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Research Article

DIVERSITY AND DISTRIBUTION OF CLIMBING PLANTS IN LITTORAL FOREST OF NORTH ANDAMAN NORTH ANDAMAN ISLANDS, INDIA

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ABSTRACT
The present study examined the floristic diversity, dominance, abundance and IVI of climbers and lianas species in the tropical littoral vegetation of North Andaman forest. A total of 377 climbing plants belonging to 53 species, 33 genera, and 20 families were identified. The most dominant families are Papilionaceae (15.09%), Arecaceae (13.20%). These consisted of 27 liana and 26 herbaceous climber species. Hook climbing was the most predominant (27%) climbing mechanism. The dominant species recorded from this forest were Calamus andamanicus, (IVI-26.84), Daemonorops manii (IVI-16.73). Tylophora indica shows the highest frequent (100%) species. Most of the species were randomly distributed (60.37%) whereas some showed clumped distribution (39.62%).

Key Words: *Diversity, Climbing Plants, Littoral, North Andaman*

INTRODUCTION
Climbers occur in all woody ecosystem of the world although a high abundance is considered to be characteristic of tropical and subtropical forests (Bongers *et al.*, 2005). Specifically in tropical rain forest, they comprise about 25-30% of species diversity (Schnitzer and Bongers, 2002). Climbers play important ecological roles in the forest ecosystem dynamics and functioning (Nabe-Nielsen, 2001; Bongers *et al.*, 2002) they contribute substantially to canopy closure after tree fall and help stabilize the microclimate underneath (Schnitzer and Bongers, 2002).
In spite of the numerous roles climbers play in ecosystems, little attention has been given to them they are scanty treated in literature (Bongers *et al.*, 2005) almost all work on forest plant communities have over relied heavily on tree (Turner *et al.*, 1996) probably due to commercial value of many trees among other reasons (Bongers *et al.*, 2005). A few quantitative ecological studies on lianas are available from the forests of Sarawak (Proctor *et al.*, 1983; Putz and Chai, 1987), Sabah, East Ma-laysia (Campbell and Newbery, 1993), Queensland, Australia (Hegarty, 1989, 1990), Hunter Valley, New South Wales (Chalmers and Turner, 1994), Knysna, South Africa (Balfour and Bond, 1993), Itu-ri, Congo (Makana *et al.*, 1998), Costa Rica (Lie-berman *et al.*, 1996), Barro Colorado island, Pa-nama (Putz, 1984) and in the subtropical humid forest of Bolivia (Pinard *et al.*, 1999). Such studies are lacking from Indian forests, except for the two recent works in the forest of Anamalais, Western Ghats (Muthuramkumar and Parthasarathy, 2000; Srinivas and Parthasarathy, 2000) and from the Ka-lrayan hills, Eastern Ghats (Kadavul and Partha-sarathy, 1999). North Andaman, a major group of islands, is rich in species diversity. But very little information exists on the ecological aspects of the littoral forest communities these Islands. The specific objectives of the present study was to determine the diversity and distribution of climbing plants in the littoral forest of North Andaman as a way of contributing to the understanding of the general floristic composition, abundance and diversity.

MATERIALS AND METHODS
The North Andaman is the northernmost island of the Andaman region and includes about 70 other smaller islands. It is located between 13°41′ N to 12°50′ N latitudes and 92°11′ E to 93°07′ E longitudes, covering an area of 1458 km^2, and is separated from the Middle Andaman by Austin Strait.

The phytosociological study in this region was carried out during the years 2001-2004, through nested quadrate sampling method. Twelve quadrate plots (32 x 32 m) were studied for recording ground covers (Mishra, 1966; Malhotra, 1973; Das and Lahiri, 1997; Rai *et al.,* 2011) (Figure 1). In each quadrate the climbing plants were enumerated and measured for girth (GBH >0.5 cm) at breast height. The collected voucher specimens were processed into mounted herbarium sheets following the conventional methodology (Jain and Rao, 1977) and were identified and deposited at CUH Herbarium.
Climbing mechanisms were also studied for each species and classified them based on observations in the field and reliable references (Putz, 1984). The collected field-data were analyzed for Species structure (frequency, density, abundance, basal area, importance value index (IVI), using the formula as suggested by Mishra (1966), Phillips (1959), Das and Lahiri (1997) and Ghosh (2006). The species diversity was determined using Shannon-Weiner's Index (1963).

