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Article *in* Landscape Research · January 2019

DOI: 10.1080/01426397.2018.1560400

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Landscape Research

ISSN: 0142-6397 (Print) 1469-9710 (Online) Journal homepage: http://www.tandfonline.com/loi/clar20

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LANDSCAPE RESEARCH
https://doi.org/10.1080/01426397.2018.1560400

Influence of *Terminalia arjuna* on the riparian landscapes of the River Cauvery of South India

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ABSTRACT

Mature and large isolated trees act as keystone structures in various ecosystems by supporting the populations of dependent organisms. *Terminalia arjuna* is one such species that is dominant in the riparian landscapes along the River Cauvery in Cauvery Wildlife Sanctuary. We tested the hypothesis that *T. arjuna* influences plant community composition in riparian landscapes and supports a distinct local riparian community. We showed plant species richness, diversity, similarity in community composition, and soil quality varied between riparian landscapes under canopy of *T. arjuna* and areas devoid of *T. arjuna*. Higher species richness, diversity, dominance, and evenness were noted in areas under canopy of *T. arjuna*. The non-metric multi-dimensional scaling ordination space analysis identifies the native riparian species assemblages in areas under canopy of *T. arjuna* with improved soil nutrient conditions. Overall, the study concludes *T. arjuna* has potential positive effects on riparian landscapes by showing the remarkable differences in biological diversity and it can be considered as keystone species in riparian ecosystems of South India.

KEYWORDS
Ecosystem engineer; resource provider; native riparian vegetation; species assemblage; biodiversity; soil nutrient

Introduction

Mature and large isolated trees act as keystone structures in various ecosystems (Paltto, Thomasson, & Norden, 2010; Zuzana & David, 2002). These mature trees are biologically significant and distinct from younger second-growth forests (Hall & Bunce, 2011) by supporting the populations of dependent organisms for longer time periods (Paltto et al., 2010). They may act as 'nurse trees' for other dependent plant species for seedling establishment (Belsky et al., 1989; Dean, Milton, & Jeltsch, 1999) by reducing extremes of environmental temperatures, providing photosynthetically active radiation (PAR) to understorey plants, and enhancing soil fertility (Zuzana & David, 2002). Some large, mature species with typical structural attributes modify the physical environment in ways that release resources for other species (Jones, Lawton, & Shachak, 1994). This alteration provides habitats that would not otherwise be available to many organisms often by means of disturbance to the physical habitat (Jones et al., 1994) and such species are referred to as 'keystone' organisms in an ecosystem (Keblawy, 2012; Munzbergova & Ward, 2002; Tripathi & Law, 2006).

Riparian ecosystems generally support a higher diversity of plants than the surrounding hillslopes and they are critical habitats for many native plant species (Lovett & Price, 2007). Certain plant species in the riparian ecosystem play a unique role in their locality modifying their own habitat to have a significant control on nutrient and energy flows within riparian corridors (Corenblit, Steiger, Gurnell, & Naiman, 2009). Thus, they act as niche constructors by supporting the growth of other plant species in their survival within the territory (Van Pelt, O'Keefe, Latterell, & Naiman, 2006).

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Removal of such supportive species may cause major changes and influence the overall riparian community (Terborgh, Pitman, Silman, Schicheter, & Nunez, 2002).

Terminalia arjuna (Roxb. ex DC.) Wight & Arn. is a tree species that dominates riparian landscapes along the River Cauvery in Cauvery Wildlife Sanctuary (CWS) (Sunil, Somashekar, & Nagaraja, 2011). The species is considered as 'near threatened' (Nandagopalan, Gritto, & Aslam., 2012; Subbaiyan, Samydurai, Karthik Prabu, Ramakrishnan, & Thangapandian, 2014; Ved et al., 2016) and occurs naturally along banks of streams and rivers and seasonally in dry water courses at low elevations. The species is a characteristic component of dry tropical riverine forests and tropical moist and dry deciduous forests. It grows well on fertile, neutral (pH 6.5–7.0) soils, especially loose, moist, alluvial loam with good water supply, and drainage (Orwa, Mutua, Kindt, Jamnadass, & Simons, 2009). Large mature individuals (Girth at Breast Height 5 ± 1 m) constitute a distinguishing feature of the riparian landscape, and are characterised by buttressed interlocking root systems and spreading canopy at a height of up to 30–40 ± 5 m height. The surrounding forest type varies from dry deciduous to scrub type in the CWS (Champion & Seth, 1968). Though immense anthropogenic disturbances prevailed along the riparian landscapes of CWS (Sunil et al., 2011), a thick canopy of *T. arjuna* is seen in some of the areas which are still intact.

The wide canopy of *T. arjuna* provides nesting and roosting sites for avifauna and mammals in the sanctuary (Sunil, 2013). Kanoje (2008) in Sitanadi Wildlife Sanctuary also noted the nesting of Indian giant squirrel (*Ratufa indica*) in *T. arjuna* along with *T. tomentosa, S. oleosa*, *and S. cumini*. Being a dominant tree species, a large proportion of this species along the riparian belt of CWS is in the size class category of >180 cm GBH. Since they constitute a major dominant ecological feature in the riparian landscapes and there are few studies documenting their importance in the Cauvery riparian ecosystems, this study was undertaken to test the hypothesis that *T. arjuna* influences the plant community composition in the riparian landscapes through improved soil quality.

