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Conspectus of Aquatic Macrophytic Flora of Jammu & Kashmir State, India

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***Abstract*-** Keeping in view importance of macrophytic in aquatic ecosystems, we focused on the diversity of macrophytes in Jammu and Kashmir State, the part western Himalaya. A total of 234 macrophytic species were reported from all three regions of state after taken into consideration both primary and secondary sources. The emergent macrophytes had the highest diversity, followed by rooted floating leaf- type, submerged and free floating. The maximum numbers of macrophytic species were recorded in the Kashmir valley while as minimum of 41 species from the Ladakh region. The lakes which have been submitted to an increasing eutrophication for the past several years is overgrown mainly by the aggressive interlopers like *Typha* sp., *Phragmites australis*, *Sparganium ramosum* and *Scirpus* sp and some free floating species.

***Keywords*:** Macrophytes, emergent, submerged, eutrophication.

I. INTRODUCTION

The term 'aquatic macrophytes' refers to a diverse group of aquatic photosynthetic organisms which are large enough to be visible by the naked eye. They share a common feature of inhabiting an aquatic environment; growing either permanently submerged or rooted in at least temporarily inundated areas. Aquatic flora is spatially strongly variable with various abiotic and biotic actors of the environment (1). The main local determinants of the composition of aquatic flora are water level fluctuation (2), exposure (3, 4, & 5), substrate composition and organic matter content (6), the amount of light (7), and water chemistry (8, 9).

Aquatic macrophytes play a vital role in healthy ecosystems. They serve as primary producers of oxygen through photosynthesis, provide a substrate for algae and shelter for many invertebrates, aid in nutrient cycling to and from the sediments, and help stabilize river and stream banks. Aquatic macrophytes also respond to the changes in water quality and have been used as indicator of pollution in several cases (10, 11). The role of macrophytes in freshwater aquatic systems has received increased attention over the last more than a decade, primarily due to their widespread decline in many lakes as a result of growing cultural eutrophication (12). Macrophytes are excellent indicators of lake condition for many reasons including their relatively high levels of species richness, rapid growth rates, and direct response to environmental change. Individual species show differential tolerance to a wide array of stressors. Thus, as environmental conditions vary, community composition respond through different shifting patterns. The composition of plant community can thus reflect, often with great sensitivity, the biological integrity of the aquatic ecosystems. The appreciation of the positive ecological values of macrophytes has led to a better understanding of their diversity and role in natural ecosystem for their scientific management.

Jammu and Kashmir State, part of northern India, represents the Trans-Himalayan zone and abounds in diverse aquatic ecosystems. Hitherto various studies pertaining to macrophytes have been undertaken, some of the significant earlier contributions to the macrophytic studies of Jammu and Kashmir lakes and wetlands include: (13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23). However, no effort has been made to provide a checklist of macrophytic species of Jammu and Kashmir State as a whole. Keeping in view the importance of macrophytes in aquatic ecosystems and their management implications, the aim of the present work was to provide an authenticated checklist of macrophytic species of Jammu and Kashmir.

II. MATERIALS AND METHODS

Study Area

Jammu and Kashmir is a state in northern India, often denoted by its acronym, J&K. It is located mostly in the Himalayan mountains, and shares borders with the states of Himachal Pradesh and Punjab to the south. The

biodiversity of the rich area of J&K happens to be one of the hotspots in India with high endemicity. The whole Himalayan belt is one of the hotspot mega centre having 8 critical areas which includes two regions from the state viz Ladakh and Kashmir. Jammu and Kashmir is not a homogeneous land and the controlling factor of the climate is the Himalayas. It is marked by undulating topography and varied soil types that lead to the growth of diverse plants. The northern frontier of the state is fortified with the majestic mountains of the Himalaya Range. These ranges and their snowcapped peaks complete a picturesque landscape that includes crystal clear streams and lush green vegetation. Except the dry plateaus of Ladakh, the state receives ample amounts of rainfall. Winter season sees extensive precipitation in terms of snowfall. In the winter, the snow resembles a vast sheet of white blanket covering the valleys.

III. DATA COLLECTION

In Jammu and Kashmir state the region-wise macrophytic species occurrence data was collected from standard published literature sources including journals, books, reports from various governmental and non-governmental agencies (24, 25, 26, 27, 28, 29, 30,31, 17, 32) and herbarium specimen. In addition, field surveys were carried out in some parts to crosscheck the already recorded species. The target species were later on grouped into different life forms and respective proportion of each life form in the aquatic species pool of the state was estimated.

