

Species Diversity amongst Aquatic, Semi-aquatic and Wetlands of Lucknow District, U.P., India

S.C. Singh*, Ekta Gupta, Richa Yadav, G.D. Bagchi, Govind Ram and Birendra Kumar

CSIR-Central Institute of Medicinal and Aromatic Plants, P.O. CIMAP, Lucknow- India

*Email: sc.singh@cimap.res.in

Introduction

The biodiversity found on earth today is the product of over 3 billion years of evolution. The life supporting environment of earth- the biosphere is composed of three chief components atmosphere, hydrosphere and lithosphere respectively. The hydrosphere is composed of all of the water on or near the earth. This includes the oceans, rivers, ponds, ditches, streams, lakes, etc. and even the moisture in the air. The aquatic environments include permanent and seasonal, flowing and standing, natural as well as man-made water bodies. Each type of water body has its own annual hydrological cycle that is characterised by its own community of aquatic organisms.

It is very difficult to draw a line between the hydrophytes and the terrestrial plant communities because aquatic habitat can not be sharply distinguished from the terrestrial ones. Therefore, they are defined in various ways by different authors. According to Weaver and Clement (1938) the hydrophytes are plants that grow in water in soil covered with water or in soil that is usually saturated with water. Muenschar (1944) stated as 'those species which normally stand in water and must grow for at least a part of their life cycle in water, either completely submerged or immersed'. Cook (1996) provide a broader definition of hydrophytes as- "All pteridophytes and spermatophytes whose photosynthetically active parts are permanently or at least for several months of each year part or whole submerged with water or which float

in the surface of water," and regarding the wetlands plants idea of Cook is very definite which stated wetland plants are those which grow in places where inundation must occurred for at least fourteen days and saturation for at least sixty consecutive days. In Indian perspective Agarkar (1923), Biswas and Calder (1936), Bhandari *et al.* (1962), Subramanyam (1962), Trivedi and Sharma (1965), Deb (1976), Rao (2004), Saini *et al.* (2010), etc. are the prominent workers who studied the aquatic and wetlands flora of different state as well as India as a whole. The aquatic and marsh vegetation of India is quite rich and diverse. Almost all the types of growth and life forms of aquatic plants are recognized in Indian wetlands. Approximately half of the world's aquatic flowering plants are present in the region. Of the 10 dicotyledonous and 11 monocotyledonous purely aquatic families, Podostemaceae with 24 species tops the list followed by Hydrocharitaceae (14 spp.) and Lemnaceae (14 spp.). A number of aquatic plants are also endemic to Indian subcontinent (Rao 1994).

The district of Lucknow formed the central part of the province of Avadh and lies between the parallels of 26° 30' and 27° 10' N latitude and 80° 31' and 81° 13' E longitude. The rain fall is about 700-800 mm annually. The district is an irregular quadrilateral with the city and cantonment of the Lucknow forming nearly the centre. Lucknow district lies almost in the centre of the area between the Ganga on one side and the Ghaghra on the other. Broadly speaking, it can be divided into three natural or physical divisions: (a) The Gomti basin (b)



The Sai and its catchment area (c) The Central upland on the higher watershed, running from the North West to the South East and separating the two. To the North and East of the Gomti, the land is an undulating plain and the numbers of rivulets, which traverse it, finally join the Gomti on its left bank. The Gomti basin comprises parts of the Malihabad tehsil on its right, those of Bakshi Ka Talab on its left, the central part of the Lucknow tehsil and the North eastern portion of tehsil Mohanlalganj. The river itself ordinarily runs in a deep and tortuous bed with high banks, cut up at places by ravines or the rivulets that join it on either of its banks. The area to the North and North East of Bakshi Ka Talab tehsil near Mahona also contain a watershed between the Gomti and the Ghaghra and resembles generally the central upland in tehsil Lucknow, though the predominant soil is slightly clayey in texture on account of its indifferent drainage it is dotted with numerous lakes. The Reth takes its rise in this area and after flowing in an easterly direction through the district Barabanki eventually joins the Gomti on its left bank.

The district is crossed by a number of rivers and nalas, among which the Gomti is the principal one. The main tributaries of the Gomti are Akraddi, Jhilingi, Reth, Kukrail and some minor nalas on the left. The other river of any importance is the Sai, which flows across the South-western corner and forms the boundary for a distance in southern part. The tributaries of this river are Nagwa and Bankh and join the main river from the North.

The central upland marks the watershed and forms the most fertile part of the district. The course of the Sharda canal marks the highest level of watershed. The Nalas originating to the North West and South East of the watershed join the river Sai while the Gomti forms the main channel of drainage for the area lying to the East of Lucknow. It is not surprising that few decades back, in Malihabad and Mohanlalganj one should have met with lakes. A triangle between Mohanlalganj and Gosainganj with Nagram as the apex is an area of inland drainage previously having a chain of lakes. The most important perennial lake is Karaula which spreads through many villages near Nagram.