Study area

The study was conducted in CWS located in Chamarajanagar district of Karnataka state in India. It occupies an area of 526.96 km^2. River Cauvery originating in the Western Ghats at Talakaveri (12°25 N, 75°34 E) in Kodagu district of Karnataka flows through the CWS and Tamil Nadu before it drains into the Bay of Bengal. The forest types are largely dry deciduous, scrub type, and some semi evergreen species along river banks (Champion & Seth, 1968; Manjunath, 2001). The dominant tree species are *Terminalia arjuna. Tamarindus indica, Pongamia pinnata, Diospyros melanoxylon*, and *Syzygium cumini* (Shenoy, Surendra, & Devi Prasad, 2006; Sunil, Somashekar, & Nagaraja, 2010; Sunil et al., 2011).

Methods

To compare the plant communities under *T. arjuna* and in other areas devoid of *T. arjuna*, belt transects of 100 × 50 m were laid randomly in both the areas at 5 km intervals. Five belt transects were laid parallel to the river in areas under *T. arjuna* and five in other areas devoid of *T. arjuna*. In each belt transect, five quadrats of 20 × 20 m were laid (four at the peripheral ends of transect and one located at centre) to ascertain the abundance of trees and shrub species (>10 cm diameter at breast height). The Importance Value Index (IVI) (Curtis & McIntosh, 1951) was calculated to describe the pattern of vegetation series in *T. arjuna*-dominated sites and other areas devoid of *T. arjuna.*

Data analysis

Biodiversity Pro software Ver. 2 (McAleece, Lambshead, & Paterson et al., 1996) was used for Bray–Curtis similarity group-average clustering to quantify the similarity between the two areas. The value of Bray–Curtis similarity index varies between 0% and 100%, where 100 means the two sites have the same composition (that is, they share same species), and 0 means the two sites do not share any common species.

To compare the species diversity for two different riparian areas, we used the Shannon–Weiner Index (*H*) (Shannon & Weiner, 1963).

$$Diversity\ Index\ H' = -\Sigma^{S}{}_{i=1} pi\ \ln\ pi$$

where $P_i = n_i/N$ (n_i = number of individuals of a species, N = total number of individuals of all species).

To measure dominance (*D*), Simpson index (Simpson, 1949) was used.

$$D = 1 - \sum^{(P_i)^2}$$

where $Pi = ni/N$ (N = total number of individuals of a species, ni = number of individuals of species).

Evenness index was calculated as:

$$E = H'/H_{max}$$

where $H_{max} = \log_2 S$, S = number of species in the community.

A two-tailed t test (XL stat software) was used to compare the mean values for Shannon's, Simpson's, and Evenness indices for each sampling plot of the areas under *T. arjuna* and in areas devoid of *T. arjuna*.

Non-metric multi-dimensional scaling (NMDS) was used to examine the species grouping based on the similarity indices by using the software package, PAST (Palaeontological Statistics, ver. 1.34, http://folk.uio.no/ohammer/past).

Soil sampling

Soil samples were collected from areas dominated by *T. arjuna* and in areas devoid of *T. arjuna*. Before collecting the samples, litter was scraped and soil samples were collected from 15 cm depth. From each transect, soil samples were collected from five quadrats chosen to ascertain the abundance of trees and shrub species and bulked into one composite sample. All the samples were pooled to represent each study population by following 'quartering technique' (Jackson, 1973). About 200 g of fine dry soil (that passed through sieve of mesh size 0.5 mm) was stored in air-tight polythene bag until laboratory analysis. Soil samples were analysed for pH, Electrical Conductivity, Soil Moisture, and Organic Carbon (OC) (Table 1).

Results

Of the total 70 species recorded in the study, 44 species occurred in the area under the canopy of *T. arjuna* and 26 were found in areas devoid of *T. arjuna*. Also, 26 (38.5%) species such as *Ailanthus excelsa, Lagerstroemia lanceolata, Macaranga peltata, Madhuca latifolia, Madhuca neerifolia*, and *Mitragyna parviflora* and 9 (13%) species such as *Acacia ferruginea, Anogiessus latifolia,*

Table 1. Methodology for soil analysis

Sl.No	Soil chemical properties	Unit	Methods adopted	Reference
1	pH	pH	Digital pH meter	Jackson (1973)
2	Electrical conductivity	(µs/cm)	Conductometry	Jackson (1973)
3	Organic carbon	(%)	Wet digestion	Walkley and Black. (1934)
4	Soil moisture	(%)	Gravimetric method	Black (1965)

Canthium parviflora, Commiphora caudata, Premna tomentosa, and *Radermachera xylocarpa* were exclusive to area under canopy of *T. arjuna* and area devoid of *T. arjuna*, respectively. Among 44 species that appeared under the canopy of *T. arjuna*, dominant species are *T. arjuna, Pongamia pinnata, Tamarindus indica, Syzygium sumini, Madhuca latifolia, Ixora bracheata, Syzygium jambose*, and *Diospyros melanoxylon*. In areas devoid of *T. arjuna*, species *Chloroxyon swietenia, Anogiessus latifolia, Acacia feruginea, Acacia catechu, Hardwickia binata, Tamarindus indica*, and *Strychnos colubrina* were found.

The Shannon–Weiner diversity index values were higher in the area under canopy of *T. arjuna* (2.5) than in the area devoid of *T. arjuna* (1.6) (Table 2). Simpson index confirmed higher values again in the area under the canopy of *T. arjuna*. The '*t*' test revealed a significant difference between the two areas for Shannon–Weiner diversity index and Simpson index. The similarity index for the species between the two areas was calculated to be around 21.4% (Figure 1).

