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Potentiality of Wall Flora in Characterization of Urban Ecology

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Abstract - The urban biota and communities that live inside city limits are home to a wealth of flora diversity information. The distinctive plant assemblages inside the fallen city walls may be maintained in order to assess floral variety thanks to the presence of favorable growing variables including temperature, humidity, and nutrition. The kinds of plants at the vertices and the overall plant mix determine the success of the wall vegetation. In metropolitan settings, it is especially important to prioritize the use of advanced technologies in wall engineering to improve quality and encourage a diverse species composition. The natural and living wall not only cleans the air, keeps carbon footprints to a minimum, and maintains ecological harmony in the city, but it also provides important data on the shifting landscape. In addition to aiding in the recovery of rare, endangered, or foreign species, an evaluation of fortification walls and pavements may provide light on ecological issues and criteria. Understanding the wall flora, or cultural landscapes, is crucial to comprehending the historic artifacts and biological characteristics of any urban habitat.

Keywords - Wall Flora, Floral Diversity, Urban Ecosystem.

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INTRODUCTION

Wall floras are unique ecosystems shaped by human intervention, which are populated by a wide variety of organisms. They serve as a home for a wide variety of plant species due to their widespread distribution in urban areas. Plants used from historic structures provide a decorative touch and highlight the value of the structures itself. Biological diversity is encouraged and maintained by the structural complexity of the wall surfaces of old structures. It is important to conduct extensive research that describes the potential ecological properties of these ancient forms of field boundary because stone walls are cultural landscapes acting as "novel" ecosystems due to their uniqueness in the landscape, especially in isolated or exposed regions. It has been noted that the vertical surfaces of walls in urban areas host a variety of plant life, and as a result, there is a need to characterize the plant species composition and distribution pattern growing in these habitats in order to better understand, manage, protect, and enhance the ecological services provided by the walls and their associated vegetation.

Walls that have been cleaned and restored are a one-of-a-kind structure that attracts a wide variety of plants from the surrounding environment. Due to the high number of species of high conservation value found in near-natural vegetation remnants, the high number of native species found in urban areas, and the rich flora composed of native species that are well adapted to anthropogenic disturbance, along with a variety of species that are non-native or of uncertain origin, an overview of inventory data is necessary for the conservation of plant diversity. Both cultural legacy and rare and unusual anthropogenic environments rely on these ecosystems, therefore careful management of them is essential. The ecological engineering of walls might sometimes benefit from a close look at the plant assemblages found on walls as part of urban biodiversity. Wall surface heterogeneity should be evaluated holistically, with a focus on species composition and cleaning procedure efficacy. Thus, the advancement of wall ecology, emphasizing the unique qualities of walls that may sustain plant species, is necessary to successfully expand the physical complexity and quality of walls containing a

considerable potential habitat inside urban areas. Since wall flora provides such a diverse and high-quality habitat, it may be used as an "ecological tool" to measure and characterize urban biodiversity.

STRATEGIES

Preferable are strategies that aim to preserve both cultural artifacts and biological variety simultaneously. Species richness is promoted by wall surface heterogeneity while species composition is promoted by restoration techniques. Wall surface structure can be quantified using boosted regression tree analyses and non-metric multidimensional scaling techniques to detect the influence of abiotic site conditions on biodiversity. Large tree species may be a fundamental concern for the maintenance of walls. Thus, regular maintenance and cleaning provide a rare chance for native plant species to colonize walls on their own. Conservation of walls and their partner plant species might prevent the deterioration of these critical enabling components, which is essential for protecting the urban biological legacy from non-beneficial and detrimental consequences. When examining the makeup of families, life forms, life strategies, and dispersion strategies of plants in a wall microhabitat, canonical correspondence analysis might be a useful tool.

