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Research Article

TAXONOMIC DIVERSITY OF LIANAS IN TROPICAL FORESTS OF ANDAMAN AND NICOBAR ISLANDS, INDIA

***Asutosh Ghosh**
Taxonomy and Biosystematics Lab, Department of Botany, University of Calcutta, Kolkata, WB, India
**Author for Correspondence*

ABSTRACT
Lianas are important in forest ecosystem and strongly influence the forest dynamics and diversity. Lianas are common in the tropical moist deciduous and rain forests, which are competing with other forest trees. Little information is known on the habitat specialization in tropical lianas diversity and the root causes for variation among forests in liana species composition. A total of 105 liana species representing 109 genera and 33 families were reported. Papilionaceae was the dominant family with 13 species and *Caesalpinia*, *Derris* was the largest genera. Stem twinner climbers (45.71%) was the most predominant climbing mechanism.

Keywords: *Lianas, Climbing Modes, Diversity, Andaman Islands*

INTRODUCTION
Lianas are prominent features of most tropical forests, where their leaves can constitute a large amount of the total area of the entire forest community (Putz and Mooney, 1991). They struggle strongly with trees, very much reducing tree growth, tree reproduction and greatly increasing tree mortality (Wright *et al*., 2005; Schnitzer and Carson, 2010; Ingwell *et al*., 2010) and altering the course of regeneration in forests (Schnitzer *et al*., 2000). Lianas add significantly to vascular plant species as their contribution to species richness ranges from 8-12%. Lianas make up 2 to 7% of total woody biomass; but as much as 6 to 36% of the total leaf biomass and production of litter 36% against that by trees 59%. Lianas are capable of growing very rapidly in length and large lianas generally grow to the canopy and hence cast shade on their host trees, thereby reducing tree growth rates (Putz, 1984). Although by growing from tree to tree, lianas might increase tree stability (Smith, 1973), trees with lianas suffer higher mortality rates then liana free trees (Putz *et al.*, 1985).

Lianas represent a very conspicuous and dominant growth form in tropical forests. Climbing plants not only form an important structural component but also play an important ecological role in the forest dynamics and nutrient recycling within these ecosystems (Schnitzer and Bongers, 2002; Reddy and Parthasarathy, 2006; Zotz, 2006). However, in many forest inventories during the last decades, lianas are ignored (Dallmier and Comiskey, 1998a, b), in contrast to herb, shrubs and trees. The overall low attention to lianas is most probably due to their low microeconomic importance. Also difficulties in delimiting individuals overall lower minimum size limit in enumerations and general lack of taxonomic studies resulted in the exclusion of lianas in many inventories. More recently, lianas have been included in systematic sampling programs (Hubbell and Foster, 1983; Hawthorne, 1996; Makana *et al*., 1998).

Interest in liana inventory has recently gained currency (DeWalt *et al.*, 2000; Muthuramkumar and Parthasarathy, 2001; Pérez- Salicrup *et al*., 2001; Phillips *et al*., 2002). In India, few studies on climbing plants have been carried out by Reddy and Parthasarathy (2003); Kouame *et al*., (2004); Mascaro *et al*., (2004); Parthasarathy *et al*., (2004); Rice *et al*., (2004); Phillips *et al*., (2005); DeWalt *et al*., (2006); Ghosh and Mukherjee (2006); Ghosh (2012); Prasad *et al*., (2009); Ghosh *et al.*, (2013); Ghosh (2013a, b); Ghosh (2014, a, b); Ghosh and Mukherjee (2014); Ghosh and Pandey (2014). However, most of the studies were not exclusively on lianas as they involve general botanical surveys with reference to herbaceous climbers. Thus, main objective of present study was to inventory the lianas diversity and ecological findings in the Andaman and Nicobar Islands forests.

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MATERIALS AND METHODS

The Andaman and Nicobar islands, a landmass of 572 islands, isles, rocks and reefs, about 1200 km from the mainland India, is located between the latitude of 6° to 14° N and longitude of 92° to 94° E, covering an area of 8249 km^2 and it covers South, Middle, North, Little Andaman and Nicobar Islands (Figure 1).

