

Programme Book

IENE 2020

INTERNATIONAL CONFERENCE

LIFELINES

Linear Infrastructure Networks
with Ecological Solutions

ONLINE | 12-14 January 2021



Organisers



UNIVERSIDADE
DE ÉVORA



Infraestruturas
de Portugal



CREDITS

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The respective authors are solely responsible for the contents of their contributions in this book.

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WELCOME TO THE IENE 2020 INTERNATIONAL CONFERENCE

The University of Évora, in the framework of the LIFE LINES project, and the Infrastructure and Ecology Network Europe welcome you to the IENE 2020 International Conference. This year, due to the COVID 19 pandemic constraints, it will not be possible to host you in Évora, the beautiful World Heritage City in southern Portugal, as originally planned. The Conference was postponed to January 2021 and will take place fully online. We will be physically distant and a hand-shake or a hug will not be possible. But we are still together to share ideas and experiences that will inspire the adoption of nature friendly solutions in Linear Infrastructure Networks.

**IENE 2020,
“LIFE LINES – Linear Infrastructure Networks with Ecological Solutions”**

“No effort is too small to preserve biodiversity”

Humans are today the main biological influencers of ecosystems, biological communities and species survival. In 2020, the World Economic Forum recognized that “biodiversity loss” is one of the threats with plausible higher impact on Global Economic Development.

Linear infrastructure (LI) networks such as roads, motorways, railways, navigation and irrigation channels, pipelines and electric powerlines, fences, etc. have grown exponentially since the middle of the 20th century. However, most existing LI networks built before the 90th decade are not environmentally friendly, do not consider properly biodiversity conservation and have immense negative impact on wildlife.

Every year, billions of animals are killed by cars, hit by trains, powerlines collisions, electrocuted in electrical poles, drowned in artificial channels, and isolated from their natural resources and mates through insurmountable LI barriers. Light, noise and human activities associated with many of these infrastructures displace wildlife from large areas or induce stress and lowers fitness of those that remain, contributing to smaller, more isolated and less resilient populations. As the climate changes progresses, species can only survive by moving along with the shifting ecological conditions. This requires even more mobility across the landscape, worsening the already detrimental impacts of LI networks. Whether acting in isolation or synergistically, these impacts are a major step to the extinction of species and populations.

On the other hand, the habitats related to linear infrastructures, including verges, areas under powerlines poles and others, if properly managed, may play an important role as corridors or biodiversity refuges, counteracting the adverse ecological effects of LI, particularly when those are embedded in highly human-modified landscapes.

Particularly in the last two decades, Environmental Impact Assessment (EIA) processes increasingly demand new LI to be ecologically sustainable. However, very often the assessment and mitigation are focused on the new infrastructure itself discharging the larger landscape context and the integration and intervention on other infrastructures already present.

Monitoring data on ecological impacts of LI and mitigation efficacy is more available than ever. New devices taking advantage of machine-learning techniques and artificial intelligence are being tested to promote safer LI for humans and wildlife through the reduction of accidents and non-natural mortality, and promotion of safer LI crossings. Big data about species occurrences and ecological needs, increasingly detailed satellite imagery, new and progressively cheaper genetic tools and powerful computers, and modelling techniques are helping us to understand better than ever, interactions between LI and biodiversity. Landscape designers and planners, LI managers and constructors, decision makers are, like never before, aware of the risks and opportunities for biodiversity associated with LI development. No net loss politics and compensatory schemes are powerful and promising tools to prevent biodiversity decline. However, till now, they are not doing enough. Achieving ecologically sustainable LI implies to mainstream biodiversity across all phases of LI development, giving natural capital the priority it deserves in all parts of the process. So, is it time to strengthen this message to top world politicians and decision-makers.

For already existing LI, the investment towards sustainability may seem huge and impossible to accommodate in short term national or institutional budgets. However, often, simple actions, like repairing a fence, adapting a culvert, isolating an electrical cable, etc., can make a difference. When understood by local human communities and authorities these small things will easily get ingrained by people and the motto “no simple action is too simple to help biodiversity” will echo and cement the cooperation across all sectors and regions. Rushing this to happen is the responsibility of all of us, but the support and incentive of decision-makers is the master pylon to implement and spread the idea, guarantying a sustainable Earth where biodiversity, including people, may thrive.

The IENE 2020 International Conference Organising and Programme Committees

CONFERENCE ORGANISERS



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GENERAL INFORMATION

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CONFERENCE LOCATION:

The IENE202 International Conference is fully online.

INFRASTRUCTURE AND ECOLOGY NETWORK EUROPE (IENE) INFORMATION:

More information about IENE and the activities of the network consult: www.iene.info

For specific questions about IENE, contact the secretariat through: info@iene.info

Do you want to become a member of IENE? Visit: www.iene.info/become-a-member

IENE AWARDS 2020:

IENE recognizes and awards outstanding efforts made to reduce the detrimental effects of transport infrastructure on nature and enhance its potential for a positive influence. The IENE Award comprises a public recognition and does not include any grants. The awards are given in two categories:

- The IENE Personal Award: appreciates outstanding engagement and special achievements made by individuals;
- The IENE Project Award: appreciates extraordinary work accomplished by initiatives, activities or plans;
- In addition to these awards, a third award will be given during the conference:
- The IENE 2020 Best Poster Presentation Award: appreciates high-quality poster presentations.

While the first two awards are granted by the IENE Awards Committee, the third award will be given to the candidate that receives most votes by the conference participants. All participants receive instructions of how to vote during online registration.

For more information:

www.iene.info/iene-awards/

The IENE Personal Award was given to Václav Hlaváč.

“For his outstanding achievements and personal engagement concerning the mitigation of negative impacts of infrastructure on nature. He has very successfully spread the ideas of road ecology and especially transformed these ideas into practical actions in the field on national as well as on European level. By his work and enthusiasm, he has achieved a lot in the Czech Republic but also internationally and thereby has been an inspiration to many other European colleagues.”

The IENE Project Award was given to the “Spanish Working Group on Habitat Fragmentation caused by Transport Infrastructure”.

“The National Working Group on Habitat Fragmentation caused by Transport Infrastructure was established in 1999 to establish Transport Ecology in Spain. It is composed of representatives from the Transportation and Environment Departments of Spain’s Regional and National Governments and is coordinated by the Biodiversity and Natural Environment Sub-Directorate General in the Ministry for Ecological Transition. The Working Group published various technical prescriptions that help to effectively prevent and mitigate habitat fragmentation throughout the entire infrastructure cycle. Apart from technical solutions the Working Group also forms a platform for knowledge exchange and awareness raising. The IENE Award appreciates the excellent work and impressive efforts that have been done by the Spanish Working Group in the last 20 years!”

CONFERENCE LANGUAGE:

The conference language will be English.

TIME ZONE:

The Conference Time Zone will be Central European Time (CET; UTC/GMT +1 hour).
General Information

CONFERENCE SCHEDULE

Monday, 11 January

Hour (CET)	
08:30 - 10:00 Training Session	Roadkills - Part 1 Room: Quercus
10:00 - 10:30	Coffee Break / Networking
10:30 - 12:00 Training Session	Roadkills - Part 2 Room: Quercus
12:00 - 13:30	Lunch Break / Networking
13:30 - 15:00 Training Session	Wildlife Crossings / Fencing - Part 1 Room: Quercus
15:00 - 15:30	Coffee Break / Networking
15:30 - 17:00 Training Session	Wildlife Crossings / Fencing - Part 2 Room: Quercus
17:00 - 17:30	Coffee Break / Networking
17:30 - 19:00 Training Session	Wildlife Crossings / Fencing - Part 3 Room: Quercus

Tuesday, 12 January

Hour (CET)

08:30 - 9:15	Welcome Session Room: Quercus				
09:15 - 10:15 Plenary	Plenary Session I: Molecular tools to assess the ecological impacts of transportation infrastructures Niko Balkenhol, University of Goettingen (Germany) Room: Quercus				
10:15 - 10:30	Coffee Break/Networking				
10:30 - 12:00 Parallel Sessions	Session 1.1.1. Full Presentations: Infrastructure Ecological Mitigation and Defragmentation – 1 Room: Quercus	Session 2.1.1. Workshop: A Review of Wildlife-Vehicle Conflict Observation Systems Room: Arbutus	Session 3.1.1. Workshop: The Potential of Smart Technologies for Ecological Planning and Landscape Measures Room: Thymus	Session 4.1.1. Full Presentations: Wildlife and Linear Infrastructure Interactions: Field Monitoring and Ecological Solutions – 1 Room: Cistus	Session 5.1.1. Full Presentations: Infrastructure Ecological Mitigation and Restoration – 1 Room: Lavandula
12:00 - 13:30	Lunch Break/Networking				
13:30 - 14:30 Plenary	Plenary Session II: Challenges and advances of road and railway ecology in Latin America Fernanda Z. Teixeira, Graduate Program in Ecology / UFRGS (Brazil) Room: Quercus				
14:30 - 14:45	Coffee Break/Networking				
14:45 - 16:15 Parallel Sessions	Session 1.1.2. Full Presentations: Infrastructure Ecological Mitigation and Defragmentation – 2 Room: Quercus	Session 2.1.2. Workshop: Mitigating Railway Impacts on Wildlife Room: Arbutus	Session 3.1.2. Side Event: LIFE SAFE CROSSING Seminar: Introduction to the Workshop and Topics concerning Large Carnivores and Transport Room: Thymus (ends 16:30)	Session 4.1.2. Full Presentations: New Tools to Monitor Ecological Impacts of Linear Infrastructures Room: Cistus	Session 5.1.2. Full Presentations: Wildlife and Linear Infrastructure Interactions: Field Monitoring and Ecological Solutions – 2 Room: Lavandula
16:15 - 16:45	Coffee Break/Networking	Coffee Break/Networking (16:15 - 17:00)	Coffee Break/Networking (16:30 - 17:00)		
16:45 - 19:00 Parallel Sessions	Session 1.1.3. Poster Session Room: Quercus	Session 2.1.3. (starts 17:00) Workshop: Advancing the Role of NGOs to Promote Wildlife-friendly Infrastructure Room: Arbutus (ends 18:30)	Session 3.1.3. (starts 17:00) Side Event: LIFE SAFE CROSSING Seminar: Thematic Discussion Session Room: Thymus		

Wednesday, 13 January

Hour (CET)

09:00 - 10:00 Plenary	Plenary Session III: Birds using (and abusing of) linear infrastructures: storks and power lines Francisco Moreira, CIBIO/University of Porto (Portugal) Room: Quercus				
10:00 - 10:30	Coffee Break / Networking				
10:30 - 12:00 Parallel Sessions	Session 1.2.1. Side Event: LIFE LINES Final Seminar – 1 Room: Quercus	Session 2.2.1. Workshop: Development of an Indicative European Defragmentation Map (IEDeM) as a contribution to preserve existing national and international important Green Infrastructure parallel to linear infrastructure improvements within Europe Room: Arbutus	Session 3.2.1. Workshop: An International Strategy and Action Plan for Stakeholders' Engagement on Sustainable Transport and other Linear Infrastructure Room: Thymus	Session 4.2.1. Full Presentations: Road Ecology: Impact Assessment, Mitigation and Monitoring – 1 Room: Cistus	Session 5.2.1. Full Presentations: Green Infrastructure Networks: Policy and Strategic Planning Room: Lavandula
12:00 - 13:30	Lunch Break/Networking				
13:30 - 15:00 Parallel Sessions	Session 1.2.2. Side Event: LIFE LINES Final Seminar – 2 Room: Quercus	Session 2.2.2. Workshop: Helping Tigers, Rhinos, and Elephants Cross the Road: Wildlife Friendly Infrastructure Measures in Asia Room: Arbutus (ends 15:30)	Session 3.2.2. Workshop: Planting and preservation of trees on dams and dykes as a part of green infrastructure: Conflicts - Solutions - Implementation Room: Thymus	Session 4.2.2. Full Presentations: Road Ecology: Impact Assessment, Mitigation and Monitoring – 2 Room: Cistus	Session 5.2.2. Full Presentations: Citizen Science and the Involvement of Civil Society – 1 Room: Lavandula
15:00 - 15:30	Coffee Break / Networking				
15:30 - 19:00 Plenary	IENE General Assembly Room: Quercus				

Thursday, 14 January

Hour (CET)

09:00 - 10:00 Plenary	Plenary Session IV: The EU Biodiversity Strategy 2030 - Perspectives and Implications Jakub Wejchert, DG Environment, European Commission (Belgium) Room: Quercus				
10:00 - 10:30	Coffee Break / Networking				
10:30 - 12:00 Parallel Sessions	Session 1.3.1. Full Presentations: Infrastruc- ture Mitigation and Defragmen- tation Room: Quercus	Session 2.3.1. Workshop: Wildlife and Traffic Handbook Update: towards European standards for fauna passages and fencing Room: Arbutus	Session 3.3.1. Workshop: GLOBAL CONGRESS: Linear Infrastructure and Environment (GCLIE): A Platform to Enhance Cooperation and Coordinated Action between the Existing Continental Conferences on Ecology and Infrastructure Room: Thymus	Session 4.3.1. Full Presentations: Infrastruc- ture Ecological Mitigation and Defragmentation – 3 Room: Cistus	Session 5.3.1. Full Presentations: Managing Biodiversity along Road Verges Room: Lavandula
12:00 - 13:30	Lunch Break/Networking				
13:30 - 15:00 Parallel Sessions	Session 1.3.2. Full Presentations: New Tools and Technologies to Prevent and Monitor Linear Infrastruc- ture Impacts – 1 Room: Quercus	Session 2.3.2. Workshop: Infrastructure, Biodi- versity and Health Room: Arbutus	Session 3.3.2. Workshop: Road sides as eco- logical traps – Challenges and solutions: Changed biotic inter- actions due to non-native seed mixtures and invasive alien plants Room: Thymus	Session 4.3.2. Full Presentations: Road Ecolo- gy: Impact Assessment, Mitiga- tion and Monitoring – 3 Room: Cistus	Session 5.3.2. Full Presentations: Infrastruc- ture Ecological Mitigation and Defragmentation – 4 Room: Lavandula

Thursday, 14 January

15:00 - 15:30	Coffee Break/Networking				
15:30 - 17:00 Parallel Sessions	Session 1.3.3. Full Presentations: Roads and Mammals: Ecological Impacts and Solutions Room: Quercus	Session 2.3.3a. Lightning Talks: New Tools to Mitigate and Monitor Ecological Impacts of Roads (15:30 - 16:00) Room: Arbutus	Session 3.3.3. Workshop: Road sides as ecological traps – challenges and solutions: changed biotic interactions due to non-native seed mixtures and invasive alien plants (Continuation) Room: Thymus	Session 4.3.3. Full Presentations: Challenges and Opportunities for Biodiversity Conservation in Linear Infrastructures Room: Cistus	Session 5.3.3. Full Presentations: Road Ecology: Impact Assessment, Mitigation and Monitoring – 4 Room: Lavandula
17:00 - 17:15	Coffee Break/Networking	Coffee Break / Networking (16:30 - 16:45)			
17:15 - 18:15 Parallel Sessions	Session 1.3.4a. Lightning Talks: Managing Infrastructure Marginal Habitats for Biodiversity (17:15 - 17:45) Room: Quercus	Session 2.3.4. (starts 16:45) Workshop: Corridors and Crossings: “Guidance for Connectivity Conservation Impacted by Linear Transportation” Room: Arbutus		Session 4.3.4a. Lightning Talks: Roadkills Impact Assessment, Mitigation and Monitoring (17:15 - 17:45) Room: Cistus	Session 5.3.4a. Lightning Talks: New Tools and Technologies to Prevent and Monitor Linear Infrastructure Impacts – 2 (17:15 - 17:45) Room: Lavandula
	Session 1.3.4b. Lightning Talks: Managing and Monitoring Ecological Impacts of Linear Infrastructures (17:45 - 18:15) Room: Quercus			Session 4.3.4b. Lightning Talks: Wildlife and Linear Infrastructure Interactions: Field Monitoring and Ecological Solutions – 3 (17:45 - 18:15) Room: Cistus	Session 5.3.4b. Lightning Talks: Citizen Science and the Involvement of Civil Society – 2 (17:45 - 18:15) Room: Lavandula
	18:15 - 18:45 Closing Remarks Room: Quercus				

Plenary Sessions



MOLECULAR TOOLS TO ASSESS THE ECOLOGICAL IMPACTS OF TRANSPORTATION INFRASTRUCTURES

PLENARY I (Tuesday, 12 January / 09:15 – 10:15)

ROOM Quercus

MODERATOR António Mira



Niko Balkenhol

Niko Barkenhol received degrees in Forest Ecology, Environmental Monitoring, and Wildlife Resources. His practical experiences include working for a private consulting company where he conducted environmental impact assessments for road construction projects. He was a postdoc at the Leibniz-Institute for Zoo and Wildlife Research (IZW) in Berlin before moving to the University of Goettingen in 2011, where he currently leads the Department of Wildlife Sciences. His research focuses on ecological connectivity, which he analyses at different biological levels (from genes to ecosystems) and by combining movement ecology, landscape genetics, and simulation modelling. Many of his projects include an assessment of road effects on functional connectivity.

Molecular tools are increasingly used to address fundamental and applied questions in ecological and biological research. Here, I provide an overview of the various ways in which molecular data can help to assess and monitor the ecological effects of transportation infrastructures. I first provide a summary of our current understanding of genetic road effects and of our analytical abilities to detect such effects. Specifically, I show that genetic barrier effects are highly variable, trait- and context-dependent and that quantifying such effects is strongly affected by the spatial and temporal distribution of available data. I illustrate these points through simulation results and empirical studies from various wildlife species. Second, I call for an increased use of genetic data to monitor barrier mitigation measures, such as over- or underpasses. While several case studies have proven the usefulness of genetic data to evaluate the effectiveness of such mitigation measures, we need to apply molecular approaches more routinely in this context and over longer time scales. Third, I review how molecular tools can greatly increase our understanding of other ecological impacts of transportation infrastructures, i.e., impacts that go beyond a barrier effect on movement and gene flow. For example, non-invasive genetic sampling or environmental DNA (eDNA) can help to detect elusive species, thus providing novel opportunities to assess how transportation infrastructures affect the distribution and/or abundance of entire communities. Finally, I will highlight that transportation infrastructures might also have evolutionary consequences that are highly relevant for management and conservation.

CHALLENGES AND ADVANCES OF ROAD AND RAILWAY ECOLOGY IN LATIN AMERICA

PLENARY II (Tuesday, 12 January / 13:30 – 14:30)

ROOM Quercus

MODERATOR Sara Santos



Fernanda Z. Teixeira

Fernanda Teixeira is a postdoctoral researcher in the Graduate Program in Ecology / UFRGS (Brazil), where she develops research projects at the Road and Railroad Ecology Group. Fernanda is a biologist, holds a PhD in Ecology and previously was a postdoc at the Geomatics and Landscape Ecology Lab at Carleton University (Canada) and at the Environmental Analysis and Modeling Program / UFMG (Brazil). Her research interests are the mechanisms underlying the effects of roads and railways on wildlife, effectiveness of mitigation measures, and the quality and effectiveness of environmental licensing.

Latin America is a region with biological, ethnic, and cultural megadiversity that currently faces a boom in infrastructure expansion. Acting to avoid and mitigate the impacts of both the existing and new infrastructure in this region requires creativity and cooperation, as there are many unique challenges. In the neotropics, habitats have a high diversity along the vertical strata. For example, the gaps created in the canopy pose a challenge for the movements of arboreal animals, like monkeys and tree frogs, and the effectiveness of mitigation measures for these animals needs to be tested. Many species that are not recorded as roadkill may avoid clearings and may be affected by the decreased connectivity and decreased habitat quality near roads, but mitigation for these cases still need to be developed and tested. The neotropics also have social and cultural particularities, since the poverty conditions of many regions pose challenges for the installation and maintenance of mitigation, requiring creativity, participation, and co-responsibility. Studies of the impacts of linear infrastructure are being carried out at many different countries, and a large network of researchers and practitioners is being created. Due to the peculiarities of this region, acting to avoid and mitigate the impacts of the existing and new infrastructure requires creativity and cooperation. In this talk I will present some of the initiatives that are happening throughout Latin America, as well as discuss some of the gaps in knowledge and challenges for decision-making

BIRDS USING (AND ABUSING OF) LINEAR INFRASTRUCTURES: STORKS AND POWER LINES

PLENARY III (Wednesday, 13 January / 09:00 – 10:00)

ROOM Quercus

MODERATOR Lourens Leeuwner



Francisco Moreira

Francisco Moreira is a Biologist and a Researcher at the CI-BIO (Research Center on Biodiversity and Genetic Resources), University of Porto, Portugal. Principal investigator of the research group “Biodiversity in Agricultural and Forest Ecosystems”, and chair holder of the REN Invited Research Chair in Biodiversity. Member of the Board of the Society for Conservation Biology – Europe Section. Research interests include: (a) the links between farmland and forest management and biodiversity (b) fire ecology; and (c) the biodiversity impacts of anthropogenic linear infrastructures (focus on power lines, and how they impact, through disturbance, collision and electrocution, bird population dynamics).

Power lines are increasingly widespread across many regions of the planet. Although these linear infrastructures are known for their negative impacts on bird populations, through collision and electrocution, some species take advantage of electricity pylons for nesting. We compiled historical information (1958-2014) of the Portuguese white stork *Ciconia ciconia* population to analyse long-term changes in numbers, distribution range and use of nesting structures. White stork population size increased 660% between 1984 and 2014. In the same period, the proportion of nests on electricity pylons increased from 1 to 25%, likely facilitated by the 60% increase in the length of the very high tension power line grid (holding the majority of the nests) in the stork’s distribution range. The main drivers of pylon use by nesting storks were distance to major feeding areas (rice fields, landfills and large wetlands), with more intensive use closer to these features. We discuss the implications of this behavioural change, and of the management responses by power line companies, both for stork populations and for managers.

THE EU BIODIVERSITY STRATEGY 2030 – PERSPECTIVES AND IMPLICATIONS

PLENARY IV (Thursday, 14 January / 09:00 – 10:00)

ROOM Quercus

MODERATOR Anders Sjolund



Jakub Wejchert

Jakub Wejchert is senior policy officer at the Biodiversity Unit, DG Environment, European Commission. He currently contributes to the core drafting team of the new EU 2030 Biodiversity Strategy. His main responsibilities include work on ecosystem condition, services, and restoration, as well as integration in to emerging economic and legal framings. Previously he worked on EU negotiations on the Sustainable Development Goals. He holds a PhD and BA in Natural Sciences, from Trinity College Dublin. He recently completed an Advanced Diploma at the University of Cambridge on ecological monitoring. Married, with three children, his hobbies include horse-riding, trekking and appreciating nature.

The loss of biodiversity, i.e. all life on earth, is a serious and urgent problem, comparable to, or even more serious than the global climate change. The European Commission’s Political Guidelines and the European Green Deal have underlined the severity of this challenge and the need to curtail biodiversity loss. The EU 2030 Biodiversity Strategy planned to be adopted by end March will outline the EU’s position internationally for the Conference of the Parties to the Convention on Biodiversity, to be held in China in October 2020. The Biodiversity Strategy will likewise outline objectives, targets and policy measures to be undertaken in the EU. My presentation will outline key elements of the strategy relating to protection, restoration and mainstreaming, and enabling conditions, as well as implications of the strategy in particular for ecosystem restoration and green infrastructure. I will also outline recent guidance documents published by the Commission to support planners, policymakers and businesses to support the deployment of EU-level green and blue infrastructure, and to integrate ecosystems and their services in decision-making. Together these will outline the range of recent EU policy developments relevant to linear infrastructure networks and ecological solutions.



Full Presentations

INFRASTRUCTURE ECOLOGICAL MITIGATION AND DEFRAGMENTATION – 1

SESSION 1.1.1. (Tuesday, 12 January / 10:30 – 12:00)

ROOM Quercus

MODERATOR Marguerite Trocmé

#1 Managing knowledge after 15 years of defragmentation

Adam Hofland (MJPO, Rijkswaterstaat, Netherlands); **Camiel Meijneken** (MJPO, ProRail, Netherlands)

During the 15 years of the Dutch national defragmentation programme MJPO enhancing the collaboration and sharing of knowledge was an important objective. Several platforms for meetings, different practical guidelines, a website and newsletters were important tools to spread, share, activate and save all types of information involved with defragmentation of natural areas in the Netherlands. Evaluating the MJPO programme these types of information are put into perspective to the development phases of common knowledge management. This will help professionals applying for a project or programme budget to strengthen their business case and to convince management of the importance.

KEYWORDS: Knowledge management, Collaboration and conjunction, Research networks, Dissemination and communication

#2 "Breaking down" global defragmentation concepts to a macro-region – the example of the Danube River Basin

Anneliese Fuchs, Michael Jungmeier (E.C.O. Institute of Ecology, Austria)

With 19 countries, the Danube River Basin (DRB) is the most international river basin. The Danube itself is the most international river flowing through 10 countries. Especially when it comes to ecological connectivity, management must also take place on a transboundary level. Joint activities, communication and exchange play a primary role. Recently, we assessed the current corridors and barriers in the DRB and the most important ongoing projects and summarised lessons learnt for the entire macro-region in one document. From this, we have derived a number of guiding principles that provide an impulse for the future direction of the region.

KEYWORDS: Ecological corridor, Danube River Basin, Guiding principles, Transboundary projects

#3 Risks and opportunities for wildlife living in road dominated environments. What pieces are missing to complete the puzzle?

António Mira; Ana Galantinho; Denis Medinas; Helena Sabino-Marques; Carmo Silva; Sara Santos (UBC – Conservation Biology Lab., Department of Biology. University of Évora, Portugal / MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Évora, Portugal)

The negative effects of roads on wildlife are well described. However, their implications at the population level and possible positive impacts arising from natural habitats remnants associated with this infrastructure are still poorly known and object of debate. In the current presentation we will address questions about the potential role of roadside remnants of natural habitats as biodiversity refuge, corridors or ecological traps, using examples from published research and case-studies from the Conservation Biology Lab of the University of Évora. Moreover, we identify knowledge gaps and further research required to optimize opportunities for wildlife conservation while minimizing major risks associated with its presence or movement near the road.

KEYWORDS: Road verges, Verge habitats, Biodiversity refuges, Refuges, Ecological traps

#4 Developing mitigation strategies to reduce the impact of land transport infrastructures on Amphibian populations: the example of Denmark, Sweden, Poland, Lithuania and Estonia

Lars Briggs, Alix Aliaga (Amphi Consult, Denmark / Univate by Symbion, Denmark)

Throughout five pilot projects in Europe, we present different mitigation strategies to limit the impact of Land Transport Infrastructures on Amphibian populations, where the first Amphibian tunnels have been built: Denmark in 1997, Sweden in 1998, Poland in 2000, Lithuania in 2013 and Estonia in 2015. We demonstrate the efficiency of ecological mitigation via the implementation of different types of infrastructures and present the need of sharing know-how experience among European countries.

KEYWORDS: Amphibians, Land Transport Infrastructure, Mitigation, Monitoring, Corridor

#5 Use of snow-tracking to evaluate the impact of Linear Transportation Infrastructures on wolf and ungulates

Sandro Bertolino, Aurelio Perrone, Giulia Mutinelli (Dipartimento di Scienze della Vita e Biologia dei Sistemi, Università di Torino, Italy); **Massimo Rosso, Elisa Ramassa** (Ente di gestione delle aree protette delle Alpi Cozie, Italy); **Elisa Avanzinelli** (Dipartimento di Scienze della Vita e Biologia dei Sistemi, Università di Torino, Italy)

We monitored wolves and ungulates through snow-tracking in an area with a high LTI mortality for the wolf and where an industrial site is planned. We followed 23 snow-tracks of wolves for a total of 20.3 km. LTI were crossed four times by wolves and 16 times by ungulates. The underpass was used once by wolves and twice by ungulates; the overpass never. The data collected confirm that animals move frequently in this stretch of the valley floor, crossing LTI. The construction of the industrial site will further reduce the permeability of this area. Monitoring and mitigation measures are proposed.

KEYWORDS: Wolf, Ungulates, Road/railways kills, Mitigation, Monitoring

#6 The barrier effect of railways and other linear grey and green infrastructure on the small fauna

Heinrich Reck, Henning Nissen (Institute for Natural Resource Conservation, Germany)

Measurements of the barrier effects of railways and railway underpasses are compared with barrier effects of other linear infrastructure and overpasses. The results are unexpected in some cases and varied significantly between the different barrier types. The data are useful for impact assessment and mitigation.

KEYWORDS: Barrier effects, Small fauna, Railways, Beetle activity, Powerline, Motorway

INFRASTRUCTURE ECOLOGICAL MITIGATION AND DEFRAGMENTATION – 2

SESSION 1.1.2. (Tuesday, 12 January / 14:45 – 16:15)

ROOM Quercus

MODERATOR Edgar van der Grift

#1 Do roadkill of different species respond in the same way to habitat and matrix? The case of four Brazilian mammals

Douglas W. Cirino (Universidade de São Paulo, Brazil / Universidade Federal do ABC, Brazil); Artur Lupinetti, Simone R. Freitas (Universidade Federal do ABC, Brazil)

Roads lead to deforestation, land-use changes and others impacts as the wildlife road-kill. The numbers are concentrated in some species, as the *Cerdocyon thous* (crab-eating fox); *Euphractus sexcinctus* (six-banded armadillo); *Tamandua tetradactyla* (collared anteater) and *Myrmecophaga tridactyla* (giant anteater). We constructed models for understand how the roadkill of those species are related to the land use and land cover, and found that crab-eating fox and six-banded armadillo roadkills have a positive relation with land use, as agriculture, and the two anteater species have a negative relation with those kinds of land use and positive with habitat patches like savanna.

KEYWORDS: Landscape, Roads, Land use, Road mortality, Savanna

#2 Do culverts contribute to reduce the number of roadkills? A study on roadkills along the Habarana-Polonnaruwa road, Sri Lanka

Dishane Hewavithana (Abess Center for Ecosystem Science and Policy, University of Miami, USA); Devaka Weerakoon, Mayuri Wijesinghe (Faculty of Science, University of Colombo, Sri Lanka); Christopher Searcy (Department of Biology, University of Miami, USA)

Roads are built to facilitate human travel in the most economical and time-efficient manner. Roads obstruct the movement of wildlife hindering natural processes. Establishing effective mitigatory measures becomes a crucial element in road construction especially when it passes through natural landscapes. This study correlates the presence of culverts, the only potential wildlife passage type at study site, with animal mortality. Findings of this study suggests that the present culverts do not effectively reduce roadkills. This re-iterates the need to have targeted animal passes along roads to provide permeability in habitats for wildlife, particularly when roads are constructed through/near protected areas.

KEYWORDS: Roadkills, Critical features, Road design

#3 Risk analysis of high-voltage power lines in Belgium to map bird collision-prone spans

Dominique Verbelen, Kristijn Swinnen (Natuurpunt, Belgium); Antoine Derouaux, Jean-Yves Paquet (Natagora, Belgium); Johan Mortier (Elia, Belgium)

Elia - the Transmission System Operator (TSO) in Belgium - commissioned a detailed risk-analysis of its 5.600 kms of high-voltage overhead lines in Belgium, in order to map its collision-prone spans. This map is currently used by Elia to set up a priority list of overhead lines that need to be equipped with bird flight diverters in order to decrease the number of further bird collisions. The risk analysis was based on millions of data on bird distribution, collected through various citizen science projects. It showed that 3,4% of the Belgian high-voltage overhead network has a high bird collision risk.

KEYWORDS: Citizen science, Bird collisions, Risk analysis, High-voltage power lines

#4 Maturity-index assessment: ecology adaptation within road authorities doesn't come easy

Camiel Meijneken (MJPO, ProRail, Netherlands); Adam Hofland (MJPO, Rijkswaterstaat, Netherlands)

In order to evaluate the Dutch national defragmentation program MJPO, the 7S-model from McKinsey, developed to analyze the performance of a company, is expanded with a scaled road ecology index. Filling it with qualitative data from interviews and evaluating sessions this model proofed to be very suitable for indicating how effective or "mature" an organization is on adapting road ecology in a before and after scenario. It also gives areas that should be focused on. Style of management and Strategy are variables that stay behind in development within the Dutch (rail)road authorities and hinder effectiveness in road ecology.

KEYWORDS: Road ecology, Evaluation, Organization, Maturity-index, 7S-Model

#5 Developing an ecological defragmentation programme in Flanders: a challenge!

Katja Claus (Flemish Government, Department of Environment and Spatial Development, Belgium); **Marleen Moelants** (Flemish Government, Agency for Roads and Traffic, Belgium); **René Meeuwis** (Flemish Government, Agency for Nature and Forests, Belgium); **Joris Everaert** (Flemish Government, Research Institute for Nature and Forest, Belgium)

By preparing an ecological defragmentation programme, infrastructure and nature partners within the Flemish Government aim to work on defragmentation of transport infrastructures according a structurally organised and programmatic approach. A regularly updated database containing all bottleneck locations is the basis of the programme. Locations with a high priority are included in a 5-year programme and will be prepared and/or implemented during this period. During this process several challenges have emerged that are inherent to such a process and to the initial situation in Flanders. The search for political support, additional budgets, etc. make this a fascinating and instructive process.

KEYWORDS: Defragmentation program, Transport infrastructure, Defragmentation policy, Partnerships, Database

INFRASTRUCTURE MITIGATION AND DEFRAGMENTATION
SESSION 1.3.1. (Thursday, 14 January / 10:30 – 12:00)
ROOM Quercus
MODERATOR Eric Guinard

#1 The Corridor Map-a-Thon: crowdsourcing baseline spatial data and building capacity to assess wildlife corridor disruption by infrastructure

Grant Connette, Katie LaJeunesse Connette (Smithsonian Conservation Biology Institute, USA); **Eunkyung Kwong, Sai Than Lwin, Hanna Helsingen, Paing Soe** (WWF – World Wide Fund for Nature, Myanmar); **Nirmal Bhagabati** (WWF US, USA)

Over the coming decades, an explosion of infrastructure development is expected worldwide, notably in high-biodiversity regions often lacking insufficient baseline data to support systematic planning to avoid or mitigate ecological impacts. We have developed a rapid assessment protocol to respond to this challenge, and conducted a five-day ‘map-a-thon’ learning event in Myanmar that combined technical capacity building with crowdsourcing of spatial data using Google Earth Engine. We worked with Myanmar researchers, government agencies and civil society to map wildlife movement corridors through forested landscapes and develop recommendations for linear infrastructure development.

KEYWORDS: Wildlife corridor mapping, Geospatial analysis, Habitat connectivity, Capacity building, Map-a-thon

#2 Eskom/Endangered Wildlife Trust partnership 1996 – 2020, 24 years of partnering together to reduce impacts on business and on biodiversity

Kishaylin Chetty, Lourens Leeuwner, Constant Hoogstad (Eskom holdings SOC, Ltd. / Endangered Wildlife Trust, Wildlife and Energy Programme, South Africa)

Eskom is responsible for providing electricity to meet the ever increasing needs of its end users. As a result, Eskom’s linear electrical infrastructure is continuously being expanded upon to support annual load growth. Negative interactions between wildlife and electrical infrastructure take on many forms including the electrocution of birds (and mammals), birds colliding with power lines and birds and/or animals causing short circuits in the electricity supply through various activities on electricity structures. In view of the complexity, scope and persistence of the problem of interactions between wildlife and power lines, Eskom and the Endangered Wildlife Trust (EWT) formalised their long-standing relationship by entering into a partnership in 1996 to address the problem in a systematic manner on a national basis and to establish an integrated management system to minimise these negative interactions.

KEYWORDS: Powerlines, Partnership, Strategic, Linear, Biodiversity

#3 Building an electrocution risk map with overhead power lines for a critically endangered raptor in Portugal

Ana Teresa Marques (cE3c – Centre for Ecology, Evolution and Environmental, University of Lisbon, Portugal / CIBIO-InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal); **João Paulo Silva** (CIBIO-InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CIBIO-InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal); **Carlos Carrapato** (ICNF/PNVG – Instituto de Conservação da Natureza e Florestas/Parque Natural do Vale do Guadiana, Portugal); **Rita Ramos** (cE3c – Centre for Ecology, Evolution and Environmental, University of Lisbon, Portugal / CIBIO-InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal); **Francisco Moreira** (CIBIO-InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CIBIO-InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal); **Jorge Palmeirim** (cE3c – Centre for Ecology, Evolution and Environmental, University of Lisbon, Portugal)

Predictive mapping can assist guiding the implementation of mitigation measures for linear infrastructures. We used GPS-GSM tracking to identify suitable areas for the Iberian imperial eagle during the non-breeding period, where mitigation actions focusing on electrocution in power lines should be undertaken. Such approach can contribute to reduce anthropogenic mortality in this threatened species, highly vulnerable to electrocution in poorly designed power line poles.

KEYWORDS: Distribution power lines, Electrocution, Mitigation, Raptors, Predictive modelling

#4 Effectiveness of an anti-bird strike tubular screen in a high-speed railway

J. Herranz (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain / CIBC-UAM – Centro de Investigación en Biodiversidad y Cambio Global, Universidad Autónoma de Madrid, Spain); L. Falcao (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain); I. Hervás (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain); C. Mata (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain / CIBC-UAM – Centro de Investigación en Biodiversidad y Cambio Global, Universidad Autónoma de Madrid, Spain); A. E. Santamaría (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain); E. García de la Morena (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain / Servicios Especializados de Consultoría e Investigación Medioambiental, Spain); J. E. Malo (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain / CIBC-UAM – Centro de Investigación en Biodiversidad y Cambio Global, Universidad Autónoma de Madrid, Spain)

Collision risk for birds crossing high speed railways (HSR) appears when they cross under or through the catenary. We show the results of an experiment measuring bird mortality after the installation of a 400m long prototype of an anti-bird strike barrier in a HSR. The prototype is made out of 5.5m tall vertical poles aimed at the increase in flight height of birds. The comparison of bird mortality along one year in the protected vs. two adjacent stretches shows that the barrier is effective at reducing bird mortality (from 45.0-55.0 to 20.0 birds/km*year), with large-bodied species profiting from it.

KEYWORDS: Pole barriers, Bird mortality, Mitigation measures, Collision, Environmental impact assessment

#5 Experimental evaluation of crossing structures used by amphibians along a high-speed railway line

Guillaume Testud (EPHE, PSL Research University, France / Egis Structures & Environnement, France); Dorothée Labarraque (Egis Structures & Environnement, France); Claude Miaud (EPHE, PSL Research University, France)

We evaluate mitigation measures implemented along a new High-speed railway line focused on the Amphibian community. A capture-marking-recapture design evaluated how newts frequent breeding ponds. We detected 123 exchanges between ponds, including 10 exchanges implying crossing the HSR. Movements in tunnels (under HSR) were studied with behavioural experiments (homing). 1296 individuals (newts, salamanders, frogs and toads) exhibited variation in complete crossing rates, crossing speed and trajectories. Some experiments to improve amphibian movements in tunnels, such as adding anuran calls with a loudspeaker, were performed.

