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Diversity and Composition of Woody Vegetation in a Riparian Forest of Western Ghats, Southern India

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ABSTRACT

The present study assessed the woody vegetation diversity and composition of the riparian forest of Athikadavu Valley, Western Ghats, India. Woody vegetation along the narrow strip of vegetation on river banks was quantified by using belt transect method. A total of 1039 individuals belonging to 34 families, 60 genera and 70 species were enumerated. Family Moraceae with eight species constituted the most predominant family followed by Fabaceae and Ebenaceae. Most dominant tree species based on Importance Value Index (IVI) included *Pongamia pinnata* (53.52%), *Terminalia arjuna* (42.90%) and *Mangifera indica* (38.31%). Shannon-Weiner diversity index of plant diversity of the study site worked out to be 2.96. A comparison of vegetation parameters of riparian forests from other parts of India was made. The need for enhanced protection of this unique habitat is suggested.

Keywords: Tree Species Diversity; Athikadavu Valley; Bhavani River; Nilgiri Biosphere Reserve

INTRODUCTION

Riparian forests that form a narrow strip of vegetation along river banks form the interface between aquatic and terrestrial ecosystems are recognized as "keystone ecosystem" (Goebel et al. 2003). Wildlife biologists recognize the riparian forests as a critically and functionally dominant component of a terrestrial landscape (Tabacchi et al. 1998). It forms a corridor for the movement of biota (Naiman and Décamps 1997) and serves many important roles for humans (Kemper 2001). They are affected by fluvial process such as flooding and deposition of alluvial soil and typically support a distinctive flora that differs in structure and function from adjacent terrestrial vegetation (Gregory et al. 1991, Tang and Montgomery 1995, Naiman and Décamps 1997). The riverine forests have been greatly exploited for meeting the increasing demand of the humans and are therefore, now considered to be among the most threatened ecosystem in the world (Richter et al. 1997, Malmqvist and Rundle 2002). Most of the world's riparian zones have been altered because of human activities including dam construction, small-scale supporting construction and channelling with artificial banks (Kim et al. 2012). The vegetation of the riverine forests serves as food for herbivores and functions as egg laying sites and a refuge of birds (Kim et al. 2012).

The riparian zones in India have suffered greatly and degraded in many parts owing to unplanned developmental activities which caused severe irreversible damage to the riparian ecosystems of many rivers (Dutta et al. 2011). Although documentation of riparian vegetation is very essential for biodiversity management, there are only a few detailed studies available from India (Bachan 2003, Joby 2012, Johnsingh and Joshua 1989, Iqbal 2012, Sunil et al. 2016). In this context, the present study was carried out in the Bhavani River, Tamil Nadu to assess the diversity and composition of woody vegetation.

Bhavani river, a tributary of river Cauvery

originates from upper Nilgiris, Western Ghats is second largest river in Tamil Nadu. The river flows through the states of Kerala and Tamil Nadu mostly traversing the forested areas covering a distance of 217 km before merging with the Cauvery at Erode Town in Tamil Nadu. The riparian zone of this river is characterized by the presence of semi-evergreen vegetation comprising tree species such as *Terminalia arjuna, Madhuca longifolia* and *Diospyros peregrina*. This important biodiversity rich area has been investigated by a few authors *viz* Varunprasath and Daniel (2010) assessed the water quality and physico-chemical parameters of Bhavani river, Balasubramanian et al. (2004) studied the nest tree use and fruit preferences of Malabar Pied Hornbill, (Rasingam 2012, Jaganathan et al. 2016) conducted ethnobotanical studies. There is lack of floristic and phytosociological studies of the river bank vegetation and therefore the present investigation was conducted.

