

Indicative Flora of Eco-Sensitive Zone of Baraila Lake Salim Ali Jubba Sahni Bird Sanctuary, Vaishali District, Bihar



Submitted by

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Central National Herbarium
Botanical Survey of India, Howrah

2018

**INDICATIVE FLORA OF ECO-SENSITIVE ZONE OF
BARAILA LAKE SALIM ALI JUBBA SAHNI BIRD
SANCTUARY, VAISHALI DISTRICT, BIHAR**

Office order no: BSI-281/19/2017-Tech dated 11th July, 2017

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Finally, I am thankful to the Director, Botanical Survey of India for the opportunity provided to work in the project.

Kumar Avinash Bharati

1. About the project

Title of the project : Indicative flora of Eco-Sensitive Zone of Baraila Lake Salim Ali Jubba Sahni Bird Sanctuary, Vaishali District, Bihar.

Office order no. : BSI-281/19/2017-Tech dated 11th July, 2017

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Duration of field tours : **06.11.2017 to 09.11.2017**

Study site : The Baraila lake Salim Ali Jubba Sahni Bird Sanctuary, Vaishali district, Bihar has aggregate area of 12.7 Km² located in between 25°45'58" & 25°45'37" North latitude and between 85°31'48" & 85°34'50" East longitude. The sanctuary is of immense ecological and environmental importance by way of performing hydrological and wetland and aquatic ecosystem functions of riverine zone in Gangetic plains and habitat of various aquatic flora and fauna.

The eco-sensitive zone of Baraila lake Salim Ali Jubba Sahni Bird Sanctuary was surveyed during the above mentioned period. About 140 species have been documented or collected for identifications. The photographs of all the plants were taken and GPS data with the range were recorded.

Extent and boundaries of Eco-sensitive Zone—
(1)The extent of Eco-Sensitive Zone varies from 100 m to 3.5 km from the boundary of the Baraila Lake Salim Ali Jubba Sahni Bird Sanctuary. The area of Eco-sensitive Zone is 1083.55 hectare. (2) The villages whose area or parts thereof falling within the Eco-sensitive Zone are, Jhil Baraila and Loma. (3) The other villages falls within the Eco-sensitive Zone are: Chaiya, Kabai-baraila,

Amthama, Mahathi Dharamuch, Deeh Buchauli and Dulwar.

Outcome : The Eco-Sensitive Zone of the Baraila Lake Salim Ali Jubba Sahni Bird Sanctuary was surveyed during the above mentioned dates. A total of 134 species of the angiosperm were documented. The photographs of all most all the plants were taken and GPS data of waypoints pathways were recorded.

2. Background

2.1 Eco-sensitive zone

In the XXI meeting of the Indian Board for Wildlife held on 21st January 2002, a “Wildlife Conservation Strategy-2002” was adopted. It state that lands falling within 10 Km of the boundaries of National parks and Sanctuaries should be notified as eco-fragile zones under section 3 (v) of the Environment (Protection) Act and Rule 5 Sub rule (viii) & (x) of the Environment (Protection) Rules. The National Wildlife Action Plan, 2002-2016 indicates that “Area outside the protected area network are often vital ecological corridor links and must be protected to prevent isolation of fragments of biodiversity which will not survive in the long run. Land and water use policies will need to accept the imperative of strictly protecting ecologically fragile habitats and regulating use elsewhere” (<http://www.moef.gov.in>).

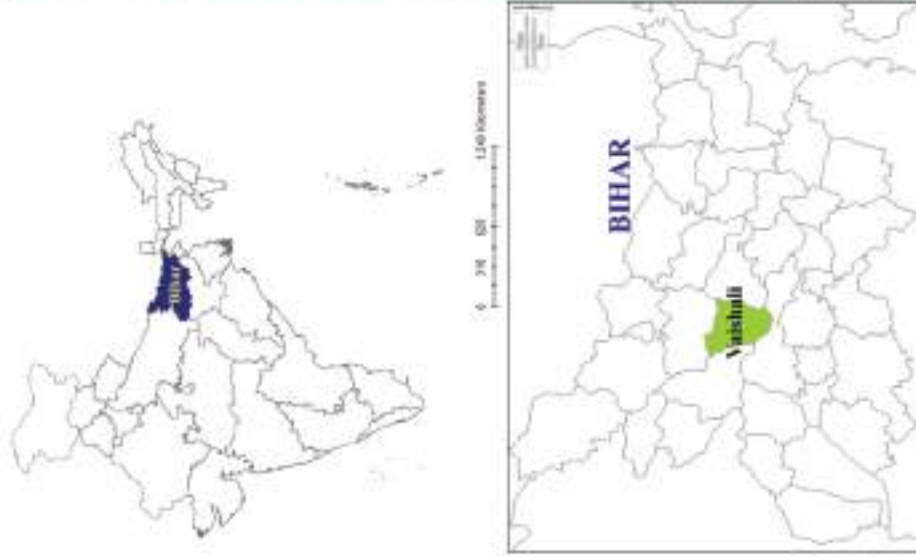
Keeping above in view, the eco-sensitive zones have been created around National Parks and Sanctuaries for the purpose of protection of the protected areas. The eco-sensitive zones works as “shock absorber” and function as transition zone from area of high protection to the areas of lesser protection. The eco-sensitive zones has immense role in the conservation of wild resources of the National Parks and Sanctuaries because it regulates the anthropogenic activities in close vicinity to the boundaries.

2.2 Baraila Lake Salim Ali Jubba Sahni Bird Sanctuary

The Baraila wetland is a seasonally flooded area located in lower Gangetic plains of the Vaishali district, Bihar. It has aggregate area of 12.7 Km² located in between 25°45'58" & 25°45'37" North latitude and between 85°31'48" & 85°34'50" East longitude (**Map 1**). The study area has immense ecological and environmental importance by way of performing hydrological and wetland and aquatic ecosystem. Keeping the conservation aspects in mind the Government of Bihar declared the wetland as sanctuary in in the year 1997. However, it was published in Gazette of India as Baraila lake Salim Ali Jubba Sahni Bird Sanctuary in 2016 (Gazette of India, 2016). Usually, during summer (May-June) the entire wetland becomes dryland and the wetland vegetation are replaced by grasses. After advent of monsoon in the end of June, the sanctuary receives water from catchment area and transformed into wetland. Another source of water in the sanctuary is Gandak canal, Baya River and Noon River. The wetlands of the Gangetic plains are essential for the survival of migratory water birds. The Baraila lake not only provide habitat to migratory birds and resident water birds but also to various other fauna like, fish, amphibians and reptiles. The Indian Shag, Red collard dove, Asian Koel, Small Bee catcher, Brahmany starlet and tree pie are main resident birds whereas, Black Ibris, Brahmany Shell Duck, Bar-headed Goose, Oriental Magpie Robin and Lesser Whistling duck are migratory birds of this sanctuary.

