

Final Evaluation Report

Your Details	
Full Name	Valentín Zárate
Project Title	Conflict mitigation of primates damaging tree plantations: the case of black capuchin monkeys, <i>Sapajus nigritus</i> , in the Atlantic Forest of Argentina
Application ID	31343-1
Date of this Report	8/2/2023

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
<p>Study the trophic ecology of capuchins living in forest plantations to understand the causes of pine bark-stripping behaviour.</p>				<p>We studied the phenology of 416 trees and lianas of 52 different species to assess the seasonality of food availability. Phenology surveys were carried out twice a month and began in June 2021 and will end in June 2023 (36 censuses so far). We detected two fruit ripening peaks: late summer - early fall (February-April) and spring (September-November). We are going to combine these data with measures of forest structure to estimate an index of food availability (Agostini et al. 2010). We carried out 14 monthly samplings of the intensity of bark-stripping of pines by capuchin monkeys. For this purpose, we marked and surveyed 2000 pines within the home ranges of four groups of capuchins. Our results showed that capuchin monkeys bark-strip the pines more frequently at the end of winter and beginning of spring when native food availability is low, and phloem and sap becomes abundant in the inner bark of pines (see next paragraph), supporting our hypothesis (Di Bitetti 2019). These surveys will be completed in November 2023.</p> <p>For 14 months we monitored the seasonal variation of the force necessary to peel off the bark and the thickness of the phloem of the pines. So far, the results showed that during late winter and the beginning of spring (July-September), the bark is easily removed and the phloem is thicker, providing further explanation of why capuchins consume more pine phloem during this period. We started to follow two groups of capuchins to study their foraging</p>

			behaviour. However, the individuals were very difficult to follow and study, probably because they were not habituated to researchers, so this activity has been delayed (see unforeseen difficulties below).
2. Study spatial ecology of capuchins that live in pine plantations landscapes.			We fitted 12 capuchins of six groups with GPS-VHF collars. Captures were successful and safe; all individuals recovered well. So far, we have recovered the data from two collars for which we have performed movement analysis. However, we also used the VHF emissions to locate the groups 3-5 times a week over 6 months to estimate their home ranges and core areas. These preliminary results showed that home ranges are more than twice bigger than those estimated in nearby Iguazú National Park (Di Bitetti 2001), and core areas are almost exclusively concentrated on the remaining native forest fragments.
3. Test the effectiveness of the diversionary feeding technique to reduce bark-stripping of pine trees by capuchin monkeys.			We successfully conducted the experiments with four groups of capuchins living in a landscape of pine plantations. During the spring of 2022 we installed five groups of three platforms per group and baited them with bananas daily. Capuchins visited the platforms 5 to 7 days a week, and, as expected, we detected less pine bark-stripping in the experimental groups than in the control groups (those without platforms). The GPS collars are still attached to the individuals. Once we retrieve them, we will be able to analyse how the capuchins' use of space has changed because of the experimental treatment.

2. Describe the three most important outcomes of your project.

a). Capuchins consume more pine phloem in late winter and early spring, which coincides with the beginning of one of the peaks of fruit ripening. During this period, the bark is easier to remove, and the phloem is thicker, which suggests that phloem profitability is an important factor in explaining why they consume pine bark when other native resources are available. We are planning to contrast the results of the nutritional analysis to check if they also support this pattern. These results are

important to understand the factors that affect crop raiding in primates and to design mitigation techniques, such as diversionary feeding, which intend to reduce bark-stripping and ultimately protect capuchin populations.

b). We estimated the home range and core areas of six capuchin groups living in pine plantation landscapes. We found that home ranges are 2.74 times bigger (mean = $441,92 \pm 85,32$ ha) compared to those estimated for groups living in a continuous native forest (161 ± 77 ha, Di Bitetti 2001). The larger size of capuchin home ranges in plantations landscapes suggests that the carrying capacity of these anthropogenically modified habitats is low compared to that of the native forest. Furthermore, we found that the native forest remnants within the plantations are heavily used by capuchins, and comprise their core areas, even though they represent a small portion of their home ranges (38%). This suggest that forest remnants are key to the subsistence of capuchins in these productive landscapes.

c). The first season of the diversionary feeding experiment was conducted successfully. Although we do not have the information stored in the GPS collars, we have two indicators of success: 1) bark-stripping was lower in the pine stands of the experimental groups in comparison to the control groups, and 2) we recorded capuchin visits to the feeding platforms, located in native forest remnants, almost every day (5 to 7 days a week) and confirmed that they heavily used these areas, located away from susceptible pine stands during the experimental period (late winter and early spring). Although still incomplete, these preliminary results indicate that this technique could be applied to mitigate the conflict that arise because of primate crop raiding and bark-stripping trees in plantations, a conservation problem spread in many countries (Di Bitetti 2019).

