

Final Project Evaluation Report

Your Details	
Full Name	Alberto González Gallina
Project Title	Jaguar and Other Mammal Use of Wildlife Crossing Structures on a Highway on North-eastern Quintana Roo State (Mexico)
Application ID	22395-1
Grant Amount	£5,000
Email Address	fodopo@hotmail.com
Date of this Report	06/08/2018

1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Differential use of the mammal community of crossing structures along the Nuevo Xcan-Playa del Carmen highway				Originally we planned for a year of monitoring effort (28 cameras), 10 in wildlife underpasses, and nine for each drainage structure (box culverts and pipes) thanks to Panthera. Thanks to Rufford support, we've managed to continue monitoring wildlife underpasses (15) for 10 more months.
Effectiveness assessment of individual crossing structures				All individual crossing structures were assessed with diversity values as response and environmental features (structure type, vegetation, nearest human settlements, etc.) as explicative variables. Analyses are on the way.
Comparative roadkill survey of the Nuevo Xcan Highway and adjacent highways.				Roadkill survey stopped for lack of periodicity. After Victor left the team for his PhD other personnel could not find enough spare time to carry it out efficiently though we have some valuable records that serve as divulgation material.
Divulgation efforts at the local level of the importance of wildlife crossing structures and the impacts of highways on wildlife				Divulgation efforts consisted on presentations on local communities and interviews with the local media. Presentations on academic forums of national and international relevance. Presentation as part of a workgroup to the Senate as part of a law initiative trying to make the construction of wildlife crossing structures obligatory by modifying two articles of the present law of highways and bridges. A divulgation book has been designed but it needs further editing and publishing. Idea is to print it and give it for free to communities in the area with possibility of local reproduction of the material (process continues).

Ph.D Thesis				Alberto González Gallina finished his PhD program on August of 2018. Thesis is finished. Degree is pending on receiving acceptance on an already sent paper.
Peer reviewed articles				To this point three peer reviewed publications have been published as part of the PhD thesis (two notes and one article). There is still information that is being analysed and processed to become articles and being published. One more is under revision and one about to be sent.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled.

Having enough camera traps. Original idea was to have 10 cameras per crossing structure type (30) and other 30 in the adjacent area of the highway working all year long. With Panthera´s budget we managed to buy 30 out of which two got lost in transit. So we decided to survey with 10 at wildlife underpasses, nine for rectangular culverts and nine for pipes. From those by carefully selecting camera sites from previous monitoring experiences by SEGA S.A. de C.V., we avoided places where cameras were stolen previously, luckily we only lost one from the highway crossing structures along the course of the project. Dr Hidalgo lent 30 other cameras for the project to survey the highway´s adjacent area. Those cameras came borrowed from other project so they could stay only for 3 months´ time. From those 30 we lost one camera and one memory card from theft. From the 28 cameras set along the highway luckily only one was stolen. Theft is a constant problem when using equipment in open access areas in Mexico and a big issue specially when getting equipment such as camera traps is complex in Mexico in terms of availability within the country, most are imported and that takes time and sometimes problems with customs, not to mention the budget constraints and the cost/effort of replacing stolen equipment. Having the highway maintenance crews and meeting the engineer in charge together with informing the locals (talking with some of their authorities) the reasons for leaving the cameras of them helped having the cameras "safe", but basically we got lucky not to have lost more equipment.

Vehicle repairs. The project´s vehicle (Ford Blazer 1999) had a lot of maintenance basically because it´s an old truck that despite having a good engine has an old electric system that failed several times and provoked that the truck was unable to work. Maintaining a working vehicle resulted in more expense than originally expected. Parts took longer to be acquired and repairs had to be done away from the respective agency due to model age (agency stops receiving vehicles after 7 years). This was particularly restraining at the beginning. Up to this day, the vehicle is not functioning at 100% despite continued maintenance. The only way was with continued maintenance and prioritizing functionality of the vehicle over minor malfunctions.

Loss of field agent. One of the main difficulties came when Victor Castelazo-Calva, man in the field got accepted for his PhD in Chile, he left on February 26th 2018. Logistics became more complex without someone in the study area. Next field assistant had less time for the project and drop out after first monthly revision (March 2018). Revisions became once every 2 months in order to maximize resources in part due to battery duration in camera traps and expenses from trips from Xalapa to Playa del Carmen site.

