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RESEARCH COMMUNICATION

Floral diversity and ecology in Kalyani area of Nadia district, West Bengal, India

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Abstract

An assessment of plant diversity was carried out to record different species of flowering plants (Angiosperms) in Kalyani township of Nadia district, West Bengal, India during January, 2014. All together 6 quadrats were laid down, and 30 flowering plant species belonging to 15 families were documented. Voucher specimens were preserved and digitized in departmental phyto-informatics center. Frequency and density varied greatly among the taxa, while many species were not evenly abundant in the study area. Out of total species, 11 species can be used as economic and medicinal plants. There are also some alien invasive species of diverse origin.

Keywords: diversity; quadrat; biological invasions; medicinal plants

Introduction

The state of West Bengal is located between 85° 50' and 89° 50' E and 21° 38' and 27° 10' N, and one of the biodiversity rich states in India (Talukdar and Talukdar, 2012; Talukdar, 2013a). The lower Indo-Gangetic basin constitutes fertile hub for diverse types of flora and fauna (Biswas *et al*., 2014). The Nadia district is an important part of this basin, dotted with numerous wetlands, forest covers and agricultural lands (Talukdar and Talukdar, 2012). Kalyani (between 22° 945' - 22° 995' N latitude and 88° 41' - 88° 47' E longitude) is situated at the southern part of the district Nadia. Since its establishment several changes have taken place in the town. It is 50 km away from the capital of West Bengal, Kolkata, with mean height 7.8 msl. The soil is mainly Ganga riverine, alluvial, and arsenic contamination has recently been reported in soil, water and crops grown in this region (Talukdar, 2013b-d, 2014; Talukdar and Talukdar, 2013a, 2014). Climatically, Kalyani represents typical tropical monsoon and thus, has magnificent reserve of plant resources (Roy and Mukherjee, 2011).

However, due to excessive deforestation, human settlements, agriculture, and industrial activities the fate of local biodiversity and the future of huge human population depending on plant resource are now in danger. Despite rich in floral diversity, limited information is available regarding status and conservation of flora in this region. No comprehensive zone wise study for floral diversity has been carried out in Kayani. Considering all the above perspectives, the present field study was undertaken around Kalyani township area. Main objectives of the study were 1) inventorizing plant community, 2) to perform ecological analysis, and 3) to identify plants used in various purposes, especially for herbal medicine in the study area.

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Materials and Methods

Study area

The present study was conducted in and around Kalyani University Campus area, which is located outskirts of the main township of Kalyani, Nadia, West Bengal, India.

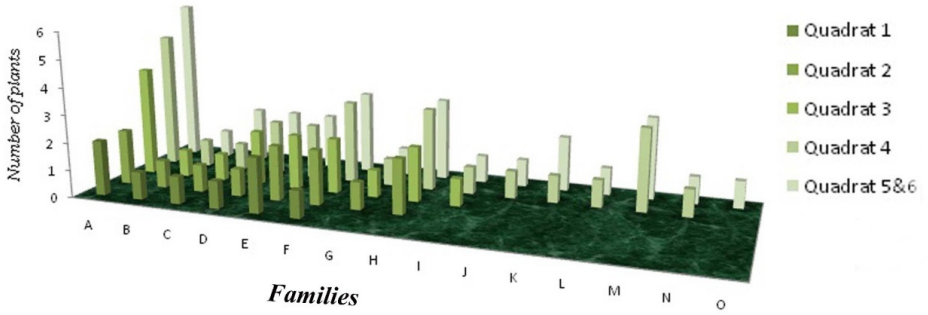

Fig 1. Comparison of families with different number of plant species found in each of 6 quadrats; In the quadrat 5 and 6 Asteraceae (A) contained highest taxa,followed by (B) Oxalidaceae (1), (C) Malvaceae (2), (D) Lamiaceae (2), (E) Poaceae (20, (F) Acanthaceae (3), (G) Convolvulaceae (1), (H) Amaranthaceae (3), (I) Ulmaceae (1), (J) Rubiaceae (1), (K) Fabaceae (2), (L) Chenopodiaceae (1), (M) Solanaceae (3), (N) Asclepiadaceae (1) and (O) Scrophulariaceae (1).

