Abstracts

IENE seeks to reflect the current state of practice and knowledge in the complex field of transportation, infrastructure and ecology. Based on this aim, abstracts and posters have been accepted that present innovative ideas and practical approaches to matters of transport infrastructure and ecological concerns.

The following section presents all abstracts from the plenary and parallel sessions as well as from the poster sessions. They are organised in chronological order by sessions and days.

October, 22–24

Plenary Session

Parallel Session

Poster Session

Monday, October, 22

Plenary Session 1

Distinguished experts from Europe and North America have been invited to introduce selected themes, discuss urgent problems and effective solutions, as well as share their visions for transport and infrastructure ecology.

ps1 Green Infrastructure

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What is Green Infrastructure?
Green infrastructure is a strategically planned and delivered, functionally linked network of high-quality ecosystems and other environmental features, designed and managed as a multifunctional resource delivering an enhanced, wide range of benefits and services that human society receives from nature.

It can be composed of natural and semi-natural areas and other features in rural and (peri-)urban, terrestrial, freshwater, coastal and marine landscapes, within protected and not protected areas. Green Infrastructure initiatives aim at maintaining, restoring and promoting ecosystem health and resilience; they enhance the multiple benefits that human society receives from nature and contribute to biodiversity conservation. Such initiatives are most effective when they are part of integrated spatial and temporal planning, enhancing the cooperation between stakeholders.

To be defined as such, the components of Green Infrastructure need to have some degree of scale, critical mass and/or connectivity. Thus while individual elements such as hedgerows, green roofs, trees may be a component of Green Infrastructure, they must form part of a larger habitat, green area, corridor or network that serves wider, multiple functions. Green Infrastructure can include natural features such as high-nature value forests and farmland with landscape elements, restored and intact wetlands and marine areas as well as parks and man-made features such as eco-ducts or green roofs and walls.

Emphasizing the economic case
Green Infrastructure is a tool that highlights the importance of and values the natural environment in project planning, while maximising socio-economic benefits. It places the emphasis on the 'service side of the natural economy': The services provided by ecosystems far exceed the value of their products. Green Infrastructure is about fully valuing these services in planning investments.

The idea of protecting high value areas or restoring degraded ecosystems is not new, and practiced in Europe since many years. A new aspect however, is that once these ecosystems are restored and well managed, they are more resilient and deliver multiple instead of limited benefits for the profit of European citizens. On top, they are efficient and sustainable solutions which save money in the mid- and long-term – an argument which should count in times of scarce financial resources.

Interventions to protect or restore Green Infrastructure can provide multiple benefits but they are not cost free. In addition to the direct financial costs of the intervention, there are often opportunity costs related to the potential income foregone from alternative developments for the site. The integration of Green Infrastructure considerations into the planning process allows all the relevant issues to be assessed and a coherent decision to be taken.

Green Infrastructure's cost-effectiveness is affected by size, management interventions and costs of alternative land uses. Generally, the additional ecological and socio-economic benefits of Green Infrastructure likely outweigh traditional engineered approaches. Multiplier effects of 1.7 of every EUR invested on the regional economy have been assumed for Green Infrastructure projects in the Netherlands.

Multi-functionality
One underlying principle of Green Infrastructure is that the same area of land can frequently offer multiple benefits once the right priorities are set – this enables the more efficient use of land. Important is not only the number of areas to be sustainably managed within a Green Infrastructure approach, but also their location, extent, and quality within the landscape, in order to deliver essential services to society generally cheaper than artificial solutions, which are not designed for providing multiple services.

Against this background, Green Infrastructure should be seen as an integral part of innovative strategic development, alongside and complementary to other 'grey' infrastructure such as utilities and transport networks. It is clearly not just an environmental domain but delivers significant interests for a number of sectors.

What are the ecosystem services Green Infrastructure could deliver?
Human society is entirely dependent upon the natural world and the benefits that it provides such as food, clean water, carbon storage, climate regulation, pollination of crop plants, mitigation of extreme events such as floods, droughts and tidal surges as well as social cultural and recreational services such as the beauty and identity of a landscape. The benefits that we receive from nature are also referred to as ecosystem services. As an example, the value of services from pollination in the EU has been estimated at EU at 15 billion EUR per year and the overall benefits of the Natura 2000 network range between 200-300 billion EUR.

It is at the core of the advent of the 'restoration economy' – the commitment of the European Union to restore 15 % of degraded ecosystems by 2020 needs large investments, to which Green Infrastructure could significantly contribute.

What are the problems it addresses?
As with other infrastructure, when natural ecosystems become degraded, too small or isolated, they are unable to provide the services our societies and economies depend on. Fragmentation of ecosystems, through transport and energy infrastructure, and through land use changes such as increased urban sprawl and agricultural intensification can severely disrupt natural ecosystem functions that are essential for the delivery of multiple services on which humanity strongly depends. Climate change impacts are adding to these pressures: It is impossible to solve biodiversity loss without addressing climate change, but it is equally impossible to solve climate change without addressing biodiversity and related ecosystem services.

One of the consequences of this weakening of the resilience and vitality of natural ecosystems is that they are less able to mitigate the impacts of natural disasters. All evidence indicates that those consequences will become worse in the future.

The fragmentation challenge
Irreplaceable natural or extensively managed areas in Europe are still being lost for the benefit of a continued expansion of artificial surfaces (urban sprawl) at the expense of agricultural land, grassland and wetland across Europe. Our continent suffers from more habitat and ecosystem fragmentation than any other part of the earth, in particular due to the replacement of sustainable land use practices with more intensive activities, especially in the agricultural and forestry sectors, and the transformation of vast areas into urban zones and fragmentation through transport infrastructure. The equivalent of the entire agricultural land area of the Netherlands is lost to urbanisation every 3-4 years.

As an example, a lack of diversity and too high fragmentation means that a forest may not deliver its full Green Infrastructure potential with the result that there is for instance, insufficient climate regulation, water savings, filtration, purification or soil protection, or fire reductions. According to the FOEN/EEA fragmentation report (2011), the four main effects of transport and energy infrastructure on wildlife populations are habitat loss, traffic mortality, barrier effects and population subdivision, leading to reduced population size and higher risk of extinction.

How can Green Infrastructure deliver in combination with transport and energy infrastructure?
Green infrastructure will be a necessary adjunct to the decarbonisation of transport and energy provision, mitigating the negative effects caused by land uptake and fragmentation, and boosting opportunities to

better integrate land use, ecosystem and biodiversity concerns into policy and planning.

As all other infrastructure, transport and energy infrastructure, including the Trans-European Networks (TEN) within the Connecting Europe facilities should be planned, upgraded and improved in such a way as to avoid, or where this is not possible, to minimise further fragmentation of landscapes and ecosystems such as by integrated spatial planning, construction of eco-bridges, underpasses or restoration of coastal shore lines, ecological reconstruction of waterways with improved migration possibilities for fish or the rehabilitation of degraded sites to recover their ecological functions. Further objective should be to achieve an improvement of the ecological situation of the planned area.

Green Infrastructure and transport infrastructure
Transport infrastructure, in particular, has both direct and indirect effects on wildlife populations. Most obviously, animal populations can suffer casualties from auto accidents; in the US alone, more than 1.2 million deer die annually due to traffic related injuries. Yet more consequential are the indirect effects of transport infrastructure, including habitat loss and reduced habitat quality, increases in habitat fragmentation with associated increases in edge density and habitat disconnectedness as well as barrier and cumulative effects. These and other effects have been explored in depth in the COST 341 European review on 'Habitat fragmentation due to transport infrastructure'.

To counteract these negative effects on biodiversity, Green Infrastructure offering improved habitat connectivity is increasingly being employed as an explicit part of wildlife and landscape management and being incorporated into regional spatial planning processes. It should be clarified that connective elements are not necessarily physically continuous and are therefore best defined by functionality. By creating such connections between habitats, Green Infrastructure serves to facilitate the dispersal, migration and exchange of genetic material between affected populations. Many measures exist to achieve these aims, including overpasses (green bridges), fauna tunnels or agricultural underpasses, large viaducts, fencing and fish migration helps.

More than 100 Green Infrastructure initiatives have been analysed, from all EU Member States. A number of them have addressed the negative effects on wildlife of grey infrastructure via the use of Green Infrastructure; examples are the Austrian Directive on wildlife protection in road construction, the Traffic Action Plan in Denmark or the Dutch Multi-Annual Defragmentation Programme. All of these have resulted in important results, and in lessons learnt in their implementation, such as cost factors and the lack of quantified data on benefits.

- Creating connective green infrastructure alongside the construction of new grey transport infrastructure is far cheaper than decreasing the barrier effects of existing infrastructure at a later date.
- There is a pressing need for integrated and coordinated approaches in local and regional spatial planning processes for new transport infrastructure to adequately cover wildlife corridors and ensure their long-term effectiveness.
- Avoiding valuable nature areas and conducting SEA/EIAs should have a high priority when planning new roads. However, as all environmental impacts cannot be avoided in constructing new grey infrastructure, the establishment of mitigation measures leading to an improvement of the overall situation should serve as a necessary component in planning exercises.
- Studies on optimising roads to minimise fragmentation, adaptation to landscape, aesthetic values of sites, traffic safety and needs of fauna and recreational passages are crucial in order to maximise the efficient use of available funds and encourage the widespread implementation of mitigation measures.
- Despite the lack of a standardised methodology for valuing the wider external costs of fragmentation or respective benefits of mitigation measures, rough estimates should provide useful indications when cost-benefit analyses are not possible.

Ultimately, the analysis points out that green and grey infrastructure are not inherently mutually exclusive. In contrast, both forms of infrastructure have the potential for compatibility and, when approached in a strategic and well-researched way, can support the needs of

surrounding species specifically and biodiversity and habitat conservation more generally.

Integrated planning
The development of Green Infrastructure requires innovative planning approaches, and the development of new organizational methods to better protect ecosystems and maintain or enhance their services.

Experience has shown that integrated planning instead of sector planning, with early communication to and involvement of citizens delivers long-term sustainable solutions. Current regulations are aiming at minimising the environmental impacts of infrastructure development but this has proven to be insufficient to halt biodiversity loss and to prevent increased ecosystem degradation and fragmentation. Examples for improving this situation are the current revision of the EIA Directive, the practical guidance and recommendations for integrating climate change and biodiversity into Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) procedures, or integrating fragmentation risk aspects into SEA and EIA procedures, as proposed in the EEA/FOEN report on fragmentation.

Key elements are therefore improved assessment tools encouraging the increased use of Green Infrastructure in – spatial and temporal – planning and assessment of plans/projects impacting the environment. Integrated planning asks for a coherent consideration of competing land use needs, which should be implemented through Green Infrastructure on landscape and river basin levels.

Information and monitoring
Information and guidance is further needed for success monitoring of GI on project and policy levels, in mid-term and long-term time spans. There is only few reliable data available e. g. on the beneficial effects of eco-ducts for the health of re-connected ecosystems.

In the context of the EU Biodiversity Strategy to 2020, Member States with the assistance of the Commission are committed to map and assess the state of ecosystems and their services in their national territory based on a coherent framework, assess the economic value of such services and promote the integration of these values into accounting and reporting systems at EU and national level by 2020.

This mapping and assessment work that is currently being carried out is a first, tentative step towards developing a comprehensive and coherent information resource regarding the status and trends of ecosystems and their services, and more information on pressures on Europe's ecosystems are necessary, such as on land use changes and fragmentation. This should help in identifying further priority areas for investments in Green Infrastructure of European importance.

What does this mean for Green Infrastructure policy on general level?
Green Infrastructure is far more than de-fragmentation caused by road or railway networks, and about mitigation measures when planning and constructing new transport infrastructure – such constructions should ultimately lead to an improvement of the ecosystems' health instead to their degradation. It is about investing in the health of ecosystems throughout the European territory – and connectivity measures can be well part of a Green Infrastructure initiative. On the other hand, further action is needed by transport planning, to minimise the impact of transport infrastructure on ecosystems wherever possible – one tool to achieve this could be to better consider benefits of grey infrastructure mitigation, such as the inclusion of wider financial implications of wildlife accidents in transport-related calculations.

How is the European Commission investing in Green Infrastructure?
The restoration and strengthening of Europe's Green Infrastructure is one of the priority actions included in the EU Biodiversity Strategy to 2020. The potential contribution of Green Infrastructure to achieving key policy objectives is already recognised explicitly in relation to resource efficiency, climate change adaptation, energy efficiency and smart cities as well as in cohesion policy.

Why is the Commission acting on European level?
The problems Green Infrastructure wants to address – degradation and fragmentation of ecosystems, adding climate change pressures, so that nature is not anymore able to deliver its services to humanity – can only be

solved if action is taken on all levels: international and European, national, regional and local responsibilities.

Green Infrastructure requires an integrated and coherent approach over large areas, which is now understood to be essential for carrying out spatially effective environmental policies, where the individual sector approach has not worked in the past. Green Infrastructure will contribute to achieving the goals of the Europe 2020 strategy, in particular linked to the 'Resource Efficient Europe' flagship initiative of 'Europe 2020', underlining that the wise management of natural resources in the next decades is a key prerequisite to sustainability.

But all this is not developing by itself at its full potential. Assessments of current policies and instruments show that without further action the economic, social and environmental decline through the ongoing degradation and loss of Europe's natural capital will continue and probably accelerate. The current rate and dimension of Green Infrastructure implementation will not considerably change this, but up-scaling is needed to achieve the potential merits of this tool. Problems are not addressed at a sufficiently large scale and integrated manner. Initiatives on increasing specific ecosystem services have not been co-ordinated, and not met the European-wide scale of the challenge. There is a need for better explaining the economic, social and environmental benefits Green Infrastructure could deliver, and an improved cooperation between stakeholders.

This is the aim of the current EU Green Infrastructure strategy: to work towards a more integrated framework to encourage and strengthen existing and new initiatives, to ensure they deliver European added value, and to promote investments in Green Infrastructure, thus contributing to mainstream its objectives in other policy agendas, including regional, development and agricultural policies. It aims to help people combat pressures related to land degradation and climate change in a coherent way, with a strong financial argument, as it is generally cheaper to invest in nature-based than in purely technical solutions. In addition these ecosystem-based approaches provide job and business opportunities, and contribute to a low-carbon economy.

ps2 Green infrastructure – concepts and implications for the transport sector from the example of Germany

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Generally, from an administrative perspective, safeguarding biodiversity in face of a transport network has at least four requirements:

- a practical legal background
- realistic concepts which support the legal background
- applied research that provides efficient solutions
- a functioning network of competent, interested and motivated experts in relevant authorities, in science, planning and in the NGOs.

The first 5 Chapters of the Nature Conservation and Landscape Management Act (Federal Nature Conservation Act- BNatSchG) of 29 July 2009 in principle offer the possibility of maintaining existing parts of the green infrastructure and the future development of necessary Green Infrastructure despite the impact of the transport network. Chapter 1 contains general provisions, one of which is to safeguard biodiversity in general. Chapter 2 describes the most important principles of landscape planning. Chapter 3 contains the basic regulations for the mitigation of impact regulation, a specifically German regulation to avoid, mitigate and compensate impacts outside protected areas. Chapter 4 specifies all regulations for the certain parts of nature and landscaping, e. g. the development of biotope networks and linking biotopes, but also the designation and conservation of protected areas e. g. Natura 2000 sites or nature reserves. Chapter 5 contains the relevant regulations for the protection of wild fauna and flora species, of their habitats and of their biotopes.

In the past, however, the attempt to maintain existing biotope networks in spite of the impact of the transport network have failed, mainly because there was a lack of realistic and visible concepts for politicians and planners from both the transport and the environmetal sector. Based on the German Habitat Network's (GHN 2004) preliminary map and the subsequent four maps (Habitat Network "Dry Biotopes", Habitat Network "Wet Biotopes, Habitat Network "Valuable Forest Biotopes" and Network for silvicolous larger mammals), the German Defragmentation Program was developed and implemented (ratified by the Ministry of Environment and the Ministry of Transport 2012).

Besides the development of political programs based on these concepts (such as the GHN and the subsequent maps) it is necessary to optimize the concepts of mitigation and compensation, their measures and their function, for the maintenance and development of green infrastructure. Therefore, more specific research is necessary into the required measures, into their function in the context of existing biodiversity, their number and their proper placement. Other relevant questions to be addressed are, for example:

- which habitat types should be restored;
- which species are relevant;
- which functions of the habitat and/or the species must be supported;
- how much time is needed for the development;

- how changing conditions due to e. g. climate change can be integrated in the concepts of mitigation und compensation, and what this means for the maintenance and development of existing green infrastructure;
- which functions are provided for species from special areas surrounding roads e. g. verges?

Answers to these questions will lead to more efficient mitigation and compensation measures, but the concrete implementation of these concepts and measures requires a functioning network of experts. In other words, at all levels - from the political to the scientific and public level - all the relevant stakeholders should be involved in the network and communicate with each other. In the German experience this has been one of the reasons for the successful development of the actions which led to the German Defragmentation Program and its implementation on the national and regional level in Germany.

Besides the efforts on the national level it is necessary to support the concept and idea of the European Green Infrastructure strategy developed by the EU. Therefore all relevant information from the member states regarding transport infrastructure, as well as regarding the mitigation and compensation concepts in general should be considered together in a concrete and visible form. At the end of the presentation three proposals will be presented regarding how and in which way this could work.

Monday, October, 22

Parallel Sessions 1

Policy & Planning I
Best Practise
Impacts on Wildlife I
Workshop: CEDR – Handbook Update
Permeability I

Lecture Session: Policy & Planning I	Room A

Environmental policy and plans

Chair: Marita Böttcher

Policies on defragmentation approaches and the development of Green Infrastructure both require an adequate administrative and legal environment. In this session, examples of policy related issues are presented, ranging from environmental impact assessment tools to national policies and plans for a future management of wildlife and traffic.

Lecture Session: Best Practise	Room B

Best practise in design of fauna passages

Chair: Britta van Dornick

Various ecoducts and smaller fauna passages have been constructed around Europe during the past years. Some of these have been monitored and evaluated and provide a valuable basis of experience for the design of new mitigation measures. This session presents examples of such studies and starts a discussion that will be continued in the following sessions.

Lecture Session: Impacts on Wildlife I — Room C

Impact of infrastrutcure on wildlife populations
Chair: Carme Rosell

There is already substantial evidence of the complex impact of traffic and infrastructure on wildlife, but still more empirical data is necessary to actually convince planners and decision makers of its significance. This session presents new important studies that help to quantify the impact and its consequences to populations and hence can support the development of new assessment tools.

Workshop: CEDR – Handbook Update — Room D

CEDR Implementation Plan for an update of the COST 341 Handbook "Wildlife and Traffic"
Chairs: Birgitte Henriksen & Hans Bekker

The CEDR project group "Wildlife and Traffic" has evaluated the usefulness of the COST 341 Handbook based on a questionnaire and a workshop at the IENE 2010 conference. This work yielded in a recommendation to the Governing Board of CEDR (Conference of European Directors of Roads) to promote an update of the handbook. The evaluation report "Mobility for Humans and Wildlife – cost-effective ways forward" can be down-loaded on this web address: (http://www.cedr.fr/home/index.php?id=5). The CEDR board replied in autumn 2011 by commissioning the Project Group to develop an implementation plan for the update.

With this workshop, we call for collaboration and aim at proposing and discussing a draft implementation plan for the handbook based on the above evaluation report. First of all this will include preparing a schedule and a structure for the update process, e. g. establishing a steering committee and working groups that focus on different subjects in the update.

It will be very helpful for the establishment of working groups, if those, who are interested in this collaboration, could clarify in advance with their National Road Agency whether the Agency is willing to support this work for example through human resources.

Permeability I — Room F

Defragmentation models and infrastructure permeability for wildlife
Chairs: Marguerite Trocmé & Tony Sangwine

Defragmentation plans that aim at strategically mitigating the barrier and fragmentation effects of transport corridors have become a standard in many countries. This session presents several approaches to identify where and what kind of mitigation is appropriate to overcome fragmentation.

a1 Road Ecology in Brazil: evolution and goals for the next decade

Fernanda Zimmermann Teixeira, Isadora Beraldi Esperandio, Igor Pfeifer Coelho, Mozart Lauxen, Alex Bager, Clarissa Alves da Rosa

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Roads are the main way for transportation of supplies and people in Brazil. Brazilian road network is growing rapidly, with the largest expansion occurring between 1960 and 1980 and reaching an extension of 1.6 million km nowadays. During this period there was not a concern with environmental impacts, and road construction was performed without any previous study. Environmental licenses only began to be required in Brazil after the publication of specific laws in 1986. The first academic study on road impacts on wildlife was published only in 1988, concerning bird roadkills. The majority of Brazilian studies in this area still now focus on roadkilled species lists, many of them without an appropriate experimental design, and are predominantly published in conference proceedings. However, in the last six years this pattern is changing, with an increase of publications in scientific journals, development of a software for spatial data analysis of road mortality (Sirieema), the organisation of specialized conferences (Road Ecology Brazil) and experience exchange and cooperation between researchers. Nowadays, construction, widening and paving of roads are carried out after performing environmental impact assessments, to inform managers about the viability and need for mitigation and environmental compensation. During this process, mitigation measures have been implemented, such as wildlife passages, based on studies carried out in temperate zones of the northern hemisphere. However, to implement these measures with success in tropical regions we need local studies, considering that species richness affected is significantly greater and ecological and social aspects may be very different. Although the installation of mitigation measures is already a reality in Brazil, the evaluation of their effectiveness is incipient and usually adopts inadequate sampling and analytical approaches. For the development of road ecology in Brazil, actions must be based on scientific research, aiming to ameliorate road planning and mitigation. The Brazilian Centre of Road Ecology Studies was created in 2011 to help the development of Brazilian road ecology, being responsible for promoting a link between academics, decision makers in environmental agencies and road planners and builders. The Centre main goals are to identify and stimulate research concerning knowledge gaps; to propose protocols for assessment, mitigation and monitoring of impacts; and to implement a database to be adopted by research centres and environmental agencies. This link is crucial in the present Brazilian scenario of government investment in the road network expansion. A national program for infrastructure predicts the building of new roads, and paving and widening of old roads summing at least 42 thousand kilometres. Also, since two new Brazilian laws were published in 2011, 55,000 km of roads already constructed must be regularized in the next 20 years, aiming to reduce environmental impacts, especially those related to roadkills and isolation of populations. While the expansion of the road network in Brazil represents a risk of increasing negative effects upon biodiversity, the recent development of Brazilian road ecology may be the opportunity to plan and implement an ecologically sustainable national transportation system.

a2 How allotment gardens mitigate the surroundings of transport infrastructures?

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Can allotment gardens and transport infrastructures coexist? Combining, from both a theoretical and methodological point of view, the disciplines of development and ecology, we have been striving since 2009 to answer this question both on the territorial scale of green infrastructures and on the local scale of the resident's experience. In the towns of Echirolles and Saint-Martin-d'Hères (France, Rhône-Alpes department), four municipal or illicit allotment gardens, often still attached to social housing, are formed and deformed with time over approximately seven hectares around a highway and a railway track. Our study underlines that if these gardens do not overcome the barriers created by the infrastructures, they take part in the dilatation of the ecological continuity existing along the transport infrastructures. These ecological continuities, according to their structural diversity, dialog with the "natural" formations of the nearby mountain ranges (ZNIEFF, APPB) and the wildlife corridors of the rivers, and with the urban plant and water formations. On a local scale, in terms of atmosphere (multi sensory perception and uses), these gardens play a significant role, creating singular universes allowing the participants and the visitors to escape momentarily the sound and visual disturbances of the road and the railway track. On the level of the garden areas, we explore a method for cross-referencing ecological criteria and atmospheric criteria. From an ecological point of view, we evaluate the favourable contribution of gardens to biodiversity, admittedly ordinary but nonetheless interesting. From the point of view of sensations, it is a case of revealing characterisable configurations of atmospheres in the gardens on a social level (social practices in the neighbourhood and in the gardens, gardening practices) but also in terms of layout morphologies and their sensory qualities (progression through the gardens, plant cover, soundscape, layout and connexions between gardens). On the scale of one allotment, we relate gardening and social practices and evaluate their impact on biodiversity. The methodology consists in ecological terms in noting down over several seasons from 2009 to 2011 the "wild" fauna and flora and in characterising ecosystemic formations present in the gardens. On a larger scale the ecological aspect is approached through cartography of the green and blue existing framework, aiming to consider the gardens as consolidating part of this framework. At the same time, in terms of atmosphere, ethnographical observations and sound recordings accompanied by measurements of sound levels are made in and around the gardens. Inside the gardens, we conduct semi-directive interviews with the gardeners. Finally, social, ecological and urban questions are approached through meetings with experts (chemists, ecologists, allotment garden managers and organisers, infrastructure designers) and with local political actors from the concerned towns. To conclude, the collaboration between the disciplines of development and ecology involves the criteria adapted to humanscapes, walkscapes and grounded natural spaces. These criteria are both an objective to reach and a way to study multishaped, complex and paradoxal settings and to foresee a sustainable design of transport infrastructures blended in the urban territory. Nevertheless, some barriers to the gardens' contribution to green, blue and human framework appear, these barriers reclaim more scientific investigations and the continuation of the dialogue with the institutional actors.

a3 Landscape sensitivity and potential of conflicts along the Austrian railway network – actual situation and prognosis for 2025

Tamara Zhuber, Katharina Zmelik

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Nowadays European landscapes are affected by a high level of anthropogenic fragmentation which is known as a major reason for the loss of biodiversity in industrialized countries. Increasing traffic and its infrastructure are having considerable impacts on nature and environment. Beside road traffic as the main cause, rail traffic is playing an important role as well. Having various negative influences (e. g. fragmentation of landscapes, pollutant and noise emission, killing wild animals or facilitating spread of neobiota) railway traffic and its spatial infrastructure is also implicating positive aspects for nature conservation. Especially in intensively used landscapes railway embankments offer refuge, substitute habitats and migration corridors for various species. Mitigating negative impacts and enhancing positive aspects of railway traffic in 2011 a joint project of the University of Vienna, the Österreichischer Naturschutzbund (Austrian League for Nature Conservation) and the ÖBB-Infrastruktur AG (Infrastructure Company of the Austrian Federal Railways) was started. Objective of the project was to implement concerns of habitat and species conservation into the management of embankments which is required for safety reasons. Along the whole Austrian railway network of about 5000 km the sensitivity of landscapes and conflict potential considering railway traffic and nature were analysed. The sensitivity assessment was based on several environmental data available for the whole of Austria (e. g. data on dry grasslands, bogs, waters, forest hemeroby, SINUS landcover, protected sites). For all grid cells (1 x 1 km) along the railway network these data were logically combined via pre-defined evaluation matrices and a dichotomic decision tree and resulted in a landscape sensitivity map displaying areas of high ecological value within railway corridors. In further analyses actual and predicted data (2009 and 2025) on railway traffic and its infrastructure (e. g. traffic volume, level of track expansion, amount of pesticide application, potential over- or underpasses for animals) were aggregated by the same principle of logical combination and matrices. Combining landscape sensitivity and impacts of railway traffic our analyses resulted in assessments of the actual and for 2025 prognosticated conflict potential between railway traffic and nature conservation for the whole of Austria. Interpretation of results and discussion of possible action plans were supported by the implementation of expert knowledge. Finally the assessment of landscape sensitivity and potential of conflicts provides a basis for an optimised management of railway embankments considering ecologically important habitats, areas in urgent need of actions and future developments of railway traffic. The integration of the data into the GIS of the ÖBB-Infrastruktur AG ensures high feasibility of the results. In further steps results of an additional sub-project investigating embankment vegetation and providing detailed management plans for 5 railway tracks in Lower Austria will be implemented.

a4 Strategic Environmental Assessment – a planning tool for ecological considerations in transport infrastructure; experiences on how ecological aspects listed in the Directive are assessed in EU

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Strategic environmental assessment (SEA) has been put forward as a planning instrument for sustainable development and a tool for environmental consideration. In accordance with the European SEA Directive 2001/42, certain plans and programmes with significant impacts on the environment in a wide range of sectors, among these the transport sector, have to undergo an SEA. The SEA directive states that likely significant effects of implementing the plan or programme, and reasonable alternatives are identified, described and evaluated. These effects should concern various environmental aspects such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors. This paper focuses in particular on biodiversity and landscape. The overall aim of this study is to analyze and discuss how environmental aspects as biodiversity and landscape are assessed according to the SEA Directive in the transport sector. The specific aims are to investigate (i) how the environmental aspects biodiversity and landscape are defined and (ii) the criteria, indicators and tools that are used to identify, describe and evaluate the likely significant effects on the environment. In order to examine SEA experiences in the European transport sectors, semi-structured interviews and literature studies were conducted among a number of countries within EU. Parts of the results have been presented at a seminar for representatives of the Swedish Ministry of Environment and the Swedish Transport Administration. In the review from the European Commission on SEA (2009), the lack of methodology to predict impacts in SEA is identified as a key problem. This problem is also reflected in the SEAs reports investigated in this study. While for example, carbon dioxide, noise and air quality can be predicted and evaluated by calculations or modeling techniques, difficulties in assessing impacts on biodiversity and landscape, for example fragmentation and habitat loss, have been revealed. Furthermore, the study concludes that clustering of the environmental aspects or restructuring into themes is common in order to be able to handle the amount of data, uncertainties and inter-relations between aspects at a strategic level. The tools used for the assessment are mainly descriptive techniques, based on tools commonly used in EIA. In the interviews, the need for a toolbox of different techniques, tools and indicators have been emphasized, rather than a standardised assessment procedure. New tools and methodologies applicable at strategic levels are needed, in particular for assessing environmental aspects such as biodiversity and landscape.

a5 Mitigating the impacts of traffic on fauna and flora. Polish experience

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Poland, which biological diversity stands out in comparison with the rest of Europe, became one of the biggest road construction site during the last few years. A development of a road network almost always involves disturbance of biogically sensitive and protected areas. As those areas cover about one third of the whole country it is virtually impossible to avoid conflicts concerning biological protection. For those reasons, steps to be taken to limit to a minimum the incidence of the construction works on the biological environment constitute an integral part of each investment. A very detailed biological inventory indicating existence and location of protected species within protected areas constitutes the basis to determine the possibility of conflicts. Information thus obtained are subsequently used when various options of exact location of the investment are examined. In this paper we present the procedures application of which allow the completion of investments with preservation of biological environment. We will describe steps which are being taken in Poland to minimalize the incidence of roads onto the environment both during the construction period and later on during their exploitation. How to determine the proper balance so that on the one hand the environment is protected and, on the other, to avoid being accused of unefficient use of financial resources. The costs of protecting unspoiled environment represent up to 30 % of the total costs of investments. The effectiveness of planned actions must consequently justify spending the considerable funds involved. Monitoring of the results of solutions used allows both verification of their usefullness and identification possible errors so that they may be avoided in the future. Monitoring which are currently carried out in Poland relate to use of animal passes, success (or failure) of relocation of protected species but also the incidence of roads on bats. How to determine the extent of monitoring of road incidence on certain groups of animals and plants? Number of actions which have been undertaken in Poland to minimalize the incidence of roads on unspoiled environment, in particular as regards the number of fauna passes, to preserve the ecological continuity, place Poland among most advanced European countries. Is it in applying the principle of balanced development or to the contrary "Too much is wrong".

a6 Sustainable transport systems – planning, infrastructure and technologies aimed at protection of environment – current Polish developments and plans for the future

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Inland transportation in Poland relies heavily on road transport, which currently serves as a major mode. Polish national roads network comprises of motorways (A), expressways (S) and national roads (numbers). Network of high class roads, such as motorways and expressways is currently under development and many areas, including metropolitan, still have to rely upon old national roads. Such roads do not have capacity required for current amount of traffic (as they are usually two-lane roads with single carriageway and junctions at one level) and prognoses show, that majority of routes will experience huge growth of vehicle movement in years to come. The need for construction of high class roads is both matter of security and road capacity issues. As for 2012 only 56 % of motorways are completed and as low as 14 % in case of expressways, with more to be constructed in the future. This particular need for road network development produces negative outcome for environment – mainly due to fragmentation of nature habitats and wildlife corridors. The White Paper 2011 – "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system" focuses on cutting carbon emissions and shift between modes of transport, together with removing conventional combustion based vehicles from cities to 2050. It also introduces a concept of "corridor approach" to various transport modes. Poland is a transit country between "western" and "eastern" part of Europe, therefore a large increase in traffic is expected and sufficient road infrastructure in necessary. To protect the environment a number of legislative procedures were implemented to Polish legal system, which are in compliance with EU directives and international agreements. Projects currently under development focus on systems which protect environment directly, but also on elements that require considering of various indirect solutions – like minimising of risk and environmental compensation or implementation of technologies that reduce impacts. Road infrastructure supports development of areas and allow for distribution of various cargoes. In Poland it is especially important to create possibilities for shift in way it is done, focusing on speed and volume. Special areas, where such services are available, can be created around cities and harbours, similar in concept to "transportation hubs" (green corridors approach). In future development of new technologies will result in implementation of new solutions. Current policy regarding protection of environment and environmental impact assessment (including first and subsequent procedure available in Polish legislation) may be fully used for road projects that are still at their very early stages. Such projects include many roads in eastern part of Poland, with great abundance of natural areas and numerous wildlife corridors. Monitoring of environment in the vicinity of roads will also be conducted for purpose of estimating the effectiveness of planning, which will allow to introduce different means of protection if required and to help stop degradation of biodiversity.

a7 Swiss standards for fauna friendly culverts

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Watercourses are the backbone of the Swiss ecological network. They are habitat and migration axis for aquatic organisms and also play also an important role for amphibian and terrestrial animals. These natural corridors and with that their ecological functions are often interrupted by – view from the animals needs – non adapted culverts along transport infrastructure. The main reason is, that most of the existing culverts were designed looking at hydraulic needs only and rarely considering animal needs. The Swiss Association of Road and Transportation Experts (VSS) integrates environmental issues in their road standards since 1994. The new VSS-standard on fauna friendly culverts (SN 640 696) was written by a team of engineers and biologists. The standard sets design specifications to insure that all new culverts are appropriate for aquatic, amphibian and terrestrial fauna. The standard discusses also the retrofitting of existing infrastructures (road and rail) as this is the most common situation. The standard distinguishes for new and retrofitted culverts 6 terrestrial fauna categories and 5 aquatic fauna categories, for which design elements may be different. The specialty of this standard is a sustainable development approach, integrating a cost/benefit analysis. Several flow charts guide planners towards the most cost-effective solution using criteria from structural engineering, fauna specifications as well hydraulic and maintenance aspects. The goal is to offer clear technical solutions which are also most cost-effective. This guarantees not only an ideal effectiveness of measures, but as well aims a cost minimization.

a8 Lessons learned from the "Small fauna-passages" – project of the Dutch railways

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ProRail is responsible for the management of the Dutch railway system. Commissioned by the Dutch government, ProRail implements 75 small fauna-passages within the rail infrastructure countrywide. More of these projects will follow, as part of the National Program for Defragmentation of ecological zones. We'd like to share our lessons learned from this project. It will be a review of specific project management problems encountered when dealing with such a specific (100 %) ecological project scope. It will not be a story about the ecological importance within the project or how the proposed ecological measures are defined and function. Overall, the project was challenged by three typical problems, each of them requiring a pragmatic solution:

- Fixed budget provisions: the proposed fauna-passage are small objects, which themselves are not that expensive. Although the object is small, all aspects concerned with contracting & building procedures are the same as for bigger objects (geotechnics, translocation of cables & pipelines, permits, temporarily land acquisition, accessibility of the building site). As the budget for project management, engineering and other reservations is set as a percentage of the estimated building-costs at the early beginnings of the project, it is a challenge to deal with the limited organizational budget available. The strategy followed by the project, has been to cluster the realization of all 75 fauna locations into one nationwide contract. Also work related to the acquisition of permits, or access to the work area, has been integrated into the contract with an incentive scheme for the contractor to seek for further cost optimization.
- Railroads can be compared with a chemical plant with its pipelines and machines: they have to be put out of service before you can safely work at it. This has to be planned well in advance and one must take into account the extensive technical requirements to comply with. Once the track has been released for construction activities, the activities are further bound to the short time gaps the tracks are free of railway traffic. The project ruled out the need of arranging track shut downs by working with round culverts which are pressed into the track body instead of using the more standard square culverts. In some places the solutions will thus not be the ecologically most optimal one, but instead certainly the best value for money.
- Small culverts with ecological function are characterized by a lot of location specific and detailed specifications, compared by for example big ecoducts. How do you put this into contracts for contractors in a way that it's an interesting job for them and with a good tender result price for the client on the other side? In order to achieve this, the project has defined a structure with seven standard specifications. This makes it easy for contractors to set their prices and to purchase materials. We also provided a contract with a long lead time, allowing contractors to optimize their workflow within their existing portfolios.

a9 How to tell target species there is a fauna passage – Practical experiences on the improvement of fauna passages functionality by establishing ecological hinterland connections

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Presently, there are more than 70 fauna passages already built or planned in Germany. Additional 90 passages can be built across existing roads in the next few years, as the "federal programme for reconnection" promises. But is the construction of fauna passages enough to reconnect habitats and thus to safeguard the regional biodiversity? How important are high quality ecological hinterland connections, especially in view of the fact that the passages are often relatively far from valuable nature reserves. In Northern Germany a project initiative has been launched to develop, implement and test a wide variety of measures and actions to reconnect habitats around fauna passages, first on the local and then on the regional scale. During the last two years, different types of measures have been implemented, and analyses of their effectiveness have been started. We present some of the most innovative and important measures and explain what effects on target species we expect and how we analyse them:

1) The fauna passage is surrounded by 140 hectares of intensively used forest dominated by non-native trees. This deters most demanding native species from reaching the fauna passage. Inside this forest we chose a network of 17 hectares size, in which we removed all non-native trees, gave up any further forestry permanently and thus initiated the transformation into a "native" forest.
2) Heath patches with few relict populations of target species occur scattered inside the forest, which is impassable for sun-loving species. We established heath corridors combining the heath islands with the fauna passage by means such as forest aisles and topsoil removal on forest edges.
3) Most donor populations of target species in the surroundings of the passage are rather small. The probability of reaching the fauna passage is a function of population size and the size and quality of habitat corridors as well as stepping stones. We introduced grazing systems as an important tool for preserving habitat quality on different isolated habitat patches in the surrounding. Then we connected the patches to each other via forest edge trailings or stepping stones in between and in the end connected this to the fauna passage. Major effects cannot be expected immediately after the implementation of measures. However, some target species inhabiting immature habitats like the natterjack toad (Bufo calamita) can react very fast. Though the analyses of effects have just started, first results already show that target species do spread from core habitats and get closer to the fauna passage. First genetic exchanges with populations on the other side of the road can be expected soon.

a10 The Evolution of the Ecology-Transportation Subdiscipline: An Analysis of 10 Years of ICOET Proceedings

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For the past decade, the International Conference on Ecology and Transportation (ICOET) has been bringing together a diverse community of researchers, practitioners, and policy makers from Europe, North America, South America, Australasia, and Asia working in the specialized field of ecology and transportation. As the largest conference in its field, ICOET provides a forum for current research, best practices case studies, and emerging questions. The ICOET proceedings comprise a compilation of all presentations made since the inception of the ICOET conference. The ten-year milestone, reached in 2011, provides a unique opportunity to evaluate the proceedings content to gain an overview of trends in topics, taxa of interest, and the affiliations and geographies of presenters since the inception of ICOET. This presentation will provide an overview of the history of ICOET as a venue and vehicle for the development of a unique subdiscipline at the intersection of ecology and transportation, including the relationship between ICOET and IENE. It will also describe the findings of a content analysis of ICOET proceedings. For the content analysis, all papers presented at ICOET from 2001 to 2011 were reviewed and the content coded to capture information about the substantive content and the paper authors. Coding of the substantive content of each paper includes taxa included in the study, transportation mode, location of the study, central topical focus of the paper (regulatory issues, analysis of effectiveness of mitigation strategies, connectivity analysis, carcass count studies, etc.) and the general approach of the paper (original analysis, descriptive case study, modeling, etc). The coding also captured information about the primary author, including geographic location, organizational affiliation, and professional role. The study allows exploration of several questions:

- Have the taxa of interest to the ecology and transportation subdiscipline changed over time? Are smaller or less charismatic species of rising interest?
- Are there changes in the transportation modes of interest over time?
- Are there patterns of content evident in the presented research?
- Is the subdiscipline trending toward descriptive studies or toward quantitative/analytic studies?
- Are there clear differences between research study design and approach between researchers in Europe compared with the United States?
- What global regions are emerging as producers of research and best practices? The analysis provides information about topical trends, evolution in approaches, shifts in conference participation, and differences among world regions in topics and research approaches.

The analysis provides a snapshot of the evolution of this subdiscipline over time and offers insight future directions for the research and practitioner community.

a11 Multipurpose ecological set-up on the international ecoduct Kempengrens

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The Flemish (Belgium) and Dutch government are working together to build an ecoduct over a highway that divides a transnational ecological valuable area. This project is based on separate initiatives of the two countries, each country having their own program and target species. As the result of a joint initiative it was decided to build one ecoduct with a width of 60 meters on the border in the middle of the transnational area. The original architectural project is designed with much attention to the adaption in to the landscape and to its ecological function. In order to make it functional it is important to fit the set-up to the demands of all the target species of the surrounding landscape. Therefore the local Forest group made a technical design for the ecological set-up of the passage. The goal is to realize different ecotopes on the bridge and the slopes: A moist zone will be installed at the Westside (Belgian side) of the ecoduct as a moderate nutrient rich situation The goal is a moist heath vegetation Variation will be established by making some depressions. A dry zone with poor nutrient conditions will be established at the eastside (Dutch side) of the ecoduct. The conditions will be suitable for dry Heath. Only few scrubs will appear in this dry situation which results in an optimal sunny environment for the target species. Micro relief (holes and bumps) and open sandy spots are very important for the target species. In order to increase the structural variation a transition zone will be established between the moist and the dry zone. The two zones will have a minimal width of 15 meters and a maximal width of 25 meters. The result is a transition zone with a variable width. On the accession ramps and on the bridge transition from the moist zone to the dry zone will also be created in the construction of the soil layers. On the bridge this will be realized with a compartmentalisation made by small retaining walls in V-shape. This is a passive way to create a wet zone by retaining the storm water. Slope screens at both edges are necessary to create a secure situation on the bridge. At the inside they will be made of gabions filled with lava stones. At the foot a sand slope will be a sunny. The green slope screens will give the construction a green appearance for the road users. A ramp of stubs will be placed from one side to the other to provide shelter, a place to hide and to hibernate. The accession ramps will have a steep and a lousy slope connected to the bended form of the retaining wall of the construction. The dry and moist zones on the bridge continue on the accession ramps. The moist zone will be completed with ponds at the two sides. In the steep slope in the dry zone a bats cellar will be build.

a12 Optimizing habitat connectivity under road bridges in Germany

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Germany maintains the densest road net in Europe and one of the densest worldwide in relation to the country's area. This results in large problems through isolation for the connectivity of natural populations. The total length of German roads measures 688,243 km for which there existed only 55 ecoducts in February 2011, a further 20 were under construction. Additionally 160 man-made structures exist, that could be used as underpasses by wildlife. As we know from many earlier studies most species of larger wildlife are able to use these underpasses, but they are only very infrequently used by many smaller species (e. g. reptiles, small mammals) because of a lack of vegetation in the passage ways. In the year 2007 we were charged by the Bundesanstalt für Straßenwesen (BaSt) with a study to evaluate the factors leading to these desert-like conditions and – if possible – to develop appropriate measures to optimize habitat connectivity by means of developing vegetation for existing underpasses. In a first step we investigated 20 motorway road bridges concerning height, width, length as well as light and wind conditions and precipitation under the bridges. Under each of the bridges we carried out a mapping of vegetation on the level of habitat types. 12 of these bridges were chosen for in-depth studies. Under these bridges vegetation was studied concerning species composition, zonation and light requirements as well as soil composition via chemical and physical parameters. The most critical factors are soil, water and light. Under motorway bridges with four non-spread lanes with a total width of 29.5 m and a height less than 4 m no vegetation is able to grow. Even with ample water supply the lack of light becomes the limiting factor. Under many bridges we found the soil to be heavily manipulated anthropogenically. These soils consisted to a large portion of rubble and were strongly compressed. On soil like this, even without a bridge above, conditions for the development of vegetation are very poor indeed. Vegetation did not manage to cover steep slopes with rocky ground even when enough rain reached the soil because erosion removed the foothold of the plants. Another important factor we observed under many bridges was constant human influence. As misuse we registered to a smaller portion human activities like motocross-biking. The larger and more frequent portion of misuse was created by agricultural activities. These included cattle fencing, straw and fertilizer storage, and in most cases parking of agricultural machines combined with their frequent movement. Potholes, providing a few moist areas or puddles were filled up with broken bricks or comparable material. Three bridges were equipped with artificial irrigation systems, two of which were fed with river water by means of a pump system, and the third was supplied with waste water from the pavement of the bridge. After three years of irrigation during the summer months the newly developed vegetation under one of these bridges could sustain a reproducing population of the Common Lizard (Zootoca vivipara). Moreover, the small mammal activity increased significantly under this bridge. But this solution should be restricted to very special cases, because these irrigation systems require intensive maintenance and are difficult to secure. The division of nature reserves or areas of the Habitats Directive by roads might justify the effort. In our opinion 70 % of the areas bare of plant cover under road bridges could be vegetated after soil melioration and the consequent exclusion of all agricultural activity. During bridge construction natural soils have to be treated carefully and should stay in place whenever possible to optimize the future possibility for plants to take root and thus enabling an increase in the migration rates of animals.

a13 Effect of landscape structure on population persistence tiger (Panthera tigris) population in western landscape of India

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Tiger is a conservation dependent animal. It requires large landscape complexes for its long term survival. We present a spatially explicit population model for analysing the dispersal of tiger and explore a general modelling frame work that allows for a systematic investigation of impact of changes in landscape structure on population dynamics of tigers in western landscape of India. The model is based on original field investigation of tiger movement and habitat use in Ranthambhore Tiger Reserve. The landscape structure was represented by GIS-derived raster map defining habitat suitability (highly suitable, moderate suitable and least suitable) and major spatially barrier to dispersal. The population model follows the fate of individual tiger and simulates reproduction, dispersal, home range establishment, and mortality in annual time steps. We used 7 years (2005-2011) camera trap data to determine key variables of population dynamics, such as population size, breeding females with cubs, dispersal distance, and mortality rates. Results obtained with spatially explicit population model show that landscape indices, which describe scale-dependent correlation between and within habitats were able to explain variation in variables of population dynamics (mean number of females with sink home range, mean dispersal distance) caused by different landscape structure. When landscape structured change, change in these variables generally followed the corresponding change of an appropriate landscape index in a linear way. This study increases our ability to improve both basic ecological knowledge of landscapes phenomena and application of landscape ecology to conservation and management.

a14 Wolf Canis lupus population in the area intersected by two motorways – Lower Silesian Forest (W Poland) as a case study

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When the wolf Canis lupus became a strictly protected species in Poland in 1998, it started to resettle areas from which it had been eradicated before. During last several years a scattered but gradually growing wolf population has been established in Western Poland and Eastern Germany. However it is still considered as critically endangered according to the IUCN criteria. The return of the wolf to Central Europe faced with rapid development of transport infrastructure in Poland, which was accelerated after the access of the country to the European Union. Currently the biggest subpopulation of wolves inhabits the Lower Silesian Forest (on average 2,000 km^2) near Polish-German border. The area is intersected with two major roads – an old A18 motorway and a newly built section of A4 motorway, which was co-financed with EU funds. To meet requirements of the Environmental Impact Assessment, the Polish Motorway Agency commissioned 3-years long (2010-2013) monitoring of the impact of new A4 motorway section, other roads and a railway on the local wolf population. The project has applied non-invasive DNA monitoring in order to recognize a potential barrier effect of transportation infrastructure for wolf dispersal, as well as intensive tracking to assess habitats utilization by wolves in relation to transportation infrastructure within forest. Preliminary results (2010-2012) showed that the local wolf population exchange individuals with other populations and wildlife crossing structures established on A4 motorway allow wolves to disperse outside the forest. Wolves utilize proximity of motorways when searching for prey, but they avoid digging dens and rearing pups in places closer than 4.4 km from motorways and major roads. We conclude that: (1) adequate mitigation measures on motorways are able to minimize barrier effects on large carnivores populations and sustain exchange of individuals between subpopulations, but (2) creating of a dense network of motorways and major roads crossing interior of forest tracks which are occupied by large carnivores should be avoided, because it may lead to excessive fragmentation of habitats and loss of areas, which are distant to sources of disturbance, thus suitable for breeding.

a15 Species-specific responses of bats to motorways: implications for conservation and green infrastructure

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It is now widely recognized that roads can adversely affect local animal populations through increased mortality and barrier effects. However, comparatively little is known how roads affect bats, even though bats are of particular interest to conservation. Here we present data from a long-term study that compared the response of European bats that differ in foraging ecology to motorways that cut through their habitat. Moreover, we present data on the effectiveness of newly constructed underpasses and green-bridges designed to facilitate the crossing of bats and other wildlife. As bats are key species in conservation, such data are required for designing management plans and for the mitigation of infrastructure projects such as the construction of new motorways or the enlargement of existing motorways. Using radio-telemetry, bio-acoustic monitoring, mark-recapture data as well as population genetic data we investigated the effects of motorways on the habitat use and population structure of forest-living bats with different foraging ecology. A special focus of the study was on the comparison of barbastelle bats (Barbastella barbastellus), which forage in open space, to Bechstein's bats (Myotis bechsteinii), which glean prey from the vegetation. Both species are among the most highly endangered European bats and are listed in the European FFH-directive (Annexes II and IV) and the ICUN conservation action plan to be of high priority. As a result, they regularly appear in conservation assessments of European infrastructure projects, such as the construction of motorways. Most of the radio-tracked barbastelle bats crossed a motorway with high traffic during foraging and roost switching, largely independently from existing underpasses. In contrast, only very few of the radio-tracked Bechstein's bats crossed the same motorway during foraging, all using an underpass. Bechstein's bats, unlike barbastelle bats, never crossed this motorway during roost switching. We compare the data obtained from a motorway with a high traffic load to motorways with less dense traffic and discuss the flexibility of bat species to react to different motorways and roads. Overall, our data on the habitat use of different bat species show that motorways can restrict habitat accessibility for bats but the effect appears to be species specific, particularly depending on the species' foraging ecology. We suggest that motorways have stronger barrier effects on bats that forage close to surfaces than on bats that forage in open space. We discuss the implications of our findings for bat conservation during road construction and suggest effective mitigation measures such as the construction of underpasses.

a16 Effects of the Transylvanian Motorway on droving of livestock

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The network of motorways are presently in a dramatic increase in east Europe, to the benefit of transportation and traffic safety, but with potential negative effects on landscape connectivity. Romania are internationally recognized for its large areas of high nature value grasslands, where the biodiversity is to a large extent depending on traditional land use, including droving of livestock in various spatial and temporal scales. Mobility in the landscape is an expected prerequisite for the continuation of such droving practices, and thereby also for the conservation of the outstanding grassland biodiversity. We studied the effects of the Transylvanian Motorway on traditional droving. The study was conducted along the first operating section of the motorway (42 km), passing through an agricultural landscape in the foothills of the Western Carpatians. We mapped previous and current land use and drover routes in the vicinity of the motorway, based on official land use records, interviews with officials and animal keepers, and field observations. To a large extent, the motorway line coincided with previous borders between land use administrative units, over which few livestock movements occurred even before the motorway was constructed. In other parts, livestock (sheep, cattle, water buffalo and horses) were regularily driven under the motorway through the many large viaducts. Some local adaptation to the motorway barrier was recorded, for example a slight re-routing of movements traversing the motorway corridor, relocation of sheep folds, or adjustment of land use administrative borders. The motorway could have caused some additional land abandonment, but the actual effect was hard to establish due to the highly variable agricultural system with frequent shifts in land use. We conclude that the motorway will not have a dramatic effect on the traditional use of high nature value grasslands in the area, but the situation may be different in a less hilly region, where fewer viaducts are constructed.

a17 Habitat use of wolves in relation to linear infrastructure disturbance zones and other secondary artificial and natural barriers

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We studied wolf habitat selection related to environmental and human infrastructure variables including landscape modification and disturbance caused by highway (study area A) and high-speed railway (study area B) under construction. Data on wildlife response during construction phase of large linear infrastructures are relatively scarce but may reflect at some degree future response during operation phase and therefore permit timely adjustments on mitigation measures when necessary. Study area A, located in northern Pindus range (450 km^2) included Egnatia highway construction zone, a heavily trafficked national road and a large river (Venetikos). Study area B, located in west Othrys mountain (600 km^2), included a high-speed railway construction zone, a single railway line, a medium sized river and a heavily trafficked national road. Wolf movement patterns were studied with satellite telemetry with 2 wolves marked in area A (2008-2009) and 3 wolves in area B (2010-2011) and additionally with snowtracking of wolves and infrared cameras. Wolf data were analyzed with multiple logistic regression and GLM models combined with kernel utilization distributions. Highway construction zone in study area A, had little effect on wolf movements with 190 crossings recorded in 10 months. Wolves crossed highway zone with significantly higher speed. Slope, distribution of livestock, road density and distance from forest edge were the most influential factors of wolf habitat selection and movement patterns observed. In area B, results were sharply different. Radiocollared wolves captured west of railway alignment crossed the construction zone only once. Wolves living eastwards crossed construction zone in a reduced rate as compared to preliminary pre-construction (2006) snowtracking data. Territorial marking was recorded in the construction zone from resident wolves. Analysis revealed as the most prominent reason the spatial combination of multiple barriers in close proximity and in parallel to the new railway alignment creating a behavioral rather than a physical barrier between adjacent wolf territories. Works at the new alignment may have further weakened an already weak linkage zone due to multiple secondary barriers. To alleviate the problem site-specific mitigation measures were proposed and constructed. Linkage zones in marginal habitats should be also given attention apart from prime habitat areas when planning for large infrastructure as may be of critical importance for species distribution persistence when combined with already existing barriers.

a18 Modeling the movement of invertebrates. Experimental and applied case studies to optimize habitat connectivity in road planning

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In the field of wildlife road crossings, road ecology mainly considers mammals, reptiles or amphibians, but less effort can be observed in research with regard to invertebrate species. Among other reasons this lack is due to the fact that • observation of movements of e. g. insects is a difficult affair, • knowledge about mechanisms of their movement is low and • expensive mitigation measures like green bridges are – at least in public opinion – not considered to be worth for those species Nevertheless biodiversity is fundamentally supported by invertebrates, and their populations are under pressure also through habitat fragmentation by roads. Particularly species existing in meta-populations are highly dependent on dispersal between habitats. Here two big questions emerge: Does the boost of populations on both sides of the road can be considered as an alternative strategy to reducing the barrier through implementing an overpass? Can overpasses built for mammals and/or humans – when designed appropriately – be used by invertebrate species? To answer those questions the above mentioned lack of knowledge and experimental data partly can be compensated by applying dispersal models. Our contribution reports an approach, which is developed to assess the efficiency of different measures for improving habitat connectivity. The species movement is modeled using an individual-based dispersal model. The model simulates 'random walk' and 'directed walk' (e. g. movement of colonizers) considering movement patterns specified by a set of input-parameters for target or umbrella species. The parameters describe: • mortality depending on habitat suitability • maximum daily movement distance depending on habitat suitability and a given statistical distribution (e. g. sigmoidal) • transition matrix: probability of movement between all classes of habitat suitability • selection of habitat suitability classes where random or directed walk is performed • percentage of 'colonizers' performing directed walk in suitable or all habitat classes • visual range and life-span of the species To support road crossing management the model is used for the evaluation of different scenarios. (e. g. dissection or establishing a connection between habitats which are affected by a transportation infrastructure). The scenarios consider strategies concerning • configuration of the wildlife crossings (one large vs. several small), • improvement of existing habitats and/or • creating new stepping stones respectively • enhancing the permeability of the landscape matrix. The case studies we present are both experimental as well as considering real crossover planning and evaluation processes. Simulation experiments compare different stepping stone / corridor configurations with regard to crossover frequency and efficiency. Different species are under consideration and for each of the species thumb rules are drafted. Analyses of a flightless bushcricket (Polysarcus denticauda) in a study area in southern Germany evaluate the effects of integrating an overpass into a habitat pattern (backed up with telemetry field studies; Fig.1). In addition movement of the grasshopper Oedipoda caerulescens, is studied to examine the effect of different alternative lines for a road near Halle (Saale). The contribution concludes with general considerations on the use and the benefit of simulation models, but also mentions, that limited data availability constrains validation and advises to interpret the result qualitatively to semi-quantitatively. The simulations demonstrated can be introduced as an important step in a comprehensive planning methodology that helps to compensate the loss of habitat connectivity as stipulated by the German Nature Protection Act.

w1 CEDR Implementation Plan for an update of the COST 341 Handbook "Wildlife and Traffic"

Birgitte Henriksen, Hans Bekker

The CEDR project group "Wildlife and Traffic" has evaluated the usefulness of the COST 341 Handbook based on a questionnaire and a workshop at the IENE 2010 conference. This work yielded in a recommendation to the Governing Board of CEDR (Conference of European Directors of Roads) to promote an update of the handbook. The evaluation report "Mobility for Humans and Wildlife – cost-effective ways forward" can be downloaded on this web address: (http://www.cedr.fr/home/index.php?id=5). The CEDR board replied in autumn 2011 by commissioning the Project Group to develop an implementation plan for the update.

