

## FERNS: A THRIVING GROUP OF URBAN DWELLERS.

SHAIESH MORAJKAR, SUDHA SAJEEV AND SMITHA HEGDE\*

Rondano Biodiversity Research Laboratory, Department of Research and Post Graduate Studies in Biotechnology, St. Aloysius College (Autonomous), Mangalore 575 003  
(\* Corresponding author email: smitha\_hegde@hotmail.com)

### ABSTRACT

Geological, ecological and evolutionary factors have resulted in patchy habitats, creating disjunct distribution and endemism in fern biodiversity. With the creation of new habitats by manmade activities, these plants are now subject to survival by selection and adaptation. The site of study, Mangalore is a city on the threshold of transition from a sleepy coastal town to a smartcity. It is located in the foothills of the central part of the Western Ghats. The fern flora of the region was studied. Eleven families of ferns are reported, several of them well adapted and thriving in the urban disturbed habitat. They are resiliently growing on concrete surfaces, tiles and metal pipes. They also colonise moist compound walls, avenue trees in the city and busy highways, crowded city parks, domestic gardens and drinking water wells with equal panache.

### Introduction

Myriads of interactions of energy and mass have resulted in diverse forms of life on this earth. These have been witnessed and well recorded on the geographical scale of evolution. The dynamic flux of energy and matter continues at macro and micro levels resulting in species adaptation and colonization. The benefits of residential vegetation may be variable, in terms of providing ecosystem services such as food supplies, mitigation of urban heat island and urban fragmentation effects, runoff reduction, and above-ground carbon storage; as well, residential vegetation may have positive effects on the quality of human life, health and well-being (Vila-Ruiz et al., 2014). Ferns are a diverse group of plants that occupy discrete niches in the forests largely dominated by trees and shrubs. In areas of rapid urbanization where the trees and shrubs have been eroded, certain species of ferns have shown amazing resilience in habitat occupation and colonization. They have adapted well

to man-made structures and urban surrounding. In this paper we aim to provide a comprehensive account of the fern flora of Mangalore city to report the ferns in the urban habitat.

### Site of study

The study reports the fern and fern allies found in the city of Mangalore, (12.87°N 74.88°E) is a rapidly developing coastal city of Karnataka with approximately 5 lakhs human population, with an area of 132.45 km<sup>2</sup>. The ferns were observed and reported from Mangalore Urban area within the city corporation limits. The city experiences tropical monsoon climate between the months of May-October. The average annual rainfall is 3,796.9 mm with temperature variations between lowest of 15°C in the month of November and highest 39.8°C in the month of March. The humidity of the region is 89% in the month of July, 62% in the month of January. It has sunshine of 313hrs/month in January while the least is 94hrs/month in July. It gets an average

of 2789 hrs/annum sunshine. The topography of the city is plain with small hilly patches. The nature of soil is characterised with hard Laterite in the hilly tracks and sandy soil along the coastal plains. It is at an elevation of 22 meters above sea level. The two rivers Netravati, along the south and Gurupura River along the north encircle the Mangalore City. The city is in the estuarine region of these rivers opening into the Arabian Sea. This creates a few fresh water swamps and marshy mangroves on the outskirts of the city.

### Observations and Discussion

Fern responses to human disturbances are highly variable and often species specific (Walker and Sharpe, 2010). Ferns are known to be good competitors while colonizing disturbed habitats. Ferns are seen often in newly cut landscapes for road construction, vacant spaces with poor soils, along waste water trails on pipelines, windowsills and poorly maintained buildings. Urban ecosystem is unique in several aspects. In urban areas there is constant flux of nutrients, resources



**PLATE A :** Epiphytic ferns: 1. *Drynaria quercifolia*, 2. *Pyrrosia lanceolata*, 3. *Psilotum nudum*. Aquatic ferns: 4. *Marsilea minuta*. Climbers: 5. *Lygodium flexuosum* 6. *Stenochlaena palustris*

and human disturbance. Under such adverse conditions a few selected ferns have successfully found a niche for growth, reproduction, succession and survival. These plants have adapted to the city habitat and grow in manmade structures. Few of the ferns observed in the city of Mangalore are discussed on basis of their habitat (Table 1).

