Green Belt.

Against the background of the testing and development project 'Experience Green Belt' this study investigates the perceptibility of the old border between East- and West Germany. A novel assessment method was developed to analyse the quality of perceptibility of the memorial landscape Green Belt. The assessment was based on accepted valuation principles to determine landscapes perceptibility. Additionally, it integrates new aspects of commemorative studies. In the first instance the landscape was evaluated by means of preliminary defined indices with regard to its natural scenery and subsequently in terms of the perceptibility of the former border.

The landscape perception assessment (LPA) was applied to four characteristic sections of the Green Belt. Each section was separated in spatial units that are homogenous in their appearance and configuration. After evaluation of each spatial unit, the complete characteristic of the boarder section was monitored as a whole and subsequently evaluated. Based on this, a profile of strengths and weaknesses for each section was produced. The results illustrate regional differences between the sections in regard to the perceptibility of the former frontier area.

The findings of the assessment approach were used to shape an overall concept and consequential future development goals for the memorial landscape Green Belt. Because of enormous rebuilding processes at the former frontier area, the experience value is already lost in many places. A sensitive adjustment of regional intrinsic characteristics and requirements appears to be essential for generating touristic value of the memorial landscape German Green Belt and for preserving the perceptibility of the historic heritage. The protection of the Green Belt does not only support wild life, it conserves natural and cultural heritage and it delivers a vivid instrument that keeps Germany's history alive.

1 INTRODUCTION

For almost 40 years an impenetrable barrier divided Germany into two political, ideological and geographical parts. From the Baltic Sea to the Saxo-Bavarian Vogtland a rigorous inner-German border stretched nearly 1,400 km through the middle of the country. More than twenty years after the reunification, the former border fortifications such as metal fences, barbed wire and border patrol paths are hardly perceivable at this historically portentous stripe. In many places it seems like history is of little importance and the "grass of forgetfulness has already grown" [1].

As a result of the "forbidden" zone of the cruel border, however, nature was granted a reprieve for decades. Therefore, this area remained comparatively undisturbed and did not undergo cultivation changes or land use intensifications. Along the former inner-German

border wilderness was thriving, providing refuge for endangered animals and plants [2]. In order to protect the valuable habitats the “Bund für Umwelt und Naturschutz Deutschland” (BUND, German section of Friends of the Earth) was committed to establish the Green Belt project. Today it is one of the most important natural landscapes in Germany. Various national, federal and local authorities are involved in this project [3].

However, in addition to the relevance from a nature conservation perspective, the socio-political function of the German Green Belt as a living memorial for recent German history should not be neglected. Previous surveys and projects mainly focused on biodiversity aspects[2], on sustainable management [4] or on touristic development of this unique area [5]. So far, only few approaches are dealing with the perceptibility of the cultural value of the former inner-German border.

With this paper I aim to close this gap by analysing the perceptibility of this landscape providing an emotional, experience-driven access to the memorial landscape for the population. Here, a novel landscape perception assessment (LPA) method was used, which is appropriate to the specific conditions of the Green Belt memorial landscape. This assessment method can help to appreciate the perceptibility of the Green Belt and supports regional decision makers with the provision of profiles of strengths and weaknesses of the perceptibility of the Green Belt.

2 CASE STUDY AND METHOD

2.1 Landscape perception assessment of the Green Belt monument

The purpose of the LPA is to assess the subjective perception of nature, landscape and of experiences made by the human viewer on the Green Belt in an objective, reliable and qualitative way. The perceptibility of the memorial landscape Green Belt is linked to two relevant valuation parts: First the spatial perception of preserved relicts of the history and second the scenic quality of the landscape. For this reason the LPA is divided into two parts, namely the spatial sensation of the former border and the natural scenery of the landscape (see **Figure 1**).

