

Impact of Urbanization on Indigenous Carnivorous Plants Species: A study from Bhubaneswar Smart City, Odisha, India

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ABSTRACT

Carnivorous plants are wonder of nature which provides a wide aspect of research areas that can help to unlock evolutionary secrets. Around 860 unique species of flesh-eating plants are reported worldwide out of which 5 genera belong to 3 families of carnivorous plants are recorded in India. These plants are seen in areas with abnormal natural conditions and low nutrient supply. But in the modern technological era, due to human activities like urbanization, these plants are on the way to extinction. From the study, it was observed that large number of construction activities in study site urban areas like Bhubaneswar smart city can greatly alter abiotic and biotic components of the native ecosystem. The carnivorous plants play an important role as ecological indicator. Construction of large scale infrastructure in the name of urbanization causes reduction in indigenous species and terrestrial insect diversity which alternately promoting the proliferation of exotic species (BCA- 0.466; ACA- 0.483) and threat to carnivorous plant diversity.

Key word: Carnivorous plants, Urbanization, Conservation, Exotic species, Bhubaneswar.

Introduction

In the modern society, urbanization helps to improve the facilities that provide favourable conditions for human sustainment. As per the report presented by global projections of urban expansion, it was estimated that nearly 36–74 million hectares of land will be utilized for urbanization by 2100, out of which 11–33 million hectares comes under natural habitats (Li, *et al.*, 2022). Urbanization has a remarkable influence on ecosystem by altering its abiotic and biotech properties which not only influence the

living organism but also the mechanism of interaction between them (Kondratyeva *et al.*, 2020). Various urbanization activities (i.e construction) greatly interference the environment conditions leading to climatic change, loss of diversity, pollution, invasive plants proliferation, variation in the natural systems and many more which causes great threat to all types organism (Li *et al.*, 2022; Dylewski *et al.*, 2023; Hou *et al.*, 2023).

The nutrient present in the soil helps in which plant grows and proliferates as one of the major factor which regulate plant's metabolic activities. Car-

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nivorous plants (CPs) are those evolved species of plant which derive the nutrition (which kind mention) by trapping small animals like insects, small fishes, protozoa, etc. in their modified organs like bladderworts (Ellison and Adamec, 2018; Cross, 2020). These plants are very small in size (2- 5 cm) and are mostly observed near swampy places or in small water bodies that are devoid of few essential nutrients (organic carbon and minerals) required by the plants. Identification of the plants become in wild like humid tropical rainforest as well as locations near urban areas. (Mulligan, 2021). In recent years most of the research activities on carnivorous plants are focused on the studies related to biodiversity, ecology and molecular phylogenetic but few works have been recorded on medicinal aspects and conservation of these plants (Jennings and Rohr, 2011; Clarke *et al.*, 2018). In a counter measure the International Union for the Conservation of Nature and Natural resources (IUCN) established Carnivorous Plant Specialist Group (CPSG; <http://www.iucncpsg.org/>) to monitor the conservation activities for protection of CPs but no significant review has been done by CPSG for systematic analysis and categorization of processing related to carnivorous plants (Clarke *et al.*, 2018; Jennings and Rohr, 2011).

Diversity of Carnivorous plants

Around 860 unique species of flesh-eating plants are reported worldwide representing 20 genera under 12 families with nearly 10 distinct evolutionary lineages (Mishra *et al.*, 2023). The largest number of carnivorous plant species (~300 species) is found in *Utricularia* genera belongs to Lentibulariaceae family. There are five genera (*Aldrovanda*, *Drosera*, *Nepenthes*, *Pinguicula* and *Utricularia*) belonging to 3

families (Droseraceae, Nepenthaceae and Lentibulariaceae) reported so far from India. In Odisha, 16 species of *Utricularia* and 3 species of *Drosera* are reported till date (Mishra *et al.*, 2021).

Materials and Methods

Field Study

Field survey was carried out several times to observe the impact of constitution activity on local ecosystem, occurrence of invasive species and carnivorous plant diversity and their impact on local environment. A sum total of 30 plots were monitored randomly in and around Bhubaneswar smart City including Chandaka Reserve Forest for over 1 year time duration in regular intervals (July 2022 to September 2023). The number of local species and number of alien/exotic species were recorded before construction activity (BCA) and after construction activity (ACA).

Data analysis

The data recorded in prescribed tabular format with the help of Microsoft Spreadsheet and ANOVA software. For development of background of the current study, different secondary literatures are referred from different databases (Web of Science, NCBI, Research Gate, etc) and systematically analyzed as per the PRISMA (2020) flowchart mentioned below.

Results

In recent years a drastic decline in the diversity of terrestrial insects in marked due to loss or degradation of landscape primary as an outcome of urbanization (Fenoglio *et al.*, 2020). Small carnivorous plants like *Drosera* and *Utricularia* genera are kind of predator of insects that demonstrates the plant and prey interaction (Axel Mithöfer, 2022). But due to

