Annual Fellows Symposium

2025

Friday, July 11

9am

Tupper Auditorium

Smithsonian
Tropical Research Institute

Agenda

Smithsonian Tropical Research Institute

Fellows Symposium | July 11, 2025

9:00am	WELCOME REMARKS	Owen McMillan's Welcome Words
9:15am	**Luke Larter**	Cadences of the Collective: Conspecific Stimulation Patterns Interact with Endogenous Behavioral Rhythms to Cue Socially Mediated Response Shifts
9:30am	**Judith Smit**	Adjustability in vibrational signaling in treehoppers
9:45am	**Patrick Cannon**	Potential for tropical canopy species classification using hyperspectral remote sensing and deep learning
10:00am	**Owen Blacker**	Chemical Communication in a Changing World: Exploring Disruption by Environmental Contaminants in Wolf Spiders
10:15am	**Amalia Ceballos**	Decoding the cues promoting mutualism in ant -caterpillar interactions
10:30am	BREAK	
11:00am	**Laura Segura**	Hitch-hiking in a changing environment: Understanding effects of abiotic changes on animal-mediated dispersal behavior
11:15am	**Carola Copa**	Una nueva historia por contar: Estudiando la historia natural de Paratemnoides nidificator (Pseudoscorpiones: Atemnidae)
11:30am	**Jorge Reque**	Using eDNA to map shark and ray species distribution in mangroves and estuaries in the Tropical Eastern Pacific
11:45am	**Natasha Hinojosa**	Tracking Shifts in Trophic Ecology Through Jaws: Ecomorphology of Reef Fish Sister Species Across the Isthmus of Panama
12:00pm	LUNCH (not provided by STRI)	
2:00pm	**Javiera Mora**	Feeding Plasticity of Sister Coral Reef Fishes
2:15pm	**Rowan McGinley**	Communication in a Variable World – Courtship Displays in Wolf Spiders (Araneae, Lycosidae)
2:30pm	**Richard Montes Lemus**	Quantifying Coral Bleaching at Scale through Photogrammetry and Underwater Colorimetry
2:45pm	**Victor Neyra**	Harmful Algal Blooms during the Last Interglacial and the Holocene based on dinoflagellate cysts off the Peruvian Coast
3:00pm	**Carmen Pérez**	Seasonal and Vertical Variability of Primary Productivity in the Oligotrophic Waters of the Gulf of Chiriquí
3:15pm	CLOSING REMARKS	Owen McMillan's and Josh Tewksbury
3:30pm	GROUP PHOTO	
3:45pm	POSTER SESSION	
5:00pm	BBQ	

Speakers Abstracts

9:15am

Luke Larter

Postdoc

• Brown University

Advisor: Rachel Page

▸ Cadences of the Collective: Conspecific Stimulation Patterns Interact with Endogenous Behavioral Rhythms to Cue Socially Mediated Response Shifts

Abstract

Many animals form behavioral collectives. Optimal interaction patterns often differ across social contexts, and maintaining well-calibrated response patterns requires rapid adjustments to social fluctuations. Túngara frog interaction patterns vary across social contexts; rivals alternate their calls in smaller choruses, but stereotyped call overlap among rivals predominates in larger choruses. To investigate cues guiding this shift, we played conspecific stimulus calls to males at various delays, and preceded these stimulus calls with motifs mimicking varied conspecific interaction patterns. Males never overlapped isolated stimulus calls. However, overlap probabilities increased when stimulus calls were preceded by stimulatory conspecific motifs, especially when presented at later delays. Thus, a multifaceted cue to social context drives interactive shifts: that, in larger choruses, males experience intense conspecific stimulation during their inter-call intervals, and that this stimulation extends until the ends of these intervals. Evidently, inactive periods between calls provide crucial assessment windows for fine-tuning impending responses.

9:30am

Judith Smit

Postdoc

- NOMIS-STRI Postdoctoral Fellow
- Smithsonian Tropical Research Institute
- Vrije Universiteit Amsterdam

Advisor: Rachel Page

▸ Adjustability in vibrational signaling in treehoppers

Abstract

Finding a mate is essential for reproduction, but it can be challenging, especially in complex environments. Animals have evolved different strategies to overcome this, with sexual signals matching both their sensory system and their habitat. Sexual signaling is often flexible, allowing animals to adjust their signaling depending on their environment. Treehoppers (Hemiptera: Membracidae) use plant-borne vibrational signals for male-female duets, a widespread but highly understudied mode of communication. Males typically initiate the interaction and if a receptive female is present, she will respond. This marks the start of a duet in which the two sexes alternate their signals, giving rise to the opportunity for real-time adjustment. Do treehoppers adapt their vibrational signaling to their social environment? And if so, how much variation is there among individuals in their ability to do this? I explore these questions through field observations and behavioral playback experiments in *Guayaquila gracilicornis* treehoppers.

9:45am

Patrick Cannon

Postdoc

• University of Reading

Advisor: Helene Muller-Landau

▸ Potential for tropical canopy species classification using hyperspectral remote sensing and deep learning

Abstract

Remotely sensed hyperspectral data has the potential to identify and map individual canopy species across vast areas, providing crucial species-specific data for examining species' responses to environmental change. Despite this, the widespread classification of tropical species remains severely hindered by the lack of sufficient training data required to distinguish between hundreds of co-occurring species. We leverage an extensive training dataset of ~6,000 ground-truthed canopy crowns of 121 tree species from over 100 ha of forest plots within the BCNM. We explore the potential for using deep learning and remote sensing to comprehensively classify the canopy tree community and examine key sources of crown and species misclassification. Overall, we find significant potential for hyperspectral species mapping, with greater variation in spectra between species than within species. Our work continues to build towards the large-scale automated collection of tropical plant data, with the aim of enhancing the monitoring of tropical forests under future global change.

10:00am

Owen Blacker

Intern

Advisor: Rachel Page

▸ Chemical Communication in a Changing World: Exploring Disruption by Environmental Contaminants in Wolf Spiders

Abstract

Wolf spiders (Araneae: Lycosidae) rely on chemical communication to search for mates. However, environmental contaminants are abundant and could possibly affect this communication pathway. I hypothesized that exposure to herbicides would disrupt wolf spiders' chemical signaling. I conducted a series of behavioral experiments to investigate this relationship with *Allocosa panamena* and *Schizocosa tristani*. Using an olfactometer, I determined that males are attracted to airborne cues of females, and that herbicides can disrupt this interaction. I exposed males to female silk in the presence or absence of herbicides to evaluate any changes in males' response to these signals. Pairs were also allowed to mate in lab environment with or without herbicides on the substrate in order to evaluate mating success under contaminated conditions. Preliminary results show that wolf spider chemical signaling can be disrupted by herbicides, which may have implications for other invertebrate species that rely on this type of communication.

10:15am

Amalia Ceballos

Postdoc

• University of São Paulo

Advisor: Sabrina Amador

▸ Decoding the cues promoting mutualism in ant-caterpillar interactions

Abstract

Herbivorous insects often face challenges feeding on plants patrolled by aggressive ants. Some caterpillars, however, form mutualistic relationships with ants, gaining protection while feeding. Cuticular hydrocarbons (CHCs) act as recognition cues in ants, enabling them to distinguish nestmates from non-nestmates, and myrmecophilous caterpillars exploit these signals to interact with ants. While studies have focused on obligate myrmecophiles, such as those in Lycaenidae, the CHC strategies of facultative myrmecophiles in Riodinidae are less understood. This study investigates the role of CHCs in mediating ant aggression towards *Eurybia elvina* (Ridonidae), a facultative myrmecophilous caterpillar. Field experiments involved swapping CHCs between myrmecophilous and non-myrmecophilous caterpillars, and chemical analyses were conducted. Ants responded positively to CHCs from myrmecophilous caterpillars, refraining from immediate attacks. Chemical profiles revealed that *E. elvina* produces distinct CHCs, different from those of its host plants and attendant ants. These unique compounds likely enable recognition, ensuring temporary protection for the caterpillars.