Before applying the assessment method each case study section was separated into spatial units which are homogenous due to their natural appearance and configuration (see 2.2) [6]. The newly formed spatial units were evaluated separately. Both assessment parts, natural scenery and spatial perception of the former border, were subdivided into assessment criteria consisting of several indices, which are classified in a weighted score (starting with 1: weak expressiveness of indices to 4: strong expressiveness of indices). After evaluating each spatial unit in both assessment parts separately, the complete characteristic and the touristic suitability of the case study region was monitored and evaluated.

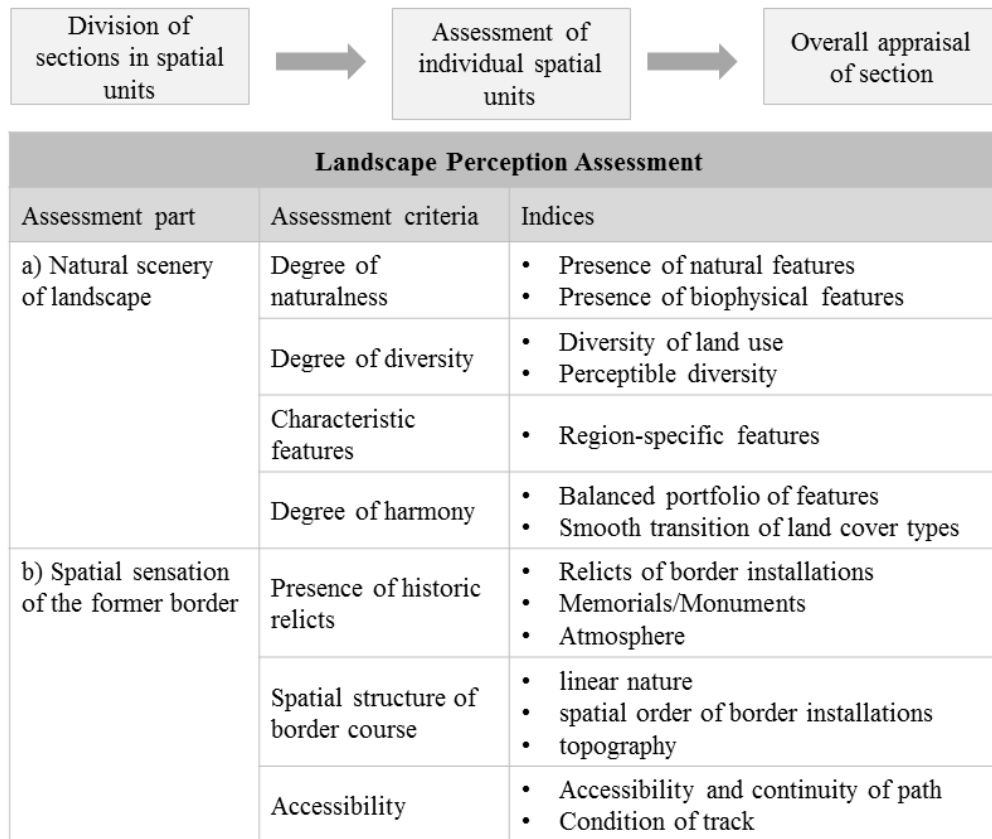


Figure 5: Scheme of LPA: Case study sections of the Green Belt for the assessment are divided into spatial units. The valuation system is divided into two parts and subdivided into assessment criteria consisting of several indices.

a) Natural scenery

This assessment part is focusing on the scenic landscape beauty observed by visitors of the Green Belt. Is the landscape perceived as aesthetically beautiful? Landscape quality derives from an interaction between biophysical features of the landscape, such as the relationship between properties and perceptual processes of the human viewer [7]. The criteria used in this part are based on accepted evaluation terms, namely naturalness, diversity, characteristic features and harmony, used in landscape planning in Germany [8, 9].

Naturalness: According to Nohl [6] the degree of naturalness of a landscape is more perceived in areas of low tangible human impact. In this sense the perception of naturalness is more important than the actual absence of human influence from a nature conservation perspective [10]. Thus, sections of the Green Belt may be high evaluated despite a long-standing human land use. The perception of naturalness is enhanced in places with a presence of positive natural and man-made landscape elements and biophysical features, such as lakes, rivers, crags and dunes.

