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Green bridges and Wildlife Corridors in Austria

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1 Introduction

Anthropogenic barriers (e.g. roads, canals, railways, belts of settlements and housing) may affect wildlife species with large home ranges and specific seasonal migration traditions in negative ways. In Austria and other industrial countries the constitution of such barriers restricts genetic interchange between populations at an increasing rate. Additionally, landscapes of intense agricultural use (lacking structural elements of vegetation cover like bush belts a.o.) reduce migration. Therefore, migration corridors should be maintained and should constitute an explicit part of wildlife and landscape management. In Austria, the first steps towards a resource management of this kind have been taken most recently with special regard to bear *(Ursus arctos)*, lynx *(Lynx lynx)*, wolf *(Canis lupus)* and red deer *(Cervus elaphus)*.

2 Project "Efficient green bridge insertion in Austria"

2.1 Problem and Purpose

The Austrian network of motorways is almost complete and fenced off but no information was available so far whether this network of barriers offered enough permeability for wildlife, especially for big game species, and where suitable passageways were situated. The purpose of this study was to examine the actual permeability of the network of motorways. (The term permeability is in this sense defined by the possibilities for wildlife to cross the motorways through existing passageways). Another aim of our study was to provide information that is needed (e.g. about corridors), to consider landscape connectivity for wildlife in future road planning processes. Recommendations for measurements referring to reconstitution of a sufficient wildlife-permeability are made (VÖLK et al., 2001).

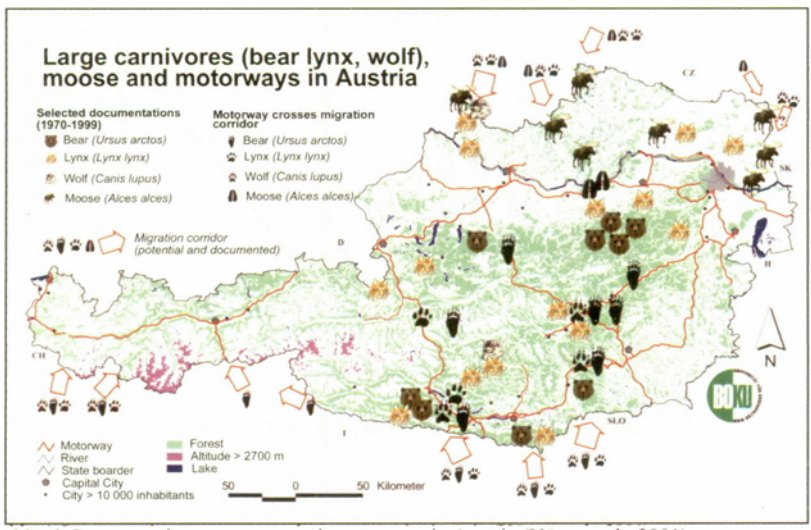
2.2 Materials and Methods

Our survey focused on forest wildlife species, which have large home ranges and, compared to other species, need the widest bridges and tunnels for crossing. As indicator species we selected rare and mobile big game species (e.g. brown bear, lynx, wolf, moose) and widespread ungulates (wide ranging red deer, additionally chamois in alpine areas and wild boar in cultural landscapes, subsidiary also roe deer). The point, that information from and cooperation with hunters and game managers were available and possible was an additional aspect for choosing these species.