3. Briefly describe the three most important outcomes of your project.

- I. Participation as a work group to modify the existing laws to make the construction of wildlife underpasses an obligation (for new projects and existing ones) and the current involvement in designing laws to apply these precepts are one of the main goals achieved, if successful, these will have national level repercussions on conservation.
- II. Jaguars (males and females) use only wildlife underpasses, specially built for them. Wildlife underpasses are worth building as a mitigation measure for maintaining connectivity for the mammal community, for they allow bigger species to go through (such as jaguars, puma, deer, etc.) despite drainage structures also function partially as wildlife crossing structures they cannot substitute for proper wildlife crossing structures.
- III. More highway mitigation is required to maintain connectivity between Yum Balam and Sian Kaan (JCU) in other highways segmenting the corridor linking both. Drainages should be retrofitted and wildlife underpasses built in order to secure connectivity for jaguars.

4. Briefly describe the involvement of local communities and how they have benefitted from the project.

Local communities are benefited in a subtle way that is by having conservation efforts such as the mitigation ones in the highway in order to maintain their wildlife on the long term.

We hope that once the divulgation book is finished and distributed, locals will have something tangible out of this research so they can use it freely as a reminder of the mammals they have and for education of their people. Education is a valuable asset especially for people that own the resources and manage them so they can make a wise use of them in a more sensible manner.

5. Are there any plans to continue this work?

Intention is to keep a long term monitoring program at least of wildlife underpasses for about 5 years to learn the true use patterns of the mammal community in particular jaguars and other priority species. So far no further support has been granted making it less plausible.

Road ecology as a research line will go on but probably somewhere else with other species.

6. How do you plan to share the results of your work with others?

To the scientific community through the publishing of academic research articles and with presentations of posters and talks in different forums (ICOET 2017, INECOL Students Colloquium 2017 and 2018). A slideshow was prepared with a summary of the projects outcomes for a road ecology workshop on the XXI SMBC congress in Costa Rica imparted by Dr A. Clevenger on October 30th of 2017 and another was prepared for Juan Carlos Bravo as speaking member of the road ecology experts group for the Senate justifying the need for a law reform to make wildlife crossing structures something obligatory for all highways at a national level.

To the local communities with the publishing of divulgation material such as posters and booklets and presentations within those communities about awareness of highway impact on wildlife, the value of crossing structures and other mitigation actions and how they can participate in the conservation effort (Puerto Morelos).

7. Timescale: Over what period was the grant used? How does this compare to the anticipated or actual length of the project?

Grant was received in August 2017 till August of 2018. Rufford support was used to continue wildlife underpass monitoring once the budget from Panthera was done after a year of monitoring. So far, after Panthera, ten months of monitoring 15 wildlife underpasses have been done. For this survey to last a year we are planning to maintain monitoring till November 2018 (even if it's past the deadline for this report).

8. Budget: Provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Gasoline	2400	3792	1392	Main expense during monthly camera checks.
Tolls	100	180	80	NXPC highway is a toll road
Air-fares	1400	1400	0	Veracruz-Cancun, Cancun-Veracruz (including transportation from airport to destination and back).

Camera-traps	3650	3650	0	Not enough as originally planned for research design due to budget constraints (30). Two got lost in transit, and one was lost due to theft. Other 30 cameras were borrowed from Dr Hidalgo-Mihart for doing the Adjacent Zone monitoring (march-May 2017).
Batteries (AA)	500	521	21	For camera traps (6 AA each camera) monthly.
Bait (sardines & perfume)	400	500	100	Used to get better photographs particularly on the adjacent area of the highway. Stopped using them after Panthera's monitoring (1 year).
Equipment	2250	1598	-652	For setting cameras (drill, screws, metallic bands, etc.)
(Including vehicle repairs)				Measuring vegetation (cover rulers, metric tapes)
				Highway work with security (reflecting vests, signalling cones) and vehicle (logos, turret, etc.). As the vehicle is rather old, expenses in repairs exceeded the original plan. Truck was vital to carry out the job.
Food	2000	1530	-510	Basically food for the field activities. Food while staying in the Peninsula during field-trips.
Printed Materials	250	250	0	Field notebooks, Posters, Photographs (for jaguar id) and Divulagation book (design, editing and printing).
Total:	12950	13421	431	

9. Looking ahead, what do you feel are the important next steps?

Maintaining a long term monitoring of wildlife underpasses to gain enough information to describe the actual use patterns for the different species.