Figure 1: Map showing the study area

The present work is the outcome of extensive field survey during 2001-2004, carried out to document the species occurring in different parts of Andaman and Nicobar Islands. The collected specimens were processed into mounted herbarium sheets following standard herbarium techniques (Jain and Rao, 1977). Climbing mechanisms were also studied for each species and classified them based on observations in the field and reliable references (Putz, 1984). Specimens were identified with the help of publishes literature (Hooker, 1872-1885; Gamble and Fisher, 1921-1935; Perkinson, 1923; Mathew, 1991) and subsequently confirmed by consulting the specimens deposited in the Central National Herbarium (CNH). The voucher specimens were deposited in the Herbarium of the Department of Botany, Calcutta University (CUH).

RESULTS AND DISCUSSION

The study area contained a total of 105 liana species representing 62 genera and 33 families, recorded from Andaman and Nicobar Islands of forests in the total of 291 grids (Table 1). Muthumperumal and Parthasarathy (2009) enumerated 175 angiosperm climbing plants of southern Eastern Ghats; 60 liana species found in Maruthamalai hills of southern Western Ghats (Sarvalingam and Rajendran, 2012); 93 climbing plant species reported in land Atlantic forest, northern Brazil (Araujo and Alves, 2010); the total number of climbers that are found in Puerto Rico and the Virgin Islands amounts to 386 (Acevedo-Rodriguez, 2005).

The present study identified a genus and species ratio of 1:1.69. Out of 105 species, only one species was Gymnosperm i.e. *Gnetum scandens* and 104 species consist of 61 genera and 32 families were angiosperms. Among the angiosperms, there were 93 species representing 28 families of dicotyledons and 11 species belonging to 4 monocotyledon families. The most specious families investigated in the present study include Papilionaceae (13 species), Annonaceae , Arecaceae, Caesalpiniaceae (8 species each) and Apocynaceae (7 species) etc., while in southern Eastern Ghats Asclepidaceae, Convolvulaceae, Papilionaceae, Apocynaceae, Vitaceae and Menispermaceae formed the most dominant familes (Muthumperumal and Parthasarathy, 2009). Papilionaceae, Cucurbitaceae, Convolvulaceae and

Asclepiadaceae formed the common liana families in Maruthamalia hills of Western Ghats (Sarvalingam and Rajendran, 2012).

