
Annual
Fellow
Symposium
2023
Tuesday, June 27
Tupper Auditorium | 8am
Smithsonian
Tropical Research Institute

Agenda

Fellow Symposium | June 27, 2023

8:00am COFFEE

9:00am WELCOME REMARKS | Owen McMillan's Welcome Words

9:15am **Eleinis Avila** | Stem photosynthesis in Neotropical trees and lianas

9:30am **Chinedu Eze** | Biochemical regulation of photosynthesis: Not a limiting factor for net photosynthesis of plants grown under elevated temperature

9:45am **Natalie Ferro Lozano** | Growth effects and related root traits effects in Theobroma cacao due to mycorrhizal communities in Panamá

10:00am **Brais Marchena** | Enhancing Forest Monitoring and Data Accessibility in Indigenous Communities: A Capacity-Building Project

10:15am **Karla Rodriguez** | Diversidad y composición florística de las comunidades de plantas adyacentes a la zona oeste de la Cuenca del Canal de Panamá

10:30am BREAK

10:45am **Jimena Pitty** | Public Programs

11:00am **Rhayza Cortes-Romay** | Inclusión de hongos Marasmius en los nidos de aves como un potencial mecanismo para repeler hormigas

11:15am **Ahana Fernandez** | The Greater Sac-winged Bat: A mammalian model for Biolinguistic Research

11:30am **Astrid Lisondro** | Elevated ammonia cues hatching in red-eyed treefrogs: a mechanism for escape from drying eggs

11:45am **Rachel Prokopius** | Is chytrid avoidance an innate or learned behavior in the strawberry poison frog?

12:00pm LUNCH *(NOT PROVIDED BY STRI)*

2:00pm **Dumas Galvez** | Optimal foraging, energy status and risk of infection in the ant *Ectatomma ruidum*

2:15pm **Logan James** | Dopaminergic influences on perception and production of courtship calls in a frog

2:30pm **Denise Dalbosco Dell'Aglio** | Ecological and behavioural divergence between *Heliconius* butterflies

2:45pm **Carrie Sims** | Who, How Many and Where: utilizing photogrammetry and AI to reveal and track Panama's eastern tropical Pacific *Pocillopora*-dominated coral reefs

Agenda

Fellow Symposium | June 27, 2023

	3:00pm	**Olivier Collard** | *Pocillopora spp* Symbiodiniaceae assemblage variation with temperature and salinity fluctuations across the Tropical Eastern Pacific (TEP) of Panama
//////	3:15pm	BREAK
	3:30pm	**Claire Williams** | Characterizing rapid shifts in the *Anolis* gut microbiome after introduction to a novel environment
	3:45pm	**Erin Dillon** | Reconstructing millennial-scale variability in reef shark communities across the Isthmus of Panama
	4:00pm	**Raiza Erlenbaugh** | Redescubriendo lo descubierto
	4:15pm	**Kelly Wuthrich** | Transient heat waves induce a rapid and reversible increase in thermal tolerance in a thermoconforming lizard
	4:30pm	**Carly Pope** | Ceramic evidence of cultural chronology and trade in pre-Columbian Isla Colon, Bocas del Toro, Panama
	4:45pm	**Caroline Bacquet** | KEYNOTE SPEAKER | Science over the abyss: weaving bridges with butterflies
	5:15pm	WINNER OF THE JACKSON/KNOWLTON ANNOUNCEMENT
	5:30pm	BBQ

Photo credit: Ana Endara

Speakers & Abstracts

Celestino Aguilar

Fellow

INDICASAT-AIP/Acharya Nagarjuna University

Advisor: Kristin Saltonstall

▸ Biodiversidad fúngica en suelos de la Reserva Forestal El Montuoso y el Parque Natural Omar Torrijos

Resumen

Los hongos representan un componente esencial de los ecosistemas, funcionando como descomponedores, patógenos y biotrofos. En los trópicos, la mayoría de las especies de hongos aún son desconocidas. En este trabajo se utilizó el método de *metabarcoding* de rDNA para descubrir la biodiversidad de los hongos en suelos de las áreas protegidas Reserva Forestal El Montuoso y el Parque Nacional Omar Torrijos. La diversidad de hongos en suelos de este tipo de áreas ha sido poco investigada en Panamá. El análisis reveló la presencia de siete filos: Ascomycota, Basidiomycota, Glomeromycota, Mortierellomycota, Mucoromycota, Rozellomycota y Chytridiomycota. Además, se registraron más 800 especies identificadas. Las especies identificadas pertenecían principalmente a Ascomycota y Basidiomycota. También encontramos especies entomopatógenas mayormente de los géneros Beauveria, Metarhizium, Metacordyceps y Pochonia. Esta investigación proporciona la primera descripción de especies fúngicas en las áreas de estudio que podrían ser evaluadas, y su protección es de suma importancia.

Angélica Arcila
Fellow
Universidad de Antioquia
Advisor: Carlos Jaramillo

▸ Taxonomic revision of *Gynoxys* (Asteraceae: Senecioneae), Antioquia (Colombia)

Abstract

I present the taxonomic revision of the Andean genus *Gynoxys* in the department of Antioquia, Colombia. The genus comprises ~ 121 species distributed along the Andes from northern Colombia to northern Argentina, at elevations between 3000 and 4500 m. *Gynoxys* is also found in the Páramo ecosystem in Colombia, Venezuela, Peru, and Ecuador. While the genus has been extensively studied in Ecuador, Bolivia, and Peru, comprehensive taxonomic works are lacking in Colombia, with most contributions focusing on new species descriptions. This study utilized herbarium specimens and field observations to examine the vegetative and reproductive morphological characters of dry material and capitula collected in the field. Seven *Gynoxys* species were identified in Antioquia, including three new records and a species complex. The work provides a morphological characterization, including a dichotomous key, detailed descriptions, taxonomic and geographic distribution notes, and relevant ecological aspects for the department.

Roxana Alveo
Intern
University of Panama
Advisor: Martijn Slot

▸ Does leaf heat tolerance of tropical plants acclimate to higher growth temperature in a greenhouse experiment?

Abstract

High temperatures can induce strong changes in plants' physiology, and when this exposure is prolonged and exceeds the thermal thresholds, leaves may die. The temperature beyond which leaves die (Tcrit) can be predicted from the temperature at which photosystem II (PSII) breaks down. We tested whether growth at elevated temperature and relative humidity would result in acclimation of thermal thresholds. We measured the maximum quantum efficiency of on leaf disks of Pseudobombax septenatum, Cochlospermum vitifolium, Calycophyllum longifolium and Dypterix Panamense species PSII using a MINI-PAM-II 24 hours after that they were incubated for 15 minutes in water baths at 12 temperatures between 42°C and 58°C. The analysis allowed us to determine that after acclimation the Tcrit increase by approximately 2°C in Pseudobombax septenatum and Calycophyllum longifolium while Cochlospermum vitifolium and Dypterix panamense showing a difference in ~1°C in comparison to the samples exposed in ambient conditions (46 – 48°C, respectively) which demonstrate that species can adjust their physiological processes to the increase in relative humidity.

Eleinis Avila

Fellow

University of California, Riverside

Advisor: Klaus Winter

▸ Stem photosynthesis in Neotropical trees and lianas

Abstract

Plants with photosynthetic stems are common in deserts and physiological advantages include extra carbon gain and improved whole-plant water-use efficiency. However, little is known about the prevalence of stem photosynthesis in more mesic ecosystems such as moist tropical forests, and whether stem photosynthetic capacity differs between trees and lianas. We studied 48 species of trees and lianas in two forests during wet and dry seasons of 2021-2023. We measured leaf and stem CO_2 exchange, chlorophyll concentration, stomatal density, and area and biomass investment into leaves and stems. All species exhibited either stem net photosynthesis or stem recycling photosynthesis, both of which improve the carbon economy of plants, with lianas having greater stem photosynthetic rates than trees. For 50 cm long terminal branches, the proportion of photosynthetic stem area to total area was greater in lianas than trees. Our results indicate that the contribution of stem photosynthesis to overall carbon gain seems particularly important in lianas as they allocate more area to green stems than trees.

Britany Ayala
Fellow
Universidad Tecnológica de Panamá
Advisor: Jefferson Hall

▸ Estimación de carbono almacenado en bosques secos de Pedasí, Panamá

Resumen

Según el último informe de la IPCC las emisiones de los gases de efecto invernadero producto de la actividad antropogénica han sido responsables del aumento de 1.1°C desde el siglo XIX y e inicios del siglo XX y se estima un aumento de entre 1.5°C y 2°C en los próximos 20 años (IPCC, 2021).

Para ello se han establecido acciones que ayuden al secuestro de CO_2 y a la disminución de emisiones de gases de efecto invernadero, entre las acciones recomendadas esta la restauración de bosques, esto debido a que los bosques son grandes bancos de carbono.

Las ecuaciones alométricas, son herramientas que consisten en modelos matemáticos, mediante los cuales se puede estimar la biomasa y/o el carbono almacenado.
Este proyecto pretende aportar a la investigación de los bosques secos, conocer más sobre sus capacidades como sumideros de carbono, para así poder incentivar la protección y restauración de estos bosques.