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

The biggest setback was undoubtedly the COVID-19 pandemic, which delayed captures of capuchins and difficulted the logistics to work efficiently in our study area (for example, a maximum of two people per field vehicle was allowed). However, once the situation stabilised, in June 2021, we were able to carry out all the activities as planned.

We also had some problems when purchasing equipment abroad. All equipment purchased abroad must pay 65% tax on its value plus the import costs. The permissions to avoid paying these taxes for when acquiring equipment that is destined to research require a series of burdensome regulatory procedures that usually take several months. These procedures delayed the beginning of part of the study.

We also have a lot of theft events in the field, mainly targeting the feeding platforms. Before the captures of capuchins, it is necessary that they have a constant and continuous process of habituation to the platforms and traps, so the thefts of these equipment (25 platforms were stolen for 13 months) were a significant setback to our project.

Another difficulty was the recovery of the GPS-VHF collars. Since a drop-off system was not available for the GPS collars used (due to the size and weight of the capuchins), during the design process of the equipment, the company (Telonics Inc.) recommended us to use a passive breakaway system. Unfortunately, this system has lasted longer than expected (approximately 4-6 months), so we still do not have all the collars and thus the information stored in them. Considering that the captures were successful and apparently harmless to the capuchins, we are planning to recapture the collared individuals to retrieve the GPS collars. However, it is not being easy to recapture the targeted individuals.

A third difficulty was the study of the capuchins foraging behaviour. Individuals were not used to researchers; they could have even had bad experiences with humans (there are poachers in this area). So, the capuchins were difficult to follow continuously, and their behaviour was probably conditioned by our presence (for example, they might choose to run away or exhibit aggressive displays instead of eating an important resource (such as *Psidium guajaba* or *Syagrus romanzoffiana* fruits). We took advantage of this scenario and, together with an Italian researcher (Sara Petracchini), we collected behavioural and physiological data (corticosteroids in faeces) related to the habituation process of these groups. Sara will compare this information with that collected from well habituated capuchin groups living in the Iguazú National Park. Now, we can follow the groups more consistently, we are starting to collect data on their feeding behaviour, and we expect to have a full year of data by the end of 2023.

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

This project provided job opportunities and academic training to people from the local communities. For example, the participation of members of the local Mbyá-Guaraní community was crucial to study capuchins in a new area. They collaborated opening trails, monitoring capuchin groups and setting feeding platforms. In addition, in this project we involved three students from the University of Misiones, Argentina, to help with field activities and participate to seminars. Tamara, Gisel and Ivana acquired scholarships granted by the National Interuniversity Council (CIN). This allowed them to have a first approach to the field of research in ecology and conservation of species; Tamara and Gisel will start their PhD in April 2023 on issues associated with conservation. In addition, so far, we have involved five students from different regions of Argentina, who helped with the field activities during 3-month periods. On the other hand, the project allowed us to interact fluidly with one of the largest timber companies in Argentina (Arauco Argentina S.A.). It was a great achievement that a large-scale multinational company has shown interest and support to find a solution to bark-stripping conflict that does not threaten capuchins. This experience and our results obtained in Arauco's plantations will be shared with small local producers. This will improve their production gains (capuchins can intensively damage a large percentage of their plantations) while at the same time reducing practices that threaten black capuchins (e.g., retaliatory killing of monkeys).

5. Are there any plans to continue this work?

This project is the first approach to study black capuchin monkeys in forest plantation landscapes in Argentina. This has brought the possibility of involvement of new students and volunteers interested in primate ecology and conservation. It has also strengthened the relationship with one of the most important timber companies of Argentina (Arauco Argentina S.A.), so this collaboration offers a wide range of possibilities. The species have been extensively studied in Iguazu National Park (Janson et al. 2012) and comparisons with this new study area (a human modified landscape) may provide crucial information for primate conservation. This project is generating information and facilitates the collaboration with new projects in this study area. For example, in 2022 a colleague, Lara Torge, started a PhD project in which movement data of capuchins collected from this project will be associated to seed dispersal in pine plantations landscapes. The susceptibility of pine stands to capuchin bark-stripping and how producers perceive this production problem will continue to be studied for the next years by a member of our team (Paula Tujague). Another line of research and PhD thesis that my advisor and Clara Scarry are developing is on the effect of the landscape of fear on capuchin behaviour. One of the most important aspects of this landscape of fear is the structure or architecture of the forest. Since the structure of pine plantations is very different from that of native forests, our study area will be used as part of these studies soon.