KEYWORDS: Amphibian, Movements, Tunnel, Homing, Capture-marking-recapture

#6 Acoustic Animal Detering Device as a mitigation measure to limit collisions of rail vehicles with wild animals

Joanna Żyłkowska, Marek Stolarski, Dorota Bartoszek-Majewska (NEEL Ltd., Poland)

Wild animals do not regard trains as their natural enemies, thus, the growing numbers of animal-train collisions. In 2003, NEEL company developed an acoustic animal deterring device to limit the number of collisions. The devices operate as an early warning for wild animals. The aim is to stimulate them to leave the tracks before a train arrives. The warning consists of sequence of natural alarm sounds and starts about a minute before the passage of a train. Studies proved high effectiveness of the devices: wild animals respond to the sound signals first with alertness and finally with escape.

KEYWORDS: Animal-train collisions, Animal deterring device, Collision mitigation, Railway traffic safety

NEW TOOLS AND TECHNOLOGIES TO PREVENT AND MONITOR LINEAR INFRASTRUCTURE IMPACTS – 1

SESSION 1.3.2. (Thursday, 14 January / 13:30 – 15:00)

ROOM Quercus

MODERATOR Marcel Huijser

#1 The conflict points between green and transport infrastructure–methodology for the multicriterial assessment

Ivo Dostál (Transport Research Centre, Czech Republic / Constantine the Philosopher University, Slovakia); Marek Havlíček (Transport Research Centre, Czech Republic)

Selection of proper conflict points for implementing technical solutions is a prerequisite for the success of each defragmentation program. The contribution presents a procedure for multicriterial analysis with the aim of defining specific localities in the intersection of a selected ecological network with transport infrastructure, which must be addressed as a priority in terms of preserving/restoring the highest possible level of green infrastructure cohesion. The evaluation uses a set of seven indexes for each of the evaluated points to produce a dimensionless characteristic describing the degree of potential conflict at a location.

KEYWORDS: Green infrastructure, Landscape permeability, Conflict points, Multicriterial evaluation, Defragmentation

#2 Automatic acoustic monitoring of wildlife

Julien Ricard (Securaxis, Switzerland)

Monitoring biodiversity is essential to define conservation strategies. Many animals produce sound for communication and navigation, which makes this modality a good proxy to detect and identify them. With the recent progress observed in data sensing, communication and machine learning, the field referred to as Passive Acoustic Monitoring (PAM) is growing rapidly. In this context, Securaxis developed the Nature Sound Box, a smart sensor for detection and identification of species through their vocalisations, combined with an ergonomic web interface featuring exploration and visualisation tools for an optimal exploitation of the detection data in different application contexts.

KEYWORDS: “machine learning”, IoT, Monitoring, Biodiversity

#3 Using evidence-based approaches and evidence customization to improve mitigation practice

Silviu Petrovan (University of Cambridge, UK)

Evidence-based approaches should become an integral part of decision making in conservation efforts, including monitoring and mitigation. We have compiled and assessed a database using manual scanning of over one million studies and we are currently developing multiple customisation and automation tools to assist decision making. We are working with multiple agencies and policy makers to include robust evaluation of the evidence during decision making processes as well as increasing the quality of testing of effectiveness for instance by selecting better study designs.

KEYWORDS: Mitigation, Evidence-based conservation, Database, Automation, Evidence customisation

#4 BioBIM – Biodiversity, BIM & Infrastructures

Sylvain Moulherat (TerrOïko, France); Denis Leroux, Martin Barbier (setec als, Immeuble Le Crystallin, France); Christophe Delran (TerrOïko, France)

The BioBIM project, aims developing a 3D digital modelling (BIM) of mitigation management in the context of large transportation infrastructure development and management. In this respect we developed BIM object dedicated to mitigation measures conception and management along the infrastructure life cycle. The BioBIM project have been implemented on a motorway upgrade in eastern France, where we focused our work on the management of *Lycaena dispar* mitigation measures and the reforestation program of the site under management.

KEYWORDS: BIM, Biodiversity, Infrastructure, Project management, Computer science

#5 The TRANSGREEN Project – Integrated Transport and Green Infrastructure Planning in the Danube-Carpathian Region for the Benefit of People and Nature – a cross-sectoral contribution to the improvement of

permeability of linear infrastructure in the Carpathians

Lazaros Georgiadis (IENE – Infrastructure and Ecology Network Europe, Greece); Hildegard Meyer (WWF-CEE – WWF Central and Eastern Europe, Austria); Miroslav Kutal (Friends of the Earth, Czech Republic); Vaclav Hlavac, Martin Strnad (Nature Conservation Agency of the Czech Republic, IENE member); Ivo Dostál, Jan Kubeček (Transport Research Centre, Czech Republic); Gabriella Nagy (CEE-web for Biodiversity, Hungary); Csaba Domokos, Tibor Sos (Association “Milvus Group”, Romania); Radu Mot (Association “Zarand”, Romania); Cristian-Remus Papp, Diana Cosmoiu, Catalina Murariu (WWF Romania, Romania); Katarina Galiková (National Motorway Company, Slovakia); Jan Kadlečík, Tereza Thompson (The State Nature Conservancy of the Slovak Republic, Slovakia); Maros Finka, Vladimir Ondrejčka, Milan Husar (SPECTRA Centre of Excellence of EU – Slovak University of Technology in Bratislava, Slovakia); Elke Hahn (IENE, Federal Ministry for Transport, Innovation and Technology, Austria)

The TRANSGREEN Project, co-funded by ERDF, contributed to the development of environmentally friendly and safer transport network in the Carpathians. Based on scientific research and multi-sectoral collaboration of stakeholders from the field of transport, nature conservation and science at the local, national and transnational level, good solutions could be identified for the conflicts between green and grey infrastructure. This was possible among others, through the elaboration of “Wildlife and Traffic - Guidelines on integrated transport infrastructure planning” for planners, implementers and decision makers, and the Catalogues of Measures with recommendations how to improve the situation in conflict areas in the four study sites.

KEYWORDS: Green Infrastructure, Linear transport infrastructure development, Cross-sectoral cooperation

#6 ICF Ecosystem Connectivity Planning Tool: A Web-based Tool Identifying Opportunities for Improved Ecosystem Connectivity

Shannon Crossen, Jon Walker, Matthew Townley, Martin Fisher (ICF Inc., USA)

The ICF Ecosystem Connectivity Planning Tool helps users identify locations where fish and wildlife movement are impeded and wildlife-vehicle collisions (WVCs) and public safety are a concern. The tool allows for deep exploration and visualization of WVC and connectivity data including multi-scale hot spot analytics. Priority locations for wildlife connectivity enhancements can be easily located using the tool. The tool is customizable allowing the objectives and priorities of each user to be integrated while providing simple and cost-effective identification of connectivity enhancement opportunities to facilitate connectivity for suite of species, road safety, and prevent lost opportunities in enhancing habitat connectivity.

KEYWORDS: Connectivity, Roadkill, Wildlife-Vehicle Collision, Fish passage, Analytics

ROADS AND MAMMALS: ECOLOGICAL IMPACTS AND SOLUTIONS

SESSION 1.3.3. (Thursday, 14 January / 15:30 – 17:00)

ROOM Quercus

MODERATOR Manisha Bhardwaj

#1 Effectiveness of wildlife fences in reducing Key deer road mortality on the Florida Keys, USA; the importance of implementing mitigation measures at the appropriate spatial scale

Marcel P. Huijser, James S. Begley (Western Transportation Institute – Montana State University, USA)

We investigated Key deer mortality data (1966-2017) on the Florida Keys, USA, to evaluate the effectiveness of a wildlife fence in reducing deer road mortality along the main highway on the island of Big Pine Key in Florida, USA. Only about half the highway was mitigated, while the other half of the highway remained unmitigated. While the mitigation was 81.3-93.9% effective in reducing road mortality along the mitigated road section, the overall road mortality along the main highway was not reduced. The results suggest that the mitigation was implemented along too short of a road section, and that mortality was moved rather than reduced.

KEYWORDS: Collisions, Deer, Effectiveness, Fence, Mitigation

#2 Dry pathways and flowing water within culverts jointly promote crossings by carnivore mammals

João Craveiro, Joana Bernardino, António Mira (UBC – Conservation Biology Lab, University of Évora, Portugal); Pedro G. Vaz (CEABN-InBIO – Centre for Applied Ecology "Prof. Baeta Neves", School of Agronomy of University of Lisbon, Portugal)

Dry pathways and flowing water within culverts jointly promote crossings by this carnivore community. Moreover, culverts with flowing streams during the wet season were still more likely to be crossed during the dry season although they no longer had water by then. Culverts including streams may act as a continuation of riparian corridors, being incorporated into carnivores' movement routes. Our results lend empirical support to recommendations advising the implementation of dry pathways to provide crossing paths. Interventions to offset the transient impacts of water flooding in new or existing culverts can be a cost-effective solution promoting landscape connectivity across roads.

KEYWORDS: Mitigation measures, Road ecology, Dry ledges, Fauna passage, Wildlife corridors

#3 Why, When and How Giant Anteaters Cross Roads? Understanding Impacts and Effects of Roads on Giant Anteater Populations

Arnaud Desbiez (ICAS – Instituto de Conservação de Animais Silvestres, Brasil); Fernando Ascensão (CIBIO/InBio – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / EBD-CSIC – Department of Conservation Biology, Estación Biológica de Doñana, Spain); Danilo Kluber, Débora Yogui (ICAS – Instituto de Conservação de Animais Silvestres, Brasil); Mariana Catapani (Programa de Pós Graduação em Ciência Ambiental, Universidade de São Paulo, Brasil); Mário Alves (ICAS – Instituto de Conservação de Animais Silvestres, Brasil)

We will summarize the Anteater road ecology project, one of the most complete and integrative of the kind, aiming to inform public planning and mitigation of landscape and road networks in order to reduce significantly the impact of roads on wildlife and particularly on giant anteater. Overall, we have collected >10,000 roadkills, with giant anteaters being the third most roadkilled mammal (7% of total). We also recorded data from GPS tracking, camera traps, necropsies, genetics, and social interviews, which will allow us to integrate all dimensions of animal-road/human interactions.

KEYWORDS: Population persistence, Population viability, Roadkill, Animal movement, Brazil

#4 New approaches to avoiding and mitigating the effects of streetlighting on bats

Fiona Mathews, Domhnall Finch, Paul Jerem (University of Sussex, UK)

Many bats, including those highly protected under European legislation, are light sensitive. Streetlighting on roads is the primary source of light pollution, so methods to avoid and mitigate the impacts are critically important for bat conservation. We here present evidence on the landscape-scale impacts of lighting on the activity of greater and lesser horseshoe bats. We show how modelling techniques based on circuit-theory can help identify the effects of streetlights on bat movements and lead to better planning decisions. Finally, we report the results of experiments to test the effectiveness of red LED lighting as a replacement for white LEDs.

KEYWORDS: Lighting, Bats, Modelling, Spectral composition, Mitigation

#5 Effects of roads on European badger occurrence in intensively used Mediterranean farmland

Ricardo Pita (MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal / UBC – Unidade de Biologia da Conservação, Universidade de Évora, Portugal); Rui Morgado (CEABN/InBIO – Centro de Ecologia Aplicada "Professor Baeta Neves"/InBIO, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal); Francisco Moreira (REN Biodiversity Chair, CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CIBIO/InBIO – Centro de Investigação

em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal)^{3,4}; António Mira (MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal / UBC – Unidade de Biologia da Conservação, Universidade de Évora, Portugal); Pedro Beja (CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal / EDP Biodiversity Chair, CIBIO/InBIO-Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal)

We investigated how road density and landscape variables affect the occurrence of the European badger in intensively used Mediterranean farmland. Occupancy-detection modelling based on repeated surveys of badgers' presence signs in 60 landscape units across SW Portugal confirmed our predictions that badgers were negatively affected by paved road density, and positively affected by the amount of forestry plantations and arboreal hedgerows. Badger conservation in intensively used Mediterranean farmland requires the protection of areas with low road density, and the retention of wood cover, even where these are mostly forestry plantations and arboreal hedgerows.

KEYWORDS: Agricultural landscapes, Carnivores, Land use cover, Road effects, Tree plantations

WILDLIFE AND LINEAR INFRASTRUCTURE INTERACTIONS: FIELD MONITORING AND ECOLOGICAL SOLUTIONS – 1

SESSION 4.1.1. (Tuesday, 12 January / 10:30 – 12:00)

ROOM Cistus

MODERATOR Andreas Seiler

#1 Infrastructures, human activities and biodiversity in co-evolution: the examples of Upper-Rhine, Danube and Inn

Andreas Huber, Sebastian Weber (European Institute for Energy Research, Germany); Jean-Nicolas Beisel, Cybill Staenzel (Laboratoire Image Ville Environnement, France); Carine Granier (EDF - Centre for Hydro Engineering, France); Manon Pons (European Institute for Energy Research, Germany)

In our contribution, we analyze the progressive expansion of energy and transport infrastructures in river spaces and how these have been involved in the development of both, human activities, and biodiversity changes. This interdisciplinary analysis combines expertise from ecology and social sciences, and draws on empirical data from six small-scale zones situated in two river systems: (i) the French-German Upper Rhine area between Karlsruhe and Basel, and (ii) Danube and Inn in the region where these rivers form the border between Germany and Austria.

KEYWORDS: Rhine and Danube, Human activities, Alluvial forests, Transport and energy infrastructures, Historical evolution

#2 Biological control of invasive Tree of Heaven (*Ailanthus altissima*) along linear infrastructures using Ailantex®

Erhard Halmschlager, Oliver Maschek, Thomas Kirisits (Institute of Forest Entomology, Forest Pathology and Forest Protection, Department of Forest and Soil Sciences, University of Natural Resources and Life Sciences, Vienna)

Tree of Heaven (*Ailanthus altissima*) is a highly invasive species that has become established in all warmer climatic zones. Due to its high rate of dissemination and the potential to replace indigenous plants *A. altissima* causes great ecological and economic problems in ecosystems. Investigations carried out at IFFF-BOKU, Vienna, indicated that the mycoherbicide Ailantex®, containing a fairly specific isolate of the wilt-inducing fungus *Verticillium nonalfalfae*, shows promise for biocontrol of this invasive tree species along linear infrastructures. The mycoherbicide, which is directly inoculated into the living sapwood, causes wilt and dieback followed by tree mortality on young but also on mature *A. altissima*-trees in field studies.

KEYWORDS: Biological control, Tree of Heaven, *Ailanthus altissima*, linear infrastructures, Ailantex

#3 Citizen participation improves the quality of green infrastructure at road verges in Poland

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

Trees accompanying transport infrastructure are an essential part of green infrastructure and are increasingly appreciated by the society and authorities. However, in Poland, many public officials view trees as an obstacle to modernisation rather than as an asset. Relaxation of tree removal permitting procedures in early 2017 led to a felling spree by private land owners. All these sparked a lively grassroots movement in support of trees. Several cases of successful public participation interventions that led to better green infrastructure are presented and lessons learned are discussed.

KEYWORDS: Public participation, Green infrastructure, Roadside trees, Avenues, Trees

#4 Factors driving the distribution of an amphibian community in stormwater ponds: a study case in the agricultural plain of the Bas-Rhin, France

Jonathan Jumeau (Université de Strasbourg, France / Conseil Départemental du Bas-Rhin, France / Université de Rennes, France); Julien Lopez (Conseil Départemental du Bas-Rhin, France); Alain Morand (CEREMA, France); Lana Petrod (Conseil Départemental du Bas-Rhin, France); Françoise Burel (Université de Rennes, France); Yves Handrich (Université de Strasbourg, France)

The modification of landscapes resulted in the disappearance of most wetlands. In this context, wetland species have to find new habitats. Our hypothesis was that depending on the water pollutant concentrations and on other factors like partitioning measures and pond design, the stormwater water ponds could serve as refuge habitat for amphibians. Amphibians were found in 84% of the 82 studied stormwater ponds in France, with an av-

erage 19.51 adults and 2.44 species per pond. Neither partitioning measures nor pollutants were correlated with community characteristics. The best explanatory factors were land use and pond design.

KEYWORDS: Refuge habitat, Retention ponds, Pollution, Modified landscape, Farmlands

#5 Maintenance of ecological asset on transport infrastructure: new chapter in the online ‘Wildlife and Traffic’ handbook

Carme Rosell (MINUARTIA, Spain / University of Barcelona, Spain); Vincent O’Malley (Transport Infrastructures Ireland, Ireland); Elke Hahn (Federal Ministry for Transport, Innovation and Technology, Austria); Adam Hofland (Ministry of Infrastructure and Water Management, Netherlands); Tony Sangwine (Highways England, UK); Anders Sjolund (Swedish Transport Administration, Sweden); Marina Torrellas, Joana Colomer (MINUARTIA, Spain); Michal Bíl (CDV – Transport Research Centre, Czech Republic); Heinrich Reck (Institute of Natural Resource Conservation, University of Kiel, Germany)

Best maintenance practice is crucial to preserve in the long term the functions of ecological assets in roads and railways and help to get the best value for money invested in ecological mitigation. A set of evidence-based guidelines have been produced to help practitioners involved in infrastructure operation to properly maintain mitigation measures such as wildlife fencing and wildlife crossings, and to manage ponds and verges that can be valuable elements of green infrastructure. Guidelines have been developed by an interdisciplinary team from CEDR in cooperation with IENE and will form part of the updated online ‘Wildlife and Traffic’ Handbook.

KEYWORDS: Ecological asset, Maintenance, Mitigation, Verges, Guidelines

#6 Introducing ‘www.TransportEcology.info’: An online, open access resource to globally share information, knowledge and experience in ecologically-friendly linear infrastructure

Rodney van der Ree (WSP Australia Pty Ltd and Ecology and Infrastructure International Pty Ltd., Australia); Clara Grilo (CESAM - Centre for Environmental and Marine Studies, Faculdade de Ciências da Universidade de Lisboa, Portugal); Wendy Collinson-Jonker (Endangered Wildlife Trust, South Africa)

There is much concern globally about the current and proposed massive investment in linear infrastructure. A significant obstacle to implementing environmentally-sustainable infrastructure is easy access to best-practise. www.TransportEcology.info is an online, open access resource to globally share information, knowledge and experience in ecologically-friendly linear infrastructure. There are 3 main streams: (1) Blog-style research summaries; (2) Best-practice instruction, including step-by-step guidance and courses; and (3) mitigation and project case studies. In this presentation I will officially launch the website, describe progress to date and invite you to get involved.

KEYWORDS: Open-access, Linear infrastructure, Resources, Training, Website

NEW TOOLS TO MONITOR ECOLOGICAL IMPACTS OF LINEAR INFRASTRUCTURES

SESSION 4.1.2. (Tuesday, 12 January / 14:45 – 16:15)

ROOM Cistus

MODERATOR Fraser Shilling

#1 Evaluating the impacts of highway mitigation measures for fish connectivity using radio-telemetry and RFID PIT-tagging technologies in France

Yann Abdallah (SCIMABIO Interface, France); Cédric Heurtebise (VINCI Autoroutes Réseau ASF, France); Arnaud Caudron (SCIMABIO Interface, France)

VINCI Autoroutes has initiated studies to evaluate the effectiveness of work carried out in rivers to restore fish continuity. Two case studies are presented: one on the installation of a culvert in a small river, and a second, on a large river, concerning the partial levelling of a weir and the integration of an asymmetrical rough ramp. The target species are brown trout and Atlantic salmon, respectively. Two technologies were used to monitor the movements: RFID on trout and radiotracking on salmon. The technological characteristics and the experimental designs are described. The results of these studies will serve as feedback for future developments.

KEYWORDS: Fish, Telemetry, RFID, Ecological gain, Highway-river crossings

#2 Monitoring the expansion of alien species along roads with remote sensing

Neftalí Sillero (CICGE – Centro de Investigação em Ciências Geo-Espaciais, Faculdade de Ciências da Universidade do Porto, Portugal); Patrícia Lourenço (CICGE – Centro de Investigação em Ciências Geo-Espaciais, Faculdade de Ciências da Universidade do Porto, Portugal / MED – Instituto Mediterrâneo para a Agricultura, Ambiente e Desenvolvimento, Universidade de Évora, Portugal); Ana Cláudia Teodoro (Departamento de Geociências, Ambiente e Ordenamento do Território, Faculdade de Ciências da Universidade do Porto, Portugal / ICT – Instituto Ciências da Terra, Faculdade de Ciências da Universidade do Porto, Portugal); José Alberto Gonçalves (Departamento de Geociências, Ambiente e Ordenamento do Território, Faculdade de Ciências da Universidade do Porto, Portugal); João Honrado (Departamento de Biologia, Faculdade de Ciências da Universidade do Porto, Portugal / InBIO – Rede de Investigação em Biodiversidade e Biologia Evolutiva, Laboratório Associado, CIBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal); Mário Cunha (Departamento de Geociências, Ambiente e Ordenamento do Território, Faculdade de Ciências da Universidade do Porto, Portugal)

Invasive species are a very important threat to biodiversity and ecosystems. Remote Sensing is the best Earth Observation tool for monitoring biodiversity, providing data at several spatial and temporal resolutions. We monitored the expansion along roadsides of five invasive plant species in the intervention area of the project Life LINES with aerial photographs of very high spatial resolution and three different periods: 1995, 2010,

and 2016. The aerial photographs were segmented and sequentially classified. Invasive species expanded in the study area between 1995 and 2016. During this period, human management hampered the expansion of invasive species by cutting down individuals.

KEYWORDS: Monitoring, Invasive species, Aerial photography, Expansion patterns, Temporal data series

#3 Mobile mapping system (MMS2) for detecting Roadkills

Hélder Ribeiro, Neftalí Sillero, Diana Guedes (Universidade do Porto, Portugal)

We used the state-of-the-art machine learning computer vision algorithm (CNN: Convolutional Neural Network) to automatically detect animals on roads. This improved version of the mobile mapping system presents very good results. The algorithm has a good effectiveness in detecting small birds and amphibians.

KEYWORDS: Roadkills, Life Lines, AI, Machine Learning, Mobile Mapping

#4 Improving Wildlife Fencing for Herpetofauna to Ensure Effective Implementation: An Analysis of Global Mitigation Case Studies

Steve Bega (Animex Fencing, UK)

Through collaboration and private-public partnerships we have analysed a comprehensive range of case studies from across the globe where innovative fencing solutions for herpetofauna have been rigorously tested to help solve problems that often hinder the implementation, management and success of wildlife mitigation schemes. This information will form a new best management handbook that will be free for practitioners across the world and aimed to meet the needs of biologists, engineers, contractors, and regulators.

KEYWORDS: Fencing, Herpetofauna, Mitigation, Best Management Practise, Innovation

#5 A simulation of WVC underreporting to hotspot spatial stability

Michal Bíl, Richard Andrášik (CDV – Transport Research Centre, Czech Republic)

Reliable localization of WVCs hotspots is an important safety issue. One of the most promising methods addressing this issue is the KDE+ method. Since underreporting is a frequent problem in the case of WVCs, the stability of a method is a crucial feature. According to our simulation study, based on an actual database of WVCs, the majority of the most important hotspots, previously identified by the KDE+ method, were stable even when underreporting up to 57% occurred. WVCs which took place at these locations follow a spatial pattern induced by local factors.

KEYWORDS: KDE+, Clustering, Underreporting, Stability, Hotspots

ROAD ECOLOGY: IMPACT ASSESSMENT, MITIGATION AND MONITORING – 1

SESSION 4.2.1. (Wednesday, 13 January / 10:30 – 12:00)

ROOM Cistus

MODERATOR Rodney van der Ree

#1 Monitoring a mature ecoduct: Intensive camera surveillance confirms significant increase in crossing rates and diversity after 13 years

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

The monitoring of fauna crossing structures usually involves brief, selective sampling for a limited duration early in the life of the passage. A large, fully-vegetated ecoduct in Australia has been comprehensively studied for more than 15 year, providing detailed information on mammals, birds, reptiles, amphibians and bats. We recently designed an intensive camera trapping approach to detect effectively all terrestrial animals using this structure continuously day and night for 60 days. This revealed 518 individuals of 25 species including significant species such as koalas. Importantly, this approach (using high-end, HiDef cameras) allowed individuals to be reliably identified, providing important ecological information without the need for invasive capture.

KEYWORDS: Intensive monitoring, Camera traps, Ecoducts, Acclimation

#2 Mitigating barn owl traffic victims using innovative design and citizen science data

Jasja Dekker (Jasja Dekker Dierecologie, Netherlands); Johan De Jong (Kerkuilenwerkgroep Nederland, Netherlands); Nico Jonker (Provincie Noord-Holland, Netherlands) Karen Zwerver (Rijkswaterstaat, Netherlands)

Ring data generated by citizen scientists allowed us to gain insight in barn owl traffic victims in the Netherlands. Novel mitigation (rollers on traffic signs and perches) were tested for effectiveness, cost-benefit and maintenance during multi-year, multi-site experiments.

KEYWORDS: Mitigation, Barn owl, Tyto alba, Citizen science/volunteer, Roadkill

#3 Development and Challenge of Green Highway Construction in China

Chen Xueping, Jian Li, Yang Yangang, Yao Jialin, Gao Shuohan, Wu Qiong, Wang Mengmeng (China Academy of Transportation Sciences, Ministry of Transportation, China)

The green highway practices have developed greatly in the past 20 years under guidance and related demonstration projects sponsored by the transportation government. Although topic relating to sustainable development has been slightly shifting continu-

ally during the past 20 years, the direction toward the harmonization between highway construction and natural environment/resources protection remain consistent. There are still some deficiencies needed to be paid attention to in a long time during the progress, especially the scientific summaries to each action of corresponding phase, planning harmonization between different departments relating to development and protection, policy-making and technical development mechanism, etc.

KEYWORDS: Green highway, Development, Challenge, China

#4 Protecting the protected through assessing driver behaviour in protected areas of South Africa

Wendy Collinson (Endangered Wildlife Trust, South Africa); Courtney Marneweck (School of Biology and Environmental Sciences, University of Mpumalanga, South Africa); Harriet Davies-Mostert (Endangered Wildlife Trust, South Africa / Mammal Research Institute, University of Pretoria, South Africa)

The Endangered Wildlife Trust (EWT) has improved our understanding of the impacts of road infrastructure on wildlife in South Africa through implementing a number of research projects, countrywide. Most of the research has been undertaken on regional and national roads, but in response to social media discussions, which highlighted public concern for roadkill inside protected areas, the EWT commenced its 'Roads in Parks' Project in 2014. We investigated factors affecting the likelihood of WVCs within Pilanesberg National Park and assessed the comparative effectiveness of wildlife-warning signage (WWS) for altering driver behaviour. Sixty-one per cent of drivers who passed a WWS changed their behaviour, compared to 37% with no sign present. Our findings of the project will contribute towards a traffic management plan for protected areas.

KEYWORDS: Mitigation, South Africa, Visitors, Wildlife-vehicle collision, Wildlife-warning signage

#5 Estimating roadkill risk when there is no roadkill data

Eloy Revilla, Andrea Barón, Marcello D'Amico, Juan Carlos Rivilla, Carlos Rodríguez, Jacinto Román (Estación Biológica de Doñana CSIC, Spain)

The propose an approach to estimate the risk of roadkill mortality using data on traffic intensity, the probability of animal crossing and the time that the crossing individuals are exposed to vehicles. The approach can be very useful in the identification of areas in which there is a high risk of collision with wildlife in already developed road networks (e.g. identifying roads to be eliminated or sites where crossing structures could be built) and to decide where to apply mitigation measures, even before road construction.

KEYWORDS: Roadkill risk estimation, Indirect methods, Regional scales

#6 Roadkill as a Threat to Global Mammal Conservation

Clara Grilo (Department of Biology, University Federal of Lavras, Brazil / Department of Biology, Faculty of Sciences of the University of Lisbon / CESAM – Centre for Environmental and Marine Studies, University of Aveiro, Portugal); Luis Borda-de-Água, Pedro Beja (CIBIO/InBIO – Research Center in Biodiversity and Genetic Resources, Universidade do Porto, Portugal / CIBIO/InBIO – Research Center in Biodiversity and Genetic Resources, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal); Eric Goolsby (University of Central Florida, USA); Kylie Soanes (Clean Air and Urban Landscapes Hub, University of Melbourne, Australia); Aliza le Roux (Department of Zoology and Entomology, University of the Free State, South Africa); Elena Koroleva (Department of Biogeography, Faculty of Geography, Russia); Flávio Z. Ferreira (Department of Biology, University Federal of Lavras, Brazil); Sara A. Gagné (Department of Geography and Earth Sciences, University of North Carolina, USA); Yun Wang (Research Center for Environment Protection and Water and Soil Conservation, China Academy of Transportation Sciences, China); Manuela González-Suaréz (Ecology and Evolutionary Biology, University of Reading, UK)

We present a framework combining a global dataset of observed roadkill rates, life-history data, and geographic distribution maps to identify which terrestrial mammal species worldwide may be at risk of extinction from roadkill and the world regions where these vulnerable species occur. We found that populations of maned wolf, little spotted cat, brown hyena and leopard may be at risk of extinction if observed roadkill levels persist. The global assessment revealed that the species most vulnerable to roadkill and higher road densities coincide in South Africa, Ghana, central and Southeast Asia, parts of the Malay Archipelago and the Andean regions.

KEYWORDS: Roadkill rates, Mammals, Age-structured models, Risk of extinction

ROAD ECOLOGY: IMPACT ASSESSMENT, MITIGATION AND MONITORING – 2

SESSION 4.2.2. (Wednesday, 13 January / 13:30 – 15:00)

ROOM Cistus

MODERATOR Carme Rosell

#1 Factors affecting usage rates of wildlife crossing structures – a systematic review and meta-analysis

Dror Denneboom (Technion – Israel Institute of Technology, Israel); Avi Bar-Masada (University of Haifa, Israel); Assaf Shwartz (Technion – Israel Institute of Technology, Israel)

The objective of this research is to comprehensively analyse the effects of wildlife crossing structure attributes on usage rates by wildlife species. We conducted a systematic review followed by a meta-analysis to aggregate the results of worldwide studies. We identified 273 relevant papers, of which 32 papers were suitable for a meta-analysis, reporting results for 80 species and 145 crossing structures. We found significant effects

of structure type and structural attributes on usage rates for various functional groups. Some effects were similar for multiple groups, while other effects were distinctive. These results are valuable for application of cost-effective mitigation measures.

KEYWORDS: Wildlife crossing structures, Meta-analysis, Usage rate, Mitigation, Effectiveness

#2 Roadkills in Europe: areas of high risk of collision and critical for populations persistence

Clara Grilo (CESAM – Ciências, Centre for Environmental and Marine Studies, Faculdade de Ciências da Universidade de Lisboa, Portugal / CDV – Transport Research Centre, Czech Republic); Elena Koroleva (Department of Biogeography, Moscow State Lomonosov University, Russia); Richard Andrášik, Michal Bíl (CDV – Transport Research Centre, Czech Republic); Manuela González-Suárez (Ecology and Evolutionary Biology, University of Reading, UK)

We determined which European birds and mammals are at risk due to roads and where roads can impact population persistence. We developed a predictive model of roadkill rates based on species traits to predict rates for all species. We used a generalized population model to estimate long-term vulnerability to road mortality. We found that high roadkill rates do not seem to directly affect long-term persistence and areas where the roadkill estimates are highest do not necessarily coincide with areas more likely to have impacts on species persistence.

KEYWORDS: Roadkill rates, Life traits, Trait-based models, Spatially explicit models

#3 A national program to monitor fauna roadkills in Portugal

Graça Garcia (IP – Infraestruturas de Portugal, Portugal)

Infraestruturas de Portugal (IP) is a public company holding a long term concession contract of the national road and rail infrastructures in Portugal. Environmental sustainability is one important goal of IP and Fauna Roadkills is one of its Environmental Indicators. IP has implemented a National Program for Fauna Roadkills Monitoring, which is executed by several road inspectors. The results are integrated in a database and analyses are made to find hot-spots and implement mitigation measures. The results are also used to establish the need of considering preventing measures in the projects for improvement and maintenance of roads.

KEYWORDS: Long-term monitoring, Fauna roadkills, Roadkills database

#4 Wildlife-vehicle accident maps – a new support tool for mitigation planning and communication in Sweden

Andreas Seiler (Swedish University of Agricultural Sciences, Sweden); Mattias Olsson (EnviroPlanning AB, Sweden); Sofia Willebrand (Calluna AB, Sweden); Ulrika Lundin, Anders Sjölund (Swedish Transport Administration, Sweden)

We present a set of aggregated maps on wildlife-vehicle collisions (WVC) that recently has been published in Sweden. These maps convey information on where accidents are especially common and where the odds for individual drivers to experience a WVC are elevated. We present data and technique behind these maps and discuss their limitations and opportunities in communication, evaluation and research.

KEYWORDS: Traffic mortality, Wildlife vehicle collisions, Hotspot, Kernel density estimation

#5 Scary sounds as a tool to prevent moose – train collisions in Norway and Sweden

Svein Morten Eilertsen (NIBIO – Norwegian Institute of Bioeconomy Research, Norway); Petter Almås (NMBU – Norwegian Institute of Life Science, Norway); Næstad Frode (INN – Inland Norway University of Applied Sciences, Norway); Aina Winsvold (Institute for Rural and Regional Research, Norway); Karen Marie Mathisen (INN – Inland Norway University of Applied Sciences, Norway)

Collisions between train and free ranging animals (moose, reindeer, deer, fallow deer) have become a serious problem in Norway and Sweden. In a field experiment on feeding sites for moose during winter 2020, we demonstrated that scary sounds (human talk and dog barking) caused the moose to be more vigilant and leaving the sites. This experiment clearly demonstrated that scary sounds might be used to scare the moose to run away from the railway to prevent moose-train collisions.

KEYWORDS: Scary sounds, Moose, Train collisions

#6 Roads as overlooked drivers of change in bird communities

Fernando Ascensão (CIBIO/InBio – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CEABN/InBio – Centro de Ecologia Aplicada “Professor Baeta Neves”, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal / Department of Conservation Biology, EBD-CSIC – Estación Biológica de Doñana, Spain); Eloy Revilla (Department of Conservation Biology, EBD-CSIC – Estación Biológica de Doñana, Spain); Henrique M. Pereira (CIBIO/InBio – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CEABN/InBio – Centro de Ecologia Aplicada “Professor Baeta Neves”, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal / German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Germany)

Increasing road density was related to a decrease in species richness and an increase in compositional dissimilarity. Species with higher body mass, predominantly feeding on invertebrates, nesting on the ground, and with higher relative brain mass tend to avoid areas with higher road density; whereas those species that are city dwellers become more common in areas with increasing road density. Moreover, species currently showing a positive population trend were related to areas with higher road density. Overall, we show that roads are probably changing bird communities, altering the species richness and composition, and by filtering species traits.

KEYWORDS: Compositional dissimilarity, Community change, Species richness, Species traits, Road effects

INFRASTRUCTURE ECOLOGICAL MITIGATION AND DEFRAGMENTATION – 3

SESSION 4.3.1. (Thursday, 14 January / 10:30 – 12:00)

ROOM Cistus

MODERATOR Darryl Jones

#1 The use of culverts in road networks as roost sites to maintain landscape connectivity for a trawling bat: a case study of the large-footed myotis (*Myotis macropus*) in Australia

Vanessa Gorecki, Ramona Maggini, Boyd Tarlinton, Caroline Hauxwell, Stuart Parsons (School of Biology and Environmental Science, Queensland University of Technology, Australia)

Concrete culverts provide roost sites for urban *M. macropus* populations, enabling this species to persist in highly modified landscapes. Culverts >1.2 m in height with lift holes and crevices, located on stream orders 2-5 in landscapes with medium to high densities of waterways, should be considered critical urban *M. macropus* habitat and sites of high conservation value for urban trawling bats. The availability of roost culverts is limited at two spatial scales and suggests that culverts containing maternity colonies may be significant sites for urban biodiversity conservation. Any disturbance to a roost culvert has the potential to cause a significant disturbance to a bat colony, especially during the breeding season.

KEYWORDS: Culvert, Myotis, Roost, Microhabitat, Connectivity

#2 Road effect zones of major prey species in roaded landscapes in India

Akanksha Saxena, Asha Rajvanshi, Bilal Habib (Wildlife Institute of India, India)

Road-related disturbances can influence the presence of species in adjacent forest areas, and this effect can percolate up to 500m near the road. Road width and temporal variation in traffic was found to influence the presence of prey species near roads, while traffic regulations such as night time closure tended to reduce the impact of traffic on use of roadside habitat by animals. Understanding the interplay of road, traffic, species and environmental factors on the impact of roads on prey species could help formulate mitigation strategies to reduce these impacts.

KEYWORDS: Road ecology, Barrier effect, Habitat loss, Avoidance

#3 Speed thrills but kills: Roadkill scenario in National Highway 715 (new) passing through the Kaziranga National Park, Assam, India

Somoyita Sur, Jaydev Mandal, Prasanta Kumar Saikia (Department of Zoology, Animal Ecology and Wildlife Biology Laboratory, Gauhati University, India)

This study tried to understand the scenario of wild animal roadkill happening in the study area, with more emphasis on smaller groups of animals, rather than large charismatic mammals. We found the situation to be over alarming since a total of 6,315 individuals were recorded over a period of one year. Although, the most killed species are common and abundant, but certain rare roadkill were also found, these might not seem to affect the present population dynamics of the animal composition in the protected area, but surely do threaten the same in the long timescale.

KEYWORDS: Animal mortality, Barrier, Road ecology, Wildlife corridor, Vehicular collision

#4 Graph-based multi-attribute decision making: Impact of barriers on ecological network

Andrius Kučas, Linas Balčiauskas (Nature Research Centre, Lithuania)

Intersecting landscapes and wildlife, roads are linear infrastructure intrusions that have direct impacts on wildlife mortality and habitat fragmentation. In this study, we analysed the effect of barriers on the Lithuanian ecological network. In order to assess network connectivity, we ranked habitat patches using graph-based network connectivity rules and spatial decision support techniques based on multiple criteria. Simulations showed that barriers may realign complexes of ecological networks by reducing the importance of adjacent patches and increasing the importance of more distant habitat patches. Such distant patches may become essential and can sometimes be the only elements preserving the realigned ecological network.

