

Final Evaluation Report

We ask all grant recipients to complete a project evaluation that helps us to gauge the success of your project. This must be sent in **MS Word and not PDF 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 – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please DO NOT fill in and submit this form until the project has been completed.

Complete the form in English. Note that the information may be edited before posting on our website.

Please email this report to jane@rufford.org.

Your Details	
Full Name	Álvaro Hernández Rivera
Project Title	The Cloud Forest Scent: Disentangling orchids and euglossine bees interactions
Application ID	43883-2
Date of this Report	04-12-2025

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
Investigate the aromatic compounds that constitute orchids fragrance			X	We successfully extracted aromatic compounds from 42 plants belonging to 12 different orchid species, all of which are pollinated by euglossine bees.
Quantify the ecosystem function of orchid bee pollination			X	<p>We conducted field observations of pollination in seven orchid species with 35 total individuals.</p> <p>We identified 9 euglossine bee species of 106 individuals.</p> <p>In general, we found high specialization of orchid pollination, with most orchid species being pollinated by one or two euglossine bee species.</p>
Interactive workshop designed for children and teenagers			X	The course was very well received by young participants (35 attendees).
Public photographic exhibition of euglossine pollinated native orchids and their pollinators			X	<p>We had the privilege of hosting the photographic exhibition at three different venues, in addition to holding an official opening lecture in collaboration with the Coatepec Orchid Museum.</p> <p>Additionally, I had the opportunity to be invited to participate in a radio program that, among other things, aims to promote science outreach. This program was broadcast on four radio stations in the state of</p>

			<p>Veracruz, Mexico. In this program, called <i>Sistema Informativo Actualizado</i>, I spoke about the photographic exhibition and the conservation of bees and orchids from our homes.</p> <p>The reach of this program is broad in southeastern Mexico, primarily covering the states of Veracruz, Puebla, and Oaxaca, making it possible for up to 3 million people to access it.</p>
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2. Describe the three most important outcomes of your project.

- a) High-quality data on orchid scents and their pollinators, which will allow us to produce at least one high-impact scientific publication to better understand the relationship between orchids and euglossine bees. The project is currently at the stage of manuscript preparation and data analysis of bee and orchid scent profiles. We therefore expect to submit it soon to a high-impact specialized journal.
- b) A workshop designed for young people and children, focused on active learning, fostering a strong connection with nature and providing practical tools and steps to promote biodiversity from their own homes.

We worked with high school students aged 15–17 in collaboration with the Antonio María de Rivera High School in Xalapa, engaging two groups. Although we did not administer formal questionnaires at the end of the course, we did ask students how the course could be improved and what knowledge they were taking home. Through this process, we received very positive feedback and were able to assess the genuine learning outcomes. We observed a clear increase in students' understanding of biodiversity, as well as a sense of ownership and appreciation of it.

- c) A photographic exhibition of orchids and euglossine bees that raised awareness among more than 2,000 people across three different venues.

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

One of the main challenges we faced was obtaining a high diversity of native orchids for laboratory analyses. While some species are relatively common (such as *Gongora galeata*), others have been heavily depleted from natural forests due to

overcollection, making them available only in private collections (e.g., *Stanhopea oculata*, *Gongora truncata*). To access these rare species, we collaborated with official collections (at the Institute of Ecology A.C. and the orchid collection of the Universidad Veracruzana), and, given their scarcity, we also worked with private collections (the orchid collection of the Coatepec Orchid Museum). This challenge ultimately became a valuable opportunity, as it allowed us to establish strong relationships with collectors who maintain high levels of orchid diversity in their collections.

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

We engaged local communities in two of our activities in different ways: (a) through our public photographic exhibition, we provided access to information on native orchids and their pollinators, strengthening and integrating people's relationship with their local natural resources by highlighting their beauty and promoting their conservation through species recognition. Across the three exhibition venues, nearly 2,000 participants had access to this information. (b) In addition, our workshop for children and young people was offered as a free course that allowed anyone interested to learn about and connect with orchids and bees through the senses. This course was designed to raise awareness and to provide participants with concrete ideas for changes in habits and actions to promote the conservation of our focal species.

