

Thursday / 10:00 – 11:00

Room: Foyer

Crossing borders in strategic planning: Models, toolboxes, web platforms and apps

Moderator: Jan Olof Helldin, SLU, Sweden

Wildlife collisions on Dutch railways: Improving decision making and strategic planning of mitigation measures using machine learning techniques and data visualization tools

Jaspert de Vries, Camiel Meijneken, Laurens Koppelaar (ProRail, Netherlands)

Every year there are approximately 1,500 reported animal related interferences on the Dutch railways. These disturbances often cause delay in travel time for passengers and is mostly fatal for animals. The goal of this project was to use advanced analytics to promote effective decisions making to prevent wildlife collisions. Using multiple data analyses tools a dashboard was created to provide insights in historical data of animal-collisions and time dependent patterns. Machine learning techniques were used to predict railroad segments with a high risk of an animal related interference for the upcoming month.

Validation of the ecological connectivity model Circuitscape using GPS-data

Lisa Maria Sjölund (Sweco Position, Sweden); Andreas Seiler (Swedish University of Agricultural Sciences, Sweden)

We simulated animal movements using the ecological connectivity model Circuitscape. To make the model reliable, we used GPS-data from different species to validate Circuitscape. For this, we looked at their movement patterns and how to use different biotopes.

Multi-level wildlife distribution models in the planning of green infrastructure

Jaanus Remm, Piret Remm, Kertu Jaik (Rewild OÜ / University of Tartu, Estonia)

In the presentation, we will demonstrate last years' experience of planning wildlife mitigation measures for Estonian roads and railways, and discuss future perspectives. We have developed a novel approach to separate the site, landscape, and regional level effects in models of species occupancy. The goal is development and integration of these multi-level models of wildlife species landscape, and habitat use in procedures of spatial planning and infrastructure development. The intention is to cross the border between basic science and real-life implementations. This means transferring knowledge between ecologists, engineers, decision makers, interest groups, and the general public.

The harmonisation of 'Grey' and 'Green' Infrastructure in South-East Europe: Introducing the GreenWeb platform

Radu Mot (Zarand Association, Romania); Lazaros Georgiadis (Infra Eco Network Europe, Greece); Antonios Mazaris (Department of Ecology, School of Biology at Aristotle University, Greece); Cristian Remus Papp (WWF Danube Carpathian Programme / Babes-Bolyai University, Romania); Niki Voumvoulaki (Egnatia Odos SA, Greece)

On-going economic development in South-East Europe, especially the growth of linear transportation infrastructure, generates additional pressure on nature. This development demands urgent action, ensuring the least possible negative impacts on the environment. A network of professionals from a variety of sectors is developing the GreenWeb Platform, aiming for proactive engagement and dialogue with all stakeholders. In this way, they can secure ecological connectivity ensuring the coherence and ecological

functionality of areas with high biodiversity value while developing linear transportation in South-East Europe.

Implementation of the Wildlife Friendly Roads Toolbox for Central America

Esther Pomareda García, Esmeralda Arévalo Huezo, Daniela Araya-Gamboa (Vías Amigables con la Vida Silvestre, Costa Rica)

For developing countries in Central America, it is essential to harmonize the relationship between infrastructure development and biodiversity conservation. The impact of roads on wildlife is scarce. In Costa Rica, even with a lot of information generated, few measures have been implemented in road development projects. To address this need, an Environmental Guide "Wildlife Friendly Roads" was developed. Technical Guidelines are at the core of this toolbox. Currently, the Guide is used as a reference on the scientific study of different roads that are going to be improved, hired by the Ministry of Transportation.

Automating Wildlife-Vehicle Conflict Tracking

Fraser M. Shilling, David P. Waetjen, Kathryn Harrold (Road Ecology Center, University of California, USA)

Wildlife-vehicle conflicts (WVC) impact society and wildlife communities and are among the most observable and spatially extensive of ecological and safety impacts. WVC data are critical for planning WVC-reduction projects, but often when data collection occurs, it is incomplete, inconsistently collected, and difficult to verify. To address this problem, we developed automated approaches for collecting and analyzing WVC data: One periodically retrieves crash data from an online incident reporting system maintained by the California Highway Patrol (CHP). We also developed an easy to use smartphone app for casual users to upload images of carcasses resulting from WVC.

Agouti: A platform for processing and archiving imagery from road crossing

Patrick A. Jansen (Wageningen University, Netherlands); Jim Casaer (Research Institute for Nature and Forest, Belgium)

Camera traps and video surveillance systems are standard tools for monitoring road-crossing structures. The information can potentially be used to address essential questions in road ecology, but this requires that the monitoring and image processing is standardized and that images and data are archived and made available to scientists. We present the web-based platform Agouti that was designed to accomplish this, show how it is being used to manage the monitoring of wildlife crossings the Netherlands and Belgium, and invite other organizations involved in monitoring wildlife crossings to use this platform so that information can support road ecology.

Thursday / 10:00 – 11:00

Room: Pollux

**Defragmentation initiatives:
Opportunities and challenges**

Moderator: Katja Claus, Flemish Government, Belgium

Impact of road-infrastructure on the environment. A question of participation and cooperation?

Wim Van Isacker, Griet Celen (Vlaamse Landmaatschappij, Belgium)

The construction of a highway inevitably has a negative impact on the surrounding environment of the highway. The correct use of an environmental impact analysis can help to make design choices and define mitigating measures necessary to limit this impact to an acceptable level. By using a long-term process of participation and cooperation, it is possible to shift the mindset from a “negative” highway with all sorts of negative impacts to the environment, to a “positive” project improving the quality

of life and establishing a future-proof environment in the surroundings.

Environmental possibilities and challenges in early-stage transport planning in a Swedish metropolitan context

Sofia Eckersten, Berit Balfors, Ulrika Gunnarsson Östling (Royal Institute of Technology, KTH, Sweden)

This study aims to identify key issues contributing to the development of strategies for integrating environmental measures in transport planning in a Swedish metropolitan context. We hypothesise that transport planning lack effective strategies in order to meet environmental objectives and climate goals. Preliminary results show that major issues were to define system boundaries of the investigated area. Also, mandate and knowledge of involved actors affected the outcome. Our findings call for flexible strategies in order to meet the governance challenges of environmental issues in transport planning, which would contribute to valuable opportunities for smart infrastructural solutions.

Redesign from an ecological perspective

Jelle Vercauteren, Marijn Struyf (De Werkvennootschap, Belgium); Koen Maes (Sweco Belgium, Belgium)

From an ecological perspective, the redesign of the Brussels ring road is crossing borders between engineers and ecologists. It is assessing the technical design from an ecological point of view and integrating the ecological findings into infrastructural works. It is searching and – hopefully – creating win-win solutions. It is trying to reconcile seemingly opposite positions and then noticing the common ground solution. It is the way to achieve a stronger, more positive, and future-proof design.

Otter road mortality in the Netherlands: population impact and effective mitigation measures

Loek Kuiters, Hugh Jansman, Dennis Lammertsma (Wageningen Environmental Research, Netherlands)

The Eurasian otter as a mobile semi-aquatic species highly suffers from traffic collision. The impact of road mortality on population size and range was assessed by genetic monitoring of the population for over 15 years. With 20-25% of total population size, road mortality appeared to be substantial. Several mitigation measures have proven to be effective by reducing the number of casualties at hot spots. By periodically inspecting the most important risk zones, the national list of high-risk zones is updated and communicated with the responsible road managers with the request to take protective actions.

Steps towards an integrated mitigation strategy for a large carnivore roadkill hotspot in North-western Greece

Maria Psaralexi (Aristotle University, Department of Ecology, School of Biology, Greece); Yorgos Ili-opoulos, Eirini Chatzimichail, Yorgos Lazarou, Alexios Giannakopoulos, Athanasios Tragos, Ioannis Tsaknakis, Yorgos Mertzanis (Callisto - Wildlife and Nature Conservation Society, Greece); Maria Petri-dou (University of Ioannina, Department of Biological Applications and Technologies, Greece); Maël Guyon (Université de Montpellier II, Faculté des Sciences, Ingénierie en Ecologie et Gestion de la Biodiversité, France)

We have identified the “Kleidi” area in northwestern Greece as a mammal roadkill hotspot via roadkill records and systematic field surveys and evidenced this sector’s importance as a critical linkage area for brown bears using a cost distance analysis. We have confirmed that the effectiveness of existing mitigation measures is poor and thus effective gene flow between two bear sub-populations

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may be compromised, and human safety is put at risk. To address the issue, Wildlife Warning Reflectors and wildlife warning signs are to be installed along these road segments, yet we discuss the need for more effective mitigation measures.

