Las Cruces REU Mentors 2019

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Behavioral ecology: social structure and local adaptation in a semi-aquatic lizard

1. Water anole home range and microhabitat use. Understanding how individuals distribute themselves in space is a fundamental problem in ecology. In collaboration with Dr. Bree Putman, this project will explore the social structure of water anole populations and their relationship to the microhabitat. Little is known about this unusual lizard's home range and social behavior. The student conducting this research will study water anole home range sizes and shapes to address natural history questions regarding sex- and age-related habitat use, territoriality, and density.

2. Social signaling in courtship and aggressive encounters. How animals use signals to communicate with others of their species is an essential component of their behavioral ecology. This project will test how water anoles use behavioral and morphological cues during staged inter- and intra-sexual encounters. Several conspicuous morphological cues are of interest, namely dewlaps (large and colorful "chin-flaps" of skin) in males and the highly changeable body coloration of both sexes. Behaviorally, both males and females perform dramatic displays of aggression, and males actively court females with head-bobs and a suite of stereotyped behaviors. Notably, these morphological and behavioral traits have never been quantified in relation to mating success or contest outcome in water anoles. Specific hypotheses can be generated in consultation with the student researcher, but some options include examining a) the relationship of male body coloration or dewlap characteristics to female mate choice, b) the effect of color change on the outcome of antagonistic encounters, or c) male courtship investment in relation to perceived female reproductive value.

Johana Goyes, Ph.D
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Emerald Glass Frog (Espadarana prosoblepon)

Project 1. Is there any parental care in *Espadarana prosoblepon?*Early studies of the natural history of this species report little or no parental care. Jacobson (1985, *Herpetologica* 41:396–404) observed females near the eggs for a few minutes after oviposition but later deserted the clutch. Since then, no studies have further explored the existence of parental care in this species. Using enclosures in the field, the student will make careful observations of mating pairs of *E. prosoblepon,* to determine if there is an adult frog brooding the eggs, which sex provides care, and for how long the adult remains with the clutch. In addition, through daily monitoring of egg clutches, the student will evaluate the benefits (if any) of the parental care behavior of this species. Elucidating the natural history of poorly studied Centrolenid species, will aid in the understanding of the evolution of parental care in this family.

Project 2. Estimating abundance of *Espadarana prosoblepon*in Las Cruces. With the current amphibian declines it is imperative that we determine abundance parameters of *Espadarana prosoblepon*in Las Cruces. This will provide a baseline for future studies of the population dynamic of this species, and will allow for comparative studies throughout the species range. Using mark-recapture methods, the student will estimate abundance of *E. prosoblepon*in Las Cruces. In this location, *E. prosoblepon* is a common species, however, to the best of my knowledge, studies estimating local abundance and population size of this species have not been undertaken. Estimating abundance will aid in the understanding of the population dynamic of this species while at the same time will provide a baseline for comparisons with other populations pre and post-arrival of the amphibian chytrid fungus.

Patricia Esquete Garrote, Ph.D
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Ecology and biology of aquatic invertebrates

1. Microhabitat preferences of benthic invertebrates in tropical ***streams***
Benthic environments in tropical streams host a variety of organisms of different life strategies, ranging from soft bodied, infaunal plathelmints to insects with aquatic larvae or macrocrustaceans. The REU student will develop a project that examines the factors affecting the aquatic invertebrates' preferences for certain microhabitats, their abundances or species composition across a tropical stream. For this purpose, they will use different field capture techniques, animal manipulation methods and habitat characterization, as well as laboratory methods including the use of microscopes and identification tools. If more than one student is interested, two projects could be carried out on this subject.

2. Predation-prey relationships of semi-aquatic spiders
Semi-aquatic spiders are fascinating animals that live in rocks and crevices in the vicinity of water bodies, preying on insects, frogs, tadpoles, and other organisms including small fish. Two species of the non-web genus *Trechalea* are abundant in the rainforest's streams of Costa Rica, where they play an important ecological role by controlling other species' populations. However, little is known about their behaviour and the factors affecting their hunting/resting activities. This study aims to investigate their predation strategy and activity rhythms; The REU student can expect searching rivers for big spiders during different times of the day, observing activity patterns, and mapping their movements. If more than one student is interested, two projects could be carried out on this subject.