KEYWORDS: Landscape connectivity, Habitat patches, Graph elements, Multiple-criteria decision-making, Ecological network

#5 Multi-level landscape analysis of wildlife vehicle collision sites in Estonia

Jaanus Remm, Piret Remm (OÜ Rewild, Estonia); Kaile Eschbaum (OÜ Hendrikson & Ko, Estonia); Kertu Jaik (OÜ Rewild, Estonia)

We analysed landscape correlations of 19,126 wildlife vehicle collision sites registered on the Estonian roads for three species: moose, wild boar, and roe deer. As a result, we positioned more than 8,444 road sections of high probability of wildlife accidents with precision of up to 50 m. The most important landscape variables determining the accident sites are density of human settlement and proportion of forest cover. It appears that landscape composition has a good predictive power on mapping wildlife-road interactions. As a result, the planning of road safety and population connectivity measures is faster, more precise, and more efficient.

KEYWORDS: Landscape, Hotspots, WVC

ROAD ECOLOGY: IMPACT ASSESSMENT, MITIGATION AND MONITORING – 3

SESSION 4.3.2. (Thursday, 14 January / 13:30 – 15:00)

ROOM Cistus

MODERATOR Fernando Ascensão

#1 A green light for blue wildlife reflectors?

Edgar A. van der Grift, Fabrice G. W. A. Ottburg, Dennis R. Lammertsma (Wageningen Environmental Research, Wageningen University and Research, Netherlands); Frans P. J. van Bommel (Van Bommel Faunawerk, Netherlands)

We studied whether blue wildlife reflectors reduce deer-vehicle collisions (DVC), and if so, to what extent. We collected roadkill data of roe deer (*Capreolus capreolus*) on 37 roads, both before and after the installation of blue wildlife reflectors. We found no significant difference in average number of DVC before and after mitigation. Our study emphasizes the need for evaluations of road mitigation measures prior to large-scale implementation. Our findings reflect the outcome of recent studies carried out elsewhere in Europe. Hence, no green light for blue wildlife reflectors yet.

KEYWORDS: Road mitigation, Wildlife reflectors, Roadkill, Roe deer

#2 Evaluation of an Animal Detection System (ADS) as an alternative for large defragmentation infrastructures

Moelants Marleen (Flemish government, Agency for Roads and Traffic, Planning and Coordination, Belgium); Stan Bollen (Flemish government, Agency for Roads and Traffic, Regional Division Limburg, Belgium); Guido Winters (Flemish government, Agency for Nature and Forests, Regional Division, Belgium); Katja Claus (Flemish government, Department of Environment and Spatial Development, Belgium)

In the east of Flanders, an Animal Detection System (ADS) has been installed along the Kamperbaan N73. This road fragments a vast heath area with many protected species. Recently also the wolf appeared. The warning system must prevent collision mainly with Wild Boar and other large fauna. The project consists of fencing 4 km with 2 wildlife crossing areas. The gaps are equipped with both AIR-sensors and PIR-sensors. 8 dynamic traffic signs warn drivers about the possibility of animals crossing. The system will be evaluated based on drivers response and animal behaviour.

KEYWORDS: Animal Detection System, ADS, Evaluation, Car accidents, Alternative solution, Wild Boar

#3 Hit the road Jane! Roads decrease the relatedness for females lesser horseshoe bats

Denis Medinas (CIBIO-UE – Research Centre in Biodiversity and Genetic Resources

es Pole of Évora / InBIO – Research Network in Biodiversity and Evolutionary Biology, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal); João Tiago Marques (UBC – Conservation Biology Lab, University of Évora, Portugal / MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal); Vera Ribeiro (UBC – Conservation Biology Lab, University of Évora, Portugal); Hugo Rebelo (CIBIO/InBIO-UP – Research Centre in Biodiversity and Genetic Resources, University of Porto, Portugal / CEABN-InBIO – Centre for Applied Ecology “Prof. Baeta Neves”, Institute of Agronomy in University of Lisbon, Portugal); Soraia Barbosa, Joana Paupério (CIBIO/InBIO-UP – Research Centre in Biodiversity and Genetic Resources, University of Porto, Portugal); Francesco Valerio (CIBIO-UE – Research Centre in Biodiversity and Genetic Resources Pole of Évora / InBIO – Research Network in Biodiversity and Evolutionary Biology, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal / MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal); Sara Santos (UBC – Conservation Biology Lab, University of Évora, Portugal / MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal); António Mira (CIBIO-UE – Research Centre in Biodiversity and Genetic Resources Pole of Évora / InBIO – Research Network in Biodiversity and Evolutionary Biology, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal)

The presence of roads has the potential to hamper exchange of individuals among populations and can have a major role in shaping the genetic structure of populations. We combine spatially explicit methods and genetic relatedness analyses to detected association between landscape resistance and relatedness structure between colonies of lesser horseshoe bat. Our results suggest that road presence reduced the relatedness among female colonies from opposite roadsides but did not halt the gene flow. We highlighted the importance of promote connectivity across a road-dominated landscapes to preserve high survival rates of breeding females and to assure continuous exchange of individuals between colonies.

KEYWORDS: Lesser horseshoe bat, Landscape relatedness, Road barrier, Relatedness structure, Sex-biased

#4 Mapping and monitoring large mammal underpasses on motorway A29

Maria Psaralexi (Department of Ecology, Aristotle University of Thessaloniki, Greece / Callisto – Wildlife and Nature Conservation Society, Greece); George Lyberopoulos, Elina Theodoropoulou (COSMOTE Mobile Telecommunications S.A., Greece); Yiannis Tsaknakis, Athanasios Tragos, Yiorgos Lazaros (Callisto – Wildlife and Nature Conservation Society, Greece); Niki Voumvoulaki (Egnatia Odos SA, 6th km Thessaloniki – Thermi, Greece); Carme Rosell, Marina Torrellas (MINUARTIA, Spain); Spyros Psaroudas, Yiorgos Mertzanis (Callisto – Wildlife and Nature Conservation Society, Greece)

In Greece, the brown bear (*Ursus arctos*) and its habitats are strictly protected, yet the motorway A29 cuts through the species’ habitat. In 2014, a bear-proof fence was installed to minimize bear-vehicle collisions, but it also increased the barrier effect. Thus, the need for evaluation of the motorway’s permeability became more pressing. Dur-

ing field visits, underpasses and potential barriers to animal movement were identified and registered. Following, 45 solar-panel/battery-powered 4G cameras were installed to monitor use of underpasses by larger mammals. Recorded species include both a variety of wildlife species and humans. Efforts towards enhancement of A29's permeability will follow the monitoring.

KEYWORDS: Mitigation measures, Underpasses, Monitoring, Brown bear, *Ursus arctos*

#5 The value of a non-scientific approach for road agencies

Victor Loehr (Dutch National Roads Agency Rijkswaterstaat, Netherlands); Jaap Mulder (Bureau Mulder-natuurlijk, Netherlands)

We captured badgers along a highway to attach GPS collars and monitored underpasses, before and during a major road expansion. Our opportunistic approach yielded valuable information about habitat use and effects of the construction works, helped in a permit application, and facilitated the execution of the project. It also produced a semi-scientific paper to guide future projects.

KEYWORDS: Badger, Disturbance, Effect distance, Habitat use, Road construction

#6 LIFE SAFE-CROSSING: A new international project for preventing large carnivore road mortality in Europe

Annette Mertens, Simone Ricci, Fabio Papini (Agristudio Srl, Italy); Mihai Fedorca (National Institute for Research and Development in Forestry “Marin Drăcea”, Romania); Spyros Psaroudas (CALLISTO, Greece); Inigo Fajardo (Junta de Andalucía, Environment and Land Planning Department, Spain); Carme Rosell (MINU-ARTIA, Spain); Antonio Antonucci (Parco Nazionale della Majella, Italy); Andrea Gennai (Parco Nazionale d’Abruzzo Lazio e Molise, Italy)

The LIFE SAFE-CROSSING project, co-financed by the European Union, aims to reduce the impact of linear infrastructures on Bears, Wolves and Iberian lynx in Italy, Spain, Greece and Romania. The following activities are implemented on round 400 km of roads:

- reduction of the direct mortality of the animals on roads through the installation of innovative prevention tools;
- mitigation of the fragmentation of the populations through readaptation of existing crossing structures;
- actions to encourage an adequate driving behavior in order to minimize the risk of collisions with wildlife.

KEYWORDS: AVC, Roads, Underpasses, Large carnivores, Public awareness

CHALLENGES AND OPPORTUNITIES FOR BIODIVERSITY CONSERVATION IN LINEAR INFRASTRUCTURES

SESSION 4.3.3. (Thursday, 14 January / 15:30 – 17:00)

ROOM Cistus

MODERATOR Rafael Barrientos

#1 How do roads affect the ecological processes and biodiversity? – summing up a systematic literature review for the decade 2008-2018

Hans Martin Hanslin (Norwegian Institute of Bioeconomy Research, Norway); Johannes Kollmann (Norwegian Institute of Bioeconomy Research, Norway / Technical University of Munich, Germany); Svenja Kroeger (Norwegian Institute of Bioeconomy Research, Norway); Larissa Uhe, Sabrina Behrendt (Technical University of Munich, Germany); Jörgen Wissman, Tommy Lennartsson (Swedish Biodiversity Centre, Sweden); Jan Christian Habel (University of Salzburg, Austria); Marcello D’Amico (CIBIO-InBIO – University of Lisbon, Portugal); Knut Anders Hovstad (Norwegian Institute of Bioeconomy Research, Norway)

Our comprehensive literature review found a range of positive and negative contributions of habitats along roads to biodiversity and species richness, structural and resource heterogeneity in the landscape, and as corridors for a diverse set of organisms. However high species-specificity in responses, conflicting results across spatial scales, and strong impact of the landscape configuration and resources points to trade-offs and knowledge gaps to be addressed.

KEYWORDS: Road ecology review, Effects, Landscape

#2 The Brazilian Network of Transport Ecology Specialists (REET Brasil)

Simone Freitas (Universidade Federal do ABC, Brazil); Clarissa Rosa (Instituto Nacional de Pesquisas da Amazônia, Coordenação de Biodiversidade, Brazil); Helio Secco (Universidade Federal do Rio de Janeiro, Programa de Pós-graduação em Ciências Ambientais e Conservação, Brazil); Mariane Biz (ProHabitat, Brazil); Fernanda Teixeira (Universidade Federal do Rio Grande do Sul, Núcleo de Ecologia de Rodovias e Ferrovias, Brazil); Marcelo Gordo (Universidade Federal do Amazonas, Instituto de Ciências Biológicas, Brazil)

The Brazilian Network of Transport Ecology Specialists (REET Brasil) is an association formed by researchers, environmental managers, public service professionals, and technical representatives of private companies who work with transport ecology. This work aims to show REET Brasil to the international community. REET Brasil was started in 2019 and has 121 members. Most members are biologists, and work on highways. Our challenges are to disseminate knowledge in the area of Transport Ecology in the North and Northeast regions of the country, in the airports and waterways, and bring the academy closer to other social actors related to Transport Ecology.

KEYWORDS: Transport ecology, Brazilian association, Applied research, Dissemination of knowledge, Environmental impact assessment

#3 Creating high voltage power lines green corridors: how to demonstrate a win-win strategy?

Lisa Garnier, Bruno Salvi, Agnès Baccelli, Amélie Lafragette, Christophe Martinez, Damien D-Eaubonne, Gérald Sambardier, Sandrine Willer, Fabien Merpillat, Delphine Bonnifay, Juliette Auger, Emma-Pacome Vejux, Alexis Roset, Luc Estachy, Grégoire Martin, Kevin Rossi, Etienne Dupuy (RTE – Réseau de Transport d'Electricité, France); Gérard Jadoul, Jean-François Godeau (Ecofirst – Biodiversity & Forest Engineering, Belgium); Céline Davril-Bavois, Nicolas Bock (Parc Naturel Régional des Ardennes, France); Jean-François Lesigne (RTE – Réseau de Transport d'Electricité, France)

BELIVE is a Transmission System Operator (RTE) project that aims to study how at an industrial level, the alternative vegetation management can be generalized underneath overhead lines for the benefit of biodiversity, ecosystem services and local stakeholders. Financial viability and ecosystem services are estimated to engage further development and expand in European countries for creating green infrastructures in forest ecosystems.

KEYWORDS: Biodiversity, High voltage lines, Ecosystem services, Vegetation management, Forest corridor

#4 Protection of birds on power lines in the Czech Republic – from monitoring to practical measures

Václav Hlaváč (Nature Conservation Agency of the Czech Republic, Czech Republic)

The problem of bird protection on power lines has been addressed in the Czech Republic since the 1980s. However, a study conducted between 2015 and 2016 showed that more than 100,000 birds die on power lines each year. Extensive protective measures have been introduced in cooperation between nature conservation authorities, NGOs and energy companies to address the problem by 2035.

KEYWORDS: Electrocution, Collision with power lines, Bird mortality

#5 Assessing Biodiversity in Railway Dry Grassland Patches

Magnus Stenmark (Calluna AB, Sweden)

The Swedish 1,400 railway stations have been surveyed for biodiversity potential. The results include that 230 railway stations contain grassland patches with high biodiversity of plants and animals. In total, more than 2,000 species of insects and vascular plants were found to have their habitat in these dry grasslands. About 100 of these are nationally red-listed species, mainly of bees, beetles, butterflies, and vascular plants. The survey has also included a method identifying and ranking sites based on nature conservation values. High-ranked railway grasslands are subject to specific biodiversity action plans.

KEYWORDS: Railway, Biodiversity, Red-listed, Pollinator, Insect

#6 Determination of the bird protection effectiveness of animal deflectors on railway overhead lines

Jana Görlich, Stefan Kornhuber (University of Applied Science Zittau, Germany); Hans-Peter Pampel (Technische Universität Dresden, Germany); Christoph Jöckle (Federal Railway Authority Bonn, Germany); Marion Leiblein-Wild (German Centre for Rail Traffic Research Dresden, Germany)

The aim of the research project was to determine whether and to which extent the use of animal deflectors may contribute to bird protection. The tests have shown that it is possible to measure the electrostatic discharge by touching the animal deflectors at different stages and with different animal resistances. It was found that the state of the insulator (dry, wet, polluted, etc.) has an influence on the intensity of the electrostatic shock.

KEYWORDS: Bird protection, Animal deflectors, Transmission line, Insulator state, Electrostatic shock, Railway, Overhead lines

INFRASTRUCTURE ECOLOGICAL MITIGATION AND RESTORATION – 1

SESSION 5.1.1. (Tuesday, 12 January / 10:30 – 12:00)

ROOM Lavandula

MODERATOR Silviu Petrovan

#1 Make amphibian defragmentation infrastructures great (again?)

Kristijn Swinnen, Ilf Jacobs, Griet Nijs, Simon Feys, Karin Gielen, Dominique Verbelen, Jorg Lambrechts (Natuurpunt Studie, Belgium); Katja Claus (Flemish Government, Department of Environment and Spatial Development, Belgium)

We conducted an inventory of the existing amphibian defragmentation infrastructures (n=93) in Flanders, Belgium. We evaluated a subset, taking into account the location in the landscape, structure and state (n=25). Initial construction was mostly at the right place, but maintenance was often inadequate. A detailed monitoring of 10 of the defragmentation infrastructures for amphibians indicated that although some structures are well used by amphibians, others are no longer functional and even seem to become a barrier to migrating amphibians. We suggest that the construction of a defragmentation infrastructure is only useful when combined with a strict maintenance schedule and a corresponding budget.

KEYWORDS: Amphibians, Maintenance of defragmentation infrastructures, Quantitative analysis, Volunteers

#2 AMPHIBIAN CONSERVATION AND HABITAT RESTORATION (LIFE AMPHICON)

Katja Poboljšaj (Center za kartografijo favne in flore, Slovenija)

Decline of amphibian populations due to habitat fragmentation, increasing traffic and loss of landscape connectivity poses a serious threat for amphibians in Europe, Slovenia included. The main objective of LIFE AMPHICON (2020-2026) project is to improve the conservation status of amphibian target species (*Triturus carnifex* and *Bombina variegata*) in three Natura 2000 areas in Slovenia through restoration of ca 90 ponds and land habitats (ca 23 ha), improving habitat connectivity, reducing road mortality (app. 60 road tunnels with fences constructed) and improving coherence of all project sites.

KEYWORDS: Amphibians, Road mitigation measures, Habitat restoration, Green infrastructure

#3 Assessing the ability of modern metapopulation models to mimic real life using genetic data

Sylvain Moulherat (TerrOïko, France); Jonathan Remon (TerrOïko, France / Station d'Ecologie Théorique et Expérimentale, France); Jérôme G. Prunier (Station d'Ecologie Théorique et Expérimentale, France); Gaël Bardon (TerrOïko, France / Centre d'Ecologie Fonctionnelle et Evolutive, France); Aurélie Coulon (Centre d'Ecologie Fonctionnelle et Evolutive, France / Centre d'Ecologie et des Sciences de la Conseration, France)

As a part of the CIRFE project, we compared genetic outputs produced by an agent based model frequently used in French EIA and SEA with equivalent genetic data produced by a three years field survey of midwife toads (*Alytes obstetricans*) and meadow browns (*Maniola jurtina*). By this way, we demonstrated that modern simulation models are able to realistically mimic metapopulation functioning at large scales. We also point out some of the limitations of such approaches. Thus, we give some recommendation to efficiently deploy routinely such models as decision support tool to ensure the No Net Loss objective.

KEYWORDS: Simulation, metapopulation dynamics, connectivity, landscape genetics

#4 Road proximity affects reproductive investment in lizards: a two-years translocation experiment

Rodrigo Megía-Palma (CIBIO/InBIO, University of Porto, Portugal); Rafael Barrientos (Departamento de Biodiversidad, Ecología y Evolución, Universidad Complutense de Madrid, Spain)

Linear infrastructures may have evolutionary impact on populations of small vertebrates. We demonstrated the selective pressure of a road by comparing the phenology of the reproduction and the changes in the phenotypes of lizards marked and recaptured in two areas, within the same population, but differing in their proximity to the road. Far-lizards reproduced earlier in the season, were bigger, increased their body condition, and invested more in nuptial coloration as compared to close-lizards, suggesting that far-lizards are of better quality. The existence of diverging lizard phenotypes as a function of road proximity suggests an evolutionary impact on this population.

KEYWORDS: Disruptive selection, Individual quality, Population dynamics, Road Ecology

#5 ControllnRoad: Controlling invasive alien plant species along roads

Friederike Trognitz (AIT – Austrian Institute of Technology, Austria); Swen Fol-lak (Austrian Agency for Health and Food Safety, Institute for Sustainable Plant Production, Austria); Alexander Fördös (AANTA AB, Sweden); Norbert Sedlacek (HERRY Consult GmbH, Austria); Herbert Seelmann (Consult, Austria); Maximilian Koch (Zasso GmbH, Germany); Angela Sessitsch (AIT – Austrian Institute of Technology, Austria)

The project “ControllnRoad” (<http://www.controlinroad.org>) was set up in 2017 in frame of the CEDR Transnational Road Research Program Call 2016 “Biodiversity - Conflicts along the Road: Invasive Species and Biodiversity”, funded by the road administration of Austria, Germany, Ireland, the Netherlands, Norway, Sweden and Slovenia. In frame of the project occurrence of invasive alien plants along roadsides were assessed, current control methods and regulations throughout Europe reviewed and different control methods tested. The results of the field trials as well as the stakeholder consultation formed the basis for guidelines for dealing with IAPs and a cost-benefit assessment of the methods.

KEYWORDS: Invasive alien plants, Road margins, weed control methods, Cost benefit analysis

WILDLIFE AND LINEAR INFRASTRUCTURE INTERACTIONS: FIELD MONITORING AND ECOLOGICAL SOLUTIONS – 2

SESSION 5.1.2. (Tuesday, 12 January / 14:45 – 16:15)

ROOM Lavandula

MODERATOR Vaclav Hlavac

#1 Risky wandering close to the railway: flight behavior of birds across the platform and viaducts in a high-speed railway

J. E. Malo (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain / CIBC-UAM – Centro de Investigación en Biodiversidad y Cambio Global, Universidad Autónoma de Madrid, Spain); I. Hervás (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain); C. Mata (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain / CIBC-UAM – Centro de Investigación en Biodiversidad y Cambio Global, Universidad Autónoma de Madrid, Spain); A. E. Santamaría (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain); J. Herranz (TEG-UAM – Terrestrial Ecology Group, Universidad Autónoma de Madrid, Spain / CIBC-UAM – Centro de Investigación en Biodiversidad y Cambio Global, Universidad Autónoma de Madrid, Spain)

A two-year study of bird flight across a section and three viaducts of a high speed railway shows that birds frequently cross it, and very often under the risk to be killed by running trains. High inter-site variability was detected in birds’ activity and against traditional thought, viaducts where neither the sites with highest bird transit nor the riskiest points for train-kill. Moreover, traditional protection screens based on those to abate

noise did not effectively dissuade birds from crossing through the risk area. This study contributes to fill a huge gap existent in the knowledge of railway impacts on wildlife.

KEYWORDS: Bird protection screens, Environmental impact assessment, Mitigation, Mortality, Roadkill

#2 Linking habitat composition, local population densities and traffic characteristics to spatial patterns of ungulate-train collisions

Karolina D. Jasińska (Department of Forest Zoology and Wildlife Management, Warsaw University of Life Sciences, Poland); Michał Żmihorski (Mammal Research Institute, Polish Academy of Sciences, Poland); Dagny Krauze-Gryz (Department of Forest Zoology and Wildlife Management, Warsaw University of Life Sciences, Poland); Dorota Kotowska (Institute of Nature Conservation, Polish Academy of Sciences, Poland); Joanna Werka (Department of Forest Zoology and Wildlife Management, Warsaw University of Life Sciences, Poland); Tomas Pärt (Department of Ecology, Swedish University of Agricultural Sciences, Sweden)

Ungulate-train collisions spots are characterised by surrounding forest, rail curvature, high train speed, and a moderate to high train traffic intensity. For all four most common ungulate species in Poland (moose, red deer, roe deer, wild boar) the collision risk increased with increasing population density, train speed and train traffic intensity but also with forest coverage and rail curvature presence. However, the collision risk connected with population density, train speed and train traffic increased in non-linear.

KEYWORDS: Collision risk, Moose, Red deer, Roe deer, Wild boar

#3 Are railways really detrimental to bird populations? The case of the new Bothnia Line Railway in northern Sweden

Adriaan de Jong (Swedish University of Agricultural Sciences, Sweden)

A before-during-after control-impact study of a 180 long new railway in northern Sweden revealed negative effects on species richness, number of territories and distance to the railway only in a few sites and species. Generally, there were insignificant or slightly positive effects. The results provide no evidence for a widespread detrimental effect of railway construction on bird faunas.

KEYWORDS: Railway, Birds, BDACI study, Agricultural landscape

#4 Bird mortality by collision with transmission power lines: analysis of 15 years of impact assessment in Portugal

Ricardo C. Martins (REN Biodiversity Chair, CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal); Teresa Marques

(REN Biodiversity Chair, CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / Centro de Ecologia, Evolução e Alterações Ambientais, Universidade de Lisboa, Portugal); João P. Silva (REN Biodiversity Chair, CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal); Francisco Moreira (REN Biodiversity Chair, CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal)

In Portugal, there is a substantial amount of data on impacts of Transmission Power Lines (TPL) on bird mortality, originated from monitoring programs in the context of impact assessment studies. We compiled the existing information on the topic from 34 studies made in the last ~15 years and used it to characterize the temporal and spatial patterns of bird mortality by collision with TPL. From a total of 3400 carcasses (~130 species), two bustard species clearly stand out as highly susceptible, with considerably high number of fatalities given their low abundance and high conservation status.

KEYWORDS: Biodiversity impacts, Overhead wires, Species' susceptibility, Mitigation

#5 Effects of linear infrastructures on the composition of local vertebrate scavenger guilds and bird carcass removal patterns in two Mediterranean agricultural landscapes

Joana Bernardino (REN Biodiversity Chair, CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal); Regina Bispo (Departamento de Matemática e Centro de Matemática e Aplicações, Universidade Nova de Lisboa, Portugal); Ricardo C. Martins (REN Biodiversity Chair, CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal); Sara Santos (MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal); Francisco Moreira (REN Biodiversity Chair, CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal)

We performed bird carcass persistence trials (using camera traps) in two different Mediterranean agricultural landscapes bisected by linear infrastructures (LI), namely power lines and roads. Our goal was to investigate whether LI presence influenced the composition of local scavenger guilds or the overall carcass removal rates. We observed that LI effect on scavenger identity and carcass persistence rates was not consistent across agricultural landscapes. Contradicting common assumptions, we also found no evidence that LI presence increases the carcasses removal rates, which suggests that broad generalizations about LI effect on scavenging patterns may not be appropriate.

KEYWORDS: Roads, Power lines, Carcass persistence, Bird mortality, Scavenging bias

#6 UIC Ecological Effects of Railways on Wildlife project (rEvERsE)

Pinar Yilmazer (UIC – International Union of Railways, France); Thomas Schuh (ÖBB-Infrastruktur AG, Austria); Lucie Anderton (UIC – International Union of Railways, France)

UIC members take a proactive role within networks to provide solutions and best practice for the correct development of an environmentally responsible railway transport system. This paper provides information about the Ecological Effects of Railways on Wildlife project (rEvERsE). Our aim is to improve the understanding of the impact of railways on biodiversity and to develop an action plan as well as guidelines for railways to protect our natural heritage. Within a period of 3 years, the UIC, with its members, will provide an overview of biodiversity issues for the first time within the railway industry at the international level.

KEYWORDS: Railway ecology, Sustainable transport system, Wildlife-train collision, Biodiversity

GREEN INFRASTRUCTURE NETWORKS: POLICY AND STRATEGIC PLANNING

SESSION 5.2.1. (Wednesday, 13 January / 10:30 – 12:00)

ROOM Lavandula

MODERATOR Marita Boettcher

#1 German's federal waterways – A linear infrastructure network for nature and transport

Volker Steege, Dirk Engelbart, Nicole Hädicke, Kai Schäfer, Jennifer Wey (Federal Ministry of Transport and Digital Infrastructure, Germany)

Major rivers are unique linear structures because they serve different purposes simultaneously: habitat and dispersal route for flora and fauna as well as navigation route, and site for recreational and economic activities. How can we move closer to achieving the aim of balancing the requirements of transport and the needs of nature? The German Federal Ministry of Transport and Digital Infrastructure is improving the ecological status of rivers with measures like building fish passes and projects for riverbank restoration. A new flagship is "Germany's Blue Belt", a Federal Government programme to develop a system of interlinked biotopes of national significance along federal waterways.

KEYWORDS: German waterways, Biodiversity, Water Framework Directive, Germany's Blue Belt

#2 Developing projects for harmonization of Green and Grey Infrastructure (the HARMON project experience in the Danube Region)

Radu Mot, Florina Ciubuc (Zarand Association, Romania); Lazaros Georgiadis (Biologist – Environmentalist, Greece / IENE – Infrastructure and Ecology Net-

work Europe, France); Miroslav Kutal (Friends of the Earth Czech Republic, Czech Republic); Emma Gileva (Black Sea NGO Network, Bulgaria); Roland Grillmayer (Austrian Environment Agency, Austria); Niki Voumvoulaki (EGNATIA ODOS S.A., Greece); Roxana Stoian (National Environmental Protection Agency, Romania); Elke Hahn (Austrian Federal Ministry for Transport, Innovation and Technology, Austria / IENE – Infrastructure and Ecology Network Europe, France); Anders Sjolund (IENE – Infrastructure and Ecology Network Europe, France); Hildegard Meyer (WWF Central and Eastern Europe, Austria); Cristian-Remus Papp (WWF Romania, Romania)

Harmonization of Grey and Green Infrastructure is the solution of sustainable connectivity for both people and biodiversity. The development of parameters for assessing the status quo of harmonization is the main original contribution of the HARMON project. A derived Strategic Action Plan was used to support the development of a main project proposal (SaveGREEN) in the field of harmonization of green and grey infrastructure in the Danube Region and to strengthen a regional platform of specialists (GreenWeb). We recommend that transnational or multiple-countries initiatives should consider this approach which highlights common objectives and existing know-how in the field of harmonization.

KEYWORDS: Green Infrastructure, Grey Infrastructure, Harmonization, Parameters, Action plan

#3 From technology to strategy: developments and perspectives of research in infrastructure and ecosystems

Yannick Autret (French Ministry for an Ecological and Solidary Transition – Directorate of Research and Innovation, France); Judith Raoul-Duval (Société Zogma, France); Bruno Villalba (AgroParisTech, France); Sylvie Van Peene (IRSTEA – Institut National de Recherche en Sciences et Technologies pour l'Environnement et l'Agriculture, France); Héloïse Benard (French Ministry for an Ecological and Solidary Transition – Directorate of Research and Innovation, France)

There are no specialized centers for research on the interactions between infrastructures and ecosystems, which is paradoxical considering the importance of infrastructure impacts on the territories. Since the beginning, the technique has been identified as a key element of the solution to the challenges posed by the growing infrastructure development. It is therefore important to consider the conditions for the development of research and innovation networks capable of responding to the growing challenges raised on the subject both at European level and at the global level.

KEYWORDS: Linear infrastructure, Research, Innovation, Public-private partnerships, Strategy

#4 The SaveGREEN Project – Safeguarding the functionality of transnationally important ecological corridors in the Danube basin

Hildegard Meyer (WWF-CEE – WWF Central and Eastern Europe, Austria); Roland Grillmayer (Environment Agency Austria, Austria); Emma Gileva (Black Sea NGO Network, Bulgaria); Petko Tsvetkov (Bulgarian Biodiversity Foundation, Bulgaria);

Miroslav Kutal (Friends of the Earth, Czech Republic); Ivo Dostál, Jan Kubeček (Transport Research Centre, Czech Republic); Gabriella Nagy (CEEweb for Biodiversity, Hungary); Árpád Ferincz, Krisztina Filepné Kovács, László Kollanyi, András Weiperth (Szent Istvan University, Hungary); Radu Mot (Association “Zarand”, Romania); Alexandra Doba, Marius Nistorescu (EPC Environmental Consulting Ltd., Romania); Cristian-Remus Papp, Diana Cosmoiu (WWF Romania, Romania); Barbara Immerova, Milan Janak (WWF Slovakia, Slovakia); Maros Finka, Milan Husar, Vladimir Ondrejčka (SPECTRA Centre of Excellence of EU – Slovak University of Technology in Bratislava, Slovakia); Elke Hahn (IENE – Infrastructure and Ecology Network Europe, Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, Austria); Lazaros Georgiadis (IENE – Infrastructure and Ecology Network Europe, Biologist-Environmentalist, Greece)

SaveGREEN, co-funded by ERDF, contributes to safeguard ecological corridors threatened by grey infrastructure and land use in the Danube basin. Based on scientific research and multi-sectoral collaboration of stakeholders from different fields of expertise, solutions will be identified to enhance permeability of bottlenecks in eco-corridors in 7 pilot areas by developing an efficient monitoring method, cross-sectoral operational plans and a comprehensive capacity building programme for authorities and relevant stakeholders. Further, the project aims at engaging with decision-makers from the national, EU, and EUSDR in order to mainstream ecological connectivity into policies and funding schemes.

KEYWORDS: Ecological connectivity, Linear transport infrastructure, Functionality of ecological corridors, Cross-sectoral cooperation

#5 Mapping ecological corridors to educate policymakers and the public

Jan Mampaey, Thomas Impens (Provinciaal Natuurcentrum Limburg, Belgium)

The Provinciaal Natuurcentrum Limburg (PNC), a service of the provincial government of Limburg, Flanders, is responsible for the themes biodiversity and nature and environmental education. In 2011 the province of Limburg has produced a map with 80 preferred ecological corridors of which a number are being realised in participation with linear infrastructure operators. The PNC experienced a certain reluctance with other policymakers. Since the PNC paid a lot of attention at the development of social support.

It developed a series of municipal nature reports with concise information about the actual situation of local and regional biodiversity and opportunities for collaboration in the realisation of ecological corridors.

KEYWORDS: Network ecological corridors, Policymaking, Educate, Social support, Collaboration partners

CITIZEN SCIENCE AND THE INVOLVEMENT OF CIVIL SOCIETY – 1

SESSION 5.2.2. (Wednesday, 13 January / 13:30 – 15:00)

ROOM Lavandula

MODERATOR Heinrich Reck

#1 Are largescale citizen science data precise enough to determine road-kill patterns?

Pablo Quiles (Departamento de Biodiversidad, Ecología y Evolución, Complutense University of Madrid, Spain); Fernando Ascensão, Marcello D’Amico (CIBIO/InBio – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal); Eloy Revilla (Department of Conservation Biology, EBD-CSIC – Estación Biológica de Doñana, Spain); Rafael Barrientos (Departamento de Biodiversidad, Ecología y Evolución, Complutense University of Madrid, Spain)

Roads are one of the most transforming infrastructures in human-dominated landscapes and citizen science is increasingly being used as source of data in this area, but it may be not precise enough to detect road-kill hotspots or road-kill trends among species. For this reason, we compared the data from the Spanish National Atlas, with our own specific roadkill survey in relation to the carnivore guild. The results showed that data from the Atlas may not be adequate to determine trends in road-kills in our study area and that for species-specific approaches, ecological or behavioural traits must be considered.

KEYWORDS: Carnivores, Citizen science, Road Ecology, Wildlife-vehicle collisions

#2 Using citizen science to survey roadkill at wide spatio-temporal scales

Wendy Collinson (Endangered Wildlife Trust, South Africa)

As the global road network expands, roads pose an emerging threat to wildlife populations. One way in which roads can affect wildlife is wildlife-vehicle collisions (WVC), which can be a significant cause of mortality. In order to successfully mitigate these problems, it is vital to understand the factors that can explain the distribution of roadkill. Although large-extent WVC systems have been deployed throughout the world, there have been few evaluations of their features and no recommendations for future developers. I report on the parallels and differences between the range of data collection methods, contributing populations, data management systems, and data visualizations used in different countries. The majority of these global systems have combined goals of protection of wildlife and driver safety and as records become more standardized, more people are participating in volunteer observations of all kinds, including of the environment.

KEYWORDS: Citizen science, Data, Roadkill, WVC, Wildlife-vehicle collision

#3 Using citizen science to uncover temporal patterns of wildlife roadkill in the UK

Amy L. W. Schwartz, Robert J. Thomas (Cardiff School of Biosciences, UK /

Eco-Explore Community Interest Company, UK); Elizabeth Chadwick, Sarah E. Perkins (Cardiff School of Biosciences, UK)

Citizen science has allowed us to collate a large dataset of wildlife-vehicle collision records which can be used to inform us on the answers to a broad range of ecological questions. Here, we use a citizen science roadkill dataset from the UK's "Project Splat-ter" to examine species specific temporal patterns that are consistent across some taxa and make suggestions as to why such patterns occur.

KEYWORDS: Citizen science, Roadkill, ecology, Wildlife behaviour

#4 Integration of sensory qualities in landscape modelling and its effect on infrastructural resilience

Lucía Jalón Oyarzun, Dieter Dietz, Aurélie Dupuis, Julien Lafontaine Carboni (École Polytechnique Fédérale de Lausanne, Switzerland)

The use of integrative valuing strategies of sensory qualities in landscape modellings used in processes with stakeholders can have an important effect on infrastructural resilience and sustainability. To address this, we will focus first, on the role material and tactile spatial modellings can play when transforming social participation processes into socioecological practices capable of addressing ecological, social and embodied dimensions of landscape which have hitherto remained invisible. Second, on how the integration of sensory and kinaesthetic dimensions of the user's experience of nature within those modellings can become a key factor to increase civic engagement in infrastructural planning today.

KEYWORDS: Embodied mobilities, Landscape modelling, Socioecological praxis, Multimodal infrastructure, Landscape infrastructure

MANAGING BIODIVERSITY ALONG ROAD VERGES

SESSION 5.3.1. (Thursday, 14 January / 10:30 – 12:00)

ROOM Lavandula

MODERATOR Jan Olof Helldin

#1 Integrating the ecological quality of highway verges in the road assets: a new evaluation tool

Marguerite Trocme (Swiss Federal Road Office, Switzerland)

A new assessment tool for highway verges has been developed. The condition of verges and whether the federal road maintenance guidelines are correctly applied is evaluated. The approach is similar to the evaluation of other road assets such as bridges. Different criteria are examined such as mowing regime (respecting 10 cm minimal height), verge stability, biodiversity, ecological corridor function, invasive plants, state

of hedges, fauna passages are examined. An alarming state (scale 5) will require immediate corrective action whereas an insufficient state (scale 3) an adaptation of maintenance. First evaluations will start in 2020.

KEYWORDS: Highway verges, Biodiversity, Corridor function, Asset management

#2 Testing wild plants seed mixtures along grey infrastructures

Mariana P. Fernandes, Paula Matono, Carla Pinto-Cruz, Anabela Belo (MED - Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal)

The promotion of native plants can mitigate the negative effects of linear infrastructures by sowing them around these infrastructures. Our work is integrated in the LIFE LINES project, where we developed two biodiverse seed mixtures of wild species to enhance the local biodiversity along roads and ecotrails. Based on previous work, two assortments of seed mixtures were installed in in-situ plots during autumn 2018 and the seed mixtures behaviour was evaluated in spring 2019. Our preliminary results suggest that the local biodiversity increased and both assortments tested seem suitable to use in the south of the Iberian Peninsula.

KEYWORDS: Biodiversity, Linear infrastructure, Restoration, Species selection, Sowing experiments

#3 Using remote-sensing to map suitable road verges for a rare small mammal, the Cabrera vole (*Microtus cabrerae*)

Francesco Valerio (CIBIO/InBIO-UE – Research Center in Biodiversity and Genetic Resources, University of Évora, Portugal / MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal); Eduardo Ferreira (UBC – Conservation Biology Lab, University of Évora, Portugal); Sérgio Godinho (MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal); Ricardo Pita (CIBIO/InBIO-UE – Research Center in Biodiversity and Genetic Resources, University of Évora, Portugal / MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal); António Mira (MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal); Nelson Fernandes (UBC – Conservation Biology Lab, University of Évora, Portugal); Sara M. Santos (MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal)

We evaluated the usefulness of Sentinel-2 sensor for explaining occurrence patches for Cabrera vole, an endangered species, in southern Portugal, that frequently occupies road verges. Habitat patches were surveyed through presence signs. We derived predictors from Sentinel-2 and from other sources to predict species occurrence. The most important predictor was a distance-based measure, road proximity (~27% importance), whereas the remaining predictors were all from remote-sensing products,

together contributing with ~73% of importance. Cabrera vole presence is more likely in areas close to roads, and remote-sensing predictors proved to be an important tool to improve species occurrence predictions.