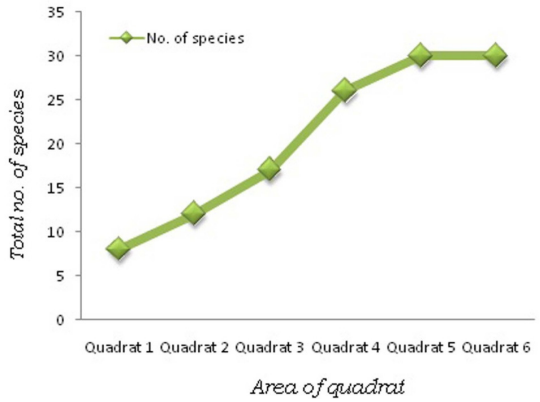

Fig. 2. Comparison of area of quadrats with total number of species. Quadrat no. 1 contains lowest number of species (8), Quadrat no. 2 (12), Quadrat no. 3 (17), Quadrat no. 4 with (26) and finally Quadrat no. 5 and 6 contain (30) species each and thus forming a plateau.

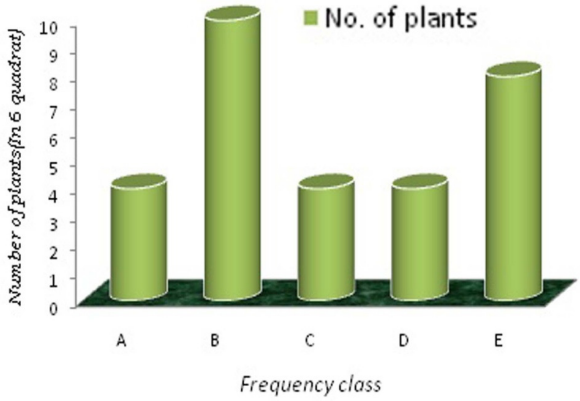

Fig. 3. Distribution of plants species in the study area under 5 frequency classes; A: 0-33.34%, B: 34.34%-50%, C: 51%-66.67%, D: 67.67%-83.34% and E: 84.34%-100%, based on frequency percentage at Table 1.

The study area was along the roadside coming straight from Kalyani Ghoshpara railway station to the Kalyani University campus in West Bengal, India.

Field study

Field work was carried out during January, 2014 to document vegetation and their uses by local communities. In study site 6 quadrats were randomly laid down for sampling of herbaceous species. This is done by sampling the vegetation with a nested quadrat method. Nested quadrats are series of quadrats laid over the others with gradually increasing size. In the present study, minimal and maximal sizes of quadrat were 30 cm^2 and 180 cm^2, respectively.

Density, frequency and abundance of plant species were determined on the basis of individual species observed in the quadrats lay. Diameter at breast height (at 1.35 m from the ground) of all the trees with >30 cm circumference in each quadrat was measured and recorded for each tree species. The plant species were identified using regional flora, IPNI (International Plant Names Index; www.IPNI.org), and herbarium collection in the Central National Herbarium, Sibpur, Howrah. Voucher specimen was deposited at departmental herbarium. Additionally, collected preserved/dried specimens have been digitalized as virtual herbarium (RPMC-H) in the 'Digital Phyto Informatics Center' of the Department of Botany, R.P.M. College (www.rpmcdigitalphytoinformatics.com), Uttarpara, Hooghly, West Bengal, India.

Ecological parameters

Baseline data of total plant number, frequency (%), density and abundance were calculated following Talukdar and Talukdar (2012). The plant specimens are enlisted by using a series of square quadrats as mentioned above.

