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Orchid Preference for Host Tree Genera in a Nicaraguan Tropical Rain Forest

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Abstract. Data were collected on orchids growing on trees larger than 10 cm diameter at breast height (dbh) in a Nicaraguan tropical rain forest in 1996. The goal was to analyze orchid occurrence on trees and to explore tree genera preferences of orchid species. A total of 71 orchid species, including seven unknown species, and 47 tree genera were recorded in a 1.2 ha area. Percentage orchid frequency data revealed that *Scaphyglottis behrii* Helms., *Maxillaria neglecta* (Schltr.) L.O. Williams, *Dichaea panamensis* Lindl., and *Sobralia fragrans* Lindl. are the most abundant orchids in the forest. Principal component analysis showed *Pentaclethra, Apeiba, Carapa,* and *Tetragastris* to be the main genera of trees inhabited by orchids. Cluster analysis revealed that the abundance of three orchid species are determinant for segregate tree genera.

Resumen. Fueron colectados datos de orquídeas epífitas en arboles con DAP igual o mayor a 10 cm en un bosque húmedo tropical de Nicaragua, con el fin de analizar la presencia de orquídeas en arboles y explorar la preferencia entre las especies de orquídeas y algunos géneros de arboles. Setenta y una especies de orquídeas, incluyendo siete especies de orquídeas no identificadas, y 47 géneros de arboles fueron registradas en 1.2 ha. El porcentaje de frecuencia de orquídeas revela que *Scaphyglottis behrii* Helms., *Maxillaria neglecta* (Schltr.) L.O. Williams, *Dichaea panamensis* Lindl., y *Sobralia fragrans* Lindl. son las más abundantes orquídeas en el bosque. Un análisis de componentes principales reveló que *Pentaclethra, Apeiba, Carapa* y *Tetragastris* son los principales géneros de árboles habitados por orquídeas. Por otra parte, un análisis de agrupamiento reveló que la abundancia de tres especies de orquídeas es determinante para separar los diferentes géneros de arboles.

Key words: epiphytes, tropical rain forest, Orchidaceae, Nicaragua

Introduction

Moist tropical forests have long been of interest to the botanist and especially to the orchidologist, because of the rich diversity of tree species and of epiphytes (Dressler 1993). In a lowland tropical rain forest, a quarter of all plant species are likely to be epiphytes (Richards 1952, Klinge et al. 1975). In a very wet forest, a bewildering diversity of epiphytes may grow on a single tree. Naturally, most of the epiphytes grow high in the canopy; however, some shade-tolerant orchids regularly occur on tree trunks (Dressler 1993). In addition, Brieger (1969), Regós (1989), Hartshorn (1991), and Walter (1991) concur on the greater richness of orchids in tropical rain forests compared to other forests. Orchids form a major group of epiphytes (Dressler 1993), with estimates from 73 (Atwood 1986) to 88% (Walter 1991) of orchid species being epiphytic.

Dressler (1993) suggests that physical factors determine plant distribution. Walter (1991) also considered biotic factors. Beckner (1979) and Regós (1989) suggested a possible cooperation or mutualism between trees and epiphyte plants. Benzing (1983) and Johansson (1974) pointed out that generally light and water availability are the major environmental factors limiting the epiphytic-host relationship.

Williams-Linera et al. (1995), Andrade and Park (1996), and Guevara et al. (1998) reported their studies of factors influencing distribution and abundance of epiphytic plants in the Neotropics. Brown (1990) illustrates a vertical distribution of epiphytes in the forest caused by a gradient of luminosity and humidity. Catling and Lefkovitch (1989) considered stages of succession as related to diameter of trunks and texture of bark. Andrade and Park (1996) found that an epiphytic cactus occurred most frequently in tree cavities and was especially abundant on two tree species; they attribute this abundance to absorption of light (photosynthetic photon flux). Beckner (1979) suggested a possible relationship between certain tree genera and certain orchids. Hartshorn (1991) found that our understanding of epiphyte ecology in the tropical rain forest is largely speculative. The work presented here was designed to advance our understanding of the relation between epiphytic orchids and host trees in a Nicaraguan tropical rain forest.

Materials and Methods

Study Area

The study area at "Los Filos" is located at 11°07′30″N latitude and 84°20′12″W longitude

TABLE 1. Percentage frequency of epiphytic orchids on 503 individual trees in "Los Filos."

