COMPARISON OF INSECT COMMUNITIES AT FOUR SITES IN COSTA RICA

JAYA A. KAVEESHWAR, SHARON D. KARLSBERG, CHRIS D. CARSON AND JENNIFER L. MITCHELL

Abstract. (SDK) Neotropical forest habitats of Costa Rica are home to a diverse insect fauna. We compared insect communities in four tropical forest sites, sampling in primary and secondary forest habitats (within each site) using sweep net and pit trap collection methods. We found that total insect abundance was higher in secondary habitats at all sites. Order diversity was similar at wet and moist forest sites (Monteverde, Corcovado, and La Selva), but was considerably lower in a seasonally dry forest (Palo Verde). Our study suggests that forest habitat differences do not greatly affect diversity at the order level.

INTRODUCTION (SDK)

The neotropical forest communities of Costa Rica are well known for their abundance and diversity of insect species. In this study, we investigated differences in insect communities in four different forest habitats: seasonally dry deciduous forest, montane cloud forest, Pacific lowland rain forest, and Caribbean lowland rain forest. Each of these tropical habitats is characterized by different temperatures, elevations, moisture levels, seasonal patterns, and plant communities which affect their insect communities. We expected these differences to result in insect communities of different abundances and diversity, at the order level, between these four sites. Additionally, we surveyed insects in primary and secondary forests within each site, expecting differences in land use and disturbance patterns to influence composition of these insect communities.

METHODS (JAK)

We conducted our comparative insect study in January and February 1995 at four sites in Costa Rica: (1) Palo Verde National Wildlife Refuge, a seasonally dry deciduous forest; (2) Monteverde Biological Reserve, a montane cloud forest; (3) Corcovado National Park, a Pacific lowland rain forest; and (4) La Selva Biological Station, a Caribbean lowland rain forest. At each site we sampled along three 25 x 2 m belt transects, 25 m apart, in both primary and secondary forest. Pit traps were placed at 8 m and 16 m at the center of each belt transect during the late afternoon. The next morning, we examined the contents of each pit trap, and sampled the length of each transect with a sweep net. All sweeps were conducted at a walking pace along the length of the entire transect. For each transect sweep and pit trap, we classified insects to order and counted the number of insects in each order.

TABLE 1. Total insect abundance and order diversity in primary and secondary habitats at four tropical forest sites in Costa Rica. Abundance=total number on three transects in each habitat; sampling area and effort were equal at all sites.

	Total Abundance		Order Diversity (Shannon-Weiner index)	
Site	Primary	Secondary	Primary	Secondary
Palo Verde	261	663	1.27	0.63
Monteverde	70	84	1.61	1.70
Corcovado	175	184	1.80	1.74
La Selva	239	261	1.68	1.72

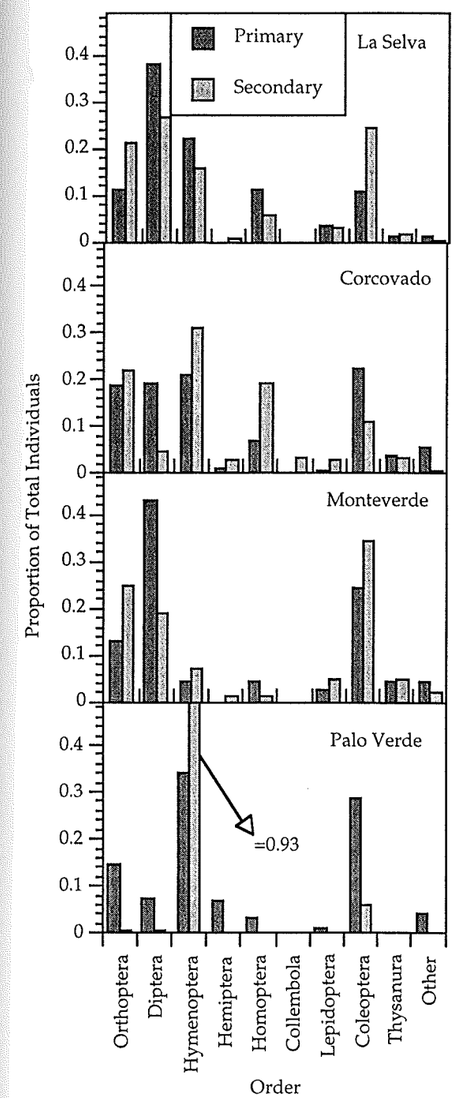

FIG. 1: Distribution of insect orders in primary and secondary habitats at four tropical forest sites in Costa Rica.

RESULTS (JLM)

Due to the low number of insects sampled in individual transects and the high variation between these transect samples, we did not conduct statistical tests of our data. In order to better discus trends in our data for each order, we combined numbers of insects from the three transects within a site habitat (primary or secondary). Additionally, for primary and secondary habitats at each site, sweep net and pit trap numbers were combined.

