A Comparison of Epiphyte Coverage on *Ficus insipida* and *Cecropia schreberiana*

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Abstract:

Epiphytes are prevalent occupants of many tree species in the Neotropics. In this study, epiphyte coverage was compared between two tree species of the family Moraceae: *Cecropia schreberiana* and *Ficus insipida* (fig). The objective was to determine whether the *Ficus* had a larger epiphyte coverage area than the *Cecropia*. Coverage was estimated by taking 30 samples from one large tree representing each species. Approximately 81% of the fig surface was covered by epiphytes compared to 43.5% of the surface of the *Cecropia*. The difference in epiphyte coverage was significant ($p<0.0001$).

Introduction:

An 'epiphyte' is a non-parasitic plant that grows on a host tree. The epiphyte does not depend on the host tree for nutrients; rather, it obtains them from the environment. Growing on a host tree enables epiphytes to readily obtain nutrients from the environment. The plants can receive more sunlight, air, and rainwater when perched on a tree rather than growing on the rainforest floor. Many epiphytes are flowering plants and ferns; lichens, mosses, cacti, bromeliads, and orchids are also common epiphytes, (Butler, 2005). Epiphyte density varies among different tree species. For this study, epiphyte density was examined in two different tree species: *Cecropia schreberiana* and *Ficus insipida*.

Cecropia schreberiana and *Ficus insipida* are tree species belonging to the family Moraceae-the Breadfruit family. Both species are prevalent throughout tropical regions of the world including the Lesser Antilles in which the island of Dominica resides.

Ficus insipida is a common fig tree. Many fig species begin life as epiphytes growing in a host tree. Some species start life as a hemi-epiphyte which grows aerial roots that wrap around the host tree in a 'strangling' fashion and extend to the ground. *Ficus insipida* lacks aerial roots and does not begin its life in this way (Lack, et al., 1997). However, hemi-epiphytes residing on the fig may do so.

Cecropia schreberiana is a pioneer species. It is one of the first plants to colonize a disturbed forest and may grow as quickly as several meters per year. The *Cecropia* have brittle, hollow trunks which usually break resulting in tree death after reaching heights of 15-20 meters. Death of the *Cecropia* can occur as quickly as ten to fifteen years. The leaves can be up to 30 cm in diameter with 8-10 lobes extending from the center with a white underside. The trees are usually sparsely branched, unless in an open area (Lack, et al., 1997).

Some *Cecropia* species exhibit mutualism with *Azteca* ants. The hollow trunk of the tree provides a home for the ants that in turn help eliminate vines and epiphytes from the tree (ACEER, 2005). Consequently, these *Cecropia* trees have reduced epiphyte loads. The two tree species were therefore compared relative to epiphyte coverage on the roots and trunk. The null hypothesis predicted: The mean percent coverage of epiphytes on *Ficus insipida* is equal to the mean percent epiphyte coverage on *Cecropia schreberiana*.

Materials & Methods:

One tree of each species was selected and sampled. The fig and *Cecropia* trees were chosen based on accessibility and proximity to the Springfield research station in southern Dominica. The fig was located in a small clearing near The Check Hall River southwest of the plantation. The *Cecropia* was located north of Springfield up the Fifi Trail and was not as easily accessible as the fig. Due to difference in tree size and ease of access, different methods were implemented in sampling the two trees. The *Cecropia* bark was mottled white and brown. It was difficult to determine whether the white was wood coloration or lichens. Therefore, lichens were excluded from the study for both trees, but mosses and all other epiphytes listed were considered. Density was assessed as percentage of epiphyte coverage.

Tree Climbing: Initially, epiphyte and moss coverage was to be assessed by climbing the fig. The fig was at least 20 meters tall and had a large buttress root system. A throw ball was attached to the end of a rope up to 50 meters long and tossed over the second lowest branch on the fig. A 30 meter climbing rope was attached to the other end of the throw rope and pulled over the branch. The throw rope was detached and the climbing rope was wrapped around a nearby tree fives times and knotted with a figure-8 knot. The rope slack was pulled tightly and the ascenders were attached. The ascender with the foot holds was placed below the other ascender. A descender and a tape measure were attached to the harness, each with a separate carabiner. The harness was fitted snuggly on the climber and the ascenders were attached to the front of the harness with the remaining two carabiners. While standing, the climber ensured that all carabiners were locked, stepped into the foot harness, and proceeded to push the top ascender up the rope until it stopped. The climber then sat down placing body weight on the harness and while bringing both knees up, pushed the lower ascender up the rope. Then the climber stood up and pushed the upper ascender up the rope until it stopped.

