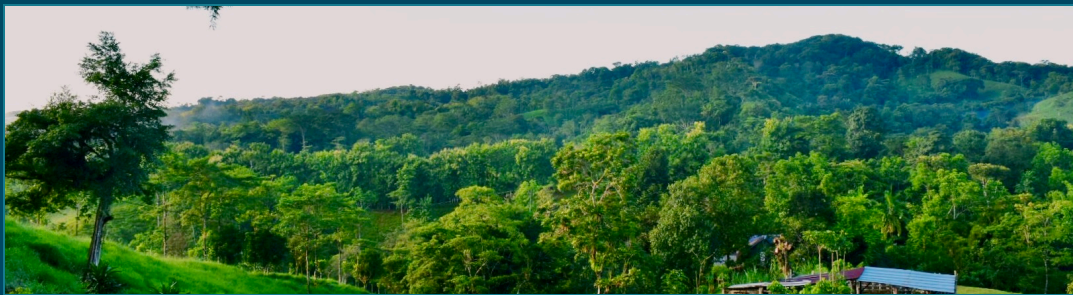


THE SCHOOL FOR FIELD STUDIES

DIRECTED RESEARCH COSTA RICA

Center for Ecological Resilience Studies · Atenas. A complete record of student research projects from the four most recent semesters.



SPRING 2026

5 projects · 24 student authors

FALL 2025

4 projects · 11 student authors

SPRING 2025

4 projects · 27 student authors

FALL 2024

3 projects · 9 student authors

16

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SEMESTERS

FALL 2024 – SPRING 2026

ABOUT THIS GUIDE

Directed Research is the capstone of every SFS semester: students work in small teams with resident faculty on questions set by the needs of the host community and its ecosystems. This guide collects the Directed Research projects completed at the Center for Ecological Resilience Studies (CERES) in Atenas, Costa Rica, over the four most recent semesters.

Projects are listed newest first. Each entry gives the project title, its faculty advisor or advisors, and the student authors with their home institutions. Where a project’s final report carries a formal author abstract, that abstract is reproduced here. Otherwise the entry closes with a research summary drawn from the Center’s semester final report.

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FACULTY ADVISORS

Directed Research at CERES was advised by 6 faculty and researchers across these semesters.

ADVISOR	PROJECTS	SEMESTERS
Dr. Jeremy Klank	5	Fall 2025, Spring 2026
Dr. Mary Little	4	All four semesters
Dr. Milena Cambronero	4	All four semesters
Dr. Gerardo Avalos	1	Spring 2025
Dr. Natalie Sánchez	1	Spring 2025
Víctor Acosta	1	Fall 2024

Center for Ecological Resilience Studies · Atenas, Costa Rica

01 Sustainable Food Futures: Building Local Food Security in Monteverde—Evaluating Community-Supported Agriculture Initiatives (Monteverde, Costa Rica)

Faculty advisor: Dr. Mary Little

Leo Arms, Aiden Beinhauer, Lindsay Dunlap, Brooke Edmunds, Isabella Ivy, Chloe Marohn, Sofia Oltramari, Shaye Phillips

Amherst College · Allegheny College · Brown University · University of Minnesota Twin Cities · Smith College · Columbia University · Denison University

RESEARCH SUMMARY

This project asked whether a community-supported agriculture initiative could work in the Monteverde food corridor, approaching the question from both ends: sustainable farmers' interest in and capacity to join a direct farmer-to-consumer programme, and consumers' interest in and barriers to engaging with one. The mixed-methods design combined a focus group with members of a regenerative agriculture NGO and a Ministry of Agriculture officer, surveys of local producers and consumers, key stakeholder interviews, and visits to sustainable farms. The stakeholder report goes to the Monteverde Institute, Corclima, and AgroRegenera, and will be set alongside parallel work on dairy farmers' interest in alternative production networks, with the aim of a joint producer presentation and a focus group to carry CSA planning forward.

02 Biophysical Assessment and Identification of Priority Areas for Restoration and Arboreal Mammal Conservation in the Quebrada Matías (Atenas, Alajuela, Costa Rica)

Faculty advisor: Dr. Milena Cambronero

Stella Keller¹, Madinah Drinkard², Gabrielle Zebron³, Alanna Benson³, Charlotte Maturo⁴, Lily Smith⁵, Ariel Kilgore⁶, Phillip Swammy

¹ Mount Holyoke College, ² Tufts University, ³ Dickinson College, ⁴ Connecticut College, ⁵ University of Puget Sound, ⁶ Saint Michael's College

RESEARCH SUMMARY

This project completes a fourteen-year assessment of the Quebrada Matías, a community restoration initiative proposed by the conservation association ADECA in 2012 and previously surveyed by SFS in 2012 and 2019. The 2026 cohort worked in four parts: forest cover along the stream and its relationship to stream depth; mapping environmental impacts against land use; the relationship between land use and erosion; and ecological connectivity with priority restoration areas for arboreal mammals. Students learned double-rope tree-climbing technique and built heat maps to identify pollution hotspots and areas of vegetation loss along the stream. Next steps are publication, communication of results back to the communities, and continued tracking of arboreal mammal movement to identify priority restoration areas in Atenas.

