



ROAD ECOLOGY WORKSHOPS

Minutes

8 July 2012

Durban, South Africa

16 July 2012

Johannesburg, South Africa

Presented by

Endangered Wildlife Trust

Daniel J. Smith, University of Florida, USA

Rodney van der Ree, University of Melbourne, Australia

1. Welcome

Harriet Davies-Mostert welcomed participants to the workshops and thanked them for making the time available to attend.

2. Present

2.1 Durban

Wendy Collinson	Endangered Wildlife Trust
Harriet Davies-Mostert	Endangered Wildlife Trust
Daniel Smith	University of Central Florida
Rodney Van Der Ree	University of Melbourne
Claire Patterson-Abrolat	Endangered Wildlife Trust
Tali Hoffman	University of Cape Town
Lelani Mannetti	Etosha Buffer Zone Project / Stellenbosch University
George Manono	MOI University, Kenya
Mack Magodiello	North West Parks Tourism Board
Philip Muruthi	AWF (African Wildlife Foundation)
Lucia Motaung	Department of Environmental Affairs
Mokemi Lesejane	North West Parks Tourism Board
Santhun Naidoo	Department of Environmental Affairs
Nomusa Mbuyazi	Department of Environmental Affairs
Shem Mwasi	School for Field Studies - Kenya
Nicola van Wilgen	SANParks
Sanjay Kalpage	University of New South Wales
Yves Hausser	University of Applied Science, Switzerland
Robyn Phillips	Strategic Environmental Focus LTD (Pty)
Olivia Rose-Innes	Media 24
Jacky Phosa	Limpopo Department of Agriculture
A J T Johnsingh	Nature Conservation Foundation, Mysore
Satish Kumar	Department of Wildlife Services, Aligarh Muslim University, India
Tebogo Mashua	Department of Environmental Affairs
Vivek Thuppil	Animal Behaviour Graduate Group, UC Davis, USA
Richard Cross	Psychology Department, US Davis, California, USA
Rocio Aguilar Fdeo	UNAM, Ecology Institute
Masilo Mashotole	Department of Agriculture of Forestry and Fisheries
Thokozani Mbanjwa	Department of Agriculture of Forestry and Fisheries
Matsima Magakgala	North West Parks Tourism Board
Bridget Sefanyetso	North West Parks Tourism Board
Theo Mostert	University Of Zululand
Paula Gonzalez	Fundacion Temaiken

2.2 Johannesburg

Wendy Collinson	Endangered Wildlife Trust
Harriet Davies-Mostert	Endangered Wildlife Trust

Marie Parramon-Gurney	Endangered Wildlife Trust
Daniel Smith	University of Central Florida
Rod van der Ree	University of Melbourne
Claire Patterson-Abrolat	Endangered Wildlife Trust
Susan Miller	Tshwane University of Technology
Craig Whittington-Jones	GDARD
Kerryn Bullock	Private
Susie Weeks	Mount Kenya Trust
Mandy Lovell	Bridgestone
Phuti Matlamela	GDACE
Ernst Retief	BirdLife South Africa
Miles le Roux	N3 Toll Concession
Anesh Madanlal	N3 Toll Concession
Gerry Camacho	Mpumalanga Tourism & Parks Agency
Matt Pretorius	Endangered Wildlife Trust
Lihle Dumalisile	GDARD
Mogole Mphahlele	SANRAL
Adriaan Barend	PhD Candidate, NMMU
Nicci Wright	FreeMe

3. Presentations

3.1 What is Road Ecology and what is the State of it Around the World? (Dr Rodney van der Ree, Deputy Director, Australian Research Centre for Urban Ecology, University of Melbourne, Victoria, Australia)

Roads exist in numerous different shapes and sizes, each with potentially different impacts. Although statistics vary widely, it is estimated that there are around 750 million vehicles on the road with around 50 million km of public road (enough to go around the world 2,200 times).

Road Ecology tries to understand the ecological impact of roads and traffic, and the individuals, populations and landscapes affected. It is an applied, cross-disciplinary branch of ecology, engineering and planning. Numerous studies have been conducted worldwide, all aimed at trying to understand impacts and mitigate against those impacts. Impacts include habitat loss, habitat fragmentation, formation of barriers (avoidance, mortality), alteration of behaviour, and an increased risk of extinction.

Two international conferences are held each year on alternate years. The Infra-Eco Network of Europe (IENE) is attended by around 300-400 delegates and the International Conference on Ecology and Transportation which is attended by approximately 500 delegates. The latter also covers rail and powerline collisions. Many papers are presented at these conferences but few from Africa, and most focus on actual deaths recorded however.

3.2 What are the impacts of Roads and traffic on Wildlife? (Dr Daniel J. Smith, Research Associate/Adjunct Graduate Faculty, Department of Biology, University of Central Florida)

The rapidly growing population of humans has resulted in widespread wildlife habitat loss and fragmentation. To date approximately 83% of the earth's land surface has been transformed by human activity. The CIA World Factbook estimates 18,015,703km of paved roads in the world. Using Richard Forman's concept of

'road effect zone' (whereby the behaviour of an animal is changed within a certain distance from a road), very little landscape remains untouched by roads.

