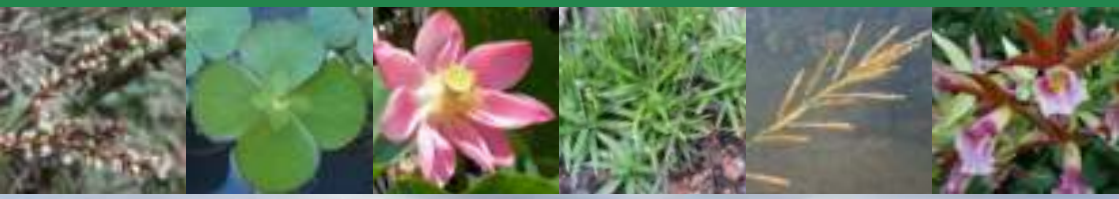
Wetland Plants of the Wet Tropics

Dr Greg Calvert



terrain
NATURAL RESOURCE MANAGEMENT

Queensland Wetlands Program

Queensland Government

Calvert, Greg

Wetland Plants of the Wet Tropics

ISBN-13: 978-0-646-96111-8

First published 2016 by
Terrain NRM
PO Box 1756 Innisfail Qld 4860
www.terrain.org.au

Graphic design by Megan MacKinnon

Printed by Harding Colour

Please reference as: Calvert G., (2016) Wetland Plants of the Wet Tropics. Terrain NRM, Innisfail.

'The Queensland Wetlands Program supports projects and activities that result in long-term benefits to the sustainable management, wise use and protection of wetlands in Queensland. The tools developed by the Program help wetland landholders, managers and decision makers in government and industry. The Queensland Wetlands Program is currently funded by the Queensland Government'.

Contents

* = Species introduced from another country

Acknowledgements

Terrain NRM would like to acknowledge Dr Greg Calvert, Townsville, for preparing this book.

Thanks to Carla Wegscheidl and Phillip Trendell from the Queensland Department of Agriculture and Fisheries (DAF) and Steve Bailey and Bart Dryden (Terrain NRM) for making the production of this book possible.

This publication was funded by the Queensland Wetlands Program as part of the Queensland Department of Agriculture and Fisheries' Wetland in Agriculture: Training, Extension and Resources (WATER) project.

This publication has been a partnership between the author, DAF and Terrain NRM with support and input provided by a steering committee comprising representatives from CSIRO, Australian Tropical Herbarium, James Cook University, Cairns Regional Council, Cassowary Coast Regional Council, Wet Tropics Management Authority, Jaragun Natural Resource Management, Terrain NRM and DAF. Thanks to Tom McShane, Julie Kenniff and the other committee members of the Lower Burdekin Landcare Association (LBLCA) who generously allowed us to expand, modify and revise their publication 'Wetland Plants of the Townsville–Burdekin Flood Plain', retaining the concept and design. The books are designed to be complementary. Thanks to Laurence Liessmann for use of his wetland plant glossary.

Numerous people have given generously of their time and knowledge of wetland plants to make this book possible. The steering committee consisted of Steve Bailey, Gerry Turpin, Steve Goosem, Liz Owen, Carla Wegscheidl, Matt Birch, Dennis Ah-Kee, Darren Crayn, Frank Zich, Eda Addicott, Damon Sydes, Tony O'Malley, Fiona George, Michael Graham, Bob Jago, and Lloyd Dave.

Document reviewers included Carla Wegscheidl, Darren Crayn, Frank Zich, Jaymie Rains, Marjorie Cutting and Steve Bailey.

Sharlene Blakeney from Terrain NRM provided the wetland maps of the Wet Tropics region. While the majority of photos were taken by Greg Calvert, several other people also contributed images, including Malcolm Calvert, Stuart Worboys, Russell Cumming, Byron Kearns and Andrea Lim.

Ruth Martin played a pivotal role in the production of this book; from her time accompanying Greg in the field, fearlessly charging into freezing or crocodile inhabited waters in pursuit of an interesting water plant, her editing and proof-reading, to her wonderful innovations and observations growing many of the species featured in this book. We are greatly indebted to the contribution her interest / obsession has made towards this publication.

In the field with Greg were the Calvert family (Malcolm, Lenore, Tiffany and Laura), Russell Constable, Kristina Ihme, Julia Koburg, Con Lokkers, Ruth Martin, Merilyn Thomas and Rohan Wilson.

Russell Constable gave generously of his time and enthusiasm in searching for some of the rarer and more difficult to find wetland plants. Matt Birch provided the location for glush weed. Belinda Bickley (Greening Australia) and Des Bolton provided some useful tips for propagating sedges. Peter Valentine provided information about butterfly food plants. Merilyn Thomas provided valuable comments on sedges.

Thanks particularly to Greg's family for their support, patience and tolerance – Tiffany and Laura.

Foreword

Wetlands – swamps, bogs, marshes, lakes, rivers and creeks etc. – are not the first landscapes most people think about upon mention of the Wet Tropics. They are not the soaring mountains, the umbrous rainforests, nor the roaring waterfalls. They harbour no celebrity species, nor do they grace tourism brochures. Yet wetlands are some of the most important communities for ecosystem health, of not only the terrestrial landscapes of the Wet Tropics World Heritage Area, but of the Great Barrier Reef lagoon into which they pass, processed, the water delivered to them by rainfall. And they are amongst the communities most threatened by land use change and introduced species.

I admit that I was among those who have overlooked wetlands, their biodiversity and their ecosystem function. Arriving in the Wet Tropics to take up an academic role eight years ago I was seduced and terrified in equal measure by the bewildering diversity of the Wet Tropics' world famous rainforests and the task of getting to grips with it. The wetlands were something I decided I would tackle 'later on'. Thanks to this book, others need not postpone the opportunity – it will inspire and enable them to jump right in.

Effective environmental management requires understanding, knowledge, and above all accurate identification of species. With this book Dr Calvert fills a critical and long standing need for a comprehensive, easy to use guide to the wetland plants of the Wet Tropics. But it is not simply a tool for their identification; it is a guide to their ecological roles and in the case of the weeds, impacts. Because of its accessibility, accuracy and comprehensiveness, it will greatly assist wetland managers to improve land management outcomes. The fascinating notes on traditional uses of the plants by Indigenous peoples of Australia and elsewhere provides an additional point of interest.

Dr Calvert is to be commended for this valuable contribution to the literature on Australian plants and environmental management. It deserves to be widely used by practitioners, educators and students, and indeed by all who live, work and recreate in the Wet Tropics.

– *Prof. Darren Crayn,*
Australian Tropical Herbarium,
James Cook University.

Introduction

Water is the very essence of the Wet Tropics, and the first vision that comes to most people's minds are mist-covered mountains, gurgling mountain streams, cascading waterfalls and the wet, humid lowlands. Water is the very lifeblood of our towns and cities, agriculture, industry and environment. Yet our natural wetland resources are too often overlooked, and we have only recently begun to understand the importance and value of these complex ecosystems that were once regarded as useless swamps. We hope this book will go some way towards achieving a better appreciation of the role, value and complexity of wetland communities and the plants that are an integral part of their function.

Wetlands in the Wet Tropics

Although the Wet Tropics bioregions accounts for only 1% of Queensland and 0.01% of Australia (an area of approximately 18497.25 km^2), the Wet Tropics contains a disproportionate amount of the country's biodiversity (Sattlter & Williams 1999). There are more than 3,000 plant species in 224 families recorded from the bioregion (UNESCO 2016), and such an enormous diversity is both challenging and daunting to experienced botanists, let alone the amateur naturalist or interested visitor. This huge botanical diversity includes 65% of Australia's ferns, 30% of the orchids and 15% of its vascular plants (Goosem 2002).

It was in appreciation of the enormous value of the region that in 1988, an area of 8,944 km^2 between Townsville and Cooktown was incorporated into the Wet Tropics World Heritage Area, extending a distance of approximately 450km (UNESCO 2016).

Most people tend to immediately associate the Wet Tropics with visions of thick, dense rainforest, however, the great diversity of the region is due in no small part to the diversity of other vegetation types, stretching from coastal mangroves to open woodlands, towering wet sclerophyll forests, and cool luxuriant rainforest stretching up to the cool windswept top of Queensland's tallest mountain – Mt Bartle Frere. Not least of these vegetation communities are wetlands.

Wetlands vary enormously too, from the warm coastal lowland rivers and swamps to the cool mountaintop streams and volcanic crater lakes. There is significant climatic variation within the Wet Tropics too. Mt Bellenden Ker has an annual average rainfall of around 8,000 millimetres, while a third of the region is significantly drier, receiving less than 800mm of rain a year (Terrain 2016). This climatic variation is reflected in the diversity of wetland types.

Different plant species have different abilities to cope with different environmental stresses, including periods of drying, flooding, salinity and even fire. This in turn dictates which species thrive in which wetlands, and it's rare to ever visit two wetlands with the same assemblages of wetland plants.

Introduction

Forests are often described as being the lungs of the earth, and if that analogy is true, then wetlands could be considered the kidneys. The microscopic organisms and plant life in wetlands have a cleansing influence of water; intercepting suspended silt, nutrients, heavy metals and toxins before the water is discharged into the Great Barrier Reef lagoon.

The days when people viewed wetlands as stinking, useless swamps have passed and we are moving into a more enlightened period, where wetlands are being appreciated for their huge contribution to biodiversity and those ecosystem processes; serving as a vital interface between our wilderness, agricultural and urban areas and the ocean. Clean water is a vital ingredient of life – not only for the environment, but also for our future and ongoing ability to live healthy, sustainable lives.

There is a strong and concerted effort amongst those that live in the Wet Tropics to conserve our valuable water resources, from adopting sustainable farming practices, maintaining and restoring natural vegetation along watercourses and helping to reduce erosion and pollution from degrading our water supplies. But the ongoing preservation and maintenance of our wetlands is also an integral part of water conservation, and their value is now recognised to the point that creating artificial wetlands is becoming a standard industry practice throughout the region.
The freshwater wetlands of the Wet Tropics contain hundreds of square kilometres of wetlands, including palustrine (marsh or swamp), lacustrine (lakes and dams) and riverine (rivers or deepwater habitats in a channel), and are shown on Figures 1 and 2. Freshwater wetland maps covering most of this area can be found on the Wetland Info web page http://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/nrm-terrain-nrm/ allowing you access to detailed wetland maps for different drainage sub basins throughout the Wet Tropics.

Values of wetlands and wetland plants

It is an unfortunate situation that the most important components of wetlands – the plants – are often the most overlooked component of wetlands. Wetlands of the Wet Tropics region have high cultural and spiritual significance to the Indigenous people of the Wet Tropics, who have inhabited the area for tens of thousands of years, and they were intimately aware of the plants that grew there and the resources they provided. A more comprehensive list of the 'Values of wetlands for Traditional Owners' can be found on the Wetland Info web page http://wetlandinfo.ehp.qld.gov.au/wetlands/management/wetland-values/traditional-owners.html

In more recent times, the role of wetlands in providing ecosystem services are now becoming better understood. Wetlands have a great many roles and values including, but not limited to:

- provide buffers against coastal erosion, storm surges and flooding which in turn provides resilience to flood and cyclone events;
- maintain and improve water quality by trapping and utilising nutrients and sediment from rivers and wetlands, that would otherwise be discharged into the ocean or other sensitive downstream receiving environments;
- sequester and store carbon dioxide helping to reduce climate variability;
- provide an important habitat for a broad range of biodiversity, including plants, fish, crustaceans, insects, frogs, reptiles, birds and mammals;
- provide a huge range of plant and animal products that are of great cultural value and importance to the traditional owners of the Wet Tropics region;
- provide a valuable resource for recreation, tourism, research and education; and
- provide important cultural, spiritual or aesthetic services and improve human well-being (DEHP 2013).

A more comprehensive list of the values of wetland ecosystems can be found on the Wetland Info web page http://wetlandinfo.ehp.qld.gov.au/resources/static/pdf/management/value.pdf

The capacity of a wetland to perform these valuable functions is largely a function of the species of plants that occur there, but the specific roles of individual plant species is comparatively poorly known. Understanding this basic principle is critical both for maintaining the health of existing systems and in constructing functional artificial wetlands. To an untrained eye, a wetland that has a full suite of native plants might not seem very different to one full of weeds; however, their values and capacity to perform ecosystem functions are vastly different.

Introduction

The values of wetland plants could be seen as being similar to the values of wetlands as a whole. Specifically, native aquatic plants provide a number of ecosystem values, including:

- maintaining water quality by varying abilities to sequester nutrients and accumulate sediment and heavy metals;
- stabilising banks of watercourses, stabilising loose sediment and erosion protection;
- providing habitat for wildlife including food, shelter, nesting and foraging resources);
- providing fodder for commercial grazing; and
- aesthetics.

Because of their many valuable roles in maintaining biodiversity, water quality and protecting valuable downstream environments such as the Great Barrier Reef, they can be regarded as keystone elements in freshwater systems.

Wetland plants are useful indicators of wetland health. The type and condition of wetland plants present in a wetland provides evidence of excess nutrient levels, salinity levels, degradation and grazing impacts. Wetland ecologists and land managers familiar with wetland plants can tell a lot about a wetland from the plants that are present, such as its depth, whether the water is permanent or seasonal, fresh, brackish or saline, clean or polluted, and if the site has had a history of disturbance.

The plants do much more than simply providing food and habitat for wildlife, but include many species deserving of special recognition and conservation efforts in their own rights. Wetlands of the Wet Tropics contain a number of threatened plant species, including, but not necessarily limited to the following:

- *Aponogeton bullosus* (Endangered)
- *Aponogeton elongatus* (Near threatened)
- *Aponogeton lancesmithii* (Endangered)
- *Aponogeton prolifer* (Endangered)
- *Carex breviscapa* (Vulnerable)
- *Cyperus cephalotes* (Endangered)
- *Eleocharis retroflexa* (Endangered)
- *Fimbristylis adjuncta* (Endangered)
- *Nepenthes mirabilis* (Bramston Beach) (Endangered)
- *Phaius australis* (Endangered)

Roles and uses for wetland plants

There are at least 18 Aboriginal tribal groups that have ongoing traditional connections to the Wet Tropics (UNESCO World Heritage Centre 2016), and this ancient connection extends back to at least 30,000 years (Cosgrove et al. 2007). Wetlands provided a valuable but seasonally variable harvest of resources, including fish, meat, medicinal plants and plant foods, including some that require careful detoxification. Wherever possible the traditional uses of the wetland plants have been incorporated into this book.

Many of our local native water plants occur naturally in other parts of Australia and the world, and it is interesting to see the values of these plants in other counties and cultures. Plants that many North Queenslanders dismiss as useless 'water weeds' are held in high esteem by other cultures, both for their spiritual connection, and for their daily use in local cuisine and traditional medicine. Recent interest in many of these plants has uncovered a broad range of useful pharmaceutical chemicals, ranging from sedatives, anti-bacterials and anti-tumour to anti-viral products, some of which are being investigated for a potential role in the fight against diabetes, tumours and human immunodeficiency virus (HIV) (Cribb & Cribb 1981b, Neeraja & Elizabeth 2011, Sun et al. 2013).

Revegetation and constructed wetlands

Throughout the world, the individual roles of wetland plants in natural wetlands is now being exploited for use in constructed treatment wetlands – wetland systems carefully designed and planted to mimic the functions of natural wetlands in improving water quality. The Wetland Management Handbook, available on www.wetlandinfo.ehp.qld.gov.au/wetlands/ has a dedicated section on constructed (treatment) wetlands in agricultural areas.

Although constructed wetlands have been in use overseas and in southern Australia for many years, this approach to dealing with wastewater is still very much in its infancy in the Wet Tropics, and there are numerous opportunities for future research and application. Most constructed wetlands in the Wet Tropics have been designed for purely aesthetic purposes, with deep water and steep sides that limit weed invasion and maintenance, but also limit their value for water plants and for improving water quality.

The strong seasonal variation in rainfall, and the subsequent flooding and drying cycles of wetlands present challenges in constructed wetland design, and this has previously discouraged their use in the area (Breen et al. 2012), however, the diversity of wetland plants available in the Wet Tropics presents an abundance of opportunities for constructed wetlands under a broad variety of conditions. This book includes species tolerant of deep inundation and seasonal drying, varying salinity levels and levels of nutrients, toxins and heavy metals that might previously been seen as an insurmountable barrier.

Introduction

These plants have a role, not only in large scale lagoon type wetlands, but also in the restoration of waterways, drains, and in the use of Water Sensitive Urban Design (WSUD) to manage waste water from urban areas. Designed to capture and absorb excess nutrients before the water is discharged into natural wetlands, WSUD must evolve and adapt to the wet tropics conditions, including using species indigenous to the wet tropics.

So far, more than 150 wetland plants have been identified as being useful in constructed wetlands (Greenway 2003). Unfortunately, our local native aquatic plants have been frequently overlooked in favour of subtropical species, due to a lack of suitable identification guides, research or local knowledge of the potential value of our local plants. Similarly, the role of bioretention basins and phytoremediation projects for treating polluted water from industrial areas should be given the attention it deserves.

It is acknowledged that the use of constructed wetlands in the Wet Tropics is still very much in its infancy, and further research and experimentation will certainly be needed before it can be perfected. There are, however, some outstanding examples of constructed wetlands, such as Tyto Wetlands in Ingham and Cattana Wetlands in Cairns. These areas are spectacular showcases of biodiversity, and demonstrate what can be achieved through careful design, aggressive weed management and the ongoing commitment of dedicated workers and volunteers.

Wetland weeds

Weeds constitute one of the greatest threats to wetlands, both native and artificial. The Wet Tropics is plagued by at least 504 species of introduced plants that have established self-maintaining populations in the Wet Tropics (Werren 2001), and a significant number of these impact wetlands. Several are also included amongst the world's worst alien invaders. All have exhibited extremely aggressive weedy tendencies elsewhere and/or are currently extremely aggressive weeds of the region and, in the case of hymenachne, para grass and elephant grass, are very aggressive and greatly impair ecosystem function. These are considered to be 'transformer species'; defined as being an invasive species that can change the character, condition, form or nature of a natural ecosystem over a substantial area (Werren 2001).

Invasive and exotic aquatic plants have resulted in a number of adverse effects on wetlands, such as:

- altering hydrological regimes (blocking water flow, increase evapotranspiration)
- displacing native plants and animals (choking and outcompeting native plants, impairing regeneration, blocking light and fish passage, removing breeding and foraging habitat)
- degrading water quality (reducing oxygen, increasing nutrients leading to algal blooms, discolouration and tainting of drinking water)
- altering soil properties (acidification)
- changing fire regimes (increasing fuel loads resulting in fire being carried into fire sensitive communities)
- reduced amenity (loss of aesthetic appeal, limiting boat and swimming access, increased mosquitoes, increasing flood damage, loss of wildlife)
- degrading fishing grounds (by blocking passage, floating binding mats, loss of fish habitat and passage).