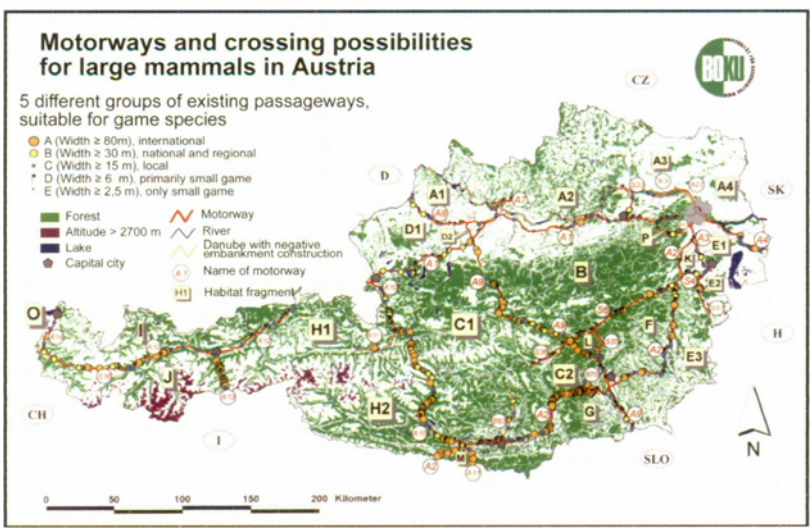
We mapped routes and locations of important migration corridors in Austria and in the border regions by means of the Austrian map (distribution of forests and settlements) and by means of multiple observations of big game species in certain regions - mainly registered by local hunters (see map 1). The movement patterns of bear, lynx, wolf and moose have been

well documented within Austria from 1970 to 1999. (ZEDROSSER and VÖLK, 1999; STEINER, 1995; MRLIK, 1995; AESCHT et al., 1995)

Besides motorways, there are numerous anthropogenic factors that act as barriers and reduce migration possibilities for game: Agricultural areas without natural woodland, belts of settlemens, embankment constructions, railway lines and others (see map 2). The reconstitution of permeability through all these barriers is possible with greenbridges, measurements at riverbanks and compounds of biotop in agricultural landscapes. But when settlements grow together and become impassable "belts of settlements" wildlife corridors are irreversibly lost!



Map1: Large carnivores, moose and motorways in Austria (VÖLK et al., 2001)



Map 2: Spatial distribution of forests and barriers in Lower Austria (VÖLK et al., 2001)

A database of The Ministry for Economic Affairs containing diverse data (width, location, height a.o.) about all passageways - most of them preliminary built for human use - was the basis for our analyses. Within the network of existing motorways we examined the potential for wildlife use for all existing overpasses, underpasses and tunnels ≥30 m, additionally for passageways with a width of <30 m that fit well in the landscape and are of suitable construction and location (e.g. near forests, hedges leading towards the passageway, not completely asphalted). With the aid of aerial immages and maps containing forest distribution and distribution of settlements, rivers and infrastructure some passageways were preselected. Afterwards a terrestrial evaluation of wildlife relevant characteristics of the remaining 764 passagways was carried out with standardised checklists. We then made track controlls at all these passageways in all four seasons to see which crossings were being used. Simultaneously, a questionnaire was sent out to local hunters and conservationists. This brought additional information about actual use of the existing passageways by game species. At last we got an impression of the current permeability of the Austrian network of motorways for the indicator species. As a result the passageways were split into 5 groups:

Passageways of type A: Width ≥ 80 m, located near migration routes of international importance; suitable for all game species

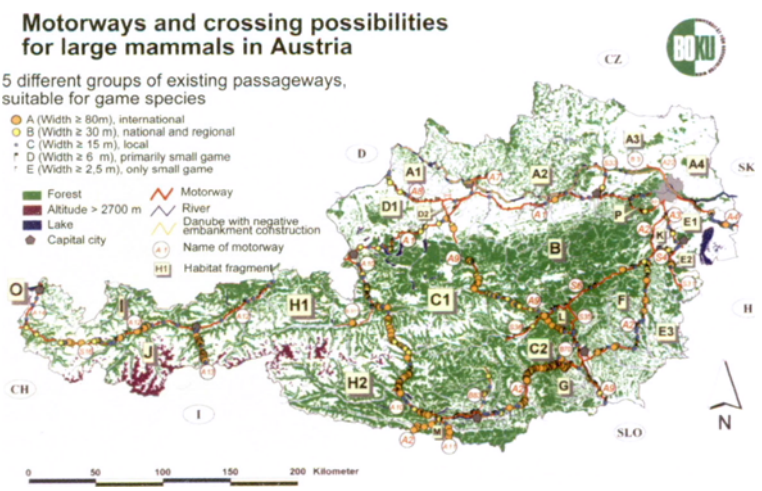
Passageway of type B: Width ≥ 30 m, located near migration routes of national or regional importance; suitable for all game species

Passageways of type C: Width ≥ 15 m, for local defragmentation; useful for roe deer and small furred game species, sometimes used by larger species, which are locally familiar with the passageway

Passageways of type D: Width ≥ 6 m, at least 1/3 is not paved over, useful only for small furred game and in some cases for roe deer.