With this workshop, we call for collaboration and aim at proposing and discussing a draft implementation plan for the handbook based on the above evaluation report. First of all this will include preparing a schedule and a structure for the update process, e.g. establishing a steering committee and working groups that focus on different subjects in the update.

It will be very helpful for the establishment of working groups, if those, who are interested in this collaboration, could clarify in advance with their National Road Agency whether the Agency is willing to support this work for example through human resources.

a19 A network wide permeability analysis of road structures

Marguerite Trocmé

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Road structures such as agricultural or forestry over- and underpasses as well as viaducts and culverts often provide local joint-use passages for fauna. These structures were not built for this purpose, but when connecting streams or forests or extensive agriculture areas, may have a role to play in ecological connectivity. This paper present a project of the Swiss federal road office, mapping all such potential structures on the Swiss highway network. Fauna passages as well as potential join-use passages are identified and introduced as such in the Federal highway structure databank called KUBA. The objective is to adapt maintenance of such structures in the future so as to enhance use by fauna and to avoid others uses that could hinder permeability (such as depots under viaducts). The inventory was done based on a aerial view analysis combined with an analysis of ecological networks around the highway structures. 4474 Structures were analyzed of which 65 % were evaluated as having a potential use for fauna. The existing KUBA databank is being adapted so as to integrate the is new dataset. The paper will present the methodology, the detailed results and future use for highway maintenance of this analysis.

a20 Model Design for ecological connectivity in the Carpathians – GIS approach to point out dispersal routes of selected umbrella species

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The Carpathian countries are on the way to modernize their infrastructures since the end of Communism. 1700 km of new motorways are expected to be constructed until 2013 in Czech Republic, Hungary, Romania and Slovakia. This run-to-development creates isolated natural areas, limiting dispersal and genetic exchange of some wildlife species. Large carnivores and herbivores, due to their habitat requirements and low densities of occurrence, react sensitively to landscape fragmentation. Thus they are appropriate for designing a GIS habitat suitability model that covers their ecological preferences which are assumed to be representative for other Carpathian species, too. Picking up that thematic issue, following the JECAMI (Joint Ecological Continuum Analyzing and Mapping Initiative) approach from the Alpine Space Project Econnect, BioREGIO, a project from the ETC South East Europe, aims to give a contribution to maintain biodiversity in the Carpathians. To explore the distribution of potential suitable habitats and the permeability of landscape, we have adapted a GIS suitability model in a three-steps approach following the ecological characteristics of seven umbrella species for the Carpathians. The first step – the suitability model - identifies patches of suitable habitats by assigning different suitability values to topographic factors for each species. The factors regarding the ecological preferences of each umbrella species received biological weights which were taken from published habitat model results. In a rule-based model approach the geometric mean for each pixel is calculated from the values of each factor and of their weights. Hence the model designed for each umbrella species returns the suitability value (0-100 %) indicating the appropriateness of a particular land cover patch (pixel) for dispersal. The second step reclassifies the suitability value from the first step, assigning a new weight, considering the proximity or the presence of an essential ecological factor for each species. The last step, the permeability model, sets a GIS moving window to analyze the spatial distribution of appropriate land cover patches for dispersal (neighbourhood effect). The most probable corridors are identified applying a minimum cost analysis that calculates the less-costs-path for passing through the land cover matrix. This enables the detection of primary ecological corridors, core areas and stepping stones across the Carpathians. Wildlife observation and presence data are integrated to validate the model and the derived dispersal paths for each umbrella species. The expected results will be visualized through a web-GIS application highlighting also the physical barriers hindering the free movement of the considered species. It is assumed that the overlap of each umbrella species will locate the crucial parts of the Carpathians ecological network in which physical barriers are limiting dispersal and where ecological structures are necessary to be maintained to enable wildlife genetic exchange. The main advantages of this method are the possibility to consider the habitat factors' preferences in different classes, to combine habitat suitability evaluation for several species and to weight different factors in different ways, integrating expert knowledge and empirical models.

a21 Indicator about defragmentation in Flanders

Joris Everaert, Johan Peymen

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Within the framework of the environmental policy plan in Flanders (= northern part of Belgium), the Roads and Traffic Agency has the objective to mitigate the ecological impact of transport infrastructure. Therefore, already in 2001, the Research Institute for Nature and Forest (INBO) produced a priority-atlas for defragmentation in Flanders, using policy maps for nature areas, vulnerability maps for ecotope loss and barrier effect, and red list species data. In the meantime, several fauna passages and eco-grids were constructed. Now, INBO also created an indicator to display and evaluate the current defragmentation measures on a large scale in Flanders. All information of current fauna passages and eco-grids, and the line infrastructure segments (from roads, canals and railways) was spatially analysed in ArcGIS. We used a classification of general species groups (small and large land mammals, water-linked mammals, amphibians and reptiles, and bats). For each species group and all groups together, every line infrastructure segment received a defragmentation code ranging from no defragmentation, medium or good quality indirect defragmentation, and direct defragmentation (= area of the fauna passage itself). Indirect defragmentation was applied for line infrastructure with eco-grids around the passages. The indicator results were combined with the information of the earlier made priority-atlas, so that values could be determined for each defragmentation priority score (bottleneck) separately. The indicator shows that – at this moment – about 3.6 % of 1200 km 'low to very high' priority line infrastructure, has medium or good quality defragmentation for a certain species group. This is about 34 % for 'very high priority' line infrastructure, but only 8 % for 'high priority', and 1 % for both 'normal priority' and 'lower priority' line infrastructure. The results also show a better quality of indirect defragmentation within the higher priority parts. Further defragmentation measures are preferably taken at (very) high priority line infrastructure, but opportunities at lower priority parts should also be taken as much as possible. A qualitative improvement in the current defragmented parts, is also highly recommended. By installing more (small) fauna passages within existing eco-grids (for example for small mammals), the quality of indirect defragmentation can be increased.

a22 Identifying the locations of high priority for reconnecting wildlife corridors in Lower Saxony and Rhineland Palatinate (Germany)

Sara Bauer, Dr. Mathias Herrmann

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In February 2012 the Federal Programme for Cross Networking (Bundesprogramm Wiedervernetzung) passed the German legislative due to constant pressure of the NGO´s. We developed a fine scale concept on how to identify areas of highest priority for the reconstruction of wildlife corridors fragmented by roads. In a first step we defined conflict areas based on the results of general habitat models and of species specific corridor models as well as demands declared by local authorities, NGO´s or hunters. All conflicts (N=139 for Lower Saxony, N=147 for Rheinland Palatine) were documented in a GIS map. In a second step we analyzed the permeability of each road section declared as a conflict with the help of a permeability model. The permeability model was based on width, type, location and function of present non-wildlife crossing structures. Road sections that were permeable for wildlife to a certain degree due to existing crossing structures with sufficient width or low traffic load were excluded from further analyses. In a third step we analyzed the potential benefit for biodiversity using data on habitat networks, known corridors, habitat suitability for target species, protected areas, and distribution of target species. Also local knowledge and transboundary needs were taken into account. As a result the specific potential ecological benefit of a reconnecting measure was documented for each road section. In a forth step we tested, whether there were already wildlife crossing structures planed or built at the defined conflict section or in a small distance to the examined road section but with the same function for the target species. In the fifth step we examined the surroundings of the defined conflict section. We examined whether the bordering habitats were optimal or less optimal, whether there was guiding vegetation structure present towards the tested conflict section and whether there was infrastructure close that may disturb animals or deter them from using the crossing structure. In conclusion we found 57 sections in Lower Saxony and 74 sections in Rhineland Palatinate of high priority to reconstruct wildlife corridors. In a last step, local authorities of the road building administration are informed, we discuss the circumstances for realization and give advices for building.

a23 How to evaluate suitability of crossing structures on roads for various groups of animals?

Simona Poláková, Jan Dušek, Ondřej Volf, Michaela Kopečková, Petr Suvorov, Jiří Pokorný

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Population fragmentation effect of highways differs between various groups of animals based on their migration abilities, ecological traits and behavioral habits. Amphibians, reptiles and mammals use crossing structures that are present on roads, either the ones built for animals as well as the non-adapted ones. We created and nowdays we test a methodology for the structure´s evaluation that could be used for all species of the three vertebrate´s classes mentioned above and living in the Czech Republic. Firstly, we made a huge review about the types of road crossing structures that our species, or ecological very similar ones, are willing to use. Also, we made an ecological analysis and we group czech species into 38 ecological-migrational groups. Then, we define 288 standart types of crossing structures. Culverts were divide according to width, presence of water, lightness and material of base part; underpasses according to width, lightness, material of base part, side-wall´s material, presence of water and human activity; overpasses according to width, lenght, shape, substrat, amount of vegetation and human activity. For all of them, we set down suitability of them for the individual ecological groups of animals. The scale was: A – preferred, B – suitable, C – unsuitable. In this methodology, suitability is easily changeable variable. The differences in behavior between geographical distant populations are quite common and the information for creating the matrix was used from whole Europe. On the other hand, animals change their habits all the time. Moreover, a lot of generalization was used during the matrix creation because not all defined crossing structures were studied and not all important information about some animal´s ecology are known. Therefore we decided to test the methodology in the conditions of the Czech Republic. We made an ecological audit of 160 km long part of D1 highway. We found out 268 crossing structures, from 0,5 m width culverts to hundreds´ meters long bridges. We evaluate each of them according to the methodology and in 2012, we started to monitor movement of animals through some of them by phototraps, haircatchers and track pads. Some habitat evaluation around the crossing structures will be also done to determine which animals could or could not appear by the crossing structure.

a24 Permeability of ecological corridors and development of road infrastructure

Paweł Mickiewicz

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The necessity to continue to develop communication links with, at the same time, a need to preserve our ecological heritage places before us a new task; How to preserve ecological connections among ecosystems separated by continually growing road network. We will attempt to answer in this paper to that question, whether it is possible to do, on a scale of a whole country and what issues must be subject to detailed considerations. The development of a road network always involves interference in human or ecological environment and determination of a best solution is very difficult to attain. How then one should choose proper solution where every option brings costs - social, environmental and finally economical. The preservation of the existing status quo of the nature appears to be impossible and recreation of ecological connections separated by road infrastructure requires examination both on whole country level as well as on a local level, A road , because of its linear position interferes with land owned by different entities (state and private) but it also runs through areas differing from each other by their respective biological characteristics. A cooperation of many institutions and entities is then necessary to arrive at the best solution. How that cooperation should look like and how it currently looks. Are common solutions being found? The division of environment results from increasing attempts to assure easy ways of human movements. Growing civilization progress causes that only the rule "prevent and do not cure" and a desire to protect the values of the nature will allow to preserve this heritage for future generation.

Monday, October, 22

Parallel Sessions 2

Policy & Planning II
Workshop: Timber Bridges
Impacts on Wildlife II
Workshop: Avoidance of Fragmentation
Workshop: Green Infrastructure
Permeability II

Lecture Session: Policy & Planning II — Room A

Environmental policy and plans
Chair: Marita Böttcher

Policies on defragmentation approaches and the development of Green Infrastructure both require an adequate administrative and legal environment. In this session, examples of policy related issues are presented, ranging from environmental impact assessment tools to national policies and plans for a future management of wildlife and traffic.

Workshop: Timber Bridges — Room B

Timber constructions for green bridges – renewable resources as an alternative to concrete?
Chairs: Martin Strein & Britta van Dornick

So far nearly all fauna passages are constructed in concrete, but a few examples from Switzerland and Germany suggest that timber constructions may provide an attractive, cost efficient and reliable alternative. Many engineers and road authorities are however unfamiliar with timber as construction material for fauna passages. This workshop addresses therefore pros and cons for timber bridges, discusses chances and risks based on practical experiences.

Invited speakers: Karl Kleinhanss (DEGES, engineer); Michael Schwesig (Schwesig & Lindschulte, planer); Frank Miebach (Schaffitzel & Miebach, wood processing).

Lecture Session: Impacts on Wildlife II — Room C

Impact of infrastrutcure on wildlife populations
Chair: Carme Rosell

There is already substantial evidence of the complex impact of traffic and infrastructure on wildlife, but still more empirical data is necessary to actually convince planners and decision makers of its significance. This session presents new important studies that help to quantify the impact and its consequences to populations and hence can support the development of new assessment tools.

Workshop: Avoidance of Fragmentation — Room D

How to avoid fragmentation in Europe´s least fragmented areas
Chairs: Jan Olof Helldin & Nuria Selva

The degree of landscape fragmentation caused by transport infrastructure varies between European countries and regions by orders of magnitude. Highly fragmented countries in west (for example BeNeLux, Germany, France) contrast with northern Europe, or mountainous areas like the Balkans or the Carpathians. Stark contrasts also occur between urban and rural regions within countries. Preventing fragmentation in generally well-connected landscapes likely requires different management tools than what conventionally is developed for creating defragmentation or for safeguarding minimum ecological function in heavily fragmented areas. There is also a need to take into account the large unfragmented natural areas still existing which provide numerous benefits and services to society. This workshop will discuss options for management in the context of integrative European programmes for green infrastructure, with special focus on roadless and low-traffic areas. It will include insights into practical indexes and how to identify roadless and low-traffic areas, as well as concrete case studies, e. g. Brandenburg state and the Polish Carpathians.

Lecture Session: Green Infrastructure — Room E

Green Infrastructure along and across transport infrastructure
Chair: Heinrich Reck

The aim of the workshop is to discuss integrative concepts of green infrastructure (GI) in the vicinity of transportation corridors and develop practical but scientifically proper recommendations for an application within the EU framework for green infrastructure and no net loss.
In particular, the workshop will address questions such as:
What should be considered as GI along and across traffic lines and what benefits can be expected from it?
Which obligations derive from GI for the maintenance and construction of transport infrastructure as well as compensation measures?
How can GI along and across transportation corridors be improved by assembling best practice examples and analysing monitoring studies?
Can we specify the desired outcome of a strategic map on GI in Europe and set priorities for defragmentation actions?
What background and empirical data is required to achieve these goals?

Lecture Session: Permeability II — Room F

Defragmentation models and infrastructure permeability for wildlife
Chairs: Marguerite Trocmé & Tony Sangwine

Defragmentation plans that aim at strategically mitigating the barrier and fragmentation effects of transport corridors have become a standard in many countries. This session presents several approaches to identify where and what kind of mitigation is appropriate to overcome fragmentation.

a25 Updating of ecological transparencies on road networks

Jérômes Cavailhes, Jean Carsignol

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During the period 1995-2005, new initiatives in favour of ecological networks emerged in France, at the levels of regions, departments and cities. In 2007, the French government eventually firmly committed to the construction of an ecological network, officially named `Trame verte et bleue (TVB)` (green and blue network). The objective of the TVB is to reduce the fragmentation of habitat, allow the displacement of species, facilitate genetic exchange, and help species to adapt to climate change. The paper will present the TVB program and the new prospects it opens up, both in terms of modernization and updating of old roads and highways where disrupted ecological corridors shall be reconnected. The TVB and the update of French legislation on protected species (2007) not only creates a situation more favourable to biodiversity, but also legitimates fauna corridors and results in the emergence of innovating practices and experiments, which we will present.

a26 Critical assessment of the Flemish policy towards ecological networks

Richard Peters, Sofie Van Brussel, Edgar van der Grift, Ilse Vanderheyden, Jorg Lambrechts

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Belgium is one of the most fragmented countries in the world due to a dense network of roads, the ongoing expansion of urban and industrial areas and the large surfaces of intensively used agricultural land. The Flemish government recognises this threat to natural areas and has set goals to establish a national green infrastructure called the VEN (Vlaams Ecological Network). Despite the efforts to realise this green infrastructure, progress has been slow. Problems in legislation but also in financing have forced the government to critically asses the legislation and methodology behind the planning and implementation of this Flemish green infrastructure. Because of this, ARCADIS has been asked to critically assess the processes and legal instruments associated with the development of an ecological network and to develop a protocol on how to prioritise and locate the areas that are important to connect. One of the problems that occurs within the process of planning an ecological network is social pressure and financing. Because of the costs involved in realising these corridors, in terms of money and land, it is essential to demonstrate the benefits too. Therefore this study is carrying out a spatial modelling on corridors in the province of Antwerp, as a case study, and trying to quantify the ecosystem services that are provided by the realisation of these areas. Ecosystem services are the benefits arising from ecological processes. Examples are climate and water regulation, pollination or biomass provisioning. The benefits provided by ecosystem services within corridor planning could greatly increase the viability of the project and help to convince stakeholders to support realizing green infrastructure. Besides the quantification of ecosystem services the study is developing a pragmatic methodology to assess whether you should connect or enlarge the area for certain species or a combination of species. To test this methodology we carried out a case study on the province of Antwerp with a large variety of different species. Per species a model was used, which implemented the habitat requirements, daily migration, maximal migration and minimum surface area requirements. After determining the habitat patches and population networks the maximum distance was calculated to which it was useful to connect certain areas. When connecting is useful a GIS least-cost model is used to calculate the specific area to construct the corridor. In this step we found that connecting is often more efficient for bigger species. In this case study we will eventually point out the five most important ecological connections in the province of Antwerp and assess the benefits arising from this network. Eventually we will create a stand-alone protocol which will aid policymakers in determining the specific locations of an ecological connection and determining the benefits arising from these connections.

a27 Road Ecology in Environmental Impact Assessment

Mårten Karlson

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A literature review was conducted with the overall aim to identify transport infrastructure – ecology interactions and how these are considered in environmental assessment of transport infrastructure projects and plans. Results indicate that ample amounts of research are readily available and that methods for assessment and decision support on ecological impacts have developed rapidly, but that these resources are ineffectively applied in environmental impact assessment (EIA) and strategic environmental assessment (SEA). Content analysis (Kvale and Brinkman 2009) was thus used to explore the treatment of ecological concerns in EIA and SEA, as described by scientific articles scrutinizing Environmental Impact Statements (EIS) and Environmental Reports, since the implementation of directive 85/337, with a specific focus on the treatment of scale, choice of impact assessment methods and trends over time. Results indicate that frequently remarked upon problems with the treatment of ecology are almost equally divided between remarks upon the EIA process, methods used for assessment and ecological competence. A positive trend - the treatment of ecological concerns has improved continuously, can be discerned, but several problems persist and will require further attention and resources. We argue that rapid improvements can be achieved by considering choice of geographical and temporal scope for the impact assessment area, as they have significant influence on which impacts (direct or indirect) that will be detected and accounted for. Structuring impacts into categories based on impact origin could facilitate attempts to approach transport infrastructure-ecology interactions. Quantitative tools and methods for assessing ecological impacts appear to have developed more rapidly within the scientific community than within the EIA and SEA sphere, and the relative scarce use of quantitative methods, and the absence of a standardized framework for display and interpretation of ecological impacts are identified as a significant disadvantage for ecological concerns in both EIA and SEA. However, both scientists and practitioners share the use of Geographic Information systems (GIS) for environmental assessment, which could enhance utilization and development of quantitative methods, and facilitate information sharing between researchers and practitioners.

a28 Environmental contributions to the "German Federal Transport Infrastructure Plan". From Environmental Risk Assessment (ERA) to Strategic Environmental Assessment (SEA)

Adrian Johann Hoppenstedt

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The German transport network is among the most densely developed networks in the world. Forecast predicts that traffic levels will continue to increase drastically, especially freight traffic. Probably environmental problems e. g. fragmentation of biotops will also increase. Setting up the "Federal Traffic Infrastructure Plan" (BVWP) is the legal task of our Federal Ministry of Transport, Building and Urban development (BMVBS). The latest plan was approved by the Federal Government in 2008 and is valid until 2015. Today the BMVBS is preparing the basic information for a new BVWP in 20XX. The BVWP includes the following modes of transport: Highways/ motorways, railway lines and waterways. The priorities for acceptance of projects in the BVWP are based on a Cost-Benefit-Analysis (CBA). In principle the plan results in projects classified as "urgent demand" and "further demand". Ensuring sustainable, environmental-friendly, and resource conserving mobility faces a great challenge for the transport development in Germany. It is thus crucial that we make our transport system environmentally acceptable and also reduce the impact of climate change. Even since the beginning of the 1980s, the BMVBS integrated a first "Environmental Risk Assessment" (ERA) of the BVWP traffic projects. This was at first a voluntary service and the first step in our four level traffic planning process with environmental contributions. Nowadays, according to the "Directive 2001/42EC of the European Parliament and the council of June 2001 on the assessment of the effects of certain plans and programmes on the environment" and the German Environmental Impact Assessment (EIA) Act a "Strategic Environmental Assessment" (SEA) for traffic programmes is a legally prescribed requirement. The lecture will give a short overview of the evolution from the "Environmental Risk Assessment" (ERA) to the "Strategic Environmental Assessment" (SEA) and will discuss the following questions: How does the procedure to integrate the future SEA into the traffic planning process look like? What are the main contents and the proposed methodology to identify, describe, and assess the significant environmental impacts of the BVWP? What kind of traffic alternatives will have to be considered? How can public participation be implemented? How will the monitoring be organized?

w2 Timber constructions for green bridges – renewable resources as an alternative to concrete?

Martin Strein, Britta van Dornick

So far nearly all fauna passages are constructed in concrete, but a few examples from Switzerland and Germany suggest that timber constructions may provide an attractive, cost efficient and reliable alternative. Many engineers and road authorities are however unfamiliar with timber as construction material for fauna passages. This workshop addresses therefore pros and cons for timber bridges, discusses chances and risks based on practical experiences.

Invited speakers: Karl Kleinhanss (DEGES, engineer); Michael Schwesig (Schwesig & Lindschulte, planer); Frank Miebach (Schaffitzel & Miebach, wood processing).

a29 Barrier impact of roads on populations of brachypterous ground beetles

Klaus Richter, Friederike Zinner

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The fragmentation of habitats and isolation of populations is one of the most often mentioned factors of road influences on animals. This project provides results of the impact of federal highways on ground living small animals at the example of brachypterous ground beetles. Effects on populations are discussed. Based on the results, recommendations are given to reduce the barrier effects. The central point of the investigations made in 2009-2011 was the direct proof of brachypterous ground beetles on central dividing strips of highways in comparison to the surrounding landscape, their behavior on roads and in traffic. A small number of brachypterous ground beetles were found on all of the seven investigated dividing strips. On the roadway they show active reactions on the traffic. At least with respect to motorcars, they are only endangered by direct tyre hits. In connection with nocturnal activity and then reduced traffic, a successful road crossing is possible at least in principle. Altogether, freeways are a very substantial barrier for ground dwelling small animals. However, for the investigated group this barrier is not absolutely insurmountable. Especially with respect to (still) common species, this permeability should be widely maintained. On the contrary, a suc-cessful crossing of specimens from rare and endangered species with small populations is ex-tremely unlikely. Those species require measures to support populations and to optimize their habitats and accessibility to green overpasses or tunnels.

a30 How do road networks influence the ranging behaviour of a nocturnal marsupial, the koala (Phascolarctos cinereus)?

Lilia Bernede, Cathryn Dexter, Darryl Jones

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Understanding the effect of roads on wildlife populations is advancing rapidly, with several influential meta-analyses recently reviewing the international literature. While many findings have universal application, the unusual features of many Australian animals will require specific attention. One such unique species is the koala (Phascolartos cinereus), a medium-sized arboreal folivorous marsupial. Although iconic in status, the species is now seriously threatened throughout its range. In the rapidly developing region of South East Queensland (SEQ), koalas have experienced a dramatic decline over the past decade with disease, attacks by dogs and, especially, mortality on roads, being responsible. While a few studies have investigated the spatial and social structure of koalas from rural environments, very little is known about the influence of traffic and roads on the spatial structure of koalas in fragmented landscapes. We aimed to answer the following: do koalas living in a highly urbanised environment exhibit different movement ranges and spatial behaviour to koalas living in rural habitats, and do differences in behavioural responses to existing roads occur within a population, as regulated by sex, or vary in time, as regulated by mating season or dispersal behaviours? We conducted an 18 month radio-tracking study of 57 koalas in five sites within SEQ, and collected spatial data using a combination of VHF tracking and GPS tracking technology. For every animal, GPS fixes were taken at 4hr intervals and VHF fixes collected once a week. Only koalas that showed a stable home range as predicted by incremental analysis were used. As predicted, the home range sizes of our urban koalas were smaller than those of rural koalas. Although both males and females included roads in their home range, inter-population differences in home range size and movement ranges were found, with males having larger home ranges than females, and travelling longer distances, particularly during mating season and other periods of dispersal. The social structure exhibited by koalas exacerbates the effect of roads on these fragile urban populations, emphasising the need for appropriate mitigation measures, and long-term monitoring of the small remaining populations in habitats fragmented by roads.

a31 How to deal with traffic noise for mitigation? Insights from the use of standard methods around wildlife crossings

Carlos Iglesias Merchan, Juan E. Malo, Cristina Mata

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Noise is defined as an annoying sound and adverse effects have been demonstrated on people and animals' health by chronic exposure. Noise from human infrastructures is a kind of environmental pollution with different extent depending on territory and infrastructure's characteristics. There are well known affections on some species, such as some amphibian and bird species communication interferences, because their audible frequencies superpose with those of traffic. Alteration of predation by bats has been documented, but no clear tendencies have been described for other mammals. Traffic noise is evaluated as a negative impact during project environmental impact assessment, and wildlife crossings are mitigation measures for habitat fragmentation that require animals' approach from quieter zones towards areas of greater human induced noise. Traffic noise assessment in road and railway projects is focused on legal indicators and defined thresholds intended for human comfort. However, no methods have been developed to aid decision making concerning noise impacts and mitigation for wildlife. This could be useful for wildlife crossing design, but we don't know the tolerable noise level limits that would recommend designing additional mitigation measures for mammals. We exemplify the problem by analyzing two cases of different success on wildlife crossing use by ungulates in Europe (A-52 in Spain) and in the United States (US-93 in Montana). We created acoustical models according with European recommended standards considering the Environmental Noise Directive (END 2002/49/EC) and we adapted procedures to wildlife crossings. We have also introduced a simplified analysis of different road cross-sections for discussion of this design factor. Our methodology proposes three noise indicators, that can be adapted to different day periods (depending on target species and traffic intensity) in two different zones: maximum and average levels at the wildlife crossings entry (25 m buffer) and average levels in their larger approximation area (200 m buffer). Results confirm that wildlife crossings are subject to high and variable noise levels which reveal the importance of considering particular hourly traffic conditions instead of gross annual average daily traffic data, as it is usually made. In our cases source emission levels vary highly depending on the period of day (from 74 dBA up to 86 dBA in US-93 highway, and from 82 dBA up to 89 dBA in A-52 highway). Although noise influence on wildlife crossing success is not clear, in this first approach we have found that possible noise thresholds in wildlife crossings are close to 60-65 dBA in a 25 meters entry buffer (depending on the period of day) and 55-60 dBA in a 200 m approximation buffer around highways. This study could guide further work on this topic in several ways, from environmental impact assessment to prey-predator relationships studies, according with some interesting tendencies found depending on species. Finally noise maps are presented as a tool for designing additional mitigation measures if necessary, and as a new tool to be introduced in design through least cost pathway analysis of pass approach.

a32 Behavioural attributes of red-necked wallaby road-crossing events

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In Australia, macropods (kangaroos and wallabies) are present in most landscapes and are widely regarded as iconic and valued wildlife. Due to their wide-ranging presence, macropods are often victims of the disturbances associated with roads, yet because of their perceived 'commonness', they are often not considered as being heavily impacted. Macropod-vehicle collisions, particularly involving larger species, can be significant and result in severe human injury or death. Some research has been conducted on the impacts of roads on macropods, particularly with regard to macropod-vehicle collisions, but many crucial aspects remain largely unstudied. There has been very little research conducted on the behaviour and movements of macropods around roads. The objectives of the present study were to investigate the road-crossing behaviour of red-necked wallabies, Macropus rufogriseus, and identify any variations with regard to gender, maturity and road conditions. Wallaby road crossings were observed and video recorded along three roads between November 2010 and May 2012. Various behaviours before, after and during the road crossings and number of locomotion pauses and duration of road crossings were recorded. All categorical behavioural attributes were analysed using classification trees. The number of pauses was analysed using a Chi-squared test with two or more pauses pooled into a single category. For all analyses involving gender, only those observations involving adult wallabies of known gender were used. For all other analyses all gender and maturity levels were used. A total of 192 road-crossing events were recorded and analysed for adult wallabies. The variables of activity before and after crossing, wallaby presence in verges before crossing and locomotion mode were not influenced by any of the predictor variables. The main activity performed by wallabies while within the road verge differed between males and females, with female main activities also being dependant on road site and season. Wallaby presence in the verge after crossing the road was dependant upon whether a vehicle approached during the crossing, and also on road site and season. These factors also influenced whether wallabies paused during a crossing, with road site being the most influential. Wallabies only paused more than three times at one road site, with up to nine pauses being observed in a crossing at this site. The number of pauses was highly significantly different between the road sites (Chi-squared = 31.6488, p = 2.257 x 10-06), with wallabies pausing more while crossing the road with the highest traffic volume and speed. In conclusion, males tend to be vigilant in road verges, whereas females concentrated on foraging when road conditions and season were favourable. This is potentially due to higher energy and nutrition needs of females supporting offspring. Road site, season and the approach of a vehicle also affected wallaby pauses while crossing and the probability of the wallaby remaining in the verge after crossing. This study is the first of its kind to investigate the behavioural attributes of any Australian animal while crossing roads.

w3 How to avoid fragmentation in Europe's least fragmented areas

Jan Olof Helldin, Nuria Selva

The degree of landscape fragmentation caused by transport infrastructure varies between European countries and regions by orders of magnitude. Highly fragmented countries in west (for example BeNeLux, Germany, France) contrast with northern Europe, or mountainous areas like the Balkans or the Carpathians. Stark contrasts also occur between urban and rural regions within countries. Preventing fragmentation in generally well-connected landscapes likely requires different management tools than what conventionally is developed for creating defragmentation or for safeguarding minimum ecological function in heavily fragmented areas. There is also a need to take into account the large unfragmented natural areas still existing which provide numerous benefits and services to society. This workshop will discuss options for management in the context of integrative European programmes for green infrastructure, with special focus on roadless and low-traffic areas. It will include insights into practical indexes and how to identify roadless and low-traffic areas, as well as concrete case studies, e.g. Brandenburg state and the Polish Carpathians.

w4 Green Infrastructure along and across transport infrastructure

Heinrich Reck

The aim of the workshop is to discuss integrative concepts of green infrastructure (GI) in the vicinity of transportation corridors and develop practical but scientifically proper recommendations for an application within the EU framework for green infrastructure and no net loss.

In particular, the workshop will address questions such as:

What should be considered as GI along and across traffic lines and what benefits can be expected from it?

Which obligations derive from GI for the maintenance and construction of transport infrastructure as well as compensation measures?

How can GI along and across transportation corridors be improved by assembling best practice examples and analysing monitoring studies?

Can we specify the desired outcome of a strategic map on GI in Europe and set priorities for defragmentation actions?

What background and empirical data is required to achieve these goals?

a33 Spatial prioritization of road defragmentation measures for the improvement of landscape connectivity using Conefor 2.6

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Defragmentation programs requires objective and quantitative approaches to identify those key road sectors where corrective measures most reinforce the ecological coherence of ecological networks. In many areas, roads were planned and built before environmental impact assessments required the implementation of wildlife crossing structures in construction projects. This makes necessary to analyse the permeability of old infrastructures in order to identify the most efficient defragmentation measures for promoting ecological flows. One of the fundamental tasks in the development of coherent ecological networks consists in identifying spatial interactions between functional corridors linking protected areas and high-volume roads, which constitute those key road sectors in which adequate corrective measures should be implemented with highest priority. Due to frequent budget constraints, a related relevant question is to calculate the contribution of each local defragmentation measure in each particular road sector to uphold habitat connectivity and availability (reachability) in the ecological network.

With this objective, we apply for the first time recent methodological developments that, deriving from the probability of connectivity index, allow evaluating the role of each key road sector to improve overall landscape connectivity, as implemented in the most recent compilation (2.6) of the Conefor software (www.conefor.org). We focus on a case study covering the forest Natura 2000 area network in the Basque country, a mountainous region in northern Spain in which the vast highway network was planned and built during the 1970s, 1980s and 1990s. We show how the proposed approach is useful to identify those road sectors where the defragmentation and barrier effect mitigation measures most contribute to uphold functional connectivity at wide spatial scales. This should allow establishing defragmentation priorities with a solid, quantitative and objective basis as resulting from the most recent developments in spatial network analysis and habitat reachability metrics, which are available in an open and transparent decision support tool suited for such purpose.

a34 Large-scale identification and prioritization of road and railway tracts where de-fragmentation measures should be applied: a country-wide project in Spain

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Roads and railways may have a relevant impact on wildlife due to habitat alteration, population fragmentation/isolation or roadkills. Furthermore, increasing road casualties with large ungulates in some countries such as Spain is a growing social problem that needs to be solved. De-fragmentation techniques which help to mitigate this problem have been well developed and applied across the world, but may imply considerable technical problems or induce increased cost of public works. Thus, identification of transport infrastructure tracts where these de-fragmenting measures should be applied is a major challenge when it comes to investing the limited economical resources. With this aim, we developed a framework based on a conservation index, habitat distribution and fragmentation, and key species mapping to produce cartography assigning an index of relevance for defragmentation for every 1 km tract of the entire national road and railway network. We collected the distribution of all vertebrate species within Spain according to distribution atlases. This information is available at a resolution scale of 10 km x 10 km UTM cells. We calculated a conservation index based on rarity and vulnerability of vertebrate species for each ecoregion of the country, i. e., Mediterranean, Eurosiberian, Balearic Islands and Canary Islands. We then modelled this response variable with a multiple lineal regression and with environmental variables related to topography, climate, spatial location and human activity. As environmental variables were available at a resolution scale of 1 km x 1 km, it was possible to downscale the model to this finer resolution using a raster calculator in a Geographic Information System. In this way, we obtained important conservation areas for vertebrates in Spain at that resolution. We also included in the analysis the information about High Natural Value areas recently produced by the Spanish Ministry of Agriculture, Food and Environment , the protected area network (including Natura 2000), the presence of target species (those endangered and highly vulnerable to road kills, as well as ungulates causing road casualties), and the presence of rivers and wetlands. Assigning different scores to each of the information layers analysed we obtained a conservation index in each 1 km x 1 km UTM cell. The information about hotspots of road casualties and ecological corridors was also considered in some regions where the information was available. We calculated also a habitat fragmentation index (Effective Mesh Size) and an infrastructure affection index for each of the squares, considering the kind of infrastructure (high speed railway, regular railway, motorway or road) and the overall surface occupying each square. We overlapped the three indexes to identify those sections showing major conflicts between transport infrastructures and conservation of the Spanish Natural Heritage. Finally, we provided proposals to apply defragmentation measures to reduce the impact at the most conflictive points. This work was developed in the context of the Spanish Working Group on Habitat Fragmentation due to Transport Infrastructure.

a35 Combining multispecies and single species approaches for planning mitigation measures on a regional scale

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The aim of the Natura 2000 network is the conservation of the most threatened species and habitats. To achieve this aim it is necessary to conserve and enhance the quality of habitats and to enable migration of species between habitats. In a highly fragmented landscape as the Upper Rhine Valley it is essential to minimise the impacts of transportation infrastructure on populations. A straightforward tool for the identification of conflicts between transportation infrastructure and species conservation at a large scale are predictive habitat-linkage models. Most habitat-linkage models are either adapted to the specific life history traits of one target species (single species approach) or they are averaging habitat needs over multiple species (multispecies approach). Therefore, both a single species as well as a multispecies approach may not cover all species of interest. To solve this issue in the case of the Upper Rhine Valley in Southwestern Germany, we combined a multispecies approach, covering Amphibia, Lepidoptera and Chiroptera species, and a single-species approach, focusing on two bat species with special habitat requirements, to design a network of habitats linked by corridors. In the case of the multispecies approach, we developed a habitat network for the habitat type "forest". For this multispecies network, we specified core areas and generated corridors between them. Core areas comprise protected forests (national nature reserves, protected forests, areas protected under the habitat directive) as well as non-protected forests with assumed source-populations of target species. Ecological corridors were then generated with the help of habitat models and least cost pathways. Then, we verified which target species actually occur in the core areas and, consequently, which species probably use the corridors for migration. In the single species approach, we identified additional corridors (model approach combined with expert validation) for two endangered bat species that regularly use foraging habitats in forests but use roosts in settlements (Myotis emarginatus and M. myotis). For these species the single species approach covers habitat links (i. e. roost to foraging habitat) that are not covered by the multispecies habitat network. By combining a general multispecies approach, real data on species occurrences and additional corridors for selected target species, we are able to cover a high porportion of species with high conservation relevance. Hence, we are able to give spatially specific and species specific suggestions for the placement of mitigation measures at existing and planned transportation infrastructure. The results of this study can be used by conservation administration as well as by planning institutions straightforwardly.

a36 Optimization of Designing Measures for Wildlife Migration Across the Road Network

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In relation to the transport infrastructure development and progressive motorway network building in the Czech Republic, the issue of landscape fragmentation and its acceptable position is becoming more and more important. The transport infrastructure disturbs ecosystem relations, has a negative impact on dynamics of animal metapopulations, and increases mortality of animals due to collisions with vehicles. The first two impacts are intensified by continuous fencing of important roads (particularly in recent years when the road fencing trend is spreading to Eastern Europe with all its negative effects). An important tool for dealing with habitat fragmentation and its negative impacts on biodiversity is the "Migration study", which evaluates the migration network in the area where a new road is planned. The outcome of the study consists of measures designed to reduce the barrier effect of roads, particularly in the area of migration objects (location and size). Recently, there has been an increasing demand for outcomes concerning the relationships between financial demands of designed measures and the negative impact of the fragmentation on individual populations, as well as the outcomes focused on suitability of different types of fencing for specific parts of landscape where the roads in question run through. Within research projects of TAČR (Technological Agency of the Czech Republic) new methodologies are being produced which are to allow to create important materials for migration studies and road designing. Two methodologies are particularly concerned: "Oplocení" (Fencing) and "Genobanka" (Gene bank), whose part will also include a data bank with first data. This report includes information on research projects, their character, production phase, and detailed objectives: The methodology "Oplocení" is dealt with within the project No. TA01030107 Methodology for Optimization of Designing Measures for Wildlife Migration Across the Road Network. Researcher: EDIP s.r.o., HBH Projekt spol. s. r.o. in cooperation with EVERNIA s.r.o. The project aims to produce a complex methodology which helps to design efficient (financial and purpose) measures to navigate wildlife migration over roads. The methodology will take into account the character of road (category, traffic volume) and migration potential of the surrounding area (type of migrating wildlife and migration volume). The methodology "Genobanka" is dealt with within the project No. TA02031259 Creation of a Genetic Database of Selected Mammal Species to be Used for Sustainable Transport Development Researcher: HBH Projekt spol. s. r.o., Mendel University in Brno The procedures for limiting landscape fragmentation by the transport infrastructure are now based on the information on the territory and ethology of wildlife. However, the information on the quality of populations based on genetics, which would allow us to find the sensitiveness of a given population to their spatial isolation, is missing. The project aims to create a genetic database of mammals which can be used not only in transport, but also in other areas as well (agriculture, land use planning, environmental protection).

Monday, October, 22

Poster Session 1

Posters will be presented by the authors during two separate poster sessions. Posters are presented alphabetically, based on the surname of the first author.

