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DISTRIBUTION OF *POMATOCALPA SPICATA* BREDA (ORCHIDACEAE) WITHIN AND AMONG HOST TREES IN MANUSELA NATIONAL PARK, SERAM, MALUKU ARCHIPELAGO, INDONESIA

SOFI MURSIDAWATI*

Bogor Botanical Garden, Jl. IR. H. Juanda 13, Bogor 16122, Indonesia

DAVID A. NORTON

School of Forestry, University of Canterbury, Private Bag 4800, Christchurch, New Zealand.
E-mail: DNORTON@fore.canterbury.ac.nz

INGGIT P. ASTUTI

Bogor Botanical Garden, Jl. IR. H. Juanda 13, Bogor 16122, Indonesia

ABSTRACT. This note presents the results of a preliminary study of epiphytic orchid distribution within lowland rain forest in Manusela National Park. *Pomatocalpa spicata,* the most common orchid in the study area, was recorded on 20/34 trees. Another 17 orchid species were recorded growing on one or two host trees. *Pomatocalpa spicata* was collected from seven host tree species, the most common being *Myristica succadaena* and *Syzygium* sp., with the Myristicaceae and Myrtaceae the most common families. *Pomatocalpa spicata* appeared to be primarily an epiphyte of host tree trunks and the lower third of the canopy. It was found most commonly growing on host tree bark as opposed to humus sites.

Keywords: epiphyte, Orchidaceae, host utilization, Indonesia

INTRODUCTION

Tropical rain forest epiphytes are dependent on host trees for exposure to the higher radiation levels that occur in the forest canopy. While epiphytes may occasionally occur on the ground (on such elevated sites as fallen logs or rock outcrops), they are usually confined in Indonesia to arboreal habitats for the advantages these sites provide in their establishment, growth, and reproduction. Because of their dependence on host plants, epiphytes have some similarities to arboreal parasitic plants (mistletoes) which also are dependent on host plants. Mistletoes, however, are totally dependent on their host for water, for nutrients, and to varying extents for carbon product (Norton & Reid 1997). In contrast, an epiphyte is dependent on its host only for a perched establishment, as it absorbs water and nutrients through its own system.

Mistletoes exhibit varying degrees of specificity toward host species. Some are very specific to a small group of hosts, while others parasitize a wider range of host species (Norton & Carpenter 1998). The reasons for specificity in mistletoes are thought to relate to selection of host plants from which the parasite is best able to utilize key resources. It would seem that epiphytes should show lower levels of host specificity than mistletoes, since they are not as directly dependent on their host for resources. Anecdotal evidence suggests that in some instances epiphytes are most common on a subset of potential host species at a site. For example in temperate rain forests of New Zealand, the epiphytic fern *Hymenophyllum malingii* (Hook.) Mett. (Hymenophyllaceae) is most commonly found on the canopy tree *Libocedrus bidwillii* Hook. f. (Cupressaceae), even when other potential host species are present. The reason for host specificity in epiphytic plants may include the nature of the bark and tree architecture. Little quantitative information exists on which to assess the relative degree of host specificity in epiphytes.

Epiphytes and mistletoes are, however, far more similar in patterns of distribution within host trees. Like mistletoes (Norton et al. 1997), epiphytes also appear to be non-randomly distributed within a host tree with different epiphytic species most abundant in different parts of the host tree (e.g., Dickinson et al. 1993). Distribution presumably reflects differences in ecological requirements of individual epiphyte species, such as available radiation or the growth form of the epiphyte. For example, larger biomass epiphytes will be confined to larger host branches.