IV. RESULT AND DISCUSSION

Jammu and Kashmir State abounds in enchanting diversity of aquatic ecosystems, including wetlands, lakes, rivers, springs, streams. These ecosystems not only vary from alpine lakes to subalpine and temperate ones but also vary in characteristics in subtropical Jammu, Mediterranean Kashmir and cold arid Ladakh regions. These systems also present a gradient of trophic status ranging from some highly eutrophic through mesotrophic to some oligotrohic systems. Overall, these biodiversity rich aquatic ecosystems support a multitude of aquatic species. The high altitude lakes situated above 4,000 m are devoid of macrophytic vegetation, whereas the Kashmir valley aquatic systems (for instance, Anchar Lake, Dal Lake, Hokarsar, Wular Lake and Manasbal Lake etc.) have well stratified vegetation. There is a typical zonation pattern of plants discernible in aquatic systems of Kashmir Himalaya. The innermost zone has submerged plants, which have their flowers and fruits above the water surface. In the shallower water zone there are plants that have their leaves floating on the surface of water. Along the lake margins, the plants stand in water with the greater portion of the plants being visible above water. Small free-floating plants occur in the shallow waters and along lake margins.

During the present study a total of 234 macrophytic species belonging to 50 families (Table1) were recorded. Most dominant families in terms of species richness are Cyperaceae (53 spp.), Polygonaceae (15 spp.), Potamogetonaceae (14) and Poaceae (12). At regional scale, the highest number of species were reported in Kashmir (163 spp.) followed by Jammu (72 spp.) and Ladakh (41 spp.) (Fig.1).

The macrophytic vegetation in the aquatic ecosystems can be classified into four distinct groups: emergent, rooted-floating type, free floating leaf type and submerged.

(i) Emergents

The whole littoral region of the aquatic ecosystems is fringed with diverse emergent macrophytes. The emergent community was represented by 176 species, out of which highest number was recorded in Kashmir (116 spp.) and lowest in Ladakh (Fig. 2).

(ii) Rooted floating-leaf type

The shallow waters of the aquatic ecosystems are dominated by rooted floating leaf type community represented by 26 species. Highest number was reported in Kashmir followed by Jammu and Ladakh (Fig. 2). The species namely *Potamogeton pectinatus* L. was reported from all three regions of the state.

(iii) Free floating type

The distribution pattern of free-floating types of macrophytes is mainly determined by hydrological fluctuations and patterns of water flow. This type of aquatic flora form thick, mat-like scum, which dominate the side channels of the aquatic ecosystems rich in organic matter. The free floating community was represented by 11 species, out which 9 species were reported from Kashmir valley, 4 from Jammu region and none among them was reported from Ladakh (Fig. 2).

(iv) Submerged

The submerged species remain well under surface and this macrophytic community was represented by a total of 21species. In Kashmir it is represented by 19 species while as in Jammu only 11 species were reported (Fig. 2).

Discussion

The overriding influence of cultural eutrophication on aquatic ecosystems of Jammu and Kashmir State has contributed significantly to nutrient loading and sedimentation rate. In spite of the tremendous ecological and socio-economic importance, the anthropogenic pressure on aquatic ecosystems seems to increase, especially in the Himalayan

state of Jammu and Kashmir. Moreover due to rapid economic growth coupled with industrial revolution has not only increased water demand but has also led to disturbances in hydrological balances in catchment areas. As a matter of fact, wide spread pollution practices has degraded the water quality of these important systems. This in turn has induced a series of changes in vegetation and such changes have been well documented for aquatic ecosystems from the other region as well (33, 34). Excessive nutrient loadings can affect the plant communities in a variety of ways, shifting the species composition away from species that take up nutrients slowly, to those that are able to exploit nutrient pulses more rapidly or which have high nutrient requirements (35). The present investigation revealed that emergent species have become quite dominant over time and the overgrowth of this growth form at the cost of others almost across regions can be linked to eutrophication as shown by Makela et al. (36). Nutrient enrichment often results in growth of species tolerant to high nutrient loadings e.g. *Typha* and *Phragmites* (37). Later invasive plants, especially non-native invaders, such as *Azolla*, usually form a solid cover which creates compact, thick, floating mats, that shade the water column below them, restricting the submerged growth forms and thus altering the system dynamics altogether.

