



Climbing Species Infestations on The Roadside Flora of Thiruvananthapuram City, Kerala, India: An Inventory

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Abstract

The present study was conducted to give an insight into climbing mechanism and taxonomic diversity of climbing plants grown as a part of roadside vegetation of the urban landscape of Thiruvananthapuram, the capital city of Kerala state, India. The survey recorded 36 species of climbers including 2 subspecies under 32 genera belonging to 19 families. Two “Red listed” *Vitaceae* members i.e., *Ampelocissus indica* (L.) Planch. and *Cayratia pedata* (Lam.) A.L. Juss. Ex Gagnep. var. *pedata* were also recorded. Climbers that were encountered in the study site were broadly categorized as Twiners, Tendril climbers and scramblers & hook climbers. Among them, vines were pronounced with 31 species and 2 subspecies and only five species of Lianas were recorded from the study site. The result also shows the study site is prone to the infestation of 16 weed species with invasive nature which can smother and kill the native plants in this region. The findings of the study can be used constructively in planning steps to have better natural environment with minimum disturbance in the city.

Keywords

Climbers, Invasive species, Roadside flora, tendrils, twiners.

INTRODUCTION

Urbanization is generally referred to as a set of multiscale phenomena that are altering the relationship between human settlements and the ecosystem, and affecting both urban and global environmental sustainability and resilience in complex ways (Romero-Lankao *et al.*, 2016). The anthropogenic landscapes that are created through urbanism are known by the terms such as cities, towns, conurbations or suburbs. The urbanization

led to the establishment of modern human civilizations and cultures, along with the exploitation of natural resources which causes serious impacts on the environment. Characterized by high human population density and infrastructure of built environment, these urban centres are considered as the most ecologically disturbed areas on earth. In recent decades especially, under the scenario of climate change and global warming, ideas like sustainable development, monitoring of urban

greenery and its management have been widely discussed to have better understanding of looming challenges posed by urbanization. The land-use in urban areas basically alter the physical features of the earth's surface such as roughness, moisture level, and vegetation coverage. Plants are extremely sensitive to these changes which are able to effect negatively, depressing their growth, suppressing photosynthesis, disturbing metabolism, giving rise to degradation and loss of natural habitat. Several workers have noted the species richness and abundance of climbing flora is usually associated with changes formed in an environment by natural or anthropogenic disturbances (Engel *et al.*, 1998; Laurance *et al.*, 2001; Addo-Fordjour *et al.*, 2013). Therefore, climbers, often regarded as mechanical parasites, may serve as indicators of disturbance in an ecosystem (Medeiros & Torezan, 2013).

The climbing plants are a key component of the vegetation in the tropics where they not only contribute substantially to the diversity (Gentry, 1991), but also play pivotal ecological roles in ecosystem dynamics, such as reducing tree growth and fecundity (Putz, 1984), and suppressing regeneration (Schnitzer *et al.*, 2000). This growth form also enables plants to colonize large areas quickly, even without climbing high. The climbing plants show a great diversity in their climbing mechanism. Darwin (1867) catalogued them into stem twiners, root climbers, tendril climber, scrambler and hook/thorn climbers. Now, with some modifications, the climbers are the generally classified into 5 different groups viz. twiners, root climber, scramblers & hook climber, adhesive climbers and tendril bearers. This flexible growth habit and diversified modes of climbing adaptations is perhaps the defining element of vines and lianas.

The lianas (woody climbers) and herbaceous vines have evolved many times during the course of plant evolution, with more than 130 plant families including one or more climbing species (Gentry, 1991). The plant families like *Convolvulaceae*, *Cucurbitaceae*, and *Dioscoreaceae* are exclusively climbers, while families such as *Fabaceae*, *Celestraceae* and *Apocynaceae* are some of the most species rich climber families with each family containing more than 50 climber species (Ali *et al.*, 2016). Despite holding 25% of the total plant biodiversity in tropical regions (Ferrero *et al.*, 2019), climbing plants, quite probably, are the most neglected of any major habit group of plants. There are not much scientific studies available on the diversity and distribution of these versatile plants in urban areas even though, they are often recognized

as the first and dominant colonisers in the ecologically disturbed conditions. Keeping these views, the present study was conducted to give an insight into climbing mechanism and taxonomic diversity of climbing plants grown as a part of roadside vegetation of the urban landscape of Thiruvananthapuram, the capital city of the Indian state, Kerala.