After reforms on the law, the need for particular norms is required (NOM in Mexican law terms) to add specifications for wildlife crossing structure design, placement, maintenance and monitoring. More workshops with authorities (SCT, SEMARNAT, CONANP, SECTUR, etc.) and land owners to develop a mitigation plan for the other highways cutting through the Yum Balam-Sian Kaan corridor, mitigate through drainage retrofit in other highways perhaps even build some other wildlife underpasses along the corridor.

Continue with road ecology research in Mexico to increase the local knowledge and praxis.

10. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the Foundation receive any publicity during the course of your work?

Yes, the Rufford Foundation logo was included in all divulgation material (posters and booklets) together with presentations (PowerPoint) after the grant was given. The logo appears in the PhD thesis along with other sponsors. The Rufford Foundation appears as sponsor on the Acknowledgements of academic publications. Suggestions for applying for the Rufford Small Grants was given to several master's and PhD students along this project.

11. Please provide a full list of all the members of your team and briefly what was their role in the project.

Victor Castelazo Calva, MSc. - A key participant in the project without him it wouldn't have been possible. Man in the field, responsible for data collection. In charge of photo-trap data retrieval, and roadkill surveys.

Dr Mircea Hidalgo-Mihart, Ph.D. - Thesis co-director and leader of the vertebrate's laboratory at Universidad Juárez Autónoma de Tabasco (UJAT). Project assessment. Lent 30 camera traps for the highway's adjacent area survey. Co-author of the published articles.

Alejandro Jesus de la Cruz- Field, Biol. - Assistant from the vertebrate's laboratory of UJAT. Helped with the setting and retrieval of camera traps in the adjacent area of the highway (March-May 2017).

Rugieri Juárez López- Field, M.Sc. - Assistant from the vertebrates laboratory of UJAT. Helped with setting the camera traps at the crossing structures and with the vegetation measures.

Alejandro González Gallina- Field, MSc. - Assistant helped with setting the camera traps at the crossing structures and with the vegetation measures.

Dr. José Arturo García Domínguez - Field assistant for the January-march monitoring session after Victor left the team.

Iridiana Guevara Andrade - Graphic designer in charge of the edition of divulgation materials.

12. Any other comments?

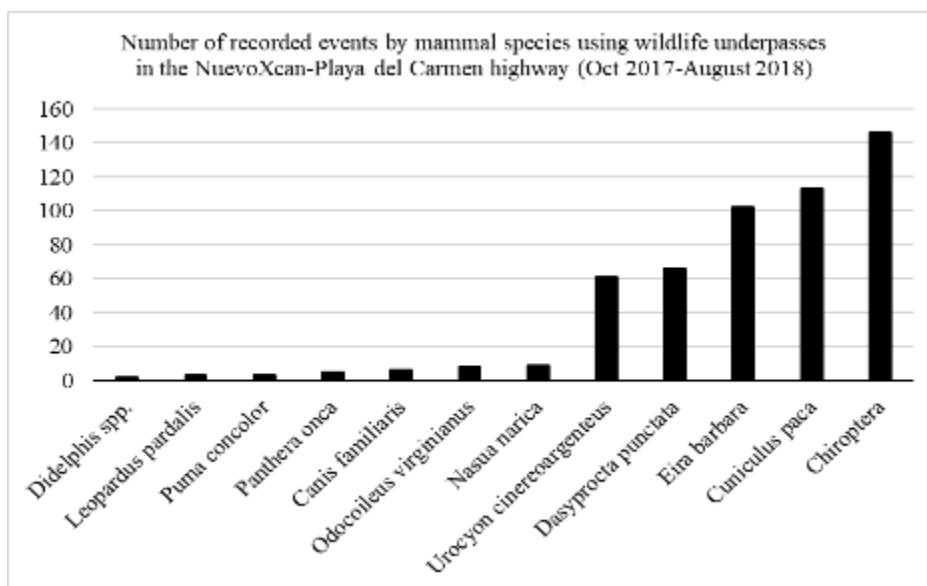
Legislation presently allows mitigation measures such as wildlife underpasses to be built but lack of enforcement made lots of highway and other linear infrastructure without proper mitigation measures. Monitoring money is scarce and budgets should be considered since project planning to ensure assessment of mitigation measures on the long term to become a reality.