2.3 Extent and boundaries of Eco-sensitive Zones

- (1) The extent of Eco-sensitive Zone varies from 100 m to 3.5 km from the boundary of the Baraila Lake Salim Ali Jubba Sahni Bird Sanctuary. The area of Eco-Sensitive Zone is 1083.55 hectare.
- (2) The villages whose area or parts thereof falling within the Eco-Sensitive Zone are, Jhil Baraila and Loma.
- (3) The other villages falls within the Eco-Sensitive Zone are: Chaiya, Kabai-baraila, Amthama, Mahathi Dharamuch, Deeh Buchauli and Dulwar.



Map 1: Location of the Baralia lake Salim Ali Jubba Sahni Bird Sanctuary, Bihar

2.4 Geography

The climatic condition of wetland is monsoon type. The winter commences in December and lasts up to February, the summer comes in March and lasts till June, southwest monsoon showers occur in between July to September whereas retreating southwest monsoon commences in October and lasts till November. The southwest monsoon contributes major share of water during the month of July and August. The average annual rainfall in the area is 1168 mm. In winter, temperature ranges between 16°C and 4°C and summer temperature rises up to 40°C. The humidity varies in between 60% (April-May) to 90% (July-August). The vegetation of Bihar is mainly dry deciduous (Champion & Seth, 1968). However, the vegetation of this wetland may be considered as grass land type.

3. Review of Literature

The botanical history of Bihar may be considered to have begun with the collection of plants by Buchanan-Hamilton from 1809-1813. He had collected both trees and herbs from Patna, Saran, Tirhut, Purnea, Bhagalpur, Mungger, Shahabad and deposited specimens at Royal Botanical Garden, Kew, England. He is probably the first botanist who made collection in Bihar. Further, Hooker (1848) had collected plants from Gaya, Kymore hills, Purnea and area around river Sone. A significant publication in form of checklist Bihar plants was published by Anderson (1863). The most elaborated botanical undertaking in the history of Bihar was undoubtedly the expedition of Hanes. In 1921-1925, Haines had published "The Botany of Bihar and Orissa" in six volumes. It is the first systematic and comprehensive work on flora of Bihar. In addition, Kurz had collected flora along the course of river Ganges, Hieronymus explored forests of Champaran, Nusker and Mokin were collected grasses from Monghyr and Gaya. Haines himself visited forests of Champarn, Shahabad, Purnea and Gaya. Besides, Thomson and Prain have also collected plants in Bihar (Hains, 1910; 1921-1925).

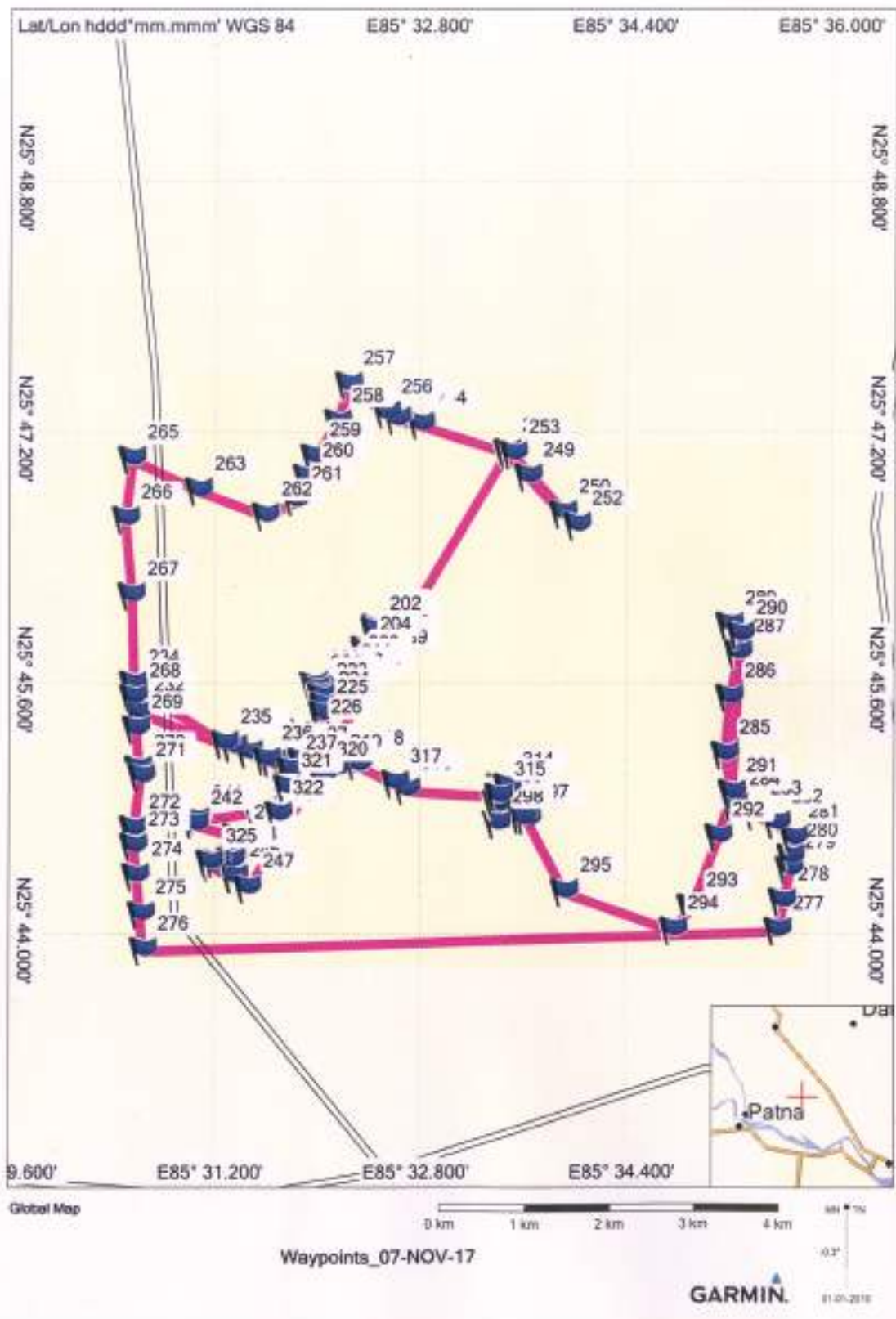
A good account on the plant species of Monghyr is given in *Forest Flora of Monghyr* and manuscripts of Buchanan-Hamilton (1809-1813). After