The three-dimensional structure of biofilms, the distribution of photosynthetic microorganisms on building surfaces, the impact of local seasonal microenvironments, the bio receptivity of stone, and the interaction among biofilms and their substrata can all be studied with image analysis. The presence of cyanobacteria was confirmed by optical and electron microscopy studies of microbial biofilms on limestone surfaces. The presence of eukaryotic algae, fungus, and bacteria with a high amount of scytonemin, which is responsible for the stone's black coloring, was also revealed by denaturing gradient gel electrophoresis and energy-dispersive X-ray spectroscopy research.

LITERATURE REVIEW

Banerjee, S.K., Singh, A.K., Bhowmik, A.K. & Jain, A. (2022) Researchers in Katni (M.P.) looked studied the air quality at several distances from the city's lime kilns to determine how widespread air pollution was in the region. Tens, fifties, hundreds, and hundreds of meters out from the emission source (Stack) were indicated on a grid. At all grid sites, summer and winter SPM, NOx, and SO2 air concentrations were calculated. In the North-West and South-East by using a large volume air sampler. All grid locations also had soil samples taken. In the south-east, north-northwest, northeast, and southwest, samples were taken and tested for physicochemical and microbiological characteristics. A link was established between soil parameters and the microbial population, and quadrats were set up to count the number of plant species present at various gird points. The data indicated that the 50 m grid point to the southeast saw the highest levels of air pollution throughout the year. As one moved farther away from the source of emission, the intensity steadily decreased. Distance from the source of emission was correlated with changes in soil pH, exchangeable Ca2, Mg2, and CaCO3, whereas changes in organic carbon, total and available N, available P, and microbial population were inversely proportional to distance from the source. Distance from the point of emission was positively correlated with the number of species present. The microbial population (bacteria, actinomycetes, and fungi) was shown to be negatively connected with soil pH, exchangeable Ca2 +, Mg2, and CaCO3, whereas the microbial population was favorably correlated with other attributes.

Bhagat, M., Sahu, P.K., Shah, R.P. & Soni, M. (2014) We conducted this analysis of dry tropical forest of sal dominating forest in Jaljali Manpat, Ambikapur (C.G.), in 2013 to better understand species diversity, structure, composition, and tree vegetation. For this research, 42 plots were established in woods that included 12 different tree species (reported e" 30 cm GBH) and an average of 4 seedlings and saplings of each species. Species richness, species diversity, basal cover, and relative density of saplings and seedlings were all quantified in this research of Mainpat Ambikapur CG trees. In most locations, Shorea robusta was found to have the highest IVI of saplings, whereas Sal had the largest basal cover area.

Bhatnagar, P., Bhalavi, R., & Lodhi, B., (2017) Seoni and Balaghat districts in the south-east of Madhya Pradesh state represent key lac producing zone in central India. Kerrialacca is an insect that produces lac by consuming the nectar of certain tree species' succulent twigs and branches. There are a number of potential substitute host tree species in the area, despite Palas (Buteamonosperma) being the most common host tree species there. In August of 2016, the authors conducted a biodiversity study of lac host plant species in this area as part of an all-India network project led by the Indian Institute of Natural Resins and Gums, Ranchi. Researchers traveled widely across the research region, mapping out where clusters of host plants were found. Plant diversity was evaluated by laying out quadrats in

these areas to explore different aspects of the putative host plants' ecology and development. With an average density of 114 and 138 trees per ha. in the Balaghat and Seoni districts, respectively, Palas was determined to be the most abundant and most frequently occurring host species in the area. In addition to Schleichera oleosa and Acacia nilotica, Acacia catechu, Acacia nilotica, Acacia auriculiformis, Annona squamosa, Diospyros melanoxylon, Pterocarpus marsupium, and Bija were also recorded as hosts in the quadrats. With an average density of 16 and 17 trees per ha. in the Balaghat and Seoni districts, respectively, Ber was determined to be the far second species in terms of abundance. The average tree density of the alternative host plants was 16 per hectare. The host species were discovered in many habitats, including forests, farms, and industrial waste areas.