Scaphyglottis behrii Hemsl.	38.39
Dichaea panamensis Lindley	24.10
Maxillaria neglecta (Schltr.) L.O. Wms.	22.06
Sobralia fragans Lindl.	13.32
Scaphyglottis minutiflora Ames & Correll	7.95
Dichaea trulla Rchg.f.	7.55
Maxillaria crassifolia (Lindl.) Rchb.f.	6.56
Scaphyglottis prolifera Cogn.	5.36
Trigonidium egertonianum Batem. ex Lindl.	5.36
Epidendrum rigidum Jacq.	4.37
Maxillaria friedrichsthalli Rchb.f.	3.57
Sobralia luteola Rolfe	3.57
Gongora sp.	2.98
Sobralia decora Batem.	2.78
Maxillaria alba (Hook.) Lindley	2.38
Aspasia epidendroides Lindl.	2.18
Epidendrum nocturnum Jacq.	1.98
Campylocentrum micranthum (Lindl.) Rolfe	1.72
Epidendrum isomerum Schltr.	1.59
Xylobium foveatum (Lindl.) Nicholson	1.59
Bulbophyllum pachyrachis (A. Rich.) Grist.	1.39
Epidendrum acuñae Dressler	1.39
Maxillaria uncata Lindley	1.39
Pleurothallis matudiana C.Schweinf.	1.39
Epidendrum eburneum Rchb.f.	1.19
Maxillaria sp.	1.19
Stanhopea ecornuta Lemaire	1.19
Stelis sp.	1.19
Brassia caudata (L.) Lindley	0.99
Cryptarrhena cuadricornu Krzl.	0.99
Maxillaria aciantha Rchb.f.	0.99
Neolehmannia difformis (Jacq.) Pabst	0.99
Pleurothallis sp. (1)	0.99
Pleurothallis sp. (2)	0.99
Pleurothallis verecunda Schltr.	0.99
Lepanthes sp.	0.79
Ornithocephallus bicornis Lindl.	0.79
Vanilla planifolia G. Jackson	0.79
Elleanthus sp.	0.59
Encyclia chacaoensis (Rchb.f.) Dressler & Pollard	0.59
Epidendrum sp. (1)	0.59
Nidema bothii (Lindl.) Schltr.	0.59
Oncidium ascendens Lindl.	0.59
Oncidium paleatum Schltr.	0.59
Polysthachya foliosa (Lindl.) rchb.f.	0.59
Elleanthus graminifolius (Barb. Rodr.) L¢jtnant	0.39
Epidendrum strobiliferum Rchb.f.	0.39
Hexadesmia fasciculata Brongn.	0.39
Jacquiniella sp.	0.39
Lockhartia integra Ames & Schweinf.	0.39
Maxillaria discolor (Lood.) Rchb.f.	0.39
Maxillaria maleolens Schltr.	0.39
Oncidium sp. (1)	0.39
Sievekingia suavis Rchb.f.	0.39
Elleanthus caricoides Nash	0.19
Encyclia alata (Batem.) Schltr.	0.19
Indet. 1	0.19
Indet. 2	0.19
Indet. 3	0.19
Indet. 4	0.19
Indet. 5	0.19
Indet. 6	0.19
Indet. 7	0.19
Lepanthopsis sp.	0.19
Oncidium sp. (2)	0.19
Oncidium splendidum A Rich. ex Duchartre	0.19
Ornithocephallus sp.	0.19
Pleurothallis alexii A.H. Heller	0.19
Sobralia powellii Schltr.	0.19
Sobralia suaveolens Rchb.f.	0.19
Xylobium sp.	0.19

near the Costa Rican border in the southeast region of Nicaragua. This region is characterized as a tropical lowland rain forest with high precipitation (2000–4000 mm per year; Castillo 1994).

Data Collection

In 1996, five small study plots (20 × 20 m) were chosen at random within each of six permanent 1-ha plots that had been established in 1990. In all, the current study sampled 1.2 ha distributed among 30 subplots. Previous work identified all trees in the five study plots. Within each sub-plot, trees larger than 10 cm dbh were sampled.