independence significant work has been done by Mooney (1941; 1950) and published "Supplement to the Botany of Bihar and Orissa". But his work was mainly focused on area which at present falls under Jharkhand. Further, some major publications on Bihar are: contribution on some plants from Champaran district (1965) and contribution to the flora of Udaipur forest in Champaran district (1966) by Thothathri; grass flora of Bhagalpur by Paul (1967); A sketch of the vegetation of Champaran district of North Bihar by Banerjee and Banerjee (1969); useful plants of Bihar and vegetation of Muzaffarpur, Purnea, Saran, Champaran, Patna by Srivastava (1955-58), vegetation of Darbhanga district by Thakur (1963). Only three district floras have been published so far *viz.*, flora of Bhagalpur (Varma, 1981), Patna (Singh, 1986) and West Champaran (Bhattacharya & Krishnendu, 1998). Varma (1981) has identified 679 species of dicotyledons in Bhagalpur districts and Singh (1986) has reported 674 species of dicotyledons in Patna district. A total of 1040 species of Angiosperm were reported from district West Champaran, of these 804 species are dicot and 236 species are monocot (Bhattacharya & Krishnendu, 1998). While literature search on the plant taxonomy of Bihar, I came across with other publications like, Sanyal (1957), Mishra (1969-1971), Mishra (1985), Mishra & Jha (1972), Jain & *al.* (1975), Paul (1966, 1973), Saxena (1976, 1978), Srivastava & *al.* (1966) and Uniyal & Datta (1984) and Bhattacharya & *al.* (2011).

4. Methodology

The botanical exploration tours were conducted in the eco-sensitive zones for the assessment of diversity of angiosperms (**Table 1**). The specimens were collected from different localities to cover almost all the areas (**Map 2, 3**). Wide range of habitats including orchards, cultivated lands, ponds, wetland and range lands were explored and plants were collected in flowering and/or fruiting stages. The plant materials were collected with the help of secateurs and the key morphological characters were documented in the field-book. All the specimens were dried inside the blotting sheets and pressed under plant-press. The plant species were identified with the help of relevant floras: Bentham & Hooker

ROUTE MAP



Map 2: Route followed during collection



Map 3: Collection localities of the species studied under Barailla Lake, Vaishali, Bihar

(1862-1883), Prain (1903), Haines (1921-1925) and Mooney (1941). Identification was also cross checked by matching voucher specimens with holdings at Central National Herbarium, Botanical Survey of India, Howrah (CAL). The botanical names of the plant specimens were updated according to the Plant List (www.theplantlist.org).

Table 1: Itinerary (06.11.2017 to 09.11.2017)

S. No.	Date	Journey & area surveyed
1.	06.11.2017 to 07.11.2017	Travelled by the train to reach the Patna railway station and hired a taxi from the Patna railway station to the Hajipur.
2.	07.11.2017	At 9.30 AM, taken taxi from Hajipur to reach the Baraila lake Salim Ali Jubba Sahni Bird Sanctuary and visited following eco-sensitive zones: Loma, Kabai-Baraila, Bizrauli, Deeh-Bizrauli and returned to Hajipur
3.	08.11.2017	At 7.00 AM, taken taxi from Hajipur to reach the Baraila lake Salim Ali Jubba Sahni Bird Sanctuary and visited following eco-sensitive zones: Kabai-Baraila, Amthama, Chakaiya, Mataiya, Mansingh pur Bizrauli and returned to Hajipur.
4.	09.11.2017	At 7.30 AM, taken taxi from Hajipur to reach the Baraila lake Salim Ali Jubba Sahni Bird Sanctuary and visited following eco-sensitive zones: Mahathi, Dullaur, Dharmuch, Amthama and returned to Hajipur
5.	09.11.2017 to 10.11.2017	Hired a taxi from Paswan Chowk, Hajipur and reached Patna railway station. Took the train from Patna to reach Shalimar railway station.



Plate 1: a-h. Different habitats under the study area



Plate 2: a-h. Villages and surroundings of the study area



Plate 3: a-h. Villages and surroundings of the study area



Plate 4: a-h. Villages and surroundings of the study area

5. Enumeration of Species

A total of 179 species of angiosperms were documented in the study area and the names of the species are enlisted as per the Angiosperm Phylogeny Group (APG IV) classifications for the orders and families of flowering plants (Chase & *al.*, 2016)

Table 2: Enumeration of angiosperm of eco-sensitive zone of Baraila lake Salim Ali Jubba Sahni Bird Sanctuary.

*APG IV family no.	Family	S. no.	Species
4	Nymphaeaceae Salisb.	1.	Nymphaea nouchali Burm.f.
38	Potamogetonaceae Bercht. & J.Presl	2.	Potamogeton natans L.
45	Dioscoreaceae R.Br.	3.	Dioscorea bulbifera L.
61	Orchidaceae Juss.	4.	Zeuxine strateumatica (L.) Schltr.
76	Arecaceae Bercht. & J.Presl	5.	Phoenix sylvestris (L.) Roxb.
		6.	Borassus flabellifer L.
78	Commelinaceae Mirb.	7.	Commelina benghalensis L.
90	Typhaceae Juss.	8.	Typha angustifolia L.
98	Cyperaceae Juss.	9.	Cyperus compressus L.
		10.	Cyperus difformis L.
		11.	Cyperus rotundus L.
		12.	Fimbristylis quinquangularis (Vahl) Kunth
103	Poaceae Barnhart	13.	Chrysopogon zizanioides (L.) Roberty
		14.	Cynodon dactylon (L.) Pers.
		15.	Digitaria ciliaris (Retz.) Koeler
		16.	Echinochloa crus-galli (L.) P.Beauv.