The effects of roads on wildlife can be summarised as follows:

- Direct
 - Direct mortality through wildlife-automobile collisions
 - Facilitate the rapid spread of invasive species that are often better competitors than native species, and less subject to predation
 - Create effective barriers to movement for many species, thus altering normal migratory, foraging, and mating behaviour
 - Create greater human access to remote areas thus facilitating habitat loss through land conversion / development

The importance and prevalence of direct mortality through wildlife-automobile collisions is highlighted by the fact that they now compromise 5% of all collisions in the USA. Of interest is that 89% occur on two-lane roads, they are more frequent on rural, low-volume traffic roads, occur more frequently in periods when ungulates are most active, daily and seasonally, and occur mostly in edge or transition habitats near riparian zones. The estimated costs of deer, elk and moose collisions in the USA is in the order of US\$50,000 per annum.

- Indirect
 - Direct mortality through wildlife-automobile collisions
 - Create fragmented habitat mosaics consisting of isolated habitat islands among road networks and urban development that can lead to genetic isolation and decay, and loss of populations and species
 - Increase access to and disturbance in remote areas for hunters, poachers, & recreationalists
 - Act as passive repositories for human-generated pollutants that degrade habitat quality and increase the threat of toxic poisoning
 - Alteration and degradation to adjacent habitat that may affect vegetation and wildlife composition

In addition to a few case studies highlighting the above, it was noted that the 'negative edge effects' which can cause the loss of certain species includes:

- High road densities shown to reduce available habitat for sensitive species such as Elk or Wolves
- Traffic noise shown to reduce presence of certain bird species
- Access may increase pressure from nest predators.

Methods used to determine impacts of roads on wildlife:

- Passive Means
 - Roadkill surveys
 - Track surveys
 - Camera/video monitoring
 - Presence-absence, species diversity and abundance studies (transects or point counts from calls/visual)
 - Genetic studies (hair snares, reptile sheds)
 - GIS and land cover/habitat analysis and models
- Active Means
 - Telemetry studies
 - Presence-absence, species diversity and abundance studies (Mark-recapture)
 - Genetic studies (baited traps or other capture)

Hotspot areas can be identified through modelling factors such as:

- Focal species hotspots
- Chronic roadkill sites
- Listed species locations
- Habitat/land cover
- Hydrology
- Topography
- Strategic habitat
- Conservation areas
- Ecological networks
- Protected lands

3.3 Road Ecology in Africa: an overview. (Claire Patterson-Abrolat, Endangered Wildlife Trust, South Africa)

As early as 1925, Stoner said “*As a killer of men, the automobile is more deadly than typhoid fever which runs a close second to influenza...not only is mortality among human beings high, but the death-dealing qualities of the motor car are making serious inroads on our native mammals, birds and other forms of animal life.*”

Despite a substantial amount of data being collected in Europe, North America and Australia, little work has been done regarding Road Ecology in Africa. Of the studies that have been done, the focus is generally on the loss of human life and not the impact on biodiversity.

South Africa ranks 25th in the world for its size, 18th for the amount of roads it has, and 74th in terms of the number of cars per 1,000 people. With such a large road network and number of cars on the road, it is imperative that road ecology be considered.

Ray *et al.* (2005) listed roadkill as the fifth highest threat to carnivores after human conflict, habitat decline, interspecific conflict, and disease in Africa, yet little attention is given to this threat in Africa.

It is evident that not only birds, but also mammals, reptiles, insects and amphibians are affected by collisions with vehicles. To highlight the importance of this impact, the IUCN Red List status of just mammals was presented. With 18 species (6.1%) being classified as Endangered, it is concerning to note that with less than 450 African Wild Dogs (*Lycaon pictus*) left in South Africa, seven deaths were reported along a particular road stretch in a 3-month period in 2012. More than 50% of African Wild Dog fatalities in Zimbabwe are attributed to roadkill (Ginsberg *et al.* 1995), and 2 African Wild Dog were deliberately run over in Botswana (Brassine 2012).

A number of roadkill studies have taken place in Africa but the study sites are mostly located in southern and East Africa. Few to no studies have taken place in West and North Africa respectively. These studies were generally as a result of tertiary study, were species specific, and localised in scope.

Few studies conducted in Africa have gone beyond measuring the impact of collisions. Examples of projects that have looked at mitigation measures include Samango monkeys in the Eastern Cape province where rope bridges are being considered, and the Mt Kenya Trust which has included an underpass for elephants in the elephant corridor.

3.4 Case Study: Roadkill Research and Mitigation Project (Wendy Collinson, Endangered Wildlife Trust, South Africa)

The EWT's Roadkill Research and Mitigation Project was conducted near Mapungubwe National Park, Limpopo, South Africa over a 3-year period. The Greater Mapungubwe Transfrontier Conservation Area (GMTFCA) is an important area due to its close proximity to the national park, a diamond mine, proposed coal mine and two international border posts. The area experiences low-volume traffic but of a mixed nature – passenger vehicles, mining trucks and delivery vehicles.

The aim of the project was to:

- Devise a standardised method for roadkill detection.
- Implement the method.
- Understand the impacts of roadkill and the possible causes.
- Propose mitigation measures and recommendations.

Research showed that existing methodologies for roadkill surveys differed widely and the protocol developed for this study considered factors such as driving speed, numbers of drivers/observers, distance, frequency of time spent locating roadkill, and time of day. Standardising a method of roadkill detection, will enable future studies to be comparative.

Traffic counters should be used to determine the type, volume and weight of traffic using the roads in question so as to understand the impact more comprehensively.

This study covered transects of 100 km driven daily for 40 days during each of the three ecological seasons. Just over 1,100 dead animals were located in total, with 166 different species recorded. The majority were birds, followed by mammals, reptiles and amphibians. Common species included Flap-necked Chameleon, Mozambique Spitting Cobra, African Civet, Scrub Hare, small antelope, owls, rollers, Nightjar and Black-crowned Tchagra.