STUDY AREA

The study was carried out in Athikadavu Valley (11°11'26" to 11°16'26" N and 76°43'49" to 76°50'25" E, Altitude 500 to 600 m), Melur slopes of Reserve Forests of Coimbatore Forest Division, southern Western Ghats, India. The study area comprised a 12 km stretch of riparian forest along Bhavani River from Sundapatti to Nellithurai (Figure 1). This Valley which is contiguous to Nilgiri south-eastern slopes forms an ecologically important region owing to the presence of pristine semi-evergreen forests alongside the Bhavani River. The narrow strip of riparian vegetation is distinct in its composition comprising tall trees such as *Terminalia arjuna* (Combretaceae), *Mangifera indica* (Anacardiaceae) and *Madhuca longifolia* (Sapotaceae) (Balasubramanian et al. 2004) offering various ecosystem services for wildlife. The semi evergreen forest on the river bank is bordered by the mixed dry deciduous forests predominated by short trees such as *Diospyros montana* (Ebenaceae), *Drypetes sepiaria* (Euphorbiaceae) and *Strychnos potatorum* (Loganiaceae) (Balasubramanian et al. 2004). It is known to harbour a large number of wildlife including Asian Elephant (*Elephas maximus* Linnaeus, 1758), Spotted Deer (*Axis axis* Erxleben, 1777), Sambar Deer (*Rusa unicolour* Kerr, 1792), Barking Deer (*Muntiacus muntjak* Zimmermann, 1780), Indian Guars (*Bos gaurus* C.H. Smith, 1827), Leopard (*Panthera pardus* Linnaeus, 1758), Common Langur (*Semnopithecus priam* Blyth,

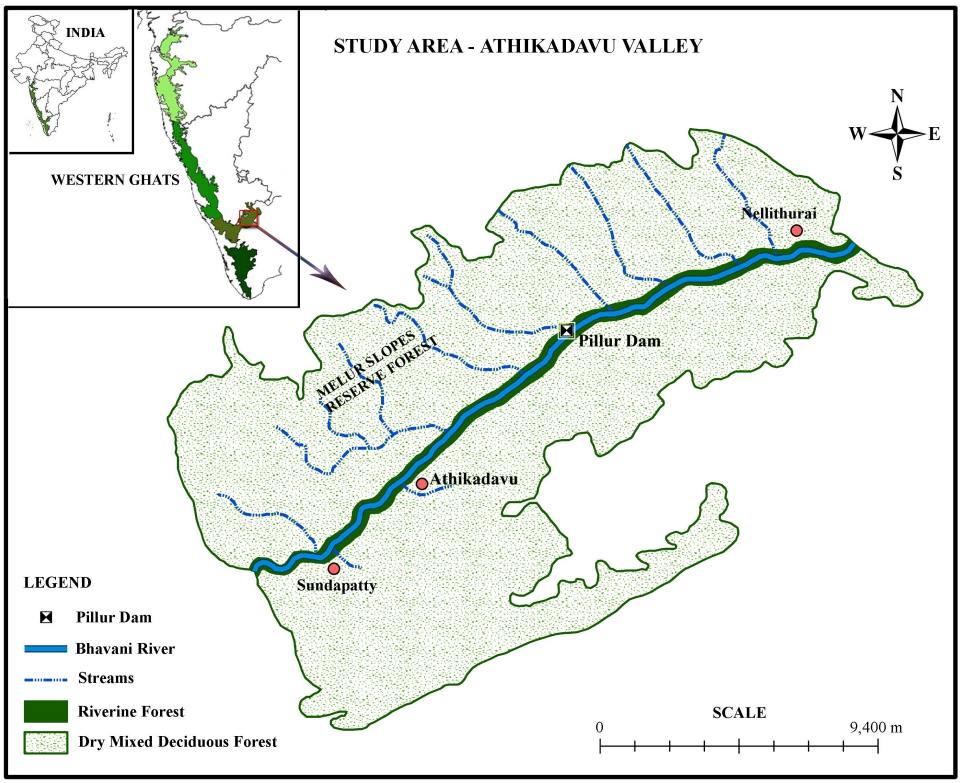

Figure 1. Map of the study area

1844), Nilgiri Langur (*Trachypithecus johnii* J.Fischer, 1829), Malabar Giant Squirrel (*Ratufa indica* Erxleben, 1777), Indian Otter (*Lutrogale perspicillata* Geoffroy St. Hillaire, 1826), Monitor Lizards (*Varanus bengalensis* Daudin, 1802), Indian Rock Python (*Python molurus* Kuhl, 1820) and avifauna (Manikandan and Balasubramanian 2016). Average annual rainfall of the study site is 556 mm and the average maximum temperature was 35.6ºC and minimum temperature 18.5ºC.