Aquatic plants and their communities are an important component of the littoral zone in various types of lakes. They form spatial characteristic patterns (7, 38) which often constitute a transitional boundary between open water and reed swamp communities. Macrophytes are involved in several feedback mechanisms that tend to keep the water clear even in relatively high nutrient loadings (39). Moreover macrophytes have been reported to affect the lake nutrient status, re-suspension of bottom materials and water turbidity (40, 41, & 42). Aquatic plants and their communities may furthermore be good indicators of the changes occurring in lakes because of human induced acidification and eutrophication (43, 44). Macrophytes constitute an important component of wetland ecosystems which sustains a number of food chains in the water body. Though the aquatic ecosystems of Jammu and Kashmir state were evaluated for limnology and anthropogenic effect (45, 23 & 46) yet very little information is available till date on the quantitative analysis of aquatic ecosystems which have utmost importance in management perspective and demands a due attention.

V. CONCLUSIONS AND FUTURE DIRECTIONS

The conspectus of macrophytic diversity in Jammu and Kashmir State, developed through primary and secondary sources, includes about 234 species in all the three regions of state. The database can potentially act as a basic corner stone for subsequent research on other vital aspects of aquatic ecosystems in the Kashmir Himalaya, a part of the world where such studies often take a back seat to other priorities. The macrophytic diversity as depicted from the present investigation still seems an underestimate because quite a large number of aquatic ecosystems across the three regions of Jammu, Kashmir and Ladakh are yet to be explored. Furthermore, there seem some taxonomic inflation also and the reported diversity of species also needs to be well characterized on various grounds for clear taxonomic status. An important challenge would be to monitor the impact of various anthropogenic pressures, land-use changes and climate change on the diversity and distribution of macrophytes.

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Figures:

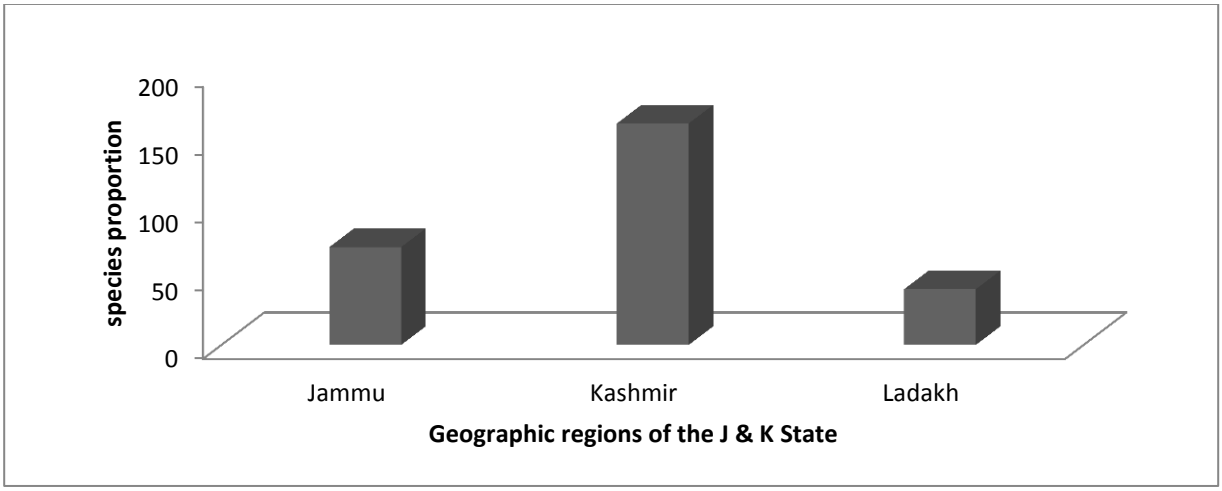

Fig.1: Proportion of macrphytic species in three different regions of state.