Total insect abundance was highest at Palo Verde, followed by La Selva, Corcovado, and Monteverde. At all four sites, abundance was higher in secondary transects than primary transects (Table 1). We calculated order diversities using the Shannon-Weiner diversity index. Diversities were similar across primary and secondary habitats, and between different sites. The only exception occurred at Palo Verde, where order diversity was lower in secondary than in primary forest, and both these diversities were less than those at other sites (Table 1).

A few trends can be seen in comparing the proportions of order between the primary and secondary transects (Fig. 1). Orthoptera accounted for a greater proportion of insects in secondary than in primary transects at all sites except Palo Verde. Hymenoptera also made up a greater proportion of secondary forest insects at all sites except La Selva. Diptera, on the other hand, were more numerous in the primary forests of all sites.

Comparison of insect orders between sites showed La Selva and Monteverde to be very similar (Fig. 1). Hymenoptera were in greater abundance at Palo Verde than at any of the other sites. Homoptera were found in greater proportions at La Selva and Corcovado than at Monteverde or Palo Verde. Finally, Hemiptera, Collembola, Lepidoptera, and Thysanura made up very small proportions (<6%) of our samples at all sites.

DISCUSSION (CDC)

The trends in abundance between sites and forest types may reflect habitat differences. The greater insect abundance in secondary forests at all four sites may be due to both the apparent higher densities of understory vegetation and the overall

higher productivity of these habitats. Because our sampling was confined to the lower understory, and many insects were herbivores, we would expect an overall higher number of insects to be captured in areas that had a greater biomass of understory vegetation. While we did not quantify differences in vegetation type or quantity, our observations indicate more understory vegetation in all secondary forest environments (with the possible exception of Palo Verde). The higher light levels in most secondary forest environments may lead to a greater amount of primary productivity, which could be an important factor determining insect abundance.

The greater total insect abundance in the Palo Verde dry forest sites is due to a large number of Hymenoptera, especially ants, found in the secondary forest pit traps (> 600 individuals). The lower total insect abundances at Monteverde may be due to lower temperatures and high moisture condition at this higher elevation site. The greater insect abundance at La Selva and Corcovado suggests that the constant warm temperatures and high moisture levels in tropical lowlands create a more optimal environment for insects.

Although habitat differences exist between the four sites, the similarity between order diversities at all sites except Palo Verde indicates that these differences may have little impact on order diversity. While order diversity may be largely dependent on the sampling methods and area sampled, the similarity between different habitats was nonetheless unexpected. Overall lower diversity in primary forests at Palo Verde may be due to extreme seasonal dryness which limits insect population growth. While seasonal dryness also contributes to low diversity in Palo Verde's secondary forest, the extremely low diversity found there is due primarily to the high numbers of ants in our pit traps.

The proportion of the total sample represented by one order may be reflective of sampling technique, rather than the actual proportion of insects in a particular habitat. For example, the low representation of Lepidoptera, Thysanura, and Collembola are probably a result of the difficulty of sampling these orders with pit traps and sweep nets. Thus it is important to use these relative abundances only as a comparison between habitats, and not as a reflection of actual insect community composition.

The greater abundance of orthopterans in secondary forests at all sites except Palo Verde may be indicative of an orthopteran foraging preference for understory vegetation. The higher abundance of *Atta cephalotes* (Brady et al. in press) and *Acacia* spp., with their attendant ants, in secondary forests may have contributed to the overall higher abundance of Hymenoptera in secondary forests at all sites but La Selva.

The greater proportion of Diptera in primary forest was largely due to high numbers of mosquitoes in our samples at most sites. Lower light levels and lower temperatures could create a more favorable environment for mosquitoes, which lack the ability to thermoregulate (K. Nislow, pers. comm.). There may also be a greater abundance of breeding sites in primary forests, due to potentially higher moisture levels and a higher density of small pools in epiphytic vegetation.

The lower proportions of Homoptera in both Palo Verde and Monteverde may be the result of lower moisture levels during the dry season at Palo Verde, and cold temperatures at Monteverde. Since homopterans feed on plant phloem, the lack of plant matter with high moisture content during the dry season at Palo Verde may limit their abundance there.

Future research should employ a greater variety of sampling methods which would better represent more of the insect orders naturally occurring at each site. Alternatively, further studies could use a single, effective sampling method which would accurately survey insects of a particular order or functional group of interest.

Although order diversity appears to be similar between different forest sites, there may be substantial differences in insect communities at the species level.

LITERATURE CITED

Brady, J. H. , S. Karlsberg, J. Kaveeshwar, N. Perlroth, and N. Pouliot. 1995. Abundance of *Atta Cephalotes* in primay and secondary forest., pages 69-70 *in* C. D. Wray editor, Dartmouth Studies in Tropical Ecology. Hanover, NH. USA.