Day 1, Monday 18 September

All times are in East Africa Time

Venue: Nandi Flame (Plenary Hall)

9:00 – 9:30	**ACLIE 2023 Opening Ceremony** **Welcome from other continental conferences**
9:30 – 10:00	**ACLIE Mkutano: Imagining the Future** **Keynote speakers:** Dr. Patrick Omondi (CEO, Wildlife Research and Training Institute) Hussein Yusuf Iman (Regional Infrastructure Manager, AfDB) Dr. Njeri Mwagiru (Senior Futurist, Institute for Futures Research)
10:00-10:45	**ACLIE Mkutano: The Systems Lens** **Keynote speakers:** Dr. Nick King (Environmental futurist) Winnie Nunda (Research Officer, Centre for Agriculture and Biosciences International) Dr. Nick Simpson (Senior Advisor, Africa Lead for Knowledge & Practice, Global Centre for Climate Mobility)

10:45 – 11:10 Tea Break

Venue: Muna

11:15 -12:15 On the Line 1

1: *Powerline effects on grey crowned cranes in south-central and south-western Uganda*;

Sarah Kugonza1,2
1International Crane Foundation

2The Endangered Wildlife Trust, South Africa

Presenter email: sarahk@ewt.org.za

Over the last three decades, Uganda has witnessed a meteoric rise in the country's linear infrastructural environment. One sector that exemplifies this is the country's electrical power industry. Since 2001, the country's electrical sub-sector has grown fast, from three-generation facilities to over 40 plants, with more expected by 2025. Total installed generation capacity began at 60 MW in 1954, rose to 400 MW in 2000, 800 MW in 2013, and is expected to exceed 2,000 MW by mid-2025. Power generation is only one side of the coin; power distribution is the other side of the coin, and this is where the huge powerline network comes into play.

Natural ecosystem habitats in Uganda are in danger for various reasons, including but not limited to the generation and distribution of electric power, rising population levels, and the effects of climate change. While it is true that both power generation and distribution have adverse effects on natural ecosystem habitats, in Uganda, there is more documented evidence about the impact of the former than the latter.

The Uganda Grey Crowned Crane and Wetland Conservation Project, a collaboration between the International Crane Foundation (ICF) and the Endangered Wildlife Trust (EWT), studies how powerlines affect Grey Crowned Cranes in western, southwestern, and central Uganda. Powerlines are one of the causes of direct mortality of the cranes. This work serves as the foundation for this presentation, focusing mostly on the information gleaned from the district of Lwengo, which is one of the areas under investigation in the overall study area. The purpose of this study is to precisely detail the interactions that take place between Grey-Crowned Cranes and powerlines, assess, and evaluate the causes and severity of Grey-Crowned Crane-powerline accidents, and recommend solutions for mitigation to decrease or eliminate the likelihood of their occurrence in the future.

2: *Northern Kenya Road Watch: Citizen science for informing retrofitting of a highway*

Matthew Muruana1 and Redempta Njeri2
1 Ewaso Lions
2 Grevy's Zebra Trust

Presenters email; matthew@ewasolions.org and redempta@grevyszebratrust.org

The Isiolo Marsabit Moyale A2 road highway cuts across the mixed-use Laikipia-Samburu-Marsabit-Meru ecosystem which is home to key wildlife species such as Lion (*Panthera leo*) and Grevy's Zebra (*Equus grevyi*) in Kenya. The greatest threat to wildlife in this ecosystem is habitat loss attributed to changes in land use, especially human settlement and infrastructure development.

The A2 road is part of LAPSSET, a regional flagship project that has boosted tourism and improved trade and access to remote areas. However, safety on the road remains a challenge

as the A2 bisects wild and domestic animal corridors. Vehicle collisions with animals have led to vehicle damage, as well as injuries and deaths of people and wild and domestic animals.

Grevy's Zebra Trust (GZT), Ewaso Lions (EL) and partners (including Action for Cheetah's Kenya, Twiga Walinzi, Save the Elephants and Kalama Conservancy) started a Citizen Science programme to address this challenge by monitoring roadkills. Since 2010, partners using A2 road have been collecting data on roadkills and wildlife sightings along the road. Between January 2010 and June 2023, 83% of roadkill's involved wild animals, many of which are endangered, while 17% involved domestic animals. Our presentation will focus on data collected from 2019 to 2023.

The data collected enabled us to map roadkill hotspots for road retrofitting recommendations. Recognizing the need for partnerships for preventing habitat connectivity loss, we shared this information with relevant partners including government agencies, conservation partners and Community Conservancies management. We hope that implementation of the proposed mitigation measures at the critical crossing points will improve connectivity of the habitat on both sides of the road. In addition, we look forward to improved safety for people, domestic and wild animals due to green infrastructure. Post-implementation monitoring shall also be designed to assess the benefits and performance of all implemented mitigation measures.

3: *Effects of linear infrastructure on vertebrates in Hluhluwe-iMfolozi Park and iSimangaliso Wetland Park, KwaZulu-Natal, South Africa (virtual)*

Cameron Cormac1, Cormac Price2, Jarryd Striecher1; Dave Druce3; Wendy Collinson4; Colleen T. Downs1
1University of KwaZulu-Natal, South Africa
2North West university, South Africa
3Welgevonden Game Reserve, South Africa
4The Endangered Wildlife Trust, South Africa

Presenter email: ctcormac@gmail.com

As human development continues to increase, so does the density of road networks and other anthropogenic structures, leading to increased impacts on the natural environment. In KwaZulu-Natal Province, the Zululand area is a biodiversity hotspot, with parks such as Hluhluwe-iMfolozi Park (HiP) and iSimangaliso Wetland Park (ISWP) being vital for biodiversity conservation and ecotourism. These protected areas experience high vehicle traffic, with HiP and ISWP being crossed by major provincial roads. Most studies have focused on the difficulties large mammals face regarding linear infrastructure in these parks but have neglected the smaller vertebrates. As such, small vertebrates have been poorly represented in park management programmes that target reducing wildlife-vehicle collisions (WVC). This study aimed to identify and compare the species assemblage of vertebrates comprising WVC along provincial roads traversing the R618 of HiP, and the R22 section of ISWP. Repeated 2 h

driven surveys were conducted monthly at sunrise and sunset with a total of 1008 survey hours across, 252 survey days. Data collected for each carcass included identity (Class to species level when possible), global positioning system (GPS) coordinates, photographs, measurements of distances to road shoulder and brush, road and habitat characteristics, presence of existing traffic calming and crossing structures, and climatic conditions. A total of 1605 carcasses were recorded across both locations, from which 108 species were identified. Amphibians were the most affected group having over 100 more WVC recorded than any other Class in both locations. Of the 108 identified species only 29 have habitat change listed as a potential threat in available species assessments. The results of this study indicate a need for increased traffic calming and crossing structures along these roads. The data will be further used to inform computational models to determine the ideal locations for implemented measures mitigating WVC.

Venue: Mugumo
11:15 -12:15 On the Line 2

1: *Comparison of cost-effectiveness of different types of wildlife crossing structure*

Manisha Bhardwaj1, Steve Béga2, Wendy Collinson3,4, Hannah de Villiers5, Marcel Huijser6, Darrelle Moffat2, Mattias Olsson7, Rodney van der Ree8

1. Wildlife Ecology and Management, University of Freiburg, Freiburg, Baden-Wüttemberg, Germany
2. Animex International, Fareham, Hampshire, UK
3. The Endangered Wildlife Trust, Wierda Park, Gauteng Province, South Africa
4. SARChI Chair on Biodiversity Value and Change, School of Mathematical and Natural Sciences, University of Venda, Thohoyandou, Limpopo Province, South Africa
5. The University of the Witwatersrand, Johannesburg, Gauteng Province, South Africa
6. Western Transportation Institute, Montana State University, Bozeman, Montana USA
7. EnviroPlanning AB, Gothenburg, Västra Götaland County, Sweden
8. WSP Australia Pty Ltd, Melbourne, Victoria, Australia

Presenter email: manisha,bhardwaj@live.ca

There are more than 64 million kilometres of road that transect nearly every landscape on earth. These roads can have severe and detrimental impacts on wildlife. Two of the most prominent impacts include habitat fragmentation (i.e., loss of landscape connectivity) and road mortality. These impacts prevent wildlife from traversing the landscape successfully, and can restrict individuals from accessing necessary resources such as habitat, food, and mates. It may be possible to mitigate and reduce the negative impacts of habitat fragmentation and road mortality by fencing roads, and providing safe crossing points by means of 'Crossing Structures'. Crossing Structures are typically over- or underpasses, providing safe crossing passage for wildlife over or under a road, respectively. Crossing

structure designs vary depending on the target species and context in which they are installed. These factors include broad width, traffic volume, the adjacent landscape and vegetation, and the movement ecology and behaviour of the targeted species. This has resulted in a plethora of crossing structure styles, for example, large vegetated overpasses, small corrugated drainage culverts running under roadways, canopy bridges that connect the from the vegetation on one roadside verge to the other, and co-use structures intended to be used by people as well as wildlife. The costs and benefits of each type of crossing structure can vary considerably. In this presentation, we will present an overview of costs and benefits of different types of crossing structures, focussing on monetary costs for constructing new structures or retrofitting existing ones, the time to complete construction, and the demonstrated benefit where possible (e.g., use of crossing structures to cross the road and potential reductions in road mortality before and after structure installation). We will conclude with guidelines for where and when different crossing structures may be more – or less – cost-effective to install. The results from this presentation will be to provide concrete advice to planners and managers based on expert opinions and experience in the field and/or in constructing crossing structures.

2: *The role of environmental, structural and anthropogenic variables on underpass use by African savanna elephants (Loxodonta africana) in the Tsavo Conservation Area*

Michael Koskei1, Joseph Kolowski2, George Wittemyer1, Fredrick Lala3, Iain Douglas-Hamilton1, Benson Okita-Ouma4

1Save the Elephants
2Smithsonian-Mason School of Conservation
3Wildlife Research and Training Institute, Kenya
4 Wyss Academy for Nature

Presenter email: koskei@savetheelephants.org

Wildlife crossing structures are effective interventions for mitigating fragmentation of habitats by linear infrastructure. The 2017 construction of a new railway cutting through the Tsavo Conservation Area (TCA), home to the largest elephant population in Kenya, affected wildlife movement and habitat connectivity. Although numerous studies have investigated the use of wildlife crossing structures by a wide range of species, few have focused on their use by megaherbivores. In this study, we examined use of 41 wildlife crossing structures by African savanna elephants (Loxodonta africana) along a 133 km section of new railway in Tsavo, Kenya. We used a generalized linear mixed modeling approach to assess the relationship between elephant crossing rate over 28 months between July 2017 to April 2021 and explanatory factors including crossing structure attributes, livestock presence and proximity to highways, water points and human settlement. We found that structural attributes of crossing structures were most strongly associated with the elephant crossing rate, particularly height and its interaction with type of crossing structure (bridges, wildlife underpasses and culverts). Higher crossing structures were associated with higher crossing rate, with the largest influence of height at culverts and wildlife underpasses. Although

bridges comprised only 19.5 % of the 41 available crossing structures, they accounted for a disproportionately high number of elephants crossing events (56 %). The results demonstrated the importance of bridges over designated crossing structures for elephants, with predicted seasonal counts of elephant crossings being 0.31 for average sized culverts, 2.88 for wildlife underpasses and 5.86 for bridges. The environmental and anthropogenic variables were not strongly associated with elephant crossing rate. Our findings have direct application for future siting and design of crossing structures across elephant ranges.

3: *Linear infrastructure and primates: impact and mitigation examples from South Africa, Africa and beyond*

Bibi Linden1
1University of Venda, South Africa

Presenter email: bibi@lajuma.com

It is estimated that 75% of the world's primate species suffer from population decline due to ever increasing anthropogenic pressure. According to the IUCN, 18% of the world's primate species are impacted by roads and railroads and 3% by utility and service lines with research investigating impacts on and mitigation measures for primates gaining more attention. Given that the African continent is home to a highly diverse primate fauna (107 species) and that African economies are currently among the world's fastest growing, linear infrastructure poses severe threats to wildlife including primates. The most direct and visible impact of roads, power lines and railways are mortalities. And although mortality reduction is a central concept in the field of linear infrastructure ecology, the extent of what we are losing in terms of local and global wildlife is still not well understood, particularly for primate species. Regarding mitigating linear infrastructure impacts on primates, canopy bridges have shown to be highly suitable in reducing mortalities. Here I give an overview of the state of knowledge on linear infrastructure impacts on primates and mitigation efforts to date in Africa, using results from my own research in South Africa, and research done to date across primate rage countries. I will focus on a) how many and which countries in Africa have done/are doing research on this topic, b) which aspects are researched (e.g. measuring impact through documenting mortalities and/or implementing canopy bridges for mitigation); c) how many countries have implemented mitigation measures, d) how efforts in Africa compare to other primate range regions, e) what canopy bridge designs are used for primates, f) what the current state of knowledge on canopy bridge success for mitigating primate linear infrastructure impact is, and lastly g) what the knowledge gaps and challenges are that still need to be addressed.

