

Final Evaluation Report

Your Details	
Full Name	Tainara Venturini Sobroza
Project Title	Sounds, Cities and "Savins": the effect of acoustic environment in the pied tamarin (<i>Saguinus bicolor</i>) communication behaviour in Manaus, Amazonas, Brazil
Application ID	24762-1
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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
Twelve groups of pied tamarins from both fragmented and non-fragmented areas will be sampled during this survey.				Nine groups of pied tamarins were followed. The groups took from 2-4 months to habituate to the bait we used in the traps. Thus, it was not possible to capture and follow one group per month as expected. A 10 th group was captured and received a radio collar, though the animals damaged the antenna, and equipment stopped functioning. Soon after, the COVID pandemic exploded, and I had no access to one of the reserves anymore.
Each group will be followed for ten full days.				All nine groups were followed for 10 full days each.
During the day, every 15 minutes, a GPS point, behavioural data (estimating all occurrences of long calls and scent marking), and a sound recording will be made.				Pied tamarins are very active and quickly shift behaviours, so I changed the sampling interval to 10 minutes, leading to 2058 behavioral samplings.
Immediately following the ten days of behavioural data collection, I will collect data concerning study-site environment acoustics (ambient noise).				I collected information about the soundscape of 78 randomly selected points inside the pied tamarins' home ranges.
This information will be used to produce an acoustic map of each study area using fixed density kernel analysis.				I changed the method and decided to use the raw data in my analysis to avoid including errors associated with modeling in my final results. In the future, I expect to do such maps, but including other relevant variables for

				sound propagation such as vegetation structure, relief, and other landscape features.
Fruiting trees used by tamarins will be marked and counted, and the number and location of fruiting trees will be controlled in the statistical analysis.				I changed the method because I would probably be biasing my sampling if I only marked the feeding trees to estimate fruit availability. Thus, I collected information about the fruit availability in 78 randomly selected plots of 10 X 10 m inside the pied tamarins' home ranges. I accounted for the fruits on the floor in such plots, which varied from 0 to 965 fruits.
I will analyze the recorded sounds with project collaborator Jacob Dunn.				I analysed the acoustic features (dominant frequency, lowest frequency, duration, and syllable repetition rate) of 520 pied tamarin calls from five forest fragments and a continuous area.
Publish at least two academic articles in international scientific journals.				I have written both manuscripts, but they still need some refinement before submitting them to good journals.

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

During this project I learned that the unlikely can happen, and we must be resilient, patient, and keep going. For example, during my fieldwork: 1) I was run over by a motorcycle and had to postpone one of my fieldwork trips; 2) I lost my microphone in the field; 3) the animals damaged more than one radio collar; and the most unlikely thing, 4) one single *buriti* fruit fell on my sound level meter while estimating noise breaking the equipment instantaneously. I had to import another of such equipment from UK, which took a while. Then, Covid happened. Fortunately, I did not lose close parents or friends, but I believe this event shook everyone on some level. Before Covid we were baiting a group from a pristine area for 5 months; we captured them but the animals removed the radio collar's antenna. We stopped fieldwork because of Covid but when the numbers of cases dropped we started fieldwork again. After 2.5 months of baiting they were ready to be captured though it was not possible because the number of Covid cases increased again and the reserve closed. In Manaus, the situation was critical. Thus, after some months of trying, I understood that it would be better (and safer) to work with the data I had so far. If I had to advise others, it would be to work collaboratively. I believe that I could only collect a sufficient amount of data before Covid exploded because I had the support of my laboratory colleagues and supervisors.

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

The three main results with this project correspond to the answers of the research questions that were the core of doctoral thesis. In my research I wanted to understand how the noise of a city of 2 million people affected the communication behavior of the pied tamarin.

First, related to the vocal activity of pied tamarins, I found that the call occurrence (i.e., if the long call occurred or not) was positively related to noise levels. In contrast, the calling rate (i.e., the number of long calls) did not differ in response to noise. Possibly when faced with intense noise tamarins emit a single call and move to quieter areas of their range. Indeed, pied tamarins used quieter areas of their home range more intensely, although this pattern occurred only in places where the number of fruits was high.

Second, when analysing specific acoustic features, I found that frequency features of calls (dominant frequency and lowest frequency) did not change in response to environmental noise nor did call duration. However, syllable repetition rate (number of syllables/call duration) decreased with increasing noise levels. That meant that pied tamarins emitted slower long calls with more time between syllables or more prolonged syllables. A longer inter-syllable duration could allow pied tamarins to call in short periods of silence. In contrast, a longer syllable could also be beneficial as it would facilitate detection by receivers.