The climber then repeated the sit down motion and ascender movement, followed by the stand up movement and so on. This procedure was repeated until the climber reached the bottom of the branch on which the rope was hung. The climber ascended onto a nearby branch and shimmied down the branch to the crotch of the tree. The climber released the tape measure from the carabiner and, holding onto the free end, dropped it to the ground in order to obtain a measurement. While sitting firmly in the tree, the climber removed the top ascender from the rope and attached the descender above the bottom ascender. Due to wet weather, the branch was slippery and the climber kept the lower ascender with foot harness attached for comfort. The climber removed both feet from the holds, shimmied back up the branch near the rope, and placed both feet back in the foot holds. The person on the ground had the climber on fireman's belay and the climber held the slack tightly down at the hip while pulling tightly and swung off the branch, placing entire body weight on the descender and the ascender with the footholds. This ascender was then detached while maintaining a safe belay from the ground and the climber lowered herself to the ground.

Estimating epiphyte density from the ground: Due to constant rainfall, climbing was hazardous and all remaining data were collected from the ground. A diagram of the fig tree was drawn and the two accessible sides of the tree including the roots and extending 10 meters up the trunk were divided into 0.50m X 0.25m quadrants (see Fig. 1). Each of the 232 quadrants was numbered. Branches were excluded. A random generator was used to generate 30 unique numbers from 1-232. These 30 numbers corresponded to the quadrants that would be sampled. The throw ball procedure mentioned above was performed twice more on two branches on opposite faces of the tree, north and east. A PVC pipe grid 1m X 1m was the template for the quadrants. The grid was further divided into 8 quadrants by tying a colored string at 0.25m and 0.75 m. Two meters of rope were tied to the top two corners of the square and a free end of a rope up to 50 meters long was tied in the center of this rope. Two smaller lengths of rope were tied to the bottom two corners of the grid and used for positioning the grid against the east side of tree trunk once in the air. The grid was hoisted up and the rope was wrapped around a nearby tree to hold the grid steady at various heights according to the quadrants being sampled, while referring to the diagram. The roots and first few meters of the trunk could be sampled simply by holding the grid. The grid was raised and lowered in this fashion until all of the quadrants were sampled. The sampling involved examination of the tree within the area of a given quadrant. Epiphytes and moss were assessed, lichens were not. The percent of bark covered by epiphytes and or moss was noted and recorded. Binoculars were used for determining coverage at heights that could not be seen easily with the naked eye. The same sampling procedure was implemented for the north side of the tree trunk until all of the randomly chosen quadrants had been sampled and the percent coverage recorded.

Epiphyte and moss coverage on the *Cecropia* was estimated in a similar fashion as the fig. A diagram of the tree was drawn and the two accessible sides up to 10 meters were divided into quadrants, 0.50m X 0.25m (see Fig. 1). Of 72 total quadrants, 30 were randomly chosen for inclusion in the sample. Because the trunk size and obstructions around the *Cecropia* did not permit the PVC pipe grid to be raised to sample the tree, a piece of string marked with flagging tape was used to gauge distance up the trunk. 10 meters of a string up to 30 meters long were marked off at one meter intervals with flagging tape. Using the throw ball technique as was done with the fig, the marked string was attached to the free end of the throw rope and pulled over a branch that was approximately 10 meters above the ground. With the string as a guide for quadrant size, epiphyte coverage was estimated on the south and east sides of the tree by eye and, for higher quadrants, with binoculars.

Statistical analysis: The percentages from the 30 randomly chosen quadrants for both trees were imported into a spreadsheet where means and standard deviations were calculated. The data were also imported into a t-test function on a web site to determine if the values obtained were significantly different (Lowry, 2005).

Results:

***Ficus insipida**:* The trunk width of the fig in this study was approximately one meter. The trunk did not decrease in width from the ground up to 10m. There was extensive moss coverage on the north and east sides of the trunk and roots. Plant-like epiphytes were present on the trunk before and after branch extensions. There were no visible ants inhabiting the fig. Refer to Table 1 for epiphyte coverage per quadrant on the fig.

Cecropia schreberiana: The diameter of the trunk of the *Cecropia* was 0.5m. Beyond seven meters, the trunk width decreased to approximately 0.25 meters. The trunk was mottled brown and white. It was not determined whether the white was bark coloration or lichens. Moss coverage was extensive on the roots and sporadic on the trunk. Plant-like epiphytes were absent on the trunk but present after branches appeared. Branches were absent below seven meters. The *Cecropia* was inhabited by large black ants. The scientific name of the ants was unknown. Refer to Table 2 for epiphyte coverage per quadrant.

Refer to Tables 3a-3b for statistics on both species. Refer to Fig. 2 for a graphical comparison of epiphyte coverage between the fig and *Cecropia*.

Discussion:

The study was initially intended to be carried out from above ground by climbing the tree. However, with the Dominican rainy season in full swing, an alternate plan had to be developed. The rain was unpredictable and did not allow a wide window of opportunity for climbing. The rain also made the ground muddy and the branches very slick. Safety being a priority, climbing was eliminated as an option for conducting the epiphyte study and a contingency plan was implemented. A quadrant sample for coverage was conducted and proved an effective alternative.