Implementation of the no-net-loss approach at the project 'Outer Ring Parkstad Limburg'

Raymond Tilmans (Provincie Limburg, Cluster Natuur en Water, Netherlands)

The specific construction of a highway in the southern part of the Netherlands and the implementation of obliged mitigation and compensation measures give affected species the opportunity to continue to live in their current or adjacent habitat. Further measures have been carried out to establish a robust and durable green infrastructure. For these kinds of road projects, it is essential to not only focus on the road itself but also to search for chances to catalyse ecological projects in the surroundings of the road. This way, it is possible to implement the no-net-loss approaches, to create a green (European) network.

Mitigating the ecological impacts of transportation infrastructure: A compilation of global case studies

Rodney van der Ree (Ecology and Infrastructure International Pty Ltd / School of BioSciences, University of Melbourne, Australia)

A challenge in planning and designing roads, railways and other linear infrastructure is that many engineers, planners and designers are not aware of the multitude of mitigation options because there is no single book containing real-life examples and case-studies to guide and inspire future projects. I am editing a book that brings together case studies of mitigation from around the world in an accessible style and format. This book will be published as an open access E-book, so that everyone, everywhere, can access it

at any time, for free. You can contribute by authoring a chapter or supporting the project financially.

Thursday / 10:00 – 11:00

Room: Neptune

Research techniques: What is new?

Moderator: Andreas Seiler, SLU, Sweden

Patterns of road threat on a global scale: Using large datasets in transportation ecology

Molly Grace (University of Oxford, England)

Meta-analyses have suggested characteristics that make animals vulnerable to roads (e.g., slow reproduction) but consider only a fraction of the world's species. I used large existing databases (The Red List of Threatened Species and AnAge) to investigate these trends on a global scale. Considering 5,430 mammalian species (124 families), I regressed the proportion of species within a family classified as road-threatened against average body mass, age at maturity, litter size, and longevity. Road threat was more pronounced in families with larger-bodied, longer-lived species and slower reproduction, highlighting how existing datasets can be used to confirm trends observed in transportation ecology.

How reliable are your data? Verifying species identification of road-killed mammals recorded by road maintenance personnel in São Paulo State, Brazil

Fernanda Delborgo Abra, Camylla Silva Pereira, Katia Maria Paschoaletto Micchi de Barros Ferraz (Laboratório de Ecologia, Manejo e Conservação de Fauna Silvestre (LEMaC) - ESALQ/USP, Brazil); Marcel Huijser (Western Transportation Institute - Montana State University, USA)

We investigated whether maintenance personnel correctly identified the species of road-killed mammals along toll roads in São Paulo State using two methods.

For method one we investigated 3,222 images and identification of road-killed animals. For method two we presented mammal's images to road maintenance personnel and asked them to identify the species. For method one we found that the maned-wolf, crab-eating-fox, European-hare, capybara, southern-tamandua, puma, ocelot, giant-anteater, and gray-brocket were correctly identified. For method two the maned-wolf, capybara, southern-tamandua, puma, ocelot, and giant-anteater were correctly identified. The data showed that non-experts usually correctly identified certain common, large, or highly recognizable species.

Better intelligent systems for mapping amphibian and small bird roadkill

Neftalí Sillero, Diana Guedes, Hélder Ribeiro (CICGE (Geo-Spatial Sciences Research Centre) – Prof. Manuel de Barros Astronomical Observatory, Faculty of Science of the University of Porto, Portugal)

Roads have multiple effects on wildlife. Monitoring roadkill is expensive and time-consuming. We developed a cheap and efficient system for detecting amphibians and small birds roadkill using computer vision techniques. The MS2 has a reduced size and energetic consumption and can be attached directly to the back of any car. We tested the MMS2 in three conditions: a control test with plastic models of amphibians and birds in a small road; a control test with collection specimens of amphibians and birds; and a real test on a 30 km road survey in Southern Portugal.

Innovative road kill monitoring with speech recognition and route registration

Diemer Vercayie, Marc Herremans (Natuurpunt, Belgium); Alex Kwak (Zoster IT & Consultancy, Netherlands)

Experience has shown that monitoring road kills with citizen scientists results in significant, reliable, and useful data if

specific criteria are met. However, two issues are still hampering data collection and use: (1) for safety reasons, many countries put restrictions on the driver-use of smartphones, and (2) most citizen-science road kills monitoring projects gather opportunistic observations of road kill without information on search effort. Technological improvements for the existing wildlife observation app ObsMapp solved both issues, resulting in a state of the art app allowing broad public participation and gathering high-quality road kill data.

How to assess species crossing natural corridors through a new kind of wildlife sensors?

Pierre-Yve Courtine (Neavia Technologies, France); Louis Laurence (Environmental Service of Haute-Savoie Department, France)

Restoring a natural corridor while reducing the risks of collisions on a highly busy road were the main reasons why Haute-Savoie department decided to test new wildlife sensors designed by Neavia. Thanks to its collaborative approach, the proposed solution contributes to improving the knowledge of the wildlife species living in the latest wetland area of the Annecy lake, established as a natural reserve in 1974. Thanks to the effective support of the local hunting federation, the solution demonstrated its efficiency very quickly after its activation. Analysis of collected data will be presented during the session.

A new approach for monitoring fauna in eco-infrastructure: A win-win arrangement for an affordable continuous way of studying and evaluating

Kristin Van Laer (Dienst Duurzaam Milieu- en Natuurbeleid, Department of Sustainable Environment and Nature Policy, Belgium)

Working together with the university and proposing topics for internships makes

it possible to have a mutually beneficial arrangement for an affordable continuous way of monitoring and evaluation of fauna in eco-infrastructure. The theory is combined with practice and professionals and volunteers can collaborate. Results are published on an open online project page. New observations provide the participants and all other interested parties with the most current information. By involvement, people have a stake in the effectiveness of defragmentation measures. Knowledge is acquired and disseminated thanks to this approach to working with students efficiently.

Assessing the effects of multiple environmental variables on aquatic biodiversity in highway stormwater ponds: Does metabarcoding improve the performance of traditional morphological methods?

Zhenhua Sun, Ekaterina Sokolova, Sebastian Rauch (Chalmers University of Technology, Architecture and Civil Engineering, Sweden); Sondre Meland (Norwegian Institute for Water Research (NIVA) / Norwegian University of Life Sciences, Faculty of Environmental Sciences and Natural Resource Management, Norway); John E. Brittain, Svein Jakob Saltveit (Natural History Museum, University of Oslo, Norway); Markus Majaneva, Torbjørn Ekrem (NTNU University Museum, Department of Natural History, Norway)

The freshwater ecosystems along the highways are subject to various traffic-related stressors, which reduce aquatic biodiversity. DNA metabarcoding has been promoted as a method to identify organisms to the species level and to increase taxonomic resolution, thereby facilitating a comprehensive understanding of the influence of environmental variables on aquatic biodiversity. In this study, this hypothesis will be tested in stormwater ponds by comparing the influences of several environmental variables on aquatic organisms identified using traditional morphology and DNA metabarcoding to

discern the differences between these methods.

Thursday / 10:00 – 11:00

Room: Venus

Impact of roads on species, communities, populations and ecosystems

Moderator: Elke Hahn, Ministry for Transport, Innovation and Technology, Austria

Forecasting the viability of Brazilian maned wolf populations in varying scenarios of road effects

Priscilla Barbosa, Alex Bager, Clara Grilo (Departamento de Biologia, Setor de Ecologia e Conservação and Centro Brasileiro de Estudos em Ecologia de Estradas, Universidade Federal de Lavras, Brazil); Nathan Schumaker, Kristin R. Brandon (Department of Fisheries and Wildlife, Oregon State University, USA)

We evaluated the potential impacts of road mortality and fragmentation on the maned wolf population size and its spreading in Brazil. We developed a large-scale, mechanistic, spatially explicit, individual-based forecasting model to generate quantitative estimates of the consequences of road mortality and fragmentation. These consequences influence the maned wolf population's dynamics, size, and spreading. Our results suggested that even low road mortality rates result in severe population decline and might be altering the species range. We were also able to identify five locations with high road kill frequency, which can optimise future efforts for the species conservation.

Effects of habitat encroachment by roads on space use and movement patterns of an endangered vole

Nelson Horta Fernandes, Eduardo Ferreira, Ricardo Pita, António Mira, Sara M. Santos (UBC – Conservation Biology Lab, Department of Biology, University of Évora, Portugal)

This study aimed to assess the influence of habitat encroachment by roads on space use and movements of Cabrera voles (*Microtus cabreræ*), an Iberian endemism. Sixteen animals were radio-tracked in two habitat patches presenting different levels of habitat encroachment by roads. We found that individual home-ranges were significantly smaller in the patch more encroached by roads. These results suggest that habitat invasion by roads may critically affect space use and movement patterns of Cabrera voles.

