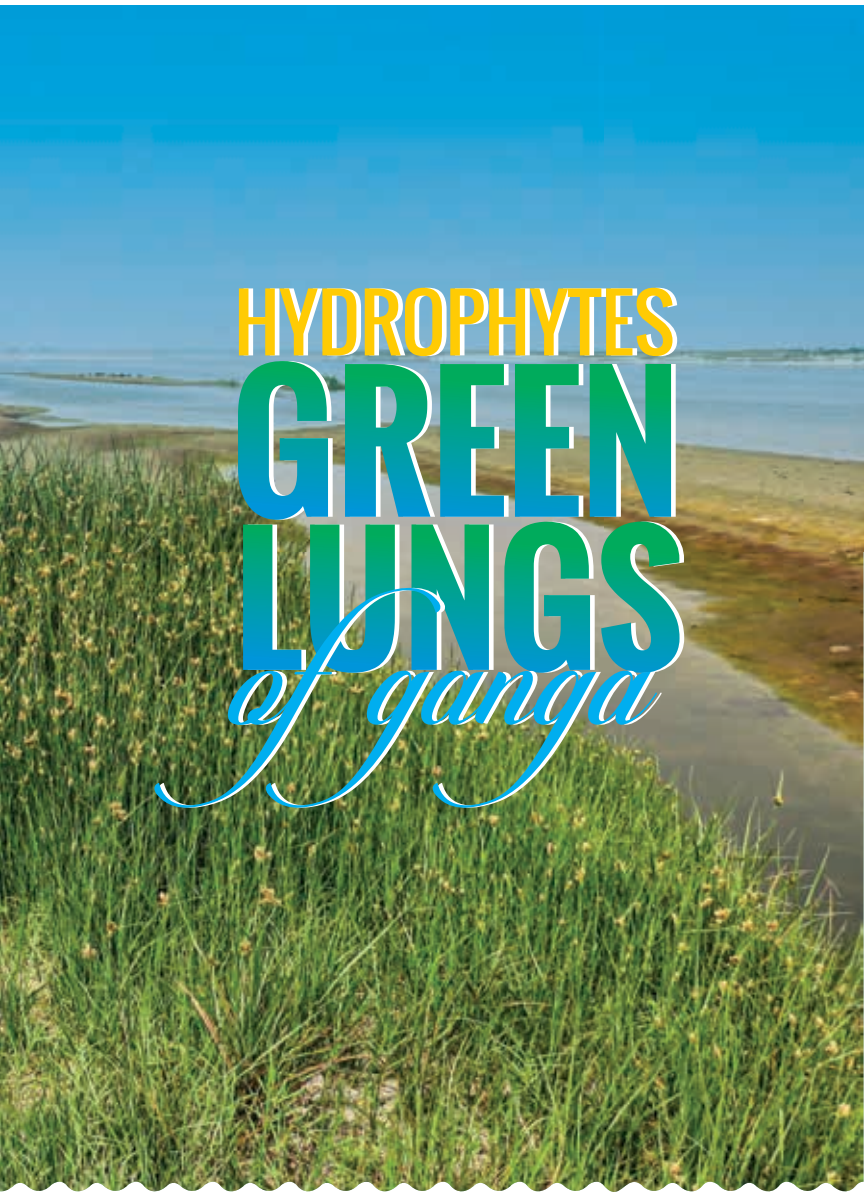
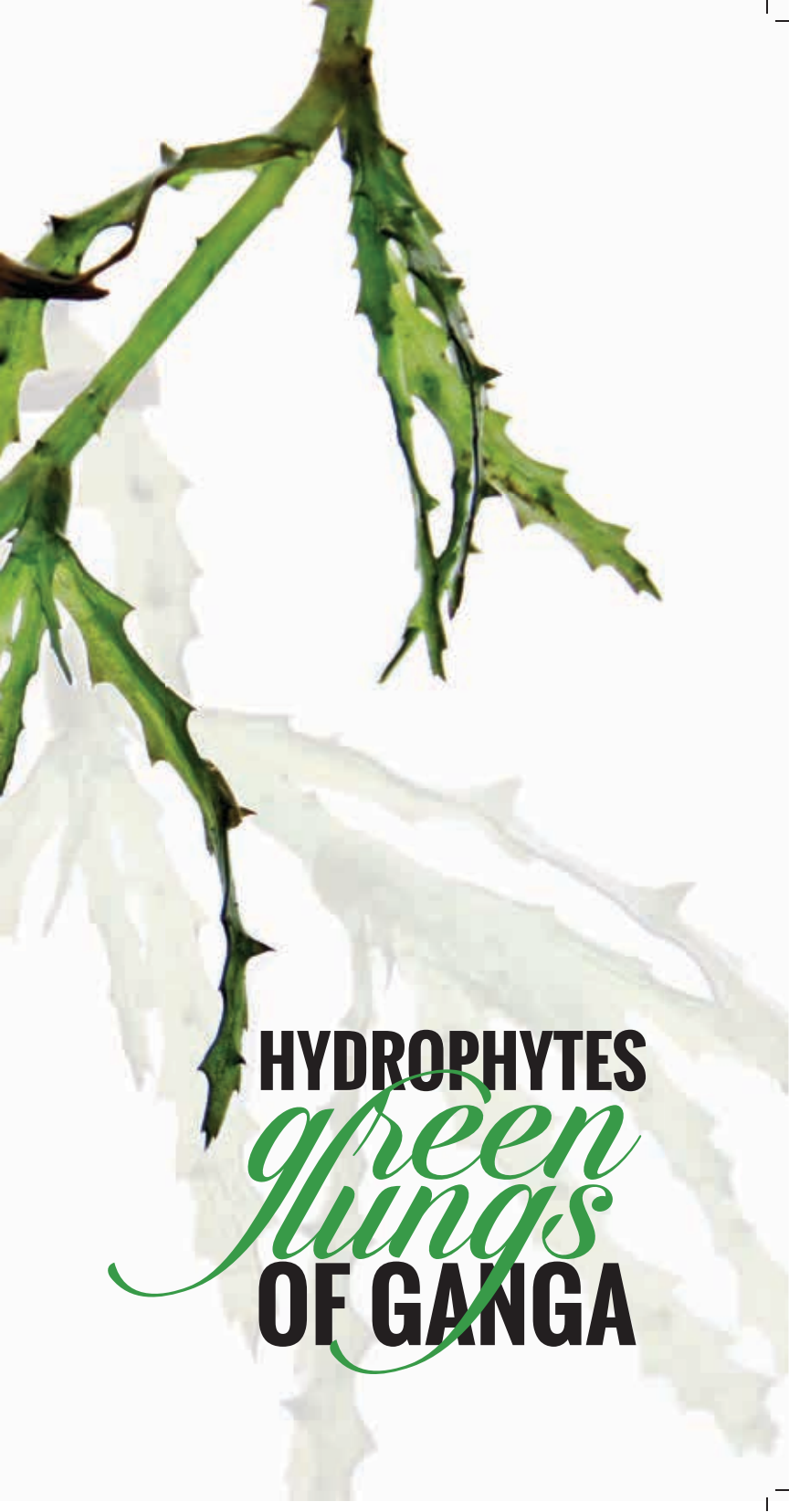
VIBRANT GANGA

नमामि गंगे



HYDROPHYTES
GREEN LUNGS
of ganga

भारतीय वन्यजीव संस्थान
Wildlife Institute of India



HYDROPHYTES
green lungs
OF GANGA

पवनः पवतामस्मि रामः शस्त्रभृतामहम् ।
झषाणां मकरश्चास्मि स्रोतसामस्मि जाह्नवी ।। ३१ ।।
भगवद गीताः अध्याय १०, श्लोक ३१

शुद्ध करने वालों में मैं वायु हूँ, और शस्त्रधारियों में मैं राम हूँ
जल जीवों में मैं मगरमच्छ हूँ, और बहती नदियों में मैं गंगा हूँ

Amongst purifiers I am the wind, and amongst wielders of weapons I am Lord Ram.
Of water creatures I am the crocodile, and of flowing rivers I am the Ganges.

PLANNING AND MANAGEMENT FOR AQUATIC SPECIES CONSERVATION AND MAINTENANCE OF ECOSYSTEM SERVICES IN THE GANGA RIVER BASIN FOR A CLEAN GANGA

Hydrophytes green lungs of Ganga
2024

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Apomogeton natans - Source: asia-medicinalplants.info

Nymphoides indica - Source: Internet

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PREFACE

The Ganga River is one of the largest and the most widely written of all the renowned rivers systems throughout the world. It is undoubtedly the most worshipped of all. The story of Ganga represents Indian culture and civilizations, a symbol of our traditions and values, and provide physical and spiritual nourishment to millions of its devotees. There are extensive classical and folk literature related to this "Divine" or "Devnadi". She flows through a total of five states, along with its tributaries, nurturing over 500 million people and supporting enormous biodiversity along its path (S. Kumar. 2001).

Aquatic plants are the most productive ecosystems in the world. The floral diversity in and along the Ganga River is represented by its riparian and riverine plant species. Any plant living in water or on a substrate that is at least periodically anaerobic due to excess water is defined as hydrophyte. The prefix 'hydro' suggests that the plant is living in water or water dominant environment. Hydrophytes reduce water pollution by sequestering carbon dioxide and fertilizers, which improves the water quality and at the same time it regulates the levels of oxygen

in water based on availability of light, making it available for the organisms thriving in it.

The riparian species, along the river banks, keeps the river flow intact avoiding flooding of adjoining areas. The flora of the river nurtures thousands of species, ranging from birds to fishes, by providing them food (in the form of stem, leaves, flowers, fruits etc.), shelter (nest or home) and cover (place to move without being seen).

The NMCG and WII project, "Biodiversity Conservation and Ganga Rejuvenation" aims at aquatic species restoration plan through science-based research and knowledge sharing. The book aims to share science-based information on floral diversity their status, ecology, local usage, and control measures to the various stakeholders with the aid of print and digital media.

OVERVIEW

HYDROPHYTES

Any plant living in water or on a substrate that is at least periodically anaerobic due to excess water is defined as a hydrophyte. Hydrophytes are plants normally growing in water and also include plants inhabiting swampy or marshy habitats containing a quantity of water which would prove much more than optimal for the average land plant.

Adaptation Features

Owing to disintegration of groups of cells or their separation, large intercellular spaces or air cavities develop in all parts of hydrophytic plants. This is one of the major adaptive features of hydrophytes. Other features like development of aerating tissue (bulbous petioles of water hyacinth), epidermal hairs (Azolla) on upper surface of plant parts in direct contact with water, air cavities in floating leaves (water lily) forming a continuous air-communicating system (submerged organs can easily exchange gases with the air outside) and the ever- open stomata. The fruits of lotus contain large air cavities rendering them buoyant and facilitating their dispersal by water. All free-floating rosette plants, e.g., Pontederia, Pistia etc., have supremely well- developed adventitious roots.

Relieved of the function of anchorage, the roots of hydrophytic plants preserve the stability of their floating rosette leaves. Conducting tissue and root system are poorly developed, stomata absent from submerged parts and almost complete absence of secondary growth in thickness of stems and roots are some important features noted in hydrophytes. These characteristic features help plants to survive and adapt to saturated water and soil conditions. Hydrophytes are further categorized into four major types, namely free-floating, floating-rooted, submerged and amphibious hydrophytes.

Free Floating Hydrophytes

The plants that freely float or are in contact with water and air but not rooted in the soil.

Examples: *Aponogeton natans, Lemna minor, Spirodela polyrhiza, Pontederia crassipes, Salvinia minima, Pistia stratiotes, Trapa natans, Azolla pinnata, Najas minor.*

Floating-rooted Hydrophytes

These plants are anchored in the muddy soil at the bottom of the water bodies, while some plant parts are floating.

Examples: *Marsilea quadrifolia, Nymphaea nouchali, Nelumbo nucifera, Nymphoides cristata, Ipomoea aquatica, Ludwigia adscendens.*

Submerged Hydrophytes

The plants of this group are completely submerged and also anchored to the substratum.