Leah Bakewell

Fellow

Florida International University

Advisor: Owen McMillan

▸ Parasite diversity and abundance in an assemblage of *Anolis* lizards in Panama

Abstract

Our understanding of biodiversity assembly in communities is biased towards free-living macro-organisms. However, most organisms are accompanied by a suite of symbionts. While the dynamics of biodiversity within communities are relatively well-studied, relationships between the diversity of symbionts and the diversity of hosts within a community remain understudied. It is particularly important to understand the shared and unique aspects of parasite communities among hosts within diverse communities, such as those that live in the lowland tropics. We assessed parasite burden across six species of anoles coexisting at a single site in Panama through the collection of mites, ticks, and helminth parasites and found differences in the abundance and composition of these symbionts across each host species. Overall, studying the diversity and abundance of parasites of these tropical anoles could help explain how parasite diversity is related to host diversity within biological communities.

Marianela Camarena
Intern
University of Panama
Advisor: Sean Connolly

▸ Capacidad de foto-aclimatización en *Pocillopora spp.* del Pacífico Este Tropical de Panamá

Resumen

En el Pacífico panameño la mayor cobertura coralina está representada por *Pocillopora spp.* Recientemente, la utilización de marcadores genéticos indican la existencia de dos posibles linajes; *Pocillopora* tipo 1: *P. meandrina/gigas* y tipo 3: *P. verrucosa* (Pinzón y Todd, 2011). *Pocillopora* tipo 1 puede asociarse con diferentes especies de simbiontes, mientras que *Pocillopora* tipo 3 se asocia primordialmente con una sola especie (Palacio-Castro *et al.,* 2023). Actualmente, se sabe que la fotoaclimatización en corales se debe a ajustes fenotípicos, a la capacidad de variaciones en zooxantelas a nivel celular y posiblemente a adaptaciones específicas al ambiente (DiPerna *et al.,* 2018, Hennige *et al.,* 2008). La variación ambiental en el golfo de Panamá es mayor que en el golfo de Chiriquí, y hasta la fecha se desconoce cuál es la capacidad fotosintética de los linajes de *Pocillopora* provenientes de ambos golfos. Nuestro trabajo evaluó de manera experimental la capacidad de foto-aclimatización en *Pocillopora spp.* que habitan en el golfo de Panamá y Chiriquí.

Leo Camino
Intern
Universidad Regional Amazónica Ikiam
Advisor: Owen McMillan

▸ Gene expression of *Hsp70* genes as a response to thermal stress in the tropical butterfly *Heliconius erato* (*Nymphalidae*)

Abstract

Climate change has increased the variability of global temperatures over the last decades. The unpredictability of climatology represents a challenge for global biodiversity conservation. The induction of heat shock proteins is a genetic mechanism to face thermal stress. It has been shown that *H. erato* is influenced by climate alterations. Nevertheless, epigenetic mechanisms are still unknown. For the first time, we quantified the gene expression of single-exon genes of the Heat Shock Protein family of 70 kDa (*Hsp70*) of *H. erato* through RT-qPCR and ΔΔCT at different temperatures. We identified three single-exon genes using Nucleotide BLAST: *Hsp70A, Hsp70B1,* and *Hsp70B2*. Gene expression was analyzed from the head, thorax, and abdomen. Heat shock at 40°C resulted in significant overexpression of all genes, whereas cold shock at 4°C resulted in slight overexpression. This study reveals the effects of heat and cold thermal shock in the *H. erato* butterfly and provides valuable information to comprehend the epigenetic impacts caused by climate change in the Neotropical butterflies.

Marcela Castañeda
Fellow
Universidad de Antioquia
Advisor: Carlos Jaramillo

▸ Pollen morphology of the Tropical Dry Forest in the northern Bolivar department, Colombian Caribbean

Abstract

The tropical dry forest of Colombia has been poorly studied. Here, we described the pollen morphology of 62 species, 55 genera and 28 families of the Tropical Dry Forest from northern Bolivar, Colombian Caribbean region, 43 species of them are described for the first time in the literature. The unit (monad), shape (oblatespheroidal), opening (tricolporate) and ornamentation (reticulate), are the most common morphological characteristics. Fabaceae, Acanthaceae and Malvaceae are the dominant families with 14, 6, and 4 species, respectively.

Sheryl Castro
Intern
University of Panama
Advisor: Rachel Collin

▸ Composición y abundancia del zooplancton en un gradiente ambiental en el Lago Gatún, Panamá

Resumen

La productividad acuática está limitada por el suministro de materia prima y por la efectividad biológica de transformarla en fuentes energéticas (Hutchinson, 1967). Los miembros del zooplancton juegan un papel muy importante en la ecología de los cuerpos de agua, ya que son los encargados de transformar el alimento producido por el fitoplancton en proteína animal (Wicksted, 1979). Describir la composición y abundancia de los organismos dentro de la comunidad zooplanctonica fue nuestro principal objetivo. Los muestreos se realizaron en 4 puntos del lago Gatun desde junio 2022, utilizando red plantónica de 20µm con arrastre vertical por la columna de agua a metro, la muestra obtenida concentro y fijo para luego ser contada al microscopio. Dando como resultados preliminares la presencia de 28 generos pertenecientes a 3 grupos que son Cladoceros, Copepodos y rotíferos y de otros organismos.

María Chacón
Intern
Universidad Federal de Río de Janeiro
Advisor: Matthieu Leray

▸ Testing innovative culturing approaches for uncovering the functional role of the coralassociated microbial dark matter

Abstract

Although there is no doubt that the coral microbiome is mainly beneficial to the host, their specific functions remain poorly known. Microbes compose a large portion of the planet's biomass; however, most of the taxa belong to the uncharacterized "microbial dark matter." This paradox is commonly seen within coral-associated microbes (CAMs). CAMs play critical roles in influencing the host's health and fitness through the supply of nutrients and the protection against coral pathogens. CAMs have been mainly recovered using amplicon sequencing and short-read metagenomics. While these approaches provide essential insights for understanding diversity, community turnover, and to some extent, predicted function, they suffer several important drawbacks. However, cultured-based methods are powerful for studying taxonomy, microbes' roles in coral health, their metabolic pathways, and ultimately their potential biotechnological use. Here, we propose to compare traditional and alternative culturedependent methods to isolate CAMs of the two dominant Tropical Eastern Pacific branching corals, *Pocillopora verrucosa* and *Pocillopora grandis*. More specifically, test the efficiency and selectivity of four culture-based approaches for cultivating the so-called "microbial dark matter" present in the coral meta-organism: (1) a coral-based culture medium called "Coral Juice"; (2) a nature-based solution resembling the chemical composition of the coral mucus; (3) Winogradsky columns; (4) traditional nonselective media (Marine agar). This study recovers the cultured coral microbiome to date and draws suggestions for developing the next generation of CAMs culturomics.

Brandi Christiano
Fellow
The University of Texas at Austin
Advisor: Rachel Page

▸ Reproductive state influences fruit ripeness preference in frugivorous bats

Abstract

Discerning the complex interplay between reproduction, nutritional demands, and food selection strategies are central to our understanding of bat ecology and evolution. Animal reproduction incurs inherent costs, giving rise to heightened nutritional demands that in turn prompt distinct foraging behaviors. Frugivorous animals generally display a preference for ripe fruits rich in sugar content, favoring them over unripe fruits. However, specific ripeness preferences can vary across animal species based on individual requirements. This study investigated the ripeness preferences of *Carollia perspicillata*, a frugivorous bat species, and explored how their foraging choices are influenced by their reproductive state. We found a positive correlation between sugar content (% brix) and the amount of food consumed. Additionally, we observed a significant interaction between reproductive state and ripeness on the amount eaten, with reproductively active bats (both male and female) particularly eating more overripe fruit than non-reproductive individuals. We are continuing to explore these questions in two other species of frugivorous bats, *Artibeus jamaicensis* and *Uroderma bilobatum.*

Olivier Collard

Intern

University of Liège

Advisor: Matthieu Leray

▸ *Pocillopora spp Symbiodiniaceae* assemblage variation with temperature and salinity fluctuations across the Tropical Eastern Pacific (TEP) of Panama

Abstract

The Tropical Eastern Pacific (TEP) of Panama has a unique oceanographic feature. It is composed of 2 gulfs: the Gulf of Chiriqui and the Gulf of Panama. Due to the different topography along the Isthmus of Panama, the former is only minimally influenced by seasonal upwelling while the latter is highly influenced by upwelling. This seasonal upwelling induces a great variation in environmental conditions particularly salinity, nutrient and temperature. Corals from the species *Pocillopora spp* live within those 2 gulfs, and some evidence suggests that the reef populations from the Gulf of Panama are better able to endure bleaching events than the reefs from the Gulf of Chiriqui, possibly because they have adapted to seasonally fluctuating conditions. I study the dynamics of associations between Pocillopora spp and their algal symbionts in response to changing environmental conditions. This mechanism of symbiont shuffling, along with other adaptive strategies may play an important role in bleaching resilience.

Rhayza Cortes-Romay
Fellow
Instituto de Ecología/Ciencia Molotov
Advisor: Sabrina Amador

▸ Inclusión de hongos *Marasmius* en los nidos de aves como un potencial mecanismo para repeler hormigas

Resumen

La sobrevivencia de las nidadas de aves depende del sitio donde ponen el nido y el material con el que construir, además de las estrategias usadas para evitar predadores. Algunas aves anidan cerca a avispas u hormigas, sin embargo, utilizan materiales que parecen repeler a estos insectos agresivos. En un estudio preliminar comprobamos que el hongo "Cola de caballo"(Rizomorfos de marasmioide) usado en nidos de *Icterus pustulatus*, repele hormigas (*Psedomyrmex spinicola*) de cornizuelo (*Vachellia collinssi)*. Teniendo estos resultadps como antecedente, gracias a una STF-STRI propuse un proyecto donde busco determinar: i) La(s) especie(s) de hongos usadas en la construcción de nido de *I. pustulatus* y *T. sulphurescens*; ii) Las sustancias químicas que expulsan los hongos; iii) Si la concentración de las sustancias que expulsa el hongo marasmioide disminuye en el tiempo y iv) Si el efecto repelente también sucede sobre otras especies de hormigas.