The IVI for *T. arjuna* is 87.3 confirming its dominance (Figure 2). The other species with high importance value in the *T. arjuna*-dominated sites are *Pongamia pinnata* (24.3), *Tamarindus indica* (22.9), *Syzygium cumini* (13.8), and *Madhuca latifolia* (16.1). In the area devoid of *T. arjuna, Chloroxylon swietenia* recorded highest importance value (64.5) followed by *Anogiessus latifolia* (46.9), *Hardwickia binata* (22.4), and *Acacia catecheu* (21.2) (Figure 3).

The NMDS ordination for the sampling sites (Figure 4(a)) reflects the formation of two separate groups in the study area. Areas coming under the canopy of *T. arjuna* areas (X6, X7, X8, X9, and X10) are found associated more closely. The ordination pattern for species association (Figure 4(b)) showed a separation of the species *Acacia catechu* (Ac), *Acacia nilotica* (Ac.nil), *Zizyphus sp, Canthuim dicoccum* (Can.di), *Acacia polygnatha* (Ac.poly), *Hardwickia binata* (Har.bin), *Melia dubia* (Mel.dub), *Wrightia tinctoria* (Wri. Tin), *Acacia leucoplea* (Ac.leu), and *Chloroxylon swietenia* (Chlo.sw) from the species *T. arjuna*. The distinct group of plant communities which includes species *Mitragyna parviflora* (Mit.par), *Madhuca latifolia* (Mad.lat), *Syzygium jambose* (Sy.cum), *Vitex altissima* (Vit.alt), *Ixora bracheata* (Ixo.bra), *Syzygium cumini, Diospyros melanoxylon* (Dio.mel), *Tamarindus indica* (Ta.indi), *Erythroxylum monogynum* (Ery.mono), and *Pongamia pinnata* (Pon.pin) observed in Figure 4(b) shows their affinity as an association towards the species *T. arjuna*.

Area devoid of *T. arjuna* in the riparian zone has slightly alkaline nature of soil (Figure 5). However, the areas under canopy of *T. arjuna* revealed neutral condition. The organic carbon and moisture content in the area devoid of *T. arjuna* are less than the area under canopy of *T. arjuna*. The '*t*' test revealed a significant difference between the two areas for soil moisture and organic carbon content (Table 3). There were no significant differences ($p > 0.05$) in soil salinity between the areas devoid of *T. arjuna* and area under canopy of *T. arjuna*.

Table 2. Shannon–wiener diversity index and Simpson's dominance index in the areas under canopy of *T. arjuna* and devoid of *T. arjuna* along the River Cauvery, South India.

Shannon–Wiener Diversity		Simpson reciprocal index		Evenness	
Under canopy of *T. arjuna*		Under canopy of *T. arjuna*		Under canopy of *T. arjuna*	
Mean	2.5	Mean	0.82	Mean	0.69
SD	0.41	SD	0.03	SD	0.04
Area devoid of *T. arjuna*		Area devoid of *T. arjuna*		Area devoid of *T. arjuna*	
Mean	1.6	Mean	0.74	Mean	0.5
SD	0.45	SD	0.10	SD	0.09
Under canopy and Area devoid of *T. arjuna*		Under canopy and Area devoid of *T. arjuna*		Under canopy and Area devoid of *T. arjuna*	
Difference	0.844	Difference	0.150	Difference	0.112
t (Observed value)	3.080	*t* (Observed value)	2.982	*t* (Observed value)	2.480
p-value (Two-tailed)	0.015	*p*-value (Two-tailed)	0.018	*p*-value (Two-tailed)	0.038

t (Critical value)—2.306; DF—8; alpha—0.05.

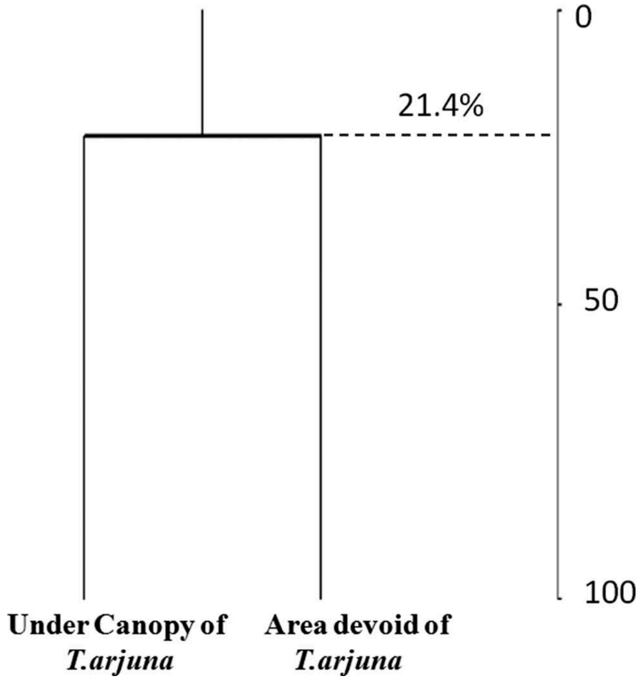

Figure 1. Bray–curtis cluster analysis (single link) for species similarity observed in two sites dominated and devoid by *T. arjuna* along the River Cauvery, South India.