		17.	Imperata cylindrica (L.) Raeusch.
		18.	Oplismenus compositus (L.) P.Beauv.
		19.	Panicum repens L.
		20.	Phalaris minor Retz.
		21.	Setaria verticillata (L.) P.Beauv.
		22.	Setaria pumila (Poir.) Roem. & Schult.
		23.	Sporobolus virginicus (L.) Kunth Révis
106	Papaveraceae Juss.	24.	Argemone mexicana L.
		25.	Fumaria indica (Hauskn.) Pugsley
109	Menispermaceae Juss.	26.	Stephania japonica (Thunb.) Miers
		27.	Tinospora sinensis (Lour.) Merr.
136	Vitaceae Juss.	28.	Cayratia trifolia (L.) Domin
140	Fabaceae Lindl.	29.	Acacia nilotica (L.) Delile
		30.	Dalbergia sissoo DC.
		31.	Desmodium gangeticum (L.) DC.
		32.	Lathyrus aphaca L.
		33.	Melilotus indicus (L.) All.
		34.	Mucuna pruriens (L.) DC.
		35.	Pithecellobium dulce (Roxb.) Benth.
		36.	Senna tora (L.) Roxb.
		37.	Senna occidentalis (L.) Link

149	Cannabaceae Martinov	38.	Cannabis sativa L.
150	Moraceae Gaudich.	39.	Ficus religiosa L.
		40.	Ficus benghalensis L.
		41.	Ficus racemosa L.
163	Cucurbitaceae Juss.	42.	Coccinia grandis (L.) Voigt
		43.	Cucumis melo L.
		44.	Luffa echinata Roxb.
		45.	Momordica dioica Roxb. ex Willd.
171	Oxalidaceae R.Br.	46.	Oxalis corniculata L.
196	Euphorbiaceae Juss.	47.	Chrozophora rottleri (Geiseler) A.Juss. ex Spreng.
		48.	Croton sparsiflorus Morong
		49.	Euphorbia hirta L.
		50.	Euphorbia maculate L.
		51.	Euphorbia prostrata Aiton
		52.	Ricinus communis L.
202	Passifloraceae Juss. ex Roussel	53.	Passiflora foetida L.
		54.	Passiflora suberosa L.
211	Phyllanthaceae Martinov	55.	Phyllanthus amarus Schumach. & Thonn.
		56.	Phyllanthus simplex Retz.
214	Combretaceae R.Br.	57.	Terminalia arjuna (Roxb. ex DC.) Wight & Arn.
215	Lythraceae J.St.-Hil.	58.	Ammannia baccifera L.
247	Malvaceae Juss.	59.	Abutilon indicum (L.) Sweet
		60.	Bombax ceiba L.
		61.	Corchorus aestuans L.
		62.	Corchorus capsularis L.
		63.	Hibiscus vitifolius L.

		64.	Pentapetes phoenicea L.
		65.	Sida spinosa L.
		66.	Urena lobata L.
269	Cleomaceae Horan.	67.	Cleome chelidonii L.f.
		68.	Cleome viscosa L.
273	Olacaceae Juss. ex R.Br.	69.	Olax nana Wall. ex Benth.
283	Polygonaceae Juss.	70.	Polygonum hydropiper L.
		71.	Polygonum plebeium R.Br.
		72.	Rumex dentatus L.
297	Amaranthaceae Juss.	73.	Achyranthes aspera L.
		74.	Alternanthera sessilis (L.) R.Br. ex DC.
		75.	Amaranthus spinosus L.
		76.	Amaranthus tricolor L.
		77.	Celosia argentea L.
		78.	Chenopodium album L.
		79.	Digera muricata (L.) Mart.
304	Aizoaceae Martinov	80.	Trianthema portulacastrum L.
308	Nyctaginaceae Juss.	81.	Boerhavia diffusa L.
312	Basellaceae Raf.	82.	Basella alba L.
333	Sapotaceae Juss.	83.	Madhuca longifolia (J.Koenig ex L.) J.F.Macbr.
335	Primulaceae Batsch ex Borkh.	84.	Anagallis arvensis L.
352	Rubiaceae Juss.	85.	Dentella repens (L.) J.R.Forst. & G.Forst.
356	Apocynaceae Juss.	86.	Calotropis gigantea (L.) Dryand.
		87.	Calotropis procera (Aiton) Dryand.

		88.	Pergularia daemia (Forssk.) Chiov.
357	Boraginaceae Juss.	89.	Coldenia procumbens L.
		90.	Cynoglossum wallichii G.Don
		91.	Heliotropium indicum L.
		92.	Heliotropium supinum L.
359	Convolvulaceae Juss.	93.	Evolvulus nummularius (L.) L.
		94.	Ipomoea aquatica Forssk.
		95.	Ipomoea nil (L.) Roth
		96.	Ipomoea triloba L.
360	Solanaceae Juss.	97.	Datura metel L.
		98.	Nicotiana plumbaginifolia Viv.
		99.	Physalis minima L.
		100.	Solanum americanum Mill.
		101.	Solanum sisymbriifolium Lam.
		102.	Solanum torvum Sw.
		103.	Solanum virginianum L.
370	Plantaginaceae Juss.	104.	Bacopa monnieri (L.) Wettst.
		105.	Scoparia dulcis L.
371	Scrophulariaceae Juss.	106.	Verbascum chinense (L.) Santapau
373	Linderniaceae Borsch, Kai Müll. & Eb.Fisch.	107.	Lindernia crustacea (L.) F.Muell.
377	Acanthaceae Juss.	108.	Peristrophe paniculata (Forssk.) Brummitt
		109.	Ruellia prostrata Poir.
382	Verbenaceae J.St.-Hil.	110.	Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson
		111.	Phyla nodiflora (L.) Greene
		112.	Verbena officinalis L.

383	Lamiaceae Martinov	113.	Anisomeles indica (L.) Kuntze
		114.	Clerodendrum viscosum Vent.
		115.	Gmelina arborea Roxb.
		116.	Leucas cephalotes (Roth) Spreng.
		117.	Salvia plebeia R.Br.
387	Orobanchaceae Vent.	118.	Orobanche aegyptiaca Pers.
403	Asteraceae Bercht. & J.Presl	119.	Acmella oleracea (L.) R.K.Jansen
		120.	Ageratum conyzoides (L.) L.
		121.	Caesulia axillaris Roxb.
		122.	Cirsium arvense (L.) Scop.
		123.	Eclipta prostrata (L.) L.
		124.	Erigeron canadensis L.
		125.	Grangea maderaspatana (L.) Poir.
		126.	Helichrysum indicum (L.) Grierson
		127.	Laphangium luteoalbum (L.) Tzvelev
		128.	Launaea aspleniifolia (Willd.) Hook.f.
		129.	Parthenium hysterophorus L.
		130.	Pseudognaphalium hypoleucum (DC.) Hilliard & B.L.Burt
		131.	Sonchus asper (L.) Hill
		132.	Vernonia cinerea (L.) Less.
133.	Xanthium strumarium L.		
416	Apiaceae Lindl.	134.	Centella asiatica (L.) Urb.