Kumar, Abhishek & Patil, Meenu & Kumar, Pardeep & Kumar, Manoj & Singh, Anand. (2022) Some of India's most vulnerable ecosystems may be found in the Himalayan foothills, often known as the Siwaliks. Both natural conditions (such as geological formation and climatic change) and human-mediated forces (such as sandstone mining, urbanization, and development activities) contribute to deterioration. A total of 20 million people depend on the Siwaliks for their survival, therefore it's critical that we do everything we can to protect this ecologically delicate area. The application of ecological concepts to the protection and management of natural resources holds enormous promise. These guidelines provide environmentally sensitive and damaged habitats like the 'Siwaliks' with natural, long-term solutions to their sustainability issues. However, more study is needed to help managers make educated choices based on facts. As a result, a comprehensive study was performed to evaluate the trends and gaps in plant ecological research in the Indian Siwalik area. This paper followed standard procedures and performed bibliometric studies on the existing peer-reviewed literature. The number of published scientific works was found to be rising, with the majority of research being conducted in the Siwalik area of the Indian state of Uttarakhand. Plant ecology has been studied, although not as extensively as landscape ecology and ecosystem ecology. Based on our research, it seems that there is a rising interest in the plant ecology of the area; yet, given the complexity and variety of this ecosystem's structural and functional features, the number of studies conducted so far seems inadequate. We also saw a movement towards ecological modeling research as a result of advancements in computer application and the availability of remote sensing satellite data, while experimental evidence still has to be addressed.

EXPLORATION OF GLOBAL WALL FLORA

Several research projects focusing on ancient and historic towns throughout the globe painted a picture of taxonomic and life-form complexity among the flora. Despite the fact that studies of the wall flora in the world's oldest city, varanasi, India, have recorded dicotyledonous angiospermic group of native woody plants, another study conducted in a separate area of the city shows the dominance of therophytes, mostly alien species, over other forms of life. Taxa that are not native to Italy's flora were recorded in an inventory of the vascular flora of metropolitan Rome. Anatolian Istanbul's vascular wall flora is a peculiar urban ecologic wall habitat because to the unusual mix of Euro-Siberian, Mediterranean, Eastern Mediterranean, Iranian-Turanian, and unidentified phytogeographical species. Most vascular plants were documented on the walls of a historic building in Sanliurfa, South-East Turkey. These plants ranged from heliophilous to shade-tolerant, and a large variety of foreign species were present, with hemicrytophytes and therophytes being the most prevalent. Archaeologists who studied the wall flora of Roman ruins used phytosociological methods, and what they found was that various classes of plants grew in different kinds of communities.

There is a decrease in species diversity from base to top, as is typical of European and Mediterranean wall floras, and annual species are more common on the wall surface than perennials, which are more common at the base and in the surrounding area, according to documentation of flora at the National Architectural Reserve of the Old Fortress Wall on Antique Pautalia and Medieval Velbuzhd. For example, the chorological analysis of the vascular flora of the walls in Siena, Monteriggioni, Pienza, Grosseto, Arezzo, Massa Marittima, Pitigliano, Sansepolcro, and Cortona reveals a boreal-tethyan dominance relative to the eurosiberian and boreal, and reveals that species living on walls are typically ruderal and stress tolerant. Herbs, bushes, trees, and climbers make up the bulk of the flora and fauna seen in the Gingee fort walls and temple towers at Villupuram, Tamil Nadu. Byzantine Wall floras of the city of Thessaloniki shows an inventory of taxa of vascular plants from a wide range of life forms, whereas analysis of the wall and pavement fragments at the Nebet Tepe Architectural Reserve in Plovdiv (Thracian Plain) reveals a relatively high proportion of ruderals and weeds with

hemicryptophytes and therophytes being the largest flora group.

Lichens and certain bryophytes prefer the upper portions of the wall; lichens like rock surfaces whilst bryophytes favours the joints. A study of urban wall flora in Christchurch and Dunedin, New Zealand, found that the majority of species were non-native. Similarly, a study of murophyte diversity in Gorakhpur, India found that there were more dicots than monocots. Finding "an urban cliff effect" on wall habitats and plant species richness varying across wall types, a study of the river Thames in central London's urban river walls reveals this to be the case. The "mass effect" idea, which states that the majority of species found in disturbed regions are found in riparian habitats, leads to the conclusion that urban flora is controlled by propagule pressure from residual or new ecosystems. Trees, then ruderals and garden escapees, were the most common types of vegetation atop Hong Kong's brick retaining walls, with indigenous outnumbering exotics 10 to 1. Researchers in the Czech Republic analyzed the wall flora of southern and western Moravia and found vascular plants, bryophytes, neophytes, and foreign species.