2. MATERIALS AND METHODS

2.1. Study area

Thiruvananthapuram is one of the ancient temple cities, situated near the southern tip of mainland India, with periodic references in many Greek and Roman literatures. Referred to by Mahatma Gandhi as the "Evergreen city of India", the city is characterized by its undulating terrain of low coastal hills and busy commercial alleys with flourished vegetation. It is located at 8.5°N 76.9°E on the west coast and is bounded by the Laccadive Sea to its west and the Western Ghats to its east (**Fig. 1**). The average elevation of the city is 4.9 m above sea level. The backwaters such as Vellayani, Thiruvallam and Aakulam lie in the city. The soil-type in the middle part of the city is dark brown loamy laterite soil. Spread over 214.86 km², The Thiruvananthapuram Corporation has a tropical climate with mean maximum temperature 34°C, and the mean minimum temperature 21°C. Humidity rises to about 90% during the monsoon. Thiruvananthapuram is the first city along the path of the south-west monsoon and gets its first showers in early June. However, summer rains are also common in April and May, accounting to about 35 cm on average. Annual rainfall is 180 cm. The rainiest months are May, June, July, August, and October.

2.2. Floristic analysis

The field appraisal on climber diversity was carried out during the period of November 2018 to April 2019. The naturalised climbing flora found within 15 m distance from the major roads of the Thiruvananthapuram city was surveyed. Climbing mechanism were assessed through direct observations in the field and each species was also assigned to one of five functional climbing mode, Twiner, Tendril climber, scrambler/Hook climber, Root climber and Adhesive climber. The plants were freshly collected and their digital photographs were also taken. The plant samples were identified with the help of published, authentic literature. The flora of the Presidency of Madras, Part I and II by Gamble & Fischer (1915-1936) and Flowering plants of Kerala - A hand book (Nayar *et al.*, 2006) have been consulted for the identification of plants. Herbaria of

these plants were prepared as per the methodology proposed by Smith (1971). The identified voucher specimens were deposited in the herbaria of Dept. of Botany, Christian College Kattakada, for future reference.

3. RESULTS AND DISCUSSION

The results of the present floristic investigation confirm the road side vegetation of the Thiruvananthapuram city is rich in vines and lianas with diversified climbing adaptations. In this region, the original vegetation is continuously disturbed due to the frequent road construction activities.

3.1. Species composition & distribution

The survey of climbers from the roadside flora of Thiruvananthapuram City recorded 36 species including 2 subspecies under 32 genera belonging to 19 families. A general account on the climbing plants recorded from the study site is summarised in the **table 1**. The ratio of family to genera and species is 1: 1.68: 1.94. Of which 18 families with 30 genera and 34 species and 2 subspecies were dicotyledonous and *Asparagus gonocladus* Baker (*Liliaceae*) was the monocotyledonous climbing plant found in the study site. *Lygodium flexuosum* (L.) Sw. is the only pteridophyte with climbing habit recorded. Examining the distribution of the recorded families, the study shows that maximum number of the species belongs to *Convolvulaceae* with 6 species and one subspecies followed by *Fabaceae*, and *Vitaceae* with 4 species each (**Fig. 3**). This trend is totally in accordance with the study conducted on the climbing flora of Adhuragiri hills southern Western Ghats (Kamatchi & Parvathi, 2018) and several authors have noted the high climber species richness of these families in the tropics (Baro & Borthakur, 2017; Maitreya, 2015; Mukherjee, 2010). The families, *Asclepiadaceae*, *Menispermaceae*, *Vitaceae* and *Cucurbitaceae* are represented by three species each. The rest of 13 families are represented by one species. The dominant genera of the total climber species observed were *Ipomoea* and *Merremia* with 3 species each followed by *Cayratia* with two species. Balachandran & Rajendran (2014) suggests the climbers are the plants which usually colonize gaps very early, growing rapidly in the high light and smothering other growth forms; restricting their growth and establishment. The open and high sunlight physiography of the city roads favours the growth of climbers thus the present study records high species richness of herbaceous climbers. An important finding that deserves special mention is that two *Vitaceae* members documented in study have been included under threatened category as

“Red listed” plants by IUCN. Of which, *Ampelocissus indica* (L.) Planch. is categorized as Endangered (*EN*) while *Cayratia pedata* (Lam.) A.L. Juss. Ex Gagnep. var. *pedata* falls under the category, Vulnerable (*VU*). Despite growing well naturalised with the roadside vegetation of the study area, they are under the severe threat of habitat loss and degradation.