Examples: *Potamogeton natans, Ceratophyllum demersum, Hydrilla verticillata, Potamogeton crispus, Vallisneria natans, Ranunculus aquatilis, Stuckenia pectinata, Utricularia australis.*

Amphibious/Riparian Hydrophytes

These plants grow in shallow water with their underground parts in water or in water saturated muddy soil, while extending their shoots well above the surface of water. They are also known as marshy plants.

Examples: *Sagittaria sagittifolia, Typha angustifolia, Phragmites karka, Ipomoea carnea, Ranunculus sceleratus, Monocharia hastata, Veronica anagallis-aquatica, Rorippa nasturtium-aquaticum, Bacopa monnieri, Enhydra fluctuans, Hygrophila polysperma, Pedalium murex, Saccharum spontaneum.*

Importance of Hydrophytes

Plant communities that grow along the river bank are ecologically termed as Riparian flora. These links the terrestrial and aquatic habitats and is represented by a particular type of vegetation that grows only along the sides of river (Dutta et al. 2011). Riparian plant habitats and communities are represented by hydrophytic plants further consisting of macrophytes, native grasses, sedges, climbers, shrubs and trees (Dutta et al. 2011). Riparian zones consisting of hydrophytic plants and river bank vegetation play an important role in ecology and environmental management. They play a pivotal role in soil conservation thus river bank stabilisation, enriching biodiversity, influencing the aquatic ecosystem along with the associated fauna, and serve as shelter and cover for fauna, especially birds and fishes (breeding and spawning respectively). River bank vegetation keeps the river bed intact thus avoiding floods in adjoining flood prone areas. Water current in turn plays a role in dispersal of vegetative propagates and pant parts (propagation) and influencing the marginal vegetation. After flooding, new fertile lands emerge allowing luxuriant herbaceous vegetation growth.

contents

PLANTS THAT FLOAT OR ARE IN
CONTACT WITH WATER AND AIR
BUT NOT ROOTED IN THE SOIL

FREE FLOATING HYDROPHYTES

Lemna minor L.

Vernacular name:	Battakh ka paudha
Common name:	Duckweed, Battakh ka paudha
Family:	Araceae
Genus:	*Lemna*
Species:	*minor*
Distribution:	Cosmopolitan.
Habit:	Aquatic plant
Habitat:	Freshwater floating plant.

Native/Exotic:
Exotic

Flowers:
Rarely flowers

Flower (Fruit) position:
Within membranous, saclike spathe (open at top only) inside budding pouches.

Ecological role:
Food for ducks and fishes especially for grass carp. Remove heavy metals from water bodies, bio-remediator, for wastewater nutrient recover. Also, an important food source for muskrats, beaver, birds (e.g., rails, herons) and small aquatic animals such as frogs.

Local usage:
Fronds possess cooling, astringent and diuretic properties; useful in skin diseases and as ophthalmic wash. It is a popular addition to water gardens and ponds, provides attractive foliage cover but also discourages algae growth.

Hydrophytic adaptations:
Root pockets are present instead of root caps. The sticky root enables the plant to adhere to the plumage or feet of birds and can thereby colonize new ponds.

Bioindicator: Nitrogen, phosphorus and potassium.

Control measures:
Manual or mechanical means can be used. Raking or seining it from the pond's surface.

IUCN status:
Least concern

Lemna perpusilla Torr.

Vernacular name:	Battakh ka pauda, Khundipana
Common name:	Duckweed
Family:	Araceae
Genus:	*Lemna*
Species:	*perpusilla*
Distribution:	Pantropical in distribution, occurring in Africa, Asia and America, locally naturalized in some more temperate areas, including France and Italy in southern Europe.

Native/Exotic:
Native

Habit:
Aquatic herb

Habitat:
Free-floating

Flowers:
Microscopic staminate flowers

Fruits:
Is an utricle

Phenology:
February to April

Ecological role:
It is a nuisance in irrigation and drainage channels, reservoirs and recreational lakes. Several mosquito larvae, particularly those of *Culex bitaeniorhynchus, C. tritaeniorhynchus* and *Ficalbia minima* are closely associated with Lemna.

Local usage:
Fodder/animal feed. The whole fresh plant is used to make medicine.

Hydrophytic adaptations:
The upper epidermis is highly cutinized and is unwettable. Have greatly reduced vascular bundles.

Bioindicator:
Mesotrophic to eutrophic environments. Relatively high levels of N, P and K.

Control measures:
Manual or mechanical means can be used. Raking or seining it from the pond's surface.

IUCN Status:
Least concern

Spirodela polyrhiza (L.) Schleid.

Vernacular name:	Battakh badha paudha, Mtor dal pana
Common name:	Greater duckweed, Duckmeat
Family:	Araceae
Genus:	*Spirodela*
Species:	*polyrhiza*
Distribution:	Found worldwide, namely in North America, Asia, more rarely in Central and South America, but also in Central Europe. It grows in tropical and temperate climates.

Native/Exotic:
Native

Habit:
Perennial floating aquatic plants

Habitat:
Free-floating aquatic plant

Flowers:
Flowers are very small and rare in many species; male and female flowers are borne on the same plant.

Fruit:
Fruit 1-2 seeded, slightly winged.

Phenology:
April to September

Ecological role:
S. polyrhiza is an ideal system for biofuels, bioremediation and carbon cycling as they are fast-growing, in direct contact with media and have smallest genomesize. Duckweeds serve as nutrient pumps, reduce eutrophication effects and provide oxygen from their photo synthesizing activity.

Local usage:
Its uses as biofuel and animal feed are also gaining importance. It is hardly used for human nutrition.

Hydrophytic adaptations:
Many species survive at low temperatures by forming a special starchy 'survival' frond known as a turion. In cold weather, the turion is formed and sunk to the bottom of the pond where it remains dormant until warm water triggers resumption of normal growth.

Bioindicator:
Heavy metals and nutrient rich water bodies. Growth rate of duckweed is favoured by organic pollutants as well as inorganic nutrients.

Control measures:
Giant duckweed can be removed by raking or seining it from the pond's surface.

IUCN status:
Least concern

Pontederia crassipes Mart.

Vernacular name:	Jal kumbhi
Common name:	Bengal terror, Blue devil
Family:	Pontederiaceae
Genus:	*Pontederia*
Species:	*crassipes*
Distribution:	Is distributed throughout the world, flourishing in tropical and subtropical regions.
Habit:	Aquatic herb
Habitat:	Free floating aquatic plant

Native/Exotic:
Exotic

Flowers:
Showy spike above rosette lavender-blue with a yellow blotch

Fruit:
A 3-celled capsule

Phenology:
April to July

Ecological role:
It forms dense, impenetrable mats which clog waterways, making boating, fishing and almost all other water activities, impossible. It also reduces biodiversity by crowding out native plants at the water's surface and below. Water hyacinth mats also degrade water quality by blocking the air-water interface and greatly reducing oxygen levels in the water.

Local usage:
Despite its adverse impacts, it has been widely planted as a water ornamental around the world because of its beautiful, striking flowers.

Hydrophytic adaptations:
Leaves are rounded and leathery, attached to spongy and sometimes inflated stalks/petioles.

Bioindicator:
Grows rapidly when nitrate and phosphate levels increase in river water.

Control measures:

Cultural/Physical:
Very small infestations of water hyacinth may be controlled by hand pulling. Water hyacinth thrives in nutrient-rich waters, so reducing nutrient concentrations in impacted waters, may decrease the vigorous growth of this plant.

Mechanical:
Mechanical harvesters and chopping machines can be used to remove water hyacinth from the water and transport it to disposal on shore.

IUCN status:
Not Evaluated

Salvinia minima Baker

Vernacular name:	African payal
Common name:	Kariba weed, Butterfly fern
Family:	Salviniaceae
Genus:	*Salvinia*
Species:	*minima*
Habit:	Aquatic Herb
Habitat:	Free-floating aquatic fern
Distribution:	The species is native to South America, but is now established in the southern states of the USA.

Native/ Exotic:
Exotic/Invasive

Flower:
No flower

Fruit:
No fruits

Phenology:
Not Known

Local use:
Used to extract nutrients and pollutants from the water. When this plant is dried out, it is used as satisfactory mulch.

Ecological role:
Speedy reproduction can out- compete growth of native water plants. Mats of *S. minima* can block sunlight, suppressing the growth of under water plants that photosynthesize, resulting in less dissolved oxygen in the water. This can lead to fish kills. Waterfowl species that feed on either fish or native aquatic plants are also affected by a lack of food.

Hydrophytic adaptations:
Species is rootless. Fine white hairs grow uniformly on the leaf surface and serve to repel water.

Bioindicator:
Heavy metals. Hyper lead accumulator

Control measures:
Mechanical methods include raking the surface of the water or seining the plants off with large nets.

Biological control:
Efforts for *S. minima* have been centered around the tiny salvinia weevil, *Cyrtobagous salviniae*, which live and feed on the *Salvinia* leaves.

IUCN status:
Least concern

Pistia stratiotes L.

Vernacular name:	Jalakumbhi, Khundipana or Takapana.
Common name:	Water lettuce
Family:	Araceae
Genus:	*Pistia*
Species:	*stratiotes*
Distribution:	Has a pan-tropical and subtropical distribution.
Habit:	Floating herb
Habitat:	Free-floating aquatic plant

Native/ Exotic:
Exotic (troublesome weed).

Flower:
Numerous, whitish, small and hidden at the base of leaves.

Fruit:
Many-seeded green berry.

Phenology:
June to September

Ecological role:
It clogs waterways preventing river travel, blocks irrigation canals, destroys rice paddies and ruins fishing grounds. It affects hydro-electricity production as its vast mats clog the turbines.

Local usage:
It has medicinal properties and can be used as fodder for cattle and pigs. It can be beneficial in certain instances as it out competes algae for nutrients in the water, thereby preventing massive algal blooms.

Hydrophytic adaptations:
Resembling a loose-leafed lettuce, it drifts freely across the water surface. Finely-divided roots hang in the water below floating rosettes of corrugated, spongy leaves, which contain air-filled cavities to keep the plant afloat. The velvety leaves are also covered with a dense layer of minute, water-repellent hairs. Air trapped between the hairs on the leaf surface make the plant difficult to sink.

Bioindicator:
Organic pollution

Control measures:
Small scale infestations can be controlled manually. Larger infestations have been tackled with specially made machinery but the running costs is high. Insects have been successfully used as biological control agents. Adults and larvae of the South American weevil *Neohydronomous affinis* feed on Pistia stratiotes leaves, and the larvae of moth *Spodoptera pectinicornis* has been reported to control *P. stratiotes*.

IUCN status:
Least concern

Trapa natans L.

Vernacular name:	Singhara
Common name:	Water Chestnut Family: Lythraceae
Family:	Lythraceae
Genus:	*Trapa*
Species:	*natans*
Distribution:	Virtually ubiquitous and are common in agricultural lands and marshy areas.
Habit:	Floating-leaved freshwater herb.
Habitat:	Free-floating hydrophyte

Native/Exotic:
Native

Flowers:
Small, white, four-petaled flowers.

Fruit:
Annually produces nuts that sink to the sediment and germinate.

Phenology:
July to frost

Ecological role:
Water chestnut is an invasive, destructive species, and has been implicated in the loss of many other plant and animal species. Shelter created by the rosettes is beneficial for duckweeds and filamentous algae.

Local usage:
Nuts have a high moisture content and are valued for quenching thirst as well as being used as a source of flour that forms the base for many different food products. The nut has also been recommended for use as paper pulp, fertilizer, fish food, compost and biofuel.

Hydrophytic adaptations:
The plant produces ramets that can break off and move away from the rest of the clone and survive to produce seeds. This attribute allows for extremely rapid clonal expansion.

Bioindicator:
Alkaline water. Sewage and calcium carbonate inputs create favourable conditions of increased alkalinity and thus increased nitrogen, which is correlated with increased petiole and fruit biomass. *T. natans does* not tolerate salinity

Control measures:
Small populations are effectively controlled by hand pulling, preferably prior to the production of the propagating nuts. Large infestations must be controlled by mechanical harvesters.