Venue: Muna
12:20 – 13:20 In the Lions' Den 1

1: *Animal vehicle conflict - a road safety blind spot in Botswana*

Maatla Otsogile1
1Society of Road Safety Ambassadors, Botswana

Presenter email: sorsa.ub@gmail.com

In Botswana, there is a free-range agricultural system meaning there are roaming domesticated animals on the highways. In addition to this, many of these roads are built near protected areas, therefore fueling conflict between animals and vehicles. Despite national efforts to reduce human mortality on roads, little has been done to document animal mortality. This presentation demonstrates the need for a greater understanding of the conflict between transport infrastructure and biodiversity in Botswana. We discuss the magnitude, trends, and challenges, in a bid to enhance the exchange of international best practices, innovations, and solutions to achieve efficient road networks that save human lives as well as work in harmony with and conserve the natural environment.

2: ***Exploring wildlife crossing effectiveness on the N4 Toll Route (TRAC N4), Gauteng Province, South Africa***

Thabo Hlatshwayo1,2, Manqoba Zungu1, Wendy Collinson2, Colleen Downs1
1University of KwaZulu-Natal, South Africa
2The Endangered Wildlife Trust, South Africa

Presenter email: thaboh@ewt.org.za

Roads have many negative impacts on biodiversity, one of which is a collision between wildlife and vehicles (i.e., roadkill), resulting in not only injury or loss of life to an animal but damage to vehicles and vehicle occupants. Moreover, the barrier effect that roads create can have adverse effects on species' populations. Planning for connectivity in the form of wildlife crossings is key in mitigating negative ecological effects of roads and facilitating species' dispersal ability throughout road-fragmented habitats, as these will save human lives and wildlife diversity. Although numerous underpasses in the form of culverts, viaducts and bridges are part of the structural road planning and design to meet human mobility, and safety needs for storm water drainage, they continue to neglect the needs for connecting wildlife and their habitats. However, to some extent, numerous animals have adapted to using these structures for crossing highways.

In this study, we explored the effectiveness of road underpass structures along the TRAC N4 highway, Gauteng, South Africa, for wildlife crossings. The underpasses were monitored continuously using mounted camera traps since December 2022. The preliminary camera trap data showed increasing animal activity and use of the monitored underpasses, with nine mammalian, two reptilian and six bird species recorded using them for crossing the highway. Animal use of the underpass structures for crossing was dependent on the characteristics of

the structure (size, shape, and adjacent roadside habitat type). This shows that gathering baseline data on wildlife roadkill, animal movement and behaviour patterns across roadways could help modify existing road structures accordingly in such that they potentially serve as effective wildlife crossings.

3. Economics of canopy bridges: Overcoming data limitations for stakeholder meetings

Pamela Cunneyworth1
1Colobus Conservation, Kenya

Presenter email: pam@colobusconservation.org

Artificial canopy bridges are seen as economically viable for mitigating the negative impacts of roads and other environmental barriers on primates. However, current economic evaluations primarily focus on capital and installation costs of bridges, lacking a comprehensive assessment of the costs and benefits of bridges for local primate populations and communities. This presentation provides a brief overview of the limitations of the literature on the economic viability of canopy bridges. However, its main objective is to outline requirements for an estimated economic analysis, offering guidance where data is lacking.

Cost-Benefit and Cost-Effectiveness Analyses are explored as potential options for estimating the economic feasibility of a canopy bridge program. Where data is lacking, using best estimates of monetary and non-monetary measures is suggested. Spreadsheet-based tools for presenting these estimated economic valuations eliminate the need for expensive software or specialized IT knowledge. These economic estimations can be a starting point for discussions with stakeholders and raise awareness about a canopy bridge program's less obvious costs and benefits. By creating a standardized framework for analyzing costs and benefits, practitioners can compare sites with unique characteristics and tailor their bridge programs to different primate species, considering the specific costs and benefits associated with their location.

Venue: Mugumo
12:20 – 13:20 Design Desk

Using Remote Sensing and Least-Cost Paths to optimise route planning

Douglas Tilbury1
1RSK International Projects Group, United Kingdom

Presenter email: dtilbury@rsk.co.uk

The overarching objective of linear infrastructure is to connect people and resources in different places via different mediums. Whether its electricity or railways, pipelines or roads; we live in an interconnected world and need to navigate the process of how we get things from one place to another. But how does one balance economic, environmental and engineering considerations in the design of such infrastructure?

The use of spatial modelling techniques such as least-cost path algorithms is nothing new in terms of how we approach such problems. However, in the face of mounting climate change and biodiversity crises, the use of modern technologies such as remote sensing should be brought to the fore to ensure that we continue to build and develop the overall practice of ESG and sustainability on the best tools available.

Using East Africa as the sandbox, this presentation aims to showcase the use of open-source technologies and data in the early-stage processes of route-planning for all linear infrastructure projects. In particular, demonstrating the incorporation of lender-standard critical habitat and landscape ecology considerations in the initial planning and screening phases of overall design, thus improving economic and environmental performance.

13:20-14:10	Lunch Break

Venue: Muna

14:15-15:30 Integrated Issues 1

Strengthening road ecology research and exchange between Asia and Africa

Qilin Li1 and Yun Wang2
1Hainan Tropical Ocean University
2China Academy of Transportation Sciences, China

Presenter emails: kylinlee49@163.com; wangyun80314@163.com

Road ecology was proposed by Richard Forman in Harvard University in 2003. Now road ecology research has spread across the world. For example, almost all continents have their own road ecology conferences, including IENE, ICOET, ANET, ACLIE (African Conference for Linear Infrastructure & Ecology), ATEF (Asia Transportation Ecology Forum) and others. Among them, ACLIE and ATEF are relatively young conferences, the inaugural ACLIE was held in 2019 in South Africa. This conference is held every two years. The first comprehensive, systematic review on road ecology research in Africa was published in Frontiers in Ecology and Evolution in 2019.

Road ecology in Asia was in the early stage compare with other continents, the first comprehensive and systematic review on road ecology advancing in Asia was completed by Center for Large Landscape Conservation funded by USAID in 2021. Also in 2021, the first road

ecology conference in Asia entitled ATEF was held online, sponsored by Chinese Academy of Transportation Sciences (CATS). In 2022, 1st Asia-Europe Transportation Ecology Forum was held online also sponsored by CATS and IENE. Both conference gathered the global road ecologists to share cutting-edge knowledge, experience, lessons on road ecology mainly focus on Asia.

Asia and Africa share a lot in similarity, such as expanding road infrastructure and rich biodiversity. To balance the contradict between them, we need to strengthen our exchange in the future. We put forward three suggestions: 1) advice policy-makers to mainstream biodiversity and ecological connectivity into development of transportation infrastructure; 2) absorb existing successful technology into whole stages of transportation infrastructure, meantime start collaborative research on key and innovative technology to construct ecology-friendly transportation infrastructure; 3) initiate Asia-Africa Transportation Ecology Forum in the near future to focus on any relevant topics.

Moderator

Lazaros Georgiadis[2,3,4]
[2] Biologist, Senior Environmental Consultant, Florina, Greece
[3] The Centre for Research & Technology, Hellas. Greece
[4] Infrastructure and Ecology Network Europe (IENE) Governance Board member

The structure of the session

The session will be organized as follows:

Step 1 (20 min): Presentation on strengthening road ecology research and exchange between Asia and Africa.

Step 2 (10 min): Introduction for the organization of the Asia-Europe Transport Ecology Forum giving an approach of cross-continental challenges.

Step 3 (10 min): Shaping a small panel of experts who have special presentation on common Africa - Asia themes

Step 4 (45 min): Open discussion inviting people and ask questions on Africa – Asia common transport ecology challenges.

Step 5 (5 min): Wrap up and conclusions of the session

Venue: Mugumo
14:00-15:30 Integrated Issues 2

Towards more sustainable and inclusive development corridors in Africa

Hamza Rafray Butt1
1UNEP-WCMC

Presenter email: hamza.butt@unep-wcmc.org

Development corridors are linear programmes of infrastructure and agricultural improvement that aim to facilitate rapid social and economic development. In Africa they represent a major focus of development activity, with 88 documented development corridors underway. Drawing on social and environmental research in Kenya and Tanzania, we examined how people and ecosystems are impacted along selected development corridors. The development corridors that we studied are being mobilised as a series of independent projects and programmes. They lack thorough social and environmental or climate risk assessments. They are often developing incrementally in siloed policy and corporate spaces. This is resulting in negative impacts on marginalised groups, habitats, biodiversity, and natural capital. We conclude that poorly planned and implemented corridors negatively affect the livelihoods of millions of people, harm ecosystems and damage the services these ecosystems provide. We also find a disconnect between investors and implementors in terms of their approach to considering potential impacts on nature and people, with some investors funding what a government has requested without applying their own safeguards. The solutions recommended will help these large-scale programmes contribute to conservation and climate targets, help achieve the SDGs and national development agendas and benefit millions of people. All this was studied within the DCP project and is highlighted in its synthesis paper.

This session will discuss the learnings from the DCP project and their relevant impacts on different stakeholder groups. It will also shed light on how the solutions presented under this project can contribute towards a nature-positive world, through integrated infrastructure planning. The session will also talk about an incoming project under the GEF-8 opportunity and how that can aid in making the DCP solutions, a reality, which could be a positive step. It will bring on board different stakeholders including academics, government and FIs.

15:30-16:00 Tea Break

Venue: Muna
16:00 – 18:00 Curriculum Corner 1

Communicating your transport ecology story to the community, engineers and your Mum: Enthralling your audience with a captivating blog or stunning audio-visuals

Authors: Rodney van der Ree[1,2], Darryl Jones[3], Katherine Aburrow[4], Steve Bega[4] Darrelle Moffat[4], Kieren Topp[5], Peter Ndung'u[6]

[1,] WSP Australia Pty Ltd
[2] The University of Melbourne, Melbourne, 3000, Australia

[3] Centre for Planetary Health & Food Security and School of Environment & Science, Griffith University, Brisbane, Australia
[4] Animex International, UK
[5] Topp Media, Melbourne, Australia
[6] Hadithi Visuals, Nairobi, Kenya

Presenter emails: rodney.vanderree@wsp.com; hello@peterndungu.com; kieren.topp@gmail.com.

Topics addressed:

- Global and open access knowledge sharing
- International collaborations
- Transport ecology – impacts and mitigation

Keywords:

Transport ecology, linear infrastructure, global case studies, knowledge sharing, science communication, community engagement, social media,

There is much concern globally about the massive scale of the current and future investment in linear infrastructure development. An additional 25-million lane km of new roads will be built by 2050, and 90% of this will be in non-OECD countries, and railways, pipelines and powerlines are similarly expanding. Many countries and regions lack the expertise, resources and experience to implement ecologically-friendly infrastructure development.

An important key step in improving the uptake of ecologically sound advice and designs in transport ecology is ensuring that everyone has a better understanding of the impacts and solutions. Global efforts to communicate and disseminate information must be:

- Accessible – can it be found and accessed? Is it behind a paywall?
- Relevant to the audience – does each audience get the information they need?
- Understandable – can the information presented be understood by each user group? Is it full of scientific jargon?
- Usable – is the knowledge applicable and able to be used? Does it fill an information gap or need?
- Is it aesthetically appealing? Does it invite your audience to read more?

In this workshop, we will give practical advice, instruction, hints and tips to enable you to write a blog-style summary or produce a short social-media clip of your research or construction project for a relevant audience. We will guide you through the process, including:

- Identifying your 'story'
- Defining your audience
- Crafting your message
- Revising and editing your story

- Disseminating and promoting your story

You are invited to use the tips you learn today to prepare a short article or blog for www.TransportEcology.info (see below for more information) or a short video or visual content for social media.

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www.TransportEcology.info is a freely accessible resource for planners, designers, ecologists, engineers, funders, approvers and construction teams to incorporate best practise in their projects. Importantly, this site gives the same information to the general community, informing them of new initiatives and world's best practise, thereby allowing them to genuinely participate in the decision-making process.

TransportEcology.info has three main components: (1) research summaries on latest findings in road ecology; (2) project and mitigation case studies and (3) news and information. Additional streams will be added as needed.

Research Summaries: are blog-style summaries of peer-reviewed journal articles and reports, expressed in a clear and concise style. Research summaries ensure that the key findings of important research are visible and accessible to practitioners, and not hidden behind paywalls and scientific jargon. Research summaries are written in a conversational scientific style and 'tell a story' that practitioners who are planning, designing, building or managing linear infrastructure need to know. The summaries include links to the published research, allowing people to find and download the primary publications if interested.

Project and Mitigation Case Studies: are written to 'tell a story', using a blended 'conversational' style and a 'scientific' style. The conversational style will ensure the lessons are readable and understandable by laypeople. The scientific style will ensure the 'story' is reliable and evidence-based, and can include references to provide supporting information or evidence sources.

News and events: There is a huge amount going on around the world and on this page you'll find news, guidance and publications that will help you learn from projects globally.