METHODS

Vegetation Sampling

Woody vegetation of the riverine forest was quantified by using belt-transect method. Sampling was done in two belt transects, each measuring 1 ha (1000x10m). The belt transect was divided into 10x10 m subplots and the trees measuring >20 cm gbh (girth at breast height). Tree species were identified using regional floras (Gamble and Fischer 1915-1936, Matthew 1991, Chandrabose and Nair 1987).

Data Analysis

The important quantitative analysis such as density, frequency and abundance of tree species were determined as per Curtis and McIntosh (1950). Density of a species is an expression of the numerical strength of a species where the total number of individuals of each species in all the quadrats is divided by the total number of quadrats studied. Frequency of a species refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage of occurrence. Abundance of a species is an expression of the numerical strength of a species where the total number of individuals of each species in all the quadrats is divided by the total number of quadrats in which the species occurred.

The role of individual species in the totality was quantified by estimating the Relative density, Relative frequency and Relative dominance. The total basal area was calculated from the sum of the total girth of woody stems. In trees and woody stems, the basal area was measured at breast height (1.3 m) and by using the formula πr^2. Importance value index is used to determine the overall importance of each species in the community structure. In calculating this index, the percentage values of the relative frequency, relative density and relative basal area are summed up together and this value is designated as the Importance Value Index or IVI of the species (Curtis 1959). Vascular plants form the dominant component of any forest ecosystem. Species diversity and dominance index are the important values of this assemblage to be determined. Family Importance Value (FIV) was calculated according to the formula of Mori et al. (1983), by the summation of relative diversity, relative density and relative basal area. The species diversity and dominance of the vascular plants was calculated by using the different indices.

Shannon's diversity index and Simpson's index of dominance were calculated using importance value index (IVI) of species. Shannon - Weaver (*H'*) index was used to calculate the species diversity of diversity (Shannon and Weaver 1963)

$$H' = -\Sigma\, p_i \ln p_i$$

Where, H' = Shannon index of diversity
p_i = the proportion of important value of the i^{th} species ($p_i = n_i / N$, n_i is the important value index of i^{th} species and N is the important value index of all the species).

To measure dominance and Simpson Index derived from probability theory used (Simpson 1949).

$$D = 1-\Sigma\, (p_i)^2$$

Where, D = Simpson index of dominance *p*i = the proportion of important value of the i^{th} species ($p_i = n_i / N$, n_i is the important value index of i^{th} species and N is the important value index of all the species).

As D increases, diversity decreases and Simpson's index was therefore usually expressed as 1 – D or 1/ D.

RESULTS

Woody Species Composition

In the riparian forests of Athikadavu valley, a total of 70 woody species belonging to 60 genera and 34 families were recorded (Table 1). It included 65 tree species, three liana and two shrubs. A total of 1039 individuals were recorded in the 2 ha sampling plots and the total basal area was 280.25 m^2. In the sample plots, highest number of individuals were recorded for *Pongamia pinnata* (n=280) followed by *Diospyros peregrina* (n= 151) and *Mangifera indica* (n= 80). The maximum value