The Akraddi nala rises in the Gundwa tehsil of Hardoi district near the boundary of Lucknow district. It is the North- most/West tributary of the Gomti and

flows for the most part in Malihabad. It is joined by some minor nalas in its lower parts and finally falls into the river Gomti near Manjhowa village, two miles to the West of Kathwarha. Jhilingi tributary originates in the tehsil Malihabad near village Masira Ratan.

The river Sai enters the district on the South-West from the tehsil Bakshi Ka Talab in the Unnao district. For about six miles, it forms the boundary between Mahona and Bijnor (Lucknow) and then it enters the latter near Darabnagar. After separating out few villages, it again forms the boundary separating Bijnaur from Govinda Parsandon and then enters Unnao at Bani. It reappears near Nigohan and forms the boundary between it and Pargana Maurawan of Unnao district at Birsinghpur. Though an important river, it serves only the southern and south western parts of the district. It is perennial stream, flowing in a narrow well-defined channel. Its bed is shallower than that of the Gomti, and the land on its banks is less dissected by ravines. Like the Gomti it also has sandy tracts on its left side.

The Nagwa nalla originates a few miles to the North of Mahona in the Unnao district. It soon reaches the boundary and separates the tehsil Mahona and Auras from Kakori. When it reaches the boundary near Bijnor, it turns abruptly to the East and forms a big loop till it reaches near Amawan. From there it flows in a South-easterly course up to the West of Banthra, where it again takes a 90° bend and finally falls into the Sai near village Bani.

There are a number of lakes viz. Kathauta, Kusaila, Khartola, Karaula, Hardoia, Jabreli, Chunaui, etc. in the district. The most important of these is the Karaula which is the only perennial lake near Nagram. The land near the banks is cultivated by people and sown with paddy and wheat. These lakes are also utilized for irrigation by cultivators either to supplement the canal irrigation where the land is within command area of canal or as an independent source of irrigation. There are no natural springs in the district and the small rivers and rivulets/nalas that take their rise from low lying lands or swamps do not serve any purpose other than that of drainage- channels during the monsoon. Formation of bunds along sides of the rivers, tributaries, rivulets and many developmental works have also damaged many habitats leading to the closure of many natural streams/nalas of the district. Shrinking of these habitats

has put many aquatic species under severe threat.

Anderson first explored the district in 1859 and published his paper "Notes on the Flora of Lucknow with Catalogues of the Cultivated and Indigenous Plants" but he could not publish a complete list. As he stated "my list is not as complete as it might be, for, as my original collections were lost during mutinies. It has been compiled from a set of duplicates I sent to Dr. Thomson and from a small collection I made, while on service at Lucknow last year". After a long gap of about one century Kapoor (1962) gave a comprehensive list of plant species indicating those species of Anderson's catalogue which could not be confirmed to be occurring in Lucknow as well as many additions to the catalogue. Patil (1963) published his flora of Lucknow and included only 330 species as he himself stated "The present list of plant is by no means exhaustive within the limits set above, but on the whole the wild herbs and almost all roadsides trees have been included". Balapure and Srivastava (1964) published the Vegetation of Lucknow and covered over 200 species. Sharma (1964) added 13 species in addition to the Kapoor's list. Husain and Kapoor (1970) added 12 species to the region. Saini (1990, 2002) has also published papers on additions to the flora of the district. Trivedi and Sharma (1965) gave an account of hydrophytes of Lucknow and its environs but no any voucher specimens are available. Singh (1990, 1991, 1993, 1995, 1996, 2009, 2010) has surveyed the area for more than twenty years in different seasons at different intervals for his thesis work and published more than 20 paper and a book entitled 'Lucknow Flora- the plant wealth of the region (2006)'. The voucher specimens are deposited in the herbarium of CSIR- CIMAP. In the present communication the species diversity along each habitat of aquatic, semi-aquatic, marshland, etc. habitats have been discussed.

A. Species diversity among aquatic, semi-aquatic, marshland, etc. bodies

The aquatic, semi-aquatic, marshlands, wetlands, amphibious, etc. plant species normally grow and develop in water and complete at least a part of their life cycle in water. The common habitat of aquatic and marshland vegetation are rivers, lakes, ponds, puddles, ditches and low lying areas which remain submerged during major parts of the year. The aquatic plants are

classified into different categories on the basis of nature and depth of water and degree of soil wetness in which they can live. Plants living in flowing and standing water with excessive supply of water do not face the problems of water loss due to transpiration, wilting and drought, they are termed as hydrophytes. The hydrophytes of Lucknow district can be classified into following six categories on the basis of their contact with air, water and soil.