You can get involved in a number of different ways:

- Submit a summary of your peer-reviewed research.
- Prepare a case study of a recent project.
- Let us know about news and events to share with the world.
- Subscribe to the site to get email updates or follow TransportEcology.info on LinkedIn or via other social media platforms.
- Are you involved in a major project or organisation doing lots of great work on linear infrastructure? Partner with us to share the results of your project or organisation to a larger audience.
- Support the site financially.

Venue: Mugumo
16:00 – 18:00 Curriculum Corner 2

Gathering data for roads 101

Trainer: Wendy Collinson1
1The Endangered Wildlife Trust

Presenter email: wendyc@ewt.org.za

Despite evidence suggesting that road traffic is a major threat to biodiversity, little is known about its impact on wildlife populations in Africa. Road density and traffic volumes are increasing globally, and although huge budgets are devoted to the construction and upgrading of roads, there is insufficient allocation to the implementation of mitigation measures for protecting fauna in most countries, particularly those in Africa.

As of 2019, the total population of Africa was estimated at 1.3 billion, representing 16.8% of the world's population. According to UN estimates, the population of Africa may reach 2.49 billion by 2050 (about 26% of the world's total), with an economic growth rate of 3.8% in 2022. To continue to enable this economic development, there are plans to "spur a major revolution" through investments in public transport, including road infrastructure, rail upgrades, freight services and intelligent transport systems, all of which will certainly impact wildlife.

To date, African road ecology studies have focused primarily on roadkill rates, with results highlighting the need not only for a greater understanding of the primary determinants of roadkill and its threat to biodiversity, but also the indirect effects of the country's roads on wildlife. In 2013, we developed a standardised protocol for the detection of vertebrate roadkill, which has since been applied in several countries in the world.

Our presentation gives a brief overview of the current road ecology projects underway in Africa outlining (i) the development of road sensitivity maps for South Africa using the EWT citizen science roadkill database, (ii) identification of hotspots related to roads for both flora iii) monitoring animals killed on roads in protected areas in South Africa, (iv) implementing roadkill-reduction-measures in identified hotspots and assessing their effectiveness in reducing roadkill numbers, and (v) the use of social media as a tool to raise awareness of the threat of roads to biodiversity and a means to submit roadkill data.

Following this, we will then discuss roadkill data collection methodologies, and assist with designing data sheets.

We plan to continue to build capacity and find solutions to Africa's roadkill issues. While Africa is fundamentally different to Europe and North America, application of the information and

lessons learned in the Global North should be explored within the African framework. Major differences that may influence this process include faunal diversity, landscapes and geography, the density of roads and humans, socio-economic priorities, and funding and support for road ecology research and mitigation measures. The development of 'African' solutions may be required to solve uniquely African issues.

Venue: Nifty Cafe	
18:30-21:00	**Welcome cocktail event**

Day 2, Tuesday 19 September

All times are in East Africa Time

7:00 – 7:30 Morning forest walk in Brackenhurst Forest

Venue: Nandi Flame (Plenary Hall)

9:00 – 10:00 ACLIE Mkutano: The Economics Lens

Keynote speakers:

Mark Gerrard (Africa Director, Conservation Strategy Fund)
Conrad Savy (Regional Biodiversity Lead, IFC)
Lucy Waruingi (Executive Director, African Conservation Centre)

10:00 – 10:30 Tea Break

Venue: Muna

10:30 -11:30 On the Line 1

1: Apes and Forests at Risk: *impacts of linear infrastructure (LI) on three species and landscapes - Hoolock gibbon in NE India, orangutans in Sabah, Borneo, and gorillas in the trans-Virunga landscape*

Megan Parker1, Melissa Butynski2
1,2 Center for Large Landscape Conservation

Presenter email: Megan@largelandscapes.org

Great apes and gibbon populations are in decline across the globe, as are the forests they inhabit. The Center for Large Landscape Conservation looked at the impacts of linear infrastructure (LI) on three landscapes where large infrastructure development projects are underway; Hoolock gibbon in NE India, orangutans in Sabah, Borneo, and gorillas in the trans-Virunga landscape. We examined national policies for safeguarding apes from LI development, conducted spatial analyses in ape ranges, focusing on LI impacts and reviewed literature from the last decade to assess the current state of knowledge for mitigating deleterious impacts of LI on apes. Our findings underscore the importance of effective, enforced policy and local community participation in transparent, collaborative planning. We found gaps in knowledge of how LI affects apes and the barrier effects of most species as well as a lack of knowledge in how to safely mitigate LI in forests. We also found extensive LI development in satellite photographs rather than publicly available data bases. We found LI spread across protected ape ranges with dirt roads, plantations and increased human development spurring off of larger roads.

Restoring forest continuity by developing and installing canopy bridges for brachiating species and learning how to provide safe crossings for terrestrial species, as well as understanding the composition of native forests and restoring species of trees and other vegetation around LI is important for long-term mitigation.

2: *Spatiotemporal patterns of wildlife along the Phalaborwa – Hoedspruit railway line in Balule Nature Reserve, South Africa*

Siboniso Thela1,2
1University of Venda, South Africa
2The Endangered Wildlife Trust, South Africa

Presenter email:

Railroads are essential transportation corridors that facilitate the movement of goods and people with important environmental and economic benefits when compared to roads. However, transport infrastructure is considered one of the leading causes of biodiversity loss and rail ecology studies have shown that wildlife can be negatively affected by human activity due to the development of railroads. There is growing evidence that human-induced disturbances affects wildlife behaviour as wildlife may adjust their spatiotemporal activity patterns to minimize encounters with human activity. However, the complete lack of data on the activity patterns of African wildlife on railroads limits our knowledge of the effects of human activities on wildlife associated with railroads.

The study investigates the activity patterns, both spatial and temporal, of six medium-large sized mammals (≥ 10 kg) on a landscape bisected by the railroad in Balule Nature Reserve. Specifically, we examined (1) the activity of mammals on the railroad to determine their daily activity patterns of occurrence on the railroad, (2) the activity of mammals in proximity to the railroad to determine whether the distance from the railroad, season, and rail-side habitat affect their activity around the railroad, and (3) the temporal overlap in the activity of mammals on the railroad with that of train activity to determine whether the degree of activity overlap differs between seasons. African buffalo and elephant exhibit a cathemeral behaviour in their occurrences on the railroad and decrease with increasing distance from the railroad. Giraffes, impala, and lion are less active around the railroad in the wet season than the dry season. Spotted hyaena is more active around the railroad in both open grassland and woodland than mixed shrubland habitat intersected by the railroad. Four focal species moderately overlapped with train activity, with no seasonal differences in the degree of activity overlap.

3: *Transport infrastructure and protection of fauna in the Czech Republic*

Vaclav Hlavac1
1Nature Conservation Agency of the Czech Republic

Presenter email: vaclav.hlavac@nature.cz

The Czech Republic is a Central European country with an area of 78,867 km2 and ten million inhabitants. The high density of the transport network has a major impact on nature. Nevertheless, 90 species of mammals survive here, including large European carnivores such as the wolf, lynx, or brown bear.

A study conducted in previous years has shown that a large number of animals die due to collisions with cars each year. More than 50 thousand roe deer, 550 thousand hares and 350 thousand hedgehogs are killed on roads every year. For some species, such as the European otter, road mortality can affect the survival of the species in the landscape. Fragmentation of habitats by transport infrastructure has even stronger impacts. Although isolated populations survive many years after construction, their long-term existence is threatened. The European moose is an example of a species that will probably become extinct in the Czech Republic as a result of fragmentation in the coming years.

The impact of traffic on fauna began to be systematically addressed in the Czech Republic after 2000, when cooperation between the Nature Conservation Agency and the Directorate of Roads and Highways began. Common guidelines for preventing, reducing, and compensating the impact of traffic on nature are widely used today by planners, designers, and nature protection authorities. 25 large "green bridges" were built during highways construction, another four were built on existing highways.

The density of transport infrastructure brings extensive fragmentation of habitats. Therefore, a complex system of migration corridors of large carnivores connecting the core areas of permanent occurrence was defined. The basic task was to ensure the protection of migration corridors in spatial plans, which was achieved in previous years. Currently, the migration corridors are protected against buildings, fencing and other interventions that can limit animal migration.

Venue: Mugumo
10:30 -11:30 On the Line 2

1: *A complex relationship between the road barrier effect and monkey-vehicle collisions: Implications for monitoring canopy bridge use*

Pamela Cunneyworth1
1Colobus Conservation, Kenya

Presenter email: pam@colobusconservation.org

The assertion that canopy bridges alone effectively reduce the road barrier effect and prevent vehicle collisions in monkeys oversimplifies the complex reality. It is crucial to analyze the underlying assumptions and available data to fully comprehend the interplay between canopy bridge utilization and its relative impact on the road barrier effect and vehicle collisions. This presentation aims to explore this relationship. To illustrate this, I present a hypothetical scenario detailing the frequency of primate road crossings (both on the ground and using bridges) and their respective effects on the road barrier and collision risk. Additionally, I conclude that monitoring ground crossings before and after bridge installation and bridge crossings is crucial for understanding the complex relationship between bridges as a mitigation for the road barrier effect and vehicle collisions. In summary, the relationship between canopy bridges, road barriers, and monkey-vehicle collisions is far from straightforward. By acknowledging the multifaceted nature of this issue and conducting a critical analysis of ground and bridge crossing data, we can refine our understanding and develop more effective strategies to mitigate the risks monkeys face when attempting to cross roads.

2: *Birds and the anthropogenic environment: a case study of Nigeria* (Virtual)

Nanchin Winifred Kazeh1, Samuel Tertese Ivande1,2, Danjuma Filibus Dami1,3
1A. P. Leventis Ornithological Research Institute. University of Jos Biological Conservatory, Laminga, Nigeria
2Global Center for Species Survival, Indianapolis Zoo, USA
3Department of Zoology, University of Jos, Nigeria

Presenter email: nanchinwinifred@gmail.com

Biodiversity is spatially heterogeneous and may vary over time with changes in the environment. The changes observed in ecological communities reflect interactions among organisms as well as between organisms and the abiotic environment. The study explores the influence of urbanization and agriculture on bird species diversity and richness in Nigeria, using data from the Nigerian Bird Atlas Project and anthropogenic variables derived from the Food and Agriculture Organization land use classification system. In terms of linear infrastructure, urbanization is characterized by urban and built-up lands, while agriculture involves various cropland types. Regarding urbanization, the study finds that higher vegetation cover (annual NDVI) within urban areas positively correlates with bird species richness. This suggests that green spaces within cities support a greater variety of bird species. However, as urban built-up areas increase, bird species richness decreases. This decline in richness could be attributed to the loss of natural habitats due to urban expansion. Concerning agriculture, the impact on bird species diversity and richness varies among different cropland types. Herbaceous croplands have a positive association with bird species richness. Conversely, other agriculturally transformed lands negatively influence both the diversity and richness of bird species. The study underscores the adverse effects of anthropogenic activities, specifically urbanization and certain agricultural practices, on bird

species richness and diversity in Nigeria. The findings emphasize the significance of preserving green spaces in urban areas to support bird biodiversity. Additionally, adopting agricultural practices that maintain diverse vegetation types can promote regional bird populations. This research contributes to understanding the intricate relationships between linear infrastructure, human activities, and avian biodiversity, which can inform conservation efforts and sustainable urban and agricultural planning.

3: *Why did the Albany Adder Cross the Road? Or did it? (virtual)*

Shona MacAffer1, Jeanne Tarrant2, Peter Lurz1, Alouise Lynch3, Kier Lynch3, Johan du Plessis2
1The University of Edinburgh
2The Endangered Wildlife Trust, South Africa
3Bionerds, South Africa

Presenter email: smacaffer@vt.edu

The Endangered Albany adder (*Bitis albanica)* is under serious threat of extinction and may have already become extinct in several historical locations, in the Eastern Cape of South Africa. Bitis albanica is an elusive and cryptic viper with only 43 confirmed sightings since 2016, including eight road mortalities, despite intensive surveys. Like many reptiles, this species is likely to face extinction soon due to continued habitat loss and potentially, road mortalities.

During October 2021, research was conducted at the last known location of Albany adder to investigate its relationship to roads and inform conservation recommendations. A single-season site occupancy model predicted low detection probabilities between < 0.01 and 0.03 (95% CI: 0, 0.18) which were increased on wider roads, in the late afternoon/evening, and on days without rain or cloud cover, while occupancy appeared to be correlated to land use, specifically wind turbines, rather than road edge habitat. During surveys invertebrate roadkill and live reptile detections showed similar hotspots in higher traffic and land-use areas and bicycle surveys detected more reptiles (0.56 per hour) and roadkill (1.64 per hour) than car surveys (0.45 live per hour and 0.18 roadkill per hour). Finally, Albany adder were all found stationary on the road edge during surveys (n=6) calling into question the complex relationship between this species and the road.

By using a range of methods during research helped to inform critical conservation recommendations and future research. Roadkill hotspots across taxa were a useful proxy to target road traffic mitigation, and temporal changes in detection to direct times of traffic moderation. A bicycle is a promising method for live reptile and roadkill surveys and further research, such as spatial telemetry would help us to understand how this species relates to roads, and the positive or negative impacts they may have.