Denise Dalbosco Dell'Aglio
Fellow
University of Bristol
Advisor: Owen McMillan

▸ Ecological and behavioural divergence between *Heliconius* butterflies

Abstract

Understanding how stimuli in different sensory domains are perceived is crucial to explain how behaviour is shaped by local adaptation to distinct environmental conditions. Using two related species, *Heliconius erato cyrbia* and *Heliconius himera*, I tested the hypothesis that divergence in sensory brain regions affects behaviour. These butterflies are isolated across an ecological gradient, which is linked to differences in brain morphology, specifically in visual and olfactory centres. I quantified differences in colour and odour perception, and flight height behaviour together with forest structure. My results have shown that these species have diverged in the emphasis placed on these sensory domains during foraging. As foraging efficiency contributes to survival, I suggest that foraging behaviour may reflect local adaptation. My results highlight the potential role of habitat-dependent divergence in behaviour during the early stages of speciation and strengthen evidence that local adaptation is partly facilitated by changes in the neural basis of key behavioural functions.

Alexandra De León
Fellow
Universidad Marítima Internacional de Panamá
Advisor: Rachel Collin

▸ Documenting seasonal patterns in diversity of hydromedusae (Cnidaria: Hydrozoa) in the coastal waters of the Bay of Panama

Abstract

Within the Phylum Cnidaria, the class Hydrozoa is the most morphologically diverse, including medusoid and polypoid phases. Medusae are seasonally produce synchronized with their benthic polyps, but the cues triggering medusa production and therefore their blooms, are unknown in most species. In the Bay of Panama, we have the presence of winds that are more intense during the dry season (January to April) giving rise to the oceanographic phenomenon known as upwelling. Upwelling phenomenon is often correlated with high productivity and been linked to medusa blooms in tropical water. To understand how medusa population fluctuates in response to these seasonal factors and to enhance our taxonomic knowledge of hydromedusae in the Bay of Panama, we performed frequent plankton sampling from April 2022 to March 2023. As a first chapter of this research, we identified 14 genera of hydromedusae using morphological analysis. For the last chapter, which is still in process we are applying molecular barcoding analysis that will help us with an accurate determination of species diversity and taxonomic revision.

Andrés Díaz
Intern
Universidad de Caldas
Advisor: Carlos Jaramillo

▸ Pollen digitization project: building a dataset for AI training

Abstract

The pollen digitization project aims to digitize 700,000 pollen grains using three microscope techniques including Bright-field (BF),differential contrast (DIC), and confocal (CF). The grains belong to the Graham pollen collection, the largest in the world. The digitization has three main objectives: 1. preservation as collection is decaying 2. accesibility beyond the CTPA building 3. training a neural network to help with pollen identification. A critical step in the digitization process is the image cropping . In this step, images are quality-controlled to avoid problems liked over-saturation and only the relevant information is preserved. Twenty grains per species are photographed in both BF and DIC, while five grains are photographed in CF . This project will introduce the discipline of Palynology to the XI century.

Erin Dillon

Fellow

University of California Santa Barbara

Advisor: Aaron O'Dea

▸ Reconstructing millennial-scale variability in reef shark communities across the Isthmus of Panama

Abstract

What is natural for sharks in the coastal seas? Shark populations have declined steeply over the last half century due to overfishing and habitat degradation, with different regions experiencing varying levels of decline. However, longer-term records of shark abundance that precede these threats are limited, making it challenging to determine how local environmental conditions influence pre-exploitation shark baselines and their susceptibility to human impacts. Here, we use fossil shark scales (dermal denticles) preserved in coral reef sediments to reconstruct shark communities during the mid-Holocene and today on both coasts of the Isthmus of Panama. Our findings shed light on the role of energetics in shaping natural variation in shark baselines and resilience. They also highlight the importance of incorporating oceanographic context into shark conservation.

Laurie Dufour

Fellow

McGill University

Advisor: Rachel Page

▸ Artificial light encourages social learning in fruit-eating bats

Abstract

Frugivorous bats are the second most numerous seed-dispersing agent after birds in the Neotropics and facilitate natural succession in deforested habitats. Artificial light at night threatens bat-mediated seed dispersal by reducing the number of fruits bats harvest each night to avoid lit areas. Although the impact of light pollution on some bat behaviours has been studied (e.g. foraging, commuting, emergence, roosting and breeding), the interaction between anthropogenic lighting and social learning - learning from others - has not yet been focused on. We asked if *Carollia perspicillata*, a fruit-eating bat, relies more on social information when foraging in a brightly lit ("risky") environment than in a naturally dark setting. We found that more bats use social information cues in the light than in the dark, but individual latency to feed and time spent feeding was unchanged across conditions.

Raiza Erlenbaugh
Fellow
University of Panama
Advisor: Ashley Sharpe

▸ Redescubriendo lo descubierto

Resumen

Recontextualizando las cerámicas de Cerro Juan Diaz, Panamá, para la divulgación pública en formatos digitales.

Actualmente en la arqueología se levantan los datos en campo, más rápidos de los que es posible procesarlos y analizarlos. Por esta situación, suele suceder que, una vez terminada la jornada de excavación, los hallazgos quedan colocados en bolsas o cajas dentro de bodegas para su posterior análisis pero estos quedan rezagados. Con el paso del tiempo y los cambios tecnológicos, a veces sucede que estos descubrimientos quedan completamente olvidados y por ende quedan perdidos dentro del registro histórico para las nuevas generaciones.

Cuando empecé a trabajar con la colección creada en los años 90, de Cerro Juan Diaz, uno de los principales retos fue el acceso a la información, debido a que la misma no siempre está accesible por diversas circunstancias tanto burocráticas como ambientales. Situación que terminó afectando el relato de estos datos que han estado esperando ser actualizados por un periodo de casi 20 años desde que se finalizó la parte de trabajo de campo de este proyecto.

Por este motivo decidí crear un Catálogo de referencia arqueológica para el estudio de Cerámicas Prehispánicas del sitio Cerro Juan Díaz , en el Área Central de Panamá, como herramienta pública y didáctica. Conectando de esta manera las evidencias rescatadas en aquel entonces con una nueva audiencia.

Eze Chinedu

Fellow

Université des Sciences, des Techniques et des Technologies de Bamako (USTTB)

Advisor: Martijn Slot

▸ Biochemical regulation of photosynthesis: Not a limiting factor for net photosynthesis of plants grown under elevated temperature

Abstract

We investigated the effects of elevated temperature and low relative humidity (RH) on biochemical controls over photosynthesis (Vcmax and Jmax) for tropical forest species in a greenhouseexperiment in Gamboa, Panama. Seedlings of six species were grown at ambient conditions (control), elevated temperature with increased RH, and at elevated temperature with decreased RH. Vcmax and Jmax values were estimated from CO2-response curves measured at 31°C and 38°C. The values were generally higher at 38°C compared to 31°C, suggesting photosynthesis was unlimited by biochemical constraints at high temperature. Most species acclimated to elevated temperature exhibit similar or higher Vcmax and Jmax values compared to the control plants. However, two species demonstrate lower parameter values for the warm-acclimated plants. The effects of different RH levels on photosynthesis were consistently small, despite large differences in drought-tolerance of the target species. These preliminary findings provide insights into the factors that limit photosynthesis under predicted climate-change.

Ahana Fernandez

Fellow

Museum of Natural History Berlin, Leibniz Institute for Evolution and Biodiversity Science

Advisor: Rachel Page

▸ The Greater Sac-winged Bat: A mammalian model for Biolinguistic Research

Abstract

The Greater sac-winged bat is a unique mammal with a remarkable set of features, including vocal learning, babbling, and song. This bat species is the only other mammalian vocal learner besides human infants that undergoes an intense vocal practice phase called babbling.

In my talk, I will present my research on the babbling behavior of Greater sac-winged bats, including recent findings on how their social environment shapes vocal practice and learning. Additionally, I would like to give an outlook on my current research which is focused on exploring the neuromolecular underpinnings of vocal learning in a non-human mammal by integrating neuroethology and bioacoustics. By studying the Greater sac-winged bat, I aim to contribute to research on the neuronal substrates of vocal learning in mammals.

With this talk, I want to demonstrate why this bat species is an excellent model for biolinguistic research.

Natalie Ferro

Fellow

Wageningen University

Advisor: Luis Mejia

▸ Growth effects and related root traits effects in *Theobroma* cacao due to mycorrhizal communities in Panamá

Abstract

A valuable perspective for plant crop development is to breed for beneficial mutualistic symbiosis, for which it is important to understand how each partner (plant and symbiont) modifies the structure that supports the symbiosis. To achieve this understanding, we evaluated the root traits relevant to the mycorrhizal symbiosis, such as the diameter (D), root tissue density (RTD), specific root length (SRL), and root N content (N), while evaluating the plant biomass production as mycorrhizal response and mycorrhizal root abundance. Regarding the aboveground biomass production, there were significant differences for main effects from AMF and progenies treatments, as well as between treatments. Moreover, RTD and SRL were highly influenced by the presence of mycorrhizal fungi, contrary to D and N. This finding strengthens the value of considering key players in the ecological niche when developing new plant cultivars, as well as the life history evolution of different plant species.