Table 1. Number, frequency (F), density (D) and abundance (AB) of plants in square quadrat methods (minimum: 30 sq cm and maximum: 180 sq cm), data pooled from selected study site and 6 quadrats (Q1-6)

Sl. no	Botanical names, habit and family	Number of individuals of the species in various quadrats						Total (a)	Total points of occurrence (b)	Density D=a/6	Frequency (%) F=(b/6)x100	AB=a/b	Frequency class
		Q1	Q2	Q3	Q4	Q5	Q6						
1.	*Achyranthes aspera* L., M, Herb, Amaranthaceae		1	5	8	10	13	37	5	6.1	83.3	7.4	D
2.	*Amaranthus spinosus* L., V, Herb, Amaranthaceae				1	2	4	7	3	3.6	50	7.3	B
3.	*Alternanthera sessilis*(L.) R.Br.ex DC, M, Herb, Amaranthaceae		2	4	5	8	12	31	5	5.1	83.3	6.2	D
4.	*Ageratum conyzoides* L., Herb, Asteraceae	3	7	15	18	24	30	97	6	16.1	100	16.1	E
5.	*Mikania micrantha* Kunth., Climber, Asteraceae	1	4	8	8	12	16	49	6	8.1	100	8.1	E
6.	*Cynodon dactylon* (L.) Pers., M, Herb, Poaceae	40	100	200	280	370	480	1470	6	245	100	245	E
7.	*Oxalis corniculata* (DC.) Raeusch, M, Herb, Oxalidaceae	6	10	18	25	32	40	131	6	21.8	100	21.8	E
8.	*Sida cordifolia* (Burm. f.) Borssum, Herb, Malvaceae	1	1	2	4	10	15	33	6	5.5	100	5.5	E
9.	*Ocimum basilicum* L., M, Shrub, Lamiaceae	1	2	4	5	7	84	103	6	17.1	100	17.1	E
10.	*Hemigraphis hirta* L., Herb, Acanthaceae	1	4	44	50	57	62	218	6	36.3	100	36.3	E
11.	*Digitaria* sp., Herb, Poaceae	5	12	15	20	28	65	145	6	24.1	100	24.1	E
12.	*Evolvulus nummularius* (L.), L, Herb, Convolvulaceae		4	5	7	7	10	33	5	5.5	83.3	6.6	D
13.	*Rungia pectinata* Nees., Herb, Acanthaceae		20	25	32	37	45	159	5	26.6	83.3	31.8	D
14.	*Trema orientalis* Bl., F, Tree, Ulmaceae			2	3	3	5	13	4	2.1	66.6	3.2	C
15.	*Synedrella nodiflora* Gaertn., Herb, Asteraceae			3	6	8	10	27	4	4.5	66.6	6.7	C
16.	*Clerodendrum viscosum* Vent, Shrub, Lamiaceae			1	1	1	2	5	4	0.8	66.6	1.2	C
17.	*Xanthium indicum* L., Shrub, Asteraceae			2	3	3	8	16	4	2.6	66.6	4	C
18.	*Oldenlandia corymbosa* L., Herb, Rubiaceae				1	3	5	9	3	1.5	50	3	B
19.	*Tamarindus indica* L., M, Tree, Fabaceae				1	1	2	4	3	0.6	50	1.3	B
20.	*Chenopodium album* L., Herb, V Chenopodiaceae				1	1	1	3	3	0.5	50	1	B
21.	*Cestrum diurnum* L., Shrub, Solanaceae				1	2	4	7	3	1.1	50	2.3	B
22.	*Calotropis procera* (Aiton), W.T.Aiton, M, Shrub, Asclepiadaceae				1	1	1	3	3	0.5	50	1	B
23.	*Physalis minima* L., Herb, Solanaceae				1	2	6	9	3	1.5	50	3	B
24.	*Vernonia cinerea* L., Herb, Asteraceae				1	3	3	7	3	1.1	50	2.3	B
25.	*Peristrophe bicalyculata* Nees, Herb, Acanthaceae				1	2	6	9	3	1.5	50	3	B
26.	*Solanum xanthocarpum* Schrad & Wendl, Herb, Solanaceae				1	1	1	3	3	0.5	50	1	B
27.	*Cassia sophera* L., M, Herb, Fabaceae					1	2	3	2	0.5	33.3	1.5	A
28.	*Gnaphalium pensylvanium* Herb, Asteraceae					1	3	4	2	0.6	33.3	2	A
29.	*Hibiscus vitifolius* L., Herb, Malvaceae					1	1	2	2	0.3	33.3	1	A
30.	*Lindenbergia indica* L., Herb, Scrophulariaceae					1	4	5	2	0.8	33.3	2.5	A