Table 1. Ecological values of woody plants enumerated in the riverine forest

Name of the species	D	BA	RDe	RBA	RF	IVI
Pongamia pinnata (L.) Pierre	280	25.02	26.95	8.93	17.64	53.52
Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	65	83.2	6.26	29.69	6.96	42.90
Mangifera indica L.	80	58.63	7.70	20.92	9.69	38.31
Diospyros peregrina (Gaertn.) Gürke	151	20.68	14.53	7.38	13.66	35.58
Syzygium cumini (L.) Skeels	71	21.43	6.83	7.65	7.58	22.06
Madhuca longifolia (J.Koenig ex L.) J.F.Macbr.	42	21.69	4.04	7.74	4.84	16.63
Drypetes roxburghii (Wall.) Hurus.	25	3.11	2.41	1.11	2.86	6.37
Hopea ponga (Dennst.) Mabb.	17	2.93	1.64	1.05	1.74	4.42
Salix tetrasperma Roxb.	17	3.09	1.64	1.10	1.61	4.35
Calophyllum apetalum Willd.	12	3.35	1.15	1.20	1.49	3.84
Aglaia roxburghiana (Wight & Arn.) Miq.	16	0.72	1.54	0.26	1.86	3.66
Terminalia bellirica (Gaertn.) Roxb.	5	6.79	0.48	2.42	0.62	3.53
Ixora pavetta Andr.	15	0.44	1.44	0.16	1.74	3.34
Ficus drupacea Thunb.	6	5.54	0.58	1.98	0.75	3.30
Pleurostylia opposita (Wall.) Alston	13	1.3	1.25	0.46	1.49	3.21
Crateva magna (Lour.) DC.	12	0.87	1.15	0.31	1.12	2.58
Atalantia monophylla DC.	11	0.11	1.06	0.04	1.37	2.46
Ligustrum perrottetii A.DC.	10	0.41	0.96	0.15	1.24	2.35
Homonoia riparia Lour.	13	1.24	1.25	0.44	0.62	2.31
Memecylon edule Roxb.	9	0.78	0.87	0.28	0.99	2.14
Hydnocarpus pentandrus (Buch.-Ham.) Oken	8	1.34	0.77	0.48	0.87	2.12
Pterocarpus marsupium Roxb.	4	3.21	0.38	1.15	0.50	2.03
Strychnos nux-vomica L.	9	0.14	0.87	0.05	0.99	1.91
Olea dioica Roxb.	8	0.34	0.77	0.12	0.99	1.89
Manilkara hexandra (Roxb.) Dubard	7	0.95	0.67	0.34	0.87	1.88
Vitex altissima L.f.	7	0.89	0.67	0.32	0.87	1.86
Celtis philippinensis Blanco	7	0.15	0.67	0.05	0.87	1.60
Alseodaphne semecarpifolia Nees	6	0.71	0.58	0.25	0.62	1.45
Ficus macrocarpa L.f.	5	0.86	0.48	0.31	0.62	1.41
Shorea roxburghii G.Don	5	0.81	0.48	0.29	0.62	1.39
Mimusops elengi L.	5	0.68	0.48	0.24	0.62	1.34
Phyllanthus polyphyllus Willd.	6	0.03	0.58	0.01	0.75	1.33
Trewia polycarpa Benth.	6	0.35	0.58	0.12	0.62	1.32
Chionanthus mala-elengi (Dennst.) P.S.Green	6	0.25	0.58	0.09	0.62	1.29
Dalbergia latifolia Roxb.	5	0.83	0.48	0.30	0.50	1.27
Psydrax dicoccos Gaertn.	5	0.34	0.48	0.12	0.62	1.22
Alphonsea sclerocarpa Thwaites	5	0.30	0.48	0.11	0.62	1.21
Schleichera oleosa (Lour.) Merr.	5	0.53	0.48	0.19	0.50	1.17
Ficus amplissima Sm.	4	0.54	0.38	0.19	0.50	1.07
Nothopegia beddomei Gamble	4	0.13	0.38	0.05	0.50	0.93
Melia dubia Cav.	2	0.96	0.19	0.34	0.25	0.78
Diospyros ovalifolia Wight	3	0.23	0.29	0.08	0.37	0.74
Litsea deccanensis Gamble	3	0.13	0.29	0.05	0.37	0.71
Diospyros ferrea (Willd.) Bakh.	3	0.06	0.29	0.02	0.37	0.68
Garcinia gummi-gutta (L.) Roxb.	3	0.06	0.29	0.02	0.37	0.68
Ficus virens Aiton	3	0.02	0.29	0.01	0.37	0.67
Ficus racemosa L.	2	0.49	0.19	0.17	0.25	0.62
Stereospermum personatum (Hassk.) Chatterjee	2	0.41	0.19	0.15	0.25	0.59
Tamarindus indica L.	2	0.22	0.19	0.08	0.25	0.52
Albizia lebbeck (L.) Benth.	1	0.82	0.10	0.29	0.12	0.51
Gmelina arborea Roxb.	2	0.20	0.19	0.07	0.25	0.51