In this study, we made a preliminary assessment of the distribution of epiphytic orchids, especially *Pomatocalpa spicata* Breda, between and within host trees. Specifically, we wanted to know if individual orchids preferentially oc-

* Corresponding author.

tors of water in tree holes and related breeding of mosquitoes. Mosquito News 29: 29–36.
Pimm, S.L. and R.L. Kitching. 1987. The determinants of food chain lengths. Oikos 50: 302–307.
Pittendrigh, C.S. 1948. The bromeliad-*Anopheles*-malaria complex in Trinidad. I—The bromeliad flora. Evolution 2: 58–89.
Reagan, D.P. 1995. Lizard ecology in the canopy of an island rain forest. Pp. 149–164 *in* M.D. Lowman and N.M. Nadkarni, eds. Forest Canopies. Academic Press, San Diego.
Stork, N.E. and P.M. Hammond. 1997. Sampling arthropods from tree-crowns by fogging with knockdown insecticides: Lessons from studies of oak tree beetle assemblages in Richmond Park (UK). Pp. 3–26 *in* N.E. Stork, J. Adis and R.K. Didham, eds. Canopy Arthropods. Chapman & Hall, London.
Snow, W.E. "The Arthropoda of Wet Tree Holes" Ph.D. diss., Univ. Illinois, Urbana, IL, USA, 1949.
Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W.H. Freeman & Co., New York.
Sota, T. 1996. Effects of capacity on resource input and the aquatic metazoan community structure in phytotelmata. Res. Populat. Ecol. 38: 65–73.
Sota, T., M. Mogi and E. Hayamizu. 1994. Habitat stability and the larval mosquito community in treeholes and other containers on a temperate island. Res. Populat. Ecol. 36: 93–104.
Srivastava, D.S. and J.H. Lawton. 1998. Why more productive sites have more species: An experimental test of theory using tree-hole communities. Amer. Nat. 152: 510–529.
Tobin, J.E. 1995. Ecology and diversity of tropical forest canopy ants. Pp. 129–147 *in* M.D. Lowman and N.M. Nadkarni, eds. Forest Canopies. Academic Press, San Diego.
Trapido, H., P. Galindo and S.J. Carpenter. 1955. A survey of forest mosquitoes in relation to sylvan yellow fever in the Panama isthmian area. Amer. J. Trop. Med. Hyg. 4: 525–542.
Webster, J.R. and E.F. Benfield. 1986. Vascular plant breakdown in freshwater ecosystems. Ann. Rev. Ecol. Syst. 17: 567–594.
Yanoviak, S.P. "Community Ecology of Water-Filled Tree Holes in Panama" Ph.D. diss., Univ. Oklahoma, Norman, OK, USA, 1999.

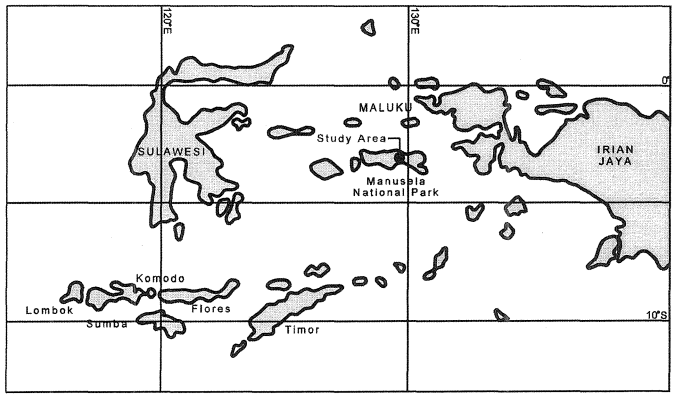

FIGURE 1. Eastern Indonesia, indicating the Manusela National Park study site on Seram, the largest island in Maluku Archipelago.

curred on particular host species and if they were confined to particular sites within host trees.

METHODS AND MATERIALS

This study site was in the southern region of Manusela National Park on the northern side of Seram (FIGURE 1), the largest island in Maluku Archipelago, Indonesia (3°S, 130°E). Seram is a volcanic island rising to 3072 m. The study focused in Sasarata and Tanjun Sasarata (0–25 m) in an outer part of the park on the road between Wahai and Pasahari. The climate is seasonal, with the rainy season extending from March–April to October–November. Daily maximum temperature is 35°C with a minimum of 22°C; annual rainfall is about 2000 mm. The forests are dominated by Myrtaceae (30–60 m tall; *Syzygium, Eugenia, Eucalyptus*), with other tree genera present including *Burckela* (Sapotaceae), *Canarium* (Burseraceae), *Ficus* (Moraceae), *Myristica* (Myristicaceae), *Terminalia* (Combretaceae), and *Barringtonia* (Lecythidaceae). Part of the study area was affected by fire in 1978, but subsequent regeneration has been rapid.