Finally, an interesting finding is that pied tamarins scent-marked more often when noise amplitude was higher. This observation suggests that multimodal signals may enhance effective communication. Though the number of long calls did not decline significantly in noisier areas, these observations do not indicate a multimodal shift as previously predicted. This study represents the first time an ecological effect on multimodal communication has been reported for a Neotropical primate. Summoning these results, we found a good scenario for conservation as pied tamarin individuals are likely to cope with city noise and communicate effectively.

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

During my data collection, more than one field assistant helped me to collect the data. All of them were unemployed biologists with a bachelor's or master's degree. Unfortunately, in Brazil, it is getting harder and harder to get ourselves jobs in our expertise areas, especially if they are related to science and conservation. So, I believe that somehow, I also helped these highly qualified biologists who were still struggling to pay their bills, a category that I currently include myself in.

Jointly with two young female researchers, Giulliana Appel (also a Rufford grantee) and Lídia Martins, I am engaged with elaborating a digital interactive book that will be freely available for children from public schools of Manaus. The book aims to educate children and their parents on the importance of forests in urban areas and how the city impact wild animals. I believe this production will also benefit the

communities by highlighting how behavioural changes (e.g. planting trees, driving safely, etc.) can benefit both humans and wildlife.

During this period, I also taught undergraduates about using sounds for ecological studies, and I tutored two young undergraduate girls; one is now doing her master's in the area. Qualified human resources are limited in the Brazilian Amazon. Hopefully, this experience will inspire and qualify them to enter the job market of the region.

Further, my project added to strengthen the capacity of Pied Tamarin Project (Projeto Sauim-de-Coleira, UFAM) to collect data cooperatively. Capture procedures of primates are not trivial because it often takes several months of personal and monetary engagement to habituate them to feeding platforms where the capturing occurs. During this study, my personal and financial help also contributed to other ongoing projects, such as a master's degree evaluating the health of these wild tamarins.

5. Are there any plans to continue this work?

Yes. The next steps of the project will be:

- Submit two papers to international journals.
- Submit proposals to post-doctoral opportunities and keep on researching the impact of soundscapes on wildlife.
- Analyse the frequency features of soundscapes of pied tamarins ranges.
- Conduct experiments to understand how noise propagates in forest fragments according to the vegetation structure, relief, and abundance of nearby planar surfaces.
- Evaluate the potential of certain tree species as barriers to sound propagation and habitat connectivity.

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

I intended to present my results in at least two scientific articles. I wrote both manuscripts that are part of my thesis defended in November 2021. Happily, I will also present my results in a poster at the Student Conference for Conservation Science at Cambridge in March 2022. I also intend to present my results in future International Primatology Congress (IPC). In 2019, I was selected for the Pre-Congress Training in Conservation which would also warranty access to IPC and cover my travel expenses to participate in the event. Due to Covid, the event was postponed, and PCTP was cancelled. I have already made several local talks and participated in the National Geographic Sciencetelling Training, and my video was exposed in the NG virtual platforms.

PhD Thesis

Tainara V. Sobroza. (2021). Sons, cidades e saúns: efeitos do ambiente acústico no comportamento de comunicação do Sauim-de-Coleira (*Saguinus bicolor*). PhD

Thesis. Posgraduate Programme in Ecology. Instituto Nacional de Pesquisas da Amazônia.

Talks

- Sounds, cities and savins: acoustic ecology of amazon tamarins. Ciclo de palestras PET-Bioogia UFRR, online (09.08.2021).
- Ecology and conservation of na amazonic primate species: the pied tamarin. Palestra no I Webnar de Ecologia e Evolução, Universidade Estadual de Feira de Santana, online (27.11.2020).
- Sounds and cities: strategies used by primates to deal with city noise (Ciclo de palestras do Projeto "Que mico é esse?") (15.06.2020).
 (all talks in Portuguese)

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

I used the Rufford grant for equipment acquirement mostly in 2018 but also in 2019 after I lost one microphone in the field, and a sound level meter was damaged. Also in 2019 and 2020 I use the remaining of the grant to do the fieldwork. Fieldwork expenses included the costs with fuel for the sampling areas, bananas for baiting the pied tamarins, food supplies for the staff that was habituating pied tamarin, and especially with the payment of a field assistant that made the telemetry during the study.