Community analysis of microcrustacean in freshwater lakes adjacent a salted road in Norway

Sondre Meland (Norwegian Institute for Water Research, Norway); Thomas Correll Jensen (Norwegian Institute for Nature Research, Norway); Mats Emil Sand, Synne Kleiven (University College of Southeast Norway, Norway)

In many countries road salt is applied to secure safe driving conditions. We hypothesised that the application of road salt on a Norwegian road have impaired the water quality and subsequently microcrustacean communities in lakes adjacent the road. The preliminary results indicate that some of the lakes were chemically affected by road salt. The microcrustacean community analysis revealed no apparent road salt effect on the lakes' ecology. The present research, together with a larger on-going monitoring program on road salt have led to an increased awareness that road salt damages water bodies. Thus, mitigation actions have been initiated.

Different effects of the habitat structure under road bridges in a human-modified landscape in Hungary: Conservation hotspots or barriers to crayfish, fish, amphibian, and reptile species?

Blanka Gál (MTA Centre for Ecological Research, Danube Research Institute, Balaton Limnological Institute / Doctoral School of Environmental Sciences, Eötvös Loránd Uni-

versity, Hungary); Géza Gelencsér (Vox Vallis Development Association, Koppányvölgy Naturpark, / Doctoral School of Environmental Sciences, Szent István University, Hungary); Miklós Pukyt, András Weiperth (MTA Centre for Ecological Research, Danube Research Institute, Hungary); Ildikó Szivák (MTA Centre for Ecological Research, Balaton Limnological Institute, Hungary); János Farkas (Eötvös Loránd University, Department of Systematic Zoology and Ecology, Hungary)

Our study aims to investigate the habitat functions of different types of streams under the road and railway bridges. Crayfish, fish, reptiles, and amphibian assemblages were surveyed beneath and around in fourteen bridges of four streams and one channel in Hungary. Our results presented that habitats under bridges affected aquatic, semi-aquatic and terrestrial species in different ways. In the case of strongly human-modified landscapes, several protected species have been detected only around the bridges. This result presented that aquatic habitats under bridges in a modified stream have a fundamental role in the conservation of native reophil species.

An assessment of the potential impacts of China's Belt and Road Initiative in Myanmar: risks and opportunities

Hanna Helsingen (WWF Myanmar, Myanmar); Nirmal Bhagabati, Michele Dailey (WWF US, USA); Ben Milligan (University College, UK)

The Belt and Road Initiative (BRI) is China's strategy to boost connectivity and trade between China and a wide swath of Asia, Europe and Africa, with massive investments in infrastructure envisioned across the to be connected countries. WWF conducted an assessment highlighting the significant extent to which BRI road infrastructure could impact Myanmar's rich biodiversity and selected ecosystem services, including disaster risk reduction and clean water

provisioning. We delineated illustrative realignments of the corridors based on potential costs and benefits of the development corridors. We provide recommendations for government and developers regarding the planning of BRI-related investments in Myanmar.

Road network development and forest fragmentation: An inter-state analysis

Deepika Mann, Girish Agrawal (Department of Civil Engineering, Shiv Nadar University, India); Pawan K. Joshi (School of Environmental Sciences, Jawaharlal Nehru University, India)

Road length in 2050 is estimated to increase globally by nearly 60%. Developing countries, India being one, are expected to contribute to nine-tenth of this total. Therefore, understanding the consequences of introducing or expanding road network in sensitive eco-regions is crucial. Our study aims at understanding the complex interaction between road infrastructure development and ecology in forest landscapes of the central Himalayan foothills from 2000 to 2016 through spatiotemporal satellite data analysis. Results could indicate the correlation between the distance to roads and the percentage of non-forest areas and changes in forest fragmentation pattern over 16 years.

Road impact assessment on the soundscape of a Costa Rican rainforest using dominant frequencies

Oscar Ramírez-Alán (Escuela de Ciencias Biológicas, Universidad Nacional, Costa Rica); Mónica Retamosa Izaguirre (Instituto Internacional en Conservación y Manejo de Vida Silvestre, Universidad Nacional, Costa Rica); Victor Colino Rabanal (Department of Animal Biology, Faculty of Environmental Science, University of Salamanca, Spain)

We evaluated the impact of a road in the soundscape of a rainforest in Costa Rica using two acoustic indices.

Thursday / 10:00 – 11:00

Room: Jupiter

Road verges: Biodiversity potential and dealing with invasive species

Moderator: Carme Rosell, Minuartia, Spain

How can transport infrastructure habitats reduce habitat fragmentation in the landscape?

Tommy Lennartsson, Jörgen Wissman, J-O Helldin (Swedish Biodiversity Centre, SLU, Sweden)

We present a review and discussion of how transport infrastructure habitats (TIH) may reduce fragmentation of habitats. Fundamental issues are (1) which ecological functions TIH can provide in the landscape and thereby enhance landscape functionality, (2) the degree of similarity between TIH and surrounding habitats, and (3) how ecological functions and similarity can be improved by applying appropriate methods for construction and management of TIH. We propose that TIH constitute a diverse group of habitat types and that this ecological variation needs to be reflected in a proper palette of tools for the management and construction of TIH.

Biodiversity potential of transport infrastructure: A reconnaissance survey in the Netherlands

Theo van der Sluis, Bas Pedroli (Wageningen Environmental Research, Netherlands); Marieke de Lange (Rijkswaterstaat, Netherlands)

A quick scan of available GIS data of the Rijkswaterstaat assets compared with various maps of nature reserves and terrains with specific biodiversity values reveals that there is considerable potential for improvement of the biodiversity values (both within the assets and in adjacent terrains). This is especially true for wet ecosystems along rivers and canals. But also the drier habitats, such

as roadsides within the Rijkswaterstaat properties represent significant opportunities for improving coherent nature networks and corridors. Priorities should be defined by taking into consideration biodiversity hotspots, an extension of specific habitats, and population growth of rare species.

To mow or not to mow? Public perception of urban roadside verge management

Olivia Richardson, Karl Evans, Philip Warren (University of Sheffield, UK)

In this study, we assess public perception of (I) a trial reducing mowing frequency of road verges on residential roads, (II) different hypothetical road verge management scenarios and (III) the ability of different road verge scenarios to support biodiversity, using face to face and postal questionnaires with residents in Sheffield, UK. While reducing the mowing frequency of road verges is a cost-effective management measure, this study shows that residents prefer frequently mown short grass, even though it is perceived by residents to be worse for biodiversity than other alternative management scenarios.

Road verge maintenance: How to eradicate invasive species simultaneously to promote species-rich, pollination-friendly habitats?

Astrid Brekke Skrindo, Håvard Hjermsstad-Sollerud, Arne Heggland (Norwegian Public Roads Administration, Climate and Environment Assessment Section, Norway)

Species-rich grasslands are essential to biodiversity and ecosystem services. The present loss of species-rich grasslands makes it vital to conserve and promote novel habitat variants such as road verges. A significant challenge with maintaining species-rich road verges is their fine-scale spatial ecological heterogeneity. Therefore, it is important to

ask the following question: what kind of road verge-maintenance strategy both protects and promotes biodiversity? We will illustrate the Norwegian maintenance model by dividing the road verge into two different types and include the possibility for further adjustment.

Control strategies for Asian knotweed

Jo Laps (Departement Mobiliteit en Openbare Werken, Belgium); Kevin Dewitte, Geert Haesaert (Universiteit Gent, Belgium); Marijke Thoonen (INBO, Belgium)

Verges are affected by the colonization of non-native invasive plant species. Big Asian knotweeds (species complex *Fallopia*) are among the most invasive plant species in Northwest Europe. The Flemish Agency for roads and traffic is responsible for reducing the spreading of it. A cost-efficient strategy for the management of the invasive plant during road construction and operation is being developed in collaboration with the Flemish Research Institute for Nature and Forest. A new method of chemical control is being tested in collaboration with the Ghent University because the use of glyphosate is more and more under discussion.

Biological control of Japanese knotweed (*Fallopia japonica*): A pilot project for the control of the invasive weed on railway infrastructure

Corinna Hecke, Michael Jungmeier (E.C.O. Institute of Ecology, Austria)

The Japanese knotweed (*Fallopia japonica*), an invasive plant species originally native to East Asia, has been spreading alongside railway infrastructure of the Austrian Federal Railways Company (ÖBB). The spreading is hindering railway construction, maintenance, and operation. Since 2014, the ÖBB has implemented a pilot project, trying to fight this invasive plant species through intensive grazing by goats and sheep. In 2017, a monitoring system for

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the documentation of the effects of grazing on *F. japonica* was established. Interim results indicate that grazing, especially with an appropriate ratio and amount of sheep and goats, is considered to be a satisfactory method in controlling the Japanese knotweed.

