

A STUDY OF AQUATIC AND MARSHLAND VEGETATION OF SRINAGAR

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(Communicated by R. Misra, F.N.I.)

(Received November 1, 1965)

The paper presents data on floristic composition, distribution and phenology of the aquatic and marshland vegetation of Srinagar. Location and climate of the area under study are given. Description of the important aquatic habitats selected for the present study is also given. Eight life forms have been recognized while classifying the hydrophytes of Srinagar. A table giving the distribution of aquatics in important environs is included. Six plants show restricted distribution and are present only in one or two habitats. Vegetation of perennial lakes is controlled by physico-chemical nature of the substratum and biotic interference. Five plants have been recorded for the first time for this region. A total number of 117 species, belonging to 69 genera and 42 families, have been recorded as occurring in the area.

INTRODUCTION

The study of aquatic vegetation has received some attention in India. The notable contributions are those of Biswas and Calder (1936), Subramanyam (1962), Misra (1946), Mirashi (1954), Pattnaik and Pattnaik (1956), Kachroo (1956), Chavan and Sabnis (1961) and Vyas (1964).

No detailed account of hydrophytes of Srinagar is available. The present study is an attempt towards that end.

AREA OF STUDY

Srinagar is situated in the centre of the valley of Kashmir, between $34^{\circ} 5' - 34^{\circ} 7'$ N latitude and $74^{\circ} 8' - 74^{\circ} 9'$ E longitude at an altitude of about 1,600 m above the mean sea level. It is the summer capital of the State of Jammu and Kashmir and is known for its lakes, springs, rivers and marshlands. An area of about 30 sq km comprising of lakes, mar canals, pools, puddles and marshlands has been covered in the present investigation.

CLIMATE

The climate of Srinagar is characterized by both seasonal as well as diurnal extremes of temperature. July and August are hot and humid with mercury sometimes touching 32° C. During January and February temperature goes below zero, resulting in the freezing of some portions of

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lakes. Spring and autumn rains in addition to heavy snowfall during the months of December to March are other peculiarities of this climate. The meteorological data for the year 1963, during which period most of the plant collections were made, are given in Table I.

TABLE I
Meteorological data for Srinagar for the year 1963

Months	Mean daily max. temp. (°C)	Mean daily min. temp. (°C)	Mean relative humidity (percentage)		Mean monthly rainfall (mm)
			0830 hr	1730 hr	
January ..	5.0	-2.6	86	77	73.7
February ..	6.7	-1.4	88	71	72.1
March ..	13.8	2.8	85	62	91.7
April ..	19.3	7.0	85	62	92.7
May ..	25.0	10.5	78	41	60.5
June ..	29.7	14.1	75	43	35.6
July ..	31.0	17.9	79	46	59.2
August ..	30.3	17.4	83	50	61.5
September ..	28.6	11.9	85	42	38.9
October ..	23.2	4.8	85	50	29.7
November ..	16.9	-0.6	84	51	11.2
December ..	9.2	-2.4	90	74	33.5

HABITATS AND VEGETATION

Hydrophytes of Srinagar grow under one of the two main types of situations. Those in the lakes and mar canals are mostly perennial whereas the ones in the low-lying areas, watercourses and marshlands last only till autumn when these habitats dry out.

1. *Vegetation of perennial lakes:*

Three lakes, viz. Dal, Anchar and Hokarsar, have been included in the present study. Dal and Anchar lakes are open whereas Hokarsar lake is a closed one.

(a) *Dal lake.*—This lake is 2.48 km long and 1.55 km broad and is situated at a distance of about 1.6 km from Srinagar towards its north-eastern side. It is being fed by a small stream, the Telbal nallah, and has an outlet near Drogjun. The portion of the lake lying between the exit and Nehru park is mainly used for anchoring houseboats and shikaras and is known as Boulevard lake. Vegetation in the centre mainly comprises of *Myriophyllum spicatum*, *Potamogeton pectinatus*, *P. leucens* and *Ceratophyllum demersum*. Near the ghats *Hydrilla verticillata* and *Potamogeton crispus* grow quite luxuriantly. The sides show occasional presence of *Nymphoides peltatum*. Water depth varies between 1.5 and 2.0 m.

The other part of the lake which extends between Nehru park and Kotar khanna is known as Gagribal lake. It is exposed to heavy biotic interference by way of weed removal and aquatic sports. Water depth is between 2.5 and 2.7 m. *Myriophyllum spicatum*, *Potamogeton leucens* and *P. pectinatus* colonize the centre of the lake. On the sides *Nymphoides peltatum*, *Potamogeton natans* and *Euryale ferox* are common. The shallower regions towards the banks support the growth of *Alisma plantago*, *Juncus glaucus* and *Phragmites communis*. In Kotar khanna enclosure *Nymphaea stellata* is observed to be well established.