Passageways of type E: Width ≥ 3 m, only for small furred game, seldom also for roe deer

3 Results

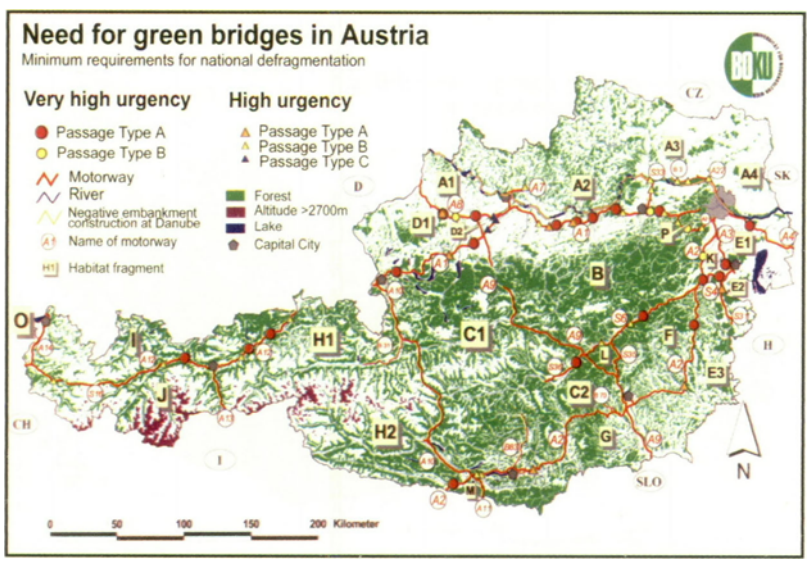


Map 3: Motorways and crossing possibilities for large mammals in Austria (VÖLK et al., 2001)

Our survey led to a national database including wildlife relevant information about the existing passageways across the Austrian network of motorways (see map 3) and shows the location of important wildlife corridors. The evaluated crossing possibilities for wildlife represent the "permeability ressource" of the Austrian network of motorways. Additionally, the database contains information about possibilities to upvalue certain passageways and make them more suitable for wildlife.

The study contains recommendations concerning the number, location, distribution, dimension and constructional design of crossing possibilities across the Austrian network of motorways. Regarding the necessary minimum permeability, we differentiated between international, regional and local defragmentation. The necessary permeability was evaluated seperately for each motorway segment between two motorway junctions. Recommendations concerning the minimum permeability for wildlife are slightly different for the existing network and for new and future motorway constructions. The stronger criteria apply to the latter.

Motorway segments with insufficient permeability for wildlife could be identified by comparing the defined standards of permeability (see Table 1) with the existing permeability (existing passageways). For segments with too little permeability, recommendations for constitution of wildlife passageways (green bridges) could be made. They included details on location, dimension, number and quality of wildlife passageways (see map 4). To avoid misinvestments, other barriers such as belts of settlements, railway lines or rivers with insurmountable embankments were considered. The developed theoretical values of minimum permeability served as terms of reference but were not strictly exerted. Corresponding to the specific local means the desired values were handled flexibly. But it would be risky to refuse any kind of standards. In that case, measurements of habitat defragmentation for wildlife would be regarded rather a luxury investment than a necessity. During each motorway construction project, the necessity and amount of measurements of compensation would have to be discussed seperately which would bring further disadvantages and inefficiency.