Of all roadkill carcasses detected, over 80% had disappeared by the next day. It is either scavenged by natural predators or removed by man to either: improve safety to fellow travellers, or collected for a variety of reasons such as trophy, skin, meat or possibly muthi. Roadkill questionnaires were conducted to gain an understanding of public use of roadkill.

Noss (2002) states that over 1 million animals are killed each day on the roads in the States, but this does not account for the animals that crawl off the road to die, or are flung off the road after being hit. Nor does it account for all species. This statistic is for large mammals and the overall figure of daily roadkill in the States is believed to be significantly higher. Roadkill on road verges is difficult to detect. To gain an understanding of undetected roadkill, sniffer dogs were trialled to determine the success of locating roadkill carcasses on the roadside verges. The results of this are not yet available.

3.5 Mammal and Bird Road Mortalities on the Upington to Twee Rivieren Main Road in the Southern Kalahari, South Africa (Kerryn Bullock, Tshwane University of Technology, South Africa)

South Africa's ever expanding road network and the increasing number of road users has a growing detrimental impact on the animal species that are exposed to them. No class is immune from vehicle collisions from creeping, crawling, flying invertebrates, hopping amphibians, slithering reptiles, and obviously birds and mammals which this study focuses on.

The study was aimed at assessing the road mortalities for mammals and birds along the R360 main road from Upington to Twee Rivieren (Kgalagadi Transfrontier Park), Northern Cape, South Africa, a semi-arid area. The factors considered included:

- In which season were the highest mortalities recorded
- if activity periods influenced mortalities
- If potential 'mortality hot spots' exist
- Does habitat characteristics play a role in mortalities
- Whether the vehicle speed influences mortality rate
- Investigated if roadside traffic warning signs succeeded in curbing road mortalities.

The total length of road is 261 km and it was divided up into eight equal zones of 15 longitudinal minutes each. The potential speed of vehicles and vegetation surrounding each portion of road was noted. Analysis was only carried out on zone 1-7 as zone 8 was substantially different to the other zones based on the inclusion of Upington, a busy city. Nine warning road signs had been randomly erected along the road in 1999/2000. The road is used by passenger vehicles as well as cargo trucks travelling to Namibia. These vehicles often travel at very high speeds. (Vehicle data was not recorded for this study).

Surveys were carried out during January/February/March and July/August/September 2007. A total of 2,796 km were travelled at a constant speed of 100 km/h.

In addition, the effectiveness of the traffic-warning signs was analysed based on the premise that after passing the sign, a vehicle slowed down and occupants increased vigilance, but with time and distance the vehicle's speed increased and vigilance decreased. Therefore, road mortalities increased within increasing distance between the vehicle and sign.

During the six month period 184 road mortalities were recorded from 22 species (152 mammals and 32 birds). Mammals were killed on average at a rate of 21.3 ± 11.7 mammals/zone or 5.44 mammals killed per 100 km travelled. Birds were killed on average at a rate of 5.3 ± 2.8 birds per zone or 1.14 birds killed per 100 km travelled. It was noted that a mammal is 2.56 times more likely to be killed in winter, indistinct mammals were 6.26 times more likely, and nocturnal animals 3.51 times more likely to be killed than diurnal mammals and a mammal was 3.97 times more likely to be killed in Gordonia duneveld.

The number of road mortalities for the first 10 km beyond each road traffic sign did not increase significantly), nor did the number of road mortalities for 50 km beyond each sign.

Of particular concern in this study was the finding that 5.44 mammals and 1.14 birds /100 km which is considerably higher than:

- 0.48 mammals- & 0.22 birds/100 km killed in the northern Cape (Siegfried 1965)
- 0.53 mammals- & 0.12 birds/100 km killed in the Succulent- & Nama-Karoo (Dean & Milton 2003)
- 1.38 mammals/100 km killed in North America (Ford & Fahrig 2007).

The identification of 'hotspots' is a starting point for mitigation methods. Such methods could include:

- Randomly erected warning signs did not seem to be effective.
- Preventing animals from gaining access to the road by impenetrable fence will more likely do more ecological harm than road collisions.
- Building 'green' bridges or underpasses is a costly option that may aid in decreasing road mortalities.
- Monitored underpasses installed in the hotspots is suggested.
- Traffic calming devices i.e. rumble strips to alert drivers and slow down fast moving vehicles. Installed the entire length of road with shorter inter-strip distances in the hotspot. The noise should also alert animals.
- Removing the vegetation from road verges.
- Driver education with an awareness campaign i.e. pamphlets.

More research is required in order to clearly understand the relationship between wildlife and roads. Vehicle collisions may represent a significant anthropogenic source of mortality to their populations, and requires further study. The study road in particular has remarkable potential to shed light on the subject of road ecology. For example what was gravel road in this study is now tarred. A follow up study would provide an interesting comparison.

3.6 An International Perspective on Mitigation (Dr Rodney van der Ree, Deputy Director, Australian Research Centre for Urban Ecology, University of Melbourne, Victoria, Australia)

Prior to a mitigation measure being implemented, it is important to know what one is mitigating against. Species show various responses to the presence of a road including, avoiding the road surface, avoidance of traffic emissions and disturbance, avoidance of vehicles, and attraction to the roadside or road surface. A combination of mitigation measures is usually needed.

Ideally, new roads should not be built in environmentally sensitive places and off-sets should be considered. Road planning should be overlain with conservation planning so that connectivity between habitats is addressed. Europe has developed a number of best-practice guidelines which cover a range of mitigation measures and the Netherlands now has legislation governing their road ecology commitments.