First authors with surnames starting with A – M will present during Poster Session 1.

p1 Effect of conventional bridges on deer-vehicle accidents

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This study evaluated whether the density and design of conventional bridges affected the frequency of reported deer-vehicle collisions along a given road or railroad section. I used official accident data from roads for 2008-2010 and from railways for 2001-2010, data on bridges and infrastructure together with digital topographic information, and estimates of regional abundances of moose (Alces alces) and roe deer (Capreolus capreolus) to develop generalized linear models of the parameters influencing the occurrence of deer-vehicle collisions. Among the obtained models, the most parsimonious were distinguished using the Akaike's Information Criterion. Single regressions revealed that the density of bridges was negatively related to the occurrence of accidents along railways but not on roads. Traffic volume on both the barrier infrastructure and inside the passage, as well as other bridge characteristics such as use, width, integrity type and shape had some but not consistent effect on the occurrence of wildlife-vehicle collisions. However, as expected, multiple regression analyses revealed that environmental variables were the main factors influencing the occurrence of accidents on railways and roads, with forest cover, the density of buildings, of infrastructure and other linear features such as watercourses as the most relevant parameters. I conclude that even conventional bridges, especially if widened and placed appropriately, can contribute to the safe crossing of barrier infrastructure by animals, reducing the occurrence of deer-vehicle collisions.

p2 An Assessment of Plant Diversity Along Roadside Verges on the Baltic Island Gotland (Sweden): Measuring Plant Responses to Varying Nitrogen Levels

Muge Apaydin

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Humans have altered the global environment mostly by land destruction and fragmentation and this have negatively affected the biological diversity. For example, we have transformed semi-natural grasslands into areas for agroforestry and urban systems. Today, maintenance of biodiversity is a key concern because extinction is occurring at a rapid rate as a consequence of human activities. Since the industrial revolution, global levels of nitrogen (N) deposition have risen significantly and it will continue to increase. Nitrogen enrichment in soil is considered a major threat to the plant species diversity in terrestrial ecosystems. Nitrogen is often the limiting factor for plant growth and since most of plant species are adapted to nutrient-poor conditions they can only compete successfully on soils with high nitrogen levels with (the few) fast-growing and highly competitive plants. An increase in nitrogen will cause a drastic loss of biodiversity because of competitive exclusion. Roadside verges have the potential to harbour meadow and pasture vegetation, which makes these areas resembling grasslands. But furthermore roads are occupying a high percentage of the world surface area. In Sweden for example, roads cover 3500 square kilometers. Because of safety reasons, roadsides are mown regularly, which resembles the management of traditionally managed semi-natural grasslands- one of the earth's most species-rich habitats. Considering the high potential floristic values of the roadside verge habitats, the Swedish Road Administration has indicated road verges with high botanical values in Sweden. Gotland's roadside flora differs from other parts in Sweden with its rich flora and fauna and it contains species worthy of protection. For all these reasons Gotland has been chosen for this study. My study highlights the combined role of competition and nitrogen in influencing the diversity of roadside verges on Gotland. Furthermore I will investigate the relationship between the productivity of the plant species and their diversity. Due to practical limitations, instead of fieldwork, an experimental analysis in laboratory has been designed. The experiment will start on February 2012 and will last for 6 months the Plant Ecology Laboratory, Uppsala University. Sweden. Experiment will have 5 treatment groups (5 different nitrogen levels) and 15 replicates per treatment (5 x 15 = 75 total observations). I will base this experimental study according to the C-S-R triangle theory. I choose to include competitive species in my study because of the competitive exclusion principle and plant diversity relation. With high nitrogen levels in plants, dominance of fast growing plant species will be associated with a decline in overall species richness. My study aims to test the hypothesis that high nitrogen levels the soil will cause a decline in plant species diversity. I expect that less competitive species will be eliminated from the system as the level of nitrogen increases. The study further aims to take necessary conservation implications for ecosystem management at roadside verges in Gotland. I will use one-way analysis of variance to test my hypothesis using R.

p3 Edge effects of roads on small mammals in tropical forest fragments

Alex Bager, Clarissa Alves da Rosa

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Studies in temperate and subtropical regions show that roads can cause neutral, positive (edge effect) and negative (edge and barrier effect) effects in small mammals. The edge effect of roads on this group depends on factors such as vegetation, topography and landscape. We evaluated the effect of road edge and environmental factors that affect the distribution of small mammals. We sampled during 15 months (five field trips) 19 forest fragments in southern Minas Gerais, Brazil. In each fragment we sampled a transect of 300 meters, totaling 16 points of capture (sampling units) perpendicular to the road, starting from the edge of the fragment and 20 meters distant from each other. We consider the number of individuals in the community, number of individuals of males and females in the populations with $N > 30$ and richness as response variables. We evaluated the edge effect by regression via adjustment curve between response variables and distance from the road. We consider an edge avoidance behavior when the relationship between the response variable and distance from the road was positive ($p < 0.05$) (negative edge effect). We used GLMM to evaluate the environmental variables that affect the distribution of individuals using vegetation density (m^2/ha), altitude, distance from the road, distance from the edge of a fragment without road and matrix as fixed effect and fragment and field trips as random effect. We consider the models acceptable when $\Delta i < 2$ and $\omega i > 0.7$. Species richness did not vary within the gradient of distance studied ($p = 0.6524$) and no model was acceptable to explain the number of species. The community and species of terrestrial habits (Akodon sp. and Cerradomys subflavus) had a positive edge effect, regardless of sex. Males of arboreal species (Riphidomys sp. and Marmosops incanus) had a neutral effect ($p > 0.05$), while females had a negative edge effect. The distance from the road, distance from the edge of fragment without road and matrix were the variables that affected the most the distribution of individuals. These variables are linked to quantity and quality of resources. Species that exploit the resources provided by the edges seems to be favored, while species that have their resources associated with the interior of forest areas are in disadvantage by the edges. Therefore, we believe that small mammals perceive the road and their edge effects in the same way they perceive a matrix of grazing or agricultural cultivation. The populations showed varied responses, with terrestrial species presenting no edge avoidance behavior, while the arboreal species present an edge avoidance behavior. This shows that we cannot give answers to a group (small mammals) when the results show specific responses to different species. To consider environmental aspects such as habits, allows a level of generalization that can lead to mitigation measures most applicable and effective than when we consider small mammals as a large group.

p4 Species valuation to maximize biodiversity representation in roadkill hotspots

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The planning of mitigation measures is usually based on mortality hotspots identification with roadkill data, which often represents dominant species and may be unsuitable on planning for conservation targets such as rare or threatened species. On the other hand, mitigation planning also will be biased if we use only few roadkill events of rare species, because the location of these sites may be occasional. We wondered whether the events of roadkill of threatened and rare species are nested in hotspots identified in usual analysis, as well as if we rank species of interest before hotspot identification. For this, we introduced a tool in Siriema Software named "Z" identifier. It is a value (an integer and positive number) that will be used in Hotspot analysis as a weight to each record, valuing different species based on criteria of interest. We performed two Hotspot analyses at Siriema Software v1.1 (available at) using different Z values for a mammal data set from a monthly monitoring, during a year, in a 100 kilometres stretch of BR-101, southern Brazil. At the first analysis, all species records received values of Z = 1. At the second analysis, we gave to each species one value according to two criteria: tolerance to anthropogenic environments (1- species that could use exclusively anthropogenic environments; 2- species that could use anthropogenic environments but need some preserved area; 3- species that only may use preserved areas), and conservation status (1- common species; 2- species with intermediate abundance; 3- rare species; 4- local threatened species; 5- national or global threatened species), both information based on IUCN red list, national/regional endangered species lists and expert opinion. We summed these criteria values, resulting in a species ranking (ranging from two to eight). We used Sørensen similarity index to evaluate congruence among the locations of single roadkill records of threatened and rare species and identified hotspots on first and second analysis. We did not found a significant similarity between the records of threatened/rare species and the hotspot locations when Z = 1 (0.081633; p = 0.267), and we found a low, but significant similarity when we ranked species (0.15873; p = 0.005). This means that the location of roadkill of threatened/rare species is not included in identified hotspots, evidencing the inadequacy of wildlife mitigation measures designed using complete multispecies data set. Using criteria for species valuation, as we exemplified here, can increase the representativeness of species of interest (e.g. rare and threatened species) without harming the most dominant or abundant species. Here, we aimed to illustrate the use of species weighting as an important tool for mitigation planning, so we selected only two criteria and adopted an arbitrary scale for each one. However, both criteria, values considered and scale should be adapted to each study context.

p5 Evaluation of select ecological bridges in the Czech Republic

Vlastimil Bogdan

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This paper evaluates some of the ecological bridges which were built in the Czech Republic within the past 13 years. These structures are described in terms of their placement, technical parameters or biotechnical design. Also relevant is their relationship with the surrounding landscape, the continuity of migration corridors and future intentions for the geographical areas in question. Eleven overpasses have been studied in total – both positive and negative examples are emphasized. Since overpasses should be built primarily for large mammals, occurrence of these species in the relevant was verified. Land use plan of area and preparation process of constructions was analyzed. For each overpass migration potential was calculated using the methodology of the Czech Ministry of Transport. Many failures and shortcomings have been discovered, and only a few good examples can be shown; however, this may prove helpful since learning comes also from errors. Ecoducts built in the Czech Republic are located in various natural surroundings, and their location and design are necessarily quite different, overpasses on the edges of large urban agglomeration or close to planned industry zone being no exception. In many cases, there is no migration corridor, what´s more, there is no occurrence of large mammals at all in locations, where constructions were placed. Important measures to protect animals against noise and illumination are often missing, though tree planting has often been properly implemented. In seven cases, migration potential of the bridges takes value close to zero, in the remaining four becomes intermediate value. Another particular issue for consideration is the multi-purpose usage of these bridges. Requirements for the construction of ecoducts are frequently not based upon professional and relevant supporting documents. For these reasons, fundamental errors arise during even the initial preparation phase, and the overpass is already doomed to wasted investment. For such economically- and technically demanding constructions it is essential to select sites with high migration pressure, avoid nearby migration barriers and interference, select the correct object parameters with respect to the migratory and behavioral demands of naturally-occurring animals in the vicinity, and finally, to construct these objects proficiently in terms of biotechnical design. Ensuring broader interaction with the surroundings and defining land use limits is another integral part of the construction's success. Areas along highways are under pressure from developers, and it is very difficult to guarantee that the investment in to the ecoduct will not be thwarted in the future by other investment plans.

p6 Flanders' flattened fauna - A web application to register wildlife road casualties

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With more than 150,000 km of roads and 56.5 km of highways per 1,000 km² (2010), Belgium has the highest road density in Europe. The roads are furthermore also used intensively (98 billion km driven in 2010). This high mobility causes not only human victims, but also takes many animal lives. It was estimated (in 1995) that each year more than 4 million wild vertebrates are killed on our roads. Meanwhile, the road network expanded considerably. More and more cars are driving more miles and thus we may assume that the number of wildlife road casualties has increased in recent years. Especially for many species of birds, mammals and amphibians, traffic is the prime unnatural cause of death. Only a very limited number of animals survive being hit and can be treated in wildlife rehabilitation centres. With the project 'Flanders' flattened fauna' the Flemish government, Natuurpunt Study and the Flemish Bird Protection Society want to improve knowledge on the amount of wildlife victims on our roads, on which species are most sensitive to traffic and on the localities of the main bottlenecks in the Flemish road network. At www.waarnemingen.be anyone can enter and consult observations of wildlife in Flanders. For this project a special road kill module was developed within this website, where besides the basic data (date, species, number, behaviour, sex, age and exact location on a map) also further information can be added such as road type, road verge type and condition of the corpse. The project runs from 2008 till 2012. Its success depends on how many people and how often they participate and enter road kills in the user friendly input screen. Between May 15th 2008 and June 15th 2011, already 12,988 different road kill records were received from Flanders, totalling 19,118 fatalities of 198 different species of vertebrates (birds, mammals, amphibians and reptiles). The largest number of victims per record occurs in amphibians (mainly common toads), which are run over in large numbers during spring migration at certain localities. Nevertheless mammals are most frequently reported (with the hedgehog on top), but these records usually involve only one individual. Considering the total number of casualties, the common toad is by far the most abundant victim. A final analysis of the data is expected by June 2012 and the results will be presented in this poster. Never before such a large-scale and long-term survey of wildlife road casualties has been conducted in Flanders. The results will supply policymakers with a unique source of information, in which they seem very interested as shown by the many questions raised on the subject in recent years in parliament. Fortunately, policymakers are already making efforts to create more wildlife-friendly road infrastructure by constructing wildlife passages to decrease habitat fragmentation and animal road kills. Hopefully the results of this project will further contribute to safer traffic on the Flemish roads, for people and animals alike.

p7 Green Infrastructures: the ISPRA activities concerning integration of ecological network concept into infrastructures projects and territorial planning

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The landscape is the result of natural and man-made elements and processes; he is the product of the aggregation of ecosystems. In the definition of strategies and plans that are able to take active protection of landscape transformation, the green infrastructures act as the scheme that combines environmental protection and development in order to integrated landscape and territorial management. The green infrastructures could be, in fact, an instrument of economic planning when is prevalent the integration and biological continuity concept, in response to the problems stemming from the fragmentation of space and ecosystems. Then the green infrastructures become also a way to integrate the protection of the ecosystem with the needs of sustainable use of natural resources without diminishing but rather increasing the environmental and landscape values. The contribution aims to present the results of ISPRA long term activities about the definition of instruments to improve and management ecological continuity in territorial plans and programs and infrastructures projects. Basically those activities are organised in order to support nationwide territorial policies for a more sustainable planning, but also to integrate ecological networks into territorial planning at the different administrative levels. In fact since 1997 (when Italy implemented the "Habitat" Directive into national environmetal rules), ISPRA has forwarded some projects and researches, inspired by the contents of the Habitat Directive, with the main aim to find out different tools to support nationwide territorial policies and projects for correct planning in order to preserving and using biodiversity in a sustainable way. In this way ISPRA (Italian Institute for Environmental Protection and Research) has promoted specific researches aimed to verify the integration of ecological network concept in the national territorial planning. In fact, the incorporation of territorial ecological connectivity topic into the processes of land use planning and land management is considered necessary in order to avoid the threats to the biological diversity and habitat fragmentation. The main objective of research is monitoring and reporting the national situation in relation to levels and forms of ecological network references in the provincial territorial planning. The result has shown an encouraging national situation, with 88 % of provincial planning instruments that include ecological network references. Other activities have concerned: - the organization and coordination of a national observatory with the aim to analyze, systematize and monitor the planning activities at different administrative level as well as projects, studies and research on the ecological connectivity of the landscape and ecology; - the publication of document The fragmentation of the territory deriving from the linear infrastructures. Addresses and best practices for the impacts prevention and reduction that offers a technical instrument for the people who work in the infrastructure design and planning. The aim is to convey basic concepts and policies necessary to reduce the environment fragmentation and to provide all necessary addresses to support infrastructure interventions in consideration of the possible environmental and ecological effects.

p8 The influence of landscape characteristics on capybara roadkill on the BR-040 highway, Southeastern Brazil

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The collision of motor vehicles with large- and medium-sized mammals on highways may cause serious accidents, including loss of human life or substantial material damages to cars. Predicting the sites of highest incidence of these collisions is a relevant matter in proposing mitigation measures and it can be done using models that relate the collision occurrences with landscape characteristics in the surroundings. Capybaras are rodents, being one of the largest mammals in the tropics (females weigh 50 kg on average, and males 60 kg) and one of the most common victim of vehicle collisions in Brazil. This work aims to determine which landscape characteristics are related to the occurrence of capybara roadkills. Capybara fatalities on the road were recorded daily, for 4 years (from April 2006 to January 2011), along 180.4 km of BR-040 between the cities of Rio de Janeiro and Juiz de Fora, southeastern Brazil. This stretch of BR-040 is a 4-lane highway under management of a private company, called CCR. The CCR employees were trained by Cecilia Bueno, through her project, called "Wildlife Paths", to record roadkills 24h a day, resulting from a 50 km/h speed on average. They used a standard form and techniques, developed by the "Wildlife Paths" project, which includes photographs, carcass removal and storage in freezers, location and time of incident. Twice a month, carcasses were taken to the laboratory and subjected to taxidermy procedures, and then they were donated to the collection of the National Museum of Rio de Janeiro. On the BR-040 highway, in 4 years, 51 roadkills of capybaras were registered. Landscape characteristics were quantified up to 1 km around roadkills: urban area, forest cover, herbaceous cover, crop fields and distance of the nearest river. Afterwards, logistic regression models were generated and the better ones were selected by Akaike's Information Criterion (AIC). The highest number of capybara roadkills was associated with river proximity. Other landscape characteristics also related to capybara roadkills were high herbaceous cover and low forest cover. These landscape characteristics are related to the capybara's habitat, as they are social and semiaquatic mammals that prefer open areas, particularly those near water bodies. Some mitigation measures are proposed to reduce collisions between vehicles and capybaras, such as installation of signs, fences and barriers close to rivers.

p9 Research into barrier effects by railway-tracks on the migration of amphibians

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In the Netherlands ProRail manages the railroad system. This organization is also responsible for the necessary fauna passages. Two years ago ProRail asked EcoGroen, an ecological consultancy, to find out where fauna passages could be effective for amphibians. When EcoGroen considered this request, another question arose: Are fauna passages necessary, anyhow? If there are no barrier effects on the migration of amphibians, it would be useless to construct expensive passages. During the migration of toads in spring we made several observations of the ways common toads cross the railway. In a number of cases it was found that crossing common toads did not survive when a train passed by. Thus, there is a real barrier effect. But during the observation we also saw that crawling common toads between the rails survived when a train passed by. A more thorough investigation was necessary to have a good answer at the question. After our first observations of amphibians which were killed by a passing train, we started a follow-up study. This consisted of placing a dummy toad on various places between the rails and on the outside of them. On two positions we also placed an anemometer for the registration of the wind speed under a passing train. In this way we could establish a relation between the distance the dummies were removed and the pressure wave under a moving train. With video cameras the research was visually clarified. The measurements with the anemometers showed that the wind speed in the middle section between the rails was the highest The dummies in the middle section were removed most. The transposing of dummies on the outside of the rails was the lowest. It can be concluded that the killing of amphibians only takes place between the rails. To diminish the mortality we suggest the placing of screens or walls outside the rail embankment which lead the amphibians to a kind of crosswalk underneath the rails. For these crosswalks cable ducts or hollow sleepers can be used as a tunnel, so that amphibians can have a safe crossing to the other side of the railway. Maintenance railwaymen are familiar with these cable ducts and hollow sleepers and they are certified by ProRail, so that the cost of placing these crosswalks is low.

p10 The HABITATS project: Social validation of INSPIRE Annex III Data Structures in EU Habitats

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Studies and analyses on the impacts of infrastructures on biodiversity are largely supported by GIS, and their outputs rely closely on good quality data. Therefore, when considering transboundary infrastructures and impacts, it is crucial to have easily accessible and inter-operable environmental spatial information among EU Countries, and this is the aim of the INSPIRE Directive. The HABITATS project, funded by the Competitiveness and Innovation framework Programme, focuses on the evolution of INSPIRE standards through a participatory validation process building a trans-European social network to generate usage scenarios and requirements, and assess the impact of project outcomes, to directly feed into interactive data/metadata modelling of the four INSPIRE data themes 16-19 (Sea regions; Bio-geographical regions; Habitats and biotopes; Species distribution). Widespread user validation is grounded in 7 pilot services covering these data themes across Europe, and led by content-providing partners:

- Wild Salmon Monitoring (IE)
- La Palma Protected Marine Area (ES)
- Hiking Trip Planner (IT)
- Soria Natural Reserve (ES)
- Sheep and Goat Herd Management (IT)
- Economical activity at marine coastal benthic habitats (LV)
- Czech National Forest Programme (CZ)

The validation pilots involve multi-stakeholder partnerships in which users actively participate in the co-design of the network services, and develop on-demand integration on the pilot service mash-up platforms. Validation pilot partnerships develop and test organisational/institutional arrangements for service sustainability and business models that underpin the project's sustainability and exploitation strategy. Specific and realistic quantified indicators measure the envisaged improvements in availability, access and use. The partners involved in HABITATS project are: TRAGSA (Spain); NSI (Italy); MAC (Ireland); HSRS (Czech Republic); TRAGSATEC (Spain); TU Graz (Austria); Madonie Park (Italy); ISPRA (Italy); FMI (Czech Republic); IMCS (Latvia).

p11 How to identify the wildlife habitat network setting up the landscape programmme for the state of Brandenburg (Germany)

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In European and German law it is requested to set up a net of connected habitats the so called "Biotopverbund". Core areas as well as connecting zones and structures as well as stepping stones have to be defined and are protected by law. The approach of nature conservation concepts is nowadays changing from a static concept of protected areas as system of the habitat net to a more functional understanding. The landscape programme for Brandenburg is the tool of the state to conserve the areas and required ecological functions within the habitat net. We identified the habitat net of state wide importance for large mammals using habitat data of the whole state. In North-East Germany large mammals like the wolf (Canis lupus) and the red deer (Cervus elaphus) are widely distributed. We developed an approach combining data of forest cover with the probability of disturbance in these areas. Corridors were identified by cost path models combined with hunters' informations throughout the state collected by the "Landesjagdverband Brandenburg". Using these data we identified sections of roads where conflicts are great or needs of reconstructing corridors are of high priority. A second habitat net refers to small aquatic habitats which are crucial for amphibians. The survival of endangered species like the fire-bellied toad (Bombina bombina) and the tree-frog (Hyla arborea) depend on a connected system of such habitats. We determined a habitat net connecting the hot spots of importance for the biodiversity of these habitats. In such habitats sections of roads with highest conflict potential were identified. Hence, measures of high priority could be taken to protect species from being killed by cars. Due to the glacial history of this landscape ancient river valleys are of particular importance for species of wet grassland such as the Large marsh grasshopper (Stethophyma grossum) or the Five-spot Burnet (Zygaena trifolii). Nowadays the historic utilization of the glacial river systems turns more and more into arable farming. Using data on the proximity of wet grassland also outside this system we identified a habitat net of importance for the survival of these species. The historic habitat net is already disconnected by settlements and intensive agricultural utilization. Spatial planning has to prioritise the conservation of still existing corridors. Natural woods such as deciduous forest are rare in Brandenburg. Pine trees are dominating the planted forests. Species like the great capricorn beetle (Cerambyx cerdo), the middle spotted woodpecker (Dendrocopos medius) or the Bechstein's bat (Myotis bechsteinii) are restricted to the small relicts of deciduous forest. The few areas in Brandenburg are still shaping a habitat net of natural forest. High needs for the conservation of the biodiversity of natural woodland are necessary. Forest planning as well as landscape planning in Brandenburg has to consider that the last part of a network of natural forest is of high priority for the protection of the species of the forest. Implementing this habitat net into the landscape programme will give legislative options for the conservation of biodiversity.

p12 Context-sensitive solutions applied to a road in the Asinara national park in Sardinia, Italy

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An infrastructural design is defined as context-sensitive when it provides both technical and functional requirements and solutions to minimize ecological impacts, favouring therefore the environmental sustainability. By this new environmental and social concept, the target of this study has been to design the functional adaptation of a stretch of road, located in the National Park of the Asinara Island in Sardinia (Italy), taking into particular account the environmental characteristics of the territory, while ensuring the performances of safety for road users. Vehicles on the island are due both to tourism and transport of foresters: the functional adaptation of the road was foreseen because an increase of tourism is expected in the next few years. The Asinara National Park is a highly natural area and it has been declared a Site of Community Importance, as it is characterized by a significant expanse and variety of habitats and since some protected and unique species are present, e. g. the white donkey (Equus asinus var. albina). Designing a road infrastructure in such a complex context demands a special care to minimize landscape fragmentation and disruption, as well as protecting biodiversity. At the design stage two different scenarios have been analyzed: the first one involves the repositioning of the road and the construction of a new coastal alignment to reduce landscape fragmentation. The second scenario involves the reuse of the existing pavement as a foundation for the new one. The second option was selected since the construction of a new track would cause severe environmental impacts due to the repeated transits of heavy vehicles. Moreover, the noise and the atmospheric externalities would be incompatible with such sensitive habitats. The choice of the road pavement materials has been very important too, as they should be ecofriendly and with a minor visual impact: a green surface mixture has been chosen, characterized by a total absence of petroleum by-products. The selected mixture has several suitable characteristics: it is environmentally friendly and recyclable, it has a pleasant pigmentation, available in various shades and colours compatible with the natural ones, it provides draining features that allow avoiding the use of curbs, which restrict the ecological permeability. Another solution evaluated to improve the environmental compatibility and provide the stability to the road pavement has been the use of green gabion walls instead of the more traditional concrete retaining structures: they are natural and flexible structures, perfectly suitable for a sensitive environment. The use of ecofriendly materials and innovative solutions to increase the integration and compatibility of the infrastructure with the highly natural context have been planned as a priority. A context-sensitive design, therefore, enables a road infrastructure to provide the perfect integration between engineering requirements and its environmental compatibility, which is fundamental to guarantee the environmental sustainability and the preservation of biodiversity.

p13 Opportunities offered by universities to inform the civil engineers on the restoration of ecological networks in transport corridors

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In 2006-2008, the University of Architecture, Civil Engineering and Geodesy (UACG) took part in a Dutch-Bulgarian Project, sponsored by the BBI-MATRA fund of the Dutch Ministry of Economic Affairs, Agriculture and Innovation and the KENNISBASIS Research Program, on Restoring Ecological Networks Across Transport Corridors in Bulgaria. Since 2008, there are a number of events that inform the academic, engineering and student community about the problem issues resulting from the habitat fragmentation and methods to reduce the barrier effects of the roads and railways. The participating lecturers from UACG presented reports at conferences and read lectures to students enrolled in transportation engineering program. One of participants currently works on a PhD dissertation – "Facilities for animal migration across roads and railways". An important problem for the ecoducts is to increase their usability. Simultaneously solving the problem of noise and illumination by appropriate noise protection facilities is one of the highlights. The idea of optimization of the latter lead to suggest a research project about the opportunities and effectiveness of green environmental barrier-noise facilities for sustainable development (BN-115/2011, funded by Center for Research and Design of UACEG). The purpose of this study is to summarize the main problems and to give the information about these problems to the civil engineers in Bulgaria. The researchers proposed classification of the different types of green environmental noise barriers, and make few suggestion for new one. Some of the lecturers supervise MEng student theses related to the above-mentioned problems and their solution by applying engineering and environmental methods. The issue has been made popular in a number of ways, which led to the establishment of multiple contacts and inspired many discussions concerning the educational strategies and eco-design in the road and railway constructions. The outcome of the communication strategies applied and the demonstrated interest of the parties confirm that this is a correct approach to inform the community of civil engineers and to prepare new personnel with innovative thinking.

p14 Measures to avoid and compensate environmental impacts caused by motorway construction of BAB A 44

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The BAB A 44 is supposed to close the gap between the agglomeration area Rhein-Ruhr and the urban axis of Eisenach – Erfurt – Dresden. The proposed section VKE 32 is situated in the east of the city of Hessisch Lichtenau in the district Werra-Meißner. It is characterized by a densely wooded low mountain range. The proposed motorway is aligned to the course of the valley („Wehretal"), a lowland area consisting largely of grassland. Facing a rich natural environment and structure it became apparent that impacts on areas of high environmental value would hardly be avoidable. Thus, it was a particular challenge to deal with the numerous and serious environmental conflicts (i. a. noise, species protection, situation between FFH sites and parts thereof) when planning the avoidance and compensation of environmental impacts. TEhe poster presentation will be set up as an additional information to the respection oral presentation. The focus wil be on measurres to optimize the technical planning. Particularly the following measures wwill be presented: - The extension of a tunnel structure to minimize the disturbance and fragmentation impact as well as collision risks for bats - The construction of a green bridge in addition to the widening of the Hasselbach-Bridge and of a service road bridge to minimize fragmentation and collision risks as well as - The construction of different kinds of protection-walls to avoid irritation, such as opaque noise protection walls, protection fences, dams, protective planting and guidance structures - improvement of bridge construction , i. a. with regard to optimized hydraulic structures

p15 The improved tunnel construction for amphibians and reptiles: Comfort Animal Transfer tunnel (CAT-tunnel)

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Fragmentation of nature areas by infrastructure can have multiple effects on species. Of all species, reptiles are most susceptible for fragmentation, followed by amphibians. This, plus the fact that reptiles only make little use of existing fauna tunnels raised the need for an improved tunnel construction. In 2011 ARCADIS designed a new type of reptile and amphibian tunnel: the Comfort Animal Transfer Tunnel, in short CAT-tunnel. This new type has multiple advantages in comparison to other fauna passages, especially for reptiles and amphibians. The improved benefits of the CAT-tunnel are: Translucent concrete for an improved light intensity and for a closed tunnel. A closed tunnel has multiple profits: There is no sound from traffic inside the tunnel. Less maintenance is needed because no dirt, leaves, salt and rainwater can enter the tunnel. It can be applied to highways in contrast to open constructions and therefore be a cheaper solution. Plates with a raw surface on top of the translucent concrete that guarantee roughness that is needed for passing traffic in case of closed constructions. Phase Change Materials elements (PCM) that make use of salt crystals for temperature regulation. The first pilot project with the CAT-tunnel has started half March 2012 in Lochem, the Netherlands. This first tunnel is aimed to transfer amphibians, mainly the Bufo bufo. Moreover, its suitability for reptiles remains interesting, especially for the Natrix natrix and the Lacerta agilis. The reason for the interest in these two species in specific is firstly, because the Natrix natrix is a frequently a target species of clients. Secondly, the Lacerta agilis appeared to be most critical from previous experiences. So if the Lacerta agilis will cross the tunnel, it is expected that also other reptile species will. In order to determine how this CAT-tunnel functions, ARCADIS will execute a monitoring pilot project in spring 2012. The monitoring will consist of an ecological component and a physical component. Species type and frequency of amphibians that transfer through tunnel will be measured, as well as the following physical conditions of the tunnel: temperature, humidity and light. A comparison of this tunnel will be made with a partially open tunnel construction. At the end of summer 2012, the outcome of this pilot project will provide information on whether the bottleneck for amphibians on this location is solved. Also, it will show if the microclimate inside the tunnel is suitable for reptiles, in particular Natrix natrix and Lacerta agilis. Furthermore, it will give an insight in the required maintenance and it can lead to improvement of the tunnel.

p16 Habitat preferences and migration corridors of large carnivores in the West Carpathians, Czech and Slovak Republics

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The Beskydy Mountains, located on the Czech–Slovak border, represent an important area of large carnivore occurrence in the Czech Republic and an important gateway in the West Carpathians. Besides poaching, the persistence of wolves, lynx and bears on the edge of their ranges in the Carpathians is threatened by habitat fragmentation caused by urbanisation and transport infrastructure. We therefore aimed to find out the habitat preferences of large carnivores and searched for functioning migration corridors. Intensive snow-tracking surveys were conducted by trained volunteers organized by NGO Friends of the Earth Czech Republic and data from field signs as well as reports from the public or experts were included in the analysis. Data were classified by their reliability according to the SCALP methodology. During the years 2003–2010, 463 records of large carnivore occurrence were collected (68 % Eurasian lynx, 25 % grey wolf, 7 % brown bear). Habitat preferences of all three species were studied in the areas of their occurrence as delimited by MCP. The basic environmental variables including altitude, road density, transport intensity, distance from nearest settlements and proportion of CORINE land cover types were described. We also analysed preferences of particular habitat type and finally we propose a habitat model for a wider area of the West Carpathians, including areas where monitoring has not yet been conducted. The results show that surrounding mountain ranges have habitat with a high potential for large carnivore occurrence. Low or no occurrence in previous years is probably a result of either insufficient landscape permeability or poaching, limiting the dispersal of young animals. Further steps concerning the long-term conservation of large carnivore populations in the West Carpathians should include protection of important migration corridors in spatial planning and implementation of mitigation measures at critical locations in both the Czech and Slovak Republics.

p17 The Ecology and Culture of Infrastructure: Teaching Emerging Professionals

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Problem

How do we educate emerging professionals about the complexities of human infrastructre needs and habitat relationships, so that new forms of ecology-friendly infrastructure continue to be designed and implemented?

Approach

"The Cultural Ecology of Water in the Netherlands" uses the power of cultural comparison for learning about infrastructure systems that are often invisible and taken for granted in one's home country. The objective of this class is the education of future professionals about issues in ecology and transportation infrastructure. This is essential in order to continue the paradigm change of integrating functional ecology with human settlement and transportation infrastructures. Offered to graduate Landscape Architecture and Urban and Regional Planning students at the University of Minnesota, the class begins with a five-week seminar in the United States to prepare students for the in-country visit. Tracking the history of the infrastructural response in the Netherlands to water safety and population pressures over the past 600 years, the class illustrates how this response now includes a robust ecological network within its definition of success. Over the course of four weeks in the Netherlands, the class uses a combination of site visits, presentations, policy study and design charrettes to examine how the Netherlands is weaving regeneration of ecological systems within its response to balancing safety, intensified land use, transportation demands and changing climate. The combination of morphological conditions and population density in the Netherlands creates an ideal laboratory for studying how the fragmentation of human settlement has affected ecological processes. Through the complex history of creating infrastructure that provides safety from water inundation, innovation has become an everyday reality in how the Dutch culturally respond to and interact with their environment. Water was historically used as the main transportation infrastructure in the Netherlands. Control of water created a safe environment for human society and commerce at the expense of robust ecological systems. Currently, the conflict of ecological requirements with intensifying land use and transportation networks is increasing. As the supporting framework of ecological systems, new forms of water management are being used in planning and designing robust ecological areas and connections. Findings Reflecting on the co-evolving morphology of landscape, infrastructure and culture in the Netherlands, students then apply the lens of their new understanding, comparing it with the infrastructure systems and policy and design responses from their home country. Now in its third year, the class has enlarged the toolkit of these future designers and planners, and increased students' understanding of the complexities of responding to the expansion of human activity and the necessity of planning and designing for ecological resiliency.

Conclusions

In studying the Netherlands, the use of a contrasting culture and landscape has benefitted the students, who are "lulled" by their unquestioning use and familiarity with infrastructure systems in their home country(s). Additionally, studying the complexity of issues encompassed by the high population density within a delta landscape informs students on what emerging issues they can prepare for in their home country(s).

p18 OostvaardersWold Corridor Photography Project: Documenting and Educating About Infrastructure Change

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Problem Statement

How does preparation for and implementation of a planned ecological corridor show up in the landscape when all landowners are not in agreement, and a changing political climate can destabilize funding?

Approach

This 10-year photographic study documents the transformation of existing agricultural land into the OostvaardersWold Nature Corridor, a planned 1 km by 10 km long corridor linking the Oostvaardersplassen nature reserve and the Horsterwold forest near Lelystad, the Netherlands. The OostvaardersWold nature corridor is part of the Netherlands National Ecological Network plan. Five major transportation corridors (two navigable canals, the A6, a national highway and a local access road) will cross this corridor as minority land uses. The corridor will include wide ecoducts for target species to cross transportation infrastructure. Unexpectedly, the OostvaardersWold corridor has also become an example of a situation where values of ecological habitat, culture and financial investment have come into conflict. In 2010, a new national government elected that was not in favor of financially supporting the construction of the corridor. The Province within which the corridor is located identified the corridor as an engine of economic health and cultural identity and has invested in its construction. Some farmers living in the corridor area support the change of land use, while others are protesting against the corridor construction. Portions of the corridor were to be used as compensatory ecology for projects that have been constructed, and time-bound agreement dates are approaching. Findings The OostvaardersWold Corridor Photography Project began in 2010. Forty-five georeferenced stations were photographed and are being rephotographed over a 10-year span of corridor construction and habitat development. After the second year of photographing, changes are evident in the landscape, although the corridor is not yet currently under construction. Presented as an archive, the project documents the physical change of the landscape from large-scale agricultural use to ecological habitat. Available to researchers and the public, this visual archive will be an educational springboard for issues around ecological requirements and human infrastructure.

Conclusions

The OostvarrdersWold Photography Project now encompasses core issues around ecological resilience and the demands of existing and planned infrastructure: What is the value of robust nature? When should nature overrule cost-benefit economics? How does the conversation about ecology expand in complexity so the web of ecological processes are valued and supported? What level of investment in ecology is valued regardless of current economics? How are long-term ecological goals supported within the shorter timeframe of changing policy? Demand for arable farmland increases, planned densification of existing transportation networks across the corridor move forward, and those responsible for the policy framework change. It is important to provide all levels of stakeholders with information about the complex requirements of human habitation and ecological processes so both can robustly function. Using a visual database of landscape change to inform stakeholders, the OostvaardersWold Photography Project supports new thinking about how humans can thrive in an environment that also supports the species and processes on which we depend.

p19 Overview of animal related-accidents in one of the world's densest road network region

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With its 4.7 km/km^2 of public roads, Southern Belgium (Wallonia) has one of the densest road network of Western Europe. This network as well as the observed increase in main game species populations (red deer, roe deer and wild boar) make Wallonia an interesting region for studying the patterns of traffic accidents caused by animals. Moreover, compared to most of European countries, no statistics are available for this area. To shed light on the current situation of wildlife roadkills, the police database of traffic accident statement was thoroughly investigated. Those statements concern accidents that occurred between 2006 and 2010. Each record includes date, time, species involved and information about the location of the accident event. Based on this dataset, we have analysed

(i) composition and percentage of involved species,

(ii) the consequence (material damages / bodily injuries),

(iii) the spatial (type of roads, proximity to landscape features, 'hot spot' map) and

(iv) temporal (daily, weekly and seasonal) distribution of animal-related accidents.

In conclusion future research perspectives and comparisons with other European results are presented.

p20 Bat friendly colour spectrum for artificial light?

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Being night active animals bats are prone to disturbance by artificial light in and around roosts, on flight paths and migration routes and while hunting. Light disturbs bats in different ways. Especially those species that fly relatively slow and emerge late, need to avoid light to lower predation risk. Being night active, their eyes are evolutionary adapted to low light intensities, with relatively few cones and many rods. While active in low light intensities their eyes are physiologically adapted to scotopic sight using primarily the rods. Confrontation with street lights disturbs the adaptation and forces the eyes in a mesopic or even photopic mode. Switching from scotopic to photopic mode occurs in a split second. Adaptation to lower light levels takes some minutes after every deviation from scotopic sight. Having eyes sensitive for low light levels, being confronted with artificial light may expected to be annoying and possibly painful. To prevent disturbance by artificial light, several tools are available in planning and developing landscapes: number of lights; intensity of light; position of light in relation to bat habitat (roost, route, hunting area); possibility to direct and target light and screen of the habitat; use of dynamic lighting schemes. All these are used as measures to avoid or mitigate negative effects. The possibility to adapt the frequency spectrum of the light to prevent disturbance is new. We have developed an experimental led lamp with a special bat friendly colour spectrum (AMBER), based on information on the frequency response of bat versus human eyes. In the absence of such information for European species we have worked with available information on neotropical species 'relatively' close to European species. In a field experiment in the summer of 2010, on a flight path of pond bats (Myotis dasycneme) following a canal with no artificial light, we compared different 'light treatments': darkness, Amber, traditional white street lamps and a green 'nature friendly' colour initially developed for birds. Five units of automatically recording stereo detectors were positioned in the middle of the canal, with the direction of the commuting bats leading from 1 to 5. The lights were set to light one half of the canal. From the amplitude of the recordings on the left or right channel, is was possible to detect whether the bats were passing the units clearly on their left or right side, or in the middle (amplitude difference not clear). The results showed a tendency to have a lower total of bat passes on all detectors and without discriminating between L, R or M. when white and green were used as compared tot darkness, and no difference between darkness and Amber, suggesting avoidance of white and green. The side on which the bats passed the units revealed a strongly significant shifting of the chosen route to the not lighted area, proving avoidance of white and green as compared to darkness, and no difference between amber and darkness.

p21 Climate change-proof defragmentation measures: the case of Ecoduct Wambach in the Netherlands

Victor Loehr

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Green bridges are defragmentation measures with projected life-spans up to 100 years. Consequently, ecosystems on green bridges may benefit from many decades of uninterrupted development, facilitating the use of these overpasses by demanding flora and fauna. Yet, the designs of green bridges are typically based on current climatic conditions, although we know that climates change. Thus, designs may not be able to support desired ecosystems on the long run, and future alterations would disrupt ecosystem development and green bridge functionality. In 2011-2012, Ecoduct Wambach was constructed as part of a new highway A74. To help Ecoduct Wambach function in a changing climate, we required the contractor to match the water management on the green bridge with Intergovernmental Panel on Climate Change (IPCC)-based climate scenarios of the Royal Dutch Meteorological Institute (KNMI). The desired vegetation, and climate projections 50 years after the construction date, served as references. The contractor identified two future threats to the vegetation: increased drought periods and increased rainfall peaks. Our contract requirement was qualitatively translated to multiple solutions. Concrete ridges glued to the deck of the green bridge formed basins to retain water available for drought periods. Similarly, polystyrene bases of embankments will retain water through raised edges covered with foil. To avoid excess water during rainfall peaks, an oversized drainage system will swiftly channel water to two ponds. The drainage system may also be used in a reversed fashion, as it features the possibility to supplement the green bridge with water. Ecoduct Wambach is a first step towards climate change-proof defragmentation measures in the Netherlands. The effectiveness of the solutions will be monitored carefully. For new defragmentation measures, the match between design and future climate may benefit from quantitative verification of contract requirements (e. g., modelling water management). Moreover, taking climate change into account in earlier project phases may help identify appropriate target species and defragmentation sites.

p22 Do High Speed - Railways Have Significant Disturbance Effects on European Woodland Bats?

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There is little scientific field research to investigate the adverse effects of new technology railroads on wildlife. The presentation reports results of a study that focused the aspect of the effects of disturbance / noise caused by high speed trains in Germany (ICE) on habitats of woodland bats. It is part of a broader study on the impact of transportation network and traffic on bats. To analyze the potential impacts of railroad lines and train traffic on woodland bats, we investigated the presence and activity of bats in the surroundings of a high-speed-railroad line. Similar structured sites in woodland areas nearby and distant of the railroad track were compared. The observed sites were pooled to distinguish between inner woodland sites and sites located in the borders of the wood because these sites were dominated by different bat species. Bat activity was monitored on transects with ultrasound detectors. Habitat characteristics were also investigated. Possible factors having impact on the appearance of bats in the surroundings of railroad lines might be sound emission, air swirling and light emission (flashing light). Sound emission at railroad lines is increased during train passage. Sensible bat species were expected to avoid the railroad lines according to the founding for highway-noise, because traffic noise reduces foraging efficiency and the hunting ground becomes less functional. Bat activity in sites near the railroad lines was tested for inferior bat presence and echolocation activity compared to distant sites. Fewer bats (all species present) were found hunting in woodland borders nearby railroad lines than in distant woodland borders. Species of the genus Myotis were significantly more frequent in distant woodland borders. This difference was only observed in the border sites. During two years of monitoring, bat activity in all inner woodland sites did not differ from each other: The presence / activity of bats (all species / only Myotis-genus) in the inner woodland (100 m from the woodland border) and even in a more distant site did not significantly differ from woodland plots only 10-25 m from the railroad track. The largely absence of the genus Myotis is a possible indication of railroad line avoidance. Notably, the investigated railroad lines were avoided even though their usage is far away from their possible capacity and disturbances were discontinuous. The described effect was only sited in the direct surrounding woodland borders of the railroad tracks. Differences between investigated nearby and distant border sites relating to vegetation and insects activity were not confirmed. Through this the differences in bat behaviour were not allegeable. If the conditions near the railroad lines, the sound and light emissions or the air swirling were causal could not be clarified under field conditions. Some species were considered to be sensitive to these effects. It was not detected, that bat individuals avoid the railroad lines only during the passing of the trains. The described avoidance effect is gradual and affects the direct rail periphery. Long-distance disturbance effects do obviously not exist.

p23 Are barrier fences effective mitigating measures to reduce road traffic bat mortality and movement barrier effects?

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Different studies have shown that roads act as movement barriers to bat species, especially to the broad winged Species. But most bats do not strictly avoid roads. Consequently, roads can be a significant source of mortality, especially when traditionally used flyways like hedges and other linear landscape structures are crossed. By re-establishing appropriate wildlife crossing opportunities over and under the road, bat mortality can be reduced. Ecologists propose about 4 m high fences along roads to keep animals off the road or – because this cannot be achieved – to cause crossing bats to fly high over the road. However, through lack of field research, there is little evidence to date to support the effectiveness of this mitigating measure. In this study we examined two-lane road sections and four-lane motorway sections with fences on either side (5 sites). At one site, a third fence was additionally arranged in the central strip of the motorway. All sites were chosen in woodland and open field. Barrier fences were constructed in places where roads crossed bat flyways. Data were compared to a two-lane-road section, where branches of trees on both sides closed the gap over the road. We used nIR-surveillance cameras combined with bat detectors and nIR-LED lamps to record the number of bats crossing the road and their flying height. We conducted 'before and after' studies (BAC) to assess the effects of different kinds of mitigation fences. If pre-construction data were absent, we compared fenced road sections with directly adjacent non-fenced sections. Each site was examined for at least 15 nights. We tested for the following hypotheses in sections with fences: Bat movement across the road is decreasing. Road-related flight heights are increasing. Our results show that Bat activity in crossing sections in the open environment did not significantly decline after road-building. In the woodland environment this could not be tested because pre-construction data were not available. A relevant proportion of the individuals observed (site-specific; up to 40 %) used the fences as flight lines. The amount of individuals crossing the road at a safe altitude (> 4 Meter) increased in road sections with fences. Flight altitude was significantly higher in road sections with fences than in sections without fences (in two-lane as in four-lane roads). A similar distribution was found along sections, where branches of deciduous trees had formed a canopy cover. Our findings suggest that fenced street sections appear to have some potential as mitigation features for bats. They can provide guiding elements after road construction and represent barriers that prevent low-flying bat species from entering the traffic area. This is relatively well proven by our studies for moderately structurally bound species like the Greater Mouse-eared bat (Myotis myotis), Whiskered/ Brandt's Bat (Myotis mystacinus / Myotis brandtii) and Common Pipistrelle (Pipistrellus pipistrellus). Further research is needed.

p24 Litter decomposition process in embankments under Mediterranean conditions

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Plant litter accumulation is a common process in embankments related to the absence of herbivores that consume the excess of biomass produced. Litter accumulation has ecological effects on plant life-cycle due to changes induced in light and microclimatic conditions in soil which determines germination, establishment and growth of plants. Accordingly, this buildup could affect community processes or ecosystem structure. From an applied point of view, the accumulation of litter coupled with high temperatures and drought characteristics of Mediterranean climate increase fire risk in summertime. Nevertheless, little is known about the key process of litter decomposition at roadside under Mediterranean conditions. The aim of our study is, therefore, to test different treatments oriented to enhance litter decomposition (by biomass removing, or nitrogen additions), as well as to simulate what would happen in the case of lengthy litter accumulation (biomass addition). With this propose, we selected 4 roadfills with high plant cover and biomass on two different localities in Central Spain, Madrid: The M12-M13 highway at Barajas international airport and the A1 highway, at El molar. On each site, we monitored the microclimatic conditions by mean of Echo and soil temperature sensors. At lower-slope level, 2x2 m plots were demarcated in each embankment. On them, we applied three different treatments: Clipping plants at the soil surface and remove from the plot; Duplicate, where litter clipping from the nearest plot was placed; and Nitrogen, where a commercial fertilizer with mineral nitrogen was applied. Likewise, control plots with no treatment were included in the design. Each block of treatments was replicated three times along each roadslope. In order to study litter degradation rate, 3 mesh bags with a standard plant material were located on each experimental plot. Bags were collected 2, 4 and 8 months after treatment application. Repeated measured ANOVA showed that decomposition rates increase with time but no effect of treatments was observed, probably due to the harsh drought in Spain over the fall and winter (2011-2012), as suggested by our results of soil microclimatic conditions (temperature and moisture). Although farther research about litter decomposition processes at the roadside is needed, this approach provides an interesting point that should be taken into account in order to improve management on these scenarios.

p25 Landscape factors influencing roe deer and wild boar roadkill frequencies on the M1, M3, M7 highways of Hungary

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According to the national standards each highway has to be surrounded by protective fencing in Hungary. Though there are thousands of animals getting onto the highway's surface and victimized to traffic annually. Roe deer (Capreolus capreolus) and Wild boar (Sus scrofa) are one of the most dangerous ones for traveller's safety amongst the regularly occurring, conflicting wildlife species. Severity of these collisions might be minimized by manipulating its influencing factors, but these factors are firstly to identify and recognize. In this study we investigated the landscape features which remain totally or almost unaltered on a larger scale of time. Our purpose was to evaluate how the easily, and free-of-charge-accessible spatial databases may be used to derive landscape factors by predicting spatial patterns of roe deer and wild boar roadkills on three of the most important Hungarian highways (M1, M3, and M7). Roadkill data were derived of the database of the State Motorway Management Company Ltd. Our results suggest that existing landscape databases which had been used in this work are not suitable to support roadecology-decisions alone, but may have a supplementary role. This consequence put the weight to other possible predicting factors (such as traffic-, and human related factors), and emphasizes the importance of the proper mitigation measures, and well maintained protective fencing, taking into special account that temporary dysfunctions of the protective fencing may lead to occasional – and so unpredictable – wildlife occurrences on highways.

p26 Amphibians on country roads of northern Portugal: spatial patterns and factors influencing mortality

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Amphibians are the most affected group and road fatalities have a significant impact on population dynamics and viability. Country roads are more permeable to amphibian passage contributing as a greater source of amphibian mortality than highways, which act as barriers. Due to the extensive country road network of Portugal, the identification of the precise locations (hotspots) and their associated variables is needed to apply mitigation measures successfully. The aim of the study was to analyze the spatial occurrence and related factors linked to amphibian mortality on different country roads in northern Portugal, using spatial statistics implemented in a GIS and applying a binary logistical regression. In a total of 631 km of road surveyed (corresponding to seven transects), 404 amphibians were observed: 74 (18.3 %) alive and 330 (81.7 %) road-killed. Bufo bufo represented 80 % of the mortality records. Three transects showed clustered distribution of road-kills: broadleaved forests and road ditches were the most important factors associated with hotspots. Logistic regression models showed that habitat quality, Bufo bufo's habitat preferences, and road ditches favoured amphibians' mortality, as well as average altitude and length of walls were negatively associated. This study also recommends knowing the condition of local amphibian populations to understand their road-kills spatial patterns and again, shows the urgency to apply mitigation measures on country roads.

p27 Facilities for small species as "Add-ons" to infrastructural objects

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When building ecological structures like ecoducts or culverts with ecological functions, public opinion is that it is an expensive solution for a minor problem, mostly imposed by regulation. The belief that these are very important links in for example increasing biodiversity is not shared. How can we turn this mindset into something that people, as well as projectmakers, themselves pursue? At ProRail, the Dutch organization responsible for the management of the Dutch railwaysystem, we initiated the making of a brochure on small, 'instant' and 'easy to add-on' facilities to increase the habitat of special species living along and in the vicinity of railroad tracks. These facilities are simple to realize and can be added to any infrastructural project, like new over- or underpasses, as well as railway expansion projects or the building of new stations, with minor effort and at virtually no additional costs. Together with the Dutch organizations that work in partnership on good and effective information about the Flora and Fauna (VOFF) we worked out the following selection:

- Bee hostel
- Scalding stacks for the green snake
- Special Flower mixtures for butterflies
- Fauna Stay-okay
- Reptiles bump
- Optimization of ditches
- Guiding elements for bats
- Summer/winter residences for bats
- Hedgehog suite

We made a pleasant and easy to read brochure for any decision maker within the project area (projectmanagers or contractors, policy and plan developer, specialists). It provides illustrative and accurate pictures of all the the types of facilities. Technical details for construction, material use, availability, and informative websites to consult expert organizations, are detailed in a separate manual. Any contractor can easily apply the facilities in his work. We believe we can tickle people's consciousness in order to convince them that they themselves can help increase biodiversity with just a small effort in their projects. These contributions to more living space for small species can also be seen as a part of corporate social responsibility programs.

p28 Wildlife-Road Observation System: A globally-accessible technology for mitigating wildlife-road impacts

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A globally-accessible online database and resource tool has been developed that utilizes smartphone and other mobile technology to assist transportation and natural resource agencies, private consultants, conservation organizations, researchers, citizen scientists and the general public to effectively collect, report and monitor wildlife-road observation data in North America, Europe, Australia and other regions of the world. Wildlife-vehicle collisions (WVCs) and wildlife-road mortality (WRM) is a growing issue in North America, Europe and elsewhere in the world where road infrastructure is predominant and expanding. Direct impacts resulting from wildlife-road interactions include: vehicle and property damage; human injury and death; insurance costs; and wildlife species mortality and population decline. Total annual costs associated with WVC's in North America and Europe are estimated to be in the billions with wildlife species mortality levels reaching well over a million per year. Similar estimates and trends are expected for other road-developed regions of the world. Efforts to address and mitigate these impacts are a priority objective of transportation agencies, wildlife conservationists and resource managers. The Wildlife-Road Observation System (WROS) is an important and powerful tool that can be used to help improve road safety and wildlife conservation. WROS integrates user-friendly mobile application software, a central online database and web portal that users can access to collect, monitor and report live and dead wildlife-road observations. WROS offers the ability to:

(1) make data collection more accessible and convenient to multiple end-users including the general public;

(2) provide a standardized means of data collection that can be compared across spatial and temporal scales;

(3) significantly increase data collection efficiency and accuracy;

(4) store and manage data in a centralized database repository that can be viewed, accessed and shared by users; and

(5) provide web tools and resources to assist with wildlife-road data analysis and impact mitigation.

p29 Multipurpose Ecological set-up on the international ecoduct Kempengrens

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The Flemish (Belgium) and Dutch government are working together to build an ecoduct over a highway that divides a transnational ecological valuable area. This project is based on separate initiatives of the two countries, each country having their own program and target species. As the result of a joint initiative it was decided to build one ecoduct with a width of 60 meters on the border in the middle of the transnational area. The original architectural project is designed with much attention to the adaption in to the landscape and to its ecological function. In order to make it functional it is important to fit the set-up to the demands of all the target species of the surrounding landscape. Therefore the local Forest group made a technical design for the ecological set-up of the passage. The goal is to realize different ecotopes on the bridge and the slopes:
A moist zone will be installed at the Westside (Belgian side) of the ecoduct as a moderate nutrient rich situation The goal is a moist heath vegetation Variation will be established by making some depressions. A dry zone with poor nutrient conditions will be established at the eastside (Dutch side) of the ecoduct. The conditions will be suitable for dry Heath. Only few scrubs will appear in this dry situation which results in an optimal sunny environment for the target species. Micro relief (holes and bumps) and open sandy spots are very important for the target species. In order to increase the structural variation a transition zone will be established between the moist and the dry zone. The two zones will have a minimal width of 15 meters and a maximal width of 25 meters. The result is a transition zone with a variable width. On the accession ramps and on the bridge transition from the moist zone to the dry zone will also be created in the construction of the soil layers. On the bridge this will be realized with a compartmentalisation made by small retaining walls in V-shape. This is a passive way to create a wet zone by retaining the storm water. Slope screens at both edges are necessary to create a secure situation on the bridge. At the inside they will be made of gabions filled with lava stones. At the foot a sand slope will be a sunny. The green slope screens will give the construction a green appearance for the road users. A ramp of stubs will be placed from one side to the other to provide shelter, a place to hide and to hibernate. The accession ramps will have a steep and a lousy slope connected to the bended form of the retaining wall of the construction. The dry and moist zones on the bridge continue on the accession ramps. The moist zone will be completed with ponds at the two sides. In the steep slope in the dry zone a bats cellar will be build.

p30 How do ecological traits affect small mammal spatial responses towards roads?

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It is generally agreed that different life strategies may influence spatial patterns towards roads and therefore, different vulnerabilities to these structures. So far, studies show that rodents seem to avoid roads but occur in relative higher abundances in the road verges. However, those studies do not take in account the different species' habits, which may correspond to different responses towards road-related features. The main goal of this study was to examine the effect of roads on the spatial behavior of three small mammal species with different ecological traits: the semi-aquatic water vole (Arvicola sapidus), the Mediterranean vole (Microtus duodecimcostatus) with fossorial habits, and the terrestrial Mediterranean mouse (Mus spretus). We addressed:

1) the size and shape of the small mammal territories in the vicinity of the highway,
2) the effect of traffic on individual movements, and
3) the highway crossing rates.

This study was conducted in the vicinity of three types of roads: unpaved, two-lane paved roads and high traffic (21,000 vehicles / day) highway (between Seville and Huelva, Spain). Adults of each species were trapped at a less distance from the highway than their average home-range radius. We radio-tagged and tracked individuals over six consecutive nights (eight hours from the sunset) and fixes were calculated by successive triangulations every 20 minutes. Our results show that different ecological traits among small mammals apparently do not affect their spatial patterns. More specifically, we found that:

1) individual home-ranges were delimited by paved roads;
2) traffic volume did not affect animal movements within territories;
3) regular crossings over unpaved roads were observed;
4) only a few road crossings were detected either in paved roads or highways, and
5) crossing structures were not used.

Further studies should be focused on genetic analyses to evaluate the apparent barrier effect provided by radio-tracking data.

p31 Shrikes love the roads in agricultural landscapes?