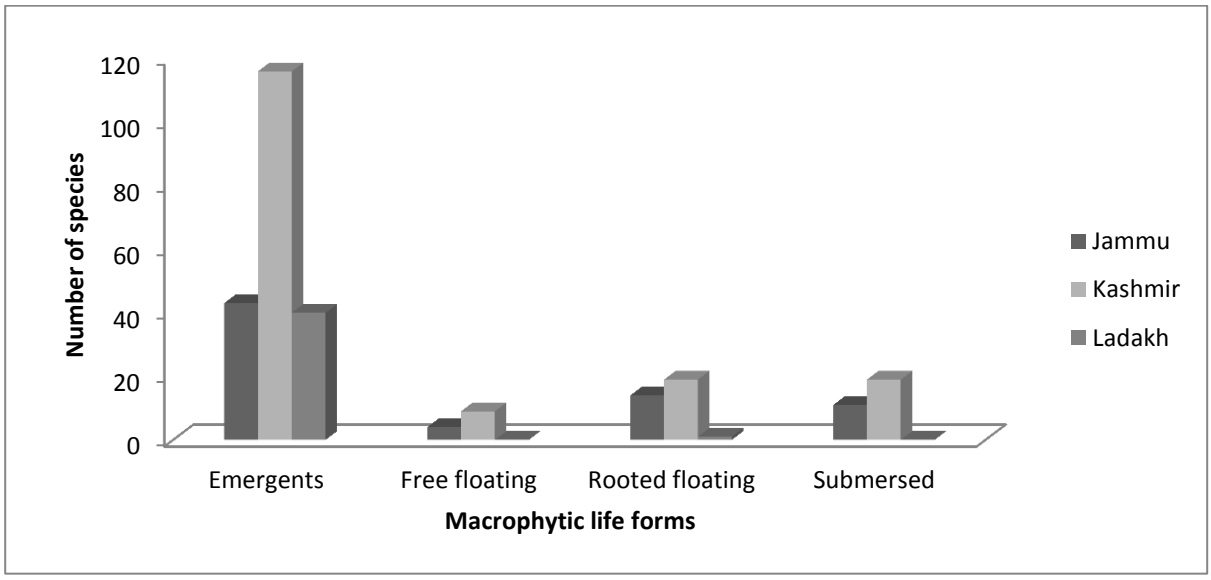

Fig. 2: Species proportion in different life forms of aquatic macrophytes.

Table 1: Checklist of macrophytic species from Jammu, Kashmir and Ladakh regions of the Jammu and Kashmir State.

Family/plant species	Growth Form	Presence /Absence data of aquatic macrphytes		
		Jammu	Kashmir	Ladakh
Alismataceae				
Alisma gramineum Lej.	E	-	+	-
Alisma lanceolatum With.	E	-	+	-
Alisma plantago-aquatica L.	E	+	+	-
Caldesia parnassifolia (L.) Parl	E	+	-	-
Saggitaria latifolia Willd.	E	-	+	-
Saggitaria sagittifolia L.	E	-	+	-
Sagittaria subulata (L.) Buchenau	RF	+	-	-
Amaranthaceae				
Amaranthus lividus L.	E	-	+	-
Alternanthera philoxeroides Griseb.	E	+	-	-
Alternanthera sessilis (L.) R. Br. ex *DC.*	E	+	+	-
Alternanthera caracasana Kuwth.	E	-	+	-
Apiaceae				
Berula erecta (Huds.) Coville	E	-	+	-
Oenanthe crocata L.	E	+	-	-
Sium latijugum C.B. Clarke	E	-	+	-
Araceae				
Acorus calamus L.	E	+	+	-
Asteraceae				
Artimisia spp.	E	+	-	-
Bidens cirnua L.	E	-	+	-
Bidens tripartita L.	E	-	+	-
Eclipta prostrata (Linn.) Mant.	E	-	+	-
Azollaceae				

