Riparian Forest Vegetation - a Highly Endangered Wetland Plant Community: a Case study from Vazhachal, Chalakkudy River, Western Ghats

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Abstract

Structure and pattern of plant community richness in the riparian forests were studied in diverse and important lower (<300 m MSL) riparian zones of the Chalakkudy River. The vegetation were distributed to very low altitudes (50 MSL). Such low altitude riparian forest vegetation is a rare phenomenon in the entire Western Ghats. The analysis and comparison of the community structure of the riparian forests reveals that altered flow and availability of water mainly by damming has serious impact on the community composition of the riparian forest vegetation. The ecosystem analysis shows that the remaining highly rich zone is the Vazhachal area (200-250 MSL, 26.4ha) and is under threat of submergence by the proposed Athirappilly Hydroelectric Project. The Riparian forests in the upstream and downstream to this zone were found to be highly disturbed and alteration in the quantum and the flow of water by the construction of this dam will also affect the remaining vegetation in the downstream. The role of riparian forests in conservation of biodiversity is very significant. The richness of this river for its riparian forests may account for the richness in fish diversity.

Keywords: Riparian forests, Wetlands, Plant Communities, Niche, Diversity, Species richness, Biodiversity,

1. Introduction

Wetlands are lands transitional between terrestrial and aquatic habitat where the water table is usually at or near surface of the land and is covered by shallow waters (Cowardin *et al* 1979). Being a transitional zone between the aquatic and terrestrial habitats they have their own unique characteristics like hydric soil, floral and faunal composition, community structure, relationships etc. The riparian wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstance do support a prevalence of vegetation typically adapted for life in saturated soil conditions (James *et al* 1992).

Generally, the swamps, marshes and bogs of fresh or saline water influence, on valleys and plateaus of hills, large river deltas, coastal areas, and the riparian fringe forests along the river margins etc. are comes under this broad category. In the riparian forests, where trees are the dominant community have rather stability as a forest ecosystem. The variation in the environmental conditions provides a diversity of inhabitant, for both aquatic and terrestrial animal community (Pratt 1995). The coastal riparian forest includes mainly the mangroves. The flooded forest in the deltas of large

rivers is an another riparian forest group and is very rare in occurrence like Riparian flooded forest in the lower Mississippi river valley. The narrow riparian forests along margins of the rivers are the major category.

The unit characteristics of riparian system result from the spatial allocation and configuration. The plant communities in these systems are likely to be affected by both longitudinal (i.e up stream-down stream) (Vannote *et al* 1980) and transversal (i.e stream-floodplain or floodplain-basin) (Newbold *et al* 1981) linkages for species recruitment and species diversity (Tabacchi 1996). Riparian zones have been reported as some of the most species rich and most productive systems and they are also some of the most sensitivity to human influence and potentially threatened ecosystems (Malanson 1993, Bentrup *et al.* 2012).

The riparian canopy regulates stream temperature through shadowing and provides organic matter via litter fall, while root system stabilize bank and filter lateral sediment and nutrient inputs, there by controlling stream sediment and nutrient dynamics: (Naiman and Decamps 1997, Melfield and Naiman 2001). Submerged leaves surfaces are sites of primary and secondary production by micro algae and bacteria, which can rival that of phytoplankton and bactereophills in water column. The community serve as food for grazing invertebrates and protozoa, it contributes to bio-purification of organically polluted water coursers, and can be substantial source of planktonic microorganism (Goulber and Baker 1991). During low river stages the riparian forests act as a buffer between the upland and the river. Rainfall on the watershed is efficiently absorbed by the litter covered forest floor. Evaporation rates are high so that runoff through the forest is generally kept at minimum. Runoff from adjacent uplands flowing across the riparian forest is purified by removal of inorganic nutrients, eroded sediments, and other materials such as agricultural pesticides (James *et al* 1991).

Penzak (1995) explain the depletion of fish diversity by the removal of a 450m width of riparian vegetation and also indicate increase in the standing crop of existing species with the growth of riparian forest. Samways (1994) explain the need of at least 30m width of riparian vegetation along the river of South Africa at least for the conservation of dragon fly (*Chlrotestes tessalatus*) an indicator species.

Linkage between river and riparian ecosystems are not unidirectional fluvial disturbances such as flooding, erosion, and sediment deposition affect succession patterns as well as soil composition and nutrient

dynamics in riparian zones, which in turn affect the pattern of vegetation growth and species composition (Naiman and Decamps 1997).