Mitigation measures can include: trees in-between carriage ways to facilitate movements, landbridges, sound abatement structures, shelves in underpasses, amphibian tunnels, stock passes can be fitted with ledges or poles for arboreal species, tree stumps to provide cover to small mammals, invertebrates etc., 'telephone' poles for gliders and so on.

A review of 123 papers reporting on these structures has been carried out (van der Ree, *et al.*, 2007 – ICOET proceedings) which shows that many are successful. All studies (except one) showed that the mitigation measure was being used and, despite the bias of the range of species being studied, a wide range of species used the structures. These measures generally needed to be used in combination with fencing to channel the animals towards the mitigation structure. The fencing does however require maintenance. Traffic calming can also be considered but signs on their own generally don't work.

Vehicle mounted deterrents have generally proved unsuccessful and the silent electric vehicles might need to be made more noisy so alter animals to their presence.

As roads are important for economic development and travel, they are going to be built. It is therefore important that road ecologists and other stakeholders get involved in their design and input made throughout the process of design and construction.

Questions

- Tunnelling of roads has been looked at but is generally far more expensive. Tunnels usually put in where cheaper/not possible to go under than around. Usually not for wildlife reasons.
- Arboreal species took about six months to start using rope bridges after they were installed. However, it should be noted that the cameras were only installed at this time and they found animals using them straight away. The animals could have started using them earlier. The number of animals using the bridges increased over a three year period. It is difficult to funnel arboreal species.
- The Colobus Trust got hotels to sponsor rope bridges along road in Kenya for Colobus monkeys. Both the monkeys and man have benefitted and the monkeys started using them straight away. (See video at <http://www.colobustrust.org/conservation.html>).
- Some predation has been confirmed on rope bridges but it hasn't yet been shown that predators use them primarily hunting. One Australian study has shown that where foxes and bandicoots use structures, bandicoots stopped using them. For this reason they add tubes on glider poles and rope bridges intermittently for shelter.

- The underpasses may need maintenance in terms of debris, especially where they have a dual purpose. If entrance is above ground level, they don't get that clogged up. Permits are needed in Australia to go into small spaces, i.e. culverts and such permission must be sought if required.

3.7 A Local Example of Effective Mitigation – the Mount Kenya Elephant Corridor (Susie Weeks, Mount Kenya Trust, Kenya)

Mount Kenya is an internationally significant protected area inscribed in 1997 by UNESCO as a World Heritage Site. The Mount Kenya Trust has been in existence for over 10 years raising funds for conservation and community-based projects. One of its recently completed projects is an elephant corridor which allows elephants access through two large farms relinking elephant habitats whose migration routes have been severed by fencing and increasing human habitation.

The purpose of this project is the preservation of the link between Mount Kenya and the northern habitat areas. This extends the existing continuous range available to the Laikipia / Samburu elephant population to a point more than 60 km further south than at present; a significant positive benefit to wildlife conservation in Kenya.

Early on the partners had to grapple with the big question: even if elephants have safe access through the land, the main highway to Northern Kenya cuts right through this ancient migration route. Encouraging elephants to cross the highway brings about all kinds of risks to people, vehicles and elephants. After much deliberation it was decided the best solution was a large 'elephant sized' box culvert under the road. Together with this, 28 km of game proof fencing was erected to minimise conflict between the elephant and local farmers. The corridor could not be opened until the two crossings (one over a highway, and the other over a rural road intersection) were dealt with.

The elephant soon realised the corridor was open and used the culvert within two days of it being opened and there are now about six bulls regularly moving up and down. Family groups have not yet started to use the culvert though. Although the elephant usually cross at night they are now starting to cross at dawn and dusk.

Crop raiding has reduced but trees are being destroyed on the farms over which the elephants traverse.

4. Discussions

The objectives of the two workshops included:

- 1) Short presentations highlighting the state of Road Ecology both internationally and in Africa.
- 2) A "stocktake" of Road Ecology in Africa.
- 3) Providing enhanced networking opportunities for both road ecologists from Africa and internationally.
- 4) Identification of key lessons and principles of Road Ecology that were established in the developed world and are relevant and applicable for Africa.
- 5) Discussion of issues associated with the development of an improved road network for local and national development versus conservation issues.
- 6) Developing an action plan that prioritises action and research needs for the next five years.

4.1 Durban Workshop (IWMC, Monday 9th July, 2012)

Participants formed groups which considered the following questions, namely:

a) **IMPACTS** (Chair: Rodney van der Ree)

- **What are the five major issues that prevent developing an ecologically sustainable road network?**
 - Economic constraints - ecologically friendly development is expensive.
 - Public attitude – mitigation measures are often seen by public as nonsense / public resistance.
 - Lack of knowledge / ignorance (people have knowledge but choose to ignore it).
 - Lack of resources.
 - Human arrogance – “not my problem, doesn’t affect me”.
 - Apathy and indifference. Some countries i.e. India, have had court rulings to halt putting roads through forest areas.
 - The public (and other stakeholder groups) are generally more concerned about megafauna (tiger, elephant) and ignore smaller creatures / less charismatic species.
 - There is a lack of planning, especially ecological input into planning, dialogue during decision-making process. Conflicting land use is a result of improper planning.
 - Some sectors perceive proper planning is a hindrance to development. Some governments see this as rich people forcing their thinking onto poorer people/country. In Africa, roads are considered a symbol of development.
 - There are insufficient alternative forms of transport (e.g. public transport).
 - Development is perceived as not compatible with conservation. If game reserves/parks can be built everywhere, why should developments such as roads?