Dale Forrister

Fellow

University of Utah

Advisor: Erin Spear

▸ Exploring the phytochemical landscape in space and time: implications for the evolution of tropical trees and species coexistence

Abstract

Plants are widely recognized as chemical factories, with each species producing dozens to hundreds of unique secondary metabolites. These compounds shape the interactions between plants and their natural enemies. We explore the evolutionary patterns and processes by which plants generate chemical diversity, from evolving novel compounds to unique chemical profiles.

We characterized the chemical profile of one-third of the species of tropical rainforest trees in the genus *Inga* (c. 100, Fabaceae) using ultraperformance liquid chromatography-mass spectrometry-based metabolomics and applied phylogenetic comparative methods to understand the mode of chemical evolution.

We show: each *Inga* species contain structurally unrelated compounds and high levels of phytochemical diversity; closely related species have divergent chemical profiles, with individual compounds, compound classes, and chemical profiles showing little-to-no phylogenetic signal; at the evolutionary time scale, a species' chemical profile shows a signature of divergent adaptation. At the ecological time scale, sympatric species were the most divergent, implying it is also advantageous to maintain a unique chemical profile from community members.

Dumas Galvez
Fellow
University of Lausanne
Advisor: Sabrina Amador

▸ Optimal foraging, energy status and risk of infection in the ant *Ectatomma ruidum*

Abstract

The optimal foraging theory (OFT) is an ecological model that helps predict how an animal behaves when searching for food. This model assumes that optimal foraging behavior will be selected by natural selection, and there are multiple examples in the vertebrate and invertebrate literature. However, few studies evaluated whether OFT decisions are influenced by the risk of infection when foraging. We investigated whether workers of the ant *E. rudium* vary their consumption response of workers of the termite *Nasutithermes corniger* inoculated with the entomopathogenic fungus *Metahirzium brunneum* or a control solution. We investigated whether this response was influenced by the ant's energy state. We found that the ants preferred healthy termites and hungry ants were more responsive, regardless of termite type. Our results suggest that infection risk exerts a powerful selection pressure that outweighs the cost that famine exerts, and this work contributes to consider new concepts when studying OFT.

Jorge Garzón
Fellow
Virginia Commonwealth University
Advisor: Kristin Saltonstall

▸ Preliminary results suggest morphological differences between the isolated populations of *Myadestes coloratus* in the Darien region

Abstract

The neotropical region exhibit geographic phenotypic variation, suggesting allopatric divergence, but few studies exist on the degree to which such phenotypic differentiation is consistent with genetic variation in bird species. Preliminary phylogeographic studies with a limited sample size reveal a modest genetic divergence in the populations of the species *Myadestes coloratus* that inhabit mountain ranges Cerro Chucantí and Cerro Pirre in the Darien region, but it has not been explored whether this divergence is also expressed at the phenotypic level. We hypothesize that the lowlands separating the highlands act as a geographic barrier, restricting gene flow between populations of upland-restricted species and promoting phenotypic divergence. To test these hypotheses, we took morphological measurements, blood samples, and throughout univariate and multivariate statistical analysis, we found significant morphological differences between the populations of *M. coloratus* that inhabit Cerro Chucantí, Cerro Pirre and Cerro Tacarcuna to discriminate between them.

Luisa Fernanda Gómez-Correa
Intern

Universidad Nacional de Colombia

Advisor: Helene Muller Landau

▸ Quantifying carbon fluxes from tree mortality and damage through the integration of drone photogrammetry and ground field surveys

Abstract

Tree mortality and damage are important aboveground biomass fluxes in tropical forests. However, both remain poorly understood, and carbon losses attributed to damage in living trees are typically underappreciated. Here, we quantify carbon fluxes from tree mortality and damage on the BCI 50 ha plot since 2016 by combining drone photogrammetry data on canopy disturbances with crown maps and ground-based tree damage and mortality surveys. We first relate the crown area lost from individual canopy trees (calculated from repeat drone photogrammetry) with ground-based observations of their damage and mortality to develop equations for estimating biomass loss fluxes from the canopy disturbance and crown map data. We then apply these methods to estimate canopy tree mortality and damage fluxes across the entire plot at monthly scales. This research develops and applies new methods that provide data on tree mortality and damage at larger scales and higher spatiotemporal resolution than previously available.

Luisa Fernanda Gómez-Vargas
Fellow
Universidad Nacional de Colombia, Sede Medellín
Advisor: Carlos Jaramillo

▸ Evapotranspiration and vegetation changes along the Fundación river, Sierra Nevada de Santa Marta

Abstract

Evapotranspiration (ETP) is a variable of the water cycle that allows to interpret balances in hydrographic basins. Most methods to estimate ETP are not accurate to cover large areas and/or can be very expensive. In order to understand how the variable changes due to human pressures, I studied the relationship of ETP with the multitemporal changes of the vegetation (NDVI) from 2001 to 2022. To validate the satellite information (MODIS 16 and FAO Penman Monteith) an adjustment was made with in-situ data of ETgage evaporimeters in five sites located along the Fundación river basin, Sierra Nevada of Santa Marta. Results indicated significant differences between the coverages, large differences in magnitude between satellite and in-situ data, but similarities in trends and behavior. Results suggest that a change in land use affects the water regimes of the area, triggered by alterations in the energy and water balances of the region.

Logan James

Fellow

McGill University/University of Texas

Advisor: Rachel Page

▸ Dopaminergic influences on perception and production of courtship calls in a frog

Abstract

Across numerous species, sounds are used for communication in courtship contexts, and receivers of these signals typically have preferences for certain acoustic features over others. The dopamine signaling system is thought to be important in these systems by inducing signalers to produce courtship calls, and by guiding the preferences in receivers. Despite the prevalence of courtship calls across thousands of species of frog, we know little about how variation in dopamine levels influences call production and perception. During my STRI fellowship, I am using the túngara frog to investigate the effects of short-term elevations in dopamine levels in both signal producers (males) and receivers (females). I have found that the influx of dopamine in females alters their species-typical acoustic preferences, and changes calling rates in males. These results begin to elucidate how this system functions in frogs, and provide the foundation for my ongoing investigations of these processes.

Julie Labau

Fellow

Maastricht University

Advisor: Owen McMillan

▸ Does the local adaptation of *Aedes aegypti* improve their survival against *Aedes albopictus*?

Abstract

Aedes aegypti and *Aedes albopictus* mosquitoes are major arboviral disease vectors in human populations. Divergent climate conditions shape the outcome of their biological interactions, and hence, the disease landscape.

Adaptive genomic loci have previously been identified in local *Ae. aegypti* populations. In Azuero, dry-adapted *Ae. aegypti* still persists in the hotter, less vegetated region colonized by *Ae. albopictus*, despite having been completely replaced by the latter in the more humid area. This suggests that adaptation to local environmental conditions may shape *Ae. aegypti's* resilience to *Ae. albopictus*' invasion.

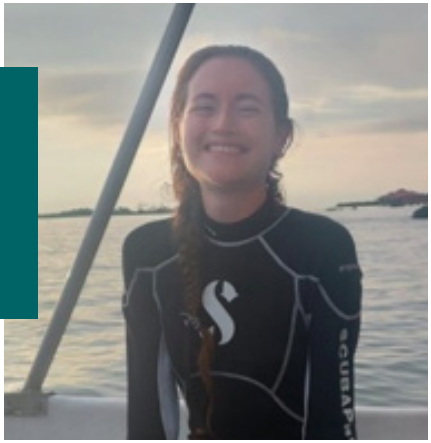
Hereby, *Ae. aegypti* and *Ae. albopictus* eggs from the driest part of Azuero are translocated to the more humid part, and vice versa. They are reared under local climate conditions, and compared for key biological traits throughout development. Here, I will show the effect of temperature and reduced food availability on *Aedes* longevity in a laboratory setting prior to field deployment.

Laura Lardinois

Fellow

McGill University

Advisor: Matthieu Leray



▸ Host species outweighs effects of seasonal upwelling on coral reef fishes' skin microbiomes

Abstract

Disentangling the diversity and drivers behind marine microbiomes is key to predicting organisms' responses to rapid environmental change. Skin microbiomes - found at the interface between a host and its surroundings - help defend hosts against pathogens, thus playing an important role for host health. We leveraged natural environmental variation created by seasonal upwelling in Panama's Tropical Eastern Pacific to assess the effects of environmental change on host-microbe interactions in wild populations of coral reef fish. Reef fishes' skin microbiomes were highly diverse, varied greatly within and among host species, and were distinct from water microbiomes. Host species and trophic group played a greater role in determining microbiome structure than environmental factors. Responses to future environmental changes may depend strongly on the host, with certain host species being more susceptible. This, in turn, could alter ecosystem dynamics as hosts and their microbiomes respond differently to changing environments.

Mauricio León

Fellow

Universidad Nacional Autónoma de México

Advisor: Carlos Jaramillo

▸ Quantifying environmental variability across modern pollen spectra and geochemical composition of lake sediments

Abstract

The sedimentary processes occurring in lakes are influenced by various environmental characteristics of their surrounding catchment areas. As a result, the deposited materials in lake sediments are related to specific environmental variables that influence their formation and deposition. This research aims to evaluate the effects of different environmental components, including climate, topography, vegetation cover, geology, and anthropogenic impact, on the geochemical and palynological composition of sediment-water interfaces of 132 lacustrine bodies. Multivariate statistical techniques and regression analysis quantified the relationships between these environmental components and sedimentary proxies. The geochemistry of sediments is influenced by basin geology, while organic geochemistry is affected by inherent factors of the lake, such as primary productivity. Pollen assemblages reflect the transition from temperate to tropical vegetation, associated with elevation and climate gradients. This study confirms that pollen reflects regional ecological gradients, while geochemistry captures local conditions, confirming their usefulness in paleoenvironmental reconstructions.

