Table 3: The number of trees with and without vines in the high wind, moderate wind, and high sun sites.

	High Wind	Moderate Wind	Gap
trees with no vines	19	0	3
trees with > 1 vine	4	9	16

Table 4: Windspeed at the three sites.

	Speed
High wind (Cerro Pedregal)	>10 mph
Moderate wind (Cerro Cacao)	5.0 ± 1.0 mph
Gap (Cerro Cacao)	6.1 ± 0.5 mph

DISCUSSION (PSW)

The data supported our hypothesis that vine contact occurs at random around the base of a tree. This is important in establishing that any patterns we observed were the result of vines moving to a preferred location as opposed to growing straight up from their point of first contact. In the high sunlight, moderate wind environment of the gap, vines oriented themselves toward the sun. In the moderate sunlight, high wind environment of Cerro Pedregal, vines tended to orient themselves away from the wind, but due to a small sample size we were unable to test the trend statistically. In the moderate sunlight, moderate wind of the understory vines did not orient themselves in reference to sunlight or wind. A possible explanation for this is that sunlight and wind are not very variable in the understory and no particular orientation results in a great increase in

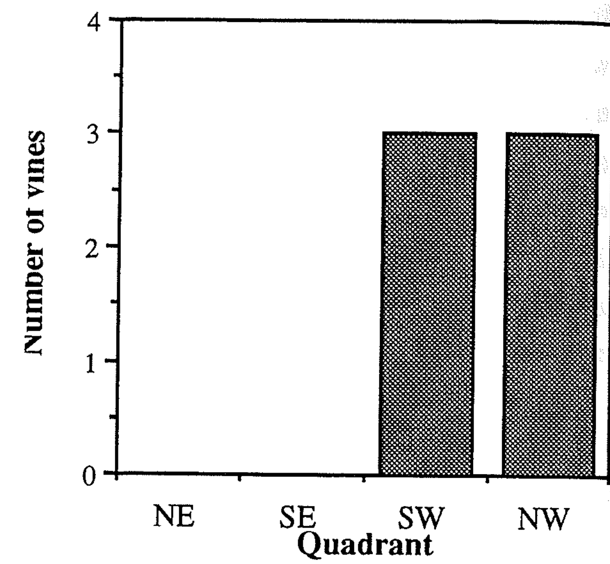

Figure 1. Orientation of vines on trees at the high wind site. NE quadrant was directly exposed to the wind.

cost or benefit. When either sunlight or wind are high, vines will orient themselves to benefit from the sun's rays or avoid the cost of wind exposure. We were unable to find a location that offered both high sunlight and high wind to determine whether one overrides the other. However, based upon our results showing a decrease in vine abundance in a high wind environment, we predict that wind would be the overriding factor. It remains an open question whether wind exerts its effects on vines through mechanical damage, dessication, or some other mechanism.

A COMPARISON OF ARTHROPOD ABUNDANCE IN GAP AND UNDERSTORY HABITATS IN A MONTANE WET FOREST

Mark E. Berry, Andrew N. Swanson and David B. Zug, Jr.

ABSTRACT (DBZ)

We examined arthropod abundance between light gaps and understory in the montane wet forest at Cerro Cacao, Guanacaste Province, Costa Rica. Relationships between sunlight and plant anti herbivore defense suggest herbivorous arthropods should be more abundant in treefall gap habitats than in understory habitats. An abundance of herbivorous arthropods may also result in an abundance of carnivorous arthropods. Herbivorous arthropods were ≈3 fold more abundant in gaps than in the understory, while carnivorous arthropods were equally abundant in both habitats. Data supports the hypothesis that high resource availability in the gaps favors fast-growing, poorly defended trees and leads to high herbivore productivity.

Key Words: montane wet forest, arthropods, light gaps, herbivory

INTRODUCTION (DBZ)

Treefall gaps in tropical forests create patches of high sunlight. The early successional trees that colonize gaps are often fast growing trees that produce low filter, high protein leaves (Coley, 1985). These trees are thought to maximize growth by investing less in defense (Coley et al., 1988). If so, light gap tree communities may support larger populations of herbivorous insects than understory communities. An additional consequence may be larger populations of predatory arthropods. We tested these predictions by comparing relative abundances of arthropod functional groups in gap and understory habitats.

METHODS (ANS)

We conducted this study at Cerro Cacao, Guanacaste Province, Costa Rica, a montane wet forest at ~1100m elevation. We selected three study sites on 21 January, 1994. One site was 100m north, and the other two were south of Estacion Cacao. Each study site contained a gap area (characterized by high light intensity, a canopy height < 10m and established secondary growth). Two gaps were dominated by Piper auritum; the remaining gap was occupied by other pioneering woody dicots. Adjacent to each gap, we identified an understory area (characterized by lower light levels, a thicker litter layer, and a closed canopy > 15m above ground). Arthropods were collected from two 2 x $4m^2$ transects in each gap and each understory site (total of 12 transects).