1. **Free floating:** In this category the species are only in contact with air and water like *Azolla pinnata* R. Br., *Eichhornia crassipes* Solms., *Hygroryza aristata* Nees, *Pistia stratiotes* L., *Spirodela polyrrhiza* Schleid, *Trapa bispinosa* Roxb., *Wolffia arrhiza* Wimm., etc.
2. **Suspended:** In this group the species are only in contact with water and are rootless, e.g. *Ceratophyllum demersum* L., *Utricularia stellaris* var. *inflexa* Cl., *U. flexuosa* Vahl, etc.
3. **Submerged anchored:** These are only in contact with soil and water but in some cases flowers are slightly raised above water, e.g. *Hydrilla verticillata* Royle, *Lagarosiphon alternifolius* Druce, *Ottelia alismoides* Pers., *Potamogeton crispus* L., *P. nodosus* Poir., *P. pectinatus* L., *Vallisneria spiralis* L. etc.
4. **Floating leaves/shoots anchored:** These are in contact with water, soil as well as air, e.g. *Aponogeton crispus* Thunb., *Ipomoea aquatica* Forsk., *Ludwigia adscendens* Hara, *Nelumbo nucifera* Gaertn., *Neptunia oleracea* Lour., *Nymphaea nouchali* Burm. f., *N. stellata* Willd., *Nymphoides indicum* Ktze., *N. hydrophyllum* Ktze. etc.
5. **Emergent amphibious:** In this case the root, lower part of the stem and in some cases lower leaves are usually submerged in water, e.g. *Aeschynomene aspera* L., *A. indica* L., *Alternanthera philoxeroides* Griseb., *Amischophacelus axillaris* R. Rao et Kam., *Eleocharis dulcis* Hen., *Eriocaulon cinereum* R. Br., *Hemarthria compressa* R. Br., *Ischaemum rugosum* Salisb., *Polygonum barbatum* L. ssp. *gracile* Danser, *P. glabrum* Willd., *P. hydropiper* L., *P. lapathifolium* L. var. *lanatum* (Roxb.) Steward, *P. limbatum* Meissn., *Limnophyton obtusifolium* (L.) Miq., *Ludwigia octovalvis* ssp. *sessiliflora* (Micheli) Raven, *L. perennis* L., *Monochoria vaginalis* Presl., *Oenanthe*



javanica (Bl.) DC., *Paspalum paspalodes* (Michx.) Schibner, *Polypogon monspeliensis* (L.) Desf., *Rottboelia cochinchinensis* (Lour.) Clayton, *Sagittaria guayanensis* H.B.K., *S. sagittifolia* L., *Shoenoplectus grossus* (L. f.) Palla, *Typha angustata* Chaub. & Bory, *Vetiveria zizanioides* (L.) Nash, *Zannicheliapalustris* L., etc.

6. **Wetland:** A large number of species represent this group e.g. *Alternanthera paronychioides* St' Hill., *A. pungens* Kunth, *A. sessilis* DC., *Ammannia auriculata* Willd., *Ammannia baccifera* L., *Ammannia multiflora* Roxb., *Bacopa monnieri* (L.) Pennell, *Caesulia axillaris* Roxb., *Cardamine scutata* Thunb., *Centella asiatica* L., *Centipeda minima* (L.) A.Br.et Aschers., *Coix lachryma-jobi* L., *Coldenia procumbens* L., *Cotula anthemoides* L., *Cyperus alulatus* Kern., *C. exaltatus* Retz., *C. imbricatus* Retz., *C.iria* L., *C. michelianus* Link ssp. *pygmaeus* (Rottb.) Aschers. et Graebn., *C. pangorei* Rottb., *C. rotundus* L., *Dentella repens* Forsk., *Echinochloa colona* (L.) Link, *E. crus-galli* (L.) Beauv., *Enhydra fluctuans* Lour., *Eragrostis* spp., *Eclipta prostrata* (L.) L., *Fimbristylis aestivalis* (Retz.) Vahl, *F. falcata* (Vahl) Kunth, *F. miliacea* (L.) Vahl, *F. ovata* (Burm. f.) Kern, *F. quinqueangularis* (Vahl) Kunth, *F. schoenoides* (Retz.) Vahl, *Hygrophila auriculata* Heyne, *H. polysperma* (Roxb.) T. Anders., *H. salicifolia* (Vahl) Nees,

Limnophila indica Druce, *Mariscus compactus* (Retz.) Boldingh, *M. sumatrensis* (Retz.) Raynal, *Marsilea quadrifolia* L., *Peperomia palucida* (L.) HBK, *Pycneus flavidus* (Retz.) T. Koyama, *Polygonum plebeium* R.Br., *Pouzolzia zeylanica* (L.) Benn., *Rorippa indica* (L.) Hiern., *Rotala indica* (Willd.) Koehne, *Shoenoplectus articulatus* (L.) Palla, *S. juncooides* (Roxb.) Palla, *S. lateriflorus* (Gmel.) Lye, *S. maritimus* (L.) Lye, *S. mucronatus* (L.) Palla, *S. roylei* (Nees) Ovczinn. Czukav., *Sphaeranthus indicus* L., *Sphenoclea zeylanica* Gaertn., *Staurogyne glutinosa* (Wall.) Ktze., *Typha angustata* Bory et Chaub., *Typhonium trilobatum* Schott., *Veronica anagallis-aquatica* L. etc.

