



SPECIFIC INTERINSTITUTIONAL COOPERATION AGREEMENT BETWEEN THE RESEARCH INSTITUTE OF THE PERUVIAN AMAZON AND PRINCETON UNIVERSITY

This document, effective July 26 2022, confirms that the “Specific Interinstitutional Cooperation Agreement” is signed by both parties; **EL INSTITUTO DE INVESTIGACIONES DE LA AMAZONÍA PERUANA**, hereafter “**IIAP**” with RUC number 20171781648 with legal address at Av. José Abelardo Quiñones Km 2.5, district of San Juan Bautista, province of Maynas, region of Loreto, duly represented by its Executive President Mrs. **CARMEN ROSA GARCÍA DÁVILA**, identified with DNI 05220064; and, by the second party, **The Trustees of Princeton University on behalf of its DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY**, hereafter “**EEB**,” with tax number 21- 0634501 and legal address at Nassau Hall, Princeton, NJ 08544, United States, duly represented by its Associate Provost of International Affairs and Operations **ALY KASSAM-REMTULLA**.

IIAP and **EEB** are jointly referred to as **THE PARTIES** in the following terms and conditions:

FIRST CLAUSE: THE PARTIES

"IIAP" is a specialized technical body with legal personality of internal public law, with economic and administrative autonomy; constitutes budgetary independence in accordance with the provisions of Law No. 23374, Law of the Institute of Investigations of the Peruvian Amazon.

Its mission is to generate and provide scientific and technological knowledge on biological and sociocultural diversity of the Amazon, for the benefit of its population and technical and political decision makers, in an appropriate, timely and efficient manner. IIAP has the purpose of carrying out the inventory, investigation, evaluation and control of natural resources; promote its rational use and industrialization for the economic and social development of the region; and has jurisdiction of the area that geographically corresponds to the Peruvian Amazon basin.

"EEB" is a department of Princeton University, which is an American institution dedicated to research, education, and scholarship. Princeton University promotes learning through quality research and teaching with an emphasis on undergraduate and doctoral education that distinguishes it as among the best universities in the world, and with a widespread commitment to serve the nation and the world.

SECOND CLAUSE: OBJECTIVES

General Objective:

Our goal is to examine the biogeochemical mechanisms that regulate ecosystem functioning and plant species specialization in the Varillal ecosystem of the Amazon basin.

Specific objectives:

- Determine how limitation by nutrients maintains distinct Varillal plant communities.



- Characterize the nutrient cycle through the plant-soil system.
- Characterize the nutrient acquisition strategies of plants within the Varillal communities.

THIRD CLAUSE: COMMITMENTS OF THE PARTIES

3.1 Of IIAP:

1. Participate in the execution of the study "Nutrient cycle and habitat specialization of plants within the Varillal ecosystem" according to the project file that is annexed.
2. Designate as coordinators of the **IIAP** in this agreement Dr. Gabriel Vargas Arana and Blgo. Kember Mejía Carhuanca, Director of the Directorate of Research in Terrestrial Amazonian Biological Diversity, as the main specialists of the project and who will participate in developing the work plan as well as the final report.
3. Support the relevant legal procedures to formalize sampling of specimens and transport of biological material, within the national territory and abroad in accordance with current Peruvian regulations.
4. Carry out the coordination of activities associated with this project between members of the **IIAP** and **EEB**, for which meetings will be convened to coordinate and support the progress and achievements.
5. Participate in the co-orientation of an undergraduate thesis on the decomposition of leaf litter and the loss of nutrients by leaching in Varillales.
6. Participate in the co-orientation of an undergraduate thesis on the relationships between mycorrhizae and trees in Varillales.
7. Disseminate findings through conferences and workshops. Other mechanisms of dissemination will be agreed upon with **EEB**.

3.2 Of EEB:

1. Coordinate and execute the study "Nutrient cycle and habitat specialization of plants within the Varillal ecosystem".
2. To finance the costs of field and laboratory work and of housing and personal expenses of EEB researchers at the Institute as mutually agreed and in accordance with **IIAP** standards in an amount not to exceed \$15,000 USD over the three year Term of this Agreement. EEB researchers are covered by Princeton University insurance while working on the project.
3. Involve at least one **IIAP** researcher as mutually agreed in the research to be carried out.
4. Disseminate experiences through conferences, workshops and other mechanisms in collaboration with the **IIAP**.