- **Is there, or should there be, common ground between development and conservation?**
 - There was general agreement that the two need to work together. Mankind needs both conservation and development and a pragmatic approach needs to be ensured. There were differences of opinion as to whether conservation biologists seem to be lagging behind developers or if conservation biologists were being blatantly ignored. The environment is often merely rubber-stamped in development processes or perceived to be a limitation to development.
 - Working together will require input from both sides, i.e. having the correct science to support why roads can't be put in an area, and being creative with engineering solutions to mitigate negative impacts.
 - Vehicles are being designed with quieter engines and need to be equipped with mitigation measures to alert animals to their presence.
 - Biodiversity is seldom correctly valued. For example, where wetlands are destroyed, who is internalising those costs?
 - There is a difference between new road developments and existing road maintenance. Who decides which one to do? Compromise often leans to development. What happens to intermediate areas? How and who values biodiversity? Corridors are also important. What guidance could be given on road design?
 - Funds for development often come from sources such as the Development Bank – what role do they play?

Time precluded all the questions being workshopped but the following ideas were put forward:

- Mitigation measures must be tailored to individual situations.
- Do we know how to design roads so that they are more ecologically friendly? Are their standards? Lots of ideas have been suggested but what has been proven?

- People are putting crosses on national roads where people have been killed. How many are for animals? These crosses/tombstones impact drivers visually and may also cause accidents. After 20 years, how many will there be alongside roads? What impact will that have on our road networks and their sustainability?
- Is there a meeting point between development and conservation? What can ecologists bring to the table of development? Some governments (i.e. Kenya) have set industrialisation targets and it was agreed to dredge Manda Bay in Lamu, Kenya, a World Heritage Site.
- Roads are going to happen. Europe and USA already have roads but much of Africa is still developing and building 'new' roads.
- Proposed Serengeti Highway – sometimes 'we' just need to say 'no' to developments.

b) **MITIGATION** (Chair: Rodney van der Ree / Daniel. J. Smith)

- If there were two things that could happen as a result of this workshop, what should they be?
- Who should be responsible (identify this – part of action plan)
- Legislative changes – what is needed?
- If you could change two things around roads / mitigation / impacts, what would they be?

Time precluded all the questions being workshopped but the following ideas were put forward:

- Mitigation often focuses on single species, not multiple species, which are harder to manage when designing mitigation measures.
- Animal behaviour and preferences need to be understood when selecting suitable crossing structures.
- Has anyone looked at the effect of roads on plants and plant population fragmentation? The general opinion was that as plants are more easily able to disperse, this is not a major consideration at present.
- If road-signs don't work, what work has been done on changing motorist behaviour? Social scientists should be approached for input.
- Average speed detection might help ensure slower speeds through areas of concern.
- Guidelines are needed on topics such as: i) how to mainstream development and biodiversity, ii) best designs for roads.
- Prevent the need to mitigate – more input is needed in the planning process and the regulation thereof. Connections must be built between developers and wildlife managers.
- Developers must adhere to building regulations and not just do something when they think they are being watched. Public pressure should be placed on officials to ensure co-operation.
- Address political constraints but be wary of perverse incentives.
- There is pressure to not put species on endangered lists as this may hamper support for mitigation measures.
- There needs to be an ecosystem based approach to roads and biodiversity conservation, especially roads and species. This requires improved understanding of impacts on ecology.
- A network of experts should be developed so that if there is an issue in Africa, people know who to contact. This should not just be for 'crisis-management', but for new developments too.
- There are some obvious no-go areas for development and the relevant stakeholders/public need to say 'no' at times. Appropriate changes to policy should be articulated and fed EIA's.
- Africa should unashamedly adopt Europe's best practices and tailor them to our needs. We should learn from cases such as India where traffic was halted on a certain road at night to prevent collisions with elephants.
- General public awareness should be raised through citizen science and a concerted campaign effort is needed. Canada did this and the biggest problem was public resistance to changes on the road. False animals were put on the road and they found people speeding up to hit them.

4.2 Johannesburg Workshop (EWT, Monday 16th July, 2012)

The plenary was asked for comments on the following questions, namely:

a) **IMPACTS** (Chair: Rodney van der Ree)

- **What are social and community responses to roadkill?**
 - People travelling to game reserves/parks report roadkill.
 - There is a difference between observed and behaviour changes – even if people see an animal or roadkill, they don't always change behaviour. This is partly due to habituation to the problem.
 - It is unclear whether people differentiate between domestic and wild animals and it was thought that this depended on their background.
 - Society needs to be more aware of the impacts.
 - An informal roadkill study was conducted which looked at which animals were pregnant or had young. The request for reports was e-mailed out to the FreeMe database and had a good response.
 - The public's perception of what constitutes roadkill varies and it has been found that initial responses to 'have you hit anything' are met with a negative response until fleshed out more thoroughly. A definition of 'roadkill' is needed for further research and mitigation work.
 - Data has been collected from the Origstad / Burgersfort / Lydenburg / Belfast area over the past 12 years by Gerry Comacho (MPB). The number of roadkill recorded over recent years has declined and this could be correlated to residential developments in the area, and impenetrable fences constructed.
 - In Kenya it has been found that the value of an animal is linked to whether or not it is avoided. Livestock is more valuable than small wildlife species. However, it should be noted that while some roadkill can't be avoided, others are deliberate. Is roadkill then an economic concern rather than a conservation problem?
 - The risk to a driver has been found to change driver behaviour – where high risk is known, i.e. Kudu on rural roads in the Eastern Cape, drivers are more vigilant. Being personally affected also plays a part in driver behaviour change.
 - Roadkill data is being used in the Mpumalanga Biodiversity Conservation Plan to develop wildlife corridors. Areas where high numbers of animals are being hit are being highlighted.