Diversity: The coexistence of different site conditions and land use types is perceived by the viewer as interesting and exciting. This can be explained by the basic human want to search for information and knowledge [6, 8]. In evaluating the landscapes diversity the indices diversity of land use types and the perceptible, sensual diversity (e.g. visual impressions, birds twitter or flower fragrance) are considered.

Characteristic features: The presence of different natural conditions and a legacy of human land uses resulted in quite specific appearances of the cultural landscapes along the

Green Belt. Landscapes with a high presence of characteristic features are likely to evoke a sense of local identity [6]. The individual character of a landscape is determined by various region specific features such as traditional management systems of orchards and pastures, rural housing schemes, cultural and historical valuable buildings.

Harmony: A landscape is perceived as harmonious if all contained elements, whether natural or man-made, appear aligned and in harmony with each other [10]. In this connection the perception of harmony is reliant on a balanced portfolio of landscape features and a smooth transition of land cover types.

b) Spatial sensation of the former border

This assessment part is focusing on the perceptibility of historic evidence at the former border. To which extent can the former boundary conditions be perceived by the observer. The assessment criteria are based on a study from Becker [1] and were adapted to evaluate the spatial sensation of the Green Belt. Last-mentioned is reliant on the expressiveness of three assessment criteria namely the abundance of historic relicts of the border fortifications, the spatial structure of the border line and the accessibility of the former border.

Historic relicts: Due to deconstructions of the military defences right after the fall of the Iron Curtain, the only continuous and frequently found leftover of the cruel border are the border patrol paths consisting of concrete slabs [1]. Despite demolishment of most fortifications occasional relicts along the course of the Green Belt of frontier closings, control units or boundary marks remained – all of them with a high value for cultural evidence [11]. Moreover, there are further indices of the historical significance of the landscape such as constructed memorials or a certain atmosphere originated by the landscape which can increase the sensation of the former unhuman border for the observer. Those border indices are crucial to increase the ability to experience the former inner-German border.

Spatial structure: In order to military examine the frontier area it was regularly mowed to prevent succession. Nowadays visitors can still perceive a land use change at the border edge (the former frontier area is mainly grassland) and identify the linear course. The perception of spatial structures is enhanced in places where the structural components of border installations, the sequence of metal fence or walls, the former mine field and patrol paths are still visible. Furthermore, a supporting topography that visualizes the border course over large distances can increase the perceptibility.

Accessibility: In many sections of the former boundary course the accessibility is limited due to redevelopment or poor maintenance condition of the hiking path. This assessment criterion will analyse the facilities for today's visitors to hike on the Green Belt. In this respect the accessibility, the continuity and the condition of the trail play a decisive role.

2.2 Case study regions

To apply the LPA four 15km long sections along the German Green Belt were chosen as representative case study regions. At the respective sites we selected representative landscapes types and sections with an average amount of man-made disruptions. In doing so I used a geographic information system and overlaid the course of the Green Belt [12] with natural landscape types of Germany [13], disruptions by roads or buildings derived from the testing and development project 'Experience Green Belt' [12] and Monuments and Memorials listed in Becker [1]. Selected and analyzed case study regions are 1. Dalldorf – Boizenburg, 2. Helmstedt Ost – Offleben, 3. Hanstein – Asbach and 4. Autenhausen – Billmuthshausen (see **Figure**).

The application of the LPA system was conducted from the perspective of the target group, hikers. Within this field study all case study regions were analyzed both by the LPA and additionally by an overall quantitative assessment of the touristic suitability, considering tourist information options, special offers regarding the Green Belt, gastronomy, lodging and public transport. The results were resumed verbally in a profile of strengths and weaknesses regarding the perceptibility of the former frontier area.