Arthropods were collected in each plot via three methods. Two pit traps, filled with a soap/water solution, were placed in each transect for 20 hours. Transects were swept twice with a 35cm diameter canvas sweep net. Finally, each transect was intensively searched by hand and eye for five minutes by two persons. Arthropod captures from all three methods were summed for each transect.

We classified arthropods by order and

categorized each as an herbivore, carnivore, or scavenger, based upon morphological features and/or general feeding characteristics of the taxon (Borror, et al.).

We analyzed relative abundances of herbivores, carnivores, scavengers and total insects with a Mann-Whitney U-test.

RESULTS (ANS)

We collected a total of 595 insects. Most of the arthropods were Hymenoptera, Orthoptera, Homoptera, or Diptera. Arachnids were also common. At one (gap and understory) site, we found a high abundance (> 500) of Isopods, but these were not included in our analyses. Approximately 80% of individuals collected in pit traps were ants (Formicidae), while sweeps and visual searches usually detected 7-8 orders.

Herbivorous insects were significantly more abundant in light gaps than in the understory habitats (31.0 ± 31.1 vs. 7.16 ± 7.0 insects per transect); ($U_s = 30.0$, $p < 0.05$; Figure 1). There was no difference in numbers of predatory arthropods ($U_s = 19.0$, $p > 0.10$; Figure 1) or scavengers ($U_s = 20.0$, $p > 0.10$; Figure 1) between gap and understory treatments. The total number of insects captured was ~50% greater in the gap habitats than in the understory, but this difference was not significant ($U_s = 23.5$, $p > 0.10$; Figure 1).

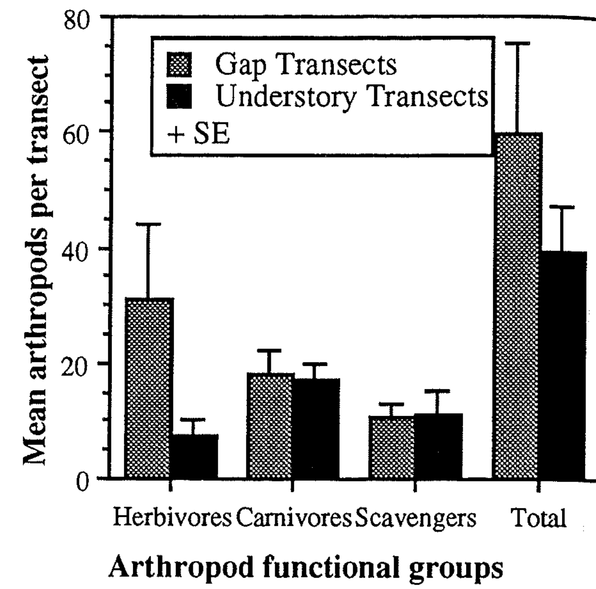

Figure 1. Abundance of arthropod functional groups in gap and understory transects (means based on sum of pit traps, net sweeps, and visual search samples).

DISCUSSION (MEB)

As predicted based on plant defense theory (Coley et al, 1985) we found a higher abundance of herbivorous arthropods in treefall gaps than in the forest understory. Our results suggest that her generalizations may apply to a tropical montane wet forest as well as the tropical wet forest at Barro Colorado Island, Panama. Isopods were not included in our calculations because their great abundance at one site and their rapid escape behavior precluded quantitative sampling. Isopods appeared to be slightly more abundant in gap than understory transects, but their overall abundance in one site suggests their presence is based on a habitat feature unique to the site and unrelated to general differences between gaps and the understory.

Although understory transects had more leaf litter than gaps, there was no difference in the abundance of scavengers and detritivores. It is possible that high protein, low fiber leaves produced in gaps may support more detritivores per leaf than high fiber understory bird canopy leaf litter. Equivalent carnivore abundances in gap and understory transects indicates that carnivorous arthropod abundance is not dependent on herbivore abundance. Because the greater abundance of herbivores in gaps does not support a greater population of carnivorous arthropods, we speculate that gaps may support more insectivorous vertebrates than understory areas.

The most important limitation of this study was our need to rely on very coarse taxonomic resolution (most animals were identified only to order). As consequence, our assignments to functional group must have sometimes been in error. We doubt that these errors were so frequent that it affects our general conclusions.

LITERATURE CITED

Borror, Donald J. and Richard E. White. 1970. A Field Guide to the Insects of America North of Mexico. Houghton Mifflin Company: Boston.

Coley, P.D., J.P. Bryant, and F.S. Chapin III. 1985. "Resource availability and plant anti-herbivore defense." Science 230: 895-899.

Coley, P.D. 1988. "Effects of plant growth role and leaf lifetime on the amount and type of anti-herbivore defense." Oecologia 74: 531-536.