The Rufford Small Grants Foundation
Final Report

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

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. 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. 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.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Pedro Mayor
Project title	Impact of crude oil extraction on the large mammals of the Peruvian Amazon and indirect effects on the health of indigenous Achuar and Kitchwa communities
RSG reference	13651-1
Reporting period	September 2013 to March 2015
Amount of grant	£5954
Your email address	mayorpedro@hotmail.com
Date of this report	21/03/2015

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
Initial phase: Coordination with indigenous Federations and communities			X	Two meetings with indigenous Federations (FECONACO and FEDIQUEP).
Training of local monitors for the biological sample collection and for the use and management of video camera traps			X	Ten local monitors were trained and directly collected biological samples from wildlife hunted by communities Twelve local monitors were trained and participated in the use and management of video camera traps.
Confirm that the main species hunted by local communities are consuming crude oil spills			X	Registration of 6.200 videos from 18 different mineral licks. Three bird species and six mammal species observed ingesting apparently oil-polluted. Videos recorded in oil-polluted sites are going to be analysed through a citizen science platform.
Collection of biological sample and shipment to laboratories		X		We collected biological samples of 213 wild species (422 different organs) that local indigenous hunted for subsistence purposes. The collected biological samples included organs from Yavari River and Pucacuro National Reserve (without oil activities n=104) and Corrientes/Pastaza Rivers (n=109). First samples collected in November 2013 (n=311 organs from 171 individuals) were sent to Spain for further laboratory analysis Samples arrived to Spain in June 2014 in a long process that started in December 2013 (7 months).
Determination of liver bioaccumulation of heavy metals			X	In February 2105, 116 samples, organs (liver, kidney and heart) from six targeted species (*Cuniculus paca, Pecari tajacu, Tayassu pecari, Mazama americana, Caiman crocodilus and Lagothrix* sp.), were analysed. We also

				analysed heavy metals in three crude oils
Determination of organic hydrocarbon compounds in fences		X		Faecal samples collected from 98 individuals that local indigenous hunted for subsistence purposes from the Corrientes/Pastaza Rivers. Standardisation of a field equipment of spectrophotometry adapted for the field assessment. This equipment will be used for the screening of contaminated faecal samples. We started determining organic hydrocarbon compounds in soils from three mineral licks. We will continue with the lab analysis of further 18 mineral licks.
Assess the pathological impact that oil consumption may cause to free-ranging wild species		X		311 biological samples dehydrated and embedded in paraffin wax. We are proceeding with the pathological analysis of organs with high levels of heavy metals.

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

The shipment of biological samples from Peru to Spain has been effort and time-wasting because of the complicated bureaucracy, including CITES permissions, Animal Health and Custom authorisations both in Peru and Spain. This fact resulted in an important delay in the laboratorial analyses. The samples collected in November arrived to Spain on June 2014, in a process that started in December 2013 (7 months). A second pack of samples collected between August 2014 and January 2015 still remains in Iquitos, Peru. We expect that sample collection will be finish in August 2015. Due to the complicated bureaucracy, we hope shipping the rest of biological samples in December 2015.

The laboratorial hydrocarbon analysis in biological samples is more sophisticated than expected. We standardised the acid digestion of the biological samples and the spectroscopic (ICP-OES) analysis. In February 2015 we conducted the first analysis of first soils from mineral licks. We expect concluding the analysis of further soils (n=18) and biological samples in June 2015.

We are developing the use of a cheap and user-friendly sensors (spectrometer kit of the Public Laboratory and paper nano-biosensors) by indigenous communities to obtain a system for near real time oil spills monitoring in tropical rainforests. This friendly methodgy may serve to discriminate contaminated soils and biological samples. Nevertheless, there is a need of standardising and adapting the methodology to the jungle conditions. We considered that this method could be a cheap alternative for the complicated and sophisticated hydrocrbon analysis. The Public Laboratory for Open Technology and Science (Public Lab) is a US-based organisation that has been working since the 2010 to develop a cheap, open source, DIY spectrometer to identify oil pollution in soil and

water, as well as a range of other possible contaminants. We will expand the current participatory monitoring of oil spills to a broaden set of physico-chemical parameters by the use of spectrometers of the Public Laboratory. However, tests need to be conducted to evaluate their reliability.