KEYWORDS: Remote sensing, Sentinel 2, Species distribution models, Road Ecology, Road verges

#4 How roadside belts can be managed for a sustainable environment?

Noreen Khalid (Department of Botany, Govt. College Women University, Pakistan); Naila Hadayat (Department of Botany, University of Okara, Pakistan); Sumreen Anjum (Department of Botany, University of Agriculture, Pakistan)

Management of roadside belts for a healthier and safer environment is the best solution to alleviate pollution caused by tail pipe and non-tail pipe vehicle emissions. For this reason, plants need to be chosen carefully keeping in view the environmental concerns along roads. Natural native vegetation can play a significant role in management of these corridors by absorbing pollutants of vehicle origin from roadside soils. The prime objective of the presentation is to provide information about the wild flora which could be used to maintain roadside belts and how it is effective in removing pollutants from the contaminated soil besides providing recreation being on purpose.

KEYWORDS: Roadside vegetation, Heavy metals, Vehicle pollution, Phytoremediators

#5 Road Ecology, Challenges and Mitigation: A case study from Abohar Wildlife Sanctuary, Fazilka, Punjab, India

Khursid A. Khan (Wildlife Institute of India, India / Department of Wildlife Sciences, Aligarh Muslim University, India); A.K. Bhardwaj, S.P. Goyal; A. Rajvanshi, K. Ramesh (Wildlife Institute of India, India)

This study was conducted in the Abohar Wildlife Sanctuary to see the impact of the Linear Infrastructure Structure (Proposed widening of the road) on the Wild animals. After the survey and road profiling of 17 km of road, we recommended two underpasses and four animal crossing points to maintain the connectivity of the wildlife in this area. It was a unique study in the sense of ownership of the land; the whole sanctuary is private land, so it was complicated to implement expedient recommendations.

KEYWORDS: Road ecology, Large mammal vehicle collision, Habitat connectivity, Mitigation Plan

#6 Results of the management on biodiversity along species rich roadsides in Sweden

Mats Lindqvist, Johanna Lindberg (Swedish Transport Administration, Sweden)

Most of the conservational work on infrastructure in Sweden consists of appointing of species rich roadsides and their management. The management of the designated

roadsides consists primarily of a late mowing regime. The tools for restauration are a) specialized maintenance descriptions to favour certain species or habitats, b) temporary restoration plans. The results of all these activities are leading to more flowers in roadsides, promoting interesting species, promoting certain red listed species, as well as insects. It is obvious that species rich roadsides need elaborated habitat and species related activities in order to keep or enhance their biodiversity values.

KEYWORDS: Species rich roadsides, Biodiversity, Maintenance of vegetation, Restoration

INFRASTRUCTURE ECOLOGICAL MITIGATION AND DEFRAGMENTATION – 4

SESSION 5.3.2. (Thursday, 14 January / 13:30 – 15:00)

ROOM Lavandula

MODERATOR Adam Hofland

#1 Ecological efficiency of an eco-bridge: Lessons from the Adrets-de-L'Estrel eco-bridge on the A8 Highway (Southeast of France)

Jean-Louis Malfère, Hippolyte Pouchelle, Christian Xhardez, Dorothée Labarraque (EGIS Group, France)

An eco-bridge was built on the A8 Highway (ESCOTA) to implement operations meant to improve environmental conditions of the Highway. The structure and layout of the eco-bridge surroundings were designed for a wide range of terrestrial, semi-aquatic and avifauna target species. Early on, it appeared that the functionality of the eco-bridge was successful for a majority of targeted faunal groups even though landscaping was not fully developed yet. Many species used the structure for transit as well as feeding and breeding. The monitoring confirms the interest of eco-bridge structures dedicated to fauna and functional for multiple species and multiple usage.

KEYWORDS: Eco-bridge, Ecological transparency, Chiropterans, Avifauna, Insects, Mammals, Wildlife crossing

#2 Importance of roadside habitats for biodiversity: what do we know?

Svenja B. Kroeger (The Norwegian Institute of Bioeconomy Research, Norway); Marcello D'Amico (Institute of Environmental Assessment and Water Research IDAEA, Spain); Hans M. Hanslin (The Norwegian Institute of Bioeconomy Research, Norway); Knut A. Hovstad (The Norwegian Institute of Bioeconomy Research, Norway); Johannes Kollmann (Department of Ecology and Ecosystem management, Technical University of Munich, Germany); Tommy Lennartson (Swedish Biodiversity Centre, Swedish University of Agricultural Sciences, Sweden)

One major threat to biodiversity resulting from human activity is infrastructure development. However, relatively recently, the idea that roadside habitats may offer an opportunity to promote biodiversity has emerged. To mitigate negative effects of roadside habitats and to facilitate positive ones, we require a holistic view of the various factors that affect biodiversity, and understand the direction and magnitude of their effects on individual taxa. Thus, we carry out meta-analyses to quantify positive and negative impacts of roadside habitats on a range of taxa, and highlight knowledge gaps that need to be addressed in the future.

KEYWORDS: Linear transport infrastructure, Biodiversity, Meta-analysis

#3 Monitoring of green bridges in Austria

Brigitte Sladek (ASFINAG Bau Management GmbH, Austria); Elisabeth Ransmayr (LACON – Consulting Engineers, Austria)

This project focuses at investigating the efficiency of 18 green bridges in Austria along motorways as mitigation tool and habitat for the whole range of species. The objective was to evaluate 1) their acceptance by target species, local, regional and less mobile species, 2) if they do also serve as habitats and 3) whether they are used by valuable species for cross-linking of habitats. Results indicated red deer (*Cervus elaphus*) as a target species and proved local crossing of several other mammals. Thus, it was demonstrated that green bridges provide valuable habitats for invertebrates.

KEYWORDS: Green bridge, Monitoring, Habitat fragmentation, Wildlife corridor, Biodiversity

#4 The SLOSS dilemma of road ecology – Single Large Or Several Small fauna passages?

Jan Olof Helldin (Swedish Biodiversity Centre, Sweden)

I address the SLOSS dilemma of road ecology, i.e., the discussion whether a Single Large Or Several Small fauna passages would produce the most benefit for wildlife. I point out risks (ecological as well as practical) with investing in one large passage and list a number of situations where it may be more beneficial to distribute the conservation efforts in the landscape by constructing several smaller passages. I argue that the default strategy should be to distribute rather than to concentrate passage opportunities along major transport infrastructures. The SLOSS issue calls for partly new directions in road ecology research.

KEYWORDS: Fauna passage, Road mitigation strategy, SLOSS Dilemma

#5 Towards next level in Road Ecology: from counting road-kills to assessing population impacts

Rafael Barrientos (Departamento de Biodiversidad, Ecología y Evolución, Universidad Complutense de Madrid, Spain); Fernando Ascensão, Marcello D’Amico (CI-

BIO/InBIO, University of Porto, Portugal / CEABN/InBIO, School of Agriculture in University of Lisbon, Portugal); Clara Grilo (CDV Transport Research Centre, Czech Republic); Henrique M. Pereira (iDiv – German Centre for Integrative Biodiversity Research, Germany)

The global road network is exponentially increasing, above all in environmentally vulnerable countries. Despite the number of studies both on road impacts and on mitigation measures is sharply increasing, most of them focus on individual level or local scale. We review the main impacts of roads on wildlife populations, and highlight those studies focused on population levels, as they allow a better understanding of the threat posed by roads for the persistence of wildlife populations. Finally, we suggest incorporating three policy goals that could reduce global road impacts, if applied to projects at national, regional and global scales.

KEYWORDS: Barrier effect, Large scale, Population dynamics, Road Ecology, Road-kills

#6 Is Connectivity Conservation via Wildlife Corridors/Linkages Sufficient?

Fraser Shilling (Road Ecology Center, Department of Environmental Science & Policy, University of California, USA)

Corridors and linkages are commonly used terms to describe connectivity for wildlife and ecological processes. Model-based maps are often used to represent these hypothetical landscape features and are often described as “data” for mitigation decision-making for wildlife movement. I will describe weaknesses in this approach, providing evidence from the literature and studies in the US. I will propose that for most wildlife in most places, the ecological property of connectivity is best conserved at linear infrastructure by making the structure more permeable at place where there is evidence of wildlife movement.

KEYWORDS: Wildlife corridor, Wildlife linkage, Connectivity, Wildlife, Mitigation

ROAD ECOLOGY: IMPACT ASSESSMENT, MITIGATION AND MONITORING – 4

SESSION 5.3.3. (Thursday, 14 January / 15:30 – 17:00)

ROOM Lavandula

MODERATOR Clara Grilo

#1 Wildlife hotspots prediction with artificial intelligence algorithms, geographic information systems and multispectral image processing

Juan Carlos González-Vélez, Juan Carlos Jaramillo-Fayad (Instituto Tecnológico Metropolitano, Colombia / PECIV – Programa de Ecología de las Carreteras e In-

fraestructura Verde, Colombia); Juan Pablo Murillo-Escobar, Maria Constanza Torres-Madroñero (Instituto Tecnológico Metropolitano, Colombia)

During the development of this research the characteristics related to the roadkill of fauna in the Eastern Antioquia, Colombia, were identified with the objective to predict roadkill hotspots. Then, different machine learning algorithms were compared. The results allowed us to identify that the random forest (RF) algorithm with ADASYN as the method with the best performance when subjected to cross-validation (AUC-ROC 0.78 ± 0.12), surpassing the results achieved by previous researches. Finally, the methodology was validated through a transference exercise, training the RF-ADASYN algorithm with three sections of the study area and validating on a different section (AUC-ROC = 0.87 ± 0.09).

KEYWORDS: Artificial intelligence, Spatial Analysis, Pattern Recognition, Prediction

#2 A simple analytical model for predicting the fence-end effect and the minimum length for wildlife fencing to be effective

Jochen A.G. Jaeger (Concordia University Montreal, Department of Geography, Planning and Environment, Canada); Stefano Re (Politecnico di Torino, Italy)

Theoretically, fencing many short road sections requires less total fencing for the same predicted reduction in mortality than fencing a few long ones. However, animals frequently move around the fence ends. This "fence-end effect" reduces the effectiveness of fences. We present a novel analytical model for predicting the fence-end effect and compare the predictions with empirical data. We predict the minimum length of wildlife fencing to be effective. The model can be considered in mortality-reduction graphs to predict the effectiveness of fencing at reducing wildlife mortality and help planners design more effective and more efficient configurations of fencing.

KEYWORDS: Effective fence length, Fence-end effect, FLOMS, Roadkill, Wildlife fencing

#3 Prioritizing road sections for wildlife fencing: Including the fence-end effect

Stefano Re (Politecnico di Torino, Italy); Jochen A.G. Jaeger (Concordia University Montreal, Department of Geography, Planning and Environment, Canada)

By analysing the spatial pattern of wildlife-vehicle collisions along roads it is possible to design effective mitigation measures. However, the locations identified for mitigation measures and their predicted effectiveness depend on the scale at which the spatial pattern of roadkill is analysed. We present an adaptive fence implementation plan that, through the combination of the information from the several scales, and by including a novel analytical model for predicting the fence-end effect, identifies the configuration of fencing that will maximize mortality reduction. This approach will help planners design more effective and more efficient configurations of fencing.

KEYWORDS: Fence-end effect, FLOMS, Mortality-reduction graphs, Roadkill, Wildlife fencing

#4 Standardized WVC Data Collection at Large Extents

Fraser Shilling (Road Ecology Center, Department of Environmental Science & Policy, University of California, USA)

Collection, management, analysis, and visualization of environmental data is increasingly being automated. I will describe standards methods the Road Ecology Center (California, US) has developed for collecting and managing large datasets for wildlife-vehicle conflict on roadways. Using our California system and similar global systems as examples, I will describe lessons learned from collecting, managing and analysing these types of data. I will describe automated and manual steps in the process. Finally, I will provide a recommended standard framework for WVC data, from collection to decision-support.

KEYWORDS: Wildlife-vehicle conflict, Roadkill, Wildlife, Mitigation

#5 Road mortality mitigation measures: concrete fence for amphibians

Antonin Conan (Université de Strasbourg, France / CNRS - Centre National de la Recherche Scientifique, France / Conseil Départemental du Bas-Rhin, France); Meven Le Brishoual, Lorène Garnier, Nicolas Durr (Université de Strasbourg, France / CNRS - Centre National de la Recherche Scientifique, France); Nathan Dehaut (Université de Strasbourg, France / CNRS - Centre National de la Recherche Scientifique, France / Conseil Départemental du Bas-Rhin, France); Jonathan Jumeau (Conseil Départemental du Bas-Rhin, France); Jean-Yves Georges, Yves Handrich (Université de Strasbourg, France / CNRS - Centre National de la Recherche Scientifique, France)

The linear transport infrastructures disrupt migrations and generate amphibian roadkill. To mitigate this problem, fences are built but their efficiency was rarely tested in controlled conditions. We tested different heights of concrete fence with three amphibian species in a PVC arena. The results showed that a 21cm high concrete fence is fully efficient at blocking amphibians and possibly guide them toward the closest wildlife underpasses.

KEYWORDS: Fragmentation, Roadkill, LTI, Road ecology, Crossing structures

#6 Canopy bridges: Innovative mitigation solutions for arboreal mammals

Tremaine Gregory (Center for Conservation and Sustainability, Smithsonian National Zoo and Conservation Biology Institute, USA); Fernanda Abra (Center for Conservation and Sustainability, Smithsonian National Zoo and Conservation Biology Institute, USA / ViaFAUNA Environmental Studies, Brazil); Farah Carrasco Rueda (The Field Museum, USA); Jessica Deichmann (Center for Conservation and Sustainability, Smithsonian National Zoo and Conservation Biology Institute, USA / The Field Museum, USA); Joseph Kolowski (Smithsonian Mason School of Conservation, USA); Alfonso Alonso (Center for Conservation and Sustainability, Smithsonian National Zoo and Conservation Biology Institute, USA)

Habitat fragmentation induced by linear infrastructure is highly problematic for arboreal mammals, causing genetic isolation and localized extinction for those that will not cross on the ground. Both natural and artificial canopy bridges provide innovative solutions to this problem. However, there have been few experiments testing their efficacy. We present data from a natural bridge study demonstrating the extreme value of leaving connecting branches intact over linear infrastructure. In addition, we describe an upcoming study testing mammal use of different artificial bridge designs. As the use of canopy bridges becomes increasingly popular, our studies will help to improve their efficacy.

KEYWORDS: Natural canopy bridge, Artificial canopy bridge, Arboreal mammals, Peru, Brazil



Lightning Talks

MANAGING INFRASTRUCTURE MARGINAL HABITATS FOR BIODIVERSITY

SESSION 1.3.4A. (Thursday, 14 January / 17:15 – 17:45)

ROOM Quercus

MODERATOR Elke Hahn

#1 Developing road verges' hosting capacity for wild bees: why and how

Denis François (IFSTTAR – l'Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux, France); **Violette Le Féon** (INRA – L'Institut National de la Recherche Agronomique, France)

For the last two decades, the decline of pollinating insects has raised concerns and questions in the scientific community and the public. Road infrastructures carry their share among pressures afflicting wild bee populations. However, into degraded environmental contexts, preexisting road verges could bring remedies to reduce the ills affecting these insects. A guidebook now shows to road managers how to act for wild bees within road verges. Recommendations are about food resources and nesting sites necessary for the various wild bee species and to ensure the consistency of actions over time and space in connection with the surrounding landscape.

KEYWORDS: Wild bees, Local flora, Nesting, Road verges, Management

#2 Moving on the verge: effects of traffic intensity and quality of the road verge on the movement of pollinating insects

Juliana Dániel Ferreira (Department of Ecology, Swedish University of Agricultural Sciences, Sweden); **Jörgen Wissman** (Swedish Biodiversity Centre, Swedish University of Agricultural Sciences, Sweden); **Åsa Berggren**, **Erik Öckinger** (Department of Ecology, Swedish University of Agricultural Sciences, Sweden)

It is unknown under which circumstances road verges are beneficial for pollinating insects and other organisms because of the complexity of interactions among roads, traffic, and the adjacent habitat. Understanding how and/or if the quality of road verges can interact with the amount of traffic in the road is relevant in order to assess the viability of populations in the vicinity of roads. This will in turn allow the identification of road verges with high conservation priority.

KEYWORDS: Traffic, Road verges, Semi-natural grasslands, Pollinator movement

#3 Both roads and power line corridors contribute to landscape scale biodiversity of plants and insects

Erik Öckinger, **Juliana Dániel-Ferreira** (Swedish University of Agricultural Sciences, Department of Ecology, Sweden)

Linear infrastructure habitats (LIH) can contain a high biodiversity of plants and insects. However, their contribution to landscape scale biodiversity is unclear. We studied biodiversity of plants, butterflies, and bumblebees in LIHs and other grassland habitats in 32 forest-dominated landscapes. Power line corridors had high diversity of all taxa, and contributed to higher landscape scale diversity of plants. Power line corridors and roads had opposite effects on the similarity of communities in a landscape, with higher similarity in the presence of power lines and lower similarity when the density of roads was high.

KEYWORDS: Biodiversity, Beta-diversity, Pollinators, Plants

#4 Feasibility of local partnerships for a more biodiversity-friendly management of linear infrastructure right-of-ways

Denis François (IFSTTAR – l'Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux, France); **Claire Etrillard** (SMART-LERE-CO, AGROCAMPUS OUEST, INRA, France); **Pascal Gastineau** (IFSTTAR – l'Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux,, France)

Nowadays, numerous and diverse local actors have expertise in the management and maintenance of (semi-)natural environments and can carry out or organise action on the field. For land transport infrastructure managers, taking advantage of these skills and knowledge could be an efficient and pragmatic way to implement more biodiversity-friendly practices in the management of right-of-ways. From a sample of French case studies, this exploratory research assesses actual possibilities and obstacles to such partnerships, considering their legal, social, economic, ecological, and technical factors. Proposals are made to solve some issues encountered by stakeholders and generally increase effectiveness of future partnerships.

KEYWORDS: Right-of-way, Management, Partnership, Local actors, Feasibility

#5 Enhancing biodiversity on Great Britain's railway network

Richard Pywell (UK Centre for Ecology & Hydrology, UK); **Neil Strong** (Network Rail, The Quadrant, UK)

Network Rail is responsible for the safe and efficient running of Great Britain's rail transport infrastructure. Managing the habitats alongside the 32,000 km of track is vital for the safety of passengers, employees, and contractors. It's a balancing act to maintain and improve the railway to keep it running safely, while being mindful of the land that surrounds it, the natural capital Network Rail are responsible for, the public benefits it offers, and the wildlife that lives on it. To this end, Network Rail has developed a new and ambitious Biodiversity Action Plan for enhancing biodiversity on the railway lineside.

KEYWORDS: Railway ecology, Sustainable transport, Biodiversity

MANAGING AND MONITORING ECOLOGICAL IMPACTS OF LINEAR INFRASTRUCTURES

SESSION 1.3.4B. (Thursday, 14 January / 17:45 – 18:15)

ROOM Quercus

MODERATOR Sara Santos

#1 Environmental monitoring of reptiles across a wildlife overpass

Marcus Elfström (EnviroPlanning AB, Sweden / Norwegian University of Life Sciences, Faculty of Environmental Sciences and Natural Resource Management, Norway); **Mats Lindqvist** (Swedish Transport Administration, Sweden)

We evaluated connectivity from an ecoduct, connecting wildlife and habitats across a major highway in west-central Sweden. Our results supported a “Connectivity hypothesis”, i.e. reptile distribution did not differ between ecoduct and surrounding reference areas, whereas reduced shadiness and increasing ambient temperature resulted in more reptiles. The highly endangered sand lizard (*Lacerta agilis*) was identified on the ecoduct only one year after its establishment. Our findings show that functional environment for reptiles can be integrated in wildlife passages for large mammals. Our results stress that management of suitable habitats is crucial across wildlife passages, in order to function for reptiles.

KEYWORDS: Ecoduct, Reptiles, Connectivity, Infrastructure barriers, Habitat

#2 Risk of bird electrocution in powerlines: a framework for prioritizing species and areas for conservation and impact mitigation

L. D. Biasotto (Programa de Pós-graduação em Ecologia, UFRGS – Universidade Federal do Rio Grande do Sul, Brazil / NERF – Núcleo de Ecologia de Rodovias e Ferrovias, Universidade Federal do Rio Grande do Sul, Brazil); **F. Moreira** (REN Biodiversity Chair, CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal); **G.A. Bencke** (Museu de Ciências Naturais, Departamento de Biodiversidade, Secretaria de Meio Ambiente e Infraestrutura, Brazil); **M. D’Amico** (THEOECO – Theoretical Ecology and Biodiversity Modelling Group, CIBIO-InBIO, University of Porto and University of Lisbon, Portugal); **A. Kindel** (Programa de Pós-graduação em Ecologia, UFRGS – Universidade Federal do Rio Grande do Sul, Brazil / NERF – Núcleo de Ecologia de Rodovias e Ferrovias, Universidade Federal do Rio Grande do Sul, Brazil); **F. Ascensão** (cE3c – Centre for Ecology, Evolution and Environmental Changes, Faculdade de Ciências da Universidade de Lisboa, Portugal)

Electrocution is one of the major sources of anthropogenic bird mortality and, although it is a problem recognized worldwide, many countries remain with unknown information on this threat. This can be mostly due to the absence of specific national laws regarding the protection of birds against powerlines electrocution and due to the difficulty in obtaining detailed data on bird mortality across large scales. We propose a framework allows to recognize target regions and species to receive priority attention to avoid or minimize the impact of bird electrocution, promoting win-win situations that help both bird conservation and powerline network integrity.

KEYWORDS: Bird conservation, Risk assessment, Power lines poles, Priority areas

#3 The Afsluitdijk, an important ecological connection

Dennis Wansink (Bureau Waardenburg, Netherlands); **Sophie Lauwaars** (Ministry of Infrastructure and Watermanagement, Netherlands)

The Afsluitdijk is a dike which was constructed in 1932. It separates the IJsselmeer from the Wadden Sea. For birds and mammals, including bats, the Afsluitdijk is an important ecological connection between east and west. The Afsluitdijk will be reinforced in the period 2018-2022. Special attention is paid to preserve the ecological function of the dyke for the special vegetation and bats. The seeds of the vegetation on the Afsluitdijk were collected by volunteers. After applying the new coating, the seeds will be replanted. Lighting that is least disruptive for bats is installed, it has a maximum of 3000 K.

KEYWORDS: Afsluitdijk, Ecological connection, Migration route, Typical seashore vegetation, Bats

#4 How well fences work?

Andrius Kučas, Linas Balčiauskas (Nature Research Centre, Lithuania)

Increased amounts of wildlife fencing may decrease the number of ungulate-vehicle collisions (UVC) on roads with high speed and traffic intensity, at least for short periods of time. However, shifts of UVC towards the roads characterised by lower speed and lower traffic intensity may occur. Wildlife fencing on main roads alter ungulate movements, thus can increase the number of UVC on neighbouring national and regional roads. Accordingly, this should be foreseen and mitigation measures deployed. Additionally, wildlife fencing can reduce the importance of adjacent habitat patches for wildlife, while increasing the importance of more distant patches.

KEYWORDS: Accident prevention, Fencing, Temporal statistical analysis, Traffic intensity, Wildlife-vehicle collisions

#5 Green and blue infrastructure: How trees can accompany our rivers and canals Conflicts - Solutions - Implementation

Katharina Dujesiefken (BUND Mecklenburg-Vorpommern, Germany)

Whether trees on dams and dykes should be planted and existing trees are to be tolerated, especially during reconstruction measures, is discussed very controversial again and again. Using the example of the Stör-waterway in the Lewitz, this presentation shows that dam reconstruction with preservation of trees is possible and even meaningful. Extensive protests have led to the preservation of those trees. The necessary work on the dams had to be discussed with a tree expert. The presentation shows the results of the planning, problems, and solutions during this process.

KEYWORDS: Dam, Dike, Canal, Tree, Reconstruction

NEW TOOLS TO MITIGATE AND MONITOR ECOLOGICAL IMPACTS OF ROADS

SESSION 2.3.3A. (Thursday, 14 January / 15:30 – 16:00)

ROOM Arbutus

MODERATOR Michal Bíl

#1 Making the road more permeable to wildlife using existing infrastructure

Dishane Hewavithana (Abess Center for Ecosystem Science and Policy, University of Miami, USA); **Devaka Weerakoon** (Faculty of Science, University of Colombo, Sri Lanka); **Christopher Searcy** (Department of Biology, University of Miami, USA)

Roads, while increase connectivity for humans, roads reduce permeability between habitats for wildlife. The most obvious impact of roads is animal mortalities and often directly affect population characteristics such as abundance, density, and sex structure of the animals that are being affected. Effective animal passages to increase the permeability between habitats could reduce the intensity of this problem. Installing new infrastructures for this purpose is costly and hence implementing such mitigation is difficult for developing countries. Therefore, the aim of this study is to evaluate the success of having guide fences at existing culverts in reducing the number of roadkills.

KEYWORDS: Existing infrastructure, Culverts, Permeable habitats

#2 New real-time mitigation measures based on animal-vehicle collision spatio-temporal models

Victor Javier Colino-Rabanal, **Roberto Rodríguez-Díaz**, **Maria Jose Blanco-Villegas**, **Miguel Lizana Avia** (Department of Animal Biology. Faculties of Biology and Environmental Science, University of Salamanca, Spain)

Spatio-temporal models can be implemented in different devices to alert drivers in real time about the risk of an animal-vehicle collision. Here we present a new prototype of variable road sign based on these spatio temporal models. In order to avoid driver habituation, this new road sign alerts the driver only when a certain risk threshold is exceeded. Models are fed in real time with data about traffic, weather, hunting, road conditions, etc. This prototype may show considerable advantages over the measures currently being implemented to minimize AVC.

KEYWORDS: Mitigation measure, Road sign, Spatio-temporal models, App, Animal-vehicle collision

#3 Daily, Annual and interannual variations of wildlife underpasses use by small and medium-sized mammals: a study case in the agricultural plain of the Bas-Rhin, France

Jonathan Jumeau (Université de Strasbourg, France / Conseil Départemental

du Bas-Rhin, France / Université de Rennes, France); **Robert Matthieu**, **Oriane Marquot** (Conseil Départemental du Bas-Rhin, France); **Françoise Burel** (Université de Rennes, France); **Yves Handrich** (Université de Strasbourg, France)

To optimize wildlife underpasses (WU) monitoring studies, we quantified during four years (2012-2016) the daily, the annual and the interannual use of seven underpasses by small and medium-sized mammals in Bas-Rhin (France). The variation of the cumulated species richness per WU was quantified to find the minimal number of days needed to accurately quantify the WU use with camera trap. Most of the 24 mammals species showed daily and annual variations of the use, not always corresponding to their biology. High interannual differences of the use were observed, with a synchronicity between preys and predators. Two years are needed to observe most of species.

KEYWORDS: Preys, Predators, Synchronicity, Phenology, Wildlife crossings

#4 A comparison of camera trap and permanent recording video camera efficiency in wildlife underpasses

Jonathan Jumeau (Université de Strasbourg, France / Conseil Départemental du Bas-Rhin, France / Université de Rennes, France); **Lana Petrod** (Conseil Départemental du Bas-Rhin, France); **Yves Handrich** (Université de Strasbourg, France)

The evaluation of wildlife crossings structures is directly impacted by the efficiency of monitoring tools. The aim of this study was to quantify the efficiency of camera traps as a common tool in a wildlife crossing evaluation. By using permanent recording video systems, the exact proportion of missed animals by camera traps was quantified. Camera traps failed to record 43.6% of small mammal events (voles, mice, shrews...) and 17% of medium-sized mammal events. This study indicates a global underestimation of the use of wildlife crossings for small mammals.

KEYWORDS: Wildlife crossings, Camera-trapping, Monitoring study, Triggered cameras, Small mammals

#5 Bat Overpasses as a Solution to Increase Habitat Connectivity Depending on the Context

Fabien Claireau (CESCO – Centre d'Ecologie et des Sciences de la Conservation, Muséum national d'Histoire naturelle, France / Zoology Institute and Museum, University of Greifswald, Germany / Naturalia environnement, France); **Yves Bas**, **Jean-François Julien**, **Nathalie Machon** (CESCO – Centre d'Ecologie et des Sciences de la Conservation, Muséum national d'Histoire naturelle, France); **Cédric Heurtebise**, **Philippe Chavaren** (ASF – Autoroutes du Sud de la France, France); **Benjamin Allegrini** (Naturalia environnement, France); **Sébastien J. Puechmaille** (Zoology Institute and Museum, University of Greifswald, Germany / ISEM – Institut des Sciences de l'Évolution de Montpellier, Université de Montpellier, France); **Christian Kerbirou** (CESCO – Centre d'Ecologie et des Sciences de la Conservation, Muséum national d'Histoire naturelle, France / Station de Biologie Marine de Concarneau, Muséum national d'Histoire naturelle, France)

Whereas bat overpasses are proposed in order to increase habitat connectivity and reduce collisions risk, these are not scientifically tested. This pitch propose to test four bat overpasses which appropriate samplly designs and demonstrates that depending the context of the location of bat overpasses, theses structure can be effective.

KEYWORDS: Mitigation measures, Bats, Acoustic surveys, Thermal camera, Highways

INFRASTRUCTURE ECOLOGICAL MITIGATION AND RESTORATION – 2

SESSION 2.3.3B. (Thursday, 14 January / 16:00 – 16:30)

ROOM Arbutus

MODERATOR Lazaros Georgiadis

#1 From dumpsite to nature sanctuary

Thomas Schuh (ÖBB-Infrastruktur AG (Austrian Federal Railways – Infrastructure), Austria); Alexandra Wieshaider (Österreichische Bundesforste (Austrian Federal Forests), Austria); Johanna Scheiblhofer (Biosphärenpark Wienerwald Management GmbH (Biosphere Reserve Vienna Woods), Austria)

A waste dump site situated in a UNESCO biosphere reserve has been used as a deposit for excavation material of a railway tunnel construction. Within a period of 12 years the area has been transformed from a barren wasteland into a lush, natural ecosystem that became habitat for many rare and protected species. In order to maintain valuable transition biotopes, the landowner (Austrian Federal Forests) and the holder of the reforestation verdict (ÖBB-Infrastruktur AG) decided to ask for a clearing permission for a few particular valuable subareas. Landscape management activities will be organised by the management of the biosphere reserve.

KEYWORDS: Railway tunnel, Waste dump site, Reforestation, Biosphere reserve, Biodiversity

#2 A guidance system for amphibians made of recycled guardrails in Kirchberg on the Raab (County Styria / Austria) – a successful alternative

Frank Weihmann (Austrian League for Nature Conservation Styria, Austria); Wolfgang Lanner (Land Steiermark Abteilung Verkehr und Landeshochbau, Austria)

Along the state road L 245 in Kirchberg on the Raab (County Styria/Austria) a long-aspired guidance system for amphibians (GSA) over a segment of 1100 metres has been installed. For the GSA discarded guardrails were used for leading elements. The implementation provided many innovative solutions. The result is one of the most robust permanently installed guidance systems for amphibians. The innovative system was profitable for a lot of Central European amphibians. The total building costs ranged at

about a third of the costs for a comparable system. This resilience towards damages of all kinds means a remarkable reduction of maintenance costs.

KEYWORDS: Amphibians, Recycled guardrails, Migration, Conservation, *Pelobates fuscus*, Common spadefoot toad, Styria

#3 Condition of amphibian road mitigation constructions in Sweden

Emma Håkansson (University of Gothenburg, Sweden); Jan Olof Helldin (Swedish University of Agricultural Sciences, Sweden)

In efforts to assess the physical condition of all amphibian road mitigations built by the Swedish Transport Administration, all such constructions were evaluated using a standardized protocol. Four out of 35 constructions were in very poor condition and few had no issues at all. Most issues seemed to occur irrespective of building material and age. However, since most problems could be avoided or remedied through proper and regular maintenance, we conclude that this is vital for ensuring long term functionality.

KEYWORDS: Amphibian, Road mitigation, Technical inspection, Maintenance

#4 Design and test of a semi-automated system based on time-lapse camera trapping for the monitoring of wildlife overpass use by amphibians

Julian Pichenot, Céline Muller (Cerema, France); Stéphanie Aravecchia, Cédric Pradalier (Georgia Tech Lorraine, France); Gérald Tekielak, Alain Morand (Cerema, France)

We tested the use of a camera trap with time-lapse image recording for the monitoring of an amphibian tunnel. A sample of the numerous images obtained was visually analysed to count crossing amphibians, mostly common toads (*Bufo bufo*). This count was highly correlated with the number of live trapped toads on the same tunnel. To reduce the task of visually analysing the large image collection, we used a computer vision algorithm to detect moving objects on images. The developed algorithm could be further improved to obtain a fully automated solution for counting and determining the moving direction of detected amphibians.

KEYWORDS: Amphibian, Road tunnel, Time-lapse camera trap, Semi-automated monitoring system, *Bufo bufo*

#5 Species-rich Energy production

Anders Sjölund, Eva Ditlevsen, Julia Litborn, Håkan Johansson (Swedish Transport Administration, Sweden)

The Swedish Transport Administration will conduct a study on species-rich energy production, a measure to produce bioenergy based on vegetation harvested from road

verges. Grassy vegetation and invasive alien species will be collected and transported to a biogas plant in order to produce biogas upgraded to vehicle fuel with the aim to replace fossil fuels in the transport sector. The measure thus contributes to climate mitigation and improved biodiversity in line with the Agenda 2030.

KEYWORDS: Biodiversity, Invasive species, Natural heritage, Energy harvesting, Biogas

#6 A dynamic restoration index to monitor and assess fragmentation reduction along a trans-Andean pipeline

Reynaldo Linares-Palomino, Héctor Chuquillanqui-Soto (Center for Conservation and Sustainability, Smithsonian National Zoo and Conservation Biology Institute, USA); Bruno Vildoso-Giesecke (Hunt LNG Operating Company, Peru); Godofredo Mamani (Grandes Montañas y Consultores SAC, Peru); Alfonso Alonso (Center for Conservation and Sustainability, Smithsonian National Zoo and Conservation Biology Institute, USA)

Large scale linear infrastructure in complex geographical and ecological settings can fragment habitats and the species living within them, such as the construction and operation of an underground pipeline. A major first step to reduce this effect is to rapidly restore vegetation cover and functionality to allow animal species to re-colonize the affected areas. However, what is an adequate level of vegetation recovery? We present data and an analytical procedure to monitor and assess recovery trends using a dynamic and updatable index at different geographical and temporal scales that help inform tailored biodiversity management decisions.

KEYWORDS: Tropical Andes, Fragmentation restoration, Vegetation monitoring methods

ROADKILLS IMPACT ASSESSMENT, MITIGATION AND MONITORING

SESSION 4.3.4A. (Thursday, 14 January / 17:15 – 17:45)

ROOM Cistus

MODERATOR Ivo Dostál

#1 Assessing the relative effect of road- and carcass-related factors on searcher efficiency: implications for future roadkill monitoring programmes

Joana Bernardino (REN Biodiversity Chair, CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal); Regina Bispo (Departamento de Matemática e Centro de Matemática e Aplicações, Universidade Nova de Lisboa, Portugal); Francisco Moreira (REN Biodiversity Chair, CIBIO/InBIO

– Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal); Sara Santos (MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal)

Carcass detection is a widely recognized source of bias in studies aiming to quantify the impacts of roads on wildlife, and more especially on small-sized vertebrates. We carried out searcher-efficiency trials in two paved roads located in Central Portugal to assess the relative importance of factors like road type, observer, carcass type, status and location (on the road) over detection rates of passerines and bats. Based on the results, we provide a set of recommendations to improve the design of carcass detection trials in future roadkill monitoring programmes.

KEYWORDS: Mortality bias, Detection rates, Experimental design, Bats, Passerines

#2 Evaluation of the impact of road infrastructure on vertebrate mortality and possible measures for ecological connectivity in the landscape in the Aburra Valley, Colombia

Juan Carlos Jaramillo-Fayad, Maria Mercedes Velásquez-López, Juan Carlos González-Vélez, Jose Luis González-Manosalva (Instituto Tecnológico Metropolitano, Colombia / PECIV – Programa de Ecología de las Carreteras e Infraestructura Verde, Colombia)

In Colombia, there are very few research articles reporting fauna that has been road killed. Besides, published research did not have a standardized methodology for diagnostic surveys. The objective of this work was to generate a standardized methodology to carry out diagnostic surveys of wildlife roadkill on highways. The proposed methodology consists of: Selection of roads, diagnostic surveys, geostatistical analysis and proposal of mitigating measures. 51 mortality surveys in a 148 km road were made, 499 records of wildlife roadkill were collected. It is estimated that 575,284 vertebrates die yearly on these routes as a result of being run over.

KEYWORDS: Roadkill, Mortality estimates, Diagnostic methodology, Siriema, R

#3 The most roadkilled mammal species in Brazil, considering sampling effort, detectability and removal rates

Simone Freitas (Universidade Federal do ABC, Brazil); Fernando Pinto (Grun Haus Soluções Sustentáveis Ltda., Brazil); Douglas W. Cirino (Universidade Federal do ABC, Brazil / Universidade de São Paulo, Brazil); Rubem Dornas (Modelo Ambiental Consultoria e Projetos, Brazil); Fernanda Teixeira (Universidade Federal do Rio Grande do Sul, Núcleo de Ecologia de Rodovias e Ferrovias, Brazil)

Brazil is a large tropical country with a high species richness of mammals and an increasing linear infrastructure network that causes a significant mortality rate by vehicle collision for many mammal species. This study aims to list the roadkilled

mammal species in Brazil and evaluate the top 10 medium and large mammal species with higher roadkill rates considering sampling effort, detectability, and removal rates on the Brazilian highways. The mammal species with the highest mortality rate per 100 km was *Conepatus chinga* with 0.552 roadkill/day/100km and other endangered species, such as *Myrmecophaga tridactyla* and *Tayassu pecari*, showed alarming roadkill rates.

