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AQUATIC FLOWERING PLANT WEALTH OF SOUTH-WESTERN MAHARASHTRA

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ABSTRACT

Data on aquatic flowering plants of South-Western Maharashtra is given and 303 species, 2 subspecies and 6 varieties belonging to 145 genera and 73 families of aquatic and semiaquatic flowering plants are enumerated in the present paper.

INTRODUCTION

Wetlands play an important role in any ecosystem and hydrology of area. Regulatory functions such as downstream flood control, ground water recharge and sediment or nutrient retention are examples of ecological functions performed by wetlands that may indirectly benefit economy. They play important role in shoreline, bank stabilization, recreation, tourism, water transport and provide habitat for migratory birds, fisheries, water plants, animals and microbes.

Aquatic macrophytes have many actual or potential uses as compost, mulches, fertilizers, human food, feeds for livestock, source for fibers for paper making and source of various chemical substances (Sculthrope, 1967; Little, 1968; Boyd, 1972). They are also used for the purification of pollutant effluents and water bodies (Byod, 1970c; Yount and Crossman, 1970; McNabb *et al.* 1971; Seidel, 1971). Rice, an emergent aquatic is a major agronomic species. In addition to rice, number of aquatic plants form a source of food and vegetable (Byod, 1972) and many of them are grown in small ponds for ornamental purposes. The sale of plants for aquarium is of growing economic importance. Excessive growth of aquatic plants and problem created by aquatic plants have attracted attention of several workers, however, number of aquatic plants play important role beneficial to man. In addition to their importance as a food, compost and fertilizers, aquatic plants play important role in removal of nutrients, heavy metals and purification of water (Mitchell, 1974; Rai *et al.*, 1995). Aquatic plants can possibly be employed to remove the nutrients and heavy metals from wastewater effluents. Plants such as *Phragmites communis*, *Scripus lacustris*, *Eichhornia crassipes*, *Spirodela polyrhiza*, *Elodea canadensis*, *Egeria densa*, *Hydrilla* species, *Ceratophyllum demersum*, *Bacopa monnieri* and *Nymphoides cristata* have been found suitable for removal of different metals (Rai *et al.*, 1995). The plants remove

the metals by surface adsorption and/or absorption and incorporate them into their own system or store them in a bound form. Effluents ameliorated by these plants thus cause less damage to aquatic environment. For developing countries like India, such technology would be extremely important where shallow ponds and wetlands are unsuited for conventional fish farming and agriculture (Mohan Ram, 1978).

Inspite of number of important functions performed by wetlands, they are continuously destroyed all over the world. According to Dugen (1990) the U. S. has lost some 54% of its wetlands, New Zealand has lost over 90 % of its natural wetlands and many parts of Europe have lost nearly all natural wetlands and tropical countries like Chad, Cameroon, Niger, Bangladesh, India, Thailand and Vietnam have lost over 80% of their fresh water wetlands (McNeely *et al.* 1990; McNeely 1992). Biodiversity crises all over the world in 20th century resulted in number of important publications on worldwide loss of biodiversity. Rio Earth Summit (1992) emphasized the need to conserve biodiversity, especially the tropics. With growing awareness, the importance of wetlands has been realized throughout the world (Gopal, 1990; Anonymus, 1992, Chatrath, 1992). The International Hydrological Decade (IHD) 1965-74, launched by the General Conference of UNESCO, promoted international co-operation in research, studies and training of specialists and technicians in scientific hydrology. Infact the RAMSAR convention is called convention of wetlands of International importance. The Indian subcontinent, also called the aquatic subcontinent, comprises 1,28,000 sq. km of water surface of which 77,000 sq. km occur in India. The subcontinent hosts approximately 470 aquatic species of flowering plants, a half of the world's known aquatic angiosperms and the number of endemic species also being high (13%), second to tropical South America (Gopal, 1990).

India has already lost over 80% of its fresh water wetlands. There is an urgent need to conserve the wetlands and their biodiversity. The meaningful conservation involves thorough understanding of the flora of a particular region. The inventory must be completed at faster rate, as the developmental activities are sure to eliminate some of the species even before we understand them fully. Considering role-played by the wetlands, their fauna and flora, it becomes important to make detailed inventory of them. Similarly, number of indigenous aquatic flowering plants of our country are demising in their populations mainly due to encroachment of obnoxious exotic aquatic weeds, destruction of wetlands and pollution of water and soil. Number of aquatic species are under threat of extinction. These endemic plants have narrow range of distribution, narrow range of tolerance and are usually very specific in their ecological requirements. Therefore, there is an urgent need to survey, document and collect detailed information on present status, distribution, ecology and taxonomy of these plants which will help in their conservation and utilization for sustainable development.

In present investigation, attempts have been made to survey and enumerate the aquatic angiosperms of South-Western Maharashtra which covers Kolhapur, Ratnagiri, Sangli, Satara and Sindhudurg districts.

REVIEW OF PREVIOUS WORK

Arber (1920) in her book 'Water plants: A study of aquatic angiosperms' surveyed the older morphological and anatomical literature and the book is indispensable even to the modern students. Sculthorpe (1967) in the 'Biology of aquatic vascular plants' has summarised more recent literature relating to the ecology and biology of aquatic plants. Similarly C. D. K. Cook *et al.* (1974) have made taxonomic overview of fresh water aquatic plants in his book 'Water plants of the world'.

The major work on survey of aquatic flowering plants of India includes Biswas and Calder (1936) who prepared an account of common water and marsh plants of India and Burma. Subramanyanam (1962) has made major contribution to the knowledge of taxonomy of aquatic plants of India. For the first time he provided key for identification of aquatic flowering plants with some excellent illustrations. C. D. K. Cook (1996) in his book, "Aquatic and wetland plants of India" has recorded about 485 species of aquatic and semiaquatic flowering plants with key for identification, description and illustrations.