3.2. Diversity of habit and climbing mechanism

Climbers that were encountered in the study site were broadly categorized as Twiners, Tendril climbers and scramblers & hook climbers. Among them, vines (including 9 shrubby vines) were pronounced with 31 species and 2 subspecies and only five species of Lianas were recorded from the study site. China (1999) reports, herbaceous vines account for a substantial portion of the diversity though they constitute a minor portion of the biomass in tropical ecosystems.

Species representation noted in different mode of climbing is depicted in **Fig. 4**. The result reveals twining is the most predominant climbing mechanism exhibited by 22 plants grown in the study site. This finding coincides well with several studies focused on the climbing behaviour of plants found in different tropical forests including Western Ghats (Sarvalingam and Rajendran, 2016; Putz 1984; Gerwing *et al.*, 2006). Twining is the most common habit among climbers and this consists of the stem twisting around the branches or stems of a host with or without the aid of specialised structures (Gentry 1985; Darwin 1865). It was observed that twiners form a helical tube of twisted tissue around the vertical support. All the twiners in the study area were observed to make right handed helix (Sinistrose). Baillaud (1968) has noted only a substantial minority of species (including *Dioscorea* spp, *Dinoreaceae*; and *Humulus* sp., *Canabaceae*) in the plant kingdom are left handed. Tendril climbers (10 species) were the next dominant climbing mode noted in the study site after twiners. Of which 8 species were stem tendril climbers. Many studies (Sarvalingam & Rajendran, 2016; Nabe-Nielsen J, 2001) carried out in different tropical locales have reported similar results. Among the tendril bearers *i.e.*, *Cardiospermum halicacabum* L. and *Antigonon leptopus* Hook. & Arn., tendrils were observed with peculiar inflorescence modified tendrils. While the cucurbits exhibit their typical extra axillary stem tendrils, *Vitaceae* members show bud stem tendrils as their climbing adaptation. Five scrambling climbers were also recorded in the study site. Among them, *Asparagus gonocladus* Baker. and *Hibiscus hispidissimus* Griff. were observed to have thorns as the supportive structure for climbing. The only

typical hook climber observed in the study site was *Dolichandra unguis-cati* (L.) L.G. Lohmann which possess peculiar climbing claws developing from nodes. Lee & Richards (1991) reports this plant shows great intra-plant variation in light response and the claw like tendrils are skototropic in nature while the shoot tips shows positively phototropic behaviour. No root and adhesive climbers were observed in the roadside vegetation of Thiruvananthapuram city.

3. 3. Invasive species

Several studies conducted on different regions have identified anthropogenic disturbance as one of the driving forces of climber success in tropical forest ecosystems (Rutishauser, 2011; Schnitzer & Bongers, 2002). The luxuriant level of climber infestation on the road side itself indicates the direct effect of intense human disturbance on the flora of the city, Thiruvananthapuram (Fig 2). These disturbed environments generally provide various conditions that better suit the exotic species invasion suppressing the natural regeneration of native species. These weeds are excellent at surviving and reproducing in these environments and are often the first species to colonise and dominate in these conditions (Chandra *et al.*, 2017). The result shows the study site is prone to the invasion of some hazardous weed species. Sixteen of the total 36 climbers found on the study site are reported to have

invasive nature. Among them, *Mikania micrantha* (L.) Kunth ex H.B.K. is listed in the top 100 of the world's worst invasive alien species (Fact sheet, 2016) which can change the natural diversity and balance of ecological communities. *Merremia vitifolia* (Burm. f.) Hallier f. and *Antigonon leptopus* Hook. & Arn. are also some high priority invasive climbers. Kerala Forest Research Institute (KFRI) has identified the aggressively colonizing *M. micrantha* and *M. vitifolia* as among the 10 high risk alien invasive species (AIS) as per the risk assessment. These climbers spread rapidly and reproduces vegetatively and is extremely difficult to remove manually, particularly when the plant is a few years old and the stem thick (Sajeev, 2012). *Dolichandra unguis-cati* (L.) L.G. Lohmann is another significant weed in many tropical ecosystems, recorded from the study site. It has been ranked 11th in the list of 340 invasive environmental weeds in New South Wales, Australia (Downey *et al.*, 2010). Gentry (1980) noted some individuals or populations of this species are polyploid at $2N = 80$ which is often associated with invasiveness in plants (Schmidt *et al.*, 2012). The invasive twiners, *Centrosema pubescens* Benth., *Ipomoea cairica* (L.) Sweet, and *Ipomoea quamoclit* L. were also documented in the present inventory. Two noxious parasitic weeds, *Cassytha filiformis* L. and *Cuscuta chinensis* Lam. were also recorded as a part of roadside flora of the city.