Grass carp, *Ctenopharyngodon idella* has been used to control water chestnut (Hummel and Kiviat, 2004).

IUCN status:
Least concern

Ludwigia adscendens
(L.) H. Hara

Vernacular name:	Keshandam, Kesharapani, Khuturia
Common name:	Water Primrose, Water Dragon, Marshy jasmine
Family:	Onagraceae
Genus:	*Ludwigia*
Species:	*adscendens*
Distribution:	Subtropical Himalayas, India, east to China, Malaysia, Australia
Habit:	Aquatic or sub-aquatic perennial herb
Habitat:	Occur as a submerged but maily as a free floating semi aquatic plant.

Native/Exotic:
Native

Flowers:
5 creamy white petals, yellow at the base.

Fruits:
The fruit is a narrow capsule, which split lengthwise to release tiny round seeds.

Phenology:
April to November

Ecological role:
Forms dense monocultures that exclude native plants and is a superior competitor because of its low requirements for light and rapid growth.

Local usage:
Whole plant is antiseptic and used as a poultice in ulcers. Extract of leaves and stem possess a strong antimicrobial activity and is used against various skin diseases. Flower petals possesses anti-inflammatory activity.

Hydrophytic adaptations:
Can tolerate colder water temperatures

Bioindicator:
Toxicities

Control measures:
Requires mechanical harvesting to clear the waterbodies.

IUCN status:
Least concern

PLANTS IN THIS GROUP ARE COMPLETELY SUBMERGED AND ARE ALSO ANCHORED TO THE SUBSTRATUM.

SUBMERGED HYDROPHYTES

Potamogeton natans L.

Vernacular name:	Pond weed
Common name:	Broad-leaved Pond weed
Family:	Potamogetonaceae
Genus:	*Potamogeton*
Species:	*natans*
Distribution:	Indo-Malesia to Australia and are found worldwide in many aquatic ecosystems. The plant occurs in plains, in the ponds and marshy places in India.
Habit:	Submerged aquatic plant
Habitat:	Shallow, fresh or brackish water, lakes, ponds, bogs, marshes, lagoons, streams

Native/Exotic:
Native

Flowers:
Greenish-brown and are composed of four rounded segments borne in a spike.

Fruit:
Spheroidal and green to brown, usually 1-3 mm in diameter, with a noticeable 'beak'.

Phenology:
June to September

Ecological role:
They are important as food and habitat for animals including insect larvae, water snails, ducks and other waterfowl, and aquatic mammals such as beavers.

Local usage:
Root-raw or cooked The plant is febrifuge and resolvent.

Hydrophytic adaptations:
Broad-leaved Leaves are glaborous and with a waxy coating.

Bioindicator:
Acid or calcareous conditions.

Control measures:
Floating pondweed can be removed by raking or seining it from the pond. Grass crap can help in biological removal of the species whereas Diaquat can be used as a herbicide for the same.

IUCN status:
Least concern

Najas minor All.

Vernacular name:	Jhangi
Common name:	Brittle naiad or Brittle waternymph
Family:	Hydrocharitaceae
Genus:	*Najas*
Species:	*minor*
Distribution:	Europe, North Africa, Asia, North America, India, Pakistan
Habit:	Submersed herb
Habitat:	Prefers calm waters

Native/Exotic:
Native

Flowers:
Small flowers are located in clusters along the leaf axils.

Fruits:
Fruits are slightly curved and have white ladder like longitudinal rows.

Phenology:
March to September

Ecological use:
Grows densely under the surface producing shoots up to a meter long that shade out native plants and interfere with recreational activity such as swimming, boating, and fishing and reduce the aesthetic value of waters.

Local usage:
Preferred food source for waterfowl.

Hydrophytic adaptations:
Leaves and roots are greatly reduced.

Bioindicator:
Viewed as an indicator of warm, turbid, eutrophic or polluted waters.

Control measures:
The use of aquatic plant harvesters, large boats that cut and remove vegetation can be used. The use of hand cutters may be effective for smaller populations.

IUCN status:
Least concern

Ceratophyllum demersum L.

Vernacular name:	Sindiya, Jhanji
Commonname:	Coontail, Coon'stail, Hornwort
Family:	Ceratophyllaceae
Genus:	*Ceratophyllum*
Species:	*demersum*
Distribution:	An aquatic plant found all over India from temperate to tropics, in ponds, and lakes.
Habit:	Aquatic herb
Habitat:	Submerged, free-floating aquatic plant

Distribution:
Cosmopolitan distribution, grows inlakes, ponds, and quiet streams with summer water temperatures of 15-30°C.

Native/Exotic:
Native

Flowers:
Small, 2 mm long, with eight or more greenish-brown petals; they are produced in the leaf axils.

Fruit: The fruit is a small nut 4-5 mm long, usually with three spines, two basal and one apical, 1-12 mm long.

Phenology:
June to September

Ecological role:
C. demersum has allelopathic qualities as it excretes substances that inhibit the growth of phytoplankton and cyanobacteria (blue-green algae). Its dense growth can outcompetenative underwater vegetation, leading to loss of biodiversity. Its fluffy, filamentous, bright-greenleaves provide excellent cover for newly hatched fish.

Local use:
Coontail is used as a health supplement as it is low in calories, and rich in protein, calcium and magnesium.

The whole plant has been traditionally used in the treatment of wounds, fever, burning sensation, hemorrhoidsorpiles, intrinsic hemorrhages, hyperdipsia, epistaxis, and hematemesis.

Hydrophytic adaptations:
Dissected blade, a large portion of aerenchyma and large mesophyll cells.

Bioindicator:
Biomonitoring and heavy metal detection.

Control measures:
Mechanical harvesting has proved sufficient to control. Triploid grass carp (*Ctenopharyngodon idella*) were successfully used to control water weeds, including *C. demersum*.

IUCN status:
Least concern

Hydrilla verticillata (L.f.) Royle

Vernacular name:	Jhangi, Kureli
Common name:	Water thyme
Family:	Hydrocharitaceae
Genus:	*Hydrilla*
Species:	*verticillata*
Distribution:	Native to India and S. Asia, naturalized all over the world.
Habitat:	Submerged rooted aquatic plant
Habit:	Aquatic Herb

Native/Exotic:
Native

Flowers:
Small, with three sepals and three petals, the petals 3-5 mm long, transparent with red streaks

Fruit:
Turions (stem tubers) can drop off the plant and successfully survive freezing or drought.

Phenology:
May to January

Ecological role:
Hydrilla is known to be an aggressive and competitive plant, even out-competing and displacing native species.

'Keystone niche' providing a variety of habitats as well as food-chains for diverse microbes, algae and micro- as well as macro-fauna. Tubers from the rhizomes are another way these plants reproduce and increase their invasive potential.

Local use:
The plant contains vitamins, minerals, and antioxidants, as well as being useful for fighting indigestion. The plant is also known for its extremely high concentration of calcium, vitamin B-12, iron and magnesium. As such, the plant has become an extremely popular "super food.

Hydrophytic adaptations:
Can tolerate oxygen depletion, low salinity of water and chemical pollution too. Since it can survive without roots, as a floating vegetation, it is independent of the depth of water it inhabits.

Bioindicator:
Accumulates both by adsorption and resorptional most all heavy metals discharged from industrial and sewage effluents. Copper particularly, in low concentrations, is taken up efficiently by Hydrilla.

Control measures:
Weed harvesters provide temporary relief and open boating lanes, but resulting plant fragments can result in further spread of the weed.

IUCN status:
Least concern

Vallisneria natans (Lour.) H. Hara

Vernacular name:	Jallil, Sawala, Sewal
Common name:	Eel grass, Tape grass
Family:	Hydrocharitaceae
Genus:	*Vallisneria*
Species:	*natans*
Distribution:	The genus is widely distributed in tropical and subtropical regions of Asia, Africa, Europe, and North America.
Habit:	Aquatic herb
Habitat:	Submerged aquatic plant

Flowers:
Single white female flowers grow to the water surface on very long stalks. Male flowers grow on short stalks, become detached, and float to the surface.

Fruit:
The fruit is a banana-like capsule having many tiny seeds.

Phenology:
June to October

Ecological role:
Dense infestations may restrict recreational activities, cause flooding and silting and reduce the aesthetic appeal of a body of water. Rooted submerged species are important in phytore mediation (biological remediation of environmental problems using plants) due to their soil-binding roots, rhizomes and stolons.

Local usage:
Are commonly kept in tropical and subtropical aquaria.

Hydrophytic adaptations:
Tapering leaves

Bioindicator:
Nutrient Bioindicator

Control measures:
Options for control of Vallisneria spp. include mechanical removal, (with weed harvesters or suction dredges), chemical control with herbicide, manipulation of the habitat by drainage or weed mats and biological control with agents such as grass carp.

IUCN status:
Least concern

Potamogeton crispus L.

Vernacular name:	Sawal
Common name:	Curly-leaf pondweed
Family:	Potamegetonaceae
Genus:	*Potamogeton*
Species:	*crispus*
Distribution:	*P. crispus* is widespread throughout much of its native range, which is commonly reported to include Europe, Asia, African and Australia whereas it is non-native and invasive in temperate areas of North America, New Zealand, and southern South America.
Habit:	Submerged aquatic plant
Habitat:	Freshwater as well as brackish water

Native/Exotic:
Exotic

Flowers:
The inflorescence is a short spike of flowers emerging above the water surface. Small flowers, with greenish-brown or greenish-red sepals.

Fruit:
3-4 achenes (fruits) per flower.

Phenology:
December to March

Ecological role:
In waters too turbid to support other submersed macrophytes, *P. crispus* may provide ecosystem benefits for fish and wildlife habitat and a source of macro invertebrate food organisms. Several species of dabbling ducks are known to eat *P. crispus* seeds and turions.

Dense stands of curly leaf pondweed can alter the predator/prey relationship and affect the overall ecology of an aquatic ecosystem. Further it reduces the flow in irrigation canals.

Local usage:
Leaves are diuretic and the infusion of dried leaves are taken internally for kidney problems. Tubers and leaves are edible.

Hydrophytic adaptations:
Can tolerate a wide range of conditions, low temperature, turbid tolerant plants and have complex root systems to withstand wind driven waves.

Bioindicator:
Eutrophication and nutrient rich water.

Control measures:
Small infestations can be removed manually by cutting, raking, or digging up plants.

IUCN status:
Least concern

Hygroryza aristata
(Retz.) Nees ex Wight & Arn.

Vernacular name:	Petuli-dol, Dol-ghanh
Common name:	Bengal wild rice, Asian water grass
Family:	Poaceae
Genus:	*Hygroryza*
Species:	*aristata*
Distribution:	Native range is Indian Subcontinent to S. China and Indo-China, Taiwan.
Habit:	Aquatic grass with slender culms
Habitat:	Floating grass

Native/Exotic:
Native

Flowers:
Inflorescence a panicle.

Fruits:
Caryopsis sub-cylindrical

Phenology:
October to February

Ecological role:
Sometimes a troublesome weed in navigation and irrigation canals.

Local usage:
The grain is eaten in times of scarcity. The whole plant constitutes a good forage, and cattle and buffalo are fond of it. The grains are sweet and oleaginous. They are said to be cooling and useful in biliousness.

Hydrophytic adaptations:
Floating leaves

Bioindicator:
Heavy metals, Contaminated environments.

Control measures:
Small-scale infestations can be controlled manually. Larger infestations have been tackled with specially made machinery.

IUCN status:
Not known

Stuckenia pectinata
(L.) Börner

Vernacular name:	Not Known
Common name:	Sago pondweed, Fennel pondweed
Family:	Potamogetonaceae
Genus:	*Stuckenia*
Species:	*pectinata*
Distribution:	Cosmopolitan
Habitat:	Fully submerged aquatic plant

Native/Exotic:
Native Habit: Aquatic herb

Flowers:
Spikes 1.5-2 cm long, cylindric 13-17 cm long

Fruits:
3-5 mm long, 2.5-3 mm broad, obliquely obovoid, smooth.