RESULTS AND DISCUSSION

In this Littoral forest, a total of 53 species of climbers and lianas were recorded, of which 52 species are angiosperms, and one species is a Pteridophyte (Lygodium flexuosum). Within the angiosperms, 37 species are from the dicotyledons (24 genera, 15 families) and 15 species are from the monocotyledons (9 genera, 5 families). In such forest, 26 species (49.05%) are climbers and 27 species (50.94%) are lianas.
The most diverse families in terms of species richness were Papilionaceae (15.09%), Arecaceae (13.20%), Caesalpiniaceae, Menispermaceae and Vitaceae (7.54%) (The details of the determined phytosociological values are recorded in Table 1).
Within the 52 species, 20 species (37.73%) are hook climbers, 15 species (28.3%) are stem twiners, 9 (16.98%) tendril climbers, 5 (9.43%) root climbers, and 4 (7.54%) branch twiners (Figure 1).
It was found that Tylophora indica shows the highest frequency (100%) with density of 13.3333/hec. in the forest; followed by Cissus discolor and Thunbergia laurifolia (frequency: 66.66%, density: 11.6667/hec). In four species (Species Codes: 6, 23, 25, and 32) the frequency is low (16.66%) with density of 4.1666/hec.; followed by six species (Species Codes: 1, 9, 26, 27, 43 and 45) same frequency (16.66%), but bit lower density (2.5/hec.).
It is found that Bridelia cinnamomea has highest relative abundance (8.2791) with 16.16% frequency in the forest followed by Bridelia stipularis (rel. abund.- 3.9216, with frequency 16.16%); Calamus longisetus (rel. abund.- 3.7764, with frequency 25%); Lygodium flexuosum (rel. abund.- 3.0502, with frequency 16.16%); Tinospora cordifolia (rel. abund.- 2.9049, with frequency 25%) and Dalbergia candenatensis (rel. abund.-2.7597, with 50% frequency). Among the littoral species, minimum rel. abundance (0.8714) with 25% frequency has been found in two species Plecospermum andamanicum and Scindapsus officinalis (Figure 2).
Data on density-Rank relationship of species show that Bridelia cinnamomea and Dalbergia volubilis occupy first rank with maximum density 15.8333/hec, followed by Tylophora indica (13.3333/hec), Cissus repens, Thunbergia laurifolia (11.6666/hec), Calamus longisetus (10.8333/hec), Capparis floribunda, and Cissus discolor (10/hec) etc. The minimum density (1.6666/hec) is found in Diploclisia glaucescens, Tetrastigma lanceolarium, Ventilago madraspatana etc. Except Bridelia cinnamomea, and Dalbergia volubilis, other species show logarithmic pattern with regression value (R^2) =0.9843 (Figure 3).
From the plotting of mean and variance of species in the littoral forest it is evident that species having values ranging from 0.1667-1.5833 and 0.3333-14.0833 of mean and variance respectively, whereas those with the range from 0.0833-1.1667 and 0.0833-1.4773 of mean and variance respectively are generally random in distribution in the habitat.
Degree of freedom is 11. The species are aggregated in distribution show 0 to 0.024371 probabilities with chi square values ranging from 22 to 97.8421, whereas species of random distribution show probability of 0.027062 to 0.894982 with chi square values ranging from 5.6667 to 21.6667 (Figure 4).
Calamus andamanicus, shows the highest IVI (26.84), followed by Daemonorops manii (16.73), Daemonorops kurzianus (16.42), Dalbergia candenatensis (13.35), Calamus longisetus (12.17), Tylophora

indica (10.89). The minimum IVI (1.18) is found in Tetrastigma lanceolarium. Except Calamus andamanicus, other species show logarithmic pattern with regression value (R^2) =0.9416 (Figure 5).