Venue: Muna
11:35 – 12:25 Design Desk 1

A tool to predict the indirect and induced land-cover change caused by new road project

Jayden Engert1
1Centre for Tropical Environmental and Sustainability Science, James Cook University

Presenter email: jayden.engert@my.jcu.edu.au

Road projects within intact ecosystems cause both direct habitat loss within the construction footprint and indirect loss by increasing access for landscape conversion. These impacts are amplified for large development corridors and highways in frontier regions, as they promote significant further road expansion and land colonisation. Such 'induced' impacts are difficult to quantify and are rarely accounted for in project impact assessments.

We aimed to develop a sharable tool that can be used to model both indirect and induced impacts of new development corridors, to assess their potential impacts more accurately. To model these impacts, we identified 13 frontier roads on the island of New Guinea and, using satellite imagery, delineated new roads that emerged following their construction. We then quantified the forest loss and degradation caused by the frontier roads themselves, as well as that caused by the new roads they spawned. Finally, we used statistical analyses to identify environmental and socioeconomic drivers of this forest loss and developed a tool to predict the extent and scale of impacts of new proposed road projects.

We found that for every 1 km of frontier road we analysed there was around 15 km of new dependent road. Consequently, the induced impacts of frontier roads - those caused by this new road expansion - were two orders of magnitude larger than their direct impacts. Additionally, we found that when considering induced impacts, the road-effect zone increased from 3.5 km from the road to 55 km from the road.

By quantifying the induced impacts of road projects, we show that they massively outweigh the direct and indirect impacts. With millions of kilometers of new frontier roads in development globally, including within conservation areas and Indigenous territories, the tool we created can be used by researchers, practitioners, and environmentalists to provide more reasonable assessments of their potential impacts.

Venue: Mugumo
11:35 – 12:25 Design Desk 2

The role of railways in sustainable mobility and habitat protection in Africa - outlining the International Union of Railways' recommendations for railway agencies and a new project launching in 2024 (Virtual)

Lorenzo Franzoni1, Pinar Yilmazer1, Lucie Anderton1, Marie Lafont1
1 UIC International Union of Railways

Presenter email: franzoni@uic.org

Railways must play a prominent role in achieving global net zero emissions before 2050. Africa is undergoing crucial change in urban development, and there is a growing need for sustainable mobility. Rail development offers African economies the opportunity for a sustainable growth preventing urban sprawl, congestion, and air quality degradation.

While Africa occupies 22% of the earth's land area and hosts 17% of the world's population, it holds only 7-8% of the worldwide railway market share. The efforts to expand the railway sector in Africa is present in the Agenda 2063, the blueprint of the African Union, where African Integrated High-Speed Railway Network (AIHSRN) is one of its 15 flagship projects. Coordinated railway development within international regulations is necessary to ensure harmonious coexistence between urban development and habitat preservation, focusing on the importance to respect nature allowing fauna and flora flourish.

In 2021, UIC's African region members pledged their commitment to bolster the development of African railways and support eco-mobility aligned with the United Nation's Sustainable Development Goals. Using UIC's strategy and vision for sustainable habitat management, developed for and with its members, this session will elaborate on UIC recommendations for railway infrastructure managers, to be applied by African stakeholders, and the risks and consequences if these recommendations are not followed, elaborating on adequate and inadequate infrastructure management scenarios. The emphasis will be on the importance of addressing infrastructure activities from design to operation with best practices from Africa and other regions.

The conclusion introduces UIC's upcoming project, Preventing rAilway Wildlife CollisionS (PAWS), launching in 2024, aiming to develop a comprehensive strategy for preventing wildlife collisions in the railway sector, encompassing a holistic view under an ecological, operational and safety perspective. African infrastructure managers will benefit from the project's results, which will combine case studies and develop guidelines for sustainable, reliable, and safe solutions.

Venue: Nandi Flame (Plenary Hall)
12:30 – 13:15 Policy Props 1

Capitalising on the biodiversity opportunity to secure ecologically sustainable pan-African linear infrastructure

Wendy Elliott1

1WWF

Presenter email: WElliott@wwfint.org

Plenary panel discussion

From the boardroom to the UN, the world is waking up to the fact that biodiversity risk is everyone's risk. Corporates, financial institutions, and governments are developing and adopting commitments, policies, and frameworks to address biodiversity loss and contribute to a nature positive future. With this comes an enormous opportunity to shape infrastructure development in ways that align with long term biodiversity persistence, whilst delivering the services people and economies need.

This session will start with setting the context of "what's on the line" including an assessment that at least 80% of the world's most important sites for biodiversity on land (Key Biodiversity Areas) currently contain infrastructure, with significant increases projected in KBAs in the future, particularly in the global south, including Africa.

The session participants will discuss the most pertinent global policy and private sector frameworks and guidance emerging (e.g. the CBD Global Biodiversity Framework, the Task Force for Nature Related Financial Disclosures) and how stakeholders can leverage these in the progression of ecologically sustainable infrastructure. We will also examine trends in sustainable finance in relation to infrastructure in Africa and beyond.

13:15 – 14:00	**Lunch Break**

Venue: Muna	
14:00 – 15:00	**In the Lions' Den 1**

1: *Wild ungulates can use passages at-grade to cross road-barriers to the same extent compared to ecoducts or other types of wildlife-designed passages at different grades*

Marcus Elfström1,2, Mattias Olsson1, Andreas Seiler2 & Jan Olof Helldin2
1 EnviroPlanning AB
2 Swedish University of Agricultural Sciences (SLU)

Presenter email: marcus.elfstrom@enviroplanning.se

Wildlife passages at-grade require less resources and are less costly compared to constructing wildlife passages over or under an infrastructure barrier. This allows for establishing more wildlife passages and may produce a greater reduction of the barrier effect of infrastructure on larger mammals than what can be achieved with fewer but larger ecoducts.

We compared the probabilities of wildlife visits resulting in passing through or not at different types of passing sites across south-central Sweden. We compared the use by wild ungulates of wildlife passages at-grade with corresponding use of wide overpasses designed for both fauna and flora and referred to as ecoducts, and underpasses which in general all were designed for large mammals to use.

We compared 986 visits by fallow deer (*Dama dama*), 815 visits by wildboar (*Sus scrofa*) and 1,556 visits by roe deer (*Capreolus capreolus*) across four sites with passages at-grade, four o[with overpasses, and five sites with underpasses.

The probability to pass through the different types of wildlife passages was the same in fallow deer, wild boar and roe deer when comparing at-grade passages and ecoducts. Crossing probability in fallow deer was also not different between at-grade passages and underpasses. However, the probability was higher to pass through underpasses than at-grade passages for both wildboar and roe deer. But the pattern in crossing probability differed among sites for all ungulate species, and individual pair-wise comparisons among different sites showed examples of both higher and lower probability to pass when comparing at-grade passages with either overpasses or underpasses.

2: *Book Launch: Impact assessment for Corridors: from infrastructure to development corridors*

Hamza Rafray Butt1
1UNEP-WCMC

Presenter email: hamza.butt@unep-wcmc.org

The book, developed as a key output under the DCP project brings together 15 case studies across Asia, Africa, and Latin America by 61 authors from 13 countries and 28 organisations. It also brings actual Environmental Impact Assessment practice closer to best practice by giving guidance on best practice and introducing tools for risk screening and assessment. The book launch will focus on highlighting the key findings of this book and how it can help drive a new future by improving the process of the environmental and social impact assessments.

3: African primates in the face of transportation network expansion: challenges and opportunities for their conservation

Mattia Quaranta1
1Università degli Studi di Bologna

Presenter email: mattiaquarantaeb@gmail.com

One of the conservation challenges in Africa is the expansion of transportation infrastructures (TI) which have been proliferating in the last two decades. The main two goals of my PhD project are a synthesis of the road ecology research in Africa to find gaps of knowledge and analyze the effects of TI on primates in this continent. More specifically, a synthesis of the road ecology research in Africa and the evaluation of the effects of TI on primates in this continent. I will address four objectives:

1) Perform a systematic literature (scientific papers, thesis/dissertations/gray literature) search of road ecology research in Africa. I intend to analyze the geographic and taxonomic scope of work undertaken to date, the main effects on wildlife and identify the gaps of knowledge to define priorities in research to guide researchers for future studies.
2) Analyze the most sensitive primate species to TI disturbances. I will focus on threatened primate species to evaluate their spatial behavior towards roads, using roadkill and species tracking data to analyze the occurrences at different distances from paved and unpaved roads (road-effect zone REZ) and road features that promote road crossings.
3) Identify the main conflict areas between TI and primate range in Africa through the evaluation of potential movement corridors that are or will be crossed by TI among protected areas. Although national parks and other protected areas (PA) are classified to conserve wildlife, the regions outside the PAs should assure landscape permeability for individuals' movement in order to maintain genetic diversity among populations.
4) Evaluate exposure of protected areas to TI and implications on the habitat fragmentation. I will analyze the relationship between fragmentation and distances from the roads in protected areas and non-protected areas and the impact of PAs have on the role of roads as a fragmentation drive.

Venue: Mugumo
14:00 – 15:00 In the Lions' Den 2

1: *Dogs as a tool for the investigation and the protection of linear structures*

Leopold Slotta-Bachmary1
1Action for Cheetahs in Kenya

Presenter email: science@actionforcheetahs.org

Over the last decade, conservation detection dogs have been increasingly used to detect rare or camouflaged species, find carcasses, and prevent the spread of invasive species. A database including 1220 publications shows that the use of conservation detection canines is well established in North America, Europe, and Oceania. However, the database only includes 17 scientific publications from Africa which are limited to studies on amphibians, reptiles, or mammals. In this presentation, we will highlight the potential use of dogs in conservation and wildlife management in general. Our presentation will also emphasise the possible use of detection dogs in monitoring corridors and determining connectivity between and owithin

populations. Here, we will showcase how conservation detection dogs may be used to search for different wildlife species or collect biological samples such as scat which can be used in population genetic-related studies. In addition, we will illustrate the validity of using conservation detection dogs as a tool for documenting barrier effects caused by linear infrastructure for example by searching for carcasses under power lines or along roads. Lastly, we will discuss the potential use of dogs in monitoring particularly in Africa where the environment (climate, parasite, disease) and the community may impact detection dog use and overall performance. We further plan to identify scientific questions and knowledge gaps which detection dogs may help to answer.

2. Erosion control and restoration of red clay highway slopes using the application of an innovative material: A Case Study in South China

Xiaochun Qin1
1Beijing Jiaotong University

Presenter email:

Ecological restoration is difficult on the red clay highway slopes in the rainy areas in South China that experience severe soil erosion. By using the hydrophilic polyurethane material W-OH to solidify and protect red clay slopes, the erosion control will be substantially improved. We employed simulated rainfall erosion experiments and pot experiments to evaluate the anti-corrosion and growth promotion performances. We found that, (1) in the initial stage of protection, W-OH had the effect of accelerating slope drainage, solidifying the soil structure, and reducing soil loss, with the sediment reduction benefit reaching 37.4–65.3%. (2) The anti-erosion effect was mainly based on soil solidification. (3) The W-OH was affected by rainfall intensity and the W-OH concentration, and the soil erosion prediction equation was constructed according to the observation. (4) W-OH had a promising water retention performance and can promote the germination and late growth of slope plants to reduce the influence of eluviation. (5) The suitable W-OH solution concentration was 3–5% for slope protection herbs and shrubs, which were commonly used in South China. (6) The reduction in porosity was the fundamental cause of water retention improvement. The ecological restoration of slopes is a comprehensive process. Therefore, both anti-erosion performance and later plant growth are necessary. Our research provides a theoretical and experimental basis for applying the W-OH in the ecological restoration of the red clay slopes in subtropical areas and expanding the scope of the W-OH.

3: ***Using the PathFindIR device to prevent collisions on our roads worldwide***

Gregory Kent Smith1
1Headsup Enterprize

Presenter email: headsup.enterprize@gmail.com

Wildlife-vehicle collisions (WVCs) are responsible for the injury and/or the loss of life for both humans and wildlife on roads. Motorists must be vigilant and observe what is ahead of them on the road, to ensure their own safety. We argue that there should be better information around technologies to enable drivers to see 'what is hidden' ahead on the road.

PathFindIR is a device that can be installed in vehicles and is one such technology that shows real time activity on the road. The benefits include being able to observe activity (of pedestrians and animals) at night through automatic detection and alert – the detection system is four times more powerful than using headlights. Without improved technologies, traffic mortality will likely multiply by approximately 65% over the next two decades.

Venue: Muna

15:00-16:30 Integrated Issues 1

Student and youth event: Building a community of practice for the future

Sarah Chiles1
1Grevy's Zebra Trust and Ewaso Lions

Presenter email: chiles.sarah@gmail.com

All (both young and older professionals) are invited to this session to discuss how we can build a community of practice regarding linear infrastructure and ecology in Africa into the future. Some of the questions to be asked are: How can we invest in young people in this field in Africa? How can we integrate linear infrastructure and environment into African university curriculums? How can we encourage inter-generational leadership on issues related to linear infrastructure and environment in Africa? This will be a dynamic session which will encourage participation in a workshop style.