KEYWORDS: Threatened species, Detectability rate, Removal rate, Roadkill, Tropics

#4 Are movement corridors coincident with areas of high road-kill likelihood? A study for felids in Brazil

Rafaela Cobuci Cerqueira (Departamento de Biologia, Universidade Federal de Lavras, Brazil); Paul Leonard (U.S. Fish & Wildlife Service, Science Applications, USA); Lucas Gonçalves da Silva (Departamento de Biologia, Universidade Federal Rural de Pernambuco, Brazil); Alex Bager (Departamento de Biologia, Universidade Federal de Lavras, Brazil); A. P. Clevenger (Western Transportation Institute, Montana State University, USA); Jochen A. G. Jaeger (Department of Geography, Planning and Environment, Concordia University, Canada); Clara Grilo (Departamento de Biologia, Universidade Federal de Lavras, Brazil / Department of Biology, Faculty of Sciences of the University of Lisbon & CESAM – Centre for Environmental and Marine Studies, University of Aveiro, Portugal)

We used potential movement corridors and road mortality data to test if areas of higher predicted movement may coincide with road sections of higher probability of road mortality for felids in Brazil. We found that potential movement corridors and high road mortality likelihood do not occur in the same locations. The behavioral states of the animals covered by each method may explain these differences. The complementary use of both methods at landscape scale should guide managers to target road segments for local-scale analysis for road mitigation.

KEYWORDS: Wildlife corridors, Road mortality, Road mitigation, Circuit theory

#5 A Transport Ecology Workshop towards developing sustainable transportation in national and international level in Myanmar

Hans Bekker (IENE – Infrastructure and Ecology Network Europe, Department Public Works; Dutch Ministry for Transport and Water Management (Retired), Netherlands); Lazaros Georgiadis (IENE, Biologist – Environmentalist, Greece); Elke Hahn (IENE, Federal Ministry for Transport, Innovation and Technology, Austria); Sai Than Lwin, Hanna Helsing (WWF Myanmar, Myanmar)

Responding to the challenges on sustainable development of transport infrastructure Myanmar, a Transport Ecology Workshop organized in Naipyidaw by WWF and IENE in November 2019. The workshop aimed to train a target group of 38 high level staff members of the Ministry of Construction, Ministry of Transport and Communication, Ministry of Natural Resources and Environmental Conservation and the Yangon Technological University towards improving the capacity on mainstreaming biodiversity and

ecological connectivity in their responsibility on planning and implementing of large scale transport plans and projects. Final conclusions and the feedback of the overall interactive process the workshop will be presented.

KEYWORDS: Sustainable Transport Infrastructure, Ecological Connectivity, Mitigation Hierarchy, Mitigation Measures, Strategic Planning, Exchange of Knowledge

WILDLIFE AND LINEAR INFRASTRUCTURE INTERACTIONS: FIELD MONITORING AND ECOLOGICAL SOLUTIONS – 3

SESSION 4.3.4B. (Thursday, 14 January / 17:45 – 18:15)

ROOM Cistus

MODERATOR Radu Mot

#1 Birdprotection on railways

Julian Heger, Gerold Punz, Thomas Schuh (ÖBB Infrastruktur AG, Austria)

ÖBB-Infrastructure is constantly taking measures to improve infrastructure availability. One of these measures is the reduction of short circuits caused by animals. The roll-out has started in 2016 in areas where rare and protected birds can be found. Electrocutation of birds and mammals is prevented with guard-devices and bird-protection caps. Retro fitting of existing facilities is not a difficult task. In the case of facility re-investments, electrification of already existing lines or new construction of railway lines, both guard-device and bird-protection cap are attached anyway. The measures outlined above, seem to have a very positive effect on the wildlife.

KEYWORDS: Bird protection, Catenary System, Availability of traction energy supply

#2 The need to consider searcher efficiency and carcass persistence in railway wildlife fatality studies

Bibiana Terra Dasoler, Andreas Kindel (NERF – Núcleo de Ecologia de Rodovias e Ferrovias, Universidade Federal do Rio Grande do Sul, Brazil); Júlia Beduschi (NERF – Núcleo de Ecologia de Rodovias e Ferrovias, Universidade Federal do Rio Grande do Sul, Brazil / Precisa Consultoria Ambiental, Brazil); Larissa D. Biasotto (NERF – Núcleo de Ecologia de Rodovias e Ferrovias, Universidade Federal do Rio Grande do Sul, Brazil); Rubem A. P. Dornas (NERF – Núcleo de Ecologia de Rodovias e Ferrovias, Universidade Federal do Rio Grande do Sul, Brazil / Modelo Ambiental Consultoria e Projetos, Brazil); Larissa Oliveira Gonçalves (NERF – Núcleo de Ecologia de Rodovias e Ferrovias, Universidade Federal do Rio Grande do Sul, Brazil); Pryscilla Moura Lombardi (Curitiba, Brazil); Talita Menger, Gabriela Schuck de Oliveira, Fernanda Z. Teixeira (NERF – Núcleo de Ecologia de Rodovias e Ferrovias, Universidade Federal do Rio Grande do Sul, Brazil)

Aiming to illustrate the need to consider sampling errors in fatality studies, we corrected the estimate of medium and large-sized mammal fatalities on a 750-km railway located in the Brazilian Savanna accounting for searcher efficiency and carcass persistence. By combining searcher efficiency, carcass persistence and search intervals we estimated the number of mammal fatalities that occurred in two years. The estimate was 2.3 times larger than the observed number of fatalities. Our results clearly demonstrate the need to improve sampling design to consider these errors and to enable more accurate estimation of fatalities on railways.

KEYWORDS: Linear infrastructure, Railway fatalities, Sampling errors, Wildlife-train collisions, Detectability

#3 Routing power lines in Brazil: towards an environmental and engineering friendly framework for reducing conflicts in the planning phase

Larissa D. Biasotto (Programa de Pós-graduação em Ecologia, Universidade Federal do Rio Grande do Sul, Brazil / NERF – Núcleo de Ecologia de Rodovias e Ferrovias, Universidade Federal do Rio Grande do Sul, Brazil); F. G. Becker (Programa de Pós-graduação em Ecologia, Universidade Federal do Rio Grande do Sul, Brazil); A. A. R. Nobrega (Institute of Geosciences, Federal University of Minas Gerais, Brazil); A. Kindel (Programa de Pós-graduação em Ecologia, Universidade Federal do Rio Grande do Sul, Brazil / NERF - Núcleo de Ecologia de Rodovias e Ferrovias, Universidade Federal do Rio Grande do Sul, Brazil)

Designing power line routes that comply with impact mitigation hierarchy steps and with the technical and economic demands is still a challenge in many countries. The early identification of conflicting areas between economic and environmental aspects in a TL planning process is important to avoid adding cost, delay in the project implementation and reduce decision-making complexity. Our study, in addition to dealing with geographic intelligence to enhance the quality of the TL design, also presents an innovative approach to select the alternatives TL segments in Brazil among different multi-criteria scenarios.

KEYWORDS: Energy, Multi-criteria analysis, Decision support system, Mitigation hierarchy, Win-win situation

#4 Level and spatial scale of impact from different linear development types

Dishane Hewavithana (Abess Center for Ecosystem Science and Policy, University of Miami, USA); Devaka Weerakoon, Mayuri Wijesinghe (Faculty of Science, University of Colombo, Sri Lanka); Christopher Searcy (Department of Biology, University of Miami, USA)

There is a clear bias in LI related research interests. It is seen regarding both infrastructure type as well as in the impacts being studied. Therefore, this present project aims to compare the level and scale of impact from roads, railways, and powerlines on wildlife at the community level in a tropical ecosystem. It is intended to investigate the change in bird

species richness and community composition as a response to distance from each type of linear development and then to investigate the degree of impact from roads, railways, and powerlines on bird species richness and community composition.

KEYWORDS: Roads, Railway, Powerline, Community composition

#5 Shedding a Light on Sensory Pollution in Road and Railway Ecology

Manisha Bhardwaj (Swedish University of Agricultural Sciences, Sweden)

A growing topic of investigation in road and rail ecology is the impact of light, noise, and vibrations on wildlife. I will present the results from a systematic review of all of the literature (1991-2019) on the impacts of sensory pollution from roads and railways on wildlife. Preliminary analysis shows that most studies focus on roads, particularly the impacts of noise from roads on birds and amphibians, and the impact of light from roads on bats. Results from this study can be used to inspire future direction in linear road and railway ecology research.

KEYWORDS: Sensory Pollution, Barrier Effect, Avoidance

NEW TOOLS AND TECHNOLOGIES TO PREVENT AND MONITOR LINEAR INFRASTRUCTURE IMPACTS – 2

SESSION 5.3.4A. (Thursday, 14 January / 17:15 – 17:45)

ROOM Lavandula

MODERATOR Neftalí Sillero

#1 Is field technician's work under threat? Video-recoding vs. traditional observation for monitoring flight behaviour of birds across a high-speed railway

A. E. Santamaría (TEG-UAM – Terrestrial Ecology Group, Departamento de Ecología, Universidad Autónoma de Madrid, Spain); G. Fabbri (Dipartimento di Scienze della Vita e Biotecnologie, Università degli Studi di Ferrara, Italy); J. E. Malo (TEG-UAM – Terrestrial Ecology Group, Departamento de Ecología, Universidad Autónoma de Madrid, Spain / CIBC-UAM – Centro de Investigación en Biodiversidad y Cambio Global, Universidad Autónoma de Madrid, Spain); I. Hervás (TEG-UAM – Terrestrial Ecology Group, Departamento de Ecología, Universidad Autónoma de Madrid, Spain); C. Mata, J. Herranz (TEG-UAM – Terrestrial Ecology Group, Departamento de Ecología, Universidad Autónoma de Madrid, Spain / CIBC-UAM – Centro de Investigación en Biodiversidad y Cambio Global, Universidad Autónoma de Madrid, Spain)

The development of monitoring systems to assess the impact of HSR should be a priority aim in railway ecology. Here, we present a comparative study of two monitoring methods of flight behaviour of birds across a HSR in Central Spain. Traditional direct

observation censuses done by an observer equipped with binocular were compared with observations extracted from video recordings. Our results showed that video recordings could be a useful method to obtain general information of crossing events, but direct observation reports more precise information about flight behaviour, species and their abundance.

KEYWORDS: Camera, Management, Avian mortality, Railway ecology, Mitigation

#2 An analysis of Vulture mortalities on powerlines in South Africa from 1996 – 2018

Lourens Leeuwener (Endangered Wildlife Trust, Wildlife and Energy Programme, South Africa); Kishaylin Chetty (Eskom holdings SOC Ltd., South Africa)

A brief overview of the efforts to reduce vulture mortalities on electrical infrastructure by the Eskom/Endangered Wildlife Trust Strategic Partnership. The presentation will summarise data from the last 23 years and explain how these were used to inform management action regarding vultures.

KEYWORDS: Powerlines, Partnership, Vultures, Impacts, Business

#3 Hotspots in the Grid: The Spatial Distribution of Bird-Energy Interactions in Europe and North Africa

Jethro Gauld (School of Environmental Sciences, University of East Anglia, UK / NEXUSS CDT – Next Generation Unmanned Systems Science Centre for Doctoral Training, UK); Wolfgang Fiedler, Steffen Oppel, Andrea Flack, Flavio Monti, Olivier Duriez, Andrea Sforzi, Carlos Carrapato, Thomas Lameris, Andrea Flack, Andrea Koelzsch, Guilad Friedemann, Ivan Pokrovsky, Klaus-Michael Exo, Ramunas Zydelis, Midaugas Dagys, Ran Nathan, Bernd Vorneweg, Dimitri Giunchi, Hristo Peshev, Jocelyn Champagnon, Johannes Fritz, Martin Wikelski, Emmanuel Pixner, Jose Manuel Lopez-Vazquez, Mariëlle Van Toor, Jonas Waldenström, Julio Blas, Pascual López-López, Peter Desmet, René Janssen, Robin Séchaud, Stefan Garthe, Stoyan Nikolov, Vladimir Dobrev, Volen Arkumarev, Elzbieta Kret, Victoria Saravia, João P. Silva, Philip W. Atkinson, Paul Record, Aldina Franco

To keep pace with the renewable energy growth required to tackle climate change, we need new methods to better target mitigation of new and existing wind farm and power line developments. Our study uses multi-species GPS tracking data from Movebank to map the intensity of bird-infrastructure interactions at a resolution of 5km across Europe and North Africa. These highlights and maps the cumulative hazard to birds in the landscape. This work can be used for informing the design of cost-effective mitigation measures required to reduce the impacts of energy infrastructure.

KEYWORDS: Collision, Electrocution, Wind, Transmission, Mitigation

#4 Using drones to track nest occupancy

Hippolyte Pouchelle, Erwan Carfantan, Dorothée Labarraque (EGIS group, France)

Ornithological inventories include observation of nests occupancy to study disturbances or effectiveness of measures such as artificial nests. These observations require significant human resources and work at a height that increases the risk of accidents for ecologists. Nest monitoring through drone has been successfully tested in the context of an ecological monitoring of artificial nests for Hobby Falcon (*Falco subbuteo*). This experimental measure has been implemented as part of a compensation program during the construction of a linear infrastructure. The experimentation highlighted time gain and interest in using drones for personnel safety.

KEYWORDS: Ecological monitoring by drone, Birds, Nest monitoring

#5 Artificial Intelligence-Based Detection of (no-)Animals in Camera Trap Images

Fraser Shilling (Road Ecology Center, Department of Environmental Science & Policy, University of California, USA)

Camera trap use for wildlife monitoring inevitably results in false triggers, images containing no animals. In addition, the sheer number of images requires a large amount of work for technicians to identify species. We describe a web-based system, with integrated artificial intelligence tools, to accurately flag and separate images with and without animals. We also describe a tool trained to identify mule deer, which had lower or greater accuracy depending on the images used to train and challenge the tool. These tools are available for anyone to use at: <https://roadecology.ucdavis.edu/imageid>.

KEYWORDS: Artificial intelligence, Machine-learning, Wildlife, Camera traps

CITIZEN SCIENCE AND THE INVOLVEMENT OF CIVIL SOCIETY – 2

SESSION 5.3.4B. (Thursday, 14 January / 17:45 – 18:15)

ROOM Lavandula

MODERATOR Yannick Autret

#1 Validity of road-based data collected by volunteers for wildlife population monitoring

Silviu Petrovan (University of Cambridge, UK); Candida Vale, Neftali Sillero (CICGE – Centro de Investigação em Ciências Geo-Espaciais, Faculdade de Ciências da Universidade do Porto, Portugal)

For countries with high road density road network coverage, survey data collected by volunteers on roads are a solid and representative dataset for large-scale assessments.

KEYWORDS: Amphibian, Citizen science, Roads, Trend estimations, MAXENT

#2 Identifying risk areas for hedgehog road collisions using citizen science data

Fiona Mathews, Patrick Wright, Frazer Coomber (University of Sussex, John Maynard Smith Building, UK / The Mammal Society, UK)

European hedgehogs are of high conservation concern in many countries, and road casualties are likely to be a significant cause of their decline. We here report the results of analyses, based on citizen-science data, that have identified areas with high risk of roadkill. We also introduce the new Mammal Mapper app for mobile phones, created by the British Mammal Society, which assists with the recording of data by volunteers, and allows the amount of survey effort to be included in future analyses.

KEYWORDS: Hedgehogs, Roadkill, Citizen science, Habitat suitability modelling

#3 A vision of a sustainable infrastructure by 2050 in different countries

Amanda Sjölund, Linda Larsson (Åkeröskola, Sweden)

Following the school curriculum about sustainable development this project is a continuing school work from 2018 in Åkerö skola in Leksand, Sweden. The aim with the project is to teach students about sustainable development using infrastructure as an instrument to get a more concrete discussion on the subject. We worked thematically on the subjects of geography, social studies, technology and biology to give the students a broader knowledge of different countries' ecological, social and economic conditions for creating a globally sustainable transport system. The students assignment was to create their own visions of how the transport system can develop by 2050.

KEYWORDS: Sustainable transport system, Vision by 2050, Students, School project



Poster Communications

POSTER SESSION

SESSION 1.1.3. (Tuesday, 12 January / 16:45 – 19:00)
ROOM Quercus

INNOVATIVE SOLUTIONS FOR LINEAR INFRASTRUCTURE IMPACT ASSESSMENT, MITIGATION AND MONITORING

#1 Wildlife crossing structures aid bats with a high-risk collision to cross the road safely

Célia Lhérondel (Naturalia environnement, France); Cédric Heurtebise (VINCI Autoroutes, France); Thibaut Ferraille (Naturalia environnement, France); Philippe Chavaren (VINCI Autoroutes, France); Benjamin Allegrini (Naturalia environnement, France); Fabien Claireau (Naturalia environnement, France / CESCO – Centre d'Ecologie et des Sciences de la Conservation, Muséum national d'Histoire naturelle, Centre National de la Recherche Scientifique, Sorbonne Université, France)

Whereas wildlife crossing structures are proposed to restore ecological habitat connectivity and reduce the risk of wildlife collisions, they are rarely scientifically tested, particularly for bats. This poster presents the quantitative and qualitative use of two wildlife overpasses by bats through a detail plan and innovative tools.

KEYWORDS: Acoustic surveys, Bats, Thermal camera, Highways, Wildlife crossing

#2 Geographically Weighted Regression for modelling amphibian road-kills: comparison with other modelling methods

Diana Sousa Guedes (CICGE – Centro de Investigação em Ciências Geo-Espaciais, Faculdade de Ciências da Universidade do Porto, Portugal); Marc Franch (CICGE – Centro de Investigação em Ciências Geo-Espaciais, Faculdade de Ciências da Universidade do Porto, Portugal / PECAT Research Group, Departament de Ciències Ambientals, Universitat de Girona, Spain); Neftalí Sillero (CICGE – Centro de Investigação em Ciências Geo-Espaciais, Faculdade de Ciências da Universidade do Porto, Portugal)

Amphibians are the most road-killed fauna group. Here, we compared the performance of five regression techniques in addressing the relationship between amphibians' road-kills/mortality hotspots and environmental variables. For this, we surveyed four country roads in northern Portugal in search of road-killed amphibians. We compared the performances of five modelling techniques: i) Generalized Linear Models (GLM), ii) Generalized Additive Models (GAM), iii) Random Forest, iv) Boosted Regression Trees, v) Geographically Weighted Regression (GWR). The results suggest that GWR is a useful

tool for roadkill modelling, as well as to better visualize and map the spatial variability of the models.

KEYWORDS: Road ecology, Logistic regression, Wildlife-vehicle collision, Ecological modelling

#3 Are roads and railroads barriers for the moor frog?

Edgar A. van der Grift, G. Arjen de Groot, Fabrice G. W. A. Ottburg, Dennis R. Lammertsma, Ivo Laros, Jan Bovenschen (Wageningen Environmental Research, Wageningen University and Research, Netherlands)

Roads and railroads have been repeatedly identified as potential barriers for amphibian movements. We studied whether (rail)roads are a barrier to moor frog movements and result in genetic differences between moor frog populations in the wetlands of the nature preserves Naardermeer and Ankeveense Plassen in the Netherlands. Our study highlights the value of applying genetic techniques in the assessment of barrier effects, provides baseline information for future evaluations of planned crossing structures and eventually help improve decision-making on mitigating barrier effects of railroads for amphibians.

KEYWORDS: Railroad, Barrier effect, Genetics, Moor frog, Mitigation

#4 Evaluating the effectiveness of a wildlife overpass in restoring gene flow in a slow worm population

Edgar A. van der Grift, Arjen G. A. de Groot, Fabrice G. W. A. Ottburg, Hugh A. H. Jansman, Ivo Laros (Wageningen Environmental Research, Wageningen University and Research, Netherlands)

We studied the genetic structure of a slow worm population that is bisected by a motorway and railroad. We found that the motorway has been a genetic barrier; individuals from the western and eastern road verges belong to different genetic clusters. Individuals that were found on a recently constructed wildlife overpass seem to originate from the genetic cluster on the western side of the transport barriers. The genetic differences between the populations will allow for evaluating gene flow after slow worms have had sufficient time to reach and accept the overpass. Therefore the genetic sampling will be repeated in 2020.

KEYWORDS: Road mitigation, Wildlife overpass, Gene flow, Slow worm

#5 Use of wildlife overpasses by roe deer: What are the effects of human co-use?

Edgar A. van der Grift, Dennis R. Lammertsma (Wageningen Environmental Research, Wageningen University and Research, Netherlands); Martin Waanders (RPS, Netherlands)

We studied the effects of human co-use on the use by roe deer of a wildlife overpass in the Netherlands. We surveyed crossing rates, crossing times and behaviour of roe deer with the help of camera traps. Simultaneously we registered the amount of human use of the overpass. We found no effect of human use on deer crossing rates. However, human use affected the time of crossing by deer. On crowded days (>250 humans) the deer passed on average three hours later than on quiet days (<100 humans). Our study may help improving decision-making on human co-use of wildlife overpasses.

KEYWORDS: Road mitigation, Wildlife overpass, Human co-use, Crossing rates, Roe deer

#6 Comparative study between environmental DNA method and electrical fishing method

Florent Skariak, Amandine Hibert (Naturalia Environnement, Site Agroparc, France)

In order to assess impact of pipelines on biodiversity, especially on fish, we tested on six rivers two methods: (i) electrical fishing method and (ii) environmental DNA method.

Concerning electrical fishing method, 9 to 10 species were founded while 14 species were found by the environmental DNA method. The environmental DNA methods permits to found a greater number of species compared to the electrical fishing method. The environmental DNA seems to be a good alternative compare to the traditionnal method on economical, efficiency and security aspects in order to lead complete inventory of fish fauna.

KEYWORDS: Environmental DNA, Electrical fishing, Pipeline, Sampling technique

#7 gDefrag: a graph-based tool to prioritize linear infrastructure defragmentation

Frederico Mestre (MED Institute, Universidade de Évora, Portugal); A. Márcia Barbosa (CICGE, Universidade do Porto, Portugal); Fernando Ascensão (CIBIO/InBio – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CEABN – Centro de Ecologia Aplicada "Professor Baeta Neves", Instituto Superior de Agronomia da Universidade de Lisboa, Portugal / EBD-CSIC – Department of Conservation Biology, Estación Biológica de Doñana, Spain)

Here we present the gDefrag package, a graph-based approach building on habitat value and accessibility after simplifying the landscape as a graph. It has several advantages: not requiring roadkill or movement data and providing effective methods to deliver reliable information. gDefrag prioritizes roads which should be targeted first to defragment the landscape. It currently implements four prioritization criteria: habitat quality, maximum number of inter-habitat paths, overall landscape connectivity, and simultaneously larger and higher-quality habitats.

We demonstrate our approach by prioritizing the defragmentation of the Iberian Peninsula road network targeting the mammalian carnivores inhabiting the region.

KEYWORDS: Spatial graphs, Roadkill hotspots, Landscape connectivity, R package

#8 Development of a Video Image Analysis System for Reducing Operation on Surveys of Wildlife Behavior

Fumihito Hara, Masato Sato, Misako Noro (Hokkaido Development Engineering Center, Hokkaido, Japan)

We developed a system that automatically detects wildlife video images from huge volume of the recorded images. A specially developed animal detection software program is installed on the system. And, the system's accuracy was verified by comparing its outputs to the visual observation results. The detection rate of sika deer image for the system was nearly the same as that for visual observation. As a result, the time to detect the recorded sika deer image came to be halved. The detection rate of birds image for the system was low, about one-third that of visual observation.

KEYWORDS: Monitoring, Video survey, Video image analysis

#9 Effectiveness of road and railway bridges for reindeer and wildlife movements – an ongoing project

Jan Olof Helldin (Swedish Biodiversity Centre, Sweden); Mattias Olsson (Environmental planning AB, Sweden); Torbjorn Nilsson, Niklas Kemi (Swedish Transport Administration, Sweden)

We present ongoing research on reindeer and wildlife use of bridges over and under roads and railways in northern Sweden. The research is conducted in northern Sweden where ungulates make seasonal migrations, and where barrier effects on movements are therefore particularly problematic. The research addresses the question of how passages for ungulates should be designed to fulfil the ecological and practical requirements in the most cost-efficient way. The project includes developing effectiveness criteria for bridges. The project is conducted in close cooperation between university, the transport authority and reindeer husbandry districts.

KEYWORDS: Bridges, Effectiveness, Migrations, Reindeer, Ungulates

#10 Optimising the ring road of Europe's capital: integrating enhancements in mobility, ecology and public involvement

Jelle Vercauteren (De Werkvennootschap, Belgium); Guy Heutz (THV Zoniën Mobiliteit, Belgium)

For the Sonian Forest, at the heart of Europe, the Brussels ring road is one of the biggest barriers to cross. For the road users in that area, the Brussels ring road is one of the most congested roads. Ecological as well as infrastructural measurements will lead to a more defragmented forest and to a less congested area by creating more bicycle lanes, public transport facilities and smart infrastructural adjustments. Optimising the ring road of Europe's capital by integrating enhancements in mobility, ecology and public involvement!

KEYWORDS: Barrier effect, Defragmentation, Ring road, Brussels, Sonian forest

#11 Quantifying the individual impact of artificial barriers in freshwater: operational technology transfer of a standardized and absolute index of genetic connectivity to regulatory studies

Jérôme G. Prunier, Camille Poesy (Station d'Ecologie Expérimentale et Théorique, France); Vincent Dubut (Institut Méditerranéen de Biodiversité et Ecologie, France); Charlotte Veyssièrre, Géraldine Loot (Laboratoire Evolution et Diversité Biologique, France); Nicolas Poulet (Agence Française de la Biodiversité - Pôle ecohydraulique, France); Sylvain Moulherat (TerrOïko, France); Simon Blanchet (Station d'Ecologie Expérimentale et Théorique, France / Laboratoire Evolution et Diversité Biologique, France)

Fragmentation by artificial barriers is an important threat to freshwater biodiversity. Mitigating the negative aftermaths of fragmentation is of crude importance, and it is now essential for environmental managers to benefit from a precise estimate of the individual impact of weirs and dams on river connectivity. We developed a standardized index of genetic connectivity (CINDEX), allowing an absolute and independent assessment of the individual effects of obstacles on connectivity. The CINDEX is now deployed in operational studies of obstacle management in French rivers.

KEYWORDS: Connectivity, Freshwater, Landscape genetics, Mitigation, Standardized index

#12 Standardisation of camera-trap monitoring of wildlife crossings

Jim Casaer (INBO – Research Institute for Nature and Forest, Belgium); Lien van Besien (Department of Environment, Belgium); Tanja Milotic, Peter Desmet (INBO – Research Institute for Nature and Forest, Belgium); Patrick A. Jansen (Department of Environmental Sciences, Wageningen University, Netherlands)

We identify six key challenges for the integrated analysis of camera trap data collected in different projects monitoring the use of ecoducts and underpasses. We show how the use of camera trap platforms such as Agouti (Agouti.eu) solve several of these problems.

KEYWORDS: Camera trapping, Mitigation, Standardisation, Data, Wildlife crossings, Ecoduct, Underpass

#13 Biodiversity information tool to supporting Environmental impact assessment

Jordi Solina, Gemma Vila, Paula Bruna, Eva Lahoz, Anna Ferrés, Israel Estopà, Susanna Carbajo, Antoni Sorolla (Ministry of Territory and Sustainability, Government of Catalonia, Spain)

The assessment of the effects over wildlife, flora and natural habitats is a complex aspect in the procedure of environmental impact assessment. A tool to improve this procedure, addressed to the technicians of the Ministry of Territory and Sustainability, as environmental authority, was developed as a user-friendly online server which facilitates biodiversity information after the user defines a query specifying project type and location.

KEYWORDS: Biodiversity, Environmental Impact Assessment, GIS

#14 Predicting wildlife collisions hotspots based on machine learning and GIS: A case study in a tropical dry forest area in Colombia

Juan Carlos González-Vélez, Juan Carlos Jaramillo-Fayad, Juliana Ríos-Barberi (Instituto Tecnológico Metropolitano, Colombia / PECIV – Programa de Ecología de las Carreteras e Infraestructura Verde, Colombia); Juan Pablo Murillo-Escobar (Instituto Tecnológico Metropolitano, Colombia)

Due to the magnitude of Animals and Vehicles Collisions (WVC) in Colombia and the lack of information of WVC hotspots, it is necessary to propose predictive techniques to prevent it from the moment of road infrastructure planning. For this reason, the objective of this work is to evaluate the performance of machine-learning techniques in predicting the places most likely to be considered as roadkill hot spots on roads in a region of Colombia. K Nearest Neighbors model had an accuracy and specificity of 88%, while for the Support Vector Machines had an accuracy of 85.5% and a specificity of 98.84%, considered as successful results in the prediction of hotspots of fauna roadkill from spatial variables. This serves as a successful precedent towards the prediction of WVC in a tropical ecosystem from spatial descriptors.

KEYWORDS: Artificial intelligence, Spatial Analysis, Prediction, Hotspots, Roadkill

#15 Ecologically friendly erosion control

Lien van Besien (Government of Flanders, Department of Environment, Belgium); Karl Fonteyne (Flemish Construction Confederation, Belgium); Steven De Maesschalck (TEXION Geosynthetics Ltd., Belgium); Jan Van Raak (Van Raak Ltd., Belgium); Gregory Quaegebeur (Isofaq Ltd., Belgium)

This poster provides decision makers a clear overview of environmentally friendly erosion control solutions covering each possible slope angle. This kind of solutions are important to install ecologically friendly verges and riverbanks, which can function as important longitudinal, green corridors.

KEYWORDS: Ecologically friendly, Erosion control, Verges and riverbanks, Technical textiles, Biodegradable

#16 The NOTEE VA method

Ludovic Le Contellec, Caroline Mallo, Ian Jannet, Anaïs Bataille, Agathe Idelon, Guillaume Laffont (AMETEN, France)

There is no current comparative approach between ex-post and ex-ante natural environments status on the right-of-way of a planning/development operation. However, for the past ten years, the obligation and willingness to control environmental impact of highway operations is increasing, thanks to a strengthened regulatory context. It demonstrates that avoidance and recovery actions with regard to natural environments and species in the work area can be performed. NOTEE VA is intended to enable project owners to measure and synthesize losses and gains related to the state of the natural environment on the work area of an operation.

KEYWORDS: Assessment, Tool, Highway, Biodiversity

#17 Long-Term Monitoring of ecological Impacts from a Road Project in Denmark 2012-2020

Martin Hesselsoe (NIRAS A/S, Denmark); J. L. Nielsen, Nadieh de Jonge (Aalborg University, Denmark); Rune Sø Neergaard (NIRAS A/S, Denmark); Per Gørtz (Laboratory of Fish Ecology, Denmark); Niels Krogh, Christina Steenbeck (Danish Road Directorate, Denmark)

A new orbital road was planned at Naestved (Zealand, Denmark). The road passes an area protected by the Natura 2000 network. A long-term monitoring program was established to compare the real impacts on the environment with the expectations as described during the pre-construction impact assessment? analysis. The period of investigation was 2012-2020 to cover the period prior to construction, during construction and after construction (operation phase). At the current state the results (including 2019) generally suggest a positive or neutral development of several of the selected parameters investigated in the period.

KEYWORDS: Habitat Directive, Long Term Monitoring, Impact Assessment, DNA methods

#18 Mitigation measures for wet grasslands, wader birds and amphibians along rail and road infrastructure in south west Sweden

Mats Lindqvist, Moa Naalisvaara Engman (Swedish Transport Administration, Sweden); Ola Sjöstedt (Norconsult AB, Sweden); Calle Bergil (Melica Miljökon-sulter, Sweden)

This longstanding project of ecological compensation covers 172 hectares of grazed wet grassland in Sweden. The mitigation is carried out by promoting cattle grazing, special mowing, better fencing and construction of wetlands. The goal is to decrease the amount of reed and increase well grazed areas. The majority of reed has decreased and a "blue zone" has developed. The results show that the same species of birds are still present in the four areas after the rail and road constructions being completed. The results for amphibians show that all constructed ponds are being used for reproduction of mostly Common frog.

KEYWORDS: Mitigation measures, Ecological compensation, Wet grasslands, Wader birds, Amphibians

#19 Prevention of Deer-train collisions by a deterrent sound

Minoru Shimura, Tomoyoshi Ushiogi, Masateru Ikehata (Environmental Biotechnology Laboratory, Railway Technical Research Institute, Japan)

To keep deer away from railway lines, we have invented a deterring sound and investigated its effectiveness. This study shows the effectiveness of the deterrent sound playback from the train will be an effective countermeasure for the collisions.

KEYWORDS: Railway, Deer collision, Deterrent sound, Mitigation

#20 Green Urban Areas: critical patches for biodiversity & ecosystem connectivity

Nefta-Eleftheria Votsi (Aristotle University of Thessaloniki, Greece)

The pattern and impacts of noise and light pollution are being investigated in Green Urban Areas of Athens, Greece. The most important finding of this research is that Green Urban areas could outline urban biodiversity patterns as well as that Sound and light patterns of a city reveal new dimensions of information for the identification and the preservation of Green Infrastructures.

KEYWORDS: Green Infrastructure, Urban biodiversity, Noise pollution, Light pollution

#21 A clustering analysis should precede the identification of local factors: evidence based on the Czech WVC data

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

WVCs took place due to two fundamental reasons: global factors usually related to drivers and local factors tightly connected to respective places along roads (e.g., the infrastructure or the closest environ). Identification of the local factors which influenced the concentration of WVCs is an important step in any targeted mitigation approach.

We used the KDE+ method as a tool to compute the WVC hotspots. We demonstrate, on the basis of computer simulations, that the strongest signal was achieved when data were separated into two groups (WVCs which took place in clusters and outside them).

KEYWORDS: KDE+, Clustering, Regression model, Environmental factors, Spatio-temporal analysis

#22 Use of drainage pipes as underpasses by wild mammals in South-east Brazil

Scarlat Dalva Ferreira, Jorge Ferreira Lima Neto, Lerrane de Fátima Cunha, Carlos Henrique de Freitas (UNIARAXÁ – University Center of Araxá, Institute of Environmental Engineering, Brazil)

The wildlife roadkill threatens the persistence of populations and ecosystems in the world, especially in extensive tropical road networks such as in Brazil. The growth of traffic flow is not matched by mitigation measures. It's important to develop studies monitoring fauna passages that enhances the implementation of roadkill control with lower cost/effectiveness. We inspected culverts and water drainage pipes use as passages for small, medium and large mammals in the MG-428 highway, Minas Gerais state, southeast Brazil. We also monitored roadkill adjacent to verify if the animal species that use the passages differ from the ones that are run over.

KEYWORDS: Roadkill, Mitigation, Low Cost Solution, Hot Spot, Cerrado

CHALLENGES AND OPPORTUNITIES FOR HABITATS RELATED TO LINEAR INFRASTRUCTURES

#1 New approach to mitigate bird-window collisions

Bettina Kain, Dominique Waddoup, Melanie Gröbl (BirdShades Innovations GmbH, Austria); Thomas Schuh (ÖBB-Infrastruktur AG, Austria)

Glass is abundant among linear infrastructure (train stations, wind and noise barriers, facades, balconies) and causes high non-natural mortality of many bird species worldwide. To increase infrastructure sustainability and hence to support innovative solutions to grow and achieve market readiness the Austrian Federal Railway (ÖBB) collaborates in a pilot customer program with the startup BirdShades. BirdShades develops an invisible high-tech window film to prevent deadly collisions with glass surfaces. A location was chosen where bird-window collisions frequently occur. Data sampling started in fall 2019 and results will be directly implemented into ongoing product development.

KEYWORDS: Bird-window collisions, Glass, Biodiversity, Bird strikes

#2 Enabling wildlife to cross linear transport infrastructures - Examples of infrastructure requalifications - Collection of 12 sheets

Jean-François Bretaud (Cerema Ouest, France); Jean Carsignol, Marc Gigleux, Alain Morand (Cerema Est, France); Sophie Berlin, Agnès Rosso Darmet (Cerema Méditerranée, France); Claude Guillet (Cerema Normandie – Centre, France); Jonathan Jumeau (Conseil Départemental du Bas Rhin, France); Christophe Hervé (LPO Champagne-Ardenne, France)

This document aims at support project owners and contractors to restore sustainably the ecological transparency of their Linear Transport Infrastructures (LTI). It presents feedbacks with different examples of achievements on the territory. It concerns various issues, technical processes, project owners (State, local authority, motorway operating companies, railway network, waterways, ...) and target species (aquatic species, small wildlife, large wildlife, ...). All these projects illustrate the need to study accurately this issue in order to apply an optimal and concerted solution with a budget often constrained. This work currently is being set up and will be free downloadable on Cerema's website at the beginning of the year 2020.

KEYWORDS: Re-qualification of infrastructures, Ecological engineering, Wildlife corridors

#3 Evidence of the positive impact vegetation management of power lines corridors on habitats and species: feed-back of LIFE Elia-RTE in Belgium

Jean-François Godeau (Ecofirst s.c.r.l., Belgium)

The LIFE Elia-RTE project restored 460 ha of forest right-of-ways of the power-lines network in Belgium, including 200 ha of grasslands belonging to the European habitat directive. A biological monitoring has been performed during 2 years and provides evidences of the success in enhancing habitat quality and in the creation of new biodiversity hotspots. These first results provide evidence of the contribution of power-lines network to species and habitats conservation. We contribute to prove that energy transmission operators can, through the conservation of biodiversity, strongly improve the ecological value of forest ecosystems and eventually its resilience to global changes.

KEYWORDS: Power-lines, Integrated Vegetation Management, Connectivity, Biodiversity hotspots, Biological monitoring

#4 Enhancing biodiversity on Great Britain's railway network

Richard Pywell (UK Centre for Ecology & Hydrology, UK); Neil Strong (Network Rail, UK)

Network Rail is responsible for the safe and efficient running of Great Britain's rail transport infrastructure. Managing the habitats alongside the 32,000 km of track is vital for the safety of passengers, employees and contractors. It's a balancing act to maintain and improve the railway to keep it running safely, while being mindful of the land that

surrounds it, the natural capital Network Rail are responsible for, the public benefits it offers, and the wildlife that lives on it. To this end, Network Rail has developed a new and ambitious Biodiversity Action Plan for enhancing biodiversity on the railway line-side.

KEYWORDS: Railway ecology, Sustainable transport, Biodiversity

#5 High occurrence of pollinating insects on new ecoduct in western Sweden

Sofia Berg (EnviroPlanning AB, Sweden); Mats Lindqvist (Swedish Transport Administration, Sweden)

Loss and fragmentation of species environments causes declines in population sizes and increases risk of local extinctions. Here, we study if suitable environments for pollinating insects can be integrated in wildlife passages for large fauna crossing trafficated roads. We have study the colonization of day-active butterflies and bumble bees on a newly constructed ecoduct in western Sweden. The results show that the area of the ecoduct hold equally the same number of species and individuals, or more, comparing to nearby habitats.

KEYWORDS: Ecoduct, Pollinating insects, Infrastructure barriers, Butterfly, Bumble bee

#6 Power line rights-of-way and pollinators: A partnership to develop!

Véronique Michaud (Biologist and scientific advisor, Hydro-Québec, Canada)

Open environments are far from being biological deserts; many plant and animal species can be found there. The vegetation growing in power line rights-of-way includes several flowering plants. Consequently, many insects are found there, including pollinators.