Mitigation efforts to maintain population connectivity along highways cutting through remaining habitat can improve conservation efforts at a national level not with a single species but talking at a community level and even across different taxa.

WILDLIFE UNDERPASS MONITORING RESULTS:

Table1. Mammal species recorded using Wildlife underpasses along the Nuevo Xcan-Playa del Carmen Highway (During Rufford monitoring session from October 2017-August 2018).

Species	Common Name	No. Of Events	Used Stations (15)
<i>Didelphis spp.</i>	Oposum	2	2
<i>Chiroptera</i>	Bats	146	13
<i>Dasyprocta punctata</i>	Agouti	66	4
<i>Cuniculus paca</i>	Paca	113	6
<i>Leopardus pardalis</i>	Ocelot	3	1
<i>Puma concolor</i>	Puma	3	3
<i>Panthera onca</i>	Jaguar	5	5
<i>Canis familiaris</i>	Dog	6	5
<i>Urocyon cinereoargenteus</i>	Grey Fox	61	9
<i>Eira barbara</i>	Tayra	102	8
<i>Nasua narica</i>	Coati	9	4
<i>Odocoileus virginianus</i>	White-tailed Deer	8	1
12 spp.		524	
Human presence:			
<i>Homo sapiens</i>	Man	31	14



SUPPLEMENTARY MATERIAL I. - PHOTOGRAPHIC MEMORIES

PROJECT ACTIVITIES:

CAMERA TRAP SETTING

After gathering the original cameras set during Panthera's sponsorship, we went out to the field once more to set 15 camera traps concentrating this time only on Wildlife Underpasses. We used all previous 10 stations plus another five for total of 15 wildlife underpasses. These were monitored from October 2017 to August 2018.

Figure 1.1. **A.** Team entering the right of way in a wildlife underpass to set a camera for monitoring. **B.** Victor mounting a camera on the wall of the wildlife underpass, we drilled and fixed the camera with screws and metallic tape at the middle of the structure. **C.** Team after mounting a camera trap checking it functions properly. **D.** Camera-trap check, downloading images to USB to analyze them back at base.



ROADKILL SURVEY

We initiated a monthly road-kill search looking for medium to big mammals, but also recording other notable organisms. Road kill transect comprehends four segments: Puerto Morelos-Playa del Carmen, Playa del Carmen-Tintal (Nuevo Xcan – Playa del Carmen highway), Tintal-Leona Vicario and finally Leona Vicario-Puerto Morelos. Each segment presents its own particular characteristics in terms of length, road

width and traffic flow. Idea is to obtain a daily estimation of roadkill's and compare roadkill/km index between highway segments.

Figure 1.2. A. V. Castelazo-Calva showing a fresh road-killed boa (*Boa constrictor*) found during the camera trap setting along the Nuevo Xcan-Playa del Carmen highway, wildlife vehicle collisions affect all taxa. **B.** A recently killed tayra (*Eira barbara*) on the edge of the Leona Vicario-Puerto Morelos highway. This mammal is considered endangered and is one of the target species for the wildlife underpasses.



Figure 1.3. Road killed fauna **A.** Grey foxes (*Urocyon cynereoargenteus*) together with **B.** Coatis (*Nasua narica*) and **C.** Opossums (*Didelphis spp.*), like the ones showed in the photographs are the most commonly found mammals dead along the monitored segments. **D.** A rare find, a kinkajou (*Potos flavus*) is a nocturnal arboreal mammal, this record is the second we've got in the area.





SUPPLEMENTARY MATERIAL II.

MAMMALS USING WILDLIFE UNDERPASSES

Figure 2.1. Photographs of carnivores using wildlife underpasses in the Nuevo Xcan-Playa del Carmen highway. **A.** Male Jaguar (*Panthera onca*), **B.** Puma (*Puma concolor*), **C.** Ocelot (*Leopardus pardalis*), **D.** A male Tayra (*Eira barbara*) **E.** A male Coati (*Nasua narica*) and **F.** A couple of grey foxes (*Urocyon cynereoargenteus*).