All canopy trees in an area within ca. 2 km of the road were searched for epiphytic orchids using binoculars. Because it is not possible, with binoculars, to determine if orchid clumps represent single large plants or groups of plants growing close together, we used clumps as our basic unit of measurement (Sanford 1968). For each host tree containing orchids, we recorded the location and species of each orchid clump in the five tree zones identified by Johansson (1975). These are I. Lower trunk (<3 m above ground level); II. Main tree trunk; III. Inner third of the canopy; IV. Middle third of canopy; and V. Outer third of the canopy. We also recorded the substrate type in which the orchid clump occurred as bark, minor humus deposits, or large humus deposits. We estimated the light intensity exposure of each clump as heavy shade, light shade, or no shade.

TABLE 1. Orchid species recorded on 34 host trees from the Manusela National Park study area.

Orchid species	No. of host plants with orchids
Bulbophyllum immobile	1
Bulbophyllum macranthum	2
Bulbophyllum patens	1
Coelogyne celebensis	1
Coelogyne sp.	1
Dendrobium acuminatissimum	1
Dendrobium crumenatum	1
Dendrobium sp.	1
Eria flavescens	2
Eria rigida	1
Grammatophyllum speciosum	1
Grosourdya sp.	2
Pholidota sp.	1
Pomatocalpa latifolia	1
Pomatocalpa spicata	20
Robiquetia sp.	1
Vanda saxaltilis	1
Vanda sp.	1

RESULTS

In all, 18 orchid species were recorded from 34 individuals of 14 host tree species (TABLE 1). *Pomatocalpa spicata* was the most common orchid, being recorded from 20 host trees (59%), while the other orchid species were recorded from one or two host trees only. Of the 34 host trees examined, 26 (76%) had only one orchid species present, and eight (24%) had two orchid

TABLE 2. Host tree species recorded for *Pomatocalpa spicata* in Manusela National Park study area.

Host tree species	Family	No. of host trees with *P. spicata*
Myristica succadaena	Myristicaceae	8
Syzygium sp.	Myrtaceae	6
Eugenia polyantha	Myrtaceae	2
Garcinia sp.	Clusiaceae	1
Melia sp.	Meliaceae	1
Myristica fatua	Myristicaceae	1
Terminalia rubiginosa	Combretaceae	1

species. Of the eight host trees with two orchid species present, only three of these included *P. spicata* (38%). Such an occurrence rate is not significantly different from that expected, based on the total number of host trees with *P. spicata* ($\chi^2 = 0.74$).

Pomatocalpa spicata was recorded growing on host trees of seven species (TABLE 2), the most common being *Myristica succadaena* Blume (eight trees) and *Syzygium* sp. (six trees). At the family level, *P. spicata* occurred most often on host trees in Myristicaceae (nine trees) and Myrtaceae (eight trees). Available data were insufficient to assess host preferences of other orchid species.

Pomatocalpa spicata is primarily an epiphyte of host tree trunks and the lower third of the canopy (TABLE 3); thus only 6.6% of records were made from the middle third of the canopy and none from the outer third of the canopy. This distribution is significantly different from what we would expect, if *P. spicata* were distributed evenly among all five tree zones ($\chi^2 = 17.01$, $P < 0.001$, $N = 30$). *Pomatocalpa spicata* most commonly grows on host tree bark (62.1%, TABLE 3) and less commonly in minor humus deposits (37.9%); and we never recorded it growing on large humus deposits. *Pomatocalpa spicata,* as with many epiphytic species, is most common at high light intensity sites (63.5%) and rarely occurs under heavy shade (3.6%). Again, available data were insufficient to assess site preferences of other orchid species.