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
Field assistant	3907	3800	-107	Source: Rufford Foundation and National Geographic Grant
Sound Level Meter	982	1177	+195	Source: Rufford Grant
Sub-total	4889	4977	+88	
Field assistant	122		-122	Source: National Geographic Grant
Radio-Collars	1345	210	-1135	We only made repairs and changed the equipment's batteries. So the costs were smaller than buying new equipment. Source: Rufford Foundation.

Antenna	90		-90	We used the antennas that we already had in the laboratory
Receptor	600	733	+133	Source: Rufford Foundation
Batteries	44	35	-9	Source: Rufford Foundation
Batteries 9V	29		+29	
Microphone	344	392	+48	Source: Idea Wild and International Primatology Society
Headphone	217	59	-158	Source: Rufford Foundation
GPS	463		-463	Source: Idea Wild
Binoculars	247		-247	Source: Idea Wild
Wood for building the feeding platforms	94	33	-61	Source: International Primatology Society
Bananas for habituating animals for capture	137	471	+334	Source: Rufford Foundation and National Geographic Grant
Food supply for two people	1771	274	-1497	Feeding costs were included in the daily payment for the field assistant. A small amount was used for the period that we were baiting pied tamarins in a pristine area, so the staff slept and ate at the reserve. Source: Rufford Foundation and National Geographic Grant
Transport to the sampling areas	298	110	-188	Source: International Primatology Society
Alcohol, Masks and disposable vests		70	+70	These items were included to improve safety of fieldwork activities and capture animals during the pandemic. Source National Geographic Grant
Sub-total	5801	2387	+3414	
Total	10690	7364	+3326	Currency exchange rate (in 2019): 1 British Pound = 5.7 Brazilian Real.

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

My personal goal is to continue in the academy and keep on researching ecoacoustics. Unfortunately, the opportunities in Brazil for scientists are scarce, but I still hope to get a post-doc position and be able to work teaching and tutoring young scientists. If this is possible, the following steps of this project will be to:

- I. Conduct experiments of sound propagation to understand how noise propagates in forest fragments relative to vegetation structure, relief and planar surfaces from the city.

- II. Evaluate the potential of certain tree species as barriers to sound propagation.
- III. Elaborate a proposal for increasing connectivity of pied tamarin habitats considering vegetation that is also optimal to mitigating noise.
- IV. Analyse additional data from the soundscape of pied tamarin ranges (ex. Frequency aspects of noise).

In addition to that, I aim to finalise the interactive book about the urban fauna of Manaus and make this book available to children of public schools. To do that, It will be necessary to articulate with the public sector and divulge the book to teachers. So I would like to do a series of workshops with teachers to exchange experiences and show how the book can be used at schools.

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?

I used the Rufford Foundation logo at the end of my presentations (in an acknowledgment slide) during talks to universities and the presentation for my Ph.D. defense. Also, I was selected to present a poster at the Students Conference in Conservation Science (SCCS) that hopefully will happen in March 2022. In this case, I also intend to use the RF logo to highlight the agency's importance for my data collection and personal growth. I will also thank RF in my future papers, as I already did in my written thesis.

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

Tainara Venturini Sobroza - Principal investigator of the project. I was the main responsible for all the phases of the project (Conceptualization, funding acquisition, methodology, field expeditions, investigation, ultrasound identification, statistical analysis, visualization, evaluation report writing, paper writing, and editing).

Adrian Paul Ashton Barnett – Tainara's PhD advisor. Contributing with the project in: Supervision, conceptualization, methodology, field expeditions, investigation, statistical analysis, visualization, paper writing, and editing.

Marcelo Gordo– Tainara's PhD co-advisor. Contributing with the project in: Supervision, logistics, fieldwork, pied tamarin captures, additional funding, investigation, conceptualization, paper writing and editing.

Jacob C. Dunn– Tainara's PhD co-advisor. Contributing with the project acoustics and statistical analysis, investigation, conceptualization, paper writing, and editing.

Caio Fábio Pereira – Biologist, field assistant that accompanied me in 90% of field activities.

12. Any other comments?

I want to show my appreciation for receiving Rufford's grant; this project would not have been possible without your support. Rufford has a fantastic reputation with conservation projects, and I feel honored that I was granted too. For the past few years, Brazilian researchers have seen the investments in science dropping down. Conservation is often not a priority for decision-makers, despite the urgency to act not to lose our diversity. Rufford has allowed many of these conservation projects to keep working and making a difference. I hope my contribution does too. Thank you so much for the trust!