Map 4: Need for green bridges in Austria (VÖLK et al., 2001)

Table 1: Defined standards of permeability for existing highways

Passageways Type A (for international habitat defragmentation)
Wherever a wildlife corridor of international relevance crosses a motorway, a passageway for wildlife with a minimum width of 80 m is needed. (Recommended width 80-100 m)
Passageways Type B (for regional and national habitat defragmentation)
To ensure a minimum permeability and a minimum habitat defragmentation for the sensitive indicator species at least 5 passageways for wildlife along one highway segment with a minimum width of 30 m are recommended. Their locations should be away from human settlements and the maximum distance between neighbouring passageways of type A or B must not exceed 20 km. If the motorway segment is longer than 75 km the number of necessary passageways increases for every started 20 km by 1. (Recommended width 30-80 m)
Passageways Type C (for local habitat defragmentation)
For local habitat defragmentation away from far ranging wildlife corridors, 5 passageways with a minimum width of 15 m along one motorway segment are necessary. The average distance between passageways of type A + B + C should not exceed 10 km. (Recommended width 15-30 m)
For very short motorway segments (<5 km , <25km) exceptions are provided.

4 Investigation of migration corridors – an example from current research

The registration of potential and important migration routes for genetic interchange is the basis (1) to secure still existing corridor-resources (e.g. in spatial planning) and (2) to reactivate corridors, which are actually interrupted by certain barriers. To find the best locations for green bridges the investigation of wildlife corridors is one of the most important issues.

Interdisciplinary research at the University of Agricultural Sciences Vienna with specialists in the fields of Remote Sensing, Landscape Ecology and Wildlife Biology was aimed to test the applicability of remote sensing techniques for the provision of information about corridor structures and barriers with relevance for wildlife migration in intensively used agrarian areas. (GRILLMAYER et al., 2002)

Within the connecting belt between the Alps and the Carpathian mountains a part of the main migration route was selected as investigation area. The study area is located east of Vienna between the floodplains of the Danube and the Leitha. The area is dominated by intensive agricultural use. Due to the long term of anthropogenic utilization many kinds of restraints (settlements, road infrastructures, fenced forest habitats a.o.) for the mobility of the chosen indicator species red deer and wild boar exist. Besides this variety of barriers the test area also contains structural potentials for corridor spaces, which can be used as starting point for measurments of improvement.

Aerial image analysis and terrestrial mapping were carried out simultaneously, the resulting database contains information on landscape elements with barrier characteristics, such with corridor characteristics and information on categories of landcover. To guarantee the comparability of aerial image analysis and terrestrial mapping, an interpretation key for the aerial image analysis was developed, which contained the same structure classes as the terrestrial assesment. The interpretation key was verified and improved after a probational mapping. For collecting actual information about wildlife migration the following methods were used: Trail surveys along defined lines, wildlife observation with infrared field glasses and questioning of local hunters.

One final result is the preparation of a low cost method for the evaluation of wildlife-relevant landscape elements and their characteristics. This method can be utilized in major parts of Austria except for Alpine areas.

Using the collected data a resistance model was developed, which allows analysis about wildlife movements in the investigation area. This resistance model enables risk analysis to show if and how future developments in this region will influence or interrupt the existing migration routes of red deer and wild boar. It will help to prepare demonstrative future szenarios regarding consequences for wildlife mobility due to regional planning strategies. The model also shows the way of the least resistance between habitat patches and can indicate rather exatly where a wildlife corridor crosses a motorway. By using this model we identified the best location for one of the recommended green bridges.

This example of research shows that basic information about the resource "wildlife corridor" can be obtained by use of remote sensing techniques so that expensive terrestrial mapping can be reduced to a necessary minimum. Especially for the development of concepts and strategies for regional and landscape planning such basic information is of great usefulness. Consequently, aspects of wildlife management as the defragmentation of habitat fragments can be considered in time. Planning strategies and concepts can be tested with regard to their fragmentation risk using the resistance model.

Summary

Landscapes and landscape structures that enable the exchange, dispersal and migration of big forest-favouring game species are resources which densly populated Europe is running short of. Two projects in Austria provide information that is needed for the management of this ressource. "Efficient green bridge insertion in Austria" is a project which lead to a concept of green bridges for the Austrian network of motorways. By evaluating existing passageways wider than 30 m and their suitability for wildlife and further by gathering information about the most important migration routes for red deer, moose and large carnivores the permeability of the network of motorways was investigated.