In addition to the adverse effects on wetlands and their values, invasive weeds also have significant impacts on grazing and farming practices within the region. These negative impacts include:

- out-competing productive native grasses and /or agricultural crops
- being toxic to stock
- limiting access to water by stock and crops
- reducing water quality, and impacts on irrigation networks and flows (blocking distribution channels and pump stations)
- increasing farm costs through increased herbicide and maintenance costs).

There are often limited options to managing water weeds; however, killing water weeds in situ can often lead to significant reduction in water quality as they decompose. Harvesting water weeds may be a useful method of stripping excess nutrients from eutrophic systems, particularly in urban areas. Like all weeds, prevention is a better management tool than containment or eradication programs. The aquarium and nursery trade is a major source of introduced aquatic plants, as these invasive species are sold for ornamental ponds and aquariums, and also inevitably find their way into local waterways and wetlands. Of particular concern is the potential and ease with which new exotic species flourish in our waterways and have negative effects. Serious waterweeds such as salvinia (*Salvinia molesta*), cabomba (*Cabomba caroliniana*), water hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*) are still commonly grown in aquariums and outdoor ponds, despite being declared weeds.

Introduction

Under the Biosecurity Act 2014, all persons have a general biosecurity obligation (GBO) to:

- take all reasonable and practical steps to prevent or minimise biosecurity risks
- minimise the likelihood of a biodiversity risk causing a biosecurity event and limit the consequences of such an event
- prevent or minimise the adverse effects the biosecurity risk could have and refrain from doing anything that might exacerbate the adverse effects.

This GBO means all persons must take all reasonable steps to ensure they do not spread a pest, disease or a contaminant. The Act classifies weeds into two separate categories – prohibited and restricted, and there are five categories for restricted plants, three of which must be reported to Biosecurity Queensland if found:

- Prohibited plant
  (not yet present, sightings must be reported to Biosecurity Queensland)
- Restricted Category 2 plant
  (present, but sightings must be reported to Biosecurity Queensland)
- Restricted Category 3 plant
  (must not be given away, sold, or released into the environment without a permit)
- Restricted Category 4 plant
  (must not be moved)
- Restricted Category 5 plant
  (must not be kept).

Weeds listed in this book have their relevant declaration status listed, however, these categories may change over time as new weeds are introduced or become a more serious risk. To ensure you have the most up to date information on legislation regarding weeds and wetland plants in general, check the following link: http://wetlandinfo.ehp.qld.gov.au/wetlands/management/policy-legislation/

How to use this book

This aim of the guide is to provide a user-friendly plant identification resource for naturalists to appreciate the contribution of wetland plants to the biodiversity of the Wet Tropics, and for natural resource managers, industry, community organisations and landholders to identify and select suitable locally-occurring species for conservation, on-ground works projects, or in the case of weeds an assessment of threats and control measures.

Wetland plants vary in their structure and form, depending on the wetland zone they inhabit. Although zones vary between wetland types, they usually fall into the categories riparian/fringing, emergent and aquatic (WetlandCare Australia 2008). Although there are some 360 plant species that can be used to indicate the presence of a Wet Tropics wetland (DEHP 2016b), this also includes marine wetlands that are not covered by this book. This book instead focuses on plants in wetlands that are considered fringing, emergent and aquatic (submerged, floating), and are permanent or seasonally flooded with freshwater.

Wetland plants (macrophytes) considered in the context of this book are those that occur within the aquatic environment for a period of their lifecycle, but excluding perennial woody plants. These wetland plants are further segregated in the book according to their form and growth habit:

Submerged – plants with leaves fully submerged

Floating attached – plants with leaves emergent but attached to the substrate

Free floating – plants that are free floating and not attached to the substrate

Herbs and shrubs – broad-leafed plants that generally grow on the margins of wetlands

Grasses – for grasses with jointed stems

Sedges and rushes – for grass-like plants triangular or round in cross section, lacking jointed stems

Weeds – plants that occur outside of their natural distribution and have an adverse effect on the environment.

In this book, we have also tried to encompass the many ways people view and interact with aquatic plants, or "macrophytes" as they are often described. These uses range from food and medicine to their importance to both Australian Aboriginal and Torres Strait Islanders (Indigenous people) and other cultures throughout the natural range of many of these plants.

This book is intended to complement the following field guides:

- Greg Calvert and Laurence Liessmann (2014) *Wetland Plants of the Townsville–Burdekin Flood Plain*. Lower Burdekin Landcare Association, Ayr
- Louise Johns (2006) *Field guide to common saltmarsh plants of Queensland*. Department of Primary Industries and Fisheries, Brisbane.

The guide is also intended to complement the publication 'Wetland rehabilitation guidelines for the Great Barrier Reef catchment' (WetlandCare Australia 2008: www.wetlandinfo.ehp.qld.gov.au/wetlands/) which gives practical guidance on wetland rehabilitation.

We trust this guide will raise the profile of these important but little-known plants, improve the success of local wetland revegetation projects, allow land managers to use wetland plants as an indicator of wetland health and degradation, and identify introduced and invasive species to allow for their strategic control and eradication.

Maps

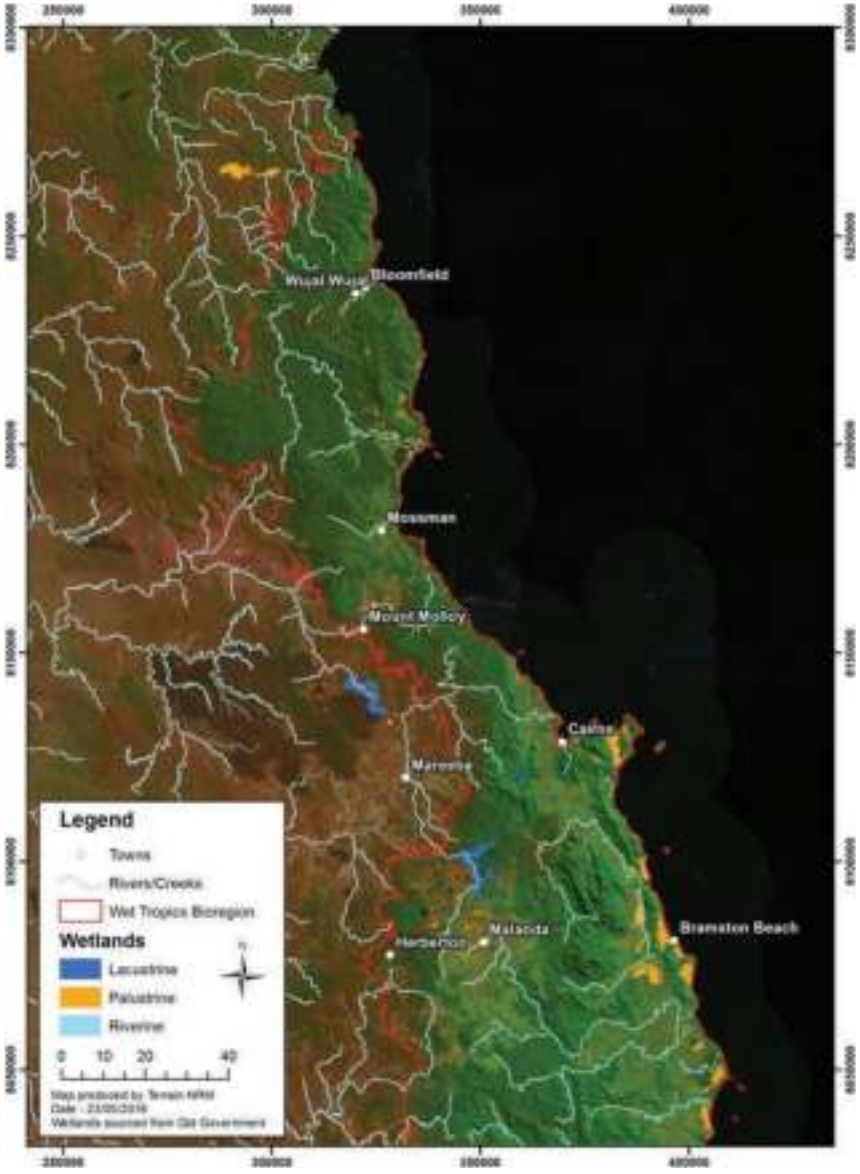


Figure 1: Extent of wetland types in the Northern Wet Tropics Bio-region (red boundary)

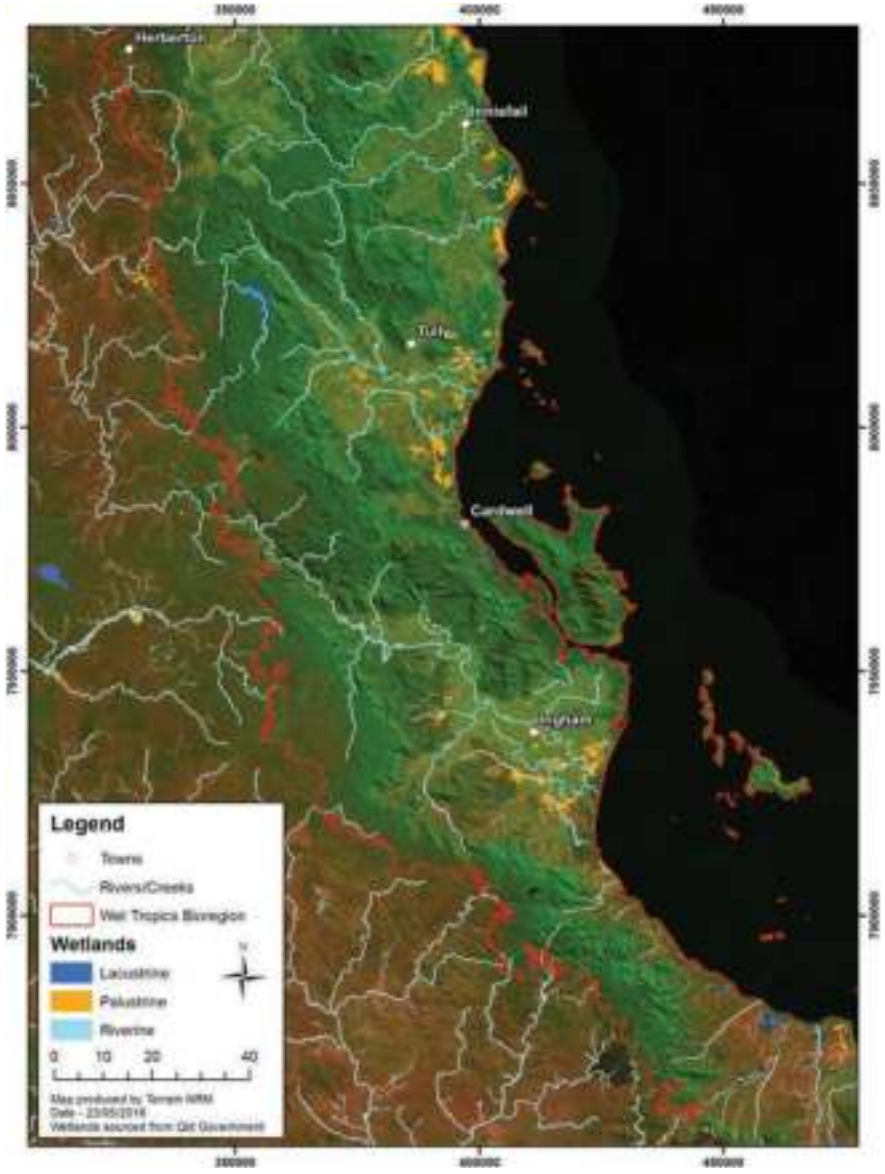


Figure 2: Extent of wetland types in the Southern Wet Tropics Bio-region (red boundary)

SUBMERGED PLANTS

Leaf blade strongly puckered and crinkled (bullate)

Tightly clustered yellow flowers usually held under the water

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering				●	●	●	●	●	●	●	●	●
Fruiting							●	●	●	●	●	

ENDANGERED

North Queensland lace

***Aponogeton bullosus* – Family Aponogetonaceae**

Other common names:
No other common name

Description: Submerged perennial plant to 0.5 m with underground tubers to 20 mm long, multiple thin linear leaves 70–500 mm long, 5–25 mm wide, on a stem (petiole) 10–100 mm long, leaf blade strongly puckered and crinkled (bullate). Flower cluster (inflorescence) is usually submerged, rarely emergent, on a stem (peduncle) 300 mm long, flowers yellow, tightly clustered, with a sheathing bract (spathe) 25 mm long. Fruit cluster cone shaped, densely packed with small fruit 4.2–6 mm long each with a prominent beak, each containing 3–8 seeds.

Distinctive features: *A. lancesmithii* also has bullate (crinkled and puckered) leaves but the flowers are emergent, leaf stems (petioles) are longer (to 360 mm), and leaves may be wider (to 38 mm). *A. prolifer* (often called a 'live bearer') produces new plants from the top of the flowering stalk (peduncle), *A. queenslandicus* produces mostly floating leaves, *A. vanbrugenii* can produce floating leaves if the water is still or turbid, and *A. cuneatus* has oval-shaped fruit.

Habitat: This submerged aquatic plant is generally confined to cool, fast flowing freshwater streams and rivers of the Wet Tropics, particularly those with a granitic rocky and sandy bed. It is tolerant of both sunny and shady positions but prefers areas where there is good canopy cover along watercourses. It is known to be severely impacted by aquatic and riparian weeds. Plants may die back to the underground tuber for a 'rest period' of 6–8 weeks.

Value in wetland:

- provides important aquatic habitat in permanent water bodies
- provide valuable habitat for juvenile endemic catfish
- absorbs nutrients directly from water
- due to its sensitivity to poor water quality and invasion by aquatic and riparian weeds, it is a useful biological indicator of stream health.

Plant uses:

- tubers of many Aponogeton species were eaten by Indigenous people.
- its attractive appearance in the aquarium trade led to it being over-harvested to the point of extinction since they are difficult to keep and often had to be replaced. All wild collecting of this plant is now illegal.

Propagation: Cross-pollination between different individuals is apparently necessary for seed production. The fruiting body disintegrates, and the heavy seed falls to the bottom of the creek. In high light levels, they normally germinate after only 3–4 days. A licence is required to keep and propagate this species; it may not be collected from the wild.

Submerged grass-like annual plant in shallow waters of lakes, ponds, and flowing creeks and rivers

Male flower buds emergent on long stems (peduncles)

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●				●	●	●	●	●
Fruiting			●	●	●	●	●	●				

Roundfruit blyxa

***Blyxa aubertii* – Family Hydrocharitaceae**

Other common names: Bamboo plant, giant blyxa. Previous scientific name: *Blyxa echinosperma, Blyxa ceylanica*

Description: Submerged grass-like annual plant 0.3–0.5 m height, leaves long and thin, 25–500 mm long, 2–12 mm wide, finely toothed along margins and tapering to a fine point. Leaves in the centre of the clump may have a reddish colour. Male flowers with three white petals and three stamens held erect above the surface of the water, on stems (peduncles) 30–500 mm long. Female flowers produced underwater on the stem, surrounded by a sheath (spathe) 35–46mm long. Fruit elongate 70 mm long, developing in the spathe, containing numerous spiny seeds 1.25–2 mm long. Two varieties occur in the Wet Tropics; *aubertii* and *echinosperma*, differing in the extent of spines on the seeds; the latter with long 'tails' on the seed.

Distinctive features: Easily confused with *Vallisneria* species, however, *Blyxa* doesn't have the spiralling stem for the flowers and fruit. When only leaves are present, *Blyxa* differs from *Vallisneria* by having a central vein in the leaf with faint cross veins and tiny microscopic spines on the leaf margin. *Blyxa octandra* also occurs in the Wet Tropics. Held up to the light, *B. octandra* has two flowers within the spathe, compared to one in *B. aubertii*.

Habitat: Occurs in a range of ephemeral and permanent aquatic habitats including the shallow waters of lakes, ponds, and flowing creeks and rivers. May grow as a perennial in permanent waters. Tolerant of slightly brackish water and high nutrient levels. A maroon colouration in the leaves can be an indicator of high iron content in the water.

Value in wetland:

- a high abundance may be an indication of high nutrient levels (eutrophic)
- leaves eaten by herbivorous fish
- in high iron concentrations, leaves may support abundant iron bacteria
- plants self-pollinate and are not known to be pollinated by animals
- native to Australia, it is a threatened species in Japan and an introduced weed in the USA

Plant uses:

- leaves and stems eaten as a vegetable in parts of south east Asia
- grown as an ornamental aquatic plant for well-lit aquariums with slightly acidic water, high CO2 and high iron

Propagation: Propagation is normally by separating large clumps by dividing the underground stem (rhizome). In an aquarium, plants will deposit seed throughout the tank but seeds can be collected once brown in colour and sown into a shallowly submerged fine grained substrate

Opposite fan-shaped leaves on end of a distinct stalk (petiole)

White 6-petalled flowers held above water line

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	•	•	•	●	●	●	●
Fruiting	Not recorded fruiting in Queensland											

WEED

Cabomba

***Cabomba caroliniana**– Family Cabombaceae*

Declaration status: Weed of National Significance, Restricted Category 3 plant under the *Biosecurity Act 2014*

Other common names: Green cabomba, Carolina fanwort

Description: Submerged perennial plant 1.5 m long, leaves are oppositely arranged, 6–11 mm long, deeply dissected and divided into five sections, the finely divided leaves fanning out to a roughly circular shape. Flowers are white, symmetrical, 8–11 mm long, with six 'petals', three inner petals yellow at base with short claws, outer petals green at base. Flowers solitary, held several centimetres above water. Fruit dark, oval 3 mm long and 1 mm wide, but plants in Queensland are not known to produce viable seed.

Distinctive features: Opposite leaves are finely-divided and fan-shaped on end of long stalks (petioles). *Myriophyllum* and *Ceratophyllum* demersum do not have leaf stalks and *C. demersum* leaves are whorled.

Habitat: Sensitive to drying out so requires permanent water. Generally prefers shallow water with a silt bed but can grow in water 3–10 m deep, and will continue to grow when free-floating. Plants grow best (up to 50 mm /day) with high nutrient levels, high light availability, high temperatures, low salinity, low pH and low calcium levels. First recorded in 1967, it is now a widespread problem in freshwater lakes, dams and rivers in the Wet Tropics.

Impacts on wetland: Native to America, this noxious weed:

- obstructs water flow, blocking creeks, drains and irrigation infrastructure
- displaces native water plants, fish and other animals
- taints water supplies and significantly increases water treatment costs
- reduces the storage capacity of dams
- severely restricts recreational activities such as swimming, fishing and boating
- creates suitable habitats for mosquitoes to breed.

