Microenvironments in Epiphytic Plants at Cerro de la Muerte and La Selva

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Introduction

Bromeliaceae is a family of epiphytic and rarely terrestrial herbs whose distribution is centered in tropical and warm temperate regions of the New World. Several authors consulted about the diversity in sepcies in this family do not agree: Heywood (1978): 50 genera and 2000 ssp.; Croat (1978): 45 genera and 1000 ssp.; Halle et al. (1978): 1700 ssp. In any case, it is a diverse family and its contribution to biomass must also be high because these plants can be found almost everywhere.

Our subject of study belongs to the genus Vriesia Lindl. The species could not be determined because of the lack of flowers at the time of our study (flowers are the only reliable character in the taxonomy of this genus). Costa Rica has more than 55 species of Vriesia (only Brazil has more) (Utley and Burt, 1974).

Vriesia has leaves spirally arranged in a basal rosette, often forming a water-tight tank. In part of the dry tropics the water retained in the leaf-base tanks of certain native bromeliads may serve as a breeding ground for malaria-carrying anopheline mosquitos. While structures of open water can be easily sprayed for mosquito control, the tanks of epiphytic and terrestrial bromeliads cannot; presence of bromeliads has been hampering the control of malaria in some parts of the tropics.

Despite the abundance, diversity, and economic importance of the organisms that live in the water retained by bromeliads, little is known about them. With the probably exception of a recent study made on the relationship between birds and an Andean genus of bromeliads (Rees and Roe, 1980), there are no recent papers about this subject.

Our study had as a main goal the intent to obtain a general idea of the kinds of organisms that inhabit the water retained by Vriesia ssp., in order to get some idea of their abundance and diversity in different individuals of Vriesia and at different heights above the ground.

Methods

Since we did not find any published studies which stated similar objectives, all the methods given here were developed after several trials with bromeliads on Cerro de la Muerte, and fully applied at La Selva.

Our preliminary studies on Cerro de la Muerte showed that, in order to do a comprehensive survey of the aquatic organisms in epiphytic plants it is necessary to sample the total volume of water, since most of the organisms live in the mud attached to the internal surfaces of the leaves. Consequently, the total volume of water was examined using a dissecting microscope. The surfaces of the leaves were also examined and, sometimes, we found more organisms on the leaf surfaces than in the water. Several specimens of the different taxa were kept in formaline (5%) for further taxonomical studies. The data related to volume of water, height of the plant above the ground, and size of the bromeliad in number of leaves, height of the plant itself, and the weight of the plant were recorded.

The bromeliads were taken from trees, put in individual plastic bags, and carried to the lab where they were weighed and measured, and the water and leaf surfaces were inspected for organisms.

Results

Because the studies performed at Cerro de la Muerte were exploratory, we did not take all the numerical data that we later recorded at La Selva. However, because there are some apparent similarities and differences in the kinds of organisms found in the two sites, we compare in Table 1 the list of organisms collected in the two different habitats.

Table 2 shows the statistical relationships between the parameters studied at La Selva. In Table 3 the diversity of organisms and taxa/tree are shown for the ten trees studied. Two bromeliads were sampled from each tree, one below and one above two meters. All these trees were in the same area.

Discussion

The most important conclusion evident from Table 2 is the difference in correlation between the number of organisms and the number of taxa, and the height of the bromeliads from the ground. Such inequality reveals a different distribution of invertebrates at different heights from the ground. Halle et al. (1978) already noted that "flying insects become most noticeable at a height of 10 to 20 meters. Colonies of cockroaches are most common in the rosettes of epiphytic bromeliads in the forest canopy. It is important, as zoologists are well aware, to be cognizant not only of the vertical (lon?) distribution of faunas, but also of the patchiness of forests which produces a horizontal mosaic." Although our data confirm that general statement, the causes of such patchiness remain unknown.

The data from Table 2 show that the intrinsic characteristics of bromeliads are more important in the diversity of organisms that they contain than is their height from the ground. We do not know anything about bromeliads that live high in the forest (35-50 m) on tall canopy trees.

