

## The Rufford Foundation

### Final Report

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Congratulations on the completion of your project that was supported by The Rufford Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to [jane@rufford.org](mailto:jane@rufford.org).

Thank you for your help.

**Josh Cole, Grants Director**

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#### Grant Recipient Details

<b>Your name</b>	Fernanda Delborgo Abra
<b>Project title</b>	Monitoring and Evaluation of the Fauna Underpasses Located on SP-225 Highway in the City of Brotas, Sao Paulo.
<b>RSG reference</b>	8215-1
<b>Reporting period</b>	January 2012 to December 2012
<b>Amount of grant</b>	£5,400
<b>Your email address</b>	fer_bio04@yahoo.com.br
<b>Date of this report</b>	January 2015

**1. Please 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
To monitor 10 underpasses and their use by medium and large mammals			x	The results indicate 800 crossings in the underpasses monitored, including crossings by threatened species like maned wolf ( <i>Chrysocyon brachyurus</i> ), puma ( <i>Puma concolor</i> ) and ocelot ( <i>Leopardus pardalis</i> ).
To compare the effectiveness of two methods of monitoring: camera traps and track beds			X	Among the different monitoring methods used – tracking beds and video cameras – tracking beds and the associated records of footprints were more efficient for all species except for capybara ( <i>Hydrochoerus hydrochoeris</i> ) and brocket deer ( <i>Mazama gouazoubira</i> ). In several events, groups of up to 17 individuals of capybara used the passages and only with the video feature was it possible to quantify the exact number of animals, just as with brocket deer females who were documented with fawns.
To verify the importance of the landscape near the underpasses		x		This study evaluated whether animals prefer wet (permanently running water through underpass) or dry (no running water through underpass) crossing structures. The study found that wildlife in this study area prefer wet crossings ( $X^2 = 236,5$ ; $P < 0,001$ ), especially capybara ( $X^2 = 344,3$ ; $P < 0,001$ ). This is likely due to the fact that 60% of the animals recorded in the crossing structure were capybara, thus the data was weighted towards wet crossings. The results cannot be used to conclude that wet underpasses are more effective than dry underpasses.
To quantify how many underpasses São Paulo State has on private and state roads			x	ARTESP is the agency that manages all the concessionaires in São Paulo State and they have documented 71 underpasses already constructed on private roads in São Paulo State, with 10 more scheduled to be constructed.
To recommend the implantation of mitigation measures to the roads licensing			x	CETESB is the environmental organisation responsible for the licensing and constructions of roads in São Paulo state. In 2012, 2013 and 2014 the researcher gave courses explaining underpasses, overpasses

organisations				and others types of mitigation measures to CETESB staff. CETESB now requires all analyses associated with the construction or duplication of roads to assess road kill issues, identify wildlife monitoring needs and include mitigation measures such as underpasses and fences.
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**2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).**

In general, the project succeeded. One unforeseen problem occurred with the installation of the cameras, because the concrete walls of the underpasses were very difficult to work with. We rented special tools including a professional concrete drill and a generator, to ensure we could install the cameras and secure them against theft.

No cameras were stolen during the project, but in March 2011 it rained much more than expected and one camera was damaged by water. Fortunately we had planned for one extra camera trap to replace cameras damaged or stolen.

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

In 96 days of sampling I recorded 800 animal crossings, 725 crossings for mammals representing 16 different species (the remainder including reptiles, amphibians and birds were 800). This study was the first official underpass monitoring in Brazil. This data is being used to encourage transportation organisations and agencies to construct underpasses and other mitigation measures in both new road construction and highway upgrades, including highway twinning or duplication projects.

Capybara (*Hydrochoerus hydrochaeris*) made up 60% of all mammal crossings. This is likely the most significant outcome of the project, as it illustrates that capybara can and do use underpasses, providing safe passage across the highway. Wildlife-vehicle collisions involving capybara are dangerous to drivers and deadly to capybara. Capybaras are the biggest rodent in the world, they are habitat generalists, and they typically travel in groups. Collisions often involve more than one animal, and can result in serious human injuries or even fatalities.

In São Paulo state, capybara are the wildlife species most often killed on highways. On highway SP-225 the capybaras crossings were documented in fenced culverts (1.7 m diameter) that had been specifically adapted to accommodate wildlife crossings. These adaptations are simple and inexpensive, allowing private, state and federal road and highway managers to implement such measures. In São Paulo state the environmental agencies/organisations are now recommending upgrade culverts with minimal sizes (> 1.5 m diameter).