B. Species diversity along banks/ margins of rivers, lakes, ponds, ditches, etc.

The species frequently met along the banks of rivers, ditches, ponds, lakes and nalas are *Ageratum*

conyzoides L., *Alternanthera paronychioides* St., Hill, *Argemone mexicana* L., *A. ochroleuca* Sweet, *Arundo donax* L., *Canscora decussata* Schultes, *Chenopodium ambrosioides* L., *Chrozophora rottleri* Juss., *C. prostrata* Dalz., *Coronopus didymus* Sm., *Corchorus capsularis* L., *Chrysanthellum americanum* (L.) Vatke, *Croton bonplandianum* Baill., *Cyperus alulatus* Kern., *C. exaltatus* Retz., *C. imbricatus* Retz., *C. iria* L., *C. michelianus* Link ssp. *pygmaeus* (Rottb.) Aschers. et Graebn., *C. pangorei* Rottb., *C. rotundus* L., *Fimbristylis bisumbellata* Bub., *Gnaphalium luteo-album* L., *G. pulvinatum* Del., *Grangea maderaspatana* (L.) Poir., *Heliotropium indicum* L., *Hydrocotyle javanica* Thunb., *Hydrolea zeylanica* (L.) Vahl, *Leucas cephalotes* (Roth) Spreng., *Lindenbergia macrostachya* Benth., *Lippia javanica* Spreng., *Nicotiana plumbaginifolia* Viv., *Phragmites karka* (Retz.) Trin. ex Steud., *Phyla nodiflora* Greene, *Polycarpon prostratum* (Forsk.) Aschers. et Schweinf., *Polygonum plebeium* R.Br., *Potentilla supina* L., *Pulicaria crispa* Sch. Bip., *Ranunculus sceleratus* L., *Rumex dentatus* L., *Sesbania sesban* Merr., *Tamarix dioica* Roxb., *Trewia nodiflora* L., *Typha angustata* Bory et Chaub., *Verbascum chinense* (L.) Sant., *Veronica anagallis-aquatica* L., *Vitex negundo* L., *Xanthium indicum* L. etc.

Discussion

Approximately world's half of the aquatic flowering plants are present in the subcontinent. Of the 10 dicotyledonous and 11 monocotyledonous purely aquatic families, Podostemaceae with 24 species tops the list followed by Hydrocharitaceae (14 spp.) and Lemnaceae (14 spp.). The maximum percentage of diversity of species among these habitats is found in sedges and grasses. Due to demographic pressures and economic growth of these natural resources are under tremendous threat. Fresh water- which holds the life line for all living organisms including humans- is a rapidly shrinking resource. Due to various threats to these habitats, the species diversity among these water bodies is depleting day by day and time is not far when these species will come under various categories of threatened and endangered species. Keeping its economic and aesthetic value, government authorities should play an important role in conserving these natural resources to help save the threat to biodiversity of these aquatic, semi-aquatic, marshlands, etc. of Lucknow district.