- **What data / information gaps do you or your organisation have?**
 - A knowledge and general guideline document needs to be produced outlining mitigation measures, identification of hotspots, recording of data, research priorities etc. A central database for such information also needs to be developed. The Important Bird Areas focus on identifying hotspot areas and possibly a similar approach could be followed.
 - It was noted that when recording data on roadkill, observer safety must be taken into account and that days when nothing is found must also be recorded.
 - As developments take place or fences are erected, animals need to find new traversing routes and this often brings them into conflict with roads.
 - The approach taken should be one of pre-empt carnage. Best practice guidelines should be produced covering factors such as how to predict roadkill.
 - The sooner mitigation measures are put in place, the cheaper they are. Planning should take this into account.
 - Where research is standardised across landscape types, it is often possible to do correlations and extrapolations for planning and mitigation purposes.
 - The action plan must note how to predict hotspots and principles for consideration.
 - A cell phone app. is currently in development which will enable people to quickly record roadkill found. This information can provide an indication of areas of concern.

- The EIA process should highlight what is of concern for a proposed development. The legislation associated with EIA's should support adherence to best practices and laid-down procedures. Cost should not always be the main consideration. This area is much undeveloped in South Africa and considerable thought and work will be required to structure this correctly.
 - Australian conservation legislation states that if an activity has a detrimental consequence on a threatened animal, mitigation action must be taken.
 - Europe ensures that wide-ranging species can continue their migrations or movements. This legislation is not specifically road related however.
 - In the USA, some states are more progressive than others and have implemented legislation. States that haven't are still bound to the Endangered Species Act, and environmental legislation. Some states have developed best practices and multi-disciplinary advisory groups. This ensures that input is made at the early stages of project planning. Some states have crews out regularly removing roadkill. These crews also record roadkill statistics.
 - South Africa has legislation covering crossings over waterways but the extent of enforcement is unclear. Workshops such as this will help lend weight to arguments for such legislation and enforcement.
 - Huisjer *et al.* (2006) states that it is much cheaper to build structures than to fix cars and the people that have been involved in collisions.
 - Insurance companies should be approached for statistics regarding collisions and the damage caused. It was noted that this often proves difficult but if these companies are approached in the spirit of trying to reduce pay-outs through reduced collisions, they are often more co-operative. It should be remembered that their data is biased towards damage-resulting accidents and near-misses and non-damage-resulting collisions are not reported.
- **What are the 5 major issues in road ecology that you think are the most critical to improving the ecological sustainability of roads?**
 - Identification of hotspots.
 - Public awareness and education. The focus needs to be on economic and life costs to emphasize severity.
 - Integrated planning of road network alignments (input needs to be made into the planning of a road). There should be better landscape planning.
 - Design and development of mitigation options.
 - Best (environmental) practical guidelines need to be available.
 - An economic analysis of related costs for various industries (e.g. freight, insurance, etc.) should be conducted.
 - Many roads have been planned historically and land acquisitions made accordingly. Thought needs to be given regarding how to amend or address these historical plans. Re-routing roads often impacts on the very people that were originally impacted on when the land was acquired.
 - Advocate for increased policy and policing of current policy. This will include a review of existing policy. Where there is no policy, policy needs to be developed.
 - Consideration needs to be given to roads extending into other countries and how to mitigate on them. The scope of issues potentially at play here are not well understood at present.
 - Post implementation monitoring of mitigation measures must be built into projects. Pre- and post- monitoring is very important from an ecological and economic point of view.

- Visibility on road was thought to be an important factor. Data indicates that there are more kills in long grass areas and the contribution that these road reserves make to conservation is uncertain. Is there a conflict between conservation and population management?
 - Should the impact of roadkill be looked at from a population level rather than an individual species level? Does it matter if a certain number of a species are killed if the population remains viable?
 - New roads require longer pre-construction monitoring. Short-study EIAs may not be enough as they may miss amphibians, for example, depending on time of year the study is done. This highlighted the need for minimum EIA standards.
 - In Australia, preconstruction monitoring varies from a day to longer periods of time. One agency is considering a year for where mitigation is to be implemented, with three-year post-construction monitoring.
 - The length of pre-construction monitoring varies in the USA depending on where the project is located. Monitoring is minimal for private land unless an endangered animal is known to be present. Studies can be very short to much longer. If the road is to be built in a national park / protected area, the road agency first has to get the land from Park and the conditions of sale may require mitigation or extended monitoring.
 - Planned roads should be documented so that road ecologists / EIA practitioners / nature conservation have a schedule of when EIAs will be conducted. This will help address the goal of integrating conservation and development.
 - Is it possible to make mitigation a standard measure?
 - It is important to remember that species conservation doesn't equal ecosystems conservation.
 - In Australia, mitigation is generally triggered by an endangered species. The mitigation structures are targeted for one but may also assist others.
 - In the USA, mitigation measures are generally designed around ecosystems / umbrella species. Often mitigation is linked to safety i.e. bears.
- **Priority locations**
 - Although it is possible to get funding for newly built roads, other roads need upgrading and/or repair, especially those near national parks. Such investments should be based on conservation needs.
 - Newly built roads can be used as a pilot study. Provinces can use this information to guide future actions.
 - **Have you hit wildlife while travelling around? What? Where?**

Workshop participants identified the following species:

- Kangaroo
- Wombat
- Birds (16 participants), especially Guinea fowl (5 participants) and large flocks (2 participants)
- Domestic animals i.e. dogs (2 participants)
- Lion
- Snakes (3 participants)
- Frogs during an emergence when they were impossible to avoid
- Insects
- Raccoon
- Squirrel
- Monitor Lizard
- Scrub Hares

Near misses included:

- Lion
- Moose
- Snakes
- Small mammals
- Large mammals
- Owl
- Waterbuck

All participants acknowledged hitting something whilst driving on roads.