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

1.- At present we have a large video record of different species consuming contaminated soils. At least three bird species and six mammal species visit oil-polluted sites to ingest soil. All of them are game species and represent the 47-70% of the meat extracted by hunting in the region. Contrary to our expectations, the white-lipped peccary (*Tayassu pecari*) has not yet been observed consuming contaminating soils.

2.- We conducted the analysis of heavy metals in biological samples in six selected species. The criteria selection was based on the species observed consuming contaminated soils in mineral licks (*Cuniculus paca, Mazama americana, Pecari tajacu*), the aquatic habitat nature (*Caiman crocodilus*) and finally we selected one primate (*Lagothrix* spp). We also included *Tayassu pecari* because the species regularly visit mineral licks. We are just now interpreting the analysis; nevertheless, we can confirm the presence of high levels of heavy metals (cadmium, barium, lead and arsenic) in some individuals. This analysis will consider the: feeding, habitat and home range of selected species, the organ analysed (liver, kidney and heart), and the soil/sediment nature (all heavy metals may be present in contaminated and non-contaminated soils).

3.- All results have been shared to local communities and indigenous federations of the Corrientes (FECONACO) and the Pastaza (FEDIQUEP) Rivers. The federations have equally informed to the settlers of all communities (General Assemblies) and to the oil enterprise (Pluspetrol). We also accompanied the indigenous federations to meetings organised by government institutions (Organismo Estatal de Fiscalización Ambiental OEFA-Ministerio de Ambiente, Dirección Regional de la Producción de Loreto DIREPRO, Centro Nacional de Salud Ocupacional and Protección del Ambiente para la Salud CENSOPAS, Autoridad Nacional del Agua ANA, Programa Forestal de Flora y Fauna Silvestre de Loreto SERFOR, and Instituto de Investigación de la Amazonía Peruana IIAP) in the frame of the declarations of environmental emergency.

The project is strongly policy oriented and we will build on tools, strategies and results of a previous project to distribute the information generated in a policy relevant manner. This evidence (pictures and videos with GPS readings), managed by indigenous leaders and authorities, has become an essential tool in negotiations with state agencies and extractive industry companies. Although not as scientifically sound as chemical analyses, these pictures and videos turn into proof that cannot be rejected and have been used to demand impacts remediation, change of operational procedures, enhanced remediation practices or even the implementation of health care programmes.

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

We have done a great effort directed to the monitor training, considering theoretical and practical components. The training has been successful, and the monitors are using by themselves the infrared video-cameras and collecting the biological material of animals hunted in local communities. We conducted a two-step training: 1) a theoretical training of 4 days (03/05/2013-19/05/2013), in the city of San Lorenzo, with the participation of 10 monitors and two leaders of

FEDIQUEP; and 2) a practical training developed in the same indigenous communities (Jose Olaya, Los Jardines, Andoas and RN Pucacuro). All field activities (20/05/2013-23/05/2013) have been carried out with the participation of 10 FECONACO's and 10 FEDIQUEP's monitors. The field training aimed to 1) locate and record new spillages and bad practices realized by the oil company, 2) use of camera traps, and 3) collection of biological samples.

Up to the date, the available results consisting in the graphical material showing that wildlife is consuming contaminated waters and soils have been shared to local communities, indigenous federations (FECONACO and FEDIQUEP) and other NGOs involved in the zone of study (PUINAMUDT and ALTERNATIVA).

5. Are there any plans to continue this work?

Firstly, we will finished all activities included in the RSG project including the hydrocarbon analysis in all collected biological samples, and the analysis of heavy metals in the biological samples that still remain in Peru. In our work plan we included a new component, Mar Cartró, who is conducting her PhD thesis on the basis of this project.

Videos recorded in oil-polluted sites (n=6.200) are going to be analysed through a citizen science platform, which will aloud the analysis of a big amount of videos and will contribute to generate interest in many countries about one of the problems that the Amazon and its inhabitants have to face nowadays.