### 1. Epiphytic ferns and fern allies:

The coastal town of Mangalore harbours many tiled roof houses. The clay tiles are excellent substrate for epiphytic ferns like *Drynaria quercifolia*. Some epiphytic ferns may depend upon particular host tree characteristics (Mehltreter *et al*, 2005). *Drynaria quercifolia* generally prefers garden and avenue trees having rough surfaces e.g. *Mangifera indica*, *Millingtonia hortensis* and *Albizia saman*. However it has shown amazing capacity of adaptation to man-made structures and material such as metal roofs and cement walls. The fern has colonised avenue trees along the State Highways, thriving well inspite of heavy flow of traffic causing air turbulence, noise and air pollution. Interestingly the availability of this fern in core area of protected forest is very rare and sometimes none. Other epiphytic fern and fern ally growing on trees include *Pyrrosia lanceolata* and occasionally *Psilotum nudum*, a fern ally. Moist, rough surfaces with adequate sunlight are essential substrates for their growth (Plate A).

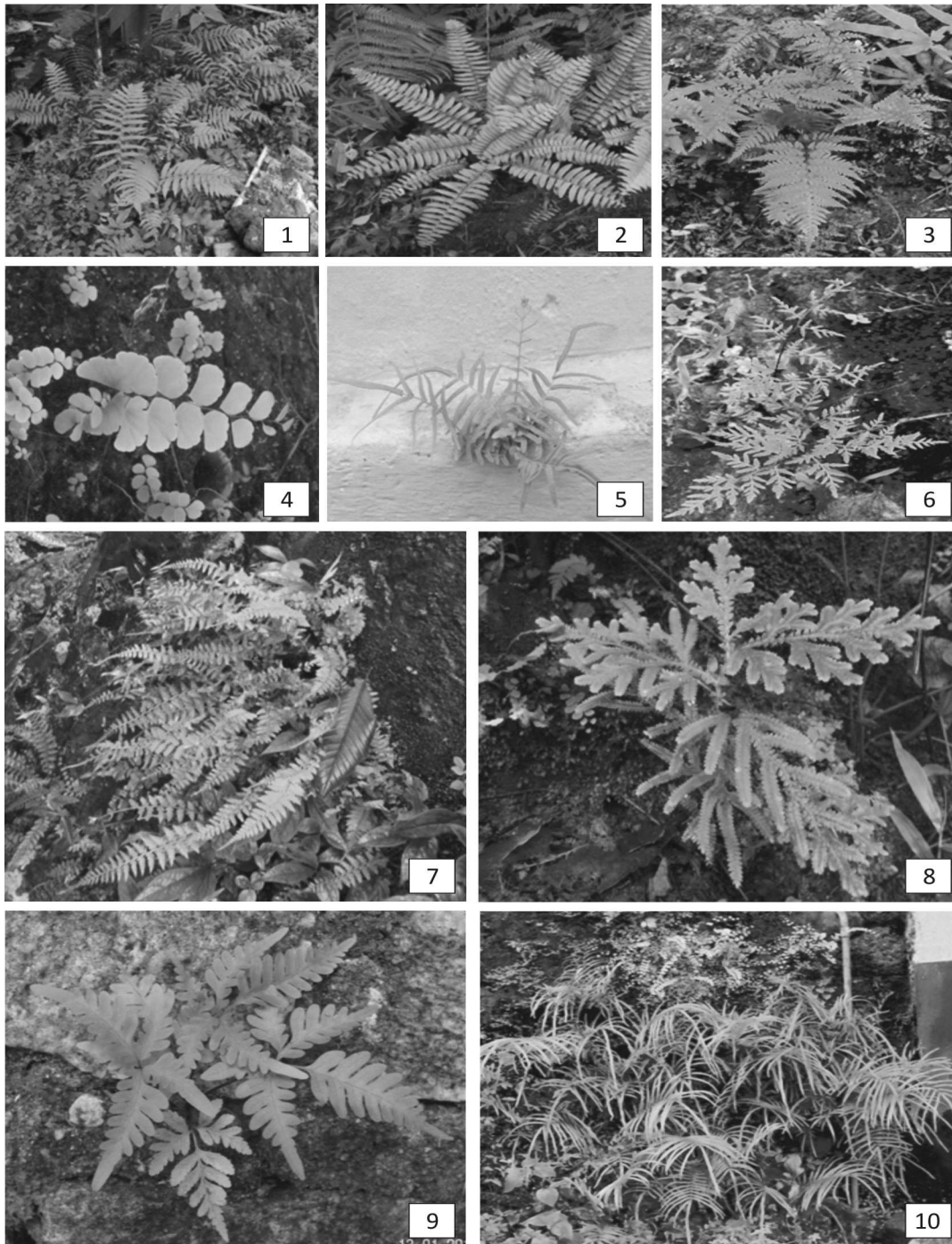
### 2. Terrestrial ferns:

The Laterite soil of Mangalore is rich in aluminium and iron but poor in organic content. It has water retention capacity favourable for the growth of ferns. *Christella dentate* is often seen in leaf litter as an undergrowth of trees and woody shrubs (Plate B). *Nephrolepis cordifolia* and *Pityrogramma calomelanos* are observed to grow in relatively dry terrain

having poor soils. *Pityrogramma* is often accompanied by *Pteris vittata* during winter as well as dry spell of summer. Amongst all the ferns found in urban areas, *Pteris vittata* is observed to show best adaptation to urban conditions. It thrives on leaky drain pipes of residential as well as office buildings. It is also seen on pipes of air conditioning units thriving on moisture condensation or in vicinity of leaking water taps. A small sized variety of *Pteris vittata* named as *Pteris vittata "Nano"* was reported by Prof. S.K. Verma in the city of Mangalore in 2013. It is seen to grow in courtyards, tiles, buildings and compound walls.

Some ferns although epiphytic in nature, but do not prefer trees as substrates. Amongst these *Adiantum philippense* and *Athyrium hohenackerianum* make an early appearance in monsoons i.e in the month of June while *Selaginella delicatula* appears with a delay of one month i.e July to appear and colonise the same moist walls and compounds in the city in co-existence with *A.philippense*. They completely dry and are non-existent in winter and summer. However they make their presence felt in the monsoons by exhibiting bursts of luxuriant green foliage growth. *Cheilanthes tenuifolia* is found in open laterite soil surfaces which have freshly been excavated for construction of buildings or roads. Its small appearance and dark green colour makes it completely unnoticeable for an unobservant eye. They thrive as small scattered patches on the vertical surfaces.

Domestic wells provide a fascinating niche for ferns. They have cool, humid atmosphere along with a clearing for entry of sunlight. The region which is exposed to direct sunlight as well as diffused patches of light show gregarious growth of ferns. The well walls are made up of granite rocks, laterite bricks or cement rings .But ferns and moss find the crevices between the blocks



**PLATE B:** Terrestrial ferns: 1. *Christella dentata*, 2. *Nephrolepis cordifolia*, 3. *Pityrogramma calomelanos*, 4. *Adiantum philippense*, 5. *Pteris vittata* "nano", 6. *Cheilanthes tenuifolia*, 7. *Athyrium hohenackerianum*, 8. *Selaginella delicatula* . 9. *Pteris biaurita*, 10.) *Pteris vittata*,



**PLATE C:** Inner wall of the wells populated with ferns in the sunlight zone.

suitable for colonizing. Large numbers of houses as well as apartments have their own well for catering to the needs of drinking water to the urban residents. These wells are a home to beautifully bipinnate *Pteris biaurita*, *Athyrium* and pinnate *Adiantum* species (Plate C).

Dianne Smith (2013) makes an interesting observation in her book on Urban Ecology, where urban pavements and walls substitute for the rock ledges in wild, the cracks in the wall provides peculiar and unique niches for plants. The amount of nitrogen content added to this niche in the form of urban biological waste such as dog urine and faeces enhances the plant growth in the region. Such plants often exhibit trampling tolerance. Ferns use the turbulence created by human activity for spore dispersal.

### 3. Climbers:

*Lygodium flexuosum* is a climber that prefers trees and shrubs to grow as a weedy climber (Plate A). It largely grows in dry, well drained soil terrain. *Stenochlaena palustris* is also a climber but it requires high humidity

and fresh water swamps to thrive. Lowlands that were traditionally growing paddy are today filled for urban housing purposes. During monsoons poor drainage of the rain water results in fresh water swamps in some areas. Palms, Mango trees in these low lying areas have are covered with fronds of *Stenochlaena*. People have found edible value in this fern and it has found its way in local cuisine.

### 4. Aquatic ferns:

Rain drains are an important part of urban planning. Mangalore has several open rain drains where we can see aquatic ferns such as *Marsilea minuta* (Plate A) and *Ceratopteris*. *Marsilea* is seen during monsoons along roadside water drains. *Ceratopteris* is occasionally found in clear flowing waters of the drains. *Acrostichum aureum* is seen in the outskirts of the city where the mangroves are found. However the plant is vanishing rapidly inside the city limits owing to the mass housing projects and high rise buildings created on landfills of the marshy mangroves. But the fern still prevails in large numbers outside the city limits.