Azolla cristata Kaulf.	FF	-	+	-
Azolla pinnata R. Br.	FF	+	-	-
Balsaminaceae				
Impatiens glandulifera Royle	E	-	+	-
Impatiens thomsonii Hook. f.	E	-	-	+
Boraginaceae				
Myosotis scorpioides L.	E	-	+	-
Myosotis caespitosa Schultz	E	-	+	-
Myosotis palustris (Linn.) Nath	E	-	+	-
Brassicaceae				
Barbarea intermedia Boreau	E	-	+	-
Barbarea vulgaris W. T. Aiton	E	-	+	-
Cardamine flexuosa With	E	-	+	-
Cardamine hirsuta L.	E	+	+	-
Nasturtium officinale W. T. Aiton	E	+	+	-
Rorippa islandica (Oeder) Borbás	E	-	+	-
Butomaceae				
Butomus umbellatus L.	E	-	+	-
Cabombaceae				
Cabomba caroliniana A. Gray	RF	+	-	-
Callitrichaceae				
Callitriche stagnalis Scop	E	-	+	-
C. palustris Linn.	E	-	+	-
C.truncata Guss.	E	-	+	-
Caryophyllaceae				
Myosoton aquaticum (L.) Moench	E	-	+	-
Ceratophyllaceae				
Ceratophyllum demersum L.	S	+	+	-
Ceratophyllum submersum L.	S	+	-	-
Convolvulaceae				
Ipomoea carnea Jace.	E	+	-	-
I. aquatic Forssk.	E	+	-	-
Cyperaceae				
Ascolepsis spp.	E	+	-	-
Blysmus compressus (L.) Panz. ex Link	E	-	-	+
Carex diluta Bieb.	E	-	+	-
C. fedia Nees	E	-	+	-
C. foliosa D.Don	E	-	+	-
C.gilessi Nelmes	E	-	+	-
Carex microglochin Wahlenb.	E	-	-	+
C. nubigena D.Don	E	-	+	-
C. orbicularis Boott	E	-	-	+
C. pseudocyperus Linn.	E	-	+	-
C. sagaensis Yen C. Yang	E	-	-	+
C. stenophylla Wahlenb.	E	-	-	+
C. distans L.	E	+	-	-
Cladium mariscus (L.) Pohl	E	-	+	-
Cyperus cyperoides (L.) O. Ktze.	E	-	+	-
C. difformis L.	E	+	-	-
C. fuscus L.	E	-	+	-
C. globosus All.	E	-	+	-
C. glomeratus Linn.	E	-	+	-
C. iria L.	E	+	+	-
C. michelianus (L.)Link	E	-	+	-
C. pygmaeus Rottb.	E	-	+	-

C. pumilus Linn.	E	-	+	-
C. rotundus L.	E	-	+	-
C. sanguinolentus Linn.	E	-	+	-
C. serotinus Rottb.	E	-	+	-
Cyperus squarrosus L.	E	-	-	+
Cyperus tenuispica Steud.	E	+	-	-
Eleocharis acicularis (L.) Roem. & Schult.	E	-	+	-
E. atropurpurea (Retz.) Kunth	E	-	+	-
E. obscura T. Koyama	E	-	+	-
E. palustris (L.) Roem. & Schult.	E	-	+	-
E. parishii Britton	E	-	+	-
E. pauciflora Link.	E	-	+	-
E. uniglumis (Link)Schult.	E	-	+	-
Eleocharis quinqueflora (Hartmann) O. Schwarz	E	-	-	+
E.plantagineum L.	E	+	-	-
Fimbristylis dichotoma (L.) Vahl.	E	-	+	-
F. miliacea (Linn.)Vahl.	E	-	+	-
F. squarrosa Vahl.	E	-	+	-
Isolepis setacea (L.) R. Br.	E	-	-	+
Kobresia schoenoides (C. A. Mey.) Steud.	E	-	-	+
Scirpus acutus Muhl. Ex Bigelow	E	+	-	-
S. articulates L.	E	+	-	-
S. juncoides Roxb.	E	-	+	-
S. lacustris Linn.	E	-	+	-
S. lateriflous Gmel.	E	-	+	-
S. martimus L.	E	-	+	-
S. mucronatas	E	+	-	-
S. setaceus Linn.	E	-	+	-
S. subterminalis Torr.	E	+	-	-
S. triqueter L.	E	-	+	-
S. validus	E	+	-	-
Elatinaceae				
Elatine triandra Schkuhr	S	-	+	-
Eriocaulaceae				
Eriocaulon sieboldianum Sieb.	E	-	+	-
Haloragaceae				
Myriophyllum verticillatum L.	E	-	+	-
Myriophyllum spicatum L.	S	+	+	-
Myriophyllum aquaticum (Vell.) Verdc.	E	-	+	-
Hippuridaceae				
Hippuris vulgaris L.	E	-	+	-
Hydrocharitaceae				
Hydrilla verticillata (L.f.) Royle	S	+	+	-
Hydrocharis dubia (Blume) Backer	RF	-	+	-
Vallisenaria americana Michx.	RF	+	-	-
Vallisneria spiralis L.	RF	+	+	-
Elodea canadensis Rich.	RF	+	-	-
Egeria densa Vict.	RF	+	-	-
Isoetaceae				
Isoetes lacustris L.	E	+	-	-
Juncaceae				
Juncus articulatus L.	E	-	-	+
Juncus aquatic L.	E	+	+	-
Juncus bufonius L.	E	-	+	+
Juncus himalensis Klotzsch	E	-	-	+