Figure 2.2. Other mammals using wildlife underpasses. Big rodents such as **A.** the pacas (*Cuniculus paca*) here we see a female with her cub and the **B.** agoutis (*Dasyprocta punctata*) a male and a female. **C.** A male white-tailed deer (*Odocoileus virginianus*) males are more prone to use the underpasses than females. **D.** A couple of bats flying inside the wildlife underpass probably eating insects.



Figure 2.3. Human presence has been recorded within the wildlife underpasses **A.** A local hunter some people usually go out with shotguns see if some animal crosses their path. **B.** A couple of hunters carrying a dead white tailed deer on his back of the one coming behind. **C.** Domestic dogs also have been seen usually associated with people. **D.** Throughout the year, the presence of maintenance crews from the highway are the most common form of human presence within the structures.



SUPPLEMENTARY MATERIAL III.

PHOTOGRAPHIC MEMORIES

DIVULGATION EFFORTS

Figure 3.1. A. Animal's Day Fair in Puerto Morelos, Quintana Roo, Mexico, in which we were invited by the NGO "ConMonoMaya A.C." through its chair Luisa Rebecchini. The event took place in the town's main square and was free. **B.** In this event we presented a divulgation poster and explained to the people attending about the impacts of highways on wildlife and why wildlife underpasses are important features for mitigating those impacts and maintaining connectivity in the long term. We used a photo slide-show on the laptop showing photographs of mammals using the crossing structures along the Nuevo Xcan- Playa del Carmen highway. Most attendants show surprise when they learned those animals (jaguars, ocelots, etc.) were photographed using crossing structures existing in a nearby highway. Also invited by them later on, V. Castelazo-Calva went with them to Leona Vicario, another city in the influence area of the Nuevo Xcan-Playa del Carmen project to give a talk to high school kids about mammals of the region in general terms and the importance of their conservation.



Figure 3.2. A. Close-up of the divulgation poster. Leading message being highway impacts on wildlife and how wildlife underpasses help mitigate those negative effects. Awareness of the Nuevo Xcan-Playa del Carmen highway as a local good example of how underpasses work. **B.** MSc. V. Castelazo-Calva posing at the divulgation poster stand. The laptop was used as visual aid with a slide show of photographs of mammals registered using crossing structures at the Nuevo Xcan-Playa del Carmen highway.



Figure 3.3. A. Certificates given to V. Castelazo-Calva and A. González-Gallina by ConMonoMaya A.C. (NGO) for participating in the fair for the “Animal day” in Puerto Morelos, Quintana Roo, México main square on October 13th 2017. **B.** Second certificate goes to V. Castelazo-Calva for a presentation in Leona Vicario for junior high level kids.



Figure 3.4. Screen capture of the local news “Esto es Puerto Morelos” Facebook site where a recorded video interview was uploaded showing **A.** A. González Gallina and V. Castelazo Calva and **B.** Another image showing one of the presentation’s slide where you can see the Rufford logo. The team explained the importance of wildlife underpasses as highway mitigation efforts to maintain local wildlife connectivity in the long term. Available at: (https://www.facebook.com/pg/EstoEsPuertoMorelos/posts/?ref=page_internal).