11:00am

Laura Segura

Postdoc

• University of Nebraska-Lincoln

Advisor: Rachel Page

▸ Hitch-hiking in a changing environment: Understanding effects of abiotic changes on animal-mediated dispersal behavior

Abstract

Many studies assessing the vulnerability of organisms to anthropogenic changes (e.g. climate change) base their assessments on physiological tolerance to abiotic conditions. However, behavioral responses to changing environments are often overlooked. These responses can be highly adaptive (e.g., they can help the organism avoid physiologically stressful conditions) or can be negatively affected by environmental changes, even if those environmental conditions are within the physiological tolerance of the species. Phoresy – a "hitch-hiking" behavior in which an organism with limited mobility, attaches to a more mobile host for transportation – is thought to have evolved to escape locations that become unfavorable. However, the mechanisms that trigger it are poorly understood. In my current research at STRI, I aim to (i) understand the physiological tolerance to temperature and desiccation conditions of a phoretic pseudoscorpion species, and (ii) assess how temperature changes can affect the decision to engage in phoresy and leave those conditions.

11:15am

Carola Copa

Intern

• Universidad Mayor de San Andrés

Advisor: Sabrina Amador

▸ Una nueva historia por contar: Estudiando la historia natural de *Paratemnoides nidificator* (Pseudoscorpiones: Atemnidae).

Resumen

La historia natural es fundamental para comprender los procesos ecológicos, evolutivos y conductuales de las especies en su entorno. En mi pasantía, nos propusimos estudiar diferentes aspectos de la historia natural de *Paratemnoides nidificator* en Panamá. *P. nidificator* es un pseudoscorpión social que vive en grietas en la corteza de árboles, donde cazan de forma colaborativa y pueden dispersarse de forma solitaria o grupal. Sin embargo, estos comportamientos solo han sido estudiados en poblaciones en la sabana tropical en Brasil, por lo que desconocemos aspectos básicos del comportamiento de las poblaciones de los bosques tropicales de Panamá. Por dos meses, realizamos observaciones nocturnas en 10 colonias entre Gamboa y Barro Colorado, donde evaluamos tamaño de la colonia, actividad durante la noche, hospederos foréticos y condiciones ambientales asociadas, entre otras. La información recopilada será fundamental para informar próximos experimentos para entender mejor la socialidad y otros comportamientos interesantes de esta especie. Me gustaría presentar estos hallazgos en una presentación oral para compartir las observaciones preliminares y discutir su relevancia para futuros estudios.

11:30am

Jorge Reque
Intern

Advisor: Matthieu Leray

▸ Using eDNA to map shark and ray species distribution in mangroves and estuaries in the Tropical Eastern Pacific

Abstract

Shark and ray distribution within coastal areas of the (TEP) that include Panama and Costa Rica are poorly understood, which poses a challenge to conservation efforts. The objective of this study is to understand the distribution of sharks and ray species along the Pacific coast ranging from Panama to Costa Rica in relation to environmental variables such as salinity, dissolved oxygen, and temperature. Seawater and sediment eDNA samples were collected at 28 estuaries and mangrove-fringed bays over two years . We were able to map changes in the distribution of over 25 species of sharks and rays. eDNA allows for the detection of cryptic species and their distributions at a large scale which expands upon currently known ranges. The data yielded by this study will assist in the development of effective sustainable management strategies for elasmobranchs.

11:45am

Natasha Hinojosa

Predoc

- University of California at Santa Cruz
- Smithsonian Tropical Research Institute

Advisor: Matthieu Leray

▸ Tracking Shifts in Trophic Ecology Through Jaws: Ecomorphology of Reef Fish Sister Species Across the Isthmus of Panama

Abstract

The closure of the Isthmus of Panama ~3 million years ago created a natural evolutionary experiment by isolating marine populations into the Caribbean (CAR) and Tropical Eastern Pacific (TEP). This study investigates how contrasting environmental conditions across this divide have shaped trophic adaptations in Pomacentrid reef fish. Focusing on sister species pairs across three genera (Abudefduf, Azurina, Microspathodon), we integrate stomach content analysis, DNA metabarcoding, and micro-CT scanning to examine gut morphology, jaw traits, and dietary strategies. In Abudefduf, we find that differences in diet correspond with variations in head width, suggesting ecological divergence. CAR species tend to have longer gut lengths, consistent with adaptations to nutrient-poor waters. These findings highlight how environmental pressures drive both inter- and intraspecific morphological divergence. By combining functional morphology with ecological data, this study offers insights into the evolutionary mechanisms shaping biodiversity across marine biogeographic barriers and informs our understanding of reef fish resilience in changing environments.

2:00pm

Javiera Mora

Fellow

• University of Panama

Advisor: Matthieu Leray

▸ Feeding Plasticity of Sister Coral Reef Fishes

Abstract

Closure of the Isthmus of Panama (2.8 MY ago) caused the physical separation of two bodies of water, the Pacific Ocean and Caribbean Sea. The separation modified the avenues of nutrient flow, making the Caribbean oligotrophic and stable, while the Eastern Pacific maintained water column productivity and developed seasonal upwelling. The evolution of transisthmian sister species (TSS) and how their life history have responded to the environmental changes has been extensively studied. However, very little is known about how these different environments influenced their diet composition. We use TSS of reef fishes as our model system because of their diverse feeding strategies to study feeding plasticity across their respective environments. This study uses visual stomach content analysis and metabarcoding sequencing to describe and compare the diet diversity across nine pairs of sister species with different trophic niches to understand if fishes with specific feeding strategies exhibit different levels of feeding plasticity.

2:15pm

Rowan McGinley

Postdoc

Advisor: Rachel Page

▸ Communication in a Variable World – Courtship Displays in Wolf Spiders (Araneae, Lycosidae)

Abstract

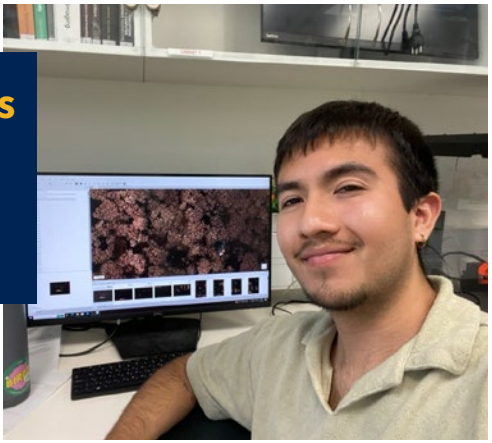
Animal communication is critical for survival and reproduction as it facilitates essential activities, such as coordinating social behaviours, deceiving prey, and deterring predators. However, animals inhabit dynamic and heterogeneous environments that can alter the transmission and detectability of communication signals. Some animals may have evolved displays that allow them to communicate across various environmental conditions, while others may have become specialized and only communicate efficiently within a narrow range of environmental conditions. I am exploring relationships between signals and signalling environments, focusing on courtship displays of wolf spiders. Wolf spiders can use a combination of visual signals, substrate-borne vibrations and/or chemical signals to communicate, and different species can inhabit different microhabitats and are active at different times of day, making them interesting subjects for studies of signal evolution. Results so far suggest that environmental heterogeneity plays a significant role in shaping the diversity of animal signals observed in nature.

2:30pm

Richard Montes Lemus

Intern

Advisor: Sean Connolly



▸ Quantifying Coral Bleaching at Scale through Photogrammetry and Underwater Colorimetry

Abstract

Mass coral bleaching events are increasing in frequency and severity worldwide, leaving corals susceptible to mortality. To understand why some reefs and coral genotypes exhibit greater resistance or resilience to bleaching, we need accurate and efficient tools for quantifying bleaching at scale. I present an optimized workflow for quantifying bleaching using underwater colorimetry and photogrammetry tools. It begins with correcting the color distortion caused by water in reef images via the application of underwater colorimetry models.This is followed by a photogrammetric reconstruction of the reef, which involves stitching together those overlapping reef images to generate a 2D model corrected for angle distortions. This 2D reef model enables bleaching quantification across sites. I highlight recent improvements to the workflow, including processing speeds and bleaching measurement accuracy.These improvements enable more robust comparisons between coral genotypes and reefs, supporting efforts to identify traits linked to reef resilience in the Eastern Tropical Pacific.

