

Final Evaluation Report

Your Details	
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Project Title	Effects of deforestation on fish communities in Amazonian headwater streams
Application ID	36352-1
Date of this Report	June 22/2023



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
Selection of sites affected by deforestation: spatial examination				Spatial analysis was carried out over sites that presented changes from forested to pastures or crops (i.e., land use change). These analyses were done using land cover information and included the complete Department of Guaviare. This allowed a broader view of this anthropic process, facilitating site selection and sampling design.
Presampling season (7 days)				I carried out a presampling trip, one week long. During this presampling I visited the areas where the spatial analysis showed changes in land cover (e.g., from forest to pastures). This allowed sites corroboration and selection. Selection criteria was based on: 1) landowner permission; 2) security; 3) accessibility; 4) land cover classification; and 5) replicability of sampling. 15 sampling sites were successfully established. Each sampling sites varied in length and according to the criteria. Stream average length was 350 m.
First sampling season (30 days). Fish sampling, Physical – chemical characteristics of water, environmental variables				From July 15 to August 14, 2022. Rainy season. At the 15 sampling sites established, I carried out the following sampling protocols: Fish sampling: passive techniques such (fish traps and gillnets) and active techniques (seine and hand nets). The use of these techniques allowed and ensure that most stream habitats (e.g., ponds, riffles, root and vegetation mats) were sampled. Physicochemical water characteristics: conductivity, dissolved oxygen, temperature, pH were measured using a multiparameter probe. Stream depth was measured using a depth sounder whereas



		width was measured using a metre tape. Channel substrate was visually inspected. Water velocity was measured using a Flowatch. Canopy: it was calculated through pictures taken at the middle of the reach, using the GLAMA app (gap light analysis mobile app). This firsts sampling season yield 849 individuals of 34 different species. The classification of the 15 sampling sites in high, medium, and low deforestation. Additionally gave information about land use at each of the sites. Fish species were identified to species level at the Ecology laboratory of Universidad Nacional de Colombia and are in process to be deposited at the Ichthyology collection at Instituto de Ciencias Naturales (ICN) of Universidad Nacional de Colombia.
Second sampling season (20 days). Fish sampling, physical - chemical characteristics, environmental variables.		From February 18 to March 10, 2023. Dry season. Sampling design was replicated at each established site. During this sampling campaign, the list of fish species increased to 64.
Field data analysis		Taxonomical identification of fish samples is still underway. So far, almost all fish species have been correctly identified, there are still two species that I have not been able to identify. They might be new species. Thus, I have requested the help of specialists. If they really are new species, then their identification and scientific report will follow.
Final presentation		Technical reports were handled to landowners and local community members. The reports included pictures of captured species, their distributions among sampling sites, water physico- chemical characteristics, scientific and common names of the species and my information in case people wanted to communicate and ask questions. Final presentation was scheduled for 28 th April 2023. Landowners, governmental entities staff and local community members were invited and encouraged



	to invite more community members. Unfortunately, I believe it was an unsuccessful event since most of the invited persons did not attend. Results were presented to only five persons, two landowners and three local community members. Members who were invited that did not attend extended their apologies and asked for another presentation when inquired why did not attend.
Other activities	Results have been presented were presented to local community members (see above). Results have been presented at academic meetings at Pontificia Universidad Javeriana and Universidad Nacional de Colombia. So far, a summary of the project and its results have been submitted to the international conference on freshwater ecology and freshwater communities (to be held in September 2024) and congreso colombiano de limnologia (to be held in November of 2023). If accepted, I will be able to present the results of the project to national and international audiences. Two scientific articles are currently underway and close to be submitted to indexed journals.

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

a). Abundance, richness, and diversity do not present any statistical differences among sites. However, these three metrics tend to be higher at low deforestation sites. These means that sites do not present any land use change and keep forest at their banks harbour more different species and more of each species than other sites. This response can be due the high heterogeneity of habitats and increase number of resources encounter in forested stream, which allow several species to thrive within these reaches.

Contrary, functional divergence and dispersion, measured as variability of species traits, tended to be higher in forested streams reaches. Which highlight the importance of the interactions with the riparian forest.

b). Headwater streams in this area are characterized as oligotrophic. Extremely low values of conductivity and acid pH, correspond with this categorisation. These finds possibly means that aquatic communities in these headwater streams received most



of their resources from allochthonous sources (i.e., the forest). This highlights the importance of forest for aquatic communities.

c). Spatial analysis showed a rapid land use change in the department of Guaviare. Forested areas are clear to give way to cattle and oil palm crops. Several possible sampling sites were discarded during the presampling campaign since they were classified as forested but during the visit, their covers had changed to crops, pastures, or cattle ranching. Land use change altered vegetation covers and homogenised both riparian and instream habitats. These are rapid changes that affect freshwater ecology and the communities within them. Moreover, is a process that is taking place all over Colombia, especially the Amazon region.

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

During the rainy season, the sampling campaign was longer than planned since accessibility to sampling sites was harder; walking or driving was difficult due to muddy conditions. Sometimes, while carrying out the sampling, it started to rain and water levels rose rapidly; making it quite challenging to complete the sampling without any risks. The best way to counter these issues was waiting until weather conditions were favourable to safely complete each sampling site.