Federico Morelli

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Roads are a pervasive feature on the landscape and their ecological effects on vertebrate wildlife have been well documented. Indeed, the main types of effects described have mainly negative consequences on birds and other vertebrates. The major effects of roads on birds include habitat fragmentation, traffic noise and direct mortality from road kills. However, others passerines like the Red-backed Shrike, Lanius collurio, seem use the areas close to roads often for nesting and hunting purposes. The aim of this work was to study the importance of road proximity in the selection of suitable shrubs for nesting by the Red-backed Shrike in the farmlands of Central Italy. The study was conducted in a breeding territory of the species in the River Foglia catchment area in Central Italy. The bird data were collected during the 2009 breeding season using a complete mapping, in an area of 600 ha. Each shrub was digitized and classified as "suitable" according to previous studies on the ecology of the species in the same region: vegetal species, size and density of foliage. The suitable shrubs were classified as "occupied" or "unoccupied" by a nest. Were also calculated the following environmental parameters: altitude, nearest road distance, shrub shape, shrub surface, shrubs density in a fixed radius of 50 m, nearest shrub distance, landscape fragmentation and land-use coverage. The relationships between nesting and environmental parameters were examined using a GLM stepwise backward procedure to select the most significant variables using the AIC criterion. In order to quantifying the effects of every independent variable (in particular "nearest road distance") was used the hierarchical partitioning protocol, that employs goodness of fit for each possible models, with R program. 739 suitable shrubs were mapped, with a density of 0.62 shrubs/ha. All of the 42 nests studied were located in shrubs, with a density of 0.35 pairs/10 ha. The mean distance of occupied shrubs from the nearest road was 12.5 m. In 76 % of the cases the nests were positioned less than 25 meters from roads. The analysis of the relative importance of every variable for the models showed that the road distance is one of the most important variables in relation to the probability of Red-backed Shrike nesting in the suitable shrubs. The preliminary results suggest that in homogeneous agricultural landscapes, Red-backed Shrike seems to build the nest mainly on the suitable shrubs nearest to the roads, preferring these also if there are other available shrubs with similar characteristics which are located away from roads. It is reasonable to argue that suitable shrub for nesting and the contemporary presence of bare soil or open spaces for hunting, both of which exist close to countryside roads, might represent the favorable components of the breeding habitat selections of Red-backed Shrikes. Our results could provide useful indications for the census techniques and conservation of the species; however, more accurate researches are needed to better explain their irregular distribution in agricultural landscapes.

Tuesday, October, 23

Plenary Session 2

Distinguished experts from Europe and North America have been invited to introduce selected themes, discuss urgent problems and effective solutions, as well as share their visions for transport and infrastructure ecology.

ps3 EU's vision on future transport and infrastructure policies

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Vision 2050 – Towards an ecologically sustainable transport infrastructure

- The new trans-European network (TEN-T) policy of the EU: a genuine network approach

The European Commission has presented its overall vision on Transport 2050 in its "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system". 40 concrete initiatives to build a competitive transport system shall contribute to one key goal: Meeting the mobility needs of citizens and the economy while cutting carbon dioxide emissions in transport by 60 %. To reach this goal, European transport needs to grow together as a system, with infrastructure, vehicle technologies and services interacting efficiently. To tap the full potential of measures to reduce emissions and enhance the environmental record, the different actors need to join their forces – public authorities from the local up to the European level, environmental experts, scientists, transport industry and transport users.

Europe's vision for transport infrastructure development until 2050 is challenging: As the basis of the transport system, infrastructure development has to pave the way for innovative propulsion technologies and vehicle generations, enable forward-looking and high-quality transport chains for passengers and freight, tackle pressing problems in urban areas, support global commodity flows and – not least – fit in with a future-oriented ecological system.

As one of the first – and pivotal – initiatives of the road map, at the end of 2011, the European Commission has adopted a legislative package on the future trans-European transport network policy. It covers the policy framework until 2050 (the TEN-T Guidelines) and the provisions for EU financing of the TEN-T until 2020 (the Connecting Europe Facility). Both proposals mark real innovations in the now twenty-year-old history of this EU policy area. On the policy side, a genuine network approach has been proposed which puts functional needs of the whole European system first and derives new projects from there. Key network planning objectives at EU level include therefore: an optimal integration and interconnection of all transport modes in order to enhance multi-modal services and encourage rail or inland waterway transport legs, strengthened emphasis on efficient infrastructure use as integral policy element, innovation – especially with a view to low-carbon technologies, concentration – with a core network as the strategically most important part and as the highest implementation priority – as well as enhanced implementation instruments. The Connecting Europe Facility proposes to support this policy approach with grants and innovative financial instruments. Particular stimuli are foreseen for rail and inland waterway projects as well as for intelligent transport systems which contribute to using infrastructure efficiently.

- Benefits for climate and environment

The TEN-T shall be developed in a resource efficient way – in terms of both natural and financial resources. With the proposed strengthening of the European network approach – resting upon the first-ever Europe-wide transport planning methodology – both objectives are properly addressed.

The overwhelming part of this network consists of existing rail, road, inland waterway, airports and ports infrastructures – equipped with intelligent and inno-

vative transport systems. It builds on axes and nodes which are particularly relevant for transport flows of international importance. New projects are identified from the European overall perspective. Whilst minimising land consumption and financial cost, however, the TEN-T policy for the next decades cannot do without new projects.

They may cover a broad range of areas such as : the removal of missing links, physical bottlenecks or interoperability barriers, real-time traffic guidance or a new European air traffic management system. There is in particular a need for major rail projects which link Member States and cross natural barriers, for the upgrading of inland waterways or the construction of terminals to interconnect modes. Road projects, too, form part of the TEN-T and are needed to close gaps and reduce endowment imbalances between different parts of the EU. It is beyond all question that these projects have to comply with the EU legislation on environmental protection – notably on the Strategic Environmental Impact Assessment, Environmental Impact Assessment, the Birds and Habitats Directives and the Water Framework Directive.

This framework offers considerable opportunities for "Green Infrastructure" development solutions, to be explored at early planning stages. Whereever evidence shows that this could bring ecological and socio-economic benefits, relevant actors are encouraged to set examples. Already in the past, a number of TEN-T projects have included ambitious Green Infrastructure elements. Amongst these projects are major railway or ports projects. Such measures may be subject to EU financial support under the TEN-T budget, provided they constitute an integral project part and have been covered by the relevant planning and authorization process.

TEN-T projects involve responsibilities at various levels – local, regional, national and European, public or private. They present a challenge and an opportunity to cooperate more closely at project level and benefit from other projects' best practices. The newly proposed TEN-T legislation wants to encourage all actors to contribute their experience and know-how to the advantage of the network and its environment.

Corridors: An instrument for efficient and sustainable TEN-T implementation and cooperation

In order for all "network beneficiaries" (including the natural environment and the climate) to take full advantage, timely project implementation is necessary. The new TEN-T approach aims at magnifying positive network effects. However, delays would also generate negative network effects. The Commission's legislative proposals, therefore, include the instrument of "corridors" which aim at facilitating coordinated and coherent infrastructure development along corridors. Such corridors include infrastructure links and nodes and cover all relevant transport modes. Action addresses both the use of existing infrastructure and the preparation and construction of new projects. Corridors shall pioneer the stronger integration of transport policy action and infrastructure development, and they shall be forerunners on innovation – both technological and organisational. In this context, they shall lead TEN-T development towards concrete gains for the climate and environment in accordance with the 2050 transport policy vision.

Corridor development requires strong governance which brings together all relevant actors – across national borders, transport modes and organisational diversity. All those involved in promoting, conceiving and implementing Green Infrastructure are encouraged to take an active part in this process which is just about to start.

ps4 The Netway System: Solving Big Transportation and Nature Problems Together

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Nature underlies civilization. Yet with built areas, agricultural areas, and our transportation system extending widely across the land, natural habitat is lost, degraded, and fragmented.

This leaves a land of green infrastructure or ecological networks, composed predominantly of vegetation patches and corridors surrounded by human activities. Our road system crisscrosses and disrupts these patterns, especially the critical "emerald network" of large connected patches. Could a significant portion of the lost and degraded nature be rather quickly recovered, and the remainder reconnected?

Motor-vehicle transportation, a central catalyst for society, uses an infrastructure largely built before modern ecology emerged, so transportation must endlessly mitigate for environmental problems. Our road system has improved (without fundamentally changing in 50, even 80, years), yet now faces many more giant problems. Finite petroleum rising in cost. Greenhouse gas emissions and effects. Huge costly legacy of roads and bridges needing repair. Rapidly mounting traffic congestion. Traffic accidents with repair, insurance and medical costs. Could these all be rather quickly addressed and solved?

First consider road ecology. The science grows rapidly, solutions spread worldwide, and successes emphasize broad spatial perspectives, ecology and transportation experts collaborating, and incorporation of road-crossing structures for wildlife. Yet more progress is needed for roadside uses, traffic noise, wetlands, hydrologic flows, and stormwater pollutants, and especially the big goals of applying road ecology: (1) improve environmental conditions alongside every road segment; and (2) restore connectivity for the emerald network and near-natural water conditions across the broad landscape.

The worldwide increases in road construction, vehicle numbers, and vehicle-distance-traveled far outstrip the rate of implementing road ecology solutions. Nature is definitely disappearing, degrading, and fragmenting, at the same moment that transportation now faces so many big challenges. The netway system, a vision yet feasible, addresses both.

In essence, the netway system consists of narrow elevated and sunken ways along which lightweight pods carry people and goods. Using inductive coupling with a wire embedded in the netway and tiny electric motor in the pod, renewable energy powers the system. Personal, public and freight pods are moved under automated control; no driving. Some pods also carry a tiny battery for driving short distances on ground level to home or work or shop. The corridor under, over, or alongside netways is flexibly used for solar collectors, wind turbines, woody vegetation corridor, service road, market-gardening, and recreation. Priority areas to begin pilot projects contain both busy highways and especially valuable nature.

The central benefits achieved are: (1) restore lost and degraded habitat, and reconnect the land; (2) safer and more efficient transportation; (3) eliminating fossil fuel use and emissions of greenhouse gas and unhealthful pollutants; and (4) new food-producing surfaces and recreational trail systems near cities and towns.

The last transformation of surface transportation was achieved quickly, from predominantly horsepower on dusty muddy roads in 1900 to motorized vehicles on black-top surfaces in 1925. It is time to take the next step. History will record the leaders who stepped forward now for both transportation and nature.

Tuesday, October, 23

Parallel Sessions 3

Fragmentation
ARC-Competition
Workshop: Vision 2050
Corridors
Roadkill I

Lecture Session: Fragmentation — Room A

Habitat and landscape fragmentation

Chair: Jochen Jaeger

Transport infrastructure networks and other exploitation works lead to an increasing fragmentation of landscapes and loss of wildlife habitats. Fragmentation is recognised as an important cause for biodiversity loss worldwide. This session presents a variety of studies that illustrate fragmentation processes and reveal the effects on wildlife and populations.

Lecture Session: ARC-Competition — Room B

The ARC Wildlife Crossing Design Competition

Chairs: Nina-Marie Lister &Anthony Clevenger

This session presents the results of the world's first international design competition for wildlife mitigation structures. The ARC competition solicited entries from international, interdisciplinary design professionals for innovation in feasible, build-able, context-sensitive and compelling design solutions for safe, efficient, cost-effective, and ecologically responsive wildlife bridges. In doing so, the ARC competition has raised international awareness of both mitigation needs and design possibilities.

Workshop: Vision 2050 Room D

Vision 2050 - towards an ecologically sustainable transport system

Chairs: Lars Nilsson & Andreas Seiler

Roads and railroads we plan and built today are intended to meet current as well as anticipated transport demands in the near future. We often overlook however, that these infrastructures will affect our environment directly and indirectly over a much longer time. Environmental mitigation is, mostly re-active and conservative and does rarely prepare for accumulating future impact. How do we envision an efficient and environmentally sustainable transport system that integrates landscape ecological values, habitat connectivity and biodiversity concerns with traffic safety, social and economic constraints? What are likely scenarios, environmental risks, and opportunities for improvement given the current strategies in transport policy, infrastructure upgrading, and trends in technical development and traffic planning? Other factors that will shape Europe's transport system are changing provisions for car fuel, necessary climate adaptations in infrastructure and a progressing urbanisation.

At this workshop, invited guests will present a brief introduction to their perspectives on a sustainable transport system and discuss these implications with the audience. Hereby, we hope to initiate a discussion that continues after the conference and can be addressed again in coming IENE events.

Lecture Session: Corridors Room E

Corridors for wildlife

Chairs: Hans Mader & Andreas Piela

Landscape wide and hence ecologically diverse corridors are an important tool to reconnect wildlife habitats and plan defragmentations measures at urban as well as at regional and international scales. This sessions presents experiences from such corridors, their implementation and management.

Lecture Session: Roadkill I Room F

Case studies of mitigation in infrastructure projects

Chair: Hans Bekker

This session presents examples of infrastructure development projects where special concern has been paid to remedy adverse effects on landscape and wildlife. It provides insights in real-life solutions, problems and opportunities that are rarely taught in university classrooms.

a37 Landscape fragmentation due to transportation network and urban development in Bornova district of Izmir metropolitan area

Işın Barut, Engin Nurlu

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Cities are growing and rapid changes in cities creating more and more pressure on both natural and cultural landscapes. Ecological indicators in metropolitan areas should be well understood to manage the human impacts on urban ecology. Landscape fragmentation, which correlates with the patch connectivity, is one of the indicators which is regarded as an important environmental indicator for monitoring environmental change. As urbanism brings more artificial settlement surfaces and road network, landscapes become more fragmented. The aim of this study is to measure landscape fragmentation caused by transportation network and urban development in Bornova district of Izmir city, Turkey. The objectives are to designate the urban development and road network development for the years 1984, 1990, 2000 and 2009. Also to understand how human impacts change the patch size. In this study, effective mesh size (meff) method is used to measure landscape fragmentation. It is an expression of whether two points in the landscape are connected or not; the effective mesh size (meff) is also defined as a method to quantify the patch connectivity. Two layers were used to investigate effective mesh size (meff) method in ArcGIS 10: urban areas and road network analysis were overlaid to create fragmentation geometry layer that regarded as the cause of landscape fragmentation. Planning unit layer, which means the area that effective mesh size measured for, was chosen from the county boundary of Bornova district. Effective mesh size (meff) was measured for the years of 1984, 1990, 2000 and 2009. According to the effective mesh size (meff) analysis results, the effective mesh size (meff) in Bornova has been decreasing, in other words, landscape fragmentation has been increasing because of the urban growth and road network development. This study creates awareness about the human pressure on urban landscape and investigates the specific reasons of landscape fragmentation in Bornova district in order to create landscape planning proposals for more sustainable landscape by using the realistic results of the effective mesh size (meff) analysis. This study also emphasizes the necessity of landscape management and protection to lessen the effects of landscape fragmentation on landscape ecology.

a38 Landscape fragmentation in the Czech Republic – current situation and prognosis till 2050

Petr Anděl, Václav Hlaváč

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Landscape fragmentation caused by traffic, industry and settlement infrastructure in the Czech Republic is a serious problem of nature conservation. Significant systematic and expert efforts haves been made in the last decade and the comprehensive set of methodology materials is the result. We can distinguish three main thematic groups: (1) General assessment of landscape fragmentation. The percentage of unfragmented areas by traffic (UAT) was 84 % in 1980, 69 % in 2000 and 63 % in 2010. The prognosis based on the nationwide traffic model of the Road and Motorway Directorate of the Czech Republic for the year 2040 assumes athe decrease toill 53 %. The same increase of landscape fragmentation confirms the indicator "effective mesh size" (meff) indicator which was 397 km^2 in 1980, 232 km^2 in 2000 and 216 km^2 in 2010 with athe prognosis of 165 km^2 for the year 2040;, (2) Protection of landscape permeability. The Significant Migration Areas (SMA, approx. 42 % of the CR area) and Long Distance Migration Corridors (LDMC, approx. 10, 000 km) were demarcated for the area of the CR. These structures are background materials in the landscape planning processes,; represent the minimum requirement for ensuring permeability ensuring and are linked to the similar structures in neighboring countries. Currently, 29 critical points (impassable, but solvable) and 178 problematic points (danger of interruption of LDMCs by traffic infrastructure development) were found in the LDMC network;. (3) Measures on transport infrastructure. The handbook has beenis available for more than 10 years for designers, investors and public administration staff. The cCurrent approach is summarized in the handbook "Permeability of Road and Highway Network for Wildlife" handbook; the measures for otters are elaborated separately. Conclusion: There is still a need for the complex conception of landscape protection against fragmentation despite many expert and systematic materials has been already being published. The prognosis till 2050 will be pessimistic without a fundamental change of approach change. The Czech Republic is following the trend of industrial western- industrial European countries in the terms of rising traffic volumes, infrastructure and settlement development, with all the negative consequences.

a39 Extinction thresholds in road density: How do they depend on traffic volumes, road network configuration, and the road avoidance behavior of the species?

Jochen A.G. Jaeger

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Road networks subdivide landscapes into smaller and more isolated parcels. They reduce the amount and quality of habitat, act as barriers to animal movement, and increase wildlife mortality. Therefore, the monitoring systems for biodiversity and sustainable development in Switzerland have adopted an indicator of landscape fragmentation: The "effective mesh density" (effective number of meshes per 1000 km^2) in Switzerland has increased by 230 % during the last 120 years. How can this high level of landscape fragmentation be assessed? How much fragmentation is too much? One approach is to study thresholds in population persistence probability derived from computer simulation models. I used a spatially explicit individual-based simulation model of population dynamics to (1) identify extinction thresholds and to (2) investigate how the thresholds depend on (a) the behaviour of the animals at roads, on (b) traffic volumes on the roads, and on (c) the spatial configuration of road networks. (3) I also asked if metrics of landscape connectivity can predict the severity of these impacts. The results clearly supported the concept of bundling roads, i. e., several roads bundled close together, or an upgraded road with more traffic on it. Therefore, large un-fragmented parts of the landscape should be kept un-fragmented. The results also showed that the thresholds strongly depend on the behaviour of the animals at roads, e. g., the degree of road avoidance, which, in turn, depends on road characteristics such as traffic volume. However, landscape metrics do not capture this relationship and therefore, their predictive value is limited. In addition, the effects of road networks have long response times leading to an extinction debt. Transportation authorities are taking advantage of this lack of knowledge when they build new roads, arguing that not enough is known about the thresholds, and more research would be needed before they would slow down with road construction. This constitutes a "fragmentation spiral", because research is (and may always be) unable to catch up, and fragmentation continues. Many more new road projects are planned, in particular in Eastern Europe, which will further increase the level of fragmentation in Europe significantly. It is highly unclear if the installation of wildlife passages along roads and the protection of wildlife corridors would be enough to prevent the loss of biodiversity. This situation is contrary to the precautionary principle and to the principle of sustainability. Therefore, the German Federal Environment Agency has suggested introducing region-specific limits to control landscape fragmentation and urban sprawl. The results of this project provide an important step towards developing a network theory for road ecology and towards the design of less detrimental road networks. Empirical studies comparing landscapes with differing road network configurations should be conducted to test the model predictions, to improve the model, and to provide a better foundation for planning highway networks. Limits to curtail landscape fragmentation and urban sprawl should be introduced, at least for the time until the thresholds and the extinction debt are known.

a40 What, where and in which configuration? An analysis of landscape connectivity combined with modeling of metapopulation viability to assess and optimize Green Infrastructure for invertebrate species with reduced dispersal ability

Reinhard Arnold Klenke, Rüdiger Jooß

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Landscape sub-dissection and habitat fragmentation caused by technical infrastructure and land-use change are main drivers for the loss of biodiversity in the industrialised countries. Beside the traditional way of nature conservation to protect special areas with remaining elements of natural or semi-natural ecosystems the new concept of Green Infrastructure plays an increasing role to preserve or establish connections between protected areas and habitat elements in the landscape matrix. These network linkages are important not only for populations of larger mammals suffering from landscape fragmentation due to traffic mortality, like e. g. Lynx (Lynx lynx) and Wild cat (Felis sylvestris) in Germany or even Badgers (Meles meles) in the Netherlands. They can play also an important role for populations of slow moving or flightless invertebrates. However, the efficiency and functionality of such elements of Green Infrastructure is strongly dependent from their placement in the landscape. We have developed an innovative methodogical approach combining elements of habitat analysis and modeling with analysis of landscape connectivity and metapopulation viability to assess the efficiency of fauna passages and habitat improvement. The approach was tested using data from two slow moving invertebrate species, the flightless bush cricket Polysarcus denticauda and the grasshopper Oedipoda caerulescens, in two different real landscapes with several planning scenarios. The results have shown big differences in the efficiency of both, fauna passages and new integrated habitat elements, which is strongly dependent from their placement, configuration and dimension. We could also show that the use of connectivity analysis in a very early stage of the planning process can help to find variants for the course of a road which may have much lesser impact then the originally planned one. The developed approach needs special scientific knowledge, good data from the landscape and the animals under investigation, and (partly) high performance computers. Therefore, we recommend the use of the developed approach especially in regional and large scale environmental impact assessments.

a41 Impact of Rapid Transportation Network on the Potential Habitat of Hydropotes inermis in Eastern Suburb of Nanjing, China

Mingyang Li, Xiaojun Wang

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Knowledge of habitat dynamics could influence wildlife protection policy. The purpose of the paper is to quantify the impact of rapid transportation network on the potential habitat of wildlife in suburban areas so as to provide scientific basis for the plan making of rapid transportation network and biodiversity conservation. In this research, River Deer Hydropotes inermis, an endangered wild mammal in the eastern suburbs of Nanjing City, China, was studied with main information sources of remote sensing images from China Brazil Earth Resources Satellite (CBERS) in 2006 and Disaster and Environment Monitoring and Forecast Small Satellite Constellation A (HJ-1A) in 2011 along with 47 occurrence data of the wild mammal with geographical coordinates. Dynamic changes in landscape patterns due to rapid transportation networks in the eastern suburbs of Nanjing were analyzed first. Then, ecological niche model of Maxent (maximum entropy) was applied to predict a potential habitat for River Deer. Finally, impact of this rapid transportation network on the predicted potential habitat was determined. Results showed that:

(1) from 2006 to 2011, the rapid transportation network in the eastern suburbs of Nanjing became more complex with road density increasing from 1116.27 to 1371.95 m/km^2;

(2) compared with a corridor pattern in 2006, the potential habitat for River Deer in 2011 decreased showing a bird cage effect which resulted in a fragmented forest island spatial pattern;

(3) also, distance to roads and distance to settlements were the two human disturbance factors which determined the suitable probability of potential habitat for River Deer.

It can be inferred from the paper that rapid developing transportation network is the enforcing factor leading to the habitat fragmentation of wildlife in suburban areas. Therefore, ecological corridors between open green lands of Purple Mountain, Qinglong Mountain, Tang Mountain in study area should be established to mitigate the negative impact of transportation on the wildlife habitats.

a42 Habitat fragmentation due to mining activities: a case study of Izmir

Farzan Azarpour, Işın Barut

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Mining activities cause the construction of roads which change the natural landscape. Roads are regarded as the biggest reason of habitat fragmentation because of creating structural barriers in the natural landscapes. Generally, mine roads cover more area than mine core zones and decrease the accessibility of landscape. This study presents the effects of mine roads on landscape ecology by focusing on one of the ecological landscape indicator of habitat fragmentation. Better understanding habitat fragmentation means better understanding the survival of natural habitat. The case study area was chosen from the mine sites of Izmir city, Turkey. The aim of this study is to create awareness about the effects of mining activities on natural habitats. The objectives are to designate the negative effects of mine roads and to map them in forested landscapes for visualizing the landscape fragmentation. Landsat TM images, Google earth maps, 1/25.000 scale topographic maps are the materials of this study. The method is to digitize the mine areas with the roads surrounding and to digitize the neighborhoods especially natural landscapes that host to the different species by using ArcGIS-10 software. Results of this study show that mine roads cause habitat fragmentation more than the mine core area because of sprawling into the bigger area. Roads create a kind of structural grid barriers, besides that mine core areas cause perforation in the landscape. This study presents planning proposals to reduce the negative effects of mine roads on habitats. Phytoremediation and fauna passage techniques are designated planning proposals for this study.

a43 Building Bridges for Landscapes & Learning: The ARC International Wildlife Crossing Design Competition

Nina-Marie Lister

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This paper will present the process, relevance and results of a recent international design competition for a wildlife overpass in Vail Colorado, with applications to other sites in North America's transborder Rocky Mountain ecosystem. Inspired by the precedent-setting crossings in Banff, Alberta along the Transcanada Highway, and based on a decade of data collected from these and various European sites, the competition sought to advance the design of wildlife crossing infrastructure and the larger goal of landscape connectivity. Initiated by the work of Dr. Tony Clevenger and supported by the Woodcock Foundation, along with a diverse range of agency and non-profit partners – including the Colorado Department of Transportation and Parks Canada – the ARC Competition opened a new role for collaborative research and design applied to highway infrastructure, along with associated opportunities for landscape architecture, habitat design and conservation planning, environmental engagement, and learning. As such, there are a range of opportunities and challenges for ecologists and designers whose work is associated with this emerging typology of infrastructure. As the world's first international design competition for wildlife mitigation structures, the ARC competition solicited entries from international, interdisciplinary design professionals for innovation in feasible, buildable, context-sensitive and compelling design solutions for safe, efficient, cost-effective, and ecologically responsive wildlife bridges. In doing so, the ARC competition has raised international awareness of a need to better reconcile the construction and maintenance of road networks with wildlife movement specifically, and with landscape conservation more broadly. An emerging critical priority for both transportation and natural resource agencies is to make North American highways safer for both drivers and wildlife. At the same time, roads have been acknowledged as a major obstacle to landscape connectivity and ecological vitality – a matter of growing concern as climate change portends increasing wildlife migrations. In this context, the continent's road systems pose a significant threat to the long-term health and viability of North American wildlife populations. The four inter-related objectives for the ARC competition were to: • Provide an avenue for international teams of design professionals to address new design challenges in the coalescent issues of road transportation safety, structural engineering, wildlife conservation and landscape ecology; • Explore creative new approaches, materials, and designs that address the fundamentals of transportation engineering and ecology; • Increase the number of potential solutions for cost efficient, innovative crossing designs that can be adapted for widespread use in other locations; and, • Engage design professionals in the interdisciplinary nature of road ecology with a real-time, in-situ application on the I-70 near Vail Colorado– a priority site for a wildlife crossing, under the jurisdiction of the Colorado Department of Transportation.

Focused on an international and interdisciplinary design competition that has resulted in 5 precedent-setting, innovative designs for wildlife bridges, the ARC competition highlights both the literal and figurative idea of "Building Bridges". Emphasis will be placed not only on the bridge design concepts developed through the competition, but on the metaphorical bridges built between wildlife and road ecology, transportation policy and the design arts, as well as the partners and stakeholders involved, ranging from ENGOs to government agencies on both sides of the Canada-US border.

a44 Wild x-ing

Tiffany Beamer

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OLIN is submitting as part of the ARC "Building Bridges for Landscapes and Learning" lecture/workshop session proposal put forth by Nina-Marie Lister. Bridges eliminate barriers and offer opportunities, not only to the possibilities of the other side, but to a physical and metaphorical vantage point from which to see where one has been and where one is going. They are iconic, powerful structures that symbolize a society's willingness to reach beyond their own borders, acknowledging the extensive nature of living systems. The ARC competition was an opportunity to explore the convergence of wildlife conservation, landscape ecology, transportation safety and structural engineering. As infrastructure that promotes connection, a bridge is paramount in the creation of a sustainable environment. At the intersection, where the imposition of static systems (roadways), on natural systems (wildlife migratory patterns) occur, adaptability and resiliency are the key to mutual success. The crossing will link two opposite sides of a major man-made thoroughfare, and in doing so, reconnect a greater, dynamic system – forming a union of structural efficiency and landscape complexity. The beauty of Landscape is in its extreme scales – it is both a broad horizon view (a larger infinite system unable to be perceived in its totality) and a mosaic of smaller components (ecotones and other discernable elements) that comprise a greater whole. Wild x-ing is inspired by both a geometry greater than itself and the adaptability of finite pieces of that larger form to changing conditions. This applies to both the structure and form of the bridge, and the landscape that inhabits it. Wild x-ing utilizes a universal diagrid structural geometry that is populated by rhomboid-shaped habitat modules. These modules are identical in shape and size, planted according to local ecological needs and are adaptable and reusable. Our wildlife crossing acknowledges the dynamic relationship between plant communities and the wildlife that thrive within it. The modular structure of the crossing supports a variety of plant communities that are ecologically responsive to current and future conditions. By acknowledging and linking the migratory patterns of local mega-fauna (creating ecotones that inform a feeling of safety and "normalcy"), we can increase the potential for crossings and inform a positive outcome. Wild x-ing will become the new standard for wildlife crossings across the nation.

a45 Hypar-nature: Design for an Efficient and Elegant Wildlife Crossing Structure

Robert Rock, Ted Zoli

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This submission is linked to the ARC WIldlife Crossing session previously submitted by Nina-Marie Lister. This presentation would feature the winning competition design created by the HNTB and MVVA Team and would be presented by the team's lead structural engineer and the team's lead landscape architect. While our winning design, "Hypar-nature" was anchored by the West Vail Pass site in the state of Colorado, the larger goal for our team was to develop an integrated approach to grade-separated wildlife crossing that is modifiable, scalable, and adaptable to diverse sites, with pragmatism and parsimony at its core. Rather than allowing the primarily visual, aesthetic drivers of landscape design to determine form, the design is inspired by the demands of ecological engineering. Instead of attempting to recreate the surrounding nature, the design distills the adjacent landscapes and habitats, condenses and amplifies multiple landscape bands (Forest, Meadow, Shrub, Scree) across the structure, and then extends these bands into habitat corridors that provide connections for a larger cross-section of species. The structure itself is composed of modular precast concrete hyperparaboloid forms that allows for minimal site disturbance and easy creation, assembly, and deployment, and can be expanded or adapted as migration pressures dictate. By combining a flexible structural solution with an adaptable approach to broad landscape management, the design concept offers a new vision for addressing habitat fragmentation. The flexibility and efficiency of the bridge's structural component makes it extremely suitable for widespread use, and its minimally invasive construction allows it to be adapted to any location. In order to address the complex conflict between roads and wilderness, three-dimensional solutions are required. The "Hypar-nature" design concept untangles the conflicting demands of human and animal transportation by bridging both under and over the road, by layering both driver experience and animal preferences, and by pursuing an adaptable framework for both vegetal and structural systems. In this new prototype of landscape and structural collaboration, the performative ground can extend from a light-touch footing to a regional land management strategy. Furthermore, this design is meant not only to physically stitch together a fragmented habitat, but also to unite the various constituencies that will ultimately be responsible for the success of preserving the Rocky Mountain wildlife. Success lies in the connection with the general population that can be attained through outreach and education. By creating a more accessible digital platform the intent is to allow the public to engage with the science of ecosystem adaptive management, the design would work toward a shift in society's approach to operating in wild lands. In our talk we will describe how the design concept sets a framework for the re-establishment of contiguous wildlife habitat and the mitigation of transportation safety concerns while meeting the rigorous technical challenges such a structure represents.

a46 Landshape Modular Constructions of Wildlife Crossings

Rob Torsing

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In 2010 the American company ARC held an international competition to design a series of 25 wildlife crossings to connect the southern and northern Rocky Mountains. Zwarts & Jansma Architects, in collaboration with OKRA landscape architects, Iv-Infra, and Sjef Jansen Plan Ecology, submitted a joint entry to the competition. The multidisciplinary team won one of the five finalists' places with their "Landshape" design. For the designers and ecologists, the main challenge was to design a series of wildlife crossings that would be buildable, affordable, and adaptable to context. To meet the set criteria, the team members made an important technical invention. They designed a repeatable, modular structure. For its construction, a flexible formwork was developed, which can be used to create variable shells. The formwork is made of cable nets, over which a fabric (textile membrane) is placed. Its unique property is that the cable nets can be re-used again and again in varying forms. The ecological composition of an area is the decisive factor in the composition of a wildlife crossing. The most important organizational feature of the architecture is the extrapolation of existing curves in the landscape. With "Landshape", the team produced a physical entity that connects culture and nature. In fact, the two worlds literally merge in this design.

a47 Revised handbook for designing fauna passageways

Jeroen Brandjes, Hans Bekker, Greet Eijkelenboom, Dennis Wansink

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In 1995 the Dutch Ministry of Transport, Public Works and Water Management published the first handbook for designing fauna passageways. In the following years a large number of passageways were realized and monitored, which improved our knowledge about the design, the construction and the actual use by animals. In 2005 the handbook was revised, based on COST 341, the European Handbook about Wildlife and Traffic.
Six years later a new update was necessary, with new information, but also a new approach towards the procedure of designing and building fauna passageways. Nowadays the Dutch ministry as well as most engineering companies work according to the procedures of Systems Engineering, when designing and building complicated constructions. Work on infrastructure is usually complicated because many stakeholders are involved. The new handbook should fit better with the procedures of Systems Engineering. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs. So, before designing and building a fauna passageway the needs of the users must be known. The most important users of fauna passageways are of course the fauna. Other user groups are maintenance personnel and occasionally local traffic (e.g. farmers and recreation). In the new handbook we focus primarily on the fauna, although we also mention requirements for maintenance and monitoring of the use of fauna passageways. Another characteristic of Systems Engineering is the iterative way of working towards a solution. Going from a general outline of the problem and possible solutions to increasing more detailed descriptions with each step. At every step new information is added resulting in a new proposal for a solution. The new information can be about the target species, landscape characteristics, needs of stakeholders (like the owner of the land where the passageway is built), characteristics of the material used, related infrastructure (railroads, waterways), etc.
For a handbook it is not feasible to present fauna passageways that meet the needs of all (local) stakeholders and can be applied at every location. However, most handbooks give examples of fauna passageways and these are often copied and, with some small adaptations to the local situation, built. In the new handbook we try to prevent this from happening. We describe how animals move through the landscape and in accordance with Systems Engineering we translate this into requirements for fauna passageways. We did this for all species that are considered as target species for fauna passageways in the Netherlands. The result is a table with basic characteristics of the passageway for each target species. Together with information about the local situation and the needs of other stakeholders a constructor can compose a proposal for a fauna passageway that fulfills these requirements and fits best to the local situation. We believe this procedure will lead to more new and creative solutions to overcome the conflicts between fauna and infrastructure.

a48 Ecological Infrastructures: Re-Connecting the North American Wilderness

Scott Foster Bishop

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As economies have globalized and production modes in the US have shifted from manufacturing to distribution and delivery, large-scale infrastructures such as highways, railways, air corridors and shipping lanes have continued to expand to support these global networks of exchange. The consequence, however, is the fragmentation of the wilds of North America. Coincidentally, our understating of the importance of ecological systems has changed the scope of design and urbanism from serving the needs of our species alone to one that must consider a much broader and diverse agenda. Scott, a landscape architect, will present a series of multi-scaler mappings, analysis and iterative modeling, that has grown out of design research first undertaken in the studio he directed at the Boston Architectural College. The work explores how to hybridize ecological, infrastructural, and urbanistic agendas in the creation of wildlife crossings that bridge the territories between Interstate 70 and the proposed light rail line between Denver and Vail, Colorado. The objective of this design research is to expand the scale of analysis for wildlife crossings beyond the site of the crossing (bridge) and to look at how other infrastructures and networks, which are seemingly disparate, can be utilized as armatures to facilitate different types of movement across territories and ultimately change the detrimental dynamic that is set up between human transportation and wildlife movement. The research that is presented is a culmination of work that was developed in a design studio environment. The studio utilizes GIS, global modeling and 3D software. As specific proposals were developed, students continued research on the parameters of their chosen infrastructural systems and utilized both digital and analogue means to represent their proposals. While the exploration of this work continues, it is clear from many of the proposals that expanding the territory and approach of wildlife crossing can alter our approach and thinking about the relationship between humans and wildlife and that approach can have beneficial impacts that stretch beyond the border of the roadway.

w5 Vision 2050 - towards an ecologically sustainable transport system

Lars Nilsson, Andreas Seiler

Roads and railroads we plan and built today are intended to meet current as well as anticipated transport demands in the near future. We often overlook however, that these infrastructures will affect our environment directly and indirectly over a much longer time. Environmental mitigation is, mostly re-active and conservative and does rarely prepare for accumulating future impact. How do we envision an efficient and environmentally sustainable transport system that integrates landscape ecological values, habitat connectivity and biodiversity concerns with traffic safety, social and economic constraints? What are likely scenarios, environmental risks, and opportunities for improvement given the current strategies in transport policy, infrastructure upgrading, and trends in technical development and traffic planning? Other factors that will shape Europe's transport system are changing provisions for car fuel, necessary climate adaptations in infrastructure and a progressing urbanisation.

At this workshop, invited guests will present a brief introduction to their perspectives on a sustainable transport system and discuss these implications with the audience. Hereby, we hope to initiate a discussion that continues after the conference and can be addressed again in coming IENE events.

a49 Implementing biotope networks in highly fragmented landscapes: A forest corridor system for the European wildcat with a European perspective

Burkhard Vogel, Thomas Mölich, Nina Klar, Friederike Scholz, Mark Hörstermann

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From a global perspective landscape fragmentation by expanding road and railway networks, urban sprawl and agricultural industrialisation belongs to the main factors responsible for the ongoing loss of biodiversity, especially throughout central Europe. To counteract this process, the German environmental group Friends of the Earth Germany/BUND started a comprehensive project on biotope networking called 'A Safety Net for the European Wildcat' in 2004. European wildcats (Felis silvestris silvestris) are dependent on old deciduous and mixed forest habitats interspersed with clearings and edge structures and suffer heavily from habitat loss and fragmentation. Human persecution remained another problem for wildcat populations until the beginning of the 20th century. As a consequence of both processes, the species has disappeared from large parts of its original habitat. Remaining populations in central and southwest Germany are genetically distinct by a variety of landscape barriers such as highways or vast agricultural areas. Overall aim of the project is the development of 20,000 kilometres of migration corridors for the European wildcat in close collaboration with government authorities, landowners and other stakeholders such as hunters and farmers. Under the BUND initiative, connectivity between existing and potential wildcat habitats will be restored through the planting of trees and shrubs along these migration routes. Furthermore, the construction of wildlife crossings is enhanced by the project through intensive lobby work. Migration routes were calculated by combining a comprehensive wildcat habitat model based on telemetry data with cost-distance analyses (http//:wildkatzenwegeplan.geops.de). Although the wildcat is the target species of the initiative many other species benefit, thereby improving the health of entire forest ecosystems. Since 2004, several corridors have been realized in Thuringia, Lower Saxony and Rhineland-Palatinate. Five new corridors are scheduled. Another pilot project focuses on the improvement of wildcat habitat patches by applying special forestry management strategies in order to strengthen wildcat source populations. Furthermore, an open database with wildcat DNA samples from 16 monitoring regions throughout Germany will be established. Using this data base, a variety of genetic analyses on landscape genetics and wildcat population structure will be conducted. The further development of international collaborations to establish an European biotope network across borders is another important focus of the project in the long term.

a50 Connecting wilderness areas

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The German federal government has decided to build up a system of wilderness areas in Germany comprising 2 % of the total surface of the country. It will be a long way to achieve this ambitious task. Wilderness areas are natural or seminatural habitats without any form of landuse or management, able to develop without obstruction. In Central Europe, they will eventually develop towards jungle or some type of autochthonous forests. The Brandenburg "Wilderness Foundation" (Stiftung Naturlandschaften Brandenburg) is the owner of some 13 000 ha of land, most of this land has been former military training ground, which statutory will become wilderness. Target species in wilderness areas are mainly forest dwelling shy animals such as Red deer (Cervus elaphus), Gray wolf (Canis lupus), Eurasian otter (Lutra lutra) and among several bird and bat species. As other valuable habitats everywhere in the world, wilderness areas are isolated patches in the intensively used landscape holding but small populations of the target species. They are exposed to several external effects from intensive landuse and suffer from structural barriers such as highways, canalized rivers and railroad tracks. The aim of the ecological corridor of South Brandenburg is to create a network of valuable forests including a system of natural forest edges and wetlands that allows the migration of the above named animals. A 20 year lasting project has been brought on the way to establish the necessary structural components to overcome the isolation and barrier effects. Various measures are taken including the renaturation of watercourses and the construction of wildlife overpasses and tunnels. The long-term objective is to establish a large ecological network stretching from the Elbe-river and the borders of Saxony-Anhalt to the German-Polish border and beyond.

a51 Measures aimed at the defragmentation of the federal trunk road network in the state of Brandenburg, Germany

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The state of Brandenburg, in the north-east of the Federal Republic of Germany, is amongst the largest of Germany's 16 states. Brandenburg is responsible for the planning, construction, operation and maintenance of some 3,600 km of federal trunk roads and 5,800 km of state highways. In many places, the heavily trafficked federal trunk road network, comprising around 800 km of federal motorways and 2,800 km of federal highways, represents an almost insurmountable or lethal barrier to wildlife. The adverse impacts, including habitat disturbance, reduction and isolation and the associated loss of biodiversity, are well-documented. In February 2012, this prompted the Federal Cabinet to adopt the Federal Defragmentation Programme, the core element of which is an investment programme to build a total of 93 wildlife passages on key sections of the German federal trunk road network prioritized for defragmentation. Nine of these measures are scheduled to take place in Brandenburg. Ahead of the Federal Defragmentation Programme, as part of an economic stimulus package adopted by the Federal Government in January 2009, five additional wildlife overpasses over federal motorways had already been planned in Brandenburg. Two of them were built during the programme's short two-year life span, and also support the "Ecological Corridor South Brandenburg" project. A third is currently under construction. A forth is now in the planning process as part of an Infrastructure Acceleration Programme. In 2009, initial results from the "Brandenburg Biotope Network, Wildlife Corridor Section" project provided valuable planning input, helping to reinforce and elucidate the Federal Defragmentation Programme at state level. In 2005, Brandenburg's first wildlife overpass was built over the federal motorway 11, reconnecting habitats that had been separated for nearly 70 years. The crossing structure has been very well-accepted by the wildlife, as impressively documented by continuous monitoring over a planned 10-year period. In recent years, the fragmentation of habitats by roads has become a growing concern, and the planning procedure for new road construction now includes an assessment of the need for wildlife passages as standard. There are currently 5 wildlife overpasses under construction or planned in Brandenburg.

a52 The effectiveness of the Queensland statutory framework in mitigating road impacts on wildlife – The case example of the Flinders-Greenbank-Karawatha bioregional corridor

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This paper examines the effect of statutory provisions at all levels of government on the uptake of barrier mitigation measures in Queensland, Australia. The Flinders-Greenbank-Karawatha bioregional corridor is used as a case example to demonstrate the effectiveness of existing provisions. The Flinders-Greenbank-Karawatha bioregional corridor extends from the southern suburbs of Brisbane, Queensland, through to wooded landscapes approximately 60 km to the south. There are multiple land owners within the corridor and only a portion of the land area is in public ownership. The corridor has been long recognised as significant in the region and is known to provide habitat for a diversity of species including several threatened flora and fauna. The area is also subject to significant and ongoing development pressure, which has included the recent and proposed construction of road and rail corridors. In the past few years there has been a growing interest in the corridor and concerted efforts by State Government agencies to ensure it is protected and managed in the face of development pressures. Some innovative statutory approaches have been employed to protect and enhance connectivity in the landscape and address the adverse impacts of roads. This has been informed by studies identifying priority locations for environmental offsets and barrier mitigation measures. Nonetheless, ongoing development continues in the corridor, including the establishment of the Wyaralong Dam in 2006 in response to a prolonged drought in the region. The dam project, which also necessitated the realignment of an existing road, was assessed by both State and Federal agencies as part of the approval process. In recognition of the habitat value of the area, barrier mitigation measures were conditioned as part of the approval. The existing statutory framework is assessed in terms of ecological impact assessments, approvals and enforcement, and considers whether the process is ultimately successful in protecting wildlife.

a53 The Alpine Carpathian Corridor

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The reinstallation and safeguarding of the Alpine Carpathian Corridor for wildlife migration, located in between the two major cities Bratislava and Vienna, was the main task of this study. This presentation discuss the application of a unique method for a cross bordering top down approach, starting with landscape scenarios. These scenarios are based on different landscape fragmentation states, considering the landscape without road network and the status quo of highways, express roads and existing mitigation measurements. Additionally two scenarios more are established, demonstrating the spatial effect of different locations of green bridges. The differences of these scenarios are discussed not only with qualitative but also with quantitative measurements derived from resistance parameters. In this way the location of new green bridges was also easier to communicate to the project partners of the federal road administrations of Austria and Slovakia and also in the discussions with the local political leaders. The method for extracting wildlife corridors was based on a resistance model for wildlife migration, considering image processing techniques and a refined least cost path algorithm. The main idea of this resistance model was the improvement of landscape connectivity. In the study area red deer and the spatial demand of this species for migration was the main factor for defining spatial rules for the GIS model. With the help of the quantitative parameters a decision for one of the scenarios was fixed. At the next level of the top down approach, the critical areas for wildlife migration were defined, the so called bottle necks. Bottle necks are characterized by an increased effort for wildlife to pass by and also spatial reduction of corridor width. In these bottlenecks the same method was applied but with improved spatial data based on orthofotos, regional planning and field studies. The advantage of this new method was not only the extraction of the migration corridor between the Alps and the Carpathians but also the extraction of the movement matrix in the bottleneck, independent of directed migration. The corridor model of the bottle necks provided the foundation for the spatial delineation of zones by a wildlife expert, considering in that way also aspects, which are hard to define in a spatial model like projected areas of settlement expansions and local characteristics. Three types of zones were defined, the core, the border and the secondary zone. The zone definition was spatially based on parcels and can act as a funding model for safeguarding existing areas and for future implementation in regional planning of the municipalities. The zones width was fixed and not variable. Critical aspects of safeguarding areas for wildlife migration due to different land users will be discussed by wind parks in the corridor zones. The social support of the project output, the bottle necks and especially the zones, was established by a Memorandum of Understanding, school projects and information events.

a54 Habitat connectivity – wildlife corridors in Brandenburg

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Based on an investigation about the permeability of Brandenburg highways, a strategy was built which includes the identification of priority areas of biodiversity (target species, protected areas' networks, landscape corridors), showing networking requirements, defining the priority activity needs for road and rail routes, presenting the cutting-up situation and defining special planning requirements. Specific landscape and land use structures were analyzed to define wildlife corridors for different species and habitat connectivity. The system of multifunctional wildlife corridors is used to identify barriers in the traffic system and the priorisation of crossing supports as well as the reconstruction of green infrastructures. The "Ökologischer Korridor Südbrandenburg" is the model project for the implementation of wildlife corridors in Brandenburg.

a55 Does hunting disturbances increase risk for wildlife-vehicle collisions?

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There is an ongoing discussion whether hunting disturbances increase the numbers of vehicle collisions with moose or not. Disturbed moose are likely to move more and change to undisturbed habitats, which may result in more animals crossing roads. This may be critical for increased collision risk, particularly in densely populated areas with dense road networks and high traffic volume. An alternative explanation for increasing numbers of moose-vehicle collisions during autumn may be that moose change their movement behaviour due to the upcoming mating season when especially males become more active. Previous findings come mostly from populations in sparse populated areas with low densities of roads and moose. To study if hunting disturbances influenced moose rates of movement and times that animals cross roads or if such behaviour is more related to the mating season, we tested for differences in moose hourly movement rates and number of road crossings between end of August and beginning of October. We thus analysed for each moose the movement behaviour before hunting season, during the first week of hunting season and during rutting season. Here, we used hourly location data of GPS-collared moose in a mixed model approach. To evaluate differences among regions, we used data of moose in six different regional areas along a latitudinal gradient of 1,100 km contrasting Southern and Northern Sweden. Preliminary results indicate different impact of hunting disturbances in the six regions, with the timing of onset the annual hunting activity as one crucial factor to consider. Moreover, in some areas the impact of hunting activities may not be detectable due to the increased movement in moose at the upcoming mating season.

a56 Ecological implications of up-grading a minor forest road: Reducing the road effect zone increases the impact

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Although much road ecology research has been directed toward the impacts of large roads, the influence of even small roads can be significant. Numerous studies on the movements of taxa such as amphibians and small mammals have demonstrated clear barrier effects of minor roads often with significant small-scale influences on gene flow. On the other hand, other taxa, including reptiles and rodents, may use such roads to aid dispersal and may be especially abundant along verges. The influence of minor roads, which are often the most widespread of all road types, requires far greater attention. We studied the implications of the up-grading of a minor road through forest on the ground–dwelling vertebrates living beside the road. Gap Creek Road was an unsealed two-lane road near Brisbane, Queensland in eastern Australia. The road connected two suburban areas by traversing a mountainous protected reserve of undisturbed subtropical forest. Because of concerns about driver safety, Brisbane City Council surfaced the road in 2009, but retained the original two lanes. To address the concerns of the local community that the improved road conditions would lead to greater traffic speeds, a series of traffic calming structures were included in the design. We assessed the abundances and diversity of small mammal populations (using baited live capture traps and hair funnels) immediately adjacent to the road and 100 m into the forest for over 6 months prior to the start of construction and for 12 months after. We also quantified levels of dust within the forest on both sides of the road using deposition and real-time techniques. In addition, a community group undertook daily driving surveys of road-kill, identifying all specimens larger than rats. The ground-dwelling fauna was found to be diverse (7 species detected regularly) and abundant (mean of 0.84+0.14 animals captures per trap per night) with little differences in both species richness and frequency near the road compared to way from the road. This was unexpected as the daily dust levels near the road resulting from normal traffic were extraordinarily high, equating to an average of 4.7 mg/m^3 during the day. The level of road-kill was extremely low, and limited mainly to the sections closest to the suburbs. Following the sealing of the road, levels of dust dropped to almost undetectable levels. The effect on the fauna was, however, negligible with no significant differences in trapping rates following construction. The most dramatic effect of the up-grade was on levels of roadkill which increased by 265 %, with 50.6 % being contributed by reptiles. Contrary to expectations, dust levels close to the unsealed road appeared to have little impact on the extent to which small mammals lived beside the road. The direct impact of the sealing of the road resulted in a dramatic increase in roadkill rates, attributable to both the attractiveness of the dark surface to ectothermic species and the demonstrably faster speeds of the vehicles despite the traffic calming structures.

a57 Hotspot maps of roadkills: how important is the sampling frequency?

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In order to minimize the negative impacts of roads on wildlife mortality and fragmentation, ecologists and road managers have been working together on assessing spatial patterns of roadkills, taxa most sensible, and road and landscape characteristics that influence roadkill numbers. Of special concern when analyzing these spatial patterns, is the location of roadkill hostspots, ie. segments of roads with clusters of wildlife mortality. The accuracy in the spatial definition of hotspots is of prime importance not only to conservation biologists, but also to road agencies and planners, as mitigation of roadways is usually expensive. Recently it has been shown that lower frequencies of road monitoring (longer intervals between samplings) may be responsible for losses of more than 50 % of roadkill numbers registered for several taxonomic groups, when compared with a daily sampling. This result highlights the need to account for other possible sources of inaccuracies when monitoring roadkills with varying sampling frequencies. Particularly important is the evaluation of the spatial accuracy of roadkill hotspot locations when different sampling efforts are implemented because inaccurate results may fail to detect "real" roadkill hotspots or can direct highly-cost mitigation measures to the inappropriate road sections. In the present study, we aim to assess the spatial discrepancy of hotspots location using four sampling frequencies (scenarios), and determine for which taxonomic groups is this spatial discrepancy most severe. We used a dataset of a one-year long roadkill daily survey, including 4453 individual records of vertebrate carcasses, for which survival time on the road is known. This dataset was arranged in five data matrices concerning different sampling frequencies: daily sampling (the baseline data), and four scenarios, 2-day interval, weekly, bi-weekly, and monthly sampling. We considered the global species data (all taxonomic groups together) and each of the 13 taxonomic groups considered for the analyses. For analyses, the road was divided in 500-m sections and hotspots were calculated according to Malo's method (using a Poisson distribution). We considered a threshold of 95 % and a corresponding minimum of two observations (road-killed animals) in order to proceed with the analyses. In order to evaluate spatial discrepancy in hotspot location at road sections (presence/absence of hotspot) between daily and each of the four sampling scenarios, we used the Phi correlation. For global data, spatial discrepancy of hotspots increased most from weekly scenario onwards (phi weekly = 0.66, phi bi-weekly =0.61, phi monthly =0.58), while the 2-day scenario had the lowest discrepancy (phi 2-day =0.89). None of the four scenarios produced a hotspot map identical to the one obtained through daily survey, neither with global data nor with separated taxa. Even for the highest correlated scenario (2-day sampling), a different hotspot map was obtained for all studied taxa. Taxa with higher discrepancy in hotspot maps were bats, toads, salamanders, snakes and small mammals. Birds of prey, hedgehogs, carnivores, and lagomorphs had the lowest spatial discrepancy in hotspot maps. These results must be taken into account when planning roadkill monitoring programs, specially if we are dealing with small species.

a58 Impact of traffic volume upon distribution of wolves in Poland

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The purpose of this paper is to compare the distribution of wolves in 1990, when the impact of road infrastructure was low and wolf was a game species with distribution in 2010 when there were more motorways and higher traffic volume, but the wolf has been protected species for 12 years. We have obtained records on wolf distribution from 431 forest districts and 23 natural parks. Comparing to 1990 number of locations that had wolves increased from 170 to 182. However in the past 20 years wolves disappeared from 48 locations, but appeared in 60 new locations where they were not present in 1990. We assigned changes in wolf locations to administrative province of Poland. The integrated traffic volume index (ITV) was calculated separately for each province. It represented an average provincial traffic volume (PTV i. e. cars per day/km^2) times annual rate of PTV increase. The integrated traffic volume index (independent variable) was correlated then with rate of change in number of wolf locations (Nt+1/Nt) between 1990 and 2010. Significant relationship ($r = - 0.70$, $p = 0.012$) between integrated traffic volume and wolf distribution was found. Data on 63 road accidents involving wolves showed that wolf mortality is related both to traffic volume and the population density.

a59 The biological and environmental factors implied in the number of bird casualties on motorways

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The movements of birds and the induced distribution of bird casualties on motorways are influenced both by biological characteristics and by environmental factors. One can consider species-specific characteristics such as density, flight initiation distance (FID), learning ability, wing shape, diet or migratory behaviour, and environmental factors such as landscape structures, vegetation of verges, traffic intensity, or road elevation. This study intends to determine which biological and environmental factors influence the number of bird fatalities on motorways, especially for Passeriformes and Strigiformes which are the most frequently killed among the birds.