2:45pm

Enrique (Kike) Neyra

Fellow

Advisor: Carlos Jaramillo

▸ Harmful Algal Blooms during the Last Interglacial and the Holocene based on dinoflagellate cysts off the Peruvian Coast

Abstract

Harmful algal blooms (HABs) intensity and frequency have been increasing in recent decades because of current global warming and other anthropic factors. Some species of dinoflagellates produce resistance cysts that accumulate in the sediment and can be preserved in the sedimentary record, being useful in the historical reconstruction of environmental changes, productivity and HABs. However, the future intensity and frequency of HABs is not yet entirely clear. Therefore, this project aims to compare the composition and abundance of dinoflagellate cysts (dinocysts) recorded in the last interglacial (130 thousand years ago), an analogous period to the expected scenario at the end of this century, and the Holocene, the current interglacial (last 11,7 thousand years) to quantify and identify dinocysts deposited in laminated sediments from Huacho and Pisco (Peru). The information obtained may be useful for predicting the intensity of HABs in the region according to future climate change scenarios.

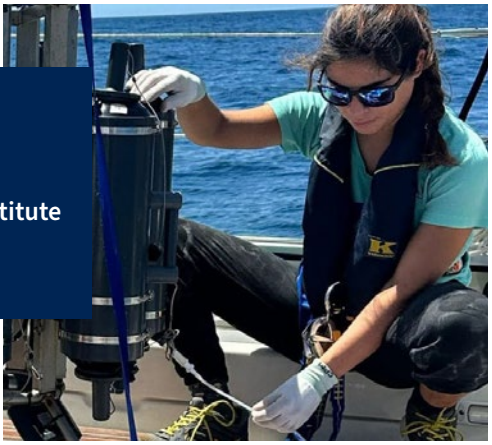
3:00pm

Carmen Pérez

Fellow

• Smithsonian Tropical Research Institute

Advisor: Aaron O'Dea



▸ Seasonal and Vertical Variability of Primary Productivity in the Oligotrophic Waters of the Gulf of Chiriquí

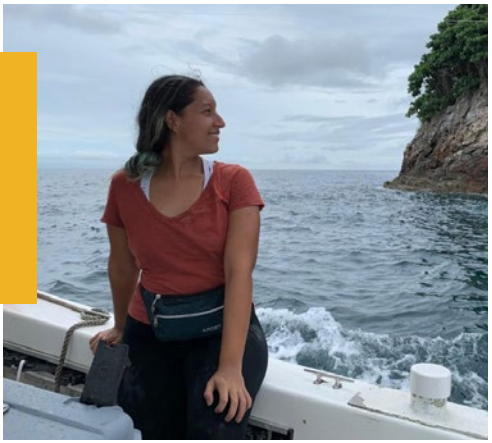
Abstract

Coastal oceanographic conditions along Central America's Pacific coast exhibit strong spatial and temporal variability. In Panama, the interaction of trade winds with the topographic features and geography of the continental shelf results in two distinct oceanographic regions: the Gulf of Panama (GoP), influenced by seasonal upwelling of cold, nutrient-rich waters, and the Gulf of Chiriquí (GoC), which maintains warm and oligotrophic conditions year-round. While ephemeral upwelling events in the GoP drive high primary productivity that helps sustain regional fisheries, the GoC paradoxically supports the presence of commercially important fish species despite its apparent lack of nutrient inputs. Our study aims to evaluate a bi-seasonal pulse of productivity observed in the GoC by combining 20 years of satellite-derived chlorophyll data with in situ water column characterization using cutting-edge analytical tools aboard the research vessel *Eugen Seibold*. Our findings provide a valuable oceanographic baseline for interpreting ecological patterns and productivity dynamics in this understudied, yet ecologically rich, region of the Eastern Tropical Pacific.

Posters Abstracts

Viviane Ali
Fellow

Advisor: Matthieu Leray



A Novel Assay for Monitoring *Pocillopora spp*. Corals in the Tropical Eastern Pacific from eDNA

Abstract

Tropical coral reefs form unique ecosystems capable of hosting a high diversity of species and supporting complex ecological interactions. In the last decades, environmental pressures due to climate change have caused mass bleaching events, with widespread coral mortality throughout the Indian and Pacific Oceans including the Tropical Eastern Pacific (TEP) where episodes of coral bleaching have occurred during El Niño Southern Oscillation (ENSO) events. Yet, some TEP reefs such as those of Panama have shown exceptional recovery to recent ENSO disturbances, possibly related to changes in coral community structure (selective mortality of susceptible genotypes) and acclimatization through time, raising the importance of accurately monitoring the dynamics of coral communities through time. A major limitation to understanding coral community changes through time is the difficulty to identify coral species based on morphological characters alone. The vast majority of corals occurring on TEP reefs of Panama belong to the branching coral genus *Pocillopora* spp., characterized by significant morphological plasticity and the prevalence of cryptic species. To address this challenge, we designed a PCR-based metabarcoding assay targeting a hypervariable region of mtORF gene to detect *Pocillopora* spp. lineages from seawater environmental DNA. A total of 117 seawater samples, from six nearshore reefs in Panama and six reefs at the offshore Isla del Coco in Costa Rica, were sequenced with this assay. Our assay effectively detected the genetic material of the two known lineages of *Pocillopora* spp. inhabiting the TEP reefs of Panama in both sampled locations. This work highlights the potential of targeted eDNA assays for the monitoring of foundational reef-building corals that are increasingly threatened by rising seawater temperatures.

Fernando Araúz

• Smithsonian Tropical Research Institute

Advisor: Helene Muller-Landau

Large-scale crown mapping in closed-canopy tropical forests: methods, data, and applications in Panama

Abstract

Remote sensing data has the potential to greatly enhance our understanding of tropical forest structure, dynamics, and composition. However, remote sensing data is dominated by top-of-canopy vegetation, and thus crown maps are a key tool for linking with ground data, including bridging to traditional forest plot data. Here, we describe methods, data, and application of large-scale crown mapping in closed-canopy tropical forests in Panama. Our crown mapping started with high-resolution drone-acquired or airborne RGB imagery, processed to produce orthophotos, which were automatically segmented into individual tree crowns. Then, a drone way-point mission obtained close-up photos of each tree crown, and these photos were identified to species by expert botanists using the LabelBox platform. We explored a variety of algorithms to automatically link tree stems in census plots to segmented crowns and tested the value of incorporating information from the close-up photos, crown illumination index data for the tree census, and prior crown maps. We conducted field work to definitively link segmented crowns to tagged trees and evaluate these algorithms. Automatic linkages performed well for larger trees, especially in cases where crown illumination data were available, as well as where species diversity was high and close-up photos were available. Accuracy declined for smaller trees, longer times since the ground census date, liana-covered crowns, and in clusters of similar-sized conspecifics. The resulting crown maps encompass > 5000 crowns of 140 tree species in 130 ha of mapped plots and represent an important resource for calibration and evaluation of remote sensing data. Planned applications include evaluating how crown size statistics relate to forest canopy height and other structural statistics from airborne lidar data, as well as linking airborne hyperspectral data collected in the February 2025 NASA AVUELO campaign to tropical tree and liana species identity and functional traits.

Jorge Bermúdez
Fellow

Advisor: Carlos Jaramillo

Analysis of sedimentary facies, depositional environments, and interpretation of the geological evolution of the Real Group (Miocene) and Recent Alluvial Fans (Quaternary) in the northern area of the Middle Magdalena Valley (Colombia).