Table 1. General account on the climbing flora of CCK

| No | Species | Local Name (MI.) | Family | Habit | Climbing mechanism | Bio geographic Category |
|-----|--|-----------------------------|------------------|------------|-----------------------|-------------------------|
| 1. | <i>Abrus precatorius</i> L. | Kunni | Fabaceae | Shrub-Vine | Twiner | Indigenous |
| 2. | <i>Allamanda cathartica</i> L. ** | Vallipala | Apocynaceae | Liana | Scrambler | Exotic |
| 3. | <i>Ampelocissus indica</i> (L.) Planch. * | Chembravalli | Vitaceae | Shrub-Vine | Stem Tendrils | Indigenous |
| 4. | <i>Anamirta cocculus</i> (L.) Wight & Arn. | Polla, Nanchuvalli | Menispermaceae | Liana | Twiner | Indigenous |
| 5. | <i>Antigonon leptopus</i> Hook. and Arn. ** | | Polygonaceae | Shrub-Vine | Inflorescence tendril | Exotic |
| 6. | <i>Aristolochia indica</i> L. | Garudakkodi | Aristolochiaceae | Vine | Twiner | Indigenous |
| 7. | <i>Asparagus gonocladus</i> Baker | Sathavari | Liliaceae | Liana | Scrambler | Indigenous |
| 8. | <i>Cardiospermum halicacabum</i> L. ** | Uzhinja | Sapindaceae | Vine | Inflorescence tendril | Indigenous |
| 9. | <i>Cassytha filiformis</i> L. ** | Akashavalli | Lauraceae | Vine | Twiner | Indigenous |
| 10. | <i>Cayratia pedata</i> (Lam.) A.L. Juss. Ex Gagnep. var. <i>pedata</i> * | Chorivalli, Vallichoriyanum | Vitaceae | Shrub-Vine | Stem Tendrils | Indigenous |