Study areas:
3 motorways in South-Western France, totalizing 221 km, in 2007-2009.

Method:
five successive counts of bird carrions, during 2.5-days surveys, were made each season by car driven at 40-50 km/h-1 on the safe lane. Species-specific traits were considered only for the Passeriformes and were taken from the literature, except the learning ability. The latter was estimated as the ratio of the number of bird recaptures divided by the number of first captures during bird ringing surveys (data of French Muséum National d'Histoire Naturelle). Road elevation (raised, sunken, level, mixed) and vegetation structure of verges (grass / shrubs / trees / artificial, in % surface) were recorded on 100 x 20 m sections, from car and from aerial photographs (BDOrtho®). Soil cover was evaluated with Corine Land Cover 2006. The influences of environmental and species-specific factors on the number of casualties were analysed separately using GLM.

Results and discussion:
The Passeriformes species the most impacted by traffic were the Blackbird Turdus merula, the European Robin Erithacus rubecula, the Song Trush Turdus philomelos, the House Sparrow Passer domesticus and, more marginally, the Blackcap Sylvia atricapilla. The numbers of fatalities of the species were only significantly influenced by their density and by their FID, the species with shortest FID being the most likely to be killed by traffic. Passeriformes fatalities tended to be more numerous on sections whose verges are planted with trees. They tended to be less numerous on sections whose verges have mixed herbaceous / artificial vegetation structure, as well as on sunken motorway sections. The Strigiformes species the most impacted by traffic were the Barn Owl Tyto alba and the Tawny Owl Strix aluco. The Strigiformes were significantly more killed by traffic on sections with mixed verges. Sunken profiles tended to decrease the impact of mixed verges. Neither landscape structure nor traffic intensity had any significant influence on Passeriformes and Strigiformes casualties on motorway sections at a 100 m length scale. Nevertheless, these factors may have an effect at larger spatial scales. Our results suggest that no tree should be planted in verges on motorway sections where bird casualties are concentrated. New motorways should be if possible sunken in such zones or at least bordered with 3 or 4 m high earth berms. Complementary to existing mitigations such as traffic calming, these results will help developing new mitigation designs in motorway sections that concentrate the main factors responsible for bird mortality.

a60 Determining the Location and Design of Measures to Reduce the Adverse Ecological Effects of US Highway 64 in North Carolina, USA

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During the summer months, the Outer Banks of Coastal North Carolina is a primary tourist destination for residents of the mid-Atlantic states and a frequent target of hurricanes. A primary transportation corridor to and from the Outer Banks is US Highway 64. This road represents one of two coastal evacuation routes and has been targeted for widening from 2 to 4 lanes to improve traffic flow during emergencies. The road bisects a network of Federal, State and privately managed conservation areas that provide habitat for black bear, red wolf (Federally endangered species), migratory birds, a diverse assemblage of herpetofauna and numerous other species. Comprehensive wildlife surveys were conducted from April 2009 to July 2010 to assess potential impacts and to make recommendations for wildlife crossing structures and other measures to reduce adverse effects of the proposed widening of the road. Road-kill, track and camera trap surveys provided data on successful and unsuccessful road crossings. Mark-recapture studies were performed at roadside and control locations in differing habitat types for small mammals and herpetofauna to determine presence-absence and potential road avoidance. Lastly, telemetry data was available on red wolf movements in proximity to the roadway. Road-kill data included 27,877 individuals of 113 species. From 31 track stations, 18 different species or taxa from 7,477 tracks were recorded. Total individual animals captured in control and roadside traps included 362 and 1,094, respectively. Diversity of species captured included 20 amphibians, 23 reptiles and 10 mammals. Spatial analysis of field data revealed significant hotspots of wildlife activity. Results of field surveys and landscape analysis were used to determine candidate locations for wildlife crossings including the design and type of structure according to site specifics and target species requirements. Another major factor in the planning of road improvements for US Hwy 64 was the ecological effects of projected sea-level rise based on recent climate change models. This project included active participation and review by a diverse group of stakeholders representing multiple levels of government, private industry and environmental advocates. This project serves as an excellent example of successful integration of long-term transportation and conservation planning.

Tuesday, October, 23

Parallel Sessions 4

Case Studies I
Workshop: Monitoring of Fauna Passages
Amphibians I
Communication I
Verge & Eco-Services I
Roadkill II

Lecture Session: Case Studies I — Room A

Case studies of mitigation in infrastructure projects

Chair: Hans Bekker

This session presents examples of infrastructure development projects where special concern has been paid to remedy adverse effects on landscape and wildlife. It provides insights in real-life solutions, problems and opportunities that are rarely taught in university classrooms.

Workshop: Monitoring of Fauna Passages — Room B

Lessons from monitoring of fauna passages: Implementation in construction – challenges, problems and new outcomes

Chairs: Mathias Herrmann & Nina Klar

Measures of mitigation are often based on theoretical concepts and assumptions. In an early stage of the process this enabled us to put measures into practice as soon as new traffic infrastructures were realised. Nowadays there are numerous such measures implemented and could be studied as examples. But still assumptions and short oral communication is guiding people implementing mitigation measures. In this workshop we will discuss advantages and disadvantages of passages monitored. Particularly the effect on species not much known will be in the focus. We studied the acceptance of measures taken to reduce the barrier effect of roads in several field studies in Germany.

Lecture Session: Amphibians I — Room C

Amphibians and transportation infrastructure
Chairs: Miklos Puky & Tom Langton

Lectures in this session address the efficacy of small tunnel and fence systems for small vertebrate connectivity on road and rail transport corridors, their design and monitoring options. The aim of the session is to summarise the state-of-the-art in this field and give a further impetus to international co-operation.

Lecture Session: Communication I — Room D

Communication, education and public involvement
Chair: Mark Hörstermann

Public involvement in road ecology work is a promising tool to both obtain important empirical data and increase awareness of and acceptance for wildlife mitigation measures. This session presents new approaches and examples of such activities.

Lecture Session: Verge & Eco-Services I — Room E

Verges and ecosystem services
Chair: Heinrich Reck

Areas linked to transportation infrastructure can provide important refuges for wildlife and exert valuable ecosystem services, if designed and managed correctly. Infrastructure habitats thereby complement and extend other, more natural, corridors in the landscape and can also be essential for the efficacy of other mitigation measures. This session present various examples of the so often underestimated potential of infrastructure habitats.

Lecture Session: Roadkill II — Room F

Traffic induced mortality in wildlife and mitigation approaches
Chairs: Clara Grilo & Victor Colino-Rabanal

Mortality in wildlife induced by traffic on roads and railroads is recognised as a growing threat to species conservation and biodiversity. This session presents a variety of studies revealing spatial and temporal pattern in traffic induced mortality, its correlates and factors; and discusses possible mitigation options.

a61 Using Team of International Experts to Aid in Developing Green Infrastructure Strategy for Connecting Wildlife Corridors in State of Uttarakhand, India, to Ensure Long Term Survival of Asian Elephants and Tigers

Terry Martin McGuire, Aditya Singh, Hans Bekker, Bjørn Iuell , Sandra Jacbson, Terry Brennan

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India is one of 13 countries in Asia that is the homeland to Asian elephants (Elephas Maximus) and holds the largest population of Bengal tigers (Panthera tigris tigris) in the wild. Being large distance migratory animals, they need relatively larger forest areas to survive. Shrinking habitat due to demographic pressure and fragmentation due to development of linear infrastructure and rapid urbanization in India is pushing the population of elephants and tigers to the wall. This subsequently manifests itself in increasing incidences of conflicts with humans, inbreeding, low reproduction, internecine fights between male elephants and territorial fights amongst tigers. The creation of the State of Uttarakhand, India in November 2000 has resulted in the Centre and State governments taking up infrastructure development activities at a large scale and fast pace to make the State self reliant and sustainable. These activities are resulting in fragmentation of elephant and tiger habitat by blocking existing narrow connections and critical corridors, resulting in isolated populations in different regions. The age-old contiguous forest landscape from River Yamuna to River Kosi in Tarai Arc landscape in the Himalayan foothills of northern India in Uttarakhand is now fragmented in many isolated zones. The forest range from River Yamuna to River Kosi is bisected by national and state highways, rail lines and wide and deep fast flowing hydroelectric and irrigation canals at many locations. The existence of these ill-planned linear impediments has adversely affected elephant migration. Their free migration across River Ganga and along their historic corridors within the landscape has been badly disrupted, compelling them to be confined to unsustainable smaller areas. It has also stopped the dispersion of tigers from more densely populated areas to areas having zero population. In December 2011, an international team of experienced road ecologists, wildlife biologists and highway engineers familiar with mitigating the effects of linear corridors on wildlife movement through the use of green infrastructure were invited to India by the Forest Department of Uttarakhand and NGO Wildlife Savers Society. Their task was to review and assist in developing a green infrastructure strategy to address the situation. This is a report on their efforts in reviewing the problems arising out of this habitat fragmentation; the appropriateness of green infrastructure solutions being proposed; consensus on both long and short term appropriate eco-friendly measures as well as bringing about awareness and education amongst stakeholders regarding mitigation measures necessary to save and protect these wild Asian elephants and tigers from extinction. In addition, areas of further study and research were identified including determining carrying capacity of the various landscapes for tigers and elephants; identifying the key problem areas for the movement of wildlife and prioritize the strengthening of wildlife corridors to ensure connectivity for the long term survival of elephants and tigers in the landscape.

a62 A bridge too far?

Raymond Tilmans

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The Province of Limburg (the Netherlands) is planning to construct a new highway: the "Buitenring Parkstad Limburg", an outer ring road forming a complete ring around the Park City Limburg region. This 26 kilometer ring is to become a full-fledged freeway with four lanes and a 100 kilometer per hour maximum speed. Construction work includes the improvement of provincial roads and addition of new sections. Without sufficient mitigation and compensation measures the construction and the use of the outer ring will have a big impact on the environment. The ring is planned in two Natura2000 areas: "Brunssummerheide" and "Kathagerbeemden", each already fragmented by an existing two-lane 80 kilometers highway. The Outer Ring Parkstad Limburg planning generates a lot of debate. Advocates argue that the significant improvement of the connections on the (inter)national and (inter) regional connecting roads substantially improves the flow of traffic, which is beneficial to the accessibility of Park City and road safety in the region. The highway is also an important contribution to the spatial structure of Park City, the living environment of residential areas and the economic and tourism development opportunities within the region. Opponents are arguing that the population in Park City will shrink in the coming years and thus the traffic will decrease so the outer ring is unnecessary. They also point out the damage on the environment despite of mitigation and compensation measures that were already foreseen. On December 7, 2011, the State Council rejected almost all objections of opponents including those on environmental grounds with the exception of one important aspect: the impact of nitrogen on the nitrogen sensitive vegetations in Brunssummerheide and Kathagerbeemden. The province failed to clarify the exact increase of nitrogen and what proportion this bears to the already existing nitrogen impact on these areas. The Council granted the opportunity to draft a new plan for the ring, taking into account the verdict. This resulted in a masterplan which included a temporary reduction of the speed to 80 kilometers per hour in the surrounding of the Natura2000 areas awaiting the environmental improvement of car engines, hydrologic measures, the purchasing of emission permits, the buying up of extra farming land (reducing nitrogen surpluses) and the levelling up of a screen near a sensitive vegetation. The most outstanding measure is a 50 meters (over-) dimensioned ecoduct across the Brunssummerheide, which is the only additional measure to encounter the nitrogen impact in this Nature2000 area. The total package of measures to reduce the nitrogen problem will cost 14 million EUR. Besides the already foreseen mitigation and compensation measures there'll be an extra impulse for the environment (6 million EUR). The total costs of the project are now estimated at 402 million EUR. Environmental conservations organizations have already announced they'll again oppose the outer ring including all environmental measures that now are taken extra. The Province expects the next verdict of the Council about March 2013.

a63 Monitoring the effects of the "Egnatia" highway (Section Siatista – Kastoria – Krystallopygi) on wildlife in Greece

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Vehicle collisions have become an important mortality factor for wildlife in Greece - since 1998 when the non-governmental organization ARCTUROS recorded the first fatal bear - vehicle collision, more than 30 bears have died. In 2009 we initiated efforts to study this new mortality source by monitoring the effects of the "Egnatia" highway (Section Siatista – Krystallopygi) on wildlife in northern Greece. During the study we focused mainly on bears and wolfs and used three different methodological approaches: satellite telemetry in order to monitor animal movements, genetic tagging in order to evaluate the genetic status and camera trapping. Within the framework of the study 7 bears and 1 wolf have been fitted with satellite collars, while at the same time genetic monitoring efforts identified 40 different bears in the area and a genetically diverse wolf population. Camera trapping and satellite telemetry revealed that the mitigation structures are used mainly during the evening hours. These research efforts have been carried out concurrently with efforts to genetically monitor brown bears throughout Greece that indicate that this part of the "Egnatia" highway is the converging point of two genetically distinct populations. In view of the urgency of the situation ARCTUROS has drafted management recommendations towards Egnatia Odos S.A. and the relevant state authorities – based also on the results of this study urgent efforts are currently underway so that the "bear-proof" exclosure fence at the sides of the highway is completed as soon as possible.

a64 Application of four wildlife studies to the design of a high speed railway in Spain

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In compliance with the conditions set by an Environmental Impact Statement (EIS) ruled by the National Ministry of Environment (NME), we have conducted four wildlife studies for the design of one 140 km long stretch of a High-Speed Railway (HSR) located at the Castilla-La Mancha region (Spain). The main objective of these studies was to conserve the biodiversity and permeability in the lands crossed by the HSR. To carry out all studies there were similar initial phases like the analysis of applicable laws, the EIS's requirements and varied bibliography. There was also collection of data provided by the Regional Environmental Agency (REA). In summary, the studies included a wildlife mobility study and proposal of protective and corrective measures, which comprised a study area of 1 km each side of the HSR, determinating two working scales (1:50.000 for territorial scope and 1:5.000 for detailed scope), to estimate potential wildlife corridors and important wildlife areas. We checked in situ the wildlife presence and the habitats distribution. We also checked the appropriateness of the location of permeability structures proposed in the original environmental impact assessment. Finally, we considered the synergistic effect of adjacent transport infrastructures. With all this information, it was made an initial proposal of wildlife crossings applying also the type and densities of wildlife crossings recommended by the NME requirements (based on COST 341). So, in the final construction projects were achieved exceptional densities plus additional protective measures, including, inter alia, specific amphibians crossings, adapted work schedule, or the use of innovative measures such as anti-collision bird posts. Our studies also included a steppe birds distribution study, focused on Protected Natural Areas next to the future railway, and especially focused on protected species like great bustard, little bustard, harriers, etc. With this study, a 'maximum use areas' for each species were established, according with the birds phenology, and analyzing different Kernel areas with GIS. The results were used to complement the previously mentioned protective measures. We also carried out a research on the Lynx pardinus presence, checking on-site the feline presence, using various techniques (sampling, photo trapping, etc.) in coordination with a related LIFE project. Then, a biological corridor that would better communicate two historical lynx areas was modeled. The result of this study was the absence of lynx in the study area and the interception of the corridor by the HSR in one point, which applied in improving railway permeability structures. Finally, we drafted a Kestrel colonies rehabilitation project, coordinating with the REA requirements and using the steppe birds data. We made a final selection of two colonies according to the kestrel population and the technical criteria of the buildings where they are located. Then we proposed the guidelines for the works to perform in the colonies rehabilitation, including costs, nest boxes characteristics, etc. This studies can be used as example of the feedback and coordination between the consultant, the promoter, and the REA to achieve the effective implementation of the studies's results in the design of the railway line.

w6 Lessons from monitoring of fauna passages: Implementation in construction – challenges, problems and new outcomes

Mathias Herrmann, Nina Klar

Measures of mitigation are often based on theoretical concepts and assumptions. In an early stage of the process this enabled us to put measures into practice as soon as new traffic infrastructures were realised. Nowadays there are numerous such measures implemented and could be studied as examples. But still assumptions and short oral communication is guiding people implementing mitigation measures. In this workshop we will discuss advantages and disadvantages of passages monitored. Particularly the effect on species not much known will be in the focus. We studied the acceptance of measures taken to reduce the barrier effect of roads in several field studies in Germany.

a65 SAIA - a management tool for assessment of road effects on amphibian populations

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In many parts of Europe, urbanisation and intensive land use have reduced and fragmented the natural habitats of the Moor frog (Rana arvalis). Thus, the Moor frog is one of the many species listed in the Annex IV of the EU Habitat Directive. We have developed a spatially explicit model, SAIA (Spatial Amphibian Impact Assessment), to be used as a standardized and quantitative tool for assessing the effect of habitat changes on protected amphibians. The project is funded by the Danish Road Directorate and the model will primarily be used for evaluation of the possible impacts of new road constructions. As model species we use the Moor frog, but the model can be extended to other amphibians with similar life history and ecology. Regional population of Moor frogs is assumed to follow a pattern of metapopulation dynamics, with colonisation, extinction and recolonisation of suitable habitat patches. Thus, road constructions must be expected to have implication on both local and regional persistence; the former due habitat destruction, the latter because of disrupted dispersal between subpopulations due to barrier effects. The model considers a landscape mosaic of breeding habitat, summer habitat and uninhabitable land. As input we use a GIS-map of the landscape with information on habitat type, habitat quality and altitude. In addition, data on observed frog populations in the survey area are needed. The seasonal migration of adult Moor frogs and the dispersal of juvenile froglets are simulated by means of individual-based modelling, while a population-based model is used for simulating long-term population dynamics. In combination the two types of models generate output on landscape connectivity, migration routes and population viability. Within the metapopulation framework subpopulations are assumed to inhabit one, continuous and homogenous habitat patch. However, in highly fragmented landscapes this premise may not hold true. Instead, a local population of pond-breeding amphibians often occupy a cluster of disjoint summer habitat patches and breeding ponds interspersed with an agricultural/semi-urban matrix. Individual based modelling allows us to integrate the spatial structure of both habitat patches and matrix into our connectivity measure and viability analyses Analysing maps without the planned road constructions constitutes a "null-model" against which other scenarios can be compared, making it possible to assess the effect of road projects on landscape connectivity and population dynamics. Analyses and comparisons of several alternative road projects can identify the least harmful solution. The effect of mitigation measures, such as new breeding ponds and wildlife passages, can be evaluated by incorporating them in the maps, thereby enhancing the utility of the model as a management tool in Environmental Impact Assessments. In this talk I will present SAIA and demonstrate the results from its use on some Danish road projects.

a66 Tunnel systems and fence maintenance, evaluation and perspectives in citizens science

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Wildlife tunnels, amphibian tunnel systems green bridges and fences are used on a large scale to mitigate the environmental impact of existing and newly created roads on amphibians and reptiles in the Netherlands. Maintenance of these tunnels and fences is often neglected, which has serious effects on local amphibian and reptile populations. RAVON evaluated both the construction errors and the state of maintenance on 24 representative locations with 63 tunnels. The majority of these systems were, because of the poor state of maintenance not functioning effectively. Cross roads are often not protected, which leads to many road victims at crossings. The diameter of tunnel systems in general is too small and the size should be adjusted better to the length of the tunnel. Many fences were in general in very poor condition, overgrown with vegetation or damaged by cars or mowing equipment. It is often not clear which organization or local authority is responsible for the maintenance. The survey and evaluation was the basis for the development of an online checklist. This checklist is linked to a rating system for each tunnel, which provides a quick overview of the current state of maintenance. The checklist is incorporated in www.padden.nu, the online community for Dutch toad patrols. More than 80 toad patrols and hundreds of volunteers collect valuable data on amphibian hotspots on roads. The website has proven to be a successful instrument in stimulating public awareness and the project has also generated several spin-off projects in urban areas. The standardized collected data from this citizens science project are used for planning of new mitigation projects (tunnels and green bridges). Green bridges often seem to be a better but also more expensive alternative than tunnel systems. They are less likely to be damaged and provide structural solutions for many years. In the past 8 years over at least 25 new green bridges were constructed in the Netherlands, which function as corridors for mammals, amphibians and reptiles. The do's and dont's will be summarised and are usefull for other European conservationists.

a67 Amphibian road crossings and a 5 year monitoring of a tunnel system for Triturus cristatus in the UK

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Here we present results from two projects related to amphibian road crossings in the UK. Since its start Froglife has been very actively involved in Toads on Roads, a project aimed to prevent amphibian (especially toad) mass mortalities caused by road traffic during spring migrations. This work is carried out by a large number of volunteer groups (Toad Patrols) which rescue amphibians from drains and ditches and by moving them across busy roads while at the same time collecting important data on amphibian numbers in their local areas. Currently around 70000 animals annually are rescued from UK roads by more than 250 groups of volunteers and a total of 879 crossing site have been recorded. Data collected since 2000 suggests that at least 19 toad populations may have become extinct in England but identifying national and regional trends is a complex process as amphibian populations typically have important annual variations. We present data on local and regional trends as well as well as a preliminary analysis of local extinctions. Froglife manages Hampton Nature Reserve, possibly the largest population of Triturus cristatus in Europe with an estimated 30000 adult individuals. Part of the work is a 5 year monitoring of a tunnel and fence system connecting two parts of the reserve which have been separated by a new road. The system comprises 2 large ARCO tunnels (2.5 m high x 5.5-6 m wide) as well as a 50x50 cm ACO tunnel. Here we present 5 year annual monitoring results demonstrating that while the system successfully connects the newt metapopulations separated by the road there is very important variability in annual tunnel crossings, probably influenced by weather conditions. Between 10 and 113 newts were annually trapped in the tunnels in different years with newts successfully crossing from both sides of the road. We suggest that such monitoring studies need to be carried out over a long period of time (5-10 years) and should include data from before the tunnel system has been emplaced in order to accurately verify their success.

a68 Towards international standards for small and micro wildlife tunnel and fence systems

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In an ideal world, busy roads would have plentiful green bridges and large underpasses, with robust fencing keeping wildlife movements and traffic apart. However in most European countries we have a deficiency of measures in existing roads and still inadequate fitting of wildlife crossings in new roads. In order to optimise any future government expenditure, careful analysis is needed to guide effective future planning. We need to more precisely define the purpose of connectivity solutions and to design systems to fit each situation; this might even include species that could be reintroduced into an area and shifts in local distribution due to climate change – one of the iene essential considerations. Nine catagories of landscape type are proposed for future evaluation of needs and this may have some value in prioritisation and partitioning future research aims. A detailed analysis of small and micro (1.0 metre or smaller) tunnels has been conducted in Western Europe and North America with emphasis on amphibians and reptiles and small mammals. The influence of tunnel conditions including light levels, temperature, moisture and humidity, tunnel base substrate and tunnel and fence construction materials and dimensions is discussed, using examples from North America and Europe. Sixty years of anecdotal and quantitative information is reviewed as are the guidelines issued by national governments and regional administrative bodies.

Although monitoring of tunnel and fence use has not been conducted to any great extent, the availability of night cameras now offers a better chance of sampling system efficiency for nocturnal species and for assessing tunnel acceptance rates in a similar manner to that achieved with larger vertebrates using underpasses and green bridges. Future monitoring protocols are considered both to help design more effective systems and as a part of international research objectives that may allow a better understanding of the extent to which such systems prevent fragmentation or assist with defragmentation. Concern about the fitting of only 'tokenistic' crossing facilities in the worst places for wildlife vehicle collision is a genuine one. Experiments must lead to a learning process that refines structures to optimal designs. There is need for clear standards in approaching small tunnel designs and in some countries bad practice has been common. Some regional clarity had been brought by the COST 341 (EU countries) and Ministry of Transport USA) exercises, but there is now a need to make further rapid progress. Small tunnel terminology should be standardised and a new handbook for small and micro tunnels is needed with universal principles that are applicable throughout the worlds linear transport systems and that may assist local governments to introduce or refine national standards.

a69 Visualizing Sustainable Transportation: the Art of Building Support for Green Infrastructure through Visualizations

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The deep green designers tool box for building sustainable transportation networks includes strategies like cycletracks, multi-use-paths, green streets, bioswales, living walls and road diets, to name a few. Opportunities abound to integrate human transport with improving stormwater quality, growing healthy urban forest habitats, promoting active lifestyles, improving safety, and creating vibrant street environments in Western Canada and the world. Building support within a locality for green infrastructure projects can be a challenge especially if the intervention and potential outcomes are poorly understood by the community. This presentation will explore the use of visualizations in evaluating and advancing green infrastructure proposals in a multidisciplinary design practice. The discussion will include; an overview of significant Western Canadian transportation and active transportation projects that have used visualizations as a communication tool, key considerations for creating sucessful visualizations, pitfalls to avoid, limitations of the medium, as well as tips for formulating sucessful visual graphics that build excitement and consensus for green infrastructure.

a70 Caminsdefauna.cat: a crowdmap of the ecological connectivity of catalan roads

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Project Description

This project is the outcome of the superposition of three different concepts:

- The ability of most smartphones for providing images with geographic tags; a lot of them with a true GPS antenna and so, able to deliver reliable information of the geographic location.
- The group of concepts orbiting around crowdsourcing and shared knowledge.
- The idea of creating a geodatabase compliant with the INSPIRE (DIRECTIVE 2007/2/EC establishing an Infrastructure for Spatial Information in the European Community).

So, this project, is a bottom-up approach with solid, normalized, and easy to validate information. How it works: The basic knowledge and methodology of data acquisition is provided by different interlinked social media platforms (Slideshare YouTubre, Pinterest. Twitter) that can be accessed from the web page of the project (www.caminsdefauna.cat). General public can be informed of the project by different ways: by early appearance on search engines like Google; by occasional appearance on TV programs; green school projects, and also QR codes placed on connectivity bottlenecks or other places of interest close to roads and railways. There is also a help mail service and a FAQs database that will be actualized. The know-how information is oriented to provide normalized data (basically how to take geotagged photos, how to provide visual information of tracks and ancillary information (f.e.: typology and size of the underpass, land use, …). When data are uploaded, they are introduced on the geobase and normalized. The data are accessible to general public trough the ArcGis viewer of the project. The normalized data are open and available to any researcher on mail request. Basic aims of the project: The principal aims of the project, which is supported by the Catalan Administration and the Obra Social Catalunya Caixa (a bank charity), are:

- Identification of road-kill aggregates and gathering of information about the landscape characteristics in order to design strategies to minimize the risk.
- Provide an unitary database for the different administrations (traffic and road administrations, territorial planning and environmental administration, …).
- Provide an open data geobase with information that can be crossed with other available geodata like traffic intensity, noise levels, land use, etc.
- Identify existing faunal passages that can be improved by collaborative action; including local administrations, local economic donors, and anyone who wants to participate.

First outcomes of the project

Some notable outcomes are the use of underpasses of extreme dimensions:

- Frequent wild boar passage on an underpass of 156 metres length with a semicircular section of only 8 meter diameter under a very busy highway.
- A one month old wild boar photographied by a camera trap managed by a local school on an railway underpass of 140 meters length with only a section of 4 meters wide and 3,5 metres height.
- Those results suggest that some other factors can be taken in to account: noise level, visual contact with the traffic, human frequentation, land use, over-density stress on wildlife populations, and time to become accustomed.

a71 Public awareness and education - crucial factors for biotope networks

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The German environmental group Friends of the Earth Germany/BUND started a comprehensive project on biotope networking called 'A Safety Net for the European Wildcat' in 2004. Overall aim of the project is the development of 20,000 kilometres of migration corridors for the European wildcat and other species. Due to the broad approach, it belongs to the largest conservation projects in central Europe. Such a project is not feasible without the support of government authorities, landowners and other stakeholders such as hunters and farmers as well as the general public. Therefore, communication was part of the master plan from the beginning. In order to raise public awareness and gain support, the BUND started an accompanying nationwide publicity campaign for the years 2010/2012. Besides the aim of actual improving of national frameworks, the campaign is designed to gather experiences and build structures for international networks. A partnership with the Austrian National Park Thayatal works as a pilot scheme. The campaign is funded by the EU (LIFE+). The strategy of this campaign was outlined at IENE 2010. At the end of its 3-year period tools, experiences, and results, will be presented as well as a preview on follow-up campaigns. It will be shown, which actions have been selected for the 4 target groups (1. national/ international stakeholder; 2. General Public; 3. Citizens and Tourists in key regions; 4. Children and Youth) and how this actions have performed. Measures of evaluation will be presented as well as outcomes of these evaluations such as surveys. Results include high quality/quantity media outcomes, proven positive change of opinion in all stakeholder groups, and new supporters. Finally it will be shown which corrective actions have been necessary and why. A special focus is on all international activities.

a72 Public awareness for wildlife and roads conflict in Greece

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In Greece, the expansion of road networks and wildlife – vehicle collisions emerged as a conservation threat to wildlife during the design and construction of the "EGNATIA" highway in the middle of the 1990ies. Since then, the Hellenic, environmental, non-governmental organization ARCTUROS, has taken decisive actions in order to promote a more environmentally-friendly alignment of this and the subsequently highways build in the country and initiated the first public discussion concerning the impacts of large infrastructure works on natural habitats, with a special focus on the functionality of natural corridors in the gene flow of large carnivores with brown bear as a key species. Except of an intense effort for political press for better solutions with specific technical memorandums and reports, a strong campaign on raising public awareness on wildlife – road conflicts organized based on concrete research studies and monitoring activities of wildlife species as large carnivores. The implementation of this campaign is talking place and enforced until the present and include several informative approaches and activities as:

- Press releasing and systematic demonstration of specific articles in news paper, magazines and the newsletter and the "Mikri Arctos" (Ursa minor) the periodical magazine of ARCTUROS.
- The use of internet as website presentation, the facebook and special activities with interactive participation of the public on monitoring of wildlife roadkills in the Hellenic Roadkill Observatory (poster proposed as Karanmanlidis A. et al 2 IENE 2012).
- Presentation of specific interviews in local and national radio – stations and TV channels.
- Production of special TV spot on bears – highways conflicts.
- Organizing the Wildlife Emergency Team with permanent present at traffic accidents with wild animals, treatment and re-introduction in the wild.
- Production of specific portable exhibits for open environmental events and educational activities.
- Creation of special thematic exhibition section related with the highways and bear habitat management, in the Bear Information Center which has more than 50.000 visitors annually.
- Organizing the 2011 IENE Scientific Workshop and General Assembly in Greece (Kastoria and Nymfeo) with participation of scientists and IENE members from both Greece and abroad as well as students of the Greek Universities.

Additionally and in a parallel way there is a systematic effort of developing of cooperation the establishing contacts with local services and authorities as the Forestry Service, the Police and Regional Governments with discussions and special common activities as the special installation of "bear road sign" in the mountain bear passes in the Region of West Macedonia. Considering the fact that the Action Plan for the Brown Bear in Greece which was drafted in 1996 does not even include vehicle-related mortality as a conservation threat and as the brown bear mortality due to vehicle collisions has increased dramatically over the last 10 years in Greece, all the above have considerable importance for the reconsidering of the needs for the updating the Action Plan for the species, as well as for the formulation of a national policy of the "coexistence" of wildlife and "green" linear infrastructure.

a73 Constructed marginal shallow water zones along a navigable canal: possibilities and constraints for helophyte and aquatic vegetation

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Until some decades ago, banks of navigable canals were often stabilized with hard-armoured materials, such as concrete revetments or metal sheet-piles. As a result, a sharp transition between water and land was created, resulting in a reduction of marginal riparian habitat. Nowadays there is a growing practice to employ ecologically friendly bank stabilisation methods. For example, a new canal branch with constructed marginal shallow water zones was recently realised along the canal Ghent-Bruges. In a shallow water zone waves and currents, generated by moving ships, are reduced by a dam built in front of it. We analysed the vegetation in the shallow water zone (in 2006 and 2009; 8 and 11 years after construction; at both inner sides and in the middle) by means of 10x1 m plots. We addressed the following research questions:

(1) Can helophyte and rooted aquatic vegetation establish and develop in the shallow water zone?

(2) Which plant species are involved?

(3) Did vegetation succession happen?

We used number of taxa, Shannon-Wiener diversity, cover of herbs, cover of shrubs, competitiveness and ruderality as response variables. Linear mixed-effect models were fitted to analyse the extent to which plot site and year of investigation and their interaction determine different response variables. The studied shallow water zones allowed the development of helophyte vegetation at both inner sides, but hardly in the middle of the shallow water zone. Compared to plots at the side constructed with riprap covered with mastic asphalt, the plots at the side made by gabion baskets contained a higher number of taxa, a more diverse vegetation, a higher cover of herbs and a higher competitiveness of the vegetation. Gabion baskets provide more interstitial spaces compared to riprap covered with mastic asphalt. We suggest that interstitial spaces are an important factor for vegetation development. In the period 2006-2009, we observed an increase in competitiveness and a decrease in ruderality of the vegetation in the shallow water zones. These findings seem to indicate vegetation succession. Apparently vegetation succession is still observed in the period 2006-2009, although the shallow water zones were constructed in 1998. Rooted aquatic plant vegetation was poorly developed in the studied shallow water zones. As a possible explanation, we indicate unfavourable abiotic conditions made by the deposition and accumulation of sediments at the bottom of the shallow water zone. The sediments originate from bank and bed erosion induced by vessel traffic and, probably, enter the shallow water zone by means of the openings in the front dam. These results draw attention to the importance of well-considered construction materials and design of shallow water zones. The insights are useful for waterway managers, policy-makers and technicians in future bank engineering projects.

a74 Biodiversity survey in Hungarian highway margins

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Data on species composition of the vegetation and fauna of plant covered highway margins and rest areas are scarce in the literature. In the present study, 33 sampling sites were surveyed along Hungarian highways. The floristic survey comprised at each site a quadrat of 4 m^2, as well as two 20 and 40 steps long transects. The faunistic survey included pitfall trapping, suction sampling, branch beating, sweep netting and individual plant inspections. Faunistic samplings took place three times (May, July and September) in 2011, but for certain taxa data are available also from the previous years. Altogether 187 herbaceous plant species were identified in the surveyed sites. The dominant species (Cerastium spp., Plantago lanceolata, Poa angustifolia, Silene latifolia subsp. alba and Taraxacum officinale) are typical for artificially created perennial grasslands. The surveyed grasses were rather homogenous throughout the country, with the only exception of the sites on the sandy area of the Hungarian Great Plain, where drought tolerant species became more important. In contrast to plants, certain insect taxa have shown surprising diversity. In scale insects, 66 % of the species of the Hungarian fauna was found along highways, while the same value was 36 % for Orthoptera. Protected and rare insect species were also found in high numbers and nine species (scale insects: 6, leafhoppers: 2, weevils: 1) were firstly shown from Hungary. Our results demonstrate that despite of their artificial origin, highway margins as habitats would merit more attention, because of their potential ecological function as corridors of spreading or as refuge areas for certain species.

a75 Transport infrastructure as green infrastructure: tree-lined roads as habitats and ecological corridors for Hermit Beetle and other organisms

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Roads are usually perceived as a barrier for many organisms, however, their role of green infrastructure for biological diversity is also increasingly appreciated. Roadside trees in Central Europe have been reported to be a key habitat for hermit beetle (Osmoderma eremita group). This saproxylic insect is totally dependent on large, hollow trees, especially growing in sun-exposed places. As a poor flyer, O. eremita has limited dispersal abilities. Thus rows of trees in agricultural landscape provide not only habitats, but also facilitate propagation of individuals. In addition to the hermit beetle, tree-lined roads have been demonstrated to serve as habitats and/or ecological corridors to numerous other organisms, e. g. bats, birds, and lichens. As these organisms are endangered due to tree removal linked to infrastructure development, knowledge of their ecology is essential prerequisite towards effective conservation measures. We performed large-scale survey of avenues in three regions of Poland to examine the relationship between the occurrence of the hermit beetle and various characteristics of its habitat. In all regions covered by the project (Lower Silesia [LS], Malopolska [MP] and Powiśle-Warmia [PW]) detailed inventories of avenues were conducted at randomly selected sites. At each study site, a sample of 70 trees were positioned with GPS and examined in terms of species, trunk size, health state, presence of hollows and occupancy by the hermit beetle. In order to identify explanatory variables responsible for differences in site occupancy, a comparison of all possible ordinary least squares regression models was performed to find the most parsimonious model. Additionally, geographically weighted regression was built to check how the effects of explanatory variables included in the model differ in the geographic space. The average diameter of tree trunks, health status and the proportion of hollow trees are among the most important factors influencing the occurrence of the hermit beetle. In all regions, the models relied on the participation of the trees usually settled by the hermit beetle (Tilia sp. in LS and PW, Salix alba in MP). Additionally, in the LS region, the share of poplars Populus sp. was included as a factor negatively affecting the occurrence of the hermit beetle. Most informative models for LS and PW took into account the share of hollow trees, while in the MP health status was recognized as more important. One of the main conclusions is that the hermit beetle has a certain ecological plasticity and may successfully use one of the major host trees (lime, willow, oak). Which of tree species dominates depends mainly on the local tradition of landscape management. The survey was conducted in the framework of the Roads for Nature (Drogi dla Natury) programme, whose mission is to protect and develop tree-lined roads in Poland, as green infrastructure. Since 2010, 30 000 trees were planted along roads considered significant ecological corridors for the Hermit Beetle. A number of seminars were held to promote the role of tree avenues as green infrastructure. More activities are being developed.

a76 Plantations can improve plant diversity and soil conditions at roadside

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In areas dominated by urban and agricultural ecosystems through by linear infrastructures, roadsides can support ecosystem services; attending as substitute natural habitats and wildlife refuge. Plantations of woody species are frequently used on roadslopes for ornamental purposes, however the new vegetation added contribute to modify ecosystem structure and may have some consequences in ecosystem functioning. The aim of this study is to assess the functional role of these plantations in these novel ecosystems. We hypothesize that increasing heterogeneity on these environments through planting of woody species can generate mosaics with different environmental characteristics (light, temperature, water and nutrients), which may enhance plant diversity and improve soil conditions. The experimental design was setup in the A-1 highway; El Molar (Madrid, Central Spain).The deforested surrounding landscape generated by agriculture and livestock activities, consists of cereal crops, xerophytic grasslands and scrubland. We selected three embankments to plant clumps of fleshy-fruited woody species. On each embankment three treatments were applied: plantation with watering, no plantation with watering and no plantation without watering. Flora surveys were performed in plots (50 x 50 cm) within each treatment and flora from the surrounding matrices was also sampled, both of them for the three consecutive years. Soil samples were collected in the same plot, close to the flora samples for two years. In soil samples we measured: pH, conductivity, texture (percentage of clay, silt and sand), total amount of nitrogen, percentage of nitrogen, percentage of organic carbon and organic matter, as well as nitrate, ammonium and phosphate concentration. The correspondence analysis of floristic composition showed high segregation between embankments and surrounding matrices and along 3 years. Nevertheless, plantation with watering plots showed aggregation in the last year of sampling. Repeated measured ANOVA indicated that vegetation coverage increases, however richness and diversity decreased along time, due to some species become dominant. Soil analysis reveals that the substrate of the embankments is characterized by a sandy loam and low nutrients. We detected an increase in the content of carbon, nitrogen, ammonium and phosphate soil over time. The results of this study suggest that plantations can provide environmental heterogeneity affecting floristic differentiations among treatments and a slight improvement edaphic due to decomposition and mineralization of litter from the abundant vegetation of embankments.

a77 Snake mortality on National Highway-7 along Pench Tiger Reserve, Madhya Pradesh, India

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Human activities have modified natural habitats in many ways. Roads are perhaps the single most dominant forms of linear intrusions across wildlife refuges that have had pervasive influence on landscape and have affected the wildlife and its habitats adversely. With the rapid and progressive improvement and expansion in road transportation infrastructure for the benefits of facilitated linkages and enhanced mobility, India is already being recognised as a country with the world's third largest road network (4.2 million km). Approximately 27,000 km of roads traverse through wildlife refuges and key wildlife habitats outside protected areas in India. As a consequence, these roads pose serious implications for many wild animals. Direct mortality of animals is one of the major impacts of roads. There is already growing evidence of road related mortality of snakes from different parts of the world. This study, conducted in a 9 km section of National Highway-7 passing through Pench Tiger Reserve (PTR) in central India essentially focused on the evaluation of the impacts of the highway on the snake species. The road section along PTR was surveyed over 430 road cruising days spread equally across three seasons and over two years from August 2008 to July 2010. This accounted for a total effort of surveying 3870 km of road corridor. A total of 490 snake kills (1.13 snakes/10 km/day) was recorded during the study. The kills represented 20 different species of snakes out of the 38 species reported from the central Indian landscape. Barred wolf snake had the highest mortality (n=99, 22 %) followed by Common cat snake (n=49, 11 %) and Striped keel back (n=38, 8 %). The highest mortality was recorded during monsoon (50 %), followed by summer (37 %) and winter (13 %). From the fatality hotspots identified within different sections of highway using Kernel Density method, it could be inferred that maximum number of snake fatalities occurred in flatter areas and in sections adjacent to crop fields. Variables influencing road use such as the distance from the village, water sources and drainage were generated using the Euclidean distance method in Arc Info. Altitude and degree of slope was derived from 30 m resolution Digital Elevation Model (DEM). In addition, distance to cover and visibility between animal and vehicle were factored in for determining variables that influence mortality. Logistic regression models explained that snake kills on roads were positively related to high elevation and distance to water sources and were negatively related to proximity of the underpasses and crop fields. Considering that snakes are a vital part of every ecosystem and that their unique life histories make their roles in food webs diverse and important, this large scale mortality of snakes in less than 10 km section of the road can have grave consequences for their conservation. The conservation challenges are far greater in the landscape that is studied as it holds ca 40 out of the 279 species of snakes found in India.

a78 Wildlife related traffic accidents in Galicia, northwest Spain: incidence, pattern and solutions

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Wildlife-related traffic accidents are a serious and increasing concern in Galicia (northwest Spain). The magnitude of this kind of accidents is related with a high road network density, the increase in traffic volume and speed, construction of new and fast roads, together with a expansion of wild boar and roe deer in the last years. In 2009 Galician Regional Government requested our group a study about animal-related traffic accidents, aimed to increase the knowledge about this topic and suggest solutions for mitigation. The aim of the work presented here is to describe the situation in Galicia about wildlife-related traffic accidents (WRTA), with respect of their magnitude and pattern, as well as discuss the kind of data necessary for the implementation of mitigation measures. We collected data from the official records of traffic accidents occurring between January 2006 and December 2010 in Galician roads, compiled by traffic authorities and by Galician Regional Government, which consisted of 9,386 animal-related accidents. We analyzed these data in order to obtain the following results: 1) The magnitude, trends and species involved in WRTA; and for the wild ungulates-related accidents: 2) Temporal pattern; 3) Spatial pattern, i. e. road sections with high density of accidents; 4) Road and landscape characteristics of the sections with high density of accidents. The sample of WRTA was 6,486. The majority (6,255) were related to wild ungulates, from which 36.5 % were roe deer-related, 62.8 % were wild boar-related. Other species involved in the accidents were deer (0,6 %), fox (2,4 %), badger (0,8 %), wolf (0,2 %) and other medium and small size mammals. Galicia is the second region in number of wildlife related accidents per km^2 in Spain. The medium number of WRTA per year was 1,404 (period 2006-2009), and it has increased between 2006 and 2009, both for wildlife-related as for domestic animals-related. Consequently, the apparently increase in wild ungulates populations is not the only and most important cause of the accidents. Our results can help the management of WRTA and the design and improvement of mitigation measures. Mitigation measures include efforts to increasing drivers awareness through warning signs and public information or education programs. For the roads´ managers to implement an effective signalization is fundamental to provide them with spatial information about the high risk road sections. The WRTA temporal pattern is essential to get a good functioning of dynamic signals. For the information and education programs it is necessary to provide drivers with information about the high risk seasons and time of the day, as well as the most dangerous zones and roads. Other mitigation measures consist on preventing wildlife crossing in dangerous places and providing safe crossing opportunities. When planning and constructing roads, as well as to improve safety in the already existing ones, previous knowledge about the high collision risk sections and the road and landscape characteristics related with high risk allow to predict the best locations to place mitigation measures as wildlife crossing passes.

a79 Mechanisms underlying the road effects on owls: move towards mitigation

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The negative effects of roads on wildlife are recognized as important contributors to the global biodiversity crisis but the underlying mechanisms remain poorly understood, a fact critical for appropriate management strategies. At this stage, a way to optimize mitigation measures is to move from the description of mortality and distribution patterns towards the study of individual behavioral responses to roads and the environmental variables that control them. In this study, using mortality and the broadcast of territorial calls records, we examined the effect of road- and landscape-related factors on distribution and mortality of barn owl Tyto alba, tawny owl Strix aluco and little owl Athene noctua. We also analyzed fine-scale movements of radio-tracked barn owls, estimated the mortality risk based on the highway crossings and compared the expected with the observed mortality. Our results show that owls tend to occur far away from the major roads. We recorded high mortality rates (59 ind./100 km/year) in road sections with low traffic and within suitable habitat. Barn owls, in particular, define their home-ranges nearby highways if there is available habitat and tend to be road-killed in the same places where they successful cross the highways. The risk of being killed per crossing event is 0.018, resulting in an expected mortality of 48-96 barn owls/100 km/year. These estimates were much higher than the observed daily mortality (6.2 ind./100 km/year). The high death toll imposed by roads may decrease density regionally over the years by acting as a demographic sink that often remains unoccupied and where dispersing individuals tend to settle. Thus, road managers must reduce road mortality risk by discouraging owls from flying along the road verges (e. g. frequent mowing and ploughing) and raising the height of the roadside verges to encourage owls to fly above the traffic in high incidence of road mortality.

a80 Informed Placement of Wildlife Mitigation Measures: Using Turtle Crossing Signs as a Case Study in Ontario

Kari Elizabeth Gunson

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In a landscape inundated with roads, the likelihood that a wildlife species will interact with roads during its lifetime is likely. To counteract wildlife road mortality, a direct consequence of road-wildlife interactions, transportation planners and wildlife biologists are working together to find solutions. Solutions include providing barriers such as fencing so wildlife cannot access roads, as well as changing motorist behaviour by targeting warning signs at specific locations along roads. Wildlife warning signage are common objects on roadsides in North America and Europe because of their ease of deployment, however these advantages also hinder its effectiveness because criteria are not well established for effective sign placement. Our overall objective for this study is to inform sign placement on roads to improve their overall effectiveness. Previous research has shown that signs are more effective if selectively placed where wildlife-vehicle collisions occur for the target species. Therefore in this study we performed spatial analyses to determine two things

1) if turtle crossing signs are placed where turtles are crossing roads and or
2) if citizen-science and expert opinion are effective methods for sign placement.

First we inventoried (with a geographic positioning system) the location and other characteristics of a rigorous sample of turtle crossing signs (n=297 of over 700) along municipal roads in Ontario. We then delineated the road segment between paired sign locations that spanned probable turtle habitat or turtle crossing hotspot. We then measured several factors at each probable turtle hotspot, presence/absence of a creek, count of dead and alive turtle crossing locations, and habitat score within a 200 m radius at the midpoint of the hotspot. The habitat score was based on a previously developed turtle predictive hotspot model that was validated with the turtle on road data set described above. We then summarized the number of probable hotspots that were also prioritized by the predictive model. Final analyses for this study are currently being conducted and will be completed in May 2012. Preliminary recommendations are a mitigation strategy across large regions requires a co-ordinated approach that utilizes current spatial technologies, expert knowledge and available on-road data sets for sign placement. If effectively placed signs can behave as markers for more permanent and effective mitigation strategies. However, this requires clearly defined criteria for sign placement because if a sign is placed to reconnect habitat from a regional perspective, then a mitigation strategy may be different than if placed to reduce road mortality for a local population. An informed strategy should also consider design, sign theft, selective placement, and evaluation techniques for warning signs in an adaptive approach.

Tuesday, October, 23

Parallel Sessions 5

Case Studies II
Workshop: Wind Farm Infrastructure
Amphibians II
Communication II
Verge & Eco-Services II
Workshop: Wildboar and Traffic

Lecture Session: Case Studies II — Room A

Case studies of mitigation in infrastructure projects
Chair: Hans Bekker

This session presents examples of infrastructure development projects where special concern has been paid to remedy adverse effects on landscape and wildlife. It provides insights in real-life solutions, problems and opportunities that are rarely taught in university classrooms.

Workshop: Wind Farm Infrastructure — Room B

Ecological effects of wind farm infrastructure
Chairs: Björn Iuell & Jan Olof Helldin

Wind power development involves the construction of roads and other infrastructure, of which we know that it may impact terrestrial mammals such as deer and carnivores. Habitat fragmentation and barriers are often mentioned in EIA's as potential impacts of wind farm development, but at present, handling officers have little support in how to deal with this issue in the wind power planning process. This workshop aims at discussing the available knowledge in the field, added with experiences and views of the participants, and identifying how this matter can be addressed in landscape planning and research. The discussion will be based on a similar workshop arranged at the international Conference on Wind Energy and Wildlife Impacts (CWW2011) in 2011.

Lecture Session: Amphibians II — Room C

Amphibians and transportation infrastructure

Chairs: Miklos Puky & Tom Langton

Lectures in this session address the efficacy of small tunnel and fence systems for small vertebrate connectivity on road and rail transport corridors, their design and monitoring options. The aim of the session is to summarise the state-of-the-art in this field and give a further impetus to international co-operation.

Lecture Session: Communication II — Room D

Communication, education and public involvement

Chair: Mark Hörstermann

Public involvement in road ecology work is a promising tool to both obtain important empirical data and increase awareness of and acceptance for wildlife mitigation measures. This session presents new approaches and examples of such activities.