Drainage culverts are installed to pass river water from one side of the road to the other. Riparian forests are typically associated with rivers and streams, and these riparian forests provide important habitat for many wildlife species. In addition to capybara, my study detected many other species using drainage culverts: gray brocket deer (*Mazama gouazoubira*), nine-banded armadillo (*Dasypus novemcinctus*), spotted paca (*Agouti paca*), Neotropical otter (*Lutra longicaudis*), white-eared opossum (*Didelphis albiventris*) and some felids.

In general, my study found a correlation between the success of crossings of medium and large-sized mammals in fauna underpasses with the presence of water within the limits of the landscape considered. There were 676 crossings in wet landscapes and 49 crossings in dry landscapes. Because many animals are traveling riparian corridors and following streams, this data shows the value of modifying existing water drainage pipes (with minimum dimension of 1.5 m in diameter, or 1.5 m x 1.5 m for rectangular boxes) to also serve as underpasses for fauna crossings. Similarly, new highway construction or highway duplication projects should be required to adapt drainage pipes to accommodate medium and large sized fauna. That said, it is important to ensure that dry wildlife crossing structures are also implemented, as wildlife also travel outside of riparian corridors and some species are less likely or even unlikely to cross in wet structures, as illustrated in the following discussion of maned wolves.

The third main outcome I would like to highlight is recordings of maned wolf (*Chrysocyon brachyurus*) crossings during this study. In Brazil this canid is threatened and therefore protected. The federal environmental agency (ICMBIO - Chico Mendes Institute for Biological Conservation) created the National Action Plan for Maned Wolf conservation, which lists all the threats this species is facing, including impacts created by roads.

Previous research has shown that approximately one third of the adults and half of the annual production of maned wolf pups die as a result of wildlife-vehicle collisions on roads and highways. The National Plan identified some urgent actions to diminish both road kill and the habitat fragmentation impacts of roads on maned wolf. Wildlife crossing structures are an important tool for addressing both of those impacts.

In this study maned wolves were recorded (including by video) using the underpasses 26 times. Maned wolves occupy open dry habitats, and in this study they clearly also preferred dry underpasses. This is critical data for understanding how to mitigate highways in maned wolf habitat. In addition, it is important to note the difference between mitigation for maned wolf as opposed to capybara – for the former, mitigation is important for the survival of the species, for the latter it is more important from a human safety perspective.

#### **4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).**

During the project I created a good relationship with the environmental department of the city of Brotas. We developed some activities together including lectures, mini courses and children's environmental education activities (for children aged 6-8, hosted on World Environment Day 2011). For example, we developed a project where each child chose an animal (ocelot, maned wolf, armadillo or brocket deer) then they made clay tracks, and then they learned more about the species they had chosen.

I also developed relationships with Itirapina Ecological Station, which is located close to the study site. Itirapina has been documenting problems with road kill on the two roads nearby (including one road that cuts through the reserve). I gave a presentation regarding my research on October 9, 2012. This event was the beginning of a good collaboration between University of São Paulo, non-governmental organisations, and public organisations to help reduce road kill problems within my study area, including within Itirapina.

## 5. Are there any plans to continue this work?

Yes, after completing my master's degree, I was hired to work on road ecology issues with a consulting firm. I'm applying the knowledge learned from the research on SP-225 to the construction of a new road: Rodoanel - Trecho Norte. Rodoanel is one of the most important roads being constructed in São Paulo state – this final "North Section" is 43 km long, and located immediately south of the largest urban neotropical forest in the world, Cantareira State Park (SPC) in São Paulo city. This section of highway will include the first wildlife overpass in Brazil. I am pleased to report that I have been able to work with CETESB, ARTESP and other agencies to improve the wildlife mitigation plans for the highway.

In 2014 I worked with Dr Marcel Huijser, a world expert in road ecology, and Dr Kátia Ferraz, to develop a grant to bring Dr Huijser to Brazil for a semester to teach a graduate level course in road ecology at the ESALQ campus of the University of São Paulo. 14 students participated in this course and several are working on additional research related to road ecology in Brazil. In addition, I coordinated road ecology workshops for road management agencies (ARTESP, CETESB) and concessionaries for Dr Huijser to share his knowledge with them. These were highly successful and received very positive evaluations from the participants, who stated they will use the new information in their work – ideally this will result in much more effective road mitigation for wildlife in São Paulo state, and perhaps even more widely across Brazil. Finally, I took the lead in coordinating a two day road ecology conference for São Paulo at the end of Dr Huijser's stay, which was attended by more than 100 people, and was cosponsored by ESALQ, ARTESP and others. Dr Huijser was the keynote speaker, and the conference included dozens of speakers who are working on mitigating the ecological impacts of transportation projects in Brazil.