Table 1: Enumeration of Lianas species found in Andaman and Nicobar Islands

Sl.	Specimen name	Family	Climbing mode	Nature of climbing organ
1	*Acacia andamanica* Nielsen	Mimosaceae	Hook climber	Stem and leaf rachis modified
2	*Acacia pennata* (L.) Willd.	Mimosaceae	Hook climber	Stem and leaf rachis modified
3	*Aganosma cymosa* (Roxb.) G. Don	Apocynaceae	Twiner	Modified stem.
4	*Aganosma marginata* (Roxb.) G. Don	Apocynaceae	Twiner	Modified stem.
5	*Alyxia reinwardtii* var. *meiantha* (stap) Markgraf	Apocynaceae	Twiner	Modified stem.
6	*Ancistrocladus attenuatus* Dyer	Ancistrocladaceae	Hook climber	Inflorescence axis.
7	*Ancistrocladus tectorius* (Lour.) Merr.	Ancistrocladaceae	Hook climber	Inflorescence axis.
8	*Anodendron manubrium* Merr.	Apocynaceae	Twiner	Modified stem.
9	*Artabotrys speciosus* Kurz ex Hook. f. Thomson	Anonaceae	Hook climber	Inflorescence axis.
10	*Atalantia monophylla* DC.	Rutaceae	Hook climber	Modified stem.
11	*Bauhinia stipularis* Korth.	Caesalpiniaceae	Twiner	Distal leaflets modified
12	*Bougainvillea spectabilis* Willd.	Nyctaginaceae	Hook climber.	Modified stem.
13	*Byttneria andamanensis* Kurz	Sterculiaceae	Hook climber	Modified stem.
14	*Byttneria grandifolia* DC.	Sterculiaceae	Hook climber	Modified stem.
15	*Caesalpinia andamanica* (Prain) Hattink	Caesalpiniaceae	Hook climber	Prickles on stem & leaf rachis.
16	*Caesalpinia bonduc* (L.) Roxb.	Caesalpiniaceae	Hook climber	Prickles on stem & leaf rachis
17	*Caesalpinia crista* L.	Caesalpiniaceae	Hook climber	Prickles on stem & leaf rachis
18	*Caesalpinia cucullata* Roxb.	Caesalpiniaceae	Hook climber	Prickles on stem, leaf rachis & petiole.
19	*Caesalpinia enneaphylla* Roxb.	Caesalpiniaceae	Hook climber	Recurved prickles on stem & leaf rachis
20	*Caesalpinia hymenocarpa* (Prain) Hattink	Caesalpiniaceae	Hook climber	Prickles on stem & leaf rachis
21	*Calamus andamanicus* Kurz	Arecaceae	Thorny branch climber	Flagella or rachillar hooks.
22	*Calamus longisetus* Griff.	Arecaceae	Thorny branch climber	Flagella or rachillar hooks.
23	*Calamus palustris* Griff.	Arecaceae	Thorny branch climber	Flagella or rachillar hooks.
24	*Calamus pseudorivalis* Becc.	Arecaceae	Thorny branch climber	Flagella or rachillar hooks.
25	*Calamus viminalis* Willd.	Arecaceae	Hook climber	Flagella or rachillar

				hooks.
26	*Calycopteris floribunda* (Roxb.) Lam.	Combretaceae	Twiner and root climber.	Stem and presence of some adventitious roots.
27	*Capparis floribunda* Wight	Cappariadaceae	Twiner & straggler	Leader axis of main stem and branches.
28	*Capparis micrantha* DC.	Cappariadaceae	Twiner & straggler	Leader axis of main stem and branches.
29	*Capparis sepiaria* L.	Cappariadaceae	Twiner & straggler	Leader axis of main stem and branches.
30	*Capparis zeylanica* L.	Cappariadaceae	Twiner & straggler	Leader axis of main stem and branches.
31	*Celastrus paniculatus* Willd.	Celastraceae	Twiner/ branch climber	Leader axis or branch.
32	*Chonemorpha fragrans* (Moon) Alston	Apocynaceae	Twiner	Modified stem.
33	*Cocculus pendulus* (J.R. & G. Forst.) Diels	Menispermaceae	Twiner	Modified stem.
34	*Combretum latifolium* Bl.	Combretaceae	Twiner	Leader axis or branch
35	*Combretum porterianum* (Cl.) Wall. ex Craib.	Combretaceae	Twiner/ branch climber	Leader axis or branch
36	*Combretum punctatum* Bl. ssp. *squamossum* (Roxb. ex G. Don.) Excell.	Combretaceae	Twiner/ branch climber	Leader axis or branch
37	*Combretum roxburghii* Spreng.	Combretaceae	Twiner/ branch climber	Leader axis or branch
38	*Connarus semidecandrus* Jack.	Connaraceae	Twiner/ branch climber	Leader axis or branch
39	*Cyathostemma viridiflorum* Griff.	Anonaceae	Twiner	Branches twisted and coiled.
40	*Cynanchum corymbosum* Wight	Asclepiadaceae	Twiner	Modified stem.
41	*Cynanchum wallichii* Wight	Asclepiadaceae	Twiner	Modified stem.
42	*Daemonorops kurzianus* Hook. f.	Arecaceae	Thorny branch climber	Flagella or rachillar hooks.
43	*Daemonorops manii* Becc	Arecaceae	Thorny branch climber	Flagella or rachillar hooks.
44	*Dalbergia confertiflora* Benth.	Papilionaceae	Hook climber	Hooks and twisted branches.
45	*Dalbergia junghuhnii* Benth.	Papilionaceae	Hook climber	Hooks and twisted branches.
46	*Dalbergia volubilis* Roxb.	Papilionaceae	Hook climber	Hooks and twisted branches.
47	*Derris andaminaca* Prain	Papilionaceae	Hook climber	Hooks and twisted branches.
48	*Derris elegans* Benth. *f. andamanensis*	Papilionaceae	Hook climber	Hooks and twisted branches.
49	*Derris elegans* Benth. *f. elegans*	Papilionaceae	Hook climber	Hooks and twisted branches.
50	*Derris elliptica* (Wall.) Benth.	Papilionaceae	Hook climber	Hooks and twisted branches

