

The Rufford Foundation

Final Report

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.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	André Costa Pereira
Project title	Land use effects on demographic performance of <i>Caiman crocodilus</i> in the Araguaia floodplain
RSG reference	23971-1
Reporting period	6 th April 2018 – 6 th April 2019
Amount of grant	£5000
Your email address	rancoper@gmail.com
Date of this report	27 th April 2019

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
Perform sampling for data collection of tissue, biometric data, and abundance				As scheduled, fieldwork took place between July and September 2018.
Perform preparation of tissue samples for isotopic analysis in the laboratory				Laboratory work took place between October 2018 and December 2019.
Obtain all isotopic data (stable isotope carbon and nitrogen quantification) from CENA/USP Laboratory				We are maintaining constant communication with CENA/USP. The perspective of isotopic analysis completion is June 2019.
Assess the effects of intraspecific variation (sex, ontogeny) on the trophic niche in a temporal scale of <i>Caiman crocodilus</i> in an agricultural landscape				Although not planned, previous fieldwork and analyses allowed verifying the isotopic ecology of <i>Caiman crocodilus</i> in an agricultural landscape. These findings will support the next results.
Model the relationships between suitable landscape features and indicators of demographic status (trophic niche, body condition, abundance)				We are carrying out the analyses of demography data (trophic niche, body condition, abundance) and preparing manuscripts. As scheduled, these objectives are in time (January–September 2019)
Communicate to and discuss with public and stakeholders on our findings on the assessment of impacts of different land uses upon wetland biodiversity				Planned activity to be done between December 2019 – June 2020

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

Until now, our planned activities were successfully carried out. However, we are waiting for isotopic data from CENA/USP Laboratory to analyse and assess the effects of land use on the trophic niche of *C. crocodilus*. Further analyses (abundance and body condition) are being performed.

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

Previous fieldwork and analyses allowed verifying the isotopic ecology of *Caiman crocodilus* in an agricultural landscape. We presented these findings at the 25th Working Meeting IUCN-SSC Crocodile Specialist Group, Santa Fé, Argentina. 2018.

- *Caiman crocodilus* had a diverse and relatively invariable diet over time, as inferred from stable isotope ratios. Impacts of human land use can cause homogenisation of resources, lower prey diversity, and consequently invariable isotopic values of *C. crocodilus* over time.
- High niche redundancy between habitats. However, $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ varied significantly between habitats. This between-habitat variation in stable isotope ratios and high niche overlap suggests a trophic dynamic resulting from movement patterns across interconnected habitats, more frequent opportunistic foraging in terrestrial and aquatic environment, or human influences on the ecosystem.
- Females had higher variability in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ and larger niche width than males. Presumably, differences in foraging and habitat use patterns lead to wider niches in females, despite both sexes feeding in similar trophic levels.

Although we are performing the body condition data, our initial results demonstrate that SMI - scaled mass index (a body condition index from Peig and Green, 2009, doi: 10.1111/j.1600-0706.2009.17643.x) are influenced by habitat type and landscape metrics in regional scale (buffer of 20 km) that are cohesion of water body and native vegetation, and nearest neighbour distance of water body. Our current interpretation indicates that habitat features reflect prey diversity and abundance. Human-made habitats, like ponds and ditches, can provide lower prey abundance to crocodilians due to anthropogenic disturbance of agricultural and livestock practices, as a consequence it harms the body condition of *C. crocodilus* and its abilities to survive. Additionally, regional features of native vegetation and water body connectivity has high implications for crocodilians persistence and wetland biodiversity. Fragmentation and native vegetation loss may reduce habitat suitability for wetland biodiversity increasing agricultural area and hostility of matrix, reverberating on prey availability and habitat suitability for *C. crocodilus*. To improve quality and suitability of landscapes for *C. crocodilus* and wetland biodiversity are necessary management practices in agricultural landscapes that allow more connectivity among forest patches and among water bodies, and consequently an increasing number of forest patch and water bodies.

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

We considered the involvement of local communities successfully until now. Before starting the study (from 20-25 February 2018), we travelled to the study region to select study sites in many municipalities of Tocantins (Formoso do Araguaia, Pium, and Lagoa da Confusão), and ensure logistic support from landowners, agricultural cooperatives, indigenous leadership, and managers of PARNA do Araguaia (in Pium, Tocantins). We met individually with stakeholders mentioned above (17 individuals; Figure 1) to explain the aims, scope, and schedule of our project, and its

importance for the conservation of caiman populations and ecosystems of the Araguaia floodplain. All of these meetings were very successful, with the people representing institutions and diverse segments of the local society being receptive, interested, and supportive.

During the study, all stakeholders mentioned above had a commitment, support, and interest, including some unforeseen difficulties that arose during the fieldwork were solved with help them. However, our project is not concluded, just with preliminary results. There were no specific immediate benefits for local communities from fieldwork activities of this project only. We will have further meetings to present and discuss our findings, and how they can be used to improve current land use practices in the region. We are confident we already started a dialogue that will promote confidence between our team and these different stakeholders towards effective engagement for conservation.



Figure 1. Meeting with an environmental leader (superior left), manager of Unidade Regional do RURALTINS - Instituto de Desenvolvimento Rural do Estado do Tocantins and COPERJAVA - Cooperativa Agroindustrial Rio Formoso Ltda (superior right), indigenous leadership (inferior left), and COOPERFORMOSO - Cooperativa Agropecuaria Rio Formoso (inferior right).