Phenology:
February to May

Ecology:
The nutritious tubers are an important food source for waterfowl, including the canvasback, which help disperse the plant. The plant can be come a nuisance weed in waterways such as canals, because it is tolerant to eutrophication.

Local usage:
The plant is harvested from the wild for Local usage as a food and a medicine. It can be used to remove toxins from aquatic environments and also to help reduce erosion along the edges of aquatic environments.

Hydrophytic adaptations:
The flowers are wind pollinated and the seeds float.

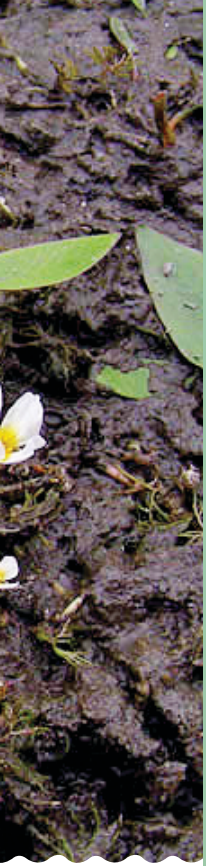
Bioindicator:
High salinity, pH, and alkaline water

Control measures:
Repeated mechanical harvesting. Dewatering lake shores and canals can suppress subsequent growth.

IUCN status:
Least concern

Ranunculus aquatilis L.

Vernacular name:	Not Known
Common name:	Common water-crowfoot or white water-crowfoot
Family:	Ranunculaceae
Genus:	*Ranunculus*
Species:	*aquatilis*
Distribution:	Native throughout most of Europe and western North America, and also northwest Africa.
Habit:	Perennial, submerged water plant.
Habitat:	Ditches, ponds, ditches, alder swamps. Often also on wet ground.



Native/Exotic:
Exotic

Flowers:
The flowers are white petaled with yellow centres and are held a centimetre or two above the water.

Fruits:
The flower center expands to a round to oval seed head, the seeds smooth to roughly hairy and with a beak almost as long as the seed body.

Phenology:
March to August

Ecological role:
Can clog water bodies if left unchecked.

Local usage:
The entire plant is boiled and eaten.

Hydrophytic adaptations:
Branching thread- like underwater leaves and toothed floater leaves. The floater leaves are used as props for the flowers and are grown at the same time.

Bioindicator:
Can be used to detect water quality and physio-chemical properties.

Control measures:
Mechanical and manual removal.

IUCN status:
Least concern

Urticularia australis R. Br.

Vernacular name:	Jhangi
Common name:	Aquatic bladderwort
Family:	Lentibulariaceae
Genus:	*Urticularia*
Species:	*australis*
Distribution:	Has a vast geographic range, being found throughout Europe, in tropical and temperate Asia, Central and Southern Africa, Australia and the North Island of New Zealand.
Habit:	Suspended aquatic rootless carnivorous plant.
Habitat:	Submerged aquatic plant.

Native/Exotic:
Native

Flowers:
Inflorescence 3-8 flowered; 1.2-2 cm long, yellow with reddish brown lines and spots on the darker lower lip.

Fruits:
Capsules apparently never produced.

Phenology:
August to January

Ecology:
If left unchecked, their growth can choke water bodies.

Local usage:
Recorded to be edible and high in nutrients.

Bioindicator:
Acidic water, low aquatic inorganic phosphorus but higher nitrogen conditions.

Control measures:

Mechanical:
Seining

Manual:
Raking and Hand pulling.

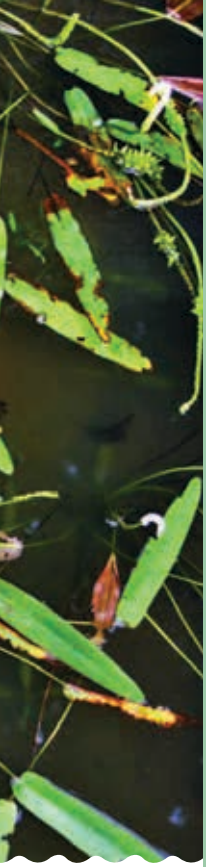
IUCN status:
Least concern

SOME PLANT PARTS ARE FLOATING WHEREAS THEY ARE TYPICALLY ARE ANCHORED IN THE MUDDY SOIL AT THE BOTTOM OF THE PONDS AND LAKES.

FLOATING-ROOTED HYDROPHYTES

Aponogeton natans
(L.) Engl. & K. Krause

Vernacular name:	Neeru balli, Neeru kasa, Kotti, Ghenchu
Common name:	Floating Lace Plant, Drifting swordplant.
Family:	Aponogetonaceae
Genus:	*Aponogeton*
Species:	*natans*
Distribution:	Native to India, Sri Lanka, Bangladesh and Myanmar.
Habit:	Aquatic floating herb
Habitat:	Free-Floating



Native/Exotic:
Native

Flower:
Spike 3-7 cm, densely covered with white-lavender flowers.

Fruit:
Globose, smooth, sharply beaked.

Phenology:
Throughout the year.

Ecological role:
They choke up the water body and responsible for reducing dam productivity. They cause loss of water through eva - transpiration, in addition cause impediment in flow of water.

Local use:
Is a popular plant for use in aquariums. Leaf pastes are consumed with hot water to treat cuts & wounds. Fresh tuber is grounded into a paste and boiled with coconut oil and applied on hair before bath to get rid of fungal infection.

Hydrophytic adaptations:
The palisade cells are cylindrical and loosely arranged. Below the palisade region, the abaxial part consists of wide reticulation of circular air chambers.

Bioindicator:
Heavy metal concentration.

Control measures:
Manual and mechanical removal from the surface. Raking the surface of the water or seining the plants off with large nets.

IUCN status:
Least concern

Nelumbo nucifera Gaertn.

Vernacular name:	Padma or Kamal
Common name:	Lotus, National flower
Family:	Nelumbonaceae
Genus:	*Nelumbo*
Species:	*nucifera*
Distribution:	Originated from continental Asia (possibly India), but is now widely distributed (wild or cultivated) from north-eastern Africa to north-eastern Australia, including South-East Asia, China and Japan.
Habit:	Aquatic perennial plant
Habitat:	Floating but rooted

Native/Exotic:
Native

Flowers:
Large, cupped, fragrant, pink or white flowers.

Fruit:
Nut-like fruits

Phenology:
Flowering occurs during July to September and fruit ripen in November to December.

Ecological role:
Varied phytofauna associated with this wetland plant including annelids, arthropods show affinity towards the plant. The associated fauna was observed to utilise the plant for feeding/grazing, gliding, oviposition, pupation etc. An asset in the fresh water ecosystems as it promotes species density and diversity. It is known to possess a great medicinal and food value. Besides this, it also acts as a natural water filter and home/shelter for wildlife.

Local usage:
Associated with mother goddesses as a symbol of fertility. Cultural and ornamental value, but also for medicinal uses and for its edible 'seeds' and rhizomes. The young leaves, leaf stalks and flowers are eaten as vegetables.

Hydrophytic adaptations:
Leaves very wide and disc shaped allowing them to float on water and absorb large amount of sunlight. The stem and leaf surfaces are coated with a wax which is very difficult to wet.

Bioindicator:
Indicates less amounts of Nitrogen, phosphorus, Mercury, sewage effluents etc. Its growth indicates clean water with high dissolved oxygen.

IUCN status:
Data deficient

Ipomoea aquatica Forssk.

Vernacular name:	Nali, Kalmi sag, Nalichi- bhaji
Common name:	Water morning glory, Swamp morning glory
Family:	Convolvulaceae
Genus:	*Ipomoea*
Species:	*aquatica*
Distribution:	Tropical areas, Sub-tropical Asia
Habit:	Semi-aquatic climber
Habitat:	Rooted-Floating

Native/Exotic:
Native

Flowers:
White, Purple, Blue, trumpet-shaped.

Fruits:
Capsular, Globose to ovoid.

Phenology:
January to December

Ecological role:
Has potential to harm natural ecosystems, rice and sugarcane production, irrigation systems, and navigation and recreation.

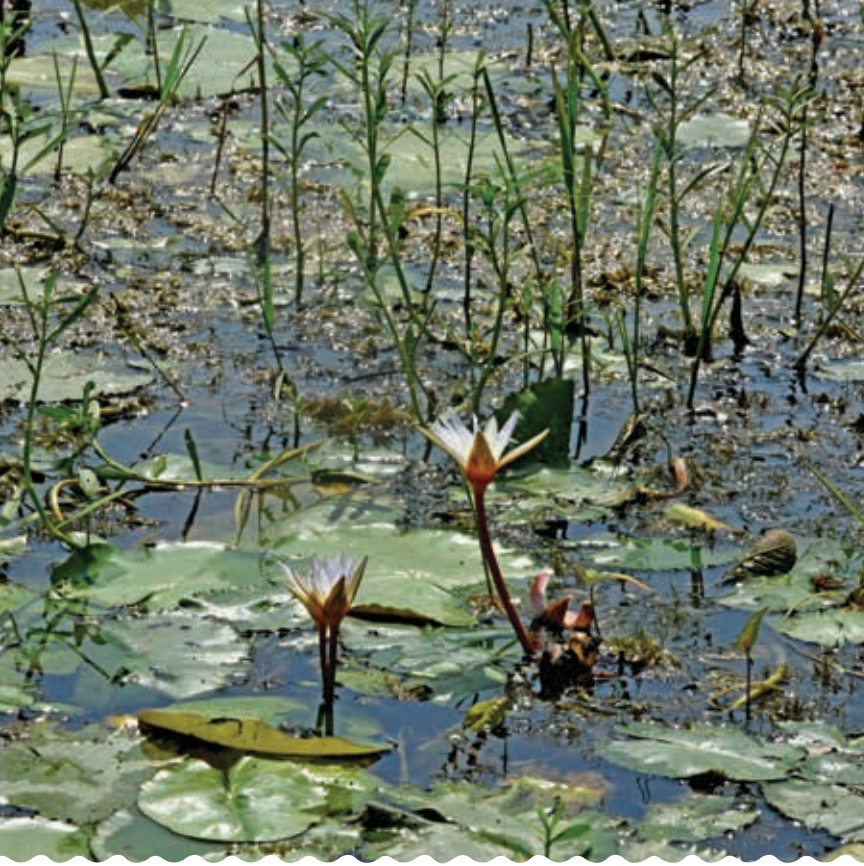
Local usage:
Very useful vegetable crop in tropical countries. Fodder for cattle and pigs.

Hydrophytic adaptations:
Round, hollow stems and petiolate.

Bioindicator:
Heavy metals

Control measures:
Manual removal, successful only if all plant parts with nodes are removed and destroyed. Containments and eradication of incipient infestations can also provide useful.

IUCN status:
Least concern



Nymphaea nouchali Burm. f.

Vernacular name:	Aambal; Alli, Kumud
Common name:	Water Lily
Family:	Nymphaeaceae
Genus:	*Nymphaea*
Species:	*nouchali*
Distribution:	Cosmopolitan
Habit:	Aquatic plant
Habitat:	Floating but rooted

Native/Exotic:
Native

Flowers:
Beautiful flower violet blue in colour with reddish edges. Some varieties have white, purple, mauve, or fuchsia-colored flowers, hence its name red and blue water lily.

Fruit:
The fruit is usually nutlike or berrylike.

Phenology:
August to December

Ecological role:
They create food and shelter (for invertebrates like pond snails, fish and frogs and newts) for both aquatic and non-aquatic wildlife.

Local usage:
Is used as an ornamental plant because of its spectacular flower and is considered a medicinal plant in Indian Ayurvedic medicine under the name ambal. Mainly used to treat indigestion. Potato-sized rhizomes have been eaten as a famine food or as a medicinal.