Venue: Mugumo

15:00-16:30 Integrated Issues 2

Integrating the concerns for mitigating the impact of linear infrastructure (Roads and Railways Line) on large mammalian species: Lessons from India

Bilal Habib1
1Wildlife Institute of India

Presenter email:

Linear infrastructure, such as roads, railways, and power lines, can significantly impact ecosystems. These structures can fragment habitats, disrupt wildlife movement, and increase the risk of pollution. The actual cost of this impact on wildlife is challenging to quantify, but it

is estimated to be in the trillions of dollars each year. One of the most significant impacts of linear infrastructure is habitat fragmentation. When a linear structure cuts through a habitat, it can create barriers that prevent animals from moving freely. This can lead to isolation of populations, decreased genetic diversity, and increased risk of extinction. Linear infrastructure can also disrupt wildlife movement. When animals are forced to cross a linear structure, they are exposed to the risk of being hit by vehicles or trains. There is a need to understand the impacts and design mitigation plans which can help in the mitigation of the loss. The success of proposed mitigation plans is only possible when it is acceptable to policymakers, engineers, and economists. There is a need to educate these people about the loss and the need for mitigation planning.

This session will attempt to navigate from ecologists to engineers, decision-makers, economists, and policymakers to that the green linear infrastructure becomes an integral part of railway and road design at the initial stages especially when passing through sensitive habitats.

16:30-17:00 Tea Break

Venue: Muna
17:00 – 18:00 Curriculum Corner 1

Mainstreaming Wildlife Incident Management into Utilities in Southern Africa

Trainer: Lourens Leeuwner1, Oscar Mohale1
1The Endangered Wildlife Trust

Presenter email: oscarm@ewt.org.za lourensl@ewt.org.za

Energy infrastructure such as power lines, power stations, substations, wind turbines, and solar developments are important interfaces between people and wildlife, particularly in Africa's growing economies. These structures are tall (standing out in any landscape) and linear (crossing vast distances), presenting extensive opportunities for wildlife interactions. When wildlife interacts with electrical infrastructure, there is a knock-on effect, costly for utilities and disruptive to end-users. When there is infrastructure damage, utilities can incur significant costs related to hardware replacement, travel to incident sites, human resources for investigations and repairs, and loss in revenue if there are power outages.

This presentation will introduce delegates to a free downloadable colour manual detailing the classification of and solutions to wildlife interactions with electrical infrastructure in southern Africa. The manual is a collaboration between the Endangered Wildlife Trust (EWT) and the USAID Southern Africa Energy Program (SAEP), a Power Africa initiative. Through describing the variety and severity of wildlife interactions with electrical infrastructures, we aim to shine a spotlight on this much understated problem faced by power utilities in southern

Africa. Within the manual, examples of wildlife interactions are listed, classified, and explained and solutions to these incidents are provided in a clear, practical manner. By providing a strategy to address these challenges, the goal is to minimize negative interactions between wildlife and electrical infrastructure in southern Africa, thereby reducing operational costs to utilities, improving the quality of electricity supply to economies, and minimizing the impact on wildlife in the region.

Venue: Mugumo
17:00 – 18:00 Curriculum Corner 2

Cross-Continental Pachyderm Practices: Sharing Best Solutions for Elephant-friendly Linear Infrastructure

Trainer: Melissa Butynski1
1 Center for Large Landscape Conservation

Presenter email: Melissa@largelandscapes.org

Discover global best practices at our cross-continental session on mitigating linear infrastructure impacts on wildlife, with a special focus on the Asian elephant. First, participants will be introduced to international best practices as detailed by the recently released report "Addressing ecological connectivity in the Development of Roads, Railways and Canals" by the IUCN World Commission on Protected Areas (WCPA) Connectivity Conservation Specialist Group (CCSG) and its Transport Working Group (TWG). The report addresses ecological connectivity in the building of roads, railways, and canals and provides information critical for the conservation of wildlife and nature in the face of rapid population growth and development. Next, participants will experience the debut of the Asian Elephant Transport Working Group's Handbook of Mitigation Measures for Asian Elephants. The document is a first-of-its-kind, expert-informed handbook which details structure types, optimal design specifications, finishing techniques, fencing installation, monitoring recommendations for crossing effectiveness, and case studies of successful practices across Asia. Participants will then be engaged in open discussion to share their personal insights on crossing structure development in Africa, species-specific needs, and the utility of creating a similar handbook for the African context. Cross-continental sharing of pachyderm best practices is our ultimate goal. Curious participants, conservationists, researchers, students, engineers, planners, and policymakers are all invited to join!

Day 3, Wednesday 20 September

All times are in East Africa Time

Venue: Nandi Flame (Plenary Hall)

8:00 – 9:00 ACLIE Mkutano: The Pamoja Lens

Keynote speakers:

Sheila Ashong (Ag. Director Natural Resources, Ghana Environmental Protection Agency)
Andrew Letura (Ecological Monitoring Officer, Grevy's Zebra Trust)
Steve Itela (CEO, Conservation Alliance of Kenya)

Venue: Muna

9:05 – 10:05 On the Line 1

1: *Martial eagles on the line: The enigma of tree-nesters in a treeless landscape*

Gareth Tate1, John Davies1, Kaajial Durgapersad2, Arjun Amar3, Jane Doherty3

1The Endangered Wildlife Trust
2Durgapersad, Kaajial. Eskom Research, Testing and Development
3DST–NRF Centre of Excellence at the FitzPatrick Institute of African Ornithology, Dept of Biological Sciences, University of Cape Town

Presenter email: garetht@ewt.org.za

Martial Eagles continue to undergo declines across their African range. Evidence for broadscale population declines has resulted in the recent uplisting of the species to globally Endangered. Although typically a tree nesting species, it is estimated that over a third of the breeding population of Martial Eagles in South Africa nests on pylons that support powerlines traversing the largely treeless, semiarid landscapes of the Karoo. This finding is at odds with the general belief that the species is confined to large, protected areas. Over 2019-2021, we closely monitored the breeding performance in 89 pairs of Martial Eagles along 1,750 km of powerline and investigate the status and sustainability of this pylon nesting population. We further deployed satellite-tracking units on 20 individuals to study the species' movements and threats across the Karoo. We discuss the features of this unique population of eagles and what is needed to conserve it.

2: *Amphibian Underpass Tunnels: A Boon for Endangered Western Leopard Toads (virtual)*;

Kim Gordon1
1Nature Connect, South Africa

Presenter email: kimg@natureconnect.earth

In an urban environment, many species are forced to negotiate a variety of built infrastructure that bisects their habitat, such as roads, walls, swimming pools, and canals, all whilst foraging or migrating to and from their breeding sites. Habitat loss, expanding urban development, and increased road traffic has resulted in population fragmentation and the deaths of countless amphibians each year. One particular species of conservation concern is the endangered Western Leopard Toad (*Sclerophrys pantherina*).

Western Leopard Toads (WLT) can only be found in a small area of the Western Cape Province in South Africa, with a large portion of the population residing in the city of Cape Town. In the urban landscape, these toads face many challenges. During the WLT breeding season, individuals make their way from foraging sites toward breeding ponds, inevitably bringing them into contact with road infrastructure. Consequently, a significant threat to their survival is road mortality.

As reported by the IUCN, trends over the past 25 years suggest that this species is in decline, with more than 50% of subpopulations being considered non-viable without dedicated conservation attention. This significant concern led Nature Connect to initiate the design, development, and phased installation, between 2021 and 2023, of six concrete amphibian tunnels at a road-crossing hot-spot in Cape Town. These tunnels, and the associated seasonal barrier system, are designed to facilitate the safe movement of the WLT under roadways. The goal of this pioneering initiative in Africa, is to incorporate the amphibian tunnels into existing infrastructure and into the planning for upcoming developments at several known WLT hot-spots.

The work carried out in the early stages of this project was presented at the 2021 ACLIE online conference. This presentation will reflect on the construction design, installation, and our initial findings.

3: Human Wildlife Connectivity in Meibae Community Conservancy (In person)

Jane Wanjira1, Mary Wykstra1
1Carnivores, Livelihoods & Landscapes-Action for Cheetahs in Kenya

Presenter email: science@actionforcheetahs.org

Action for Cheetahs in Kenya (ACK) has been based in the Meibae Community Conservancy (MCC) since 2011. The conservancy is community-managed with the conservation of land and wildlife in mind alongside protecting local culture. Shared resources within the conservancy result in similar movement patterns by pastoralists, with their livestock, and by wildlife in search of water and pasture. To better understand the joint use of the land we implement walking transects set along linear developments such as roads and powerlines to monitor wildlife trends and predator movements from 2014-2021. To further understand the wildlife and human interaction, past and current corridors were mapped in 2021 and camera trap

transects were identified through staff and community discussions. In an initial camera trap pilot study less than 10% of captures consisted of wildlife, the majority of which were elephants. People, livestock, and wildlife were also observed using the same routes of movements. Movement times were noted for both people and wildlife. As part of the government's initiatives, infrastructure development especially in Northern Kenya is underway. The project aims to fill in the picture of human impact elements on wildlife movements in order to inform community management and relevant parties on elements of conservation needed for continued sustainable linear developments within the region.

4: Effects of phone mast-generated electromagnetic radiation gradient on the distribution of terrestrial birds and insects in a savanna protected area

Vincent Raphael Nyirenda1, Ngawo Namukonde1, Esther Buunda Lungu2, Sande Mulwanda3, Kenneth Kalezu4, Matamyo Simwanda5, Darius Phiri5, Chansa Chomba6, Josephat Kalezhi7, & Chisala Abbie Lwali5

1Department of Zoology and Aquatic Sciences, School of Natural Resources, The Copperbelt University, P.O. Box 21692, Kitwe, Zambia. vincent.nyirenda@cbu.ac.zm; vrnyirenda@hotmail.com; namukonde@gmail.com; ngawo.namukonde@cbu.ac.zm; ORCID: https://orcid.org/0000-0002-3506-3912; https://orcid.org/0000-0002-4140-8876
2Department of Environment and Social Corporate Responsibility, Kansanshi Copper Mine, P.O. Box 110385, Solwezi, Zambia. buumbasykes@gmail.com
3Department of Natural History, Livingstone Museum, P.O. Box 60498, Livingstone, Zambia. sandemulwanda@gmail.com
4Kemiko Limited, Zambia Agriculture Research Institute, P.O. Box 710129, Mansa, Zambia. kennethkalezu@gmail.com
5Department of Plant and Environmental Sciences, School of Natural Resources, The Copperbelt University, P.O. Box 21692, Kitwe, Zambia. darius.phiri@cbu.ac.zm; chisala.lwali@cbu.ac.zm https://orcid.org/0000-0001-6363-7410
6Disaster Management Training Centre, School of Agriculture and Natural Resources, Mulungushi University, P.O. Box 80415, Kabwe, Zambia. chansachomba@rocketmail.com
7School of Information and Communication Technology, The Copperbelt University, P.O. Box 21692, Kitwe, Zambia. kalezhi@yahoo.com; kalezhi@cbu.ac.zm

Presenter email: vrnyirenda@hotmail.com

Inappropriate deployment of linear physical infrastructures, such as game fences, roads, electric power-lines, buildings, and phone masts can be detrimental to wild fauna. Fatalities arising from wildlife collisions with such infrastructure have been widely documented. However, there are non-physical and less studied effects, such as the 'hidden' negative ecological effects of electromagnetic radiation (EMR) on terrestrial fauna. In this study, the effects of phone mast-generated EMR on abundance, richness and distribution of terrestrial birds and insects in the Kafue National Park were studied. Ten (10) sample plots of 100 m x

100 m each were set at three (3) radial locations, based on the phone mast generated EMR strengths. For birds, point counts, while hand collection, cryptic searching, vegetation beating, sweep netting, pitfall trapping, sorting and identification for insects were employed for data collection. Data were analysed using biological indices (i.e., Shannon-Wiener and Simpson's) and Analysis of Variance (ANOVA). The wildlife diversity significantly reduced with increasing EMR strengths, especially in areas (<12 km from phone mast) with greater than 250±20 µA/m EMR levels. We suggest that deployment of wireless telecommunication infrastructure should consider EMR levels, safe zones and avoid or minimize biological loss in hotspots.

Venue: Mugumo

9:05 – 10:05 Special Session

Special session: *Sustainable Infrastructure: The Future We Want*
(The session is in honour of the late Dr. Tobias Nyumba)

Lucy Waruingi1, Rob Marchant2, Toby Otieno23, Evans Sitati24, Stellah Ndiwa5
1African Conservation Centre
2University of York
3Ewaso Lions
4 Mara Siana Conservancy
5Kenya Railways

Presenter email: lucy.waruingi@acc.or.ke

The session, moderated by Lucy Waruingi, seeks to look at key findings on the impacts of various development investments in Kenya/Africa and the role of research and providing policy considerations that would address a sustainable development model. The panelists have been investigating these issues under various land use planning arrangements and contributing to developing future scenarios in a participatory manner to inform the future we want in Africa. Presentations will include:

- Rob Marchant: Topic KESHO: Future scenario tools to create Space for Giants
- Toby Otieno: Developing Lion Futures for the Samburu area of northern Kenya
- Evans Sitati: Conservancy Futures - insights from the Siana conservancy Masai Mara
- Stellah Ndiwa: Transport futures: The role of scenarios in sustainable transport planning

Discussions, and Q&A on establishing principles/guidelines for an inter-sectoral development approach for Africa will follow.