Various factors found to be effect the existence of these riparian forests. The major causative elements were related with human activities like excessive water removal, catchment area destruction, damming of the rivers, changes in the riparian lands for agricultural, industrial and domestic purposes, mainly for monoculture and industrial plantation. In tropical regions, most of the significant ecological changes which have occurred in surface water have been accelerated with the damming of stream at rivers by human (Obeng, 1992). The flow of rivers has great influence on the riparian forests (Auble 1994). The altered flow affect the community composition of these forests is mainly induced by construction of dams (Johnson 1995). Forest fire also have major role in the damage of wetland communities. Crumpacker (1984) estimate that 70 – 90 % of the natural riparian ecosystems in the United State have been lost human activity.

Considering the climate and geography of Kerala (8^0 18^1 to 12^0 48^1 North latitude and 74^0 52^1 to 77^0 22^1 East longitude) in the South Western corner of India. Characterized by monsoon rainfall and the Western Ghats with its 44 rivers. There are no such large river deltas and the lower valleys were occupied by human settlements. The remaining riparian forests are mainly the small islets in the mountains and the narrow strip of riparian forest along the river margins. The mangrove vegetation is very less in Kerala unlike other southern states of India. India has 7% of the world mangrove vegetation, 6740 sq. km (Status report 1987).

1.1. Study area

The Chalakkudy River (10^0 10^1 and 10^1 33^1 N and 76^0 17^1 and 77^0 41^0 E) is the 5^{th} largest river in Kerala having a length of 144 km. It originates from the Anamala and Nelliyampathy ranges of Southern Western Ghats. The major tributaries the Sholayar, Parambikulam Aar, Karappara Aar and the Kuriarkutty Aar joins at Orukumbankutty and flow as the river Chalakkudy. The rivers have five large dams in its tributaries and another one after Orukumbankutty at Poringalkuthu. The remaining 70 km length of the river after Poringalkuthu dam is not having any large obstruction except a River Diversion Scheme at Thumboormuzhi to irrigate 14, 000 hector of land. The Chalakkudy River joins with another river Periyar at Elanthikkara just 6 km before they together ends in the Lakshadweep sea.

This 70 km length of river from Poringalkuthu (400 MSL) to Elanthikkara (sea level) is the area having more human impacts. This river is used for

domestic, industrial and agricultural purposes. 18 Panchayath and 12 Municipalities were depending this river mainly for drinking water (George 2000) when comparing with other rivers of Kerala it is having relics of riparian forest in the margins and now this river is found to be the richest in fish diversity perhaps in India (NBFGR, 2000). This 70 km area is found to be having comparatively good amount of riparian forest vegetation. 5 plots have been selected to analyse the floristic composition of the riparian vegetation and to analyse the dynamic of species composition and richness in relation with attitude, water availability and other physical interference.

2. Materials and Methods

A field survey has been carried out for the preliminary analysis of the remaining riparian forest. For the phytosociological analysis five plots with very less slope where identified and quadrats of 10x10 m width were laid. The minimum areas of the quadrates were identified by species area curve method. Phytosociological parameters like Relative Density, Relative Frequency, Relative abundance, Relative Basal Area and Important Value Index were calculated following the methods of (Misra 1969, Curtis and Mclntosh 1950, and Stromberg 1995). The Simpson's (1948) and Shannon – Wiener (1963) indices for richness and diversity were also calculated. Different life forms and number of seedlings per m^2 were also analysed separately for each plots. The plant components were identified and analysed by using floras of Gamble (1935), Sasidharan (1996), Pascal (1987) and Weaver and Clements (1973)

3. Results

From the preliminary field survey and analysis (Table 1) out of 70 km, 10.5 km area (64.5 ha) is found to posses > 10m width of riparian forest vegetation. This lies between 50 to 300 m elevations from the sea level. These areas also contain 15 small islets. The area having comparatively good natural riparian forest is only 7 km in length (58.5 ha). Out of this 26.4 ha area in the Vazhachal (200-250 MSL) represents the core area and it includes three large islets. Plots III and IV under study are in this area. The table II reveals the conditions of the different study plots. Plot I is found to be have less water flow due to the Poringalkuthu Dam and fire marks are also observed. Presence of animals associations like Otters, Elephants etc were observed in the plots II, III, and IV. Human interference were high in the plot V. Ecosystem analysis (Table III) shows that plot III and then IV having high values in species richness, basal area, seedling count and Important Value Index and Plot I is having least value for these parameters. Deciduous and weed plant elements were high in plot I and then in plot V.