The third portion of the lake is known as Bod dal. This is demarcated by a tongue-shaped projection from Gagribal and a bund from Hazaratbal side. It is slightly deeper than the other two parts, depth varying between 2.6 and 3.0 m. Scarcity of vegetation in this part is the direct result of severe biotic interference. It is also exposed to slight winds during summer. *Myriophyllum spicatum*, *Potamogeton leucens*, *Najas graminea* and *N. major* are supported in the centre. Towards the sides *Nelumbo nucifera*, *Nymphoides peltatum*, *Trapa natans* and *Potamogeton natans* are common. *Myriophyllum verticillatum* and *Typha angustata* grow in shallower parts.

The fourth part is known as Hazaratbal lake, which is gradually getting silted up by the Telbal nallah. A part of this lake dries up during winter. *Ceratophyllum demersum* and *Myriophyllum spicatum* in the centre and *Utricularia flexuosa*, *Myriophyllum verticillatum* and *Typha angustata* towards the sides have got well established. The recession of water level during winter gives birth to a number of wet-land forms which include plants like *Rotala densiflora*, *R. indica*, *Ammania auriculata*, *Amaranthus blitum*, *Roripa islandica* and *Cyperus iria*.

The fifth part, viz. Nagin lake, is the deepest with depth varying between 5.2 and 5.5 m and is exclusively used for aquatic sports. Towards the centre *Ceratophyllum demersum* and *Myriophyllum spicatum* are common. On the sides *Nymphaea alba*, *Nymphoides peltatum*, *Nelumbo nucifera*, *Phragmites communis* and *Typha angustata* form well-demarcated zones.

There are a good number of water channels that connect the lake with different parts of the city which are used for navigational purposes. The majority of these channels are ephemeral, drying out during autumn-winter. *Salvinia natans* forms a continuous mat of vegetation in these water bodies. The other floating forms are *Lemna minor*, *L. gibba*, *L. trisulca*, *Spirodella polyrhiza* and *Ricciocarpus natans*. *Ceratophyllum demersum* grows well under the shade of the floating mat of *Salvinia natans*. It is replaced by species like *Hydrocharis dubia*, *Marsilea quadrifolia*, *Ranunculus trichophyllus*, *R. sceleratus*, *Polygonum amphibium*, *P. glabrum*, *Rumex maritima* and *Hydrilla verticillata* in the regions where the floating mat does not get established due to one cause or the other.

Floating gardens are common in the lake which support the growth of plants like *Spiranthes sinensis*, *Bidens tripartita*, *Lythrium salicaria*, *Menyanthes trifoliata*, *Equisetum diffusum* and *Lycopus europaeus*. Permanent floating gardens present slightly different vegetation because of drier habitat conditions. Their characteristic plants are *Xanthium strumarium*, *Potentilla reptans*, *Scirpus lacustris*, *Polypogon fugax* and *P. littoralis*.

(b) *Anchar lake*.—This lake is situated to the north-west of Srinagar at a distance of 14 km and covers an area of 12 km sq. It is 3 km long and 1.40 km broad. The lake is being fed by the cold water river, Sind. *Myriophyllum spicatum*, *Potamogeton leucens*, *P. crispus* and *Hydrilla verticillata* constitute the submerged plant forms of 2.5 m deep zone, while *Potamogeton natans*, *Nymphoides peltatum* and *Trapa natans* colonize the areas up to 2 m depth. On the sides with lesser depth *Nelumbo nucifera*, *Callitriche verna*, *Ranunculus lingua* and *R. sceleratus* followed by *Sparganium ramosum*, *Butomus umbellatus*, *Alisma plantago* and *Phragmites communis* are supported. This zonation though obvious and very much distinct is sometimes found to be lacking from some parts due to human interference. Free floating forms comprise of *Salvinia natans*, *Lemna gibba*, *L. minor* and *L. trisulca*. The floating gardens support the growth of *Mentha arvensis*, *M. piperata*, *Nasturtium officinalis*, *Roripa indica*, *R. islandica*, *Phalaris arundinacea* and *Phragmites communis*.

(c) *Hokarsar lake*.—It is a somewhat smaller lake situated at a distance of about 9.5 km to the north-west of Srinagar. It is a closed type of lake and is shallow with depth varying between 1 and 1.3 m. The water remains very turbid and does not allow any submerged vegetation to establish. The lake is exclusively used for wild-duck shooting. It is otherwise exposed to little biotic interference as the weeding is strictly prohibited. *Trapa natans*, *T. bispinosa* and *Nymphaea stellata* form the main bulk of the vegetation. *Nymphoides peltatum* grows towards the sides. There are a number of small islands in the centre of the lake which support thick stands of *Phragmites communis*, *Typha angustata*, *Barbarea vulgaris*, *Menyanthes trifoliata*, *Galium hertifolium* and *Scirpus lacustris*. Besides, there is a long stretch of marshes on the sides of this lake which form the main source of grasses and other fodder plants. *Myosotis sylvatica*, *Veronica anagallis*, *Roripa indica*, *Sium latijugum*, *Juncus glaucus* and *Menyanthes trifoliata* have been recorded from these marshes.