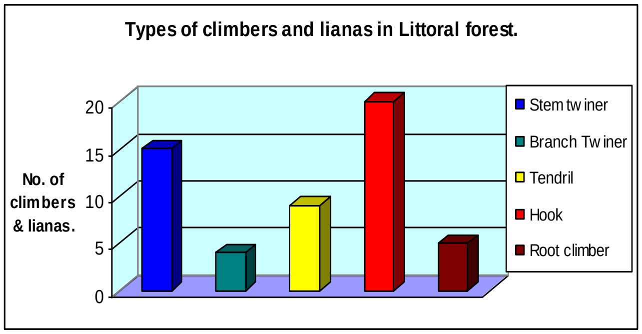

Figure 1: Types of climbers and lianas in Littoral forest

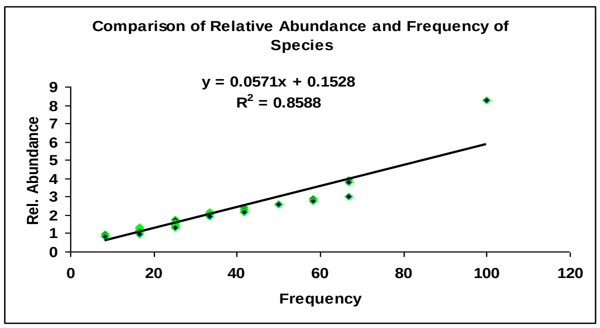

Figure 2: Comparison of Relative Abundance and frequency of Littoral forest

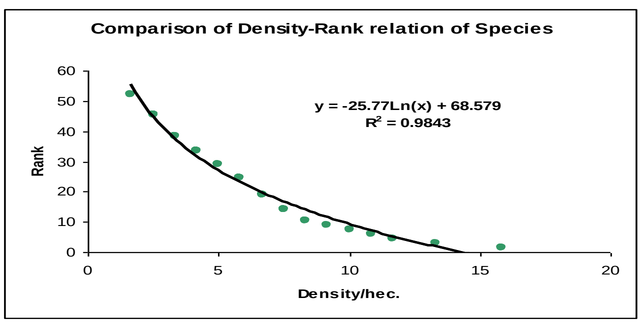

Figure 3: Comparison of density-rank relation of Littoral forest species

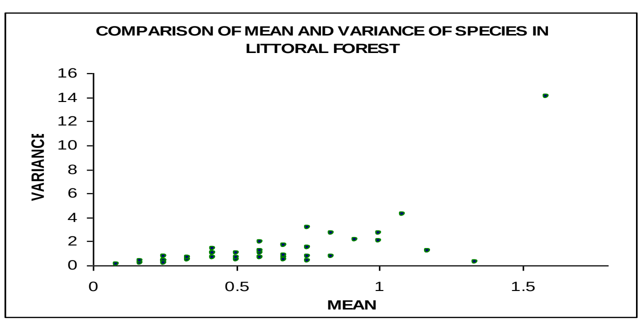

Figure 4: Comparison of mean and variance of Littoral forest species

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Table 1: Phytosociological analysis of the recorded species [F= Frequency, D= Density, RA = Relative Abundance, RD = Relative Density, RF = Relative Frequency, IVI = Importance Value Index, A/F= Abundance and frequency Ratio]

Sp. code	Species	Family	F	D	RA	RF	RD	Rel. Dom.	IVI	A/F Ratio
1	*Adenia cardiophylla* (Masters) Engler	Passifloraceae	16.67	25	1.30	1.04	0.8	0.01	1.83	9
2	*Adenia trilobata* (Roxb.) Engl.	Passifloraceae	25	58.33	2.03	1.55	1.86	0.01	3.42	9.33
3	*Ancistrocladus tectorius* (Lour.) Merr.	Ancistrocladaceae	50	66.67	1.16	3.11	2.12	0.88	6.10	2.66
4	*Bridelia cinnamomea* Hook.f	Euphorbiaceae	16.67	158.3	8.27	1.04	5.04	1.11	7.18	57
5	*Bridelia stipularis* (L.) Bl.	Euphorbiaceae	16.67	75	3.92	1.04	2.39	0.57	3.99	27
6	*Caesalpinia andamanica* (Prain) Hattink	Caesalpiniaceae	16.67	41.67	2.17	1.04	1.33	1.81	4.16	15
7	*Caesalpinia bonduc* (L.) Roxb.	Caesalpiniaceae	58.33	83.33	1.24	3.63	2.65	3.27	9.55	2.44
8	*Caesalpinia crista* L.	Caesalpiniaceae	25	33.33	1.16	1.55	1.06	1.55	4.16	5.33
9	*Caesalpinia enneaphylla* Roxb.	Caesalpiniaceae	16.67	25	1.30	1.04	0.8	0.61	2.44	9
10	*Calamus andamanicus* Kurz	Arecaceae	66.67	75	0.98	4.15	2.39	20.3	26.84	1.68
11	*Calamus longisetus* Griff.	Arecaceae	25	108.3	3.77	1.55	3.45	7.17	12.17	17.33
12	*Calamus palustris* Griff.	Arecaceae	25	50	1.74	1.55	1.59	3.52	6.66	8
13	*Calamus pseudorivalis* Becc.	Arecaceae	25	33.33	1.16	1.55	1.06	2.4	5.01	5.33
14	*Calamus viminalis* Willd.	Arecaceae	41.67	66.67	1.39	2.59	2.12	3.76	8.47	3.84
15	*Capparis floribunda* Wight	Cappariadaceae	41.67	100	2.09	2.59	3.18	0.03	5.80	5.76
16	*Cayratia japonica* (Thunb.) Gagnep.	Vitaceae	25	41.67	1.45	1.55	1.33	0.08	2.96	6.66
17	*Cissus discolor* Bl.	Vitaceae	66.67	116.7	1.52	4.15	3.71	0.25	8.10	2.62
18	*Cissus repens* Lam.	Vitaceae	33.33	100	2.61	2.07	3.18	0.22	5.47	9
19	*Cyclea peltata* (Lam.) Hook. f. & Thomson	Menispermaceae	33.33	58.33	1.52	2.07	1.86	0.02	3.94	5.25
20	*Daemonorops kurzianus* Becc	Arecaceae	50	75	1.30	3.11	2.39	10.9	16.43	3
21	*Daemonorops manii* Becc	Arecaceae	41.67	58.33	1.22	2.59	1.86	12.3	16.74	3.36
22	*Dalbergia candenatensis* (Dennst.) Prain	Papilionaceae	50	158.3	2.76	3.11	5.04	5.2	13.35	6.33
23	*Dalbergia confertiflora* Benth.	Papilionaceae	16.67	41.67	2.17	1.04	1.33	1.17	3.528	15
24	*Dalbergia junghuhnii* Benth.	Papilionaceae	41.67	50	1.04	2.59	1.59	1.53	5.71	2.88
25	*Dalbergia volubilis* Roxb.	Papilionaceae	16.67	41.67	2.17	1.04	1.33	0.09	2.44	15
26	*Derris andaminaca* Prain	Papilionaceae	16.67	25	1.30	1.04	0.8	0.79	2.61	9
27	*Derris elegans* Benth. f. andamanensis	Papilionaceae	16.67	25	1.30	1.04	0.8	1.03	2.86	9