*Angiosperm Phylogeny Group IV classification (Chase & al., 2016)



Plate 5: a. *Acacia nilotica* (L.) Delile; b. *Acmella oleracea* (L.) R.K.Jansen; c. *Ageratum conyzoides* (L.) L.; d. *Ammannia baccifera* L.; e. *Anagallis arvensis* L.; f. *Anisomeles indica* (L.) Kuntze; g. *Argemone mexicana* L.; h. *Basella alba* L.

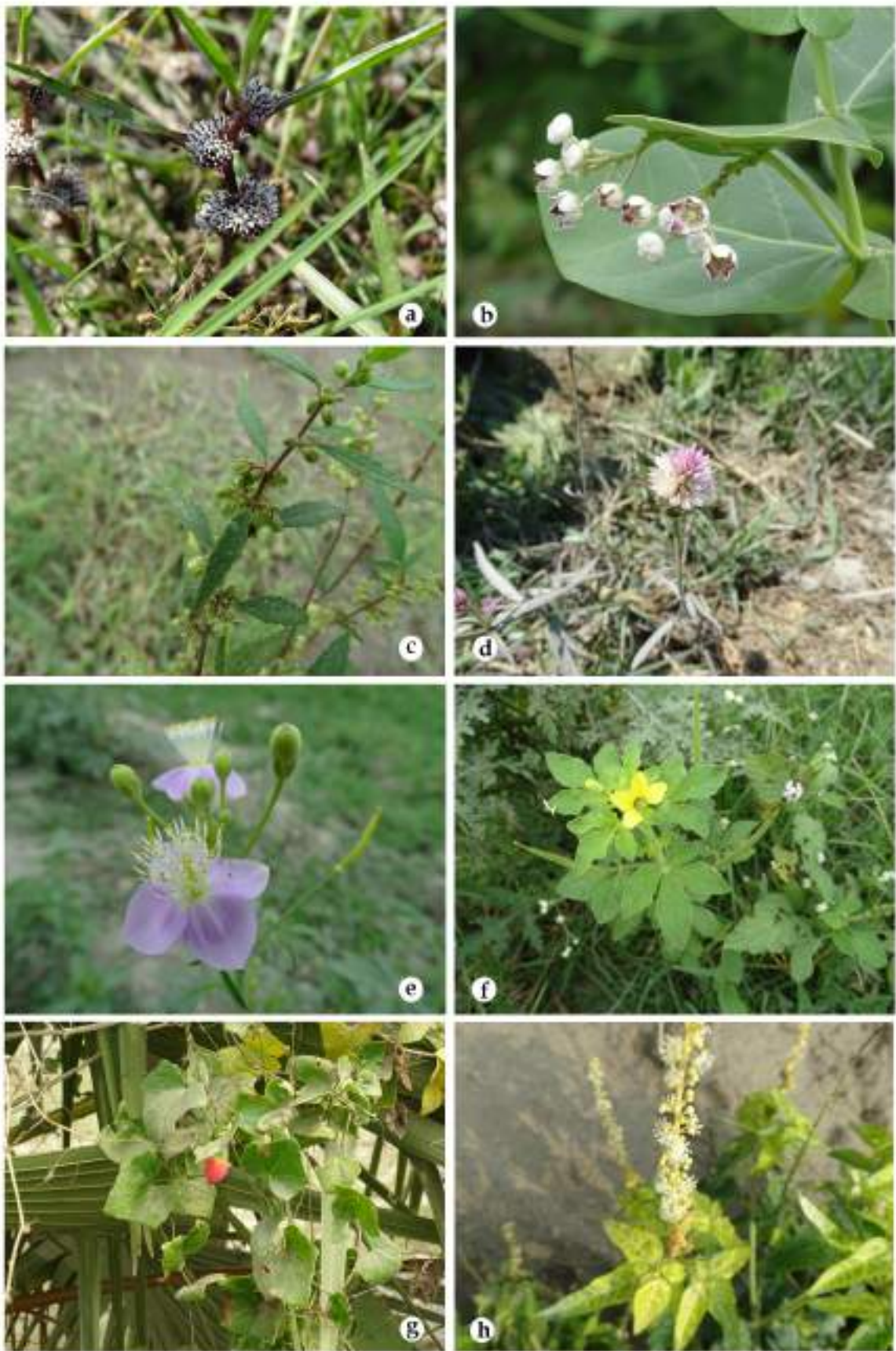


Plate 6: a. *Caesulia axillaris* Roxb.; b. *Calotropis procera* (Aiton) Dryand.; c. *Cannabis sativa* L.; d. *Celosia argentea* L.; e. *Cleome chelidonii* L.f.; f. *Cleome viscosa* L.; g. *Coccinia grandis* (L.) Voigt; h. *Croton sparsiflorus* Morong