51	*Derris scandens* (Roxb.) Benth.	Papilionaceae	Hook climber	Hooks and twisted branches
52	*Derris trifolita* Lour.	Papilionaceae	Hook climber	Hooks and twisted branches
53	*Desmos cochinchinensis* Lour.	Anonaceae	Twiner	Branches twisted and coiled.
54	*Dinochloa andamanica* Kurz	Poaceae	Branch climber	Branches.
55	*Dinochloa scandens* (Bl. ex Nees) Kuntz	Poaceae	Branch climber	Branches.
56	*Entada rheedei* Spr.	Mimosaceae	Tendril climber	Modified axillary branches.
57	*Friesodielsia khoshooi* Vasud. & T. Chakrab.	Anonaceae	Twiner	Branches twisted and coiled.
58	*Gnetum scandens*(Warburg) Chun	Gnetaceae	Twiner	Modified stem.
59	*Gouania andamanica* var. *andamanica* King	Rhamnaceae	Tendril climber	Pedicel or peduncle.
60	*Gouania leptostachya* DC.	Rhamnaceae	Tendril climber	Pedicel or peduncle.
61	*Gynochthodes macrophylla* Kurz	Rubiaceae	Twiner	Modified stem.
62	*Harrisonia brownii* A.H.L.Juss.	Simaroubaceae	Hook climber	Modified stem.
63	*Harrisonia perforata* (Blanco) Merr.	Simaroubaceae	Hook climber	Modified stem.
64	*Hibiscus scandens* Roxb.	Malvaceae	Twiner	Modified stem.
65	*Hippocratea grahamii* Wight	Celastraceae	Twiner	Leader axis or branch.
66	*Hiptage benghalensis* (L.) Kurz	Malpghiaceae	Twiner	Modified stem.
67	*Ichnocarpus frutescens* (L.) W. T. Aiton	Apocynaceae	Twiner	Modified stem.
68	*Illigera appendiculata* Bl.	Hernandiaceae	Twiner	Modified stem.
69	*Jasminum angustifolium* (L.) Willd.	Oleaceae	Twiner	Modified stem.
70	*Jasminum arborescens* Roxb.	Oleaceae	Twiner	Modified stem.
71	*Jasminum sambac* (L.) Aiton	Oleaceae	Twiner	Modified stem.
72	*Korthalsia laciniosa* (Griff.) Mart.	Arecaceae	Thorny branch climber	Flagella or rachillar hooks.
73	*Mucuna gigantea* (Willd.) DC.	Papilionaceae	Twiner	Modified stem.
74	*Mucuna monosperma* DC. ex Wight	Papilionaceae	Twiner	Modified stem.
75	*Olax imbricata* Roxb.	Olacaceae	Twiner	Branch modified
76	*Parabaena sagittata* Miers ex Hook. f. & Thomson	Menispermaceae	Twiner	Modified stem.
77	*Paramignya andamanica* (King) Tan.	Rutaceae	Hook climber	Modified stem.
78	*Parsonsia alboflavescens* (Dennstedt) Mabberley	Apocynaceae	Twiner	Modified stem.
79	*Pisonia aculeata* L.	Nyctaginaceae	Hook climber	Stem modified
80	*Plecospermum andamanicum* King	Moraceae	Hook climber.	Short stiff nodal adventitious roots.
81	*Pterolobium macropterum* Kurz	Caesalpiniaceae	Hook climber	Prickles on stem & leaf rachis.
82	*Pueraria tuberosa* (Willd.) DC.	Papilionaceae	Twiner	Modified stem.