2. Vegetation of low-lying areas and other watercourses:

(a) *Chandmari*.—It is situated towards west of Srinagar at a distance of 3 km and presents an array of waterlogged depressions and irrigation channels. These depressions are colonized during March-April by *Ranunculus trichophyllus* and *R. sceleratus*. These species are the earliest to flower

and are joined by *Potamogeton crispus*, *P. leucens*, *Nymphoides peltatum*, *Marsilea quadrifolia*, *Myriophyllum verticillatum* and *Barbarea vulgaris* later in the season. With the decrease in water level and subsequent drying up of these ephemeral water bodies, most of these species disappear. Towards the end of August when moisture content has decreased appreciably a few grasses and sedges are seen to replace the earlier growths. Irrigational channels situated towards Bemna support the growth of some interesting plants, viz. *Equisetum diffusum*, *Drepanocladus exannulatus*, *Monochoria vaginalis*, *Utricularia minor*, *Polygonum minus* and *Veronica beccabunga*.

(b) *Iddgah*.—It is a large stretch of land used for Id prayers by Muslims. It is situated at a distance of 4 km towards south-west of Srinagar and has a number of water channels which dry out during November. *Acorus calamus*, *Ranunculus lingua*, *Hippuris vulgaris*, *Nymphaea alba*, *Polygonum aviculare*, *Portulaca oleracea* and *Scirpus maritimus* are some of the notable plants collected from these water channels.

(c) *Marshlands along the base of Shankarachariya hill*.—During the construction of the present Boulevard road (1932–34) a portion of Dal lake was cut off which has turned into a marsh. The plants from this mosaic of marshes are *Callitriche verna*, *Veronica beccabunga*, *Utricularia flexuosa*, *Roripa indica*, *R. islandica*, *Nasturtium officinalis*, *Juncus griesbachii*, *Sium latijugum* and *Epilobium hirsutum*.

(d) *Partially silted up bed of flood channel*.—Flood channel has been surveyed near Rambagh which is situated towards south of Srinagar at a distance of 4 km. The partly submerged and partly silted up bed was seen to support the plant species like *Alisma plantago*, *Juncus glaucus*, *Sagittaria sagittifolia*, *Butomus umbellatus* and *Phragmites communis*.

Vegetation of Nallamar and other kindred canals:

Nallamar or the snake canal is the most important of the canals which intersect the city. It connects Srinagar with Anchar lake and the Sind valley. The Dal lake cultivator brings his vegetables and the lake products through this and other canals to different parts of the city. The abundance of *Lemna minor*, *L. gibba* and *Spirodella polyrhiza* gives a green crust to these canals. The other plants growing therein are *Sparganium ramosum*, *Myriophyllum verticillatum*, *Alisma plantago*, *Sium latijugum* and *Menyanthes trifoliata*.

ECOLOGICAL CLASSIFICATION

On the basis of their contact with soil, water and air the hydrophytes of Srinagar can mainly be grouped into eight life form classes after Arber (1920) and Welch (1935). These are

A. FLOATING HYDROPHYTES

1. *Free floating*.—They live unattached to the soil
 - (i) With roots: *Lemna minor*, *L. gibba* and *Spirodella polyrhiza*.
 - (ii) Rootless: *Salvinia natans*.
2. *Anchored with floating leaves*.—They are attached to the soil by roots and are in contact with water and air: *Euryale ferox*, *Nymphoides peltatum* and *Nelumbo nucifera*.

B. SUBMERGED HYDROPHYTES

3. *Roots penetrating the substratum*.—Flowering shoots raised above the surface of water: *Myriophyllum spicatum*, *Potamogeton leucens* and *P. pectinatus*.
4. *Roots not reaching the substratum*.—*Lemna trisulca*.
5. *Rootless*.—These plants are in contact with water only
 - (i) Hydrophilous pollination: *Ceratophyllum demersum*.
 - (ii) Inflorescence raised above the level of water: *Utricularia flexuosa* and *U. minor*.

C. AMPHIBIOUS

6. *Emergent amphibious forms*.—They are rooted in substratum and projecting out of the water for part of their length: *Typha angustata*, *Phragmites communis* and *Sparganium ramosum*.
7. *Marsh and wet-land plants*.—Soil in this case is saturated with water for major part of their life: *Menyanthes trifoliata*, *Roripa islandica* and *Hippuris vulgaris*.
8. *Moist meadow plants*.—They are primarily land plants but grow on wet lands for part of their life and show hydrophytic characters: *Potentilla reptans* and *Xanthium strumarium*.