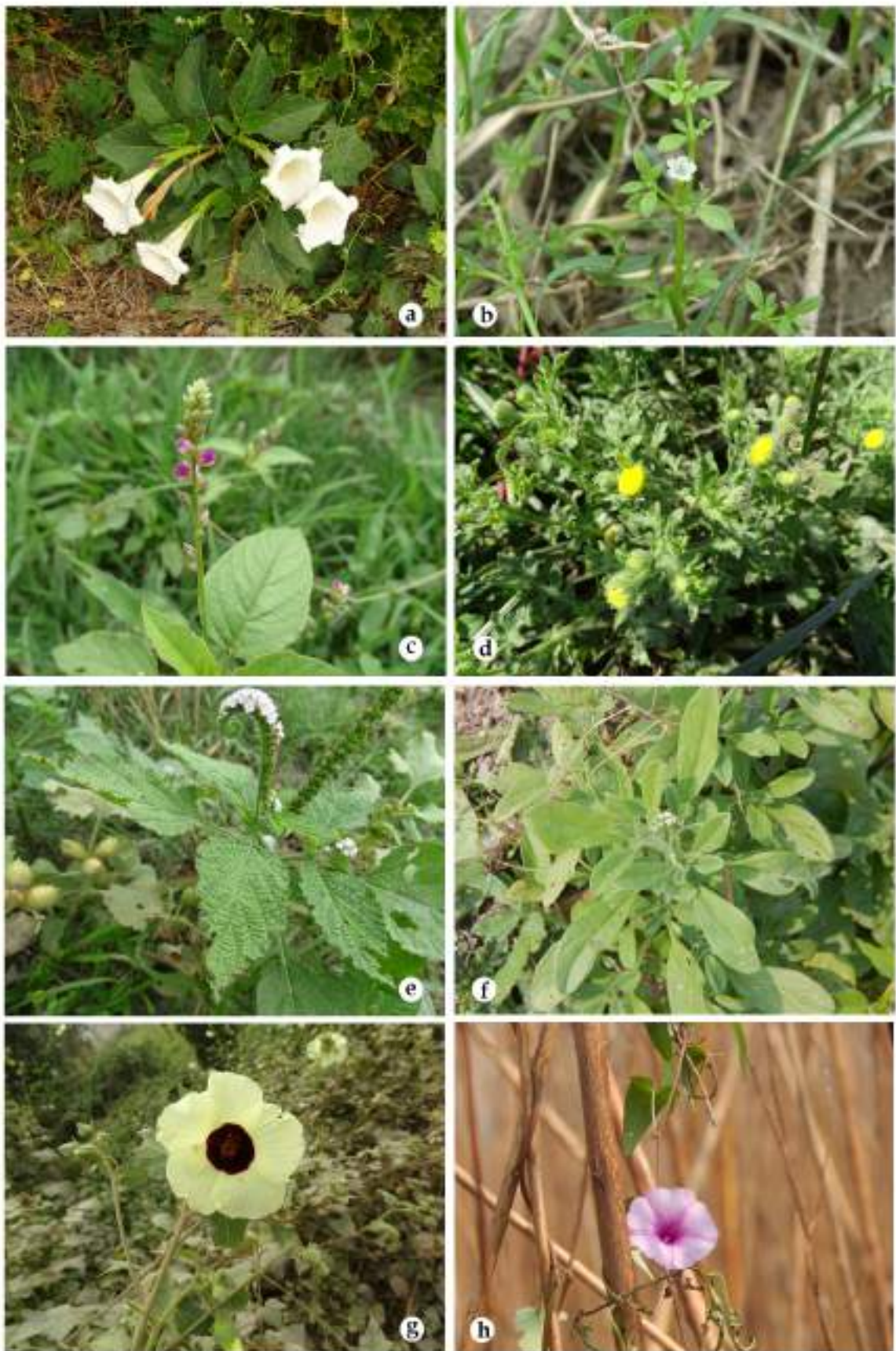


Plate 7: a. *Datura metel* L.; b. *Dentella repens* (L.) J.R.Forst. & G.Forst.; c. *Digera muricata* (L.) Mart.; d. *Grangea maderaspatana* (L.) Poir.; e. *Heliotropium indicum* L.; f. *Heliotropium supinum* L.; g. *Hibiscus vitifolius* L.; h. *Ipomoea aquatica* Forssk.



Plate 8: a. *Ipomoea nil* (L.) Roth; b. *Ipomoea triloba* L.; c. *Lindernia crustacea* (L.) F.Muell.; d. *Luffa echinata* Roxb.; e. *Mucuna pruriens* (L.) DC.; f. *Nymphaea nouchali* Burm.f.; g. *Olax nana* Wall. ex Benth.; h. *Passiflora foetida* L.



Plate 9: a. *Passiflora suberosa* L.; b. *Pentapetes phoenicea* L.; c. *Pergularia daemia* (Forssk.) Chiov.; d. *Phyla nodiflora* (L.) Greene; e. *Phyllanthus amarus* Schumach. & Thonn.; f. *Phyllanthus simplex* Retz.; g. *Physalis minima* L.; h. *Polygonum hydropiper* L.