10:05-10:30 Tea Break

10:30 Leave for day trips

Day Trip 1: Nairobi National Park
Day Trip 2: Kijabe Forest and the Rift Valley
For those who are attending online, tune in for a livestream of the day trips at 14:00.

17:00	**Return from day trips**
18:00-21:00	**Fireside dinner and awards**

Day 4, Thursday 21 September

All times are in East Africa Time

Venue: Nandi Flame (Plenary Hall)
9:00 – 10:00 ACLIE Mkutano: The Innovation Lens
Keynote speakers:
Mark Xavier (CEO, V-TOL Aerospace)
Thabo Hlatswayo (PhD candidate, University of KZN & Endangered Wildlife Trust)
Manisha Bhardwaj (Post-doctoral researcher, University of Freiburg)

10:00 – 10:30 Tea Break

Venue: Muna
10:30 -11:30 On the Line 1

1: *For more sustainable railways: measures to prevent and mitigate the impacts on a Brazilian railroad on wildlife*

Tatiane Bressan Moreira1, Stefani Gabrieli Age2
1,2 Rumo S.A

Presenter email: tatiane.moreira@rumolog.com

Rumo S.A. is the largest railroad operator in Brazil. Railroads are essential to socio-economic development, promoting accessibility and transporting a series of goods.. However, they cause numerous impacts to the environment, among them, the barrier effect, animals being run over and the trapping of small animals between the rails.

Rumo S.A has been active on the fronts of preventing and mitigating the impact of its operations on wildlife. Regarding prevention, we were the first Brazilian railroad to use predictive analysis of wildlife-train collisions in a railroad expansion project in the state of Mato Grosso, North of Brazil. This study identified likely critical stretches for the wildlife-train collisions, with mammal species in general or with threatened specific species, such as Lowland Tapir (*Tapirus terrestris*), and white lips White-lipped Peccary (*Tayassu pecari*). This study is innovative and applied, allowing to make decisions where the mitigation measures would be more useful to prevent wildlife mortality.

Another front of action is the mitigation of the impact on chelonians (terrapin and tortoises). The imprisonment and death of these animals on railways have been reported in Brazil and several countries. We identified that the access of these animals to the rails is facilitated by level crossings, where there is an interception of a road and railroad. Once between rails, the

possibility of escape is low, especially for small specimens. Studies show that Chelonians have difficulties in overcoming obstacles. On the railroad, this results in hours of exposure to the sun with consequent death from hyperthermia and dehydration. We were the first in Brazil to test, implement and monitor the effectiveness of exclusive passages for Chelonians. The results obtained are promising and resulted in a reduction in the mortality rate of these animals.

2: *Trans-species accompaniment during the public participation process for a road planned to be built within endangered Western Leopard Toad habitat and breeding ponds in Cape Town, South Africa (virtual)*

Andrea Marais-Potgieter 1, Alison Faraday 2
1 Department of Psychology, School of Human and Community Development, University of the Witwatersrand and the Noordhoek Environmental Action Group, South Africa
2 ToadNUTs and the Western Leopard Toad Conservation Committee, South Africa.

Presenter email: andrea@conservationpsychology.co.za

New ways of thinking are required to address complex ecological challenges such as the approval of inappropriate developments. Many of these developments are roads planned to be built in low- and middle-income countries with high biodiversity. The concept of trans-species accompaniment challenges the dominant paradigm of human-centered thinking, where non-human animals receive little consideration because they are either treated as resources for human benefit or as collateral damage in the ceaseless pursuit of economic progress. As advocates of trans-species accompaniment in Cape Town we sought to challenge this paradigm by recognising the inherent value and rights of the endangered and endemic western leopard toad (Schlerophrys pantherinus). We will discuss the South African public participation process for a 1 218 km road planned to be built through endangered western leopard toad habitat and breeding ponds within a biologically sensitive wetland. The anticipated negative impacts of this road will extend into the greater Noordhoek wetland system in Cape Town. The presentation will discuss this road as a case study of a controversial linear structure and our experience of advocating that more equitable relationships between humans and other species are crucial for ecological justice. The discussion will describe the contesting of power in public participatory spaces as a form of trans-species accompaniment, and the generation of emotive knowledge (including distress and a sense of betrayal).

The road described in this case study is currently the subject of a High Court case in the South African judicial system.

3: *Using acoustic monitoring to explore the impacts of a railway and road traffic on the local marine environment in False Bay, South Africa*

Fannie Shabangu1
1Department of Forestry, Fisheries, and the Environment

Presenter email: fannie.shabangu@yahoo.com; fshabangu@dffe,gov,za

The influences of linear infrastructure on the terrestrial environment are well documented, however, the effects of these linear infrastructures on the underwater environment are poorly understood. Here, passive acoustic monitoring data collected in False Bay, South Africa, were analysed with the aim to establish the influence of a nearby railway line and road traffic on the marine environment. The train schedules were linked to detected underwater noise using time of the recorded acoustic files. Results of this work indicate that vibrations from the railway line could be detected by a hydrophone deployed 5 km offshore from the railway line, where train sounds were heard before, during and after trains have arrived or departed the local nearby stations. Vocalisation of whales, fish and dolphins were masked by the noise from the nearby railway line. Some marine organisms reduced their acoustic activity in response to this noise, whilst some increased their vocal activities to compensate for this noise source and some animals maintained their acoustic activities showing habituation. Nonetheless, sounds from the nearby roadway were not detected by the underwater recorder indicating no effect from this linear infrastructure. This study indicates that some linear infrastructures on land have a negative impact on marine organisms, and this is especially concerning for marine organisms that show negative reactions to noise produced by these infrastructures. Thus, management and regulatory bodies need to consider this influence to conserve and protect some of the endangered underwater species. Particularly, results of this study are applicable to other ecosystems such as freshwater environments where nearby linear infrastructure can affect the health and existence of underwater organisms. Lastly, my results suggest that underwater noise environmental impact assessments should be done before erecting linear infrastructure near water bodies since sounds from land can be detected underwater.

Venue: Mugumo
10:30 -11:30 On the Line 2

1: *Livestock & wildlife corridors to protect connectivity across roads and through developing areas in northern Kenya*

Benjamin Loloju1
1Save the Elephants

Presenter email: loloju@savetheelephants.org

In Northern Kenya, wildlife species are facing threats to their natural habitats due to human population growth and infrastructural developments. This is placing increasing pressure on people, livestock and wildlife as they share space and available resources. Save the

Elephants (STE) and Wyss Academy for Nature (WA) aims to evaluate and secure the livestock and wildlife movement corridors to ensure there is connectivity between the fast-changing landscapes in the northern frontier. It will also aim to evaluate key challenges and future threats to connectivity in the Samburu-Laikipia ecosystem and viable management approaches through the local communities. A data science analysis of elephant radio collar tracking, using data collected by STE from elephants who have moved through the corridors between the years 1998 and 2021, combined with knowledge from local communities, has revealed key corridors. Together with other datasets such as human settlements, it has shown how corridors are facing blockage by rising human population pressures. The Samburu nomads rely on seasonal migration to get grazing and water for their livestock. Many species of wildlife also migrate seasonally, and they have to manoeuvre their way through a landscape increasingly altered by the effects of climate change, population growth and land degradation. The future of major movement corridors seems dire and thus the urgent need to make sure there is proper awareness and understanding from the communities to reopen and protect the blocked parts of the migratory corridors. The local communities are the key decision makers on what happens in the landscape, and they are further supported by the conservancies. Their involvement is paramount to avoid internal politics and wrangles that may drive conflict and put up unnecessary barriers. Issues involving land matters are significant and sensitive, so holistic agreements are needed to ensure a smooth process with clearly defined conservation goals. STE and WA have reiterated that the corridors are for the benefit of the communities, and that they strike a measured balance between the needs of livestock and wildlife. Human-wildlife coexistence and sustainable development should be a priority to enable both development and conservation goals to be achieved. Proper management of the spread of human settlements should be undertaken to avoid further encroachments to the corridors. This will be achieved through improved spatial planning, since informatics-based approaches are shown to offer value to conservation practices.

2: *Research status and challenges of road impacts on wildlife in China: a summary of 144 case studies conducted including on ungulates on the Tibetan Plateau, the giant panda and Asian elephant*

Abudusaimaiti Maierdiyali1
1Peking University

Presenter email: ma20ab@163.com

Habitat loss and fragmentation, driven by expansion of global transport infrastructure networks, has become one of the significant factors contributing to the decline of biodiversity. Many studies on the impact of roads on wildlife have been conducted abroad, yet only a modest number of studies have been conducted in China.

This review summarises 144 case studies conducted in China by the year 2021 and 210 posts relating to roadkill from Sina Microblog. The impacts of roads on wildlife in China were divided

into seven types: habitat loss, habitat fragmentation, avoid or gather at the roadside, hinder, or promote migration, population isolation, wildlife crossing structures and roadkill. Recent, relevant studies in China are mainly concentrated in Hoh Xil, Changbai Mountains, and Qinling Mountains. The main species studied are ungulates on Tibetan Plateau, the giant panda (Ailuropoda melanoleuca) and Asian elephant (Elephas maximus).

Collecting data on the impacts of roads on wildlife, is critical to inform interdisciplinary and multi-departmental management and conservation solutions of road-wildlife conflicts in China. Social media platforms can be important sources of data on roadkill occurrences. Key words: highway; transportation; habitat; wildlife crossing structures; roadkill; citizen science; road ecology

3: *Incidences of power line collisions and electrocutions involving the Grey Crowned Crane in Western Kenya*

Vivian Kitui1,2,3
1. International Crane Foundation
2. The Endangered Wildlife Trust
3 Community Action for Nature Conservation

Presenter email: viviann@ewt.org.za

Powerline collisions involving Grey Crowned Cranes in Western Kenya is a growing concern. The Kenya Crane and Wetland Conservation Program focuses on the Grey Crowned Crane which is listed as Endangered on the IUCN Red List of threatened species owing to a decline of over 80% of its population over the last 40 years. The Kenyan population of the species has recently been estimated at 8,500-10000 individuals. The species faces a myriad of threats including wetland conversion to agricultural fields, poisoning, powerline collision, and electrocution. Infrastructural development expanding to rural areas has eased access to utilities like water and electricity. These networks especially for the power lines impact negatively on wildlife as the transmission wires are naked and birds easily fly into them. This study is important as it will help us to raise awareness of the incidents involving cranes, help in reducing mortalities arising from this threat and help the power utility service providers to reduce losses to their revenue due to collision incidences. We report opportunistic observations of a three-year (2020-2023) data of recorded incidences and observations reported by crane custodians spread across the study area. Ten incidences were recorded during the study period. These were distributed as follows: Uasin Gishu (2), Nandi (7), and Kakamega (1). There is a need to work together with Power Service providers in Kenya to be able to understand the numbers lost to collisions. Environment Impact Assessments should also be conducted for projects involving flyways and an environmental audit of the existing lines to help in developing mitigation measures that will benefit the species and the utility companies.

Venue: Muna
11:35 – 12:25 Design Desk 1

Plans, trains, and automobiles: using tools, data, and AI to plan for sustainable linear infrastructure

Hamza Rafray Butt1
1UNEP-WCMC

Presenter email: hamza.butt@unep-wcmc.org

The prospective impacts of road and rail construction and use are routinely measured at local and subnational levels. However, until now, there has not been a standardised, comparable global assessment of the ecological risks and economic benefits of planned transport infrastructure projects. To provide such an overview, we needed to first create a global database of planned large-scale road and rail projects. We then developed a methodology to map the risks of these projects to biodiversity and ecosystem services. To understand the associated socio-economic benefits for this planned infrastructure, we estimated potential boosts to jobs and countries' gross domestic product. Combining these various analyses, we highlighted the overall risks and benefits on a country level. In addition to national overall impact results, we calculated risks and benefits per km of road and rail infrastructure.

In the study, it was found that the planned or in progress transport projects will 1) impact habitats of nearly 2,500 amphibian, bird and mammal species of conservation concern, with a high risk to persistence for 42 species; 2) intersect protected areas or Key Biodiversity Areas (KBAs) for 5% of the total summed length; 3) release 883 million tonnes of carbon from removed trees and vegetation – more than in Costa Rica's rainforests - and potentially 1.17 million tonnes of nitrogen with toxic downstream impacts; create 2.4 million global jobs, with varying increases in GDP, from 0.1% in higher income regions to 1.3% in lower income countries.