Weed facts:

- although it is still used in the aquarium trade, it is illegal to grow or sell a declared weed in Queensland
- it is in the top 20 priority weeds in Cairns and in the top five high risk wetland weeds in the Wet Tropics.

Spread and control: Humans are the main dispersers. Plants mostly spread vegetatively from broken fragments. Seed production in Queensland is unknown but possible and requires more research. Drying out may eradicate populations. Prevention of spread by quarantine and wash-down of boats and vehicles is the highest priority in susceptible areas. Contact your local council Lands Protection Officer for advice on controlling infestations. For further information on control, refer to Department of Agriculture and Fisheries – Cabomba: www.daf.qld.gov.au/__data/assets/pdf_file/0005/72896/IPA-Cabomba-PP30.pdf

Whorls of finely-divided leaves and elongate fruit 3–4 mm long

Leafy stems often form dense submerged mats

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Hornwort

***Ceratophyllum demersum* – Family Ceratophyllaceae**

Other common names: Coontail, common hornwort. Previous scientific name *Ceratophyllum muricatum*

Description: Submerged perennial plant, floating or weakly attached to substrate, to 60 cm long. Roots are absent. Leaves whorled, 15–35 mm long, branching 1–4 times, each of the fine thread-like 'leaves' has teeth along its length. Flowers are inconspicuous, male and female separate, petals absent. Fruit is dark brown 3–4 mm long with 1–3 spines up to 3 mm long.

Distinctive features: Whorled, finely-divided leaves with small marginal teeth arising directly from the stem. Leaves of *Cabomba caroliniana* are borne on the end of stalks and are oppositely arranged. *Myriophyllum spp.* do not have teeth on leaf edges.

Habitat: Occurs in still and slow-moving freshwater, including coastal rivers and creeks (especially those with weirs and dams), bunded wetlands, oxbow lakes, flood plains or permanently wet drainage channels. Occurs in water up to 5 m deep and generally only where salinity is relatively low.

Value in wetland:

- provides important aquatic habitat in permanent water bodies
- effective in absorbing nutrients
- can become prolific with high nutrients, and has become a weed in countries outside its native range. Forms dense underwater mats, creating hazard for swimmers and entanglement has resulted in drowning. It is sometimes managed by mechanical harvesting.

Plant uses:

- used in traditional medicine for ulcers, diarrhoea, scorpion stings and to improve healing of wounds
- it rapidly absorbs nutrients and apparently limits algal blooms making it a useful plant in managing wastewater
- effective in removing heavy metals such as lead, zinc, and copper from solution
- in some countries it is used in animal feed and for mulching
- a popular aquarium plant.

Propagation: Propagation is normally from tip cuttings; however, seeds can be germinated in submerged pots. It is propagated from seeds which are heavier than water and sink to the bottom.

Submerged whorls of thread-like leaves on long stems

Tightly packed flowers on round black heads held erect above water

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Water pincushions

***Eriocaulon setaceum* – Family Eriocaulaceae**

Other common names: Pipewort, Eriocaulon

Description: Submerged annual or weak perennial plant, rooted into substrate, to 70 cm long. May break from substrate and grow in the water column. Leaves are thin and threadlike (filiform), 25–160 mm long, arranged randomly around the stem, crowded towards the growing tips. Flowers are tightly arranged into round black heads 3.5–6 mm wide, held erect above the water on stems (peduncles) 50–270 mm long, mature seeds are minute 0.5–0.6 mm long.

Distinctive Features: Although there are 14 species of Eriocaulon in the Wet Tropics, only *E. setaceum* is a submerged aquatic with an elongated stem and wispy leaves. Other species grow in the moist margins of wetlands and creeks as a rosette of longer and broader leaves. Identification of *Eriocaulon* is difficult and requires microscopic examination of the minute bracts that make up the flower heads. *Najas tenuifolia* has a much narrower stem and the flowers are not held above the water line.

Habitat: Occurs in still swamps and backwaters or within flowing freshwater stream, in water up to 1 m deep. Often in rocky or sandy substrates with low nutrient levels. Vegetation communities range from Melaleuca-dominated swamps to wet sedgelands. Seeds may remain dormant for several years.

Value in Wetland:

- provides important aquatic habitat in permanent water bodies.

Plant Uses:

- boiled in oil and applied as a poultice for itches
- very attractive aquarium plant but needs high light levels and low nutrients
- of interest to botanists as it is one of the few submerged aquatic plants with stomata on their leaves.

Propagation:

Grown from seed sown onto waterlogged soil or from stem cuttings with lots of leaves planted into submerged sand bed. New plantlets may develop from the plant tips, which can be separated.

Short leaves usually in whorls of five with minute serrations on the margins, with white female flowers on long stems

Submerged 'lawn' of *Hydrilla* in a fast flowing rainforest stream

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering		●	●	●	●	●	●	●	●	●	●	●
Fruiting							●	●	●	●		

Water thyme

***Hydrilla verticillata* – Family Hydrocharitaceae**

Other common names: Hydrilla.
Previous scientific name: *Serpicula verticillata*

Description: Submerged perennial plant, attached to substrate, stems up to 2 m long. Produces tubers under the ground. Leaves in whorls of 3–8 (usually 5), 2–20 mm long, 1–5 mm wide. Leaf margins finely toothed with pointed tip. Male and female flowers separate but rarely seen. Female flowers white and transparent, 2–3 mm long, solitary, borne on long stalks. Male flowers are round and released to float to the surface, where they burst and release their pollen. Fruit rarely seen, to 7 mm long.

Distinctive features: Broad, whorled leaf with serrated margin. *Najas tenuifolia* has narrower leaves, leaf stalk sheathing at base and leaves usually sub-opposite. In the Wet Tropics it can be mistaken for the introduced Pondweed (*Elodea canadensis*) which has leaves in whorls of three and no teeth or serrations of the leaf margin.

Habitat: Occurs in still and slow-moving freshwater bodies such as lakes, dams and slow-moving creeks. High abundance is usually an indicator of high nutrient levels. *Hydrilla* has a high resistance to salinity.

Value in wetland:

- in a natural wetland community *Hydrilla* is not regarded as a weed, and will improve water quality and provide a valuable habitat for juvenile fish
- absorbs nutrients directly from water
- under high nutrient levels, it can grow rapidly and become weedy, displacing other species. It has become a serious weed in the United States and is herbicide resistant in some areas.

Plant uses:

- widely sold as a dietary supplement, containing high levels of calcium and vitamin B-12
- claims of medicinal value include properties that are anti-tumour, antibacterial, improve cardiovascular function, improve digestion and circulation, and increase endurance
- used in traditional medicine to treat abscesses and boils and to improve healing of wounds
- ability to absorb nutrients directly from water makes it useful for treating wastewater, though generally requires high dissolved oxygen levels
- a popular aquarium plant for improving oxygen levels and providing food for fish
- of scientific interest for its ability to switch between C3 and C4 photosynthesis pathways, depending on conditions.

Propagation: Seeds are rarely seen. Propagation chiefly by stem pieces or from vegetative buds that develop in leaf axils. Underground tubers can be divided.

Emergent leaves change shape (feather-like)

Upright emergent stems with flowers and buds

Population with submerged and emergent leaves

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●			●	●	●	●	●	●	●	●	●
Fruiting	●			●	●	●	●	●	●	●	●	●

Parrot's feather

***Myriophyllum verrucosum* – Family Haloragaceae**

Other common names: Water milfoil, red milfoil. Previous scientific name: *Myriophyllum variifolium* var. *microphyllum*, *Myriophyllum crispatum*

Description: Perennial submerged and emergent herb, attached to substrate, 0.1–1.5 m long. Submerged and emergent leaves are very different. Submerged leaves are whorled, round, 7–18 mm long, deeply divided into 12–20 thread-like 'leaves'. Emergent leaves are whorled, deeply lobed/ 'feather-like' 2–7 mm long, 2–4 mm wide, often becoming reddish/ purple. Male and female flowers are separate. Male flowers are yellowish, round to oblong, and 0.6–0.8 mm long. Female flowers are simple, petals absent. Flowers borne at junction of emergent leaves and stem. Fruit is an elongate nut with longitudinal ridges, 1.4–1.5 mm long.

Distinctive features: Whorled, compound, feather-like leaves that are both submerged and emergent. *M. simulans* leaves are longer (more than three times as long as wide). The introduced invasive weed *M. aquaticum** does not occur in the Wet Tropics but is often grown in aquariums.

Habitat: Occurs on the margins or shallow sections of rivers, creeks, oxbow lakes and farm dams in fresh or brackish water generally less than 0.5 m deep. Its different leaf types make it tolerant of cycles of flooding and drying, and it will grow in wet mud. Can become over-abundant when nutrient levels are high.

Value in wetland:

- an attractive plant, providing a valuable aquatic and terrestrial cover on muddy margins of wetlands
- effective for absorbing nutrients
- in high abundance it can block drains and pumps, and taint water with an unpleasant smell.

Plant uses:

- used medicinally as a cure for diarrhoea and to reduce fever
- used to treat wastewater due to its ability to absorb nutrients but plants may become toxic from high concentrations of hydrogen cyanide
- used in artificial wetlands such as ponds and dams to improve water quality (does not thrive in aquariums)
- used as feed for pigs, ducks, and fish but can be poisonous under some conditions
- used in polishing wood.

Propagation: Seeds are thought to be able to remain dormant in dried mud for years. Usually propagated by stem cuttings. Planted into artificial wetlands at one per square metre.

Narrow leaves alternate on stems, becoming crowded towards tips of branches

Leaves with minute teeth and male flowers in reddish sheaths

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●						●
Fruiting	●	●	●	●	●	●						

Water nymph

***Najas tenuifolia* – Family Hydrocharitaceae**

Other common names: Thin-leaved Naiad, Previous scientific name: *Najas leichhardtii*

Description: Submerged annual or weak perennial up to 1 m long (usually much shorter), leaves crowded towards tips, then arranged alternately in whorls along a thin stem 0.5–1 mm thick, leaves thin, linear 12–25 mm long, 0.4–1 mm wide, often with a prominent pale midrib and minute teeth along the margins. Leaves have a sheath at the point of attachment with the stem. Male and female flowers are separate, in the corners of the leaves. Male flower 2–3 mm long occur towards the tips of branches and are enclosed in a reddish sheath (spathe). Female flowers 3–4 mm long, occurring in lower axils. Seeds are 1.7–2.6 mm long.

Distinctive features: Two other species of Queensland *Najas* (*N. browniana and N. marina*) do not occur in the Wet Tropics. The submerged leaves of *Potamogeton octandrus* appear similar, but are all arranged in a single plane compared to *Najas tenuifolia* which has leaves in a whorl.

Habitat: Mostly occurs in still or slow flowing permanent water, such as billabongs, swamps, farm dams and drainage channels. Mostly occurs in fresh water but is tolerant of brackish water. This is a fully submerged aquatic plant in water up to 2 m deep, sometimes forming extensive colonies.

Value in wetland:

- provides important aquatic habitat in permanent water bodies
- thought to be an important food resource for waterfowl and fish.

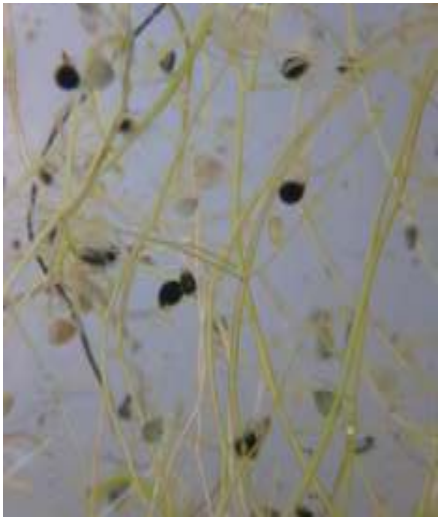
Plant uses:

- some species of *Najas* are known to be used as food for humans and livestock, but the edibility of this species is unknown
- can be used to remove heavy metals from phytoremediation ponds, especially lead and copper
- has been recommended for use in the submerged zone or permanent pools of constructed treatment wetlands and sedimentation basins, particularly to assimilate and retain Phosphorus
- often grown in aquariums but can break into multiple fragments if light levels or nutrients are low.

Propagation:

Plants are self pollinating. Seeds are heavy and sink to the substrate. The seeds have a hard casing which allows them to survive drying and potentially can remain dormant for several years. Germination methods currently unknown, but plants can grow easily from cuttings and stem fragments.

Utricularia aurea: Yellow flowers with small upper lip and bladder traps on whorled branches



Utricularia gibba: Yellow flowers with larger upper lip and bladders on untidy masses of stems

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	•	●	●	●	●
Fruiting	•	•	•	●	●	●	•	•	•	•	•	•

Floating bladderwort

***Utricularia gibba* – Family Lentibulariaceae**

Other common names: Creeping bladderwort, humped bladderwort.
Previous scientific name: *Utricularia exoleta*

Description: Submerged annual or perennial plant, free-floating or weakly attached to substrate, to 20 cm long. Roots absent but anchors with specialised stems (stolons). Leaves opposite, alternate or whorled towards the tip, thread-like, many bearing small rounded sacs (bladders) 1–2.5 mm long, used as vacuum traps to capture microscopic animals. Flowers bright yellow, with large upper petal and smaller lower petal, often with red nerves, 4–25 mm long, borne several centimetres above water in groups of 1–3 on erect stalks up to 30 mm long. Fruit round, 2–3 mm diameter, winged.

Distinctive features: 'Leaves' sparsely branched. Bladder traps are attached to leaves by a short stalk. *U. aurea* and *U. australis* are both aquatic with yellow flowers; however, both have a smaller upper petal than lower petal. *U. aurea* has neatly arranged whorls of branches with bladders and thread-like leaves arranged along the branches. *Utricularia caerulea* and *U. uliginosa* are bog plants with blue flowers.

Habitat: A common plant of still or slow-flowing wetlands, including river margins, lakes, swamps and drainage channels. Prefers full sun and shallow water. Although it can grow as a free-floating plant, it does best when loosely attached to the substrate and where levels of nutrients such as phosphorus and nitrogen are low.

Value in wetland:

- an attractive flowering plant in the shallow margins of wetlands, providing fish habitat and improving oxygen levels.

Plant uses:

- a popular novelty aquatic carnivorous plant for outdoor ponds and small dams, but generally not popular in aquariums due to its untidy growth habit
- sometimes planted for mosquito control; however, its usefulness is dubious
- this plant is famous among geneticists due to its very small genome.

Propagation: Regarded as very easy to propagate and grow. Can be grown from seeds but normally grown from divided sections wedged into a submerged pot of sand and peat. Best not to fertilise but grow in pond water to provide the necessary zooplankton such as rotifers and copepods.

Thin strap-like leaves and coiled flowering stems

Female flowers enclosed in a sheath

Thicket of Ribbonweed with coiled flower stems

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering			●	●	●	●	●	●	●	●	●	●
Fruiting			●	●	●	●	●	●	●	●	●	●

Ribbonweed

***Vallisneria nana* – Family Hydrocharitaceae**

Other common names: Eel grass, freshwater eelgrass, narrow leaf eelgrass, jungle val. Previous scientific name: *Vallisneria spiralis*

Description: Perennial herb, with submerged or floating thin leaves and slender above-ground stems (stolons) about 50 mm long. Leaves are long and strap-like, 0.7–2+ m long, 6–15 mm wide, with 3–5 obvious longitudinal veins and minute teeth along the leaf margins. Male and female occur on separate plants. Female flowers green with inconspicuous petals, enclosed in a sheath (spathe) 9–18 mm long and borne on the ends of long spiralling stems (peduncles) to 700 mm long. Male flowers are minute (0.5 mm) and produced in leaf sheaths at the base of the plant. The male flowers break off and rise to the surface where they pollinate the floating female flowers. Pollinated flowers are pulled underwater and produce a cylindrical greenish yellow fruit, about 10–90 mm long, 2.3–3.3 mm wide, with numerous small seeds 1.3–1.6 mm long, covered in dense, short hairs.

Distinctive features: *V. nana* is perennial with blunt (acute to obtuse) leaf tips, *V. gracilis* (*annua*) is an annual with tapering (attenuate) leaf tips. Introduced *Vallisnerias* are often grown in aquariums, especially Jungle val (*Vallisneria americana**). *Blyxa aubertii* may resemble *Vallisneria* but doesn't produce spiralling flower stems. Close examination of *Blyxa* leaves shows obvious cellular structure unlike *Vallisneria*.

Habitat: Grows submerged in still or, preferably, gently flowing permanent water in creeks, rivers, billabongs, floodplain channels, and irrigation drains in water 0–1.3 m deep. Can grow vigorously under high light levels. Prefers low salinity and a mud or sandy substrate.

Value in wetland:

- considered a keystone (very important) submerged plant species, providing valuable in-stream habitat and food for fish, macroinvertebrates and freshwater turtles (turtles eat the leaves)
- is a useful indicator species for a range of ecosystem health issues, including nutrient levels, competition from weeds and turbidity. High abundance in some coastal rivers has been attributed to high nutrient loads.

Plant uses:

- a useful submerged aquatic species suitable for use in the submerged zone in constructed wetlands for stormwater treatment
- very popular aquarium plant, apparently good for providing oxygen, and several cultivated varieties are known. Often grown in pots to limit spread in the aquarium.

Propagation: Seeds may require acid treatment to germinate, usually propagated by dividing the stolon.

Other submerged plants and algae

Aponogeton elongatus (Queensland lace) – Near Threatened – Submerged native perennial plant 7–35 cm long, in clear fast-flowing streams and rivers

Chara sp. (Stonewort) – A branching green algae often growing as a turf in alkaline water. It has whorled branches that are stiffened by secretions of calcium carbonate

Cladopus queenslandicus (Torrenticola) – Submerged flowering plant with scale like leaves and roots resembling liverworts, attached to rocks in clear fast-flowing rivers, rapids and waterfalls (Photo:Stuart Worboys)

Leptolyngbya tentaculiformis (Hot springs algae) – A thermophilic (heat loving) blue-green algae only known from the thermal springs at Innot Hot Springs

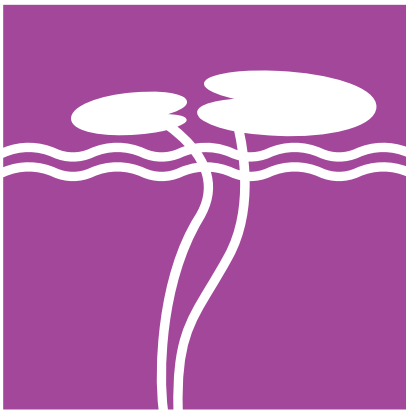

Limnophila brownii (Native ambulia) – Submerged and emergent native perennial herb 0.3 m tall, with different submerged and emergent leaves, in swamps and slow flowing backwaters of freshwater streams


Nitella pseudoflabellata (Nitella) – Branching algae found in a range of wetlands including lakes, shallow creeks and vegetated swamps. Similar to *Chara*, but grows in less alkaline water, has finer stems and has an unpleasant fishy odour when crushed.