TABLE II

	Number of families	Number of genera	Number of species
<i>Bryophyta</i>			
<i>Marchantiales</i>	1	1	1
<i>Bryales</i>	1	1	1
<i>Pteridophyta</i>			
<i>Equisetales</i>	1	1	1
<i>Hydropteridinae</i>	2	2	2
<i>Angiosperms</i>			
<i>Dicotyledons</i>	23	36	61
<i>Monocotyledons</i>	14	28	51

TAXONOMIC DATA

In addition to the rich and varied angiospermic flora, the lakes, pools and puddles of Srinagar are also rich in algal flora, the details of which will be published elsewhere. On the basis of the authors' own collections the following taxonomic data of the vascular and other hydrophytes could be presented here. (The plants are deposited in the herbarium of the Botany Department of the University of Jammu and Kashmir at Srinagar.)

DISCUSSION

The floristic composition shows that the aquatic vegetation of this locality includes a number of angiosperms representing both dicotyledons and monocotyledons. The families represented include the most advanced one like Compositae and also the most primitive one like Alismataceae. The 117 species encountered in the present survey belong to 69 genera and 42 families. Families in groups other than angiosperms include Ricciaceae, Marsileaceae, Salviniaceae and Equisetaceae. Of the 37 families of angiosperms there are 14 monocotyledonous and 23 dicotyledonous families. The percentage of the monocot and dicot families comes to 36 and 64 respectively. The monocot families have 51 species distributed among 28 genera and dicots have 61 species distributed among 36 genera. Cyperaceae has the highest representation, having 16 species, and is followed by Polygonaceae with nine species, Gramineae and Potamogetonaceae with seven, Onagraceae with five and Cruciferae, Lythraceae, Scrophulariaceae, Labiatae, Juncaceae and Lemnaceae with four species each. Table III indicates the relative range of distribution of various species in different habitats. The plants like *Hippuris vulgaris*, *Trapa bispinosa*, *Callitriche verna*, *Monochoria vaginalis*, *Acorus calamus* and *Utricularia minor* show restricted distribution and are confined to one or two habitats only. Among the widely distributed ones are *Ranunculus sceleratus*, *Barbarea vulgaris*, *Typha angustata*, *Sparganium ramosum*, *Butomus umbellatus* and *Phragmites communis*.

Because of their plasticity the aquatic plants usually show dual behaviour in different environments and it becomes rather difficult to delimit the term 'Hydrophyte'. In accordance with the definition of Reid (1961), according to whom 'Hydrophytes are those plants whose seeds germinate in either the water phase or the substrate of a body of water, and which must spend part of the cycle in water', the aquatic flora of Srinagar has been classified into eight life forms by the present authors. Separation of moist bank forms from the wet land and marsh types is done on the basis of moisture content of the substratum.

Difference in the composition of vegetation of the perennial lakes is due to the type of seepage, silting, physico-chemical properties of the water, substratum and the type of the biotic interference. Zonation is well marked in

TABLE III
 Specific enumeration and detailed distribution of hydrophytes in different habitats of Srinagar

Sl. No.	Name of plant	Habit	Flowering season	Localities							
				1	2	3	4	5	6	7	8
RANUNCULACEAE											
1.	<i>Ranunculus lingua</i> L. (103 DZ)	..	May-Sept.	+	A	-	R	+	+	-	+
2.	<i>R. sceleratus</i> L. (358 DZ)	..	March-July	+	+	+	+	A	A	+	+
3.	<i>R. trichophyllus</i> Chaix. Syn. <i>R. aquatilis</i> L. (101 DZ)	..	March-June	+	A	-	-	A	A	-	+
NYMPHAEACEAE											
4.	<i>Nymphaea alba</i> L. (214 DZ)	..	May-Sept.	+	+	-	-	+	+	-	+
5.	<i>N. stellata</i> Willd. (281 DZ)	..	May-Sept.	+	+	A	-	-	+	-	-
NELUMBIACEAE											
6.	<i>Nelumbo nucifera</i> Gaertn. (204 DZ) Syn. <i>Nelumbium speciosum</i> Willd.	..	June-Oct.	A	A	R	-	+	R	-	-
7.	<i>Euryale ferox</i> Salisb. (266 DZ)	..	June-Sept.	+	R	-	-	-	-	-	-
CRUCIFERAE											
8.	<i>Nasturtium officinale</i> R. Br. (333 DZ)	..	May-Aug.	+	+	+	-	+	+	+	+
9.	<i>Roripa indica</i> (L.) Hochreut (421 DZ) Syn. <i>Nasturtium indicum</i> DC.	..	April-July	+	+	+	-	+	+	+	+
10.	<i>Roripa islandica</i> (Oedr.) Borbas Syn. <i>Nasturtium pakistans</i> DC. (435 DZ)	..	June-Oct.	R	-	R	-	+	+	-	-
11.	<i>Barbarea vulgaris</i> R. Br. (230 DZ)	..	May-Aug.	+	+	+	+	+	A	+	+
PORTULACACEAE											
12.	<i>Portulaca oleracea</i> L. (319 DZ)	..	June-Sept.	+	+	-	-	+	-	-	-
LEGUMINOSAE											
13.	<i>Aeschynomene indica</i> L. (259 DZ)	..	June-Sept.	R	-	-	-	-	+	+	-