In addition to that, the role of tools such as Global Infrastructure Impact Viewer, IBAT and ENCORE will also be explored in planning for sustainable linear infrastructure and how they can contribute to inclusive planning that takes into account natural capital, human capital, ecosystem services' considerations. Among many others, promoting connectivity and understanding nature risks and opportunities.

Venue: Mugumo
11:35 – 12:25 Design Desk 2

Artificial Canopy Bridges: An effective and economic mitigation measure to reduce road effects in Diani, Kenya

Pamela Cunneyworth1
1Colobus Conservation, Kenya

Presenter email: pam@colobusconservation.org

Canopy bridges are recognised as effective solutions to mitigate road impacts on primates. However, few studies have quantified whether they do so across various species of monkeys. To address this gap, we analyzed datasets collected in Diani, southeastern Kenya, by the local conservation organization Colobus Conservation. These datasets focused on the four sympatric species of monkeys occurring within the town: colobus (*Colobus angolensis palliatus*), Sykes' monkey (*Cercopithecus mitis albogularis*), vervet (*Chlorocebus pygerythrus hilgerti*), and baboon (*Papio cynocephalus cynocephalus*). Our objective was to assess the variable impact of the road on these species and determine whether canopy bridges mitigated monkey-vehicle collisions and the road barrier. We first determined the annual percentage of the local population of each species involved in road incidents resulting in injuries or mortalities. Next, we investigated bridge crossing rates and assessed whether canopy bridges reduced collision hotspots. Our findings revealed that arboreal species (colobus and Sykes' monkeys) had a higher percentage of individuals involved in road incidents (~2%) compared to terrestrial species (vervet: ~1.75%; baboon: ~1.0%). Surprisingly, however, the bridge crossing rate was significantly higher for Sykes' monkeys than for the other species. Despite an increase in canopy bridge numbers from 8 in 2000 to 30 in 2022, the annual collisions did not significantly decrease. Collision hotspots persisted along the road, and in some cases, new hotspots emerged after bridge installation. These results indicate that the impact of canopy bridges in mitigating vehicle collisions and the road barrier effect varies across species, likely influenced by factors such as body mass and substrate preference. Our study provides valuable insights for practitioners developing canopy bridge programs, as the findings can be generalized across diverse species, given the taxonomic range of the species occurring in Diani.

Venue: Nandi Flame (Plenary Hall)
12:30 – 13:15 Policy Props

A global international policy perspective: presenting states' international obligations to address linear infrastructure impacts on migratory species under the Convention on Migratory Species

Mark Attallah1
1 Convention on Migratory Species

Presenter email: marc.attallah@un.org

In May 2022, the CMS Secretariat organized the meeting of the Intersessional Working Group (IWG) on linear infrastructure. The Working Group formulated a number of

recommendations by identifying missing links between the environmental, finance, and planning sectors that should be overcome through improvements in international and national governance structures. It recommended addressing awareness and capacity gaps within the planning and finance sectors to better integrate the requirements of migratory species in planning processes; enhancing data availability on species distribution and mitigation measures for the finance and planning sectors; and making development plans more easily available to migratory species' experts. The full meeting report is linked here.

The Working Group's recommendations have been formulated as draft amendments to a resolution and decisions (linked here) that will be considered by the Fourteenth Meeting of the Conference of the Parties to CMS in October 2023 in Samarkand, Uzbekistan.

In this session, the CMS Secretariat will introduce to the ACLIE conference a global international policy perspective by presenting states' international obligations to address linear infrastructure impacts on migratory species under CMS as well as the outcomes of the Working Group's meeting and next steps — as was done at the 1st Asia-Europe Transportation Ecology Forum.

13:15 – 14:00 Lunch Break

Venue: Muna
14:00 – 15:00 In the Lions' Den 1

1: *Community-Based Conservation, Ecosystem-Based Adaptation and Population Health and Environment in Rukiga, Southwestern Uganda*

Phionah Orishaba1,2
1International Crane Foundation
2The Endangered Wildlife Trust, South Africa

Presenter email: phionaho@ewt.org.za

As populations grow and the need for more efficient transportation systems rises, so does infrastructure demand. Linear infrastructure like roads and powerlines disrupt ecological conditions, fragment natural habitats, and may diminish wildlife numbers. Participating in dialogue with causative and affected stakeholders makes it feasible to find solutions that improve adaptability to environmental changes and reduce the negative repercussions of infrastructure development. Human, animal, environmental, and community livelihood sustainability are interconnected. Human pressures on ecosystems endanger biodiversity, ecological services, and natural resource-dependent livelihoods. Ecosystem stresses threaten human health and well-being. Communities need integrated solutions to address the interconnected issues of human population dynamics, human and animal health, and ecosystem health. One such endeavour was and is still presently underway in the

Southwestern Ugandan region of Rukiga as part of the Uganda Grey Crowned Crane and Wetland Conservation Project, a collaboration between the International Crane Foundation (ICF) and the Endangered Wildlife Trust (EWT). The former and latter also partner with Rugarama Hospital, the Margaret Pyke Trust, and the London School of Tropical Medicine. A portion of the project focuses on integrating three approaches, namely Population, health, and environment (PHE), Community-based Adaptation (CBA), and Ecosystem-based Adaptation (EBA), in enhancing natural resource resilience in the district of Rukiga in southwestern Uganda. This paper intends to convey the experiences and lessons generated by the project up to this point and provide recommendations for relevant future endeavours.

2: ***Mammal utilisation of non-wildlife railway underpasses within the Greater Kruger***

Hannah de Villiers1
1The Endangered Wildlife Trust, South Africa

Presenter email: hannahdv@ewt.org.za

Railways are an integral component of sustainable transport systems, but cause significant impacts to biodiversity, primarily through wildlife-train collisions and habitat fragmentation. Crossing structures (CSs) for wildlife are the key mitigation measure for these adverse impacts, which will be critical throughout Africa, where 85,000 km of new railway lines are predicted to cut through hundreds of protected areas. For the first time in southern Africa, mammal usage of railway underpasses that were not designed to facilitate wildlife movement was studied using camera traps in the Greater Kruger, South

Africa. This study demonstrates that 70% of the terrestrial medium-large mammal species present in the area used at least one non-wildlife CS during the study, with a total of 1,823 visitations by 33 species. Twelve African mammal species used underpasses regularly, improving the permeability of the railway line for these species. A viaduct design had almost four times the usage rate of a typical box culvert and was used by twice as many species, including megaherbivores and mesoherbivores, whereas box culverts supported a smaller number of species, of which the majority were predators. Species most affected by rail collisions seldom used non-wildlife underpasses. These results indicate that a railway line with only culverts and the occasional viaduct is not effective in providing adequate safe CSs for megaherbivores and ungulate mesoherbivores. Contrary to expectations, vegetation and environmental factors influenced mammal usage of box culverts more than structural dimensions. Ensuring that there is high visibility through the structure, with less herbaceous cover and more woody cover outside of entrances, is likely to enhance culvert usage by most trophic groups. In a savanna context, a range of underpass designs including larger viaducts, located in different types of vegetation cover, thereby combining the range of requirements of different guilds, is recommended.

3: ***Combining Citizen Science and animal movement data to Monitor Road kills in Northeastern Kenya***

Ali Abdullahi1
1Hirola Conservation Programme

Presenter email: ali@hirolaconservation.org

Linear infrastructure projects, such as roads, railways, pipelines, transmission lines, and canals play a crucial role in connecting communities, facilitating economic activities, and enabling the movement of goods and services. However, these projects often intersect with ecologically sensitive areas, posing significant challenges to biodiversity conservation and ecosystem integrity. Therefore, there is a need to explore innovative approaches to minimize impacts of such infrastructure development on biodiversity. In this presentation, I will discuss the potential of citizen science in monitoring and addressing the ecological impacts of Lappset corridor, particularly road kills, in Northeastern Kenya. Our program involves a community led roadkill monitoring program where we are combining these data with GPS telemetry data to identify high-risk areas to inform mitigation measures. Our study demonstrates the effectiveness of engaging local communities in collecting roadkill data to enhance ecological awareness and develop management strategies. This participatory approach not only enhances ecological awareness but also empowers communities to take an active role in mitigating the negative impacts of linear infrastructure on wildlife.

Venue: Mugumo
14:00 – 15:00 In the Lions' Den 2

1: *An innovative approach to maintaining landscape connectivity and mitigating wildlife accidents on Swedish railroads through acoustic signals*

Andreas Seiler[1], Aina Windsvold[2], Svein-Morten Eilertsen[3], Carolin Berndt[1], Mattias Olsson[4]

1 Sveriges Lantbruksuniversitet, SLU.
2 Ruralis - Institute for Rural and Regional Research.
3 NIBIO – The Norwegian Institute of Bioeconomy Research.
4 EnviroPlanning.

Presenter email: mattias.olsson@enviroplanning.se, andreas.seiler@slu.se

Wildlife accidents on railways are problematic both for authorities, train operators and conservation. To reduce the ecological and socio-economic effects, better mitigation measures and new mitigation strategies are needed. Fences and fauna passages usually have a good effect but are expensive measures that can be justified only along particularly accident-prone sections. They therefore need to be supplemented by measures that can provide protection along major parts of the railway networks.

We use acoustic signals to create a controlled flight response by the animals prior to the arrival of the train, thus warding off animals from the rail corridor when the risk of accidents is imminent. This shall be achieved both with an infrastructure-based solution (acoustic devices at sites along the railroad) and a complementary vehicle-based solution (loudspeaker at trains), as the responsibility for avoiding collisions is shared between railway managers and train operators.

The infrastructure-based study is ongoing, but our preliminary results are indicating that the human voice is the most effective signal for ungulates, inducing a flight response in 88% of the trials, compared to railway bell, train horn, and train sound that on average repel animals in about 65% of the observed cases. Hence, we conclude that a simple voice message may indeed be a sufficient signal to temporarily keep animals off the track.

Our studies show that it is very likely that a warning system based on acoustic signals can be a cost-effective measure. A commercial, rail-based solution is considered very possible and may be available within a few years already. A train-based solution requires further studies and technical development to allow both the testing of repelling sounds and the full integration in train safety systems. Beside our own studies, we discuss a variety of aspects of innovative solutions for wildlife protection at railroads.

2: ***The growing potential of canopy bridges in fragmentation mitigation for arboreal mammals***

Tremaine Gregory1,2, Fernanda Abra2,3, Birthe Linden4, Fernanda Teixeira5, Kylie Soanes6, Anna Nekaris7,8, Ines Azofeifa Rojas9,10, Pamela Cunneyworth11, and Yibo Fan12

1World Wildlife Fund, USA
2Smithsonian's National Zoo and Conservation Biology Institute, USA
3ViaFAUNA Estudos Ambientais, Brazil
4University of Venda, South Africa
5Universidade Federal do Rio Grande do Sul, Brazil
6University of Melbourne, Australia
7Oxford Brookes University, UK
8Little Fireface Project, Indonesia
9SalveMonos, Costa Rica
10University of Costa Rica, Costa Rica
11Colobus Conservation, Kenya
12Fudan University, China

Presenter email: Tremaine.Gregory@wwfus.org

For human safety reasons and for their visibility and charisma, terrestrial megafauna tend to dominate the growing conversation on mitigation solutions for the fragmentation effects of linear infrastructure (LI). But those effects are likely to be even more substantial for arboreal wildlife, which prefer branches for safe passage across forest clearings. Indeed, some species will not come down to the ground at all, making LI an entirely impermeable barrier to movement, gene flow, and the important seed dispersing, pollinating, and other services this group provides to forests. While less discussed than over- and underpasses, canopy bridges are a mitigation solution for arboreal wildlife that is gaining increased traction. However, many canopy bridge studies are small and grassroots, and results are not always published in the peer reviewed literature, making knowledge exchange challenging. In an effort to increase the visibility of this method, a substantial addition was made to the body of literature on this topic with the publication of 23 case studies in a 2022 special issue of Folia Primatologica. Additionally, we are embarking on two endeavors to encourage the uptake of this extremely low-cost mitigation method that can be highly effective and easily retrofitted over existing LI: 1) a deep dive literature review on the topic in the peer reviewed and gray literature which has recovered over 85 publications on the topic and 2) a set of guidelines for canopy bridges for primates for the IUCN SSP. We will discuss findings and recommendations that are emerging from these two endeavors in hopes of expanding uptake in Africa: a continent with substantial proportions of arboreal and semi-arboreal species in forested habitats.

3: Understanding automated detection and driver warning systems for wildlife on roads

Steve Bega1
1Animex International Inc.

Presenter email: steve@animexinternational.com

In 2019, there were almost 15,000 human fatalities from road accidents in South Africa – that's just over 40 people per day. Many of these incidents involved a collision with an animal, although the number of animals killed on roads each day in South Africa is not easy to quantify. Reports from the Humane Society on roads in the USA estimate that approximately one million animals are killed each day (the size of a jackal or above), with this figure likely to be significantly higher if smaller species are included.

Mitigating for Wildlife Vehicle Collisions (WVCs) has several options; some involve expensive installation of over-and-underpass bridges, or the less costly option of retrofitting these structures to allow connectivity of wildlife passage. Some countries in the world have opted for wildlife-warning signage or animal detection and driver warning systems (ADDWS) that effectively alert drivers to the presence of an animal.