Ottelia alismoides (Duck lettuce) – Submerged perennial native herb 0.6 m in freshwater dams, shallow pools and slow-moving watercourses in water up to 2 m deep


Potamogeton crispus (Curly pondweed) – perennial native 1–4 m long, in dams, lakes and streams to 4 m deep

FLOATING ATTACHED PLANTS



Robust erect clumps of rounded leaves

Yellow flowers on the end of angular branched stems

Infested rice paddy, Sulawesi, Indonesia

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

WEED

Yellow burr head

Limnocharis flava* – **Family Limnocharitaceae**

Declaration status: Restricted Category 2, 3, 4, 5 plant under the *Biosecurity Act 2014*

Other common names: Bur head, sawah flower rush, sawah lettuce, velvetleaf

Description: Perennial attached herb, 0.2–1.2 m tall. Leaves rounded and succulent 50–300 mm long, 40–250 mm wide, arising from angular stalks, 50–750 mm long. 11–15 parallel veins. Flower heads (inflorescence) borne on angular stalks from the base of the plant, each with 5–15 pale yellow flowers. Flowers have three white or yellow petals, and numerous bright yellow stamens in the centre. Fruit is a globular capsule which splits into 10–20 floating segments, each crescent containing about 1,000 shaped dark brown seeds, 10–15 mm long.

Distinctive features: Succulent angled stems and triangular leaf stalks are distinctive. Distinguished from *Eichhornia* (water hyacinth*) by being anchored, having taller triangular leaf stalks, broader leaves with more prominent veins and pale yellow flowers. *Monochoria* species (Bog hyacinth) are also anchored, but are smaller plants, have blue flowers, smaller leaves and stems are not angular.

Habitat: Prefers shallow muddy areas with good nutrient levels in freshwater pools, swamps, irrigation ditches and margins of slow-flowing streams. Grows as a significant weed of rice paddies in South East Asia. Since 2001, this plant has been subjected to an eradication campaign in Queensland, and in 2016 there are no known populations in the Wet Tropics region.

Impacts on wetland: Originally from Central and South America, this weed:

- forms dense infestations that displace native plants and animals
- chokes waterways and irrigation channels
- provides mosquito-breeding habitats and traps silt
- has a significant impact on agriculture, especially rice.

Weed facts:

- previously used as an ornamental pond plant; however, it is illegal to grow or sell a declared weed in Queensland. It is in the top 20 priority weeds in Cairns
- this is a Category 2 weed, so any sightings should be immediately reported to Biosecurity Queensland on 13 25 23.

Spread and control: Produces abundant seeds, which are dispersed by running water, water birds and animals, and by mud attached to vehicles, boats, machinery and footwear. Therefore, good hygiene practices, such as washing down vehicles and equipment, are critical in preventing spread. Seeds may remain dormant for several years. Also reproduces vegetatively from cuttings, detached leaves and stems. For information on control, refer to: www.business.qld.gov.au/industry/agriculture/species/invasive-plants/restricted/limnocharis

Masses of floating leaves with coloured bands towards the base of four wedge-shaped leaflets

Underground spore capsules (sporocarps) densely hairy, with no teeth

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	Not applicable											
Fruiting	Not applicable											

Smooth nardoo

***Marsilea mutica* – Family Marsileaceae**

Other common names: Rainbow nardoo, banded nardoo, Australian water clover, variegated water clover. Previous scientific name: *Marsilea brownii*

Description: Perennial floating or creeping fern with underground stems (rhizomes). Stems (stipes) about 25–300 mm long, hairless except at base. Leaflets wedge shaped in clusters of four, mostly hairless, 5–27 mm long, 4–28 mm wide. Leaves smaller in drier conditions. Leaves are darker green toward the ends and often, but not always with ragged bands of brownish green about the middle. Banding may be indistinct or absent on many leaves. No flowers are produced. Spore capsules (sporocarps) in clusters beneath the ground at the end of stalks (peduncles) 3–6 mm long, sporocarps 4.5–6 mm long, densely hairy, with no teeth.

Distinctive features: Several Nardoo species occur in the Wet Tropics. Only *Marsilea mutica* has the coloured bands on the leaves and is the only species without teeth on the sporocarp. *Marsilea crenata* has a distinctly wavy/scalloped edge of the leaves. Both *M. mutica* and *M. drummondii* have shorter sporocarps than the stems that attach them, but *M. drummondii* has sporocarps with 2 prominent teeth. Although sometimes mistaken for a four-leaved clover, they are unrelated to clover which is a legume.

Habitat: Grows in mud in shallow water of lagoons, swamps and billabongs up to 60 cm deep, and the wet, damp or drying margins. Tolerant of some salinity and may occur in wetlands influenced by king tides. In water, the leaves float on the surface or stand erect above it when crowded. Often forms a dense ground cover in drier areas subject to only seasonal inundation.

Value in wetland:

- sporocarps eaten by water birds, often passing through undamaged
- provides shelter for aquatic invertebrates and fish
- protects and stabilises mud banks, preventing erosion
- provides a moist microclimate during dry periods, and valuable habitat for frogs and invertebrates
- native to Australia, it has become a serious aquatic weed in the United States.

Plant uses:

- ground into starchy flour, mixed with water and cooked, but the outer cases contain toxic levels of thiaminase, an enzyme that destroys thiamine (vitamin B1). Explorers Burke and Wills died because they didn't separate the outer cases.
- young leaves are toxic to cattle, sheep, horses and pigs, potentially causing death
- used for treating household greywater
- a valuable plant for stabilising mud banks and banks of wetlands
- In ponds and dams, helps provide shade to minimise algal growth.
- commonly grown ornamental in aquaria and outdoor ponds, including in submerged pots.

Propagation: Propagation is usually by separating the underground stems (rhizomes). Sporocarps should be lightly scarified and soaked in water to release spores which germinate rapidly. Undamaged sporocarps are drought-resistant and can remain dormant for many decades. Plant on boggy margins, not actually into deep water.

Large spectacular flowers and erect round leaves

Generates extensive thickets along the deep margins of wetlands

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering			●	●	●	●	●	●	●	●	●	
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Pink lotus lily

***Nelumbo nucifera* – Family Nelumbonaceae**

Other common names: Sacred lotus, pink water lily. Previous scientific name: *Nelumbo speciosa, Nelumbium leichhardtii*

Description: Perennial robust herb, with underground stems (rhizomes) containing large hollow chambers up to 10 mm wide. Leaves initially floating, becoming mostly erect on spiny stems (petiole) to 1.5 m long. Leaves rounded, 200–700 mm wide, waterproof, with prominent veins radiating from the centre. Flowers pink or reddish pink, rarely white, 150–250 mm diameter, with bright yellow receptacle in the centre, developing into the fruit. Fruit are a flat-topped conical structure containing multiple solitary seeds. Fruit are erect at first, then tipping towards the water upon maturity. Seeds 14–16 mm long, initially green but hardening and turning dark grey to black upon maturity.

Distinctive features: The only waterlily with robust emergent leaves and large pink flowers.

Habitat: Occurs primarily in still or slow-flowing rivers, dams, billabongs, oxbow lakes, permanent or seasonally inundated swamps in water up to 2 m deep. Tolerant of a broad range of pH, but generally prefers lower salinity levels.

Value in wetland:

- generates extensive thickets along the deep margins of wetlands, creating an excellent habitat for a range of water birds, including white-browed crakes, swamp hens and bitterns
- flowers attract numerous insects, which in turn attract insectivorous birds. The pink lotus is able to generate heat in the flowers to maintain a warm temperature, possibly a mechanism to attract pollinating insects.

Plant uses:

- Indigenous people ate the immature peanut-sized seeds raw, roasted or boiled, or ground into flour for bread. The explorer Ludwig Leichhardt roasted and pounded the seeds as 'a most excellent substitute for coffee'. Flower petals are used in soups or as a garnish
- rhizomes edible raw or cooked. In Asia, they are boiled and dried, or tinned and used as a vegetable, or candied as a sweet. Has been investigated as a potential cash crop exporting rhizomes to Japan. Indigenous people ate the lower part of leaf stalks after stripping off the tough outer skin
- extensively used in Chinese medicine – seeds are used as a tonic tea to stop vomiting, soothe stomach upsets, and cure insomnia, fever, restlessness and hypertension. The leaves and juice from leaf stalks used to cure diarrhoea, fever, haemorrhoids and leprosy (untried by author). Rhizomes used to cure diarrhoea. General cure for mushroom or alcoholic poisoning
- the distinctive conical woody seed pods are used in dried floral arrangements
- huge mature leaves used as hats or to wrap food for steaming
- cultivated as an ornamental in lakes and ponds. Several cultivated varieties are known
- of great significance to Buddhists, who regard the flower as a symbol of purity and tranquillity.

Propagation: Seeds are very hard and require careful cutting or sanding (scarification) before planting into submerged pots, otherwise they may remain dormant. Seeds found during archaeological excavations in China have been known to germinate after 1350 years. Commercially, the pink lotus lily is propagated by division of the rhizome to reduce genetic variation. In small ponds, they are often grown in tubs to prevent from spreading. Has been mistaken for an introduced plant.

Toothed leaves with large blue or white flowers that fade with age

In deep permanent wetlands, Blue water lily provides valuable in-stream habitat for a range of waterbirds and aquatic macroinvertebrates

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●							

Blue water lily

***Nymphaea gigantea* – Family Nymphaeaceae**

Other common names: Giant waterlily. Previous scientific name: *Nymphaea georginae*

Description: Perennial robust herb, with globular underground stems (rhizomes). Floating leaves are produced on the ends of long stem (petioles) 150 cm long. Leaves round, 200–800 mm diameter (apparently increases with water depth), green above, purplish underneath, and notched deeply at the base to the centre of the leaf. The margin of the leaf has prominent teeth 4–5 mm long. Flowers up to 300 mm wide, borne on the ends of long stems (peduncles) up to 500 mm above the water. Flowers open during the day and close at night; with up to 32 petals, usually blue but can be white or, rarely, pink, fading with age. Centre of flower is a dense mass of around 400 yellow stamens. Fruit are round and spongy, around 50 mm diameter, sinking beneath the water after the flower has finished. Fruit contain numerous oval-shaped seeds to 2.5 mm, each with rows of short hairs.

Distinctive features: Four species of *Nymphaea* occur in the Wet Tropics. *Nymphaea gigantea* has regularly spaced teeth to 5 mm long, unlike *N. nouchali* and *N. violacea*, with smooth leaf margins. *N. immutabilis* also has a toothed leaf but petals do not fade with age. *N. nouchali* is a very small plant, with leaves only 100mm diameter. The introduced *N. caerulea** (*N. capensis**) has blue tips on the anthers and is cultivated in this region, however, it is a highly invasive weed. Several other introduced *Nymphaea* are common in cultivation but haven't been recorded as wild populations in the Wet Tropics yet.

Habitat: Occurs primarily in still or slow-flowing fresh water up to 3 m deep, in swales, swamps, billabongs, oxbow lakes, and on the edges of lakes and rivers. Prefers relatively clear water and may eventually die in turbid water.

Value in wetland:

- provides valuable in-stream habitat for a range of water birds and aquatic macroinvertebrates
- due to its sensitivity to poor water quality and invasion by water hyacinth, it is a useful biological indicator of wetland health.

Plant uses:

- most parts are edible. Indigenous Australians roasted and ate the thick rhizomes, which are rich in carbohydrates
- fruits were collected before they split, then roasted for easier extraction of the seeds. Seeds are high in potassium and were pounded with rocks to make flour
- young flower stalks were stripped of fibres and eaten
- Indigenous people in Western Australia rubbed the leaves over their bodies to prevent bites from aquatic leeches
- many cultivated varieties are grown in artificial pools for their colourful fragrant flowers.

Propagation: Can be propagated by seeds or by dividing the rhizome. Seeds need to be moist prior to sowing. The seed with the surrounding pulp needs to be covered by approximately 25 mm of water, with a temperature of 23–27°C. Once the first floating leaves appear, the water level needs to be increased as they grow. For propagation using the rhizome, a portion of the rhizome with a sprouting eye should be removed and potted in a small pot immersed in water.

White flowers with a delicate fringed margin

An abundant plant of most permanent freshwater wetlands

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting			●	●	●	●	●	●	●	●	●	

Water snowflake

***Nymphoides indica* – Family Menyanthaceae**

Other common names: Snowflake marshwort. Previous scientific name: *Menyanthes indica*

Description: Perennial or annual herb, with floating leaves and floating above-ground stems (stolons) up to 2 m long that sometimes send out roots at the nodes. Leaves are produced on the ends of long stem (petioles) 2 m long. Leaves are roughly circular in shape, 20–270 mm long, 20–250 mm wide, broadly notched at base to the centre of the leaf (cordate). Margins of the leaf are smooth or, rarely, slightly wavy. Clusters of 4–7 white flowers borne erect above the water surface on stems (pedicels) 10–80 mm long. White flowers with five (rarely, four or seven) delicately fringed petals, yellow at the base. Fringed petals increase surface tension which helps prevent dunking. Fruit is a globular capsule, containing between 1–50 round seeds, 1–2 mm diameter.

Distinctive features: There are five *Nymphoides* in the Wet Tropics. *Nymphoides crenata* and *N. exiliflora* have yellow flowers. *Nymphoides parvifolia* and *N. quadriloba* have white flowers but much smaller floating leaves, and are annuals, not perennials. *N. quadriloba* has a horseshoe-shaped leaf and usually only four petals with a thin membrane on the margins of the petals rather than a fringe.

Habitat: Occurs in a broad range of freshwater wetland types, including lakes, lagoons, billabongs, swamps and margins of slow-flowing creeks and rivers. Prefers permanent water on either a clay or sandy substrate. Often naturally colonises artificial wetlands.

Value in wetland:

- provides valuable in-stream habitat for a range of fish and aquatic macroinvertebrates
- generates excellent habitat for a range of water birds, including comb-crested jacanas and white-browed crakes
- flowers reflect UV to attract numerous insects, which in turn attract insectivorous birds
- captures nutrients from the water
- adds colour and beauty to wetlands (aesthetic values).

Plant uses:

- young leaves, stems, flower buds and fruits can be boiled and eaten in curries
- used medicinally in Vietnam to treat fever and flatulence, and prevent scurvy (antiscorbutic)
- has been established easily and quickly in local constructed wetlands projects
- used in constructed wetlands to strip nutrients from wastewater
- water snowflake is a highly ornamental species popular in dams and aquariums, often as a substitute for the introduced *Nymphoides aquatica**.

Propagation: Easily propagated, as each leaf produces a plantlet. If not dislodged from the parent plant, then plants can be divided by cutting the stolons and removing the plantlets. Propagation can also be undertaken by leaf and herbaceous stem cuttings. Can be grown from seed, although division has been shown to be the simplest method.

Other waterlilies

Brasenia schreberi (Water shield) – Native perennial appearing like a waterlily but oval leaves only 8 cm long, covered in slime underneath. Occurs in shallow freshwater billabongs and lagoons (Photo: Andrea Lim)

Nymphaea immutabilis (Unchanging waterlily) – Native perennial waterlily with toothed leaves and deep blue flowers that don't fade with age, in permanent swamps, lakes and billabongs

Nymphaea nouchali (Tiny waterlily) – Annual or perennial waterlily with blue or white flowers and small leaves up to 100 mm across, in permanent or seasonal swamps, creeks or costal swales

Nymphaea violacea (Blue water lily) – Native perennial waterlily with smooth leaf margins and blue or rarely pink flowers, in permanent lakes, billabongs, dams and swamps

Large white flowers with three broad white petals, maroon / magenta at base

Broad floating leaves and flowers held erect on angular stems

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●			●	●	●	●	●	●

Swamp lily

***Ottelia ovalifolia* – Family Hydrocharitaceae**

Other common names: Water poppy. Previous scientific name: *Damasonium ovalifolium*

Description: Perennial or annual herb. Young leaves are submerged and strap-like, maturing to floating leaves borne on stems (petioles) 1.2 m long. Mature leaves are oval shaped, 160 mm long, 30–70 mm wide, and tapering to a blunt point. Leaves are reddish underneath and usually have seven prominent veins. Flowers 60 mm diameter, borne on angular stems (peduncle) with three broad white petals, maroon / magenta at base, lasting one day. A second type of flower is produced underwater, never opens and is self-pollinated (cleistogamous). Fruit is a submerged bladder-like sac (utricle) containing numerous seeds embedded in a gluey substance.

Distinctive features: Floating leaves similar to *Aponogeton queenslandicus*, which does not have numerous distinct veins. *O. alismoides* has completely submerged leaves and the centres of the flowers are yellow, without any magenta colouring. *Potamogeton octandrus* and *P. tricarinatus* have shorter and narrower leaves and dense spikes of small flowers.

Habitat: Occurs primarily in still or slow-flowing freshwater creeks, dams, lagoons, billabongs or swamps, to 1 m deep, with muddy substrates. High growth rates are often indicative of high nutrient levels.

Value in wetland:

- provides valuable in-stream habitat for a range of fish and aquatic macroinvertebrates
- important dry season source of food for fish and water birds
- captures nitrogen and phosphorus nutrients from the water
- adds colour and beauty to wetlands (aesthetic values).

Plant uses:

- leaves, flowers, fruit and stems cooked as a vegetable in South-East Asia
- Indigenous people ate the tubers and roots but method of preparation is unknown
- in the Philippines, leaves are used as a poultice (compress) to treat fevers and haemorrhoids
- used in constructed wetlands for removal of nitrogen and phosphorus
- often grown in outdoor ponds and dams for attractive flowers and leaves. Reported to be difficult to grow, but can also be over-abundant when there are excess nutrients.
- provides drought feed for stock.

Propagation: Can be propagated from fresh seed, which germinates readily in mud and in warm, shallow water to produce narrow, entirely submerged ribbon-like leaves.

Submerged leaves are long and thin, floating leaves narrowly oval shaped

Flowers and fruit on a short spike held erect above water level

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	•	•				•	●	●	●
Fruiting	●	●	●	●	•				•	●	●	●

Pondweed

***Potamogeton octandrus* – Family Potamogetonaceae**

Other common names: Lesser pondweed, small pondweed, Java pondweed. Previous scientific name: *Potamogeton javanicus, P. tenuicaulis, P. quinquenervius, P. ligulatus*

Description: Perennial herb to 3 m long with an underground stem (rhizomes). Submerged and floating leaves arranged alternately along the stem, and submerged leaves long and thin 50–100 mm long. 2–3 mm wide, floating leaves narrowly oval shaped 20–40 mm long, less than 10 mm wide, borne on leaf stalks (petioles) 7–16 mm long. Flower head (inflorescence) is a dense spike 20 mm long, held erect above water level, followed by small fruit 2–2.5 mm long with a noticeable beak.