Orchid occurrence (number of species and abundance) was recorded for each tree. Hemiepiphytic plants were not included in this work. Published descriptions of orchid species, collections, photographs, and herbarium specimens were used to prepare for the fieldwork. Binoculars (12 × 50 mm) were used to observe orchids. Voucher specimens of orchids collected were deposited in the Herbario Nacional de Nicaragua.

Data Analyses

Frequency data for orchids in each tree on the 30 subplots were used to determine the most abundant orchid species. In addition, principal components analysis was conducted to identify the host tree genera most frequently inhabited by orchids. Cluster analysis, conducted simultaneously, was based on measure of resemblance and cluster structure between genera of trees. Orchid frequency in each tree (chord distance and strategy flexible, $\beta = -0.25$) was considered, as recommended by Ludwig and Reynolds (1988), Crisci and López (1983), and Pla (1986).

The software GWBASIC 2.02. (Statistical Ecology: A Primer on Methods and Computing) was used for cluster and principal component analysis. The software computes a cluster analysis of N sampling units (tree genera) based on abundance data of S species (orchids) and a

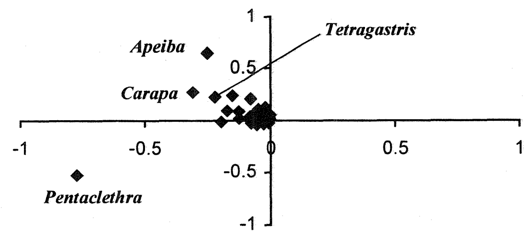

FIGURE 1. Principal components ordination of 24 tree genera in a tropical rain forest in Nicaragua, 1996.

principal component based on species correlation with sampling unit (tree genera) and species (orchids) ordination.

RESULTS

In the subplots at "Los Filos," 503 trees, belonging to 47 genera and nine unknown species, were registered along with 71 orchid species. The most frequent orchids were *Scaphyglottis behrii* Helmsl., *Maxillaria neglecta* (Schltr.) L.O. Wms., *Dichaea panamensis* Lindley, and *Sobralia fragrans* Lindl. Of the 71 recorded orchid species, only nine had frequencies exceeding 5% (TABLE 1).

TABLE 2. Percentage of variance explained by five first principal components.

	Eigenvalues	% of variance	Cumulative % of variance
1	69.64	80.6	80.6
2	5.44	6.3	86.9
3	3.37	3.9	90.2
4	1.72	2.0	92.8
5	1.28	1.5	94.3

Principal components analysis revealed *Pentaclethra, Apeiba, Carapa,* and *Tetragastris* as the leading host tree genera for orchids and the most frequently inhabited (FIGURE 1). The slight variability of orchid species among host tree genera may explain why the greatest variability occurs in the first component (TABLE 2).