Diatom species, which are often aerophilic and cosmopolitan in character, predominate in the assessments of cave ecosystems equipped with artificial and natural lighting, which represent underground habitats. In addition, a case study conducted in Pune, India demonstrates the usefulness of secondary sources data in recording extinct and extant species of dicot and monocot groups gleaned from wall flora.

FAVOURABLE CONDITIONS FOR EMERGENCE OF WALL FLORA

According to research done in the old RTO Office Sidhi, Chandreh temple, Churhat old Garhi building, Govt. Girls College, Govt. SGS college old building Sidhi district, (M.P.) a profusion of flora is favored by PH, macro and micro nutrients, necessitating mechanical and chemical management measures. Colonization of algae and cyanobacteria on building façades is affected by a number of environmental parameters, including but not limited to precipitation, thermal amplitude, hygrometry, sea distance, and proximity to vegetation. Brick walls in extensively engineered urban river corridors show a greater diversity of plant life than sheet piling does, owing to significant variations in surface integrity between the two materials. Vegetation in caves becomes more diverse as temperatures rise.

In certain locations, the composition of the wall floristics that symbolize the "urban characteristic" changes significantly during the seasons. The majority of the non-woody wall flora was recorded during the rainy and winter seasons, with Asteraceae, Poaceae, and Amaranthaceae as the dominant families at the hostel of Govt. Girls college Sidhi, old building of Govt. SGS. College Sidhi, old building of State bank of Sidhi., PWD rest house Sidhi, old building of RTO office Sidhi, old building of collectorate, old building of Sanjay Tiger reserve office Sidhi district (M.P.), India. Maximum species observed during rainy season, followed by maximum species throughout winter and summer, and murophytic species appear on the wall of the research site year-round, according to seasonal analysis of wall flora in Sidhi district M.P, India.

Lichens and mosses are indications of water and nutrient availability in a wall environment. Medium-sized plants such as herbs, shrubs, and seedlings need the combined effect of water-nutrient availability and habitat connectivity, whereas giant trees demonstrate dependence on the larger-scale habitat size element. The establishment of wall vegetation is encouraged by natural ecosystems that are spatially adjacent, since they provide reliable sources of seed, water, nutrients, a pleasant microclimate, and clean air. The availability of diaspores from the surrounding semi-natural vegetation is crucial to the colonization of walls by vascular plants.

Location- Churhat Garhi

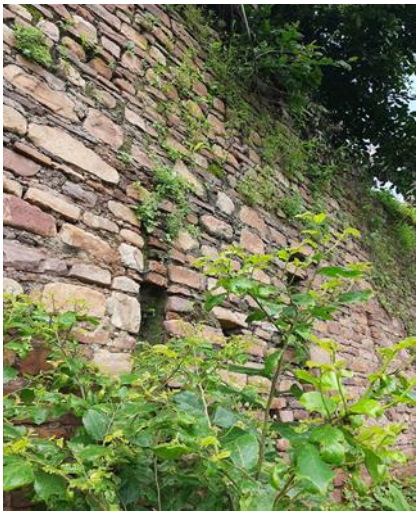
Location- Gaughat, Sidhi

Location- Churhat Garhi

Location- Goriyara Dam

Location- old Builing of SBI Sidhi

Location- GDC College Campus Sidhi



Location- Govt. old ware house Madhuri, Sidhi

Location- old Tribal Hostel Building Sidhi

Location- Govt. SGS PG College Sidhi

Location- Govt. GDC College Sidhi

Location- Old RTO Office Sidhi

Location- Old Building State Bank of India Sidhi

BENEFITS

Stone retaining walls are used in harbor reclamation and terracing hill slopes to assist maintain the steep faces between adjacent hill slope platforms and create developed land. Vegetation has taken hold of these man-made cliffs in the middle of the city. Firm attachment to the vertical habitat and exploration of proximal soils are shown by the polymorphic roots' morphological flexibility and self-grafting nature, as well as by the many types of interactions with wall niches. For healthy root development, the aft-soil behind the walls acts as a catchment.