Several other workers such as Chavan and Sabnis (1961); Satyanarayana (1962); Seerwani (1962); Vyas (1964); Majumdar (1965); Gupta (1965); Kaul and Zutshi (1967); Manilal and Sivarajan (1978); Sahai and Sinha (1968); Kaushik (1969); Karthikeyan, *et al.* (1982); Gopal (1990); Naskar (1990) have contributed to aquatic plant diversity of India. In last few decades, additions to the aquatic angiosperms have been made by several workers. A number of new species also have been added by several workers such as Bruggen (1968); Raghvan, *et al.* (1982); Joseph and Sivarajan (1988); Joseph (1991); Joseph and Sivarajan (1990) and Yadav, *et al.* (1994, 1994, 1998), etc. C. D. K. Cook has revised genera viz. *Rotala* (1979), *Blyxa* (1983) and *Ottelia* (1984). Sivrajan and Joseph (1983) have revised genus *Nymphoides* for India. In addition to this, several other publications on floristics and vegetation have also made references to aquatic plants.

Although there is considerable amount of work on general flora of study area, there is no single source documentation of aquatic plant diversity of the region. Taking into account the importance of wetlands and the wetland flora the present work was undertaken in the year 1996.

MATERIALS AND METHODS

The present work has been undertaken mainly to bring-out a comprehensive account of aquatic plant diversity of South-Western Maharashtra.

The present work is an outcome of 5 years extensive and intensive field studies in the region. During the period, several field visits were arranged to different localities to cover entire study area. During collection special attention was paid to rare and endemic aquatic plants. While collecting the specimens, data on habit, habitat, month of flowering and fruiting, ecological and field observations on each species were noted in the field itself. Specimens were processed for herbarium by usual method (Rao & Sharma, 1990) and herbarium specimens are deposited in the Herbarium of Botany Department of Shivaji University.

Most of the specimens and field identifications were confirmed satisfactorily with the help of available literature such as floras, monographs, revisions and research articles. The tentatively identified specimens and doubtful identifications were confirmed by matching specimens with authentically identified specimens deposited in the Herbarium of Botanical Survey of India, Western Circle, Pune and Blatter Herbarium, St. Xavier's College, Mumbai.

The present data is based mainly on the information collected during last five years. The nomenclature adopted in present work is based on latest taxonomic literature and in accordance with the recommendations made by International Code of Botanical Nomenclature (Stafleu, 1978). Aquatic flowering plants of South-Western Maharashtra are enumerated in Appendix-I

STATISTICAL ACCOUNT

A. Aquatic Flowering Plants of South-Western Maharashtra

Sl. No.		No. of families	No. of genera	No. of species
1.	Dicots	51	79	150
2.	Monocots	22	66	153
	Total :	73	145	303

B. Dicots

	Families	Genera	Species
Pure Aquatic	10	14	25
Marshy	21	41	94
Riverine	9	10	11
Mangroves	11	14	20
Total :	51	79	150

C. Monocots

	Families	Genera	Species
Pure Aquatic	11	27	39
Marshy	10	38	112
Riverine	1	1	2
Total :	22	66	153

DISCUSSION

The Indian subcontinent, also called the aquatic subcontinent harbours about 470 aquatic species of flowering plants (Gopal, 1990), half of the world's known aquatic angiosperms and the number of endemic plants are also being high (13%), and is second to tropical South America (Gopal, 1990). Cook (1996) reported some 485 aquatic and semiaquatic plants from India. Karthikeyan, *et al.* (1982) recorded 279 aquatic flowering plants from Maharashtra. During present investigation intensive and extensive search for aquatic plant diversity for last five years resulted in collection of 303 aquatic and semiaquatic species of flowering plants from South-Western Maharashtra which include three new records for the State of Maharashtra viz., *Eriocaulon palghatense* Ansari & Balakr., *Utricularia malabarica* Janarthanam & Henry and *Utricularia minutissima* Vahl. In addition to these, three new species *Eriocaulon ratnagiricus* Yadav *et al.*, *Utricularia naikii* Yadav *et al.* and *U. janarthanamii* Yadav *et al.* have been described from South Western Maharashtra. There are about 64 flowering plants, which are true aquatic, of which, 25 plant species belong to dicot and 39 to monocot. Ponds, puddles and lateritic plateaus in coastal plains harbour very peculiar and interesting monsoon wetlands and aquatic plants. Monsoon wetlands possess very characteristic flowering plants. Of the 303 species recorded for the region, 150 belong to dicots and 153 to monocots.

Present investigation have revealed that aquatic plants can be classified into four major categories such as true aquatic plants, marshy and monsoon aquatics, riverines and mangroves. In South Western Maharashtra about 64 species are pure aquatic, 206 marshy and monsoon aquatics, 13 riverine and 20 mangroves. About 57 species of aquatic and semiaquatic flowering plants found in the South Western Maharashtra are endemic. The monotypic grass genera *Hubbardia heptaneuron* Bor has been recollected after about 8 decades from Tillari Ghat in Kolhapur district, which was supposed to be probably extinct (Nayar & Sastry, 1987; Nayar, 1996; Cook, 1996). Some of the endemic plants *viz.*, *Aponogeton bruggenii*, *Aponogeton satarensis*, *Blyxa auberti* var. *aubertii*, *Cryptocoryne spiralis* var. *cognatoides*, *Eriocaulon breviscapum*, *E. fluviatile*, *E. ratnagiricus*, *E. richardianum*, *Limnophyton obtusifolium*, *Nymphoides aurantiaca*, *Rotala ritchiei*, etc. are of rare occurrence and critically endangered.