Juncus inflexus L.	E	-	+	-
Juncus membranaceus Royle ex D. Don	E	-	-	+
Juncus thomsonii Buchenau	E	-	-	+
Juncus turkestanicus V. Krecz. & Gontsch	E	-	-	+
Juncaginaceae				
Triglochin palustris Linn.	E	-	+	+
Labiatae (Lamiaceae)				
Lycopus europaeus L.	E	-	+	-
Mentha aquatic L.	E	-	+	-
Mentha arvensis L.	E	-	+	-
Mentha longifolia (L.) Huds.	E	-	+	-
Mentha piperita L.	E	-	+	-
Mentha spicata L.	E	-	+	-
Mentha royleana Benth.	E	-	-	+
Lemnaceae				
Lemna gibba L.	FF	-	+	-
Lemna minor L.	FF	+	+	-
Lemna trisulca L.	FF	-	+	-
Lemna turionifera Landolt	FF	-	+	-
Spirodela polyrhiza (L.) Schleid.	FF	+	+	-
Wolffia arrhiza (L.) Horkel ex Wimm.	FF	-	+	-
Wolffia trifoliate H. Karst.	FF	-	+	-
Lentibulariaceae				
Utricularia aurea Lour.	S	-	+	-
U. minor Linn.	S	-	+	-
Lytharaceae				
Ammania auriculata Willd.	E	-	+	-
Ammania baccifera L.	E	-	+	-
Lythrum salicaria L.	E	-	+	-
Rotala densiflora (Willd.) Koehne	E	-	+	-
Marsiliaceae				
Marsilia quadrifolia L.	E	+	+	-
Menyanthaceae				
Menyanthes trifoliate L.	E	-	+	-
Nymphoides aquatic (J.F.Gmel.) Kuntze	RF	+	-	-
Nymphoides indica (L.) Kuntze	RF	+	-	-
N. Cristata (Roxb.) O. Ktze.	RF	+	-	-
N. stellata Willd.	RF	+	-	-
N. peltata (S.G.Gmel.) Kuntze	RF	-	+	-
Najadaceae				
Najas graminea Del.	S	+	+	-
N. indica (Willd.) Cham.	S	+	-	-
N. marina L.	S	-	+	-
N. minor (Pers.) All.	S	+	+	-
Nelumbonaceae				
Nelumbo nucifera Gaertn.	RF	+	+	-
Nymphaeceae				
Eurayle ferox Salisb.	RF	-	+	-
Nymphaea alba L.	RF	-	+	-
N. candida C. Presl.	RF	-	+	-
N.lotus L.	RF	-	+	-
N. Mexicana Zucc.	RF	-	+	-
N. stellate Willd.	RF	-	+	-
N. tetragona Georgi.	RF	-	+	-
Onagraceae				
Epilobium cylindricum D. Don	E	+	+	+