Preserving parks and green walls in the city provides a benchmark against which to evaluate the city's continually evolving pattern of land use. The reconciliation ecology idea is supported by several instruments and crucial "bottom-up" strategies, including the existing natural wall flora and living

roofs and walls built in metropolitan locations. They provide habitat for a wide variety of taxa at regional scales, and may serve as a "science model" for how humans and other species use urban areas. Most riparian species in urban ecosystems rely on extensively designed urban river walls as their primary home, making these barriers ideal locations for implementing reconciliation ecology. The insulating and purifying effects of green walls in urban settings are well-known. Environmental advantages from covering a building's exterior with a vertical garden include lower energy use and a smaller carbon impact. Therefore, the design and assessment of vertical gardens in the future should get particular attention. Ivy (Hedera helix L.) is one such plant that may contribute to a building's preservation via its biodeteriorative function because its rootlets penetrate tiny crevices in the wall and create a microclimate that protects the wall from frost and salt damage. Plant communities growing on walls may be limited in their dispersal by variables such as light nitrates and water content. Shrubs replace trees in the top section of the ecosystem, which may be used to assess biodeterioration issues and learn more about plant communities as bioindicators of environmental factors.

It is possible that recovering rare and endangered plant species may greatly benefit from wall flora research. Cerastium tauricum Spreng and Melica transsilvanica Schur, both native to the flora of the Thracian Plain, were discovered during an investigation of the walls and pavements at Garhi Building Churhat, Goriyara Dam Sidhi, Gaughat Sidhi, and Old SBI building Sidhi. Similar results are found while analyzing the campus flora in Sidhi district, (M.P.), India, where the endangered Acacia nilotica is discovered.

Morphological Differences between the plants of Lantana Camara, Calotropis Procera

Morphological characteristics of Calotropis Procera

The flowers of the calotropis, a huge, bushy shrub, have a purple corolla with upright lobes, and their leaves are decussate, obovate, coriaceous, auriculate. Morphological analysis of the leaves found that they are subsessile, measure between 6 and 15 centimeters in length and width, and may be broadly ovate, ovate-oblong, elliptic, or obovate. They are acute, pubescent when young, and glabrous on both sides when fully mature (Figure 1).

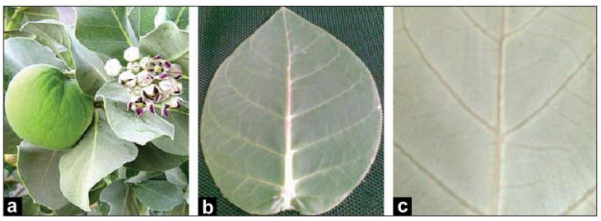


Figure 1: The Calotropis procera leaf has the following characteristics: (a) a twig with oppositely placed subsessile leaves; (b) broad ovate or elliptical, cottony, pubescent when young, and glabrous when mature; (c) a portion of the lamina displaying venation pattern.

Tabulated in Table 1 below are the quantitative and qualitative findings from our study of these leaf samples. Leaves, because to their photosynthetic mechanism, are both a source of and a sink for a wide variety of bioactive chemicals. Identification of this medicine would benefit greatly from macroscopic and microscopic analysis of Calotropis procera leaves, as well as quantitative assessment of leaf constants.

Table 1: Calotropis procera leaf constants

Leaf constant	Value
Stomatal index	44
Stomatal number	11
Palisade ratio	14.7
Vein-islet number	25.1
Veinlet termination number	19.6

Morphological identification of plant Lantana camara

From a morphological perspective, the most important features are shown in (Table 2; Fig. 2). Flavonoids and phenolics concentration: According to these findings, the phenolic and flavonoid content of red flowers is highest, followed by that of deep yellow petals.