Abstract

This project focuses on the geological characterization of the Magdalena River valley in northern Colombia, specifically between southern Barrancabermeja and northern Aguachica, from the foothills of the Eastern Cordillera to the piedmont of the Serranía de San Lucas. The study aims to analyze the facies associations, sedimentological features, Lithology-geochemistry, and geomorphological aspects of the Real Group and Quaternary alluvial fans. Through fieldwork, stratigraphic profiling, laboratory analyses—including geochemical data produced by the author—and remote sensing techniques, I seek to establish correlations between current sedimentary dynamics and the Miocene deposition of the Real Group. The goal is to interpret the geomorphological evolution of modern alluvial fans as a response to tectonic activity, particularly the influence of the Santa Marta–Bucaramanga Fault, and the broader uplift of the Eastern Cordillera. This work contributes to reconstructing the basin's paleoenvironmental conditions and understanding fluvial–alluvial interactions during the Neogene.

Shireen Charalaghi

• Smithsonian Tropical Research Institute

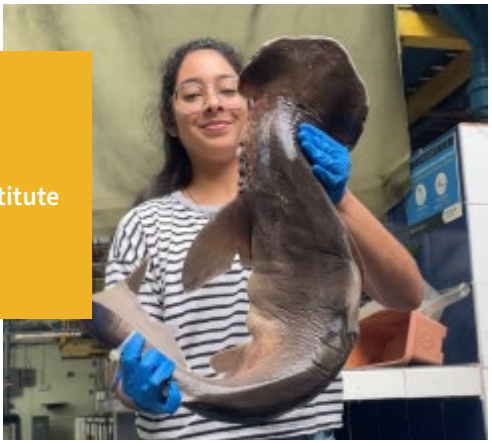
Advisor: Erin Spear

Evaluating the pathogenicity and growth rates of a native phytopathogen with broader ecological and economic importance

Mycoleptodiscus suttonii is a fungal species that is of broad scientific interest due to its relatively wide geographic and host distributions with *Theobroma cacao*. The *Mycoleptodiscus suttoni* isolates ERS19.23.Le.C., ERS19.30.Le.B., and ERS19.42.Le.A. were collected from naturally occurring, symptomatic leaves of *Pouteria reticulata* plants on Barro Colorado Island, Panama in 2019. The leaves of 20 *Pouteria reticulata* plants were inoculated with the three fungal isolates to determine whether they are capable of causing infection of the plant species. After two weeks of inoculation, the isolate that yielded the largest wound sizes and was recovered from the inoculated leaves at the highest rate was ERS19.23.Le.C. Growth trials entailing growing the isolates separately on potato dextrose agar (PDA), corn meal agar (CMA), and malt extract agar (MEA) are in progress to determine their growth rates and the ideal media for culturing.

Yaliana Chichaco
Intern
• Smithsonian Tropical Research Institute

Advisor: Matthieu Leray



Distribution of the Largetooth Sawfish (*Pristis pristis*) in the Pacific of Panama using Environmental DNA Samples and the Platform, Droplet Digital™ PCR.

Abstract

The Critically Endangered Largetooth Sawfish (*Pristis pristis*) once had a circumtropical range but is now extinct in 27 countries. Panama remains few potential key areas where populations may persist, yet its current status and distribution there uncertain, highlighting the need for monitoring. To address this, we conducted a spatial-temporal survey in coastal sites of Panama using eDNA analyses with a highly sensitive species-specific Digital droplet™ PCR assay targetting *P. pristis* DNA. Out of 460 water and sediment samples analyzed, we obtain two detections—one representing a previously unrecorded site and another near a known "bright spot". This findings offer a rare snapshot of sawfish extant in Panama. By placing detections in spatial-temporal context, we highlight the value of eDNA and ddPCR™ as a powerful tool for monitoring elusive, low-abundance species. This approach enables rapid assessments across broad areas, helping to prioritize conservation efforts for *P. pristi*s and similarly threatened species.

María Isabel Cordón-Krumme

Fellow

- Centro de Investigación en Ciencias del Mar y Limnología (CIMAR)
- Escuela de Biología, Universidad de Costa Rica, Costa Rica

Advisor: Mark Torchin

▸ Revisiting Ascidian Species and Phylogenetic relations (Tunicata: Ascidiacea) in Northern Pacific of Costa Rica

Abstract

Ascidians are marine invertebrates that play key ecological roles as filter feeders and bioindicators of environmental change. Despite their importance, Costa Rica's ascidian fauna remains poorly studied. This research provides baseline data on ascidian biodiversity in the Tropical Eastern Pacific, characterizing species from the north Pacific coast of Costa Rica through morphological and molecular approaches. From 2019 to 2024, 456 specimens were collected from 32 sites, identifying 33 species across 16 genera, seven families, and three orders. Introduced species such as *Polyclinum constellatum, Diplosoma listerianum, Didemnum perlucidum, Ascidia sydneiensis, Botrylloides niger*, and *Polyandrocarpa* cf. *zorritensis* were detected, raising concerns about their invasive potential. DNA barcoding with mtCOI and 18S rRNA supported species identification and phylogenetic analysis, confirming the monophyly of Ascidiacea and the effectiveness of mtCOI. This study improves the understanding of ascidian biodiversity in the region, validates mtCOI as a molecular identification tool, and highlights the importance of integrative approaches in tunicate taxonomy, providing valuable insights for invasive species management.

Laura Díaz
Intern

Advisor: Carlos Jaramillo

Pollen Relationships Among Species of the Bignoniaceae Family (Juss.)

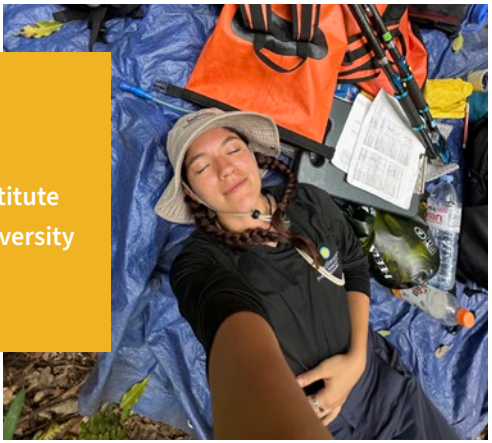
Abstract

Studies across various botanical families have demonstrated the importance of pollen morphology in plant taxonomy and evolution. The Bignoniaceae family has been a subject of study due to its diversity and challenges in taxonomic classification; the diversity of forms and habits in these plants endemic to Central America and the Caribbean reflects unique reproductive strategies, evidencing their adaptation to the environment. These characteristics highlight the importance of understanding and analyzing similarities or differences among species based on uncommon structures used to delimit such differences, such as pollen grains. Advanced microscopy techniques and statistical analyses were used at the Center for Tropical Paleoecology and Archaeology (CPAT) of the Smithsonian Tropical Research Institute (STRI) in Panama through the review of the palynological collections deposited there. High-resolution images of the pollen grains were obtained using differential interference contrast and brightfield optical microscopy, along with confocal microscopy to obtain three-dimensional images. The palynomorphs identified for the Bignoniaceae species were described in detail, outlining patterns and relationships among species and habits, providing a deeper understanding of the taxonomic relationships between species and genera of the family, contributing to the knowledge of the morphology of their pollen grains and recognizing morphopalynology as an important tool for taxon identification.

Sugey Galván
Intern

- Smithsonian Tropical Research Institute
- Global Sustainability Scholars, University of Colorado Boulder

Advisor: Erin Spear



Assessing the competitive fitness of endophytic fungi in the tropical forest of Panama

Abstract

Fungal communities are shaped by competitive interactions, leading to community shifts across individual plants and tropical forests. Successful establishment in a host depends on a fungus's ability to evade its defense mechanisms and compete with the pre-existing fungal community. Pathogens able to outcompete resident endophytes can result in disease, impacting plant fitness and local diversity. To assess the competitive fitness of fungal pathogens isolated from leaves of three tree species (*Castilla elastica, Anacardium excelsum, and Luehea seemannii*), we inoculated seedlings with fungal pathogens against heterospecifics and re-isolated them in culture. In addition to noting the presence of the inoculant, we counted the number of emerging resident fungi. Three pathogenic isolates from *C. elastica* (141, 217A, and 222) successfully established and reduced the number of resident fungi observed in the leaves of *L. seemanii* and *A. excelsum*. In a dynamic fungal community, understanding which endophytic fungi are strong competitors can provide insight into their effects on host fitness and local plant diversity.