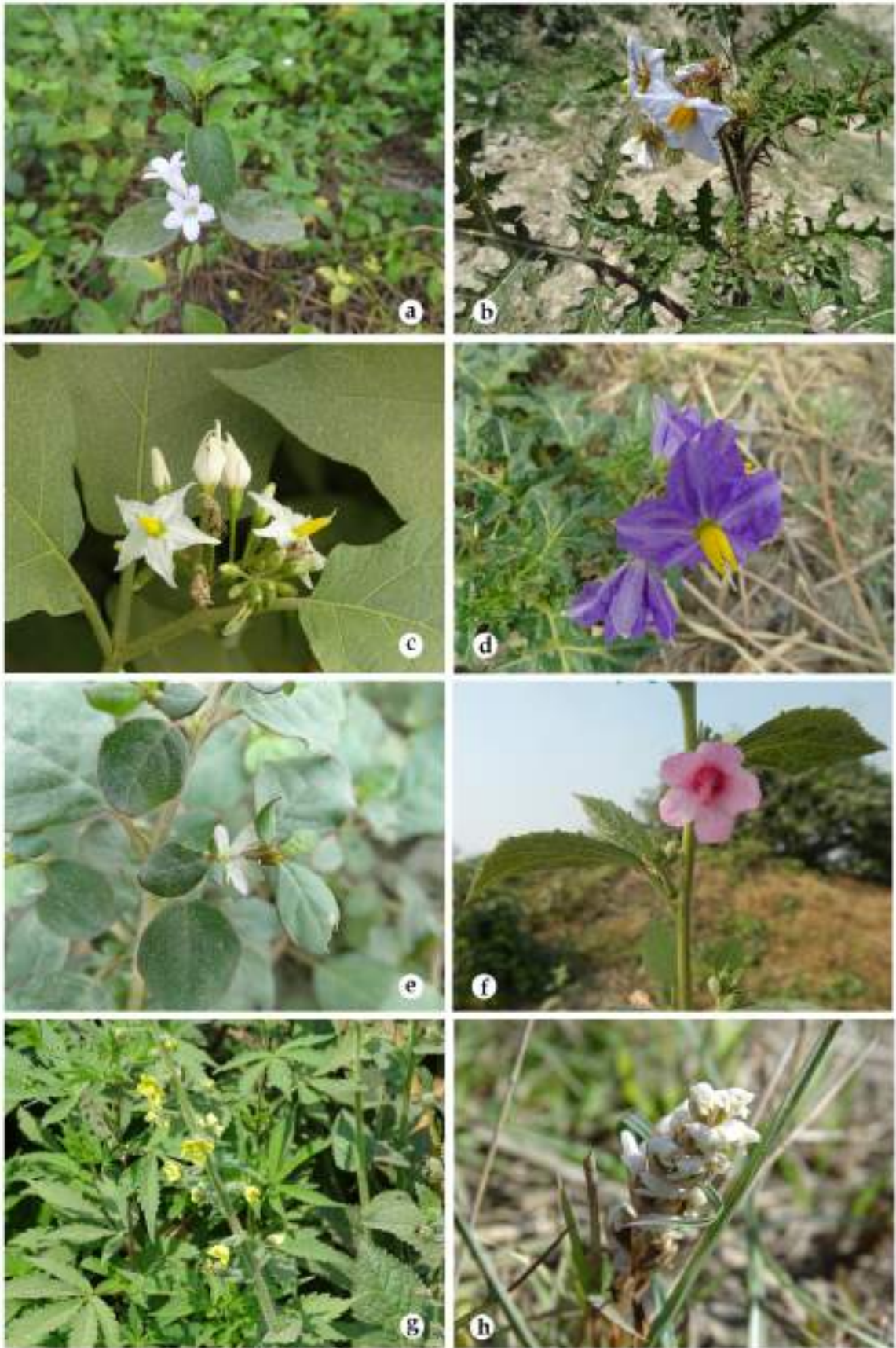


Plate 10: a. *Ruellia prostrata* Poir.; b. *Solanum sisymbriifolium* Lam.; c. *Solanum torvum* Sw.; d. *Solanum virginianum* L.; e. *Trianthema portulacastrum* L.; f. *Urena lobata* L.; g. *Verbascum chinense* (L.) Santapau; h. *Zeuxine strateumatica* (L.) Schltr.

Table 3: Distribution of species in the families

S. no.	Family	Species count
1.	Asteraceae Bercht. & J.Presl	15
2.	Poaceae Barnhart	11
3.	Fabaceae Lindl.	9
4.	Malvaceae Juss.	8
5.	Amaranthaceae Juss.	7
6.	Solanaceae Juss.	7
7.	Euphorbiaceae Juss.	6
8.	Lamiaceae Martinov	5
9.	Cyperaceae Juss.	4
10.	Cucurbitaceae Juss.	4
11.	Boraginaceae Juss.	4
12.	Convolvulaceae Juss.	4
13.	Moraceae Gaudich.	3
14.	Polygonaceae Juss.	3
15.	Apocynaceae Juss.	3
16.	Verbenaceae J.St.-Hil.	3
17.	Arecaceae Bercht. & J.Presl	2
18.	Papaveraceae Juss.	2
19.	Menispermaceae Juss.	2
20.	Passifloraceae Juss. ex Roussel	2
21.	Phyllanthaceae Martinov	2
22.	Cleomaceae Horan.	2
23.	Plantaginaceae Juss.	2
24.	Acanthaceae Juss.	2
25.	Nymphaeaceae Salisb.	1
26.	Potamogetonaceae Bercht. & J.Presl	1
27.	Dioscoreaceae R.Br.	1
28.	Orchidaceae Juss.	1
29.	Commelinaceae Mirb.	1
30.	Typhaceae Juss.	1
31.	Vitaceae Juss.	1

32.	Cannabaceae Martinov	1
33.	Oxalidaceae R.Br.	1
34.	Combretaceae R.Br.	1
35.	Lythraceae J.St.-Hil.	1
36.	Olacaceae Juss. ex R.Br.	1
37.	Aizoaceae Martinov	1
38.	Nyctaginaceae Juss.	1
39.	Basellaceae Raf.	1
40.	Sapotaceae Juss.	1
41.	Primulaceae Batsch ex Borkh.	1
42.	Rubiaceae Juss.	1
43.	Scrophulariaceae Juss.	1
44.	Linderniaceae Borsch, Kai Müll. & Eb.Fisch.	1
45.	Orobanchaceae Vent.	1
46.	Apiaceae Lindl.	1