5. Include collaborating researchers as co-authors in the publications that are derived from the data generated in the project.
6. To designate as directly responsible for this Agreement Dr. Lars O. Hedin, Professor at Princeton University, faculty and chair of **EEB** and his doctoral student Julie Tierney. They will participate in the preparation and implementation of a work plan with the representative of the **IIAP**, as well as in the preparation of a final report containing the results of the activities and the study that is the subject of the agreement.
7. Participate in the co-orientation of an undergraduate thesis on the decomposition of leaf litter and the loss of nutrients by leaching in Varillales.
8. Participate in the co-orientation of an undergraduate thesis on the relationships between mycorrhizae and trees in Varillales.
9. **EEB** will credit the technologies and knowledge applied in the research activities it promotes that have been generated in collaboration with the **IIAP**.
10. Comply with the legal provisions in force in Peru for the conduct of scientific research.

FOURTH CLAUSE: FINANCING

EEB will allocate financial resources to support:

- Expenses of reagents to perform tests on the nutrient and chemical content of plants, water and soil in Varillales.
- Reagents and equipment for mycorrhizal testing.
- Reasonable expenses as governed by University policy for travel, food and accommodation of the personnel involved in the project to comply with the collection of biological samples and information.
- Specialized personnel according to the subject of the study.

IIAP shall provide and/or facilitate:

- Use of the infrastructure of the Laboratory of Chemistry and Natural Products.
- Support in the determination of phenolic compounds in water and leaves.
- The collaboration of **IIAP** professionals in the preparation of work plans, work meetings, progress and final reports, follow-ups and technical assistance.

The parties may seek financing for the execution of potential future joint projects that will strengthen and give continuity to the activities initiated in this agreement.



FIFTH CLAUSE: OWNERSHIP AND BENEFITS

The goods, information, knowledge and/or technologies provided by each of the parties are the property of the person who contributes them.

Any exchange of information, knowledge and/or technologies between the parties does not imply the exchange of the rights to its publication.

The goods, information, knowledge and technologies generated within the framework of this agreement shall be the property of the participating parties.

The use and/or disclosure by one of the parties of the goods, information, knowledge and technologies generated within the framework of this agreement shall require the express authorization of the other party(s).

The publication of the results and/or final reports shall refer to this Agreement and express the recognition to the signatory parties. It will also appear on the cover of the document to be published, under the heading "**PU-EEB – IIAP Agreements**".

SIXTH CLAUSE: LABOR REGIMES

Neither party has the power or authority to create any express or implied employment obligation on behalf of any of the other parties.

This agreement does not create rights for either party or its employees to receive employment and insurance benefits that employees of either party receive.

SEVENTH CLAUSE: PROTECTION FROM DAMAGES

The work to be carried out by the personnel of each of the parties within the framework of this agreement will be executed under the sole responsibility and risk of the party providing the personnel.. Neither party shall hold the other party liable for any material or personal loss that has been caused in the execution of the actions subject to this agreement.

If, within the framework of this agreement and as a result of the sole negligent action or omission of one of the parties, damages or losses occur, that party will take action to hold harmless the other party against any and all claims, demands and actions that arise as a result of that negligent performance.

EIGHTH CLAUSE: ACCESS TO OPERATIONAL DOCUMENTATION

The parties will keep the financial reports, supporting documents, statistical reports and other records related to this agreement for a period of 3 years after the end of the agreement. If any litigation, claim or audit is initiated or announced before the expiration of the three-year period, the reports and records will be kept until such litigation, claims or audits are concluded or resolved.



Authorized representatives of the parties must have free and timely access to any book, document or record that is relevant to this agreement for the purpose of conducting audits and making copies or transcripts.

NINTH CLAUSE: RESOLUTION

This agreement may be terminated at any time:

- By common agreement of the parties, with an anticipation of thirty (30) days.
- By unilateral decision, communicating your intention no less than thirty (30) calendar days in advance.
- For breach of the commitments derived from this agreement by any of the parties.

