COMPARISON OF ARTHROPOD DIVERSITY AND ABUNDANCE UNDER LOGS BETWEEN TWO ELEVATIONS OF COSTA RICAN CLOUD FOREST

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Abstract (J.K.)

We measured the number of arthropod orders and individuals found under logs at two elevations in the Monteverde Cloud Forest, Costa Rica. We found no significant difference between the diversity and abundance of arthropods at the two elevations. However, there were more individuals in all orders at the low altitude than the high one and three orders found at the lower elevation that had no representation at the high altitude. Also there were more than three times as many total individuals for the low than the high. These findings strongly support our hypotheses that the number of arthropod orders and individuals represented will be fewer at the higher altitude. The most likely reason for the lack of statistical significance was our small sample size and large variance.

Introduction (G.Y.)

Our study focused on differences in the diversity and abundance of arthropod communities under dead wood at different altitudes in the cloud forest at Monteverde Biological Reserve, Costa Rica. We hypothesized that there are less orders of arthropods represented under logs at a higher altitude in a cloud forest. We also hypothesized that there are less individual arthropods represented under logs at a higher altitude in a cloud forest. Our hypotheses are based on two presumptions, first that temperature is higher and soil moisture is lower at a lower altitude site, and second that arthropods associated with dead wood far better in conditions of higher temperature and lower soil moisture. Positive results could reveal differences in the absolute contribution of arthropods to deadwood decay at low and high altitudes in a cloud forest.

Methods (G.Y.)

Our two study sites were a low site at an altitude of 1500-meters and a high site at an attitude of 1620-meters. The low site was secondary forest, with a well developed canopy and a moderately thick shrub layer. The high site was primary forest, located about 50m east of the continental divide. Casual observation indicates that the high site receives higher precipitation and contains more dead wood and detritus than the lower site. At each site we located four decaying logs, 16cm to 22cm in diameter, and all at similar

stages of decay; all logs lacked bark and each was still firm. We moved each log, placed a 45cm by 45cm wooden square on the exposed soil, and collected each visible arthropod (length > 4mm). Then we collected the soil to a depth of 1-2cm in a 15cm by 15cm square within the initial square. We identified the taxonomic order of all visible arthropods, or arthropods with length > 3mm, from each of the two sample squares then placed four tablespoons of each soil sample in a Berlese funnel to isolate the visible arthropods which we had previously missed. We multiplied the surface subsample and four tablespoon subsamples to make them proportionally equivalent to the largest surface sample, then summed them to determine the visible arthropod community per 45cm by 45cm under each log.

Results (G.Y.)

We identified 11 orders of arthropods in the low elevation samples and 8 orders in the high elevation samples (See Table One). We found no significant difference between the number of arthropod orders represented under decaying logs at 1500m altitude and 1620m altitude ($U = 12.5$, $p > 0.10$, $n_1 = 4$, $n_2 = 4$). We also found no significant difference in the number of arthropod individuals present under decaying logs at 1500m altitude and 1620m altitude ($U=12.5$, $p > 0.10$, $n_1 = 4$, $n_2 = 4$). The lower altitude samples always contained a higher number of individuals within an order than the higher altitude samples. However, we found no significant difference in the number of individuals within an order in low and high altitude samples (again, see Table One). We found a significant difference between low and high altitude samples when we compared for all 11 orders together the number of individuals within each order ($U = 97.5$, $p < 0.005$, $n_1 = 11$, $n_2 = 11$).

Discussion (J.K.)

We hypothesized that there are fewer orders of arthropods represented under logs at a higher altitude in a cloud forest and that there are fewer individual arthropods under logs at a higher altitude in a cloud forest.

Our first two tests showed that there was no significant difference either for the number of orders or the number of individuals represented between the two altitudes. A third test, however, based on the total number of individuals across all orders for each altitude (opposed to the number of individuals in the four sites for each altitude) revealed a significant difference between total arthropod populations at two altitudes. Unfortunately the data for this test came from a comparison of the sums of eleven populations in both altitudes that were not significantly different; thus, we cannot, then, accept the third test as valid statistical support of our hypotheses.

Why then were our results so marked with non-significance? We have identified several possible sources of error.

1. Our inexperience in identifying various orders most likely resulted in several misidentifications whose consequences were amplified by extrapolation.
2. We most likely introduced error at several points due to our changing and indeterminant sampling protocol. For example, while collecting surface invertebrates we avoided those less than three millimeters in length. While using the microscope, however, we recorded many invertebrates less than three millimeters in length.
3. Our sample size was too small. If our Berlese funnel method had been quicker, we could have collected more than four samples at each altitude.
4. We used a non-parametric test. This test - much weaker than a parametric test - combined with a small sample size may have masked what were significant differences.

Normally one does not dispute the results of a statistical test, but our empirical data is so compelling that this should be addressed. The low-altitude (totals) had more individuals present in every order than the high-altitude (totals) including three orders with no representation at the high altitude (see Table 1). Furthermore the total number of individuals at low altitude was more than three times those at high altitude. Although subjective, we are reluctant to attribute these empirical results to chance alone, (especially when they strongly support both our hypotheses). The high intrasite variance seems to be the most plausible explanation.

It is also possible that our statistical results are indicative of reality. Empirical results illustrated great variance in both the number of orders and the numbers of individuals for each of the eight logs. There may be, in fact, no distributional pattern or difference in numbers. This may be because there was not enough altitude difference between the two sites (although the habitats differ markedly); or temperature and water moisture simply play little or no part in the distribution of arthropods.

In conclusion, we find our empirical data quite compelling, and if we could increase the sampling size we might show statistical significant differences. With this, we could conclude altitude-related temperature and water moisture decreases arthropod diversity and abundance with altitude. And, on a large scale, the absolute arthropod contribution to decomposition could be significantly less at higher altitudes of cloud forest.

Table 1 Listing of the arthropod orders and numbers of individuals present under logs at 1500m and 1620m altitudes in the Monteverde Cloud Forest, Costa Rica.

Order	Low Totals (1500m)	High Totals (1620m)	Significant Difference	P-Value
Araneida	5	0	No	>.05
Coleoptera	107	57	No	>.1
Collembola	128	90	No	>.1
Diplopoda	318	29	No	>.1
Diptera	10	9	No	>.1
Hymenoptera	34	29	No	>.1
Malacostraca	100	38	No	>.1
Orthoptera	52	10	No	>.1
Protura	81	0	No	>.1
Psocoptera	96	22	No	>.1
Thysanura	34	0	No	>.1
Total	965	284	Yes	P<.005*

*This p-value represents the comparison of the sums of 11 populations: there was no significant difference between any pair of populations within each other; thus, the p-value fails to account for a large amount of error.