Astrid Lisondro

Fellow

Universidad Autonoma de Chiriquí

Advisor: Karen Warkentin

▸ Elevated ammonia cues hatching in red-eyed treefrogs: a mechanism for escape from drying eggs

Abstract

Egg dehydration can kill terrestrial frog embryos, a threat that is increasing with climate change, but in several lineages embryos accelerate hatching to escape from drying eggs. As water evaporates from eggs, the concentration of metabolic waste increases and ammonia might reach toxic levels. Red-eyed treefrog embryos hatch early to escape from many threats, including dehydration. We hypothesized that high ammonia concentration could serve as a cue, stimulating embryos to hatch. To test this, we exposed stage-matched pairs of well-hydrated sibling embryos to ammonia and control solutions in shallow water baths and recorded their behavior for 30 minutes. Control embryos remained unhatched while 95% of ammonia-treatment embryos hatched. This demonstrates that elevated ammonia can serve as a hatching cue for *Agalychnis callidryas* embryos, revealing a key component of a self-defense mechanism that may be increasingly important for terrestrial frog embryos as their risk of dehydration is exacerbated by climate change.

Paula Lopera
Fellow
Universidad de Antioquia
Advisor: Carlos Jaramillo

▸ Natural affinities of 3 morphotypes of the fossil genus *Proxapertites*

Abstract

The late Maastrichtian to Paleocene fossil pollen morphotypes *Proxapertites humbertoides*, Proxapertites magnus, and *Proxapertites tertiaria* are hypothesized to be produced by plants that belong to Annonaceae. Annonaceae is one of the oldest lineages of Angiosperms and it is the most diverse family within Magnoliales in terms of species richness, individual abundance, and morphological variation. By analyzing pollen morphology, estimating the chronology of Annonaceae tribes, and reconstructing the paleoclimatic conditions of sites where fossils have been found, we provide support for the hypothesis of a close taxonomic relationship between the fossils and the tribe *Bocageeae* (Annonaceae).

Yanileth López-Tacoaman
Intern
Universidad Regional Amazónica Ikiam
Advisor: Owen McMillan

▸ Antimicrobial potential of cutaneous secretion of *atelopus nanay* (bufonidae)

Abstract

This research focuses on the endangered and endemic species *Atelopus nanay* in Ecuador to explore its potential as a source of antimicrobial peptides (AMPs) for therapeutic development. The study characterizes the antimicrobial activity of *A. nanay's* skin secretion and identifies the primary structure of eight putative AMPs through molecular cloning and mass spectrometry. The analysis reveals 28 secretion fractions that exhibit activity against *Escherichia coli, Staphylococcus aureus, and Candida albicans,* potentially due to the presence of temporins, andersonins, and tryptophilins. Additionally, eight novel peptides named Arlequinin-AN1-8 are discovered, with Arlequinin-AN3 predicted to possess antimicrobial properties. The findings highlight *A. nanay* as a species with pharmacological potential deserving further evaluation. This research sheds light on the significance of endangered amphibians in the discovery of new AMPs and the development of alternative therapeutics against pathogens.

Priscila Lopez

Intern

Universidad Nacional de Salta, Argentina

Advisor: Carlos Jaramillo

▸ Microspores of *Selaginella*, the oldest and most diverse genus of vascular plants

Abstract

The genus *Selaginella* P. Beauv. includes 800 species of cosmopolitan distribution and originated about 383 million years ago. The genus is characterized by its uninervate leaves and heterosporous sporangia with trilete spores. The aims of my study are: (1) to describe the microspore morphology of 22 species from Africa, Asia, North and South America and (2) to identify spore characters that could be related to xeric and mesophytic environments. The spores were visualized with Confocal and Scanning Electron Microscopy. The studied species were classified into three groups according to their habitat: mesophytes growing in montane and gallery forests (9 species), mesophytes of exposed areas (3 species), and xerophytes (10 species). Xerophytic species have granulate or rugulate spores and a thick perispore. In contrast, the ornamentation of mesophyte spores is more diverse including rugulate, reticulate, echinulate, baculate, or tuberculate grains. Next step in my study is optimize the spore characters into a well-supported DNA-base phylogeny.

Brais Marchena
Fellow
Weber State University
Advisor: Katherine Potvin

▸ Enhancing Forest Monitoring and Data Accessibility in Indigenous Communities: A Capacity-Building Project

Abstract

Indigenous territories in Panama are vital carbon sinks, yet indigenous stakeholders face barriers accessing carbon monitoring tools. Existing data collected by academics and regulatory agencies often lack any cultural context, resulting in a disconnection between data creation, policy implementation, and community involvement. This presentation highlights a capacity-building project focused on enhancing forest carbon monitoring and data accessibility in two Emberá territories in Eastern Panama. In 2022, indigenous technicians were trained on computer literacy and carbon accounting. Additionally, user-friendly automated tools were developed to facilitate allometric calculations and estimation of carbon dioxide equivalents using diameter at breast height and species identification. This year, the training encompassed data entry, verification, and management, aiming to involve technicians in the complete data lifecycle. We argue that participatory approaches can enhance forest monitoring in indigenous territories and yield publicly available scientific data that integrates local values and knowledge, and is usable towards participatory environmental governance.

Blaine Martin
Intern
Tulane University
Advisor: Erin Spear

▸ The Effect of Rooting Substrate on Tropical Liana Endophyte Communities

Abstract

Lianas outcompete trees both above and below ground, having root traits for better resource acquisition and mutualistic endophytes. Fungal mutualists (AMF and DSE) play a vital role in nutrient uptake and stress tolerance that could give lianas a further edge in tropical forest ecosystems. I analyzed communities of liana roots from substrates (water, air, soil) within rivers along Pipeline Road in Soberanía National Park, Panama. Through root staining and microscopic quantification, AMF and DSE colonize liana roots inversely. AMF and DSE also showed significant difference in colonization by substrate (soil>air>water and soil/air>water). My hypothesis that endophyte colonization depends on substrate is supported by these results, as well as the prediction that soil roots would have the highest endophyte colonization. These results provide clarity to tropical liana ecology and call for more research in microbial ecology to understand liana competition in the face of climate change.

Ana Raquel Martinez

Intern

University of Panama

Advisor: Sabrina Amador

▸ Phylogenetic determination of the fungus Leucoagaricus gongylophorus in *Sericomyrmex amabilis* ants in Panama

Abstract

Understanding the biological interactions between individuals of the same species and between different species allows us to understand the basic and fundamental aspects of organisms. All species are involved in two or more interspecific relationships, and these can be classified according to the effects or "results" they have between the different organisms involved. Currently, mutualism is known to occur in numerous habitats around the world, a clear example of this relationship being the Attini tribe ants and their cultivated basidiomycete fungus. Where all attine ants are obliged to the cultivation of fungal gardens for their food.

The ant genus *Sericomyrmex* has a wide distribution in the Neotropics, especially *Sericomyrmex amabilis* has a distribution that goes from Mexico to Ecuador. *Sericomyrmex* ants are commonly found in a wide range of habitats, including wet forests, preferably in leaf-litter, savannahs, mid-elevations deserts

We propose to carry out research in different sites in Panama in order to collect colonies of *S. amabilis* and carry out genetic studies on the symbiont fungi of these Attine ants and thus be able to determine the geographic and phylogenetic distribution of the symbiont fungus within the Attine system.

Jhonatan Martinez
Intern
Universidad de Caldas, Manizales
Advisor: Carlos Jaramillo

▸ Analysis of the Eocene paleoflora in the Middle Magdalena Valley Basin, Colombia. Paleoclimatic and paleoecological implications.

Abstract

Movement toward our current climate state began in the middle Eocene to early Oligocene interval when the global temperature cooled and the first Antarctic ice sheet appeared. This dramatic climate change caused a significant global turnover in both marine and terrestrial biotas. The biotic response to this event at low latitudes remains mostly unexplored. In the last decade, paleogene rocks have shown a high potential for the evolutionary study of tropical vegetation, through their micro and macropaleontological record. This study presents the paleobotanical record of the Eocene rocks belonging to the Middle Magdalena Valley basin (Colombia), which includes the analysis of more than 9000 fossil palynomorphs and more than 700 macrofossil specimens found in two localities represented in leaves, seeds, cuticles, fruits and flowers. With the above, a general evolutionary vision of the vegetation is presented as a whole and the paleoclimatic conditions (precipitation and temperature) are reconstructed from a coexistence analysis, comparing the environmental results with modern analogues.

Olivia Milloway
Fellow
Emory University
Advisor: Mark Torchin

▸ Experiencing science through sound: night fishing on Lake Gatún

Abstract

A place's soundscape can communicate unique information about its natural and cultural context. Frogs calling, boats in the distance, a nearby highway, or overheard music can ground the listener in place, season, and even time of day. Because field work is often a visual process, Panama's rich soundscapes are overlooked in scientific research when sound is not directly tied to a research question. However, sound can be used as an effective medium for science communication, which is necessary to inspire care for the natural world, help diverse audiences understand the value of science, and face existential challenges like the climate crisis. To demonstrate, I am recording sound during night field work in Lake Gatún. My research involves catching Atlantic needlefish (*Strongylura marina*), a marine fish that is invading the Panama Canal, in order to examine parasites that might be "hitchhiking" into a novel habitat.