Name of the species	D	BA	RDe	RBA	RF	IVI
Erythrina stricta Roxb.	2	0.12	0.19	0.04	0.25	0.48
Ficus benghalensis L.	2	0.11	0.19	0.04	0.25	0.48
Ficus religiosa L.	1	0.74	0.10	0.26	0.12	0.48
Cassine glauca (Rottb.) Kuntze	2	0.04	0.19	0.01	0.25	0.46
Mallotus philippensis (Lam.) Müll.Arg.	2	0.06	0.19	0.02	0.25	0.46
Celtis tetrandra Roxb.	2	0.02	0.19	0.01	0.25	0.45
Streblus asper Lour.	2	0.02	0.19	0.01	0.25	0.45
Pleiospermium alatum (Wight & Arn.) Swingle	2	0.01	0.19	0.00	0.25	0.44
Albizia chinensis (Osbeck) Merr.	1	0.22	0.10	0.08	0.12	0.30
Gyrocarpus asiaticus Jacq.	1	0.16	0.10	0.06	0.12	0.28
Acacia polyacantha Willd.	1	0.13	0.10	0.05	0.12	0.27
Butea parviflora Roxb.	1	0.16	0.10	0.05	0.12	0.27
Sterculia guttata Roxb. ex G.Don	1	0.09	0.10	0.03	0.12	0.25
Hiptage benghalensis (L.) Kurz.	1	0.02	0.10	0.01	0.12	0.23
Premna tomentose Willd.	1	0.02	0.10	0.01	0.12	0.23
Anamirta cocculus (L.) Wight & Arn.	1	0.01	0.10	0.00	0.12	0.22
Ardisia solanacea (Poir.) Roxb.	1	0.005	0.10	0.00	0.12	0.22
Murraya paniculata (L.) Jack	1	0.003	0.10	0.00	0.12	0.22
Scleropyrum pentandrum (Dennst.) Mabb.	1	0.01	0.10	0.00	0.12	0.22

D = density, BA = Basal Area (m^2), RDe = relative density, RBA = relative basal area, IVI = Importance Value Index

for relative density, relative dominance, and relative frequency were recorded for *Pongamia pinnata* and the values were 26.95, 30.65 and 17.64 respectively. The dominant tree species included *Pongamia pinnata* (IVI-74.64) *Diospyros peregrina* (41.75) and *Mangifera indica* (41.16). The plant community of the riverine forests in Athikadavu valley can be described as *Pongamia pinnata -Diospyros peregrina - Mangifera indica* community (Table 1, Figure 2).

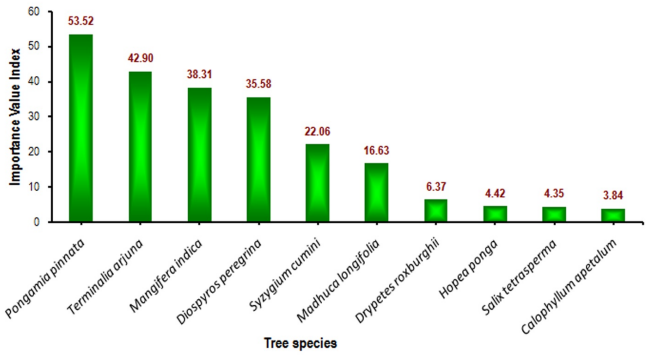

Figure 2. Top ten predominant tree species based on the IVI values in the riverine forests

Family Composition of Tree Species

Family Moraceae was represented by the highest number of species (n=8) followed by Euphorbiaceae and Fabaceae being represented by 5 species each. Sixteen families were represented by single species each. At the generic level, *Ficus* had the highest number of species (n=7). The most dominant families were Fabaceae, Ebenaceae and Anacardiaceae. In the riverine forest, Fabaceae was the most important family with FIV of 45.71. This elevated value resulted from the fact that many Fabaceae individuals were large statured. A greater proportion of relative density was Fabaceae (28.10 %) followed by Ebenaceae (15.11%) and Anacardiaceae (8.08%). The family Fabaceae had highest number of individuals of trees (292) in the riverine forest. The highest total basal area of Combretaceae (90 m^2) and lowest values (0.01 m^2) were exhibited by families such as Malpighiaceae, Menispermaceae and Santalaceae etc. (Table 2).