List of hydrophytes of Lucknow District

- | | | | |
|----|--|----|---|
| 1 | <i>Acalypha indica</i> L. | 44 | <i>C. forskalaei</i> Vahl |
| 2 | <i>Adiantum capillus-veneris</i> L. | 45 | <i>C. hasskarlii</i> Cl. |
| 3 | <i>Aeschynomene aspera</i> L. | 46 | <i>C. paludosa</i> Bl. |
| 4 | <i>A. indica</i> L. | 47 | <i>Corchorus capsularis</i> L. |
| 5 | <i>Ageratum conyzoides</i> L. | 48 | <i>Coronopus didymus</i> Sm. |
| 6 | <i>Alternanthera paronychioides</i> St' Hill. | 49 | <i>Cotula anthemoides</i> L. |
| 7 | <i>A. philoxeroides</i> Griseb. | 50 | <i>Croton bonplandianum</i> Baill. |
| 8 | <i>A. pungens</i> Kunth | 51 | <i>Cynodon dactylon</i> (L.) Pers. |
| 9 | <i>A. sessilis</i> DC. | 52 | <i>Cyperus alulatus</i> Kern. |
| 10 | <i>Alysicarpus</i> spp. | 53 | <i>C. exaltatus</i> Retz. |
| 11 | <i>Amaranthus spinosus</i> L. | 54 | <i>C. imbricatus</i> Retz. |
| 12 | <i>Amisophacelus axillaris</i> R. Rao et Kam. | 55 | <i>C. iria</i> L. |
| 13 | <i>Ammannia auriculata</i> Willd. | 56 | <i>C. michelianus</i> Link ssp. <i>pygmaeus</i> Asch. et Graeb. |
| 14 | <i>A. baccifera</i> L. | 57 | <i>C. pangorei</i> Rottb. |
| 15 | <i>A. multiflora</i> Roxb. | 58 | <i>C. rotundus</i> L. |
| 16 | <i>Antigonon leptopus</i> Hook. et Arn. | 59 | <i>Dentella repens</i> Forsk. |
| 17 | <i>Aponogeton crispum</i> Thunb. | 60 | <i>D. serpyllifolia</i> Wall. Ex Craib. |
| 18 | <i>A. natans</i> (L.) Engl. et Krause | 61 | <i>Desmodium triflorum</i> (L.) DC. |
| 19 | <i>Argemone mexicana</i> L. | 62 | <i>Dipteracanthus prostratus</i> (Poir.) Nees |
| 20 | <i>A. ochroleuca</i> Sweet | 63 | <i>Echinochloa colona</i> (L.) Link |
| 21 | <i>Arundo donax</i> L. | 64 | <i>E. crus-galli</i> (L.) Beauv. |
| 22 | <i>Azolla pinnata</i> R. Br. | 65 | <i>Eclipta prostrata</i> (L.) L. |
| 23 | <i>Bacopa monnieri</i> (L.) Pennell | 66 | <i>Eichhornia crassipes</i> Solms. |
| 24 | <i>Basella rubra</i> L. | 67 | <i>Eleocharis dulcis</i> Hen. |
| 25 | <i>Bergia ammannioides</i> Roxb. | 68 | <i>Enhydra fluctuans</i> Lour. |
| 26 | <i>Blumea</i> spp. | 69 | <i>Eragrostis</i> spp. |
| 27 | <i>Brachiaria</i> spp. | 70 | <i>Eriocaulon cinereum</i> R. Br. |
| 28 | <i>Breea arvensis</i> (L.) Less | 71 | <i>Euphorbia</i> spp. |
| 29 | <i>Caesulia axillaris</i> Roxb. | 72 | <i>Fimbristylis aestivalis</i> (Retz.) Vahl |
| 30 | <i>Canscora diffusa</i> (Vahl) R.Br. | 73 | <i>F. bisumbellata</i> Bub. |
| 31 | <i>Cardamine scutata</i> Thunb | 74 | <i>F. falcata</i> (Vahl) Kunth |
| 32 | <i>Carex fedia</i> Nees | 75 | <i>F. miliacea</i> (L.) Vah |
| 33 | <i>Cassia alata</i> L. | 76 | <i>F. ovata</i> (Burm. f.) Kern |
| 34 | <i>Centella asiatica</i> L. | 77 | <i>F. quinqueangularis</i> (Vahl) Kunth |
| 35 | <i>Centipeda minima</i> (L.) A.Br. et Aschers. | 78 | <i>F. schoenoides</i> (Retz.) Vahl |
| 36 | <i>Ceratophyllum demersum</i> L. | 79 | <i>Gisekia pharnaceoides</i> L. |
| 37 | <i>Chenopodium ambrosioides</i> L. | 80 | <i>Glinus lotoides</i> L. |
| 38 | <i>Chrozophora rottleri</i> Juss. | 81 | <i>G. oppositifloius</i> (L.) DC. |
| 39 | <i>C. prostrata</i> Dalz. | 82 | <i>Gnaphalium luteo-album</i> L. |
| 40 | <i>Chrysanthellum americanum</i> (L.) Vatke | 83 | <i>G. polycaulon</i> Pers. |
| 41 | <i>Coix lachryma-jobi</i> L. | 84 | <i>G. pulvinatum</i> Del. |
| 42 | <i>Coldenia procumbens</i> L. | 85 | <i>Grangea maderaspatana</i> (L.) Poir. |
| 43 | <i>Commelina benghalensis</i> L. | 86 | <i>Heliotropium indicum</i> L. |