03 Amazing Avians: Difference in Bird Diversity from Two Elevations in a Dry to Wet Premontane Forest, Atenas, Costa Rica

Faculty advisor: Dr. Jeremy Klank

Madeline Bratvold¹, Juliana Smith²

¹ University of Minnesota Twin Cities, ² Lawrence University

ABSTRACT

Ecological diversity and the factors that influence it have been studied in ecology for decades. However, little research has focused on the transition zones of dry and moist premontane forests. More specifically, data for many transitional locations on bird diversity is lacking, which could be used for studying ecological theory or conservation. For this paper, particular interest was placed on elevation as an influencing factor. Our objectives were to gather species richness and abundance data from two sites differing in elevation. Both sites were located in Atenas, Alajuela, in the transition zone between dry forest, moist forest, and premontane forests of Costa Rica. One site (Andromeda) is located at 500 meters in elevation, the other (Bosque Municipal) at 1000 meters. Mist netting and point counts were performed over a 5-day period, and a total of 769 individuals were identified, comprising 82 species. Through rarefaction curves, results showed significant differences in species richness. Andromeda had a significantly higher species richness, diversity of common species, and diversity of dominant species. Non-metric Multidimensional Scaling (NMDS) and PERMANOVA analyses showed differentiation in the community structure between the two sampling sites. Previous ecological theory supports the idea that as elevation increases, species richness decreases, lining up with the results from our study. Overall, significant differences were found between the two sites in bird community composition and richness.

04

Energetic Emigration: Scaled Mass Index of a Resident and Migrant Bird Species in Atenas, Costa Rica

Faculty advisor: Dr. Jeremy Klank

Claudia Cummings¹, Samantha Seepersad², Ian Watt³

¹ Brandeis University, ² Hamilton College, ³ University of New Hampshire

ABSTRACT

Costa Rica is home to over 918 bird species, 250 of which are migratory. There is limited information about how resident birds are affected by the movement of migrants in Central America. This study explores how scaled mass index (SMI) differs between a resident (*Chiroxiphia linearis*) and a migrant (*Catharus ustulatus*) between two sites of different elevations located in a transition zone between dry and moist forest within premontane slopes of Costa Rica. Our hypothesis was that there will not be a difference of SMI between sites because of similarities in location and resources. We also hypothesized that the species' migratory status will affect SMI because of physical preparations for seasonal movements. Mist nets were set up at each site over the course of a week, and data collected included species, tarsus length, and weight. We found no difference in the SMI between species, between site location, or between species across the locations. These findings are likely due to differences in dietary and foraging niches, a limited period of interaction, or breeding season timing. Future research could analyze a species of migrant and resident birds that have similar ecological niches to reveal a more accurate representation of potential competition. However, our study suggests that some residents may be better adapted to the presence of migrants to reduce negative effects on body condition.

05

A Functional Diversity Analysis of Bird Communities at Two Elevations in Transitional Premontane Dry and Moist Forests in Atenas, Costa Rica

Faculty advisor: Dr. Jeremy Klank

Maggie Conklin¹, Amanda Dennis², Emily McNeal³

¹ Dickinson College, ² Elon University, ³ Denison University

ABSTRACT

Functional diversity is an important component of biodiversity, providing valuable context for ecosystem health. There is currently very little information regarding the functional diversity of bird communities in Atenas, Costa Rica. This study quantifies a change in functional diversity of bird communities in two forests at differing elevations in transitional premontane dry and moist forest, Bosque Municipal de Atenas (1000 m a.s.l.) and Andr meda (500 m a.s.l.). Using point counts and mist nets, we measured bird abundance, richness, and morphological traits at each site. We calculated five functional diversity indices, and found functional divergence was the only index with a statistically significant difference between sites, influenced by the preference of migratory birds to mid-elevation secondary forests. The lack of significant results for the remaining functional indices may have been influenced by site and surrounding land use. This study provides valuable information that can be used to understand the relationship between functional diversity and elevation in tropical bird communities in understudied ecosystems.