83	*Quisqualis indica* L.	Combretaceae	Twiner/ branch climber	Leader axis or branch
84	*Salacia exsculpta* Korth.	Celastraceae	Twiner	Leader axis or branch.
85	*Salacia tortuosa* Griff.	Celastraceae	Twiner	Leader axis or branch.
86	*Sarcostigma kleinii* Wight & Arn.	Icacinaceaceae	Twiner	Modified stem.
87	*Smilax aspericaulis* Wall. ex A. de Candolle	Smilacaceae	Prickle and tendril climber	Tendril-modified stipule.
88	*Spatholobus acuminatus* Benth.	Papilionaceae	Twiner	Modified stem.
89	*Sphenodesme involucrata* (Presl) Robinson	Verbenaceae	Twiner	Modified stem.
90	*Stixis suaveolens* (Roxb.) Pierre	Cappariadaceae	Twiner	Leader axis of main stem and branches.
91	*Strychnos anandamanensis* Hill.	Loganiaceae	Hook climber	Hooks and twisted branches
92	*Strychnos axillaris* Colebrooke	Loganiaceae	Hook climber	Hooks and twisted branches
93	*Strychnos minor* Dennst.	Loganiaceae	Tendril climber	Modified branchlet ends.
94	*Strychnos wallichiana* Steudel ex A. de Candolle	Loganiaceae	Tendril climber	Modified branchlet ends.
95	*Tetracera sarmentosa ssp. andamanica* (Hoogl.) Hoohl.	Dilleniaceae	Twiner	Rough stem and leader axis.
96	*Tetrastigma andamanicum* (King) Suesseng.	Vitaceae	Tendril climber	Apical part of the main axis, apparently leaf opposed.
97	*Uncaria sessilifructus* Roxb	Rubiaceae	Hook climber (Paired hooks)	Axillary branchlets.
98	*Uvaria andamanica* King	Anonaceae	Branch climber	Branches twisted and coiled.
99	*Uvaria cordata* (Dunal) Alston	Anonaceae	Branch climber	Branches twisted and coiled.
100	*Uvaria hamiltoni* var. *Kurzii* Arn.	Anonaceae	Branch climber	Branches twisted and coiled.
101	*Uvaria rufa* Bl.	Anonaceae	Branch climber	Branches twisted and coiled.
102	*Ventilago denticulate* Willd.	Rhamnaceae	Twiner	Modified stem.
103	*Ventilago madraspatana* Gaertn.	Rhamnaceae	Twiner	Modified stem.
104	*Ziziphus oenoplia* (L.) Mill var. *oenoplia*	Rhamnaceae	Hook climber	Stem and thorns.
105	*Ziziphus oenoplia* (L.) Mill Var. *pallens* Bhandari & Bhansali	Rhamnaceae	Hook climber	Stem and thorns.

Families such as Smilacaceae, Menispermaceae, Passifloraceae, Cucurbitaceae and Convolvulaceae are entirely dominated by species with a climbing habit (Araujo and Alves, 2010). According to Gentry (1991) New World families, with the highest diversity of climbing plants, are Apocynaceae (esp. Asclepiadoideae), Convolvulaceae and Papilionaceae.

The dominant genera in the present study were *Caesalpinia, Derris* (6 species), *Calamus* (5 species), *Capparis, Combretum, Strychnos* and *Uvaria* (4 species each). Muthumperumal and Parthasarathy (2009)

recorded that *Jasminum*, *Acacia*, *Argyreia* and *Capparis* were the most abundant genera in southern Eastren Ghats.

In this study, six major mechanisms of climbing systems were recognized: stem twiners (45.71%) followed by hook climbers (34.28%). Branch twiner (21.9%), tendril climbers (6.66%), and root climbers (0.95%). Several authors have reported that stem twiners were most common in the different tropical forests (Ghollasimood *et al*., 2012; Parthasarathy *et al*., 2004; Kuzee and Bongers, 2005).