- **What are the major impacts of roads in your area? Which species?**

Time precluded all the questions being workshopped.

b) MITIGATION (Chair: Marie Parramon-Gurney)

- **Is there an appropriate balance between development and conservation?**

- Experience, albeit limited, has shown that input into road designs has had little impact and is often too late. The preferred design is shortest (route) or most efficient (process). The economic consideration often trumps conservation.
- There is no one-stop shop for road plans as these reside with municipalities, provinces, and so on. Very often one's perspective determines whether conservation is overemphasised or if development is necessary. There must be a give and take solution as it will be almost impossible to find a win-win solution in all cases.
- Climate change drives many decisions today and it is uncertain as to when biodiversity is incorporated.
- All 'greenfields' roads are subject to an EIA and the specialist studies inform the developers of the alignment of the road. Sometimes corridors may be fixed by historical planning but local realignment may occur. Although mitigation is a practical solution, the cost for a road is fixed well in advance and alterations may not be possible. EIA's should not be used to halt development but rather to help it happen in an appropriate manner. It was also pointed out that the EIA phase is too late to influence the decision-making process.
 - The USA experiences similar challenges but there has been a greater meeting of minds over the past decade. Success has been achieved in some cases by helping keep road costs down whilst taking environmental concerns into account. A lot of creativity has been required though. A platform from which to work together to find solutions needs to be developed.
 - The audience was unaware of any roads proposed for development that had been stopped due to environmental concerns. Historically areas were set aside for roads and have been undeveloped, often leaving these areas as the best quality habitat remaining which exacerbates the problem.
- The function of an EIA is to make a development work. Social pressures are important and political decisions often come into play. The N3TC noted that a few roads have been impacted by EIA input.
- A Department of Rural Development and Land Reform are currently working on a bill to address some of these concerns. It is hoped that municipalities and provinces integrate these ideas. Agreement is needed on what tools to look at.
- Engineers like challenges and should be presented with the opportunity to mitigate against wildlife hazards from early on in the planning process.

- Should rail be used as an alternative to roads? There are many large trucks on roads carrying cargo that could be sent via rail.
- Tools other than just roads should be investigated to address the concern of wildlife-transport collision at a higher level. Efforts will be limited to a case-by-case basis otherwise.
 - Unless a nationally listed species is being impacted upon, Australian states do not have to adhere to specific national legislation. There are some standards for national highways.
 - The states of the USA are independent in terms of road construction. However, those receiving federal funding have to adhere to federal regulations.
- There is a need for a champion to raise awareness.
 - A comment by a politician in Australia about Koalas raised awareness of the species and so people invested money in retrofitting mitigation. Agencies are generally cautious about installing mitigation in privately owned land where zoning could change. Generally, the only evaluation of a road takes place during the planning process.
 - In the USA, mitigation is generally only considered when the land is protected in some form or another. This can mean being in partnership with private land owners who have permission to sue the land for conservation. However, some States have internal policies for mitigation but there is no formal legislation. For example, Florida will consider mitigation when certain criteria are met.
- How are funds raised for mitigation?
 - The Mount Kenya Trust did not receive government funding for their underpass but had to raise the funds themselves (in the order of around \$1 million). The fundraising took some time to do.
 - Having an identified champion to assist raise the profile of the project may help fundraising efforts.
- Change happens regardless and the general public needs to have some trust in the country's environmental legislation. Currently there is no recognised expert in Road Ecology. Roads agencies and provincial governments should look to employ appropriate personnel to guide input.
- Data must be collated.
- In some instances, private developers should contribute toward the costs of mitigation structures. Where a road needs to be developed for a specific purpose, the users of that road, whether it be residential, commercial, or agricultural, and the road goes through a protected area, then the users should off-set the costs associated with the development. It should not always be up to the taxpayer. The primary user should pay.
- Are off-sets possible and do we understand enough about how they work from a practical perspective?
 - The representative from SANRAL mentioned that they are currently working on a project whose EIA stipulated that an off-set must be made. As conservation is not their core business they approached the local government to assist in the management of this area. They have had no response to their request asking how they should comply with the EIA stipulations. This could be an important case study.
- Neither the conservationists nor the developers want contraventions and engagement must be done in the spirit of co-operation and be proactive.
- Road Ecology requires a process of adaptive management. Often, learning takes place from findings and experience. An inventory should be done of what structures exist as they may be functioning as crossings without it being realised. For example, examine dry culverts for footprints. Apart from road agencies employing a biologist, they can also consult universities, NGOs etc.