Usefulness of power line right-of-way for wild bees and butterflies in agro-forestry landscapes

Denis François, Héroïse Blanchard, David Martinière (IFSTTAR, AME/EASE, France); Violette Le Féon, Bernard E. Vaissière, Mickaël Henry (INRA, UR 406, France); Eric Guinard, Jean-François Bretaud, Christophe Pineau (CEREMA Ouest, France)

The usefulness of power line right-of-ways for wild bees and butterflies was assessed in an agroforestry landscape in France. Comparisons were carried out between ROW sites in wooded areas (n = 31) and reference sites in open habitats as grasslands (n = 25). Average species richness (bees and butterflies) and bee abundance appear statistically equivalent between ROWs and reference sites. ROWs provide nesting resources to bees, host some threatened species and contribute substantially to the regional pool of pollinating insects. Some similarities between bee communities suggest possible exchanges along forest ROWs and between ROWs and the surrounding landscape.

The achievements of the LIFE Elia-RTE project (2011-2017)

Jean-Francois Godeau (EcoFirst, Belgium)

The 'LIFE Elia-RTE' (2011-2017) project implemented seven innovative vegetation management methods across 460 hectares of right-of-way along high-tension lines (Belgium & France). It enhanced cooperation with various local stakeholders (hunters, municipalities, forest administration) and Transport System Operators to combine electrical safety and biodiversity. It resulted in enhancing

the area and the quality of natural habitats (e.g., 100 hectares of Natura2000 habitats) and the populations of rare or threatened species. Additionally, 270 hectares of forest edges were created or managed properly.

Thursday / 10:00 – 11:00

Room: Saturn

Performance evaluations of mitigation works

Moderator: Wiel Poelmans, Province Noord-Brabant, Netherlands

Prevention of wildlife-vehicle collisions: An evaluation of odour repellent effectiveness

Michal Bíl, Richard Andrášik, Zuzana Křivánková, Jiří Sedoník (CDV – Transport Research Centre, Czech Republic); Tomáš Bartonička (Masaryk University, Department of Botany and Zoology, Czech Republic)

Wildlife-vehicle collisions (WVC) pose a safety issue in many countries. Collisions with large mammals result in numerous deaths and severe injuries to animals, property damage and injuries to car passengers. Therefore, the effectiveness of possible safety measures needs to be investigated. We examined the effectiveness of odour repellents with respect to reduction of WVC. The Before-After-Control-Impact study design was applied to control both the effect of odour repellents and the expected natural variation in wildlife populations at the monitored sites over time. We found out that a WVC decrease accounting for 26-43 % can be expected at treated sites.

TSONic devices effectiveness in keeping wildlife off the road

Diana Guedes, Hélder Ribeiro, Neftalí Sillero (CICGE – Prof. Manuel de Barros Astronomical Observatory, Faculty of Science of the University of Porto, Portugal)

The increasing development of linear

infrastructures affects wildlife in many ways. Mitigation measures are being applied to the species more vulnerable to roadkill, but there is little proof about their effectiveness. Here we tested an alternative measurement to reduce road and electrocution mortality with sound or ultra-sound devices that are activated when motion is detected. We tested two devices to discourage mice from approaching roads and consequently reduce the number of vehicle-collisions and, in parallel, we tested two devices to dissuade and monitor large birds in and on electrical lines.

Evaluating the success of wildlife crossing structures using genetic approaches and an experimental design: Lessons from a gliding mammal

Kylie Soanes, Peter Vesk (The University of Melbourne, Australia); Andrea Taylor, Paul Sunnucks, Silvana Cesarini (Monash University, Australia); Rodney van der Ree (Ecology and Infrastructure International, Australia)

We evaluated the success of wildlife crossing structures for an arboreal mammal using a before-after comparison, and the use of genetic techniques. We found that the freeway was not a complete genetic barrier, with a strong effect evident at only one site. However, we also found that installing a crossing structure at the location with a strong barrier effect restored gene flow within just 5 years of mitigation. Our study highlights the importance of using genetic techniques not just to evaluate the success of road-crossing structures for wildlife, but also to guide their placement within the landscape.

Using eDNA metabarcoding to evaluate the effect of nature-friendly banks as mitigation measures for fish

Jelger Herder, Jan Kranenborg (Reptile, Amphibian and Fish Conservation, Netherlands); Alice Valentini (SPYGEN, Savoie Technolac, France); Nico Jonker (Provincie Noord-Holland, Netherlands)

In the Netherlands alone, 2,500 km of nature-friendly banks (NFBs) have been constructed since 2009 to mitigate for heavily defended banks. We evaluated the effects of NFBs on fish in a large canal. Besides traditional methods eDNA-metabarcoding was used, a new innovative method based on the identification of DNA that species leave behind in their environment. The eDNA-metabarcoding method will be explained in detail and results of the study on the NFBs will be presented. Furthermore, we give recommendations for further use and implementation of the eDNA-metabarcoding method, for example in evaluating the effectiveness of fish-passages.

Wildlife crossings in Poland: A source of data for placement and effectiveness evaluation process

Karolina Danuta Jasińska, Dagny Krauze-Gryz, Joanna Werka, Piotr Kowal (Department of Forest Zoology and Game Management, Warsaw University of Life Sciences WULS-SGGW, Poland)

Based on the questionnaires sent to managers of public roads, we analysed the methods used to choose the placement of wildlife crossings (over and underpasses for medium and big mammals). We also evaluated their effectiveness. The survey concerned over 3,500 crossings. Wildlife crossing structures placement in Poland was chosen mostly on quite rough data. The pre-investment monitoring was conducted in only half of the planned crossings. However, post-investment tracking was performed more often. Almost all big and medium mammals, excluding brown bear, used 95% of crossings.

A journey to success: How to identify high-risk roads, plan and monitor amphibian tunnels

Marcus Arnesson, Daniel Segerlind (Ecom AB, Sweden)

We have identified potential conflict road

parts, where amphibian species face the risk of being killed during road crossing. In a field survey we identified and classified which of these roads are of high priority for securing a safe amphibian passage. In 2017, amphibian tunnels were established on two high priority roads. Our aim is to present and get input on our method of identifying, planning and monitoring these amphibian tunnels.

Green bridges in the dunes: Monitoring of wildlife bridges in Zuid-Kennemerland

Vincent van der Spek (Waternet, Netherlands); Dick Groenendijk (PWN, Netherlands)

In the dunes of Zuid-Kennemerland, along the Dutch west coast, three wildlife bridges were built between early 2014 and spring 2018. The bridges connect protected dune grasslands and scrub habitats that were previously separated by two busy roads and a railway. Monitoring started in 2014 and included vegetation, mammals, herpetofauna and different groups of insects. Results show that 17 out of 23 assigned key animal species for the Zuid-Kennemerland region were recorded within four years. Our monitoring results suggest that these bridges provide mitigation for ecological fragmentation of dune habitats.

Thursday / 16:00 – 17:00
Room: Foyer

Animal-vehicle collisions: survey techniques, hotspot analyses and mitigation success

Moderator: Clara Grilo, CDV – Transport Research Centre, Czech Republic

Comparative study of animal carcass survey methods on roads

Eric Guinard, Jean-François Bretaud, Luc Chevallier (Cerema Sud-Ouest, France); Lucille Billon, Ro-main Sordello, Isabelle Witté (UMS 2006 PatriNat, France)

Fauna casualties on Linear Transport Infrastructures (LTI) are potentially dangerous and cause economic damage. This underlines the need to detect the most important fauna mortality hotspots. But the scientific knowledge is incomplete concerning carcass surveys methods efficiency on LTI. The aim of this study is to conduct comparative analyses on spatial distribution, taxonomic group numbers and composition of fauna mortality hotspots on LTI, with data obtained from two carcass survey methods: one conducted by an ecologist, one by patrollers. According to preliminary results, these two survey methods seem to be complementary and could be used together to obtain more accurate data.

AVC data by volunteers and official crash data: a comparison based on three years of experience with reporting the application srazenazver.cz

Michal Bíl, Jan Kubeček, Richard Andrášik, Jiří Sedoník (CDV – Transport Research Centre, Czech Republic)

We present new developments connected with the animal-vehicle collision reporting application srazenazver.cz. We further provide a comparison between official data and data collected by volunteers to report their strengths and weaknesses.

Which factors are different between WVC hotspots with large mammals and randomly selected sites along roads?