Trithuria konkanensis was known only from type locality Achirne in Sindhudurg district (Yadav & Janarthanam, 1994). However, intensive and extensive field visits for the species have revealed that it occurs throughout in coastal plains of Maharashtra, Goa and Kanara. Thus, its distribution extends from Ratnagiri to Manglore.

Cryptocoryne cognata was considered as probably extinct and listed in Red Data Book (Nayar & Sastry, 1987). However, it is found in almost each and every stream in coastal plains of Maharashtra and fairly common in the region. Similarly, *Wiesneria triandra was* supposed to be rare plant and also listed in Red Data Book, however, it is common in Konkan. Some of the rare Plants *viz.*, *Aponogeton bruggenii*, *Aponogeton satarensis*, *Nymphoides aurantiaca*, found in the South Western Maharashtra, are already included

in 'Red Data Book'. *Eriocaulon ratnagiricus* is very rare plant that is known only from its type locality -Pavas in Ratnagiri district.

Most of the wetlands in the region are destroyed for road and building construction, especially in and around cities. Similarly, wetlands are over exploited for water and modified to a great extent. Besides, these wetlands have become dumping places for garbage, plastic bags, poisonous iefluents, polluting entire aquatic ecosystem of the region. This has raised a great threat to the flora of the region and there is need for serious efforts to conserve these wetlands and minimise water pollution.

ENUMERATION OF AQUATIC FLOWERING PLANTS OF SOUTHWESTERN MAHARASHTRA

The families, genera and species are arranged alphabetically. Districtwise distribution is given for each species. Remarks on occurrence of the species is also indicated under present status.

Taxon	Present status	Distribution
A. DICOTS:		
1. True aquatics		
ACANTHACEAE		
Hygrophila pinnatifida (Dalz.) Sreem.	rare	Kolhapur, Sindhudurg.
CERATOPHYLLACEAE		
Ceratophyllum demersum L.	frequent	all districts
HALORAGACEAE		
Myriophyllum oliganthum (Wt. & Arn.) Miller	common	all districts
LENTIBULARIACEAE		
Utricularia aurea Lour.	common	Ratnagiri, Sindhudurg.
U. australis R. Br.	common	Ratnagiri, Sindhudurg.
U. stellaris L.	common	Ratnagiri, Sindhudurg.
LYTHRACEAE Ratnagiri, Sindhudurg		
Rotala macrandra Koehne	common	Ratnagiri, Sindhudurg.
R. ritchiei (Cl.) Koehne	rare	Satara.
MENYANTHACEAE		
Nymphoides aurantiaca (Dalz.) O. Ktze.	rare	Sindhudurg.
N. hydrophylla (Lour.) O. Kuntze	common	all districts
N. indica (L.) O. Ktze.	common	all districts
N. parvifolia (Griseb) O. Ktze.	common	Ratnagiri, Sindhudurg.
NELUMBONACEAE		
Nelumbo nucifera Gaertn.	common	Kolhapur.
NYMPHAEACEAE		
Nymphaea nouchali Burm.	frequent	all districts
N. pubescens Willd.	frequent	all districts

Taxon	Present status	Distribution
Nymphaea rubra Roxb. ex. Andr.	common	Sindhudurg.
PODOSTEMONACEAE		
Dalzellia zeylanica (Gardn.) Wt. var. *konkanica* (Wills.) Janardhanan	rare	Kolhapur.
Griffithella hookeriana (Tul.) Warm.	rare	Kolhapur.
Hydrobryopsis sessilis (Willis) Eng.	rare	Kolhapur.
Indotristicha ramosissima (Wt.) Royen	rare	Kolhapur.
Polypleurum stylosum (Wt.) Hall	occasional	Sindhudurg.
SCROPHULARIACEAE		
Limnophila heterophylla (Roxb.) Benth.	common	all districts
L. indica (L.) Druce	common	all districts
L. polystachya Benth.	occasional	Sindhudurg.
L. sessiliflora (Vent.) Bl.	common	Kolhapur, Sindhudurg.
2. Marshy and Monsoon Aquatics		
ACANTHACEAE		
Hygrophila polysperma (Roxb.) T. Anders.	common	all districts
H. ringens (L.) Steud.	common	all districts
H. schulli (Buch.-Ham.) Almeida	common	all districts
H. serpylla (Nees) Anders.	common	Kolhapur.
AMARANTHACEAE		
Alternanthera paronychioides St. Hil.	common	all districts
A. sessilis (L.) R. Br. ex DC.	common	all districts
APIACEAE		
Centella asiatica (L.) Urb.	common	all districts
Hydrocotyle sibthorpioides Lamk.	common	all districts
ASCLEPIADACEAE		
Oxystelma esculentum (L.f.) R. Br.	common	Kolhapur, Ratnagiri.
ASTERACEAE		
Caesulia axillaris Roxb.	common	all districts
Centipeda minima (L.) A. Br. et. Ascher.	common	all districts
Cyathocline purpurea (D.Don) O. Ktze.	common	all districts
Eclipta prostrata (L.) L.	common	all districts
Epaltes divaricata (L.) Cass.	occasional	Ratnagiri, Sindhudurg.
Grangea maderaspatana (L) Poir.	common	all districts
Sphaeranthus africanus L.	common	Ratnagiri, Sindhudurg.
S. indicus L.	common	all districts
Spilanthes calva DC.	common	all districts
S. paniculata Wallich ex. DC.	common	all districts