Remote sensing
A major challenge to investigate negative impacts of oil activities in tropical rainforests is the lack of surveillance systems to monitor activities of oil companies in these ecosystems. Remote sensing can contribute to the detection and identification of oil impacts. Today, RADARSAT-1 and ENVISAT are the two main providers of satellite SAR images for oil spill monitoring. However, most of this research has focused in the marine environment, for off-shore oil spills, ice and coastal vegetation - wetlands and marshlands, but has never been applied on oil spills monitoring in tropical rainforests. Furthermore, almost no research has been conducted regarding oil spills monitoring in onshore operations, and transport (pipelines). However, there is scope for some progress as illustrated by the use of remote sensing, specially hyperspectral imagery, to provide a basis for assessing temporal dynamics of vegetation due to air pollution stress (Hobbs, R.J. 1990), to detect stressed vegetation and mapping of heavy metal polluted soils (Reusen *et al.* 2003), or even to estimate total petroleum hydrocarbons concentrations in soils (Slonecker *et al.* 2010, Zhu *et al*. 2013).

In tropical rainforest, remote sensing has only been applied to monitor deforestation of tropical rainforests (Viña *et al.* 2004, Asner *et al.* 2005, Oliveira *et al.* 2007). However, aerial photography was already used for the qualitative detection, identification and assessment of impacts of oil activities in Ecuador (Kimerling 1991). We are working for the first-time remote sensing techniques for the detection and identification of stressed vegetation related to oil pollution in rainforests. Such methodology would be very valuable due to the remoteness and difficult access of tropical areas in developing countries.

Real time system for the oil spills monitoring
As we stated before, we are developing the use of cheap and user-friendly sensors (spectrometer kit of the public laboratory and paper nano-biosensors) by indigenous communities to obtain a system

for near real time oil spills monitoring in tropical rainforests. We will expand the current participatory monitoring of oil spills to a broaden set of physico-chemical parameters by the use of spectrometers of the public laboratory. However, tests need to be conducted to evaluate their reliability.

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

- We are facilitating the dissemination and communication of research findings with indigenous organisations, taking advantage of the fieldwork periods in the past and in the future. All results have been shared to local communities, indigenous federations and government institutions.
- Publications in peer-review scientific journals (SCI). We are just preparing one short communication expected to be published in Biological Conservation. We expect publishing at least three manuscripts in peer-review scientific journals in the framework of the project.
- Publications in IUCN journals. We published a manuscript in *The Newsletter of the IUCN/SSC Tapir Specialist Group (*Mayor P, Rosell T, Orta-Martínez M. 2014. Actividades petroleras en la Amazonía: Nueva amenaza para las poblaciones de tapir? *The Newsletter of the IUCN/SSC Tapir Specialist Group* IUCN 23(32): 26-29. INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE, ISSN: 1446-991X).
- Oral presentations in international meetings and symposiums. We presented preliminary results in the 11th International Conference on Wildlife Management in Amazonia and Latin America) University of the West Indies, St. Augustine Campus, from 17th to 22rd August 2014 in the Republic of Trinidad and Tobago. We also presented the state of art in the Petroleum Company of Trinidad and Tobago Limited (Petrotrin), the public oil company working in the Republic of Trinidad and Tobago.

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

The main project includes activities that began in the 2003, when we promoted the participative monitoring system at the study area. Nevertheless, the study on the impact of oil activities on wildlife began in the 2013, with first coordination with indigenous local communities and federations, and the previous feasibility study. RSG funds has been acting between September 2013 and February 2015, between the beginning of the executive activities directly involved in the study and the first chemical analyses. Nevertheless, as we stated previously, the scientific activities needed to determine the impact on wildlife are not yet finished, since they waste more time than expected. These activities were carried out parallel to the study of environmental pollution study, which are fundamental for the better understanding of the problem and for the estimation of the real impact on wildlife. We expect to finish the whole study in a maximum period of 2 years. The rest of components of the study of the impact of the oil activities on the integrated ecosystem (including habitat, fauna and persons, and strengthening of the system of participatory environmental monitoring) needs a major tour. We cannot define the temporary scale since we are dependent on new funds to support all planned activities.