Richard Andrášik, Michal Bíl, Jiří Sedoník (Transport Research Centre, Czech Republic); Martin Duľa (Mendel University, Czech Republic)

The numbers of wildlife-vehicle collisions (WVC) are continually increasing in many European countries. A precise selection of high-risk locations on roads is therefore needed to effectively apply mitigation measures. First, we used the KDE+ method to identify these

sites. Subsequently, we focused on determining the differences between significantly dangerous places and other locations where a WVC occurrence is still possible. We demonstrated a significant difference between the WVC hotspots and the randomly chosen WVC which do not form a spatial pattern. We found, in contrast, no significant difference when comparing hotspots of collisions with roe deer and wild boar.

Combined use of KDE+ software and empirical observation to identify animal-vehicle collisions' hotspots in South Tyrol, Northern Italy

Filippo Favilli, Thomas Streifeneder (Eurac Research, Italy); Michal Bíl, Jiří Sedoník, Richard Andrášik (CDV – Transport Research Centre, Czech Republic); Peter Kasal, Andreas Agreiter, Lena Schober, Philipp Sicher (Autonomous Province of Bolzano Administration, Department for Nature, Landscape and Spatial development, Italy); Lothar Gerstgrasser (Hunting Association of South Tyrol, Italy)

Animal-vehicle collisions (AVC) with red and roe deer in South Tyrol, Northern Italy, count some 700 cases per year. This amount of animal-vehicle collisions causes several socioeconomic, human health and ecological implications. In order to have an effective AVC prevention and reduction, a combined approach has been adopted. This approach has used empirical observation of animal behaviour close to the roads, visual identification of ecological corridors and KDE+ statistical analysis on AVC data to identify the riskiest hotspots and define the most appropriate strategies to reduce/prevent AVC.

How citizen scientists and innovative construction design allow finding and mitigating hotspots in barn owl traffic victims

Jasja J.A. Dekker (Jasja Dekker Dierecologie, Netherlands); Johan de Jong (Stichting Kerkuilenwerkgroep Nederland, Netherlands)

Ring data generated by citizen scientists allowed us to gain insight in barn owl traffic victims. The data was used to determine age, timing and origin of victims, and will be used together with data on breeding success, how determine how traffic mortality affects the population. Hotspots in victims are mitigated using an innovative construction technique.

Wild vertebrate road kill on selected highways passing through four spatially isolated protected areas of Eastern Ethiopia

Getachew Muluaem Muche (Ethiopian Biodiversity Institute, Ethiopia); Wendy J. Collinson (Endangered Wildlife Trust, South-Africa)

Current research shows that highways have an adverse impact on road kill of wild vertebrate species. About 44 species of vehicular mortality were identified. Birds were the most impacted taxon in the surveyed highway. There are certain Endangered and Vulnerable species victimized by the vehicular casualties. Diurnal species constitute the highest figure of road kill. In contrary to several studies, nocturnal animals were less susceptible to the vehicular collision. The specific location of the highway was the highest wild vertebrate mortality site within the protected area relative to unprotected agricultural and semi-urban areas of Eastern Ethiopia.

Animal-vehicle collision and ecological connectivity in the Mont Blanc area: The role of local stakeholders in managing local human-wildlife conflict

Filippo Favilli, Prune Claire Giatti, Andrea Omizzolo, Thomas Streifeneder (Eurac Research, Italy); Aline Breton, Marion Guitteny (ASTERS, France)

Animal-vehicle collision (AVC) in the Mont Blanc region is a hot topic, although local stakeholders and the public sector have been working on mitigation techniques

through the years. Eurac research, in collaboration with ASTERS, has involved local stakeholders in developing what should become soon new forms of collaborations to manage the AVC conflict, in order to protect some of the prominent ecological corridors. The main objective was to discuss the issues and the measures for a specific area and also the best way to get the visions and the opinions of all the relevant stakeholders and of local populations.

Thursday / 16:00 – 17:00
Room: Neptune

Crossing borders in our way of working: Knowledge exchange and collaboration

Moderator: Camiel Meijneken, ProRail, Netherlands

Crossing borders between sender and recipient: Better communication and marketing for better wildlife corridors

Jan Guerke (Pro Natura, Switzerland)

In 2017 Pro Natura (Friends of the Earth Switzerland) started the campaign "Make way for wildlife!". Our experience shows that practical projects are more likely to be successful if there is a master plan that includes the project itself as well as matching fundraising and communication activities. Objectives : (1) Inspire other organisations to consider new ways to fund connectivity measures; (2) Support other organisations by providing them with a case study about the awareness-raising effects of political and educational projects. The revenue provides the financial basis for connectivity measures: purchase anti-tank obstacles and increase their value as wildlife corridors.

Monitoring together! Government and NGO monitoring arboreal crossings and underpasses on Costa Rican roads

Daniela Araya-Gamboa, Deiver Espinoza-Muñoz, Roberto Salom-Pérez (Panthera,

Costa Rica); Juan Bonilla-Villalobos, Andrea Avila-Alfaro, Jesús Zamora-Hidalgo (Costa Rica Ministry of Transportation, Costa Rica)

In Costa Rica, development needs to be in balance with conservation. The roads are getting greener. The Ministry of transportations and Panthera started designing a monitoring protocol for arboreal crossings and underpasses. This has to be implemented as a mandatory feature in future projects. To test this methodology, we set up camera traps on arboreal crossings, underpasses, drainages, and in the forest on a new road. Through this joint monitoring, the Costa Rican government started to learn how to evaluate the use of infrastructure by wildlife and how to implement adjustments. Additionally, they learned to test the methodology for the monitoring protocol that will be implemented when building new roads in the country.

TRANSGREEN Project: An example of cross-border cooperation in the Carpathian Mountains

Václav Hlaváč (Nature Conservation Agency, Czech Republic); Hildegard Meyer (WWF International, Danube-Carpathian Programme, Austria)

The project TRANSGREEN co-funded by the ERDF aims at enhancing the safety and environmental-friendliness of road and rail networks developed in the Carpathian region along the Trans-European Network of Transport (TEN-T). The project focuses on 4 pilot areas in Czech Republic, Hungary, Romania, Slovakia, and Ukraine. Amongst others a handbook on the harmonization of wildlife and traffic and catalogues of measures for the 4 pilot areas will be produced. Activities being carried out in the Beskydy pilot area located in the border area of the Czech and Slovak Republic will be presented as case study for cross-border.

Interdisciplinary language barriers that impact on the implementation of the All-Ireland Pollinator Plan

Aoife Bernadette McAleenan, David Woodward, Phillip Millar (Ulster University, School of Architecture and Built Environment, UK)

Different disciplines have their own languages with their own terminologies that have specific meaning and interpretations, which are different from the meanings and understandings in the natural use of the same words and phrases. In the case of road verge wildlife maintenance within the United Kingdom, we have engineers and environmentalists talking two different disciplinary languages, that can create confusion and lead to the misunderstanding of essential processes. This study aims to break this “language barrier”; therefore, creating a more precise understanding between the two disciplines and a united objective.

A cross-sectoral and interdisciplinary approach to improving management of trees as Green Infrastructure

Piotr Tyszko-Chmielowiec (Foundation for Sustainable Development, Poland)

Trees are an essential part of Europe’s green infrastructure in urban and rural landscapes. They maintain biodiversity as habitats and ecological corridors. However, trees are among the least appreciated elements, often taken for granted by both society and tree managers. Since 2009, the Roads for Nature programme has worked in Poland with people and institutions responsible for trees to improve their skills and support a network of grassroots activists. An international support network was created. The new LIFE+ project Trees for Europe’s Green Infrastructure wants to improve the role of trees as green infrastructure through generating and disseminating better management practices.

Turning scientific knowledge into official technical recommendations

Fernanda Zimmermann Teixeira (Graduate Program in Environmental Systems Analysis and Modelling, Federal University of Minas Gerais / Road and Railroad Ecology Group, Federal University of Rio Grande do Sul, Brazil); Larissa Donida Biasotto, Larissa Oliveira Gonçalves, Bibiana Terra Dasoler, Júlia Beduschi, Andreas Kindel (Road and Railroad Ecology Group, Federal University of Rio Grande do Sul / Graduate Program in Ecology, Federal University of Rio Grande do Sul, Brazil); Gabriela Schuck, Giulia Barbieri (Graduate Program in Ecology, Federal University of Rio Grande do Sul, Brazil)

As a strategy to improve the effectiveness of the decision-making process in environmental licensing of roads and railroads, we have developed workshops in Brazil in the past four years involving academia, environmental managers, transportation agencies, and environmental consultants. These workshops resulted in the definition of sampling protocols and guidelines for mortality surveys and monitoring of mitigation effectiveness in the contexts of roads and railroads.