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

The results of our work will be disseminated among different stakeholders and, particularly, among timber companies and NGOs that promote the responsible use of forests and natural resources (e.g., Forest Stewardship Council [FSC], which has a local office in Puerto Iguazú). We can achieve this aim because we have a good relationship with chief staff of the main forestry companies that manage pine plantations in northern Misiones, among them with Arauco Argentina S.A., and Pindó S.A. These two companies are interested in our work and willing to receive suggestions on how to improve management. Thus, we will share with them the results of our work, mostly as technical reports that we will produce based on the results of this project. We will also engage with policy- and decision-makers to discuss and promote primate conservation strategies. Since we started this project, we have made four technical reports for Arauco Argentina S.A. in which we detail the scenario of black capuchins in their territory and provide information about the reduce bark-stripping behaviour without harming capuchins.

Our Iguazú-based NGO CeIBA (Asociación civil Centro de Investigaciones del Bosque Atlántico; <http://ceiba.org.ar/proyectos/proyecto-cai/>) is active in promoting outreach and communication activities to the general public, thus we will use all of these means to disseminate our results. For example, it usually produces a newsletter, *Conservación en Práctica* (Conservation in Practice), focused on special topics (e.g., <http://ceiba.org.ar/conservacion/>), one of which would be focused on this project. CeIBA and the regional (northeast) office of CONICET also produces series of talks and interviews based on the research conducted by scientists of our institute. Our institute also produces news, press releases and notes that are posted in their web sites (e.g., <https://nordeste.conicet.gov.ar/mutaciones-del-adn-de-los->

monos-caraya-rojos-podrian-haberlos-salvado-de-la-fiebre-amarilla/). This news and press releases are later reproduced by mass media, which usually contact researchers for newspaper, TV (e.g., Iguazú News interviews, <https://www.facebook.com/watch/?v=368522901377805>) or radio interviews (e.g., "Con Tonada Científica" (https://www.youtube.com/watch?v=Ws4ePyB_c&ab_channel=ConTonadaCient%C3%ADfica))

In the academic sphere, I will publish the results of this project as a doctoral thesis, and at least three chapters will be published in high impact conservation journals. In November 2022 we have presented results on the home ranges and core areas of black capuchins on pine plantations at the "XXXIII Jornadas Argentinas de Mastozoología" (XXXIII Mastozoological Meeting). Also, we may be presenting (if the proposal or the symposium is approved) results of this project in a symposium at the International Primatology Society Congress (August 2023) entitled Measuring Sustainability Targets in Primatology.

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

The next step is to continue with the collection of feeding behaviour data, which will end in June 2024. At the same time, we will finish measuring the seasonal variation in the thickness of the pine phloem, the force necessary to peel the bark and the intensity of bark-stripping by capuchins. In addition, we will continue to recover the GPS-VHF collar that capuchins, hopefully before June 2023. After this, we will have all the data to test our hypothesis about the causes of capuchin's bark-stripping behaviour and to study capuchin's landscape use and movement ecology. In addition, it will allow us to test the effectiveness of the diversionary feeding technique as a solution to the conflict between capuchins and timber companies. Results will be published in peer-reviewed journals and presented at conferences. Another important step forward will be to produce a protocol that can be applied to mitigate the conflict that exists between primates and foresters around the world.

We hope to establish a long-term study area in productive landscapes of north-eastern Argentina, as was done and continues to be done in the nearby Iguazú National Park (Janson et al. 2012). Comparison of these two scenarios will allow us to address many conservation issues that black capuchins (and other primates) are increasingly facing.

8. 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, I used the logo when I presented my work at the "XXXIII Jornadas Argentinas de Mastozoología" (XXXIII Mastozoological Meeting), organised by the CeIBA and IBS (Instituto de Biología Subtropical), in Misiones province, Argentina, in November 2022. The logo also was used in seminars within my institution. I will use the logo and recognition to Rufford Foundation support in all the upcoming materials, such as scientific publications, presentations in National and International Congresses and in social media.