Irene García
Intern

Advisor: Aaron O'Dea

Entre Arrecifes coralinos y tiburones

Abstract

Nuestro proyecto se enfoca en lograr una reconstrucción de las abundancias y diversidad funcional de las comunidades de tiburones en tres momentos distintos (antes, durante y después del hiato), este tiempo será definido por las estimaciones previas registradas de las tasas de acreción del arrecife y análisis de la composición coralina. A su vez la diversidad funcional de tiburones se hará a través del tiempo utilizando escamas de tiburón fósiles (dentículos dérmicos) como indicador de la abundancia de tiburones y la estructura funcional de la comunidad, exploraremos las consecuencias que puede traer los escenarios de cambio climático a las comunidades de tiburones. Los dentículos fósiles serán un proxy para observar cómo cambiaron las poblaciones de tiburones tras la pérdida de su hábitat, qué grupos funcionales disminuyeron y cómo la resiliencia de otros grupos puede ser comprometida. Para ello emplearemos un enfoque paleológico donde identificamos los diversos morfotipos de dentículos fósiles, de esta forma podremos trazar las pistas de los grupos funcionales que se vieron comprometidos en cada momento del arrecife. El proyecto busca ofrecer pistas sobre la relación entre la salud del arrecife y las comunidades de tiburones.

Sofía García
Intern

Advisor: Carlos Jaramillo

Fossil Woods from the Miocene in the Central Andean Plateau of Bolivia

Abstract

During the Cenozoic (66-2.6 Ma), Andean orogenesis uplifted the Altiplano-Puna plateau, transforming ancient Amazonian ecosystems into Puna-like landscapes. Previous studies indicated high-altitude vegetation on the western Altiplano during the mid-late Miocene, but recent analyses point to lower elevations in the north. In Achiri, Bolivia, the discovery of fossil wood allows the reconstruction of past environmental and climatic conditions, as well as the evolution of flora and altitude. Through the anatomical study of these woods and their comparison with present-day species, it is possible to interpret the floristic continuity between the past and the present. Samples are prepared by cutting into three sections (XS, LTS and LRS), polished, adhered to slides with UV resin and refined for microscopic analysis. Anatomical measurements are taken to allow taxonomic classification and paleoflora reconstruction using the nearest living relative (LNR) method. Four morphotypes were identified, including a fern and a liana.

Amanda Godbold
Postdoc

Advisor: Sean Connolly

Refining Temporal Resolution in the Panama Paleontological Project: Unlocking Finer-Scale Ecological Patterns Across the Emergence of the Isthmus of Panama

Abstract

The Panama Paleontological Project (PPP) has produced a robust fossil dataset documenting marine biodiversity changes linked to the emergence of the Isthmus of Panama—a geologic event that dramatically reshaped ocean circulation and ecosystems. However, many faunules—lithologically constrained fossil assemblages—are dated only at the formation level, limiting temporal resolution and masking fine-scale ecological patterns. This study refines age estimates for 64 faunules spanning the past 11.5 million years by improving their stratigraphic context and applying multiple geochronological techniques. These enhanced age constraints support more detailed analyses of community composition, biodiversity shifts, and extinction dynamics. By resolving faunule ages, we can better correlate ecological patterns with environmental drivers linked to the Isthmus' formation. This work builds on the PPP's foundational contributions and expands its capacity to address critical questions about the evolutionary and ecological consequences of major Earth system transformations.

POSTER SESSION

Kevin Gómez
Intern

Advisor: Matthieu Leray

What Jaws Reveal: Functional Adaptation in Reef Fish

Abstract

Coral reefs host an astonishing diversity of fish species. Comparing closely related species allows researchers to control for shared evolutionary history and detect differences driven by local selective pressures. This study examines 10 pairs of sister species distributed on either side of the Isthmus of Panama, all of which play important ecological roles in reef systems of the Caribbean and Eastern Pacific. The poster will focus on detailed images of their jaws, highlighting differences in shape, muscle investment, tooth morphology, and mechanical advantage. Mechanical advantage will be assessed as an indicator of functional efficiency, while muscle investment will offer insight into the force exerted during biting. This visual and comparative approach aims to reveal how small anatomical shifts reflect ecological adaptations, providing a clearer understanding of functional evolution in reef-associated sister species.

Paola Gómez
Academic Programs Coordinator
• Smithsonian Tropical Research Institute

Bridge to Science: A Cohort-Based Internship Program for Latin American Scientists in Tropical Research

Abstract

The Smithsonian Tropical Research Institute (STRI) in Panama has been a pioneer in advancing scientific knowledge of tropical ecosystems. However, there remains a critical gap in training opportunities for local scientists, particularly in Panama and Latin America. Although Panama represents a significant proportion of STRI's annual visitors, the representation of local students at the postdoctoral and graduate levels remains disproportionately low. This program addresses this gap by offering internships to undergraduate students and recent graduates from universities in Panama and Latin America in biology and related sciences. The internships integrate mentor-led research and advanced training, providing hands-on experience that fosters critical thinking, scientific skills, and international collaboration. These experiences play a key role in building the educational foundation and capacity of the next generation of tropical scientists. In 2025, we launched the first cohort-based internship program specifically for Latin American scientists, designed to build the capacity of the next generation of tropical scientists. This program recruited 10 exceptional participants from Panama and across the region, who worked directly with STRI scientists, gaining access to cutting-edge technologies and internationally recognized mentorship. In addition to research, the participants engaged in professional development activities, strengthening leadership, communication, and technical skills, which are essential to advancing their scientific careers and leadership in tropical research.

Valeria González
Intern

Advisor: Rachel Page

When night meets day: nocturnal eavesdropping bats prey on diurnal reptiles.

Abstract

Bats in the Phyllostomidae family display diverse diets, and the frog-eating bat (Trachops cirrhosus) is no exception. Although it is known for relying on the sound of frogs' mating calls to hunt them, this species has also been found to consume Anolis spp. This unexpected dietary choice raises questions, as these lizards are usually inactive and silent at night. To explore how these bats detect and hunt Anolis, we conducted behavioral experiments using auditory cues, as well as live lizards in a captive setting simulating the wild. Video and high-frequency audio recordings revealed that the bats used multiple strategies, catching lizards both when they were moving and when motionless. Interestingly, most predation events occurred during daylight, an unusual behavior for this nocturnal species. These findings provide new insight into predator-prey dynamics, sensory ecology, and the evolutionary pressures shaping both species.

Greta Hernández
Fellow

Advisor: Owen McMillan

Investigating the role of iridescence in thermoregulation in *Morpho* butterflies

Abstract

The charismatic coloration of many butterfly species, while well known for its use in sexual communication and anti-predator signaling, is often underappreciated for its role in temperature regulation. Previous research on the role of butterfly wing color in thermoregulation has primarily focused on pigmentary colors. The thermoregulatory role of iridescence - a structural, non-pigmentary color strategy - remains largely unexplored. Here, we investigated whether *Morpho helenor* butterflies, reared under different temperature regimes (hot, cold, or ambient), exhibit differences in warm-up times, which are important for attaining flight. While we found no effect of developmental temperature treatments on warm-up times, we observed that dorsal wing surfaces warmed significantly faster than ventral surfaces. We further conducted behavioral experiments and confirmed that *M. helenor* butterflies adopt a dorsal basking posture in the sun, suggesting an adaptive potential for the iridescence infacilitating heat gain. These findings provide novel insights into the thermal strategies of iridescent butterflies and underscore the potential contribution of

Julia Holder
Intern

Advisor: Owen McMillan

Investigating the role of non-coding RNA *ivory* in Heliconius Wing Patterns

Abstract

The Heliconius system has provided powerful insight into the genetics of coloration in Lepidoptera and evolutionary genetics. With their striking and diverse color patterning and Mullerian mimicry, Heliconius provide a natural evolutionary experiment that has demonstrated how species can modulate between color patterns largely controlled by a few genes of large effect. However, a recently identified locus of large effect in Heliconius wing coloration is not a gene at all. A mutation which caused near total loss of coloration in *Heliconius* wings was initially attributed to the protein coding gene *Cortex*, but previous investigation indicated that it was the nearby long non-coding RNA *Ivory* whose disruption caused the loss of melanization. In this project, we have used CRISPR-Cas9 to disrupt the promoter of *Ivory* as well as *miRNA193*, a microRNA hypothesized to be the functional product of *Ivory*. Using these guides, we have generated mutants in several subspecies of *Heliconius melpomene* and in *Heliconius numata*. PCR amplification of the target region and sequencing confirm that these mutations are on target. This experiment confirms the role of *Ivory* in regulating wing pigmentation and allows us to compare its effect across butterflies that are closely related, but visually very different.