Taxon	Present status	Distribution
BALSAMINACEAE		
Impatiens acaulis Arn.*	common	Kolhapur, Satara, Sindhudurg.
BORAGINACEAE		
Coldenia procumbens L.	common	Kolhapur, Satara.
Heliotropium indicum L.	common	all districts
H. ovalifolium Forssk.	common	all districts
H. supinum L.	common	all districts
CAMPANULACEAE		
Lobelia alsinoides Lam.	occasional	Kolhapur, Satara.
L. heyneana Schult.	occasional	Kolhapur, Satara.
CONVOLVULACEAE		
Ipomoea aquatica Forssk.	common	Kolhapur, Ratnagiri, Sindhudurg.
DROSERACEAE		
Drosera indica L.	common	all districts
D. burmanii Vahl	occasional	Ratnagiri, Sindhudurg.
FABACEAE		
Aeschynomene aspera L.	occasional	Ratnagiri.
A. indica L.	common	Kolhapur, Satara, Ratnagiri.
Geissaspis cristata Wt. et Arnott	common	Ratnagiri, Sindhudurg.
G. tenella Benth.*	rare	Kolhapur.
Sesbania bispinosa (Jacq.) Steud. ex Wt.	common	Ratnagiri, Sindhudurg.
S. sesban (L.) Merr. subsp. *sesban* var. *sesban* Guill.	common	Ratnagiri, Sindhudurg.
GENTIANACEAE		
Hoppea dichotoma Willd.*	common	Kolhapur, Ratnagiri, Sindhudurg.
HYDROPHYLLACEAE		
Hydrolea zeylanica (L.) Vahl	occasional	Kolhapur.
LAMIACEAE		
Pogostemon deccanensis (Panigr.) Pers.	Frequent	all districts
LENTIBULARIACEAE		
Utricularia albocaerulea Dalz.*	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
U. caerulea L.*	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
U. graminifolia Vahl	common	Kolhapur, Ratnagiri, Satara, Sindhudurg
U. janarthanamii Yadav, Sardesai and Gaikwad*	Rare	Kolhapur.
U. malabarica Janarthanam &. Henry*	common	Ratnagiri, Sindhudurg.
U. minutissima Vahl*	common	Ratnagiri, Sindhudurg.

Taxon	Present status	Distribution
Utricularia naikti Yadav, Sardesai and Gaikwad*	rare	Simdhudurg.
U. praeterita Taylor*	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
U. purpurascens Grah*.	common	Satara.
U. reticulata Smith*	frequent	Kolhapur, Ratnagiri, Satara, Sindhudurg.
U. striatula Smith	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
LOGANIACEAE		
Mitrasacme indica Wt.	occasional	Ratnagiri, Sindhudurg.
LYTHRACEAE		
Ammannia baccifera L.	common	all districts
A. multiflora Roxb.	common	all districts
Rotala densiflora (Roth ex Roem. et Sch.) Koeh.	common	all districts
R. fimbriata Wt.	common	Kolhapur, Ratnagiri, Satara, Sindhudurg
R. floribunda (Wt.) Koeh.	common	Kolhapur, Ratnagiri, Satara, Sindhudurg,
R. indica (Willd.) Koeh.	common	Kolhapur, Ratnagiri,
R. malampuzhensis Nair	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
R. occultiflora Koeh.	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
Rotala rosea (Poir.) Cook	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
R. serpyllifolia (Roth) Bremekamp	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
ONAGRACEAE		
Ludwigia hyssopifolia (Don) Exell.	common	all districts
L. octovalvis (Jacq.) Raven subsp. *sesssiliflora* (Mic.) Raven	common	all districts
L. perennis L.	common	all districts
POLYGONACEAE		
Polygonum barbatum L. subsp. *barbatum* var. *stagninum* (F. Hamilton ex Meisn.) Stewart	common	Ratnagiri, Sindhudurg.
P. glabrum Willd.	common	all districts

Taxon	Present status	Distribution
Polygonum hydropiper L. var. *glandulissima* Gauge	common	Kolhapur, Satara.
P. plebeium R. Br.	common	all districts
RUBIACEAE		
Dentella repens (L.) Forst.	common	all districts
Oldenlandia corymbosa L.	common	all districts
O. diffusa (Willd.) Roxb.	rare	Sinshudurg.
SCROPHULARIACEAE		
Bacopa monnieri (L.) Wettst.	common	all districts
Centranthera nepalensis D. Don	common	all districts
Dopatrium junceum (Roxb.) Buch.-Ham. ex Benth.	common	all districts
Glossostigma diandrum (L.) O. Ktze.	rare	Kolhapur.
Limnophila aromatica (Lam.) Merrill	common	Ratnagiri, Sindhudurg.
Lindernia anagallis (Burm. f.) Pennell	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. angustifolia (Benth.) Wettst.	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. antipoda (L.) Alston	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. caespitosa (Bl.) Panigrahi	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. ciliata (Colsm.) Pennell	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. crustacea (L.) F. Muell.	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. estaminoidiosa (Blatt. & Hallb.) Mukerjee	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. hyssopioides (L.) Haines	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. nummularifolia (D. Don) Wettst.	common	Kolhapur, Ratnagiri.
L. oppositifolia (Retz.) Mukerjee	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. parviflora (Roxb.) Haines	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. pusilla (Willd.) Boldingh	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. rotundifolia (L.) Alston	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. ruellioides (Colsm.) Pennell	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.