5. Are there any plans to continue this work?

After 1 year of development, our project has not concluded yet. This final report provides an evaluation and monitoring of activities. We are performing statistical analyses for body condition and abundance status, but waiting for isotopic data from CENA/USP. As the project schedule, we will finish the study between December 2019 – June 2020. Our plans include future activities involving public and stakeholders with the goal to enhance the science-society relationship and public engagement for wildlife conservation.

Our plans to continue this work are:

- To sample more areas under different land uses along Araguaia floodplain, adding more data and providing robust inference and evaluation of land use impact on wetland biodiversity and ecosystem functioning of the region.
- To investigate food web related to paddy crops and livestock, which retains prey for *C. crocodilus* in human-made water bodies. Implications of this assessment could elucidate the energetic contributions of crops (rice, soybeans) for wetland biodiversity.
- To investigate land use effects on the physiological and immunological indices of *C. crocodilus*, supposing that crocodylians in anthropic habitats face numerous stressors such as food deprivation, toxicant exposure, infection, and parasites. Such stressors may reduce fitness and survival.

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

We are currently working on manuscripts of the study, which we intend to submit to an international peer-reviewed scientific journal with an impact factor that suggests many will access the research results.

One of our objectives is “communicate to and discuss with public and stakeholders”, planned to achieve between December 2019 – June 2020. We intend to disseminate our results in popular media (local newspaper), media and virtual social networks, as well as forward recommendations to interested agencies/institutions/agencies. We will promote public engagement with science (Dudo & Besley, 2016, doi: 10.1371/journal.pone.0148867) through participation, dialogue, and exchange of experiences between scientists and local society, increasing public understanding and empathy with science and its application in society. Target audiences are public schools, indigenous villages, agricultural cooperatives, landowners, non-governmental organisations, state and local agencies and organizations. These are crucial stakeholders in the implementation of land management, agricultural investment policies, indigenous policies, and biodiversity conservation in the state of the Tocantins, capable of supporting actions to conserve and improve environmental policies for biodiversity and ecosystem services.

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

All resources from the grant were used for fieldwork and isotopic analyses from July 2018 to January 2019. The Rufford Foundation funded and made feasible the project as a whole.

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.

The real exchange rate was £ 1.00 = R\$ 4,8219; the value used by Banco Central do Brasil in the day that I safely received the grant (May 02, 2018).

Item	Budgeted Amount	Actual Amount	Difference	Comments
Boat rental	1368	1149	-219	Boat rental included expenditures related to boat, motor, and pilot by 20 days, costing £ 57.45 per day.
Food	548	643	+95	Food comprised expenditures for three researchers by 90 days with cost to £ 7.15 by day
Fuel	1048	1230	+182	The fuel costs related to fieldwork displacement (1,256 liters). Diesel consumption of 1 liter per 10 km with the petrol price of £ 0.98 per liter during the fieldwork.
Laboratory supplies	82	111	+29	We had to purchase 11 liters of liquid nitrogen during fieldwork to store tissue samples.
Field supplies	505	505		
Travel tickets		93	+93	We had to purchase travel tickets (Nova Xavantina/MT → Brasília/DF and Brasília/DF → Nova Xavantina/MT) for a fieldwork assistant before and after the fieldwork activities.
Isotopic analysis	1449	1269	-180	-
Totals	5000	5000		

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

We are going to finish the analyses and apply the objective “communicate to and discuss with public and stakeholders.” However, we visualise and establish new possible goals to project, with the focus to new areas, especially to physiological and immunological conditions. This approach succeeds findings of body condition of *C. crocodilus*.

Crocodylians in the anthropogenic environment can suffer much disturbance and face numerous stressors. Human disturbance alters endocrine and immune

responses, affecting individuals in its behavior, digestive processes, immunosuppression, pathogenic exposure, growth, reproduction, and genetic responses with consequences to population viability associated to decreasing fitness-related immune measures (French et al., 2018, doi:10.1093/icb/icy052). To investigate effect of stressors on crocodylian physiology and immunity, indices related to white blood cells counts, natural antibody levels, and plasma corticosterone are applicable and replicable (Finger et al. 2015, doi:10.1111/jzo.12513; Moleón et al. 2018, doi:10.1016/j.ygcen.2015.01.023; French et al., 2018, doi:10.1093/icb/icy052). This information provides more ecological knowledge about land use impacts and human disturbance on *C. crocodylus* and consequently wetland biodiversity.

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

Yes. We participated in the 25th Working Meeting of the Crocodile Specialist Group (CSG/SSC/IUCN) in Santa Fé, Argentina, with an oral presentation as an initial result of the first collections. We provided the abstract and presentation in Project Updates (https://www.rufford.org/projects/andré_costa_pereira) for divulgation.

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

Member	Role in the Project
André Costa Pereira	Applicant and project coordinator
Guarino Rinaldi Colli	Advisor (sample design, statistical analyses, supervision, additional funding)
Gabriela Bielefeld Nardoto	Co-advisor (sample design, stable isotope analysis interpretation, additional funding)
Tiago Borges Kisaka	Laboratory assistant and stable isotope analysis interpretation
Bruno Araújo de Souza	Fieldwork assistant
Humberto Coelho Nappo	Fieldwork assistant

12. Any other comments?

We would like to thank The Rufford Foundation for the opportunity and trust. We hope that the foundation can support us in future projects, we intend to continue the project, sampling more areas and investigating other factors that affect crocodylians and wetland biodiversity. To acquire more ecological knowledge can provide convincing and critical information for promoting the sustainable use and public engagement, mainly by landowners and managers of protected areas, optimizing the land use and multiple uses of water supplies in the Araguaia floodplain, to contribute to the sustainable development of the region.