- **What two things would you want to see happen as a result of this workshop? (Also, what do you need?)**
 - An action plan outlining the work to be done over the next few years as well as who will do it (where appropriate).
 - Research priorities must be established and people to conduct the research identified. Catalogue what is available and look at adapting mitigation measure to our conditions. Cost-effective solutions may be possible and should be encouraged.
 - More baseline data is needed.
 - A network of expertise is established.
 - There should be a one-stop shop where people can go for advice. This will also help prevent duplication of costs, i.e. if each province employs a road ecologist.
 - The eco-engineering forums of India could be used as a basis to bring the various disciplines into contact with each other.
 - An expansion of the Road Ecology workshop itself. Input should be sought from decision makers.
 - Follow-on workshops should be held regularly and relatively often.
 - There must be improved communication between conservationists and developers.
 - Forums are in danger of staying 'forums' and actions plans must be associated with them.
 - Awareness materials are needed to raise the profile of this issue. Developers should be informed and a general discussion forum established.
 - Information must also be available to the general public.
 - A lobby group is needed to lobby government and road agencies. Awareness must be raised. The workshop delegates need to take this issue back to their organisations and convince them of the importance of the issue and to take action.
 - A champion is needed to highlight and promote the issue. The champion should ideally be able to get political support.
 - Guidance is needed on how to enhance the conservation friendliness of existing roads as well as what new designs could be used. The broader landscape and zoning should be taken into consideration and could be indicative to future designs. People need to work together to find solutions and not work in silos.
 - Best practice guidelines are needed for conducting EIA. For example, EIA consultants must take certain basic criteria into account when conducting pre- and post-monitoring. Guidance also needs to be given regarding what to look out for when assessing the impact of the road.
 - Provincial conservations plans must be taken into consideration prior to the EIA process in order to gain an initial indication of where conservation sensitivities lie.
 - Secondary problems should be considered when deciding how to proceed with a project. For example, Chinese construction is relatively cheap but may bring secondary problems such as an increase in poaching.
 - Many corporates are looking for ways to get involved in conservation projects but as their core business isn't conservation, they are often unaware how to contribute. Road ecology presents a wonderful opportunity for such involvement.
 - Avoid making the mistakes of other countries around the world. Look at what they have done and adapt the solutions to Africa's situation. Africa has the opportunity to accelerate progress.
 - Change is often expedited by having a champion or a flagship / charismatic / endangered species to raise the profile of road ecology. These should be sought out.
 - The message of Road Ecology needs to be sold and to do this we need to know what services are available. Case studies will help.
- **Role of developed countries for RSA and role of RSA for the rest of Africa?**

- Forums can share information.
 - The two North American and European conferences started out much the same as the two Road Ecology workshops documented here. They have grown into international events with delegates from 20-30 countries attending. However, this attendance is often biased to North America.
 - Despite the decision made regarding the Serengeti Highway, lobbying should continue.
- **What institutional / legislation changes are required?**
 - **Who should initiate, design, fund and build better roads with mitigation?**

5. Closure

5.1 Durban Workshop (IWMC, Monday 9th July, 2012)

HDM thanked the participants for their time and valuable inputs. She pointed out that the EWT would be using the information gained at the workshop to develop a five-year action plan. The minutes of the workshops would be circulated to all participants and the presentations put on the internet.

5.2 Johannesburg Workshop (EWT, Monday 16th July, 2012)

CPA thanked the participants for their time and valuable inputs. She pointed out that the EWT would be using the information gained at the workshop to develop a five-year action plan. The minutes of the workshops would be circulated to all participants and the presentations put on the internet.

CPA explained that the EWT has expanded the Airport Wildlife Programme into the Wildlife and Transport Programme in response to interest expressed by key role-players in various transport sectors, and the increasing need to address biodiversity conservation in the rapidly growing, but potentially impactful transport industry. By encompassing the broader transport industry, the EWT will ensure a more integrated and comprehensive conservation approach to transport and biodiversity issues.

6. References

- Brassine, A. Greater Mapungubwe Network (GMN) meeting, 28 July 2012. Unpublished report.
- Dean, W.R.J. and Milton, S.J. 2003. The importance of roads and road verges for raptors and crows in the Succulent and Nama-Karoo, South Africa. *Ostrich: Journal of African Ornithology* 74(3-4):181-186
- Ford, A.T. and Fahrig, L. 2007. Diet and body size of North American mammal road mortalities. *Transportation Research Part D: Transport and Environment* 12(7):498-505
- Ginsberg, J.R., & Macdonald, D.W. 1990 Foxes, Wolves, Jackals and Dogs: An Action Plan for the Conservation of Canids. *IUCN/SSC Canid Specialist Group, IUCN Wolf Specialist Group. IUCN Publications, Gland, Switzerland.*
- Huijser, M. P., P. T. McGowen, W. Camel, A. Hardy, P. Wright, A. P. Clevenger, Alaska Department of Transportation and Public Facilities, Departments of Transportation of CA, IN, IA, KS, MD, MT, NV, NH, NY, ND, PA, WI, WY, and Federal Highway Administration. 2006. Animal vehicle crash mitigation using

advanced technology Phase I: Review, design, and implementation. Final Report to Federal Highways. SPR-3(076). http://trb.org/news/blurb_detail.asp?id=6690.

IUCN 2008. Red List Statistics

IUCN 2008. Red List reveals world's mammals in crisis. Press Release

Noss, R. (2002) The Ecological Effects of Roads. <http://www.wildlandscpr.org/ecological-effects-roads>
[posted June 29 1995; accessed 26 January 2012]

Ray, J.C., Hunter, L. & Zigouris, J. Setting Conservation and Research Priorities for Larger African Carnivores. 2005 *Wildlife Conservation Society*. Working Paper no. 24 December 2005

Sigfried, W.R. 1965. A survey of wildlife mortality on roads in the Cape Province. *Cape Department of Nature Conservation Investigational Report No. 6*, Cape Town, South Africa.

Stoner, D. 1924. The Toll of the Automobile. *Science* 61: pp 56-57