Common ground: When road authorities and community groups actually work together

Darryl Jones (Environmental Futures Research Institute, Griffith University, Australia)

A major new motorway upgrade in Australia threatened to lead to familiar conflicts between road authorities and community groups. Instead, the planning team took the initiative of inviting representatives of local community and environmental groups to form an independent reference group. This group was involved in all aspects of the design and conceptualisation of the works, resulting in a significant number of innovative permeability measures. This current project represents one of the most ambitious landscape-level road ecology collaborations yet attempted.

Thursday / 16:00 – 17:00

Room: Saturn

Mitigation projects and animal responses

Moderator: Marita Bötcher, Federal Agency for Nature Conservation, Germany

The behaviour of wild mammals living in the vicinity of railway tracks in the field and forest landscape mosaic

Karolina Danuta Jasińska, Dagny Krauze-Gryz, Joanna Werka (Department of Forest Zoology and Game Management, Warsaw University of Life Sciences, Poland)

The study aimed to determine the behaviour of animals living in the vicinity of railway tracks. We looked at their behaviour in different situations: when the train was approaching and when no train was approaching, and what factors influenced that behaviour. The study discovered that mammals didn't avoid railway tracks. The way they used the tracks (and their vicinity) depended on a given species. Season, time of day and moon phase influenced the way the animals used the railway. When a train would approach, animals would escape, become alarmed or show no reaction at all. Only the moon phases influenced animal reactions to the train.

The dispersal route of wolf Naya from Germany through The Netherlands into Belgium: Insight from GPS-GSM telemetry on activity patterns and barrier crossings

Norman Stier, Vendula Meißner-Hylanová (T.U. Dresden, Forstzoologie, AG Wildtierforschung, Germany); Hugh A.H. Jansman, Dennis R. Lammertsma (Wageningen Environmental Research, Netherlands)

A female wolf, Naya, was fitted with a GPS-GSM collar to study her activity pattern, habitat use, and interaction with prey species. Her dispersal route from Lubteener Heide (Mecklenburg-Vorpommern, Germany), through The Nether-

lands, and into Flanders, Belgium, will be presented, focussing on barrier crossing.

Innovative approaches to open the Afsluitdijk for fish

Roef Mulder (Province Fryslân, De Nieuwe Afsluitdijk, Netherlands); Sophie Lauwaars (Ministry of Infrastructure and Water Management, Netherlands)

The Afsluitdijk is a barrier between the Wadden Sea and Lake IJsselmeer. National and regional parties are working together on innovative solutions to restore this connection. In two joint presentations, we will present current and new measures to facilitate fish migration. Current measures are the fish-friendly operation of the discharge sluices and ship locks, and the fish passage for small fish near the province of North Holland. A new measure is the construction of a Fish Migration River consisting of an estuary, with natural tidal influences and brackish habitats.

Reevediep a new connection between the River IJssel and the bordering lakes

Arjan Otten (Province Overijssel, Netherlands)

More space for water is created in the Room for the River project IJsseldelta to control the risk of flooding in the Kampen-Zwolle region due to climate change. A combination of two measures is used: the deepening of the summer bed of the river IJssel and the construction of a river bypass (Reevediep), which connects the river IJssel with the adjacent lakes. In the Reevediep more than 350 hectares of new nature is created, containing a new reed marsh (Natura 2000 area Veluwerandmeren) and habitat for protective fish species (Weatherfish), Eurasian water shrew, and pond bat.

Tracking glass eels

Martijn Schiphouwer, Sanne Ploegaert, Edo Goverse (RAVON, Netherlands)

Glass eel recruitment is monitored in large citizen science projects at more than 40 locations by over 150 volunteers in the coastal regions to contribute to trends, gain knowledge on the timing of migration and to prioritise fish migration measures at barriers. The migration efficiency of fish passages for glass eels has been poorly documented. In 2017 VIE-tags (Visible Implant Elastomer) in a mark-recapture set-up were used for the first time in the Netherlands. This research indicated that migration efficiency of the fish passage in Scheveningen was low and therefore additional measures should be taken.

WiConNET: A large-scale multimodal wildlife-vehicle-collision mitigation project

Andreas Schalk, Rainer Schalk (iPTE Traffic Solutions Ltd, Austria); Michael Aleksa, Klemens Schwieger (Austrian Institut of Technology, Austria); Martin Forstner (WWN Forstner, Austria); Alexander Frötscher (AustriaTech, Austria)

Austria is a leader in development and deployment of WVC avoidance (WVC-A) systems. It has led to a broad base of installed WVC-A roadside devices. The Austrian institutions gained about 20 years of insight into the applicability and limitations of passive and active WVC-A systems. In 2017, the relevant stakeholders (the government, road, rail and highway operators, wildlife experts, industry, and research) teamed up to create the WiConNET project. The WiConNET project is a WVC research and development project. However, it also includes a test and certification laboratory for WVC equipment and deploys 16 large test sites all across Austria.

WiConNET-Test sites: Validation Test sites across Austria for of wildlife-vehicle-collision mitigation systems

Florian Saliger, Thomas Schuh, Bernd Stigger, Martin Forstner, Andreas Schalk

(ÖBB-INFRA, Austria); Rupert Gartler (ASFINAG, Austria)

The WiConNET is an extensive Wildlife-Vehicle Collision Avoidance (WVC-A) research and deployment project launched by all relevant Austrian stakeholders. The project is deploying 16 large test sites across entire Austria to evaluate the efficiency of its advanced Wildlife-Vehicle Collision Avoidance (WVC-A) systems. The test sites have been carefully selected to reflect most of the typical wildlife and environmental challenges in Austria, and to cover the operator's requirements. Five national road sites, six highway sites, and five railway sites have been chosen. The efficiency of the WVC-A systems will be validated by accident statistics, by observation of the wildlife behaviour and video monitoring.

Thursday / 16:00 – 17:00

Room: Venus

Designing and maintaining greener transportation infrastructure

Moderator: Marleen Moelants, Flemish Government, Belgium

Designing a ring road, a landscape or both?

Luc Vander Elst (Vlaamse Landmaatschappij, Belgium)

In redesigning the ring road, the planning for a broader ring road has been going on for years now. However, no final decision has been made. Since the northern part of the ring road is located on a deep level of the landscape, there is an opportunity to lower the ring road and connect the landscape on both sides above the lower ringroad. On one side, there is a Nature 2000 area, and on the other side, there is a significant agricultural area. Connecting those two parts would benefit both nature, biodiversity, and people. Should we only focus at mobility or should we go for multifunctional solutions that benefit everyone?

Improving the ecological quality of secondary waterways using the standard approach 'Sustainable Civil Engineering'

Dineke Mulderij (Province of Noord-Holland, Netherlands)

The Province of Noord-Holland signed both the Green Deal GWW 2.0 and the Green Deal Infra-nature. In these deals, parties commit themselves to implement a standard approach to improve the sustainability of infrastructural projects. In the province of Noord-Holland, the standard approach was used to improve the ecological quality of secondary waterways in some shore protection projects. The approach resulted in a wide variety of measures, from simple contractual demands to selection criteria. In conclusion, the approach offers a useful and systematic method to improve sustainability in shore protection projects. However, the approach should ideally commence in the project's study stage.

System certification for eco-friendly materials constructing a greener transport infrastructure: A way to gain knowledge and enhance quality crossing borders between stakeholders

Lien van Besien (Department of Environment & Spatial Development, Belgium)

A way to create an ideal playground where nature can develop hand in hand with transport infrastructure is to work with eco-friendly materials. How can we enhance the quality of these materials, their application, and the architecture's choice? A market analysis defined what kind of eco-friendly materials are used. Determining factors in the quality of these 'living' materials were listed and combined with the experience that cooperation between all different stakeholders is essential. These findings resulted in the development of an eco-technical material care system (NTMB-zorgsysteem). Using it enhances the spreading of knowledge.

Plastic Bridges: New materials for the integrated design of landscape and infrastructure

Nina-Marie Lister (School of Urban + Regional Planning, Ryerson University, USA); Robert Ament, Matthew Bell (Western Transportation Institute, Montana State University, USA); Marta Brocki (Ecological Design Lab, Ryerson University, USA)

This presentation highlights outcomes from a CoLaboratory held in Bozeman, Montana co-hosted by Robert Ament (WTI, Montana State University) and Nina-Marie Lister (Ecological Design Lab, Ryerson University). The CoLab tested opportunities and generated prototypical designs for crossing infrastructure built using recycled plastics, which have been widely adopted in pedestrian and bicycling bridge applications. Experts in the disciplines of structural and civil engineering, wildlife ecology, urban planning, and landscape architecture and design identified existing opportunities and barriers, both procedural and design-based, to the uptake and widespread adoption of plastic bridges for wildlife by planning and transportation agencies.