Lecture Session: Verge & Eco-Services II — Room E

Verges and ecosystem services

Chair: Heinrich Reck

Areas linked to transportation infrastructure can provide important refuges for wildlife and exert valuable ecosystem services, if designed and managed correctly. Infrastructure habitats thereby complement and extend other, more natural, corridors in the landscape and can also be essential for the efficacy of other mitigation measures. This session present various examples of the so often underestimated potential of infrastructure habitats.

Workshop: Wildboar and Traffic — Room F

Wild boar population increase and traffic safety: how can we reduce the conflicts?

Chairs: Carme Rosell & Mattias Olsson

Wild boar populations are expanding notably in Europe and the adaptive flexibility of the species enables it to colonise human landscapes, croplands and urban areas that have a high density of transport infrastructures. This has led to a significant increase in road accidents caused by wild boar, which has become a major road safety issue. In many countries, especially in southern Europe, wild boar is responsible for most of the recorded accidents with wildlife. However, this conflict can be reduced. We already have considerable experience of measures implemented to reduce the number of accidents. We have observed the remarkable ability of the species to use wildlife crossings and we know what kind of perimeter fences can prevent wild boar from accessing roads. The workshop will be focused on sharing experiences, success stories and failures, discussing new proposals and talking about the need for further research on the subject.

a81 Measures to avoid and compensate environmental impacts caused by new motorway construction of BAB A 44, section VKE 32

Oliver Gockel, Dietrich Kraetzschmer

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The BAB A 44 is supposed to close the gap between the agglomeration area Rhein-Ruhr and the urban axis of Eisenach – Erfurt – Dresden. The proposed section VKE 32 is situated in the east of the city of Hessisch Lichtenau in the district Werra-Meißner. It is characterized by a densely wooded low mountain range. The proposed motorway is aligned to the course of the valley Wehretal, a lowland area consisting largely of grassland. In the planning area, large coherent forest areas alternate with highly structured open landscapes. The topography and diversity of valuable landscapes represent a particular challenge for the technical planning process. Facing a rich natural environment and structure it became apparent that impacts on areas of high environmental value would hardly be avoidable. Thus, it was a particular challenge to deal with the numerous and serious environmental conflicts (i. a. noise, species protection, situation between FFH sites and parts thereof) when planning the avoidance and compensation of environmental impacts. With regard to endangered species the introduced example illustrates, that a considerable reduction of impairment can be accomplished by optimizing the technical planning. Within the FFH site crossing Werra- und Wehretal (ARGE 2005), particularly the following measures were taken into account: - The extension of a tunnel structure to minimize the disturbance and fragmentation impact as well as collision risks for bats - The construction of a green bridge in addition to the widening of the Hasselbach-Bridge and of a service road bridge to minimize fragmentation and collision risks as well as - The construction of different kinds of protection-walls to avoid irritation, such as opaque noise protection walls, protection fences, dams, protective planting and guidance structures. To point out is the fact that those measures help to avoid significant impairments of essential parts of the conservation goals of the FFH site Werra- and Wehretal and the FFH site Reichenbacher Kalkberge. In addition to those central optimization measures, further measures to avoid and minimize conflicts (minimization of construction site demand; optimization of retention respectively discharge of road runoff; improvement of bridge structures, i. a. with regard to optimized hydraulic structures) will be discussed in the presentation. Altogether, the possibilities of environmental and ecological sound technical planning will be outlined. Compensation planning was based on a case-by-case, verbally reasoned deduction of compensation measures and scope of compensation. This contribution presents primarily measures of river revaluation and development which aim at optimizing the longitudinal continuity and at improving the structure of the river bed and the riparian zone as well as adjacent floodplains. Furthermore, measures to establish a close-to-nature river management are presented. The contribution will explain the deduction and planning of measures along practical examples.

a82 Ensuring ecological quality after the planning phase: the case of the A74 highway in the Netherlands

Victor Loehr

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Road construction and other infrastructural projects tend to invest considerably in ecological aspects during the planning phase, in order to secure a well-informed, irrevocable planning approval for the project. Decisions taken may include the development of ecological infrastructure (e.g., underpasses, overpasses, fences), and other important mitigatory and compensatory measures to reduce the impact of the road and its construction on flora and fauna. However, the efforts of the planners are often diluted in design and construct contracts, when the contractor is responsible for the detailed design work, and when increasingly smaller government departments have insufficient means to fully supervise the contractor. In the Netherlands, the ecological quality of the design and construction of the A74 highway (2010-2012) was ensured by using a system-based contract supervision approach (Systeemgerichte Contractbeheersing). This approach concentrates on the project risks, and ensures that the contractor has a well-functioning quality management system. Indirectly, this should lead to products that are in conformity with the contract requirements. The small team of site supervisors concentrates on the quality management system of the contractor and specific processes therein, rather than the final products on site. On the A74, several quantitatively large risks for the ecological quality led to four process audits (interviews) that investigated how the contractor ensured that; (a) all the ecological contract requirements were taken into account in the design process, (b) mitigatory and compensatory measures were carried out in compliance with the plans, and (c) the final products complied with the contract requirements. In addition, one product (fences) was checked on site. To ensure that perceived risks were consistent with actual risks, the construction site was briefly visited in alternate weeks. This approach resulted in an ecological quality that appeared to exceed that achieved in many other Dutch road construction projects. The emphasis on the contractor's quality management system helped him develop and implement effective processes. Furthermore, process audits helped to identify potential problems in advance. Another advantage was that the Dutch highways agency invested relatively little time in ecological aspects on site compared to projects with a traditional site supervision approach. Nevertheless, several important pre-conditions were identified for the success of this type of supervision. Since the approach was entirely risk-based, considerable time had to be invested in a realistic, quantified (ecological) risk database, in order to strategically and efficiently plan audits and site checks. Another condition was the ability and willingness of project staff, including ecologists, to think in terms of processes rather than products, and to trust the contractor's quality management system. The system-based contract supervision approach uses contract requirements as an objective reference for all audits and checks. It is therefore essential that the contract requirements are sufficiently thorough. A continuous informal dialogue with the contractor can also help to avoid diverging expectations.

a83 Barriers to migration of wild ungulates in Mongolia

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In Central Asia, and in Mongolia in particular, the number of planned and constructed large infrastructure projects (including railroads, mining sites, pipelines, border fences, roads, etc.) has increased rapidly over the last years. The Convention on Migratory Species (UNEP/CMS) agreed to cooperate with the WWF Mongolia Programme Office for the purpose of analyzing the effects of linear infrastructure on migratory terrestrial mammals using Mongolia as a case study and, based on this analysis, developing a report on "Barriers to Migration" in Mongolia. The main objectives of the study were to review the existing literature on habitat fragmentation and migration routes due to infrastructure as well as on tools and measures to avoid negative impacts on habitat fragmentation and on migratory species, including Goitered gazelle (Gazella subgutturosa), Mongolian gazelle (Procapra gutturosa), Asiatic wild ass (Equus hemionus) and Mongolian saiga (Saiga borealis). The findings of the study showed that the planned road and constructions will be in parallel with railroad in critical habitats, and will go right through the Mongolian saiga, gazelle and wild ass populations. The planned railway track will cut through prime habitats of the species and without mitigation measures, will provide a major migration barrier for them. After construction of the planned railroad in 2025, the Mongolian gazelle populations will be divided into nine isolated populations separated by railway and border fences, while the Khulan and goitered gazelle populations will be divided into five and seven populations respectively. The Mongolian saiga population will be isolated as two separate populations. It was recommended that governmental and non-governmental organizations, national and international bodies involved in mining and infrastructure developments in Mongolia should take into account wildlife-friendly options in their construction and development projects. The report concluded that Environmental Impact Assessments must be done prior to any developments, monitoring of wildlife movements and identification of critical habitats and seasonal ranges are critical for development planning. In order to prevent and reduce these potential impacts, the proposals e. g. remote sensing wildlife movements, building wildlife crossings underneath auto roads and railways where appropriate, should be considered. Biodiversity assessments in the region and implementation of the long term biodiversity monitoring programme are essential. Recent studies show that establishment of non-fenced areas along the railway are necessary. Fence design should be considered removing barbs from upper and bottom wires of fences. There is a need to develop of guidelines, where appropriate measures to mitigate negative impacts, such as construction of under and/or overpasses in critical migration points, suitable design of railway fences are addressed. This report was the first specific paper, which emphasizes the urgent need to identify the effects of the current infrastructure developments in Mongolia through critical habitat and migration routes of major migratory ungulates, in order to develop recommendations and appropriate measures to avoid negative impact on these species.

a84 Habitat fragmentation, alteration and ecological compensation after road construction: Ortolan Buntings and bird communities in Umeå, Sweden

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The riparian-agricultural landscape around the city of Umeå, northern Sweden, has a rich bird community, of both breeding and resting migratory birds. Umeå is a growing city, characterised by on-going infrastructure development. New roads cause noise disturbance, as well as loss and fragmentation of habitats. Thus, there are potential negative effects on birds. Some of these effects can be mitigated by ecological compensation. Enetjärn Natur runs a control programme for the Swedish Transport Administration, concerning two areas on the outskirts of Umeå – Grubbänget and Söderslätt. Grubbänget includes both railway and road construction, whilst Söderslätt includes only a new stretch of road. Breeding birds were surveyed before, during and after road construction. Standard methods for mapping bird territories were used to provide distribution and numbers of territories. Among the surveyed breeding birds were Curlew, Lapwing, Ortolan Bunting, Skylark, Grey Wagtail, Meadow Pipit and Winchat. In 2009 baseline surveys were performed. By 2010 a new railway line had been built at Grubbänget and road construction took place during 2010-2011. At Söderslätt road construction commenced in 2010 and the new road was put to use in 2011. After initaial decline in both areas, Curlew territories have increased at Söderslätt, but remain at a lower level at Grubbänget. The Ortolan Bunting, Winchat and Grey Wagtail all declined in number during and after construction. This was particularly clear for Ortolan Buntings at Grubbänget, where the numbers of territories declined from eight in 2009 to two in 2010 and 2011. In contrast, Skylark territories remained at the same level, before, during and after construction. Skylark and Curlew territories were closer to the new roads in 2011 compared with 2010. Future surveys will be performed at Grubbänget. It is of particular interest to see whether bird numbers increase again after construction is completed. Special emphasis will be put on Ortolan Buntings, a nationally red-listed species, also occurring om EU's birds directive. Ecological compensation for loss and alteration of habitats from road construction is currently being planned in connection to the Grubbänget site. This will create new natural and recreational values in the area. By restoring a local stream, new wetlands can be combined with grazing and farming land. Within this mosiac landscape suitable habitats can be created for Ortolan Buntings, including open sun-exposed mineral soils.

w7 Ecological effects of wind farm infrastructure

Bjørn Iuell, Jan Olof Helldin

Wind power development involves the construction of roads and other infrastructure, of which we know that it may impact terrestrial mammals such as deer and carnivores. Habitat fragmentation and barriers are often mentioned in EIA's as potential impacts of wind farm development, but at present, handling officers have little support in how to deal with this issue in the wind power planning process. This workshop aims at discussing the available knowledge in the field, added with experiences and views of the participants, and identifying how this matter can be addressed in landscape planning and research. The discussion will be based on a similar workshop arranged at the international Conference on Wind Energy and Wildlife Impacts (CWW2011) in 2011.

a85 New mitigation measures provide safe road crossing for the mass migration of a burrowing, nocturnal toad, Pelobates fuscus, in Hungary

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One of the focuses of linear infrastructure-related conservation is to help migrating animal species across roads and railways. Amphibians are a key group in this process as most species regularly migrate between their winter habitats and spawning grounds in large numbers in Europe. As a result, mitigation measures were built to help them over or, what is more common, under roads sinve 1969. By today, nearly 2,000 of such constructions exist in the continent. Most of them were built to help the mass migration of common species in Western Europe such as Bufo bufo and Rana temporaria. As a result, less information is available from the field and also from experimental studies on other species, while there is a need for their effective conservation as well. Pelobates fuscus is a protected taxa of the European Union listed in Annex 4. of the Habitat Directive. In spite of its decline in some areas, it is one of the predominant species in the Great Hungarian Plain, where road sections with mass mortalities have been identified in the last ten years. In autumn, 2011 26 ACO climate tunnels and 8 km ACO guide walls were built to protect migrating amphibian communities with a P. fuscus predominance at three sites, between Ópusztaszer and Baks, between Kistelek and Balástya and at Mórahalom in the Kiskunság area. The aim of the study was to collect information on the migration characteristics of this species. Here we summarise the first results of the monitoring of the first spring migration.

Two levels of the monitoring system is presented here, the efficiency of the new systems keeping amphibians away from roads and tunnel crossing is discussed. The efficiency of the barrier system at Ópusztaszer to keep amphibians away from roads was very high. Only sporadic road kills were detected along the protected road stretches. A 1.6 % - 3.7 % efficiency was measured comparing the road kill data along the final 100 metres of the barrier walls and the adjacent 100 metre sections in rainy nights (The obvious bias of animals getting on the road at the non-fenced stretches killed along fenced stretches lowering the calculated efficiency ratio cannot be excluded though.). The calcuation of this ratio for the whole system was even more favourable, below 1 %. One key issue in this process was the efficiency of the grid system of the elements put across earth roads joining the road stretch. Crossing efficiency was very low there, most P. fuscus individuals fall into the first, second or third rows of holes of the seven hole system unit. According to the study carried at the Mórahalom and the Ópusztaszer site, P. fuscus needs at least two successful jumps to cross the grid successfully. Tunnel use was also satisfactory, ten amphibian and reptile taxa including Appendix 2. species of the Habitat Directive such as Bombina bombina were found in them so far. To complete monitoring activities, breeding areas are to be checked regularly during the year.

a86 How to build amphibian passages that function for mass migration

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The author and his team has builded the first amphibian passages systems in Denmark (1997), as part of new road, and in Poland (2002), as part of an 4 year long EU accession demonstartion project "Fauna Passages in Poland, Education, monitoring and building". In 2009 a the first system for testing the function of 4 types of amphibian fences (concrete, metal, polymerconcrete and plastic) was build for Danish motorways. The 3 systems have been monitored by counting number of amphibians passing through the tunnels during spring migrations. Trapping has been used to document absolute numbers and filming have been used to document migration behaviour along fences and in tunnels. The Best functioning system build in Poland 2002 documents a yearly migration through the tunnel system of more than 15000 Common toad (Bufo Bufo), more than 10000 Grass frog (Rana temporaria) and more than 1000 Alpine newt (triturus alpestris).

a87 Amphibian Rescue Project with a Drift Fence as a Monitoring and Environmental Education Device

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The Great Reed beside Farmos (Hungary) is located in the Tápió-Hajta Protected Landscape Area, where an average of 45 000 amphibians migrate annually. First in 2007, an approximately 1.5 km long, temporary drift fence was erected alongside Road 311 and a close railway track which cross migration routes of the amphibians between their overwintering and breeding area to prevent their mass overrun. The frog saving program has been run since then and is currently being coordinated by the Danube-Ipoly National Park Directorate, the Hungarian Jane Goodall Institute and Tápió Nature Conservation Association. In addition to rescuing the amphibians, we have been recording the number of specimens, their species and the habitat where they were found. Between 2007 and 2011 we observed 9 amphibian species in the area. 95 % of the rescued amphibian specimens were common speadfoot toads (Pelobetes fuscus). The number of specimens, as well as the timing of the migration intensity alters year by year, influenced by environmental factors (mainly by precipitation). Although Pelobates fuscus occurs in large numbers in particular areas, conserving and monitoring the populations are both crucial, since a decline in its population size have been observed throughout Europe. Furthermore, we highly emphasize the importance of environmental education. With a simple questionnaire, we demonstrated the significant change in attitude and motivation of the children involved in the project during and after their active work. We have shown that independently of their attitude towards frogs, they began to appreciate the usefulness of our work and became aware of the dangers that threaten the amphibians. Nevertheless, we detected that they could still not see clearly why amphibians are important beings and why their conservation is necessary. By 2012, we managed to train the first children volunteer generation. The older students can already direct the rescuing programme, as well as guide, coordinate and teach the younger children without any professional help. It is important to highlight that in our case the easy accessibility of the rescue site and the safe work circumstances were suitable for an environmental education purpose. As a conclusion, we emphasize that in similar circumstances it is recommended to focus on the establishment of environmental education programs. In our presentation, we demonstrate the establishment, the process, the results and the future plans of the amphibian rescue program.

a88 IT Adaptive Interface: Research and Modeling EIA Highway Project on Ecosystems

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Research and educational program demonstrate impact of the main anthropogenic factors caused by planned highway on different ecosystems in middle European landscape (forest, meadows, water bodies, agricultural fields) with immediate general evaluation. Last decades PIARC (C14), IENE elaborated basic philosophy, recommendations on reducing ecological risk of fragmentation, general and certain impact of biodiversity dynamics, on old automobile roads reconstruction, new highways planning and operating. Environmental policy addressed road administration, managers, planners, economists, engineers, insurance companies, local authorities, environmentalists produced original products: COST Action 341 (The European review), "IENE-ABC" posters, "VIA-VITAE" –simulation game, national manuals on landscape defragmentation. To make next step toward sustainable highways planning special adaptive interface was designed on the "AnyLogic" system dynamic software platform tj integrated efforts of different economical and managerial interests of different public sectors. Presentation include short introduction and demo to IENE participants decision on planning highway in landscape with migration of several species, forests, meadows, water bodies, agricultural fields, urban areas. After project budget distribution done trainees design highway on gained information on 2D screen and get feedback on the IEA of the project in most general indicators on one year or longer period. Report includes landscape (de)fragmentation, traffic causalities, insurance balance, biodiversity dynamics, and quality of ecosystems: loss of biodiversity, game animals, woods, agricultural harvest. Exercise on highway planning possible to continue to find one of the lowest EIA

a89 Connective Landscapes

Pete H. North

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Ecological systems in urban environments have become increasingly fragmented. Urban parks and open spaces too often exist in isolation and no longer function alongside natural systems and resilient connected ecologies. Highways, railways, and infrastructural corridors form strong barriers and further exacerbate this universal condition. Landscape design has the potential to reconnect and strengthen fragmented ecologies and open space networks by rethinking the role of parks and open space in urban environments today and in the future. Current design research conducted at the University of Toronto in the Master of Landscape Architecture program focused on developing design strategies that address these urgent issues using landscape as a means to reconnect and bridge fragmented urban ecologies. Students were asked to develop design strategies and revitalization frameworks for Toronto's High Park and envision its reconnection to adjacent ecological systems. At 160 Hectares (400 acres), this metropolitan scale park is the largest park within the city of Toronto. It is recognized as one of the city's most significant natural systems containing an outstanding concentration of rare plant species and rare Oak Savannah ecology. However, despite its large scale, the park is currently in deteriorating ecological health and is poorly connected to adjacent ecologies and the surrounding urban fabric. A critical area of design exploration focused on the tenuous connection between High Park and the western waterfront territory along the park's southern edge. Currently severed from its historic connection to the Lake Ontario waterfront by more than six layers of sprawling transportation infrastructure - 1 major highway, 2 blvds, 2 railway lines and a light rail street car line – the reconnection of High Park to the waterfront and the creation of a more holist park network along Toronto's western beaches was a primary objective. Through presenting a series of projects and current research this presentation will discuss a comprehensive design language that explores contemporary technologies, materials and design approaches necessary to reconstruct urban ecological systems and connect landscapes.

a90 Wildlife Observation Informatics Systems to Support Transportation Decision-Making

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Transportation systems and traffic cause extensive and variable impacts to wildlife populations and species. These impacts include: direct mortality from collisions with vehicle; indirect mortality from separation from necessary habitat elements; population fragmentation due to aversion to roads/traffic, or mortality at the roadway; population elimination due to the afore-mentioned impacts; and local or distribution-wide threats to and extinction of species due to the afore-mentioned impacts. Understanding and quantifying these impacts requires extensive monitoring and analytical systems in developed and un-developed areas. We describe a successful online system for reporting and visualizing live and dead animal observations associated with road systems at very large extents (>10^5 km^2). The system was created using Drupal (free, open-source, well-supported) and has been operating for 3 years. This system can include reports from dedicated research programs, or from opportunistic observations from large, informed "crowds". Formalizing the ontology of the systems, as well as simple rubrics for observations ("where", "what", "who", "when") allows these systems to be implemented with local "skins" (i. e. web presence), as well as to support large-extent tracking of biodiversity and conflicts between wildlife and transportation systems. The systems have been piloted at US state-scales with volunteer-observers (>21,000 observations, >1,000 observers) and are suitable for national-scale wildlife observation networks. In California, half of all native terrestrial vertebrates have been reported as roadkill in the California Roadkill Observation System (CROS; http://www.wildlifecrossing.net/california) and accuracy of animal identification has been measured to be >93 %. In the Maine system (http://www.wildlifecrossing.net/maine), observers can submit opportunistic observations and are also trained to regularly survey transect roads both within and outside "wildlife linkages", in order to assess the utility of the mapped "linkages". Despite very different operating principles and organizers for each state system, the results of observations are remarkably similar. These large systems are also suitable for other methods of monitoring and analyzing wildlife occurrence and movement, including from wildlife cameras, track and scat . In each state, they also represent the largest wildlife monitoring systems currently operating. Three criteria are critical for the success of these systems:

1) formalized informatics rules among similar systems to facilitate large-extent data analyses;
2) parallel institutional or social networks that provide the observers to populate the systems;
3) obvious transportation and conservation planning benefits from the observation/reporting activity; and
4) frequent communication with observers to maintain interest and participation.

a91 A Wildlife collision reporting system, for roads and railroads. The Swedish Wildlife Accident Council (Viltolycksrådet)

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Following the insight that the number of wildlife accidents increased independent of changes in moose and roe deer populations the problem was given a new interest from authorities and the public. The ensuing discussion revealed big difficulties locating the scene of the accidents and voluntary hunters who often had problems to trace the injured animal, suffered from poor equipment, unskilled dogs or insufficient training. Added to the situation was a growing population of wolves, brown bears and lynx in larger parts of Sweden. In 2007, the Swedish Government installed a completely new organisation, the National Wildlife Accident Council, with the purpose to improve the unsatisfactory situation. An initial step and a key factor were to build up an accident database to support the administration and for public information. Since 2010, car drivers are legally obliged to report any accident with larger wildlife species that are listed in the §40 of the Swedish Haunting law. The system was built primarily for road accidents only, but since July 2012, wildlife collisions on railways are also included. When an accident occurs, the procedure is as follows: The driver reports the accident to the police, the engine driver reports to an operational centre where some traffic information is added and reported to the police. The police register the accident in the accident data base where it is given a unique code. The accident database also communicates with other databases regarding train a location, speed etc. and this information is automatically transferred to the accident database. Based on the given information, the police decide whether or not further action is needed. If yes, the coordinator of the approved hunters in the particular region is given the mandate to visit the scene of accident and decide to commission a hunter with dog to trace the wounded animal and kill it. After the animal is killed, the hunter reports back to the co-ordinator who in turn reports back to the police. All reporting is made using the database. The event must be completed in the database before involved hunters can get reimbursement. It is important to notify that the hunters involved through this system are authorized by the police and are given permissions and responsibilities they would not have otherwise. For example they may trace a wounded animal irrespectively of landownership and hunting season, but they must wear special clothing, use certain security equipment, go through a special training and pass a final exam. Furthermore, applications are developed for smart-phones for illustration of recent accident hotspots and guidance of drivers when they report to the police. The user is informed step by step which actions need to be taken. The Police can be phoned using one button and coordinates are shown on the screen. If the application is active during driving, it gives warning signals when hotspots or recent accidents are approached. So far, focus has been on building an organisation, develop the accident data base and to improve the cooperation between involved organisations. Ahead focus will be on improving the prevention of accidents through better information to drivers and more efficient use of available measures. This means use of a locally adapted battery of measures such as fences, speed limits, fauna passages, animal detection systems, adapted forestry and farming, adapted hunting, real time information to drivers etc.

a92 Soil Fertility and Developing Plant Communities on National Road Schemes in Ireland

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Since 2000, Ireland has undertaken a major upgrade of its road network with some 1200 km being developed to motorway or dual-carriageway standard. This has the potential to impact considerably on both the immediate and wider landscape. Much of this construction has crossed agricultural land which had been intensively managed to a greater or lesser degree. Through the appropriate landscaping of the road corridor, the opportunity exists to offset some of the potential impacts of the road and, in doing so, address some of the impacts of the more intensively-managed agricultural landscape. A key area to addressing any impacts is the treatment applied to the wider verge area, away from that immediately adjacent to the road pavement. The creation of an appropriate, semi-natural plant community is a fundamental aspect to this treatment. One of the main limiting factors to the establishment of semi-natural plant communities is the high nutrient status ([N] and [P]) of the soil. High levels of nutrients are frequently a feature of soil from agricultural land. There are several approaches to dealing with this: the one adopted by the National Roads Authority in Ireland in their 2006 landscaping guidelines, is to use subsoil, rather than topsoil, as the former is less fertile. The opportunity has now arisen to make a comparison of roads landscaped in a manner prior to these guidelines with others which follow the new practices. This investigation analyses the potential contribution of the fertility of the soil to the plant community present. The study sites were located along the E30 (N25 and N22) between Rosslare, Co. Wexford and Tralee, Co. Kerry, some 310 km. Each had a southerly aspect and had one of the following engineered bases: rock/scree slope (1:2), soil slope (1:1), soil on a flat wider verge (1:0). Categories were then subdivided into landscape treatments (pre- or post NRA 2006 guidelines). The landscape treatments included the planting regime in addition to the use or not of soil (and type of soil incorporated). In addition, 10 improved grasslands and 10 semi-natural grasslands were incorporated into the design as reference sites along the E30 transect. In 2009, the vegetation was surveyed. In 2010, the sites were revisited and soil collected (12 cores per habitat were amalgamated) for nutrient/pH testing. Preliminary indications are that, overall, the soil found along the road verge is marginally less fertile than that of the adjacent field. Furthermore, in certain circumstances, the levels of [P] and [N] on the road verge may be more greatly influenced by the topography and use of the adjacent field. The implications for developing plant communities along major Irish roads are discussed.

a93 Can road verges provide any ecosystem services? A theoretical framework

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In the last few decades the area covered by road and road verges have significantly increased, to the point of becoming another feature modern landscapes. When we focus only on the road and its road verges, restoration measures have important but little ambitious goals (to reduce sediment movement on roadslope, to improve visual perception for passengers, etc.). However, the area ecologically affected by roads is much larger. Traditionally, these effects have been studied from a viewpoint of their negative impacts on ecosystems (mainly habitat fragmentation, modification of animal behaviour, alteration of the physical and chemical environment) and some restoration measures have been focused on mitigation of impacts (e.g: wildlife crossing). Can roadslope restoration projects be more ambitious in setting its objectives? Can we get impacts derived from road construction on the ecosystem as positive? TEEB (The Economics of Ecosystems and Biodiversity: the major international initiative to draw attention to the global economic benefits of biodiversity) has recently highlighted the importance of ecosystems services to human welfare. In that sense, we have synthesized a theoretical framework to analyze how road verges could provide ecosystem services. Our line of argument is based upon 2 main approaches: On the one hand, in intensive agricultural areas there are almost no crop-free zones and natural vegetation is confined in marginal lands. For instance, road verges can support natural vegetation and thus provide ecosystems services as pollination and natural pest control by predators. Additionally, roadside are also home to wild relatives of cultivated species. On the other hand, highways are corridors for passengers and freights, in addition roadsides can also support dispersal paths for animals and plants in highly anthropic landscapes. These dispersal nodes can play a role as potential connectivity elements among populations. Moreover, in a scenario of climate change, these lineal habitats can provide routes for species migration. Both arguments require a landscape-scale perspective, therefore restoration practitioners have to work at larger scales for providing these ecosystems services. To illustrate this, we present an example in which the motorway network in the Comunidad de Madrid (Spain) was surveyed, by mean of aerial photographs and mapping available, in order to analyze the relationship between woody vegetation at each embankment with its surrounding matrix.

a94 Tree avenues and "ecological corridor" policies in Europe: current situation and potential developments

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Avenues form an indivisible whole that combines a traffic route with lines of trees on either side, forming a canopy that arches over the road. This combination of trees and roadway makes avenues an important asset for both highway engineers and environmentalists, at a time when all need to be concerned with biodiversity. Avenues mitigate the severance caused by road infrastructure, they overlay it with an ecological corridor and they create a specific, rich biotope. This triple contribution to biodiversity is explained by the geometry of avenues (vertical dimension and linear structure), the particular physical environment they create (light and microclimate conditions), and the great age they can attain (given that they are exempt from forestry exploitation). Studies of bat and bird flight paths, in particular, have begun to stress the role of avenues as hop-overs and as corridors. We show how the specific characteristics of avenues are taken into account in the biodiversity protection and "ecological corridor" policies of various European countries, from the simple advice of scientific committees to the transposition into law. We identify where there is room for improvement, in terms of knowledge, management and protection. Avenues constitute a shared, European cultural heritage, whose importance is now generally recognised; nonetheless, there is extremely heavy pressure to transform those roads that are still edged with trees into barren strips of asphalt, at best edged with hedges. Such transformations have disruptive effects on wildlife and create barriers or deadly traps (when they are traversed at vehicle level), thus requiring costly compensatory measures.

a95 Ecosystem services in road planning and maintenance

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Ecosystem services refer to the direct or indirect benefits obtained either to people or the rest of the ecosystems from the structures and functions of ecosystems. The aim of this work was to draw guidelines and to look into the possibilities how ecosystem service-based thinking provides means to examine the environmental impacts of infrastructure maintenance and construction. Ecosystem services can be built into infrastructure maintenance in a way that strengthens ecological structures and functions in ecosystems. In safeguarding ecosystem services, the focus will be shifted from minimising the environmental disadvantages caused by infrastructure building and maintenance to secure services provided by nature in accordance with its carrying capacity and principles of sustainable use. How to work for ecosystem services in practice? In road building area the maintaining the purity of waters is important measure in the progress of regulating ecosystem services and preserve the quality of surface and ground waters. The completed motorway is equipped with runoff collecting systems. To keep the good shape of surface waters the runoff waters from road area are purified and delayed before conducting them to natural water systems. The artificial wetlands and ponds made during road construction and the natural wetlands not to mention are important for many aspects. They form small microclimate areas and make good carbon sinks. They offer habitats for many species like amphibians and bottom species. Even small ponds regulate storm water and flood in the road environment. They enrich also landscape. The groundwater protection ensures pure ground water for community water supply for the water supply is based mainly in ground water in Finland. The fragmentation of natural areas decreases biodiversity and can cause extinction of the sensitive species. Protection of endangered species and protected areas will promote production services. In planning we confirm, that the other united nature areas and forest will stay complete and the ecological network with functional connections are working. The barrier effect, which the built motorway construction and wildlife fence forms prohibit the animal movements and the natural dispersal. Even if the green bridges, animal underpasses and small animal tubes and otter constructions make possible the animal movements over the road area reducing the barrier effect, these constructions do not remove it entirely. The "overbuilding" in road environment planning is in many cases expensive and useless. Using the original humus, which is removed from the road area and used to cover road verges saves energy costs in transportation. The cultural ecosystem services can be secured by protecting cultural heritage and nowadays historical and natural landscapes and the recreation connections. Research, teaching and monitoring serves our knowledge about our environment and impacts, which human is causing. Ecosystem service-based thinking emphasises scale-sensitivity planning and also give justifications for measures in road construction.

w8 Wild boar population increase and traffic safety: how can we reduce the conflicts?

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Wild boar populations are expanding notably in Europe and the adaptive flexibility of the species enables it to colonize human landscapes, croplands and urban areas that have a high density of transport infrastructures. This has led to a significant increase in road accidents caused by wild boar, which has become a major road safety issue. In many countries, especially in southern Europe, wild boar is responsible for most of the recorded accidents with wildlife. However, this conflict can be reduced. We already have considerable experience of measures implemented to reduce the number of accidents. We have observed the remarkable ability of the species to use wildlife crossings and we know what kind of perimeter fences can prevent wild boar from accessing roads. The workshop will be focused on sharing experiences, success stories and failures, discussing new proposals and talking about the need for further research on the subject.

Tuesday, October, 23

Poster Session 2

Posters will be presented by the authors during two separate poster sessions. Posters are presented alphabetically, based on the surname of the first author.

First authors with surnames starting with N – Z will present during Poster Session 2.

p32 Wildlife crossings as secondary habitats for the common wall lizard (Podarcis muralis) – suggestions for future proper design

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The wildlife crossing over the Autobahn A1/A48 at the motorway junction at Wittlich (Germany) was built as a CEF-measurement for the expected habitat fragmentation and destruction due to the construction of the Bundesstraße B50neu. The population of common wall lizard (Podarcis muralis) located on the wildlife crossing was investigated in the framework of an efficiency monitoring in the year 2011. It became apparent that the investigated wildlife crossing is an optimal secondary habitat for wall lizards. The question was whether the passage could be a habitat connection or even a habitat for the strictly protected wall lizard. In order to allow a high diversity of habitats on the green bridge, the ground on the wildlife crossing was not leveled, as it is usually done, therefore offering lots of microstructures for lizards and small animals, like invertebrates.

Three years after building, the bridge turned out to be a source habitat for this species. The wooden walls fencing the bridge and protecting the surface from light turned out to be a popular spot for sunbasking and thermoregulation, which also offered the lizards protection from predators. The sandstrip for monitoring game animals on the wildlife crossing is used for egg deposition. By using capture-recapture the determined wall lizard population counts about 90 individuals on the 0.25 ha big area of the wildlife crossing. About the half of the population seems to be stationary on the wildlife-crossing, the other half seems to be mobile. The results of the efficiency monitoring suggest that wildlife crossings are not only suitable for connecting habitats of wall lizards, wildlife crossings may also be a preferred habitat itself.

p33 Prevention of Deer-Vehicle Collisions by Using the Sound Produced by Tires Passing Over Grooved Pavement

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Deer populations have tended to increase throughout the world, and this has led to various problems, including deer-vehicle collisions. Various measures, including deer-proof fences and wildlife warning systems, have been implemented to prevent these collision accidents; however, no solution has had notable mitigation effects, and areas with deer-vehicle collisions continue to expand. This study proposes a new collision-prevention measure that uses the sound made by tires passing over grooved pavement. The measure and its effectiveness as determined by monitoring experiments are presented. The grooves were installed on pavement such that the frequency of sound (2kHz, fundamental wave 1kHz) made by the tires of vehicles passing over the grooves is close to that of alert calls made by deer (2.16kHz). Because deer warn the herd of potential danger by alert calls, a sound similar to such calls was thought might restrain deer from crossing the road in front of driving vehicles. The grooves were ground into the pavement at an interval of 16 mm, which is about half the interval of typical drainage grooves (32 mm) in Japan. Onsite video camera monitoring was conducted to determine the effect on deer of the sound made by vehicles passing over the grooves. The recorded video images showed that more than half of the monitored deer reacted to the sound produced by approaching vehicles. Some deer temporarily stopped moving or those that had been at the roadside before vehicles approached remained there. The monitoring results indicate that the sound may be useful in restraining deer from abruptly crossing the road in front of a vehicle. If this measure is effective enough at preventing deer-vehicle collisions, it will have the positive features of cost efficiency, elimination of the need to install costly large-scale facilities, extended effectiveness compared with other acoustic devices and absence of detrimental effects on the roadscape. The cost efficiency of this measure depends on the durability of the grooves; therefore, the effect of groove wearing on the sound was also investigated. At one year after installation, the sound continued to be produced, but only the fundamental tone was confirmed, while the harmonic tone was lost. Maintaining an effective groove sound to keep deer away from the roadway remains an issue to be addressed. To clarify the expected accident prevention effectiveness and cost efficiency of this measure, more data on monitoring experiment results and the relationship between the sound's effects and the state of groove wearing with time are required.

p34 En marge … Landscape, ecology and urbanization along infrastructure in the Eurometropolis Lille-Kortrijk-Tournai

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The paper describes the result of a research project elaborated by the 'Labo Stedenbouw' (Laboratory for Urbanism, Department of Architecture and Urban Planning, Ghent University) in collaboration with the Ecole Nationale Supérieure d'Architecture et de Paysage de Lille (En marge… Paysage et biodiversité des délaissés et accotements infrastructurels de l'eurométropole Lille-Kortrijk-Tournai). Subject of the study is the eurometropolis Lille-Kortrijk-Tournai, a cross-border polynuclear region in which the important cities in 2008 have made an agreement to collaborate. Within this region the infrastructure (roads and highways, rail roads, canals) holds an important position: it composes the framework joining the dispersed urban condition. Furthermore, biologists have ascertained that the infrastructure's margins also hold an important ecological value. Along the infrastructure, multiple "terrains vagues" are situated, sites that have lost their status or function as they were cut through by infrastructure. Also many highway and railway banks, as well as the shores of waterways are little or not accessible, as a result of which a new, but 'wild' nature comes into being. A first part of the research, executed by Lille University's biologists, visualizes the biological diversity of the margins along infrastructure and their possibility to function as ecological corridors. In particular, the hypothesis of considering the infrastructure also as a green and blue network structuring the Eurometropolis is tested. A second part of the research, and this is where the paper focuses on, regards the relationship between these corridors and urbanisation. Which landscape qualities do these corridors offer? How are they used? Can they be made accessible and absorb urban functions? How do they relate towards the neighbouring urban tissue en how can they be a structuring element for the urbanised region of the Eurometropolis?

p35 The use of a moose and roe deer permeability index to develop performance standards for conventional tunnels and bridges

Mattias Olsson, Andreas Seiler

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In order to mitigate barrier effects of highways and exclusion fences, many countries have designed and constructed wildlife crossing structures and ecoducts. While such structures may benefit wildlife conservation or management at local scales, they may not provide adequate opportunities for maintaining landscape connectivity at broader scales. However, conventional non-wildlife road bridges, tunnels and culverts are common along major infrastructure corridors and are known to be used by wildlife occasionally. Given the large number and density of such passages, their cumulative benefits to wildlife may be underestimated. However, there is uncertainty about how the effectiveness of such structure should be evaluated, because clear objectives and performance standards have not been developed. We used track inventories in sand beds to study the relative use of 92 conventional road bridges or tunnels and wildlife crossings in south-central Sweden by moose (Alces alces) and roe deer (Capreolus capreolus). The permeability index of each passage related the number of tracks through the passage to mean number of tracks in the reference beds, following Yanes (1995). We examined the influence of structure dimensions, design, human disturbance and landscape features on structure use by moose and roe deer. We also discuss how to use the permeability index to develop standards for the design of conventional tunnels and bridges, and wildlife crossings. In general, moose and, to some degree roe deer, used both bridges and underpasses much less than expected from their occurrence in reference track beds. Passage width appeared to be a strong predictor of relative use, but traffic volume through the passage, human use and distance to nearest forest cover were also important predictor variables. Bridges and tunnels with a width of 19 m were likely to be used by moose at random, i. e. as much as expected from the activity on control track beds. Roe deer used bridges and tunnels with 18 m width at random. We propose establishing random passage use (use as expected) as a minimum performance standard for wildlife crossing structures. Lower targets could be set for conventional tunnels and bridges adapted for wildlife. It is important that these targets are jointly evaluated by conservationists and the road administration in order to develop size and design recommendations. We conclude that only a minor proportion of conventional road tunnels and overpasses built for local access roads provide effective passages to moose and roe deer in our study area. However, a slight increase in width and other modifications that increase their attractiveness to wildlife could increase the use and thus reach levels acceptable for ungulate conservation and management. Also, it would be worthwhile studying whether additional protective features could increase the attractiveness of existing structures with low human use, and thereby provide more cost-efficient mitigation than the investment in new, adapted wildlife passages.

p36 Theory and practice on planning, construction and maintenance of wildlife crossing structures

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The effects of landscape fragmentation due to transportation infrastructure in Germany are well known. The defragmentation of landscapes is a very important part of planning and usually implemented when building new roads. The Federal program for Defragmentation also simplifies the construction of wildlife crossing structures on existing roads. All wildlife crossing structures have to work on a long-term, hence good planning, construction execution and long-term maintenance works are indispensable. In Germany the road administration is responsible for the maintenance of all constructions including fauna passages. When the planning for the construction of the motorway A20 on behalf of DEGES started in 1995, the fragmentation impacts on habitats and wildlife corridors of animals with large area requirements were analyzed, conflict points were identified and appropriate fauna passages were recommended. Discrepancies between theory and practice on planning, construction and maintenance of wildlife crossing structures were determined during a first monitoring, e. g.:

1. Late compliance with defragmentation measures within a planning process and lack of coordination between different planning processes • Decreased wildlife ecological functions of fauna passages due to disregarding and/or lacking knowledge on ecological requirements • bad coordination when positioning compensation measures near fauna passages • bad placing of noise barriers and screens
2. Insufficient regard of wildlife ecology knowledge • Bituminization of underpasses and overpasses • Heavy technical construction of river crossings • Large sealing (maintenance ways, slopes, platforms)
3. Reduced acceptance through restrained access • compensation measures near fauna passages are fenced off for too long a distance • large-scale fences around rainwater detention basins
4. Construction faults • fencing of small fauna passages • bad drainage of fauna passages • culverts without sediments • deficient connection between fences and buildings
5. Maintenance faults of fauna passages • insufficient control and correction of defects during guarantee period • compensation measures are transferred very late to the responsible person after the construction phase • bad maintenance and cultivation of fauna passages due to lack of knowledge

Not all problems diminish the use of fauna passages by large mammals. But the aim must be that as many species as possible use these structures. Following recommendations can correct the mentioned problems: - Early and consistent cooperation between planner, building company and ecologist during and after the construction - Better coordination between concepts for fauna passages and compensation measures to enable a green infrastructure - Quality control during the construction phase (fauna passages and compensation measures) - Multi-functionality of fauna passages so that as many species as possible can use them - Plantation of wildlife overpass and green structures at the earliest time possible - Early determination of maintenance responsibilities. Important is the delivery of documents with the aims and maintenance measures of fauna passages If these aspects are considered in future planning or in already existing fauna passages than more animals will use them to cross roads safely. This would also reduce the construction and the maintenance expenses. Wildlife crossing structures are built for animals and nature and not for people.

p37 Factors related to amphibian road-kill in Atlantic Forest, Brazil: basis for a comprehensive mitigation approach

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Due to the high diversity of species affected by vehicle collision, a biodiversity approach in mitigation planning must be adopted. In such approach, different animal groups/species and particular mitigation strategies should be considered. Amphibians are probably the vertebrate group most impacted by vehicle collisions, though often ignored in mitigation initiatives. Although amphibians can be considered a "mitigation group", in a sense that species can have common mitigation strategies - such as amphibian specifically designed underpasses -, single species may also present particularities important to be considered for a comprehensive mitigation program. Finding such particularities is especially relevant in regions with high amphibian species diversity. We evaluated factors related to temporal and spatial patterns of amphibian and single species roadkills on a 4.4 km road section in southern Atlantic Forest, Brazil. We recorded 1433 roadkills and estimated a mortality rate of 9002 amphibians/km/year. The species most often recorded were the largest ones: Leptodactylus latrans, Rhinella icterica, Leptodactylus gracilis and Hypsiboas faber. Amphibian and single species mortality were both concentrated in summer, and were mostly associated with temperature, rainfall and photoperiod. Leptodactylus roadkills were strongly influenced by vehicle traffic, probably due to its high abundance during the entire study period. The location of roadkill hotspots differed between amphibians as a group and single species, and factors related to spatial distribution of roadkills for each group were also different. Amphibians' hotspots were associated to water area and negatively to distance from permanent waterbodies. Leptodactylus latrans mortality was mostly related with road ditches. Rhinella icterica roadkill was mainly associated with street lights, Leptodactylus gracilis with water area and Hypsiboas faber with agriculture, marshy forest and pasture area. Mitigation measures at species level must be combined with measures at group level for a comprehensive roadkill mitigation program. For example, hotspots of all amphibian species and also of target species must be considered for selecting locations for passages. Specific factors related to roadkills should be taken into account to address a greater diversity of species at mitigation. Considering that, roadside ditches, artificial waterbodies, and conventional street lights should be reduced as much as possible, since they may represent ecological traps for amphibian populations. Species particularities should be investigated to refine mitigation strategies, and basic knowledge on species/populations ecology and local factors driving roadkills must be elucidated to achieve an effective conservation approach.

p38 Case Study: amphibian migration corridors on the background of developing network of roads in Poland

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In recent years Poland made a huge step forward in the field of environmental protection. After EU accession our country made obligation to introduce Birds and Habitats directives to national law, establishing Natura 2000 sites on one hand and describing methods of environmental impact assessment on species and habitats of planned investments on the other. It forced all institutions and companies to implement changes, which enable for realisation of common EU goals and agreements. One of many elements, which are subject to analyses, is to establish the scale of investment impact on amphibians, also indicating proposals of actions, necessary to undertake for purpose of minimising the influence of roads on these animals and methods of monitoring during construction and operation. The following presentation is about a group of animals, that is endangered throughout the world, and due to that requires special means of protection. Species of amphibians living in Poland are briefly introduced, the description of their migration routes is explained, when they are used and especially how new road investment influences them and amphibian population on site of investment and in close surroundings. Together with development of road network methods of environmental protection against their negative impacts are developed simultaneously. What you will find in this presentation are methods of securing amphibian habitats before construction stage, to prevent them from entering works area and ways to minimise and compensate for negative impact of investments on them, utilised in Polish road construction industry, based on existing projects. It is doubtless that keeping the ecological continuity of habitats is necessary in the same way as taking care of amphibians safety during construction and operation. Question arises however, whether we are capable of finding a reasonable solution, which maintains stability between protection of nature and road profitability?

p39 Brown bear mortality on roads and railways in Slovakia: patterns, trends, factors

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The brown bear (Ursus arctos) has recovered in the Western Carpathian Mountains from a small relict population in the 1930s to a current estimate of several hundred individuals. Around 95 % of the population is in Slovakia, where collisions with vehicles are now the second most common cause of known mortality after hunter harvest. At least 47 bears collided with vehicles in central Slovakia between 2000 and 2010. A matched-pair case-control study was performed to test the hypothesis that bear-vehicle collisions are associated with a) the presence of food sources, b) disturbance of biocorridors, c) low visibility due to the structure of travel routes and vegetation. The characteristics of bears involved in collisions were investigated using conditional logistic regression. The spatial distribution of collisions was visualised using ArcGIS. Anthropogenic factors significantly associated with collision sites (n = 47) compared to non-collision sites (n = 47) along roads and railways were identified. Thirty-two (68 %) of collisions involved a road vehicle and 15 (32 %) a train. Accidents most often occurred in June, October and September. They usually involved male bears up to the age of 3 years. Multivariable conditional logistic regression showed a strong association between collision sites and the presence of forest cover and arable land ($p < 0.05$). These factors were approximately eleven times more likely to be present at a collision site compared to a control site (OD 11.19, 95 % CI 0.94 – 133.04). When developing measures and prioritising locations to decrease the number of bear-vehicle collisions, the presence of both forest cover and arable land should be considered. Possible mitigation measures include 'green bridges' to facilitate safe wildlife crossing of transport routes, electric or other wildlife-proof fencing in areas with a high risk of collision and, possibly, use of chemical or other repellents.

p40 Designing wildlife corridors in the Czech Republic - habitat suitability approach

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The presented poster introduces methods and some outputs of a project aiming to improve protection of the landscape permeability for migration of large mammals in the Czech Republic. The main objective of the project was delimitation of migration corridors representing a coherent ecological network connecting areas of existing or potential presence of species of interest. Based on mapping of current and historical occurrence of selected species of large carnivores (lynx, wolf, bear) and ungulates (roe deer, moose), areas of potential presence of such species including the analysis of connectivity of these areas were defined. In case of large carnivores in the Czech Republic, where only "presence-data" were available, two different method were used: 1.Mahalanobis Typicality is derived from Mahalanobis distance which expresses the likelihood that a set of environmental variables at specific location is typical to a known location of the species (Sangermano & Eastman 2007). 2.Environmental Niche Factor Analysis (ENFA) compares, in the multidimensional space of ecological variables, the distribution of the localities where the focal species was observed to a reference set describing the whole study area (Hirzel et al. 2002). At the same time, all categories of anthropogenic as well as natural barriers were described and analysed. Migration corridors designed over detailed topographic datasets regarding the results of habitat analyses of both groups of animals were subsequently tested in field. The project resulted in a coherent network of both existing and potential migration corridors categorized according to permeability as well as management plan and monitoring proposal.

p41 Totfund-Kataster Schleswig-Holstein; A System for Surveying Dead Vertebrates in Landscapes

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Railways and roads are a great source of hazard not only for humans but also for wildlife, and wildlife-vehicle collisions are the most frequent cause of death for some species. In our project we offer an open system to survey all accidents with wildlife - and more: It is also possible to register all animals found dead in the landscape -. For further investigation of the causes of accidents it is necessary to collect exact locations of the accident sites and species involved. In the long run, we collect the data for prevention of accidents. Planning authorities, ecologists, and wildlife biologists can use this data for research and for prevention of accidents involving deer at known deer crossing points. The fragmentation of landscapes by new and existing roads or railroad tracks and settlements is still expanding. Traffic is also increasing and will be for many years. Meanwhile, collisions with wildlife are a risk for humans life and also play an important role for populations of many wildlife species . Implementation and Method In Germany normally hunters will be informed by police if an accident with wildlife happens. All of Germany is divided into hunting districts, and for each district there is a hunter who is responsible. Hunters have a great experience on roadkill, this is of great importance for the project, and for this reason collaboration with hunters is important. The first phase of the project was a survey of all hunting districts of our project area (Schleswig-Holstein). All hunters received a questionnaire with a map of their district, and were asked to document all places with accidents involving wildlife on this map and in the questionnaire. We requested information about species, age, gender, date and if possible hour of accident, as well as some additional information. For second phase of the project we have developed an internet-based platform using WebGIS for reporting accidents involving wildlife. This system is designed for long term use. More than 9000 roadkills are reported since the program started in May 2011. Goals The data generated can be used in many contexts: traffic- and land use planning, prevention of accidents and wildlife research. In the last ten years the public has become much more aware of the effects of landscape fragmentation from traffic, including its influence on distribution and genetic exchange between populations. Further perspectives The architecture of the web system is open for further expansion. Through collaboration in research, public administration of this surveying system can be improved. It is open for all federal states of Germany and in principle could be implemented in any country. For example, data on birds killed by wind energy plants could be collected. In our project region (Schleswig-Holstein) we use the official basic topographic maps and aerial photos. Since May 2012 an App "WTK-SH" for Apple(TM) iPhone is available.

p42 Permeability of road and railroad networks for large wildlife in Sweden

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The Swedish Transport Administration is developing environmental quality goals for a sustainable infrastructure and among these permeability and safety (for wildlife) are recognised targets. Roads and railroads can substantially diminish chances for a sustainable wildlife management and conservation. Mitigation by means of safe wildlife passages is possible but very costly and the effect is often rather local. Mitigation measures should hence be placed where their overall effect is maximised. However, conventional road bridges, culverts and other technical crossing structures may also serve this purpose, even if to degree and hence contribute to create a permeable and safe transport infrastructure. We developed evaluation criteria for such conventional measures based on our previous empirical studies on wildlife-vehicle accidents and passage use. We then applied these criteria to the Swedish road and railroad network in order to identify potential deficiencies in permeability for lager wildlife. This analysis provides input to a nationwide mitigation plan that shall help the Transport Administration to reach its sustainability objectives. Our approach contained multiple steps:

1) We mapped potential infrastructure barriers based mainly on traffic and design characteristics combined with transport safety policy and planned infrastructure upgrades.
2) We evaluated existing conventional crossing structures with respect to their probable use by wildlife and estimated their remedying effect on the identified barriers, combining passage efficacy and area-effect.
3) We identified the remaining, i. e. unresolved barriers and evaluated the need and feasibility for mitigation measures in dependence of regional and local terrain features and in dialogue with managers, engineers and land owners.
4) From this, we estimated the overall level of permeability of the road and railroad network for larger wildlife. The permeability measure and the resulting mitigation deficiency shall serve as an ecological performance indicator for the administrative districts of the Swedish Transport Administration. The approach will be developed further to include more, especially smaller species. In our paper, we focus on the GIS work, its fundamental assumptions based on empirical studies, important practical simplifications and implementation constraints that enforce pragmatic results.

p43 Identification of areas with high probability of bat-crossings on the regional scale

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Several bat species are highly sensitive to habitat fragmentation caused by transportation infrastructure. Collisions of bats with traffic are likely wherever train routes and motorways cross regularly used flight routes. In order to mitigate conflicts between bat conservation and transportation infrastructure potential conflict areas are to be identified in advance. As some of the most sensitive bat species are highly mobile – e. g. Geoffroy's Bats (Myotis emarginatus) commute up to 15 km between colony and foraging habitats – the identification of flight paths may require extensive field studies. To address this issue efficiently, we developed a model approach to identify flight paths of the Geoffroy's Bat without the need for large scale field studies. We developed a flight path suitability model based on presence-absence data and a least-cost analysis for the Geoffroy's Bat. Based on telemetry data of 20 known flight paths of 7 Geoffroy's Bats, we identified habitats preferred by animals on commuting flights. Important parameters were distance to water streams as well as height and coverage of trees and shrub. Based on these habitat parameters, a cost-distance matrix with a spatial resolution of 10 x 10 m per cell was calculated. Cells with high values for vegetation cover, vegetation height and low values for distance from water streams had a low space resistance and vice versa. In a second step, least-cost pathways from starting points to destination points were calculated. Starting points were known roosts of Geoffroy's Bats. Destination points were known or potential foraging habitats within the range of the colonies. The resulting flight paths were validated in three steps. First, we checked whether the known flight paths were "identified" by the model approach. Second, we controlled all modeled flight paths concerning existing guiding structures. Third, we checked if there were obvious potential flight paths that were not identified with the model approach. The results showed that nearly all known flight paths of the colonies were matched by the model approach and that all modeled flight paths were plausible. Therefore, this approach enables the prediction of areas with high probability of commuting flights on the regional scale and, as a consequence, it enables to identify potential conflict areas at transportation infrastructure efficiently.

p44 Study of predatory arthropod assemblages on Hungarian highway verges

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Highway verges should play an important role as habitat, green corridor or refuge for arthropods in human-dominated landscapes. During a two year-long survey (2009- 2010) Spider (Araneae) and ladybird (Coccinellidae: Coleoptera) assemblages were studied (from faunistical and ecological point of view) on 28 highway rest stops of 5 Hungarian highways. Ground-dwelling spiders were sampled by D-vac suction sampler, spiders and ladybirds from the shrub layer were collected by limb-beating. Two guilds of ground-dwelling spider species seemed to be dominant on grassy habitats of highway stops: agrobiont spiders (Trichoncus hackmani, Meioneta rurestris, Pardosa agrestis) and myrmecophag species (Asagena phalerata, Thanatus arenarius, Hahnia nava). The mowing means similar disturbance pattern as harvesting on agricultural landscapes. The agrobiont species accommodated to regular periodic disturbance on their natural habitats so these are suitable pioneers of highway grassy habitats too. The regular disturbance subserve ant communities to reach high abundance, therefore the myrmecophag spider species could easily survive in these habitats. At shrub layer the disturbance-tolerant spider and ladybird species were abundant (Philodromus cespitum, Phylloneta impressa, Araniella spp.; Adalia bipunctata, Coccinella septenpunctata, Hippodamia variegata) which are dominant species of intensively managed orchards and urban parks as well. The invasive harlekin ladybird (Harmonia axyridis) seemed to be the 2nd most abundant species although it was first recorded in Hungary in 2008. A few protected spider species (Argiope lobata, Geolycosa vultuosa) and rare species (Alopecosa taeniopus, Xysticus marmoratus) were also found during the surveys.
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p45 Influence of forest fragmentation on biodiversity: Consequences for green and transport infrastructures

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Habitat loss and fragmentation are thought to be major drivers of the ongoing global biodiversity crisis. A central tenet of fragmentation theory, the extinction threshold hypothesis, states that fragmentation aggravates the effects of habitat loss, making more habitat necessary to avoid extinctions. However, adequate empirical tests of this hypothesis are scarce, and there are none at broad geographical scales –i. e. the scale most critical to inform biodiversity conservation policies and strategies. Here we present a Spanish- and European-scale research proposal that combines atlas species distribution data, the satellite imagery-generated CORINE Land Cover database, and statistical modelling with logistic regression techniques in order to: (1) test this hypothesis for the plant and vertebrate forest species of both regions; and (2) employ the resulting logistic models to generate maps at both scales reflecting risks of local extinctions due to forest loss and fragmentation. Also, to support these questions methodologically and expand their theoretical scope, (3) analyze the influence of transport infrastructures on these values of fragmentation and related biodiversity. The results of this research are relevant for the development of an integrated green/transportation infrastructure and for conservation policies involving the forest biotas of Europe in general and Spain in particular.

p46 GIS methodology for the spatial analysis of wildlife-related traffic accidents

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Wildlife-related traffic accidents are not distributed randomly on the road network of a territory. From the previous research it is evident that they occur at clusters on certain road sections. Geographic Information Systems (GIS) and the existing range of spatial analyst statistic tools allow to process large amounts of data about the location of the accidents, and thus precisely obtain the high risk sections. These results are extremely useful to locating potential mitigation measures. Measures which need information about optimal location are those which consist of improving drivers awareness (signalization) and those aimed at providing safe crossing opportunities (passes or channelling animals towards high visibility zones to cross). Knowledge of the location of these sections also allows for the development of tools based on GPS navigators and mobile technologies to alert drivers when they are approaching a high risk accidents section. Once we know where these high risk sections are located it is possible to assess predictors of the wildlife-related accidents risk on a given section; previous research has found road, traffic and landscape characteristics to influence the occurrence of accidents. This information facilitates transportation planners to prevent future risk sections and to design mitigation measures for specific points, even in the road design phase. We present a GIS analysis methodology to identify the wildlife-related accident risk sections and to extract the road (road characteristics, existing signalization), traffic (volume, temporal pattern) and landscape (vegetation and fragmentation metrics) variables to be used in the analysis of the factors that may influence the probability of accidents. Calculation of the risk sections was performed using Kernel Density Estimation through the software Sanet. The variables were selected based on existing literature and each one was extracted from the existing GIS data layers using diverse procedures with GIS. We have worked with a data set with 3,143 wildlife-related traffic accidents occurring between 2006 and 2010 on Galician (northwest Spain) regional roads.

p47 Optimizing verge mowing management along navigable waterways in Flanders

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The ultimate aim of an ecological mowing management is to enhance biodiversity. Mowing changes the competitive relationships in a vegetation by suppressing productive species and favouring small-statured species. Through repeated mowing with disposal of cutting material, soil nutrient availability is gradually lowered. In this way, the dominance of productive plant species is reduced so other and more plant species can co-exist. A decade ago, verges along several Flemish navigable waterways were mowed half June and half September. In Flanders, these dates are part of a legislative regulation. Recently, mowing management have been optimized according to verge vegetation and structure:

- Non-productive vegetations require only one cut per year around half September. The aim is to preserve these nutrient-poor vegetations.
- Productive and species-poor vegetations are mown two times per year. The aim is to develop species-rich vegetations. A first cut half June and a second one half September is advised.
- For moderately productive and species-rich vegetations, two cuts per year are applied.