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|-----|---|----------------------------|----------------|----------------|----------------------------|------------|
| 11. | <i>Cayratia trifolia</i> (L.) Domin | Vathakodi | Vitaceae | Shrub- Vine | Stem Tendrils | Indigenous |
| 12. | <i>Centrosema pubescens</i> Benth.** | Kattucherupayar | Fabaceae | Vine | Twiner | Exotic |
| 13. | <i>Ceropegia candelabrum</i> L. <i>Cissampelos pareira</i> L. var. <i>hirsuta</i> (Ham. ex DC.) Forman | Nagathumba | Asclepiadaceae | Vine | Twiner | Indigenous |
| 14. | <i>Cissus repens</i> Lam. | Chunnambuvalli | Vitaceae | Shrub- vine | Stem Tendrils | Indigenous |
| 16. | <i>Clitoria ternatea</i> L.var. <i>ternatea</i> | Sankhupushpam | Fabaceae | Vine | Twiner | Exotic |
| 17. | <i>Coccinia grandis</i> (L.) Voight | Koval | Cucurbitaceae | Vine | Stem Tendril | Indigenous |
| 18. | <i>Combretum indicum</i> (L.) DeFilipps ** | Thookkuchethi | Combretaceae | Liana | Twiner | Indigenous |
| 19. | <i>Cuscuta chinensis</i> Lam.** | Moodilla thali | Convolvulaceae | Vine | Twiner | Indigenous |
| 20. | <i>Cyclea peltata</i> (Lam.) Hook. f. & Thoms. | Padathali Patticheviyan | Menispermaceae | Vine | Twiner | Indigenous |
| 21. | <i>Dolichandra unguis- cati</i> (L.) L.G. Lohmann ** | Poochamanthi | Bignoniaceae | Liana | Scrambler/ Hook climber | Exotic |
| 22. | <i>Hemidesmus indicus</i> (L.) R. Br. var. <i>indicus</i> | Naruneendi Nannari | Asclepiadaceae | Shrub- vine | Twiner | Indigenous |
| 23. | <i>Hibiscus hispidissimus</i> Griff.** | Upanacham | Malvaceae | Vine | Scrambler | Indigenous |
| 24. | <i>Ipomoea cairica</i> (L.) Sweet** | Kolambipoo | Convolvulaceae | Vine | Twiner | Exotic |
| 25. | <i>Ipomoea pes-tigridis</i> L. | Pulichuvadi | Convolvulaceae | Vine | Twiner | Indigenous |
| 26. | <i>Ipomoea quamoclit</i> L.** | Akashamulla | Convolvulaceae | Vine | Twiner | Exotic |
| 27. | <i>Luffa cylindrica</i> (L.) Roem.** | Eencha | Cucurbitaceae | Vine | Stem Tendril | Indigenous |
| 28. | <i>Lygodium flexuosum</i> (L.) Sw. | Vallipanna | Lygodiaceae | Vine | Twiner | Indigenous |
| 29. | <i>Merremia tridentata</i> subsp. <i>hastata</i> (Hallier f.) Ooststr. | Cheruvayara | Convolvulaceae | Vine | Twiner | Indigenous |
| 30. | <i>Merremia tridentata</i> subsp. <i>tridentata</i> (L.) Hallier f. | Thiruppanvalli | Convolvulaceae | Vine | Twiner | Indigenous |
| 31. | <i>Merremia vitifolia</i> (Burm. f.) Hallier f.** | Manja-vayaravalli | Convolvulaceae | Shrub- vine | Twiner | Non-native |
| 32. | <i>Mikania micrantha</i> (L.) Kunth ex H.B.K.** | Vayara, | Asteraceae | Vine | Twiner | Exotic |
| 33. | <i>Mukia maderaspatana</i> (L.) Roem. | Mukkapeeram | Cucurbitaceae | Vine | Stem Tendril | Indigenous |

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|-----|---|--------------|----------------|------------|--------------|------------|
| 34. | <i>Passiflora foetida</i> L.** | Poochapazham | Passifloraceae | Vine | Stem Tendril | Exotic |
| 35. | <i>Pergularia daemia</i> (Forssk.) Chiov. | Veliparuthi | Asclepiadaceae | Vine | Twiner | Indigenous |
| 36. | <i>Piper longum</i> L. | Thippali | Piperaceae | Shrub-vine | Scrambler | Indigenous |
| 37. | <i>Pueraria phaseoloides</i> (Roxb.) Benth.** | Kalapayar | Fabaceae | Vine | Twiner | Indigenous |