We also know very little about the dynamics of the communities inside the bromeliads. What organisms bring others of completely aquatic origin (e.g., copepods, ciliata)? What is the pattern of colonization of the bromeliad microenvironment? The only thing that we can be sure of from the data given here is that there is predation by arachnids, because remains of insects were always associated in bromeliads which had arachnids (and even a scorpion) as part of their inhabitants. Since half of the samples studied had such organisms, the process of predation must be fairly common there.

Bromeliads have microenvironments inhabited by aquatic or hydrophilic organisms. Our data showed that many organisms (sometimes in high numbers and diversity) live in these microenvironments. We do not know about the general population processes that occur there, but interesting patterns of colonization, growth, predation, and dispersion must exist. Further studies on these plants (including those that live in the tree canopy) would yield interesting data about microenvironments in the tropics. That these microenvironments are not uniform, depending on the nature of the plant and its height from the ground, is a clear conclusion from our results.

Table 1. Comparative list of organisms found in water tanks of *Vriesia* bromeliads at Cerro de la Muerte and La Selva.

Organisms	Cerro de la Muerte	La Selva
Number of plants studied	6	20
Mosquitos: pupae	1	0
larvae	26	23
Transparent chironomid larvae	3	210
Red chironomid	4	55
Copepods	16	13
Nauplius larvae	-	116
Ciliata	1	10
Oligochaeta larvae	-	23
Nematodes	-	11
Isopods	1	9
Platyhelminthes	1	-
Mites	-	3
Remains of insects	2	10*
Arachnids	-	13**
Scorpions	-	1
Unidentified	2	1
Total	63	518

*In the same plants where spiders were found.

**Number of plants with spiders = 10.

Table 2. Relationships between the number of organisms, number of taxa, diversity, and correlations with the height of the bromeliad from the ground, weight of the bromeliad, number of leaves, height of the bromeliad itself (i.e., the length of the longest leaf), and the volume of water in the bromeliad. Data from Vriesia plants at La Selva. Spearman-rank correlation coefficients are given.

		Height	Weight	Number of Leaves	Length, Longest Leaf	Water Volume
Number of Organisms	<2m	ns	0.75*	0.74*	0.68*	0.74*
	>2m	ns	ns	ns	ns	ns
	combined	ns	0.65*	0.63*	ns	0.46*
Number of Taxa	<2m	ns	0.77*	0.64*	0.85*	0.71*
	>2m	ns	ns	ns	ns	ns
	combined	ns	0.55*	ns	0.73*	ns
Diversity	<2m	ns	ns	ns	0.69*	ns
	>2m	ns	ns	ns	ns	ns
	Combined	ns	ns	ns	0.41	ns
Mann-Whitney U value <2m vs >2m		0*	ns	ns	8*	ns

ns = not statistically significant
* = statistically significant ($p < 0.05$)

Literature cited

Croat, T. B. 1978. Flora of Barro Colorado Island. Stanford University Press: Stanford, California.

Halle, F., R. A. A. Oldeman, and P. B. Tomlinson. 1978. Tropical trees and forests: an architectural analysis. Springer-Verlag: New York.

Heywood, V. H. (Editor). 1978. Flowering plants of the world. Mayflower Books: New York.

Rees, W. E. and N. A. Roe. 1980. Puya raimondii (Pitcairnioideae, Bromeliaceae) and birds: an hypothesis on nutrient relationships. Can. J. Botany 58: 1262-1268.

Utley, J. and K. Vurt-V. 1974. Vriesia leucophylla var. subtessellata from Costa Rica. Brenesia 4: 5-7.

Table 3. Diversity of organisms and taxa/tree studied. Organisms and taxa represent aquatic organisms only. Diversity was computed using the Shannon-Weiner formula.

Tree	Less than 2m Height			Greater than 2m Height		
	Organisms	Taxa	Diversity	Organisms	Taxa	Diversity
1	39	4	0.79	39	7	2.29
2	16	3	1.52	31	6	1.56
3	8	4	1.52	1	1	0.00
4	5	2	0.69	27	2	2.49
5	8	1	0.00	7	2	1.12
6	38	4	1.29	16	3	1.75
7	128	5	0.79	9	1	0.00
8	5	4	1.89	18	3	0.86
9	4	2	0.79	11	3	1.22
10	55	9	2.55	9	3	0.96