Species Diversity, Abundance and Basal Area

The lowest girth class harboured more species richness and abundance. But the highest girth class had comparatively less species richness and abundance. The basal area was low in the lowest girth class, very high in inter-

Table 2. Families with the highest importance values

Families	NG	NS	NI	BA	RDi	RDe	RBA	FIV
Fabaceae	5	5	292	29.3	7.14	28.10	10.47	45.71
Ebenaceae	1	3	157	21	4.29	15.11	7.48	26.88
Anacardiaceae	2	2	84	58.8	2.86	8.08	20.97	31.91
Myrtaceae	1	1	71	21.4	1.43	6.83	7.65	15.91
Combretaceae	1	2	70	90	2.86	6.74	32.11	41.71
Sapotaceae	3	3	54	23.3	4.29	5.20	8.32	17.80
Euphorbiaceae	5	5	52	4.79	7.14	5.00	1.71	13.86
Moraceae	2	8	25	8.32	11.43	2.41	2.97	16.80
Oleaceae	3	3	24	1	4.29	2.31	0.36	6.95
Dipterocarpaceae	2	2	22	3.74	2.86	2.12	1.33	6.31
Rubiaceae	2	2	20	0.78	2.86	1.92	0.28	5.06
Meliaceae	2	2	18	1.68	2.86	1.73	0.60	5.19
Salicaceae	1	1	17	3.09	1.43	1.64	1.10	4.17
Celastraceae	2	2	15	1.34	2.86	1.44	0.48	4.78
Clusiaceae	2	2	15	3.41	2.86	1.44	1.22	5.52
Rutaceae	3	3	14	0.12	4.29	1.35	0.04	5.68
Capparaceae	1	1	12	0.87	1.43	1.15	0.31	2.89
Verbenaceae	3	3	10	1.11	4.29	0.96	0.40	5.64
Lauraceae	2	2	9	0.84	2.86	0.87	0.30	4.02
Ulmaceae	1	2	9	0.17	2.86	0.87	0.06	3.78
Loganiaceae	1	1	9	0.14	1.43	0.87	0.05	2.34
Melastomataceae	1	1	9	0.78	1.43	0.87	0.28	2.57
Achariaceae	1	1	8	1.34	1.43	0.77	0.48	2.68
Annonaceae	1	1	5	0.3	1.43	0.48	0.11	2.02
Sapindaceae	1	1	5	0.53	1.43	0.48	0.19	2.10
Mimosaceae	2	3	3	1.17	4.29	0.29	0.42	4.99
Bignoniaceae	1	1	2	0.41	1.43	0.19	0.15	1.77
Caesalpiniaceae	1	1	2	0.22	1.43	0.19	0.08	1.70
Hernandiaceae	1	1	1	0.16	1.43	0.10	0.06	1.58
Malpighiaceae	1	1	1	0.02	1.43	0.10	0.01	1.53
Menispermaceae	1	1	1	0.01	1.43	0.10	0.00	1.53
Santalaceae	1	1	1	0.01	1.43	0.10	0.00	1.53
Solanaceae	1	1	1	0.01	1.43	0.10	0.00	1.53
Sterculiaceae	1	1	1	0.09	1.43	0.10	0.03	1.56

NG = number of genera; NS = number of species; NI = number of individuals; RDi = relative diversity; RDe = relative density; RBA = relative basal area; FIV = family importance value

mediate girth classes (101-200 and 401-500 cm) and normal in remaining girth classes (Figure 3). The girth class distribution of stems in riparian forests showed a reverse "J" shaped curve except riparian forest of stream indicating vegetation dominated by small individual stems.