Discussion

T. arjuna is a giant tree with girth varying from 3.5 to 6 m and canopy extending up to 30–35 m diagonally and represents the remnant tree cover along the riparian zone of CWS (Figures 6 and 7). In certain areas, the canopy continuity of the riparian vegetation is fragmented due to human pressure and livestock grazing, uncontrolled conventional tourism, fire, roads, and settlements (Sunil et al., 2011). Despite the anthropogenic pressures, several pockets along the riparian corridor remain intact, and the region is listed as a protected area under section 18 of the Indian Wildlife Protection Act of 1972.

The presence of *T. arjuna* along the riparian fringes of CWS had a positive effect on the riparian forest in terms of species richness, having 25% more species than in the area devoid of *T. arjuna* and diversity (*H*) with a difference of 34% between the two categorised areas. Among the observed species, 36% are exclusive to the area under the canopy of *T. arjuna*, with a sizable number of riparian species such as *Syzygium cumini, Syzygium jambos, Olea dioca, Madhuca latifolia*, and *Ixora brachiata*, constituting 27% of the stands. In contrast, the areas devoid of *T .arjuna* have negligible amounts of the same riparian species. Only 21% of similar species were found in common between the two areas.

Comparing the area under canopy and area devoid of *T. arjuna* in terms of species diversity and evenness, a positive effect of *T. arjuna* was observed. The Simpson index confirmed the species richness at both the sites, with a lesser dominance by a few species indicating heterogeneity of vegetation along the riparian zone. The heterogeneity in the area under canopy of *T. arjuna* is caused by the accumulation of riparian and other moist deciduous species such as *Ixora bracheata, Mitragyna parviflora, Diospyros melanoxylon, Vitex altissima, Madhuca latifolia, Schlechera oleosa* and *Sapindus emerginatus*, whereas in the open area, the heterogeneity is observed on account of

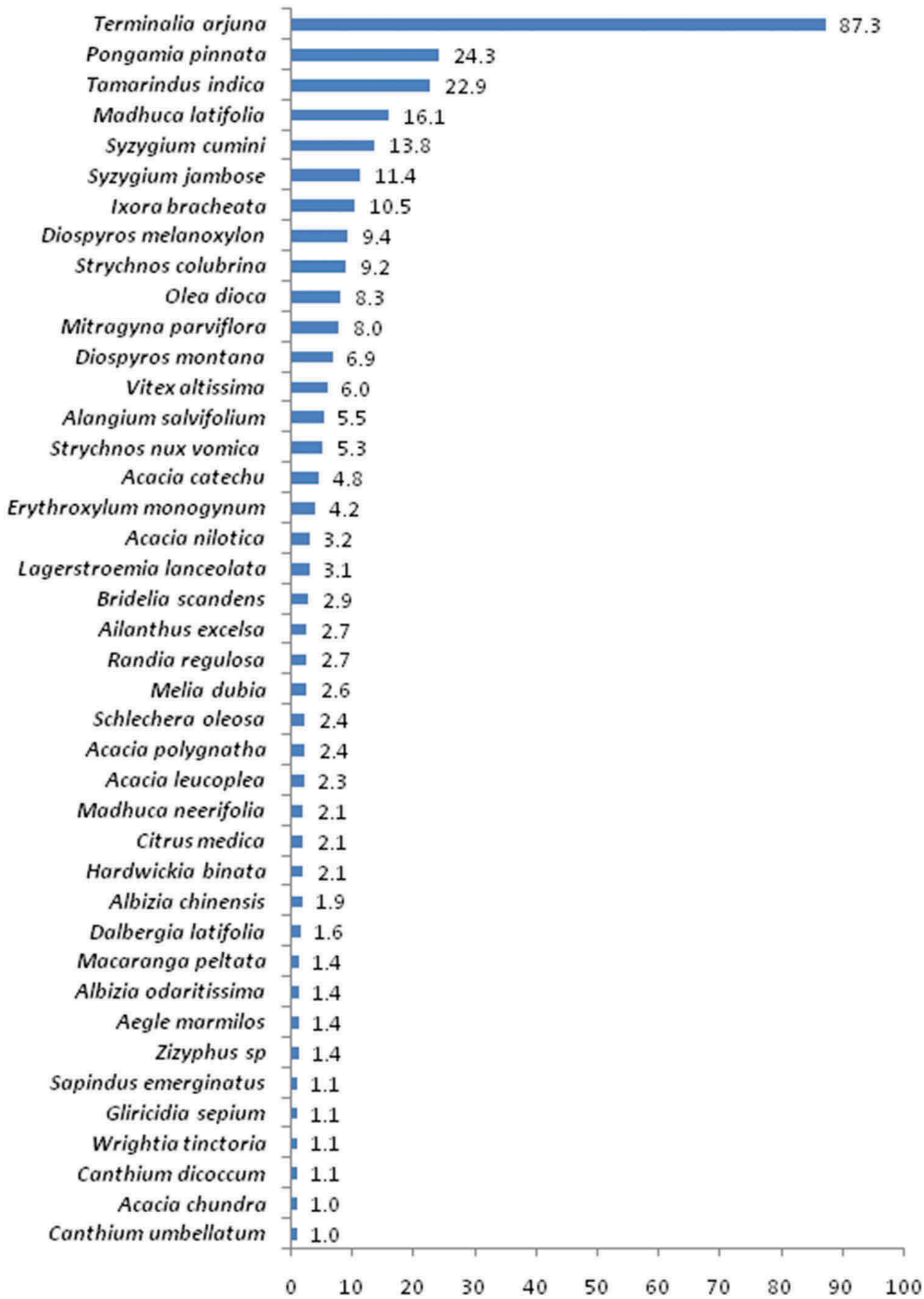

Figure 2. IVI of the tree species-recorded sites dominated by *T. arjuna* along the River Cauvery, South India.

invasion of adjacent scrub species such as *Chloroxylon swietenia* and *Anogoessus latifolia*, species of *Canthium* and *Acacia*.