An interdisciplinary project in Austria, titled "Wildlife corridors", examined the applicability of remote sensing methods and terrestrial surveys to identify corridor structures at different landscape scales. With the collected data and information from aerial / satellite images and terrestrial surveys a resistance model for the investigation area and the indicator species red deer and wild boar could be developed. The most probable migration route between the floodplains of the Danube and the floodplains of the Leitha was detected.

Both projects reveal explicit measurements of "resource management", which ensure genetic exchange on the long term. They are a contribution to sustainable wildlife management in Austria and the border areas. Besides the improvement and implementation of the gained data, the integration of our results in instruments of regional planning and landsape planning are the most important next steps. Only thereby the ressource wildlife corridor can be taken into consideration in planning processes and strategies at different scales.

Keywords: migration, corridors, Austria, passageways, green bridges, roads, red deer, big game, fragmentation, connectivity, large carnivores, ressource management

Zusammenfassung

Grünbrücken und Wildkorridore in Österreich

Landschaften und Landschaftsstrukturen, die Wanderungen, Ausbreitung und den Austausch

großräumig lebender Tierarten zwischen Teilpopulationen ermöglichen, stellen im dicht besiedelten Europa immer knapper werdende Ressourcen dar. Durch zwei Projekte in Österreich werden notwendige Grundlagen für ein Management dieser Ressourcen bereitgestellt. Im Projekt "Kostenreduktion bei Grünbrücken durch deren rationellen Einsatz" wurde die für eine ausreichende Vernetzung notwendige Durchlässigkeit des übergeordneten und gezäunten Straßennetzes aufgezeigt. Die Ermittlung der tatsächlich vorhandenen Durchlässigkeit erfolgte durch Bewertung sämtlicher existierender Über- und Unterführungen mit mehr als 30 m Breite (aus der Sicht des Wildes) hinsichtlich ihrer Tauglichkeit für Wildtiere sowie durch Erhebung der wichtigsten Wildtierkorridore für Rotwild, Elche und Großräuber mittels Kartenanalysen, Befragungen und Auswertung vorhandener Daten. Aus dem Vergleich der notwendigen mit der tatsächlichen Durchlässigkeit ergab sich schließlich ein Grünbrückenkonzept für das Österreichische Schnellstrassen- und Autobahnnetz.

Im Projekt "Wildökologische Korridore" wurden anhand eines Teilareals des Alpen-Karpaten Korridors Möglichkeien der Fernerkundung zur Erkennung von Korridorstrukturen getestet und angewendet. Mittels der aus den terrestrischen Erhebungen, Luft- und Satellitenbildanalysen gewonnenen Daten und Informationen war es möglich ein Widerstands- bzw. Durchlässigkeitsmodell, gültig für Rot- und Schwarzwild, für das Untersuchungsgebiet zu entwickeln. Die wahrscheinlichste Migrationsroute zwischen den Donau- und den Leithauen konnte ermittelt werden.

Aus beiden Projekten leiten sich konkrete Maßnahmen des "Ressourcenmanagements" ab, die für die langfristige Sicherung des Genflußes von Bedeutung sind. Beide Projekte tragen dadurch auch bei zur Sicherstellung eines nachhaltigen Wildtiermanagements in Österreich und seinen Grenzgebieten bei. Neben der Verfeinerung und Anwendung sind Verankerung und Berücksichtigung dieser Grundlagen in den Instrumentarien der Raumplanung und Landschaftsplanung die wichtigsten nachfolgenden Schritte. Erst dadurch kann die Ressource "Wildtierkorridor" als Planungsgrundlage auf den verschiedenen Ebenen der Planung berücksichtigt und in Planungsstrategien auf verschiedenen Ebenen miteinbezogen werden.

Schlüsselwörter: Migration, Korridore, Österreich, Über- und Unterführungen, Grünbrücken, Straßen, Rothirsch, Großwild, Fragmentation, Vernetzung, Großcarnivoren, Ressourcen-Managenent

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