28	*Dinochloa andamanica* Kurz	Poaceae	33.33	91.67	2.39	2.07	2.92	2.44	7.43	8.25
29	*Diploclisia glaucescens* (Bl.) Diels	Menispermaceae	16.67	16.67	0.87	1.04	0.53	0.1	1.67	6
30	*Dregea volubilis* (L. f.) Benth. ex Hook.	Asclepiadaceae	41.67	58.33	1.22	2.59	1.86	0.31	4.76	3.36
31	*Ficus fruticosa Roxb.*	Moraceae	25	66.67	2.32	1.55	2.12	3.93	7.61	10.67
32	*Ficus sarmentosa* Buchanan-Hamilton ex Smith	Moraceae	16.67	41.67	2.17	1.04	1.33	1.73	4.09	15
33	*Flagellaria indica* L.	Flagellariaceae	8.33	25	2.61	0.52	0.8	0.03	1.34	36
34	*Gouania leptostachya* DC.	Rhamnaceae	33.33	75	1.96	2.07	2.39	2.46	6.91	6.75
35	*Hoya parasitica* Wall. ex Wight	Asclepiadaceae	41.67	75	1.56	2.59	2.39	0.02	4.99	4.32
36	*Ipomoea obscura* (L.) Ker Gawler	Convolvulaceae	25	58.33	2.03	1.55	1.86	0.01	3.42	9.33
37	*Ipomoea pes-caprae* (L.) R. Brown	Convolvulaceae	33.33	50	1.30	2.07	1.59	0.01	3.67	4.5
38	*Ipomoea pes-tigridis* L.	Convolvulaceae	25	66.67	2.32	1.55	2.12	0.02	3.69	10.67
39	*Lygodium flexuosum (L.) Sw.*	Lygodiaceae	16.67	58.33	3.05	1.04	1.86	0.01	2.90	21
40	*Momordica charantia* L.	Cucurbitaceae	25	41.67	1.45	1.55	1.33	0.01	2.89	6.66
41	*Mucuna gigantea* (Willd.) DC.	Papilionaceae	8.33	25	2.61	0.52	0.8	1.01	2.31	36
42	*Mucuna monosperma* DC. ex Wight	Papilionaceae	16.67	33.33	1.74	1.04	1.06	1.38	3.47	12
43	*Paramignya andamanica* (King) Tan.	Rutaceae	16.67	25	1.30	1.04	0.8	1.04	2.87	9
44	*Plecospermum andamanicum* King	Moraceae	25	25	0.87	1.55	0.8	1.37	3.72	4
45	*Raphidophora pertusa* (Roxb.) Schott	Araceae	16.67	25	1.30	1.04	0.8	0.31	2.14	9
46	*Scindapsus officinalis* (Roxb.) Schott	Araceae	25	25	0.87	1.55	0.8	0.02	2.37	4
47	*Stephania japonica* (Thunb.) Miers	Menispermaceae	58.33	66.67	0.99	3.63	2.12	0.53	6.27	1.95
48	*Tetracera sarmentosa ssp. andamanica (Hoogl.) Hoohl.*	Dilleniaceae	16.67	33.33	1.74	1.04	1.06	0.51	2.61	12
49	*Tetrastigma lanceolarium* (Roxb.) Planchon in A. & C. DC.	Vitaceae	8.33	16.67	1.74	0.52	0.53	0.13	1.18	24
50	*Thunbergia laurifolia Lindley*	Thunbergiaceae	66.67	116.7	1.52	4.15	3.71	0.23	8.09	2.62
51	*Tinospora cordifolia* (Willd.) Hook.f. & Thomson	Menispermaceae	25	83.33	2.90	1.55	2.65	0.2	4.40	13.33
52	*Tylophora. indica* (Burm.f.) Merr.	Asclepiadaceae	100	133.3	1.16	6.22	4.24	0.43	10.8 9	1.33
53	*Ventilago madraspatana* Gaertn.	Rhamnaceae	8.33	16.67	1.74	0.52	0.53	1.15	2.19	24