In areas under the canopy of *T. arjuna*, the species *Syzygium cumini, Syzygium jambos, Madhuca latifolia, Diospyros melanoxylon, Tamarindus indica*, and *Ixora bracheata* were dominant. Several of

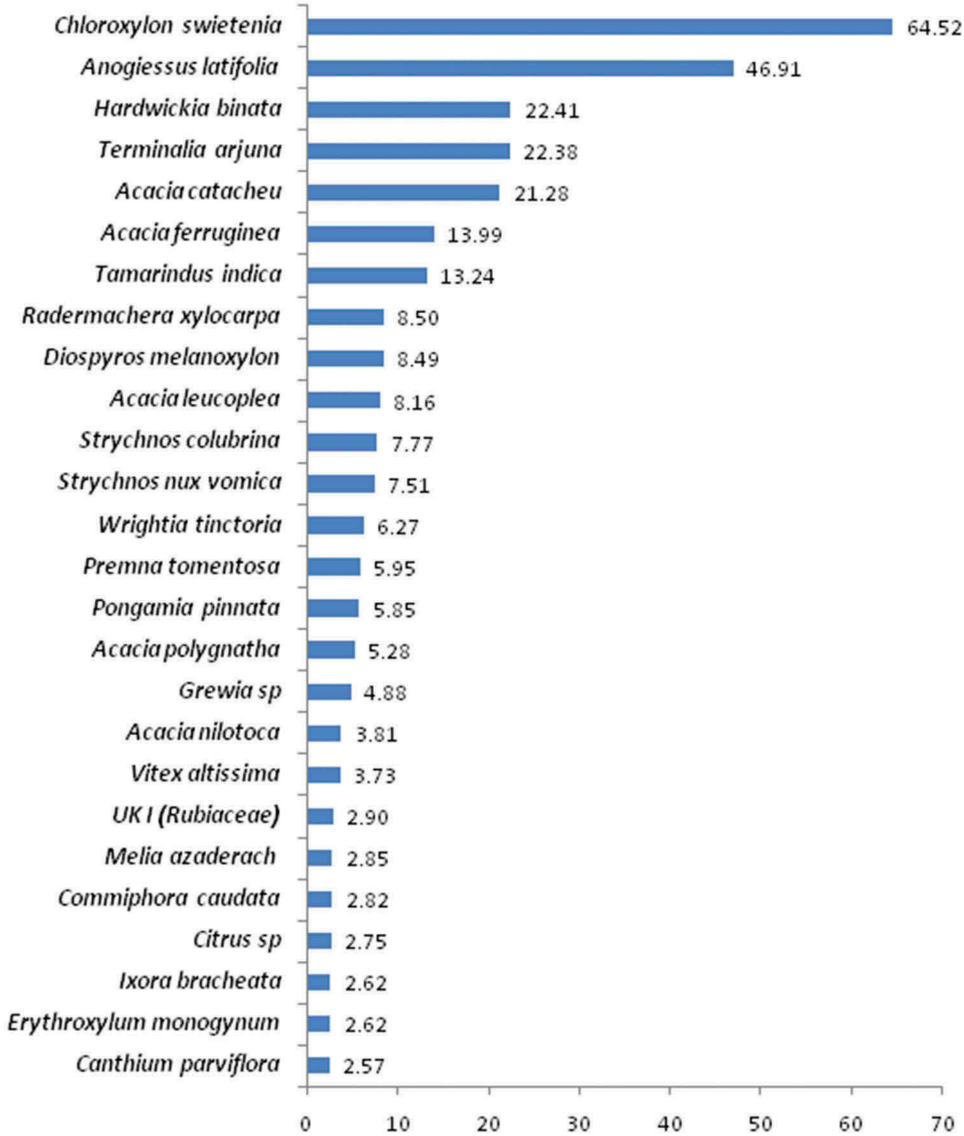

Figure 3. IVI of the tree species in areas devoid of *T. arjuna* along the River Cauvery, South India.

these species such as *Tamarindus indica, Syzygium cumini, Syzygium jambos*, and *Madhuca latifolia* possess a considerable wildlife value because their fruit resources are consumed by the Indian giant squirrel *Ratufa indica* (Kanoje, 2008). Baskaran, Senthilkumar, and Saravanan (2011) emphasise the importance of *Tamarindus indica* in the riverine forest of CWS for the conservation of Threatened species Grizzled Giant Squirrel (*Ratufa macroura*). The canopy cover provided by *T. arjuna* increases sufficient moisture in the soil, which is essential for promoting the regeneration and establishment of native riparian species present in the study area such as *Syzygium cumini, Syzygium jambos, Ixora bracheata, Madhuca latifolia*, and *Terminalia arjuna* (Figures 8 and 9) which require moisture in the soil during early stages of regeneration (Gautam, Tripathi, & And Manhas, 2007; Rothe, 2011). Also, the buttressed and interlocking root system of *T. arjuna* species stabilises the river bank and helps prevent the dispersal/flushing of seeds to the downstream,