01 Cultivating Agroecological Resilience: Honey Production and Agrotourism in the Bellbird Biological Corridor

Faculty advisor: Dr. Mary Little

Emma Larson¹, Lillian Robinwhite²

¹ Connecticut College, ² Clark University

RESEARCH SUMMARY

Working with the Monteverde Institute, this project examined how reforestation and restoration in the Bellbird Biological Corridor affect honey production, and whether honey producers see agrotourism as a route to economic diversification. Students interviewed members of the Guacimal Honey Producers Association, native bee producers, and activists to document methods, assess production alongside conservation efforts, and identify obstacles, and surveyed tourists on their interest in agrotourism and beekeeping tours and products. The findings on tourist interest go back to the beekeepers, who are considering selling honey directly to customers at a better price and want to teach the public about pollinators and the harm caused by agrochemicals. The report and papers will be lodged with the Monteverde Institute's digital library and shared with the Bellbird Biological Corridor.

02 Connecting Canopies: Identifying Priority Areas for Ecological Connectivity and Arboreal Mammal Conservation in Atenas (Alajuela, Costa Rica)

Faculty advisor: Dr. Milena Cambroner

Catherine Ferrantino¹, Hadas Brownstein², Elliot Needle³, John Ramsey⁴

¹ Hamilton College, ² Clark University, ³ Reed College, ⁴ Davidson College

RESEARCH SUMMARY

This project identified priority connectivity areas for arboreal mammals in Atenas. Semi-structured interviews were conducted with two rescue centres, SINAC, the fire department, ICE (the Costa Rican Electricity Institute), the Municipality of Atenas, and farm owners near riparian zones, alongside review of camera trap data; students learned double-rope climbing technique to service cameras placed in the canopy. The work split into two studies: a network analysis of the institutions dealing with arboreal mammal electrocutions in Atenas, and identification of priority conservation areas for white-faced capuchins (*Cebus imitator*). Results were presented at the III Water and Biodiversity Festival, and data collection on arboreal mammals and riparian corridors continues.

03 Through the Looking Glass: The Role of Coloration in Highland Neotropical Salamanders

Faculty advisor: Dr. Jeremy Klank

IZ Kurtz¹, Jenna Gentert-Corso², Anika Overvoorde¹

¹ Colorado College, ² Allegheny College

ABSTRACT

Coloration plays an essential role in ecosystem interactions. Both physiological and morphological factors determine coloration, which is commonly investigated through chromatic and achromatic components. Observations of the predatory systems of *Bolitoglossa* species and research on visual models for potential predators are nonexistent.

Salamander populations as a whole are declining and face the risk of extinction, underscoring the urgency of understanding their ecology and the ecosystem they inhabit. The objective of this investigation is to explore the role of coloration in three species of *Bolitoglossa* from the highlands of Costa Rica through visual models of birds, snakes, and salamanders. Our results indicated similarities in the perception of individual salamanders by visual models for birds, snakes, and salamanders. Specifically, salamanders with dark and orange color morphs were more conspicuous across all three models. In contrast, tan-colored salamanders were better camouflaged. The color overlap between the substrate and the species was lower for *Bolitoglossa tica* than for *Bolitoglossa cerroensis* and *Bolitoglossa pesrubra*. This research emphasizes the importance of baseline information on species that are unrepresented and at high risk due to environmental challenges, as well as further developing information on environmental camouflage and conspicuousness of harder-to-witness species.

04 A Comparison of Diet Between Three Highland Neotropical *Bolitoglossa* Salamanders in Costa Rica

Faculty advisor: Dr. Jeremy Klank

Lesly Hernández¹, Liam Shields²

¹ Lehigh University, ² Allegheny College

ABSTRACT

Diets convey important information about the ecology and natural history of species, providing insight into their interactions within their respective ecosystems. There is little to no information regarding the diet of *Bolitoglossa* salamanders within the Cordillera de Talamanca in Costa Rica. We describe and quantify the diet of three species of *Bolitoglossa* on the Cerro de la Muerte, Costa Rica. We flushed the stomachs of *Bolitoglossa pesrubra*, *Bolitoglossa cerroensis*, and *Bolitoglossa tica* collected from páramo and montane forest ecosystems. Stomach contents were then analyzed and categorized into 13 taxonomic groups. We found that the three sampled species have a similar diet and it does not differ by ecosystem. We also found that there is no correlation between the size of the individual salamander and their prey size consumed, nor did the size of the salamander influence the abundance of prey they eat. This study provides foundational baseline information about the diets of *Bolitoglossa* salamanders in Costa Rica that can be used to understand their ecological role within neotropical montane and páramo ecosystems.