Hydrophytic adaptations:
Leaves are very wide and disc shaped. This allows them to float on water

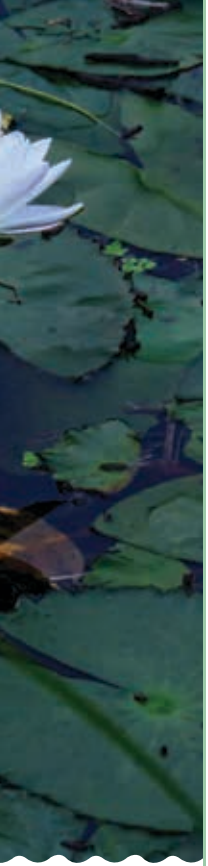
Bioindicator:
Neutral to slightly alkaline pH, mesotrophic and oligotrophic waters.

Control:
Populations can be removed by digging; however, all tubers must be removed to prevent regrowth.

IUCN status:
Least concern

Nymphaea pubescens Willd.

Vernacular name:	Shaluk, Kannaidile, Nal, Koka.
Common name:	Water lily
Family:	Nymphaeaceae
Genus:	*Nymphaea*
Species:	*pubescens*
Distribution:	Throughout temperate and tropical Asia.
Habit:	Aquatic plant
Habitat:	Rooted-floating



Native/Exotic:
Native

Flowers:
Quite large, White to pink, 12-14 petals.

Fruits:
Berry, 3.5-5 cm, globose, maturing under the water.

Phenology:
June to October

Ecological role:
Pollination is entomophilous i.e., by insects making them dependent on the plant for food.

Local usage:
As a source of food and medicines, whilst it is also widely grown as an ornamental plan. It is used in dysentery, cough, vomiting, fever, gall and heart diseases.

Hydrophytic adaptations:
Its leaf blades are round above the water; toothed leaves are papery and have fine hair on them.

Bioindicator:
Heavy metals

Control measures:
Rhizome uprooting manually and mechanically.

IUCN status:
Least concern

Nymphoides cristata
(Roxb.) Kuntze

Vernacular name:	Kumudini, Pan chuli
Common name:	Crested Floating-heart
Family:	Menyanthaceae
Genus:	*Nymphoides*
Species:	*cristata*
Distribution:	China, India
Habit:	Standing water herb
Habitat:	Floating-rooted

Native/Exotic:
Native

Flowers:
Flowers are white, with membranous margins.

Fruits:
The fruit is a capsule bearing many flattened seeds.

Phenology:
August to October

Ecological role:
Outside their native range they can escape cultivation and become nuisance weeds.

Local usage:
Its slim stem (spear) is edible, and is used as vegetable. The plants are commonly sold for use in ornamental water gardens.

Hydrophytic adaptations:
Large heart shaped buoyant leaves.

Bioindicator:
Trophic status of water bodies.

Control Measures:
Prevention typically include measures such as quarantines, bans on sale and importation, and creating public awareness in stopping the spread of a species or new infestations.

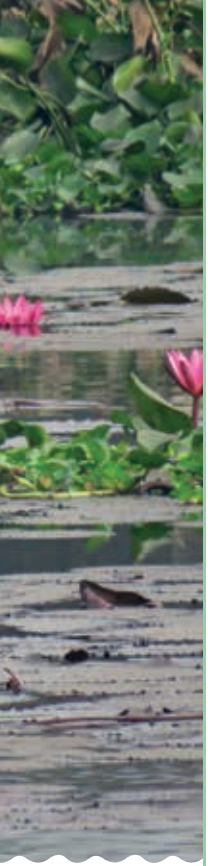
Mechanical control:
Dredges, harvesters and cutter/shredder boats.

IUCN status:
Least concern

Nymphaea rubra

Roxb. ex Andrews

Vernacular name:	Laal Shapla, Kokaa, Laal kamal
Common name:	Red water lily
Family:	Nymphaeaceae
Genus:	*Nymphaea*
Species:	*rubra*
Distribution:	Native to India. It is widely cultivated in other countries.
Habit:	Aquatic plant
Habitat:	Floating but rooted



Native/Exotic:
Native

Flowers:
Intensely red or rose-coloured.

Fruits:
Globose berry

Phenology:
All year

Ecological role:
Pollination is entomophilous. Shelter for aquatic animals.

Local usage:
Used as an ornamental plant and also as a source of food in some local communities. Stem and leaves are consumed as vegetables.

Hydrophytic adaptations:
Large floating, toothed leaves that are water repellent.

Bioindicator:
Urban air pollution.

Control measures:
Manually and mechanically uprooting the rhizomes and stolons.

IUCN status:
Least concern

Nymphoides indica (L.) Kuntze

Vernacular name:	Kumudini, Chandmala
Common name:	Water snowflake, Robust marshwort
Family:	Menyanthaceae
Genus:	*Nymphoides*
Species:	*indica*
Distribution:	Native to tropical areas around the world.
Habit:	Aquatic plant
Habitat:	Floating-rooted

Native/Exotic:
Native

Flowers:
White, 6-petals.

Fruits:
Capsules, elliptic.

Phenology:
April to October

Ecological role:
Minor weed. Form a dense mat displacing native species, reducing biodiversity, decreasing water quality, impeding recreational activities.

Local usage:
Ornamental species.

Hydrophytic adaptations:
Flat, rounded, floating leaves.

Bioindicator:
Contaminated aquatic environments.

Control measures:
Recreationists drain all water and clean off all gear to minimise spread. Hand raking can be effective.

IUCN status:
Least concern

Euryale ferox Salisb.

Vernacular name:	Makhana
Common name:	Prickly waterlily, Gorgon Plant
Family:	Nymphaeaceae
Genus:	*Euryale*
Species:	*ferox*
Distribution:	Native to eastern Asia and southern Asia, and is found from northeast India to Korea and Japan, as well as parts of eastern Russia.
Habit:	Prickly aquatic plant
Habitat:	Submerged-Floating

Native/Exotic:
Native

Flowers:
Cup-shaped, deep violet with an outer row of white petals.

Fruits:
Soft and pulpy, about the size of a small orange.

Flowering - Fruiting:
March to September

Ecological role:
Insect pollinated bright coloured flowers.

Local use:
Makhana are used in traditional medicines to treat and cure various diseases, including chronic diarrhoea, spleen disorders and excessive leucorrhea, diabetes and kidney problems. It is considered a good food for babies and invalids. They help in reducing inflammation and thus reduce the chances of cardiovascular diseases in the body. They also act as aphrodisiac

Hydrophytic adaptations:
Leaves are large and round, often more than a meter (3 feet) across helps to float on surface.

Bioindicator:
Heavy metals

Control measures:
Manually and mechanically.

IUCN status:
Least concern

Marsilia quadrifolia L.

Vernacular name:	Sushni
Common name:	Water clover
Family:	Marsiliaceae
Genus:	*Marsilea*
Species:	*quadrifolia*
Distribution:	It is one of the most widely distributed among ferns. But the genus has a preference to the warmer parts of the world.
Habit:	Aquatic, rooted with floating leaves.
Habitat:	Ponds, ditches and paddy fields and Shallow water of lakes, ponds, or quiet sections of rivers and streams and on wet shores.

Native/Exotic:
Native (Introduced)

Flowers and Fruit:
Reproduces through spores. Spores are located in hard-shelled cases near the rhizomes.

Phenology:
Non-flowering

Ecological role:
It has been labelled as 'Invasive' in many countries, and has become a major weed of paddy fields and a troublemaker in ponds, lakes and irrigation systems.

Local usage:
A famine food, only used in times of scarcity. The plant is anti-inflammatory, diuretic, depurative, febrifuge and refrigerant.

A juice made from the leaves is diuretic and febrifuge. The plant is also applied externally in the treatment of snakebites and skin injuries, including abscesses.

Hydrophytic adaptations:
Thin green stalks rise from the rhizome to the water surface, each stalk bearing a single shamrock-like leaf with four wedge-shaped floating leaflets.

Bioindicator:
Indicates eutrophication of water bodies.

Control measures:
Treatment options may include herbicide and hand-pulling.

IUCN status:
Least concern

AMPHIBIOUS/RIPARIAN HYDROPHYTES

PLANTS IN THIS GROUP GROW IN SHALLOW WATER WITH THEIR UNDERGROUND PARTS IN WATER OR IN WATER- SATURATED MUDDY SOIL, WHILE EXTENDING THEIR SHOOTS WELL ABOVE THE SURFACE OF WATER

Persicaria hydropiper
(L.) Delarbre

Vernacular name:	Bishkatal; Packurmul
Common name:	Marsh pepper
Family:	Polygonaceae
Genus:	*Persicaria*
Species:	*hydropiper*
Distribution:	*P. hydropiper* is most commonly reported from the USA, China, India, Taiwan and Japan.
Habit:	Weed of wet places
Habitat:	Shallow water in ponds, ditches etc and in wet places on land

Native/Exotic:
Native

Flowers:
The inflorescence is a nodding spike. Each tiny flower consists of four or five segments, united near its green base and white or pink at the edges.

Fruit:
Dark brown oval, flattened nut.

Phenology:
Flowering in May-August and bears fruits in July-September

Ecological role:
Infests grain, tilled and flax crops, growing on wet soils, it may occur in irrigated crops. It often grows on unimproved lands. Admixture of the smart weed seeds to the grain decreases the quality of flour.

Local use:
Leaves of Water-pepper have a strong peppery taste and have been used in oriental spice mixtures and, in small quantities, in salads.

Medicinal properties have been claimed for extracts from *Persicaria hydropiper*, and its acidic juices can be used to dye wool yellow.

Hydrophytic adaptations:
Hollow stem

Bioindicator:
Heavy metals

Control:
Plants should be hand-pulled or mechanically controlled before flowering. They must be either uprooted or buried, as simply breaking the stem will result in resprouting at the soil surface.

Beetle *Gastrophysa atrocyanea* has been shown to damage this species in trials against *Rumex japonicus* (Xiaoshui, 1991).

IUCN status:
Least concern

Persicaria barbata (L.) H.Hara

Vernacular name:	Bekh-unjubaz, Rukji, Bish
Common name:	Bunchy sedge, Field sedge, Bearded knotweed
Family:	Polygonaceae
Genus:	*Persicaria*
Species:	*barbata*
Distribution:	S.E. Asia, Malesia to tropical Australia. Tropical Africa.
Habit:	Aquatic erect herb
Habitat:	Rooted

Native/Exotic:
Native

Flowers:
Terminal spike, stalked, white or pink.

Fruits:
Nuts

Phenology:
January to December

Ecological role:
The whole plant is used as a fish poison.

Local usage:
Gathered from the wild and used locally as a food and medicine. The seeds are used to relieve the griping pains of colic. The root is astringent and cooling.

Hydrophytic adaptations:
Stems erect or procumbent, round, hollow.

Bioindicator:
Heavy metals

Control measures:
Plants should be hand- pulled or mechanically controlled.

IUCN status:
Least concern

Pontederia vaginalis

Burm. f.

Vernacular name:	Bhat-meteka; Bih-meteka; Gachli; Garoposki; Jonakiphul; Junaki-phul; Launkia; Nukha; Pani-meteka
Common name:	Hastate-leaved pondweed
Family:	Pontederiaceae
Genus:	*Pontederia*
Species:	*vaginalis*
Distribution:	Occur throughout Indonesia, at a wide range of altitudes and probably in all districts of Bhutan throughout India, from Kashmir to Assam and in East, Central and South China.
Habit:	Tropical aquatic herb
Habitat:	Amphibious rooted

Native/Exotic:
Native

Flowers:
The flowers are 13-16 mm long, purple or whitish. One anther is coloured blue.

Fruit:
A loculicidally dehiscent capsule.

Phenology:
November to March

Ecological role:
Noxious Weed.

Local usage:
Plant is considered alterative, tonic and cooling. Juice of leaves is applied to boils. Rhizomes are powdered with charcoal and used for scurf.

Hydrophytic adaptations:
The leaves are floating and the petioles are soft and hollow.

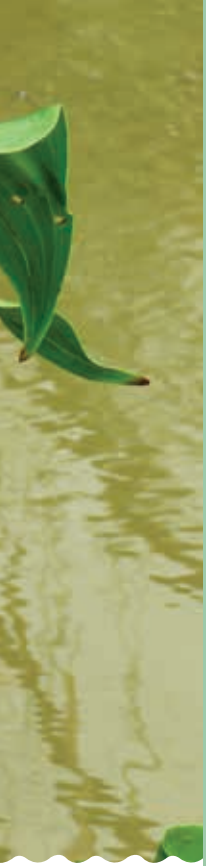
Bioindicator:
Heavy metals

Control measures:
It is not difficult to remove by hand, but requires persistence to remove successive flushes of germination. A single weeding or herbicide treatment after the germination flush could give season-long control.