Distinctive features: *Aponogeton queenslandicus* has only a single leaf on the end of each stalk and no obvious parallel veins. *Potamogeton crispus* has long, thin submerged leaves with a distinctly wavy margin. *Potamogeton tricarinatus* has a longer flower cluster (inflorescence), no narrow submerged leaves and usually much larger (40–90 mm long) floating leaves. *Najas tenuifolia* looks similar to submerged leaves of *Potamogeton octandrus*, but are arranged in whorls compared to *Potamogeton octandrus* which has leaves in a single plane.

Habitat: Prefers to grow in still or flowing permanent fresh or brackish water up to 1 m deep, including the margins of lakes, creeks and rivers.

Value in wetland:

- may occur in discrete dense masses, providing valuable in-stream habitat for a range of fish and aquatic macroinvertebrates
- captures nitrogen and phosphorus from the water.

Plant uses:

- easily grown as an aquarium plant in high light environments
- has been recommended for use in the permanent submerged zone of constructed wetlands, sedimentation basins and stormwater treatment pools
- used overseas to remove heavy metals from phytoremediation ponds, by concentrating moderate amounts of cadmium, zinc and lead.

Propagation: Can be propagated from seeds or, more simply, vegetatively from rhizomes and stem fragments.

Leaves with parallel veins and short erect flower spikes

Submerged and emergent leaves are both broad, arranged alternately along floating stems

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting				●	●	●	●	●	●	●	●	●

Floating pondweed

***Potamogeton tricarinatus* – Family Potamogetonaceae**

Other common names: Furrowed pondweed. Previous scientific name: *Potamogeton natans*

Description: Annual or weakly perennial herb, with submerged and floating leaves, and underground stems (rhizomes). Submerged leaves, lance-shaped 80–110 mm long, 15–25 mm wide. Floating leaves borne alternately along stems up to 3 m long, connected via a leaf stalk (petiole) 25–11 mm long. Leaves broad to oval shaped, 20–70 mm long, 7–30 mm wide, with 11–15 veins, reddish underneath. Flower head (inflorescence) is a dense spike 30 mm long, held erect above water level. Individual flowers 3–4 mm wide, followed by small fruit 3–3.5 mm long with a short beak.

Distinctive features: *Aponogeton* has only a single leaf on the end of each stalk and no obvious parallel veins. *Potamogeton crispus* has long, thin submerged leaves with a distinctly wavy margin. *Potamogeton octandrus* has long, thin submerged leaves. *Ottelia ovalifolia* has longer, broader leaves and large single white flowers.

Habitat: Grows in either permanent or seasonally dry (ephemeral) water bodies, either shallow or up to 3 m depth, including dams, billabongs, channels and rivers. Prefers a muddy substrate but has been recorded on rocky substrates.

Value in wetland:

- provides valuable in-stream habitat for a range of fish and aquatic macroinvertebrates
- captures nitrogen and phosphorus nutrients from the water
- can become seasonally over-abundant in dams and irrigation channels, blocking pump intakes.

Plant uses:

- used in constructed wetlands for removal of nitrogen and phosphorus from storm and wastewater. Tolerant of broad range of water quality and light levels.
- grown as an ornamental in outdoor ponds and dams, but not often used in aquariums despite being able to be pruned to maintain the submerged leaves.

Propagation: Can be propagated from seeds or, more simply, vegetatively from rhizomes and stem fragments.

FREE FLOATING PLANTS

Scale-like leaves harbour blue-green algae. Plants turn red in bright sunlight

Floating plants triangular with small scale-like leaves

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	Not applicable											
Fruiting	Not applicable											

Water fern

***Azolla pinnata* – Family Azollaceae**

Other common names: Ferny azolla

Description: Free-floating perennial fern to 30 mm long, generally triangular-shaped with feathery roots. Fronds with scaly lobes 1 mm long in alternating rows; initially green but changes colour to reddish when exposed to direct sunlight. Upper rows of leaves contain photosynthetic blue-green algae (*Anabaena azollae*). Reproduces either vegetatively from broken fragments or by two types of spores. Microspores are produced in conical structures under the plant surface, while megaspores are produced in the lower lobe of the leaves.

Distinctive features: *A. pinnata* has fine rootlets that are absent from *A. filiculoides*. *A. filiculoides* is irregularly shaped, not triangular like *A. pinnata*.

Habitat: Occurs primarily in still or slow-flowing rivers, creeks, channels, ponds, swamps and dams. Often occurs as scattered plants caught up in vegetation along the sides of creeks but, in the presence of high nutrient levels, especially phosphorous, it can double every seven days and eventually completely cover water bodies.

Value in wetland:

- through its association with blue-green algae, *Azolla* fixes atmospheric nitrogen and rapidly takes up nutrients in the water, thereby limiting the growth of introduced weeds such as salvinia* and water hyacinth* and, by reducing light penetration, reduces blooms of blue-green algae
- provides a high protein food source and habitat for water birds, fish, insects, snails and crustaceans
- high nutrient loads may cause *Azolla* to become over-abundant, potentially blocking pumps and water inlets, and reducing stock access to water; however, spraying herbicide on *Azolla* will cause de-oxygenation of the water, potentially causing fish-kills. If *Azolla* is removed from high nutrient wetlands, toxic algal blooms may result.

Plant uses:

- valuable as a biological indicator of nutrient levels in wetlands
- valuable in constructed wetlands for reducing nutrient loads and limiting algal growth
- mats of *Azolla* can be used as a form of biological mosquito control by preventing mosquito larvae surfacing for air (sometimes called 'Mosquito fern')
- excess *Azolla* can be harvested, and has been used for compost or as a chicken feed supplement
- grown as companion plant in rice paddies, as it fixes nitrogen and suppresses weeds
- attractive plant easily grown in dams, garden ponds and aquaria
- of botanical interest as a living fossil—*Azolla* fossils extend back at least 80 million years.

Propagation: *Azolla* is propagated vegetatively and from fragments. Under ideal conditions, it can double every seven days.

Floating plant with round glossy leaves and clusters of large pink/purple flowers

One of the world's most invasive water weeds, it can completely cover water bodies

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●			●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

WEED

Water hyacinth

Eichhornia crassipes* **– Family Pontederiaceae**

Declaration status: Weed of National Significance, Restricted Category 3 plant under the *Biosecurity Act 2014*

Other common names: Previous scientific name: *Pontederia crassipes, Eichhornia speciosa*

Description: Perennial floating herb to about 1 m tall, with dense masses of fibrous purple or black roots, and connected via spongy above-ground stems (stolons). Leaves glossy green, almost circular in shape, 30–250 mm diameter, held erect on stems (petioles) 30–750 mm long, 30 mm wide, swollen and spongy towards the base. Flower head (inflorescence) is a vertical spike to 200 mm long, with 4–20 flowers. Flowers 60–100 mm wide, with six petals, pink or purple. Upper petal with a blue circle surrounding a yellow blotch. Fruits are a capsule 15 mm long, submerged, containing multiple seeds.

Distinctive features: Clusters of large pink or purple flowers, floating habit, bulbous stems are rounded, leaves are highly distinctive. *Limnocharis flava** is superficially similar but has yellow flowers. The anchored water hyacinth (*Eichhornia azurea**) has larger leaves, tends to be anchored into mud instead of free-floating and has not yet been recorded in Queensland. *Monochoria* species (Bog hyacinth) are also anchored with smaller blue flowers and no swollen leaf base.

Habitat: Occurs primarily in still or slow-flowing freshwater wetlands, including rivers, creeks, swamps, billabongs and dams. Under high nutrient loads it is capable of doubling every two weeks, covering entire water bodies. Has a relatively low salt tolerance so has benefited from bunding of salt-marsh areas that are supplemented with irrigation runoff. Floating rafts eventually die if flushed into brackish or saline areas.

Impacts on wetland: Native to South America, this noxious weed is widely considered to be the world's worst water weed, due to the following:

- can rapidly spread to completely cover the surface of water bodies, effectively blocking light, reducing oxygen, killing aquatic plants, and reducing fish and water bird diversity
- blocks water flow in creeks and irrigation channels, blocks access to water by stock and wildlife, limits boat and recreational access, ruins fishing grounds, clogs hydro-electricity turbines and increases flood damage
- high rates of evapotranspiration causes water loss from dams far in excess of normal evaporation
- floating mats of hyacinth allow other weeds such as para grass to establish
- as hyacinth mats decay, nutrient levels increase, causing algal blooms and further loss of oxygen.

Weed facts:

- young leaves are supposedly edible after boiling
- stems are used as a source of fibres for making cord, or pulp for making paper
- originally used in the aquarium trade since the 1890s; however, it is illegal to grow or sell declared weeds in Queensland. It is in the top 20 priority weeds in Cairns and in the top five high risk wetland weeds in the Wet Tropics.
- provides good compost with high phosphorous levels; however, its high capacity for the uptake of heavy metals makes it generally unsuitable for use as stock fodder.

Spread and control: Seeds may germinate in a few days or remain dormant for up to 15 years; however, most spread is vegetative by growth of new plants from stolons. A biological control agent *Neochetina bruchi* leaves distinctive scars on the leaves. There are only a few herbicides registered for use of weeds in waterways. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label. For further information on control, refer to www.business.qld.gov.au/industry/agriculture/species/declared-pests/weeds/water-hyacinth

Floating plant with a oval-shaped leaf and a single root, divide to form daughter plants

Plants may form dense colonies when nutrient levels are high

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Lesser duckweed

***Lemna aequinoctialis* – Family Araceae**

Other common names: Common duckweed, tropical duckweed, three-nerved duckweed. Previous scientific name: *Lemna perpusilla*

Description: Free-floating annual or perennial herb 1–6 mm long, consisting of a green, oval, lance-shaped to round leaf, flat with three indistinct veins, and a single root to 30 mm long, with a sheath at the base. Flowers are produced on separate leaves, inconspicuous, minute, developing into small fruit 0.5–0.8 mm long.

Distinctive features: Many other duckweed species look superficially similar. Roots in *Wolffia angusta* are absent and often absent in *L. trisulca*. *L. trisulca* often grows as branched chains. *Spirodela oligorrhiza* and *S. polyrhiza* have more than one root per plant.

Habitat: Occurs as a floating plant in still freshwater ponds and lagoons, and among streambank vegetation in lakes and slow-flowing waterways, often where medium-high nutrient levels are present.

Value in wetland:

- important native floating plant, providing structural diversity in wetlands
- important protein-rich food for waterfowl such as fish and ducks
- valuable indicator of nutrient levels, improves water quality by removal of excess nutrients
- used for toxicity bioassays to test for water quality parameters and levels of toxins.

Plant uses:

- can be cooked and eaten as a vegetable
- used medicinally in South-East Asia to treat hypothermia, flatulence and acute kidney infections
- this and other duckweed species are widely used in constructed wetlands throughout the world to improve water quality. They are highly effective in removing suspended solids, faecal coliforms and nutrients, especially nitrates.
- duckweed can be grown and harvested for stock feed, generating 10–30 tons of dried feed per hectare per year
- harvested *Lemna* has been successfully converted to produce gasoline, diesel and kerosene
- often grown in dams as a food source for ducks, pygmy geese and other water birds. Freshwater fish enthusiasts often grow duckweed as food for goldfish and native freshwater fish.
- of interest to botanists as these are among the smallest flowering plants in the world.

Propagation: Plants rarely flower and set seed. Reproduction is usually vegetative, by 'budding' new plants at either side of the floating leaf, leading to small irregular clusters of cloned plants developing. Plant numbers may double every couple of days under optimal conditions.

Infestation at Yorkeys Knob, Cairns
(Photos: Byron Kearns NQ Dry Tropics)

Rosettes of glossy oval leaves

Honeycomb-like flotation cells (aerenchyma cells) on underside of leaves

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering			●									
Fruiting												

WEED

Amazon frogbit

Limnobium laevigatum* **– Family Hydrocharitaceae**

Declaration status: Not currently declared, status under *Biosecurity Act 2014* under review

Other common names: Smooth frogbit, West Indian spongeplant. Previous scientific name: *Salvinia laevigata*

Description: Perennial floating or rooted herb to about 0.6 m tall, with long, branched roots. Leaves arranged in rosettes wrapped around the stem, scale-like leaves at the base of the rosettes, floating leaves oval to broadly oval-shaped, 5–90 mm long, 3–78 mm wide on inflated stems (petioles) highly variable in length 5–400 mm long, Leaves are leathery, glossy green above, the underside mostly covered in spongy, honeycomb-like floatation cells (aerenchyma cells) up to 10 mm thick. Leaves tend to become more erect when plants are crowded and competing for light. Flowers are white, held erect above the water. Male flowers have three greenish-white to yellowish petals and a column bearing 1–6 stamens in whorls. Female flowers greenish-white, with 0–3 petals, with 2–6 long thin sterile stamens (staminoides). Fruit is a berry-like capsule on a curved stem (pedicel) containing up to 100 seeds covered in minute hairs.

Distinctive features: The frogbit (*Hydrocharis dubia**) also have discs of flotation cells on the underside of the leaves but these don't extend to the edge of the leaf and their thickness is significantly less than *Limnobium laevigatum**. *H. dubia* have flowers with three large, showy petals. Young seedlings can resemble duckweed (*Lemna* and *Spirodela* species) but leaves are larger (10–20 mm long). *Hydrocleys nymphoides** have flotation cells concentrated along an obvious midrib of the leaf.

Habitat: Occurs as a floating plant or rooted along the shallow margins of still or slow flowing freshwater ponds, lakes, swamps, drains, canals and rivers. Prefers high light and nutrient-rich, muddy substrates.

Impacts on wetland: Native to Central and South America, this noxious weed:

- can double in five days through vegetative spread and also produces vast numbers of seed
- forms a dense mat of interconnected plants and runners that cover the surface of the water, blocking light, reducing oxygen, killing aquatic plants and reducing fish and water bird diversity
- blocks water flow in creeks and irrigation channels, blocks access to water by stock and wildlife, limits boat and recreational access, ruins fishing grounds, clogs hydro-electricity turbines and increases flood damage
- floating mats of Amazon frogbit allow other weeds such as para grass to establish
- during decay, nutrient levels increase, causing algal blooms and further loss of oxygen
- has a higher salinity tolerance than water hyacinth, forms denser infestations, a residual seed bank and is considered more difficult to control.

Weed facts:

- first discovered in the Wet Tropics in 2011
- originally introduced as an ornamental plant for outdoor ponds, but is a highly invasive plant in Queensland and should not be grown.

Spread and control: Plants spread by runners and seeds. Floating plants form new plants on the end of runners. Seeds can remain dormant for 3–4 years, producing very small seedlings that can be easily dispersed by wind, currents, waterbirds and boats and in other floating waterplants. Eradication is best achieved if controlled before a seed bank is formed. Mechanical treatment can spread fragments so containment nets should be used. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label. For further information on control, contact Biosecurity Queensland or your local lands protection officer. In 2015, the only known location was at Yorkeys Knob near Cairns, where it has since been eradicated.

Lettuce-like rosette of leaves

Small flowers are easily overlooked

Water lettuce can completely cover the surface of water bodies, effectively blocking light

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●			●			●			
Fruiting	Not recorded fruiting in Queensland											

WEED

Water lettuce

Pistia stratiotes* – Family Araceae

Declaration status: Restricted Category 3 plant under the Biosecurity Act 2014

Other common names: Water cabbage, Nile cabbage, water bonnet, tropical duckweed

Description: Perennial floating herb 17 cm diameter (rarely, up to 30 cm), with a lettuce-like arrangement of leaves, long feathery roots and often connected via above-ground stems (stolons). Leaves are pale green, oval to spatula-shaped (spathulate), with distinct longitudinal nerves. Leaf length varies from 20–115 mm long, 15–85 mm wide, with smaller leaves towards centre of rosette. Flower head (inflorescence) 8–12 mm long, with separate male and female flowers, but this plant is not known to produce viable seed in Australia. Reproduction is vegetative.

Distinctive features: Lettuce-like rosette of leaves make it unlikely to be confused with other water plants.

Habitat: Occurs as a floating plant in still or slow-moving freshwater wetlands, such as slow-flowing streams, dams and lagoons, especially where nutrient levels are high. Has a relatively low salt tolerance so has benefited from bunding of tidal creeks and salt-marsh areas. Floating rafts often get flushed into brackish and saline areas, where they eventually die.

Impacts on wetland: Probably native to South America, and possibly parts of Asia, Africa and the Northern Territory, this noxious weed can completely cover the surface of water bodies with the following impacts:

- blocks light penetration
- reduces oxygen levels
- kills aquatic plants
- reduces fish and water bird diversity
- blocks water flow
- limits boat and recreational access
- ruins fishing grounds
- clogs hydro-electricity turbines
- increases flood damage
- provides habitat for disease-carrying mosquitoes to breed
- when it forms floating mats, it allows other weeds such as para grass* to establish
- is generally not as problematic as water hyacinth in the Wet Tropics region, possibly due to impacts of biological control by weevils and moths, or competition from other floating weeds.

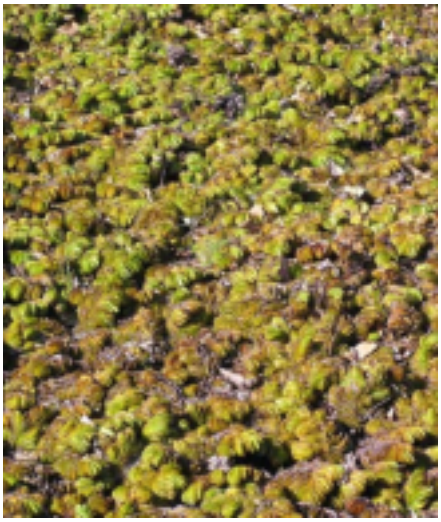
Weed facts:

- despite its similar appearance to lettuce, it is not edible. It contains calcium oxalate crystals and other toxins that cause intense burning of the mouth, tongue and throat, resulting in swelling and choking. Causes nausea, vomiting and diarrhoea
- leaves have been used medicinally to treat stomach problems, painful urination (dysuria), gonorrhoea, boils, syphilis and haemorrhoids. Roots have been pounded and used to treat burns
- harvested material is good for composting
- although it is still used in the aquarium trade, it is illegal to grow or sell as it is a declared Category 3 weed in Queensland. It is in the top 20 priority weeds in Cairns.