Mia Mitchell

Intern

Brown University

Advisor: Helene Muller Landau

▸ Spatial Contagiousness of Canopy Disturbances

Abstract

Questions have been raised and tested on whether canopy disturbances are spatially and temporally related to one another – whether new disturbances are more likely to occur near existing gaps than away from them. Young and Hubbell (1991) found evidence that supported the 'gap contagion' hypothesis on Barro Colorado Island. However, other studies within tropical forests falsify this hypothesis. Still, within the last ten years, the volume and quality of lidar and drone photogrammetry data have increased on Barro Colorado Island, which allows for a re-evaluation of this question. Moreover, this project has begun to evaluate and analyze the hypothesized drivers of spatial contagiousness, which include crown asymmetry, canopy rugosity, increased turbulence around existing gaps, and the deterioration of standing dead trees.

Javiera Mora
Intern
Universidad de Panamá
Advisor: Matthieu Leray

▸ Influencia de la variación ambiental en la ecología alimenticia de especies hermanas de peces de arrecife de coral

Resumen

Estaré abriendo los estómagos de dos especies planctívoras y dos especies carnívoras. El objetivo principal es estudiar el efecto de la variación ambiental en la alimentación, dentro de los específicos determinaremos la composición de la dieta, identificaremos las presas en la medida de lo posible y compararemos el efecto de la variación ambiental entre especies. Se utilizará el método numérico, el gravimétrico y el volumétrico para los análisis del contenido. Se evaluará si hay o no hay diferencia significativa en la diversidad y abundancia de presas encontradas en los estómagos de las especies hermanas. Dentro de mis análisis estadísticos estaré usando los índices de Shannon-Weaver para diversidad y el de Bray-curtis para abundancia. Se sabe que la aparición del istmo de Panamá influyó drásticamente en la dinámica oceanográfica del Pacífico y el Atlántico, por lo que Los parámetros ambientales a relacionar serán: temperatura, Ph, turbidez, clorofila, salinidad y oxígeno disuelto.

Brenda Orosco
Intern
Universidad Peruana Cayetano Heredia
Advisor: Carlos Jaramillo

▸ Pollen morphology of Sanguisorbeae (Rosaceae): Comparison with fossil elements

Abstract

The tribe Sanguisorbeae (Rosaceae) is mainly distributed in the Andes, including genera such as Acaena, Margyricarpus, Polylepis, and Tetraglochin, which diversified from the Verruchaena lineage during the late Miocene. Polylepis and Acaena exhibit different ecological habits, but their pollen morphology is similar (i.e., Byttneripollis rugulatus). New microscopy techniques (e.g., confocal microscopy) should be employed to differentiate them, as this would assist palynologists in distinguishing the structures of plant communities in their paleoecological analyses.

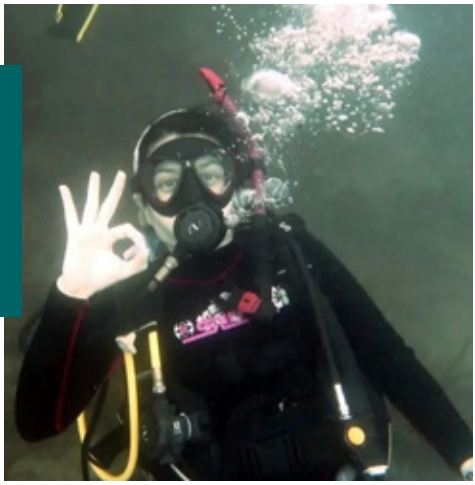
To differentiate the genera within Sanguisorbeae, 30 species collected from herbarium specimens were analyzed and compared with fossil samples from the Peruvian Pacific coast (~8 million years ago).

Natalia Ossa

Fellow

Universidad del Valle, Cali- Colombia

Advisor: Carlos Jaramillo



▸ Phylogeny and morphological evolution of transisthmian species of marine fishes separated by the Isthmus of Panama

Abstract

The uplift of the Isthmus of Panama was a major geological event, causing alterations in the environment of the divided oceans. This type of large-scale ecosystem alteration, which isolates previously continuous populations, is considered a primary factor driving biological diversification, generating spatial and temporal patterns of genetic and morphological differentiation. However, changes in functional traits of marine organisms on each side of the barrier have been seldom studied. This project seeks to explore the mode of diversification of a group of fishes (families Carangidae, Centropomidae, Gerreidae, and Haemulidae) to answer the question if the trajectory and rate of morphological traits of marine fish species were altered due to the emergence of the isthmus of Panama. We hypothesize that overall Caribbean species have faster rates of morphological evolution and experience more changes in the evolutionary trajectories of functional traits such as suction index, total length, and pectoral fin area, among others, due to changes in environmental conditions (an increase of salinity, an increase of temperature, lower abundance of nutrients, and extensive reef development) after the uplift of the isthmus of Panama.

Natalia Ovalle
Intern
Universidad Nacional Autónoma de México
Advisor: Carlos Jaramillo

▸ Paleoenvironmental reconstruction of the Late Holocene in Lake Amarillo, Chiapas- Mexico

Abstract

The Lacandon forest in southeastern Mexico houses the largest and most biodiverse terrestrial tropical ecosystems in the country. Its varied topography creates steep environmental gradients, fostering microclimates that likely offered shelter to species during climatic shifts. Studies on lacustrine sediments have unveiled the region's highly variable vegetation since the mid-Holocene, influenced by climate and human activities. However, little is known about the middle elevations and their role in protecting biodiversity during environmental hardships. This study presents the sedimentary record of Lake Amarillo, a 2.3-hectare water body with a 3800-year-old sedimentary record. Through the analysis of multi-elemental, organic, and isotopic geochemistry, as well as pollen and charcoal concentrations, this research aims to reconstruct the vegetation history of the area and its relationship with environmental variability. The findings indicate a resilient vegetation mosaic that rapidly recovered from both climatic and anthropic disturbances, shaping the region's modern ecosystems over the past 700 years.

Teresa Peil

Intern

University Rostock and the Max Planck for Marine Microbiology

Advisor: Aaron O'Dea

▸ PANSYMBIOSIS - Evolution of lucinid clams and their bacterial endosymbionts after the closure of the Isthmus of Panamá

Abstract

Symbiotic relationships between Bacteria and eukaryotic hosts can be found throughout all habitats around the world. These interactions are known to have a strong influence on biodiversity and affect the evolution of both partners involved. By looking at the host-associated microbiome, adaptive responses due to environmental changes can be studied. Bivalves of the Family Lucinidae (lucinids) are a divers family of clams that live in a chemosymbiotic relationship with sulfur-oxidizing Gammaproteobacteria. The clams are nutritionally dependent on their bacterial symbionts, who pass organic carbon on to their host. Recently it has been found out that the symbionts of some species of lucinids additionally possess the ability to fix nitrogen and therefore increasing their hosts fitness in oligotrophic environments. The presented project is focussing on the evolution of nitrogen fixation in populations of lucinid clams and their bacterial endosymbionts (in the Caribbean Sea and the Tropical Eastern Pacific) that diverged due to the closing of the Isthmus of Panamá.

Carly Pope
Fellow
University of California, Los Angeles
Advisor: Ashley Sharpe

▸ Ceramic Evidence of Cultural Chronology and Trade in Pre-Columbian Isla Colon, Bocas del Toro, Panama

Abstract

Isla Colon, the largest island in the Bocas del Toro archipelago on the northwest coast of Panama, is unique in the region with respect to its density of archaeological features. Sitio Drago, the largest site yet found in Bocas del Toro, includes ceremonial and settlement mounds that contain a diverse and sizable collection of subsistence remains and cultural materials dating to between AD 750 and 1450. Preliminary inspections noted the presence of pottery styles from at least five distinct culture areas, ranging from Central Panama to Pacific Nicaragua and up to 400 linear km away, at Sitio Drago. Overall, Sitio Drago has the most diverse ceramic assemblages yet found in the region and was likely tied to overland and maritime exchange networks. However, the chronology and intensity of these interactions remain unclear. Ongoing research at STRI focuses on data collection and analysis to investigate these issues.

Rachel Prokopius
Fellow
Florida International University
Advisor: Roberto Ibañez

▸ Is chytrid avoidance an innate or learned behavior in the strawberry poison frog?

Abstract

Batrachochytrium dendrobatidis (Bd) is deadly fungus responsible for declines in amphibian populations worldwide. Learned avoidance of *Bd* has been documented, but no frog is known to exhibit innate avoidance, and avoidance has never been studied in an individual from the poison frog family. This study tested strawberry poison frog *(Oophaga pumilio)* ability to avoid *Bd* through chemosensory choice trials. Frogs were allowed to smell but not touch the fungus, and separate trials were run with live and dead *Bd*. The time spent in the control (broth media), experiment *(Bd)* and neutral (neither) areas of the trial chambers was recorded for each frog. Additional trials were run with frogs infected and cleared of *Bd* to test learned avoidance. Models were generated to determine under which circumstances *Bd* avoidance occurred. These results will provide information for how frogs may use avoidance tactics in a world with a deadly fungal pathogen.

Helio Quintero
Fellow
Universidad de Panamá
Advisor: Matthieu Leray

▸ eCSI: mapping elasmobranch diversity in the Tropical Eastern Pacific using eDNA

Abstract

The Tropical Eastern Pacific is home to migratory and endemic elasmobranchs, but many of them are highly endangered because of unregulated fishing. Yet, data on elasmobranch distribution and migrations collected at a scale that is relevant for management and conservation remains scarce. We are conducting the first multi-year cross-national study to understand spatial and temporal patterns of distribution of elasmobranchs along the Pacific coasts of Panama and Costa Rica using eDNA. With the support of local fishermen, we collected 568 seawater samples at 27 estuaries. We are also generating mitochondrial genomes for 18 species and nuclear genomes for two hammerhead species to build genomic resources for TEP elasmobranchs. We use 12S metabarcoding sequencing to generate species lists and delineate diversity hotspots and sites where critically endangered or elusive species occur. Thus, we lay the groundwork to ask further questions about the distribution, ecological role, and evolution of elasmobranchs of the TEP.