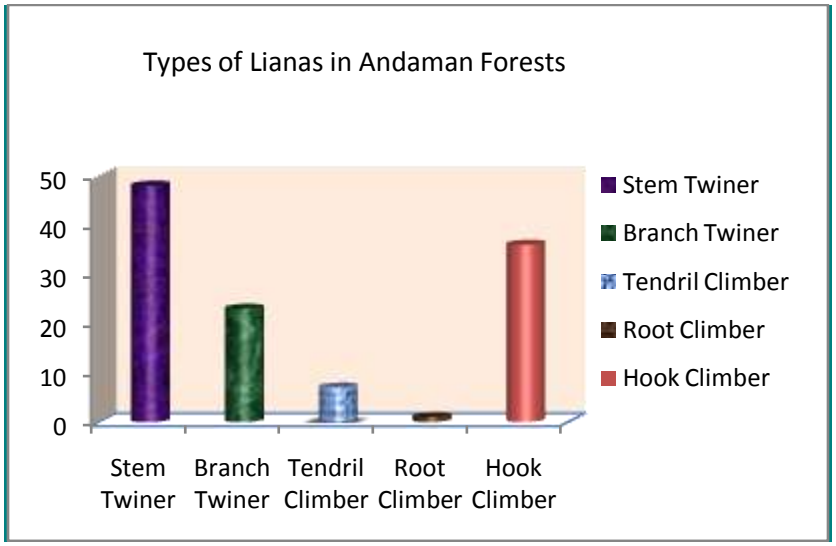

Figure 2: Types of lianas in Andaman and Nicobor Islands

Lianas play a key role in the ecology and dynamics of forests and may be helpful in conservation of forest resources. The present study has shown that the tropical forests of Andaman and Nicobar have a high floristic diversity of lianas, which contribute to the overall biodiversity of the forests. These forests are deteriorating under constant anthropogenic activities. The present data of floristic diversity of lianas would be useful in species conservation and management. The importance of climbers can be useful to biologists in the establishment of a standardized methodology and to provide these data on the structural threats to tropical forests for a global audience.

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REFERENCES

Acevedo-Rodriguez P (2005). Vines and climbing plants of Puerto Rico and the Virgin Islands Contribution from the United States National Herbarium **51** 1-483.

Araujo D and Alves M (2010). Climbing plants of a fragmented area of lowland Atlantic Forest, Igarassu, Pernambuco (northeastern Brazil). *Phytotaxa* **8** 1-24.

Dallmier F and Comiskey JA (eds.) (1998b). Forest biodiversity in North, Central a South America, and the Caribbean: research and monitoring. *Man and the Biosphere Series*, *UNESCO*, Paris (France: Parthenon Publishing Group, New York) **21** 768.

Dewalt SJ, Schnitzer SA and Denslow JS (2000). Density and diversity of lianas along a chronosequence in a central Panamanian lowland forest. *Journal of Tropical Ecology* **16**(1) 1-19.