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
Internal travels (Lima-Iquitos)	675	273	401,7	We did a great effort to reduce this waste
Stationary (pencils, paper, markers, etc.)				
Material for the sampling of biological samples from wild species	843	635	208,3	Use and re-use of materials
Bushnell 8MP HD Trophy Cam Trail Camera (n=18)	1349	1972,9	-623,6	One of our priorities. We acquired 11 Cam Trail Cameras and 25 Scandisk cards. Due to the importance of this issue, we bought 2 additional cameras
Internal travel (Iquitos-local communities): Fuel (320 gallons fuel/expedition; 3 expeditions; 1-gallon fuel=6€)	1147	361,3	785,6	We collaborated with other research groups and local indigenous federations, to reduce this waste
Food for expeditions (10€/person/day; 20 days/expedition; 3 persons; 3 expeditions)	675	61,5	613,1	We collaborated with other research groups and local indigenous federations, to reduce this waste
Field supplies (machetes, flagging tape etc.)				
Material for the post-mortem analysis				
Supplies for the determination of organic hydrocarbon compounds in fences	253		253	
Supplies for the determination of liver bioaccumulation of heavy metals		2650	-2650	Redirection of the funds saved from the interaction of other work groups to allow the improved laboratorial analysis of heavy metals
Supplies for the histopathological analyses	1012		1012	The histopathological analyses will be free charged in the laboratory of our Veterinary faculty (UAB). Biological samples are dehydrated and embedded in paraffin wax

Remission of biological samples				
TOTAL	5954	**5954**		

We could improve collaborations with other research groups and local indigenous federations, and with the laboratory in charge of the histopathological analyses. Consequently, we could considerably reduce the waste involved in expeditions and histopathological analyses. All these funds saved from the interaction with other work groups allowed the improved laboratorial analysis of heavy metals. All this change were step by step notified to RSG, and will be fundamental to assure the further analysis of biological samples which still remain in Peru.

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

Next steps on behalf the present project are:

- Publication of a short communication in a peer-review scientific journal: preliminary results of video-camera traps. Submission expected in April 2015.
- Detailed interpretation of heavy metals analysed. Expected in May 2015.
- Publication of a manuscript in a peer-review scientific journal: preliminary results of heavy metals in wildlife. Submission expected in July 2015.
- Hydrocarbon analyses of all soils from mineral licks (n=18) and biological samples shipped to Spain. Expected in July 2015.
- Statistical analysis of all video-camera traps. Nowadays we are still collecting new videos. Expected in July 2015.
- Shipment of biological and environment samples from Peru to Spain. Expected in September 2015.
- Publication of a manuscript in a peer-review scientific journal: final results of video-camera traps. Submission expected in December 2015.
- Statistical analyses of hydrocarbons and heavy metals of last samples. Expected in December 2015.

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

We used the logo of RSGF in all materials and documents in relation with the project including PowerPoint presentations and scientific related production. RSGF received some publicity during the course of our work.

- "Indicadores de salud ecosistémica". Ciencia, Tecnología, Innovación, Alternativa de Desarrollo Amazónico Sostenible, 2014. Iquitos, Perú, 23-25th October 2014.
- XICIMFAUNA (11th International Conference on Wildlife Management in Amazonia and Latin America) University of the West Indies, St. Augustine Campus, from 17 to 22 August 2014 in the Republic of Trinidad and Tobago.
- PowerPoint presentation in the in the Petroleum Company of Trinidad and Tobago Limited (Petrotrin), the public oil company working in the Republic of Trinidad and Tobago, 20th of August 2014.

- Mayor, P., Rosell, T., Orta-Martínez, M. 2014. Actividades petroleras en la Amazonía: Nueva amenaza para las poblaciones de tapir? IUCN, 23(32): 26-29. INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE, ISSN: 1446-991X.

The RSGF logo will be included in further manuscripts included in the framework of the project.

11. Any other comments?

We want to apologise for the delay caused in the planned activities. Unfortunately, we suffered considerable delay in the shipment of biological samples from Peru to Spain, due to the difficult coordination between both state institutions. On the other hand, we collected a greater sample collection and graphical video records than expected. The analysis of the additional material will improve the scientific quality of our study. In its turn this fact has multiplied all our time-effort. Thanks to RSG's flexibility and collaborations with other institutions we could re-adapt the previous budget and we could optimize our funds. This fact forced us to delay all deadlines but allows us to improve to a great extent the quality of the project.