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COMPARISON OF ARTHROPOD COMMUNITIES IN TERMS OF TAXONOMIC RICHNESS, FUNCTIONAL GROUPS AND COLORATION IN THREE TYPES OF TROPICAL FOREST

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ABSTRACT (JJR)

This study examined variation in arthropod populations across different tropical forest habitats and life zones. Species richness was greatest in open habitats and, more generally, in lowland wet forest. Herbivore taxa richness was highest in open area, while scavangers dominated in primary forest understory. Predator avoidance by coloration, both cryptic and aposomatic, was more common in open habitats and drier forests. This descriptive study leads to a number of testable hypotheses suitable for future investigation.

Key Words: arthropod, crypticity, aposomatic coloration, Palo Verde, Cerro Cacao, Corcovado, La Selva.

INTRODUCTION (JJR)

Various types of tropical forest differ in terms of flora, fauna and environmental factors. This descriptive project investigated variation in the arthropod populations among open grass, secondary forest and primary forest habitats in three different tropical life zones (dry forest, cloud forest, and lowland wet forest). We examined taxonomic richness and distribution across functional groups and coloration strategies. Hopefully these data can aid the development of hypotheses and experiments concerning the factors responsible for variation in arthropod populations across these habitats and life zones.

METHODS (EHA)

On January 14, 22 and 29, 1994, we sampled arthropods from three distinct life zones in Costa Rica: 1) Palo Verde National Wildlife Refuge, a tropical dry forest; 2) Cerro Cacao National Wildlife Refuge, a tropical cloud forest; and 3) Corcovado National park, a lowland tropical rainforest. At each s ite we chose open grass, secondary growth forest, and primary forest habitats in which to run 25 x 2m transects of haphazardly chosen direction. The evening before sampling, we set up five plastic pit traps filled with ethanol, flush with the ground, at 5m intervals along each transect. We sampled arthropods along these transects using the pit traps, sweep nets and visual searches, and recorded numbers of taxa collected. Six people searched each transect, and spending approximately four hours in each life zone, dividing our time approximately equally among the three habitats. We categorized each arthropod into functional group (herbivore, predator, scavenger, nectarivore, other) and coloration (cryptic, aposematic, other). We used Chi-square analyses to compare functional group, coloration, and overall species richness across life zones and across habi-

tats within life zones.

RESULTS (DBZ)

In a comparison among sites, species richness was highest at Corcovado (277), followed by Cerro Cacao (215) and Palo Verde (99) ($X^2 = 82.88$, df = 2, $p < 0.001$).

We found more herbivores in the open habitat than in secondary growth or primary forest at both Corcovado ($X^2 = 30.90$, df = 4, $p < 0.001$) and Cerro Cacao ($X^2 = 18.40$, df = 4, $p < 0.005$). Conversely, scavengers were more important in the primary forest than in open habitats (e.g. 30% vs. 2% at Corcovado).

At Palo Verde, the proportions of species in functional gropus were similar across habitats ($X^2 = 5.35$, df = 4, $p < 0.50$).

In open habitats there were relatively fewer herbivores at Palo Verde than at Cerro Cacao or Corcovado ($X^2 = 14.08$, df = 4, $p < 0.01$). In other habitats the distribution of taxa among functional groups was similar across sites.

There tended to be more cryptic species in open habitats at both Corcovado ($X^2 = 25.91$, df = 4, $p < 0.001$) and Cerro Cacao ($X^2 = 8.58$, df = 4, $p < 0.10$). For example, 40% in the open habitat compared to 11% in the primary forest at Corcovado. The proportion of aposomatic species were similar among habitats and the percentage of "other" species was lower in the open than in the secondary growth or primary forest. The expected values were too low at Palo Verde for statistical comparisons.

In secondary growth and primary forest habitats, there were relatively more crytic species (≈ 40%) at Palo Verde than at Cerro Cacao and Corcovado ($X^2 = 12.03$, df = 4, $p < 0.025$, in secondary growth; $X^2 = 10.99$, df = 4 , $p < 0.05$ in primary forest). In the open habitat, distribution of taxa among coloration categories was similar across sites.

DISCUSSION (PSW)

Initially, we had hoped to give a detailed description of arthropod abundance and diversity at three distinct tropical life zones in Costa Rica. In Palo Verde, a tropical dry forest and the site most similar to a temperate system, we were able to fairly confidently record the number of individuals and taxa found. However, upon arriving at Cerro Cacao, we quickly learned that our limited time and resources were going to be overwhelmed by the region's incredibly diverse arthropod community. In an effort to get some sort of data that would help reveal major trends within and among sites, we focused on describing diversity rather than sheer abundances. Despite working with very complex systems, we were able to describe several interesting trends.

Corcovado and Cerro Cacao both had over twice as many taxa as Palo Verde. It would appear that the high and seasonably constant primary production in the wetter sites are capable of sustaining as much more diverse arthropod community.

In general, we found the highest diversity in open habitats, and the lowest diversity in primary forests. This is probably not a true representation as the primary forest was incompletely sampled. Our methods were able to census nearly the complete range of microhabitats in the open areas but were limited to the understory (up to 2m high) in the primary forest. The understory comprises only a fraction of the available habitat in a primary forest. Sampling the canopy and subcanopy would undoubtedly add to our estimate of species richness.

Certain functional groups tended to be most diverse in particular habitats. At both Cerro Cacao and Corcovao, we found that herbivores were the most diverse group in the open habitat, and scavengers had an increasing proportion of the diversity in the primary forest (or more precisely, the understory). With a greater density of leaf tissue in the open habitat, it is not surprising to find a higher diversity. of herbivores there. Similarly, with a greater amount of particulate organic matter littering the floor of a primary forest, it is not surprising to find an increasing diversity of scavengers. There were no such trends at Palo Verde, perhaps due to the small difference in vegetation and litter (relative to the more complex sites) between the open habitat and the primary forest.

In the open habitat, Palo Verde had a lower diversity of herbivores than the other two sites. It is possible that the more lush growth of Corcovado and Cerro Cacao is capable of sustaining a higher proportion of herbivorous species. This trend was not found in the secondary growth or primary forest. This could be due to our inability to census the subcanopy and canopy where most of the palatable vegetation and, presumably, the majority of the herbivores would be found.

Along with estimating diversity of functional groups, we estimated diversity of coloration strategies. We found that with a decrease in habitat complexity (open habitat being the least complex), crypticity became more prevalent. Those species categorized as "other" were most diverse in the secondary growth and primary forest. The lack of dense, varying vegetation could leave many arthropods exposed to predation and may have forced them to seek protection in cryptic coloration. In the complex environments of secondary growth and primary forest, arthropods can hide amongst the confusing backdrop of vegetation and may have a reduced need for protective coloration.

This idea was further supported by comparing coloration strategies (among sites). Palo Verde, the least complex site of the three, had the highest proportion of cryptic species. Cerro Cacao and Corcovado, arguably of equal complexity, had similar proportions of cryptic species and the highest proportions of those species categorized as "other".

By the end of this project, we discovered some trends hidden within the complexity of the tropical systems we studied. This study was not capable of sharply defining these trends, yet, we were able to expose them for future hypothesis development and testing. There are two areas that we feel would be particularly important to investigate. One is testing whether herbivore and scavenger diversities are related to the proportion of palatable vegetation and particulate organic matter in a particular area. The other is to test whether coloration strategies are related to habitat complexity.