TABLE III—contd.
 Specific enumeration and detailed distribution of hydrophytes in different habitats of Srinagar

Sl. No.	Name of plant	Habit	Flowering season	Localities							
				1	2	3	4	5	6	7	8
ROSACEAE											
14.	<i>Potentilla reptans</i> L. (213 DZ)	..	Moist banks	+	+	R	-	+	+	-	-
15.	<i>P. supina</i> L. (442 DZ)	..	"	+	+	R	-	+	+	-	-
HALORAGACEAE											
16.	<i>Myriophyllum spicatum</i> L. (401 DZ)	..	Submerged	A	A	-	R	+	+	+	+
17.	<i>M. verticillatum</i> L. (204 DZ)	..	Emerged	+	+	-	A	+	+	+	+
18.	<i>Hippuris vulgaris</i> L. (346 DZ)	..	Wet lands	-	-	-	-	+	+	-	-
LYTHRACEAE											
19.	<i>Lythrum salicaria</i> L. (205 DZ)	..	Moist banks	+	+	+	-	R	+	-	+
20.	<i>Rotula densiflora</i> (Roth) Koehn. Syn. <i>Ammania pentandra</i> Roxb. (208 DZ)	..	Wet lands	+	-	-	-	-	+	-	-
21.	<i>Rotula indica</i> Koehn. (210 DZ) Syn. <i>Ammania peploides</i> Spreng.	..	"	+	-	-	-	-	+	-	-
22.	<i>Ammania auriculata</i> Willd. Syn. <i>A. senegalensis</i> (207 DZ)	..	"	+	-	-	-	-	+	-	-
ONAGRACEAE											
23.	<i>Epilobium tomentosum</i> Boiss. (436 DZ)	..	Emerged	+	+	-	-	+	+	-	-
24.	<i>E. cylindricum</i> D. Don (433 DZ)	..	"	+	+	-	+	+	+	-	+
25.	<i>E. bispernum</i> Hauss. K. (282 DZ)	..	"	+	+	-	+	-	+	-	-
26.	<i>E. royleanum</i> Hauss. K. (455 DZ)	..	"	-	+	-	-	+	+	-	-
27.	<i>E. hirsutum</i> L. (110 DZ)	..	"	+	+	+	-	+	+	+	A
TRAPACEAE											
28.	<i>Trapa natans</i> L. (203 DZ)	..	Floating	+	A	R	-	+	+	-	-
29.	<i>T. bispinosa</i> Roxb. (105 DZ)	..	"	-	-	A	-	-	-	-	-

TABLE III—contd.
Specific enumeration and detailed distribution of hydrophytes in different habitats of Srinagar

Sl. No.	Name of plant	Habit	Flowering season	Localities								
				1	2	3	4	5	6	7	8	
UMBELLIFERAE												
30.	<i>Sium latijugum</i> C.B.Cl. (217 DZ)	Emerg	July-Oct.	+	+	+	+	+	+	+	+	+
31.	<i>Pimpinella diversifolia</i> DC. (27 DZ)	"	July-Oct.	+	-	-	-	-	-	-	-	+
RUBIACEAE												
32.	<i>Galium hirtifolium</i> C.B.Cl. (329 DZ)	Moist banks	July-Sept.	-	+	-	-	R	-	-	-	-
CALLITRICHACEAE												
33.	<i>Callitriche verna</i> L. (363 DZ)	Floating	June-Aug.	R	R	-	-	-	-	-	-	-
COMPOSITAE												
34.	<i>Bidens tripartita</i> L. (287 DZ)	Wet lands	June-Nov.	+	+	-	-	-	-	-	-	-
35.	<i>Xanthium strumarium</i> L. (28 DZ)	Moist banks	June-Aug.	+	R	-	-	+	+	+	-	-
36.	<i>Eclipta prostrata</i> L. (294 DZ)											
	Syn. <i>Eclipta alba</i> Hassk.	Wet lands	July-Sept.	R	-	-	-	+	+	-	-	-
GENTIANACEAE												
37.	<i>Nymphoides peltatum</i> Link. (241 DZ)											
	Syn. <i>Limonanthemum nymphoides</i> L.	Floating	May-Sept.	A	A	+	R	A	A	A	+	+
38.	<i>Menyanthes trifoliata</i> L. (021 DZ)	Wet lands	July-Sept.	+	R	A	+	-	-	-	-	-
BORAGINACEAE												
39.	<i>Myosotis sylvatica</i> Hoff. (335 DZ)	Moist banks	May-Sept.	+	+	+	-	+	+	+	+	+
40.	<i>Cynoglossum wallichii</i> D. Don. (11 DZ)	"	June-Sept.	+	+	-	-	-	-	-	-	-
SCROPHULARIACEAE												
41.	<i>Veronica anagallis</i> L. (228 DZ)	Emerg	April-Aug.	+	+	+	-	+	+	+	+	+
42.	<i>V. beccabunga</i> L. (360 DZ)	Wet lands	May-Aug.	+	+	R	-	+	+	+	-	+
43.	<i>V. salina</i> Sehur. (367 DZ)	Moist banks	May-Sept.	-	-	R	-	+	+	+	-	-
44.	<i>Lindernia crustacea</i> (L.) F. V. Muell (293 DZ)	"	May-Sept.	+	+	-	-	-	-	-	+	+