IUCN status:
Least concern

Pontederia hastata L.

Vernacular name:	Junaki-phul
Common name:	Heartshape false pickerelweed, oval-leafed pondweed.
Family:	Pontederiaceae
Genus:	*Pontederia*
Species:	*hastata*
Distribution:	South-East Asia and Oceania.
Habit:	Aquatic-herb
Habitat:	Amphibious-Rooted



Native/Exotic:
Native

Flowers:
Each with 6 purple-blue tepals.

Fruits:
Capsule

Phenology:
August to March

Ecological role:
It is invasive in rice paddies and other water bodies.

Local usage:
Entire plant eaten as a vegetable and roots are used medicinally for treatment of nausea, toothache, itching, asthma, coughs, cold, fever, stomach and liver problems, general debility, haemorrhage, hepatitis, anaemia, scurvy and diabetes.

Hydrophytic adaptations:
Petioles soft and hollow. Leaves light weighted.

Bioindicator:
Heavy metals

Control measures:
The use of herbicides can the incidence of weed.

IUCN status:
Least concern

Nasturtium officinale

W. T. Aiton

Vernacular name:	Chhuch, Jal-indushoor
Common name:	Watercress
Family:	Brassicaceae
Genus:	*Nasturtium*
Species:	*officinale*
Distribution:	Watercress commonly occurs throughout the United States, southern Canada, Europe and Asia. It's actually native to Europe and Asia and naturalized elsewhere.
Habit:	Semi-aquatic herb
Habitat:	Riparian

Native/Exotic:
Native

Flowers:
Small, white, and green flowers are produced in clusters, each flower with four white petals.

Fruit:
The straight or slightly curved fruit (i.e., siliquae) resemble small pods.

Phenology:
June to September

Ecological role:
Regarded as an environmental weed.

Local usage:
Watercress is an edible green with a peppery flavor that is commonly used in salads, as a garnish, or cooked, and which contains significant amounts of iron, calcium and folic acid, in addition to vitamins A and C. Acts as a mild stimulant, a source of phytochemicals and antioxidants, a diuretic, an expectorant, and a digestive aid.

Hydrophytic adaptations:
A hollow succulent stem allows the plant parts to float on water surface. Fragments are dispersed unintentionally by wind, water, and animals.

Bioindicator:
Associated with nutrient-rich waters and very high concentrations of nutrients, particularly nitrogen.

Control measures:
Manual removal recommended for small populations. A non-selective compound glyphosate will provide some control but will harm other plant species if it comes in contact and in flowing water will not be effective. Glyphosate-isopropyl amine has shown control of the species and studies have indicated that the product had no significant adverse effects on wildlife, fish and aquatic micro-organisms.

IUCN status:
Least concern

Veronica anagallis-aquatica L.

Vernacular name:	Sada, Sadevi
Common name:	Water speedwell
Family:	Plantaginaceae
Genus:	*Veronica*
Species:	*anagalis-aquatica*
Distribution:	Native to Europe, Asia, and Africa; now widely naturalized in the New World.
Habit:	Semi-aquatic
Habitat:	Shallow water along streambanks, in ponds, and in other wetland environments.

Native/Exotic:
Native

Flowers:
The inflorescence is a raceme Each flower is borne on a short, curving pedicel. It is blue, lavender, or violet with purple lines near the base of each lobe.

Fruit:
Fruit is a capsule, swollen, 2.5-4 mm long.

Phenology:
June to September

Ecological role:
It is regarded as an environmental weedd is thought to be a potential threat to one or more vegetation formations.

Local usage:
Leaves - raw or cooked. Rich in vitamin C, the leaves can be added to salads or used as a potherb. The root and the leaves are alterative, appetizer and diuretic. The leaves are used in the treatment of scurvy, impurity of the blood etc. The plant is bruised and applied externally as a poultice on burns, ulcers, whit lows, etc.

Hydrophytic adaptations:
The smaller internodes, leaf area, and thickness of submerged plants at high velocity apparently confer greater flexibility to the stem, allowing it to withstand the associated pulling forces of the water.

Bioindicator:
Metal accumulation

Control measures:
Application of 2,4-D in cereals and in playgrounds and lawns. Controlled with paraquat in uncultivated areas and orchards.

IUCN status:
Least concern

Phragmites karka

(Retz.) Trin. ex Steud.

Vernacular name:	Narkul, नाल Nal, Doka- ghas
Common name:	Tall Reed
Family:	Poaceae
Genus:	*Phragmites*
Species:	*karka*
Distribution:	Distributed from Africa through India and South-East Asia to Australia and Oceania.
Habit:	Reed
Habitat:	Warm swampy valleys and river banks. Often grows in swamps and standing water it is not so sensitive to rainfall.

Native/Exotic:
Native

Flowers:
Flowers are borne in panicles, brownish purple.

Fruit:
Fruit is a caryopsis with an adherent pericarp.

Phenology:
April to November

Ecological role:
It can be planted by rivers as a means of protecting the soil from erosion and can also be planted in beds in order to purify water.

Local usage:
Young shoots - cooked. They can be eaten like asparagus or bamboo sprouts. The panicles can be arranged in a fan-like manner form a broom, whilst the culms are tightly bound to a central strengthening piece of bamboo to form a handle. The stems have been used for weaving coarse hats, mats, hurdles etc.

Hydrophytic adaptations:
The plant has a dense root system and is an excellent species for planting by water to protect the land from erosion.

Bioindicator:
Freshwater

Control measures:
Initial herbicide treatment, such as prescribed fire, followed by mechanical treatment, or water level management. Creating stresses through a regime of multiple treatments on the plants is the most effective way to control Phragmites.

IUCN status:
Least concern

Typha angustifolia L.

Vernacular name:	Cumbungi
Common name:	Lesser bulrush, Narrow leaf cattail or lesser reedmace
Family:	Typhaceae
Genus:	*Typha*
Species:	*angustifolia*
Distribution:	It is commonly found in the northern hemisphere in brackish locations.
Habit:	Herbaceous plant
Habitat:	Common cattail is a marsh plant and so grows best in extremely moist environments including freshwater marshes, ditches, and shorelines.

Native/Exotic:
Native

Flowers:
Brown, fluffy, sausage-shaped flowering heads

Fruit:
Fusiform

Phenology:
June to August

Ecological role:
It is a competitive species occurring in aquatic to wetland habitats.

Local usage:
Several parts of the plant are edible.

Hydrophytic adaptations:
Large underwater/underground rhizomes and clonal growth pattern that allow for quick and dense proliferation

Bioindicator:
Metal pollution.

Control measures:
Reduce the water level during the growing season for mowing or hand pulling. Grazing by ungulates has been shown to help reduce stand densities.

IUCN status:
Least concern

Sagittaria sagittifolia L.

Vernacular name:	Paani kachu
Common name:	Broadleaf arrowhead
Family:	Alismataceae
Genus:	*Sagittaria*
Species:	*sagittifolia*
Distribution:	Native to wetlands most of Europe from Ireland and Portugal to Finland and Bulgaria, and in Russia, Ukraine, Siberia, Japan, Turkey, China, India, Australia, Vietnam and the Caucasus.
Habit:	Erect emergent aquatic plant, an obligate wetland species

Habitat:
Forming colonies in shallow waters, in long bands following the curves of rivers, ponds and lakes. It is also found in ditches, in open woodlands that are prone to frequent flooding, in swamps, marshes, bogs, seeps and freshwater wetlands, stream-sides, ditches, floodplains, low-lying areas with wet mud.

Native/Exotic:
Native

Flowers:
Flowers have showy, white petals and are arranged in a whorled raceme.

Fruit:
Clustered, winged achenes.

Phenology:
April to September

Ecological role:
Tubers of this Genus are planted extensively to restore and create wetlands. They provide food for many waterfowl, shorebirds, and geese. Beaver, porcupine, and muskrat consume the entire plant, while Canadian Geese are partial to the tubers. This species has been used in wastewater treatment systems for the removal of dissolved nutrients.

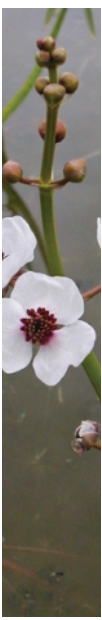
Local usage:
These tubers can be eaten raw or cooked. Plant is used in Chinese medicines.

Hydrophytic adaptations:
The plant has strong roots and can survive through wide variations of the water level, slow currents and waves.

Bioindicator:
Displays an affinity for high levels of phosphates and hard waters. a bioindicator of nitrogen (N) and phosphorus (P).

Control measures:
Manual or mechanical.

IUCN status:
Least concern



Phyla nodiflora (L.) Greene

Vernacular name:	Bukkan, Jal buti, Jal pippali
Common name:	Frog fruit, Sawtooth fogfruit, Turkey tangle
Family:	Verbenaceae
Genus:	*Phyla*
Species:	*nodiflora*
Distribution:	Succeeds in wide range of habitats from the subtropics to the tropics. In India, it occurs in almost all states at lower elevations.
Habit:	Prostrate herbs.
Habitat:	It grows in a groundcover or turflike manner, and is often present in yards. Moist ground, pond, ditches, puddles, marshes swamps.

Native Exotic:
Native

Flowers:
The inflorescence consists of a purple centre encircled by small white-to-pink flowers.

Fruit:
Consists of two small nutlets found within a persistant calyx.

Phenology:
Can flower and produce fruit all year round.

Ecological role:
Attracts numerous insect pollinators especially honeybees. Creeps along the ground, forming roots as it spreads, and often forming large mats or colonies keeping the soil system intact. It can be used to control water and wind erosion.

Local usage:
Plant decoction is given in uremia. Fresh juice is applied to bleeding gums. Infusion of leaves and tender stalk is given to children in indigestion and to women after delivery. It is sometimes cultivated as an ornamental plant and ground cover

Hydrophytic adaptations:
Tolerates drought and flooding. Will go dormant during hard winters. The plant spreads rapidly by means of running stems and can carpet large areas

Bioindicator:
Nitrate rich soils

Control measures:
Apply mulch around flowers and ornamentals in a layer that is at least 2 inches thick to block the light that match weed needs for growth. When matchweed plants are young or actively growing -- typically in the four-leaf to flower growth stage -- they take up the herbicide readily and the roots systems are weakened as a result

IUCN status:
Least concern

Ranunculus sceleratus L.

Vernacular name:	Shim, Aglaon
Common name:	Celery-leaved buttercup
Family:	Ranunculaceae
Genus:	*Ranunculus*
Species:	*sceleratus*
Distribution:	It has a circumpolar distribution in the northern hemisphere, native to temperate and boreal North America and Eurasia.
Habit:	Annual semi-aquatic herb
Habitat:	Cursed Crowfoot appears to favor degraded wetlands, amphibious environments with a history of disturbance.

Native/Exotic:
Native

Flowers:
The yellow flowers are 5-10 mm across with five or fewer yellow petals a few millimetres long and reflexed sepals.

Fruit:
Achene borne in a cluster of several

Phenology:
May to September

Ecological role:
Primarily short-tongued bees, flies, and beetles visit the flowers for nectar or pollen. Buttercups are also host plants for such aphids The seed heads are probably a minor source of food to some species of waterfowl and small rodents.

Local use:
When the leaves are wrinkled, damaged or crushed, they bring out unsightly sores and blisters on human skin.

Hydrophytic adaptations:
This plant grows readily in shallow water, but it will tolerate occasional droughts that cause the surface water to evaporate. The foliage is rarely bothered by insects or disease.

Bioindicator:
Heavy metal pollution

Control measures:
Can be controlled manually, mechanically or herbicidally depending on situation.