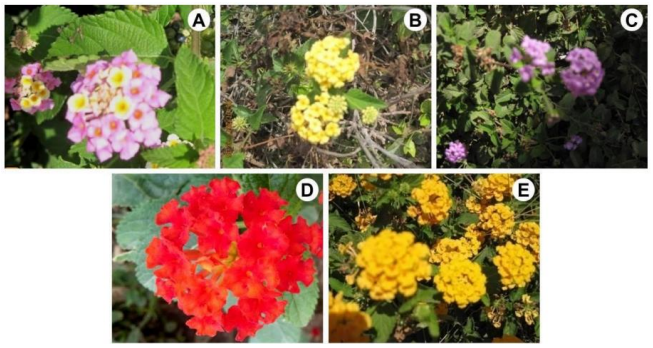


Figure 2: The samples of various hues that were gathered. A, Multicolor; B, Pale Yellow; C, Deep Purple; D, Red; and E, Dark Yellow samples

Table 2: Lantana camara morphological features analyzed throughout a spectrum of flower hues

Habit	Character	Multi Colour	Pale Yellow	Deep Yellow	Deep Purple	Red
		Shrub	Herb	Herb	Herb	Shrub
Leaves	Blade Max width (cm)	4.5	1.6	2.5	1.8	3.6
	Blade Max long (cm)	6.0	3.0	3.3	3.0	7.0
	Petiole length (cm)	1.5	0.5	0.8	0.3	1.3
		Decussate	Decussate	Decussate	Decussate	Decussate
	Textile	Rough	Smooth	Rough	Smooth	Rough
	Blade	Large	Small	Small	Small	Large
	position	Opposite	Opposite	Opposite	Opposite	Opposite
	Shape	Ovate	Lancelate to ovate	Lancelate	Ovate	Ovate
	Margin	Serrate	Serrate	Serrate	Crenate	Coronate
	Apex	Acuminate	Acute	Acute	Acute	Acuminate, acute
	Color	Dark green	Pale green	Pale green	Pale green	Pale green

LIMITATIONS

Historic sites in Sidhi district, hostel of Govt. Girls college Sidhi, old building of Govt. SGS. College Sidhi, old building of State bank of India, Sidhi., PWD rest house Sidhi, old building of RTO office Sidhi, old building of collectorate, old building of Sanjay Tiger reserve office Sidhi and Chandreh temple, Churhat old Garhi building, old Forest rest house Jamodi, are home to a wide variety of annual therophytes and dicot adventitious species, as well as fissuring perennial trees that pose a significant risk to bulwark walls and degrade the site of Chella (Roman ruins). Biodeterioration of stone cultural heritage by green algae and fungi is a serious problem that calls for a comprehensive ecological study, including the development of novel molecular and laboratory-based simulation techniques and the construction of robust models integrating biotic and abiotic factors for use in the prediction and management of microbial growths on these historic stones. Biodegradation of the substratum due to cyanobacterial biofilms has been linked to aesthetic and structural harm to cultural artifacts.

Autotrophic organisms, often known as lampen flora, thrive in artificially lit cave environments that humans have constructed. Exocellular polymeric substances (EPSs) are produced by these organisms, which mostly consist of blue-green algae, diatoms, chlorophytes, mosses, and ferns and are comprised of polysaccharides, lipids, proteins, and nucleic acids. To facilitate the adsorption of cations and dissolved organic compounds, the anion-enriched EPS matrix joins with intercellular connections and takes part in chemical exchanges with the substratum. Mineral surfaces corrode as a result of the metabolic activities of heterotrophic bacteria inhabiting biofilms.

CONCLUSION

In conclusion, wall floras as a dynamic ecosystem play a vital role in identifying floral variety, providing a safe haven for a wide range of life forms, and preserving ecological parameters, all of which have the ability to shed light on the long-standing historical and natural ecology of urban areas.

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