Taxon	Present status	Distribution
Lindernia tenuifolia (Colsm.) Alston	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
L. viscosa (Hornem.) Boldingh	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
Microcarpaea minima (Koenig.) Merrill	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
VERBENACEAE		
Phyla nodiflora (L.) Greene	common	all districts
3. Riverine Plants		
BORAGINACEAE		
Rotula aquatica Lour.	common	Ratnagiri, Sindhudurg.
COMBRETACEAE		
Terminalia arjuna (Roxb. *ex* DC.) Wt. & Arn.	common	Kolhapur, Satara.
EUPHORBIACEAE		
Homonoia riparia Lour.	frequent	all districts
Phyllanthus lawii Grah.	common	all districts
LECYTHIDACEAE		
Barringtonia acutangula Gaertn.	common	Ratnagiri, Sindhudurg.
MELASTOMATACEAE		
Melastoma malabathricum L.*	occasional	Sindhudurg.
MYRTACEAE		
Syzygium cumini (L.) Skeels	common	all districts
S. heyneanum (Duthie) Wall. *ex* Gamble	common	all districts
SALICACEAE		
Salix tetrasperma Roxb.	common	Kolhapur.
TAMARICACEAE		
Tamarix ericoides Rottl.	occasional	Ratnagiri.
VERBENACEAE		
Vitex leucoxylon L.	common	Kolhapur, Sindhudurg.
4. Mangrove		
ACANTHACEAE		
Acanthus ilicifolius L	common	Ratnagiri, Sindhudurg.
APOCYNACEAE		
Cerbera manghas L.	rare	Ratnagiri, Sindhudurg.
AVICENNIACEAE		
Avicennia alba Blume	common	Ratnagiri, Sindhudurg.
A. marina (Forsk.) Vierh.	common	Ratnagiri, Sindhudurg.

Taxon	Present status	Distribution
Avicennia officinalis L.	common	Ratnagiri, Sindhudurg.
CAESALPINIACEAE		
Caesalpinia nuga (L.) Ait.	common	Ratnagiri, Sindhudurg.
Cynometra ramiflora L.	occasional	Ratnagiri.
COMBRETACEAE		
Lumnitzera racemosa Willd.	common	Ratnagiri, Sindhudurg.
EUPHORBIACEAE		
Exocoecaria agallocha L.	occasional	Ratnagiri, Sindhudurg.
MYRSINACEAE		
Aegiceras corniculatus (L.) Blanco.	common	Ratnagiri, Sindhudurg.
RHIZOPHORACEAE		
Bruguiera gymnorrhiza Lamk.	rare	Ratnagiri, Sindhudurg.
B. parviflora (Roxb.) Wt. & Arn.	rare	Ratnagiri, Sindhudurg.
Ceriops tagal Robinson	common	Ratnagiri, Sindhudurg.
Kandelia candel (L.) Druce.	common	Ratnagiri, Sindhudurg.
Rhizophora apiculata Bl.	common	Ratnagiri, Sindhudurg.
R. mucronata Poir.	common	Ratnagiri, Sindhudurg.
SALVADORACEAE		
Salvadora persica L.	occasional	Ratnagiri.
SONNERATIACEAE		
Sonneratia alba Smith	common	Ratnagiri, Sindhudurg.
S. apetala Buch.-Ham.	common	Ratnagiri, Sindhudurg.
S. caseolaris (L.) Engl. & Prantl.	common	Ratnagiri, Sindhudurg.
B. MONOCOTS		
1. True Aquatics		
ALISMATACEAE		
Limnophyton obtusifolium (L.) Miq.	rare	Ratnagiri.
Sagittaria guayanensis H.B. & K.	rare	Ratnagiri, Sindhudurg.
Wiesneria triandra (Dalz.) Micheli*	common	Ratnagiri, Sindhudurg.
APONOGETONACEAE		
Aponogeton bruggenii Yadav and Govekar*	rare	Sindhudurg.
A. satarensis Ragh., Kulk. & Yadav	rare	Satara.
A. undulatus Roxb.	rare	Sindhudurg.
ARACEAE		
Cryptocoryne cognata Schott*	common	Ratnagiri, Sindhudurg.
Lagenandra ovata (L.) Thw*.	occasional	Sindhudurg, Kolhapur.
Pistia stratiotes L.	common	Ratnagiri.

Taxon	Present status	Distribution
ERIOCAULACEAE		
Eriocaulon breviscapum Koern.*	rare	Sindhudurg.
E. dalzellii Koern.	common	Kolhpur, Ratnagiri, Satara, Sindhudurg.
E. fluviatile Trimen*	rare	Satara.
E. setaceum L.*	common	Ratnagiri, Sindhudurg.
HYDROCHARITACEAE		
Blyxa aubertii Rich. var. *aubertii*	rare	Sindhudurg.
B. aubertii Rich. var. *echinosperma* (Cl.) Hook.	common	Ratnagiri, Sindhudurg.
B. octandra (Roxb.) Planch. ex Thw.	rare	Ratnagiri, Sindhudurg.
Halophila decipiens Ostenf.	rare	Ratnagiri, Sindhudurg.
H. ovalis (R.Br.) Hook. f.	rare	Ratnagiri, Sindhudurg.
Hydrilla verticillata (L.f.) Royle	frequent	all districts
Ottelia alismoides (L.) Pers.	common	Kolhpur, Ratnagiri, Sindhudurg.
Vallisneria spiralis L.	frequent	all districts
LEMNACEAE		
Lemna gibba L.	common	Kolhapur.
Spirodela polyrhiza (L.) Schleid	common	all districts
Wolffia arrhiza (L.) Horkel ex Wimmer	occasional	Kolhapur
NAJADACEAE		
Najas graminea Del.	common	all districts
N. indica (Willd.) Cham.	common	all districts
N. marina L.	occasional	Kolhapur, Satara.
N. minor All.	common	Ratnagiri, Sindhudu g.
POACEAE		
Coix aquatica Roxb.	common	all districts
Hygrorhiza aristata (Retz.) Nees ex Wt. & Arn.	occasional	Ratnagiri.
Leersia hexandra Swartz	common	Sindhudurg.
Oryza rufipogon Griffith	common	Ratnagiri, Sindhudurg.
Paspalidium geminatum (Forssk.) Stapf	common	all districts
Pseudoraphis spinescens (R. Br.) Vickery	common	Ratnagiri, Sindhudurg.
POTAMOGETONACEAE		
Potamogeton crispus L.	frequent	all districts
P. nodosus Poir.	frequent	Kolhapur, Satara.
P. pectinatus L.	common	Kolhapur, Satara.