IUCN status:
Least concern

Stellaria media (L.) Vill

Vernacular name:	Buch-bucha, Safed Phulke, Badyalu
Common name:	Common chickweed, Chickenwort, Craches, maruns, and Winter weed.
Family:	Caryophyllaceae
Genus:	*Stellaria*
Species:	*media*
Distribution:	It is native to Eurasia and naturalized throughout the world.
Habit:	Annual and perennial flowering semi- aquatic herb
Habitat:	It will grow on a very wide range of substrates, but prefers moist, fertile soils with a neutral pH and good aeration.

Native/Exotic
Native

Flowers:
Flowers are white and small with five very deeply lobed petals.

Fruit:
Fruit is a dehiscent capsule, ovoid.

Phenology:
May to October

Ecological role:
Contains plant chemicals known as saponins, which can be toxic to some species (notably fish). *S. media* is also, an alternative host for a number of economically important pathogens that attack a range of crop plants. A large number of nematode species which carry viral diseases are associated with *S. media*. Large mats help in erosion control or dune stabilization.

Local use:
This species is used as a cooling herbal remedy, and grown as a vegetable crop and ground cover for both human and poultry consumption. It has been used as a remedy to treat itchy skin conditions and pulmonary diseases

Hydrophytic adaptations:
Its seeds can survive in the soil for over fifty years making it nearly impossible to eradicate.

Bioindicator:
High fertility

Control measures:
S. media has an unprotected growing point, and as such, is susceptible to flame weeding. Integrated approach for weed management involving competitive crop varieties, high crop densities and increased N fertilization have been successful in suppressing weed populations.

IUCN status:
Not Evaluated

Grangea maderaspatana
(L.) Poir.

Vernacular name:	Mustaru, Bhediachim, Leibungou
Common name:	Madras Carpet
Family:	Asteraceae
Genus:	*Grangea*
Species:	*maderaspatana*
Distribution:	This species grows commonly in moist places in warm temperate to tropical areas. It is widely distributed throughout India and Nepal.
Habit:	Herb
Habitat:	Marshy areas, bunds of fields and sandy river beds.

Native/Exotic:
Native

Flowers:
The solitary flower heads are 6-8 mm (0.24-0.31 in) in diameter, with yellow florets.

Fruit: Achenes, pale brown and compressed.

Phenology:
December to May

Ecological role:
It is a type of weed that is found near the wetlands. Common weed of rice- fields, wastelands and meadows.

Local usage:
Leaves are regarded in India as a valuable stomachic possessing de-obstruent and antispasmodic properties, and are prescribed as an infusion and an electuary in cases of obstructed menses and hysteria.

Bioindicator:
Quality of water

Control measures:
Hand weeding most common and effective method whereas mechanical weed control methods are easy to perform.

IUCN status:
Least concern

Pseudognaphalium luteoalbum
(L.) Hilliard & B. L. Burtt.

Vernacular name:	Kubi
Common name:	Weedy Cudweed, Jersey Cudweed, Everlasting Cudweed
Family:	Asteraceae
Genus:	*Pseudognaphalium*
Species:	*luteoalbum*
Distribution:	Widely distributed in all temperate and tropical areas.
Habit:	Spreading perennial herb
Habitat:	Erect herbaceous biennial

Native/Exotic:
Native

Flowers:
Inflorescences formed small yellow clusters, grouped in simple or compound corymbs. The flowers are small, numerous and usually yellow.

Fruit:
Papillate; pappusbristles loosely coherent, shed in clusters or easily fragmented rings.

Phenology:
March to August.

Ecological role:
Common weed of rice-fields, wastelands.

Local use:
The plant is used as a food ingredient, it has also been used in traditional medicine of the region, asadiuretic, haemostatic, antipyretic, for the treatment of cough, and for pain relief.

Hydrophytic adaptations:
The leaves have a waxy coating and can survive frozen over in winter.

Bioindicator:
Eutrophication

Control measures:
Propermowing, watering, fertilizing, and maintenance will be the best method to combat the spread of cudweed.

IUCN status:
Least concern

Ipomoea carnea Jacq.

Vernacular name:	Behaya
Common name:	Pink morning glory
Family:	Convolvulaceae
Genus:	*Ipomoea*
Species:	*carnea*
Distribution:	It is mainly distributed in tropical and warm temperate regions of the world. Naturalised distribution (global).
Habit:	Shrub
Habitat:	Along river beds, river banks, canals and other waterlogged (wetland) areas.

Native/Exotic:
Exotic

Flowers:
4-inch pink flowers all spring and summer long.

Fruit:
Ovoid (oval), glabrous, capsule-like, non-fleshy, dehiscent, up to 2 cm long and 1.5 cm wide, pale brown when ripe.

Phenology:
Around the year.

Ecological Role:
Are slightly purgative and considered to be toxic to livestock

Local usage:
The stem of *I. carnea* can be used for making paper. The plant is also of medicinal value. It contains a component identical to marsilin, a sedative and anticonvulsant. A glycosidic saponin has also been purified from *I. carnea* with anticarcinogenic and oxytocic properties

Hydrophytic adaptations:
It is a strong competitor for resources (e.g., nutrients and water), with the potential to outcompete native plants.

Bioindicator:
Polluted environment.

Control measures:
I. carnea can be effectively controlled by mowing plants in the early dry season, when their production and capability to resprout are reduced *I. carnea* seeds are heavily infested by the beetle *Megacerus flabelliger*, which has been suggested as a biological control agent in areas where this plant is a troublesome weed.

IUCN status:
Not Evaluated

Fimbristylis dichotoma (L.) Vahl

Vernacular name:	Eight-day grass
Common name:	Forked fimbry, Eight-day grass
Family:	Cyperaceae
Genus:	*Fimbristylis*
Species:	*dichotoma*
Distribution:	*F. dichotomais* widely distributed in Asia, Africa and Australia as well as in other parts of the tropics.
Habit:	Tall grasses/Sedges

Habitat:
F. dichotoma grows well on wet or even flooded soil; it is also found in uplands where the soil has good water retention. It is also found in swamps, open waste places, grassy roadsides, grasslands and some plantation crops.

Native/Exotic:
Native

Flowers:
Inflorescence a simple or compound, loose or dense umbel.

Fruit:
Obovate to broadly obovate nutlet.

Phenology: June to November

Ecological Role:
F. dichotoma an aggressive invader in favourable environments. It is most noted as a weed of paddy rice. Plants can clog canals, affecting water flow. It has the capacity to choke other species, altering the local flora.

Local usage:
Cattle may graze on *F. dichotoma* but it has low nutritional value. It is considered a poor green manure crop and has been used to make inferior mats.

Bioindicator:
Eutrophication and pollution

Control measures:
Use of competitive varieties (fast growing, tall and leafy varieties. Hand-pulling and Inter-row cultivation is an effective, though somewhat laborious, method of control.

IUCN status:
Least concern

Cyperus rotundus L.

Vernacular name:	Bara-nagar-motha, Korehi- jhar, Deela; Gantola;
Common name:	Coco-grass, Java grass, Nut grass, purple nut sedge
Family:	Cyperaceae
Genus:	*Cyperus*
Species:	*rotundus*
Distribution:	Worldwide distributionin tropical and temperate regions.
Habit:	Tall Grasses-Sedges
Habitat:	Prefers dry conditions, but will tolerate moist soils and often grows in wasteland and in crop fields.

Native/Exotic:
Native

Flowers:
The flower is bisexual and has three stamina and a three-stigma pistil, with the inflorescence having three to eight unequal spikes.

Fruit:
The fruit is a three-angled achene.

Phenology:
June to October

Ecological use:
Its existence in a field significantly reduces crop yield, both because it is a tough competitor for ground resources, and because it is allelopathic, the roots releasing substances harmful to other plants. Tubers can survive harsh conditions, further contributing to the difficulty to eradicate the plant.

Local usage:
It is a staple carbohydrate in tropical regions for recent hunter-gatherers and is a famine food in some agrarian cultures. The well dried coco grass is used in mats for sleeping.

Bioindicator:
Heavy metals

Control measures:
Integrated control, such as crop rotations (Rambakudzibga, 1999) should be considered as part of the management strategy.

Mowing 1-3 times a week reduces shoot and tuber populations on recreational turf grass. Organic mulch made from crop residues, such as coir dust (Van Mele et al., 1996) provides temporary suppression of *C. rotundus*.

IUCN status:
Least concern

Lysimachia arvensis var caerulea Turland & Burgmeier

Vernacular name:	Biliputi (Punjabi); Krishnaneel
Common name:	Poor man's barometer, Poor man's weather-glass, Shepherd's weather glass or Shepherd's clock.
Family:	Primulaceae
Genus:	*Lysimachia*
Species:	*aervensis*
Distribution:	*L. arvensis* is now naturalised almost worldwide, wit harange that encompasses the Americas, Central and East Asia, the Indian Subcontinent, Malesia, the Pacific Islands, Australasia and Southern Africa.

Habit:
Herb

Habitat:
Riparian or amphibious environments.

Native/Exotic:
Introduced

Flowers:
Range, redor blue, radially symmetric flowers.

Fruit:
The dehiscent capsule fruits ripen from August to October.

Phenology:
Spring to autumn.

Ecological role: It is harmfully toxic in several respects and accordingly undesirable in pastures. The plant is acrid and bitter, and grazing livestock generally avoid eating it except in conditions of overgrazing or grazing of unsatisfying stubble.

Local usage:
Used in folk medicine worldwide than where it has long been familiar in its countries of origin. In various countries however, the plant aterial has been applied externally to slow-healing ulcers and wounds. It is insecticidal, or at least is repellent to some insects, possibly by virtue of its pungent essential oil which has a characteristic smell.

Bioindicator:
Considered a weed and is an indicator of light soils.

Control measures:
Can usually be controlled by careful inter-row and interplant cultivation. Deep weed-free mulches will generally prevent further germination.

IUCN status:
Not Evaluated

Ammannia baccifera L.

Vernacular name:	Acrid weed, Monarch redstem, Tooth cup
Common name:	Aginbuti, Ban mirich, Jungli mehendi
Family:	Lythraceae
Genus:	*Ammannia*
Species:	*baccifera*
Distribution:	It is widespread in the tropical regions of Asia, America and Africa.
Habit:	Annual herb
Habitat:	Found in marshes, swamps, rice fields, waste places and water courses at low elevations.

Native/Exotic:
Native

Flowers:
Small, about 1.2 mm long, greenish or purplish, and borne in dense clusters in leaf axils.

Fruits:
The capsules are nearly spherical, depressed, about 1.2 mm in diameter, purple.

Phenology:
August to December

Ecological role:
The plant is often found as a weed of cultivated land, especially wet sites such as rice fields.

Local use:
Leaves are exceedingly acrid, irritant, and vesicant, and are being used by the village-folk to raise blisters, being applied to the skin for half an hour or a little longer.

Bioindicator:
Contamination

Control measures:
Manual or Mechanical, but difficult as severed parts regenerate easily.

IUCN status:
Least concern

Bacopa monnieri (L.) Wettst.

Vernacular name:	Brahmi, Jal-Brahmi, Jalnaveri
Common name:	Waterhyssop, Indian Pennywort
Family:	Plantaginaceae
Genus:	*Bacopa*
Species:	*monnieri*
Distribution:	Native to the wetlands of southern and Eastern India, Australia, Europe, Africa, Asia, and North and South America.
Habit:	Non-aromatic aquatic herb
Habitat:	Grows best near flowing water and wetlands in plains and foothills, and is particularly abundant in monsoon.

Native/Exotic:
Native

Flowers:
The flowers are small, actinomorphic and white, with four to five petals.

Fruits:
Capsule is ovoid in shape, acute, two-grooved and two-valved with numerous seeds.

Phenology:
September-October, sporadically throughout the year.

Ecological role:
In aquatic habitats, it has deleterious effects on native plants and animals, water quality, water flow and sedimentation. In terrestrial situations, it degrades riverbanks, margins of ponds, lakes and coastal areas.

Local usage:
Used in Ayurvedic traditional medicine to improve memory and to treat various ailments.