Results and Discussion

Plants are the vital part of the world's biological diversity and an essential resource for human well-being. Besides the crop plants that provide our basic food, thousands of wild plants have great economic and cultural importance for vast numbers of

people throughout the world. The IUCN and its Species Survival Commission in accordance with various rules and recommendations of Ramsar Convention and convention on Biological diversity (1992) adopted the global strategy for plant conservation, including functional ecosystem diversity in wetlands and medicinal plants conservation (Hamilton, 2004; Leaman, 2006; Mishra and Sinha, 2012).

In the present study as many as 30 plant species (angiosperms) distributed in 15 families have been identified. Among these, 28 species were dicots and only 2 species were monocots. Out of the 15 families, dicot plants belonged to 14 families and monocots were represented by only 1 family. Family Asteraceae contained highest number of plant species, represented by 6 taxa, followed by the family Acanthaceae, Amaranthaceae and Solanaceae with 3 taxa each. Family Malvaceae, Lamiaceae and Fabaceae in dicot and family Poaceae in monocot possessed 2 taxa each and were closely followed by Oxalidaceae, Convolvulaceae, Ulmaceae, Rubiaceae, Chenopodiaceae, Asclepiadaceae and Scrophulariaceae with only 1 taxon each in the study area (Fig. 1). The predominance of Asteraceae indicates the high impact of neotropical flora in the study area.

Maximum numbers (23) of plants were herbaceous, followed by shrubs (04), trees (02) and climbers (01) documented in the present study (Table 1).

Among the baseline diversity parameters, plant frequency (%), density (D), and abundance (AB) varied greatly in the study area. Plant frequency ranged between 33.3% and 100% with maximum frequency was recorded for *Ageratum conyzoides L., Mikania micrantha* Kunth*, Cynodon dactylon (L.)Pers. Sida cordifolia L. Ocimum basilicum L., Hemigraphis hirta* T. Anderson and *Digitaria* sp. and minimum for *Cassia sophera* L.*, Gnaphalium pensylvanicum* Willd., *Hisbiscus vitifolius* L. and *Lindenbergia indica* Kuntze (Fig. 2). More than 80% frequency was estimated for the 12 taxa, namely *Ageratum conyzoides* L., *Mikania micrantha* Kunth, *Cynodon dactylon (L.) Pers.*, *Oxalis corniculata* L., *Sida cordifolia* L., *Ocimum basilicum* L.*, Hemigraphis hirta* T. Anderson*, Digitaria sp*., *Achyranthes aspera* L., *Evolvulus nummularius* L.*, Alternanthera sessilis* (L.) DC. and *Rungia pectinata* Nees. (Fig. 2). Among these, *Ageratum conyzoides and Mikania micrantha*, both belonging to the family Asteraceae are enlisted within 100 worst invasive plant species (Lowe *et al*., 2000) and have found to have allelopathic effect on neighbouring crop plants (Talukdar, 2013e). Biological invasions by alien species are widely recognized second worst threat to native biodiversity after habitat destructions and impose high costs to agriculture, forestry, and aquatic ecosystems (Feng and Zhu, 2010; Talukdar, 2013f). The screening of these two obnoxious weeds in the present study thus assumes significance in this regard.