01 **Cultivating Agroecological Resilience: Assessing Food System Transformation at the Local Level**

Faculty advisor: Dr. Mary Little

Alli Scheid¹, Samar Haddad², Rin Hendricks³, Megan Scalera⁴, Diego Avalos⁵, Sophia Dziekan¹, Janet Spingarn⁶

¹ Columbia University, ² University of Massachusetts, ³ Salisbury University, ⁴ Fordham University, ⁵ Holy Cross College, ⁶ Smith College

RESEARCH SUMMARY

Based in Santa Elena, this project assessed food system transformation at the local level by visiting the stakeholders behind Hecho en Monteverde, a community-based local origin certification, and examining first-hand what motivates producers to join. The work built an experiential understanding of how such a certification diversifies revenue and strengthens resilience, and a more balanced picture of social solidarity action and of how producers decide whether to take up regenerative practice. Stakeholders asked for video material explaining the certification's benefits to tourists and to locals, which students set out to produce. Next steps are to widen the work on knowledge exchange among local businesspeople, evaluate the certification's social, economic, and environmental impacts, and map participants to make the invisible network of connections between local businesses visible.

02 **More Than Water: Diversity of Medium and Large-Sized Mammals in Water Source Protected Areas Managed by Communal Aqueducts in a Fragmented Landscape (Atenas, Alajuela, Costa Rica)**

Faculty advisor: Dr. Milena Cambronero

Abigail Rajala¹, Ayla Feia², Eliza Lynch³, Ella Lysne⁴, Jane Ivey Johnson⁵, Meredith Klinzing⁶, Zoë Heard⁷

¹ University of Wisconsin–Madison, ² University of Minnesota, ³ Wellesley College, ⁴ Lawrence University, ⁵ Wake Forest University, ⁶ Denison University, ⁷ University of North Carolina/Chapel Hill

RESEARCH SUMMARY

Water source protection areas managed by communal aqueducts function as habitat islands in a fragmented landscape, and this project surveyed the medium and large-sized mammals they hold in Atenas. It was the first time SFS students worked in the forest canopy: they helped relocate camera traps in two trees, an exercise that required exploratory field trips, tree preparation, and management of natural hazards. To capture the social side of communal aqueduct management, two social cartography workshops were held with an anthropologist facilitating. Data collection on arboreal mammals and aqueduct management continues, with a manuscript planned on the mammals detected at ground level.

03 **Singing in the Face of Danger: Sex-Specific Vocal Behavior of *Thryophilus rufalbus* Under Predation Risk**

Faculty advisor: Dr. Natalie Sánchez

Ally Fetterman¹, Margot Hilyard², Penny Robinson³, Jeanne Blau⁴, LeNora Preston⁵, Yvie Scarlett⁶, Lorenzo Tovanche⁷

¹ College of the Holy Cross, ² Mount Holyoke College, ³ Brown University, ⁴ Elon University, ⁵ Salisbury University, ⁶ Smith College, ⁷ Allegheny College

ABSTRACT

Animals face predation risk, and their responses have implications for fitness and survival. In predation scenarios, animals may emit signals to alert both conspecifics and heterospecifics, reducing their chances of being preyed upon. In birds, vocalizations act as signals to alert more individuals to react against a potential predator, resulting in more vocalizations and physical attacks on the predator; this behavior is known as mobbing. As part of ongoing research, I study the behavioral responses of the Rufous-and-white Wren (*Thryophilus rufalbus*) to predation risk in the tropical dry forest. This species is pertinent because males and females sing and perform duets, which allows us to investigate the different selection pressures that males and females face in different predation scenarios. During the directed research, we studied the vocal behavior of wrens by recording their vocalizations and their responses to playbacks of calls of a common predator. We analyzed the vocalizations of males and females using acoustic analysis software, comparing songs performed under natural conditions with those performed under the predation risk simulation. In dynamic environments, such as the tropical dry forests where drastic changes in temperature and precipitation occur, limited resources could increase predation risk. Therefore, we provided new insights into how animals communicate and adapt to variable predation scenarios.