Spread and control: In Australia, plants only reproduce vegetatively by producing new plantlets on the end of stolons. There are only a few herbicides registered for use of weeds in waterways. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label. For further information on control, refer to www.business.qld.gov.au/industry/agriculture/species/declared-pests/weeds/water-lettuce

Leaves covered in stiff white 'egg-beater' hairs

Leaves fold along the midrib when compressed



Dense smothering infestations can generate up to 400 tonnes of wet weight per hectare

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	Not applicable											
Fruiting	Not applicable											

WEED

Salvinia

Salvinia molesta* **– Family Salviniaceae**

Declaration status: Restricted Category 3 plant under the *Biosecurity Act 2014*
Other common names: giant salvinia, dariba weed, water moss

Description: Perennial floating fern with green floating fronds and brown submerged fronds to 300 mm long that are branched and hairy, resembling roots. Floating fronds are oval shaped or circular, 8–35 mm long, 5–35 mm wide, with a distinct folding midrib. Leaf surface is covered in stiff four-sided 'egg-beater' shaped hairs that repel water and assist flotation. When plants become crowded, the leaves fold along the mid-rib, allowing them to pack together tightly. Although *salvinia* has spore-producing structures (sporocarps), they are not known to produce spores in Australia. All *salvinia* in Australia are sterile clones, reproducing vegetatively.

Distinctive features: *Salvinia molesta** is the only *Salvinia* species in Australia and is distinguished by its 'egg-beater' shaped hairs on the upper surface. All other 11 species are also totally prohibited.

Habitat: Usually grows on still or slow-flowing water such as lakes and dams, especially where nutrient levels are very high (eutrophic).

Impacts on wetland: Native to Central and South America, this noxious weed:

- can rapidly spread to completely cover the surface of water bodies, generating up to 400 t of wet weight per hectare, effectively blocking light, and killing native aquatic plants and fish
- significantly reduces the use of wetlands by water birds, wildlife and recreational users
- reduces water quality by tainting and discolouring water supplies
- may provide habitat for disease-carrying mosquitoes to breed
- can reduce oxygen levels in the water, creating barriers to fish passage and leading to fish kills
- allows other weeds such as para grass* to establish and bind the infestation.

Weed facts:

- originally introduced in 1953 for the aquarium trade; however, it is illegal to grow or sell as it is a declared weed in Queensland. It is in the top 20 priority weeds in Cairns and one of the top five high risk wetland weeds in the Wet Tropics.

Spread and control: Plants are sterile, and any spores are usually deformed. Spread is vegetative by dividing into daughter plants, doubling in as little as 3–4 days. Although infestations tend to be flushed out during wet season rains, the size of infestations in the Wet Tropics region has been substantially reduced since introduction of the salvinia weevil (*Cyrtobagous salviniae*) in the 1980s. Other controls include mechanical (aquatic mechanical harvesters) or chemical. There are only a few herbicides registered for use of weeds in waterways. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label. Note that large quantities of decomposing salvinia can cause nutrient blooms and a loss of oxygen levels leading to fish kills. For further information on control, refer to www.business.qld.gov.au/industry/agriculture/species/declared-pests/weeds/salvinia

HERBS AND SHRUBS

A. aureum with blunt leaf tips

A. speciosum with tapering leaf tips

Forms clumps or dense stands on the margins of lowland freshwater swamps, marshes and lakes

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	Not applicable											
Fruiting	●	●	●	●	●	●	●	●				

Golden mangrove fern

***Acrostichum aureum* – Family Pteridaceae**

Other common names: Golden leather fern, leather fern, swamp fern, marsh fern.

Description: Perennial clumping fern to 3–4 m tall, with a thick underground stem (rhizome) covered in brown scales. The tall fronds have leaflets arranged alternately along the stem (stipe). Leaflets green to golden yellow, up to 350 mm long, 40–50 mm wide, tips of the leaves are very bluntly rounded on the ends with a small pointed tip. The plant does not flower, but produces dense brown spores on the underside of fertile leaves towards the tip of the fronds.

Distinctive features: The mangrove fern (*Acrostichum speciosum*) is generally shorter and rarely found in freshwater environments. It is a similar looking plant but the tips of the leaves taper to a point. Both are found in the Wet Tropics.

Habitat: Although tolerant of salinity levels up to 50 ppt, it requires fresh water to establish. It can be seen growing in the landward side of the mangroves and brackish swamps, and also in a range of lowland freshwater swamps, marshes and lakes where it can form dense stands. It often colonises disturbed areas in these environments.

Value in wetland:

- provides important wildlife habitat. An over-abundance can lead to reduced diversity of waders by reducing areas of open mud bank
- considered an indicator of disturbance when growing in abundance
- has been considered over-abundant in areas where mangroves have been disturbed.

Plant uses:

- stems (rhizomes) were eaten by Indigenous people after roasting
- young shoots are sometimes cooked or eaten raw in a salad in central Asia
- fiddleheads (curled growing tips) have been eaten raw or cooked and have been described as resembling asparagus
- in Malaysia, the stems (rhizomes) are pounded and used to treat wounds and boils
- leaves and roots used to treat bleeding, haemorrhoids, gastritis, dysentery and stomach disorders
- stems used for weaving fishtraps
- fibres in mature leaves can be used to make string and cord
- dried fronds are used to thatch houses in Vietnam and the Pacific, and are apparently fire-resistant
- in brackish areas, it's an indicator of freshwater
- grown in cultivation as an attractive container plant, though the roots should be kept wet.

Propagation: Although difficult, clumps can be transplanted and divided, but relatively easy to grow from spores.

Yellow pea flowers with a red splotch, compound leaves and an elongated pod

Forms low, dense thickets on wet mud along wetland edges or shallow depressions

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●			●	●
Fruiting	●	●	●	●	●	●	●	●			●	●

WEED

Budda pea

Aeschynomene indica* **– Family Fabaceae**

Declaration status: Not declared

Other common names: Indian joint vetch, Previous scientific name: *Aeschynomene pumila*

Description: Annual scraggly shrub 0.5–2 m tall, with long, tapering compound leaves. Compound leaves are alternately arranged on stems 50–145 mm long, consisting of 30–60 oblong leaflets, 2–10 mm long, alternately arranged and becoming smaller towards the tip of the compound leaf. Leaves are green but become distinctly silver during the cooler, dry season. Stipule (leaf-like structure at base of leaf) 7–10 mm long, roughly triangular, falling with maturity. Flower head (inflorescence) is borne on the end of a stem (peduncle) 15–60 mm long, bearing 1–4 pea flowers. Petals are pale yellow, though enlarged top petal (standard) has a red splotch and red-streaked veins. Fruit is a elongate pod 10–45 mm long, 3.5–5 mm wide, green, and dotted with distinct glandular hairs when young, maturing to brown with distinct segments, containing up to nine dark seeds 4 mm long, 3 mm wide.

Distinctive features: Aeschynomene americana* has pink flowers with a yellow centre, and seed pods with obvious constrictions between segments.

Habitat: Grows singly or in small dense thickets on clay soils in or along the margins of creeks, billabongs, flood plains, melon holes or seasonally flooded depressions in woodland or grassland habitats. Often indicates the presence of shallow water, or poorly drained pockets of wet or drying mud in grasslands.

Impacts on wetland: The origin of this weed is obscure but possibly from the Americas. This plant:

- grows in dense thickets on muddy ground, outcompeting smaller bog plants such as bog hyacinth
- is a serious weed of rice paddies and drains
- is toxic to stock but of low palatability, so tends to increase in abundance under grazing
- reduces aesthetic appeal of wetlands after plants have died off.

Weed facts:

- used in Indian traditional medicine for treating kidney stones, leprosy and snake bite. Research shows it has strong antimicrobial and antifungal activity, and may have potential as a drug for enhancing sperm count
- wood is burnt to provide charcoal for gun powder
- light wood is used as floats for fishing lines and nets
- although introduced for stock fodder, it has relatively low palatability, and is suspected being mildly toxic. Stock deaths are reported from overseas. Seeds are known to be toxic to pigs.

Spread and control: Flowering takes place in summer and autumn, where seed sets and germinates in spring and summer. Has a prolific seed production, with seeds dispersing within 4 weeks of flowering. Seeds have a hard seed coat that allow them to remain dormant in the soil. Burning may be necessary to remove a dormant seed bank. Although several broad-leaved selective herbicides are effective at control, there are limited products registered for use in waterways. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label.

Flower cluster a tall erect spike partially enclosed a green sheath giving rise to clusters of pink or red berries (not edible)

Large spade-shaped leaves held erect on thick, fleshy stems

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●							●	●	●	●	●
Fruiting	●	●	●	•	•					•	●	●

Cunjevoi

***Alocasia brisbanensis* – Family Araceae**

Other common names: Elephant ear, native elephant ear, spoon lily, alocasia. Previous scientific name: *Alocasia macrorrhiza* var. *brisbanensis*, *Colocasia macrorrhizos* var. *brisbanica*

Description: Perennial erect herb or shrub 1–1.5 m tall with a thick underground stem (rhizome) 10–15 cm thick. Leaves are spade-shaped, 400–800 mm long, 300–600 mm wide, hairless and lobed at the base. The mid rib and veins of the leaves are raised above the leaf surface. Leaves are held erect on leaf stem (petiole) 1,100 mm long, thick and fleshy, and deeply furrowed along the upper edge. Flower cluster (inflorescence) is a tall erect spike 250 mm long, partially enclosed a green sheath (spathe). Flowers are in two zones – male flowers on top, and female flowers on a 30 mm long section entirely enclosed by the spathe. Fruit are orange, pink or red berries 4.2–6 mm long, in a dense conical cluster.

Distinctive features: Often confused with taro (*Colocasia esculenta*), which may be readily distinguished by its more slender petiole, and arching habit, so leaves tend to hang rather than being held erect in *Alocasia*. The only other *Alocasia* in Queensland is *A. macrorrhiza*, which is only found in the Torres Strait.

Habitat: Not restricted to wetlands. Often found in a range of rainforest types, in gullies, damp margins of creeks and rivers. Often increases in response to disturbance.

Value in wetland:

- native bees are attracted to scented flowers
- fleshy fruit eaten by a wide range of bird species including cassowaries (but toxic to humans)

Plant uses:

- most parts of the plant contain toxic levels of oxalate crystals that can cause eye and skin irritation, burning and swelling of the lips, tongue and mouth and can result in death if eaten
- although technically edible, the rhizome contains a range of dangerous toxins that require extensive preparation and treatment before they can be eaten (strongly recommend against trying it)
- crushed leaves used as fish poison
- underground stems (rhizomes) have been used in traditional medicine for snake bite and insect stings
- leaf poultice used for back pain
- sap has been used as a cure for stinging tree (*Dendrocnide moroides*) but is of questionable value and may cause further skin irritation
- has been used in creek-side rehabilitation and erosion control projects
- although native to Queensland, it has become a minor environmental weed of waterways in Western Australia and New Zealand
- often grown in gardens and as an indoor potted plant for its attractive leaves, perfumed flowers and tolerance to low light levels
- of interest to botanists because of the way the chloroplasts in the leaves change orientation depending on light levels.

Propagation: Usually grown from seed which quickly germinates if sown fresh. Dividing the underground stem (rhizome) is also used.

Forms thick mats on wetland margins and floating mats on water

Opposite leaves and dense flower heads of white, papery flowers (Photos: Russell Cumming)

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●									
Fruiting	Not applicable											

WEED

Alligator weed

Alternanthera philoxeroides* **– Family Amaranthaceae**

Declaration status: Weed of National Significance, Restricted Category 3 plant under the *Biosecurity Act 2014*

Other common names: Alligator Grass, Pig weed, Previous scientific name: *Bucholzia philoxeroides*, *Telanthera philoxeroides*

Description: Perennial creeping herb, forming thick mats on wetland margins or sprawling and floating in water with hollow stems to 10 m long. On land, it often develops underground stems (rhizomes) up to 1 m deep. Leaves arranged along the stem in opposite pairs, with a ring of white hairs on the stem between the pairs. Leaves lance-shaped to round, 30–130 mm long, 10–35 mm wide on leaf stalks (petioles) 0–5 mm long. Flower heads (inflorescence) 10–20 mm diameter, consisting of numerous small white papery flowers. Flowers borne on the end of a stem (pedicel) to 90 mm long. Does not produce seed in Australia.

Distinctive features: There are numerous other native and introduced *Alternanthera* species in the Wet Tropics, but Alligator weed is the only one that has hollow stems. The only other aquatic species is Sessile joyweed* (*A. sessilis)* which has stalkless flowers clustered at the junction of the leaves. Joyweed* (*A. ficoidea*) looks similar but is not aquatic. The native hairy joyweeds (*A. denticulata* and *A. nana*) also have similar looking flowers but are stalkless. Khaki weed* (*A. pungens*) is a much smaller plant with painfully sharp flower bracts.

Habitat: Invades the damp margins of dams, drains, channels, swamps and floodplains, or grows out over the surface of fresh or brackish water (up to 30% salinity of sea water in flowing water), especially if nutrient levels are high. Permanent water is not required. This plant will invade ephemeral swamps that are only occasionally flooded.

Impacts on wetland: Native to Brazil, Paraguay and Argentina, this noxious weed:

- is a 'high-risk' invasive species that poses a significant threat to wetlands, waterways and irrigation areas in Queensland
- produces dense mats of interwoven stems up to 1m thick, restricting water flow and causing flooding, choking irrigation channels and drains
- damages infrastructure (e.g. pumps and irrigation equipment)
- dense mats exclude native plants and animals, lowering biodiversity
- causes increases in mosquitoes by preventing access by predators
- prevents use of water bodies for swimming, fishing and boats
- reducing dissolved oxygen levels, increased evapotranspiration causing high water losses
- smothers agricultural land and crops.

Weed facts:

- was mistakenly grown as a vegetable by people thinking it was a related aquatic species (*A. sessilis*) which has stalkless flowers clustered at the junction of the leaves
- listed in the top 10 priority weeds in the Wet Tropics and in the top 20 priority weeds in Cairns.
- as a Category 3 declared weed in Queensland, it is prohibited to keep, sell or trade this plant

Spread and control: Does not set viable seed in Australia. Reproduces from floating stem fragments which quickly establish roots, though entire mats can break off and float downstream. Often controlled with metsulfuron methyl, however, the dense interwoven mats makes herbicide control very difficult. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label. The alligator weed flea beetle (*Agasicles hygrophila*) was released as a biological control agent in 2013. For more information refer to www.business.qld.gov.au/industry/agriculture/species/declared-pests/weeds/alligator-weed

Circular-shaped leaves deeply notched at base

Inconspicuous flowers at base of stems

Creeping herb forming mats along the edges of wetlands

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	•	•	●	●	●	●
Fruiting	●	●	●	●	●	●	•	•	●	●	●	●

Pennywort

***Centella asiatica* – Family Apiaceae**

Other common names: Centella, Gotu Kola, Spadeleaf, Indian Pennywort. Previous scientific name: *Hydrocotyle asiatica*

Description: Creeping perennial herb forming mats along the edges of wetlands, with creeping stems developing roots at the nodes. Leaves arranged in a loose rosette, 10–45 mm diameter, almost circular and deeply notched at the base with veins radiating out from the centre. Leaf margins bluntly toothed, borne on long stems (petioles) 10–200 mm long. Flowers are rarely seen, clustered in groups of 3–4 at the base of the stems, pink or reddish, 2.5–3 mm long. Fruit are flattened, ribbed, 2–3 mm long.

Distinctive features: Can be mistaken for the native violet (*Viola hederacea*) which has similar leaves but has distinctive purple and white flowers held erect above the plants. Pennyworts (*Hydrocotyle* species) usually have more distinctly lobed leaves and the flower is held above the height of the leaf.

Habitat: Grows in damp margins of wetlands and swamps, sometimes creeping into the shallow margins. May occur in riparian forests, disturbed areas or as a weed of lawns. Tolerant of heavy shade.

Value in wetland:

- valuable for stabilising muddy banks of streams and wetlands
- considered a good biological indicator due to its sensitivity to chemical pollution.

Plant uses:

- grown as an ornamental in damp gardens
- studies have shown it to take up and accumulate copper, zinc and lead so is recommended for phytoremediation, and would be suitable in the saturated zones of bioretention basins
- widely eaten in South East Asia as a side dish with rice and curry, in salads or sweetened drinks
- widely claimed as a cure for a range of ailments including epilepsy, senility, stress, depression, burns, wounds, scars, varicose veins, leg cramps, urinary tract infections, haemorrhoids, high blood pressure, leprosy, fever, malaria, diarrhoea, venereal diseases, and hepatitis. Some of these claims have been debated.
- the plant has been claimed to be an abortifacient (causes abortion), a mild skin irritant or may cause problems with high blood pressure or diabetes. Prolonged use may cause a range of other health issues.

Propagation: Can be propagated by seed or by division of the parent plant, separating the stem into sections with rooting nodes.

Slender fertile fronds (left) and broad sterile fronds (right)

Small plantlets developing in the junctions (axils) on fertile fronds

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	Not applicable											
Fruiting	Not applicable											

Water fern

***Ceratopteris thalictroides* – Family Parkeriaceae**

Other common names: Water sprite. Previous scientific name: *Acrostichum thalictroides*

Description: Aquatic perennial fern to 1 m tall, either submerged, emergent or free-floating. Fronds occur in two distinct types, and are clustered and fragile. Stems (stipe) are fleshy and contain numerous long air canals. Sterile fronds 40–600 mm long, erect or spreading, with broad dissected and irregularly shaped paper-thin green leaves (lobes). Fertile fronds are longer and more erect than sterile fronds, initially green, becoming brown after maturity, with long, narrow and recurved lobes. Small plantlets may form in the junctions (axils) on both fertile and sterile fronds. Spore capsules (sporangia) are solitary and are scattered along the veins, containing 16–32 spores.

Distinctive features: *C. thalictroides* is the only aquatic erect freshwater fern, apart from *Pityrogramma calomelanos**, which is silver on the underside of the leaves. *Acrostichum speciosum* (mangrove fern) is a much taller robust species and prefers estuarine areas.

Habitat: A strictly aquatic plant, usually growing in still or slow-flowing freshwater wetlands such as swamps, billabongs and bunded watercourses, or in the quiet backwaters of faster flowing creeks. Sometimes occurs in saline areas such as saltwater couch grassland. At various stages of its life cycle it can be either attached or free-floating. Tends to die off as water levels recede. The plant is fragile and often grows in partly shaded areas tangled with or partly protected by other plants. Easily overwhelmed by many introduced water weeds.

Value in wetland:

- provides habitat for small fish and fry, food source for herbivorous fish, snails and waterfowl
- assists stripping nutrients from the water, thereby reducing algal growth.