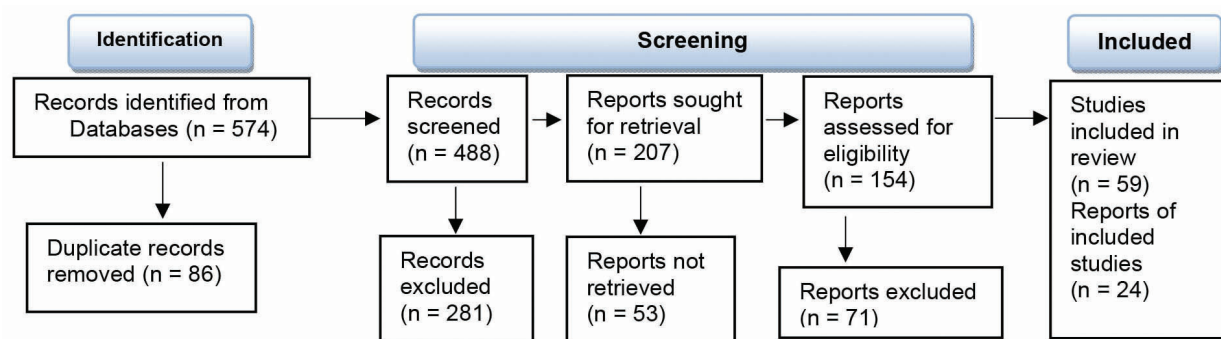


Fig. 1. PRISMA flowchart indicating the identification of studies via Database and number of literatures reviewed for the present study.

urbanization there is an unbalanced in the interaction leading to loss of indigenous plant diversity. Besides scarcity of prey, the indigenous carnivorous plants species also face a great threat from impact of exotic invasive species. Invasive alien species are highly adaptive in nature and can rapidly wide spread over a larger area even under adverse conditions, as a result a high competition appears among the species for utilization of limited resources (Monty *et al.*, 2013).

The current study shows that, construction activities (i.e. house, transportation, office, roads, etc.) can greatly disturb the native ecosystem. During the study period of last six months, large number of residential construction activities has been observed in and around the Bhubaneswar smart city that highly declined the number of indigenous plant species. In comparison to native species, the number of invasive alien plant species shows a slow but steady elevation (Figure 2). Before six month back, *Drosera* species and *Utricularia aurea* were marked only in two study sites in Chandaka Forest where there was no construction activity earlier. During the field visit in the early stage of the current study (October 2022), on sites of Lingipur, Bhubaneswar, *Drosera spp.* was also noticed and recorded but due to construction activity impact (April, 2023) the species was not further noted.

Discussion

Urbanization has been in the focused area that correlates its impact on ecosystem, environment, economics and many more. Rapid development in urban/cities can lead to formation of new niche which

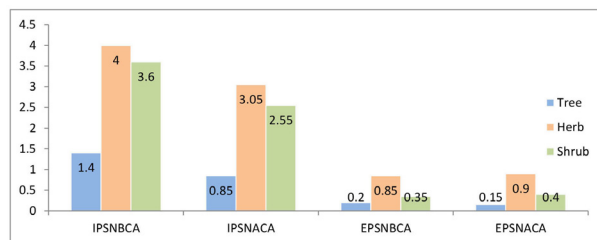


Fig. 2. Impact of construction activity on indigenous and exotic plants recorded in all the 30 plots before and after construction activities (IPSNBCA- Indigenous Plants Species Number Before Construction Activity; IPSNACA- Indigenous Plants Species Number After Construction Activity; EPSNBCA- Exotic Plants Species Number Before Construction Activity; EPSNACA- Exotic Plants Species Number After Construction Activity).

facilities the growth and proliferation of alien species (Marques *et al.*, 2020). Carnivorous plants such as *Sarracenia purpurea* are invasive in nature and can alter the ecosystem by affecting small invertebrates like Formicidae and Diptera (Wycke *et al.*, 2018). Construction causes alteration in the surrounding ecosystem which was marked that, with high construction activities the number of indigenous plants (tree, herb and shrub) species was reduced. In case of exotic plants, the number tree species was reduced due to accumulation of dust particles produced from construction sites and cutting down of trees for construction site preparation but there is slight increase in the number of herb and shrub species (Figure 3). *Utricularia aurea* and *Utricularia stellaris* are indigenous to Bhubaneswar and were observed in different urban location whereas *Utricularia bifida* was observed in the Chandaka Forest. *Drosera natalensis* was observed near the outside location of Bhubaneswar close to the buffering zone of Chandaka Forest (Figure 3). It was noticed that construction activities disturb the balance between the plant species in the ecosystem and to stabilize the balance an interchange in plant species population. During the study, *Chromolaena odorata* and *Lantana camara* which are exotic and invasive species were observed in most of the construction sites in and around Chandaka Forest and Bhubaneswar area (Figure 3).



Fig. 3. a-Occurrence of *Chromolaena odorata* near road construction site inside the Chandaka Reserve Forest, b- *Drosera* and *Utricularia* spp. observed near the Chandaka Forest area, c- Detection of carnivorous plants in Chandaka Forest, d-g-impact of construction before and after at study sites of Lingipur, Bhubaneswar area .

Conclusion

Urbanization can provide a better sustainable future for human civilization but in return it can destroy the Earth's environment. Urban development can alter the native ecosystem which disrupt the biogeochemical cycles, affecting the interaction between the biotic and abiotic components. Indigenous plant and animal species are adversely affected while the introduced exotic/invasive species get benefited by urbanization activities. In the current study it was recorded that due to construction activities the indigenous plant species (Tree, Herb and Shrub) population declined gradually (BCA-3.00; ACA- 2.15). Construction activity was seen in one of the three areas where indigenous carnivorous plant species were marked which caused loss of *Drosera spp.* If in nearby future any more construction activities took place it will greatly affect the carnivorous plants. Before devastation and disappearance of the carnivorous plants and indigenous plant due to construction sites, major afforestation and conservation of the native plants in different ways should be care taken.

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Conflict of Interest

Authors declare no conflict of interest.

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