The aim is to preserve these vegetations. When ecologically important early flowering species are lacking, a first cut around half May is advised. At this time productive species have gained a lot of biomass, so that mainly these species are disadvantaged by mowing. By performing a first cut in May small-statured species still have the ability and time to regrow, flower and set seed during the growing season. When ecologically important early flowering species are present, they should have time to flower and set seed. In that case it is advised to postpone the first cut, for example, until half July. • A differentiated management (partly one cut, partly two cuts) is set up for wide verges. In this way, the structure of vegetation is made more favourable to fauna. It is recommended to use mowing machinery that produces coarse-structured cutting material, like disk mowers or cutter bars. By this way cuttings can be removed efficiently. Flail mowers produce fine cuttings and, therefore, cuttings are difficult to remove thoroughly. As a consequence nutrients can leach out of the cuttings and enrich the soil. Another option is to work with machinery that, at the same time, cut and remove the material by air suction. However, these negatively affect the invertebrate community and plant propagules density. In future, verge mowing can be optimized by performing following research:

- for productive vegetations: research to determine mowing dates suppressing productive species as much as possible by removing highest possible biomass;
- for moderately productive vegetation: research to optimize the period of first cut to achieve a maximum degree and duration of flowering;
- concerning mowing material: expanding the knowledge of the effect of different mowing machinery on the occurrence of plant propagules, fauna mortality and nutrient leaching.

p48 The role of dry ledges and combined fencing in maintaining landscape connectivity for carnivores

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Wildlife crossing structures combined with fencing seek to improve permeability and habitat connectivity across roads and reduce wildlife-vehicle collisions. However, the presence of water inside culverts can limit their use and the implementation of dry ledges can be a good measure to allow crossing when flooded. So far, there is lack of knowledge on the effectiveness of dry ledges and fencing for a wide diversity of vertebrates. The main goal of this study is contribute for an appropriate design and placement of dry ledges and fencing to reduce mortality and improve habitat connectivity for Mediterranean mesocarnivores (red fox Vulpes vulpes, stone marten Martes foina, Eurasian badger Meles meles, otter Lutra lutra and genet (Genetta genetta). Between January and March 2008, wooden dry ledges were placed in 15 of 31 surveyed culverts. Additionally 100 meters of small mesh size and buried fences were installed along each side of all culverts. We used video surveillance and track-plates to detect crossing events. Monitoring was conducted over seven consecutive nights per season in each culvert for one year. We used GLMM to evaluate the relative importance of dry ledges on culvert use and compared the number of road-kills within a 100 m buffer radius around the culverts before and after fence installation. Although species responded to culvert features differently, dry ledge was the most relevant feature explaining crossing events, in particular, for stone martens and genets. Opposite to the expected, buried fencing did not reduce the effects of road-kills even for ground-dwelling species. Several factors may explain these results:

1) implementation of the small mesh buried fence was not long enough (100 m on each side), especially for mesocarnivores with large spatial requirements;

2) the fence did not have any structure to prevent climbing.

Our results imply that for a successful management of the road network, permeability should take in account not only the number and complementary sizes of crossing structures but also identify where the permanent streams intersect with the roads and place ledges in flooded structures (above 3 cm water-depth) most of the year. Thus, ledges should be placed when there are no available suitable crossing structures to provide safe highway crossings within the distance of the species daily movements. In the case of stone martens and genets, if there are no dry crossing structures within 1000 m, we suggest placing at least one dry ledge. We also recommend testing longer fences and different designs to prevent individuals from climbing over in segments of roads with high road-kill incidence to obtain clear and quick results.

p49 Is the opportunity for creation of green infrastructure on Service Areas (MOP) made use of? Case study on Polish motorways

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The aim of this study, was to verify to which extent the management of green areas along the motorways used the opportunity to introduce elements of natural environment into areas designed for rest and recreation, i. e. created an element of green infrastructure. Materials and methods. The study comprised flora and vegetation on all service areas along Polish motorways. The share of plant species of different origin (native versus alien) and of plant communities (natural, seminatural and synanthropic) was analyzed on the background of habitat diversity, type of surrounding landscape, geographic region and intensity of management. Results. The study confirmed the presence of some remnants of natural elements despite transformation of habitat connected with motorway construction. On the other side the newly arranged greenery has shown little differentiation and small affinities with surrounding landscape as result of very uniform management. Conclusions. The management of greenery along studied motorways very seldom made use of opportunity to include some natural elements in accordance to habitat conditions and type of surrounding landscape. Proper management could create a more diversified space without being in contradiction with anthropocentric functions i. e. rest and recreation.

p50 Factors determining the use of culverts underneath highways and railway tracks by bats in lowland areas

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In urbanising environments the construction of suitable underpasses for bats under highways and railway tracks is becoming increasingly important to avoid habitat fragmentation. Culverts provide valuable and low cost underpasses as they are already an intrinsic part of highway design and many bat species associated with water are likely to follow the streams or canals that flow through them. Bat detectors were employed to study the use of 54 culverts by bats in the Netherlands. The aim of the study was to define the factors that determine bats' use of culverts. Bats were observed in the vast majority of the culverts that were studied, thereby underlining the importance of culverts in habitat defragmentation. Species adapted to hunting in open habitats, such as the noctule (Nyctalus noctula) and the serotine (Eptesicus serotinus), were often recorded in front of the entrance but rarely inside culverts. For the three species that were regularly recorded inside culverts, Daubenton's bat (Myotis daubentonii), the pond bat (Myotis dasycneme) and the common pipistrelle (Pipistrellus pipistrellus), cross sectional area was the most important factor that determined their use of culverts. Height was the most important component of cross sectional area for bats. Length proved a non-significant factor, suggesting that bat underpasses are not affected by the widening of the above-lying infrastructure. Additional guidance by treelines along the banks did not increase the use of culverts by the three species. The implication of the different preferences for cross sectional area on the design of infrastructure is discussed.

p51 Factors determining the efficacy of badger tunnels

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In the Netherlands hundreds of small mammal tunnels have been built under roads and railway lines; in most cases with badgers as the target species. The tunnels show considerable similarity, but they differ in size, shape, inclination, distance to badger sets, etc. For most tunnels the use by badgers and other fauna is monitored. For each species the frequency of use is reported as the number of visits during a standard period of time. This resulted in a large set of quantitative data for more than 400 tunnels. We used a selection of this dataset to test which physical components determine the use of the tunnels by badgers. Only tunnels with badgers known to be present in the neighbourhood were selected, resulting in a dataset of 139 tunnels. We tested the use of the tunnels, expressed as the frequency of passage, against a number of tunnel aspects, like its dimensions (width and length), shape (circular or rectangular), material (concrete, steel, plastic), inclination (horizontal or with a slope at one or both ends) etc. Aspects such as the general maintenance state of the tunnel and the adjacent fence, the state of the surrounding area (open, half open, closed, urban), the presence of landscape elements as guiding structures, badger density and distance to the nearest badger set were also included in the analysis. Because many of the aspects were interdependent, we carried out the analysis in sequential steps. The techniques we used were Non-parametric test (pre-analysis), Principal Component Analysis (PCA) and Generalized Linear Model (GLM). The final result of the tests was that none of the physical aspects of the tunnel explains the frequency of use. When corrected for the badger density and distance to the nearest badger set the landscape structure was the decisive factor to predict badger use. In half open landscapes, with c. 50 % (25-75 %) wooded banks, hedgerows and c. 50 % grassland, arable land, ditches etc, the frequency of use was highest, while in urban landscapes it was lowest. Other physical aspects also influenced tunnel use, like the permanent presence of water in the tunnel or the condition of the adjacent fence, but these aspects are of secondary importance and too incidental to have a significant effect. This study shows that badgers have a large tolerance towards the type of mammal tunnels used in the Netherlands. The frequency of use depends primarily on the surrounding landscape. The type of passageway seems of minor importance.

p52 The Northern Stretch of the "Mario Covas Beltway" - Environmental Impacts and mitigation measures

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The Northern Stretch of the "Mario Covas Beltway" (Ring Road), one of the largest and most important current roadworks in Brazil, will be 42 km long. Its goal is to link the major state and federal highways that reach the city of São Paulo, ordering traffic in a region where more than 11 million inhabitants live. The great complexity in its construction occurs due to proximity to the Cantareira State Park and consolidated urban areas. It should be noted that this park has 79,16 km^2 and is part of the Atlantic Forest and has the status of City Greenbelt Biosphere Reserve by UNESCO. The Environmental Impact Statement (EIS), containing data to help analyze the environmental feasibility of the project included studies of locational alternatives. Macro-guidelines were defined, called "Internal", "Intermediate" and "External". From the analysis of these studies, it was found that the "Internal" macro-guideline was the least impactful to the biota, since it would result in less pronounced effects associated with forest fragmentation, preserve important wildlife corridors, and avoid direct interference in the Cantareira State Park. Although more environmentally friendly, this alternative would be closer to the urban area of the metropolis. It is noteworthy that, for this reason, there was significant popular participation in the licensing process. According to the EIS, it was estimated for the implementation of the project a suppression of 113,9 ha of native vegetation. Furthermore, it was expected to intervene in 178,5 ha of Permanent Preservation Area. Regarding the fauna, the field survey revealed the great diversity of the region, with 64 species of mammals, 211 species of birds, 48 species of amphibians, 16 species of reptiles and 19 species of fish, with a total record of 342 species. To mitigate impacts on flora and fauna, the following programs are to be provided: Rescue of flora and fauna during construction; Environmental Management Program Operation (Fauna Monitoring - to check the efficiency of fauna underpasses and the rates of road kill wildlife) Forest Monitoring and Fauna in Areas Adjacent to the Cantareira State Park and Monitoring for Targeted Populations of howler monkeys (Alouatta clamitans) in specific areas. To the South of the Cantareira State Park, separated by a strip of grass which difficult connectivity, there is a forest fragment characterized by vegetation in the intermediate stage of regeneration, inhabited by howler monkeys. The passage of the Beltway through this band could represent a physical barrier to further significant populations of howler monkeys. Thus, there will be a program targeted specifically to these animals. It is emphasized that the ecological question guided the majority of decisions for the Project Northern Stretch of the Mario Covas Beltway, regarding in choosing the choice of the route, in defining technological alternatives and in preparing Environmental Programs. Adjustments were required and the adoption of more flyovers in order to minimize impacts related to removal of vegetation, fragmentation of remaining forest and movement of fauna.

p53 Effects on terrestrial mammals of access roads in wind farms – a review

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We synthesized available knowledge on the effects of access roads in wind farms on terrestrial mammals. Presently, there is a rapid increase in wind farm development in Sweden, and most new farms are planned in the boreal forest region. Moreover, wind farm development is selectively targeted to hilly or rugged terrain away from human settlements; areas which often serve as refugia for large mammals. Concerns are hence raised on the impact on forest wildlife and semi-domestic reindeer. Because studies specifically addressing transport infrastructure in wind farms are few, conclusions were to a large extent extrapolated from research on other types of minor roads. The review gave at hand that i) the major impact on ungulates and large carnivores may be disturbance from human recreation (including hunting and leisure traffic) facilitated in wind farms by the new road network, ii) although roads in wind farms may be barriers for small mammal movements, they may also function as corridors for large mammals, iii) the conversion of original habitat into roads and roadsides should in most cases be of little detriment to large mammals, that move over large areas and whose population densities are mainly regulated by harvesting, but iv) secondary growth along roads may benefit mammalian herbivores. Therefore, deliberate siting of wind farms and management of recreation and other disturbances appear to be crucial factors to avoid negative impacts from access roads on large mammal populations. Roads in wind farms are however unique in structure and use, and we call for research addressing this specific road type. We particularly point out the importance of assessing the cumulative ecological effects of wind farm roads in combination with the existing road network, and to establish scientifically sound monitoring programs to improve the knowledge base.

p54 Socio-economic drivers of landscape fragmentation in Europe

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The current trend of steadily increasing landscape fragmentation contradicts the principle of sustainability. However, many more new transportation infrastructure projects are planned, which will further increase the level of fragmentation in Europe significantly. The extent of landscape fragmentation is largely a function of interacting socio-economic drivers such as population density and geophysical factors such as topography. How well various socio-economic factors explain landscape fragmentation in Europe? The project quantitatively investigated the degree of landscape fragmentation for 28 countries and 580 NUTS-X regions. It applied the method of "effective mesh density" to quantify the degree to which the possibilities for movement of wildlife in the landscape are interrupted by barriers. Many highly fragmented regions are located in Belgium, the Netherlands, Denmark, Germany, France, Poland and the Czech Republic. The project investigated potential causes that contribute to an increased or decreased degree of landscape fragmentation. Current levels of landscape fragmentation need to be interpreted within the context of these regional socio-economic and geophysical conditions. Therefore, we analysed the statistical relationships between landscape fragmentation and a range of predictive variables, applied these relationships to predict the likely fragmentation values for all regions in our study area, and compared actual values with predicted values. To examine how the socioe-conomic parameters are related to fragmentation levels, we used generalized linear models (GLM). In general, the most relevant variables affecting landscape fragmentation were population density, gross domestic product per capita, volume passenger density, and the quantity of goods loaded and unloaded per capita. The amount of variation in the level of fragmentation that was explained by the predictor variables was high, ranging from 46 % to 91 % in different parts of Europe. The statistical relationships indicated that different drivers of landscape fragmentation are important in different parts of Europe. Efforts for curtailing landscape fragmentation should take these differences into account. The results demonstrate that there is an urgent need for action. Large discrepancies between predicted and observed fragmentation values provide a basis for identifying areas for prioritising management action. Such data also provide a starting point for scenarios for the future development of landscape fragmentation in Europe. There is an increasing need for indicators of landscape fragmentation in monitoring systems of sustainable development, biodiversity, and landscape quality. The results of this project can be used for this purpose and be updated on a regular basis. Fragmentation analysis can be used as a tool for performance review in transportation planning and regional planning. We recommend a set of measures to control landscape fragmentation, e. g., more effective protection of remaining unfragmented areas and wildlife corridors, the setting of targets and limits, and a European defragmentation strategy.

p55 The Hellenic Roadkill Observatory

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The pace of the modern world and economic development require the existence of well-developed and extensive road networks. The expansion of these networks poses a serious threat to wildlife and their natural ecosystems through increased mortality, habitat fragmentation and reduced gene flow between fragmented populations of wildlife. In Greece, wildlife – vehicle collisions first emerged as a conservation threat to local wildlife during the design and construction of the "EGNATIA" highway in the middle of the 1990ies. Since then, the Hellenic, environmental, non-governmental organization ARCTUROS, has been taking decisive actions in order to promote an environmentally friendly strategy in the construction and operation of the national road network, while initiating at the same time the first public discussion concerning the impacts of large infrastructure works on natural habitats. In 2012 and in order to improve the level of knowledge concerning wildlife mortality on Greek roads, ARCTUROS, with the support of Vodafone – Hellas, designed and established the Hellenic Roadkill Observatory (HRO). The HRO is an open-access, public website (epatap.arcturos.gr) for reporting and recording all available information regarding wildlife – vehicle collisions in the country. The specific aims of the HRO are: To raise public awareness regarding wildlife – vehicle collisions and promote active citizen participation and involvement in such issues. To improve our knowledge about wildlife mortality on roads in Greece through the collection of accurate field data. T0 identify the hot-spots of wildlife road-related mortality in the country. In the first year of its operation the HRO has collected information on more than 50 fatal collisions involving various species of Greek wildlife, ranging from small mammals such as hedgehogs to large mammals, such as bears, wolves and wild boars. It has also registered more than 50 cases of fatal collisions of domestic animals such as dogs and cats throughout the national road network. This information will complement the already existing information that has been collected circumstantially by ARCTUROS since 1990 and will be used in an overall evaluation of the national road network in order to promote effective management measures that will mitigate wildlife – vehicle collisions on a national scale in Greece.

p56 Mitigating wildlife roadkills in a Brazilian Amazon railway: a proposal of pilot study

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Terrestrial transport infrastructures (unpaved roads, roads and railways) are essential in the current socioeconomic context of most human societies, allowing the flow of a wide variety of resources and services. Thus, roads and railways cover a large territory in all continents except Antarctica. Currently, the greater recognition, by the society and governments, of the impacts of road structures leads the search for alternatives that are less striking in the planning of transport networks and the implementation of mitigation measures to the existing networks. Although considerable attention has been payed to environmental impacts of transportation corridors on wildlife, most studies are focused on the highways. Thoroughly tested for highways, efficacy studies on the adoption of mitigation measures on railroads are scarce. The Estrada de Ferro Carajás (EFC) is an 892-km-long railway linking the Carajás's mining complex, in southeast Pará state, to the Ponta da Madeira Maritime Terminal, in São Luís, capital of Maranhão state. With the purpose of the EFC expansion, Brazilian environmental agency (Ibama) has requested the monitoring of wildlife casualties, with consequent indication of mitigation structures. After making the first roadkill census, a pilot study was proposed to test the structures commonly used for highways, especially those that can be assigned even before a more robust range of information. The location of the EFC chosen is a stretch (km 791.5 to 793.5) formed by a large forest fragment (≅ 130 km^2) separated by the railroad into two parts, a lower (north – 7 km^2) and a larger (south – 123 km^2). The fragment analysis is constrained by disturbed areas such as grazing, transmission line, unpaved road, besides the EFC. This site provides outstanding wildlife roadkill, blackspot of mammals, especially primates and wild canids. Also, the mortality of snakes, frogs and tortoises in this site was registered. This area was designated as an important fauna microcorridor in the region and it is likely that these animals are dying while crossing the railroad. As a mitigation measure, it has been suggested the installation of 2.5 meters of high fences along the 2 km corridor, the mesh opening varying from 4 mm to 4 cm. Rope ladder arboreal overpasses in every 500 m will also be installed, totaling 5 structures. Finally, a tunnel (dimensions 2.2 m x 3.0 m) will be deployed as underpass and will be decorated to simulate rainforest aspects, similar to those present in their environment. The use of mitigation devices will be evaluated by camera traps, which will be installed in each of the under and overpasses. Therefore, the objective is to determine the frequency and species that use the structures installed, and also to verify their effectiveness as actions of roadkill mitigation and the maintenance of the connectivity between the fragments.

p57 First proper "after construction" monitoring in Slovenia immediately reveals bats (Chiroptera) as highway traffic casualties

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Construction of highways in Slovenia started in 1970; but the development of highways increased rapidly after 1996, when the Republic of Slovenia accepted the National Motorway Construction Programme. Since then, approximately 73 % of the 726 km of Slovenians' highways were built. This resulted in habitat fragmentation and destruction, but Slovenia's motorway managing company inconsistently monitored its consequences. When performed, monitoring in the highway operation phase was mainly conducted for larger mammals, birds and amphibians, while for bats not even environment impact assessments were made. Therefore the data on bat casualties collected on the highway section Beltinci-Lendava (NE Slovenia) represent first known facts on bat mortality caused by highway traffic in Slovenia. The standard highway-monitoring method is monitoring by car, driving with the minimal highway-speed of 60 km/h. At the beginning we surveyed the highway section Beltinci-Lendava (NE Slovenia) for bird and mammal traffic casualties using the standard car method. At the same time we also surveyed a sub-section by foot, which proved standard method to be unsuitable for detecting animals bumped of the road and smaller animals, like bats. From April 2011 to January 2012, we performed eight foot surveys on a highway stretch of 7.9 km, during which we found 17 bat carcasses out of 211 mammal casualties. The bat carcasses belonged to five species; the most frequent being Myotis mystacinus (6), followed by Pipistrellus kuhlii (5), Barbastella barbastellus (3), Nyctalus leisleri (2) and Pipistrellus pygmaeus (1). In early autumn, we found the highest number of bat carcasses (11), representing all five species, while, as expected, winter surveys did not yield bat casualties. The most interesting findings were M. mystacinus and N. leisleri, which are the first findings of these species in NE Slovenia. This indicates how under-researched Slovenian bat fauna still is. Species distribution due to habitat use could be detected, since transect included grasslands, agricultural areas, forests, forest edges and water bodies. The two forest species, B. barbastellus and N. leisler, were mainly found in forests and forest edges. P. kuhlii, which often foraging at street lights, was found in open habitats, including a lighted highway resting area. P. pygmaeus was found near Ledava River, which supports water edges being the species' most important foraging habitat. On the other hand, M. mystacinus data indicate that this species is using diverse habitats, as carcasses were found along all pre-mentioned habitats. We can conclude that highway in this area is surely disrupting commuting flights, possibly migration routes, and has fragmented bat foraging areas. However, mitigation measures are difficult to suggest without further detailed research therefore similar studies should be performed on other Slovenian highways. On general the results of presented pilot study of highway traffic impacts to protected and endangered bat species should be the cause for similar studies performed on other Slovenian highways and the call for highway planning authorities to take bats into careful consideration in pre-, mid- and post construction phases.

p58 Is there a threshold on traffic volume that change from mortality to barrier effect?

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It is known that traffic volume constitute a major factor on limiting animal's movement, through mortality and barrier effect. In general, mortality rates tend to increase with an increment in traffic intensity at a certain level and decrease above this level, suggesting a threshold on the traffic that lead to a change from mortality to barrier to movement. The main goal of this study is to evaluate this threshold on species with different life history traits. For that we collected daily road-kill and traffic data from approximately 1000 km of highways in Portugal over seven years (2003-2009). We focused on four species with high mortality rates and distinct life history habits: red fox Vulpes vulpes (29.5 ind/100 km/year), barn owls Tyto alba (5.3 ind/ 100 km/year), wild rabbit Oryctolagus cuniculus (32.7ind/100 km/year), and hedgehog Erinaceus europaeus (12.8 ind/100 km/year). We used Generalized Linear Mixed Models to evaluate the effect of traffic on their mortality rates. Models show that the number of road-kills are negatively associated with traffic volume. Mortality rates are high when highway segments are used by 500-3000 vehicles/night and are low when traffic is 3000-22000 vehicles/night. Unexpectedly, differences in mortality rates between these to traffic volume classes were more clear for less sensitive species to traffic like rabbit and hedgehog. Species detectability and abundance might be important factors influencing mortality records and therefore the relationship with traffic. These results show that apparently there is no clear traffic threshold and the low mortality rates associated with high traffic volumes may be related to low species occurrence likelihood in the vicinity of urbanized areas.

p59 Measuring the connectivity of natural areas in cities as an indicator in the City Biodiversity Index (CBI) using the effective mesh size (meff)

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Cities can contribute significantly to global efforts to reduce the rate of biodiversity loss. The City Biodiversity Index (CBI) was developed as a tool to evaluate the state of biodiversity in cities and to provide insights for improving conservation efforts. It was proposed at the 9th Meeting of the Conference of the Parties (COP-9) to the Convention on Biological Diversity (CBD) by the Minister for National Development of Singapore, Mr. Mah Bow Tan, in May 2008. Three expert workshops in 2009, 2010 and 2011 were organized by the National Parks Board of Singapore and the Secretariat of the CBD in collaboration with the Global Partnership on Cities and Biodiversity to develop the index. The CBI includes 23 indicators such as the proportion of natural areas in the city. We present the CBI with a focus on indicator 2, which measures the connectivity of natural areas in cities. Connectivity is "the degree to which the landscape facilitates or impedes movement among resource patches" and it "can be measured by the probability of movement between all points or resource patches in a landscape". However, the previous method suggested for this indicator in the CBI was inconsistent. We propose an improvement that produces more reliable results without compromising practicality in the application of the metric. The new version applies the effective mesh size method, which is based on the probability that any two randomly chosen locations in the landscape are connected and not separated by any barriers. It includes both within-patch connectivity and between-patch connectivity. The method has been slightly modified in order to keep calculations simple. We applied the old and new versions of the connectivity metric to Montreal (in collaboration with the Ville de Montreal, Direction des grands parcs et du verdissement) and Lisbon. Montreal and Lisbon agreed to test the CBI, among various other cities. The improved method has been implemented in the CBI in collaboration with the National Parks Board of Singapore and the Secretariat of the CBD. It provides a better account of the state of connectivity of natural areas, which may have implications for cities' conservation efforts. The CBI is supposed to be applied by many cities in the world for monitoring their efforts and successes in halting the rate of biodiversity loss.

p60 Road-effect zone: a tool for the environmental impact assessments and ecological compensation proposals

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The construction of a new road causes relevant impacts on wildlife, such as direct mortality through traffic, population fragmentation, and habitat destruction or damage. The identification and evaluation of ecological impacts is key for the process of Environmental Impact Assessment, since it is the basis for the proposal of mitigation measures to counteract the negative effects of development projects. But this assessment of ecological impacts is not an easy task. Although much research effort has been put into this issue, the identification and measurement of road impacts usually entail uncertainties that make difficult to ascertain their reach and significance. When dealing with impacts on wild populations, it is possible to define a zone along the roads (the road-effect zone) in which relevant changes in species richness and abundance can be detected. The width of this zone, delimited by the extent of significant ecological effect from the edge of a road, usually varies with the species and the characteristics of the road and the traffic. Within this zone, the impact caused by the road tends to diminish as distance increases. In this sense, the relationship between the magnitude of the impact and the distance to the road edge might be non-linear. From the standpoint of impact assessment, the study of these road effect zones may provide an estimation of the impact that a road can cause on a certain animal population. Although several studies have been published on this subject, they are dispersed and respond to different methodologies. This work reviews available bibliography on road-effect zone in animal communities, and gathers current data for different species with the aim of offering a tool for environmental managers and road planners. Moreover, we add some recommendations about how to use them within impact assessment procedures.

p61 Re-thinking Christaller´s central place theory: implications for spatial planning and green infrastructures

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The geographer Christaller created the central place theory (CPT) in 1933. This theory attempts to explain the urban network organization, distribution and hierarchy in an unbounded isotropic and homogeneous surface. Each human settlement acts as a central place which provides services in the area under its influence. The model proposes a hierarchical arrangement of settlements conceptualized with hexagons. The result is a kind of fractal structure where the largest hexagons, which correspond with the most important cities, contain other hexagons of smaller sizes representing the influence areas of less relevant settlements. Road network is also known to have fractal features and its patterns are closely related to the urban system. For this reason, the conceptual scheme of CPT is a useful tool to study the spatial distribution patterns of the road network. This road network alters the landscape spatial pattern and impacts on ecological communities. Thus, calm areas with low road densities have been proposed as conservation target areas. CPT could be used to locate these calm areas and, therefore, to serve as theoretical framework to plan the co-existence between human and ecological networks. In other words, CPT can be useful in defragmentation plans and green infrastructure design. We are aware of Christaller´s model cannot be found in the real world because of its initial assumptions. Obviously, the environment is not isotropic and homogeneous, at least at large scale. Nevertheless, CPT can be a good approach to understand the spatial relationship between anthropogenic pressures and biodiversity.

p62 Wildlife road mortality along Ring Changbai Mountain Scenic highway, Jilin Province, China

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Though direct wildlife mortality as a result of collisions with vehicles is now widely regarded as a conservation problem, it remains little studied in China. We conducted a wildlife road mortality study along the Ring Changbai Mountain Scenic Highway as a case study. The road bisects and is also adjacent to the Changbai Mountain Nature Reserve. We conducted a survey for one year along an 84 km section of this highway, checking the highway for road killed wildlife at least twice monthly. Overall we conducted 33 checks and we recorded 1057 roadkilled animals representing 50 different species. The recorded mortality rate was 53.65 individuals/100 km. Amphibians were the most abundant species group, representing 69.25 % of the total number of observations. Collisions between wildlife and vehicles peaked in April-July (n=898; 84.96 % of the observations). Amphibians were the most abundant species group during this period (n=715, occupied 97.68 %); The number of species were most from May to October, counting for 17, 22, 26, 21, 12, 14, respectively, the number of bird's species were most, exceeding 10 species from May to August, while less than 6 species in other months. The number of species concentrated along K5-K40, K45-K50 sections, exceeding 10 species, the number of mammal and bird species of concentrated in K5-40 section, amphibian in K10-20 section, reptiles in K10-25. There is significant correlation between species of mammal, bird and reptile of spatial distribution, except for amphibian species. The number of road casualties concentrated from K10-20, 734, accounted for 69.44 % of the total, with amphibians ranked as highest having 629 individual, occupying 86.16 % of the total, and spatial distribution of mammal, bird, amphibian and reptile of were in significant correlation (except for amphibian and reptile).This research indicates proper wildlife crossing structures needs to be locating at least along each K10-20 for safe movement of amphibians, along K5-K50 for safe movement of mammal and reptile. Limiting speed of vehicles and locating alert signs along this section are also necessary for reducing wildlife road mortality. The highest mortality was recorded from April to October, so during this period, the above measures should be primarily implement

p63 No effect of local roads on the habitat use by the Whiskered Bat (Myotis mystacinus)

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Roads can have a significant negative impact on bats. However, previous studies concentrated on major roads, while little research has been done into the effects of local roads, despite their substantial availability. As bats are crucial species in conservation, such data are needed for designing conservation plans. Using radio-telemetry on 33 individuals (18 males and 15 females) we investigated the effects of local roads with low traffic on the habitat use and selection of shelters by the Whiskered bat (Myotis mystacinus) in Western Carpathians (Southern Poland), 2009-2011. All breeding roosts of bats where located in the close proximity to roads and their location was slightly closer to roads than points selected randomly within study area. During nights bats frequently cross roads (on average 1 cross every 100 minutes) when flying from shelters to foraging grounds and between them. Moreover no individuals followed with radio-telemetry was killed or injured in traffic accidents. Our data show that local roads do not restrict habitat accessibility for Whiskered bats in Western Carpathians.

p64 Species composition and utilization of a flyover by mammals at S69 motorway in the Western Carpathians, S Poland

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Mammals are very vulnerable to road effects because of their large spatial requirements and high mobility. Wildlife crossing structures have mitigated negative effects of roads for the most of mammals, but effectiveness of various types of wildlife passes vary substantially among species. Flyovers are proposed as a mitigation measure, which may support movement of virtually all mammals, but more research is needed to fully understand utilization of such constructions by animals. We surveyed a 200 m-long viaduct at the S69 motorway situated in the Western Carpathians (Southern Poland) in order to recognize species composition and annual dynamic of its utilization by mammals. Data was collected during 12 months (from July 2010 to June 2011) of monitoring. We registered animals footprints on a sand-bed located beneath the flyover. We also applied recording of tracks on snow in winter and direct observations. Altogether the monitoring showed a presence of 15 species of wild mammals. Amongst them five are strictly protected in Poland (common shrew Sorex araneus, hedgehog Erinaceus sp., stoat Mustela erminea, least weasel M. nivalis and red squirrel Sciurus vulgaris), 2 partly protected (otter Lutra lutra and mole Talpa europea). Remaining eight species were game animals (fox Vulpes vulpes, marten Martes sp., badger Meles meles, common polecat M. putorius, red deer Cervus elaphus, roe deer Capreolus capreolus, wild boar Sus scrofa and brown hare Lepus europaeus). We recorded 2831 tracks from which wild animals accounted for 68.8 %, while domestic animals and humans for 22.3 % and 8.9 % respectively. On average, 19 crossings of wild mammals were recorded each day. The crossing structure was used mostly by roe deer (41.6 %), red fox (20.3 %), red deer (14 %) and European hare (7.5 %). Our observations support earlier suggestions, that flyovers may secure movement of all species of wild mammals across motorways.

p65 May we use large animals as indicators for mitigation planning?

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A decisive factor for the effectiveness of roadkill mitigation measures is the correct location for its implementation. Identifying roadkill hotspots through monitoring of roads has been used as the main tool to generate information and support for choosing mitigation sites. However, monitoring can be influenced by observer's detection ability and removal of carcasses, which varies according to animal body size, among other factors. Most of roadkill monitoring studies consider that detectability and carcass removal are homogeneous among different taxonomic and body size classes, which may lead to an underestimation of the magnitude of mortality and a prioritization of single species and large animals during mitigation planning. The objective of this study was to investigate whether the results obtained through identification of hotspots of large animals can be used as surrogates for hotspots of small animals, regardless of taxonomic groups. We monitored monthly, for one year, 99 km of BR-101 highway and 88 km of ERS-389 in Southern Brazil. Species were divided in 2 classes: large and small animals. Snakes with less than 1 m, birds with less than 30 cm, mammals and other reptiles with less than 1 kg were included as small animals, whereas all remaining were classified as large. We performed an adapted K-Ripley analysis to verify scales of significant aggregations, and roadkill hotspots location were identified performing a bidimensional hotspot analysis, both using Siriema Software v1.1. To test if hotspots of different size classes overlap, we performed an association test using Sorensen resemblance measure. To test if overlapping is a scale-dependent pattern, these analyses were carried out in three different scales that have significant aggregation in K-Ripley analysis: 500 m, 1000 m and 2000 m radius. We recorded 577 roadkill events at BR-101, including 89 birds, 430 mammals and 58 reptiles, resulting in 53 small animals and 524 large animals. At ERS-389, we recorded 250 roadkills, including 60 birds, 102 mammals and 88 reptiles, resulting in 70 small animals and 180 large animals. At BR-101, the similarity on roadkill hotspot location between large and small animals for 500 m scale was 0.17 ($p = 0.02$), 0.27 ($p = 0.001$) for 1000 m, and 0.37 ($p = 0.001$) for 2000. At ERS-389, the similarity of hotspots location for 500 m scale was 0.13 ($p = 0.02$), 0.17 ($p = 0.01$) for 1000 m and 0.39 ($p = 0.001$) for 2000 m. Our results show that coincidence of roadkill hotspot location is relatively low between large and small animals although this pattern is scale dependent, i. e., larger scales result in a higher coincidence. This means that larger animals, of easier detection and greater persistence on road, cannot be used as surrogates if mitigation planning aims to reduce mortality in a "biodiversity" context.

Wednesday, October, 24

Plenary Session 3

Distinguished experts from Europe and North America have been invited to introduce selected themes, discuss urgent problems and effective solutions, as well as share their visions for transport and infrastructure ecology.

ps5 How to address biodiversity and safeguard ecological functions when implementing fauna passages or green infrastructure across and along roads

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The core of biodiversity is, first and foremost, species diversity. However, biological diversity is much more: the genetic diversity within populations, the diversity of species communities and their ecosystems, the diversity of landscapes, the diversity of population dynamics and especially the (resulting) interactions between populations of species and between species and abiotic environmental traits. From a functional perspective, the main driving forces of species diversity are the interactions between species and their spatiotemporal dynamics in the context of geological and climatic heterogeneity. All of it is strongly dependent on the mobility of specimens or genes. Life is mobility. And all of it is also strongly affected by landscape and habitat intersection. Most of it, however, is overlooked: the majority of species, namely insects, and especially ecological functions such as zoochory (dispersal of seeds and small animals by bigger ones), habitat creation and habitat heterogeneity accomplished by bioengineers, shifting predator-prey interactions that lead to habitat diversity, mosaic communities and mosaic cycles (habitat dynamics) etc. are disregarded in impact assessment and regulation.

Integrative monitoring results meanwhile suggest that e. g. overpasses that are suitable for paw footed mammals are not necessarily fit for hoofed animals and even the best deer passages can be inadequate for flightless insects and vice versa. Consequently all significantly affected ecological guilds must be considered and, most of all, ecological functions like zoochory, migration and dispersal of habitat engineers, spatiotemporal population dynamics of habitat engineers, predators and prey species or even pests that are part of the disturbance system have to be taken into account. If EIA, impact regulation or monitoring are concentrated either on only a few species, on single species groups or on habitat topology, any outcome will be inadequate.

Using integrative monitoring results of the Holsatian Habitat Corridor System (since 2005), long term monitoring of the "B31"-overpasses (since 1991) and investigations of the effects of game on insect reproduction, insect mobility, plant communities and habitat structure, the presentation will propose why and how biodiversity could be practically addressed in planning and monitoring. Therefore the representativeness of indicator systems should be discussed accordingly to the different scales of spatial planning.

The monitoring mainly comprises big and medium sized mammals, reptiles and amphibians, ground beetles and grasshoppers, vascular plants and habitat traits but also bats and rodents, birds, butterflies and dung beetles, spiders, lichens and mosses. The proposal will show practical representative indicators for deriving impact analysis and mitigation planning, and it will show the necessity of combining overpasses with the strengthening of dynamic habitat corridors on local to regional scales and wildlife management and corridors on local to supra-regional scales. Certain road side verges as well as railway and energy lines can be part of such integrative mosaic corridor systems.

ps6 Wildlife crossing structures: How to evaluate their effectiveness?

Edgar A. van der Grift

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Roads may have a severe impact on wildlife. They have the potential to cause mortality in wildlife, disrupt animal movement and affect both the amount and quality of wildlife habitat. Consequently, road networks can potentially jeopardize the long-term persistence of wildlife populations, communities and ecosystems. To prevent such impacts, currently road administrations and nature conservation organisations around the world spend considerable amounts of money annually on wildlife crossing structures. The question that consequently rises in response to such investments is: do they work? And how can we best evaluate their effectiveness?

Previous studies have clearly demonstrated that many wildlife species will use wildlife crossing structures to cross roads. They have also shown that the rate of passage use varies according to species and depends primarily on the design/dimensions of the structures and their position in the landscape. Although knowledge about the use and performance of a wildlife crossing structure provides proof of passage acceptance by wildlife and the existence of a certain level of habitat connectivity, usually little conclusions can be derived about to what extent pre-road conditions have been restored or genetic interchange is guaranteed, and even less about the effect of taken measures on the viability of the population. Hence in most studies the effectiveness of wildlife crossing structures at reducing road impacts, including the risk of population extinction, remains unclear.

The paucity of studies directly examining the effectiveness of crossing structures is exacerbated by the fact that such studies are often poorly designed, which limits the level of inference that can be made. Without well performed evaluations of the effectiveness of road mitigation measures, we may endanger the viability of wildlife populations and inefficiently use financial resources by installing structures that are not as effective as we think they are. he essential elements of a good experimental design for such assessments :

(1) Identify species and goals for mitigation;

(2) Select species for evaluation;

(3) Select measures of interest;

(4) Select study design;

(5) Determine sampling scheme;

(6) Select appropriate study sites;

(7) Select covariates to measure;

(8) Select suitable survey methods;

(9) Determine costs and feasibility.

It is recommended to use population models prior to the start of the monitoring to explore the best experimental design, e. g. to assess the best study design and sampling scheme. Such model simulations may provide valuable insights in the probability to measure effects of road mitigation in relation to e. g. the number of study sites or the duration of the monitoring. Hence, money and efforts can be spent more efficiently and better-founded decisions can be made what monitoring actions to start and what not. The here presented framework will facilitate collaboration between road agencies and scientists to undertake research programs that fully evaluate effectiveness of road mitigation measures.

The difficulty with such research programs in practice, however, is that they are often time-consuming, costly and complicated to carry out. After all, in such programs a BACI study design is the preferred one, where population parameters are measured both Before and After the construction of the crossing structures, at both Impact and Control sites, i. e. sites where crossing structures are build and sites where they are not. The use of modeling tools to estimate planned or established impacts of wildlife crossing structures on population viability may therefore be a valuable substitute to such research programs. With the metapopulation model METAPOP we analyzed the effects of wildlife movements across a wildlife crossing structure between two subpopulations and the survival probability of both subpopulations. We ran the analyzes for a small, medium-sized and large mammal. Based on the model simulations we developed general guidelines for the amount of exchange needed for population persistence. These guidelines, together with data on crossing frequencies acquired in field surveys, help to assess what type of wildlife crossing structure, and how many, are needed in any particular situation to facilitate the necessary wildlife movements. Although the model estimations do not exactly reflect reality due to model assumptions and the rather simple model 'landscape' chosen, they do provide a quick-and-dirty first indication whether our road mitigation measures are, in terms of improving population persistence, on the right track or not.

ps7 Incorporating experiments into road mitigation and monitoring projects

Rodney van der Ree

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Introduction

Roads and traffic have significant negative impacts on a wide range of taxa ranging from snails to bears and birds to bats (e. g. Fahrig and Rytwinski 2009). Increasingly, road designs are modified and specific structures installed on new roads and retrofitted to existing roads to mitigate these negative effects. The mitigation typically includes fences that limit access to the roadway to prevent mortality of wildlife and under- or over-passes to facilitate connectivity. There is clear and unequivocal evidence from around the world that a wide range of species of wildlife regularly and frequently use crossing structures and that well-designed and maintained fencing greatly reduces rates of wildlife mortality and funnels animals towards the crossing structures (van der Ree, van der Grift et al. 2007). However, the extent to which the reduction in road mortality and increased connectivity improves the viability of the local population remains unclear for many species (but see van der Ree, McCarthy et al. 2009)

While not always explicitly stated, the over-arching objective of mitigation is to ensure that the construction and operation of a road does not further endanger (or preferably improves) the persistence of populations of wildlife. If the mitigation is ineffective and the population of the target species continues to decline (and assuming other causes of decline have been eliminated), something should be done. Presumably, the road agency would be required to modify the road or mitigation measures to ensure the recovery of the threatened species. Decisions must therefore be made about which feature of the road or mitigation should be modified and by how much. For example, should twice as many crossing structures be installed, or should the existing culverts be retrofitted to have a dirt floor, furniture or skylights? Do the culverts need to be higher, shorter or wider? Should the underpasses be replaced with land bridges? The current approach to road mitigation is focused on installing the best mitigation for the least cost at as many locations as is needed and feasible. This approach ensures that current best practice is adopted and that priority locations are identified and are mitigated. However, this approach does not explicitly facilitate the learning of new information about which parameters proportionally influence mitigation effectiveness because the mitigation was installed to solve a problem, not generate new data.

The evaluation of most mitigation programs usually quantifies the rate of crossing and identifies variables (e. g. crossing structure dimensions, vegetation structure at entrances to structures) that are correlated with the rate of use. Consequently, most monitoring programs are unlikely to be able to confidently identify the variables to modify, nor the extent to which they should be modified, because that was not one of the goals of the mitigation or the monitoring. An experimental approach to mitigation and/or monitoring is therefore required.

An experimental approach tests a hypothesis or competing ideas and allows confounding variables to be held constant. For example, we may be interested in figuring out if a 1.5 m tall fence is as effective as a 1.8 m tall fence at preventing ungulates from entering the highway and being killed after collision with vehicles. It would be possible to test this by comparing rates of roadkill along two different roads, each with fences of different heights. However, it is difficult to always take into account the effect of confounding variables

between the two sites, such as differences in vegetation structure, topography, traffic volume or local densities of ungulates. With an experimental approach, manipulations (i. e. varying fence height) could occur over time or space, whilst explicitly controlling for confounding effects. Other considerations are also required, such as randomization, ensuring adequate levels of replication and the inclusion of control sites and collecting data before and after the manipulation.

Experimental design

Current monitoring programs of wildlife crossing structures typically measure the rate of use of the structure by different species of wildlife and relate the rate of use to the characteristics of the structure or surrounding landscape. In an experimental approach, the mitigation measures themselves are designed to test a specific parameter, and the monitoring component must reflect the modified parameter. Therefore, the experimental design of the monitoring program is critical (Roedenbeck, Fahrig et al. 2007), and must take into account the collection of before and after data and must include control sites (i. e. unmanipulated sites). The experiment could be as simple as changing the substrate of a culvert after construction by adding a layer of leaf litter to half of the culverts and leaving the second half with a concrete floor. Alternatively, the experiment could be part of the road construction project which commences before the road is built and mitigated – i. e. where the experimental design is incorporated into the road project.

Selecting study sites

Depending on the size of the road construction project, there could be 1 or 15 or more mitigation structures to experiment with. Inevitably though, most projects, even large ones, do not have enough mitigated sites with similar characteristics to be called replication. In this case, there are two solutions. First, and easily developed now, is to compile a (inter)national database of all wildlife mitigation measures. This will allow researchers to identify and select a suite of potential locations where the experiments may take place. The second option is to include experimental mitigation options when designing and building a number of new roads and over time, the effect of certain parameters can be thoroughly tested.

Making it happen

The current approach to mitigation is to identify the problem and modify the location or design of the road to avoid the problem. If the problem can't be avoided, the best mitigation structures (e. g. under- or over-passes and/or fencing) are installed at the locations where it is most needed. If cost or engineering constraints limit the installation of the best mitigation at the locations where it is most needed, compromises are made. The monitoring which may follow construction typically evaluates the rate of use of the structures by wildlife.