Laura Manrique
Intern
• Universidad de los Andes
Advisor: William Wcislo

Pollinators Under Pressure: Can Climate Shape Bee Sociality Through Floral Resource Availability?

Abstract

Climatic extremes driven by the El Niño Southern Oscillation (ENSO) alter flowering patterns and floral resource availability, impacting pollinators. On Barro Colorado Island (BCI), El Niño increases floral abundance, while La Niña reduces it. The facultatively social bee *Megalopta genalis* nests either solitarily or socially, but the drivers of this variation remain unclear. We analyzed a decade of behavioral data alongside ENSO cycles and floral resource trends on BCI. Additionally, we conducted a diet restriction experiment during the nest-founding phase and monitored foraging behavior using automated cameras. Results suggest that *M. genalis*, exhibits changes in the frequency of social nesting behavior under conditions of resource scarcity. These findings imply that climate-driven shifts in floral availability may influence pollinator sociality over time. As extreme climatic events become more frequent, understanding how pollinators adjust their social structures is key to predicting changes in pollination networks and informing conservation strategies in tropical ecosystems.

Alessandra Mikich
Fellow
• Universidade Federal do Paraná

Advisors: Lynette R. Strickland and Owen McMillan

Cold tolerance and Chill-Coma Recovery Time in Panamanian Tortoise Beetles (Chrysomelidae: Cassidinae)

Abstract

Temperature is one of the main abiotic constraints shaping the distribution of ectothermic taxa. In insects, chill tolerance is strongly related to fitness and survival, driving the evolution of a wealth of physiological and behavioural adaptations to cope with cold stress. One such mechanism is a reversible chill-coma state characterized by neuromuscular paralysis when exposed to non-lethal low temperatures. A widely used physiological bioassay to measure cold tolerance is Chill-Coma Recovery Time (CCRT), which measures the amount of time for an individual to regain neuromuscular function after an induced chill-coma. CCRT varies greatly within and among species, specially across a latitudinal gradient. The present research aims to measure intra- and interspecific variation in CCRT of Panamanian Cassidines; as well as its variation along a latitudinal gradient in the widespread Golden Tortoise Beetle, *Charidotella sexpunctata* (Boston=116 individuals; Panamá=39). To do so, 509 beetles, belonging to 16 species, collected throughout the Panamanian isthmus were submitted to 0°C for 2 hours and their CCRT was recorded over two consecutive days. Our results show significant interspecific variation in CCRT, wherein larger species tend to recover faster from chill-coma, while others can acclimate faster to cold temperatures following their second exposure to cold stress. Moreover, *C. sexpunctata* from Boston recover faster than those from Panamá, suggesting they have locally adapted their thermal tolerance due to persistent selective pressures at higher latitudinal gradients. Understanding these adaptations provides insights into insects' thermotolerance limitations, supporting conservation and pest management strategies in the face of climate change.

Cristian Molina
Predoc
• University of Toronto

Advisor: Sabrina Amador

Evidence of opportunistic pollen consumption, but not pollinator deterrence, by a non-defending acacia ant

Abstract

Conflicts may arise when species engage in multiple mutualistic interactions. Swollen-thorn acacias (*Vachellia collinsii*) provide food and nesting spaces to ants in exchange for defense against herbivores. This defense may come at an increased expense when acacias flower, due to the potential conflict between pollinators and aggressive ants. At two field sites in Panama, we characterized floral visitation frequency by resident ants. While the obligate ant-mutualist *Pseudomyrmex spinicola* rarely visited inflorescences, non-defending *Crematogaster* ants were frequent floral visitors and consumers of pollen. Unexpectedly, the presence of predatory *Crematogaster* ants on inflorescences was not associated with decreased floral visit length by a species of megachilid bee. It remains unclear whether pollen consumption poses a significant fitness cost to acacias, but preliminary data suggest that acacias may offset any potential costs via prolific floral production when hosting *Crematogaster sp.* This work demonstrates the importance of considering third parties in species interactions.

Lucia Morales
Intern

Advisor: Aaron O'Dea

Crecimiento Pre y Posnatal del Tiburón Mart illo Común (*Sphyrna lewini*) en el Pacífico Panameño

Resumen

En Panamá, *Sphyrna lewini* es la especie de tiburón martillo más común en las pesquerías artesanales, donde se registra una alta captura de neonatos y juveniles, lo que pone en riesgo la sostenibilidad de sus poblaciones. Para apoyar su manejo, este estudio analiza vértebras de individuos jóvenes capturados incidentalmente en el Pacífico panameño, evaluando el crecimiento prenatal y postnatal a través de la observación de anillos de crecimiento bajo microscopía de luz transmitida. Se espera que los tiburones con mayor crecimiento intrauterino presentarán un crecimiento postnatal más lento, mientras que aquellos con menor desarrollo prenatal mostrarán una tasa de crecimiento más acelerada tras el nacimiento. Estos resultados podrían proporcionar información clave sobre las estrategias de crecimiento temprano de la especie, contribuyendo al diseño de medidas de manejo más efectivas para proteger las etapas más vulnerables del ciclo de vida de *S. lewini*, y así fortalecer la sostenibilidad pesquera en el Pacífico.

Javier Pardo
Intern

Advisor: Aaron O'Dea

Reconstruction of the Relative Abundance of Fossil Shark Teeth in the Gatun Formation (Late Miocene), Panama

Abstract

This project focuses on the paleoecological characterization of the San Judas locality within the Gatun Formation (Late Miocene, ~11.8–11.6 Ma) on Panama's Caribbean coast. The study aims to analyze taxonomic composition, relative abundance, diversity indices, and methodological biases associated with the collection of fossil shark teeth. Through fieldwork conducted in 2025, including surface sampling across three expeditions with 53 participants, specimens were recovered, identified, and compared to previous studies from the region using more systematic techniques such as screenwashing and handpicking. Laboratory classification of 70 teeth allowed genera and species identifications using reference guides from STRI and the Florida Museum of Natural History. Genera identified include †*Otodus, Carcharhinus, Negaprion*, †*Hemipristis,* and *Sphyrna.* Using declared effort and diversity metrics, this study evaluates sampling completeness through rarefaction and contrasts fossil data with modern shark distributions. The results contribute to the understanding of Late Miocene neritic shark ecosystems in the region and highlight the value of replicable, effort-reported surface collection methods for community science and paleoecological research in the Gatun Basin.

Sol Parra Santos
Fellow
• McGill University
Advisor: Owen McMillan

Validating *Lepidoneiva teuthras* as a developmental model for scale differentiation in wing transparency of wasp-mimicking moths

Abstract

Transparent wings are a striking adaptation in wasp-mimicking moths of the subtribe *Euchromiina*. This adaptation is due to a change of scale type, from lamellar to piliform. While butterflies have long served as models to study scale type development and genetics, moths, especially those with unique mimicry strategies, have been largely overlooked. Here, we establish *Lepidoneiva teuthras* as a tractable moth model for studying the development and genetic bases of the piliform scale responsible for wing transparency. We describe its life history and host plant (*Serjania mexicana*), develop a lab-rearing protocol that supports a multigenerational stock, and demonstrate key experimental advantages: sexing at the pupal stage, survival after wing disc exposure, and tolerance to heparin injections. Importantly, heparin-induced disruption of Wnt signaling caused a shift from piliform to lamellar scales in transparent regions (Fig. 4), suggesting that Wnt genes play a key role in scale fate specification. These results validate the use of *L. teuthras* as a model to explore the development and genetics of adaptive scale types.