- 87 *H. morifolium* Retz.
88 *H. supinum* L.
89 *Hemarthria compressa* R. Br.
90 *Hoppea dichotoma* Heyne ex Willd.
91 *Hydrilla verticillata* Royle
92 *Hydrocotyle javanica* Thunb.
93 *Hydrolea zeylanica* (L.) Vahl
94 *Hygrophila auriculata* Heyne
95 *H. polysperma* (Roxb.) T. Anders.
96 *H. salicifolia* (Vahl) Nees
97 *Hygroryza aristata* Nees
98 *Imperata cylindrica* Beauv.
99 *Indigofera linnaei* Ali
100 *Ipomoea aquatica* Forsk.
101 *I. fistulosa* Mart. ex Choisy
102 *I. turbinata* Lag
103 *Ischaemum rugosum* Salisb.
104 *Jatropha glandulifera* Roxb.
105 *Justicia japonica* Thunb.
106 *J. quinqueangularis* Koen. ex Roxb.
107 *Lagarosiphon alternifolius* Druce
108 *Laportea interrupta* (L.) Chew
109 *Lathyrus aphaca* L.
110 *Leucas cephalotes* (Roth) Spreng.
111 *Limnophila indica* Druce
112 *Limnophyton obtusifolium* (L.) Miq.
113 *Lindenbergia macrostachya* Benth.
114 *Lindernia antipoda* Alst. ssp. *verbenifolia* Benn.
115 *L. crustacea* (L.) F. Muell.
116 *Lippia javanica* Spreng.
117 *Ludwigia adscendens* (L.) Hara
118 *L. octovalvis* ssp. *sessiliflora* (Micheli) Raven
119 *L. perennis* L.
120 *Majus pumilus* (Burm. f.) Steen.
121 *Mariscus compactus* (Retz.) Boldingh
122 *M. sumatrensis* (Retz.) Raynal
123 *Marsilea quadrifolia* L.
124 *Medicago lupulina* L.
125 *M. polymorpha* L.
126 *Melochia corchorifolia* L.
127 *Merremia gangetica* (L.) Cufo
128 *Mollugo* spp.
129 *Monochoria vaginalis* Presl.
130 *Murdania nudiflora* (L.) Bren.
131 *Nelumbo nucifera* Gaertn.
132 *Neptunia oleracea* Lour.
133 *Nicotiana plumbaginifolia* Viv.
134 *Nymphaea nouchali* Burm. f.
135 *N. stellata* Willd.
136 *Nymphoides indicum* Ktze.
137 *N. hydrophyllum* Ktze.
138 *Oenanthe javanica* (Bl.) DC.
139 *Oryza* sp.
140 *Ottelia alismoides* Pers.
141 *Parthenium hysterophorus* L.
142 *Paspalum flavidum* (Retz.) Camus
143 *P. paspalodes* (Michx.) Schibner
144 *Pedaliium murex* L.
145 *Peperomia palucida* (L.) HBK
146 *Phragmites karka* (Retz.) Trin. ex Steud.
147 *Phyla nodiflora* Greene
148 *Phyllanthus urinaria* L.
149 *Pistia stratiotes* L.
150 *Poa annua* L.
151 *Polycarpon prostratum* (Forsk.) Asch. et Sch.
152 *Polygonum barbatum* L. ssp. *gracile* Danser
153 *P. glabrum* Willd.
154 *P. hydropiper* L.
155 *P. lapathifolium* L. var. *lanatum* (Roxb.) Steward
156 *P. limbatum* Meissn.
157 *P. plebeium* R.Br.
158 *Polypogon monspeliensis* (L.) Desf.
159 *Potamogeton crispus* L.
160 *P. nodosus* Poir.
161 *P. pectinatus* L.
162 *Potentilla supina* L.
163 *Pouzolzia zeylanica* (L.) Benn.
164 *Pulicaria crispa* Sch. Bip.
165 *Pycneus flavidus* (Retz.) T. Koyama
166 *Ranunculus sceleratus* L.
167 *Rorippa indica* (L.) Hiern.
168 *Rotala indica* (Willd.) Koehne
169 *Rottboelia cochinchinensis* (Lour.) Clayton
170 *Rumex dentatus* L.
171 *Sagittaria guayanensis* H.B.K.
172 *S. sagittifolia* L.
173 *Salix tetrasperma* Roxb.
174 *Scoparia dulcis* L.