Sampling sites were corroborated and established during presampling field campaign. However, land used dynamics in the area changed and four of the selected sampling sites were altered and no longer had the characteristics that made them optimum. This was tackled with a new round of corroboration of possible sampling sites. I was able to establish 15 sampling sites that did not change during the time at which samplings were carried out.

Tropical freshwater fish identification remains a challenge. Although there has been an increase in literature and description of new species, there are scores that still that remain unknown and identified to the genera level. To have taxonomic certainty on those species hard to identify specialists were consulted.

Although a peace treaty was sign in 2016 between the Colombian Government and the FARC (illegal guerillas), this part of the country is still facing several security issues. Gaps left by the former guerilla were filled by other illegal groups looking to exert control over those areas and keep illegal crops and illegal logging going. I did not receive any direct warning or treat, but I was told by six landowners that unknown and unidentified people asked about me and the activities that I was carrying out to develop the project. Landowners suggested caution and not to visit areas without those already established while local political, social, and economic situation get better. I followed their advice.

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

Local communities were pivotal actors during the development of the project, and they were involved from the beginning and had had active roles during the



development of it. First, as landowners they provided permission to use their lands. Second, they actively participated during sampling campaigns, contributing with their knowledge, learning about the sampling techniques and the used of instruments and gear used. Third, they spread the word about our research and many locals reach us to offer help and their interest in knowing what species can be found within the streams flowing through their lands and how the different activities that the carry out affect streams and its communities.

Field work involves the active participation of local community members who help during sampling, transport, support, samples handling, food. This granted me the opportunity to closely work with local people who greatly contributed to the development of my PhD project in this isolated place of Colombia.

5. Are there any plans to continue this work?

Certainly. On one hand, local community members that were not contacted have reach us expressing their willingness to be part of the project and have offered help and their permission to sample. On the other hand, I would like to broaden this project with new approaches such as stable isotopes, ecomorphology, macroinvertebrate and algae sampling, stomach content analysis, among others.

As such, the project has the opportunity to growth and extend its cover in the near future. This means future projects could include other water bodies, different land uses, other ecological disturbances affecting the area such as fire, other ecological interactions such as competence, predation, and behaviour, and involve more community members.

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

As planned, results will be share with the academic community and governmental entities through scientific papers in indexed journals; two articles are currently under construction to be submitted at indexed journals. Additionally, summaries of the project were sent to be presented at national and international seminars and conferences.

Two presentations of the project had taken place, one at Pontificia Universidad Javeriana and the other one at Universidad Nacional de Colombia.

Finally, local communities received technical reports describing out findings. If possible, a 2nd final presentation will be scheduled; this will allow to reach more local community members, NGOs, non-NGOs, landowners amongst others. This will allow us to receive feedback and improve for future works in this region of Colombia.

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

First, I would like to finish samples processing and data analysis to complete the preparation if scientific publications derived from this work. This will allow me to complete my PhD dissertation and project.



Second, make the most of academic conferences, seminars, and lectures to reach national and international audiences and spread my results. I believe the results of these project could be used to plan future agricultural and infrastructure development in the region and the country and I would like to actively participate in these processes.

Third, if possible, carry out another round of sampling during both seasons to strengthen my data and therefore the results of this project.

Fourth, broaden this project including new areas, increasing the number of sampling sites, involving more local community members, new ecological approaches, interactions, and disturbances.

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, The Rufford Foundation logo has been used on all produced material related to this project. Technical reports showing the results of the project have been handed to landowners, community members and government institutions; these technical reports include our information and the logo of The Rufford foundation.

Oral presentations of the results and the project were given at Pontificia Universidad Javeriana in Bogotá and at Universidad Nacional de Colombia and the logo was used during the presentations.

Finally, the results of this project were submitted to be presented as oral presentation and posters at the international conference on freshwater ecology and freshwater communities (held on September 2024) and Congreso Colombiano de Llimnología (held November of 2023). The logo will be used during these presentations.

Credits will be duly given to the Rufford foundation for the founding and help in future conferences, lectures, and seminars.

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

Gabriel Colorado Zuluaga, PhD: Ph. D advisor, he has collaborated with the scientific, administrative, and technical part of the project.

Juan David González, PhD: Biologist with experience in freshwater ecosystems, aquatic sampling, and data analysis. He has collaborated with data analysis and field sampling.

Edilberto Pachón Granada: local community member (San José del Guaviare). He helped with logistics of field trip and fish sampling. Also, he collaborated with transportation.

Marco Melo: Local community member (San José del Guaviare). He helped with sampling, samples handling, and lodging logistics.



Daniela Reyes, **B.Sc.**: biologist with experience in sampling techniques. He helped with fish sampling and samples manipulation.

Javier Melo: local community member (San José del Guaviare). He helped with sampling, samples manipulation and transportation logistics.

Diana Rodriguez: local community member (San José del Guaviare). She helped with samples handling and lodging logistics.

Dora Pachón: local community member (San José del Guaviare). She helped with lodging and food logistics.

10. Any other comments?

Additional resources needed to complete parts of the project and its planned activities have been provided by the government of Colombia through the Ministry of Science, Technology, and Innovation.

I want to express my gratitude to The Rufford Foundation for the small grant awarded. It has been a great help for the development of my PhD project. Also, the small grant allowed me to work in a difficult region, but the rewards and experiences derived from this work are priceless.

It has been an honour to be a little part of The Rufford foundation through this small grant and I will keep using the logo of the Foundation in all the material derived from this project and announcing the great opportunities you can provide.



Thank you!