Laura Peñafiel
Intern
• Universidad del Magdalena
Advisor: Sabrina Amador

Crossfit de mandíbula en hormigas Pseudomyrmex

Resumen

Mi nombre es Laura Andrea Peñafiel Maldonado, soy Colombiana. En mi proyecto estudio la anatomía interna de los músculos mandibulares de dos especies de hormigas pertenecientes al género *Pseudomyrmex*, por medio de microscopía confocal y reconstrucciones en 3D con ayuda de ImageJ y 3D Slicer. Determino el volumen de cada tipo de músculo mandibular y lo relaciono con el estilo de vida particular de cada especie, *P. boopis* con hábitos de alimentación omnívoros, y *P. spinicola* con un hábito mirmecófito. Además, hago la comparación entre la casta de las obreras y las reinas. Este proceso manual de segmentación manual (dibujo) es dispendioso, así que entreno a una inteligencia artificial llamada Biomedisa para que dibuje por mí, y así procesar datos más eficientemente. Aún no tengo resultados definitivos, sin embargo, me gustaría presentar mi proyecto mediante un poster y resultados preliminares.

Samuel Rivera
Intern

Advisor: Aaron O'Dea

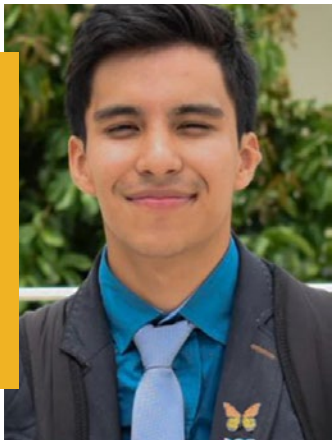
Comparing the trophic strategies of chloroplast-stealing *Elysia* sea slugs

Abstract

The formation of the isthmus of Panama divided the Tropical Eastern Pacific from the Western Atlantic, creating an oligotrophic Caribbean and a productive Pacific driven by upwelling. This altered marine communities, but the effect this event had on organisms with specialized feeding strategies like Sacoglassan sea slugs is poorly understood. Sacoglossans perform kleptoplasty, whereby they sequester chloroplasts from algae to photosynthesize. How this unique trophic strategy evolved in distinct oceans has yet to be understood. Previous investigations have focused on *Elysia crispata* from the Caribbean, but little is known about the ecological role of Pacific *E. diomedea*. We compare their diets by metabarcoding their sequestered chloroplasts and compare the δ15N values to quantify reliance on photosynthesis versus herbivory. This natural experiment will help us explore how these slugs adapted to distinct conditions and illuminate the evolutionary consequences of this major geological event, with implications for communities facing current climate change.

Joshué Ruiz Moreira
Intern
- Universidad Regional Amazonica Ikiam, Tena, Ecuador
- Smithsonian Tropical Research Institute

Advisor: Owen McMillan



Assessing Reference Gene Stability Across Temperature Variations in a Neotropical Butterfly

Abstract

Predicting the effects of climate change on biological systems at the cellular level is complex, especially in Neotropical insects, where molecular responses to extreme temperatures remain largely unexplored. Quantitative real-time PCR (qPCR) is a powerful tool to study gene expression involved in adaptation, but its accuracy relies on stable reference genes across varying conditions. This study evaluated the expression stability of eleven candidate reference genes (ACT1, ACT2, ANX, AK, eEf1α, eEf1α2, pAbp, RS3A, RPL3, UCCR, and GAPDH) in the Neotropical butterfly *Heliconius erato lativitta* under different temperature treatments. Expression levels were analyzed at a control temperature (25°C), and under thermal stress (4°C and 40°C), across tissues (head, thorax, abdomen) and sexes. Stability was assessed using four algorithms: geNorm, NormFinder, BestKeeper, RefFinder, and GMLs. Results revealed that eEf1α and pAbp were the most stable genes across tissues, while UCCR and GAPDH were most stable between sexes. Under thermal stress, pAbp and ANX showed high stability, and ANX and UCCR were the most reliable under combined variation of temperature, tissue, and sex. These findings provide a validated set of reference genes, offering a standardized framework for future qPCR-based studies. This is crucial for understanding the molecular basis of thermal tolerance and adaptability in Neotropical butterflies in the face of rapid environmental change.

Heraclio Sanjur
Intern

Advisor: Matthieu Leray

Progress in the Research of Muscle & Liver Tissue Isotopes in Sister Species of the Reef Sergeant Fish (Genus: *Abudefduf*) across the Isthmus of Panama.

Abstract

The closure of the Isthmus of Panama about 2.8 million years ago resulted in the geographic isolation of coral reef species, exposing them to different environmental conditions: the nutrient-rich, upwelling waters of the tropical eastern Pacific and the more stable, oligotrophic Caribbean Sea. Stable isotope analysis serves as a tool to infer long-term dietary patterns, with $\delta^{13}C$ values indicating primary carbon sources and $\delta^{15}N$ values reflecting trophic positions. We aim to study dietary adaptations in two sister species of tropical reef fish, *Abudefduf troschelii* from the Pacific Ocean and *Abudefduf saxatilis* from the Caribbean Sea of Panama, by analysing stable isotopes of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) in muscle and liver tissue. By comparing isotopic signatures of two different tissues, the study aims to assess the extent of dietary plasticity and adaptation in response to different environmental stresses and seasonal changes. The results of this research will improve our understanding of how environmental variability influences feeding strategies in reef fishes and contribute to a broader understanding of the mechanisms of ecological adaptation and resilience in marine ecosystems.

Pablo Sarango
Intern
• Smithsonian Tropical Research Institute

Advisor: Jefferson Hall

A unified methodology for processing stream flow data from V-notch Weirs in Agua Salud's experimental catchments

Abstract

Due to their simplicity and reliability, V-notch weirs are commonly used in monitoring studies to estimate stream flow in small catchments. However, the lack of standardized protocols leads to inconsistencies in quality control and prevents cross-site comparison. This study presents a unified methodology for processing stream flow data collected from V-notch weirs. Non-vented pressure sensor loggers recorded water pressure measurements. The workflow includes uploading data into the Aquarius Time-Series™ server and the following steps: (1) the concatenation of water pressure records; (2) correction of timing errors and atmospheric pressure; (4) conversion of absolute pressure to stage; (5) correction of errors in stage due to weir clogs; and (6) applying V-notch equations to calculate flow rate. This methodology was successfully applied to long-term monitoring records from forested and pasture catchments in the Agua Salud project, demonstrating high efficiency, accuracy, and interpretability of stream flow dynamics in the humid tropics in Panama.

Axel Tejada-Fajardo
Intern

Advisor: Carlos Jaramillo

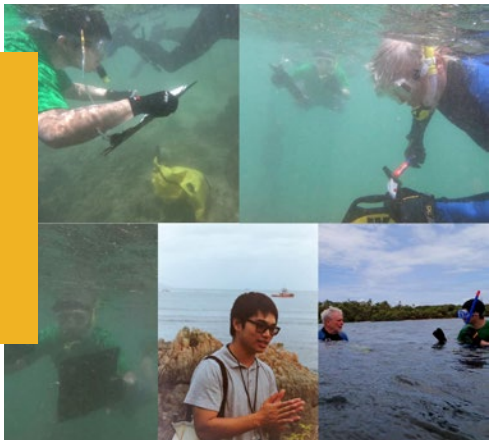
Morphological variability in the fern spores from the seasonal coastal Lomas of Peru

Abstract

The Pacific coastal landscapes of Peru are dominated by desert and dry-forest biomes, which have undergone shifts in extent and floral composition in response to Plio–Pleistocene climatic fluctuations. Within this arid setting, the coastal *Lomas* form seasonal vegetation patches, renowned for their high endemism, exceptional floral diversity, and vital ecosystem services. Despite their desert surroundings, the *Lomas* sustain moisture-dependent plants such as ferns, which serve as pioneer species—particularly during transitional periods between dry and wet seasons. Here, we characterize the spore morphology of 26 fern species documented in the *Lomas*, evaluating how their niches and growth habits shape morphological traits and, consequently, their role as ecological pioneers in this unique biome. This analysis provides insights into the ecosystem's adaptive dynamics.