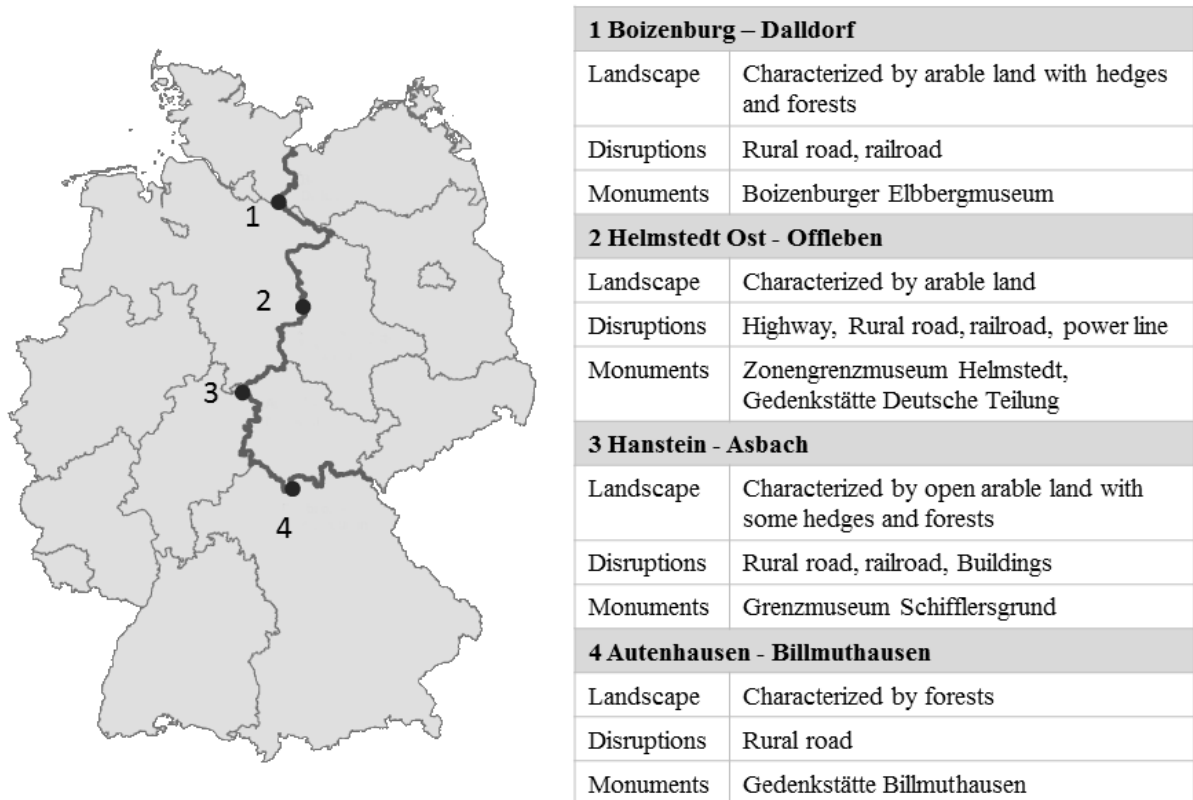


Figure 6 Case study regions along the German Green Belt with their characteristics.

3 RESULTS AND DISCUSSION

The application of the perception assessment on spatial units of case study regions yielded in quite different responses to the examined criteria (see **Table 1**).

Case study region 1 *Boizenburg – Dalldorf*, divided into two spatial units, is characterized by a satisfactory landscape close to the river Elbe and a quite monotonous appearance apart from the river. The spatial sensation of the former frontier area becomes apparent at a former checkpoint which was converted into a vivid museum. In the remaining section only few relicts can be experienced, the border patrol path is not conserved everywhere or is in poor condition. The touristic infrastructure is already well established, however, only little information is offered about the former border and the project Green Belt.

The second region, *Helmstedt Ost – Offleben*, was divided into four spatial units all characterized by an intense land use by open pit mining and power generation. Border fortifications are exclusively but impressive existing around the checkpoint *Marienborn*. Due to excavation of lignite the border course remains interrupted. Diverse information and cultural offers in respect to the inner-German border are available and the region is well

connected via public transportation. However, information on the Green Belt is missing and the hiking path network in the southern part is poorly developed.