- | | | | |
|-----|--|-----|--|
| 175 | <i>Sesamum orientale</i> L. | 193 | <i>Trapa bispinosa</i> Roxb. |
| 176 | <i>Sesbania sesban</i> Merr. | 194 | <i>Trewia nodiflora</i> L. |
| 177 | <i>Shoenoplectus articulatus</i> (L.) Palla | 195 | <i>Trianthema</i> spp. |
| 178 | <i>S. grossus</i> (L. f.) Palla | 196 | <i>Triumfetta rhomboidea</i> Jacq. |
| 179 | <i>S. juncooides</i> (Roxb.) Palla | 197 | <i>Typha angustata</i> Chaub. & Bory |
| 180 | <i>S. lateriflorus</i> (Gmel.) Lye | 198 | <i>Typhonium trilobatum</i> Schott. |
| 181 | <i>S. maritimus</i> (L.) Lye | 199 | <i>Utricularia stellaris</i> var. <i>inflexa</i> Cl. |
| 182 | <i>S. mucronatus</i> (L.) Palla | 200 | <i>U. flexuosa</i> Vahl |
| 183 | <i>S. roylei</i> (Nees) Ovczinn. Czukav. | 201 | <i>Vallisneria spiralis</i> L. |
| 184 | <i>Sisymbrium irio</i> L. | 202 | <i>Verbascum chinense</i> (L.) Sant. |
| 185 | <i>Solanum nigrum</i> L. | 202 | <i>Verbena officinalis</i> L. |
| 186 | <i>Soliva anthemifolia</i> R. Br. ex Lessong | 204 | <i>Veronica anagallis aquatica</i> L. |
| 187 | <i>Sphaeranthus indicus</i> L. | 205 | <i>Vetiveria zizanioides</i> (L.) Nash |
| 188 | <i>Sphenoclea zeylanica</i> Gaertn. | 206 | <i>Vitex negundo</i> L. |
| 189 | <i>Spirodela polyrrhiza</i> Schleid | 207 | <i>Wolffia arrhiza</i> Wimm. |
| 190 | <i>Staurogyne glutinosa</i> (Wall.) Ktze. | 208 | <i>Xanthium indicum</i> L. |
| 191 | <i>Stellaria media</i> (L.) Vill. | 209 | <i>Zannichellia palustris</i> L. |
| 192 | <i>Tamarix dioica</i> Roxb. | 210 | <i>Zeuxine strateumatica</i> (L.) Schltr. |



Water plants



Gomti river showing the diversity of species in around and on its surface



A wetland vegetation showing *Eichhornia crassipes*, *Ludwigia*, *Nymphaea* spp., etc.