**Table 1– Common fern flora of Urban Mangalore**

SI.No.	Botanical Name	Seasonal availability	Habitat and Ecology
<b>A Epiphytic ferns and fern allies (PLATE A)</b>			
1.	<i>Drynaria quercifolia</i> Family: <i>Polypodiaceae</i>	April – December	<b>Habit:</b> Epiphytic, weedy. <b>Habitat:</b> Prefers to grow on garden trees. But is seen on building pipes, bricks and window sills. It is also found in abundance on tile roofs, metal and plastic shades that cover car parks and air conditioning units.
2.	<i>Pyrrhosia lanceolata</i> (L.) Farw Family: <i>Polypodiaceae</i>	June – December	<b>Habit:</b> Epiphytic <b>Habitat:</b> It is found in abundance on Mango trees and bougainvillea woody shrubs in urban parks and gardens.
3.	<i>Psilotum nudum</i> (L.) P. Beauv Family: <i>Psilotaceae</i>	All round the year	<b>Habit:</b> Epiphytic <b>Habitat:</b> It is found on the trunk of trees such as coconut palm, neem, etc. It is also seen as a weed amongst the indoor potted foliage plants. It is able to grow all through the year in pots placed in shade.

<b>B Terrestrial Ferns (PLATE B)</b>		
1.	<i>Adiantum philippense</i> L. Family: <i>Adiantaceae</i>	June – October <b>Habit:</b> Herb. <b>Habitat:</b> A terrestrial fern which prefers vertical distribution. It is found on moist shady places, along roadside compound walls and slopes. They need well drained substrate and direct sunlight. The exposure to sunlight although direct need be only for a limited period of time striking a fine balance of light and shade.
2.	<i>Athyrium hohenackerianum</i> (Kunze) T. Moore Family: <i>Woodsiaceae</i>	June – October <b>Habit:</b> Terrestrial/Epiphytic. <b>Habitat:</b> Grows on vertical walls, rock crevices along shady regions on the roads sides. It is often interspersed with <i>Adiantum philippense</i> and <i>Cheilanthes tenuifolia</i> . It has very delicate fronds, The plant needs high humidity.
3.	<i>Cheilanthes tenuifolia</i> (Burm. f.) Sw. Family: <i>Adiantaceae</i>	June – January <b>Habit:</b> Terrestrial/Epiphytic. <b>Habitat:</b> It is relatively common. Growing in tufts on barren rocks and Laterite surfaces. It dries up immediately after monsoons and remains as dried curly mass through summer.
4.	<i>Christella dentata</i> (Forssk.) Holttum Family: <i>Thelypteridaceae</i>	June – January <b>Habit:</b> Terrestrial herb. <b>Habitat:</b> A common fern in shaded regions in gardens and on banks of rain drains. Attractive foliage. It is found near public taps and domestic wells.
5.	<i>Nephrolepis cordifolia</i> Family : <i>Davalliaceae</i>	All round the year <b>Habit:</b> Terrestrial, gregarious herb. <b>Habitat:</b> Often cultivated. Found in large number in fully exposed roadsides vacant plots, water sources and occasionally building crevices.
6.	<i>Pityrogramma calomelanos</i> (L.)Link Family : <i>Adiantaceae</i>	June – March <b>Habit:</b> Terrestrial herb. <b>Habitat:</b> Grows in regions with moisture. Very diverse in habitat, grows in sandy soil, rocky surface and Laterite walls. Found in large clusters, rarely found as individual plant. Commonly associated with <i>Pteris vittata</i> .
7.	<i>Pteris biaurita</i> L. Family : <i>Pteridaceae</i>	May – December <b>Habit:</b> Terrestrial shrub. <b>Habitat:</b> Generally grows along shady wet places rich in humus. It is found near garbage dump runoffs. Although it is never in direct contact with the waste, it thrives on organic nutrients derived from the dump.
8.	<i>Pteris vittata</i> Family: <i>Pteridaceae</i>	All round the year <b>Habit:</b> Small and medium sized herb, Weedy potential. <b>Habitat:</b> Most adapted fern for developing cities. Grows undeterred on pipes, buildings, compound walls and even footpaths. It shares habitat with <i>Adiantum</i> , <i>Selaginella</i> , <i>Athyrium</i> and <i>Pityrogramma calomelanos</i> .
9.	<i>Pteris vittata "Nano"</i> Family: <i>Pteridaceae</i>	June – March <b>Habit:</b> Small <b>Habitat:</b> It is seen on tiles, brick and clay surfaces showing horizontal and vertical distribution. It shrivels and dries in the month of march. Revives in monsoons. Found in close contact with human dwellings such as outdoor steps and staircase made of concrete or metal.
10.	<i>Selaginella delicatula</i> (Desv. ex Poir.) Family : <i>Selaginellaceae</i>	July – November <b>Habit:</b> Epiphytic/Terrestrial herb. <b>Habitat:</b> It is common and occurs all on the compound walls of clay and Laterite. They need high humidity for survival. They appear post the first vigour of monsoon. Their live and flourish in immediate vicinity of homes.