Vegetation Parameters in the Riverine Forest

The vegetation features revealed that the species richness was 65 $ha^{-1,}$ species abundance 520 ha^{-1} and total basal area 280.25 m^2. Species diversity index values are Shannon-Wiener Index 2.96 and Simpson's Index 8.83. Several tribal settlements are located in the present study area. They mainly depend on forest and forest products such as honey, amla, queen sago, medicinal plants and other plant materials. Out of 70 woody species recorded in the riverine forests, 36 woody species was exploited by tribals for various purposes. It included fruits for dyeing, leaves for cattle feed, wood for house construction, support poles for fencing and fuel wood etc. Five plant species were heavily exploited, six species were

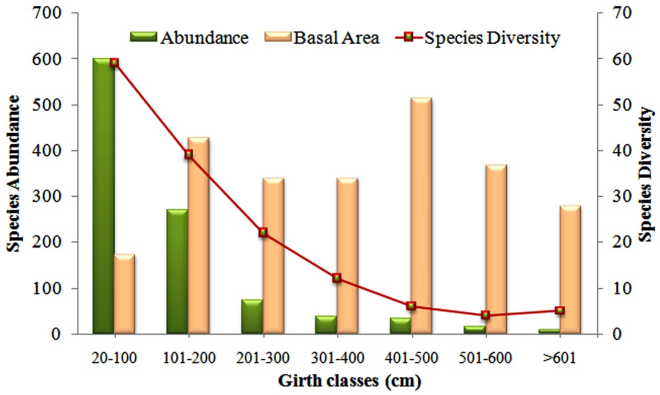

Figure 3. Girth classes distribution, species abundance and density

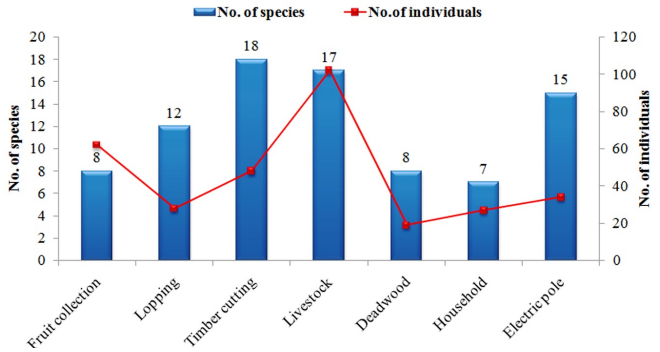

Figure 4. Various purpose of species utilisation by local people in riverine forests

moderately used and remaining species less exploited. Heavily exploited species included *Diospyros peregrina, Mangifera indica* and *Madhuca longifolia.* Among the different kinds of utilisations, cutting for timber (18 species and 48 individuals) and feed for livestock (17 species and 102 individuals) constituted more when compared to other utilisations (Figure 4). In addition, other anthropogenic activities such as livestock grazing and agriculture along the river banks were commonly noticed.

DISCUSSION

Riparian forests of Athikadavu Valley, Western Ghats harboured 70 woody species comprising 65 tree species. In a similar ecosystem in river Cauvery, Karnataka (Sunil et al. 2010) recorded 84 species exclusively in the riparian zone. Johnsingh and Joshua (1994) recorded 47 tree species in the riverine forests of Mundanthurai Plateau, Western Ghats, southern India. In the Pampa river, Western Ghats, Kerala, Joby (2012) recorded 79 tree species. In the Alakyam river, Kerala Manoj et al. (2012) recorded 63 tree species. Igbal et al. (2012) recorded 23 tree species in Khoh river, Himalayan region, India. In Sathyamangalam Wildlife Sanctuary, Eastern Ghats, Tamil Nadu (Balasubramanian et al. 2011) recorded 64 tree species in a riverine forest.

Tree species diversity recorded in the riverine forests of Athikadavu Valley is relatively less when compared with Chalakkudy river basin, (Bachan 2003) and Cauvery river basin (Sunil et al. 2010) and higher than the values recorded for Mini river, Vadodara, Gujarat (Shah et al. 2015) and Khoh river, Himalayas (Iqbal et al. 2012). The tree density of riverine forest in Athikadavu valley is found to be higher (519.5 ha^{-1}) than the Cauvery (118.6 ha^{-1}, Sunil et al. 2016) and in Khoh river (66 ha^{-1}). Basal area of trees in the riparian forest of Athikadavu valley was observed to be 140.12 m^2 ha^{-1} and it is very similar to that of Cauvery river 143.43 m^2 ha^{-1} (Sunil et al. 2016). However, Iqbal et al. (2012) reported higher values for the Khoh river of the Himalayas.