Kukrail rivulet showing species diversity



Ranunculus sceleratus



Nicotiana plumbaginifolia



Lindenbergia macrostachya



Lindenbergia macrostachya



Phyla nodiflora



Salvia plebeia



Verbascum chinense



Polygonum barbatum ssp. gracile



Polygonum plebeium



Polygonum hydropiper



Glinus lotoides



Echinochloa crus-galli



Chenopodium ambrosioides



Nelumbo nucifera



Tamarix dioica



Ammannia baccifera



Centella asiatica



Caesulia axillaris



Merremia gangetica



Spilanthes ciliata



Pouzolzia zeylanica



Rumex dentatus



Coix lachrymal-jobi



Heliotropium indicum



Soliva anthemifolia



Veronica anagallis-aquatica



Polygonum glabrum



Bacopa monnieri



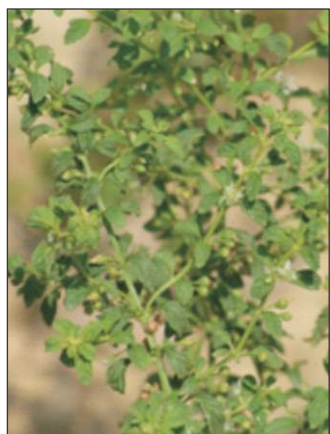
Phyla nodiflora



Medicago lupulina



Phyllanthus urinaria



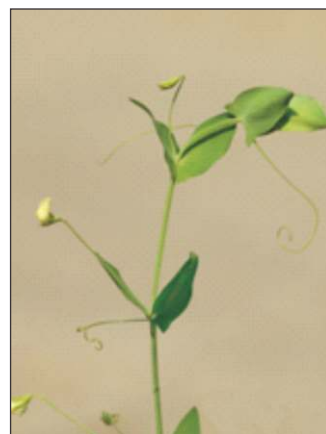
Scoparia dulcis



Majus pumilus



Sphaeranthus indicus



Lathyrus aphaca



Pedalium murex



Hydrocotyle javanica



Amaranthus spinosus



Lippia javanica



Poa annua



Breea arvensis



Lathyrus aphaca

References

- Agarkar, S. P. 1923. The present position of our knowledge of the aquatic flora of India. Indian. Bot Soc. 3: 252-260.
- Balapure, K.M. and Srivastava, J.G. 1964. The vegetation Lucknow district (U.P.). Mirzapur educational supplies co. Mirzapur.
- Banerjee, L. K. and Kumar, P. S. 2000. An overview of vascular diversity of wetlands, its conservation and sustainable development in India. ENVIS News letter, No. 7.
- Bhandari, B. B., Singh, B. and Desai, B. L. 1962. Water plants. New Delhi.
- Biswas, K. and Calder, C. C. 1936. Handbook of common water and marsh plants of India and Burma. New Delhi.
- Cook, C. D. K. 1996. Aquatic and wetland plants of India. New York.
- Dutta, S. A., Desai, N., Almeida, S. M. and Das, A. P. 2002. Aquatic macrophytes of Apalchand reserve in the Jalpaiguri district of West Bengal. In: Perspective of plant biodiversity (ed. A. P. Das). Dehradun. pp. 53-65.
- Ghosai, S. K., Santra, S. C. and Mukherjee, P. K. 1993. Phenological studies in aquatic macrophyte plant of lower Gangetic delta. West Bengal, India. Feddes Repertorium. 104: 93-111.
- Kapoor, S.L. 1962. On the botany of Lucknow district. J. Bomb. Nat. Hist. Soc. 59: 862-896.
- Majumdar, N. C. 1965. Aquatic and semi-aquatic flora of Calcutta and adjacent localities. Bull. Bot. Soc. Bengal 19: 10-17.
- Mitra, S. and Mukherjee, S.K. Diversity of aquatic and wet land plants of west Dinajpur district, West Bengal. In: Biodiversity impact and assessment (ed. P.C. Trivedi). Printer Publishers, Jaipur, India.
- Muenschar, W. C. 1944. Aquatic Plants of United States. London.
- Mukhopadhyay, C. R. 1987. Aquatic and semi-aquatic plants of Birbhum district, West Bengal. J. Econ. Tax. Bot. 9: 230-238.
- Naskar, K.R. 1990. Aquatic and semi-aquatic plants of the lower Ganga delta, New Delhi.
- Patil, R.P. 1963. A contribution to the flora of Lucknow. Bull. Bot. Surv. India 5: 1-35.
- Prain, D. 1903. Bengal plants. Vol. 1 and 2. Calcutta (Rep. Ed. 1963).
- Rao, R.R. 1994. Biodiversity in India (Floristic aspect). BSMPs, Dehra Dun.
- Sculthorpe, C. D. 1967. The biology of aquatic vascular plants. London.
- Saini, D.C. 1990. Addition to the flora of Lucknow. J. Econ. Tax. Bot. 14(3): 561-568.
- Saini, D.C. 2002. New distributional record of some plants for flora of Lucknow district in Uttar Pradesh. J. Econ. Tax. Bot. 26(2): 371-384.
- Saini, D.C. 2002. *Talinium portulacifolium* (Forsk.) Asch. ex Schw.- A useful vegetable and garden plant- Hitherto unrecorded taxon from upper gangetic plain. J. Econ. Tax. Bot. 26(3): 579-582.
- Saini, D.C. Singh, S.K. and Rai, Kamallesh 2010. Biodiversity of aquatic and semi-aquatic plants of Uttar Pradesh. UP State Biodiversity Board, Lucknow.
- Sharma, P.C. 1964. A note on the flora of Lucknow district. Bull. Bot. Surv. India 6: 101.
- Sharma, V.C. 1959. Uttar Pradesh district gazetteer Vol. 37. Lucknow.
- Singh, S.C. 1993. *Spilanthes uliginosa* Sw. A new record for gangetic plain. J. Bomb. Nat. Hist. Society 90(3): 541-542.
- Singh, S.C. 1995. Some interesting plant record after a gap of more than one century from Lucknow district, U.P. J. Econ. Tax. Bot. 19(2): 419-425.
- Singh, S. C. 2009. Contribution to the flora of Lucknow. Jour. Econ. Tax. Bot. 33(2): 437-442.
- Singh, S.C. 2010. *Bidens pilosa*: A potential medicinal pantropic weed extends its distribution to Lucknow, UP, India. J. Med. Arom. Pl. Sci. 32(4): 483-486.
- Singh, S.C. and Khanuja, S.P.S. 2006. Lucknow flora- The plant wealth of the region. Central Institute of Medicinal and Aromatic Plants, Lucknow.
- Singh, S.C. and Shah, N.C. 1990. Contribution to the flora of Lucknow district Wild species. J. Econ. Tax. Bot. 14(1): 237-238.
- Singh, S.C. and Shah, N.C. 1990. New record for upper gangetic plain from Lucknow district. J. Econ. Tax. Bot. 14(3): 748-750.
- Singh, S.C. and Shah, N.C. 1991. Contribution of the flora of Lucknow district. 2 Cultigens. J. Econ. Tax. Bot. 15(3): 599-601.
- Singh, S.C. and Srivastava, G.N. 1996. New records for Lucknow district, U.P. Jour. Econ. Tax. Bot. 20(3): 645-649.
- Subramanyam, K. 1962. Aquatic Angiosperms. New Delhi.
- Trivedi, V.S. and Sharma, P.C. 1965. Studies on the hydrophytes of Lucknow and its environments. Proc. Nat. Acad. Sci. 35: 1-14.