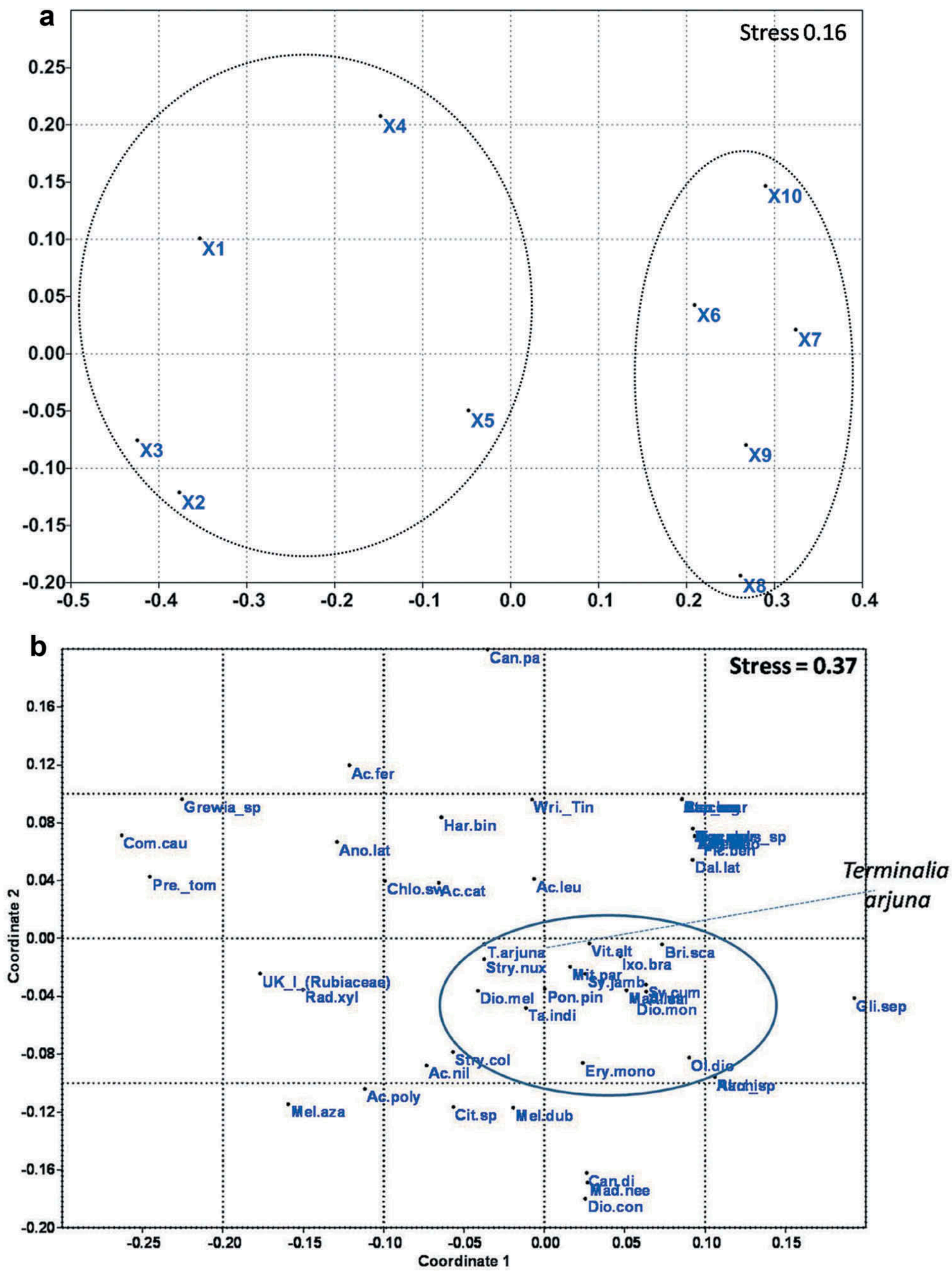

Figure 4. (a) Site classification of riparian zones using Non-metric multi-dimensional (NMDS) scaling for the areas under the canopy of *T. arjuna* (X6,X7,X8,X9 and X10) and in the areas devoid of *T. arjuna* (X1,X2,X3,X4 and X5). (b) Non-metric multi-dimensional (NMDS) scaling for the riparian vegetation in *T. arjuna*-dominated sites along the River Cauvery, South India.

during heavy flow in the river. The sediment and gravel retained between the roots of *T. arjuna* provide new substrate for riparian plant colonisation.