Taxon	Present status	Distribution
PONTEDERIACEAE		
Eichhornia crassipes (Mart.) Solms	frequent	all districts
Monochoria vaginalis (Burm.) K. B. Presl	frequent	Ratnagiri, Satara, Sindhudurg.
ZANNICHELLIACEAE		
Zannichellia palustris L.	rare	Ratnagiri.
2. Marshy and Monsoon Aquatics		
ARACEAE		
Cryptocoryne retrospiralis (Roxb.) Kunth	occasional	Kolhapur, Ratnagiri.
C. spiralis (Retz.) Fischer ex Widler	frequent	all districts
C. spiralis (Retz.) Fischer ex Widler var. *cognatoides* (Blatt. & McC.) Yadav, Patil & Bogner.	rare	Sindhudurg.
BURMANNIACEAE		
Burmannia pusilla (Wall. ex Miers) Thw.	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
COMMELINACEAE		
Commelina benghalensis L.	common	all districts
C. diffusa Burm. f.	common	all districts
C. hasskarlii Cl.	common	all districts
C. subulata Roth	common	Kolhapur.
Floscopa scandens Lour.	common	Satara, Sindhudurg.
Murdannia nudiflora (L.) Brenan	common	all districts
M. pauciflora (Wright) Brueck	common	Kolhapur, Satara.
M. semeteres (Dalz.) Sant.	common	all districts
M. spirata (L.) Brueck.	common	all districts
M. vaginata (L.) Brueck.	common	Kolhapur, Sindhudurg.
M. versicolor (Dalz.) Brueck.	common	Ratnagiri, Sindhudurg.
CYPERACEAE		
Bulbostylis densa (Wall.) Hand.-Mazz.	occasional	Kolhapur, Sindhudurg.
Cyperus alopecuroides Rottb.	common	Kolhapur, Ratnagiri.
C. alulatus Kern.	common	all districts
C. articulatus L.	common	all districts
C. castaneus Willd.	common	Kolhapur, Sindhudurg.
C. compressus L.	common	all districts
C. corymbosus Rott.	common	Satara, Sindhudurg.
C. cuspidatus Kunth	common	Kolhapur, Satara. Sindhudurg.

Taxon	Present status	Distribution
Cyperus difformis L.	common	all districts
C. distans L.	common	all districts
C. exaltatus Retz.	common	
C. halpan L.	common	all districts
C. iria L.	common	all districts
C. nutans Vahl var. *nutans*	common	all districts
C. nutans Vahl var. *eleusinoides* (Kunth) Haines	common	all districts
C. pilosus Vahl	common	Satara, Sindhudurg.
C. rotundus L.	common	all districts
Eleocharis acutangula (Roxb.) J. A. Schult.	occasional	all districts
E. atropurpurea (Retz.) J. & K. Presl.	common	common All districts
E. dulcis (Burm. f.) Trin.	common	Kolhapur, Sindhudurg.
E. geniculata (L.) R. & S.	common	all districts
E. retroflexa (Poir.) Urb.	common	all districts
Fimbristylis aestivalis (Retz.) Vahl	common	all districts
F. argentea (Rottb.) Vahl	common	Ratnagiri, Sindhudurg.
F. bisumbellata (Forssk.) Bub.	common	all districts
F. complanata (Retz.) Link	common	all districts
F. dipsacea (Rottb.) Cl.	common	Kolhapur, Sindhudurg.
F. ferruginea (L.) Vahl	common	all districts
F. littoralis Gaud.	common	Satara.
F. miliacea (L.) Vahl	common	all districts
F. ovata (Burm. f.) Kern	common	all districts
F. polytrichoides (Retz.) Vahl	common	Kolhapur, Sindhudurg.
F. schoenoides Kunth	common	all districts
F. tetragona R. Br.	common	all districts
Fuirena ciliaris (L.) Roxb.*	common	all districts
Kyllinga brevifolia Rottb.	occasional	Ratnagiri, Sindhudurg.
K. tenuifolia Steud.	occasional	Ratnagiri, Sindhudurg.
Mariscus compactus (Retz.) Boldingh	common	Sindhudurg.
M. squarrosus (L.) Cl.	common	all districts
Pycreus flavidus (Retz.) T. Koyama	common	all districts
P. pumilus (L.) Nees ex Cl.	common	all districts
Rhynchospora corymbosa (L.) Britt.	common	Ratnagiri, Sindhudurg.
Schoenoplectus articulatus (L.) Palla	occasional	Ratnagiri, Sindhudurg.
S. juncoides (Roxb.) Palla	common	Ratnagiri, Sindhudurg.
ERIOCAULACEAE		
Eriocaulon achiton Koer.	common	all districts
E. cinereum R. Br.	common	all districts