Plant uses:

- has been used in constructed wetlands receiving high nutrient levels
- one of the most popular and commonly used tropical aquarium plants, but requires high light
- leaves are considered a delicacy in many countries, either raw or cooked as a green vegetable, or used in salads. Can be used as a substitute for spinach or watercress
- commonly used in Chinese medicine as a tonic, to stop bleeding (styptic) and heal skin complaints, including treatment of severe abscesses and boils
- contains anti-viral properties, due to the presence of the anti-HIV protein CVN (cyanovirin-N)
- used as a teaching aid for botanists examining the genetics, biochemistry, and cell biology of ferns.

Propagation: Propagation can occur from plantlets, developing from the asexual buds and breaking away to form separate plants. Spores can also be used for propagation, by burying or placing the spores on wet mud.

Inflorescence is a clustered mass of small white flowers surrounded by thin white petals (ray florets)

Often grows as a sprawling woody herb along the wet margins of creeks and swamps

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

White eclipta

***Eclipta prostrata* – Family Asteraceae**

Other common names: False daisy, swamp daisy. Previous scientific name: *Eclipta erecta*, *Eclipta alba*

Description: Annual woody herb, low growing or erect to 30 cm tall. Leaves are opposite, with a very small or absent leaf stem (petiole), narrow and tapering to a point 25–90 mm long, 5–30 mm wide. Young leaves may be densely hairy, becoming sparsely hairy with age and rough to the touch. Leaf margins are irregular or sparsely toothed. Flower heads (inflorescence) appear at first glance like single flowers but are actually a clustered mass of small white flowers (capitula) surrounded by a circle of thin white petals (ray florets). Fruit are masses of small dry brown seeds (achenes) 1.5–3 mm long, with a small ring or hairs (pappus) about 0.5 mm long.

Distinctive features: *Eclipta* spp. are the only semi-aquatic daisies with opposite leaves. E*clipta platyglossa* has yellow flowers.

Habitat: Usually found on moist soils, and low banks on seasonally flooded rivers, lagoons and billabongs, particularly on clay soils with recent disturbance. Often colonises bare wet soil.

Value in wetland:

- provides habitat complexity along the moist margins of wetlands, probably suitable for bank stabilisation in a range of environments as it can form dense stands.

Plant uses:

- can be a minor nuisance weed in some crops
- young leaves and shoots are apparently edible after cooking
- roots and leaves are used medicinally throughout Asia for various problems, including toothache, coughs, asthma, obesity, anorexia, anaemia, spleen and liver complaints, tuberculosis, skin diseases, athlete's foot, bacterial infections, snakebite and headaches
- in Malaysia, tea from roots and leaves is taken for dizziness or as a tonic following childbirth
- chemical extracts are being commercially trialled to stimulate hair growth and have been investigated as a treatment for HIV
- boiled leaves are used as an ingredient in shampoos, hair dye and tattooing
- leaves have been found to contain small amounts of nicotine.

Propagation: Propagation is by seed barely covered in a moist seed tray, preferably planted in spring, as germination is influenced by light and temperature. Seeds have no dormancy. Plants may also spread vegetatively from stems that produce roots at nodes.

Flowers are produced between opposite pairs of leaves

Forms dense thick masses in, and on the margins of wetlands

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●								●	●
Fruiting	●	●	●									●

WEED

Glush weed

Hygrophila costata* – Family Acanthaceae

Declaration status: Restricted Category 3 plant under the *Biosecurity Act 2014*

Other common names: Sword leaf stricta, gulf swampweed, lake hygrophila. Previous scientific name: *Hygrophila atricheta*

Description: An erect perennial herb to 1.5 m tall. Stems are hollow, reddish-brown, square in cross section and coarsely hairy. Leaves are borne along the stem in opposite pairs, 35–180 mm long, 5–40 mm wide, lance-shaped and tapered at both ends. Leaves on short leaf stalks (petioles) 0–35 mm long. Leaf midrib often purplish towards base. A scar extends across the stem between the leaf pairs, often with a tuft of white hairs at the junction. Flowers are stalkless, tubular with broadly lobed petals, white, produced between the junction of the opposite leaves, 10mm long. Fruit is a capsule 7–13mm long, brown, containing 12–18 flattened brown seeds that are sticky when wet.

Distinctive features: The native *hygrophila* (*Hygrophila angustifolia*) is a much smaller plant (0.15–0.45 m tall), with solid, not hollow stems. The leaves are comparatively long and narrow and the flowers either have obvious markings, or are violet, blue or mauve in colour.

Habitat: Forms dense thick masses in shallow fresh water and damp soil on the margins of slow moving streams, ponds, lakes and dams. Stems float or scrambles across floating vegetation, producing new roots at each node.

Impacts on wetland: Native to North, Central and America, from south-eastern USA to Argentina, this noxious weed:

- causes dense infestations, including floating mats, that exclude native plants and animals, lowering biodiversity
- alters flow regimes of waterways, affecting stream health
- alters water quality, including causing eutrophication
- blocks creeks and irrigation channels, reducing water supply to crops and causing siltation
- reduces use of water bodies for swimming, fishing and boats.

Weed facts:

- although it was introduced for the aquarium trade, it is regarded as a serious environmental weed in Queensland and should not be cultivated or sold.
- first detected in the Wet Tropics in 2011 and subject to an eradication campaign. It threatens to invade and transform wetlands throughout the Wet Tropics.

Spread and control: Can reproduce by seeds, vegetatively by leaf or stem fragments. Seeds are sticky when wet so can be spread by birds, boats, vehicles and humans. Once in contact with soil, stems will produce new roots from the nodes. Adopting good hygiene practices, such as washing down vehicles, boats and equipment is critical in preventing spread. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label. Mechanical clearing is not recommended as it can break up the rhizome and facilitate spreading. For information on control refer to www.business.qld.gov.au/industry/agriculture/species/declared-pests/weeds/hygrophila

Floating stems allow tangled thickets to spread out from the waters' edge

Large funnel-shaped flowers white with a pink centre and a star shape radiating from the centre

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering			●	●	●	●	●	●	●			
Fruiting			●	●	●	●	●	●	●			

Kang kong

***Ipomoea aquatica* – Family Convolvulaceae**

Other common names: Swamp morning-glory, swamp convolvulus, water spinach. Previous scientific name: *Ipomoea reptans*

Description: Low trailing or weakly climbing perennial, or annual vine or herb, with trailing or floating hollow green or reddish stems that often develop roots at the nodes. Glossy, smooth leaves are borne alternately along the stem, roughly triangular in shape with a deeply lobed base (cordate), 60–105 mm long, 30–70 mm wide, on a stem (petiole) 20–100 mm long. Leaves have a prominent mid-rib and numerous raised veins. Flowers in groups of 1–4, but usually solitary, funnel-shaped, 40–50 mm long, white, with or without a pink centre and a star shape radiating from the centre. Entirely white flowered forms may be an introduced Asian variety. Fruit is a smooth woody, spherical capsule 10–3 mm long, containing 1–4 reddish-brown three-cornered seeds.

Distinctive features: Twenty-one other *Ipomoea* species occur in this area, but nearly all are vigorous climbers, and no other species has a tendency to grow prostrate in fresh water.

Habitat: Occurs on the margins of fresh and brackish creeks, dams, bunded depressions, swamps, lagoons and billabongs, in gullies and irrigation channels, or as a component of wet grasslands and sedge-lands. It usually germinates on the muddy bank and grows out over deeper water, with floating hollow stems. It may take advantage of other floating vegetation to form large floating mats. It rarely climbs but may scramble over low features.

Value in wetland:

- a valuable plant for stabilising creek banks and dam walls
- provides good aquatic habitat for fish
- significantly reduces suspended solids and nutrients.

Plant uses:

- has been successfully used in constructed wetlands in Africa, significantly reducing suspended solids and ammonia from waste water
- useful in wetland revegetation or cultivation in damp boggy areas, or around the margins of wetlands where the plant can grow out into the water to develop a floating fringe
- stem cuttings will grow in a vase of water as an indoor plant
- in the Wet Tropics, the roots were traditionally soaked, baked and washed before eating
- young shoots and leaves are a mild-flavoured but popular ingredient in Melanesian and South-East Asian cooking, containing many vitamins and minerals
- young shoots can be eaten raw or in salads but care should be taken if plants were growing in contaminated areas
- studies have revealed hypoglycaemic compounds useful for treating diabetes.

Propagation: Is easily propagated by cuttings. Stem cuttings can be rooted in water or moist sand and transplanted into pots of fertile potting soil mixture. Seeds should be lightly cut (scarified) and soaked in water for 1–3 weeks before planting. White flowering forms should be regarded as introduced, potentially invasive and not used in revegetation projects.

Flowers are yellow with four spatula-shaped petals underlain by four large green leafy sepals

Usually grows as a dense woody shrub on permanently or seasonally wet margins of wetlands

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Willow primrose

***Ludwigia octovalvis* – Family Onagraceae**

Other common names: Shrubby water primrose, raven primrose willow. Previous scientific name: *Jussiaea suffruticosa*

Description: Annual or weakly perennial, woody shrub, 0.4–2 m tall. Leaves are arranged alternately on the stem, hairy, elongate to lance-shaped, 60–165 mm long, 2–35 mm wide on leaf stalks (petioles) 2–8 mm long. Flowers are yellow with four spatula-shaped petals underlain by four large green leafy sepals. Fruit is brown, roughly cylindrical, 20–55 mm long, 3–6 mm wide, with the four leafy sepals persisting on the end. Fruits split longitudinally to release hundreds of small globular seeds.

Distinctive features: *Ludwigia adscendens* and *L. peploides* are prostrate plants with five petals. *Ludwigia hyssopifolia** has smaller flowers (< 10 mm wide) and shorter leaves (10–90 mm long). *L. perennisis* is smaller (up to 1 m) and has a shorter fruit (< 10 mm). *L. longifolia** has comparably much longer (to 350 mm long), thinner and hairless leaves.

Habitat: Usually occurs in permanently or seasonally wet margins of wetlands, including rivers, billabongs, flood plains, depressions in open woodland, shallow swamps, gullies and drains. Plants may be sparsely spread or may form narrow thickets.

Value in wetland:

- provides habitat complexity along the moist margins of wetlands, probably suitable for bank stabilisation in a range of environments, as it can form dense stands
- provides habitat for a range of species, including frogs and small birds such as cisticolas and grassbirds.

Plant uses:

- used in herbal medicines to treat diarrhoea, dysentery and parasitic worms and as a laxative
- has been used to promote vomiting (purgative) and to relieve headache, chest pain and rheumatoid pain
- Indigenous people made small spear shafts from the stems of large plants
- used as an early pioneer species in wetland revegetation sites
- plant can become a weed in irrigated crops
- may cause gastroenteritis in sheep and cattle.

Propagation: Propagated easily by seed, which germinates immediately in wet or flooded soils, without the need for any special treatments.

Glossy alternate leaves and yellow flowers with five petals

Low-growing perennial herb, either trailing across water or forming low tangles at waters edge

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Water primrose

***Ludwigia peploides* – Family Onagraceae**

Other common names: Water buttercup. Previous scientific name: *Jussiaea peploides*

Description: Low-growing perennial herb, either trailing across water with floating stems that develop roots at the nodes, or forming low tangles at water edge. Leaves are arranged alternately on the hairy stems, broadly elongated to lance-shaped, 10–100 mm long, 4–30 mm wide on leaf stalks (petioles) 2–30 mm long. Leaves are glossy green with a distinctly pale midrib, coarsely hairy on the underside. Stems rise vertically when flowering. Flowers are yellow, 20–30mm diameter, with five petals underlain by five tapering green sepals. Fruit is an elongated, recurved capsule, 10–40 mm long with five angles. Fruit split irregularly to release numerous small seeds.

Distinctive features: *Ludwigia hyssopifolia**, *L. longifolia** and *L. octovalvis* are erect woody plants with four petals. *L. longifolia** has comparably much longer (to 350 mm long), thinner and hairless leaves. *L. adscendens* has white flowers with a yellow centre.

Habitat: Usually occurs on the moist and muddy margins of still or slow-moving creeks, swamps, dams, lagoons and other water impoundments. Young plants establish in this wet zone before growing outwards over the water on floating stems, eventually developing partially floating thickets along wetland margins. Generally not seen in areas subject to regular floods, as fast-flowing water will damage their stems.

Value in wetland:

- provides habitat for fish and aquatic macroinvertebrates
- seeds are a food source for ducks and other water birds
- removes phosphorus and other nutrients from the water column
- colourful plant, adding aesthetic values and structural complexity to wetland margins.

Plant uses:

- has been successfully used in constructed wetlands for improving water quality, particularly when planted along the sunny margins of wetlands
- an excellent species for wetland revegetation, or as an ornamental in dams and artificial ponds, providing a lot of colour if the site is not too shaded
- can become over-abundant under high nutrient loads, potentially obstructing water flow in extreme cases.

Propagation: Can be propagated by seeds or fragmentation, where rooting occurs at the nodes.

Erect wiry stems with strobili hanging from tips of branches

Forms low thickets in moist, exposed areas

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	Not applicable											
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Bushy clubmoss

***Lycopodiella cernua* – Family Lycopodiaceae**

Other common names: Pine tree fern, Christmas tree fern, wolf's foot fern, coral fern, scrambling clubmoss, staghorn clubmoss. Previous scientific name: *Lycopodium cernuum*

Description: Perennial herb with a long creeping stem and erect stems 0.2–1 m tall, with branches in tiered whorls, small leaves thin and curved 1.5–4.5 mm long, stiff and wiry. Spores are borne in specialised capsules (strobili) 10 mm long that hang down like tassels from the tips of the branchlets.

Distinctive features: *Lycopodium deuterodensum* also occurs in the Wet Tropics, but has an underground stem (rhizome), longer wiry branches and the fertile branch ends (strobili) are erect, rather than hanging.

Habitat: Not restricted entirely to wetlands, can be found on roadsides in very high rainfall areas. Often found on the damp, swampy areas on the edge of rainforest or lakes where there is low nutrients and a high water table, scrambling over sedges but not in completely waterlogged areas. Can form extensive patches.

Value in wetland:

- forms thickets in exposed moist areas that may otherwise be prone to erosion or weed invasion
- provides habitat for a range of fauna species.

Plant uses:

- entire plants were pressed into a pad and used to dress cuts and wounds
- used in traditional medicine for a broad range of ailments, from coughs, bruises, burns and psoriasis, to the more severe arthritis, gonorrhoea, dysentery and hepatitis
- used as an insect repellent, particularly for cockroaches
- the plant is used to make wreaths and in flower decorations. In Indonesia and Colombia it is used to stuff cushions.
- studies have shown it to take up and accumulate aluminium, so may be useful for phytoremediation. It would be suitable in the moist margins of bioretention basins
- dried spores burnt to create special effects and were once used in fireworks
- of great interest to botanists due to its very primitive associations - these are the closest living relatives to the large lycopod trees (e.g. *Leptophloeum australe*) that dominated during the Carboniferous period and provided most of the fossil fuel reserves in Australia
- plants are very ornamental and would be more popular in cultivation if propagation methods could be improved.

Propagation: A low tolerance to root disturbance makes them notoriously difficult to transplant. Has been grown from tip layering and cuttings. May require mycorrhizal fungi to grow.

Large purple or mauve flowers with two types of stamens

Black fleshy fruit have numerous small seeds imbedded

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Blue tongue

***Melastoma malabathricum* – Family Melastomataceae**

Other common names: Native lasiandra, Bank's melastoma. Previous scientific name: *Melastoma affine*, *Melastoma polyanthum*

Description: Woody shrub 1.5–3 m tall, leaves in opposite pairs along the stem, 40–135 mm long, 10–75 mm wide, rough-textured with 3–5 prominent longitudinal veins, large hairs on the stem between the pairs of leaves, flowers with five prominent purple or mauve petals. Two types of stamens occur – yellow stamens provide pollen to attract pollinators, while purple stamens achieve most pollination. Fruit fleshy 10 mm wide, black with numerous small seed imbedded, 10 mm long.

Distinctive features: *Melastoma cyanoides* occurs in the Wet Tropics but not usually in swampy areas. It is also a woody shrub but has white petals and red fruit. Osbeckia chinensis also occurs in swampy areas in the Wet Tropics, but is a smaller plant with smaller leaves and only four petals.

Habitat: Not restricted to wetlands, can be found in a range of moist forests, often in disturbed areas in full sunlight. Often occurs along the edges of open watercourses and the margins of freshwater wetlands and swamps.

Value in Wetland:

- buzz-pollinated by a range of native bee species, providing pollen instead of nectar as a reward
- fruit eaten by a range of bird species including double-eyed fig-parrots
- fast growing pioneer plant that rapidly colonises unstable disturbed areas.

Plant Uses:

- edible sweet-tasting fruit that temporarily stains the tongue blue
- young leaves edible raw or cooked
- roots eaten raw
- roots chewed to alleviate toothache
- leaves and shoots used in traditional medicine for a broad range of ailments, from cuts and wounds to diarrhoea, dysentery and stomach problems
- dried leaves crushed and applied as powder to wounds or mixed with water to treat haemorrhoids
- fruit used to make a black dye
- accumulates aluminium in the leaves and roots – more than 10 g of aluminium (Al) per kg in mature leaves, so may be useful for phytoremediation
- often grown in gardens where it benefits from heavy pruning and regular water, extensively used in roadside landscaping in high rainfall areas
- although native to Queensland, this plant is listed as a noxious weed in the USA (including Hawaii).

Propagation: Easily grown from fresh seed or cuttings.

M. vaginalis with six pollen-bearing stamens;

M. cyanea stamens are all yellow tipped

Semi-aquatic herb, rooted in mud with glossy, elongate heart-shaped leaves on fleshy stems

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●					
Fruiting	●	●	●	●	●	●	●	●	●			

Bog hyacinth

***Monochoria vaginalis* – Family Pontederiaceae**

Other common names: Pickerelweed, heartleaf false pickerelweed, oval-leafed pondweed. Previous scientific name: *Pontederia vaginalis*

Description: Perennial semi-aquatic herb, rooted in mud in or adjacent to shallow water, leaves floating or forming clusters of leafy stems 0.3–0.4 m high. Glossy green leaves initially narrow, maturing to become broad at the base, tapering to a fine point, resembling an elongate heart-shape, 30–150 mm long, 30–80 mm wide, borne singly sheathed on the ends of fleshy, hollow stems (petioles) 20–180 mm long. The flower heads (inflorescence) are 10–90mm long, containing 3–15 flowers. Flowers are blue or purple, 10–20 mm long, with six yellow pollen-bearing stamens. One stamen is blue-tipped and much larger than the others. The female stigma is tipped with fine white hairs. Fruit is a capsule broadly oval in shape, 10–15 mm long.

Distinctive features: *Eichhornia crassipes** (water hyacinth) is a floating plant with larger, paler flowers and bulbous stems. *Monochoria cyanea* doesn't have a larger blue stamen – all are equal sized and yellow.