In the areas devoid of *T. arjuna*, species which are non-native to riparian habitats such as *Chloroxylon swietenia, Anogiessus latifolia, Acacia ferruginea, Acacia catechu*, and *Hardwickia binata* account for higher IVI value. These species are observed as a dominant species in adjacent scrub forest as reported by Manjunath (2001) and are found in the riparian landscapes. It is an established

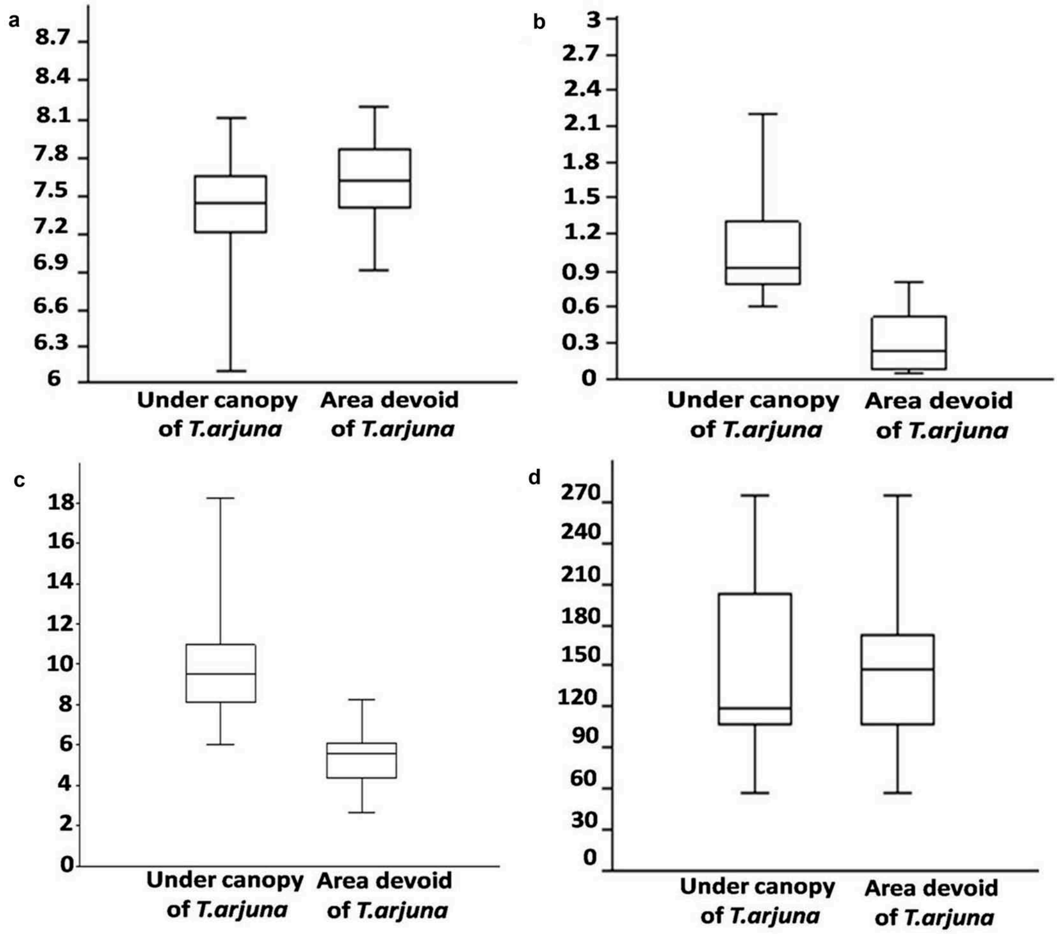

Figure 5. Whisker plots for (A) pH, (B) Organic carbon, (C) Soil Moisture, and (D) Soil electrical conductivity in the areas under canopy of *T. arjuna* and devoid of *T. arjuna* along the River Cauvery, South India.

Table 3. Soil moisture, pH, electrical conductivity, and organic carbon content in the areas under canopy of *T. arjuna* and devoid of *T. arjuna* along the River Cauvery, South India.

Soil moisture		pH		Electrical conductivity		Organic carbon (%)	
Under canopy of *T. arjuna*		Under canopy of *T. arjuna*		Under canopy of *T. arjuna*		Under canopy of *T. arjuna*	
Mean	9.83	Mean	7.38	Mean	144.8	Mean	1.06
SD	2.3	SD	0.48	SD	66.1	SD	0.45
Area devoid of *T. arjuna*		Area devoid of *T. arjuna*		Area devoid of *T. arjuna*			
Mean	5.1	Mean	7.56	Mean	146.1	Mean	0.31
SD	1.4	SD	0.32	SD	51.8	SD	0.24
Under canopy and Area devoid of *T. arjuna*		Under canopy and Area devoid of *T. arjuna*		Under canopy and Area devoid of *T. arjuna*		Under canopy and Area devoid of *T. arjuna*	
Difference	4.6	Difference	−0.180	Difference	−1.3	Difference	0.75
t (Observed value)	7.08	*t* (Observed value)	−1.440	*t* (Observed value)	−0.06	*t* (Observed value)	6.3
p-value (Two tailed)	<0.0001	*p*-value (Two tailed)	0.167	*p*-value (Two-tailed)	0.94	*p*-value (Two-tailed)	<0.0001

t (Critical value)—2.1; DF—18; alpha—0.05.

fact that the invasion of non-native species in the riparian zone constitutes one of the most serious threats to the native riparian communities through the displacement of native species (Shigenari & Izumi, 2004). Native riparian species such as *Syzygium cumini, Syzygium jambos*, and *Madhuca sp* are very sparsely evident in these areas, wherein their absence might lead to decline of natural source

Figure 6. *T. arjuna* species dominated along the bank of R. Cauvery in CWS.

Figure 7. Wide buttressed roots of *T. arjuna* species.

Figure 8. Seedlings of Syzygium cumini, Ixora bracheata, and Dalbergia latifolia growing under canopy of *T. arjuna*.

of leaves, twigs, fruit, and insects that underpins the aquatic food web (Lovett & Price, 2007). Hence *T. arjuna* shows enormous importance in this region wherein its absence might cause a major change in the riparian vegetation structure and composition which in turn is likely to affect the precious aquatic ecosystem in the region.