*Red listed by IUCN; ** Listed as invasive Weed



Fig. 1. Map of Thiruvananthapuram Corporation area

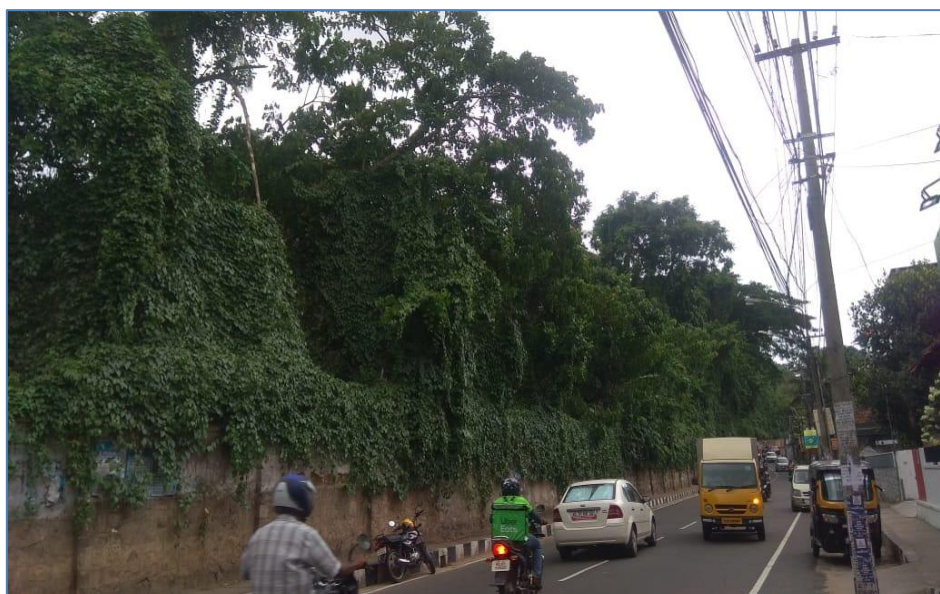


Fig. 2. Climbing plant infestations on the roadside flora of Thiruvananthapuram

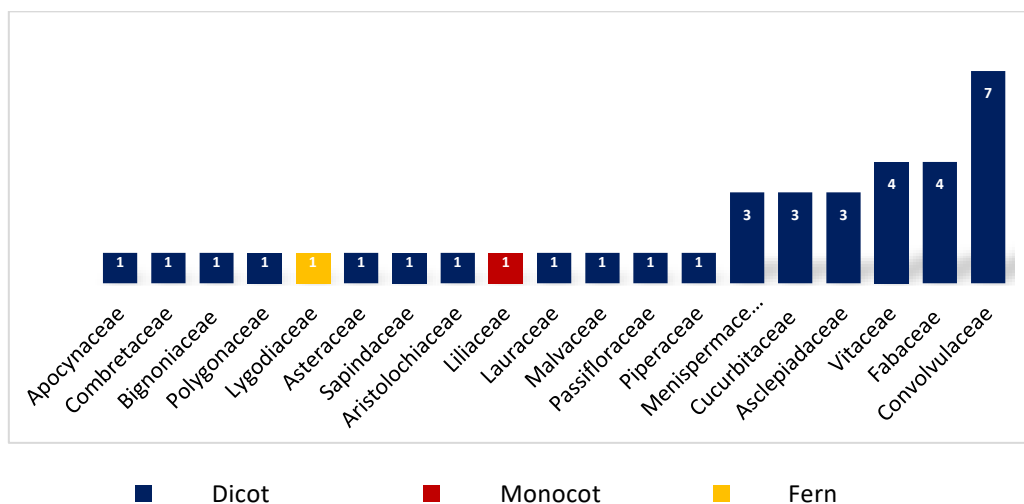


Fig. 3. Species richness of climbers per family on the roadside flora of Thiruvananthapuram city

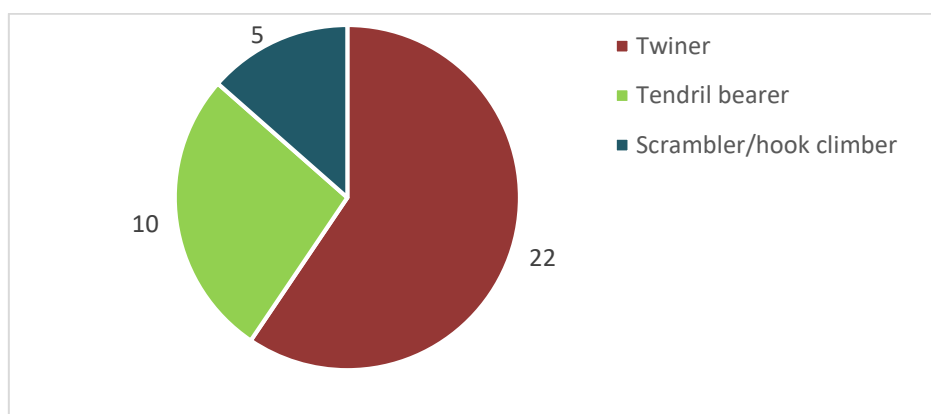


Fig. 4. Diversity of climbing mechanism observed in the study site

4. CONCLUSION

The present investigation scrutinized various aspects of the climbing plants, which are often known 'mechanical parasites', grown as the part of roadside vegetation of urban centres of Thiruvananthapuram. The findings are pointing towards the fact that environment of the study site is getting disturbed in an alarming rate and it is facing the serious threat of heavy infestations of some hazardous invasive weed climbers which can smother and kill the native plants in this region. The current study also provides insights into the importance of urban green space and greatly helps in urban conservation planning and management. The outcome of the study can be used constructively in planning steps to have better natural environment with minimum disturbance in the city.

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