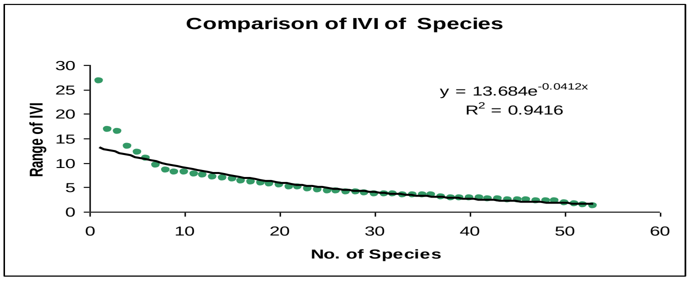

Figure 5: Comparison of IVI of littoral forest species

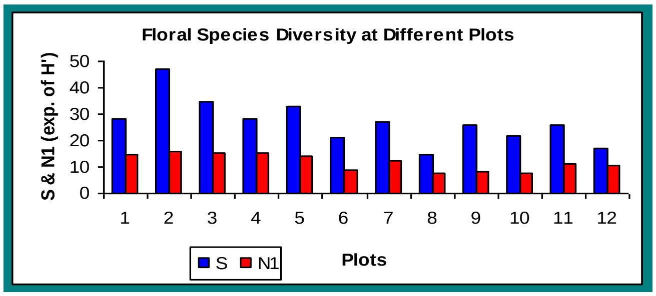

Figure 6: Comparison of species richness (S) and diversity (N1) of littoral forest plots

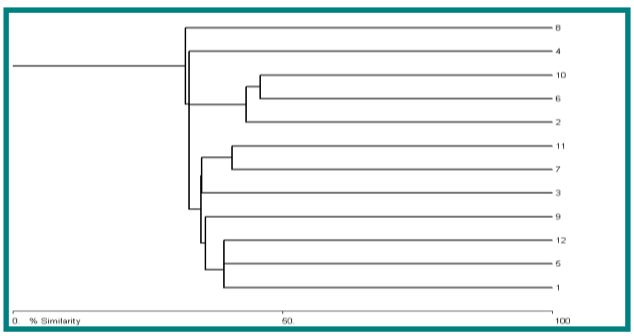

Figure 7: Dendogram of taxic similarity of littoral plots

In this vegetation, highest number of stems and species are found in the diameter classes of 5 cm to 6.99 cm. and 7- 8.99 cm. No stem has been recorded in 2-2.49 cm. and above 18 cm diameter classes; though number of stems and species are appreciably high in the diameter classes of 0.5-0.99 cm and 1.5-1.99 cm.
Shannon Wiener Index (H') showed that the plot numbers 2 and 3 show high species richness (S >_47), the diversity of these plots are relatively high (N1> 15.15) in comparison to plot number 1, 4 and 5, where species richness is high (S<28) but the diversity is relatively low (N1 >14.05). It is also found that the plot numbers 7, and 12 show high diversity (N1 <10.42), but their species richness is low (S <17). Plots like 6, 8, 9, 10, and 11 show more or less proportionate S and N1 values (Figure 6).
It has been observed that the plots 6th and 10th, situated in the Paget-Point Island with the highest taxonomic similarity (45.92593002) are similar to plot 2nd (43.25204468). Plots 7th and 11th are quite far from each other but they show relatively high similarity (40.68965912) and together with plots 1st, 5th, 12th are more or less similar in species composition with similarity 39.16667175. 3rd and 9th plots are in different locations separated by sea and show poor similarity. Plot 8th is entirely of different composition and is found as a separate cluster form the rest (Figure 7).

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