Road agencies must recognize the importance and potential value of experimentation to allow them to better meet their obligations at building and managing ecologically sustainable road networks. There are also potentially large cost-savings if smaller or cheaper mitigation structures are equally as effective as more expensive structures or road designs. The design of the experiments must be integrated with the design of the roads to test the effects of parameters that road agencies are most interested in. For example, road agencies often ask during the design stage if an underpass must be at least X m wide or Y m high to be functional for species Z. If an experimental approach was adopted, half (randomly selected of course) of the standard-sized culverts could be built (say 2 m tall x 2 m wide) with removable walls or ceilings that make them 1.5 m x 1.5 m. After a suitable length of time of monitoring, the baffles could be moved over to the standard-sized culverts, and the experiment continued, ensuring any confounding effects are accounted for. The parameters that could be tested and the experimental methods to test them are varied and often limited only by the creativity of the engineering and design teams working in collaboration with the scientists.

It is clear that this request on road agencies is just one of many other competing demands on the location, design, timing and cost of the road and mitigation. It is certainly possible, and in some cases inevitable, that it is just not feasible to adopt an experimental approach to mitigation on a particular road project. Under these conditions we may pull out completely, adopt a staged approach where other mitigation measures that are to be built on another project elsewhere are incorporated into the study design or use a suite of existing struc-

tures already completed. The opportunities to explicitly include manipulative experiments in road mitigation projects are numerous, and should be emphasized as a priority by scientists and road construction and management agencies.

References

Fahrig, L. and T. Rytwinski (2009). "Effects of roads on animal abundance: an empirical review and synthesis." Ecology And Society 14(1): 21 (online).

Roedenbeck, I. A., L. Fahrig, et al. (2007). "The Rauischholzhausen agenda for road ecology." Ecology and Society 12: 11. [online]
URL: http://www.ecologyandsociety.org/vol12/iss11/art11/.

van der Ree, R., M. A. McCarthy, et al. (2009). "Wildlife tunnel enhances population viability." Ecology and Society 14(2): 7 (online).

van der Ree, R., E. A. van der Grift, et al. (2007). Overcoming the barrier effect of roads – how effective are mitigation strategies? An international review of the effectiveness of underpasses and overpasses designed to increase the permeability of roads for wildlife. International Conference on Ecology and Transportation Little Rock, Arkansas, USA, Center for Transportation and The Environment, North Carolina State University, Raleigh, NC.

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Wednesday, October, 24

Parallel Sessions 6

Landscape Genetics
Monitoring
Workshop: CEDR – European Research
Workshop: Biotope Networks
Roadkill III

Lecture Session: Landscape Genetics — Room A

Landscape genetic approaches in road ecology

Chairs: Niko Balkenhol & Karl Jarvis

This combined sessions and workshop contains 3 standard lectures which are followed by an introduction to genetic analytical methods for non-experts and a concluding discussion. The goal of the workshop is to provide a brief overview of landscape genetic approaches in road ecology and transportation planning. Specifically, after the workshop, participants should be familiar with the basic terms and concepts of landscape genetics and have a general understanding of the main analytical steps involved in a landscape genetic study focusing on road effects. This should enable non-experts to better evaluate published studies in molecular road ecology, realise the potential and limitations of genetic approaches for their own study questions, and avoid commonly encountered pitfalls with respect to study design and data analysis.

Lecture Session: Monitoring — Room B

Monitoring of wildlife mitigation measures

Chair: Edgar van der Grift

Are fauna passages really effective and worth the money? This sessions presents a variety of monitoring studies providing important empirical evidence for the success or failure of mitigation measures. If designed and conducted properly, monitoring studies can also provide valuable input to meta-databases from which general mitigation guidelines can be developed.

Workshop: CEDR – European Research — Room D

CEDR Plans for an international research programme on wildlife and traffic

Chairs: Marianne Lund Ujvári & Lars Nilsson

The CEDR (Conference of European Directors of Roads) Governing Board has asked its Project Group "Wildlife and Traffic" to develop an implementation plan for three recommendations given in the group's earlier report "Mobility for Humans and Wildlife – cost-effective ways forward" (http://www.cedr.fr/home/index.php?id=5).

One of the three recommendations is to promote a coordinated research effort at European level on developing cost-effective mitigation measures for wildlife and improving mitigation practices of National Road Agencies. Questions that could be addressed are:

Can ecological criteria be translated into performance indicators?
Where should fauna passages be located to meet both wildlife needs and budget frames?
Which indicators can be used to evaluate the efficacy of mitigation measures?
How do infrastructure and mitigation measures effect wildlife populations?
Are there alternative mitigation measures that are cheaper or more effective in protecting wildlife populations?
What research needs may we be facing 20 year from now concerning wildlife and traffic?

The aim of the workshop is to discuss ideas for themes, and if possible sketch a draft implementation plan for a coordinated European research. The result shall help the CEDR Group "Wildlife and Traffic" to set the research focus and initiate a working group.

Workshop: Biotope Networks — Room E

Biotope networks in fragmented landscapes: Implementation tools and stake holder dialogue

Chairs: Burkhard Vogel, Thomas Mölich & Friederike Scholz

The workshop addresses different strategies and conservation tools for implementing biotope networking projects. The role of stakeholders and concepts for an effective integration of different interest groups in biotope network planning will be discussed. The BUND biotope networking project 'A Safety Net for the European Wildcat' will serve as an initial case example. In the course of the workshop the participants will bring in own expertise and experience and discuss challenges as well as concepts and strategies in network planning and implementation. The chairpersons of the workshop will be representatives of the BUND wildcat corridor project with a strong practical background in the field of biotope networking.

The aim of the workshop is to bring together experts and practitioners in order to exchange knowledge, experiences and ideas regarding the realisation of biotope network projects. The development of alternative and innovative approaches for practical biotope networking as well as ideas for new cooperations among the workshop participants are possible outcomes of the workshop. The results can be used to give an idea how mitigation and compensation measures in road planning can be used to improve wildlife corridors.

Lecture Session: Roadkill III — Room F

Traffic induced mortality in wildlife and mitigation approaches

Chairs: Clara Grilo & Victor Colino-Rabanal

Mortality in wildlife induced by traffic on roads and railroads is recognised as a growing threat to species conservation and biodiversity. This session presents a variety of studies revealing spatial and temporal pattern in traffic induced mortality, its correlates and factors; and discusses possible mitigation options.

w9 Landscape genetic approaches in road ecology

Nico Balkenhol, Karl Javis

This combined sessions and workshop contains 3 standard lectures which are followed by an introduction to genetic analytical methods for non-experts and a concluding discussion. The goal of the workshop is to provide a brief overview of landscape genetic approaches in road ecology and transportation planning. Specifically, after the workshop, participants should be familiar with the basic terms and concepts of landscape genetics and have a general understanding of the main analytical steps involved in a landscape genetic study focusing on road effects. This should enable non-experts to better evaluate published studies in molecular road ecology, realise the potential and limitations of genetic approaches for their own study questions, and avoid commonly encountered pitfalls with respect to study design and data analysis.

a96 The individual-level approach: an original genetic field sampling scheme to optimize barrier detection in patchy populations.

Jérôme Prunier, Bernard Kaufmann, Serge Fenet, Jean-Paul Lena, François Pompanon, Pierre Joly

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Landscape genetics focus on assessing the resistance of a landscape matrix by relating observed spatial genetic structure to landscape characteristics. When studying patchy populations, landscape genetic studies are usually based on population-level analyses, i. e. on estimations of genetic distances between pairwise populations. Because a low number of pairwise populations only provides a poor scan of landscape heterogeneity, we tested the capacity of an individual-based sampling at evaluating the impacts of landscape on genetic structures. Using both simulated and empirical genetic datasets, we assess the efficiency of an individual-level approach in detecting Isolation-by-Distance and Isolation-by-Barrier genetic patterns in patchy populations. Simulated datasets were created using CDPOP, a spatially explicit cost distance population genetics program: the individual-level approach proved to be a powerful methodological alternative to the more conventional population-level approach, especially in barrier detection. The empirical dataset concerned a widespread amphibian in north-eastern France, the alpine newt Ichthyosaura alpestris, in the outskirts of two transportation infrastructures (a highway exploited since 1969, and a high-speed railway, exploited since 1981). The study was designed so as to optimize barrier detection (30 to 40 year-old infrastructures, 417 genotypes sampled at the individual-level across 225 sites and use of 12 polymorphic microsatellite loci). However, no barrier effect could be detected, whatever the statistical analyses we carried out; on the contrary, we highlighted an unexpected spatial genetic pattern along the highway. Although it may not be possible to reject the hypothesis of an historical pattern, these results question the resistance of these transportation infrastructures on gene flow in this species: I. alpestris may actually benefit from artificial aquatic networks (transverse and lengthwise water flow routing) for dispersal.

a97 Simulations on the Effects of Road-Induced Wildlife Mortality on Gene Flow and Genetic Diversity

Karl Jarvis, Samuel Cushman

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Much research has been done on roads as a cause of wildlife population fragmentation, but relatively little work has focused on the additional effect of road-induced mortality. Fragmentation has far-reaching effects because it limits genetic exchange between populations, leading to increased genetic differentiation, and eventually a loss of genetic diversity. Genetic diversity is critical for healthy populations, and the loss of genetic diversity leads to detrimental effects such as inbreeding. Therefore, the indirect loss of genetic diversity due to fragmentation can have major consequences for natural populations. While it is clear that fragmentation is an important effect of roads, it is also possible that road kill is also a major driver of genetic diversity loss, because road-killed individuals are directly removed from populations. Recent simulations indicate that road-induced mortality is a more important cause of genetic diversity loss than fragmentation. However, no studies have addressed the effect of landscape structure and road-induced mortality on genetic patterns. Using simulation modeling, we tested the hypothesis that road kill can cause a direct loss of genetic diversity, independent of indirect effect of fragmentation on genetic diversity. We performed computer simulations of individuals in realistic, heterogeneous landscapes. We approached this question by using individual-based spatially explicit simulations in CDPOP v1.2. This framework allows users to assign a probability of mortality when individuals disperse from one region to another. In addition, CDPOP allows users to vary migration rates across a barrier (road avoidance) by specifying a decreased ability to move through a pixel of the landscape (cost). We varied these parameters independently at five different levels, and simulated populations across all combinations of mortality and migration rates on three landscape types:

1) random mating,
2) isolation by distance, and
3) isolation by resistance on a variety of simulated landscapes.

We found three principal results:

1) Genetic diversity decreases more quickly in scenarios where road mortality is most severe than when it is mild, indicating that road kill has a recognizable effect on genetic patterns.
2) In combination with fragmentation, mortality has a more severe effect on genetic diversity than mortality alone.
3) As landscape complexity increases, mortality and barrier effects of roads become more extreme.

This project has theoretical implications for population genetics and practical applications for road mitigation for wildlife. Our work helps to establish the similarities and differences between population-based approaches common in classical population genetics to the individual-based approaches common in modern landscape genetics. In addition, this knowledge about causes of changes in genetic patterns can help land managers to understand the relative importance of mitigating mortality and fragmentation effects of roads. With a more realistic landscape-based understanding of the importance of rates of migration and population decline, transportation planners can establish more objective goals for preventing genetic differentiation and maintaining genetic diversity.

a98 Molecular Road Ecology: Genetic Approaches for Researching the Ecological Impacts of Transport Infrastructures

Niko Balkenhol

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Understanding the environmental impacts of roads and other transportation infrastructures is crucial for safeguarding ecological functions in human-dominated landscapes. Genetic data are increasingly used to test for road effects on ecological flows and functional connectivity. Since gene flow includes movement (of individuals, pollen etc.), plus survival, plus successful reproduction, genetic data has tremendous potential for assessing ecological transportation impacts. However, successfully applying molecular approaches requires expertise in analyzing population genetic data, and few road ecologists and transportation planners have received this kind of specialized training. As a result, the full potential of genetic data for road ecology has yet to be realized. In this presentation, I will introduce the basic idea behind 'molecular road ecology' to non-geneticists. I will first provide an overview of commonly-used data types and analytical methods, with a special emphasis on 'landscape genetics' approaches. Next, I will discuss the advantages and limitations of molecular approaches compared to other approaches used in road ecology. Specifically, I will highlight that molecular approaches require the same scientific rigor when designing a study and that genetic approaches should ideally be combined with other methods (e. g., telemetry, mark-recapture). I will also illustrate that modern molecular methods can do much more than detecting gene frequency derivations between populations. Novel quantitative approaches can be used to detect actual reproductive events across roads, to estimate (effective) population sizes, or to identify rare and elusive species. This means that genetic data can be used to address research questions that go well beyond simple 'barrier effects', and are of high practical conservation relevance. Finally, I will identify future research needs for molecular road ecology, and highlight the need for interdisciplinary collaborations. Throughout the presentation, I will give examples from the published literature and from my own work. These examples will illustrate the potential of molecular road ecology for

a) testing barrier effects of transportation infrastructures,

b) evaluating the utility of highway-crossing structures, and

c) optimizing routes for conservation corridors.

a99 Factors affecting utilization of wildlife crossing structures by mammals at A4 motorway (Western Poland)

Robert W. Mysłajek, Sabina Nowak

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Large carnivores and their prey, which are mainly ungulates, are vulnerable to negative road effects. Wildlife crossing structures are intended to maintain connectivity of their populations across roads and railways. However, in Europe most studies on the effectiveness of these mitigation measures were conducted in areas where large carnivores do not occur. As big mammals, including large predators, are generally rare and in many areas threatened, such information is necessary to make adequate decisions related to their conservation. Mammals crossing frequencies were evaluated for 15 wildlife crossing structures (7 widened bridges, 6 large overpasses and 3 big underpasses), build at the new 51 km-long section of A-4 motorway, which goes through the Lower Silesian Forest (Western Poland, near Polish-German border). Data was collected during 24 months (2010-2012) of monitoring. We used sand-beds to get animals footprints and a complementary video camera system. We recorded 10 species of large (wolf Canis lupus, red deer Cervus elaphus, fallow deer Dama dama and wild boar Sus scrofa) and medium-sized (roe deer Capreolus capreolus, otter Lutra lutra, badger Meles meles, red fox Vulpes vulpes, marten Martes sp., European hare Lepus europaeus) mammals utilizing crossing structures as well as people and domestic animals. Among wild mammals roe deer and red deer were the most numerous. Ungulates used most frequently overpasses and avoided underpasses, while wolves utilized all kinds of crossing structures without noticeable preference. Crossing structures heavily used by humans were avoided by wild animals. We concluded that these wildlife crossing structures which are overused by humans are not suitable for fauna, even if the location and size of passes are optimal. However, passages which are moderately visited by people could be useful for animals, even when less well designed.

a100 Where did the koala cross the road: Assessing retrofitted road structures for koalas using remote detection technologies.

Lilia Bernede, Cathryn Elizabeth Dexter, Darryl Noel Jones

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Decades of research on the barrier effect of roads and linear infrastructure has widely described the impacts on movement for many wildlife species. Urbanisation and associated road networks has one of the most profound effects on landscape permeability, which is key to the conservation of wildlife remaining in fragmented environments. This is particularly evident in eastern Australia where accelerating urban development poses a serious threat to koala (Phascolarctos cinereus) populations. Road authorities in Australia have been tackling this challenge by building safe fauna passages over and under roads during new construction, but now recognise that retrofitted existing under-road culverts with dry ledges may offer viable road mitigation solutions. Koala populations have declined by 64 % in south-east Queensland in the last decade and vehicle strike is listed as a primary cause for this decline. As part of a trial to reduce koala road-kill, a series of retrofitted road structures, constructed as safe koala passages on major roads, where studied. Mitigation study sites were selected based on previous koala road-kill 'hot spot' data, and on existing structures suitable for linking koala habitat under roads. Exclusion fencing was installed to limit koala access onto roads and to funnel koalas towards retrofitted structures. Our study aimed to assess the effective use of retrofitted structures by koalas. Using GPS collars, mobile infrared cameras and remote technology specifically designed for this project we tracked and monitored the movement of 57 koalas over 18 months at six study sites. Koalas were collared prior to structures being retrofitted and continued to be monitored post retrofit. Understanding that a crossing event would likely be a rare event for a primarily arboreal animal, it was vitally important to obtain evidence for an actual crossing event. Accepting GPS is not accurate enough for proof of crossing and that cameras could not be placed at all locations, data loggers and wireless identification remote technology, designed as ear tags or attached to GPS collars, were developed specifically to tackle this problem. The wireless identification remote technology logged four separate crossings for two sites, and mobile cameras were able to detected koalas using a structure retrofitted with a dry ledge multiple times at one site. The success of the wireless identification remote technology in this trial has advanced the ability for road ecologist to effectively log specific crossing events at vital locations. The outcome of which may strengthen future monitoring results.

a101 Post-construction monitoring of the ecological effects of road crossing structures on watercourses in Special Areas of Conservation in Ireland

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Poorly designed and constructed watercourse crossings, such as culverts or bridges, without adequate consideration of a river's natural hydrology and ecology can alter habitats and disrupt ecological continuity. Such barriers to the movement of aquatic species can spatially isolate populations, increase genetic isolation and decrease the long-term viability of species. Under the EU Habitats Directive 92/43/EEC, Special Areas of Conservation (SACs) were established to preserve important habitats or protected species. Hence, road construction across SACs requires mitigation of potential impacts of the scheme at the planning, design and construction stages. A 3-year study was undertaken by the authors to monitor the aquatic environment in the vicinity of a number of recently completed motorway construction projects across SACs. The objectives of the proposed paper are:

(a) To review the literature on best practice in road design and construction to ensure hydrological and ecological connectivity;

(b) To present results of field studies undertaken on the as-built performance of road structures crossing watercourses along recently completed motorways traversing Special Areas of Conservation (SACs) in Ireland.

The authors undertook an integrated programme of water quality monitoring (both physico-chemical and biological) to assess the impacts of road construction activity on the aquatic environment. This programme encompassed both manual sampling and the deployment of a pilot-scale real-time water quality monitoring system. The ecological and hydrological performance of the crossing structures assessed was benchmarked against best national and international design practice. The hydrological measurements included flow velocities and water depth. The ecological assessment examined the effects of earthworks activities on: (a) macroinvertebrates; (b) fish; (c) mammals. Macroinvertebrate sampling was undertaken using 'kick-nets' to examine the impacts of earthworks activities on aquatic biological species. Fish passage through the culverts was assessed using an electro-fishing technique (under license). The numbers of fish captured at the time of watercourse diversions prior to culvert construction were compared to the post-construction numbers passing through the culverts. In addition, the water velocities through a number of culverts were measured using a current meter during flood and drought events to assess the likelihood of fish passage being impeded. Mammal passage was assessed in terms of the provision of mammal ledges and access to the ledges during flood events of specified return period. The results of post-construction monitoring shows that as-designed and/or as-built road crossing structures of watercourses can significantly differ from best practice and more uniform implementation of design standards would appear necessary. The water quality results indicated some short-term deterioration in water quality, but this did not appear to have any longer-term ecological impacts. The electro-fishing data has shown that fish passage is possible. Nevertheless, dry-weather water depths in some culverts were below recommended thresholds and hence may impede fish passage under low-flow conditions. Provision of mammal passage was found to vary considerably, ranging from inadequate to meeting best practice across the road schemes examined.

a102 Monitoring guideline for demonstrating the effectiveness of Konjunkturpaket II-greenbridges for the reconnection of migration corridors

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In 2009 a federal stimulus package, the "Konjunkturpaket II" earmarked funds that were used by states to construct 16 overpasses. As a result, a guideline was needed to set standards for monitoring those overpasses to ensure that the funds were used properly and that the overpasses met the technological and ecological functionalities promised by engineers and designers. The standards that are used were developed in cooperation between state specialists and those from NGOs, the Federal Ministry of Transport (BMVBS), the Federal Institute of Nature Conservation (BfN), and the Federal Highway Research Institute (BASt). The present Monitoring – guideline is based on the results and networks of the BfN –Project: Priorities of Habitat – Reconnection at Roads in Germany. This proposal explains how such monitoring should be carried out. This is done by documenting what has been proposed; documenting what has been done; conducting an ecological check of the functionality of the four networks, i. e. Forest, Large Mammals, Wetlands, and Drylands; and conducting a technological check of the functionality of the overpass. Recurring ecological monitoring should be maintained as simple and cost effective as possible, there should be no need for complicated monitoring approaches. Rather it is provided to find out indicator species for the occurring networks around the greenbridge. These species are to be found on the greenbridge and in its surrounding areas in simple presence – absence studies. Proposals will be made that will recommend what needs to be done in cases where the technological and/or ecological functionalities have not been fulfilled. The guideline contains Checklists for road maintenance staff, experts and consultants and standardized questionnaires for rangers or placefamiliar people. After each monitoring period (1,3,5,10 years) and finally after 15 years the results will be collected and evaluated by the Federal Highway Research Institute (BASt).

a103 Habitat of Bechstein's bats overlapping a motorway

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Causing fragmentation and increasing mortality, motorways pose a threat to many bat species. Especially for clutter-adapted bats, motorways are considered to have barrier effects on their flight paths. To mitigate the fragmentation of habitats, wildlife overpass are built to regain connectivity for the local populations. Yet little is known about the acceptance of wildlife overpasses by clutter-adapted bat species. Representative for the group of gleaning bats we investigated the habitat use of Bechstein' s bat (Myotis bechsteinii) before and after the construction of a wildlife overpass over an existing motorway in Germany. For our study we examined a very fit maternity colony of approximately 100 adult females using an ancient 32 ha oak forest cut by the motorway A1 south of Wittlich in Rhineland-Palatinate. The spacial behaviour of the colony was monitored via radio-tracking of 19 females in 2006, 2008 and 2009. In 2006, before the wildlife overpass was built, half of the radio-tracked females crossed the gap each night, foraging on both sides, in spite of the complete absence of connecting elements bridging the motorway. Already one month after opening the wildlife overpass in 2008 it was used by bats - the majority being M. bechsteinii. In 2008 und 2009 the colony foraged and roosted on both sides of the motorway. This was the first proof of roost switching over a heavily used motorway. After the wildlife overpass was build significantly more radio-tracked individuals had their home ranges on both sides of the motorway. Although being a heavily trafficked motorway, the A1 does not seem to have a complete barrier effect on the investigated colony. Reasons for that may be the degree of fragmentation and size of ancient woodlands available as well as the motorway design. Still our data show that the availability of foraging sites and roost on both sides of the motorway was enhanced by the connecting wildlife overpass.

a104 The bigger, the better? Species-specific factors influencing the use of under-motorway passageways by bats

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Under-road passageways potentially reduce negative impacts of roads on bats. However, knowledge of the factors influencing passageway use by different bat species remains scarce, and is essential for predicting road impacts and planning solutions. In order to assess the influence of factors including

(i) passageway dimensions,

(ii) connectivity with surrounding landscape features such as hedgerows,

(iii) presence of a water channel,

(iv) age of motorway,

(v) distance to nearest alternative passageway, and

(vi) distance to nearest roost, where known (EU Habitats Directive Annex II species, Rhinolophus hipposideros, only),

bat activity was measured acoustically inside 81 under-motorway passageways of widely varying dimensions (heights 0.57-19 m, lengths 23-125 m). Since bats risk collision mortality by flying directly over motorway traffic lanes, even above a passageway site, bat activity was simultaneously recorded above passageways for a subset of 31 sites. Bat activity was detected in 73 % of passageways, and 75 % of very newly constructed passageways (10.6 m). Edge-adapted species (P. pipistrellus, P. pygmaeus) simply did not use narrow passageways below a certain height threshold. In contrast, clutter-adapted R. hipposideros and Myotis spp. used very narrow pipes (heights <1.1 m). Intriguingly, one clutter-adapted species, Pl. auritus, was not detected in narrow passageways (minimum height where detected 2.5 m), suggestive of interesting differences in flight/orientation behaviour among the clutter-adapted guild, and different mitigation requirements. Considering only the four most ubiquitously detected species groups, N. leisleri was much more likely to be recorded flying over motorways, above passageways of a given height, compared to edge-adapted species (P. pygmaeus and P. pipistrellus), which in turn flew over in greater proportions than the more clutter-adapted Myotid species. River/stream crossings with low motorway bridges seem likely hotspots for bat mortality, given that bat activity is often highly concentrated at tree-lined waterways, and that the lower the clearance height above water, the fewer species accommodated, and the greater the probability that bats fly over rather than under the motorway. Widening of low bridges to increase overall cross-sectional area is not likely to be an effective alternative to building passageways of greater clearance height.

w10 CEDR Plans for an international research programme on wildlife and traffic

Marianne Lund Ujvári, Lars Nilsson

The CEDR (Conference of European Directors of Roads) Governing Board has asked its Project Group "Wildlife and Traffic" to develop an implementation plan for three recommendations given in the group's earlier report "Mobility for Humans and Wildlife – cost-effective ways forward" (http://www.cedr.fr/home/index.php?id=5).

One of the three recommendations is to promote a coordinated research effort at European level on developing cost-effective mitigation measures for wildlife and improving mitigation practices of National Road Agencies. Questions that could be addressed are:

- Can ecological criteria be translated into performance indicators?
- Where should fauna passages be located to meet both wildlife needs and budget frames?
- Which indicators can be used to evaluate the efficacy of mitigation measures?
- How do infrastructure and mitigation measures effect wildlife populations?
- Are there alternative mitigation measures that are cheaper or more effective in protecting wildlife populations?
- What research needs may we be facing 20 year from now concerning wildlife and traffic?

The aim of the workshop is to discuss ideas for themes, and if possible sketch a draft implementation plan for a coordinated European research. The result shall help the CEDR Group "Wildlife and Traffic" to set the research focus and initiate a working group.

w11 Biotope networks in fragmented landscapes: Implementation tools and stake holder dialogue

Burkhard Vogel, Thomas Mölich, Friederike Scholz

The workshop addresses different strategies and conservation tools for implementing biotope networking projects. The role of stakeholders and concepts for an effective integration of different interest groups in biotope network planning will be discussed. The BUND biotope networking project 'A Safety Net for the European Wildcat' will serve as an initial case example. In the course of the workshop the participants will bring in own expertise and experience and discuss challenges as well as concepts and strategies in network planning and implementation. The chairpersons of the workshop will be representatives of the BUND wildcat corridor project with a strong practical background in the field of biotope networking.

The aim of the workshop is to bring together experts and practitioners in order to exchange knowledge, experiences and ideas regarding the realisation of biotope network projects. The development of alternative and innovative approaches for practical biotope networking as well as ideas for new cooperations among the workshop participants are possible outcomes of the workshop. The results can be used to give an idea how mitigation and compensation measures in road planning can be used to improve wildlife corridors.

a105 Forecast maps of potential economical damages caused by animal-vehicle collisions

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The increasing number of animal-vehicle collisions (AVC) throughout the world in recent decades has caused substantial economic losses due to material and human damages. To reduce the number and seriousness of AVC, several mitigation measures have been proposed. Following economic criteria, the decision making in measure selection can be improved knowing the main variables affecting the economic amount of AVC damages. For this purpose we analyzed reports from an insurance company of AVC which occurred in NW Spain between 2004 and 2009. Economic losses varied with the species, the type of vehicle and the type of road. AVC with wild boars and with motorcycles involved had higher average costs and a higher proportion of personal damages. Costs also tended to be higher on the main roads. We used generalized additive models (GAMs) to model the spatial distribution of the AVC economic costs. Speed was the main explanatory variable in all GAMs. This knowledge enables the incorporation of the spatial dimension to cost-benefit analysis and the creation of forecast maps of potential economic damages on which to base a hierarchy in the actions.

a106 Road causalities and appropriate measures for the wildcat in central Europe

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The wildcat (Felis s. silvestris) is a species of conservation concern throughout Europe. After some centuries of massive hunting and deforestation only small isolated populations were left. Despite a strict protection still only 10-15 % of the suitable habitat in Germany is populated. We radio-tracked 18 wildcats for several years along a section of a new motorway and along a section of a motorway already existing 50 years to document the effects. This resulted in more than 30 000 localisations of wildcats and many direct observations of behaviour near and on roads. Along the observed sections of the motorways we also looked intensively for wildcat road kills. Additionally we collected and analysed 402 wildcat road kills from South-west Germany. Construction details of roads as well as landscape features were reported for each road kill. In motorway sections with a wildcat-proof fence no animals could climb the fence. The wildcat-proof fence with a metal sheet at the top was effective in keeping animals from the road. Relating the results of sections with this fence to sections without a wildcat-proof fence we could show, that road mortality in sections with the wildcat proof fence was not permanently reducing the local population while in the section without the fence road mortality was higher than the reproduction estimated for the local population. Still the wildcat-proof fence is only providing its functionality if the fence is properly maintained after its installation. One wildcat was killed because there was a gap in the fence at a door. Another animal was killed because it entered the motorway at a junction. Technical details in construction therefore are crucial for its success, because even one gap on a long section makes the whole fence useless. Because of the high risk of population fragmentation this measure will only be recommended when crossing possibilities are present. Most of the 402 wildcat casualties occurred near forests larger than 1000 ha and hardly any casualties were found close to buildings. Guard railings and the lack of road verges pose a high risk to the wildcat. The results of this study can be used to define conflict areas and target roads where wildcat-proof fences and other measures should be established.

a107 Comparing spatial statistical methods to detect amphibian road mortality hotspots

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Animal mortality on roads is one of the main concerns on wildlife conservation. Due to their habitat requirements, amphibians became one of the most commonly road-killed group and this may affect their population viability. Implementation of mitigation measures may overcome the problem. However, due to the extensive road network, their application is very expensive and required a better understanding in where they should be implemented. Mortality hotspots can be identified as clusters of road-killed records) using GIS (Geographic Information Systems). Although there are several statistical methods available, it is lacking a comparison analysis of them in order to understand their pros and contras. The aim of this study was to analyse possible differences between global, multi-scale and local spatial analysis methods in defining hotspots using amphibian road fatality data collected in northern Portugal country roads. We calculated the Nearest neighbor index, Morans I and Getis-ord General in order to compare the global clustering of points in seven sampled roads, and three were identified as clustered. We used Ripley K-function, Ripley L-function and F function to calculate the best scale for Malo's equation and Kernel density analysis in detecting hotspots and we compared their detection performance with Local Indicators of Association (LISA) (i.e Local Moran's I and Getis-ord Gi*). Three different GIS software applications were used: ArcGis, Quantum GIS with R (opensource) and GeoDa (opensource). Results showed the importance of using multi-distance spatial cluster analysis to define the best scale for hotspot detection with Malo´s equation and Kernel density analysis. Here we also suggest the advantages of Local Indicators of Association (LISA) for detecting clusters with the contribution of each individual observation (Local Morans I and Getis-ord Gi*).

a108 Wild boar and traffic safety: a major challenge in Europe

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Animal-vehicle collisions (AVC) pose a serious challenge for traffic safety and have high social and economic costs. It has been estimated that around one million accidents due to collisions with ungulates are recorded every year on European roads. In some regions of southern Europe, wild boar caused a high proportion of the total AVC for several years - around 95 % of ungulate-vehicle collisions in some Mediterranean regions. Wild boar populations are now increasing and their range is expanding in northern European countries and the British islands. The species is colonising not only forests, but also croplands and urbanised areas. The overabundance of wild boar and the occupation of human habitats have led to an increase in wild boar road casualties that is currently a major concern throughout Europe. A review of the scarce literature and of unpublished reports reveals that wild boar road collisions patterns show several differences from those of other ungulates. The conflict shows strong seasonal variation, which is conditioned by the biological cycle and other factors that affect mobility, such as the hunting period. In most regions, a marked peak in wild boar casualties is observed during the autumn, which overlaps with the rut period and the hunting season. Various studies have reported conflict hot spots in roads crossing cropland areas (e. g. irrigated maize) or periurban areas. The location of attractive points - such as feeding places - and no-hunting areas has a strong effect on the distribution pattern of wild boar-vehicle collisions. Other studies found a correlation between high wild boar population density and the number of wild boar collisions. The use of wildlife passages has also been investigated. The results indicates that wild boars become habituated to fauna passages and a progressive increase in wild boar crossing frequencies has been observed, even in small underpasses. Conflict mitigation measures must consider the characteristics of wild boar behaviour and ecology and should involve the cooperation of traffic and transportation authorities and game management agencies.

a109 Effects of roads on wildlife: Spatial analysis of road permeability patterns

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Roads induce landscape fragmentation and create barriers to wildlife movement. A most prominent effect of roads is road-kills. Recent studies estimate that road-kill mortality totals several millions vertebrates per-year, which in turn, can lead to local population extinction and change community composition. Clearly, models, and especially those that incorporate scale-oriented spatial heterogeneity, that can predict where road-kills are more likely to occur should have significant contribution to reduce negative effects to both humans and wildlife. Our main objective was to identify variables (determinants) that correlate to patterns of road-kill patterns at different spatial scales and to set-up a predictive spatially explicit model of road-kill likelihood. We identified explanatory variables for road-kill patterns by comparing various models in R and using model selection. The models are based on ecological mechanisms and composed of variables describing landscape heterogeneity (e. g., land uses, distribution of resources), roads' attributes (e. g., curves, fencing, Jersey barrier) and structure characteristics (e. g., structures' physical attributes, plant cover, illumination). Additionally, we examined influence of species' attributes, such as home-range size and trophic level. We surveyed three roads located in central Judea lowlands, Israel (total road length of ~40 km). Road-kill surveys were conducted by low-speed driving at dawn, 5-10 days per month. Landscape heterogeneity was incorporated into GIS, using orthophotos and field measurements. We analyzed data using geostatistics applications and multivariate statistical tools to correlate roads' attributes, their spatial context and species' characteristics with road-kill observations. More than 500 road-kills were documented, with highest number of observations at the more intense road. Ripley's k statistical analysis revealed that observations of road-kills' locations are spatially aggregated in all three roads. However, the spatial range in which aggregations were found differed between the two less intense roads and the more intense one, suggesting that the latter imposes a more profound fragmentation on the landscape. Additionally, we found significant effects of the spatial context of specific road's sections, with determinants from different scales affecting road-kill patterns. At a local scale, illumination and road conjunction were correlated with road-kills. At a broader scale, proximity to settlements and road intensity were positively correlated with road-kills. Our results relate to two main processes: 1) at the landscape scale, wildlife activity (the flux of movement) is determined by the road-section accessibility and its spatial context, and 2) at the local scale, risk of getting hit by a vehicle, is influenced by local, within road-section characteristics. Consequently, these processes need to be considered when dealing with road-induced fragmentation.

a110 The Influence of Primary and Secondary Roads upon Mammal Populations: Lithuania, a Case Study

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Data on wildlife-vehicle accidents (WVA) from 2002 to 2011 were obtained from the Lithuanian Police Traffic Supervision Service (TSS). Extensive fieldwork was conducted from 2007 to 2011 to collect data on the WVA unregistered by the TSS. Roadkills were recorded through the regular driving of the entirety of the road lengths and noting all animals killed. Additional data on smaller mammals was obtained by walking road fragments (total length 167 km) several times between December 2008 and November 2009. Extrapolation of unregistered WVAs was carried out using a road-kill index (average number of killed individuals per 100 km / day).

From 2002 through to the end of 2011, the TSS registered over 450 WVA involving moose, 76 with red deer, nearly 4000 with roe deer and 650 with wild boar. Despite preventive measures, the number of accidents is still growing. In addition to the numbers registered by TSS, we collected data on over 3000 mammal individuals of 20 species killed on the road between 2007–2011. The most numerous mammals killed were hedgehogs, raccoon dogs and red foxes. The numbers of roadkills of other mammal species were smaller.

After start of a highway fencing program, the percentage of WVA on highways decreased, from 34.7–42.8 % of all WVA in 2002–2005 prior to fencing, to 33.1–36.6 % in 2006–2009 (chi-square = 9.99, $p < 0.002$) and to 28.4–28.5 % in 2010–2011 (chi-square = 539.9, $p < 0.001$). The percentage of ungulates killed on the main roads also decreased. In 2002–2005, 47.4–73.3 % of road-killed moose were registered on main roads, while in 2006 to 2011 this percentage fell to 39.1 % (the decrease between these periods was significant, chi-square = 8.49, $p < 0.005$). Of all road-killed roe deer, the highway toll was 27.8–38.9 % in 2002–2005, decreasing to 28.2–32.0 % in 2006–2009 (chi-square=19.5, $p < 0.001$) and to 22.2–23.2 % in 2010–2011 (chi-square=14.6, $p = 0.001$). For wild boar, no significant decrease was recorded; 39.1–45.5 % of all killed individuals were registered on highways in 2002–2010. Only in 2011 did this percentage fall, highways deaths then accounting for 28.8 %.

In 2009, we concluded that fencing of the highways significantly reduces WVA numbers involving ungulates: on highway A1, the average number of roe deers killed per km was 6.6 times less in fenced sections than unfenced, with the figure for wild boar being 3.5 times less. No roadkills of moose and red deer were registered in the fenced sections. On highway A2, fencing reduced the average number of roe deer roadkills by 3.3 times and moose by 1.1 times.

Fencing and underpasses at least partly decreased ungulate roadkills on the main roads too, but the number of roadkills on national roads remains high and is not acceptable. However, fencing of the national roads would require significant financial resources and would also lead to much greater fragmentation of wildlife populations that at present. Analysis of the roadkills of threatened mammal species (European bison, lynx and otter) show that national and smaller regional roads have little or no influence on their populations.

Wednesday, October, 24

Parallel Sessions 7

Effect Zone
Workshop: Impact Minimisation
Workshop: Communication for Networks
From Model to Plan

Lecture Session: Effect Zone — Room A

The road effect zone

Chair: Heinrich Reck

Traffic and infrastructure impose various disturbing effects on adjacent habitats. Noise, chemical compounds, invasive species and other agents of disturbances can spread far into the landscape and degrade quality, suitability and economic value of adjacent areas. This complex effect zone can be measured and mapped and should provide an obligatory tool in impact assessment and ecological compensation.

Workshop: Impact Minimisation — Room B

Construction impact minimisation techniques

Chair: Randal Noel Reeve

Current construction practices have large cumulative environmental impacts that often can be avoided or minimised using appropriate techniques and present know-how. This workshop will discuss various examples of mitigation techniques such as methods to reduce the hydro-acoustic impacts or spill effects during bridge construction to fish and other aquatic organisms; water bypass designs and work isolation methods; improve storm-water treatment; or use of grubbed materials from construction clearing, back into the finished landscape areas. The workshop will be based on the interaction with and among the participants.

Workshop: Communication for Networks — Room C

Communication for biotope networks

Chairs: Mark Hörstermann, Christiane Bohn & Izabela Skawinska-Luther

This workshop addresses participants with special interest in communication background of green infrastructure. It will focus on strategic and practical issues of communication in the context of mitigation and building green infrastructure. Communication is the key for stopping the loss of biodiversity in general. Communication is essential when economic and conservational requirements collide. Friends of the earth Germany will present experiences from their large projects "International Green Belt" and "Safety Net for the wildcat". Participants are welcome to present and discuss additional experiences. The workshop will rise the following questions: Which positive and negative experiences in communicating green infrastructure do the participants have? Which of these experiences are transferable to other projects and/or other countries? How can international networks of people foster international networks for fauna? The ultimate aim of the workshop is to initiate an "International working group of Communicators for green infrastructure".

Lecture Session: From Model to Plan — Room D

From model to plan: Transferring ecological models into planning practice

Chair: Mathias Herrmann

Ecological modelling is mostly based on landscape data. Approaches that take into account biological data such as the demands of species are necessary to proof the applicability of such models. This session presents a series of studies that deduce defragmentation measures from ecological field data and illustrate how such knowledge can be implemented in actual planning processes.

a111 Efficacy and improvement of wash down facilities in preventing weed seed spread by vehicles in Queensland, Australia

Ikramullah Khan, Sheldon Navie, Doug George, Shane Campbell, Steve Adkins, Wayne Vogler

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Weed seed spread plays a critical role in the invasion of alien species. Among all vectors, vehicular spread of weed seeds is gaining more importance due to increased use of vehicles. In Australia, currently there are 16.06 million and in Queensland 3.4 million motor vehicles with almost all liable to spread weed seeds. An increasing number of vehicles is expected to have a considerable effect on weed seed spread and weed invasion in future. More than 200 viable weed seeds were found on small vehicle and more than half of these being seeds coming from alien or introduced species in Australia. Therefore, weed seed spread prevention strategy is the best option for weed management. For this purpose, > 80 wash down facilities have been built by different stakeholders in Queensland to prevent weed seeds spread, particularly in noxious weed infested areas. Some are set up with high pressure-low volume and some are low pressure-high volume of water systems with different nozzles. Studies were conducted on the efficacy of wash down facilities in Queensland to see their role in removing mud and hence weed seeds from vehicles. Using high pressure-low volume of water or low pressure-high volume of water systems, at least 15 minutes continues wash is required to clean the vehicle completely. Experiments were also conducted to improve those wash down facilities and the time of wash and consumption of water were significantly minimized, and significantly higher number of weed seeds including those of noxious weed seeds were removed, when the automatic wash down facility was improved. This improved wash down method could significantly reduce weed seed spread and invasion of alien species through vehicles in Australia.

a112 Habitat Use of Butterflies along the 224 National Road, Hainan Province, China

Qilin Li

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Chinese domestic road construction is growing fast, which causes many ecological impacts. Indirect effects on wildlife include reduced access to habitat due to road avoidance and human exploitation. Transportation infrastructure also undermines ecological processes through the fragmentation of wildlife populations, restriction of wildlife movements, and the disruption of gene flow and metapopulation dynamics. In China, researchers began to pay attention to the impact of roads on large mammals such as Asian elephants and Tibetan Antelopes. However, nobody express concern on invertebrate conservation along the road. To study the impacts of highway on habitat use of butterflies, we carried out the investigation along the 224 National Road in Hainan Province from August, 2011 to May, 2012. We set up 15 plots on each side of the road. In each plot, because of the steep slopes, we set up three subplots at close various distances, i. e. 10 m, 50 m, 100 m away from the roads. In each subplot we established three 5 m×5 m grids to record the species and number of butterflies. We totally recorded 58 species (=9.52 % of Hainan species) in the broad-leaved forest along the road, including 9 families: Papilionidae, Pieridae, Danaidae, Satyridae, Nymphalidae, Acraeidae, Libytheidae, Riodinidae and Lycaenidae. The results showed that the average species number peaked in 100 m-grids which was significantly higher than in 10 m-grids and 50 m-grids. In general, butterfly densities and diversity tended to decline with their proximity to infrastructure. Further studies on roadkill of adult butterflies are urgently needed.

a113 Geographically Modeling the Road Effect Zone for Transportation Planning

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The geographic area affected by road systems has been called the "road effect zone" (REZ, Forman et al., 2005, "Road Ecology"). The extent and intensity of impacts within the REZ varies with the context of the roadway and the type of impact. We propose the REZ as an important tool for assessing transportation system impacts in order to reduce the impacts and to inform planned changes in infrastructure and traffic operations. We describe a REZ conceptual model that is organized around categories of effects (e. g., human health effects), includes effect distances, and estimates of decay rates for effects. There is sufficient information in the literature to populate roughly half of the effect distances for likely impacts. There is less information about the shapes of the decay functions for change in effect over distance from roadways. We use a combination of spatially-explicit traffic noise and air quality models to describe areas affected by these two parameters around model highways. The distances and total affected areas are several-fold greater than typical effects analysis distances in environmental analysis during transportation planning and infrastructure development. We describe a potential web-based tool that would allow planners to conduct coarse-resolution assessments of the REZ useful in planning and impact minimization. The tool uses a combination of effects distances from the literature, intersection with valued attributes (e. g., presence of listed species), and the results of noise and air quality modeling to calculate the REZ around any given roadway. We present preliminary results from use of the REZ approach for several US highways. We demonstrate how the REZ can be used in accounting for and reducing existing and new impacts in corridor planning and alternatives development.

a114 Corporate environmental management: Integrating the ecological impacts of land use change and fragmentation caused by road transport activities

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From an economic perspective, two possible starting points when looking at human impacts on the environment are consumption and production. Focusing on production, the aim of this research is to identify all relevant and to measure two selected potential environmental impacts originating from road transport. As of today, in the logistics industry primarily CO_2-equivalent emissions are being considered as environmental impact. However, further influences of road transport exist; among them are land use change and fragmentation. Both effects still are publicly and corporately underrated in their significance for the natural environment. This work reasons why initially these two aspects should enter environmental management accounts and it presents a methodology that should help companies to more completely measure their transportation footprint. The methodology to be presented for land use calculates the share of sealed area that an individual transport is responsible for. For fragmentation, extensive geographical data on priority connectivity issues can be used in order to determine the severity of an individual transport's impact. Possible environmental improvements can be brought about by choosing more area efficient transportation means, by bundling traffic on fewer and connectivity ensuring roads, and by decreasing transport intensity in production and distribution. In order to further improve the proposed methodology, further discussion on the central suppositions concerning the size of the area degraded from noise, spills or light, concerning the adopted thresholds of daily traffic volumes that classify a road as a barrier, and concerning ecological demands and the quality of connectivity enabling elements is necessary.

w12 Construction impact minimisation techniques

Randal Noel Reeve

Current construction practices have large cumulative environmental impacts that often can be avoided or minimised using appropriate techniques and present know-how. This workshop will discuss various examples of mitigation techniques such as methods to reduce the hydro-acoustic impacts or spill effects during bridge construction to fish and other aquatic organisms; water bypass designs and work isolation methods; improve storm-water treatment; or use of grubbed materials from construction clearing, back into the finished landscape areas. The workshop will be based on the interaction with and among the participants.

w13 Communication for biotope networks

Mark Hörstermann, Christiane Bohn, Izabela Skawinska-Luther

This workshop addresses participants with special interest in communication background of green infrastructure. It will focus on strategic and practical issues of communication in the context of mitigation and building green infrastructure. Communication is the key for stopping the loss of biodiversity in general. Communication is essential when economic and conservational requirements collide. Friends of the earth Germany will present experiences from their large projects "International Green Belt" and "Safety Net for the wildcat". Participants are welcome to present and discuss additional experiences. The workshop will rise the following questions:

Which positive and negative experiences in communicating green infrastructure do the participants have?

Which of these experiences are transferable to other projects and/or other countries?

How can international networks of people foster international networks for fauna?

The ultimate aim of the workshop is to initiate an "International working group of Communicators for green infinininfrastructure".

a115 Defragmentation in planning process of the Highway A 39 in northern Germany

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The A 39 is part of the Federal Trunk Road Upgrading Act and was Classified "Urgent Necessity". The Determination of the corridor (line) was carried out in accordance to an environmental impact assessment (EIA). The Investigation area was determined in respect to the Network Natura 2000 and to avoid significant adverse effects on Natura 2000 sites. Step two of the EAI with final appropriate assessment and fragmentation impact assessment war carried out to prepare the approval procedure. On the basis of the national ecological network concept (HABITAT-NET, HÄNEL 2007) and a comprehensive habitat-mapping with GIS-Modulation for the Investigation area of the A 39 and the needs of a coherent ecological network was investigated for wetland habitats, dry habitats and woodlands and for bigger mammals. The necessity of defragmentation/ connectivity of the ecological network and Mitigation measures were analyzed accordingly to target species (representative)

- Mammals: Deer, Otter, Wulf, Lynx, Wildcat
- Bats: Myotis nattereri (Fransenfeldermaus), Pipistrellus nathusii (Rauhautfledermaus)
- Amphibians: Hyla arborea (Laubfrosch), Rana arvalis (Moorfrosch), Triturus cristatus (Kammmolch)
- Reptiles: Coronella austriaca, (Schlingnatter), Vipera berus (Kreuzotter)
- Birds: Crane, Ciconia nigra (Schwarzstorch), Emberiza hortulana(Ortolan), Lullula arborea (Heidelerche), Perdix perdix (Rebhuhn)
- Insects (dragonflies, grasshoppers, bugs) and
- to the national concept (2004) of important ecological corridors.

The crossing points of the A 39 with the ecological network are the base for the dimensioning of fauna passages. Functional components of the defragmentation concept are:

- Reducing the barrier effects by fauna passages,
- Stabilization and enhancement of important habitats and step stones to maintain populations in the surrounding of the project
- Habitat creation (Major coherent habitats)

The concept also takes into account future dispersal and potential habitats of species as for example the Lynx.

a116 Quantifying permeability of existing major roads – A model based on field data

Mathias Herrmann

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Modeling landscape connectivity is an established practice constructing wildlife corridors. Models are based on hypothesized or proofed habitat preferences of species and use available landscape data. However, most models do not consider predictions about the permeability of the traffic network. For wise decisions about measures reconstructing ecological corridors we need knowledge on how many individuals cross major roads in different landscape contexts. Our model predicts the permeability of major roads for mammals. It takes into account the permeability at crossing structures (e. g. passages not build for wildlife) and the barrier effect of road surface, traffic load, fences and walls. Also landscape parameters guiding mammals to a crossing structure or banish the approaching individuals are taken into account. For the estimation of the number of individuals crossing at different crossing structure types with different widths we evaluated protocols of more than 300 crossing structures from literature and own observations. A first analysis showed three groups of mammals representing different behavioral types in respect to crossing structures: carnivores, ungulates and hares. Own snow tracking data (168 km; before and after construction of roads) were used to document the permeability of major roads. Nevertheless we could not find enough proofed data on permeability of road surfaces, so that we had to determine categories for practical reasons. In a first step we applied the model to all motorways in Germany using the official German information system for cartography and topography (ATKIS) to get information on type and size of crossing structures, landscape context (e. g. forest edge, edge of a settlement) and function (e. g. paved or dirt road underpass, viaduct). Using the model we calculated for all crossing structures (mostly not build for wildlife) at motorways in Germany a number of potential crossing individuals of each group according to width, type, landscape context and function. Permeability of motorway sections without crossing structures was set to zero, but can be adjusted as soon as enough data is available. Subsequently the number of crossing individual mammals per km could be calculated for each motorway section between two motorway junctions for whole Germany. Obviously South German motorways (on average 7.12 mammals/km in Bavaria) are a lot more permeable for mammals than North German motorways (on average 1.6 mammals/km in Brandenburg). This is due to the hilly landscape in South Germany with open span viaducts and tunnels here and then and the flat landscape in Northern Germany where no bigger crossing structures are required. The model can be used to show the importance of crossing structures for wildlife in different landscape contexts and to compare permeability of major roads to the permeability of other land use features.

a117 The fauna net – a new concept in the frame of mitigation planning in Germany

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Nation wide concepts of fauna corridors were the first steps showing the necessity of conserving wildlife corridors throughout the country. For this reason road planning administration thought how to integrate corridor concepts into the planning process. At the moment we are in a final stage with fauna nets for two motorways. On the 123 km of the A39 from Wolfsburg to Lueneburg we have implemented 77 constructions with function as a passage for the fauna. On the 121 km of the A20 from Oldenburg to Stade the number of constructions will be somewhat smaller since there are less conflicts. We would like to discuss the advantages and disadvantages of a fauna net as part of the planning process. The demands for mitigating the barrier effect were analysed using target species (vertebrates and none vertebrates). The distribution of these species was mapped for the planning area. Moreover a model based analysis of the local and regional habitat net was conducted additionally to the already existing habitat net for the federal state. The third tool was a visual search or proof of existing corridors by wildlife biologists in the field. All three tools showed results close to each other. During the planning process demands of the fauna net (e. g. width and type of passages) had to be defined in a very early stage when information on the occurrence of species or habitat data were not completely available. To justify the planned passages was requested at a later stage. In the concept we analysed the fragmentation of the habitat of the target species. In this approach we did not restrict our concept on the locations of proofs of the species. Using the habitat model we could show several locations without actual proofs but of high importance for the species at least for dispersers. The purpose was not only to focus on sedentary individuals, but show the importance of the habitats for dispersers and the genetic exchange. Analysing the final data we can show that the measures are proper for safeguarding the population exchange in between populations of target species.