TABLE 3. Distribution of *Pomatocalpa spicata* clumps within host trees with respect to host position, substrate type, and shade intensity. Tree zones used for host position: I. Lower trunk (<3 m above ground level); II. Main tree trunk; III. Inner third of canopy; IV. Middle third of canopy; and V. Outer third of canopy.

Orchid distribution	Orchids recorded %
Host position	
I	36.7
II	36.7
III	20.0
IV	6.6
V	0.0
Substrate type	
Bark	62.1
Minor humus	37.9
Major humus	0.0
Shade intensity	
None	64.3
Light	32.1
Heavy	3.6

DISCUSSION

Pomatocalpa spicata shows a strong host preference, occurring primarily on Myristicaceae and Myrtaceae host trees, especially *Myristica* and *Syzygium* (TABLE 2). The reason for epiphyte specialization on this group of trees is unclear but may reflect in part the nature of the bark. *Pomatocalpa spicata* clumps are most common on exposed bark or areas with only minor humus accumulations and higher light intensities. It would seem probable that orchid establishment on heavy humus accumulations would show lower host specificity than establishment on little or no humus accumulation; as heavy humus accumulations can occur on any tree with suitable architecture (e.g., forked branches). For those orchid species occurring primarily on bark, aspects of bark morphology and chemistry may limit establishment; but the basis for such relationships is not well understood.

Our data (TABLE 2) show that *Pomatocalpa spicata* is primarily a plant of the main host trunk rather than a canopy epiphyte. These data are in agreement with Comber (1990), who also noted that *P. spicata* was a low-growing epiphyte. The use of binoculars to assess epiphyte distribution in tall rain forest trees may bias data toward those plants growing lower on the trees. The partitioning of epiphytic habitat is a product of the response of individual species to a range of environmental gradients, especially those of radiation and vapor pressure deficit (Dickinson et al. 1993). In addition, the presence of suitable establishment sites and the ability of epiphytes to acquire key resources (especially nutrients and water) will control epiphyte distribution within host trees. The apparent restriction of *P. spicata* to the main trunk and the lowermost canopy branches may reflect a requirement for elevated radiation levels but without the severe evapotranspirational demands that epiphytic orchids in the upper parts of the canopy experi-

ence. Furthermore, the main trunk provides the bark that this orchid appears to prefer as an establishment site.

Our study presents preliminary data on the ecology of *Pomatocalpa spicata* in a tropical rain forest. Results suggest that this orchid is non-randomly distributed both among potential host species and within individual host plants in a manner similar to that observed for many mistletoes (e.g., Norton et al. 1997). Clearly, further studies need to consider a wider range of epiphytic orchid species, if we are to better understand the key ecological factors that determine their distribution patterns within tropical rain forests.

Literature Cited

Comber, J.B. 1990. Orchids of Java. Bentham-Moxon Trust, Royal Botanic Garden. Kew, England.

Dickinson, K.M.J., A.F. Mark and B. Dawkins. 1993. Ecology of lianoid/epiphytic communities in coastal podocarp forest, Haast Ecological District, New Zealand. J. Biogeog. 20: 687–705.

Johansson, D.R. 1975. Ecology of epiphytic orchids in West African rain forest. Amer. Orchid Soc. Bull. 44: 125–136.

Norton, D.A. and M.A. Carpenter. 1998. Mistletoes as parasites: host specificity and speciation. Trends Ecol. Evol. 13: 101–105.

Norton, D.A., J.J. Ladley and H.J. Owen. 1997. Distribution of the loranthaceous mistletoes *Alepis flavida, Peraxilla colensoi,* and *Peraxilla tetrepetala* within two New Zealand *Nothofagus* forests. New Zealand J. Bot. 35: 323–336.

Norton, D.A. and N. Reid. 1997. Lessons in ecosystem management from management of threatened and pest loranthaceous mistletoes in New Zealand and Australia. Conserv. Biol. 11: 759–769.

Sanford, W.W. 1968. Distribution of epiphytic orchids in semi-deciduous tropical forest in Southern Nigeria. J. Ecol. 56: 697–705.