Breanna (Bree) J. Putman, Ph.D
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Behavior and ecology of water anoles (Anolis aquaticus) at sites differentially impacted by human disturbance.

1. Water anole personality and spatial ecology. Understanding whether consistent individual differences in one or more personality traits associates with movements and home range size.
2. Water anole boldness and predation risk. Understanding whether bolder individuals experience more risk in terms of tail loss rates, and/or are exposed to more risk in terms of amount of time spent defending territories.

Tia Harrison
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Impact of disturbance and ecological succession on two tropical mutualisms: the legume-rhizobia mutualism and the ant-plant mutualism.

Project Summary 1: Tropical legume – rhizobia mutualisms across various stages of succession

Nutrient availability is low in early-succession communities compared to late-succession communities. Thus, mutualisms that provide additional nutrients are expected to be more important in recently disturbed communities. The student will test this prediction in a legume-rhizobia mutualism across successional plots of increasing age at Las Cruces. Rhizobia form nodules on plant roots in which plants and rhizobia exchange nutrients (fixed nitrogen and carbon). The student will assess whether the most abundant legume species in recently disturbed plots have higher nodulation (nodule number, nodule size, nodule colour) compared to plants in established communities, indicating that plants in recently disturbed plots are more dependent on mutualist-provided resources.

Project Summary 2: Extrafloral nectary production in tropical plant communities

Herbivores are more common in late-succession communities than in early-succession communities. Therefore, defense mutualisms are expected to be more important for plants growing in late-succession communities, where herbivore populations have recovered from disturbance. The student will test this prediction in an ant-plant mutualism, a common mutualism in tropical ecosystems in which ants protect plants from herbivores in exchange for a food reward (nectar) plants produce in structures called extrafloral nectaries. To assess whether plants in recently disturbed communities invest less in attracting ant bodyguards, the student will measure the food rewards in extrafloral nectaries (sugar concentration, nectar volume) on the most abundant nectar producing plant species across various succession plots at Las Cruces.

Project Summary 3: Multiple mutualist common garden experiment in the tropics

Mutualisms that occur over a large geographic range are exposed to a wide diversity of partners. Therefore, we might expect widespread mutualists to be adapted to their local partner. The students will test this prediction in a multiple mutualist system: rhizobia, legumes, and ants bodyguards. Rhizobia form nodules on plant roots and provide fixed nitrogen to the legume in exchange for carbon. Ants protect the legume against herbivores in exchange for sugar from plant extrafloral nectaries. The students will plant legume seeds (*Chamaecrista nictitans*) collected from temperate, sub-tropical, and tropical locations at a field site at Las Cruces. The student will measure seed production, nodule number, and extrafloral nectar concentrations to test local adaptation.

José-Cristian Martínez, Ph.D.
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Insect biodiversity; Insect ecology; Forest restoration

Project 1: Tropical restoration and its effect on the insect community

Students can assess what impact tropical forest restoration have on the insect community across the transitional grasslands, secondary forest, and primary forest at Las Cruses biological station. An additional question such as does selective logging change the leaf-litter habitat compared to the uncut primary forest, can also be addressed.

Project 2: Impact of tropical woodland restoration on leaf litter decomposition dynamics and insect activity density

Students can assess how restoration activities at Las Cruses impact the ground leaf-litter habitat, and what members of the detrital insect community are most affected by changes in leaf litter structure. This question can be assessed by documenting the leaf litter characteristics and by using pitfall traps to gauge activity density of major ground active insects such as spiders and beetles.

Justin Montemarano, Ph.D
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Community-level effects on decomposition dynamics in aquatic systems.

1. Investigating the longitudinal distribution of fish communities in Las Cruces. Previous surveys of fish communities at Las Cruces have suggested low richness (four species), but a possible elevational range extension of at least one fish species. I would like to continue monitoring fish community composition, and extend the monitoring along the Rio Java river.

2. Controllers of freshwater crab behavior and implications for decomposition dynamics. We have found two species freshwater crab (Pseudothelphusidae) associated with stream systems at Las Cruces. Previous projects show that (1) the distribution of the crabs within and outside of streams is highly variable, and (2) that the crabs contribute to the decomposition of leaf matter through shredding. I would like to explore factors controlling crab behavior, densities, and leaf processing rates. For example, crab species and parasite load (trematode metacercariae were discovered in both crab species) may impact activity.