The third case study region from *Asbach* to *Hanstein* possesses a very attractive, diverse landscape. The spatial structure of the former frontier area can be well experienced at the museum *Schiffgründ*. As well as in the other regions the border patrol path is not completely preserved, the border course is therefore hardly recognizable. The touristic infrastructure is well established, various offers concerning the former border are available, only few about the project Green Belt. The case study region possesses a good network of trails but these do not integrate the border patrol path.

Case study region 4 is categorized as a typical rural landscape partial with quite monotonous land use and appealing topography. Due to the visible land use change from grassland to coniferous forest and continuous border patrol paths the course of the former border is well observable. Two monuments, one in *Erlebach* and one at the site of the demolished village *Billmuthausen*, increase the perception of the memorial landscape. Tourism and hiking options are well established. Nevertheless, information about the Green Belt project is missing and the region is badly connected to public transportation.

Table 1 Landscape quality assessment applied on case study regions. The assessment is divided in two parts: natural scenery and spatial perception of the former border; Subdivision into assessment criteria and classified in a weighted score (starting with 1: weak expressiveness of indices until 4: strong expressiveness of indices).

Case study regions		1) Boizenburg - Dalldorf		2) Helmstedt Ost - Offleben				3) Hanstein - Asbach			4) Autenhausen - Billmuthausen			
Spatial units		1.1	1.2	2.1	2.2	2.3	2.4	3.1	3.2	3.3	4.1	4.2	4.3	4.4
Natural scenery	Naturalness	4	3	3	1	3	3	3	3	3	3	3	2	2
	Diversity	3	2	2	2	2	3	4	3	2	4	4	1	2
	Characteristic features	4	3	1	3	2	2	3	3	3	3	3	1	3
	Harmony	3	2	1	1	2	2	4	4	2	4	4	1	2
	Summary	3.5	2.5	1.75	1.75	2.25	2.5	3.5	3.25	2.5	3.5	3.5	1.25	2.25
Spatial sensation	Historic relicts	3	1	4	2	1	1	4	2	1	4	3	3	3
	Spatial structure	2	2	4	2	2	2	4	3	3	2	3	4	4
	Accessibility	3	1	3	2	1	3	3	2	1	2	2	3	4
	Summary	2.67	1.33	3.67	2.00	1.33	2.00	3.67	2.33	1.67	2.67	2.67	3.33	3.67

The aim of this study was to develop and implement an assessment method for the evaluation of visitor's perceptibility of the memorial landscape of the former inner-German border. This was achieved by combining accepted evaluation criteria and the adaptation to the specific requirements of the memorial landscape. Therefore, this landscape quality assessment is innovative in regard of analysing both the natural scenery and the historical perceptibility of a landscape.

However, the assessment method is mainly focussing on the aesthetical perception of the viewer, ecological criteria remain neglected. For the prospective development of the

project Green Belt it is suggested to combine this present assessment system with nature conservation perspectives.

In this assessment method we classify the viewers' subjective perception of the landscape on a numerical scale, similar to physical features. This leads to a paradox between on the one hand, planners and scientists, treating the landscape as a feature to be classified and mapped, and on the most possible objective manner and on the other hand, the appreciated subjective perspective of the tourist. This assessment concept shall be applied to other sections of the Green Belt in order to identify generality in human perception of this outstanding landscape monument.

4 CONCLUSIONS

Huge rebuilding processes and intensified land use along the former inner-German border has already reduced the perceptibility of the memorial landscape in many places. The course of the border and the border fortifications can be experienced nowadays only on few places – mostly around memorial sites and museums. Most analysed regions are providing a wide range of touristic infrastructure, however, there is almost no placement of more holistic concepts of information that are addressing the landscape quality of the former inner-German border and especially of the Green Belt project.

The Green Belt should be further developed as a backbone of both a nationwide connection of natural habitats and a living monument of Germans history. A sensitive adjustment of the former border's present condition may contribute to generate enhanced touristic value and to support a sustainable regional development. Consequently, this would also lead to the preservation of the perceptibility of this unique historical heritage.

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