TABLE III—contd.
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Sl. No.	Name of plant	Habit	Flowering season	Localities								
				1	2	3	4	5	6	7	8	
LENTIBULARIACEAE												
45.	<i>Utricularia flexuosa</i> Vahl. (232 DZ)	..	Submerged	+	+	-	-	R	R	-	-	+
46.	<i>U. minor</i> L. (362 DZ)	..	"	-	-	-	-	-	-	-	-	-
LABIATAE												
47.	<i>Lycopus europaeus</i> L. (238 DZ)	..	Wet lands	+	+	+	+	+	+	+	+	+
48.	<i>Mentha sylvestris</i> L. (257 DZ)	..	Moist banks	+	+	+	-	-	-	-	-	-
49.	<i>M. piperita</i> L. (233 DZ)	..	"	+	+	+	-	-	-	-	-	-
50.	<i>M. arvensis</i> L. (295 DZ)	..	"	R	+	+	-	-	-	-	-	-
AMARANTHACEAE												
51.	<i>Amaranthus bitum</i> L. (369 DZ)	..	"	R	-	-	-	-	-	-	-	-
POLYGONACEAE												
52.	<i>Polygonum glabrum</i> Willd. (59 DZ)	..	Emerged	+	+	-	-	+	+	+	+	-
53.	<i>P. nodosum</i> Pers. (299 DZ)	..	"	+	+	+	-	+	+	+	+	+
54.	<i>P. posumbu</i> Ham. (300 DZ)	..	"	+	R	+	-	+	+	+	+	+
55.	<i>P. minus</i> Huds. (320 DZ)	..	"	R	R	R	-	+	+	+	+	+
56.	<i>P. aviculare</i> L. (227 DZ)	..	"	+	+	-	-	+	+	+	+	+
57.	<i>P. lapathifolium</i> L. (298 DZ)	..	"	+	+	+	-	+	+	+	+	+
58.	<i>P. amphibium</i> L. (231 DZ)	..	Floating	+	+	R	-	+	+	+	+	+
59.	<i>P. hydropper</i> L. (471 DZ)	..	Emerged	+	+	R	-	+	+	+	+	+
60.	<i>Rumex naritima</i> L. (330 DZ)	..	"	+	+	R	-	+	+	+	+	+
CERATOPHYLLACEAE												
61.	<i>Ceratophyllum demersum</i> L. (54 DZ)	..	Submerged	A	+	-	+	A	A	+	+	+
HYDROCHARITACEAE												
62.	<i>Hydrilla verticillata</i> (L.f.) Royle (240 DZ)	..	"	A	+	-	-	+	+	-	-	+

TABLE III—contd.
Specific enumeration and detailed distribution of hydrophytes in different habitats of Srinagar

Sl. No.	Name of plant	Habit	Flowering season	Localities							
				1	2	3	4	5	6	7	8
HYDROCHARITACEAE (contd.)											
63.	<i>Hydrocharis dubia</i> (Bl.) Blacker (211 DZ)	..	June-Sept.	+	+	-	+	+	+	-	-
64.	Syn. <i>Hydrocharis morsus-ranae</i> F.v.M. <i>Spiranthes sinensis</i> (Pers) Ames (403 DZ) Syn. <i>Spiranthes australis</i> Lindl. ..	.. Wet lands	June-Sept.	+	+	+	-	-	R	-	R
PONTIDERACEAE											
65.	<i>Monochoria vaginatis</i> (Burm. f.) Presl. (312 DZ)	Emerged	Aug.-Oct.	-	-	-	-	-	R	-	-
JUNCACEAE											
66.	<i>Juncus glaucus</i> Ehrh. (364 DZ)	..	May-Sept.	+	+	+	-	+	+	+	+
67.	<i>J. grisebachii</i> Buch. (328 DZ)	..	May-Sept.	+	+	+	-	+	+	+	+
68.	<i>J. lampocarpus</i> Ehrh. (354 DZ)	..	May-Sept.	+	+	+	-	+	+	+	+
69.	<i>Juncellus serotinus</i> C.B.Cl. (106 DZ)	..	May-Sept.	+	+	+	-	+	+	+	+
TYPHACEAE											
70.	<i>Typha angustata</i> Bory and Chaub (222 DZ)	..	June-Sept.	A	A	+	+	+	+	R	+
ARACEAE											
71.	<i>Acorus calamus</i> L. (268 DZ)	..	July-Sept.	-	-	-	-	R	-	+	-
LEMNACEAE											
72.	<i>Lemna minor</i> Griff.	..	Not seen in flowering	+	+	+	A	+	+	+	+
73.	<i>L. gibba</i> L.	..	"	+	+	+	A	+	+	+	+
74.	<i>L. trisulca</i> L.	..	"	+	+	+	+	+	A	+	+
75.	<i>Spirodella polyrrhiza</i> (L.) Schleid	..	"	+	+	R	+	+	+	+	+