Hydro-Québec recognizes the importance of pollinators in the context of ecological services. The linear configuration of rights-of-way turns these spaces into ecological corridors by creating a network of interconnected open environments. These corridors help pollinators reach various natural and semi-natural environments. The presentation provides an overview of the primary results of Hydro-Québec's pollinator research program.

KEYWORDS: Connectivity, Pollinators, Wild bees, Biodiversity

LINEAR INFRASTRUCTURE ECOLOGY

#1 Temporal patterns of humans and ungulates at bridges - Co-existence or disturbance?

Fabian Knufinke (Institut für Wildbiologie und Jagdwirtschaft, Universität für Bodenkultur Wien, Austria); Jan Olof Helldin (Swedish Biodiversity Centre, Sweden); Manisha Bhardwaj (Grimsö Wildlife Research Station, Department of Ecology, Sweden); Mattias Olsson (EnviroPlanning AB, Sweden)

We studied temporal patterns of human activity and ungulate passage at six road or railway bridges in Sweden. The amount of usage was not consistent for humans and ungulates over the study period. We noted a temporal separation in the use of wildlife and humans, however variable over time and among species, and some indications of human disturbance. The results suggest differences in susceptibility of semi-domestic reindeer and wild ungulates to human disturbance with moose being more sensitive to human usage than reindeer. The results are however preliminary, and the study is ongoing.

KEYWORDS: Bridges, Disturbance, Temporal patterns, Ungulates

#2 Bird species more frequently recorded in roadkill studies in Europe: A review using a trait-based approach

Federico Morelli, Ricardo Rodríguez, Yanina Benedetti, Juan D. Delgado (Czech University of Life Sciences Prague, Faculty of Environmental Sciences, Department of Applied Geoinformatics and Spatial Planning, Czech Republic / Área de Ecología, Department Sistemas Físicos, Químicos y Naturales, Universidad Pablo de Olavide, Spain)

In this study, using a large dataset collected from several European studies, we explored the frequency of occurrence of bird casualties, species by species, focusing on the percentage of roadkills in the complete set of European studies. Then, we tested the potential phylogenetic relatedness on roadkill frequency, and finally we explored the association between roadkill frequency and some avian traits (e.g. body mass, type of diet, distribution range and period of activity during the day).

KEYWORDS: Avian species, Bird traits, Conservation, Literature review, Roadkill

#3 Effects of noise from transport infrastructure on bats

Fiona Mathews, Domhnall Finch, Paul Jerem (University of Sussex, UK)

Noise pollution from linear infrastructure is a growing environmental issue. We conducted experimental playback of road noise to free-living bats, and assessed the effects of both the audible and ultrasonic spectra. We found that there were profound effects of noise playback across a range of different species, with most of the effect being gen-

erated by audible noise. Work is now needed to establish whether there is habituation to noise over time, and to identify suitable mitigation techniques.

KEYWORDS: Noise, bats, phantom road, playback experiment, railways

#4 Modelling roadkill hazard zones for ten different vertebrate species in Austria using remote sensing data, expert knowledge and previous studies

Florian Heigl, Daniel Dörler (University of Natural Resources and Life Sciences, Austria); Mathias Schardt (Graz University of Technology, Austria); Florian Schögl (Graz University of Technology, Austria / Pentamap Mapping Services, Austria); Carina Sobe (Graz University of Technology, Austria); Rainer Prüller (Graz University of Technology, Austria / Pentamap Mapping Services, Austria); Silke Schweiger, Susanne Stückler (Natural History Museum Vienna, Austria); Norbert Teufelbauer, Christina Nagl, Erwin Nemeth (BirdLife Austria, Austria)

Roadkills involving huntable or non-huntable wildlife are a risk for humans and biodiversity. The number of road kilometers is increasing worldwide. Consequently, the potential number of roadkills will also increase. Worldwide only very few systematic studies on a national level investigating road-killed animals exist. It is important to get an overview of locations where roadkills are clustered to verify prediction models and to effectively implement mitigation measures. The aim of the project presented with the poster is to derive hazard zones for AVCs in the vicinity of roads using remote sensing data, expert knowledge and results from previous studies.

KEYWORDS: Public participation in science, Animal vehicle collision, Prediction models

#5 Roads as a driver of changes in the bird community and disruptors of Ecosystem Services provision

Joana Araújo (cE3c – Centre for Ecology, Evolution and Environmental Changes, Portugal); Rodrigo Bergamin (Laboratório de estudos em vegetação campestre, Universidade Federal do Rio Grande do Sul, Brazil); Inês Catry (CIBIO/InBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Laboratório Associado, Universidade do Porto, Portugal / CIBIO/InBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Laboratório Associado, Instituto Superior de Agronomia, Universidade de Lisboa, Portugal); Fernando Ascensão (cE3c – Centre for Ecology, Evolution and Environmental Changes, Portugal / Department of Conservation Biology, EBD-CSIC – Estación Biológica de Doñana, Spain)

Roads may affect the ecosystem service provided by birds, biological pest control. The goal of this study was to test if to assess if road proximity affects the structure of the predator-prey relationship of Mediterranean oak woodlands.

We sampled points at increasing distance to the road, performed bird and pests surveys. Significant differences were found between points, bird abundance decreases with road

proximity, whereas the abundance of pest increase, suggesting a cause-effect relation between the two groups, mediated by road effects.

KEYWORDS: Road ecology, Biological pest control, Prey-predator relations, Conservation

#6 Potential ecological impacts and their mitigation of Central Asia-South Asia (CASA-1000) transmission line: Afghanistan part

Khalid Farooq Akbar (Fourth Dimension Consulting, Pakistan)

The CASAREM is aimed at promoting regional cooperation in energy trade between central and south Asian countries. CASA-1000 is first project of this program to trade 1300 MW of electricity between The Kyrgyz Republic, Tajikistan, Afghanistan and Pakistan. It consists of 750 km of 500 KV transmission line between Tajikistan (117km), Afghanistan (562km) and Pakistan (71km). In Afghanistan, the major part of the transmission line passes through areas of low ecological importance. However, it may have negative impacts on local resources such as soils, water channels, vegetation assemblages and migratory birds which can be minimized by adequate mitigation measures.

KEYWORDS: CASA-1000, Electricity transmission line, Afghanistan, Ecological implications

#7 Evaluation of selected methods to control invasive species along transportation linear infrastructures: a preliminary approach

Mariana P. Fernandes, Paula Matono, Anabela Belo, Carla Pinto-Cruz (Departamento de Biologia, Escola de Ciências e Tecnologia, MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal)

Roads and railways are a privileged channel for the establishment and spread of invasive flora, making the control of these populations urgent. This study aimed to evaluate the effectiveness of different methods to control the species *Acacia dealbata*, *Acacia melanoxylon*, *Ailanthus altissima*, and *Arundo donax*. The control of *A. donax* was effective, especially through rhizomes removal. The methods applied to *Acacia* species have shown different effects and effectiveness. Control actions should be carried out continuously, particularly targeting shoots. These methods also had impact on native species community. Results have a preliminary character, being essential to continue the planned monitoring.

KEYWORDS: Invasive species, Control, Restoration, Vegetation structure, Native vegetation

#8 A chronicle of brown bear-vehicle collisions in Greece

Maria Psaralexi (Department of Ecology, Aristotle University of Thessaloniki,

Greece / Callisto: Wildlife and Nature Conservation Society, Greece); Yiorgos Mertzanis (Callisto: Wildlife and Nature Conservation Society, Greece); Maria Lazarina, Danaï-Eleni Michaelidou, Stefanos Sgardelis (Department of Ecology, Aristotle University of Thessaloniki, Greece)

Large carnivores are seriously impacted by transportation infrastructure through habitat loss and fragmentation, traffic disturbance and wildlife-vehicle collisions. In Greece, although brown bears (*Ursus arctos*) are strictly protected by national and international legislation, more than 100 bear-vehicle collisions have been recorded over the past 20 years and the species is still threatened by road-related mortality. Our data indicated 6 collision clusters in northwestern Greece. Bear-proof fences have been installed along some major motorways, partially mitigating the problem. Efforts for further implementation of mitigation measures are ongoing and aim towards safe transportation networks for both humans and wildlife.

KEYWORDS: Brown bear, *Ursus arctos*, Roadkill, Wildlife-vehicle collisions

#9 Mitigation measures on Alqueva Irrigation Project canals

Rita Azedo, Ana Ilhéu (EDIA, S.A. – Empresa de Desenvolvimento e Infraestruturas do Alqueva S.A., Portugal)

Canals from Alqueva Irrigation project have mitigation measures in order to reduce mortality and fragmentation, such as fences along the canal, under and overpasses, fauna passages and pipes in sensitive areas. To assess the results of those measures, EDIA implemented a monitoring program to answer some basic questions. Canals, are underrepresented in science and is important to present some results from mitigation measures assessment.

KEYWORDS: Canals, Irrigation, Mitigation measures, Barrier effect

#10 Measures to favour the pollinators in environmental restoration

Susanna Carbajo, Jordi Solina, Israel Estopà, Antoni Sorolla (Ministry of Territory and Sustainability, Government of Catalonia, Spain); Anselm Rodrigo, Jordi Bosch (CREAF, Spain)

A suitable revegetation practices on road verges can be a useful tool to increase the habitat availability for pollinators. The Ministry of Territory and Sustainability and CREAM have created a guide to favour pollinators and the creation of nest building substrata for the wild bees in restoration works. The guide contain a list of appropriate species to attract the maximum diversity of pollinator species; a layer GIS available for public consultation and a set of practices to ensure the availability of nest building substrata for wild bees. Some other tasks related with it are exposed.

KEYWORDS: Verge management, Pollinators, GIS tools

#11 Monitoring fauna in the road environment

Teillagorry Manon, Anne-Claire De Rouck, Florian Fournier, Olivier Pichard (Cere-ma Nord-Picardie, France)

This poster deals with the techniques which are particularly adapted in order to survey the presence of amphibians and mammals on roads. The different parameters defining the practicability of roadkill surveys protocols, as well as their adaptation to road manager's constraints, will be detailed. Among these techniques, two of them are considered as inherent to roads: roadkill surveys and "krospection", and thus unavoidable when monitoring species in road environment. Along with these two techniques, others are considered as very useful and recommended on the road and its green verges: pitfalls, thermal cameras, fluorescent powder, infrared beam and camera traps.

KEYWORDS: Amphibians, Mammals, Monitoring, Road, Surveys

#12 Temporal patterns in animal-vehicle collisions based on neural networks and temporal density functions

Victor Javier Colino-Rabanal, Roberto Rodríguez-Díaz, Maria Jose Blanco-Vilegas, Miguel Lizana Avia (Department of Animal Biology, University of Salamanca, Spain)

The temporal patterns of animal-vehicle collisions (AVC) in 219 Castile and Leon hot-spots were analysed using self-organizing maps and temporal density functions. Different temporal patterns were identified depending on the species involved and the characteristics of the road. In most of the hotspots, more than 50% of the AVC were concentrated in 10% of the hours.

KEYWORDS: Temporal patterns, Animal-vehicle collision, Neural networks, Temporal density functions

CITIZEN SCIENCE AND THE INVOLVEMENT OF CIVIL SOCIETY

#1 A comparison of state-wide databases related to bird roadkill in Czechia

Michal Bíl (CDV – Transport Research Centre, Czech Republic); Zbyněk Janoška (Czech Ornithological Society, Czech Republic); Jan Kašinský (Czech Union for Nature Conservation, Czech Republic); Jan Kubeček (CDV – Transport Research Centre, Czech Republic)

We analyzed four state-wide databases related to or including data on bird road mortality within Czechia. Databases predominantly differed by kind of users, their background and general interests. Whereas temporal roadkill pattern was rather similar, spatial data

and species composition varied. Opportunistic biological data collected by public can be valuable source of information for nature conservation, but as demonstrated here, can also be non-representative or skewed due to varied interests and background of data collectors.

KEYWORDS: Birds, Road mortality, Citizen science, Database

LEGISLATION AND POLICY

#1 Risk-based Conservation Plan of fauna passages

Claudia Rodrigues (Road Agency (Rijkswaterstaat), Netherlands)

A good maintenance of fauna passages is essential for its functionality. The region South Holland of the Dutch Road Agency has developed a Conservation Plan that describes the risk-based maintenance. In these conservation plan the annual and long term maintenance measures are defined in order to guarantee the functionality of all building components of a fauna passage, as well as the process that fits within the financial planning for the next 20 years of our Road Agency. The risk-based conservation plan has different components: a descriptive report, an object risk analyses table (ORA), a decomposition software (Ultimo) and a geographic information system software (SIG).

KEYWORDS: Risk-based Conservation Plan of fauna passages

#2 The Impact on Bats of Traffic Infrastructure: Eurobats Guidance

Jean Matthews (Eurobats Advisory Committee, UK); Fabien Claireau (Naturalia Environnement, France / National Museum of Natural History, France); Jasja Dekker (BatLife Europe, Netherlands); Branko Karapandža (Wildlife Conservation Society "Mustela", Serbia); Primož Presetnik (Centre for Cartography of Fauna and Flora, Slovenia); Charlotte Roemer (National Museum of Natural History, France)

Bats are relatively long-lived animals with low fecundity thus populations cannot quickly recover from losses. They are vulnerable to disturbance, damage and loss of roosting sites and habitat, and intentional or incidental killing.

An Intersessional Working Group set up under the Eurobats Agreement was requested to publish guidance highlighting the effects on bats of transport infrastructure and providing guidance in minimising impacts. The guidance discusses the challenge of minimising collision mortality whilst maintaining or enhancing landscape-scale permeability for bats. It distinguishes between "use" and "effectiveness" of mitigation and recommends measures shown to be effective.

KEYWORDS: Bats, Transport infrastructure, Barrier effect, Collision, Mitigation measures



Workshops

WORKSHOPS

A Review of Wildlife-Vehicle Conflict Observation Systems

SESSION 2.1.1 (Tuesday, 12 January / 10:30 – 12:00)

ROOM Arbutus

Fraser Shilling (Road Ecology Center, University of California, USA); Wendy Colinson (Endangered Wildlife Trust, South Africa); Michal Bil (CDV – Transport Research Centre, Czech Republic); Diemer Vercayie (Natuurpunt, Belgium); Florian Heig (Institute of Zoology, University of Natural Resources and Life Sciences Vienna, Austria); Sarah E. Perkins (School of Biosciences, Cardiff University, UK); Sandra MacDougall (School of Arts and Science, Red Deer College, Canada)

Globally, wildlife-vehicle conflict (WVC) damages vehicles and can prove fatal to drivers, fragments wildlife populations (due to road/traffic-aversion), kills and injures individual animals, can cause population declines, and may eventually contribute to local or total extinction of certain species. Preventing WVC begins with recording locations of conflict, such as vehicle crashes, animal carcasses (roadkill), or animal behaviour around roads, such as avoidance of roads or crossing-behaviour. These data are ideally used to inform transportation policy and planning and to retrofit roadways and their structures to reduce WVC. We collectively manage eight regional and/or national systems for reporting WVC in collaboration with volunteers. In this review, we survey systems for recording WVC by volunteers and agency staff on different geographical levels, based on existing literature and our personal experience. We report the range of data collection methods, data management systems and data visualizations employed as well as mention of the groups and type of volunteers and agencies involved. We use our expertise and the global survey to provide methodological recommendations based on current best-practice for collecting and using WVC data to inform transportation and conservation decisions. We conclude with a vision of next steps toward a global network of WVC reporting systems. The outcomes of this session are intended to provide a suite of practical measures and tools for both new and current experts in the linear infrastructure field that participants can apply in their local systems.

KEYWORDS: Citizen science, Data collection, Volunteer, Wildlife-vehicle conflict, Wildlife vehicle collision

Mitigating Railway impacts on wildlife

SESSION 2.1.2 (Tuesday, 12 January / 14:45 – 16:15)

ROOM Arbutus

Andreas Seiler (Swedish University of Agricultural Sciences, Grimsö Wildlife Research Station, Sweden); Marina Torrellas, Carme Rosell (Minuartia, Spain); Manisha Bhardwaj (Swedish University of Agricultural Sciences, Grimsö Wildlife Research Station, Sweden); Mattias Olsson (EnviroPlanning AB, Sweden)

As railways regain interest as a competitive transportation system, with faster and more efficient rail infrastructure planned for the future, we need a better understanding of how railways and train traffic impact biodiversity and how these impacts can be mitigated. Knowledge from road ecology can be applied partly to railways, but new innovative solutions are needed that address the specific restrictions in rail systems. Several countries have initiated projects to address wildlife use of and mortality in railways, especially in high-speed railways. Both impacts and solutions sought are similar across countries and systems, suggesting that international and cross-corporative collaboration can lead to a fast and cost-efficient development of mitigation options. With this workshop and through the IENE Working Group on Railway Ecology, we intend to foster exchange between countries, organisations and projects that will enable concrete collaboration. We invite governmental agencies, rail authorities, train operators and wildlife experts alike to discuss and develop a joint endeavour.

KEYWORDS: Rail ecology, Train-animal collisions, Rail habitat, Railway mitigation, High speed railway

Advancing the Role of NGOs to Promote Wildlife-friendly Infrastructure

SESSION 2.1.3 (Tuesday, 12 January / 17:00 – 18:30)

ROOM Arbutus

Rob Ament (Center for Large Landscape Conservation, USA / Western Transportation Institute, Montana State University, USA); Kate Newman, Nilanga Jayasinghe (World Wildlife Fund, USA)

Non-governmental organizations (NGOs) have a key role to play in addressing the unique social, economic, cultural, and environmental concerns created by the world's rapidly expanding linear infrastructure. A growing number of individuals and institutions have been collaborating informally, but there is need for expanding this effort. This workshop seeks to align NGO efforts with those of other stakeholders to mutually achieve proactive policies, appropriate legal frameworks, better planning, and innovative science-based solutions. It will include presentations from various NGOs on their efforts to address infrastructure impacts to date, followed by a panel discussion where NGOs, government representatives and members of the audience will discuss and provide input for improving the role of NGOs in advocating for wildlife-friendly infrastructure initiatives, policies and practices. Representatives from several NGOs will present their perspectives, acknowledging the unique advantages and challenges of NGO-led initiatives. Government and academic partners will also provide their perspectives on the roles that NGOs can play. Workshop participants will discuss opportunities for engagement, priorities for action, and desired outcomes that can inspire the creation of a network of NGO partners.

KEYWORDS: Network, Collaboration, Partnership, Non-governmental organizations

Development of an Indicative European Defragmentation Map (IEDeM) as a contribution to preserving existing national and internationally important Green Infrastructure while transport infrastructure improvements are delivered within Europe

SESSION 2.2.1 (Wednesday, 13 January / 10:30 – 12:00)
ROOM Arbutus

Marita Böttcher (BfN – Federal Nature Conservation Agency, Division Impact Mitigation Regulation, Transport Infrastructure Planning, Germany); **Cindy Baierl** (Kassel University Department of Landscape and Vegetation Ecology, Germany)

Habitat destruction, isolation and fragmentation remain serious threats for biodiversity in general and migrating species across Europe caused by infrastructure enhancements and extensions. This will be exacerbated by climate change. Although we have already a dense transportation network, particularly in the highly frequented central European (transit) countries, there is a lot of valuable Green Infrastructure, which needs an appropriate protection in light of the EU's aim to develop a modern integrated transport system (TEN-T). Most European countries have important Green Infrastructure at national and international level, consisting of valuable core areas and interlinking corridors for migration and spread of species. These available parts of GI are harmonised and visualised in an Indicative European Defragmentation Map (IEDeM) that has been continuously developed since 2015. By now, the map shows ecological core areas and connecting corridors within and among 15 European countries. This information can be used to mitigate impacts on this component of GI due to fragmentation by linear infrastructure in highlighting sensitive areas and critical points at national and EU level. Not only the protection but also the development of a coherent and functioning European habitat network is a fundamental objective of the map to be presented in the workshop. The invited participants (national and EU government representatives, researchers, ecologists) will be encouraged by the workshop to become part of the co-operation and to establish strategic international partnerships as well as secure funding for mitigation and development measures by the EU at national and transnational level.

KEYWORDS: Habitat Networks, Green Infrastructure, Impact Mitigation, The Trans-European Transport Network expansion, Indicative European Defragmentation Map

Helping tigers, rhinos, and elephants cross the road: wildlife friendly infrastructure measures in Asia

SESSION 2.2.2 (Wednesday, 13 January / 13:30 – 15:30)
ROOM Arbutus

Nilanga Jayasinghe (Senior Program Officer - Asian Species, WWF-US, USA); **Nirmal Bhagabati** (Lead Natural Capital Scientist, WWF-US, USA); **Kate Newman** (Vice President Forest and Freshwater Public Sector Initiatives, WWF-US, USA); **Hanna Helsing** (Sustainable infrastructure advisor, WWF-Myanmar, Myanmar); **Rodney van der Ree** (Director and Principal Ecologist, Ecology and Infrastructure International, Australia)

According to projections, 75% of the infrastructure in 2050 is yet to be built. Ambitious infrastructure plans in place to connect countries and markets pose enormous threats to the places and species we need to protect. This is especially the case in Asia, where tigers, elephants, snow leopards and numerous other species and landscapes are at increased risk from linear infrastructure. A number of countries in Asia are starting to implement measures to reduce infrastructure-related wildlife mortality, improve connectivity, and further wildlife friendly, sustainable infrastructure planning. Until now, there has been limited dissemination of Asian experiences within and outside the continent, and the goal of this workshop is to enable presentation of examples and lessons learned from Asian countries.

The workshop will be structured around presentations by representatives from Thailand, Nepal, Myanmar, India and Mongolia that will encompass case studies relevant to their countries, where various planning efforts and mitigation measures have been implemented and monitoring is now beginning to demonstrate the results and effectiveness of these efforts.

Following these presentations, each allotted for 10-15 minutes, a moderator will facilitate a panel discussion on the future of sustainable infrastructure development in Asia, including opportunities and challenges. The discussion will also explore what more is needed for these countries to push for inclusion of biodiversity considerations into infrastructure development plans. The moderated panel session will include a question and answer session for broader participants, with an opportunity for feedback, suggestions and guidance from lessons learned in wildlife friendly infrastructure from Europe and beyond.

Findings and outcomes from the session will be captured in a brief document and shared with workshop participants and inform future events that will support further networking and knowledge sharing across Asia.

The target group for this workshop will be attendees from across Europe and North America who may have interest in learning about wildlife friendly infrastructure efforts in Asia and engaging in discussions that would further provoke thought and provide recommendations to the group.

KEYWORDS: Road ecology, Sustainable infrastructure, Asia, Tiger, Elephant

Wildlife and Traffic Handbook Update: towards European standards for fauna passages and fencing

SESSION 2.3.1 (Thursday, 14 January / 10:30 – 12:00)
ROOM Arbutus

Carme Rosell (Minuartia, Spain); **Luc Chrétien**, **Eric Guinard** (Cerema, France); **Antonio Righetti**, **Cécile Eicher** (B+S AG, Switzerland); **Marguerite Trocmé** (Standards, Research and Safety, Federal road office, Switzerland); **Václav Hlaváč** (Nature Conservation Agency of the Czech Republic, Czech Republic); **Andreas Seiler** (Swedish University of Agricultural Sciences, Grismö Wildlife Research Station, Sweden)

The workshop aims to introduce proposals for fauna passages and fencing design, construction and maintenance to update European standards. The work in progress is being developed by a team of organizations from countries in the IENE Working Group to update the online ‘Wildlife and Traffic Handbook’. The proposed standards are based on a review of existing guidelines and information from evaluations of existing practice and published literature. The outputs of the workshop should improve European standards, identify new sources of information and test the consensus between experts on the proposed standards. Gaps and conflict points will also be identified. Workshop participation could foster future cooperation in the handbook update and the review of new standards. The target audience includes professionals from administrations, engineering and consultant companies, research centres and other organizations involved in developing or applying standards for wildlife mitigation measures in transportation infrastructures.

KEYWORDS: Road ecology, Guidelines, Mitigation measures, Fauna passages, Fencing

Infrastructure, Biodiversity and Health

SESSION 2.3.2 (Thursday, 14 January / 13:30 – 14:30)
ROOM Arbutus

Wendy Collinson (Wildlife And Transport Programme, Endangered Wildlife Trust, South Africa); Fraser Shilling (Road Ecology Center, Department of Environmental Science and Policy, University of California, USA); Yannick Autret (French Ministry for an Ecological and Solidary Transition, Directorate of Research and Innovation, France)

The worldwide development of roads increases the risk of new human disease emergence (not to mention wild animal to domestic animal transmission). Many factors contribute to this: demographic (for example, population growth, especially in urban areas), economic, such as, increased and accelerated national and international trade, and political factors, which are themselves reinforced by the effects of climate change.

Linear infrastructures may facilitate dispersal, and/or displacement of particularly generalist species (i.e. zoonotic reservoirs), to habitats proximal to human populations. In short, positive relationship of increased zoonoses and species abundance (i.e. mammal), are often more adapted to human landscapes. Increased understanding of spread, improvement or establishment of transport networks can play a recognised facilitating and accelerating role for an integrated risk framework for transportation.

The present workshop will have a duration of 90 minutes. It will start with a 10-min introduction by Fraser Shilling (University of California, USA), two or three guests’ interventions (15 min each) and a final discussion and workshop summary by Wendy Collinson (Endangered Wildlife Trust, South Africa) and Fraser Shilling.

KEYWORDS: Zoonosis, Disease spread, Health risk, Human health, Zoonoses

Corridors and Crossings: “Guidance for Connectivity Conservation Impacted by Linear Transportation”

SESSION 2.3.4 (Thursday, 14 January / 16:45 – 18:15)
ROOM Arbutus

Rob Ament (The Center for Large Landscape Conservation, USA / Montana State University Western Transportation Institute, USA); Rodney van der Ree (WSP Australia Pty Ltd., Australia / Ecology and Infrastructure International, Australia)

1. Over the last 30 years, many countries have learned how to avoid or minimize impacts to ecological connectivity and wildlife mortality caused by linear transportation infrastructure—roads, railways, and canals. As the globe faces unprecedented growth in transport infrastructure, a new publication published under the auspices of the IUCN’s World Commission on Protected Areas is a comprehensive effort to synthesize the ecological impacts of linear transportation infrastructure, highlight existing and innovative practices, and draw on lessons learned from around the world to recommend best-practices for surface transport infrastructure development. The Transport Working Group of the IUCN WCPA’s Connectivity Conservation Specialist Group will lead a presentation of the Guidance and how its lessons contribute to reducing fragmentation and enhancing the interconnectedness of protected and conserved areas. Experts from NGOs, academic institutions, and government will discuss application, articulating the multiple actions in policy, research, technology, and public involvement that can result in more sustainable linear transportation projects.

KEYWORDS: Guidelines, Best Practices, Research

The Potential of Smart technologies for ecological planning and landscape measures

SESSION 3.1.1 (Tuesday, 12 January / 10:30 – 11:30)
ROOM Thymus

Sven Reiter (Landesamt für Straßenbau und Verkehr Mecklenburg Western-Pomerania (State office for road construction and traffic), Germany)

In order to solve new challenges, landscape planning measures have to become more and more technical oriented. The workshop is intended to facilitate better cooperation between landscape planners and engineers.

The content and the strategy for the workshop will be presented using 6 examples relating to innovative detection methods, technical orientated landscape measures and intelligent infrastructure systems.

The discussion will contribute to achieve a better understanding of ecologists for smart technical solutions and get motivated to create posters with best practice examples.

For further consideration of the workshop results, an international platform on the website of the FGSV and a cooperation with the Technical University of Dresden will be used.

KEYWORDS: Smart technologies, Intelligent infrastructures, Ecological detection, Landscape measures, Creation of posters

An International Strategy and Action Plan for Stakeholders' Engagement on Sustainable Transport and other Linear Infrastructure

SESSION 3.2.1 (Wednesday, 13 January / 10:30 – 12:00)

ROOM Thymus

Lazaros Georgiadis (IENE – Infrastructure and Ecology Network Europe, Biologist – Environmentalist, Greece); Rob Ament (IUCN/CCSG/TWG – International Union for Conservation of Nature / Connectivity Conservation Specialist Group / Transport Working Group, Center for Large Landscape Conservation, USA); Anders Sjölund (IENE, Swedish Transport Administration, Sweden); Elke Hahn (IENE, Federal Ministry for Transport, Innovation and Technology, Austria); Marita Böettcher (IENE, Federal Agency for Nature Conservation, Germany); Rodney van der Ree (ANET – Australasian Network for Ecology and Transportation, Ecology and Infrastructure International Pty Ltd., Australia); Kate Newman (WWF-USA – World Wide Fund, USA); Wendy Collinson (ACLIE – African Conference for Linear Infrastructure and Ecology, South Africa / EWT – Endangered Wildlife Trust, WTP – Wildlife and Transport Programme, South Africa); Lourens Leeuwner (ACLIE – African Conference for Linear Infrastructure and Ecology, South Africa / EWT – Endangered Wildlife Trust, WEP – Wildlife and Energy Programme, South Africa); Fraser Shilling (ICOET – International Conference on Ecology and Transportation, Road Ecology Centre, University of California, USA); Hans Bekker (Retired (Department Public Works; Dutch Ministry for Transport and Water Management), Netherlands); Yun Wang (Research Centre for Environment Protection and Water and Soil Conservation, China Academy of Transportation Sciences, China); Fiona Mathews (University of Sussex, UK); Andreas Seiler (IENE, Swedish University of Agricultural Sciences, Grimsö Wildlife Research Station, Sweden); António Mira (IENE, University of Évora, Portugal); Carme Rosell (IENE, Minuartia, Spain)

Transport and other Linear Infrastructure (TLI), which includes, roads, railways, navigable channels, power lines, and pipelines, extend across large swaths of the globe and are essential for an interconnected world allowing the expansion of human societies and improved livelihoods. Accordingly, global demand for TLI has progressed rapidly in the last decade providing access to remote areas as well as generating an improved understanding of both the positive and negative impacts on natural systems both spatially and over time. Nevertheless, beside intensive agricultural land-use and urban expansion, TLI is a major cause of fragmentation of natural ecosystems and biodiversity decline worldwide. Further impacts resulting from edge effects can extend for many km on either side of the structures affecting ecosystems for many years to come. These less obvious impacts often create barrier effects for migrating wildlife as well as consequences for human safety due to animal vehicle collisions (AVC). The demand for improving humans and wildlife safety, and resilient TLI, under the climate change scenario, requires the development of a strategy that involves all stakeholders.

Other Linear Infrastructure, such as power lines, are also major causes of human-induced mortality for birds worldwide due to collision and electrocution, especially when towers and poles become attractive perches and roost sites. Both voltage distribution and transmission lines present a near-invisible flight barrier and collisions between birds and conductors and shield wires are well-documented.

Since 2015, a growing number of professionals and organizations, from all over the world, have joined forces. Comprising the four TLI continental conferences (ACLIE, ANET, ICOET, IENE) as well as international organisations (IUCN, WWF), this collaborative team have developed 'International Guidance for Ecologically Friendly Linear Infrastructure' (IGELI). IGELI aims to ensure that the TLI built today are safe for both humans and wildlife, and ecologically sustainable. With this in mind the mainstreaming of biodiversity in TLI sectors, has been introduced as part of the Convention for Biological Diversity framework (CBD) and the achievement of Aichi Global targets in CBD 2018 COP 14 in Egypt, resulting in our coalition developing an International Strategy and Action Plan on Sustainable TLI Stakeholders' Engagement (Strategy).

The Strategy aims to support the CBD 2020 COP 15 in China, through the development of an international roadmap. This roadmap seeks to engage different stakeholders, as key players, on mainstreaming biodiversity for the sustainable development of TLI by integrating environmental, social and economic components. The Strategy has a number of tiers: firstly, identifying relevant TLI stakeholders and their crucial roles in launching proactive policies and establishing appropriate legal frameworks; and secondly, supporting the relevant TLI stakeholders with guidance towards better planning, construction and maintenance of resilient TLI, ultimately promoting multi-sector cooperation and encouraging innovative science-based solutions.

The Workshop will include three phases of 20, 60 and 10 minutes accordingly: a) Presentation of the main elements of the Strategy, b) Discussion about the next steps towards developing of international cooperation on sustainable transport and other linear infrastructure, c) Conclusions of the workshop.

KEYWORDS: Sustainable Linear Infrastructure, Ecological Corridors, Ecological Connectivity, Mitigation Hierarchy, Strategic Planning

Planting and preservation of trees on dams and dykes as a part of green infrastructure: Conflicts - Solutions - Implementation

SESSION 3.2.2 (Wednesday, 13 January / 13:30 – 14:30)

ROOM Thymus

Katharina Dujesiefken (BUND Mecklenburg-Vorpommern, Germany); Piotr Tysko-Chmielowiec (Foundation for Sustainable Development, Poland)

The straightening of rivers and streams led to a great loss of habitats for a wide variety of species. In order to compensate for part of the loss of natural habitats, the thousands of kilometres of dams and dikes along the rivers should be used as green infrastructure and make an important contribution to the protection of plant and animal species as well as lichens and fungi. From the point of view of climate protection, it is also important to improve the green infrastructure and take every opportunity to plant and con-

serve trees and shrubs. In addition, avenues and tree rows along waterways are also important links between biotopes, especially in the cleared agricultural landscape we find in many places in Europe.

Yet, the demand currently manifested in standards states that woody plants (trees, shrubs and hedges) on dykes and dams are fundamentally unacceptable because they apparently impair stability and maintenance. These standards hinder not only planting of trees and shrubs along new construction, but also when it comes to tolerating and planting trees on dams and dykes during renovation measures.

For many decades, representatives of nature conservation and landscape management, associations and local citizens have been calling for environmentally compatible solutions to be implemented. Landscape architects and hydraulic engineers are also increasingly questioning these regulations.

Engineering biology has very good answers to the question of how plants can be used as living building materials to secure dams and dikes. Using the example of the rehabilitation of the dams along the Störkanal in the Lewitz in north-eastern Germany the workshop will demonstrate that a rehabilitation of a dam with preservation of the tree population is possible and even meaningful. Here technical solutions were found, which made the reconstruction of the dams with preservation of an especially beautiful oak avenue on the dam possible.

The workshop will be used to highlight the importance of trees along waterways as part of the green infrastructure to identifying conflicts and solutions.

Our aim is to use the workshop to identify positive examples where it was possible to preserve woody plants on dams and dikes during renovation work or even to plant new ones and use them to stabilize dams and dikes. Thus, a brochure already available with examples from Germany can be supplemented and made available in its entirety as “best practice” for the conservation and use of woody plants on dams and dikes along waterways in Europe by 2020. The IENE Committee and the workshop participants will be informed about the publication of the brochure, which will be available on our website.

KEYWORDS: Dam, Dike, Canal, Tree, Reconstruction

GLOBAL CONGRESS: Linear Infrastructure and Environment (GCLIE): A Platform to Enhance Cooperation and Coordinated Action between the Existing Continental Conferences on Ecology and Infrastructure

SESSION 3.3.1 (Thursday, 14 January / 10:30 – 11:30)
ROOM Thymus

Fraser Shilling (Road Ecology Center, Department of Environmental Science and Policy, University of California, USA); Wendy Collinson-Jonker (Wildlife and Transport Programme, Endangered Wildlife Trust, South Africa)

The Global Congress on Linear Infrastructure and the Environment is a new concept to capture existing momentum to examine impacts of linear infrastructure (LI) and develop ways to reduce or eliminate these impacts. The Congress is a collaboration among the existing continental conferences, capturing and distilling the international and global issues, interests and needs associated with LI and environmental impacts. The first Congress will be held in partnership with ICOET in September 2021 and future Congresses will accompany other continental conferences in rotation.

KEYWORDS: Global collaboration, Linear infrastructure, Environmental impact

Road sides as ecological traps – Challenges and solutions: Changed biotic interactions due to non-native seed mixtures and invasive alien plants

SESSION 3.3.2 (Thursday, 14 January / 13:30 – 15:00) **AND**
SESSION 3.3.3. (Thursday, 14 January / 15:30 – 17:00)
ROOM Thymus

Johannes Kollmann (Technical University of Munich, Germany / Norwegian Institute of Bioeconomy Research, Norway); Larissa Uhe (Technical University of Munich, Germany); Marcello D’Amico (University of Lisboa, CIBIO-InBIO, Portugal); Hans Martin Hanslin, Knut Anders Hovstad, Svenja Kroeger (Norwegian Institute of Bioeconomy Research, Norway); Tommy Lennartsson, Jörgen Wissman, Anna Westin, Jan-Olof Helldin (Swedish University of Agricultural Sciences, Sweden); Jan Christian Habel (University of Salzburg, Austria)

Ecological traps are a hot topic in roadside ecology, because recent strategies aim at encouraging biodiversity along roads. However, there are some reports that plants and animals have reduced fitness along roads, while the factors causing this unwanted effect are less clear. The workshop will focus on non-native seed mixtures and invasive alien plants as drivers of reduced fitness of roadside populations. These negative factors must be discussed within the perspective of climate change. The workshop will assemble an interdisciplinary group of experts with the aim of exchanging current trends in applied ecology with engineers and road authorities. The topic fits well under the conference theme “Challenges and opportunities for habitats related to linear infrastructures” with the subthemes “Refuges, ecological traps, corridors and linkage areas” and “Invasive plant detection, control and monitoring”. However, there are as well links to other themes of the IENE conference.

KEYWORDS: Biotic interactions, Ecological trap, Invasive alien plant, Roadside, Seed mixture



Side Events

LIFE SAFE CROSSING SEMINAR

Organiser(s): LIFE SAFE CROSSING project

PROGRAMME CONTENTS:

LIFE SAFE CROSSING Seminar

LIFE SAFE CROSSING SEMINAR: INTRODUCTION TO THE WORKSHOP AND TOPICS CONCERNING LARGE CARNIVORES AND TRANSPORT

SESSION 3.1.2. (Tuesday, 12 January / 14:45 – 16:30)

ROOM Thymus

MODERATOR Annette Mertens & Carme Rosell

#1 LIFE SAFE-CROSSING: the project overview

Annette Mertens, Simone Ricci, Fabio Papini (Agristudio S.r.l, Italy)

The LIFE SAFE-CROSSING side event during the IENE2020 conference is organized as a tool to raise interest and enhance future cooperation with stakeholders involved in large carnivore conservation and transportation infrastructure associated with the project activities. The aim of the workshop is also to identify cases in which project activities could be replicated. The first part will include presentations about the main project activities: prevention measures, adaptation of crossing structures, monitoring and communication. Talks will be followed by thematic working groups in which the participants are actively involved in a discussion, guided by a facilitator, on each of the topics.