Table .I

Preliminary analysis

	Length in (Km)	**Area (ha)**	**Number. Of islets**	**Area of islets(ha)**	**Total area (ha)**
Area having >10m Riparian Forest	10.5	21	15	43.5	64.5
Area having continuous stretch of Riparian forest *	7	14	3	19.5	26.4
Area having comparatively rich vegetation	7	14	15	43.5	58.5

* This area is the Plot III and IV at Vazhachal (200 MSL)

Table .II

Plot	**Altitude (MSL)**	**Terrain**	**Place**	**Water**	**Interferences**	**Animal associations**
PL-I	300	River side	Below Poringal dam, before Power house	Water very less	Fire	na
PL-II	250	Rocky river outcrop	After Powerhouse	normal	na	otter
PL-III	200	Islets	Submergible area of Proposed dam	normal	na	otter, elephant, Giant squirrel
PL-IV	200	Riverside	Submergible area of Proposed dam	normal	na	otter, elephant, Giant squirrel
PL-V	60	Islets	Downstream	normal	Cutting,	na

Table .III-Comparison of Plots

Plot	Species richness	No of seedlings/ m2	Basal Area (cm)	Basal Area of Evergreen	Basal Area of Deciduous	IVI of Evergreen	IVI of Deciduous
PL-I	21	3	1941	601	1340	166.87	133.13
PL-II	17	9	4770	4470	300	270.21	29.79
PL-III	28	62	5909	5444	465	285.66	14.33
PL-IV	36	76	3961	3801	160	283.84	16.16
PL-V	17	21	2784	2248	536	219.83	61.79