TABLE III—contd.
Specific enumeration and detailed distribution of hydrophytes in different habitats of Srinagar

Sl. No.	Name of plant	Habit	Flowering season	Localities								
				1	2	3	4	5	6	7	8	
ALISMACEAE												
76.	<i>Alisma plantago</i> L. (253 DZ)	Emerg.	June-Sept.	+	+	+	+	+	+	+	+	+
77.	<i>A. tenellum</i> Mart. (349 DZ)	Wet lands	Aug-Oct.	-	-	-	-	-	-	R	-	-
78.	<i>Sagittaria sagittifolia</i> L. (264 DZ) Syn. <i>Sagittaria sinensis</i> L.	Emerg.	June-Sept.	+	+	+	R	-	-	-	-	-
POTAMOGETONACEAE												
79.	<i>Potamogeton natans</i> L. (301 DZ)	Floating	May-Sept.	+	A	R	-	+	+	+	-	R
80.	<i>P. nodosus</i> Poir. (229 DZ) Syn. <i>P. indicus</i> Roxb.	"	May-Sept.	R	A	-	-	+	+	-	-	-
81.	<i>P. pectinatus</i> L. (201 DZ)	Submerged	April-Sept.	+	+	-	-	+	+	+	-	-
82.	<i>P. crispus</i> L. (52 DZ)	"	May-Sept.	+	+	-	-	+	+	A	+	R
83.	<i>P. leucens</i> L. (56 DZ)	"	May-Sept.	A	+	-	-	+	+	+	-	R
84.	<i>P. pusillus</i> Roxb. (029 DZ)	"	June-Sept.	+	+	-	-	-	-	-	-	-
85.	<i>Zanichellia palustris</i> L. (028 DZ)	"	June-Aug.	+	+	-	-	-	-	-	-	-
NAJADACEAE												
86.	<i>Najas major</i> All. (379 DZ)	"	July-Sept.	+	+	-	-	-	-	R	-	-
87.	<i>N. graminea</i> Del. (51 DZ)	"	July-Sept.	+	+	-	-	-	-	R	-	-
SPARGANIACEAE												
88.	<i>Sparganium ramosum</i> Huds. (206 DZ)	Emerg.	April-Sept.	+	+	+	A	+	+	A	+	+
BUTOMACEAE												
89.	<i>Butomus umbellatus</i> L. (239 DZ)	"	May-Sept.	+	A	+	+	R	+	+	+	+
CYPERACEAE												
90.	<i>Cyperus flavidus</i> Retz (297 DZ)	Wet lands	June-Sept.	+	+	+	-	+	+	+	-	+

TABLE III—*concl.*
Specific enumeration and detailed distribution of hydrophytes in different habitats of Srinagar