A cluster analysis diagram (FIGURE 2) reveals

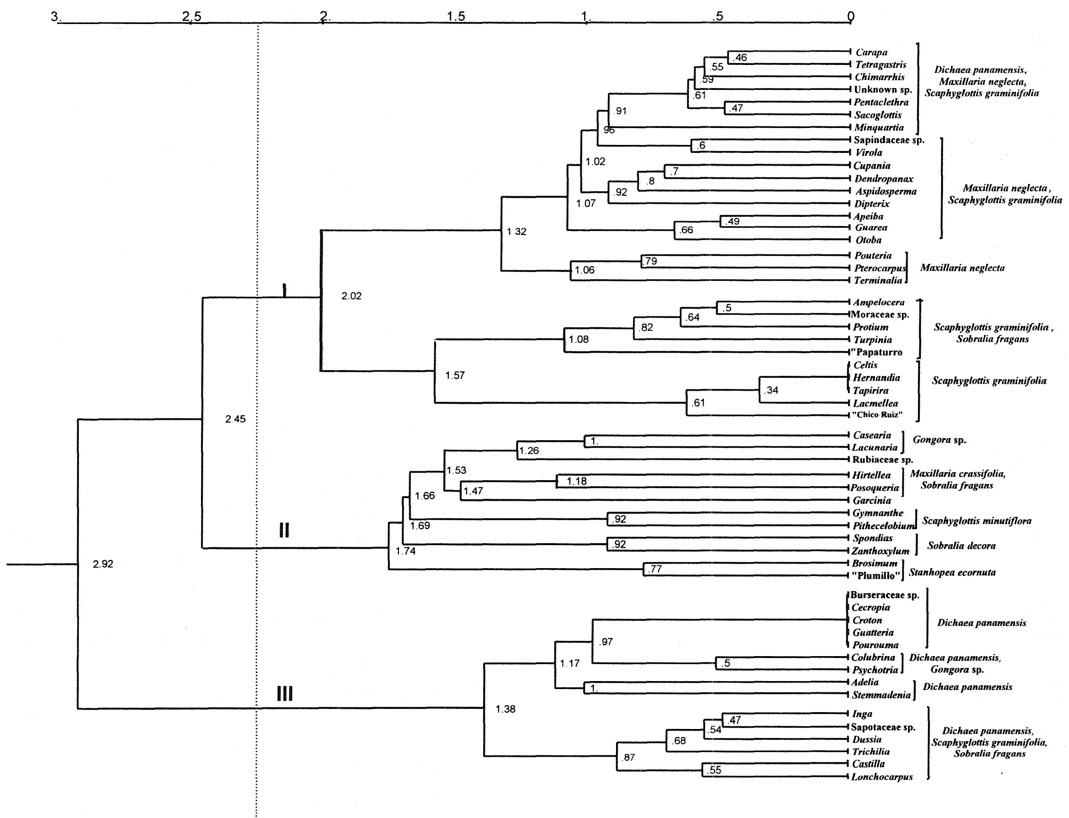

FIGURE 2. Cluster analysis of 47 tree genera and nine unknown species based on abundance data collected on 71 orchid species growing on trees.

three clusters caused by the abundance of three orchid species. Cluster I is determined by *Scaphyglottis behrii* (the most abundant species) and *Maxillaria neglecta.* Cluster II is formed by tree genera slightly inhabited by *S. behrii* and *M. neglecta* but with *Gongora* sp., *M. crassifolia, Scaphyglottis minutiflora, Sobralia decora,* and *Stanhopea ecornuta* present in relatively high abundance. Cluster III is formed by tree genera inhabited mainly by *Dichaea panamensis.*

Discussion

In general, several physical and biological factors and considerations determine the distribution of epiphytes in a forest. The results of this study suggest the need to consider the relationship between host trees and epiphytic orchids. The cluster analysis (Figure 2) indicated that certain tree genera serve more frequently as epiphytic hosts. For instance, 29 tree genera (Cluster I) were preferred by *Maxillaria neglecta* and *Scaphyglottis behrii*; 15 tree genera (Cluster III) were preferred by *Dichaea panamensis,* and 10 genera (Cluster II), although uninhabited by *M. neglecta, S. behrii,* and *D. panamensis,* were inhabited mainly by *Gongora* sp., *M. crassifolia, S. minutiflora, Sobralia decora,* and *Stanhopea ecornuta.* These results concur with Beckner (1979), who suggested that some orchids with highly specialized needs are only found on a particular host, but the host tree preferences of many orchid species remain unclear, because of their low frequency.

Williams-Linera et al. (1995) indicate that each landscape element permits the survival of orchids. Results of the principal component analysis in this study suggest that the host tree genera, *Pentaclethra* (Fabaceae), *Apeiba* (Tiliaceae), *Carapa* (Meliaceae), and *Tetragastris* (Burseraceae), must contain elements necessary for the survival of at least the four most abundant orchid species in the study area, *Scaphyglottis behrii, Maxillaria neglecta, Dichaea panamensis,* and *Sobralia fragrans.* Other tree genera are closely related. Cluster I includes *Sacoglottis* (Linaceae), Sapotaceae, Sapindaceae, *Trichilia* (Meliaceae), *Otoba* (Myristicaceae), and *Chimarrhis* (Rubiaceae), which are each inhabited by a similar abundance of several orchids. Cluster II includes other tree genera inhabited by orchids, which do not display a pattern of preference or relationship between host tree and orchid.

The study results indicate that epiphytic orchid populations display patterns of preference for some host tree genera. Preference patterns may consist of complementary physical factors, such as forest fragmentation (Williams-Linera et al. 1995, Guevara et al. 1998) and light and humidity (Brown 1990). Such patterns also may be related to biological factors of species association and plant growth stages, as suggested by Catling and Lefkovitch (1989); or preference patterns may represent a possible cooperation or mutualism between host trees and epiphytic plants, as suggested by Beckner (1979) and Regós (1989).

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