KEYWORDS: LIFE SAFE-CROSSING, Side-event, Dissemination, Stakeholders, Transferability

#2 Large carnivores and transportation infrastructure: a review

Djuro Huber (Faculty of Veterinary Medicine, Croatia)

Transportation infrastructure can kill and/or fragment populations of large carnivores. Collisions with vehicles are a threat to very small populations and create damage to vehicles and risk for passengers' lives. The worst situation is habitat fragmentation that results in genetic isolation. Fencing highways can reduce mortality but increases fragmentation. Solution are wildlife crossing structures. Guidelines are needed for environmental impact studies that are focused on securing the permeability of traffic routes. Large carnivores need large overpasses called green bridges or ecoducts, large and high underpasses and tunnels.

KEYWORDS: Habitat fragmentation, Carnivore, Road, Fencing, Croatia

#3 Planning measures to avoid Animal-Vehicle Collisions: the approach of the LIFE SAFE-CROSSING Project targeting the Apennine brown bear

Mauro Fabrizio, Giovanna Di Domenico, Antonio Antonucci (Majella National Park, Italy)

In the Life Safe-Crossing project, road-kill data, barrier effects, and the presence of underpasses and overpasses have been evaluated to identify the most relevant factors

determining animal-vehicle collision risk and to delineate high-risk areas, thus favouring the planning of effective interventions in terms of type and locations of mitigation measures. Interventions to be implemented are the adaptation of existing crossing structures, the use of road signs and road information panels, the use of the virtual fence, a barrier that consists of electronic deterrents, and the installation of AVC Prevention Systems tested during the Life Strade Project.

KEYWORDS: Mitigation measures, AVC, Road mortality, Life Project, Apennine brown bear

#4 Adapting underpasses to be used as wildlife crossings: An action of the LIFE SAFE-CROSSING project to reduce large carnivore habitat fragmentation

Marcos López (Junta de Andalucía, Agencia de Medio Ambiente y Agua de Andalucía, Spain); Carme Rosell (MINUARTIA, Spain / University of Barcelona, Spain); Marina Torrellas (MINUARTIA, Spain); Matias de las Heras Carmona (Junta de Andalucía, Agencia de Medio Ambiente y Agua de Andalucía, Spain)

The LIFE Safe-Crossing project includes actions to adapt existing underpasses as large carnivore crossings in road sections identified as Brown bear or Iberian lynx mortality hotspots or sections frequently used by these target species to cross roads. Basic steps are drawing up a preliminary inventory of existing transversal structures and establishing criteria to identify which are the most suitable structures for adaptation as wildlife crossings. Key features must be determined in relation to crossing structure design, location, fencing, surroundings and uses of the structure. The topic will be presented and experiences exchanged to encourage collaboration among the audience.

KEYWORDS: Large carnivore, Fauna passages, Fencing, Mitigation, LIFE Safe-Crossing

#5 LIFE SAFE-CROSSING in Greece: Analysis and mapping of crossing structures on the A29 and activities to enhance connectivity through interventions on underpasses and road sides

Maria Psaralexi (Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece / Callisto: Wildlife and Nature Conservation Society, Greece); George Lyberopoulos, Elina Theodoropoulou (COSMOTE Mobile Telecommunications S.A., Greece); Yiannis Tsaknakis, Athanasios Tragos, Yiorgos Lazaros (Callisto: Wildlife and Nature Conservation Society, Greece); Niki Voumvoulaki (Egnatia Odos S.A., Greece); Carme Rosell, Marina Torrellas (MINUARTIA, Spain); Spyros Psaroudas, Yiorgos Mertzanis (Callisto: Wildlife and Nature Conservation Society, Greece)

In Greece, motorway A29 has penetrated brown bear habitat since 2009. In 2014, a bear-proof fence was installed to minimize bear-vehicle collisions. The motorway is equipped with ca. 140 underpasses. However, the lack of monitoring resulted in concerns about fence effects on mammal communities. In the context of the LIFE SAFE-CROSSING project, field inspections have been performed and potential crossing structures and

barriers have been identified. Forty-five solar-panel/battery-powered 4G cameras, supported by back-end infrastructure for storage/visualization of camera feed, have been installed. Based on the findings, interventions on underpasses and roadsides to increase the motorway's permeability will be proposed.

KEYWORDS: Mitigation measures, Underpasses, Monitoring, Brown bear, *Ursus arctos*

#6 Increasing awareness to encourage the adoption of driving behaviour to reduce AVC risk: new approach applied at LIFE SAFE-CROSSING

Laura Scitillani, Roberta Latini (Ente Parco Nazionale d'Abruzzo, Lazio e Molise, Italy); Annette Mertens, Simone Ricci (Agristudio S.r.l., Italy)

One of the main causes of animal-vehicle collisions is inadequate driving behaviour. Therefore, the LIFE SAFE-CROSSING project aims to increase drivers' awareness of the impact of these accidents on endangered species, and to encourage the adoption of responsible driving behaviour. This will be achieved by installing specific road information panels created through the application of neuroscience. The project also includes a set of other communication activities for future and young drivers. To reduce AVC, it is vital to act on driving behaviour, and this study could be a first step to work in this direction.

KEYWORDS: Driving behaviour, Awareness, Communication, Neuroscience, Road signs

LIFE LINES FINAL SEMINAR

Most of the Linear Infrastructures networks worldwide were built prior to the dissemination and mandatory implementation of Environmental Impact Assessment policies. Therefore, many of these infrastructures are not prepared to couple with biodiversity conservation issues and need to be adapted. Very often simple and inexpensive solutions can be used to increase environmental performance of old infrastructures. We will discuss successes and failures of actions/ adaptations often implemented to reduce the ecological impacts of Linear Infrastructures and strategies to promote a widespread dissemination of solutions which proved to be successful. We will use the experience of the LIFE LINES project (LIFE14 NAT/PT/001081) to contribute to this discussion. The project aims to essay, evaluate and disseminate practices directed at mitigation of negative effects from transport/energy infrastructures on biodiversity. Simultaneously, it contributes to the creation of a demonstrative Green Infrastructure based in habitat corridors and stepping-stones that increase connectivity and improve conservation of local/ regional biodiversity. Its target area is one of the main transport/ energy corridors linking Portugal to Spain. Through this seminar, we will also gather inputs from shared experiences and networking to use in the Post-LIFE Communication and Conservation Plan.

ORGANISER(S): Organized by LIFE LINES project, University of Évora, in collaboration with Project Partners (Município de Évora; Município de Montemor-o-Novo; Universidade do Porto; Infraestruturas de Portugal, S.A.; MARCA – Associação de Desenvolvimento Local; Quercus A.N.C.N. – Associação Nacional de Conservação da Natureza; Universidade de Aveiro)

PROGRAMME CONTENTS:

TIME	WHAT
10:30	LIFE LINES FINAL SEMINAR – 1:
	#1 Linear Infrastructure Networks with Ecological Solutions
	#2 IP’s participation in LIFE LINES: Reducing Fauna Roadkills and De-fragmenting Habitats
	#3 Bustards and power lines in Portugal: an overview of research done so far and its implications on impact assessment, mitigation and planning
	#4 Predicting wildlife-vehicle collisions using movement simulation models with the novel software <i>SiMRiv</i>
	#5 LIFE, Biodiversity and Infrastructures
12:00	#6 Implementation of volunteer environmental programs
	Break - Lunch + Networking
13:30	LIFE LINES FINAL SEMINAR – 2:
	#1 Assessing behaviour states in a forest carnivore in a road-dominated landscape with hidden Markov models
	#2 Effectiveness of amphibian mitigation measures to reduce roadkills in low traffic roads
	#3 Road effects on Tawny owls (<i>Strix aluco</i>): patterns in road-kills, abundance, population trend, and movements
	#4 Minimization of electrocution risk in priority areas for the Iberian Imperial Eagle (<i>Aquila adalberti</i>)
	#5 Protocols Avifauna – Joint efforts to mitigate bird mortality in powerlines
15:00	#6 Can power line poles bases be used as habitat promotion?
	Closing

LIFE LINES FINAL SEMINAR – 1

SESSION 1.2.1. (Wednesday, 13 January / 10:30 – 12:00)

ROOM Quercus

MODERATOR Nuno Pedroso

#1 Linear Infrastructure Networks with Ecological Solutions

Nuno M. Pedroso (MED - Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal); Anabela Belo (MED – Mediterranean Institute for Agriculture, Environment and Development, Department of Biology, University of Évora, Portugal); João Craveiro, Sofia Eufrazio (MED - Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal); Mariana P. Fernandes, Paula Matono (MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal); André Oliveira, Tiago Pinto (MED - Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal); Carla Pinto-Cruz (MED – Mediterranean Institute for Agriculture, Environment and Development, Department of Biology, University of Évora, Portugal); Luis Guilherme Sousa, António Mira (MED - Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal)

The LIFE LINES project (LIFE14 NAT/PT/001081), located in the Alentejo region, Portugal, aims to essay, evaluate and disseminate practices directed at mitigation of negative effects from transport/energy infrastructures in biodiversity and promote the creation, along them, of a demonstrative Green Infrastructure, based in corridors and stepping stones that can increment connectivity and improve conservation of local/regional biodiversity. In its 5-year duration, the project has contributed, among others, to the decrease in roadkilled fauna, control of invasive flora species, increase in flora / fauna richness and abundance, and contributed to decision support data for balancing linear infrastructures and biodiversity.

KEYWORDS: Roads, Power lines, Roadkill mitigation, Green Infrastructure, Biodiversity

#2 IP's participation in LIFE LINES: Reducing fauna roadkills and defragmenting habitats

Graça Garcia (IP – Infraestruturas de Portugal, Portugal)

Infraestruturas de Portugal (IP) is a public company holding a long-term concession contract of the national road and rail infrastructures. Being one of the partners of LIFE LINES Project, IP is responsible for the implementation of several actions to mitigate fauna roadkills and promote landscape connectivity. Several solutions were implemented such as dry ledges, nets to avoid rabbits on the slopes and barriers to elevate owls' flight. It was also created a national database and a mobile application to record animal

roadkills. Other actions of the Project concern the road verges management and the control of invasive vegetation.

KEYWORDS: Habitat defragmentation, Fauna roadkills, Public awareness

#3 Bustards and power lines in Portugal: an overview of research done so far and its implications on impact assessment, mitigation and planning

João Paulo Silva (CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal); Ana Teresa Marques (CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Instituto Superior de Agronomia da Universidade de Lisboa, Portugal)

Bustards are among the most susceptible threatened birds to collide with overhead power lines. Here we review 10 years of research carried out in Portugal with the little and great bustard, aiming for a better understanding on how power lines may impact these species, what mitigation measures can be implemented and where there is a greater probability for collisions to occur.

KEYWORDS: Bustards, Overhead power lines, Impact, Mitigation, Research review

#4 Predicting wildlife-vehicle collisions using movement simulation models with the novel software *SiMRiv*

Lorenzo Quaglietta, Miguel Porto (CIBIO/InBio – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / CEABN/InBio – Centro de Ecologia Aplicada "Professor Baeta Neves", Instituto Superior de Agronomia da Universidade de Lisboa, Portugal); Adam Ford (Department of Biology, University of British Columbia, Canada)

Real otter (*Lutra lutra*) movements (from radiotracking data) and null models (individual multistate movements simulated using the novel R package *SiMRiv*) incorporating landscape effects (here, water dependence) were compared to evaluate *SiMRiv*'s potential for reproducing wildlife movement patterns and predicting road-kill risk areas. The number of road crossings - and other emergent movement properties - in real and simulated movements were remarkably similar, and limited real otter road-kill data supported *SiMRiv*'s road-kill risk predictions. Overall, thus, *SiMRiv* constitutes a flexible, powerful, and intuitive tool to test mechanistic hypotheses on wildlife movement ecology, including those related to wildlife-vehicle interactions.

KEYWORDS: Landscape connectivity, Individual-based mechanistic movement simulation models, Movement ecology, Road ecology, Road-kill hotspots

#5 LIFE, Biodiversity and Infrastructures

Isabel Lico, Ana M. Santos (APA – Portuguese Environment Agency, Portugal)

The LIFE programme is the EU’s funding instrument for the environment and climate action. The environment sub-programme funds nature conservation projects, in particular, in the areas of biodiversity, habitats and species. In each EU country there is a national contact point to help you with your application. Agência Portuguesa do Ambiente (Portuguese Environment Agency) is the portuguese NCP for LIFE. Since the start of LIFE and until 2018, a total of 174 projects have been funded in Portugal of which 86 on Nature Conservation. With the help of LIFE, European infrastructures are in an ongoing process to be increasingly environmentally friendly.

KEYWORDS: LIFE, Environment, Nature, Climate action

#6 Implementation of volunteer environmental programs

Rosa Coelho, Marta Mattioli, Lúcia Pereira (Marca Associação de Desenvolvimento Local, Portugal)

This communication will target Youth and Institutional Volunteering Program results, demonstrating how they have been developed, showing the added value of it and the difficulties we have been facing, as well as the solutions we have implemented in the linear infrastructures works. In this sense, it should be noted that the implementation of the Youth and Institutional Volunteering Program has been shown to be an asset for the execution of the Life Lines Project actions, in particular green infrastructure development.

KEYWORDS: Citizen awareness, Invasive species, Plant nursery, Plantation, Ecotrail

LIFE LINES FINAL SEMINAR – 2

SESSION 1.2.2. (Wednesday, 13 January / 13:30 – 15:00)

Room: Quercus

MODERATOR: Pedro Salgueiro

#1 Assessing behaviour states in a forest carnivore in a road-dominated landscape with hidden Markov models

Eduardo Ferreira (MED - Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal); Francesco Valerio (MED - Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal / CIBIO/InBIO-UE – Research Center in Biodiversity and Genetic Resources, University of Évora, Portugal); Nelson Fernandes, João Craveiro, Pedro Costa (UBC – Conservation Biology Lab, University of Évora, Portugal); Denis Medinas (CIBIO/InBIO-UE – Research Center in Biodiversity and Genetic Resources, University

of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal); João Paulo Silva (CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal); Carlos Carrapato (ICNF/PNVG – Instituto de Conservação da Natureza e Florestas/Parque Natural do Vale do Guadiana, Portugal); Filipe Carvalho (CIBIO/InBIO – Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Portugal / Department of Zoology and Entomology, University of Fort Hare, South Africa); António Mira, Sara Santos (MED - Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Évora, Portugal)

The barrier effect posed by roads has several negative effects (e.g. long-term population viability, connectivity, behavioural) on some species. Yet, the behavioural consequences of such constraints remain poorly understood. We studied the relationship between common genet (*Genetta genetta*) behaviour and road proximity in southern Portugal using hidden Markov model (HMM) to model the fine-scale movement. Our results suggest that the proximity of roads, along with heterogeneous and fragmented areas, might favour foraging opportunity for genets. On the contrary, genets tend to move larger distances in areas further away from roads, in more dense and homogeneous areas and along riparian habitats.

KEYWORDS: Movement model, Genet, Behaviour, Hidden Markov Models, Roads

#2 Effectiveness of amphibian mitigation measures to reduce roadkills in low traffic roads

Tiago Pinto, Luis Guilherme Sousa, António Mira (UBC – Conservation Biology Lab, University of Évora, Portugal / MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal)

Amphibians are one of the groups most affected by road mortality. We monitored two roads where mitigation measures (amphibian tunnels and concrete guiding barriers) were implemented, in order to evaluate their effectiveness. In the year after the installation, amphibian mortality was dramatically reduced when compared to control areas, with no mitigation measures. In the control areas we registered even a higher number of amphibians roadkills when compared with the previous years. However, more data is needed to account for the long term effect of these measures on amphibian roadkills and viability of their populations in the intervened sites.

KEYWORDS: Amphibians, Roadkill, Mitigation measures, Roads

#3 Road effects on Tawny owls (*Strix aluco*): patterns in road-kills, abundance, population trend, and movements

Rui Lourenço (LabOr – Laboratory of Ornithology, University of Évora, Portugal / MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal); Fernando Goytre (UBC – Conservation Biology Lab, University of Évora, Portugal); Shirley van der Horst, Ana Marques (LabOr – Lab-

oratory of Ornithology, University of Évora, Portugal); Denis Medinas (CIBIO/In-BIO-UE – Research Center in Biodiversity and Genetic Resources, University of Évora, Portugal / UBC – Conservation Biology Lab, University of Évora, Portugal); André Oliveira (UBC – Conservation Biology Lab, University of Évora, Portugal / MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal), Pedro Pereira (LabOr – Laboratory of Ornithology, University of Évora, Portugal); Pandora Pinto (UBC – Conservation Biology Lab, University of Évora, Portugal); Sara Santos, António Mira (UBC – Conservation Biology Lab, University of Évora, Portugal / MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal)

We studied road mortality and abundance of Tawny owl in southern Portugal from 2005 to 2019, more recently within the project LIFELINES. Mortality of tawny owls on roads varied across years and within years. Tawny owls are affected by both main and secondary roads, although the impacts may alter different individual and demographic aspects. Tracking of tawny owls reveals that the movement behaviour relating roads is individual specific, although roads generally are home range boundaries.

KEYWORDS: Disturbance, Movement behaviour, Owls, Population trend, Road-killing

#4 Minimization of electrocution risk in priority areas for the Iberian Imperial Eagle (*Aquila adalberti*)

Paulo A. M. Marques, Bruno H. Martins, Liliana Barosa, Hugo Lousa (LPN – Liga para a Protecção da Natureza, CEAVG – Centro de Educação Ambiental do Vale Gonçalinho, Portugal); Carlos Rochinha (EDP Distribuição - Energia S. A., Portugal); Rita Alcazar (LPN – Liga para a Protecção da Natureza, Portugal)

Electrocution is a significant factor of mortality for Iberian Imperial Eagle (*Aquila adalberti*) and is one of the most important non-natural mortality. To reduce this impact, different types electrocution reduction methods were compared and a “combined” method was used. Mortality rate prior and subsequent to the application was monitored. The results revealed the occurrence of high mortality, (36 birds, in a year) before the application of the protection method. After the application of the “Combined” method, in a total of 27 km of electrical lines (175 pylons, 6 disconnectors), there was no mortality during the following year after the intervention.

KEYWORDS: Iberian imperial eagle, *Aquila adalberti*, Conductor protection cover, Electric line support, Electrocution

#5 Protocols Avifauna – Joint efforts to mitigate bird mortality in powerlines

Julieta Costa (SPEA – Sociedade Portuguesa para o Estudo das Aves, Portugal); Rita Alcazar (LPN – Liga para a Protecção da Natureza, Portugal); Samuel Infante (Quercus, A.N.C.N., Portugal); Rui Machado (SPEA – Sociedade Portuguesa para o Estudo das Aves, Portugal); Rita Ramos (LPN – Liga para a Protecção da Natureza,

Portugal); Paulo Alves (Quercus, A.N.C.N., Portugal); Carlos Rochinha (EDP Distribuição - Energia S. A., Portugal)

Protocols Avifauna 7 and 8 are a step forward in the protection of birds against mortality in powerlines in Portugal. It brings together EDP Distribuição, ICNF, SPEA, LPN and Quercus. These two-year projects continue the previous protocols and target new species and deeper analysis of mitigation methods, such as validated collision risk maps for Great bustard, electrocution risk maps for vulnerable raptor species, new GIS databases and new fields for intervention. It also addresses the long-term effectiveness of mitigation devices and assesses the efficiency in mortality-reduction for new safety, anti-electrocution devices.

KEYWORDS: Powerlines, Bird mortality, Electrocution, Collision, Portugal

#6 Can power lines poles bases be used as habitat promotion?

Mariana P. Fernandes, Paula Matono, Carla Pinto-Cruz, Anabela Belo (MED – Mediterranean Institute for Agriculture, Environment and Development, University of Évora, Portugal)

The wide distribution of power lines poles in the landscapes and the negligible use of their bases enables these areas to be used for promoting wild species populations. Our work aimed to analyse the potential of poles bases to become habitat patches by assessing the effect in flora structure and diversity of the application of three management types (without intervention, fenced, and fenced and sown). Preliminary results suggest that fencing and sowing poles bases is the most suitable solution to attain this goal in grazed areas, since it simultaneously increases the floristic richness and the habitat and refuge for fauna.

KEYWORDS: Biodiversity, Connectivity, Restoration, Vegetation structure

Training Session



MONITORING WILDLIFE CROSSINGS AND ROADKILLS

Monday, 11 January

This course is suitable for students, young researchers and practitioners involved in projects targeting the identification of roadkill hotspots and evaluation of the effectiveness of measures aiming to mitigate road-barrier effect and mortality. It includes sessions focused on the importance of monitoring road mortality and the effectiveness of wildlife crossings and fencing. Information provided will help the definition of monitoring aims and targets, and the selection of the best protocols and techniques to respond to each project specific goals. Participants will also receive basic training on data analyses and associated software. Participants will be invited to discuss, in situ, monitoring results considering the methodological protocol that has been used and the landscape context. The field trip initially planned for the second day was cancelled and the training course is now scheduled for a full-day online Theoretical-practical session.

INSTRUCTORS: Carme Rosell (Minuartia, LIFE Safe Crossing, Spain); António Mira, Sara Santos (University of Évora, LIFE LINES, Portugal); Michal Bíl (CDV – Transport Research Centre, Czech Republic); Marina Torrellas (Minuartia, LIFE Safe Crossing, Spain); Nuno Pedroso, Luis G. Sousa (University of Évora, LIFE LINES, Portugal)

PROGRAMME CONTENTS:

1. ROADKILLS

- a. Why monitor roadkills?
- b. Roadkill survey methods and protocols:
 - b.i. Traditional methods
 - b.ii. Innovative devices for automatic detection and identification of car-casses using artificial intelligence
- c. Planning and executing a road kill monitoring program:
 - c.i. The need for standardized sampling designs
 - c.ii. Defining goals
 - c.iii. Identifying the data and resources that are needed
 - c.iv. Identifying possible constrains
 - c.v. Undertaking the roadkill survey
- d. Analysing and reporting roadkill data

2. WILDLIFE CROSSINGS / FENCING

- a. Goals of wildlife crossings and fencing in the overall mitigation strategy
- b. Fencing:
 - b.i. Fencing types according to target species
 - b.ii. Key points to be monitored to check appropriate status and functionality
- c. Wildlife crossings:
 - c.i. Main types of wildlife overpasses and underpasses
 - c.ii. Goals and target species according to type
 - c.iii. Key features to be registered in the crossing and its surroundings
- d. Implementing a wildlife crossing monitoring program:
 - d.i. Defining monitoring goals and targets
 - d.ii. A framework for standardized sampling design
 - d.iii. Methods and devices to monitor wildlife crossing data according to target species
 - d.iv. Analyzing wildlife crossing data and evaluating effectiveness



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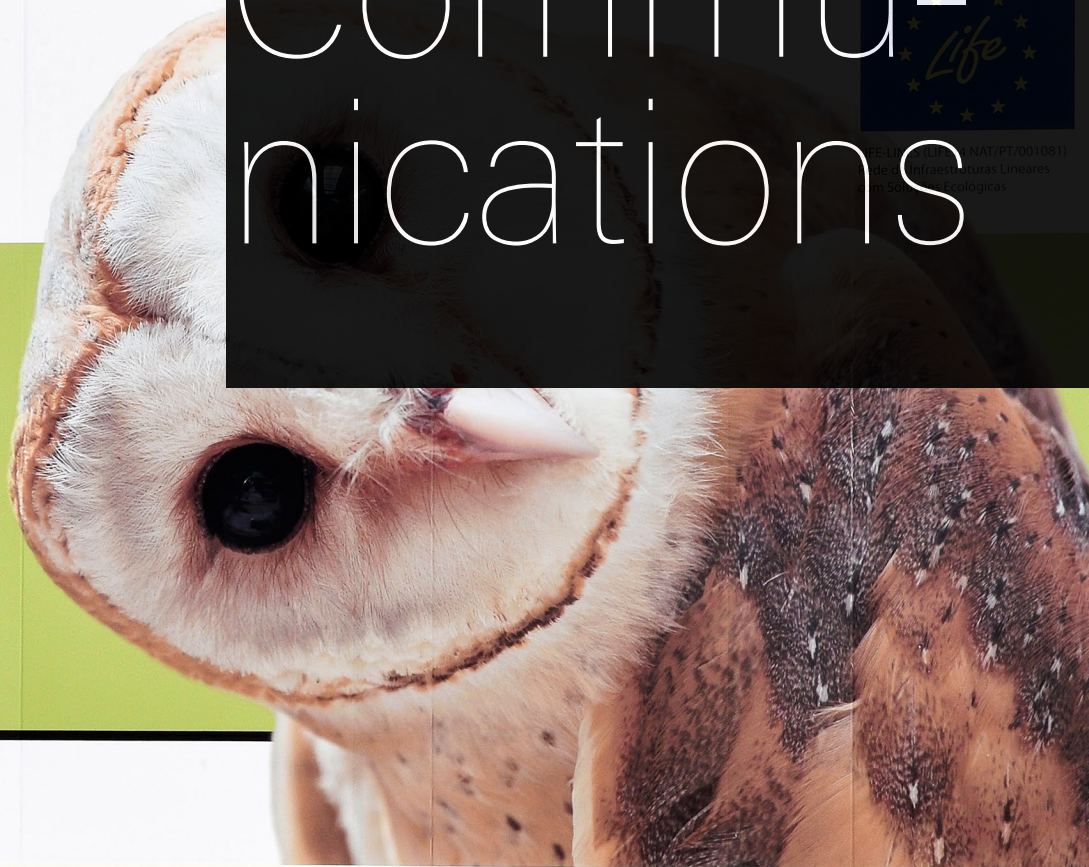


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List of
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Full Presentations

SESSION 1.1.1. INFRASTRUCTURE ECOLOGICAL MITIGATION AND DEFRAGMENTATION – 1

#1 Managing knowledge after 15 years of defragmentation - Adam Hofland, Camiel Meijneken

#2 "Breaking down" global defragmentation concepts to a macro-region – the example of the Danube River Basin - Anneliese Fuchs, Michael Jungmeier

#3 Risks and opportunities for wildlife living in road dominated environments. What pieces are missing to complete the puzzle? - António Mira, Ana Galantinho, Denis Medinas, Helena Sabino-Marques, Carmo Silva, Sara Santos

#4 Developing mitigation strategies to reduce the impact of land transport infrastructures on Amphibian populations: the example of Denmark, Sweden, Poland, Lithuania and Estonia - Lars Briggs, Alix Aliaga

#5 Use of snow-tracking to evaluate the impact of Linear Transportation Infrastructures on wolf and ungulates - Sandro Bertolino, Aurelio Perrone, Giulia Mutinelli, Massimo Rosso, Elisa Ramassa, Elisa Avanzinelli

#6 The barrier effect of railways and other linear grey and green infrastructure on the small fauna - Heinrich Reck, Henning Nissen

SESSION 1.1.2. INFRASTRUCTURE ECOLOGICAL MITIGATION AND DEFRAGMENTATION – 2

#1 Do roadkill of different species respond in the same way to habitat and matrix? The case of four Brazilian mammals - Douglas W. Cirino, Artur Lupinetti, Simone R. Freitas

#2 Do culverts contribute to reduce the number of roadkills? A study on roadkills along the Habarana-Polonnaruwa road, Sri Lanka - Dishane Hewavithana, Devaka Weerakoon, Mayuri Wijesinghe, Christopher Searcy

#3 Risk analysis of high-voltage power lines in Belgium to map bird collision-prone spans - Dominique Verbelen, Kristijn Swinnen, Antoine Derouaux, Jean-Yves Paquet, Johan Mortier

#4 Maturity-index assessment: ecology adaptation within road authorities doesn't come easy - Camiel Meijneken, Adam Hofland

#5 Developing an ecological defragmentation programme in Flanders: a challenge! - Katja Claus, Marleen Moelants, René Meeuwis, Joris Everaert

SESSION 1.3.1. INFRASTRUCTURE MITIGATION AND DEFRAGMENTATION

#1 The Corridor Map-a-Thon: crowdsourcing baseline spatial data and building capacity to assess wildlife corridor disruption by infrastructure - Grant Connette, Katie LaJeunesse Connette, Eunkyung Kwong, Sai Than Lwin, Hanna Helsingen, Paing Soe, Nirmal Bhagabati

#2 Eskom/Endangered Wildlife Trust partnership 1996 – 2020, 24 years of partnering together to reduce impacts on business and on biodiversity - Kishaylin Chetty, Lourens Leeuwner, Constant Hoogstad

#3 Building an electrocution risk map with overhead power lines for a critically endangered raptor in Portugal - Ana Teresa Marques, João Paulo Silva, Carlos Carrapato, Rita Ramos, Francisco Moreira, Jorge Palmeirim

#4 Effectiveness of an anti-bird strike tubular screen in a high-speed railway - J. Herranz, L. Falcao, I. Hervás, C. Mata, A. E. Santamaría, E. García de la Morena, J. E. Malo

#5 Experimental evaluation of crossing structures used by amphibians along a high-speed railway line - Guillaume Testud, Dorothée Labarraque, Claude Miaud

#6 Acoustic Animal Detering Device as a mitigation measure to limit collisions of rail vehicles with wild animals - Joanna Żyłkowska, Marek Stolarski, Dorota Bartoszek-Majewska

SESSION 1.3.2. NEW TOOLS AND TECHNOLOGIES TO PREVENT AND MONITOR LINEAR INFRASTRUCTURE IMPACTS – 1

#1 The conflict points between green and transport infrastructure–methodology for the multicriterial assessment - Ivo Dostál, Marek Havlíček

#2 Automatic acoustic monitoring of wildlife - Julien Ricard

#3 Using evidence-based approaches and evidence customization to improve mitigation practice - Silviu Petrovan

#4 BioBIM – Biodiversity, BIM & Infrastructures - Sylvain Moulherat, Denis Leroux, Martin Barbier, Christophe Delran

#5 The TRANSGREEN Project – Integrated Transport and Green Infrastructure Planning in the Danube-Carpathian Region for the Benefit of People and Nature – a cross-sectoral contribution to the improvement of permeability of linear infrastructure in the Carpathians - Lazaros Georgiadis, Hildegard Meyer, Miroslav Kutal, Vaclav Hlavac, Martin Strnad, Ivo Dostál, Jan Kubeček, Gabriella Nagy, Csaba Domokos, Tibor Sos, Radu Mot, Cristian-Remus Papp, Diana Cosmoiu, Catalina Murariu, Katarina Galiková, Jan Kadlečík, Tereza Thompson, Maros Finka, Vladimir Ondrejčka, Milan Husar, Elke Hahn

#6 ICF Ecosystem Connectivity Planning Tool: A Web-based Tool Identifying Opportunities for Improved Ecosystem Connectivity - Shannon Crossen, Jon Walker, Matthew Townley, Martin Fisher

SESSION 1.3.3. ROADS AND MAMMALS: ECOLOGICAL IMPACTS AND SOLUTIONS

#1 Effectiveness of wildlife fences in reducing Key deer road mortality on the Florida Keys, USA; the importance of implementing mitigation measures at the appropriate spatial scale - Marcel P. Huijser, James S. Begley

#2 Dry pathways and flowing water within culverts jointly promote crossings by carnivore mammals - João Craveiro, Joana Bernardino, António Mira, Pedro G. Vaz

#3 Why, When and How Giant Anteaters Cross Roads? Understanding Impacts and Ef-

fects of Roads on Giant Anteater Populations - [Arnaud Desbiez](#), [Fernando Ascensão](#), [Danilo Kluber](#), [Débora Yogui](#), [Mariana Catapani](#), [Mário Alves](#)

#4 New approaches to avoiding and mitigating the effects of streetlighting on bats - [Fiona Mathews](#), [Domhnall Finch](#), [Paul Jerem](#)

#5 Effects of roads on European badger occurrence in intensively used Mediterranean farmland - [Ricardo Pita](#), [Rui Morgado](#), [Francisco Moreira](#), [António Mira](#), [Pedro Beja](#)

SESSION 4.1.1. WILDLIFE AND LINEAR INFRASTRUCTURE INTERACTIONS: FIELD MONITORING AND ECOLOGICAL SOLUTIONS – 1

#1 Infrastructures, human activities and biodiversity in co-evolution: the examples of Upper-Rhine, Danube and Inn - [Andreas Huber](#), [Sebastian Weber](#), [Jean-Nicolas Beisel](#), [Cybill Staenzel](#), [Carine Granier](#), [Manon Pons](#)

#2 Biological control of invasive Tree of Heaven (*Ailanthus altissima*) along linear infrastructures using Ailantex® - [Erhard Halmschlager](#), [Oliver Maschek](#), [Thomas Kirisits](#)

#3 Citizen participation improves the quality of green infrastructure at road verges in Poland - [Piotr Tyszek-Chmielowiec](#)

#4 Factors driving the distribution of an amphibian community in stormwater ponds: a study case in the agricultural plain of the Bas-Rhin, France - [Jonathan Jumeau](#), [Julien Lopez](#), [Alain Morand](#), [Lana Petrod](#), [Françoise Burel](#), [Yves Handrich](#)

#5 Maintenance of ecological asset on transport infrastructure: new chapter in the online 'Wildlife and Traffic' handbook - [Carme Rosell](#), [Vincent O'Malley](#), [Elke Hahn](#), [Adam Hofland](#), [Tony Sangwine](#), [Anders Sjölund](#), [Marina Torrellas](#), [Joana Colomer](#), [Michal Bíl](#), [Heinrich Reck](#)

#6 Introducing 'www.TransportEcology.info': An online, open access resource to globally share information, knowledge and experience in ecologically-friendly linear infrastructure - [Rodney van der Ree](#), [Clara Grilo](#), [Wendy Collinson-Jonker](#)

SESSION 4.1.2. NEW TOOLS TO MONITOR ECOLOGICAL IMPACTS OF LINEAR INFRASTRUCTURES

#1 Evaluating the impacts of highway mitigation measures for fish connectivity using radio-telemetry and RFID PIT-tagging technologies in France - [Yann Abdallah](#), [Cédric Heurtebise](#), [Arnaud Caudron](#)

#2 Monitoring the expansion of alien species along roads with remote sensing - [Neftalí Sillero](#), [Patrícia Lourenço](#), [Ana Cláudia Teodoro](#), [José Alberto Gonçalves](#), [João Honrado](#), [Mário Cunha](#)

#3 Mobile mapping system (MMS2) for detecting Roadkills - [Hélder Ribeiro](#), [Neftalí Sillero](#), [Diana Guedes](#)

#4 Improving Wildlife Fencing for Herpetofauna to Ensure Effective Implementation: An Analysis of Global Mitigation Case Studies - [Steve Bega](#)

#5 A simulation of WVC underreporting to hotspot spatial stability - [Michal Bíl](#), [Richard Andrášik](#)

SESSION 4.2.1. ROAD ECOLOGY: IMPACT ASSESSMENT, MITIGATION AND MONITORING – 1

#1 Monitoring a mature ecoduct: Intensive camera surveillance confirms significant increase in crossing rates and diversity after 13 years - [Darryl A Jones](#), [Ben Mackenzie](#), [Kat Mackenzie](#)

#2 Mitigating barn owl traffic victims using innovative design and citizen science data - [Jasja Dekker](#), [Johan De Jong](#), [Nico Jonker](#), [Karen Zwerver](#)

#3 Development and Challenge of Green Highway Construction in China - [Chen Xueping](#), [Jian Li](#), [Yang Yangang](#), [Yao Jialin](#), [Gao Shuohan](#), [Wu Qiong](#), [Wang Mengmeng](#)

#4 Protecting the protected through assessing driver behaviour in protected areas of South Africa - [Wendy Collinson](#), [Courtney Marneweck](#), [Harriet Davies-Mostert](#)

#5 Estimating roadkill risk when there is no roadkill data - [Eloy Revilla](#), [Andrea Barón](#), [Marcello D'Amico](#), [Juan Carlos Rivilla](#), [Carlos Rodríguez](#), [Jacinto Román](#)

#6 Roadkill as a Threat to Global Mammal Conservation - [Clara Grilo](#), [Luis Borda-de-Água](#), [Pedro Beja](#), [Eric Goolsby](#), [Kylie Soanes](#), [Aliza le Roux](#), [Elena Koroleva](#), [Flávio Z. Ferreira](#), [Sara A. Gagné](#), [Yun Wang](#), [Manuela González-Suaréz](#)

SESSION 4.2.2. ROAD ECOLOGY: IMPACT ASSESSMENT, MITIGATION AND MONITORING – 2

#1 Factors affecting usage rates of wildlife crossing structures – a systematic review and meta-analysis - [Dror Denneboom](#), [Avi Bar-Massada](#), [Assaf Shwartz](#)

#2 Roadkills in Europe: areas of high risk of collision and critical for populations persistence - [Clara Grilo](#), [Elena Koroleva](#), [Richard Andrášik](#), [Michal Bíl](#), [Manuela González-Suárez](#)

#3 A national program to monitor fauna roadkills in Portugal - [Graça Garcia](#)

#4 Wildlife-vehicle accident maps – a new support tool for mitigation planning and communication in Sweden - [Andreas Seiler](#), [Mattias Olsson](#), [Sofia Willebrand](#), [Ulrika Lundin](#), [Anders Sjölund](#)

#5 Scary sounds as a tool to prevent moose – train collisions in Norway and Sweden - [Svein Morten Eilertsen](#), [Petter Almås](#), [Næstad Frode](#), [Aina Winsvold](#), [Karen Marie Mathisen](#)

#6. Roads as overlooked drivers of change in bird communities - [Fernando Ascensão](#), [Eloy Revilla](#), [Henrique M. Pereira](#)

SESSION 4.3.1. INFRASTRUCTURE ECOLOGICAL MITIGATION AND DEFRAGMENTATION – 3

#1 The use of culverts in road networks as roost sites to maintain landscape connectivity for a trawling bat: a case study of the large-footed myotis (*Myotis macropus*) in Australia - [Vanessa Gorecki](#), [Ramona Maggini](#), [Boyd Tarlinton](#), [Caroline Hauxwell](#), [Stuart Parsons](#)

#2 Road effect zones of major prey species in roaded landscapes in India - [Akanksha Saxena](#), [Asha Rajvanshi](#), [Bilal Habib](#)

#3 Speed thrills but kills: Roadkill scenario in National Highway 715 (new) passing through the Kaziranga National Park, Assam, India - [Somoyita Sur](#), [Jaydev Mandal](#), [Prasanta Kumar Saikia](#)

#4 Graph-based multi-attribute decision making: Impact of barriers on ecological network - [Andrius Kučas](#), [Linas Balčiauskas](#)

#5 Multi-level landscape analysis of wildlife vehicle collision sites in Estonia - [Jaanus Remm](#), [Piret Remm](#), [Kaile Eschbaum](#), [Kertu Jaik](#)