ADDWS are an innovative solution used to mitigate the impacts of collations with wildlife on roads. The systems utilise innovative technologies to detect wildlife approaching the roadside and alert drivers to the risks through various means including animated signs,

flashing lights, sirens and digital notifications. These real-time alerts encourage drivers to alter their behaviour and avoid a potentially deadly crash.

With a variety of different technologies available including radar, thermal, break beam and lidar these low impact solutions have been proven to be effective alternatives to fencing, visually more appealing and optimum solutions for vast open landscapes. The infrastructure required to power these systems has a very low footprint and can utilise solar power and wireless connections to increase their suitability to be used in remote locations.

In this presentation I am going to explain how these systems work and make the pitch to convince the Lions to install the first animal detection and driver warning system in Africa.

Venue: Muna

15:00-16:30 Integrated Issues 1

Sharing experience on transport ecology policy and best practices between Africa and Europe

Organizers and moderators

Elke Hahn[1,2], Lazaros Georgiadis[3,4,5]

[1] *Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology, Vienna, Austria*

[2] *IENE Governance Board Chair,*

[3] *Biologist, Senior Environmental Consultant, Florina, Greece*

[4] *The Centre for Research & Technology, Hellas. Greece*

[5] *IENE Governance Board member*

The structure of the session

The session will be organized in three steps:

Step 1 (15 min): Asking questions from the audience about priorities of lessons learned on policies and practices from Europe and Internationally

Step 2 (45 min): Presentation of selected topics and cases of policy and best practices from Europe developed by members of Infrastructure and Ecology Network Europe (IENE) and other transport ecology stakeholders in International, trans-European and national level. Three presentations will be presented:

a) Presentation of IENE as European Network and association with international exposure.

b) The BISON project which implemented in European level in the framework of the European Union Horizon Programme with a joined Advisory Group with members from international organizations and institutions.
c) The Austrian Defragmentation Program as a case of practice developed in national level.

Step 3 (30 min): Discussion and conclusions on where initial questions would be answered and framing of priority topics that can be presented in the future ACLIE not covered from the session.

International participants of the conference activated on the transport ecology in different continents and sectors and different specialties will be asked and encouraged to participate in the session in order to increase the global perspective of the session.

Students will be encouraged to:

- give their questions first
- express their opinions during the session first
- participate in the process of extraction of conclusions expressing their conclusions first but to the final as well

<u>Presentation 1</u>: The Infrastructure Ecology Network Europe (IENE) – a European initiative for Harmonizing Transportation and Nature

Elke Hahn[1,2], Johan Rydlov[3,4], Toine Morel[5,4], Yannick Autret[6,4], Carme Rosell[7,4], Marita Böttcher[8,4], Lazaros Georgiadis[9,10,4], Tony Sangwine[11,4], Jean-François Lesigne[12,4], Andreas Seiler[13,14], Charlotte Navarra[15]

[1] *Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology, Vienna, Austria*
[2] *IENE Governance Board Chair*
[3] *Swedish Transport Administration (Trafikverket), Sweden*
[4] *IENE Governance Board member*
[5] *Dutch Ministry of Infrastructure and the Environment, The Netherlands*
[6] *Ministry for an Ecological Transition, Paris, France*
[7] *Minuartia, Barcelona, Spain*
[8] *Federal Agency for Nature Conservation (BfN), Leipzig, Germany*
[9] *Biologist, Senior Environmental Consultant, Florina, Greece*
[10] *The Centre for Research & Technology, Hellas. Greece*
[11] *Highways England, Bristol, United Kingdom*
[12] *Environmental attaché at RTE, Paris, France*
[13] Swedish University of Agricultural Sciences, Grimsö Wildlife Research Station, Sweden
[14] *IENE Scientific and Expert Committee Chair*
[15] *IENE Executive Secretariat*

Presenter email: Elke.Hahn@bmk.gv.at

Established in 1995 the Infrastructure and Ecology Network Europe (IENE www.iene.info) is a network of experts working with various aspects of transport, infrastructure, and ecology. IENE provides an independent, international, and interdisciplinary arena for the exchange and development of expert knowledge, with the aim to promote a safe and ecologically sustainable pan-European transport infrastructure including international cooperation to undertake defragmentation actions.

The first initiative started in 1995 through the COST 341 Action "Habitat Fragmentation due to Transportation Infrastructure "which established a first bridge between civil engineers and ecologists, scientists, and practitioners. The European Wildlife & Traffic Handbook was edited.

After some more quiet years IENE experienced its full reactivation in 2009. IENE activities and initiatives include the organisation of biannual international conferences, the release of Declarations, the organisation of workshops, production of scientific papers, reports, publications, etc. By that, IENE, as a network of experts (Scientists, Practitioners as well as Decision makers) gathered more than 400 members from all over the world. In 2021 IENE became a European association as per French law.

IENE has been cooperating in the development of the European initiative BISON (Biodiversity and Infrastructure Synergies and Opportunities for European transport Networks, www.bison-transport.eu) project, funded under Horizon 2020, which has a strategic dimension for future infrastructure investments and their effects on biodiversity. Main outputs are the online Handbook "Biodiversity and Infrastructure – A Handbook for Action" (updated IENE Handbook Wildlife and Traffic), the European Defragmentation Map and the Strategic Research and Deployment Agenda (SRDA).

Presentation 2: Best practices and policy commendations for action on infrastructure and biodiversity in Europe derived from the BISON project

Lazaros Georgiadis[1,2,3], Carme Rosell[4,3], Marita Botcher[5,3], Yannick Autet[6,3], Elke Hahn[7,3], Eleni Chalkia[2], Matina Loukea[2], Radu Mot[8], Cristian Remus Papp[9], Andreas Seiler[10,11], Vaclav Hlavac[12], Charlotte Navarro[13]

[1] *Biologist, Senior Environmental Consultant, Florina, Greece*
[2] *The Centre for Research & Technology, Hellas. Greece*
[3] *IENE Governance Board member*
[4] *Minuartia, Barcelona, Spain*
[5] *Federal Agency for Nature Conservation (BfN), Leipzig, Germany*
[6] *Ministry for an Ecological Transition, Paris, France*
[7] *Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology, Vienna, Austria*

[8] *Zarand Association, Brasov, Romania*
[9] *WWF Danube Carpathian Programme Romania, Bucharest, Romania*
[10] *Swedish University of Agricultural Sciences, Grimsö Wildlife Research Station, Sweden*
[11] *IENE Scientific and Expert Committee (SEC) member*
[12] *Nature Conservation Agency, Prague, Czech Republic*
[13] *IENE Executive Secretariat*

Presenter email: lazgeo36@gmail.com

Transport infrastructure is a major cause of ecosystems' alteration and fragmentation minimizing ecological connectivity and contributing to biodiversity decline worldwide. Defining policies and sustainable practices is one of the great challenges and needs urgent reaction adopting defragmentation practices in already fragmented landscapes and avoidance of fragmentation in pristine habitats e.g. adaptation of technical elements such as bridges and culverts to wildlife passages. Inappropriate transport development can also have consequences for human safety e.g., due to animal-vehicle-collisions. In Europe and worldwide is urgent to achieve sustainable infrastructure for biodiversity while ensuring their reliability, efficiency and resilience especially on balancing the adaptation to climate change. These needs of international demands to reverse the biodiversity loss are highlighted under the status of the 2022 Kunming – Montreal Global Biodiversity Framework of COP 15 of Convention on Biological Diversity (CBD) and the need of mainstreaming biodiversity on the development of several sectors as decided in CBD COP 15 in 2018 in Egypt.

Reacting to these challenges, appropriate policies accompanied by concrete practices will be presented based on the experience gained through the activities of the Infrastructure and Ecology Network Europe (IENE) in the framework of the BISON project 'Biodiversity and Infrastructure synergies and opportunities for European Transport Networks'. As EU Horizon Coordination and Support Action project on the topic of transport and biodiversity issues, BISON aims to identify future research and innovation needs for a better integration of biodiversity with infrastructure. Focused on specific topics the presentation will describe deliverables as, a) the "Biodiversity and Infrastructure. A Handbook for Action" based upon 'Wildlife and Traffic' handbook and aiming to accelerate the deployment of effective actions as well as innovative solutions and technologies, b) the "European Defragmentation Map and planning guidelines to use the map", and c) the "Recommendations for policy/strategy harmonisation".

Presentation 3: Austrian Defragmentation Efforts

Elke Hahn[1,2]
[1] *Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology, Vienna, Austria*
[2] *IENE Governance Board Chair*

Presenter email: Elke.Hahn@bmk.gv.at

Austria has a total of about 2000 km of motorways. Since 1986 it is obligatory to fence them on both sides for traffic safety reasons. Since then Austrian motorways build an impermeable barrier to most fauna species.

In 2006 the former Ministry for Transport, Innovation and Technology released the Directive "Habitat connectivity", which obliges the Motorway company, ASFINAG, to install 20 wildlife crossing structures along existing motorways within 20 years. Several studies investigated and elaborated the most important crossing points between the existing motorways and internationally important migration corridors and thereby defined the locations for the planned defragmentation actions.

So far only 4 bridges have been built, 5 more will be constructed in the near future. Nevertheless, about half of the necessary locations face big difficulties caused by the lack of legal protection of the corridors in spatial plans or by barrier effects of other linear transport infrastructure very close to the motorways.

Examples for the successful implementation will be shown, as well as examples of the main challenges and so far unsolved problems. The Austrian experience shows that it is always easier, cheaper and more efficient to consider connectivity right from the beginning. Successful defragmentation needs much more effort, money, strong cooperation and commitment from various stakeholders!

Venue: Mugumo
15:00-16:30 Integrated Issues 2

Contextualising the impacts of linear infrastructure on African drylands and seeking mitigation

David Kimiti[1],Sarah Chiles[1,2], Colleen Seymour[3]
1 Grevy's Zebra Trust
2 Ewaso Lions
3 South African National Biodiversity Institute

Presenter emails: kimiti@grevyszebratrust.org, chiles.sarah@gmail.com, C.Seymour@sanbi.org.za

Drylands make up close to 45% of Africa's land area and support nearly half of its population. African rangelands are primarily utilized by nomadic pastoral communities through various types of traditional livestock production systems, in addition to supporting a significant portion of the continent's wildlife. More than 70% of these drylands are considered moderately to severely degraded, with patches of high productivity interspersed within a low productivity substrate. The long-term health of livestock and wildlife in these systems relies on movement between these connected resource patches. Linear infrastructure is being developed across Africa's

drylands and will increasingly impact connectivity in these landscapes. The specific biophysical characteristics of drylands lead to unique and often poorly understood interactions between linear infrastructure and wildlife, which is often endemic to those landscapes. This session will explore those unique interactions through cross-landscape learning. It will also set a foundation for determining some of the broadly effective mitigation measures, including land restoration, that can be used across these systems in Africa. The session will be useful to pan-African and national policy-makers, infrastructure financiers, economists, planners, engineers and ecologists.

16:30-16:45 Break

Venue: Muna
16:45 – 17:45 Curriculum Corner

Animal Detection and Driver Warning Systems

Trainer: Manisha Bhardwaj1, Mattias Olsson2, Michele Deis3, Falko Brieger3

1 University of Freiburg, Faculty of Environment and Natural Resources, Chair of Wildlife Ecology and Management, Freiburg, Germany
2 EnviroPlanning AB, Gothenburg, Sweden
3Wildlife Institute, Forest Research Institute of Baden-Württemberg, Freiburg, Germany

1 University of Freiburg,

Presenter email: manisha.bhardwaj@live,ca

Roads and other linear transport infrastructure can have detrimental impacts on wildlife, including mortality effects from wildlife-vehicle collisions, and barrier effects due to loss of landscape connectivity. Wildlife crossing structures combined with suitable fencing are a commonly implemented mitigation strategy to reduce wildlife-vehicle collisions and increase landscape connectivity for wildlife. However, the effectiveness of fencing for traffic safety has an arguable effect on wildlife mortality since wildlife-vehicle collisions tend to occur more often on medium-sized roads, where fencing for wildlife is not prioritized, and wildlife crossing structures are seldom installed due to economical and constructional constraints. In such instances, at-grade fauna passages with roadside **Animal Detection and Driver Warning Systems (ADDWS)** may serve as an alternative to wildlife bridges and underpasses, since they are cheaper to install, simpler to construct and easier to maintain. ADDWS include systems to detect wildlife within a detection zone and warn drivers of the potential collision risk. In this workshop, we will discuss the design of ADDWS, and the landscapes in which they can be used effectively. This workshop is for those with experience using detection and/or warning systems, and those without. We encourage all to attend and it would be great to get

a mixture of experiences, including government officials, practitioners and managers, engineers, and researchers.

This workshop is hosted in part by the Infrastructure and Ecology Network Europe working group on Animal Detection and Driver Warning Systems.

Venue: Nandi Flame (Plenary Hall)

17:45 – 18:30 Closing ceremony, announcement of ACLIE