Epilobium glaciale P. H. Raven	E	-	-	+
Epilobium hirsutum (L) Gray	E	-	+	-
E. parviflorum (Schreb.) DC.	E	-	+	-
Epilobium palustre L.	E	-	+	-
Epilobium royleanum Hausskn.	E	-	-	+
Epilobium tibetanum Hausskn	E	-	-	+
Orchidaceae				
Spiranthes lancea (Thunb.) Baker	E	-	+	-
Papilionaceae				
Aeschynomene indica L.	E	+	-	-
Poaceae				
Agrostis gigantea Roth	E	-	-	+
Arundo donax L.	E	+	-	-
Echinochloa colonum (L.) Link.	E	-	+	-
Echinochloa crus-galli (L.) P.Beauv.	E	-	+	-
Hymenachne amplexicaulis (Rudge) Nees	E	+	-	-
Paspalidium germinatum (Forssk.) Stapf	E	+	-	-
Paspalum paspalodes (Michx.) Scribner	E	-	+	-
Poa annua L.	E	+	-	+
Polypogon monspliensis (L.) Desf.	E	+	-	+
Phalaris arundinacea L.	E	-	+	-
Phragmites australis (Cav.) Trin. Ex Steud.	E	-	+	+
Hygrorhiza aristata	E	+	-	-
Polygonaceae				
Koenigia islandica L.	E	-	-	+
Persicaria barbata (L.) H. Hara	E	+	-	-
Persicaria flaccidum (L.) H. Hara	E	+	-	-
Persicaria glabrum (Willd.) M. Gómez.	E	+	-	-
Persicaria glacialis (Meissn.) Hara	E	-	-	+
Persicaria hydropiper L.	E	-	+	+
P. lapathifolia(Linn.) Gray ex Nakia	*E*	-	+	+
P. nepalense Meisn.	E	-	+	+
P. punctate (Eliot) Smoel	E	-	+	-
P. nodosa (Pers.) Opiz.	E	-	+	-
Rumex aquaticus L.	E	-	+	-
Rumex chalepensis Mill	E	-	+	-
Rumex conglomeratus Murray	E	-	+	-
Rumex dentatus L.	E	-	+	-
Rumex paulsenianus Rech.	E	-	+	-
Pontederiaceae				
Monochoria vaginalis (Burm. F)Presl. Ex Kunth	E	-	+	-
Eichhornia crassipes (Mart.) Solms	E	+	-	-
Potamogetonaceae				
Potamogeton crispus L.	S	+	+	-
Potamogeton filiformis Pers.	S	-	+	-
Potamogeton fluitans Roth	RF	-	+	-
Potamogeton natans L.	RF	+	+	-
Potamogeton nodosus Poir.	RF	+	+	-
Potamogeton lucens L.	S	+	+	-
Potamogeton pectinatus L.	RF	+	+	+
Potamogeton perfoliatus L.	S	+	+	-
Potamogeton pusillus L.	S	+	+	-
P. salicifolius Wolfg. ex Schult. & Schult.f.	S	+	-	-
Potamogeton wrightii Morang	S	-	+	-
Potamogeton berchtoldii Fieber	S	-	+	-

Potamogeton amblyphyllus C. A. Mey	S	-	+	-
Potamogeton trichoides Cham.	S	-	+	-
Portulaceae				
Portula oleracea L.	RF	-	+	-
Ranunculaceae				
Anemone rivularis Buch.	E	-	-	+
Halerpestes sarmentosa (Adams) Kom. & Aliss.	E	-	-	+
Ranunculus arvensis	E	+	-	-
Ranunculus longicaulis C. A. Mey.	E	-	-	+
Ranunculus muricatus L.	E	-	+	-
Ranunculus sceleratus L.	E	+	+	-
Caltha alba K. Jacq	E	-	+	-
Rananculus lingua L.	E	-	+	-
Ranunculus trichophyllus Chaix	RF	-	+	-
Rosaceae				
Potentilla anserina L.	E	-	-	+
Potentilla reptans Linn.	E	-	+	-
Rubiaceae				
Galium aparine L.	E	-	+	-
Salviniaceae				
Salvinia molesta Mitchell	FF	+	-	-
Salvinia natans All.	FF	-	+	-
Scrophulariaceae				
Bacopa monnieri (L.) Pennell	E	+	-	-
Pedicularis longiflora subsp. *tubiformis* (Klotzsch) Pennell	E	-	-	+
Pedicularis punctata Decne.	E	-	-	+
Veronica anagallis-aquatica L.	E	+	+	-
Veronica salina Schur	E	-	-	+
Veronica beccabunga L.	E	-	+	+
Limosella aquatica L.	E	-	+	-
Limnophila spp.	S	+	-	-
Sparginaceae		-	-	-
Sparganium erectum Huds	E	-	+	-
Trapaceae				
Trapa natans L.	RF	-	+	-
Typhaceae				
Typha angustata Bory & Chaub.	E	+	+	+
Typha laxmannii Lepech.	E	-	+	+
Umbelliferae				
Seseli mucronatum (Schrenk) Pimenov & Sdobnina	E	-	-	+
Sium medium Fisch. & C. A. Mey.	E	-	-	+
Verbenaceae				
Phyla nodiflora (L.) Greene	E	+	-	-
Zannichelliaceae				
Zannichellia palustris L.	S	-	+	-