SESSION 4.3.2. ROAD ECOLOGY: IMPACT ASSESSMENT, MITIGATION AND MONITORING – 3

#1 A green light for blue wildlife reflectors? - [Edgar A. van der Grift](#), [Fabrice G. W. A. Ottburg](#), [Dennis R. Lammertsma](#), [Frans P. J. van Bommel](#)

#2 Evaluation of an Animal Detection System (ADS) as an alternative for large defragmentation infrastructures - [Marleen Moelants](#), [Stan Bollen](#), [Guido Winters](#), [Katja Claus](#)

#3 Hit the road Jane! Roads decrease the relatedness for females lesser horseshoe bats - [Denis Medinas](#), [João Tiago Marques](#), [Vera Ribeiro](#), [Hugo Rebelo](#), [Soraia Barbosa](#), [Joana Paupério](#), [Francesco Valerio](#), [Sara Santos](#), [António Mira](#)

#4 Mapping and monitoring large mammal underpasses on motorway A29 - [Maria Psaralexí](#), [George Lyberopoulos](#), [Elina Theodoropoulou](#), [Yiannis Tsaknakis](#), [Athanasios Tragos](#), [Yiorgos Lazaros](#), [Niki Voumvoulaki](#), [Carme Rosell](#), [Marina Torrellas](#), [Spyros Psaroudas](#), [Yiorgos Mertzanis](#)

#5 The value of a non-scientific approach for road agencies - [Victor Loehr](#), [Japp Mulder](#)

#6 LIFE SAFE-CROSSING: A new international project for preventing large carnivore road mortality in Europe - [Annette Mertens](#), [Simone Ricci](#), [Fabio Papini](#), [Mihai Fedorca](#), [Spyros Psaroudas](#), [Inigo Fajardo](#), [Carme Rosell](#), [Antonio Antonucci](#), [Andrea Gennai](#)

SESSION 4.3.3. CHALLENGES AND OPPORTUNITIES FOR BIODIVERSITY CONSERVATION IN LINEAR INFRASTRUCTURES

#1 How do roads affect the ecological processes and biodiversity? – summing up a systematic literature review for the decade 2008-2018 - [Hans Martin Hanslin](#), [Johannes Kollmann](#), [Svenja Kroeger](#), [Larissa Uhe](#), [Sabrina Behrendt](#), [Jörgen Wissman](#), [Tommy Lennartsson](#), [Jan Christian Habel](#), [Marcello D'Amico](#), [Knut Anders Hovstad](#)

#2 The Brazilian Network of Transport Ecology Specialists (REET Brasil) - [Simone Freitas](#), [Clarissa Rosa](#), [Helio Secco](#), [Mariane Biz](#), [Fernanda Teixeira](#), [Marcelo Gordo](#)

#3 Creating high voltage power lines green corridors: how to demonstrate a win-win strategy? - [Lisa Garnier](#), [Bruno Salvi](#), [Agnès Baccelli](#), [Amélie Lafrayette](#), [Christophe Martinez](#), [Damien D-Eaubonne](#), [Gérald Sambardier](#), [Sandrine Willer](#), [Fabien Merpillat](#), [Delphine Bonnifay](#), [Juliette Auger](#), [Emma-Pacome Vejux](#), [Alexis Roset](#), [Luc Estachy](#), [Grégoire Martin](#), [Kevin Rossi](#), [Etienne Dupuy](#), [Gérard Jadoul](#), [Jean-François Godeau](#), [Céline Davril-Bavois](#), [Nicolas Bock](#), [Jean-François Lesigne](#)

#4 Protection of birds on power lines in the Czech Republic – from monitoring to practical measures - [Václav Hlaváč](#)

#5 Assessing Biodiversity in Railway Dry Grassland Patches - [Magnus Stenmark](#)

#6 Determination of the bird protection effectiveness of animal deflectors on railway overhead lines - [Jana Görlich](#), [Stefan Kornhuber](#), [Hans-Peter Pampel](#), [Christoph Jöckle](#), [Marion Leiblein-Wild](#)

SESSION 5.1.1. INFRASTRUCTURE ECOLOGICAL MITIGATION AND RESTORATION – 1

#1 Make amphibian defragmentation infrastructures great (again?) - [Kristijn Swinnen](#), [Ilf Jacobs](#), [Griet Nijs](#), [Simon Feys](#), [Karin Gielen](#), [Dominique Verbelen](#), [Jorg Lambrecht](#), [Katja Claus](#)

#2 AMPHIBIAN CONSERVATION AND HABITAT RESTORATION (LIFE AMPHICON) - [Katja Poboljšaj](#)

#3 Assessing the ability of modern metapopulation models to mimic real life using genetic data - [Sylvain Moulherat](#), [Jonathan Remon](#), [Jérôme G. Prunier](#), [Gaël Bardon](#), [Aurélien Coulon](#)

#4 Road proximity affects reproductive investment in lizards: a two-years translocation experiment - [Rodrigo Megía-Palma](#), [Rafael Barrientos](#)

#5 ControllnRoad: Controlling invasive alien plant species along roads - [Friederike Trognitz](#), [Swen Follak](#), [Alexander Fördös](#), [Norbert Sedlacek](#), [Herbert Seelmann](#), [Maximilian Koch](#), [Angela Sessitsch](#)

SESSION 5.1.2. WILDLIFE AND LINEAR INFRASTRUCTURE INTERACTIONS: FIELD MONITORING AND ECOLOGICAL SOLUTIONS – 2

#1 Risky wandering close to the railway: flight behavior of birds across the platform and viaducts in a high-speed railway - [J. E. Malo](#), [I. Hervás](#), [C. Mata](#), [A. E. Santamaría](#), [J. Herranz](#)

#2 Linking habitat composition, local population densities and traffic characteristics to spatial patterns of ungulate-train collisions - [Karolina D. Jasińska](#), [Michał Żmihorski](#), [Dag-ny Krauze-Gryz](#), [Dorota Kotowska](#), [Joanna Werka](#), [Tomas Pärt](#)

#3 Are railways really detrimental to bird populations? The case of the new Bothnia Line Railway in northern Sweden - [Adriaan de Jong](#)

#4 Bird mortality by collision with transmission power lines: analysis of 15 years of impact assessment in Portugal - [Ricardo C. Martins](#), [Teresa Marques](#), [João P. Silva](#), [Francisco Moreira](#)

#5 Effects of linear infrastructures on the composition of local vertebrate scavenger guilds and bird carcass removal patterns in two Mediterranean agricultural landscapes - [Joana Bernardino](#), [Regina Bispo](#), [Ricardo C. Martins](#), [S. Santos](#), [Francisco Moreira](#)

#6 UIC Ecological Effects of Railways on Wildlife project (rEvERsE) - [Pinar Yilmazer](#), [Thomas Schuh](#), [Lucie Anderton](#)

SESSION 5.2.1. GREEN INFRASTRUCTURE NETWORKS: POLICY AND STRATEGIC PLANNING

#1 German's federal waterways – A linear infrastructure network for nature and transport - [Volker Steege](#), [Dirk Dr. Engelbart](#), [Nicole Hädicke](#), [Kai Schäfer](#), [Jennifer Dr. Wey](#)

#2 Developing projects for harmonization of Green and Grey Infrastructure (the HARMON project experience in the Danube Region) - Radu Mot, Florina Ciubuc, Lazaros Georgiadis, Miroslav Kutal, Emma Gileva, Roland Grillmayer, Niki Voumvoulaki, Roxana Stoian, Elke Hahn, Anders Sjölund, Hildegard Meyer, Cristian-Remus Papp

#3 From technology to strategy: developments and perspectives of research in infrastructure and ecosystems - Yannick Autret, Judith Raoul-Duval, Bruno Villalba, Sylvie Van Peene, Héloïse Benard

#4 The SaveGREEN Project – Safeguarding the functionality of transnationally important ecological corridors in the Danube basin - Hildegard Meyer, Roland Grillmayer, Emma Gileva, Petko Tsvetkov, Miroslav Kutal, Ivo Dostál, Jan Kubeček, Gabriella Nagy, Árpád Ferincz, Krisztina Filepné Kovács, Laszlo Kollanyi, András Weiperth, Radu Mot, Alexandra Doba, Marius Nistorescu, Cristian-Remus Papp, Diana Cosmoiu, Barbara Immerova, Milan Janak, Maros Finka, Milan Husar, Vladimir Ondrejčka, Elke Hahn, Lazaros Georgiadis

#5 Mapping ecological corridors to educate policymakers and the public - Jan Mampaey, Thomas Impens

SESSION 5.2.2. CITIZEN SCIENCE AND THE INVOLVEMENT OF CIVIL SOCIETY – 1

#1 Are largescale citizen science data precise enough to determine road-kill patterns? - Pablo Quiles, Fernando Ascensão, Marcello D'Amico, Eloy Revilla, Rafael Barrientos

#2 Using citizen science to survey roadkill at wide spatio-temporal scales - Wendy Colinson

#3 Using citizen science to uncover temporal patterns of wildlife roadkill in the UK - Amy L. W. Schwartz, Robert J. Thomas, Elizabeth Chadwick, Sarah E. Perkins

#4 Integration of sensory qualities in landscape modelling and its effect on infrastructural resilience - Lucía Jalón Oyarzun, Dieter Dietz, Aurélie Dupuis, Julien Lafontaine Carboni

SESSION 5.3.1. MANAGING BIODIVERSITY ALONG ROAD VERGES

#1 Integrating the ecological quality of highway verges in the road assets: a new evaluation tool - Marguerite Trocmé

#2 Testing wild plants seed mixtures along grey infrastructures - Mariana P. Fernandes, Paula Matono, Carla Pinto-Cruz, Anabela Belo

#3 Using remote-sensing to map suitable road verges for a rare small mammal, the Cabrera vole (*Microtus cabreræ*) - Francesco Valerio, Eduardo Ferreira, Sérgio Godinho, Ricardo Pita, António Mira, Nelson Fernandes, Sara M. Santos

#4 How roadside belts can be managed for a sustainable environment? - Noreen Khalid, Naila Hadayat, Sumreen Anjum

#5 Road Ecology, Challenges and Mitigation: A case study from Abohar Wildlife Sanctuary, Fazilka, Punjab, India - Khursid A. Khan, A. K. Bhardwaj, S. P. Goyal, A. Rajvanshi, K. Ramesh

#6 Results of the management on biodiversity along species rich roadsides in Sweden - Mats Lindqvist, Johanna Lindberg

SESSION 5.3.2. INFRASTRUCTURE ECOLOGICAL MITIGATION AND DEFRAGMENTATION – 4

#1 Ecological efficiency of an eco-bridge: Lessons from the Adrets-de-L'Esterel eco-bridge on the A8 Highway (Southeast of France) - Jean-Louis Malfère, Hippolyte Pouchelle, Christian Xhardez, Dorothée Labarraque

#2 Importance of roadside habitats for biodiversity: what do we know? - Svenja B. Kroeger, Marcello D'Amico, Hans M. Hanslin, Knut A. Hovstad, Johannes Kollmann; Tommy Lennartson

#3 Monitoring of green bridges in Austria - Brigitte Sladek, Elisabeth Ransmayr

#4 The SLOSS dilemma of road ecology – Single Large Or Several Small fauna passages? - Jan Olof Helldin

#5 Towards next level in Road Ecology: from counting road-kills to assessing population impacts - Rafael Barrientos, Fernando Ascensão, Marcello D'Amico, Clara Grilo, Henrique M. Pereira

#6 Is Connectivity Conservation via Wildlife Corridors/Linkages Sufficient? - Fraser Shilling

SESSION 5.3.3. ROAD ECOLOGY: IMPACT ASSESSMENT, MITIGATION AND MONITORING – 4

#1 Wildlife hotspots prediction with artificial intelligence algorithms, geographic information systems and multispectral image processing - Juan Carlos González-Vélez, Juan Carlos Jaramillo-Fayad, Juan Pablo Murillo-Escobar, Maria Constanza Torres-Madroño

#2 A simple analytical model for predicting the fence-end effect and the minimum length for wildlife fencing to be effective - Jochen A. G. Jaeger, Stefano Re

#3 Prioritizing road sections for wildlife fencing: Including the fence-end effect - Stefano Re, Jochen A.G. Jaeger

#4 Standardized WVC Data Collection at Large Extents - Fraser Shilling

#5 Road mortality mitigation measures: concrete fence for amphibians - Antonin Conan, Meven Le Brishoual, Lorène Garnier, Nicolas Durr, Nathan Dehaut, Jonathan Jumeau, Jean-Yves Georges, Yves Handrich

#6 Canopy bridges: Innovative mitigation solutions for arboreal mammals - Tremaine Gregory, Fernanda Abra, Farah Carrasco Rueda, Jessica Deichmann, Joseph Kolowski, Alfonso Alonso

Lightning Talks

SESSION 1.3.4A. MANAGING INFRASTRUCTURE MARGINAL HABITATS FOR BIODIVERSITY

#1 Developing road verges' hosting capacity for wild bees: why and how - Denis François, Violette Le Féon

#2 Moving on the verge: effects of traffic intensity and quality of the road verge on the movement of pollinating insects - Juliana Dániel Ferreira, Jörgen Wissman, Åsa Berggren, Erik Öckinger

#3 Both roads and power line corridors contribute to landscape scale biodiversity of plants and insects - Erik Öckinger, Juliana Dániel-Ferreira

#4 Feasibility of local partnerships for a more biodiversity-friendly management of linear infrastructure right-of-ways - Denis François, Claire Etrillard, Pascal Gastineau

#5 Enhancing biodiversity on Great Britain's railway network - Richard Pywell, Neil Strong, Rory O'Connor

SESSION 1.3.4B. MANAGING AND MONITORING ECOLOGICAL IMPACTS OF LINEAR INFRASTRUCTURES

#1 Environmental monitoring of reptiles across a wildlife overpass - Marcus Elfström, Mats Lindqvist

#2 Avian electrocution risk: a framework for prioritizing the conservation of species and areas across large spatial scales - L. D. Biasotto, F. Moreira, G. A. Bencke, M. D'Amico, A. Kindel, F. Ascensão

#3 The Afsluitdijk, an important ecological connection - Dennis Wansink, Sophie Lauwaars

#4 How well fences work? - Andrius Kučas, Linas Balčiauskas

#5 Green and blue infrastructure: How trees can accompany our rivers and canals Conflicts - Solutions – Implementation - Katharina Dujesiefken

SESSION 2.3.3A. NEW TOOLS TO MITIGATE AND MONITOR ECOLOGICAL IMPACTS OF ROADS

#1 Making the road more permeable to wildlife using existing infrastructure - Dishane Hewavithana, Devaka Weerakoon, Christopher Searcy

#2 New real-time mitigation measures based on animal-vehicle collision spatio-temporal models - Victor Javier Colino-Rabanal, Roberto Rodríguez-Díaz, Maria Jose Blanco-Villagas, Miguel Lizana Avia

#3 Daily, Annual and interannual variations of wildlife underpasses use by small and medium-sized mammals: a study case in the agricultural plain of the Bas-Rhin, France - Jonathan Jumeau, Robert Matthieu, Oriane Marquot, Françoise Burel, Yves Handrich

#4 A comparison of camera trap and permanent recording video camera efficiency in wildlife underpasses - Jonathan Jumeau, Lana Petrod, Yves Handrich

#5 Bat Overpasses as a Solution to Increase Habitat Connectivity Depending on the Context - Fabien Claireau, Yves Bas, Jean-François Julien, Nathalie Machon, Cédric Heurtebise, Philippe Chavaren, Benjamin Allegrini, Sébastien J. Puechmaille, Christian Kerbiriou

SESSION 2.3.3B. INFRASTRUCTURE ECOLOGICAL MITIGATION AND RESTORATION – 2

#1 From dumpsite to nature sanctuary - Thomas Schuh, Alexandra Wieshaider, Joahanna Scheiblhofer

#2 A guidance system for amphibians made of recycled guardrails in Kirchberg on the Raab (County Styria / Austria) – a successful alternative - Frank Weihmann, Wolfgang Lanner

#3 Condition of amphibian road mitigation constructions in Sweden - Emma Håkansson, Jan Olof Helldin

#4 Design and test of a semi-automated system based on time-lapse camera trapping for the monitoring of wildlife overpass use by amphibians - Julian Pichenot, Céline Muller, Stéphanie Aravecchia, Cédric Pradalier, Gérald Tekielak, Alain Morand

#5 Species-rich Energy production - Anders Sjölund, Eva Ditlevsen, Julia Litborn, Håkan Johansson

#6 A dynamic restoration index to monitor and assess fragmentation reduction along a trans-Andean pipeline - Reynaldo Linares-Palomino, Héctor Chuquillanqui Soto, Bruno Vildoso-Giesecke, Godofredo Mamani, Alfonso Alonso

SESSION 4.3.4A. ROADKILLS IMPACT ASSESSMENT, MITIGATION AND MONITORING

#1 Assessing the relative effect of road- and carcass-related factors on searcher efficiency: implications for future roadkill monitoring programmes - Joana Bernardino, Regina Bispo, Francisco Moreira, Sara Santos

#2 Evaluation of the impact of road infrastructure on vertebrate mortality and possible measures for ecological connectivity in the landscape in the Aburra Valley, Colombia - Juan Carlos Jaramillo-Fayad, Maria Mercedes Velásquez-López, Juan Carlos González-Vélez, Jose Luis González-Manosalva

#3 The most roadkilled mammal species in Brazil, considering sampling effort, detectability and removal rates - Simone Freitas, Fernando Pinto, Douglas W. Cirino, Rubem Dornas, Fernanda Teixeira

#4 Are movement corridors coincident with areas of high road-kill likelihood? A study for felids in Brazil - Rafaela Cobuci Cerqueira, Paul Leonard, Lucas Gonçalves da Silva, Alex Bager, A. P. Clevenger, Jochen A. G. Jaeger, Clara Grilo

#5 A Transport Ecology Workshop towards developing sustainable transportation in national and international level in Myanmar - Hans Bekker, Lazaros Georgiadis, Elke Hahn, Sai Than Lwin, Hanna Helsing

SESSION 4.3.4B. WILDLIFE AND LINEAR INFRASTRUCTURE INTERACTIONS: FIELD MONITORING AND ECOLOGICAL SOLUTIONS – 3

- #1 Birdprotection on railways - Julian Heger, Gerold Punz, Thomas Schuh
- #2 The need to consider searcher efficiency and carcass persistence in railway wildlife fatality studies - Bibiana Terra Dasoler, Andreas Kindel, Júlia Beduschi, Larissa D. Biasotto, Rubem A. P. Dornas, Larrissa Oliveira Gonçalves, Pryscilla Moura Lombardi Talita Menger, Gabriela Schuck de Oliveira, Fernanda Teixeira
- #3 Routing power lines in Brazil: towards an environmental and engineering friendly framework for reducing conflicts in the planning phase - L. D. Biasotto, F. G. Becker, A. A. R. Nobrega, A. Kindel
- #4 Level and spatial scale of impact from different linear development types - Dishane Hewavithana, Devaka Weerakoon, Mayuri Wijesinghe, Christopher Searcy
- #5 Shedding a Light on Sensory Pollution in Road and Railway Ecology - Manisha Bhardwaj

SESSION 5.3.4A. NEW TOOLS AND TECHNOLOGIES TO PREVENT AND MONITOR LINEAR INFRASTRUCTURE IMPACTS – 2

- #1 Is field technician’s work under threat? Video-recoding vs. traditional observation for monitoring flight behaviour of birds across a high-speed railway - A. E. Santamaría, G. Fabbri, J. E. Malo, I., Hervás, C. Mata, J. Herranz
- #2 An analysis of Vulture mortalities on powerlines in South Africa from 1996 – 2018 - Lourens Leeuwner, Kishaylin Chetty
- #3 Hotspots in the Grid: The Spatial Distribution of Bird-Energy Interactions in Europe and North Africa - Jethro Gauld, Wolfgang Fiedler, Steffen Oppel, Andrea Flack, Flavio Monti, Olivier Duriez, Andrea Sforzi, Carlos Carrapato, Thomas Lameris, Andrea Flack, Andrea Kozelzsch, Guilad Friedemann, Ivan Pokrovsky, Klaus-Michael Exo, Ramunas Zydelis, Midaugas Dagys, Ran Nathan, Bernd Vorneweg, Dimitri Giunchi, Hristo Peshev, Jocelyn Champagnon, Johannes Fritz, Martin Wikelski, Emmanuel Pixner, Jose Manuel Lopez-Vazquez, Mariëlle Van Toor, Jonas Waldenström, Julio Blas, Pascual López-López, Peter Desmet, René Janssen, Robin Séchaud, Stefan Garthe, Stoyan Nikolov, Vladimir Dobrev, Volen Arkumarev, Elzbieta Kret, Victoria Saravia, João P. Silva, Philip W. Atkinson, Paul Record, Aldina Franco
- #4 Using drones to track nest occupancy - Hippolyte Pouchelle, Erwan Carfantan Dorotheé Labarraque
- #5 Artificial Intelligence-Based Detection of (no-)Animals in Camera Trap Images - Fraser Shilling

SESSION 5.3.4B. CITIZEN SCIENCE AND THE INVOLVEMENT OF CIVIL SOCIETY – 2

- #1 Validity of road-based data collected by volunteers for wildlife population monitoring - Silviu Petrovan, Candida Vale, Neftali Sillero
- #2 Identifying risk areas for hedgehog road collisions using citizen science data - Fiona Mathews, Patrick Wright, Frazer Coomber

#3 A vision of a sustainable infrastructure by 2050 in different countries - Amanda Sjölund, Linda Larsson

Poster Communications

SESSION 1.1.3.

INNOVATIVE SOLUTIONS FOR LINEAR INFRASTRUCTURE IMPACT ASSESSMENT, MITIGATION AND MONITORING

- #1 Wildlife crossing structures aid bats with a high-risk collision to cross the road safely - Célia Lhérondel, Cédric Heurtebise, Thibaut Ferraille, Philippe Chavaren, Benjamin Allegrini, Fabien Claireau
- #2 Geographically Weighted Regression for modelling amphibian road-kills: comparison with other modelling methods - Diana Sousa Guedes, Marc Franch, Neftali Sillero
- #3 Are roads and railroads barriers for the moor frog? - Edgar A. van der Grift, G. Arjen de Groot, Fabrice G. W. A. Ottburg, Dennis R. Lammertsma, Ivo Laros, Jan Bovenschen
- #4 Evaluating the effectiveness of a wildlife overpass in restoring gene flow in a slow worm population - Edgar A. van der Grift, G. Arjen de Groot, Fabrice G. W. A. Ottburg, Hugh A. H. Jansman, Ivo Laros
- #5 Use of wildlife overpasses by roe deer: What are the effects of human co-use? - Edgar A. van der Grift, Dennis R. Lammertsma, Martin Waanders
- #6 Comparative study between environmental DNA method and electrical fishing method - Florent Skariak, Amandine Hibert
- #7 gDefrag: a graph-based tool to prioritize linear infrastructure defragmentation - Fred-erico Mestre, A. Márcia Barbosa, Fernando Ascensão
- #8 Development of a Video Image Analysis System for Reducing Operation on Surveys of Wildlife Behavior - Fumihito Hara, Masato Sato, Misako Noro
- #9 Effectiveness of road and railway bridges for reindeer and wildlife movements – an ongoing project - Jan Olof Helldin, Mattias Olsson, Torbjorn Nilsson, Niklas Kemi
- #10 Optimising the ring road of Europe’s capital: integrating enhancements in mobility, ecology and public involvement - Jelle Vercauteren, Guy Heutz
- #11 Quantifying the individual impact of artificial barriers in freshwater: operational technology transfer of a standardized and absolute index of genetic connectivity to regulatory studies - Jérôme G. Prunier, Camille Poesy, Vincent Dubut, Charlotte Veyssièrre, Géraldine Loot, Nicolas Poulet, Sylvain Moulherat, Simon Blanchet
- #12 Standardisation of camera-trap monitoring of wildlife crossings - Jim Casaer Jim, Lien van Besien, Tanja Milotic, Peter Desmet, A. Patrick Jansen

#13 Biodiversity information tool to supporting Environmental impact assessment - **Jordi Solina, Gemma Vila, Paula Bruna, Eva Lahoz, Anna Ferrés, Israel Estopà, Susanna Carbajo, Antoni Sorolla**

#14 Predicting wildlife collisions hotspots based on machine learning and GIS: A case study in a tropical dry forest area in Colombia - **Juan Carlos González-Vélez, Juan Carlos Jaramillo-Fayad, Juliana Ríos-Barberi, Juan Pablo Murillo-Escobar**

#15 Ecologically friendly erosion control - **Lien van Besien, Karl Fonteyne, Steven De Maesschalck, Jan Van Raak, Gregory Quaegebeur**

#16 The NOTEE VA method - **Ludovic Le Contellec, Caroline Mallo, Ian Jannet, Anaïs Bataille, Agathe Idelon, Guillaume Laffont**

#17 Long-Term Monitoring of ecological Impacts from a Road Project in Denmark 2012-2020 - **Martin A Hesselsoe, J. L. Nielsen, Nadiéh deJonge, Rune Sør Neergaard, Per Gørtz, Niels Krogh, Christina Steenbeck**

#18 Mitigation measures for wet grasslands, wader birds and amphibians along rail and road infrastructure in south west Sweden - **Mats Lindqvist, Moa Naalisvaara Engman, Ola Sjöstedt, Calle Bergil**

#19. Prevention of Deer-train collisions by a deterrent sound - **Minoru Shimura, Tomoyoshi Ushioji, Masateru Ikehata**

#20 Green Urban Areas: critical patches for biodiversity & ecosystem connectivity - **Nef- ta-Eleftheria Votsi**

#21 A clustering analysis should precede the identification of local factors: evidence based on the Czech WVC data - **Richard Andrášik, Michal Bíl, Jiří Sedoník**

#22 Use of drainage pipes as underpasses by wild mammals in Southeast Brazil - **Scarlat Dalva Ferreira, Jorge Ferreira Lima Neto, Lerrane de Fátima Cunha, Carlos Henrique de Freitas**

CHALLENGES AND OPPORTUNITIES FOR HABITATS RELATED TO LINEAR INFRASTRUCTURES

#1 New approach to mitigate bird-window collisions - **Dominique Waddoup, Bettina Kain; Melanie Gröbl, Thomas Schuh**

#2 Enabling wildlife to cross linear transport infrastructures - Examples of infrastructure requalifications - Collection of 12 sheets - **Jean-François Bretaud, Jean Carsignol, Marc Gignoux, Alain Morand, Sophie Berlin, Agnès Rosso Darmet, Claude Guillet, Jonathan Jumeau, Christophe Herve**

#3 Evidence of the positive impact vegetation management of power lines corridors on habitats and species: feed-back of LIFE Elia-RTE in Belgium - **Jean-François Godeau**

#4 Enhancing biodiversity on Great Britain's railway network - **Richard Pywell, Neil Strong**

#5 High occurrence of pollinating insects on new ecoduct in western Sweden - **Sofia Berg, Mats Lindqvist**

#6 Power line rights-of-way and pollinators: A partnership to develop! - **Véronique Michaud**

LINEAR INFRASTRUCTURE ECOLOGY

#1 Temporal patterns of humans and ungulates at bridges - Co-existence or disturbance? - **Fabian Knufinke, Jan Olof Helldin, Manisha Bhardwaj, Mattias Olsson**

#2 Bird species more frequently recorded in roadkill studies in Europe: A review using a trait-based - **Federico Morelli, Ricardo Rodríguez, Yanina Benedetti, Juan D. Delgado**

#3 Effects of noise from transport infrastructure on bats - **Fiona Mathews, Finch Domhnall, Jerem Paul**

#4 Modelling roadkill hazard zones for ten different vertebrate species in Austria using remote sensing data, expert knowledge and previous studies - **Florian Heigl, Daniel Dörler, Mathias Schardt, Florian Schöggel, Carina Sobe, Rainer Prüller, Silke Schweiger, Susanne Stückler, Norbert Teufelbauer, Christina Nagl, Erwin Nemeth**

#5 Roads as a driver of changes in the bird community and disruptors of Ecosystem Services provision - **Joana Araújo, Rodrigo Bergamin, Inês Catry, Fernando Ascensão**

#6 Potential ecological impacts and their mitigation of Central Asia-South Asia (CASA-1000) transmission line: Afghanistan part - **Khalid Farooq Akbar**

#7 Evaluation of selected methods to control invasive species along transportation linear infrastructures: a preliminary approach - **Mariana P. Fernandes, Paula Matono, Anabela Belo, Carla Pinto-Cruz**

#8 A chronicle of brown bear-vehicle collisions in Greece - **Maria Psaralexi, Yiorgos Mertzanis, Maria Lazarina, Danai-Eleni Michaelidou, Stefanos Sgardelis**

#9 Mitigation measures on Alqueva Irrigation Project canals - **Rita Azedo, Ana Ilhéu**

#10 Measures to favour the pollinators in environmental restoration - **Susanna Carbajo, Jordi Solina, Israel Estopà, Antoni Sorolla, Anselm Rodrigo, Jordi Bosch**

#11 Monitoring fauna in the road environment - **Teillagorry Manon, Anne-Claire De Rouck, Florian Fournier, Olivier Pichard**

#12 Temporal patterns in animal-vehicle collisions based on neural networks and temporal density functions - **Victor Javier Colino-Rabanal, Roberto Rodríguez-Díaz, María Jose Blanco-Villegas, Miguel Lizana Avia**

CITIZEN SCIENCE AND THE INVOLVEMENT OF CIVIL SOCIETY

#1 A comparison of state-wide databases related to bird roadkill in Czechia - **Michal Bíl, Zbyněk Janoška, Jan Kašinský, Jan Kubeček**

LEGISLATION AND POLICY

#1 Risk-based Conservation Plan of fauna passages - **Claudia Rodrigues**

#2 The Impact on Bats of Traffic Infrastructure: Eurobats Guidance - **Jean Matthews, Fabien Claireau, Jasja Dekker, Branko Karapandža, Primož Presetnik, Charlotte Roemer**

Workshops

SESSION 2.1.1. A REVIEW OF WILDLIFE-VEHICLE CONFLICT OBSERVATION SYSTEMS

Fraser Shilling, Wendy Collinson, Michal Bil, Diemer Vercayie, Florian Heig, Sarah E. Perkins, Sandra MacDougall

SESSION 2.1.2. MITIGATING RAILWAY IMPACTS ON WILDLIFE

Andreas Seiler, Marina Torrellas, Carme Rosell, Manisha Bhardwaj, Mattias Olsson

SESSION 2.1.3. ADVANCING THE ROLE OF NGOS TO PROMOTE WILDLIFE-FRIENDLY INFRASTRUCTURE

Rob Ament, Kate Newman, Nilanga Jayasinghe

SESSION 2.2.1. DEVELOPMENT OF AN INDICATIVE EUROPEAN DEFRAGMENTATION MAP (IEDEM) AS A CONTRIBUTION TO PRESERVING EXISTING NATIONAL AND INTERNATIONALLY IMPORTANT GREEN INFRASTRUCTURE WHILE TRANSPORT INFRASTRUCTURE IMPROVEMENTS ARE DELIVERED WITHIN EUROPE

Marita Böttcher, Cindy Baierl

SESSION 2.2.2. HELPING TIGERS, RHINOS, AND ELEPHANTS CROSS THE ROAD: WILDLIFE FRIENDLY INFRASTRUCTURE MEASURES IN ASIA

Nilanga Jayasinghe, Nirmal Bhagabati, Kate Newman, Hanna Helsingen, Rodney van der Ree

SESSION 2.3.1. WILDLIFE AND TRAFFIC HANDBOOK UPDATE: TOWARDS EUROPEAN STANDARDS FOR FAUNA PASSAGES AND FENCING

Carme Rosell, Luc Chrétien, Eric Guinard, Antonio Righetti, Cécile Eicher, Marguerite Trocmé, Václav Hlaváč, Andreas Seiler

SESSION 2.3.2. INFRASTRUCTURE, BIODIVERSITY AND HEALTH

Wendy Collinson, Fraser Shilling, Yannick Autret

SESSION 2.3.4. CORRIDORS AND CROSSINGS: “GUIDANCE FOR CONNECTIVITY CONSERVATION IMPACTED BY LINEAR TRANSPORTATION”

Rob Ament, Rodney van der Ree

SESSION 3.1.1. THE POTENTIAL OF SMART TECHNOLOGIES FOR ECOLOGICAL PLANNING AND LANDSCAPE MEASURES

Sven Reiter

SESSION 3.2.1. AN INTERNATIONAL STRATEGY AND ACTION PLAN FOR STAKEHOLDERS’ ENGAGEMENT ON SUSTAINABLE TRANSPORT AND OTHER LINEAR INFRASTRUCTURE

Lazaros Georgiadis, Rob Ament, Anders Sjolund, Elke Hahn, Marita Böettcher, Rodney van der Ree, Kate Newman, Wendy Collinson, Lourens Leeuwner, Fraser Shilling, Hans Bekker, Yun Wang, Fiona Mathews, Andreas hSeiler, António Mira, Carme Rosell

SESSION 3.2.2. PLANTING AND PRESERVATION OF TREES ON DAMS AND DYKES AS A PART OF GREEN INFRASTRUCTURE: CONFLICTS - SOLUTIONS - IMPLEMENTATION

Katharina Dujesiefken, Piotr Tyszko-Chmielowiec

SESSION 3.3.1. GLOBAL CONGRESS: LINEAR INFRASTRUCTURE AND ENVIRONMENT (GCLIE): A PLATFORM TO ENHANCE COOPERATION AND COORDINATED ACTION BETWEEN THE EXISTING CONTINENTAL CONFERENCES ON ECOLOGY AND INFRASTRUCTURE

Fraser Shilling, Wendy Collinson-Jonker

SESSIONS 3.3.2. AND 3.3.3. ROAD SIDES AS ECOLOGICAL TRAPS – CHALLENGES AND SOLUTIONS: CHANGED BIOTIC INTERACTIONS DUE TO NON-NATIVE SEED MIXTURES AND INVASIVE ALIEN PLANTS

Johannes Kollmann, Larissa Uhe, Marcello D’Amico, Hans Martin Hanslin, Knut Anders Hovstad, Svenja Kroeger, Tommy Lennartsson, Jörgen Wissman, Anna Westin, Jan-Olof Helldin, Jan Christian Habel

Side Events

LIFE SAFE CROSSING SEMINAR

SESSION 3.1.2. LIFE SAFE CROSSING SEMINAR: INTRODUCTION TO THE WORKSHOP AND TOPICS CONCERNING LARGE CARNIVORES AND TRANSPORT

- #1 LIFE SAFE-CROSSING: the project overview - Annette Mertens, Simone Ricci, Fabio Papini
- #2 Large carnivores and transportation infrastructure: a review - Djuro Huber
- #3 Planning measures to avoid Animal-Vehicle Collisions: the approach of the LIFE SAFE-CROSSING Project targeting the Apennine brown bear - Mario Fabrizio, Giovanna Di Domenico, Antonio Antonucci
- #4 Adapting underpasses to be used as wildlife crossings: An action of the LIFE SAFE-CROSSING project to reduce large carnivore habitat fragmentation - Marcos López, Carme Rosell, Marina Torrellas, Matias De Las Heras Carmona
- #5 LIFE SAFE-CROSSING in Greece: Analysis and mapping of crossing structures on the A29 and activities to enhance connectivity through interventions on underpasses and road sides - Maria Psaralexi, George Lyberopoulos, Elina Theodoropoulou, Yiannis Tsaknakis, Athanasios Tragos, Yiorgos Lazaros, Niki Voumvoulaki, Carme Rosell, Marina Torrellas, Spyros Psaroudas, Yiorgos Mertzanis
- #6 Increasing awareness to encourage the adoption of driving behaviour to reduce AVC risk: new approach applied at LIFE SAFE-CROSSING - Laura Scillitani, Roberta Latini, Annette Mertens, Simone Ricci

LIFE LINES FINAL SEMINAR

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- #1 Linear Infrastructure Networks with Ecological Solutions - Nuno M. Pedroso, Anabela Belo, João Craveiro, Sofia Eufrazio, Mariana P. Fernandes, Paula Matono, André Oliveira, Tiago Pinto, Carla Pinto-Cruz, Luis Guilherme Sousa, António Mira
- #2 IP’s participation in LIFE LINES: Reducing fauna roadkills and defragmenting habitats - Graça Garcia
- #3 Bustards and power lines in Portugal: an overview of research done so far and its implications on impact assessment, mitigation and planning - João Paulo Silva, Ana Teresa Marques
- #4 Predicting wildlife-vehicle collisions using movement simulation models with the novel software SiMRiv - Lorenzo Quaglietta, Miguel Porto, Adam Ford
- #5 LIFE, Biodiversity and Infrastructures - Isabel Lico, Ana M. Santos
- #6 Implementation of volunteer environmental programs - Rosa Coelho, Marta Mattioli, Lúcia Pereira

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- #1 Assessing behaviour states in a forest carnivore in a road-dominated landscape with hidden Markov models - Eduardo Ferreira, Francesco Valerio, Nelson Fernandes, João Craveiro, Pedro Costa, Denis Medinas, João Paulo Silva, Carlos Carrapato, Filipe Carvalho, António Mira, Sara Santos
- #2 Effectiveness of amphibian mitigation measures to reduce roadkills in low traffic roads - Tiago Pinto, Luis Guilherme Sousa, António Mira
- #3 Road effects on Tawny owls (Strix aluco): patterns in road-kills, abundance, population trend, and movements - Rui Lourenço, Fernando Goytre, Shirley van der Horst, Ana Marques, Denis Medinas, André Oliveira, Pedro Pereira, Pandora Pinto, Sara Santos, António Mira
- #4 Minimization of electrocution risk in priority areas for the Iberian Imperial Eagle (Aquila adalberti) - Paulo A. M. Marques, Bruno H. Martins, Liliana Barosa, Hugo Lousa, Carlos Rochinha, Rita Alcazar
- #5 Protocols Avifauna – Joint efforts to mitigate bird mortality in powerlines - Julieta Costa, Rita Alcazar, Samuel Infante, Rui Machado, Rita Ramos, Paulo Alves, Carlos Rochinha
- #6 Can power lines poles bases be used as habitat promotion? - Mariana P. Fernandes, Paula Matono, Carla Pinto-Cruz, Anabela Belo

A pink carnation flower with fringed petals is in sharp focus on the left side of the image. It stands on a thin green stem amidst a field of tall, out-of-focus green grass. The background is a soft, blurred mix of green and grey tones, suggesting a natural outdoor setting. On the right side, there is a solid black rectangular box containing the text 'Authors Index' in a white, thin, sans-serif font.

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