The mean epiphyte density or coverage for *Ficus insipida* (fig) was 81.2(±22.2)%, as compared to 43.5(±27.6)% for the *Cecropia* (Fig. 2). Because standard deviation describes the proportion of the population that deviates to one extreme or the other from the mean, a larger value devalues the significance of the data. A hypothesis test called the t-test for independent samples was performed on the data to determine the significance of the results. It is useful for acquiring information about the mean when comparing two random samples. Given the statistics (Tables 3a & 3b), it is reasonable to conclude that epiphyte coverage was greater on the fig than the *Cecropia*.

From a strictly observational standpoint, the fig was almost completely covered in moss while the *Cecropia* was mottled with bark and moss. On the two sides of the fig that were observed up to ten meters, there were several plant-like epiphytes growing on the trunk. The *Cecropia* trunk was about a fourth the width of the fig tree. There were no plant-like epiphytes observed on the *Cecropia* until a height of 7 meters, which is when the branches began and the trunk width decreased. Size aside, the *Cecropia* had less epiphyte coverage based on percentage per quadrant. Some *Cecropia* species exhibit mutualism with *Azteca* ants. Medium-large sized black ants were crawling over and around the *Cecropia schreberiana* on Mt. Joy. These ants were probably too large to belong to the genus *Azteca*, but the same sort of symbiosis could be in effect in this situation. Though it is not conclusive, it may be worth pondering whether the ants visible on the *Cecropia schreberiana* have a mutualistic relationship with the tree.

Another possible explanation for the smaller density of epiphytes on the *Cecropia* could involve the structure of the tree itself. Epiphytes grow readily in grooves, cracks, and other areas were compost and organic nutrients are abundant (Butler, 2005). The trunk of the *Cecropia* is relatively smooth in comparison to the fig. The *Cecropia* in this study also had fewer branches because it was nestled within other trees and flora. On the other hand, the *Ficus* was located in a more open area and had more room to grow and extend branches. The buttress roots also provide an ideal place for organic matter to collect and promote epiphyte growth.

This study examined the percent coverage of epiphytes between the *Ficus* and the *Cecropia*. It was determined that the evidence obtained was significant enough to reject the null hypothesis. Therefore, it may be concluded that of the two trees surveyed in this study, *Ficus insipida* had a larger proportion of epiphyte coverage than *Cecropia schreberiana*. The reason for this is most likely multifactorial. The structure of the fig provides an ideal environment for epiphyte growth. The *Cecropia* has fewer crevices to collect organic nutrients which favor epiphyte growth. On some *Cecropia* species the presence of ants contributes to epiphyte elimination and this may be the case with the *Cecropia schreberiana*; however this is inclusive and would require further investigation of the ant species inhabiting the tree.

References:

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Figures and Tables:

Figure 1: Grid Diagram

Entire square: 1 m X 1m
Each rectangle: .50m X .25m

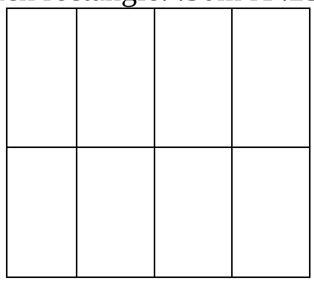

Table 1: Percent Coverage of epiphytes on *Ficus insipida*. 30 quadrants were sampled.

Quadrant Number	% Coverage
4	100
8	95
18	100
27	90
29	85
33	100
39	50
41	95
43	75
53	60
67	95
69	100
71	95
72	85
74	95
82	55
89	90
91	95
97	100
98	90
148	20
150	100
151	95
154	90
165	100
167	60
173	75
180	30
204	55
211	60

Table 2: Percent Coverage of epiphytes on *Cecropia schreberiana*. 30 quadrants were sampled.

Quadrant Number	% Coverage
1	21
2	100
3	30
4	80
6	45
7	45
13	80
14	5
20	5
21	75
22	15
23	75
32	80
33	45
34	35
36	80
37	0
38	40
39	50
40	5
41	50
46	20
51	10
53	10
56	40
66	45
67	60
68	65
69	50
71	45

Table 3a: Summary Values for Data in Tables 1 & 2

Values	***Ficus***	***Cecropia***
n	30	30
sum	2435	1306
mean	81.1667	43.5333
sumsq	211925	78966
SS	14284.1667	22111.4667
variance	492.5575	762.4644
st. dev.	22.1936	27.6128

Table 3b: t-test results

$Mean_A$ - $Mean_B$	t	df	P
37.6333	+5.8185	58	<.0001

Fig. 2: Mean Epiphyte Coverage