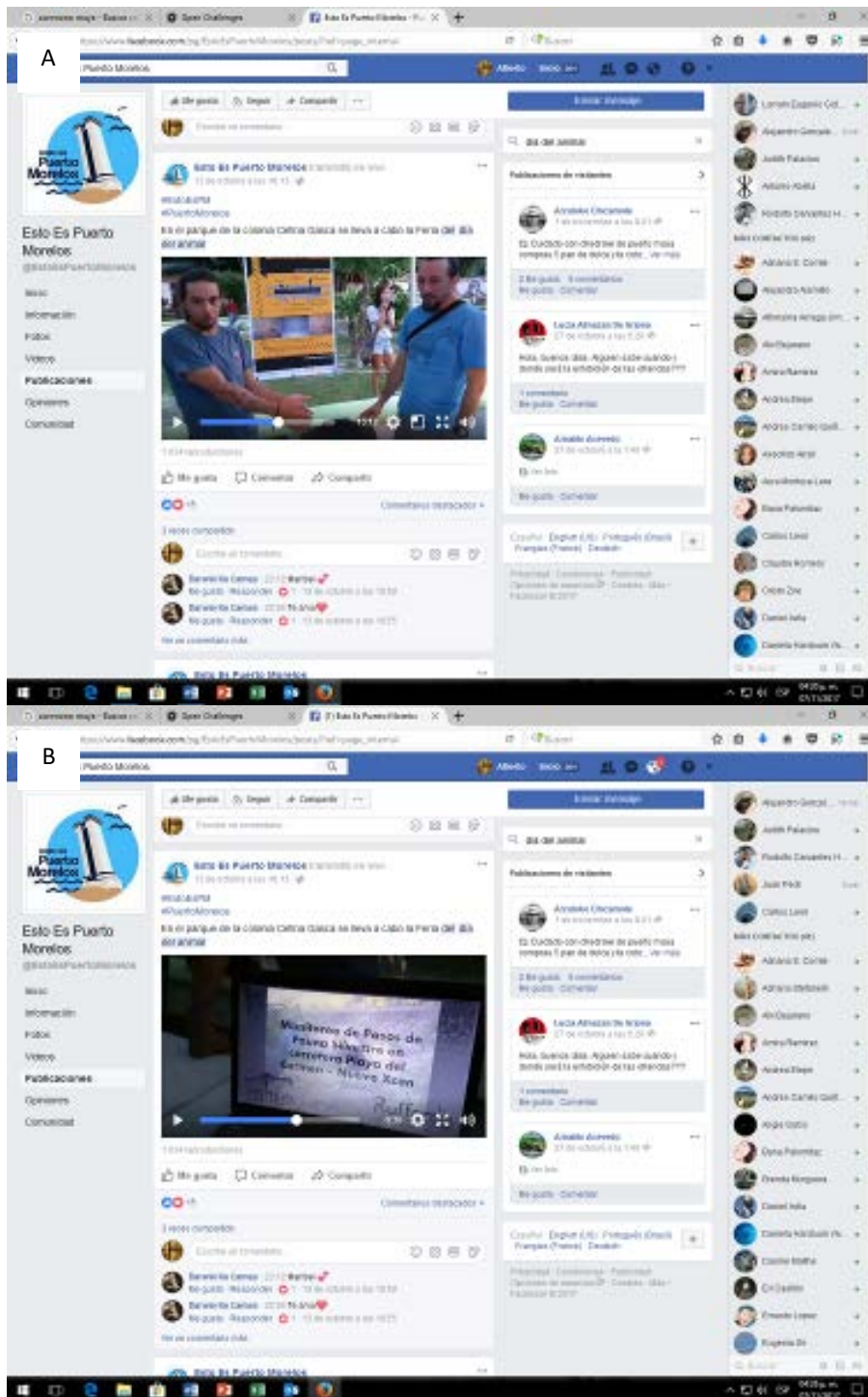


Figure 3.5. Won third place at the poster contest in the INECOL during the Students Colloquium 2017. This poster resumed the Panthera’s monitoring session along the NX-PC previous to Rufford funding, but as part of the same project is important to mention. Dr Stuart Pim was part of the jury during this event mentioning “It was a nice applied conservation effort”.



Figure 3.6. An oral presentation was given on the International Conference of Ecology and Transportation (ICOET) 2017 as part of the Crossings and Connectivity 4: Monitoring Use and Effectiveness of Crossing structures.

ICOET 2017 SESSIONS AND PRESENTATIONS

Securing Connectivity for Jaguars Along Expanding Highways of the Sky Islands of Mexico
 Authors: Juan Carlos Bravo (Wildlands Network, Mexico); Mima Mastroianni and Samantha Hancock (Sky Island Alliance, Arizona, United States); David Theobald (Conservation Science Partners, Colorado, United States); José Manuel Pérez (Cuenca Las Ojías, Arizona, United States); Anthony Clavinger (Western Transportation Institute, Montana State University, Alberta, Canada); Robert Amour (Western Transportation Institute, Montana State University, United States); Joe Siskinger (Arizona Center for Nature Conservation—The Phoenix Zoo, United States)

Crossings and Connectivity 4: Monitoring Use and Effectiveness of Crossing Structures