In 2015 I will start a PhD on road ecology at University of São Paulo, ESALQ campus. My primary advisor is Dr Kátia Ferraz (ESALQ) and my co-advisor is Dr Marcel Huijser (Montana State University in the United States). For my PhD, I will analyse road kill data from 6,500 km of roads. The data comes from the 19 concessionaires in the Sao Paulo state, and I will be analysing road kill issues related to maned wolf (*Chrysocyon brachyurus*), puma (*Puma concolor*) and capybara (*Hydrochoerus hydrocharis*). We also intend to study the effects of solid median barriers on wildlife by monitoring several crab eating foxes (*Cerdocyon thous*) along two types of roads, with and without median barriers.

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

I have been promoting and distributing the results of this work with many different entities and audiences throughout the life of the project. I presented at conferences and workshops, met with newspapers and television news, etc. and, as stated above, I have been working to help build the field of road ecology in Brazil.

My thesis is available to download on the University of São Paulo website, and had been downloaded 1268 times as of December 2014:

<http://www.teses.usp.br/teses/disponiveis/41/41134/tde-21012013-095242/pt-br.php>

I co-authored a paper in collaboration with Dr. Marcel Huijser from Western Transportation Institute:

Huijser, M.P.; Abra, F.D.; Duffield, J.W. 2013. Mammal road mortality and cost–benefit analyses of mitigation measures aimed at reducing collisions with capybara (*Hydrochoerus hydrochaeris*) in São Paulo State, Brazil. *Oecologia Australis* 17(1): 129-146.

Bellow are 3 main Brazilian TV and internet stories featuring the research funded by the Rufford Foundation:

(866 views) <http://g1.globo.com/sp/sao-carlos-regiao/noticia/2013/04/pesquisa-da-usp-mostra-importancia-das-passagens-de-fauna-nas-rodovias.html>

<http://tvbrasil.ebc.com.br/reporterbrasil/bloco/passagens-subterraneas-em-estradas-reduzem-acidentes-com-animais-silvestres>

(1.900 views) <http://noticias.r7.com/domingo-espetacular/videos/conheca-os-brasileiros-que-dedicam-a-vida-a-salvar-os-animais-05012015>

(674 views) <http://www.oeco.org.br/convidados/28467-atropelamento-de-fauna-desastre-ambiental-facil-de-evitar>

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

The Rufford Small Grant Foundation was used from January through December, 2011, enabling me to conduct my field work for my master’s research.

**8. Budget: Please 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.**

Item	Budgeted Amount	Actual Amount	Difference	Comments
Car Rental	£2845	02845	0	The budget was totally used. Beyond gas, tolls and car rentals the researcher spent money with tools like hammer, pliers, wire, special glue and drill rental and generator rental to install the cameras trap inside the fauna underpasses. During the final of project the researcher used her personal car to travel to study area. The University of São Paulo also provided more resources during the field research for food, lodge and eventual equipments to be bought.
Fuel	£2222	2000	222	
Toll	£363	0350	13	
Generator rental	0	130	-130	
Drill rental	0	115	-115	
<b>Total</b>	<b>£5430</b>	<b>£5440</b>	<b>-10</b>	

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

I think it’s very important to continue this type of road ecology research in Brazil, and especially in Sao Paulo, where many roads are currently being upgraded and duplicated. We have an opportunity to influence these road projects, and to engage at both the planning and implementation phases to mitigate how these roads impact wildlife. Moreover, it is necessary to create other lines of research to investigate different impacts, in São Paulo state, for example nobody is studying the barrier effect

of roads on wildlife, specifically when roads are duplicated and then median barriers are installed between the different directions of traffic. We need to understand whether or not this type of road upgrade increases the barrier effect (including potential geographic isolation). If so, we need to ensure that this type of road construction includes mitigation to enable wildlife to cross from one side of the road to the other.

I will study these types of impacts during my PhD research, with the intent to propose mitigation measures and alternatives to the transportation agencies that oversee such road projects.

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

Yes, I used the Rufford Logo in all of my presentations, and I specifically named The Rufford Foundation in all interviews and other activities. I participated in 16 different events (one international, four in other states in Brazil, and the remainder in São Paulo state). My participation ranged from giving oral or poster presentations to coordinating workshops. I've included a list of presentations below.