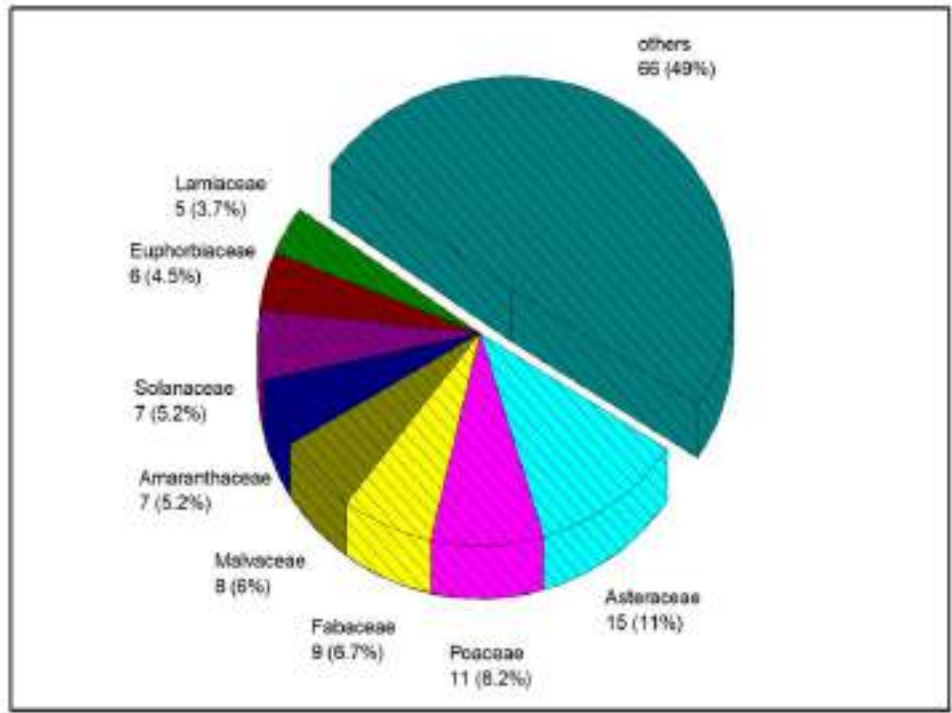


Fig 1: Percentage share of dominating families

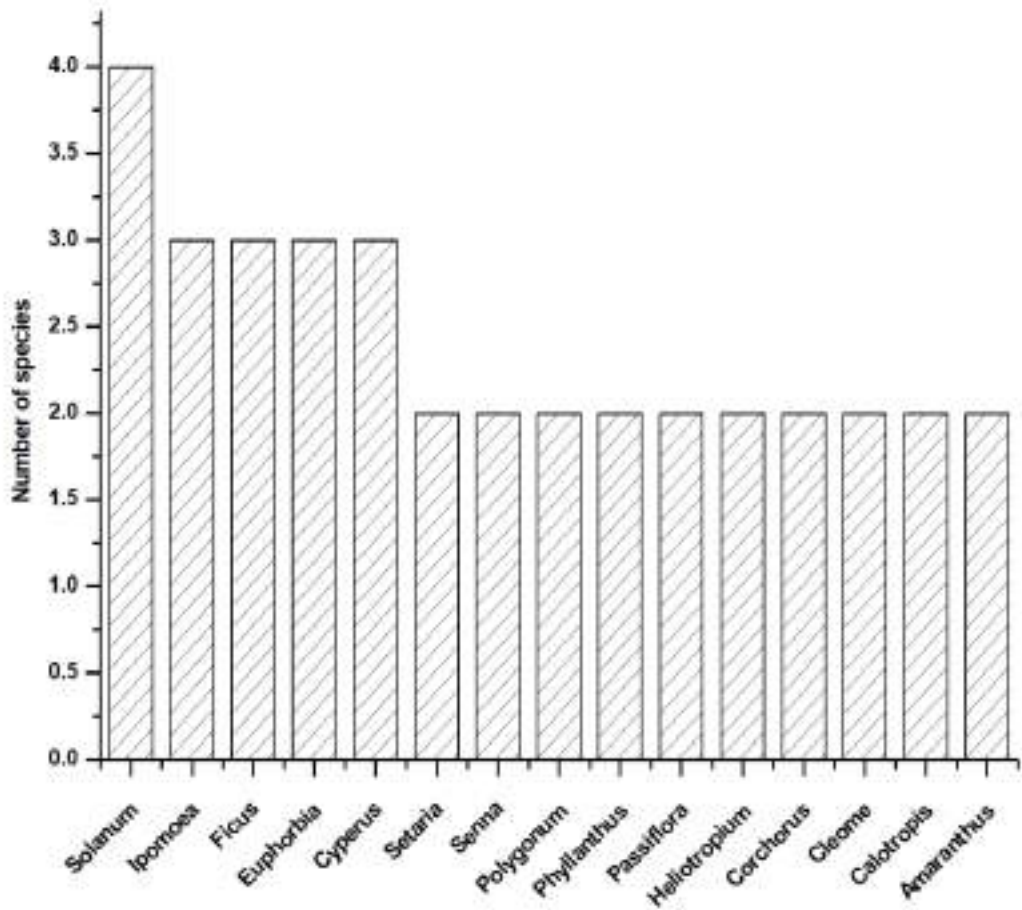


Fig. 2: Distribution of species in genus

6. Discussion

A total of 134 species documented in the eco-sensitive zone of Baraila lake Salim Ali Jubba Sahni Bird Sanctuary, Vaishali district, Bihar (**Table 2**). These species are distributed in 113 genera and 46 families (**Table 3; Fig. 1, 2**). Out of them, 37 families, 93 genera and 111 species are belongs to dicotyledons; 8 families, 19 genera and 22 species are belongs to monocotyledon and one species (i.e. *Nymphaea nouchali*) is belongs the family Nymphaeaceae which is regarded are distinct clade from monocots and dicots (Chase & al., 2016). Among the monocotyledons 50% are grasses (11 spp.) and 18% are sedges (4 spp.), rests of the monocotyledons are poorly represented by members of Orchidaceae (*zeuxine strateumatica*), Arecaceae (*Borassus flabellifer*, *Phoenix sylvestris*) and Commelinaceae (*Commelina benghalensis*), Typhaceae (*Typha angustifolia*), Potamogetonaceae (*Potamogeton natans*) and Dioscoreaceae (*Dioscorea bulbifera*). As for habit, it was found that 104 species were herbaceous (77.61%), 15 spp. (11.19%) are climbers, 11 spp. (8.20%) are trees and 04 spp. (2.98%) are shrubs. The species were also checked in IUCN red list for their threat status but none of them are categorized in any threat categories (<http://www.iucnredlist.org/search>). The water logging for prolong time is responsible for the less number of trees in the adjacent to protected area. Further, some cultivated trees are common in the orchards like, *Mangifera indica*, *Litchi chinensis*, *Syzygium cumini*, *Syzygium guajava*, *Azadirachta indica*, etc. and some tree species are less common like: *Tectona grandis*, *Populus tremula*, *Terminalia arjuna*, *Dalbergia sisso*, *Eucalyptus* spp., *Manilkara hexandra*, etc. Some invasive species are visible in the study area: *Parthenium hysterophorus*, *Lantana camara*, *Eucalyptus* spp., *Eichhornia crassipes*, etc. The harvesting of herbs for fodder and grazing is point of concern. There are many bricks manufacturing units are present in the eco-sensitive zones which are major threats to the ecosystem.

The proportion of monocotyledons to the dicotyledons is 1:5. The total genus to species ratio is 1:1.8. The genus-species ratio for upper Gangetic Plain is 1:2.2; 1:6 for India and 1:7 for Flora of British India (Hooker, 1904; Sarma & Sarkar, 2001). The members of family Orchidaceae, which holds first rank in the flora of British

India and but *Zeuxine strateumatica* is the only species recorded in the present investigation.

In present survey, 12 families are represented by 4 or more members: Asteraceae (15 spp.), Poaceae (11 spp.), Fabaceae (9 spp.), Malvaceae (8 spp.), Amaranthaceae & Solanaceae (7 spp. each), Euphorbiaceae (6 spp.), Lamiaceae (5 spp.) Cyperaceae, Cucurbitaceae, Boraginaceae & Convolvulaceae (4 spp. each) (**Table 3; Fig. 1**). All together these 11 families shares 62.68% of the species diversity of the study area. Four families have 3 spp. each, 8 families have 2 spp. each and rest of the 22 families have one species each. A total of 15 genera were represented by more than one species. It has been observed that the most dominating genus is *Solanum*, represented by 5 species, followed by representation of *Cyperus*, *Euphorbia*, *Ficus* and *Ipomoea* by 3 species each, *Amaranthus*, *Calotropis*, *Cleome*, *Corchorus*, *Heliotropium*, *Passiflora*, *Phyllanthus*, *Polygonum*, *Senna* and *Setaria* by 2 species each and rest of the 100 genera are represented by one species each (**Fig. 2**).

7. Conclusion

In conclusion, the present study list highlights the high diversity of wild and naturalized angiospermic species within the eco-sensitive zone of Baraila lake Salim Ali Jubba Sahni Bird Sanctuary, Vaishali district, Bihar. A total of 134 wild or naturalized species of angiosperm are documented. The present study will provide inputs in policy making. While survey, it was observed that grazing is putting pressure on natural vegetation. In addition, there are many brick manufacturing units are located inside the eco-sensitive zones which are the major threats to the ecosystem.

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