<b>C Climbers (PLATE C)</b>			
1.	<i>Lygodium flexuosum</i> (L.) Sw. Family: <i>Schizaeaceae</i>	June – February	<b>Habit:</b> Creeper and climber. <b>Habitat:</b> Grows well in exposed regions in the shrubs. Prefers to grow in shaded patches in the soil at the base of large trees of the garden.
2.	<i>Stenochlaena palustris</i> (Burm. f.) Bedd Family: <i>Blechnaceae</i>	All round the year	<b>Habit:</b> Climbers <b>Habitat:</b> Shady fresh water marsh. It is found in abundance near temple ponds and places of worship having fresh water source. It grows on tall, upright trees having crowns exposed to sunlight.
<b>D Aquatic ferns (PLATE D)</b>			
1.	<i>Acrostichum aureum</i> Family: <i>Pteridaceae</i>	All round the year	<b>Habit:</b> Estuarine, marshy region <b>Habitat:</b> Grows gregariously in clusters along the track of the tidal flow, in Mangroves and back-waters.
2.	<i>Ceratopteris thalictroides</i> (L) Brong. Family: <i>Pteridaceae</i>	July – October	<b>Habit:</b> Aquatic (Fresh water) <b>Habitat:</b> It is found in submerged conditions in rain water drains of the city. The spiky sterile foliage is more luxurious in monsoons. The sterile leaves are very few at the base of the plant. It is very flexible and can withstand flowing water currents in the drain. They are not found post monsoons after the drying of the rain drains.
3.	<i>Marsilea minuta</i> L Family: <i>Marsileaceae</i>	July – December	<b>Habit:</b> Aquatic (Fresh water) <b>Habitat:</b> It thrives in rain water drains. Its abundant foliage is seen during monsoons. It can withstand the surging water currents in the drain and colonize the sides and surface of the flowing waters. They dry and shrivel post monsoons as the drains dry up.

Several studies report the ecology of ferns in forest areas and disturbed areas. Ferns are weedy colonisers of disturbed landscapes and are also found scattered among the rocks of semi-arid deserts, savannas, coasts and high alpine mountains where they resist drought, fire or cold temperatures (Walker and Sharpe et al, 2010). They have found their way into the urban habitat as ornamentals and weeds. The fern flora observed in Mangalore city represented a rich diversity representing 11 families namely *Adiantaceae*, *Blechnaceae*, *Schizaeaceae*, *Marsileaceae*, *Pteridaceae*, *Woodsiaceae*, *Polypodiaceae*, *Psilotaceae*, *Selaginellaceae*, *Thelypteridaceae* and *Davalliaceae*. Their adaptations and diversity studies in an urban ecosystem are limited. Their conservation is of importance from biodiversity perspective. Habitat study will help us to create special niches in urban ecosystem where the ferns can be accommodated and conserved. Peter Del

Tredici asserts that the management of spontaneous vegetation in urban areas to increase its ecological and social values is a sustainable strategy rather than an attempt to restore historical ecosystems existing before the establishment of the current city (Del Tredici, 2010). European ecologists have begun documenting the coverage of spontaneous urban vegetation in urban ecosystems using GIS technology (Herbst and Herbst, 2006; Rink, 2009). Ferns also provide aesthetic value to the abandoned areas in the city. Some of the ferns can even turn into a weed. The need to handle unwarranted growth of weedy ferns in urban areas is ever-increasing. Anthropogenic activities and land use are implicated along with climate change for weedy behaviour in plants (Clements et al, 2014). And the study of these urban dwellers can help not only to assess and conserve biodiversity but also to keep a check in time before the ferns providing aesthetic value turns into a weed.



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