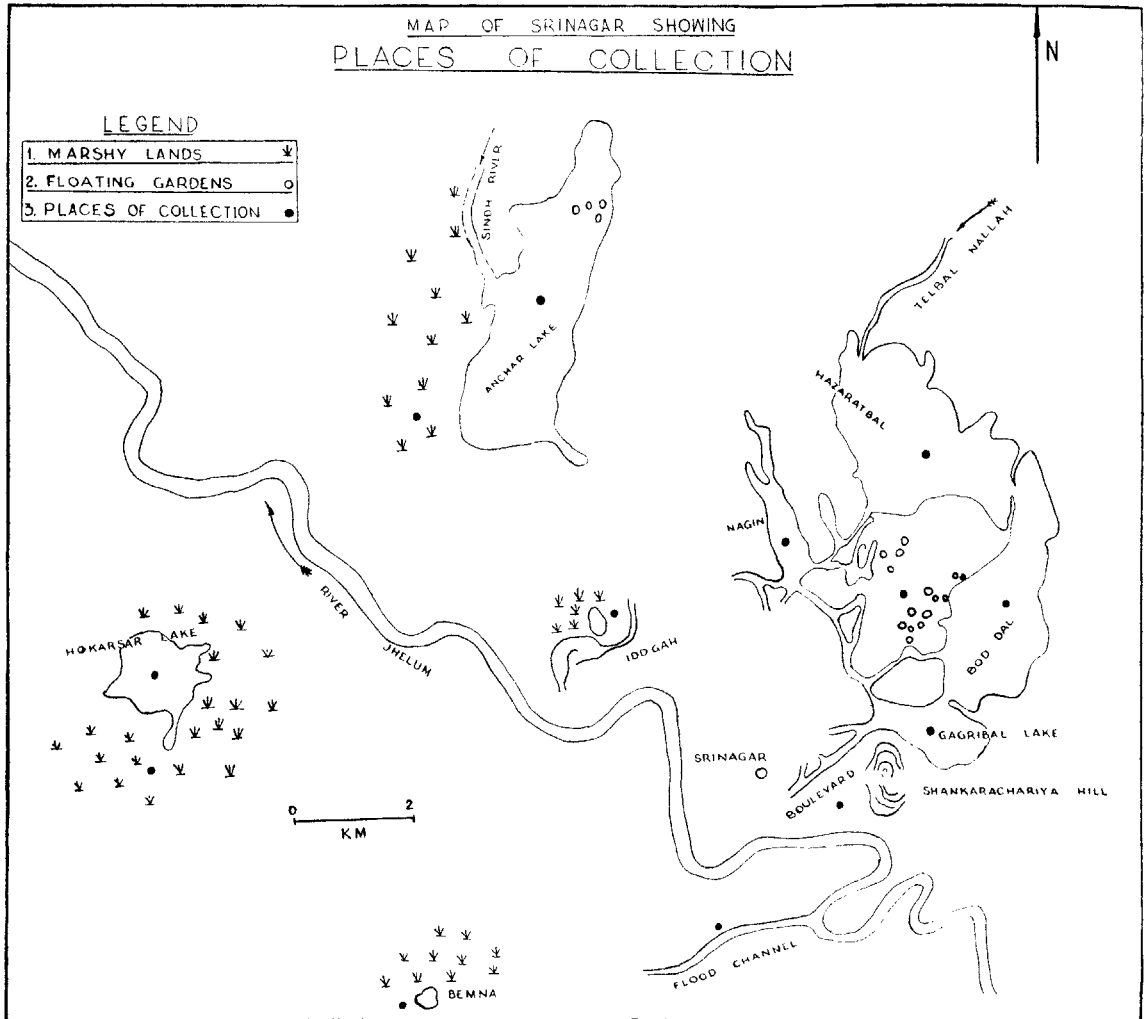
Sl. No.	Name of plant	Habit	Flowering season	Localities							
				1	2	3	4	5	6	7	8
HYPOBRYALES											
114.	<i>Drapanocladus exannulatus</i> (B.S.G) Warnst (030 DZ)	Submerged	Seen in vegetat condition only	+	-	-	-	+	+	-	-
MARSILIACEAE											
115.	<i>Marsilea quadrifolia</i> L. (57 DZ)	.. .. . Floating	Aug.-Oct.	+	+	+	+	A	A	+	+
SALVINIACEAE											
116.	<i>Salvinia natans</i> L. (433 DZ)	.. .. . "	June-Oct.	A	+	+	A	+	A	+	A
EQUISETACEAE											
117.	<i>Equisetum diffusum</i> Don. (359 DZ)	.. .. . Emerged	July-Aug.	-	-	-	-	+	A	-	-

Explanation of symbols

- | | | | |
|-------------|----------------|------------------|--------------|
| 1. Dal lake | 2. Anchar lake | 3. Hokarsar lake | 4. Mar canal |
| 5. Iddgah | 6. Chandnari | 7. Rambagh | 8. Gagribal |
| + = Present | - = Absent | A = Abundant | R = Rare |

the Dal and Anchar lakes where the vegetation shows regular pattern from deep water zone of centre to shallower ones towards the margins, i.e. *Myriophyllum spicatum* → *Nymphaoides peltatum* → *Phragmites communis* → → *Typha angustata*.

Water-level fluctuations are important in the case of wet-land forms which usually invade the lake margins during the recession period.



MAP

Low-lying areas and water channels last till autumn and present a varied plant life which initiates with *Ranunculus trichophyllus* → *Ranunculus sceleratus* community. The majority of the aquatics of this region flower during June–August period when the water temperature is appreciably high and day length is of 12–14 hours' duration.

The new records for these localities are

1. *Utricularia minor* Linn.
2. *Rotala indica* Koehne., Syn. *Ammania peploides* Spreng.
3. *Veronica salina* Schur.
4. *Alisma tenellum* Mart.
5. *Epilobium bispermum* Hanssk.

ACKNOWLEDGEMENTS

The authors are highly grateful to Professor R. Misra, Ph.D (Leeds), F.N.I., Head of the Botany Department, Banaras Hindu University, Varanasi, for going through the manuscript critically. They are thankful to Drs. K. Subramanyam, Calcutta, P. J. Dubash, Bombay, K. C. Misra, Varanasi, and R. S. Chopra, Chandigarh, for their helpful suggestions. One of us (D. P. Z) wishes to thank Principal Saif-ud-Din and Professor T. N. Dhar of S.P. College, Srinagar, for encouragement. Thanks are also due to the Botany branch of the F.R.I., Dehra Dun, and the Central Herbarium, Sibpur, for helping us with the identification of some plants. Meteorological data have been obtained by the kind courtesy of the Director of the Meteorological centre, New Delhi.

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