The resolution of the agreement shall not prevent the parties by separate agreement from continuing ongoing activities through to conclusion.

TENTH CLAUSE: ASSIGNMENT

The parties may not assign their rights or position in this agreement without the prior written authorization of the others under sanction of resolution of this agreement.

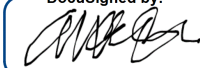
ELEVENTH CLAUSE: VALIDITY, TERM AND MODIFICATION

This Specific Agreement shall enter into force from the date of its subscription by the parties and shall have a duration of 03 (three) years and may be modified via addendum by agreement of the parties.

TWELTH CLAUSE: FINAL PROVISIONS

This document may be translated into other languages, but the English version shall control. Any matter not expressly provided for in this Agreement and/or any discrepancy in its application or interpretation shall be resolved or clarified through the direct understanding of the representatives designated by the intervening parties, taking into account the rules of good faith and common intention of the parties.

The parties express their agreement with each and every one of the clauses established in this agreement, in witness of which they sign it in one (1) original in September of 2022.

DocuSigned by:

7285FBABC54B4D8..

CARMEN ROSA GARCÍA DÁVILA
Presidenta Ejecutiva del IIAP

ALY KASSAM-REMTULLA
Associate Provost of International
Affairs and Operations

Annex 01.



Project: Nutrient cycle and habitat specialization of plants within the Varillal ecosystem

Summary:

The terra firme forests of the Amazon basin are home to some of the world's most productive trees, but they grow in some of the poorest soils in the tropics. However, nestled within the highly productive forests are depauperate Varillal forests that sustain a completely different community of tree species with low biomass and low growth rates compared to the surrounding terra firme. Why do the mechanisms that sustain such vigorous growth despite soil-poor soils fundamentally fail in Varillales? The goal of our project is to evaluate how feedbacks between plants, soil and nutrients contribute to habitat specialization and ecosystem function in Varillales. This will be achieved in three parts: 1. An evaluation of the nutrient cycle between plant and soil, including those nutrients lost by leaching; 2. A garden fertilization experiment to understand how nutrient limitation maintains Varillal plant communities; and 3. A characterization of how Varillal plants acquire nutrients in symbioses with associated mycorrhizae. A large part of our project will focus on understanding how the evolutionary characteristics of trees, such as high investment in herbivory defense compounds, influence their unique nutrient environment.

Intellectual Merit:

Ecosystem properties, such as productivity and biodiversity, can be the result of external environmental variables, such as climate and soil, but they can also be the product of dynamic feedback between the traits of the biological community itself and its resource environment. The Varillal plant community of the Peruvian Amazon are a model system for testing these ideas. In this proposed research, we used the contrast between white sand and land-based forests to address the question: how does the biological community interact with its resource environment to maintain divergent ecosystem types? In this way, our study will contribute to a global understanding of how ecosystem properties arise, such as carbon storage, nutrient cycling and biodiversity. In addition, our combined approach to observation and experimentation, which integrates principles of biogeochemistry and evolution, will serve as one of the most rigorous explorations of ecosystem function in Varillales to date.

Large-Scale Impacts:

The Amazon basin serves as one of the most important global buffers against climate change, sequestering more than 25% of the world's annual terrestrial carbon sink. However, we do not fully understand what limits the productivity of Amazonian forests and therefore their ability to sequester carbon. This research on Varillales which represent an extreme example of limited productivity in the tropics, will help elucidate how plant-soil interactions shape the carbon cycle of tropical forests. In addition, this work will continue the ability to create collaboration between

U.S. and Peruvian institutions and will represent the first collaboration between Princeton University and IIAP. Our institutions will work together to advise two undergraduate students as they develop their first careers in science. These students will be invited to apply to Princeton University's "EEB Scholars" program, as we recruit underrepresented students into a program designed to help them navigate the graduate school selection and application process.

Objectives:



The general goal of this research is to examine the biogeochemical mechanisms that regulate ecosystem functioning and habitat specialization in varillales. This will be achieved in three objectives:

Objective 1: Determine how the limitation of nutrients maintains different communities of varillales.