Event/Conference	Organization	Date	City/State
<b>2011</b>			
Palestra: Ecologia de rodovias e a Conservação da biodiversidade	Secretaria de Meio Ambiente de Brotas/São Paulo	05 June 2011	Brotas/ São Paulo
Estudos sobre a fauna no licenciamento ambiental	CETESB/Secretaria de Meio Ambiente do Estado de São Paulo	10-11 May 2012	São Paulo/ São Paulo
<b>2012</b>			
Mini curso de Ecologia de Rodovias (8 hours)	USP – Faculdade de Medicina Veterinária e Zootecnia	12 May 2012	São Paulo/São Paulo
VI Congresso Brasileiro de Mastozoologia	Sociedade Brasileira de Mastozoologia	25-29 June 2012	Corumbá/Mato Grosso do Sul
<b>2013</b>			
Oral presentation: Mammal road mortality and cost–benefit analyses of mitigation measures aimed at reducing collisions with capybara ( <i>Hydrochoerus hydrochaeris</i> ) in São Paulo state, Brazil	ICOET – International Conference on Ecology and Transportation	23-27 June 2013	Scottsdale/Arizona/USA
Lecture: Ecologia de rodovias: segurança do usuário, conservação da biodiversidade e economia.	Unicamp – Universidade Estadual de Campinas	03 September 2013	Campinas/ São Paulo

I Encontro sobre a Fauna Silvestre no Licenciamento Ambiental Estadual	CETESB/Secretaria de Meio Ambiente do Estado de São Paulo	10-11 September 2013	São Paulo/ São Paulo
V Simpósio de Restauração Ecológica	Instituto de Botânica/CNPQ/FAPESP	06-08 November 2013	São Paulo/São Paulo
<b>2014</b>			
Mini curso de Ecologia de Rodovias (8 hours)	Pro Training Desenvolvimento Profissional	26 April 2014	São Paulo/São Paulo
Lecture- 38º Congresso da Sociedade de Zoológicos e Aquários do Brasil	Sociedade de Zoológicos e aquários do Brasil	23-26 May 2014	Bauru/São Paulo
Lecture: Ecologia de rodovias: segurança do usuário, conservação da biodiversidade e economia.	Geotec - Consultoria	26 September 2014	Piracicaba/São Paulo
Guest speaker on Road Ecology grad course of Dr. Marcel Huijser at ESALQ/USP	ESALQ/USP	06 October 2014	Piracicaba/São Paulo
Lecture: Ecologia de Rodovias e opções de medidas de mitigação para médios e grandes mamíferos	Fundação Florestal, Parque Estadual Carlos Botelho	11 October 2014	São Miguel Arcanjo/São Paulo
Lecture - Congresso Brasileiro de Gestão Ambiental e sustentabilidade	Congestas (UFPB, IBAMA, ICMBIO)	29-31 october 2014	João Pessoa/Paraíba
Lecture- <i>Workshop</i> "Impactos da rodovia BR-101 na Reserva Biológica de Sooretama: estudos, alternativas e mitigação"	Universidade Federal do Espírito Santo	12-15 November 2014	Vitória/Espírito Santo
Conferece organizer and speaker: 1º Conferência Paulista de Ecologia e Transportes - Ecotrans	ARTESP/Secretaria de Logística e Transporte/ESALQ-USP	01-02 December 2014	São Paulo/São Paulo

# Conservação da Biodiversidade e Ecologia de Estradas

Fernanda D. Abra

Mestranda em Ecologia USP-SP

Laboratório de Ecologia da Paisagem e Conservação - Lepac



Figure 1- Rufford logo used on presentations.

## 11. Any other comments?

I would like to thank The Rufford Foundation for your generous support. The grant was enormously important for ensuring I was able to conduct my field work. All logistic and the renting of special equipment was critical to make the project happen.

This project was new to Brazil and the results were applied to biological conservation issues and they are already having real world effects, helping reduce new road construction impacts to wildlife.

Road ecology is a growing field in Brazil, and many students are now beginning to research a variety of impacts of roads as our transportation infrastructure is upgraded. With so little research currently available on this topic specific to Brazilian wildlife and landscapes, I hope The Rufford Foundation will consider providing additional grants for this type of research in Brazil. Only 10% of the Brazilian road network is paved, but that number is increasing every day. As more and more roads are paved, Brazil has an opportunity to implement and upgrade its road system in a more environmentally friendly way. Additional road ecology research will be critical for identifying geographic- and species-specific mitigation practices that can reduce road impacts to Brazilian wildlife.