Imran Razik
Fellow
Ohio State University
Advisor: Rachel Page

▸ Formation of new relationships among vampire bats reveals individual variation in cooperativeness

Abstract

The formation and strength of a cooperative relationship depends on the behaviors of both a focal actor and its partner. Relationships are therefore likely to be influenced by both among-actor variation (e.g., consistent differences in "cooperativeness") and within-actor variation owing to differences in traits and experiences across partners. Consequently, consistent differences in helping among actors should be more evident towards new partners than towards familiar partners because variation in social experiences within familiar relationships should become more important for predicting an actor's helping decisions through time. We test this idea in common vampire bats, a species in which unrelated and unfamiliar females form new cooperative relationships that involve clustering, allogrooming, and eventually food sharing. First, we measure allogrooming and food-sharing rates among captive bats that were caught from the same or different sites. We then test if (1) actors show more consistent individual differences in helping rates to new partners than to familiar partners, and (2) actors differentiate their helping rates more through time to new partners than to familiar partners. This work provides an opportunity to evaluate how relationship formation can provide novel insights into individual differences in cooperativeness.

Karina Rodriguez
Intern
University of Panama
Advisor: Roberto Ibañez

▸ Biobank, the first protocol to freeze sperm from *Triprion spinosus*

Abstract

Triprion spinosus is an amphibian species categorized as Near Threatened (NT) by the IUCN. Cryobanks have been implemented as conservation tools to help mitigate genetic loss. Developing amphibian sperm biobanks is an intricate and species-specific process but necessary to help preserve these endangered species.

Our study developed the first sperm freezing protocol for *T. spinosus*. Spermic urine was collected 2. 5 h after stimulation with 0.5 IU/µl hCG. The effect on motility recovery after equilibration in cryoprotectants was measured. Samples were exposed for 5, 10, 15 and 20 minutes at 4 °C to cryoprotectants with different concentrations of dimethylformamide (DMF - 5-10%) and trehalose (5-10%). Freezing was carried out using three ramps above the liquid nitrogen level. Sample thawing was carried out for 10 seconds in water baths at 35°C and 25 °C. An average motility was recovered after an equilibration time of 5 minutes in CPA 1 to 25°C.

Karla Rodriguez
Fellow
University of Panama
Advisor: Daisy Dent

▸ Diversidad y composición florística de las comunidades de plantas adyacentes a la zona oeste de la Cuenca del Canal de Panamá

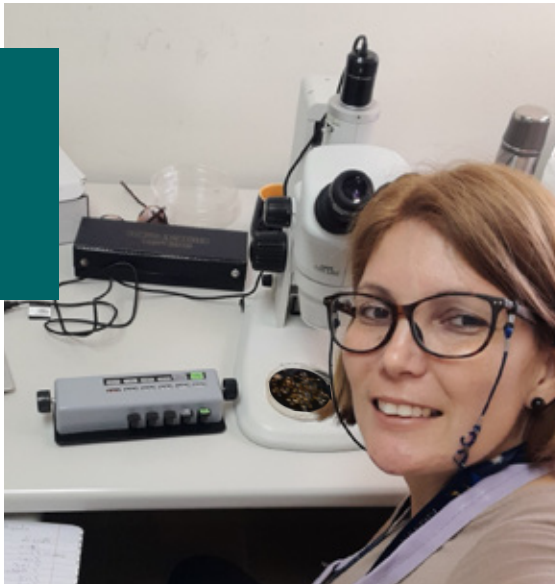
Resumen

Los bosques forman el ecosistema terrestre dominante en la Tierra y desempeñan un importante rol incluyendo, regulación de ciclos biogeoquímicos, clima, y conservación de biodiversidad. No obstante, entre 2015-2020, hubo una pérdida anual de aproximadamente 10 millones de ha de bosques mundialmente. Esta, se debe principalmente a actividades como la agricultura, ganadería y minería. Simultáneamente, la cobertura boscosa de plantaciones es más frecuente, alcanzando un estimado global de 290 Mha en 2020.

Actualmente, los bosques restantes se distribuyen en parches, dentro de matrices antropogénicas conocidas como paisajes tropicales modificados. La capacidad de estos parches para mantener la biodiversidad depende del contexto del paisaje (calidad y configuración), una dinámica de la comunidad a nivel de paisaje, poco conocida.

Este estudio procura evaluar la composición y diversidad de las comunidades vegetales y sus configuraciones en el paisaje a partir de cuatro tipos de hábitats ubicados en el oeste de la cuenca del Canal de Panamá.

Raquel Rodriguez
Fellow
Advisor: Kristin Saltonstall



▸ Arbuscular mycorrhiza in native timber plantations in the panama canal watershed

Abstract

Reforestation strategies that include native timber plantations can optimize both the production of ecosystem services and economic returns in tropical degraded landscapes. We worked in the fully replicated plantation system at the Agua Salud Project in the central basin of Panama to characterize variation in the communities of arbuscular mycorrhizal (AM) fungi across monocultures and mixed species plantations. We focused on Terminalia amazonia planted in monoculture and mixtures with other four native timber species (*Anacardium excelsum, Dalbergia retusa, Pachira quinata*, and *Tabebuia rosea*). Areas of secondary forest, mature forest and *Tectona grandis* (teak) plantation were also included as references. We assessed spore density, mycorrhizal colonization and inoculum potential in January 2023 (dry season). Spore density varied between 27 and 63 spores per gram of dry soil. The lowest values were observed in *Terminalia* monoculture and mature forest whereas the highest values were found in teak plantation and secondary forest. Mycorrhizal colonization varied between 41 and 73%, In general, all native plantations showed high mycorrhizal colonization rates (>58%). The assay of AM inoculum potential identified the plantation of five species mixture as the one with the highest amount of active AM propagules, whereas teak, secondary forest and *T.amazonia–A. excelsum* mixed plantations had the lowest activity. In conclusion, our results suggested that native timber plantation improve the activity of AM fungal communities.

Made Roger

Intern

Cal Poly State University, San Luis Obispo

Advisor: Sabrina Amador

▸ 9-year update on gender equality in US plant production and soil sciences and a deeper look into the mechanisms of vertical segregation

Abstract

Gender inequality is historically well-documented in the US horticultural and soil sciences. In 2005, women comprised just 13% of US plant production and soil science faculty, were concentrated in lower ranks, and were paid significantly less than their male counterparts while accounting for rank. The percentage of women earning PhDs in this field has increased steadily since 1% in 1966, reaching near-parity in 2012. However, in 2014 women remained severely underrepresented in respective government, journal, and academic science professions. This phenomenon, in which each respective "next step" from undergraduate to faculty or research scientist becomes less representative of women, is referred to as vertical segregation. One factor that is believed to at least somewhat account for vertical segregation in the plant and soil sciences is that hands-on experience prior to scientific careers is associated with greater access to collaborators and field sites, and this prior hands-on experience is more common in male scientists. In this poster, I replicate the nationwide survey conducted by Cho et al. (2017) to quantify the progress toward gender equality that has occurred since 2014. I also investigate whether women undergraduate students studying plant production face barriers in gaining hands-on experience, using California Polytechnic State University as a case study. Preliminary findings indicate that women's representation in plant production and soil science has increased since 2014 and that gender-based barriers to gaining hands-on experience could persist through less explicit means than they have historically.

Diego Samaniego
Intern
University of Panama
Advisor: Roberto Ibañez

▸ Artificial Fertilization applied to the conservation of the Panamanian Harlequin Frogs

Abstract

Species loss and the amphibian crisis coexist interdependently in the Anthropocene. In Panama, valuable amphibian species are in the Amphibian Rescue and Conservation Project, a captive breeding program. Many of them with difficulties reproducing are now being studied for the application of assisted reproduction techniques. For *Atelopus varius* and *Atelopus zeteki* species, male and female gametes were collected through hormonal stimulation for subsequent artificial fertilization. For this purpose, hormonal treatments were applied with GnRH at a concentration of 4 µg/g body weight for sexually mature females, which were constantly monitored until the oocytes were expelled. Once oviposited, they were transferred to Petri dishes moistened with Amphibian Ringer Solution to be exposed to spermic urine previously collected by sexually mature males. Fertilized eggs were placed in 100 ml plastic containers with sterilized water and oxygen sources for up to 7 days monitoring until hatching and having a total of 74 juveniles.

Mareli Sanchez
Fellow
Tulane University
Advisor: Kristin Saltonstall / Klaus Winter

▸ Fantastic symbioses and how to study them: unravelling tree nutrient acquisition strategies and carbon costs in lowland tropical forests

Abstract

Soil phosphorus (P) limitation plays an outsized role in the growth, distribution, and predicted response to elevated CO_2 (eCO_2) of lowland tropical trees. Across central Panama, tree species distributions are linked to soil P availability, yet the mechanisms underlying these resource specializations remain unknown. While at STRI, my research has focused on unravelling the range of strategies that tree species use to acquire this limiting resource, such as associating with *arbuscular mycorrhizal (AM)* fungi, producing root phosphatase to access organic P pools, and adjusting root morphological traits. With a focus on *AM* fungi as a prevalent strategy, I have been developing a method to quantify plant carbon transfer to *AM* fungi, which are thought to trade soil nutrients for plant carbon reciprocally. Developing this method may help us determine the carbon costs of outsourcing P acquisition to symbionts, and what factors mediate a plant's investment to *AM* fungi.