Hypothesis 1: While varillal species outcompete terra firme species in varillal habitats under normal conditions, terra firme species will be able to invade varillal habitats if given sufficient access to nutrients.

Objective 2: Characterize the nutrient cycle through the plant-soil system.

Hypothesis 2a: Varillales are characterized by a very slow nutrient cycle with low availability of phosphorus and nitrogen compared with terra firme;

Hypothesis 2b: Nutrient limitation in varillales is maintained by continuous large losses of dissolved organic nutrients through leaching;

Hypothesis 2c: Low-quality litter from varillal plants suppresses the availability of nutrients in varillales.

Objective 3: Characterize the nutrient acquisition strategies of varillal plant communities.

Hypothesis 3: Due to nutrient scarcity, varillal plants will invest more in mycorrhizal symbiosis to acquire nutrients.

Methodology:

This study will take place in the Allpahuayo Mishana Reserve, where we have 4 forest plots of Varillal and terra firme. *Objective 1: Determine how nutrient limitation maintains Varillal plant communities.*

We established a garden fertilization experiment to understand how nutrient limitation maintains Varillal communities. In April-July 2020, we established 40 experimental gardens in the Varillales near P.V. Irapay in the Allpahuayo-Mishana National Reserve. We transplanted 400 seedlings of 5 genera arranged in pairs of terra firme/Varillal congeners with 10 individuals per garden.

We assigned each garden one of five treatments: + nitrogen (+N), + phosphorus (+P), + nitrogen and phosphorus (+N+P), exclusion from belowground competition, and control. Since establishment, we have measured the growth rate, herbivory and mortality of each individual. We expect this experiment to continue until January 2023, when we will harvest the plants, determine the nutrient content of their tissues, and measure the production of defense compounds such as phenolics.

Objective 2: Characterize the nutrient cycle through the plant-soil system.

This objective is addressed in three parts, corresponding to our three hypotheses (see objectives above). To address hypothesis 2a, we visited 4 previously established forest plots of Varillal and terra firme to quantify N cycle rates using N mineralization and estimated P cycle rates by measuring the activity of acid phosphatase, a P-cycle soil enzyme. In addition, we measure the organic matter content in the mineral soil to compare the amount of organic nutrient sources.

To address hypothesis 2b, we have installed 4 lysimeters on each in 2 Varillal plots and 2 plots of terra firme. These lysimeters will collect water leachate from the soil, which we will analyze for dissolved organic nutrients and for phenolic compounds. From these



measurements, we can estimate the total nutrient losses due to leaching and how nutrient losses relate to the total phenolic content in the system.

To address hypothesis 2c, we are planning to establish a leaf litter decomposition experiment to investigate how differences in leaf and leaf litter nutrient content between terra firme and Varillal species lead to differences in soil cycle and nutrient availability. We will collect freshly fallen leaves from Varillal and terra firme forests and transplant them reciprocally into mesh bags. Over 36 weeks, we will measure the rates of decomposition and loss of nutrients.

Objective 3: Characterize the nutrient acquisition strategies of Varillal plant communities. We identified and extracted fine roots from common Varillal specialists as well as from species of the genus *Protium* that specialize in terra firme habitats. We plan to collect additional samples. We will investigate the extent to which these species are acquiring nutrients from their symbiotic mycorrhizal companions. To do this, we will quantify mycorrhizal colonization by fungal staining and microscopy.

Products

1. At least one article published in a peer-reviewed journal.

Schedule

Dates

June – December 2022

June - August 2022

July - August 2022

January - February 2023

January – April 2023

April – December 2023

Activity

Execute field work in Allpahuayo-Mishana National Reserve, including:

1) monitor the garden experiment; 2) collect water samples; 3) begin decomposition experiment.

Process root samples to determine mycorrhizal colonization.

Begin the determination of phenolic compounds in water in the laboratory of Chemistry and Natural Products.

Finish field work.

Continue to analyze phenolic compounds in water and begin to analyze phenolic compounds in leaves from the garden experiment.

Analyzed data and begin to write results.

Certificado de finalización

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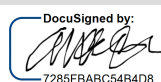
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cooperacion@iiap.gob.pe

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Eventos de notario	Firma	Fecha y hora
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