In Athikadavu Valley, Moraceae constituted the largest family with eight species followed by Fabaceae and Euphorbiaceae. Mimosaceae (6 species) constituted the largest family in Cauvary river basin (Sunil et al. 2016). Euphorbiaceae constituted largest family in Khoh river in the Himalayas (Iqbal et al. 2012). In Kerala, riparian forest of Pampa river was dominated by Fabaceae and Moraceae (Joby 2012). Family Euphorbiaceae (Manoj et al. 2012) was dominant in Alakyam river, Kerala. Leguminosae constituted the largest family (Jhonsingh and Joshua 1994) in the riparian forest of Tambiraparani. It is to be noted that plant families such as Moraceae, Euphorbiaceae, Leguminosae (Fabaceae, Caesalpiniaceae, Mimosaceae) constituted the dominant families in the riverine forest of India. The riparian vegetation of the study area is predominated by *Pongamia pinnata, Terminalia arjuna* and *Mangifera indica*. Similar composition was reported by Balasubramanian et al. (2011) in Sathyamangalam Wildlife Sanctuary, Southern India. In the Cauvery river, Karnataka, Sunil (2016) reported the predominant occurrence of *Terminalia arjuna* and *Pongamia pinnata.* In the Tamiraparani river of Mundanthurai Plateau *Hopea parviflora, Aglaia roxburghiana* and *Pongamia pinnata* predominance was recorded (Jhonsingh and Joshua 1994). In Kerala, dominant tree species of the riverine forest are *Humboldtia vahliana,* and *Neolamarckia cadamba* (Joby 2012) in Pampa river and *Hopea ponga* and *Hopea parviflora* (Manoj et al. 2012) in Alakyam riverine

forest. Majority of the riverine forests of southern India showed similar tree community composition. It is inferred that the predomi-nant tree species of riverine forests is *Pongamia pinnata, Terminalia arjuna, Mangifera indica* and *Diospyros peregrina* in the present study site. A close similarity of vegetation composition of riparian forest was observed in Tamiraparani (Jhonsingh and Joshua 1989), Chalakkudy river (Bachan 2003), Cauvery river (Sunil et al. 2010, 2016) and in a wild stream Sathyamangalam (Balasubramanian et al. 2011).

The species diversity (Shannon's) values of riverine forest in the present study (2.91) was more or less similar to the values reported by Jhonsingh and Joshua (1994) (2.92) in Tamiraparani river and Cauvery river basin (Sunil et al. 2016) in Karnataka. The Sathyamangalam Wildlife Sanctuary (Balasubramanian et al. 2011) presents a comparatively higher tree species diversity value (3.40).

The riparian vegetation of Athikadavu valley is disturbed by agricultural activities, grazing by cattle and goat, cultivation and timber and wood collection. Anthropogenic activities such as agriculture, livestock, grazing, mining, industrialization and urbanization have caused alteration and degradation of many riparian environments (Gurnell 1997, Merritt and Cooper 2000, Robertson and Rowling 2000). Consequences of different anthropogenic disturbances influence species diversity (Pickett and White 1985, Maarel van Der 1993, Biswas and Mallik 2010). Regular or frequent disturb-ance by livestock may result in abnormally small tree sizes along the riverine systems. This further retards regeneration of the trees, woody lianas and woody shrubs. Tiver and Andrew (1997) found that cattle were the most significant vertebrates affecting regeneration of woody species in Australia. In the present study goat and sheep were founding mainly feed on saplings of riparian species contributing to habitat degradation.

CONCLUSION

From the vegetation assessment of riverine forests at Athikadavu valley, Western Ghats it is inferred that it is an old-growth forest that harbour good diversity of indigenous trees. The woody vegetation not only provides shelter to birds and other wildlife but also food in the form of nectar, fruits etc. Hence, it is suggested to enhance the protection measures of this unique habitat against human disturbances.

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