Influence of phorophyte, habitat and climate on the diversity, spatial distribution and community structure of epiphytic orchids of the Southern Western Ghats

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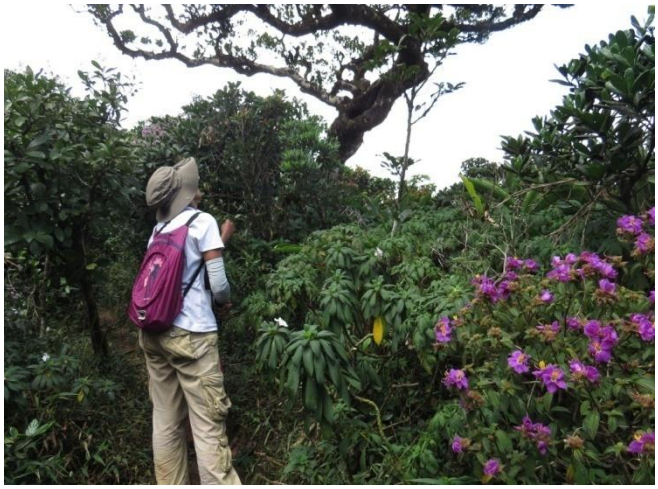
Introduction:

Theenormous representation of epiphytes in the tropical forests is usually related to variations in the local environment, climate (Johansson 1974), and resultant high niche diversification (terSteege and Cornelissen 1989). The selection of habitat and climate by different species of epiphytes may closely be interconnected. Canopy epiphytes, like a community, tend to make a set of microhabitat and microclimatic conditions within the canopy. Characteristics of host, habitat, and climate would be very important in the conservation of canopy epiphytes if epiphytes in the Western Ghats followed such an advanced mechanism for their vertical and horizontal pattern of distribution.Epiphytes, which vary in form and structure but share ecological traits, can also be found in the Western Ghats. Since no comprehensive study has ever been made, data is lacking on the ecology of epiphytes from the Western Ghats. In Silent Valley NP, 50% of total epiphytes recorded are Orchids (Kumar and Manilal 1992). Therefore, Orchids become an interesting group to be studied representing epiphytes, especially in the southern Western Ghats. Orchids are known to be very specific to climatic conditions. Epiphytic orchids could potentially serve as an indication for the health of the southern Western Ghats, given the expected changes in climate such as rainfall and temperature trends in the Western Ghats. Therefore, the influence of habitat, host, and climate on diversity, spatial distribution, and community structure of epiphytic orchids was studied in major vegetation types from the Western Ghats in Kerala to understand:

1. Diversity patterns, spatial distribution, and community structure of epiphytic orchids of southern Western Ghats
2. Phorophyte specificity of orchids
3. Influence of selected environmental variables on epiphytic orchids in differentspatial scales by using suitable empirical models
4. Community level ecological interactions of epiphytic orchids with other epiphytic plants those are associated

Materials and methods:

Due to the limited seasonal access and logistics selected study sites from geographic subdivisions such as Wayanad plateau, Upper Nilgiris, Anamalai hills, Periyar-cardamom hills, and Agasthyamalai hills. Were selected. Lower altitude class (0-800 m asl.), Mid altitude class (801-1600 m asl.), and High-altitude class (1601-2400 m asl.); latitudinal zones such as 8° N- 10° N, 10° 01'N°-12° N, and 12° 01' N-12°50' N; habitats such as Evergreen (EVEG), Montane/Southern Hilltop EVEG (MEVEG-EVEG between 1400 m to 1700 m), Semi-Evergreen (SEVG), Shola (SHLA), Moist Deciduous (MDEC), Savannah (SVNA) and Semi-natural Plantations (SNPL); a tree divided into Trunk Zone, Inner Crown Zone, Middle Crown Zone, and Upper crown Zone were the spatial scales used. The method developed, linear line transects with selective tree scanning (LLTSTS) was carried out in these spatial units. Data on habitat characteristics, host tree characteristics, and the substrate (immediate surrounding) was recorded. The Climatic variables such as Relative humidity (RH), Temperature, Light Intensity, and Rainfall were recorded by using HOBO climate loggers. The associated epiphytes of sampled orchids were collected from the host tree and have been identified.



In statistical software R, Species-Area relationships, Rank Abundance Dominance (RAD) Models ComparingSpecies Diversity, Species Richness, Species Turnover across and within gradients, and ordination(CCA) to address community structure was carried out. Spearman's (rs) correlation coefficient was used to recognize the degree of correlation among species richness of orchids and predictors which includes host characteristics and basedon thesignificance of the correlation, a regression versionwasorganized in R (model 3.6.0). The specificity of orchids within gradients of each tree characteristic was also tested with one-way ANOVA and Tukey's pairwise post hoc. Principal Component Analysis (PCA) with Euclidean distance explained variance in species diversity and abundance along with climatic variables at different logger regions. Redundancy analysis explained the pattern of the epiphytic orchid assemblage with respect to the presence or absence of other epiphytes.

Results:

The study yielded 95 species of epiphytic orchids and 65 sp of terrestrial orchids. Large spatial scales such as altitude, latitude, and habitat affect epiphytic orchid composition on a horizontal scale. The spatial distribution of epiphytic orchids on a vertical scale on the host tree is highly separated into zones. Inner Crown Zone is the most preferred zone as it provides consistent microclimatic conditions. The structure of epiphytic orchid assemblage is best explained at habitat level along distance to water, slope, and habitat/vegetation type. The structure of epiphytic orchid assemblage at the level of tree/macrohabitat is best explained along bark nature, GBH, and height of a tree. The structure of epiphytic orchid assemblage at the level of substrate/microhabitat is explained along position on the tree, substrate girth, inclination aspect of the substratum, degree of substrate inclination, orientation, and height on phorophyte. An exclusive specificity for orchid species on a host species was not seen. Epiphytic orchids are composed in response to the substrate level characteristics and then tree-level characteristics. A combination of optimum light, temperature, and RH determines species diversity and abundance in a region. Other epiphytes do not predict the presence of epiphytic orchids on a tree. However, the community structure of an epiphytic orchid assemblage on a tree/metacommunity/individual community can be distinct responding to the presence or absence of other epiphytes.

Orchids indicate the importance of the micro-environment associated with mature and aged trees and hence the structural complexity of tropical forests. Conservation of epiphytic orchids would ensure conservation of old aged, natural, structurally complex trees hence primary forests.

Meanwhile, our minor research addressed orchid fall in semi-natural plantations and adjacent semi-evergreen forests. Following the sampling of 500 trees in each, seminatural plantations were found to have more taxa of orchids, a high rate of endemism, and found more prone to orchid fall from management activities. Semi-natural plantations (with native trees but transformed land use) are a major habitat that equally supports epiphytic orchids as in other major forest types.

Rare and threatened epiphytic orchids from the study area

Rhytionanthos indicum

Luisia abrahamii

Tricoglottis tenera

Vanda wightii

Smithsonia straminea

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Suggested citation:
Sebastian J. (2021). Influence of phorophyte, habitat and climate on the diversity, spatial distribution and community structure of epiphytic orchids of the Southern Western Ghats,Prithivya, An Official Newsletter of WCB Research Foundation and WCB Research Lab. Vol 1(3) 47-51.