Taxon	Present status	Distribution
Eriocaulon conica (Fyson) Fischer *	common	Sindhudurg.
E. cuspidatum Dalz.*	common	all districts
E. duthiei Hook.	occasional	Kolhapur
E. eleanorae Fyson*	common	Kolhapur, Sindhudurg.
E. eurypeplon Koer.*	common	all districts
E. fysonii Ansari & Balak.*	occasional	Sindhudurg.
E. heterolepis Steud.*	common	all districts
E. lanceolatum Miq. ex Steud.* var. *lanceolatum*	rare	Sindhudurg.
E. lanceolatum Miq. ex Steud. var. *pilosum* Mold.*	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
E. margaratae Fyson	common	Kolhapur, Sindhudurg.
E. minutum Hook.	common	all districts
E. nepalense Prescott & Bongard	occasional	Kolhapur.
E. odoratum Dalz.*	common	all districts
E. palghatense Ansari & Balak.*	common	Ratnagiri, Sindhudurg.
E. parviflorum (Fyson) Ansari & Balakr.	common	all districts
E. quinquangulare L.*	common	Sindhudurg.
E. ratnagiricus Yadav, Gaikwad & Sardesai	rare	Ratnagiri.
E. redactum Ruhl.	common	all districts
E. richardianum (Fyson) Ansai & Balak.	rare	Sindhudurg.
E. robusto-brownianum Ruhl.	common	Kolhapur, Sindhudurg.
E. sedgwickii Fyson	common	Ratnagiri, Sindhudurg
E. sharmae Ansari & Balakr.	common	Sindhudurg
Eriocaulon stellulatum Koern.	common	Kolhapur, Satara.
E. trilobum Buch. -Ham. ex Koern.	occasional	Kolhapur.
E. truncatum Ham. ex Mart.	occasional	Satara
E. tuberiferum Kulk. & Desai	common	Kolhapur, Satara, Sindhudurg.
E. xeranthemum Mart.	common	all districts
HYDATELLACEAE		
Trithuria konkanensis Yadav and Janarthanam	common	Ratnagiri, Sindhudurg.
JUNCACEAE		
Juncus prismatocarpus R. Br.	occasional	Kolhapur, Ratnagiri, Satara, Singdhudurg.
POACEAE		
Arundo donax L.	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.

Taxon	Present status	Distribution
Brachiaria mutica (Forssk.) Stapf	common	Kolhapur, Ratnagiri, Sindhudurg.
B. eruciformis (Smith) Grisebach	common	Kolhapur, Ratnagiri, Sindhudurg.
Coelachne minuta Bor	common	Kolhapur, Ratnagiri, Sindhudurg.
C. simpliciuscula (Wt. ex Arn.) Munro ex Bentham	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
Echinochloa stagnina (Retz.) P. Beauv.	common	Kolhapur, Satara.
E. crus-galli (L.) P. Beauvois	common	all districts
Elytrophorus spicatus (Willd.) Camus	occasional	Satara
Eriochloa procera (Retz.) Hubbard	common	Kolhapur, Satara.
Glyphochloa forficulata (Fisch.) Clayton	common	Ratnagiri, Sindhudurg.
Hubbardia heptaneuron Bor*	rare	Kolhapur
Ischaemum molle Hook.	common	all districts
I. rugosum Salisbury	common	Kolhapur, Satara.
I. travancorense Stapf ex Fischer	common	Kolhapur, Ratnagiri, Satara.
Isachne globosa (Thunb.) Ktze.	common	all districts
Oryza rufipogon Griffith	common	Ratnagiri, Sindhudurg.
Panicum repens L.	common	Kolhapur, Ratnagiri, Satara.
Paspalidium geminatum (Forssk.) Stapf	common	Kolhapur, Ratnagiri, Satara, Sindhudurg.
Paspalum canarae Veldkamp	common	Kolhapur, Ratnagiri, Satara.
Saccharum spontaneum L.	common	all districts
Sacciolepis interrupta (Willd.) Stapf	common	Ratnagiri, Sindhudurg.
Urochloa panicoides P. Beauv.	common	Kolhapur, Ratnagiri, Satara Sindhudurg.
TYPHACEAE		
Typha angustifolia L.	frequent	all districts
XYRIDACEAE		
Xyris indica L.	common	Ratnagiri, Sandhudurg.
3. Riverine		
PANDANACEAE		
Pandanus furcatus Roxb.	occasional	Sindhudurg.
P. odoratissima L.	common	Ratnagiri, Sindhudurg.

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REFERENCES

AHMEDULLAH, M. AND M.P. NAYAR. Endemic Plants of Indian Region. Botanical Survey of India. 1987.

ANNONYMOUS, Global Biodiversity Strategy. WRI, IUCN, and UNEP. 1992.

ARBER, A. Water plants: A study of aquatic angiosperms. University Press, Cambridge (Reprint 1963. J. Carmer Weinheim Historiae Naturalis classica. Tomus. xxii). 1920.

BISWAS, K. AND C. C. CALDER. Handbook of common water and marsh plant of India and Burma. New Delhi. 1936.

BOYD, C. E. Vascular aquatic plants for mineral nutrient removal from polluted water. *Econ. Bot.* 24: 95-103. 1970c.

BOYD, C. E. A bibliography of interesting the utilization of aquatic plants. *Econ. Bot.* 26. 1972.

BRUGGEN, H.W.E. Revision of Genus *Aponogeton* L. The species of Madagascar. *Blumea* 16: 243 263. 1968.

CHATRATH, K. J. S. *Wetlands of India.* Ashish Publishing House, New Delhi. 1992.

CHAVAN, A. R. AND S. D. SABNIS. Study of Hydrophytes of Baroda and environs. *J. Ind. Bot. Soc.* 40: 121 -130. 1961.

COOK, C.D.K. *Aquatic and wetland plants of India.* Oxford Uni. Press. Delhi. 1996.

COOK, C.D.K. *et al.* Water plants of world. A manual for the identification of the genera of fresh water macrophytes. W. Junk, The Hague. 1974.

COOK, C.D.K. A revision of the genus *Blyxa* (Hydrocharitaceae). *Aquatic Botany.* 15: 1-52. 1983.