Dewalt SJ, Ickes K, Nilus R, Harms KE and Burslem DFRP (2006). Liana habitat associations and community structure in a Bornean lowland tropical forest. *Plant Ecolology* **186** 203-216.
Gamble and Fisher (1921-1935). *Flora of Presidency of Madras,* edited by Nair NC and Henry AN (Adlard and Son Ltd., London) **13**.
Gentry AH (1991). The distribution and evolution of climbing plants. In: *The Biology of Vines*, edited by Putz FE and Mooney HA (Cambridge University Press, Cambridge, UK) 3-49.
Gollasimood S, Faridah-Hanum I, Nazre M and Kamziah AK (2012). Abundance and distribution of climbers in a coastal hills forest in Perak, Malaysia. *Journal of Agricultural Science* **4**(5) 245-254.
Ghosh A and Mukherjee PK (2006). Diversity of Climbers and Lianas of North Andaman. National Conference on Forest Biodiversity Resourse: Exploration, Coservation and management, Madurai Kamraj Univ., Madurai.
Ghosh A (2012). Diversity of Climber and Liana of North Andaman with special reference to ecology, Ph.D. Thesis, University of Calcutta, Calcutta 65-70.
Ghosh A, Chaudhury K and Mukherjee PK (2013). An interactive approach of remote sensing and geographical information system in the understanding of north Andaman forest. *Bioherald* (International Journal of Biodiversity & Environment) **3**(1) 37- 40.
Ghosh A (2013a). Diversity and distribution of climbing plants in littoral forest of North Andaman, Andaman Islands, India. *Indian Journal of Plant Sciences* **2**(3) 35-42.
Ghosh A (2013b). Taxonomic diversity of climbing plants of North Andaman forest. India. *Indian Journal of Plant Sciences* **2**(4) 20-43.
Ghosh A (2014). Diversity and distribution of climbing plants in Mangrove forest of North Andaman Islands, *International journal of Pharmacy and Life science* **5**(4) 3463-3466.
Ghosh A (2014a). Survey and presence class of climbing plants in the flora of Andaman Islands, India. *International Journal of Innovative Research and Review* **2**(1) 35-46.
Ghosh A and Mukherjee PK (2014). Diversity and distribution of climbing plants in Dry Deciduous forest of North Andaman islands, India. *Indian Journal of Plant Sciences* **2**(3) 49-57.
Ghosh A (2014b). Endemic climbing genera of North Andaman Islands, India. *International Journal of Pharmaceutical and Life Sciences* **5**(6) 3611-3616.
Ghosh A and Pandey HP (2014). Diversity and distribution of climbing plants in Semi Evergreen forest of North Andaman Islands, India. *International Journal of Biodiversity & Environment* **3**(3).
Hawthorne WD (1996). Holes and sums of parts in Ghananian forest: regeneration, scale and sustainable use. In: *Essays on Ecology of the Guineo-ongo Rain Forest*, edited by Alexander IJ, Swaine MD and Waiting R, *Proceeding of the Royal Society of Edinburgh* **104B** 75-176.
Hooker JD (1872-1897). *The Flora of British India* (L. Reeve & Co. London) I- VII.
Hubbell SP and Foster RB (1983). Diversity of canopy trees in a neotropical forest and implications for conservation. In: Sutton SL, Whitmore TC and Chadwick AC, *Tropical rain forest: Ecology and management,* Special publications series of the British Ecological Society No. 2 (Blackwell Scentific publications, Oxford, U.K.) 25-41.
Ingwell LL, Wright SJ, Becklund KK, Hebbell SP and Schnitzer SA (2010). The impact of lianas on 10 years of tree growth and mortality on Barro Colorado Island, Panama. *Journal of Ecology* **98** 879-887.
Jain SK and Rao RR (1977). *A Handbook of Field and Herbarium Methods* (Today and tomorrow's Printers and Publishers, New Delhi).
Kouame FN, Bongers F, Poorter L and Traore D (2004). Climbers and logging in the Forêt Classée du haut-Sassandra, Côte-d'Ivoire. *Forest Ecology and Management* **194** 259-268.
Kuzee ME and Bongers F (2005). Climber abundance, diversity and colonization in degraded forests of different ages in Côte d'Ivoire. In: *Forest climbers of West Asia: Diversity, Ecology and Management*, edited by Bongers F, Parren MPE and Traore D (CABI Publishing) 67-84.
Matthew KM (1991). An Excursion Flora of Central Tamil Nadu, India (New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd).

Makana JR, Hart TB and Hart JA (1998). Forest structure and diversity of lianas and understory treelets in monodominant and mixed stands in the Ituri forest, Democratic Replublic of Congo. In: *Forest Biodiversity Research, Monitoring and Modelling Conceptional background and Old World case studies*, edited by Dallmier F and Comiskey JA, Man and the Biosphere Series, UNESCO, Paris, (France: Parthenon Publishing Group Ltd) **20** 429-446.