Crossing the ecofence of the Sonian Forest: joint management and maintenance of infrastructure

Andreas Baele, Yoeri Bellemans (Agentschap voor Natuur en Bos, Belgium)

In this presentation, we give an overview of the realised infrastructure and the elaborated joint management plan after the Life + OZON project (2013-2018) in the Sonian Forest (Flanders / Belgium).

Creating a simple solution for a complicated situation: Maintenance of a diverse eco-infrastructure network (Niel, Belgium)

Isolde Aelvoet (Dienst Duurzaam Milieuen Natuurbeleid, Province of Antwerp, Belgium)

A new 1.5 km fauna passage is being created: including an amphibian wall, exit step, bat cellar, and various types of tunnels and vegetation. The fragmented ownerships involved make it difficult to manage this project as a whole. The Province of Antwerp engages itself to bring all stakeholders together and work out a detailed management proposal that will bring continuity and unity in the short and long term. To do this, it will define all necessary management and maintenance work in explicit, easy-to-use management leaflets. It will also look for a suitable partner and method to guide and implement the unified approach.

Evaluation of vegetation management in verges of Dutch highways

Peter-Jan Keizer (Rijkswaterstaat, Netherlands); Paul Boddeke (Bureau Waardenburg, Netherlands)

Management of the roadside vegetation of Dutch highways aims at – next to traffic and safety requirements – an increase of the botanical value. 1600 plots were sampled during 16 years with 4 years interval, in roadside forests, ditches, but mainly grasslands. Roadside forests have low botanical value. In grassland and ditches non-pioneer ruderal (tall grass) species increased, but rarer species, indicators of nutrient-poor dry grassland, small herbs, the proportion of “flowering herbs” and botanical value decreased. Main cause of this seems to be an inaccurate management practice in the roadside vegetation.

Implementation of dynamic wildlife warning systems and the use for specifically selected (small) animals

Gert Hamberg (Traffic 2000 / Prowild, Netherlands)

In general, wildlife vehicle-collision (WVC) mitigation measures at ground level crossings are mainly taken to protect passing traffic, and secondary for the protection of animals. We will provide

information about the possibilities and steps to take in the procedure to implement dynamic wildlife warning systems with the main purpose to protect specifically targeted species. We also compare different detection methods and how to use them in particular circumstances. Choosing the right configuration will lower maintenance costs and makes the system function well.

Thursday / 16:00 – 17:00

Room: Pluto

Planning for biodiversity and green infrastructure development

Moderator: Yannick Autret, Ministry of Ecology, Sustainable Development and Energy, France

Infranature – Infrastructural collaboration and solutions yield more biodiversity

Albert Vliegenthart (Dutch Butterfly Conservation, Netherlands)

Infranature aims raising biodiversity in a wide spectrum of infrastructures. This initiative is supported by NGOs, national companies and governments who work together on sustainable solutions for infrastructural developments, e.g. business models, contracts and regulations. The impact can be regarded as an optimum form of nature conservation, since this requires a change of culture and where the projects are just reflecting good examples. After two years the first transition to biodiversity-based infrastructure reveals; better known as Infranature!

Creating landscape connectivity along present transport infrastructure: It takes more than just constructing a wildlife-crossing

Claude Eugen Steck, Annette Kohnen (Freiburger Institut für angewandte Tierökologie, Germany)

Germany aims at reconnecting large-scale wildlife corridors by removing

current barrier effects imposed by the national highway network. We contributed to this project by evaluating two wildlife corridors in southwestern Germany. Landscape analyses revealed that only in one case mitigation measures would yield a long-term functioning ecological corridor for certain key species. Communication of our results to different stakeholders increased the acceptance and thereby the future effectiveness of the passage. We highlight that focusing on barrier removal alone is not sufficient, but incorporating the human dimension and surrounding landscape is necessary to ensure the long-term functionality of wildlife corridors.

Migration study of large mammals at highways in Slovakia

Michal Králik, Marek Sekerčák (HBH projekt spol. s r.o., Slovakia); Tomáš Šikula (HBH projekt spol. s r.o., Czech Republic)

Our migration study of large mammals at highways in Slovakia is resolving the absence of a comprehensive base for the definition of corridors at a national level. In this study, we also recommend measurements to reduce the overall impact of transport on the superior road infrastructure and the mortality of the observed species. The species we observed were: bear, wolf, lynx, wildcat, elk, deer, roe deer, wild boar, mouflon and fallow deer.

Inserting ecological connectivity issues and defining ecological corridors in the framework of developing the Strategy for Biodiversity of the Region of Western Macedonia in Greece

Lazaros Georgiadis, Virginia Avgoustinaki, Panagiotis Kokinidis, Elias Mouratidis (Managing Authority of Region of Western Macedonia, Greece); Elena Tsikardani, Giannis Karagiannis (Development Agency of Western Macedonia, Greece)

Developing the Strategy for Biodiversity of the Region of Western Macedonia in Greece and towards supporting ecolog-

ical connectivity in interregional-national and transboundary level, a mapping implemented based on a combination of green and grey infrastructure zones and securing the ecological coherence between the Natura 2000 areas. The results showed the recognition of five main ecological corridors, seven crossing points between ecological corridors and roads and two high sustainable interest areas with needs of conflict level evaluations in a more ecosystem and holistic approach and identification of complementary environmental impacts of multiple development sectors.

Designing ecological corridors network for brown bears in Romania

Ancuta Fedorca, Georgeta Ionescu, Mihai Fedorca, Marius Popa, Ramon Jurj (National Institute for Research and Development in Forestry "Marin Dracea", Romania); Mihai Daniel Niță, Ovidiu Ionescu (Transilvania University of Brasov, Romania)

While development of highway infrastructure is vital to country's economic development and prosperity, long-term conservation of the biodiversity can be achieved only by implementing successfully mitigation measures and by harmonizing the sectorial policies for development with conservation strategies. The brown bear requires the use of extensive habitats due to their large home ranges.

Integration of an ecosystem service approach in national highway-planning and development in Pakistan: Opportunities and challenges

Khalid Farooq Akbar (University of Lahore, Pakistan)

Pakistan is going through an extensive program of road building that may have negative implications for its landscapes, ecosystems, and biodiversity. However, if this program is planned and executed based on an ecosystem service approach, it can help in building a sustainable road transport network, protection of

landscapes, safer roads, environmental conservation, and prosperity of local communities. This needs ecological road infrastructure for the planning, building, and managing of road schemes. This paper describes the opportunities, benefits, and challenges to the incorporation of an ecosystem service approach in road development in Pakistan.

Green infrastructure, ecosystem services and road network in Spain

Víctor Colino-Rabanal (Department of Animal Biology, Faculty of Environmental Science, University of Salamanca, Spain)

I examine the relationship between the elements of GI, ES and road networks on the mainland of Spain. GI elements are those that will be included in the future Spanish Strategy: protected areas, critical areas for birds and mammals, river and coastal public domains, agricultural areas of high natural value, etc. GI elements have on average lower road densities. However, some essential landscape connectors show high road densities, especially river valleys and their riparian forest associated. The areas with a predominance of provision services show higher densities than those related to the supply of regulation and cultural services.

Identification and development of habitat defragmentation priority projects, within the Green Infrastructure Programme of Catalonia

Jordi Solina, Sergi Rasero, Paula Bruna, Antoni Sorolla (Ministry of Territory and Sustainability, Government of Catalonia, Spain)

Within the framework of the Green Infrastructure Programme of Catalonia, the Directorate General of Environmental Policies and Nature has adopted the objective of restoring ecological connectors affected by terrestrial transport infrastructures. We carried out cartographic analysis and fieldwork to identify critical areas and to define required actions.

Over 40 areas were identified for their defragmentation, and proposals were prioritised. Examples of some developed defragmentation actions are exposed.

Thursday / 16:00 – 17:00

Room: Jupiter

Wildlife crossing structures: Implementation and innovation

Moderator: Victor Loehr, Rijkswaterstaat, Netherlands

Evidence-based development of a commercial arboreal wildlife bridge to prevent habitat fragmentation and isolation

Sophie Hughes (Animex International, United Kingdom); Ian White (People's Trust for Endangered Species, United Kingdom)

The ever-increasing global transport network has the potential to fragment and isolate habitats for arboreal wildlife, prompting the need for evidence-based, effective mitigation solutions. Although many arboreal wildlife bridges have been installed in the UK in the past, most have proven to be expensive or likely ineffective, highlighting the requirement for further research into a cost-effective and proven design. Here we explore the development of an affordable arboreal bridge that has been proven, through dedicated research, to effectively enable a broad range of arboreal species to traverse habitats fragmented by construction projects around the world.