Fig – 1

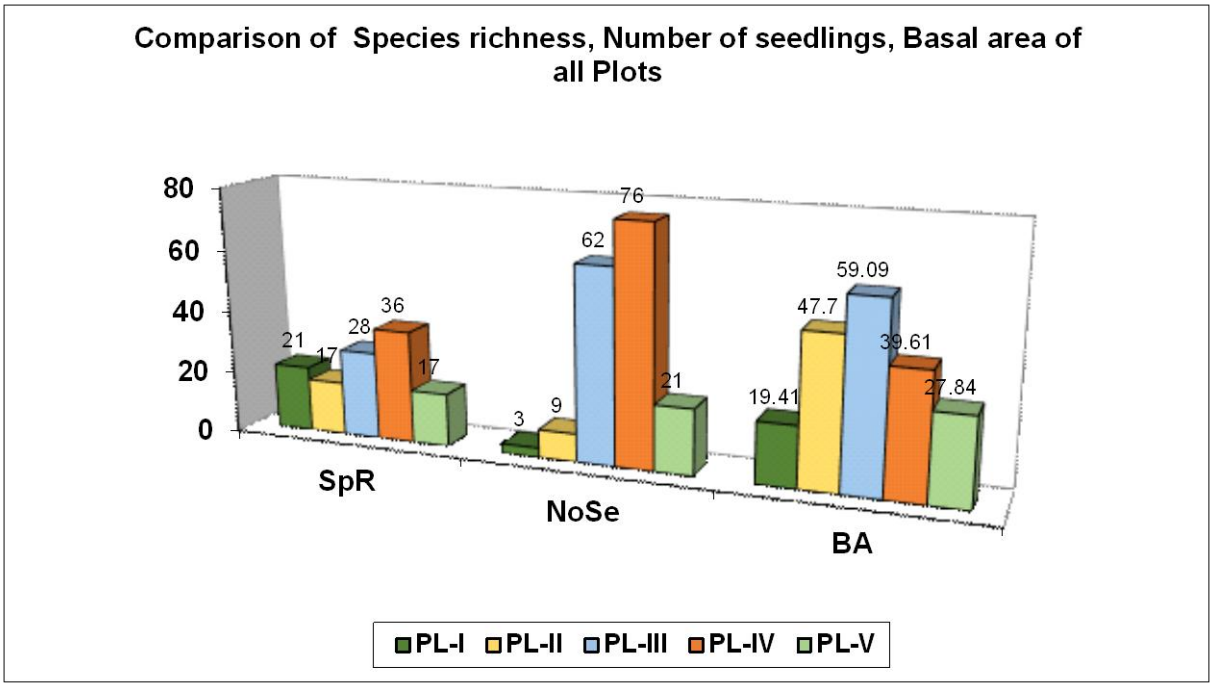


Fig-2

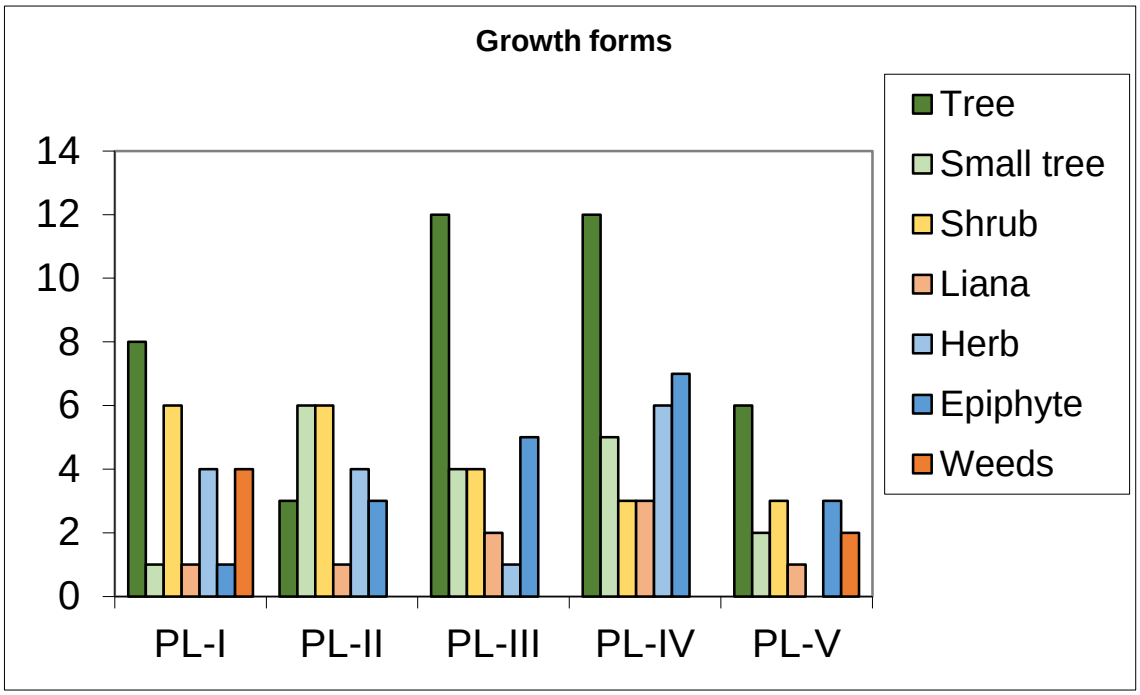
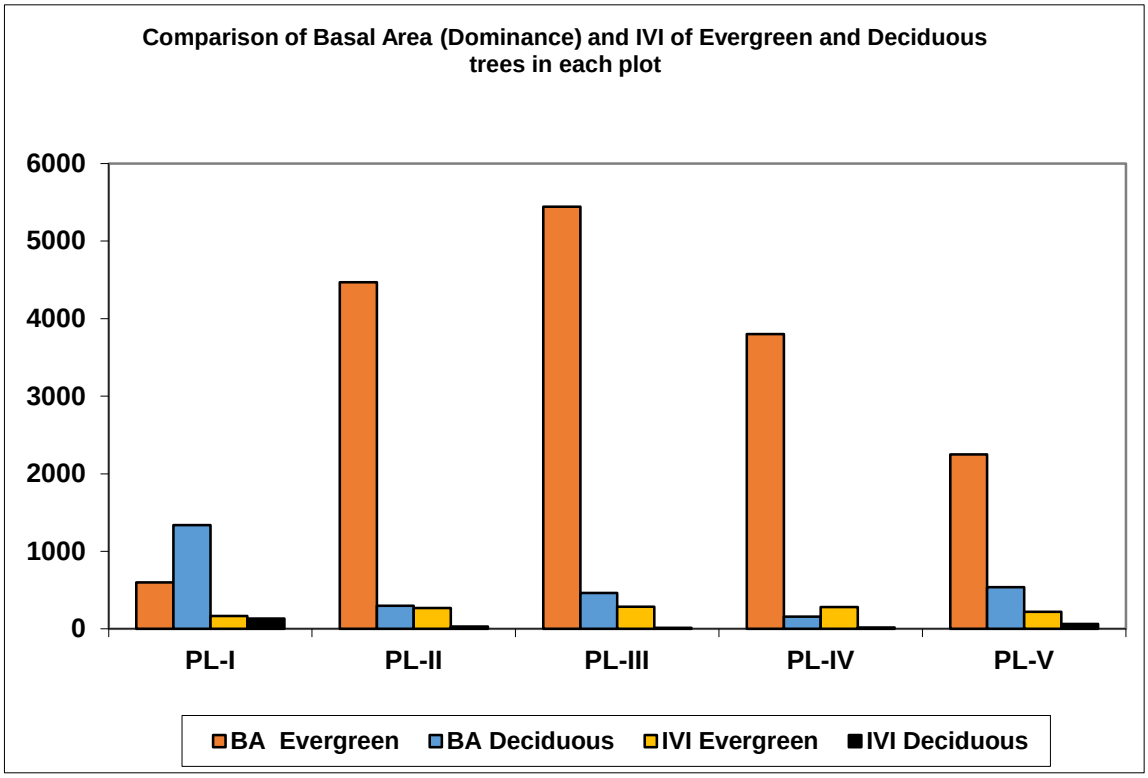