5. Are there any plans to continue this work?

Yes. I have recently completed my doctoral studies and plan to continue my work in both science outreach and academic research. In particular, I am interested in pursuing this line of work through a postdoctoral position or in a teaching role, depending on the availability of relevant opportunities.

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

We believe it is essential to disseminate information about the identity of orchid pollinators, particularly those pollinated by euglossine bees. One key criterion for assessing the potential risk faced by orchid species is the degree of specialization in their pollination systems, which is exceptionally high and still poorly understood in this group. For this reason, we intend to share our findings.

At present, I would like to continue developing the photographic exhibition and turn it into a traveling exhibit. I believe that macro photography can highlight the beauty of small organisms and, ultimately, help raise awareness among the general public and promote positive changes in behavior.

Although we have not yet published the results of our perfume analyses, we have previously conducted research on orchid bees and orchids that served as a precursor to the present project (<https://doi.org/10.1016/j.scitotenv.2024.176553>).

Additionally, we are currently working on the production of a short video documentary that will be released at the International Orchid Festival 2026, to be held in April in Coatepec, Mexico.

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

A valuable next step would be the development of a practical manual on orchid cultivation for people who already maintain specimens in their collections. This manual would provide clear guidelines for proper care, tailored to different growth forms and habits.

Another important direction would be to further document native orchid species and their pollinators (as in the case of *Stanhopea tigrina* with *Eufriesea caerulescens*), not only through photography but also by assessing their real abundances in the field. This represents a major challenge, as these orchid species and some of their pollinators are rarely encountered in natural conditions. Documenting these interactions would be a crucial step toward assessing the level of risk faced by these species, potentially associated with (a) low orchid abundance, (b) low pollinator abundance, and (c) high specialization of the interaction.

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 Rufford logo for the photographic exhibition, the workshop, my doctoral thesis presentations, and also in science outreach talks that I delivered.

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

Lot Sinuhe Pérez Ortega – In addition to actively assisting in the workshop, he participated in the installation of the photographic exhibition, served as a laboratory assistant during the extraction of aromatic compounds, and contributed to the development of educational materials.

Diana Ivette Domínguez Plandiura – Workshop assistant who was actively engaged in supporting and working with the participating students.

Dr. Daniel González Tokman – Lead researcher of the host laboratory. Intellectual co-author of the projects and actively involved in the supervision of my doctoral thesis and in developing ideas to enhance the scope and impact of the projects.

Dr. Patricia Romero Arellano – Head of the Chemical Ecology Laboratory at the Institute of Ecology A.C. A key collaborator with whom we conducted the collection of volatile compounds from aromatic orchids. She is an expert in this field.

Dr. Rebeca Menchaca García – Key collaborator from the Universidad Veracruzana and an expert in the management and conservation of orchids.

10. Any other comments?

I would like to express my deepest gratitude to the Rufford Foundation for the support provided. This financial support represented invaluable opportunities for an early-career researcher like myself and meant far more than just funding—it opened doors to opportunities that are usually very difficult to access. I strongly believe that in Latin American countries it is becoming increasingly challenging to secure financial support for research, which often forces both scientific research and outreach activities to rely on personal resources and remain very limited. Therefore, the Foundation's support was fundamental to my professional development, allowing me not only to generate high-quality scientific data, but also to deliver high-quality science outreach—something that many people can only dream of achieving. Without the Foundation's support, I would not have been able to carry out such extensive monitoring, I would not have had the motivation to pursue science communication so actively, and I would not have been able to supervise my first undergraduate student. The ideals of the Foundation regarding the dissemination of knowledge are now deeply embedded in my personal and professional values, and I strongly hope to continue implementing them in my daily work, whether as a teacher and/or as a researcher. Thank you very much.

ANNEX – Financial Report
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