Hydrophytic adaptations:
Fleshy leaves

Bioindicator:
Metal pollution

Control measures:
Waterhyssop can be cut manually and the rhizomes can be dug up.

IUCN status:
Least concern

Enhydra fluctuans Lour.

Vernacular name:	Harkuch, Haruch, Matsayaakshi
Common name:	Buffalo spinach, Water cress
Family:	Asteraceae
Genus:	*Enhydra*
Species:	*fluctuans*
Distribution:	Occurs in tropical Asia and Africa. It is common to all countries of Southeast Asia. Grows commonly all over the country.
Habit:	Semi-aquatic tropical herb
Habitat:	The species grows in and along ditches, water courses, margins of fish ponds and rice fields in the open.

Native/Exotic:
Native

Flowers:
Flowers are white or greenish-white.

Fruits:
The achenes are enclosed by rigid receptacle-scales.

Ecological role:
It is able to reproduce by fragmentation and may be so abundant that it clogs water courses.

Phenology:
November to April

Local usage:
The leaves are slightly bitter, cure inflammation, skindiseases, laxative, bronchitis, nervous affection, leucoderma, biliousness and good in small pox.

Hydrophytic adaptations:
Aerial parts of this plants how mesophytic or some times xerophytic features, while the submerged parts develop true hydrophytic characters.

Bioindicator:
Metal toxicity

Control measures:
It is able to reproduce by fragmentation and may be so abundant that it clogs water courses.

IUCN status:
Least concern

Hygrophila polysperma
(Roxb.) T. Anders.

Vernacular name:	Sarpat
Common name:	Marsh Carpet, Dwarf hygrophila, Dwarf hygro, Miramar weed, Indian swampweed.
Family:	Acanthaceae
Genus:	*Hygrophila*
Species:	*polysperma*
Distribution:	India, Indochina, North America, Bhutan, Sri Lanka, Nepal, Pakistan.
Habit:	Aquatic Herb

Habitat:
Mostly submerged, an immersed plant along banks, preferring flowing waters, but also found growing in slow-moving systems such as lakes, marshes, canals, rivers, swamps, wetlands, and irrigation ditches.

Native/Exotic:
Native

Flowers:
White

Fruits:
Linear-oblong

Phenology:
September to January

Ecological role:
Rapidly grow out of control, taking light and nutrients away from more other plants, displacing native plant species, reducing biodiversity, decreasing water quality and flow.

Local usage:
Are sold for aquariums and water ponds.

Hydrophytic adaptations:
It will accept most water parameters.

Bioindicator:
It will grow even faster in nutrient rich water/ substrate and it benefits from additional Co2.

Control measures:
Movement Control drain all water and clean off all gear used on water bodies in order to minimize the chance of spreading aquatic invasive species.

IUCN status:
Least concern

Pedalium murex L

Vernacular name:	Gokhru
Common name:	Large Caltrops, Crow thorn
Family:	Pedaliaceae
Genus:	*Pedalium*
Species:	*murex*
Distribution:	It is distributed in India, Sri Lanka and Tropical Africa.
Habit:	Stiff-stemmed herb
Habitat:	Grows like a crop in open areas and agricultural lands, and also grows intermingled with other herbaceous weeds.

Native/Exotic:
Native

Flowers:
Flowers are pedicellate, 2-3 cm long, pale yellow.

Fruits:
Green later brown.

Phenology
During monsoon season.

Ecological use:
Has the ability to form thick blanket of population covering the ground due to which soil erosion is controlled in areas of its growth. The plant displays its solitary yellow flowers by presenting them above the foliage in order to attract flower foragers.

Local usage:
Different parts of the plant are used to treat various ailments like, cough, cold and as an antiseptic. The leaves are used as curry in splenic enlargement the decoction of the root is antibilious. It is an important famine food - leaves eaten as vegetable.

Bioindicator:
It is a saline soil indicator, and occurs on sandy and limestone soils.

Control measures:
Mechanical and manual

IUCN status:
Not known

Saccharum spontaneum L.

Vernacular name:	Kash and Kasatandi
Common name:	Wild sugarcane, Kans grass
Family:	Poaceae
Genus:	*Saccharum*
Species:	*spontaneum*
Distribution:	Native to the Indian Subcontinent.
Habit:	Reed
Habitat:	Kans grass quickly colonises exposed silt plains created each year by the retreating monsoon floods, forming almost pure stands on the lowest portions of the floodplain.

Native/Exotic:
Native

Flowers:
Panicle 25-40 (-60) cm long, the peduncle usually hairy.

Fruits:
The fruits are laceolate spikelets held in pairs. Spikelets do not have awns.

Phenology:
July to September

Ecological role:
Has the potential to become a serious invader of cultivated land, often resulting in its abandonment. It has been shown to reduce the productivity of a number of crop species including wheat, tea, rubber and sugarcane, for example. In addition to this, it is a host to a large number of pests and diseases which may acts as a reservoir enabling spread into adjacent crops.

Local usage:
Reported as good fodder for goats and camels and suitable for the production of silage. it a very efficient binder of soils, and hence, particularly useful for controlling and preventing soil erosion. It provides good thatching material and is also used in the production of ropes, mats and brooms.

Bioindicator:
Heavy metals

Control measures:
Deep ploughing is effective for the control of this weed. Embanking and flooding of infested areas can reduce infestations where these occur in localised pockets in the field.

IUCN status:
Least concern

Tripidium bengalense
(Retz.) H. Scholz

Vernacular name:	Sarkanda, Munj
Common name:	Sweetcane
Family:	Poaceae
Genus:	*Tripidium*
Species:	*bengalense*
Distribution:	North India, Nepal, Afghanistan, Pakistan and Iran
Habit:	Reed
Habitat:	Kans grass

Native/Exotic:
Native

Flowers:
Panicle, 20-75 cm long, White-grey.

Fruits:
Caryopsis

Phenology:
October to January

Ecological role:
It is a food source for animals such as the Indian rhinoceros and the pygmy hog.

Local usage:
It is used by low income locals for making ropes, hand fans, baskets, brooms, mat, hut and shields for crop protection. It is a choice species for stabilizing erosion-prone rugged slopes and their conversion into biologically productive sites of high socio-economic values.

Bioindicator:
Not known

Control measures:
Deep ploughing and embanking and flooding of infested areas.

IUCN status:
Not known

Tripidium ravennae (L.) H. Scholz

Vernacular name:	Ekra, ikora
Common name:	Elephant grass
Family:	Poaceae
Genus:	*Tripidium*
Species:	*ravennae*
Distribution:	It is native to southern Europe, western Asia and South Asia and is known in North America as an introduced species.
Habit:	Reed
Habitat:	Riparian reed

Native/Exotic:
Native

Flowers:
Plume-like panicle of spikelets covered in white or pale-colored silky hairs.

Fruits:
Caryopsis

Phenology:
September to December

Ecological role:
Invasive and troublesome noxious weed. Used for stabilizing soil to prevent erosion. It can anchor soils normally more subject to shifting (e.g. mid-channel) and act as a physical barrier to stream flow through its biomass and accumulation of flotsam, thatch and sediment. This may shift erosion locations.

Local usage:
Sold in nurseries for use as an ornamental grass in gardens.

Bioindicator:
Heavy metals

Control measures:
Manual removal proved effective for treating small clumps with roots removed and piled up to dry, away from moist ground. annual deep cultivation will help reduce the vigour and spread.

IUCN status:
Least concern

Alernanthera philoxeroides
(Mart.) Griseb.

Vernacular name:	Phackchet
Common name:	Alligator weed
Family:	Amaranthaceae
Genus:	*Alternanthera*
Species:	*philoxeroides*
Distribution:	Native species to the temperate regions of South America, which includes Argentina, Brazil, Paraguay and Uruguay.
Habit:	Herb
Habitat:	Thrive in both dry and aquatic environments.

Native/Exotic:
Exotic

Flowers:
Whitish, papery flowers along its short stalks.

Fruits:
Plant does not always set viable seed under natural conditions; but reproduces vegetatively from axillary buds at each node.

Phenology:
December to April

Ecological use:
Adverse effects it poses on both aquatic and terrestrial environments. They compete the native vegetation for space and solar energy through these dense mats. This then be comes a major issue for native herbivores because their food source declines. it degrades river banks, pastures, and agricultural lands producing massive underground lignified root systems penetrating up to 50-60 cm deep.

Local usage:
Fodder for animals and ornamental value.

Hydrophytic adaptations:
Thanks to its hollow stems, floats easily. The weed's intricate root system can either allow them to hang free in the water to absorb nutrients or directly penetrate the soil/ sediment and pull their nutrients from below.

Bioindicator:
Heavy metals

Control measures:
Can only establish itself in shallow waters no deeper than 2 metres (2 yards), so one method of control is to erect barriers in shallower areas to limit the amount of suitable space the plant has. When it comes to terrestrial environments, overpopulating the area with native species can limit the suitable space available for it.

Most successful and widely used is *Agasicles hygrophilaas* biological control.

IUCN status:
Not known

Mazus pumilus
(Burman f.) Steenis

Vernacular name:	TaapreJhaar, MaalatiJhaar
Common name:	Japanese mazus
Family:	Mazaceae
Genus:	*Mazus*
Species:	*pulmilus*
Distribution:	Native to south and east Asia, where it is found in Bhutan, China, India, Indonesia, Japan, Korea, Nepal, New Guinea, the Philippines, Russia, Taiwan, Thailand, and Vietnam.
Habit:	Flowering herb

Native/Exotic:
Native

Flowers:
Purple and white with yellow spots on the throat.

Fruits: Fruit is a capsule, dry and splits open when ripe.

Phenology
Throughout the year

Ecological role:
ls self-pollinating weed that is commonly found in arable land, vegetable gardens and roadsides. This weeds harbours insects and pathogens that attack vegetables.

Local use:
The plant is a perient, emmenagogue, febrifuge and tonic. The juice of the plant is used in the treatment of typhoid.

Bioindicator:
Heavy metals

Control measures:
Hand pulling, lawn mowing, and mechanical machinery.

IUCN status:
Not Evaluated

Eriocaulon cinereum R. Br.

Vernacular Name:	Pipewort
Common name:	Ashy pipeworts
Family:	Eriocaulaceae
Genus:	*Eriocaulon*
Species:	*cinereum*
Distribution:	Tropical Asia, Australia, Europe, North America, India, Bangladesh, Sri Lanka, Nepal.
Habit:	Grass
Habitat:	Rooted shallow water surface

Native/Exotic:
Native Flower White

Phenology:
August to November

Ecological role:
Weak competitors compared to many other wetland plant species.

Local usage:
Diuretic, febrifuge and ophthalmic.

Hydrophytic adaptations:
Narrow-leaved and almost cushion growing plant.

Bioindicator:
Not known

Control measures:
Manual or mechanical means.

IUCN status:
Least concern

Eclipta prostrata (L.) L.

Vernacular Name:	Karisalankanni , Bhringraj,
Common name:	False daisy
Family:	Asteraceae
Genus:	*Eclipta*
Species:	*Prostrata*
Distribution:	A native of Asia, now widely distributed in the tropical, subtropical and warm temperate regions.
Habit:	Herb
Habitat:	Amphibious, widespread in damp places

Native/Exotic:
Native

Flowers:
Small white flowers.

Fruits:
Achenes (small, thin-walled one-seeded dry indehiscent fruit).

Phenology:
All around year

Ecological role:
It is a common weed of rice.

Local usage:
Traditional and Folklore medicines.

Hydrophytic adaptations:
Round cylindrical stems.

Bioindicator:
Not known

Control measures:
Germination and growth of *E. prostrata* in lowland rice are suppressed by flooding for 3-4 weeks after planting.

IUCN status:
Least concern

REFERENCES

http://www.theplantlist.org/

http://www.flowersofindia.net

https://www.cabi.org

https://www.biologydiscussion.com/

Naskar, K. R. (1990). Aquatic and Semi-Aquatic Plants of The Lower Ganga Delta, Delhi. Daya Publishing House

Kumar, S. (2001). Plant Diversity along Ganga River. Dehradun, Sai Publishers

नमामि गंगे

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