9. Provide a full list of all the members of your team and their role in the project.

Valentín Zárate. Team leader. Member of CelBA and PhD Student at the IBS.

Iara Torge. Field assistant. Member of CelBA and PhD Student at the IBS. She is studying the ecology of seed dispersal by black capuchin monkeys that live in plantation landscapes.

Sara Petracchini. Field assistant and leader of the project of habituation process of black capuchins that live in plantation landscapes.

Fermino Silva. Field assistant. Members of the local community Mby'a Guaraní. He has worked with Proyecto Caí for more than 20 years. Fermino has great experience collaborating in studies on capuchins behaviour and ecology and has helped opening trails, searching for capuchins groups and setting the feeding platforms.

Damián Silva. Field assistant. Member of the local community Mby'a Guaraní.

Celia Baldovino. Member of CelBA. She has more than 25 years studying capuchins. Celia helped with advice on the ecology and behavior of capuchins, and during the captures of individuals.

María Paula Tujague. Member of CelBA and Researcher of CONICET at the IBS. Paula is studying the susceptibility of pine stand to bark-stripping by capuchins, and she also relates that prediction with the perception of producers considering their scale of production. She helped in captures of capuchins and monitoring the intensity of bark-stripping by capuchins.

Yamil Di Blanco. Member of CelBA and Researcher of CONICET at the IBS. He has lot of experience in movement and spatial ecology. Yamil helped with the programming of the GPS collars and will help analysing data.

Clara Scarry. Assistant professor at California State University. She is studying the ecology of capuchin groups that live in Iguazú National Park; Clara helped with advice about capuchins.

Ezequiel Vanderhoeven. Veterinarian. Member of CelBA and Postdoc at the IBS.

Juan Pablo Arrabal. Veterinarian. Member of CelBA, and Postdoc at the IBS.

Sebastián Costa. Veterinarian. Member of CelBA, and Technician at the IBS.

Daniela Lamattina. Veterinarian. Member of CelBA, and researcher of CONICET at the INMeT (Instituto Nacional de Medicina Tropical).

Luciano Colli. Volunteer Field assistant. Biologist.

Giovanina Dominguez. Volunteer Field assistant. Park ranger student.

Joel Ayelén Díaz. Volunteer Field assistant. Biology student.

Abril Iara Daldoss. Volunteer Field assistant. Biology student.

Antonella Catania. Volunteer Field assistant. Biology student.

Tamara Friedenbergen. Field assistant. Student from the National University of Misiones (UNaM) – Scholarship-holder from the CIN.

Gisel Candia. Field assistant. Student from the UNaM – Scholarship-holder from the CIN.

Ivana Barrionuevo. Field assistant. Student from the UNaM – Scholarship-holder from the CIN.

Ilaria Agostini. Member of CeIBA, Researcher of CONICET at the CENAC, and co-advisor of the doctoral thesis of V. Zárate.

Mario Di Bitetti. Member of CeIBA, Researcher of CONICET at the IBS, Associate Professor, University of Misiones, and Advisor of the doctoral thesis of V. Zárate.

10. Any other comments?

I am deeply grateful to The Rufford Foundation for funding this project and thereby contributing to protect black capuchin monkeys that live in productive landscapes. Argentina is going through a very serious economic crisis and without financial support like RF's it is almost impossible to carry out research projects like ours.





To left) Valentín, Iara and Top bottom) Fermino installing feeding platforms for black capuchin monkeys (*Sapajus nigritus*). Bottom) Sara, Iara, Sebastián and Valentín preparing a Tomahawk trap for capturing capuchins. © Hernando Rivera (1, 3), Valentín Zárate (2).





Top) Adult female black capuchin monkey (*Sapajus nigritus*) captured with a Tomahawk trap, Bottom left) weighted and Bottom right) fitted with a GPS-VHF collar. © Agostina Juncosa (1,2) and Luciano Colli (3).



Valentín tracking a black capuchin monkey (*Sapajus nigritus*) using the VHF signal from one of the GPS-VHF collars. © Hernando Rivera.



Left) Pine tree (*Pinus taeda*) bark-stripped by a Black Capuchin Monkey (*Sapajus nigritus*), and Right) a strip of bark recently removed by a capuchin. © Hernando Rivera (1) and María Paula Tujague (2).

References

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