04

Environmental Factors Influence Trait Variation More Than Plant Size in the Tropical Dry Forest Shrub *Bonellia nervosa*

Faculty advisor: Dr. Gerardo Avalos

Bridget McBride¹, Jaden McCleery Brown², Ciara Duff¹, Jillian Rosenbaum³, Grace Millard⁴, Sam Rickert⁴

¹ Mount Holyoke College, ² Carnegie Mellon University, ³ University of Massachusetts/Amherst, ⁴ University of Wisconsin/Madison

ABSTRACT

Bonellia nervosa is a sun-loving shrub native to Costa Rica's tropical dry forests (TDF), notable for its reverse phenology. This study examined how that phenological strategy influences intraspecific variation in functional traits. We assessed how plant size, life stage, and canopy structure relate to variation in structural and photochemical traits in individuals from Santa Rosa National Park. We hypothesized that smaller plants would adopt acquisitive strategies, larger individuals would follow conservative ones, and plants in more open canopy conditions would exhibit higher electron transport rates. Data were collected from 54 individuals, including measurements of plant height, diameter, leaf traits (thickness, SLA, water content, stomatal density), and canopy structure (openness and LAI) using hemispherical photos. A Chapman-Richards model identified the transition to reproductive stage at 1 m. Photosynthetic parameters were recorded using a chlorophyll fluorimeter, and analyses included PCA and linear regressions. Our findings show that canopy openness significantly influenced SLA, indicating that light availability drives trait variation in *B. nervosa*. Although photosynthetic efficiency was similar across life stages, the species showed substantial functional plasticity in response to light conditions. These results support a trade-off between fast growth and survival consistent with the leaf economics spectrum (LES), highlighting *B. nervosa*'s adaptive strategy as a phreatophyte in TDF environments. Further research is needed to explore how such trait plasticity may buffer this species against climate change.

01 Cultivating agroecological resilience: Assessing food system transformation factors among farmers

Faculty advisor: Dr. Mary Little

Elijah Hill¹, Felix Spaniol², Lydia Herkert³

¹ Columbia University, ² Lawrence University, ³ University of San Francisco

RESEARCH SUMMARY

Staying at a regenerative farm and planting alongside the farmers, this project assessed the factors that shape food system transformation among Costa Rican producers. The immersion produced an experiential understanding of how ecosystem services and diversified revenue sources contribute to resilience, and a more balanced picture of agroecological practice and of how farmers decide whether to adopt regenerative methods. A visiting professor from Reed College provided guidance on using Climate Engine and helped the group map the farms. Next steps are to expand the work on knowledge exchange among farmers, increase the sample size, and identify which institutions and organisations serve as effective sources of practical information for the co-production of knowledge.

02 Relationship between flammability and water potential in Costa Rican moist vs. dry forests

Faculty advisor: Dr. Milena Cambroneró

Sofia Aguayo¹, Elizabeth Muller², Rayna Rose³

¹ University of San Diego, ² Sewanee: University of the South, ³ Smith College

RESEARCH SUMMARY

This project examined the relationship between plant flammability and water potential across Costa Rican moist and dry forests, testing how a plant's water status governs how readily it burns. The collaboration of Dr. Aaron Ramírez was central: he supplied expertise, the pressure chamber used to measure water potential, and technical support for the analysis. The data are being published with him in the journal *Forests*. This DR closes the project, which may be reopened once the Center's mammal conservation projects conclude.

03 Preliminary checklist of amphibians and reptiles of Bajo La Paz, Piedades Norte, San Ramón de Alajuela

Faculty advisor: Víctor Acosta

Sofía Rico¹, Macey Barone², Jolie Jaffe³

¹ Fordham University, ² Clark University, ³ Reed College

ABSTRACT

Since the 1980s, amphibian populations worldwide have experienced significant declines, with *Agalychnis annae* notably disappearing from many locations in Costa Rica, including San Ramón. To evaluate the status of this species and document the amphibian and reptile diversity in the region, we conducted surveys at three sites in Bajo La Paz, San Ramón, during both dry and wet seasons in 2024. Our research also used citizen science to identify species that may have gone undetected, including the threatened *Rhinoclemmys pulcherrima* (IUCN). We recorded a total of 63 species, comprising 23 amphibians and 40 reptiles, but *A. annae* was not present. Detection rates varied significantly between

seasons and influenced species phenology. Although amphibian diversity was moderate and included species of interest for tourism, there is insufficient data on reptile populations to draw definitive conclusions; reptile diversity may still be underestimated. Citizen science has proven to be a valuable tool for discovering more cryptic species. We encourage ongoing research, enhanced conservation efforts, and expanded citizen science initiatives to protect the region's herpetofauna.

THE SCHOOL FOR FIELD STUDIES

Center for Ecological Resilience Studies (CERES), Atenas, Costa Rica. Titles, faculty advisors, student authors, and home institutions compiled from the SFS Directed Research project lists for Fall 2024, Spring 2025, Fall 2025, and Spring 2026.