COOK, C.D.K., J. SYMOENS AND K. URMI KORG. A revision of the genus *Ottelia* (Hydrocharitaceae)1. Generic consideration. *Aquatic Botany.* 18:268-274. 1984.

DESHPANDE, S., B.D. SHARMA AND M.P. NAYAR. Flora of Mahabaleshwar and adjoining, Maharashtra. Botanical Survey of India. 1995.

DUGEN, P. J. Wetland Conservation: A review of current issues and required action. Gland. IUCN., 1990.

GOPAL, B. (ed.) Ecology and management of aquatic vegetation in the Indian subcontinent. Academic Publisher, Dehradun. 1990.

GUPTA, R. S. A study of the hydrophytes and marshy plants of Kota and environs (India). *Trop. Ecol.* 7: 153-160. 1965.

JOSEPH, K.T. *Nymphoides sivarajanii* (Menyanthaceae) a new species from India. *Wildenowia* 20: 135-138. 1991.

JOSEPH, K.T. AND V. V. SIVARAJAN. *Rotala cookii* a new species of Lythraceae from India showing *Hippuris* syndrome. *Pl. Syst. Evol.* 159: 141-144. 1988.

JOSEPH, K.T. AND V. V. SIVARAJAN. A new species of *Nymphoides* (Menyanthaceae) from India. *Nord. J. Bot.* 10: 281-284. 1990.

KARTHIKEYAN, S., ANAND KUMAR AND B.D. SHARMA. Aquatic angiosperms of Maharashtra (India) *J. Econ. Tax. Bot.* 3 (2): 423-446. 1982.

KAUL, V. AND D.P. ZUTSHI. Study of aquatic and marshland vegetation of Srinagar. *Proc. Nat. Inst. Sci. India.* 33: 111-127. 1967.

KAUSHIK, J.P. The vegetation of marshes, ponds and river bank in Shivpuri, Madya Pradesh. *Bull. Bot. Surv. India.* 11: 84-88. 1969.

KULKARNI, B. G. Flora of Sindhudurg District. Botanical Survey of India. 1988.

LITTLE, E. C. S. Handbook of utilisation of aquatic plants. Food and Agriculture Organisation of the United Nations. Rome. 1968.

MAJUMDAR, N. C. Aquatic and Semi-aquatic flora of Calcutta and adjascent localities. *Bull. Bot. Soc. Bengal* 19: 10-17. 1965.

MANILAL, K. S. AND V.V. SIVARAJAN. A contribution to the study of hydrophytic flora of Kerala. *Proc. Natn. Acad. Sci. India* 45B: 225 231. 1978.

MCNABB, C. D., D.P. TEIRNAY AND S.R. KOSEK. The uptake of phosphorus by *Ceratophyllum demersum* from waste water. Project A-031-Mich of the Inst. Wat. Research, Michigan State Univ. 1971.

MCNEELY, J. A. The Sinking Ark: Pollution and the world wide loss of biodiversity. *Biodiv. & Conserv.* 1: 2-28. 1992.

MCNEELY, J.A., MILLER, K. R. REID, W. MITTERMEIROR, R. AND T. WARMER. Conservation of world biodiversity. Washigton, D. C. IUCN. World Resource Institute, World bank. WWF. US and Conservation international. 1990.

MITCHELL, D. S. Aquatic vegetation and its use and control. UNESCO. Paris. 1974.

MOHAN RAM, H.Y. In vitro culture of aquatic flowering plants: achievements and prospects. Tenth P. R. White memorial lecture. Ahemdabad, India. 1968.

NASKAR, K.R. Aquatic and semiaquatic plants of the Lower Ganga Delta. Daya Pub. House. Delhi. 1990.

NAYAR, M.P. Hot Spot of Endemic Plants of India, Nepal, and Bhutan. Tropical Garden and Research Institute, Palode. Trivandrum. pp 217-218. 1996.

NAYAR, M.P. AND A.R.K. SASTRY. (eds.) Red Data Book of Indian Plants. Vols. 1-3, BSI. 1989.

RAI, U. N., S. SINHA, R.S. TRIPATHI AND P. CHANDRA. *Ecology Engineering* 5: 5-12. 1995.

RAO, R. R. AND B.D. SHARMA. A manual for herbarium collections. Botanical Survey of India 1990.

SAHAI, R. AND A.B. SINHA. A supplement to the aquatic and swampy vegetation of Gorakhpur. *Indian Forester* 94: 819-821. 1968.

SATYANARAYANA, G. Hydrophyte vegetation of Jhalukbari. *Bull. Bot. Surv. India* 4: 217-218. 1962.

SCULTHORPE, C. D. The biology of aquatic vascular plants. Edward Arnold, London. 1967.

SEERWANI, A.B. Study of hydrophytes and plants of low lying habitats in Jabalpur. *Bull. Bot. Surv. India* 4: 227-231. 1962.

SEIDEL, K. Macrophytes as functional elements in the environment of man. *Hydrobiologia* 12: 121-30. 1971.

SIVARAJAN V. V. AND K.T. JOSEPH. The genus *Nymphoides* Seguier in India. *Aquatic Botany;* 45. 145 170. 1993.

STAFLEU, F.A. *International Code of Botanical Nomenclature* Adapted by the 12 th International Botanical Congress, Leiningard, July, 1975 IAPT. Utrecht. 1978.

SUBRAMANYAM, K. *Aquatic Angiosperms*. C. S. I. R. New Delhi. 1962.

VYAS, L. N. Study of Hydrophytes and marsh plants of Alwar and environs. *J. Ind. Bot. Soc.* 43: 17-30. 1964.

YOUNT, J. I. AND R.A. CROSSAMAN. Eutrophication control by plant harvesting. *J. Wat. Pollut. Control* Fed 42: 173-83. 1970.