Next generation of arched wildlife overpass – Yoho National Park, Canada

Terry M. McGuire (McGuire Consulting, Canada)

Twenty years after the first wildlife overpass on the Trans-Canada Highway in Banff National Park was constructed, the seventh wildlife overpass within Canada's national parks has been constructed. This arch structure, along with four wildlife highway underpass

LIGHTNING TALKS

crossings represent a continuation of the largest highway mitigation complex in the world as Parks Canada embarks on widening a further 48 kilometers of highway through Yoho National Park, Canada. This presentation explores designing, tendering and constructing what may be the largest 33 meter single span precast concrete arch wildlife overpass in the world as well as a look ahead to other planned mitigations.

Adaptation of drainage culvert for a jaguar underpass in a highway, in Guanacaste, Costa Rica

Esther Pomareda, Esmeralda Arevalo, Araya Daniela (Vias Amigables con la Vida Silvestre, Costa Rica)

Costa Rica has been improving its roads. For example, expanding the Northern Interamerican Highway from two to four lanes. One month after it was in operation, a jaguar was killed on the road. This location coincides with a drainage culvert. Camera traps were at the site, and months later another jaguar was detected. Currently, the government is planning to install a fence to prevent further wildlife road kills. This fence will also make sure that the animals use the drainage culvert as an underpass. It is important to highlight the efforts of researchers and the government in the adaptation of road infrastructure for wildlife passages.

Can ecoducts contribute to the coherence of large forest habitat?

Gerard Smit, Dimitri Emond, Jeroen Brandjes (Bureau Waardenburg BV, Netherlands)

In the Netherlands, vast forest and heath habitats are fragmented by dense and intensively used infrastructure. Ecoducts are constructed to reconnect habitats intersected by highways. The observation of multiple species in the first year after construction shows that the habitat at the ecoducts is quickly colonised when animals are present in the

surrounding habitat. Ecoducts facilitate the movements of fauna over highways for a wide range of species, contributing to the connectivity of forest and heath habitat.

Sleeper Fauna Passage

Gideon Vreeman, Rien Veldsink (Movares, Netherlands)

Amphibians live in areas with high water levels. These species also have high demands when it comes to dimensions of fauna tubes. This makes it hard to lift railway barriers for amphibians. Movares engineered a solution to this problem. When steel sleepers with an H profile replace standard sleepers, a plastic fauna passage can be slid in. This makes it possible to construct a fauna passage in and under the ballast bed. The Sleeper Fauna Passage (SFP) is compliant with railway maintenance and can withstand some influences surrounding the railway (such as passing trains, vibrations, and weather influences).

Comparing the use of railway underpasses by wildlife before and after widening the passages

Stefan M. Suter (Institute of Natural Resource Sciences, Zurich University of Applied Sciences, Switzerland); Barbara Karwowska (WildLife Solutions WLS.CH, Switzerland); Esther Schweizer (Schweizer - Lebensraum für Wildtiere SLW, Switzerland)

Size and dimension of wildlife passages are still object of discussion. In our study two railway underpasses have been widened from 5 m up to 12 m and 15 m respectively. We monitored people and wildlife in the underpasses during one year before and four years after widening. Before widening, both underpasses were accessible to animals and people. After widening, both underpasses were still freely accessible for wildlife but in one of the underpasses the gravel road was removed and the environment naturally restored. This passage officially closed

for people. The widening and the access limitation for people have had positive effects on the wildlife use of the underpasses.

Upgrading existing drainage culverts to eco-tunnels and bat hibernacula, a multifunctional and cost-effective method?

Ben Van der Wijden (Brussels Environment, Belgium)

Five new bat hibernacula were constructed in Brussels in the last decade. Four were constructed under the railroad embankment in the Sonian forest. The structures were intensively monitored. Three hibernacula attracted hibernating bats of two species. At least two hibernacula attract swarming bats in autumn. Results of temperature surveys indicate that there is a gradual variation in temperature in the labyrinth. Small animals up to the size of a fox frequently use the structures that double as a small eco-tunnel. Ecologically upgrading existing underground drainage structures proved a successful and cost-effective strategy.

Thursday / 16:00 – 17:00

Room: Pollux

New directions in transportation ecology: What is on the horizon?

Moderator: Tony Sangwine, Highways England, UK

The ecology of radical transport infrastructure innovation

Carmen Aalbers, Bas Pedroli, Michiel van Eupen (Wageningen University and Research, Netherlands)

Dutch planning has developed from comprehensive and strong spatial visions (Randstad, Green Heart), toward network governance in which especially market parties play an essential role. There are growing concerns about the implications of this approach for the quality of life of

Dutch citizens. Will Dutch cities remain appealing in the long term? Especially car transport has a significant impact on the quality of life. What if we would start looking for alternative transport infrastructures? What does the transition theory teach us about change? Are companies and investors willing to take charge of the development of a better quality of life in Dutch cities, while preserving high levels of mobility?

Adapting the infrastructure to the surrounding landscape

Lars Nilsson (Trogon Consulting, Sweden); Anders Sjölund (Swedish Transport Administration, Sweden); Jan Olof Helldin (Swedish Biodiversity Centre/SLU, Sweden)

The Swedish Transport Administration (STA) has decided on standards for adaptation of infrastructure to the surrounding landscape. It is the result of a 20-year development, initially aimed at a system for targets and indicators for ecological and cultural heritage values. By knowledge from research programs such as Triekol and the road ecology program of CEDR, STA could produce standards for a "landscape-adapted road or railway". These standards are now in place.

Can we plan and build a 'nature-neutral' road?

Lene Sørli Heier, Astrid Brekke Skrin-do, Kjersti Wike Kronvall, Håvard Hjemstad-Sollerud (Norwegian Public Roads Administration, Climate and Environment Assessment Section, Norway)

The Norwegian Ministry of Transport and Communication has given the initiative to elucidate if it is possible to plan, build, operate and maintain roads that are 'nature-neutral'. However, what does 'nature-neutral' mean? The presentation will present our approach to this new term, what it may include and our suggestion for the way forward.

Ecological infrastructure joins recreational bicycle bridge

Ruud van Gorkom (Provincie Noord-Holland, Netherlands)

On September 7, 2018, the Bicycle Bridge and Nature Connection Nigtevecht will be opened officially. This project produces double defragmentation. A recreational bridge has been built over the Amsterdam-Rhine Canal; an integrated tendering, design, and realisation of a bicycle bridge with a nature connection over a crowded canal, an unpassable ecological barrier. However, there has been significant local resistance, and after an intensive citizen participation process, the location of the bridge could not be determined until 2013. The work has been put out to tender and has been executed for Best Value.

Avenues connecting across borders

Katharina Dujesiefken (Bund für Umwelt und Naturschutz Deutschland, Germany)

With this presentation, three examples are demonstrated of how bridges can be built between authorities, politicians, residents, and activists to find ways to preserve this endangered landscape element. (1) The planting of a cross-border avenue connecting Germany and Poland lets politicians and authorities agree that tree-lined roads in European countries represent shared European cultural and natural heritage; (2) With an Avenue Preservation Programme we demonstrate how to secure and develop avenues under the requirements of modern mobility; (3) With a cycle tour along the German Avenue Road, we carry the idea of the Avenue Preservation Programme through Germany.

Status of road ecology research in Africa: what more do we need to know?

Wendy Collinson, Harriet Davies-Mostert, Lizanne Roxburgh (Endangered Wildlife Trust, South Africa); Rodney van der Ree

(Ecology and Infrastructure International, Australia)

The science of road ecology is well-developed in North America, Europe and Australia, but is only in its infancy in Africa, which is likely to experience rapid infrastructure development in the future. In this study, we provide a review of the state of road ecology in Africa, to investigate the scale, scope and geographic extent of current knowledge, and identify gaps and priorities for future research. We used Web of Science to undertake a systematic literature search, generating a database of 210 peer reviewed papers related to aspects of road ecology across 38 African countries between 1954 and 2016.

A vision of sustainable infrastructure by 2050: A project in secondary school with students in the age of fifteen and sixteen in Sweden

Amanda Sjölund, Stefan Olsson (Åkerö skola, Sweden)

Sustainable development is an area that extends across many topics and central content in the school curriculum. It is important that today's schoolchildren have a broad foundation and knowledge of sustainable development as it is them who are our future. The aim with the project is to use infrastructure as an instrument to provide students with knowledge and understanding of sustainable development, and additionally to create their own vision of how infrastructure can develop in the future. The project is thematic about the topics technology, as well as biology with a focus on ecology and the impact on biodiversity.