Growth forms
Tree
Small tree
Shrub
Liana
Herb
Epiphyte
Weeds
14
12
10
8
6
4
2
0
PL-I
PL-II
PL-III
PL-IV
PL-V

Fig – 3


Comparison of Basal Area (Dominance) and IVI of Evergreen and Deciduous trees in each plot
6000
5000
4000
3000
2000
1000
0
PL-I
PL-II
PL-III
PL-IV
PL-V
BA Evergreen
BA Deciduous
IVI Evergreen
IVI Deciduous

4. Discussions and Conclusion

4.1 *Components of the vegetation and its dynamics*

The riparian forest vegetation in the study area is mainly located in the Vazhachal area (200-250m MSL). This area of the river represents the highly rich study plots III and IV and is can be regarded as core area. The islets in this area are very rich and islets in the down streams have good amount of riparian forest elements. The analysis reveals the presence of evergreen and semi evergreen forest components throughout the study area (300-50m MSL). The less value in the diversity, richness, and Important Value Index and presence of more deciduous and weed elements and the forest fire in the plot I reveals the impact of altered flow and availability of water by the construction of dam.

4.2 *Importance of vegetation*

The riparian forests have great influence on the water quality and temperature, influence the riparian environment and have great influence on the aquatic and terrestrial organisms. Presence of this riparian forest may account for the richest fish diversity of this river perhaps in India (NBFGR 2000). The studies of Naiman *et al* (1997) and Penzak (1995) supports this aspects. 24 endemic plants of the Western Ghats, 10 rare and endangered plant species, and the occurrence of *Pothos crassipendunculatus* Sivadasan *et al* a new distributional record which is hitherto known only from Agasthiamala region etc recorded recently from this core area. They also recorded 215 species of birds and animals which include many rare and endangered mammals like the Lion Tailed Macaque, Asiatic Elephant, Nilgiri langur, the mouse deer, aves such as Great Indian hornbill, reptiles like monitor lizard and butterflies such as Sothern birdwing, Budha peacock etc. The presence of animal like Otter in the study plots indicates the richness of this vegetation. This natural riparian forest area acts as a buffer zone for the forests in the downstream through recruitment of seeds and nutrients. Tabacchi (1995) stress on the importance of riparian systems for maintaining the conservation of local and regional species pools.

4.3 *Uniqueness of this area*

Such low attitude riparian forest vegetation is very rare occurrence in the entire Western Ghats (Fig IV.). The presence of such riparian forest vegetation, its complexity, diversity and richness for both floral and faunal elements, presence of evergreen plant components and similarity in the structure, its distribution upto such a low altitude (50m MSL), its relation to the fish diversity and the fact that this area represents the major portion of the remaining riparian forest vegetation in

this river perhaps in all rivers of Kerala etc account for the uniqueness of this riparian forest area. The particular niche characteristics, richness in biodiversity and productivity, very rare and endangered status, in the world reveals the importance of this wetland forest community.

4.4 ***Threats***

The major threats for this riparian forest are the human interference, felling of trees, forest fire and the altered flow and quantum of water by construction of dams. The disturbed state of the plot I just after the Poringalkuthu Dam indicate this impact. Auble (1994) and Johnsons (1992), Ramachandra *et al*. 2016 reveals the impact of altered flow induced by dams on the riparian forest components. The area that found as the core area in the Vazhachal is going to submerge by the construction of Athirappilly Hydro electric project EIA (1991). According to this 28.4 ha of riparian forest will be submerged by the construction of the dam. The best remaining forest area (26.4 ha) comes under this zone and is under threat. The remaining riparian forest in the down stream will also be affected by the alteration in the river flow through the construction of this dam. Considering the importance, uniqueness of this highly endangered wetland forest; conservation of the remaining areas has great value.

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