Bryan To
Intern
• Princeton University

Advisor: Haris Lessios



Origin, presence, and transmission mechanism of pathogenic scuticociliates (*Philaster apodigitiformis*) that killed millions of sea urchins (*Diadema antillarum*)

Abstract

Diadema antillarum, a keystone species whose herbivory controls algal overgrowth from outcompeting corals for space and light, found 97% of their populations eliminated in mass die-off events across the Caribbean in 1983-4. Pathogenic scuticociliate *Philaster apodigitiformis* were found to have caused another mass mortality of *D. antillarum* in West Indies, Mexico's Atlantic Coast, and Florida in 2022. Unfortunately, the origin, presence, and transmission mechanisms of these pathogenic scuticociliates are still unknown. We seek to determine *P. apodigitiformis* presence in *D. antillarum* microbiome and other marine organisms (echinoderms, crustaceans, corals, fishes, seawater) in both Caribbean and Pacific waters. Molecular methods through PCR and DNA sequencing of the 18S gene revealed *Philaster* in *D. antillarum* (Saba) and *Siderastrea* corals (Punta Galeta), but not within *Diadema antillarum* from Punta Galeta, Bocas del Toro, nor *Diadema mexicana* in Taboga and Saboga. Investigating the origin and presence of *P. apodigitiformis* among marine organisms is our first step towards understanding and protecting *Diadema* sea urchin populations and, by extension, coral reef ecosystems in the face of emerging marine pathogens.

Caroline Troy

Intern

Advisor: Helene Muller-Landau

Tropical tree species exhibit niche complementarity in interannual growth patterns

Abstract

Numerous studies have demonstrated positive effects of species diversity on stability and ecosystem function in temperate grasslands, but evidence for the value of biodiversity in highly biodiverse tropical forests remains limited. One proposed primary mechanism underlying biodiversity-stability and biodiversity-function relationships is niche-complementarity, which posits that species differ in their resource use and environmental responses, such that more diverse communities can better utilize total available resources under varying environmental conditions. To examine the niche-complementarity effect in tropical forests, we assessed if tree species exhibit complementary responses to interannual variation in climate using a 15-year dendrometer dataset, which measures yearly tree stem diameter change for 2855 trees of 178 species in a lowland moist tropical forest on Barro Colorado Island, Panama. We calculated correlations in growth time series for every pair of trees and then compared the distributions of correlations for conspecific vs. heterospecific pairs. Mean and median correlation coefficients were significantly larger for conspecific than for heterospecific pairs. In agreement with the niche-complementarity hypothesis, this suggests that species differ in their response to interannual variation in climate and fulfill different functional niches in the community. Thus, more diverse tree communities are likely to benefit from a "portfolio-effect," with less variation and more stability in total forest productivity over years than would be expected in less diverse communities. Essentially, divergent responses of different species to interannual climate variation increase the resilience of the community as a whole. Future analyses will evaluate how these different responses relate to species traits, climate, and phylogeny. Improved understanding of how tropical tree species differ in their responses to climate variation is important to inform policies on sustainable forest ecosystem management and guide restoration efforts, leading to enhanced productivity, stability, and environmental benefits.

Diego Valladares
Intern

Advisor: Mark Torchin

Impacto del afloramiento en la actividad alimenticia de peces arrecifales en el Golfo de Panamá

Resumen

La variación estacional del afloramiento en el Golfo de Panamá durante la temporada seca deposita agua fría y rica en nutrientes en zonas costeras. Mi objetivo es evaluar cómo esos cambios ambientales afectan la depredación de peces arrecifales. Propongo que las bajas temperaturas durante eventos de afloramiento reducen la actividad alimenticia de los peces al disminuir su metabolismo, y que incrementos en el reclutamiento de organismos sésiles durante este periodo disminuye los efectos generados por depredadores. Para evaluar estas hipótesis, cuantifiqué el reclutamiento y las tazas de depredación en el archipiélago de Las Perlas y Coiba durante las estaciones seca y lluviosa. Los resultados revelan una mayor biomasa de organismos sésiles durante la temporada seca en el Golfo de Panamá, generando contrastes regionales entre esa región y el Golfo de Chiriquí. Además, observé una mayor diversidad y abundancia de consumidores durante la temporada de surgencia en el Golfo de Panamá.

Armando Vera
Intern

Advisor: Erin Spear

¿Tienen los hongos generalistas un rango de hospedadores más amplio porque infectan más plantas o porque compiten mejor con otras cepas?

Abstract

Se sabe que los hongos generalistas infectan una amplia gama de hospedadores vegetales, a diferencia de los especialistas, que se limitan a una o pocas especies. Sin embargo, los mecanismos que permiten este rango de hospedadores más amplio en los generalistas aún no están claros. Este estudio investiga si los hongos generalistas logran su amplio rango de hospedadores principalmente mediante una mayor infectividad en diversas especies vegetales o mediante la inhibición competitiva de otras cepas fúngicas. Recolectamos y aislamos cepas fúngicas de tres especies arbóreas y realizamos experimentos de inoculación para evaluar tanto su éxito infeccioso como su capacidad para suprimir cepas competidoras. Al comparar el rendimiento de los hongos generalistas y especialistas en términos de infección del hospedador e interacciones competitivas, buscamos comprender mejor las contribuciones relativas de la capacidad infectiva frente al comportamiento antagónico. Comprender estos mecanismos nos proporciona información sobre la dinámica planta-patógeno y puede fundamentar las estrategias de gestión forestal donde las enfermedades fúngicas impactan la biodiversidad y la salud del ecosistema.

Pushkar Wagh
Intern
• Smithsonian Tropical Research Institute

Advisor: Owen McMillan

Investigating the role of iridescence in thermoregulation in *Morpho* butterflies

Abstract

The charismatic coloration of many butterfly species, while well known for its use in sexual communication and anti-predator signaling, is often underappreciated for its role in temperature regulation. Previous research on the role of butterfly wing color in thermoregulation has primarily focused on pigmentary colors. The thermoregulatory role of iridescence - a structural, non-pigmentary color strategy - remains largely unexplored. Here, we investigated whether *Morpho helenor* butterflies, reared under different temperature regimes (hot, cold, or ambient), exhibit differences in warm-up times, which are important for attaining flight. While we found no effect of developmental temperature treatments on warm-up times, we observed that dorsal wing surfaces warmed significantly faster than ventral surfaces. We further conducted behavioral experiments and confirmed that *M. helenor* butterflies adopt a dorsal basking posture in the sun, suggesting an adaptive potential for the iridescence in facilitating heat gain. These findings provide novel insights into the thermal strategies of iridescent butterflies and underscore the potential contribution of structural colour to thermoregulation in tropical species.

Isabella Willard
Intern
• Colorado State University
Advisor: Rachel Page

Effects of Anthropogenic Noise on Stress Levels in Tropical Bats

Abstract

In a growing world, noise pollution impacts ecosystems and their inhabitants in ways that alter their behavior and physiology. Bats may be affected by these anthropogenic sounds, showing higher cortisol levels than bats in less acoustically disturbed areas. This can affect communication, foraging, reproduction, and predator detection. We broadcasted different types of anthropogenic sounds and measured the effect on cortisol levels, a key stress hormone, and behavior, in various species of tropical bats living in artificial roosts. We hypothesized that the treatment of human conversation would result in the highest cortisol levels and altered behavior compared to silence and traffic noise. Different audio treatments were each broadcast over three days at five different locations, including silence, traffic noise, and human conversation. We documented bat activity levels and behaviors during the playbacks. After each treatment, we collected the fecal samples of the bats to measure cortisol levels.

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