Evaluation of Wildlife Crossing Structures on U.S. Highway 93 in Montana's Rosebud Valley Utilizing a Before-After-Control-Impact Monitoring Design
 Authors: Robert Hovela (Consultant, Utah, United States); Pamela Cramer (Consultant, Utah, United States); Patrick Basting (Josses Engineering Group, Colorado, United States)

Wildlife Crossing Structure Use by Jaguars and Other Mammals Along the Nuevo Xcan-Playa del Carmen Highway, Quintana Roo, Mexico
 Author: Alberto González (INECOL, Mexico)

Wildlife Use of Highway Underpasses in Southern Shikoku
 Authors: Kazuo Chigeta (EPOCO Consultancy, Shikoku); Hiromi Doi (AZTEC Engineering Group, Arizona, United States); Kazuo Yamaguchi (Asian Development Bank, Philippines)

A Contribution Toward Standards in the Use of Multiscale Trapped Cameras for Quantifying Wildlife Crossings Using Highway Structures
 Author: Kelly McArthur (Washington State Department of Transportation, United States)

Tuesday 1:30 PM Parallel Sessions

Partnership and Collaboration in Programmatic Consultation for The Indiana Bat and Northern Long-Eared Bat – A Rangeland Approach

Implementing a Rangeland Programmatic: The Indiana Bat and Northern Long-Eared Bat Programmatic Consultation in Practice
 Panel Session Organizers: Julianne Schreiner (U.S. DOT Virginia Center, Massachusetts, United States); Brian Yarnick (U.S. DOT Federal Highway Administration, South Carolina, United States); Forest Clark (U.S. Fish and Wildlife Service, Indiana, United States)

Stormwater and Water Quality Management: Go With the Flow

A Comprehensive Approach to Erosion and Sediment Control and Stormwater Management During Construction of a Major Highway Project
 Author: Grant Kuffman (DGI Limited, Ontario, Canada)

Stream Restoration Toward TMDL Compliance and SRA Implementation Examples
 Author: Joshua Gilman (Stream Consulting Services, Inc., North Carolina, United States)

Re-Flushing Roadside Ditch Networks: The Unrecognized Driver of Flooding, Water Pollution, and In-Stream Erosion and Habitat Degradation
 Authors: Rebecca Schneider, David Orr, Sara Davis, Rebecca Morino, and Nathan Baker (Cornell University, New York, United States)

When Opportunity Knocks: Opportunistic Stormwater Treatment Banking to Meet Endangered Species Act Streamwater Management Requirements
 Author: William Peltzer (Oregon Department of Transportation, United States)

ICOET 2017 | Beyond Boundaries: Building on Common Ground | 19

Figure 3.7. A slide was prepared with a summary of the project's outcomes for a Road-ecology workshop on the XXI SMBC congress in Costa Rica imparted by Dr. A. Clevenger on October 30th of 2017.

Autopista Nuevo Xcan – Playa del Carmen
 Quintana Roo, México

A2: 2 carriles con acotamientos, 12m corona, 60m derecho de vía. 54km longitud. Circulación 110km/h



28 Cámaras trampa:
 *10 Pasos de Fauna
 *9 Alcantarillas de Losa
 *9 Ductos de concreto

Paso de Fauna
 (3m ancho x 4.5m alto) con cercado de inducción. Suelo natural.

Alcantarillas de Losa
 (2m ancho x 1m alto)

Ductos de concreto
 (1.5m diámetro)

Puntos Relevantes:

- * Los jaguares utilizan típicamente los pasos de fauna (6 individuos, machos y hembras, 24 registros)
- * Uso diferencial por la comunidad de mamíferos
- * No toda la comunidad de mamíferos está representada (aunque sí la mayoría).
- * Muy pocos ungulados, requieren probablemente mayor ancho en estructuras.
- * A pesar de estar en el área los perros no parecen utilizar las estructuras.

M.Sc. Alberto González Gallina
 M.Sc. Víctor Castellano Cebal
 Dr. Mónica G. Hatalgo Milner



Figure 3.8. Towards public policy. **A.** Invitation for the forum on wildlife crossing structures on April 03 of 2018 at the Congress. **B.** Photo from the Road ecology expert's group at the Senate as spokesman Juan Carlos Bravo (Wildlands Network NGO) talking about the project showing a slide with the main outcomes.