Under the canopy of *T. arjuna*, presence of higher number of species *Pongamia pinnata, Tamarindus indica, Ixora bracheata, Madhuca latifolia, Syzygium cumini*, and *Syzygium jambose* have contributed to clustering in these areas. The ordination space shows species assemblages under the canopy of *T. arjuna* species, in which the position of *Ixora bracheata, Syzygium cumini, Tamarindus indica, Syzygium jambose, Pongamia pinnata, Diospyros melanoxylon*, and *Madhuca latifolia* indicates a healthy association with *T. arjuna*. In the NMDS plot, the majority of separated species such as *Acacia polyacantha, Acacia chundra, Wrightia tinctoria*, and *Zizyphus sp*. belong to adjacent scrub forest species where their presence might be a matter of chance since the adjoining forest is of scrub type. However, *T. arjuna* with good canopy cover limits the establishment of invasive species in riparian landscapes such as *Canthium sp, Alangium salviforum*, and *Acacia catechu*, existing as potential dominants in adjacent scrub and dry land forest.

Soil analysis data for the sites dominated by *T. arjuna* species revealed its alkaline nature (Figure 5, Table 3) confirming the report of Srivastava, Ram, and Masto (2010). The EC values of the soil samples varied from 57.4 to 210.2 µs/cm indicating low salinity in the riparian zone. The occurrence of higher organic carbon and soil moisture in *T. arjuna* areas than in the other areas devoid of species *T. arjuna* indicates that *T. arjuna* along the riparian corridor effectively contributes to the maintenance of micro climatic conditions, namely, soil moisture and nutrients. The average organic carbon content is 1.07, being high rating for organic carbon (Abah, 2015; Ravikumar & Somashekar, 2013). The average soil moisture content is 10, ascertaining that the soil beneath *T. arjuna* has enough moisture to support regeneration of other riparian species

Figure 9. Seedlings of Syzygium cumini, Ixora bracheata, and Dalbergia latifolia growing under canopy of *T. arjuna*.

including *Syzygium jambos, Syzygium cumini, Madhuca neriifolia*, and *Madhuca latifolia*, which require sufficient moisture in the early stage of growth (Gautam et al., 2007; Rothe, 2011).

The invasion of scrub forest species such as *Acacia chundra, Acacia nilotica, Anogiessus latifolia, Hardwickia binata*, and *Canthium sp*. is already evident in the study area. The canopy provided by *T. arjuna* checks the intrusion of light-demanding species and their subsequent dominance in the riparian landscape. The huge canopy offered by *T. arjuna* forms a dense cover in the riparian landscape serving as an important buffer in the semi-arid ecosystem that provides a vital link to sensitive wildlife species such as *Ratufa macroura* (Grizzled Giant Squirrel), an IUCN Red listed near threatened species (Baskaran et al., 2011) which demands thick canopy cover along the riparian zones for breeding and feeding purposes (Joshua & Johnsingh, 1994). *T. arjuna* acts as resource provider, as the leaves and flowers of this species

Figure 10. *Terminalia arjuna*, acting as roosting sites for bats during the daytime.

falling into the water form the diet for many varieties of fish such as the famous 'mahseer fish (*Tor putitora*)'. The tree-lined river bank also provides shelter and shade to fish populations. Shade also keeps the growth of water weeds in balance, and regulates the temperature of water. The smooth coated otter (*Lutra perspicillata*) categorised as 'vulnerable' by 2004 IUCN Red List in the CWS also needs a healthy aquatic ecosystem with plenty of fish. The shade provided by trees along the water edge helps to promote fish abundance with obvious benefits for the otter. *T. arjuna* in the riparian zone also provides good potential nesting sites for bees and numerous bats which roost during the daytime (Figure 10). The bats play an important role as pollinators and seed dispersal agents. Flood is a regular event in the downstream of River Cauvery, and *T. arjuna* acts as a barrier against erosion and stabilises the river bank in the riparian forest.

Conclusion

The study carried out in the two areas, namely, area under the canopy of *T. arjuna* and areas devoid of *T. arjuna* along the riparian zone showed remarkable differences in floral diversity. Our study revealed that plant species diversity and soil carbon content beneath the canopies of *T. arjuna* are higher than in the areas devoid of *T. arjuna* in the riparian ecosystem. *T. arjuna* is supporting the growth of other native species in the riparian zone and is limiting the invasion of adjacent scrub species in riparian habitat. In agreement with Stagoll, Lindenmayer, Knight, Fischer, and Manning (2012) and Manning, Fischer, and Lindenmayer (2006), we confirmed the importance of large mature trees for maintaining plant species richness with increased soil nutrients. Furthermore, dominance of non-native species in riparian habitats in areas devoid of *T. arjuna* exhibits the serious negative effects on the population of native riparian trees species in the region, consequently affecting the allied biodiversity of the ecosystem. With this evidence base, recognising the biodiversity values of *T. arjuna*, this species can be considered as one of the keystone species associated with the riparian ecosystem of South India and also perpetuated in the degraded forested areas of riparian zones towards its restoration.

Acknowledgements

We thank University Grants Commission (UGC), New Delhi for financial assistance and Karnataka Forest Department for assisting in field sampling.

Disclosure statement

No potential conflict of interest was reported by the authors.

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