Bruno Scudeiro
Fellow
Universidade Federal de Mato Grosso
Advisor: Carlos Jaramillo

▸ Pollen morphology of species of the subfamily Malvoideae

Abstract

Malvaceae comprises 9 subfamilies, one of them being Malvoideae (more than 100 genera distributed along the tropics). This subfamily is described with colporate and pantoporate pollen grains, and spine ornamentation. The study analyzes pollen from Malvoideae in order to compare them with molecular phylogenies to discuss its evolutionary relationships. Several pollen characters were measured including shape, size, aperture type, ornamentation and exine. The preliminary results of 22 pollen genera and 55 species indicate that there are two well-defined groups:1) spheroidal, pantoporate, and echinate; 2) suboblate, colporate, and echinate. The spine height and width of base, the inter spine distance, type of spine, number and size of pores or colpi, and nexine thickness are potential traits that can be used to identify taxa at the genus level. The next steps are to increase the number of genera and optimize the traits into molecular phylogenies.

Vinicius Santos Valle
Intern
Universidade Federal de Mato Grosso
Advisor: Carlos Jaramillo

▸ Fossil Fungi from Miocene of the Solimoes Formation (Well 1-AS-105-AM), Wester Brazilian Amazon

Abstract

I am analyzing the fungal spores and other reproductive structures in the Miocene Solimões Formation in the western Brazilian Amazon. Strata from different depositional settings will be examined to quantify the abundance and diversity of fungi. During the Miocene, the Amazon went through various environmental changes caused by the uplift of the Andes. I hypothesize that fungal spore communities is different from each other when comparing flooded, non-flooded, and marine environments. Therefore, the objective of this study is to quantity the abundance and morphological variation of fungi in each of those three depositional environments.

Carrie Sims
Fellow
The University of Queensland
Advisor: Sean Connolly

▸ Who, How Many and Where: utilizing photogrammetry and AI to reveal and track Panama's eastern tropical Pacific *Pocillopora*-dominated coral reefs

Abstract

Panama's eastern tropical Pacific shallow coral reefs were initially thought to comprise up to seven *Pocillopora* species. Molecular studies have revealed significant morphological plasticity within the group and that they are composed instead of two putative species hence, mudding the waters of our current ecological and evolutionary understanding of this system.

The Rohr Reef Resilience (RRR) program has been conducting bi-annual assessments of *Pocillopora* reef dynamics in the Gulf of Panama and Chiriqui since 2020, capturing data from permanent transects via photogrammetry. In this presentation, I will explain how I processed this data to generate orthomosaics suitable for use in AI-assisted segmentation software to 1) outline colony boundaries and 2) classify the two putative species based on current taxonomic characteristics to capture abundance and distribution data across space and time. Additionally, we will compare this with the estimated *Pocillopora* putative species abundances obtained from eDNA samples. This approach will be in valuable for estimating demographic parameters and providing insights into community dynamics.

Joel Trejos
Intern
University of Panama
Advisor: Sabrina Amador

▸ Diversidad de rizomorfos fúngicos en nidos de aves

Resumen

En el mundo, sabemos que las aves usan rizomorfos como material de construcción en nidos (al menos 176 especies de 37 familias). Los rizomorfos son estructuras compuestas de hifas vegetativas, que se organizan como fibras largas. Varias hipótesis explican por qué las aves incorporan rizomorfos en los nidos, pero las razones pueden depender de las especies de rizomorfos o del ave. Sin embargo, la información que se tiene de la taxonomía y diversidad de especies de rizomorfos en el neotrópico (Centroamérica) es escasa, aún en años recientes se describen nuevas especies (e.g. *Marasmius nidus-avis* en 2020). Por lo tanto, en mi pasantía en STRI colectaré nidos de aves una vez pasada la época de anidación, para buscar rizomorfos. También, buscaré de estos rizomorfos de crecimiento libre en diferentes sustratos en el bosque. Como estos rizomorfos rara vez tienen cuerpos fructíferos, utilizaré DNA barcoding y análisis filogenéticos para identificarlos. Espero generar nueva información para Panamá sobre taxonomía e historia natural de los rizomorfos utilizados en la construcción de nidos de aves.

Vicente Vasquez
Intern
University of Panama
Advisor: Helene Muller Landau

▸ Quantifying individual tree crown growth and loss with drone imagery: Development and application of an automated workflow using convolutional neural networks

Abstract

Tree crown area is poorly quantified in comparison to trunk diameter even though crown area predicts better tree size and photosynthesis. The Panama forests drone dataset has not being fully utilized to delineate crowns due to the horizontal shift across time, and the time-consuming process of manual delineation. We have developed an all-encompassing workflow to process, combine, align, and segment tree crowns across time series. It applies convolutional neural networks and crown maps for detection of trees and AI models for tree crowns segmentation. The main application is to track tree crown growth and loss to understand inter-annual and seasonality variation of crown size of individual trees. Preliminary results display tree crown area changes for a subset of trees within the BCI 50ha plot between 2018 and 2023. Robust methods for quantifying tree crown area are necessary to understand the phenology of forests.

Esther Velasquez

Fellow

Universidad distrital de Colombia

Advisor: Martijn Slot

▸ Effect of warming on root associated fungi and phosphorusacquisition by seedlings

Abstract

Tropical forests are the most biodiverse and productive terrestrial ecosystem. Therefore, it is critically important to understand how they may be affected by the predicted warming this century. It has been widely reported that high rates of tropical forest productivity are partly maintained through the activity of root-associated fungi and their capacity to acquire 'plant-growth-limiting' phosphorus from the soil. In this proposal, I will test how a warming climate will affect root-associated fungal communities and phosphorus cycling in the rhizosphere. I will collect roots and rhizosphere soil samples from seedlings growing within the SWELTR study (Soil Warming Experiment in Lowland Tropical Rainforest) on Barro Colorado Island (BCI), which has been operating since 2017. I will test the hypothesis that soil warming can result in changes in root fungal communities, an increase in mycorrhizal colonization, an increase in root phosphatase activity, and an overall phosphorus availability with a potentially positive effect on plant growth. We will characterize the root-associated fungal communities based on Illumina sequencing, quantify the different fractions of phosphorus in the soil, and the colonization of arbuscular mycorrhizal fungi (AMF) of six plant species growing in warming and control treatments. Understanding the effect of warming in root-associated fungal communities, particularly AMF, and the absorption of phosphorus in seedlings, would help predict potential outcomes of climate change in fungi-plant interactions in tropical forests

Claire Williams
Fellow
University of Nevada, Reno
Advisor: Owen McMillan

▸ Characterizing rapid shifts in the *Anolis* gut microbiome after introduction to a novel environmen

Abstract

As rising temperatures threaten biodiversity worldwide, tropical ectotherms may be particularly vulnerable due to their narrow thermal tolerance ranges. Gut microbiota can affect physiology and change rapidly in response to environmental change. Thus, shifts in gut microbial communities might play a role in adaptation of hosts when thermal environments change quickly. To evaluate the role of the gut microbiome in a host's response to warming, we transplanted slender anole lizards (*Anolis apletophallus*) from a mainland population to four islands in the Panama Canal and characterized shifts in gut microbiomes within and across generations on these warmer islands. The composition of the gut microbiome changed rapidly in response to transplantation and pre-transplant microbiome composition was correlated with host survival on at least one island. We are currently conducting additional studies to understand how shifts in microbiomes might impact host fitness in our rapidly changing world.

Kelly Wuthrich
Fellow
Florida International University
Advisor: Owen McMillan

▸ Transient heat waves induce a rapid and reversible increase in thermal tolerance in a thermoconforming lizard

Abstract

How and if organisms are able to endure climactic changes is important to understand population trajectories during climate change. One coping mechanism employed by many species is phenotypic plasticity to maintain physiological processes under differing thermal conditions. Reversibility in a plastic trait can decrease the costs of a mismatched phenotype when climatic shifts are rapid and reversible. Because thermoconforming ectotherms are more likely to be affected by increased mean and thermal variability, it is crucial to understand the plastic potential and reversibility of their thermal traits. We studied the plastic potential and reversibility of voluntary thermal maxima (VTmax) in a tropical ectotherm, the slender anole, after exposure to a warming event. We found that VTmax is plastic but decreases in a circadian rhythm. We found that elevated VTmax spikes again 24h after the 32oC treatment. This study increases our understanding of the role of plasticity in response to changing environments.

KEYNOTE SPEAKER

Caroline Bacquet

PROFESSOR

Universidad Regional Amazónica Ikiam

▸ Science over the abyss: weaving bridges with butterflies

Abstract

Western society is currently undergoing a period of accelerated scientific and technological growth, driven by globalization. However, it is clear that this growth is not equal in all countries. There is an asymmetry in the access to resources, infrastructure and scientific education, and this disparity is a major factor in defining the nature of progress that can be achieved in each region. On the other hand, there are areas with a high density of biodiversity, which happen to be located in countries with the lowest investment in science and technology. This, in turn, hinders the conservation and improvement of these areas. The academic mobility between both sides of this asymmetry is what makes it possible to reduce the gap in education, on the one hand, and basic biodiversity research, on the other.

In this sense, neotropical butterflies are an excellent example of model species that have made it possible to build bridges between scientists from very different countries and cultures, enhancing undergraduate and graduate education, basic and applied research, and the creation of innovative ventures with high economic impact. As a concrete example, the research on butterflies of the genus *Heliconius*, the network of researchers who study them, and their importance for the development of science in Latin America are presented.

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