The density which denoted total number of individuals per quadrat crossed 10 value in 7 species with highest value of 245 recorded in grass *Cynodon dactylon*, which was followed by *Hemigraphis hirta* (36.3), *Rungia pectinata* (26.5), *Digitaria* sp. (24.1), *Oxalis* sp. (21.8), *Ocimum basilicum* (17.1) and *Ageratum conyzoides* (16.1). Rest of the species exhibited values <10. *Mikania micrantha* (8.1, Asteraceae), *Achyranthus aspera* (6.1, Amaranthaceae), and *Sida cordifolia* (Malvaceae) as well as *Evolvulus* sp. (Convolvulaceae) denoted values of 5.5 each and *Alternanthera sessilis* (Amaranthaceae) showed 5.1 (Table 1). Lowest density was estimated for Malvaceous shrub *Hibiscus vitifolius* (0.3), followed by *Calotropis procera, Chenopodium album, Solanum xanthocarpum* and *Cassia sophera* with 0.5 each.

Highest abundance value (245) was observed for *Cynodon dactylon*, followed by *Hemigraphis hirta* (36.3), *Rungia pectinata* (31.8), *Digitaria* sp. (24.1), *Oxalis* sp. (21.8), *Ocimum basilicum* (17.1) and *Ageratum conyzoides* (16.1). Low density but high abundance was observed for *Xanthium strumarium* L., *Oldenlandia corymbosa* L.*, Amaranthus spinosus* L.*, Peristrophe bicalyculata* Nees*, Cassia sophera, Gnaphalium pensylvanicum* and *Lindenbergia indica* (Table 1).

Status for 6 taxa i.e, *Cynodon dactylon, Hemigraphis hirta, Digitaria sp., Oxalis sp., Ocimum basilicum* and *Ageratum conyzoides,* exhibiting very high frequency, density as well as abundance in the study areas has been documented. Among the 6 quadrats laid, *Cynodon dactylon*, *Mikania micrantha*, *Ageratum conyzoides*, *Oxalis* sp., *Sida cordifolia*, *Ocimum basilicum*, *Hemigraphis hirta* and *Digitaria* sp. were recorded in maximum (6) number of quadrats. Among these, *Ageratum, Mikania, Sida* and *Ocimum* exhibited tremendous capacity to grow along roadside as well as deep inside the study areas. Quadrat studies revealed high frequency and abundance of some other taxa like *Rungia pectinata*, *Achyranthus aspera*, *Evolvulus* sp. and *Alternanthera sessilis*. Among these, *Rungia pectinata* showed highest density (26.5) and abundance (31.8) followed by the rest 3 species in the study area (Fig. 3; Table 1).

Resource utilization

Out of 30 taxa, eight plants were used as medicinal purposes such as cough and cold, diarrhea, insomnia, as febrifuge, diuretic etc., while one plant *Trema orientalis* Blume was used as cheap fuel wood. Tender leaves of

Amaranthus spinosus L. and *Chenopodium album* L. have been used as vegetables (Talukdar and Talukdar, 2012). Talukdar and Talukdar (2013b) studied ethnomedicinal uses of different weed taxa in sub-Himalayan as well as Gangetic West Bengal. The importance of traditional knowledge in conservation of local biodiversity resources have widely been recognized (Antons, 2010).

Conclusion

The present investigation for the first time revealed rich floral diversity and utilization of local flora for medicine and other economic purposes. The Kalyani University campus region where the present study was carried out is gradually witnessing deforestation due to pressure from local developmental purposes and other industrial pollutions. Present inventory, therefore, may give vital clues in conservation of floral diversity in and around Kalyani University area.

Competing interests

Authors declare that they do not have any competing interests.

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