Mascaro J, Schnitzer SA and Carson WP (2004). Liana diversity, abundance, and mortality in a tropical wet forest in Costa Rica. *Forest Ecology and Management* **190** 3 -1.

Muthuramkumar S and Parthasarathy N (2001). Tree-liana relationships in a tropical evergreen forest at Varagalaiar, Anamalais, Western Ghats, India. *Journal of Tropical Ecology* **17**(3) 395-409.

Muthumperumal C and Parthasarathy N (2009). Angiosperms, climbing plants in tropical forests of southern Eastern Ghats, Tamil Nadu, India. *Checklist* **5**(1) 092-111.

Parthasarathy N, Muthuramkumar S and Reddy MS (2004). Patterns of liana diversity intropical evergreen forests of peninsular India. *Forest Ecology and Management* **190** 15-31.

Perez-Salcrup DR, Sork VL and Putz FE (2001). Lianas and trees in a liana forest of Amazonian Bolivia. *Biotropica* **33**(1) 34 -47.

Parkinson CE (1923). *A forest flora of the Andaman Islands* (Govt. of India Press, Shimla India).

Phillips OL, Martinez RV, Arroyo L, Baker TR, Killeen T, Lewis SL, Malhi Y, Mendosa AM, Neill D, Vargas PN, Alexiades M, Ceron C, Fiore AD, Erwin T, Jardim A, Palacios W, Saldias M and Vinceti B (2002). Increasing dominance of large lianas in Amazonian forests. *Nature* **418** 770-774.

Phillips OL, Martínez RV, Mendoza AM, Baker TR and Vargas PN (2005). Large lianas as hyperdynamic elements of the tropical forest canopy. *Ecology* **86**(5) 1250 -1258.

Putz FE (1984). The natural history of lianas on Barro Colorado Island, Panama. *Ecology* **65** 1713-1724.

Putz FE, Lee HS and Goh R (1985). Effects of post-felling silvicultural treatments on woody vines in Sarawak. *Malaysian Forester* **47** 214-256.

Putz FE and Mooney HA (1991). *The Biology of Vines* (In Cambridge University Press, Cambridge, United Kingdom) 53-72.

Reddy MS and Parthasarathy N (2003). Liana diversity and distribution in four tropical dry evergreen forests on the Coromandel coast of south India. *Biodiversity and Conservation* **12** 1609-1627.

Reddy MS and Parthasarathy N (2006). Liana diversity and distribution on host trees in four inland tropical dry evergreen forests of peninsular India. *Journal of Tropical Ecology* **47**(1) 109-123.

Rice K, Brokaw N and Thompson J (2004). Liana abundance in a Puerto Rican forest. *Forest Ecology and Management* **190**(1) 33 -41.

Sarvalingam A and Rajendran A (2012). Diversity of liana species in Maruthamalai hills of southern Western Ghats, India. *Phytotaxonomy* **12** 131-135.

Schnitzer SA and Carson WP (2010). Lianas suppress tree regeneration and diversity in tree fall gaps. *Ecology Letters* **13** 849- 857.

Schnitzer SA and Bongers F (2002). The ecology of lianas and their role in forests. *Trends in Ecology and Evolution* **17**(5) 223-230.

Schnitzer SA, Dalling JW and Carson WP (2000). The impact of lianas on tree generation in tropical forest canopy gaps: Evidence for an alternative pathway of gap-phase regeneration. *Journal of Ecology* **88** 655-666.

Smith AP (1973). Stratification of temperate and tropical forests. *American Naturalist* **107** 671-683.

Wright SJ, Jaramillo AM, Pavon J, Condit R, Hubbell SP and Foster RB (2005). Reproductive size thresholds in tropical trees: variation among individuals, species and forests. *Journal of Tropical Ecology* **21** 307-3115.

Zotz G, Cueni N and Korner C (2006). In-situ growth stimulation of a temperate zone liana (*Hedera helix*) in elevated CO2. *Functional Ecology* **20** 763-769.