Habitat: Usually occurs in soft mud on the edges of still or slow-moving swamps, lagoons, billabongs and flood plains, including depressions, gullies and roadside drains. Perennial if constantly wet. In seasonal (ephemeral) wetlands, plants die when they dry out with receding water levels, but regenerate the next season from the seed bank.

Value in wetland:

- can occur as a dominant herb in shallow marshes and swamps (significant weed of rice paddies in South-East Asia) but often outcompeted by introduced grasses (e.g. para grass*)
- seeds are eaten by a range of water birds, including magpie geese and brolgas
- moderate capacity for uptake of nutrients such as phosphorus
- adds colour and beauty to shallow wetlands (aesthetic values).

Plant uses:

- most parts apparently edible raw or cooked, including leaves, stalks and tubers
- used to treat burns, asthma, nausea, fever, haemorrhage, scurvy and snakebite
- leaves mixed with ginger and honey to treat coughs and colds
- studies have shown that the roots contain pain-killing (analgesic) compounds and have been used to treat toothache
- used as an ornamental plant in aquariums and outdoor ponds
- studies have shown it to accumulate arsenic in roots, therefore it has been recommended for phytoremediation and would be suitable in the saturated zone of bioretention basins.

Propagation: Propagation is by seeds planted below the water level. Seed germinates reliably, though sporadically in water temperatures above 28°C. Patterns of seed germination vary greatly according to moisture levels, with optimal germination occurring in submerged conditions, with a germination peak of 15–25 days. Plants can also be propagated from root stock.

Female plant with fruits and liquid-filled pitcher

Male flowers are brown-purple (Photo by Malcolm Calvert)

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●				●	●	●	●	●	●
Fruiting	●	●	●				•	•	●	●	●	●

ENDANGERED
(Bramston Beach population)

Pitcher plant

***Nepenthes mirabilis* – Family Nepenthaceae**

Other common names: Tropical pitcher plant, common swamp pitcher-plant. Previous scientific name: *Nepenthes phyllamphora*, *N. kennedyana*, *Phyllamphora mirabilis*.

Description: Perennial tangled shrub, scrambler or climbing vine to 10–15 m, leaves arranged alternately along the stem, 100–400 mm long, 20–80 mm wide on a stem (petiole) 250 mm long. Leaves often with a modified tendril, terminating in a carnivorous pitcher 240 mm long, 60 mm wide with broad wings, a recurved lip, and lid, sealed until the pitcher matures. Filled with liquid. Lower pitchers are smaller and reddish, upper pitchers larger and yellowish. Male and female flowers are produced on different plants. Male flower heads (inflorescences) 150 mm long consist of multiple brown-purple flowers. Female flowers green, in a raceme 220 mm long. Fruit a long, leathery capsule to 20 mm, splitting along the side to release numerous thin winged seeds.

Distinctive features: This is the only species of pitcher plant in the Wet Tropics and is unmistakable. *Nepenthes rowanae* and *N. tenax* occur on Cape York. *N. rowanae* is a smaller plant to 3 m with broader reddish purple pitchers or green with red splotches. *N. tenax* has narrow v-shaped leaves and funnel-shaped pitchers.

Habitat: Not restricted entirely to wetlands. Occurs on low nutrient and very low salinity damp soils in open forest edges, wet vegetated swamps, including sedgelands, mixed swamp forest and *Melaleuca* swamps with *Pandanus*. Generally grows best in high light environments but can grow as a scrambling vine in partly shaded areas. Often occurs in association with forked fern (*Dicranopteris linearis*).

Value in wetland:

- carnivorous; the pitcher is an insect trap modified from the mid-rib of the leaf. The lower part of the trap contains glands which absorb nutrients from captured prey. Along the upper inside part of the trap is a slick, waxy coating which makes the escape of its prey nearly impossible.
- although common on Cape York, the Wet Tropics population are Endangered under the Queensland Nature Conservation Act. Their trade is restricted under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Plant uses:

- roots boiled as medicine for dysentery
- liquid in unopened pitchers is sterile and was apparently used to flush wounds and sore eyes (opened pitchers have high levels of bacteria)
- stems have been used as rope
- because of the unusual carnivorous pitchers, it is commonly grown as a novelty in hanging baskets
- hybrids with other non-native species are common in cultivation.

Propagation: Seeds are wind dispersed. In a nursery, seeds are sown onto a mix of perlite and sphagnum moss. The seeds have a short period of viability and may take two months to germinate.

Branches with spikes of white/ greenish white flowers

Ochrea with a collared sheath

Thick, dense pure stands on the banks and edges of wetlands provides good wildlife habitat

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting		●	●	●	●	●	●	●	●	●	●	●

Water pepper

***Persicaria attenuata* – Family Polygonaceae**

Other common names: Smartweed, velvet knotweed. Previous scientific name: *Polygonum attenuatum*, *Polygonum australe*

Description: Perennial erect herb, growing to 1 m tall on wetland margins or sprawling and floating in water with stems to 3 m long. The leaves are arranged alternately on the stem, broadly elongate and tapering, 50–250mm long, 15–45 mm wide, densely covered in short white hairs especially on veins and leaf margins. Leaf stem (petiole) may be absent or up to 30 mm long. A basal leaf membrane (ochrea) sheaths the stem, is generally hairless, striated and may or may not be ringed with small stiff hairs (cilia). Flower heads (inflorescence) consists of 2–4 spikes 30–130 mm long, densely covered in white/greenish white (rarely pink) flowers 3–5 mm long with 5 petals. Fruit is a shiny lens-shaped nut 2.5–3 mm long.

Distinctive features: *Persicaria decipiens*, *P. orientalis* and *P. subsessilis* have pink flowers. *P. orientalis* has a basal leaf membrane (ochrea) with a collared sheath. *P. decipiens* is a smaller plant (up to 30 cm) and a narrower leaf (5–13 mm wide). *P. barbata* and *P. subsessilis* have ochreas with cilia more than 3 mm long. *P. lapathifolia* has no cilia. *P. strigosa* has a shorter spike (up to 1 cm).

Habitat: Usually occurs along the margins of floodplains, swamps, lagoons, billabongs, dams and rivers, in both seasonal (ephemeral) and permanent freshwater. Often forms thick dominant stands, spreading out over the water, developing partially floating thickets along wetland margins.

Value in wetland:

- thick, dense pure stands provide valuable food source and habitat for birds, frogs and other wildlife
- one of the best native plants for withstanding wetland degradation and weed invasion. Can be used to replace and displace para grass* but has not been investigated for allelopathic chemicals
- an over-abundance as dense floating mats can lead to reduced diversity of aquatic macroinvertebrates.

Plant uses:

- leaves may be used as a salad plant or as a cooked vegetable
- various parts used to treat to syphilis, rheumatism, haemorrhoids, diarrhoea, fever, itching, stomach aches, or used to clean and purify the blood
- Indigenous people used the stems as smoking pipes
- has been used in wastewater treatment, as it grows well under high nutrient loads and is known for removal of arsenic from contaminated water
- used in revegetation to rehabilitate areas previously smothered by para grass*
- useful as a companion plant for stabilising the margins of wetlands and artificial ponds
- leaves may cause irritation in sensitive people.

Propagation: Seed germination best using the 'bog method' – fresh seed sown shallow in a water-logged pot in bright light. Seeds can be hand-broadcast onto a bare muddy bank. May also be propagated from stem cuttings.

Branches with spikes of pink or white flowers

Ochrea with erect stiff bristles

Forms masses in and along the edges of wetlands

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Slender knotweed

***Persicaria decipiens* – Family Polygonaceae**

Other common names: Slender waterpepper. Previous scientific name: *Polygonum decipiens*, *P. minus* subsp. *decipiens*, *Polygonum salicifolium*

Description: Sprawling annual or weak perennial herb to 0.3–0.6 m tall, rarely exceeding 1m, leaves alternately arranged along the reddish stem 50–150 mm long, 5–25 mm wide narrowly tapering to the tip, with hairs along the margins and leaf veins. Leaf stem (petiole) 1–7 mm long. A basal leaf membrane (ochrea) sheaths the stem, is sparsely hairy, with stiff hairs (cilia) 2–10 mm long. Flower heads (inflorescence) on the end of stems, consisting of numerous pink or white, star-shaped with 5 petals, at nodes along the stem. Fruit is a shiny brown nut 1.5–2 mm long, triangular in cross section.

Distinctive features: *Persicaria orientalis* and *P. subsessilis* may also have pink flowers. *P. orientalis* is the largest of this genus (2.2m tall) and the ochrea has a broadly collared sheath. *P. subsessilis* is a more sprawling plant whose leaves are stem are covered with upward facing hairs and spike of flowers 20–25 mm long. *Persicaria attenuata* is a larger plant with larger, broader leaves and the basal leaf membrane (ochrea) has much shorter hairs (cilia). *P. strigosa* is often (but not always) orange on the underside of the leaf and has a shorter spike (up to 10 mm long). *P. lapathifolia* and *P. barbata* both have a branched flower heads (inflorescence). *P. lapathifolia* is also a tall species (0.5–1.8 m) and the flowers are very densely packed onto the branched flower heads.

Habitat: Occurs as an aquatic in water up to 30 cm deep, semi-aquatic or on the wet margins of creeks, gullies, coastal swales, swamps, lagoons and lakes, often in *Melaleuca* swamps in sedgeland/grassland or in riparian forest. Occurs on sand, gravel, clay or mud substrates. Often occurs in dominant stands in small patches around wetland margins.

Value in wetland:

- provides valuable habitat for frogs and waterbirds, allowing shy species to approach the water unseen
- attracts seed eating birds such as finches
- provides a useful cover along the banks of watercourses, dams and wetlands.

Plant uses:

- leaves eaten raw or boiled, but not considered a delicacy
- seeds eaten raw or cooked but may be very time consuming to harvest
- plant is burnt and ashes used as a salt substitute or licked to treat sore throat and tonsillitis
- boiling leaves to extract the contents, which can be used as a laxative
- crushed leaves rubbed on skin to cure skin diseases, including syphilitic sores
- used in gardens (frog ponds, bog gardens) and revegetation – can be used in wet depressions or around farm dams. Useful for moist and boggy sites and around edges of water.

Propagation: Plants are easily grown from seed or by division of large clumps.

Narrow yellow flowers with two petals

Exceptional specimens up to two metres tall

Population on the moist margins of a coastal swamp

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Woolly frogmouth

***Philydrum lanuginosum* – Family Philydraceae**

Other common names: Frogmouth lily, woolly waterlily.

Description: Clumping perennial herb 1–2 m tall, Leaves mostly arising from base of plant, with additional leaves sheathed alternately along the stems, leaves 100–700 mm long, 4–15 mm wide, leaves and roots contain air-filled chambers making the plants spongy. Flower heads (inflorescence) borne on the ends of tall spikes to 2 m tall, branched, usually densely covered in woolly hairs. Tips of branches with alternately spaced pointed bracts that peel back to reveal the narrow yellow flowers 15 mm long with two petals. Flowers only last one day. Fruit is a capsule, dark reddish brown, 10 mm long containing several seeds.

Distinctive Features: This is the only species of *Philydrum* in Australia. Young plants without flowers may be mistaken for immature bulrush (*Typha*), however the woolly hairs on *Philydrum* are distinctive.

Habitat: Occurs in moist habitats such as roadside drains, swamps and edges of ponds, dams and slow flowing streams. Grows both in shallow water and the moist soil around the margins.

Value in Wetland:

- provides habitat for a range of wildlife, including frogs and fish
- Pollinated by a range of bees, wasps and other insects.

Plant Uses:

- not edible, seeds and leaves toxic and may cause skin irritation in some sensitive people
- mildly toxic to stock, causing diarrhoea but generally avoided by livestock
- leaves were traditionally used to make 'grass skirts' in the Torres Strait
- used in revegetation in both full sun and shade to help stabilise unstable slopes and sediment around wetlands
- has been recommended for use in stormwater management wetlands in the 0–20 cm zone
- shown to bioaccumulate nitrogen and phosphorus, it has been used to remove excess nutrients from wastewater but generally doesn't do well with regular cropping
- used as an ornamental plant on the margins of artificial ponds and dams, particularly for the long season of attractive yellow flowers
- has been suggested as a potential commercial cut flower.

Propagation: Grown from seed laid in trays of wet soil or by division of clumps.

Separate male and female flowers

Submerged rosette of strap-like leaves

Grows either submerged or in a dense, spreading infestation on wet, muddy banks

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●				●	●	●	●

WEED

Delta arrowhead

Sagittaria platyphylla* – Family Alismataceae

Declaration status: Restricted Category 3 plant under the *Biosecurity Act 2014*, Weed of National Significance

Other common names: sagittaria, broad-leaf arrowhead. Previous scientific name: *Sagittaria graminea*

Description: Perennial submerged or emergent aquatic herb up to 1.5 m tall, developing spreading clusters of erect leaves via underground stems (rhizomes), commonly developing underground tubers 40 mm long and 15 mm wide. Submerged leaves are thin and strap-like, 500 mm long, 20 mm wide. Emergent adult leaves are borne on erect stalks (petioles) to 800 mm long, triangular in cross-section. Leaves are glossy green, broadly elongated, to 280 mm long and 100 mm wide, with prominent parallel veins and sometimes elongated lobes at the leaf base. Flower heads (inflorescence) borne on a leafless erect stem from the base of the plant, and consist of clusters of separate male and female flowers. Female flowers lower in the inflorescence, petals absent and resemble lobed green berries on short stalks. Male flowers 30 mm diameter have three rounded white petals with yellow centre. Fruit is a 5–10 mm wide cluster of small one-seeded segments 1.5–3 mm long. A single plant can produce up to 20 000 seeds.

Distinctive features: *Monochoria vaginalis* has blue flowers and shorter, less erect leaves. Other species of *Sagittaria*, *Echinodorus* and *Alisma* do not have stems that are triangular in cross-section and have not been recorded from this region.

Habitat: Usually growing in still or slow-flowing permanent freshwater, such as lagoons, dams, bunded watercourses, irrigation channels, drains and rivers. Usually occurs in shallow water, where it can grow up to the water surface, but is also known to break free as part of large floating mats. Although first introduced to Queensland in 1959, it was first recorded in the Kuranda region in 2000 and Mission Beach in 2002.

Impacts on wetland: Native to North and Central America, this noxious weed:

- blocks creeks and irrigation channels, reducing water supply to crops and causing siltation
- alters flow regimes of waterways, affecting stream health
- causes dense infestations that exclude native plants and animals, lowering biodiversity
- reduces use of water bodies for swimming, fishing and boats
- can also be a weed in crops.

Weed facts:

- although it is still used in the aquarium trade, it is regarded as a serious environmental weed in Queensland and should not be cultivated or sold.

Spread and control: Can reproduce by seeds, vegetatively by stem or root fragments, or underground rhizomes and corms, allowing them to spread rapidly and survive adverse conditions. Each plant has the ability to produce thousands of seeds that can either germinate or remain dormant in the soil. Seeds can float up to three weeks prior to settling, which aids in their dispersal. Adopting good hygiene practices, such as washing down vehicles, boats and equipment is critical in preventing spread. Research is underway to develop a biological control and new herbicide options as there is currently only one herbicide registered for use on delta arrowhead in waterways (2014). It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label. Mechanical clearing is not recommended as it can break up the rhizome and facilitate spreading.

Tall annual woody shrub with compound leaves and narrow, hanging pods

Clusters of 1–8 hanging yellow pea flowers

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Sesbania pea

***Sesbania cannabina* – Family Fabaceae**

Other common names: Yellow pea bush. Previous scientific name: *Aeschynomene cannabina*

Description: Annual woody shrub to 3.5 m tall, developing a woody trunk up to 100 mm diameter. Long compound leaves are alternately arranged on stems, 50–250 mm long, consisting of 16–70 oblong leaflets 6–22 mm long, 2 mm wide, often with a small spine on the tip, opposite or alternately arranged on the compound leaf. Flower head (inflorescence) consists of 1–8 yellow pea flowers 10–16 mm wide hanging on a stem 20–60 mm long. Fruit is a brown pod 120–200 mm long, 2.5–3 mm wide containing around 25–35 hard seeds 3–4 mm long.

Distinctive features: *Leucaena leucocephala** is larger perennial shrub or tree with dense white pom-pom flowers and broad pods. Budda pea (*Aeschynomene indica**) is a much smaller plant, with smaller leaves, shorter flat pods and a red splotch on the yellow flowers.

Habitat: Usually grows along the margins of swamps and watercourses, or in seasonally waterlogged areas of grassland and open woodland, particularly low, wet depressions. Tolerates a broad range of soil types, including relatively saline soils, but prefers heavy, cracking clays.

Value in wetland:

- rapidly growing pioneer of disturbed sites (3.5 m tall in 6 months), with a seed bank that can remain dormant for years under swards of introduced grasses. Seed germination is stimulated by fire or direct sun after weed removal
- grows in infertile soils and can fix nitrogen – useful for soil improvement and bank stabilisation
- provides roosting habitat for many small bird species, attracts many insects, including bees.

Plant uses:

- used in revegetation sites as a windbreak, erosion control and habitat for birds
- tolerant of heavy metal toxicity, and has potential for use in phytoremeditation of mercury contaminated soil
- flowers are edible and are used as a vegetable in India
- various plant parts are used medicinally to treat dysentery, fevers, headaches, small pox, sores, sore throat, and inflammation or infection of the mouth and lips. Eating leaves as a vegetable is reported to improve eyesight
- straight stems used by Indigenous Australians to make fishing rods and light spear shafts for hunting fish and small animals
- seeds contain a water-soluble gum with broad applications as a food additive, textiles, paper products and various industrial uses
- stems contains a fibre similar in quality to jute
- fast-growing habit provides reliable fuel wood in developing countries, used as pulpwood
- widely used in Asia as green manure crop to increase yields of rice, wheat and maize
- young plants are grazed by stock and have high protein but are generally unpalatable
- may be a weed of cotton, and other irrigated crops on heavy soils.

Propagation: A single plant can produce over 1,200 seed pods, and seeds can remain dormant for long periods. Dormancy can be broken by dunking seeds in boiling water, then planting.

Prominent yellow flowers and opposite pairs of toothed and lobed leaves

Forms extensive monocultures along the margins of wetlands, excluding all other species

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●					

WEED

Singapore daisy

Sphagneticola trilobata* – Family Asteraceae

Declaration status: Restricted Category 3 plant under the *Biosecurity Act 2014*

Other common names: Bay Biscayne creeping oxeye, creeping daisy. Previous scientific name: *Wedelia trilobata*

Description: A sprawling perennial plant up to 0.45–0.7 m tall but with trailing stems up to 2 m long, leaves arranged in opposite pairs on the hairy stems, 30–110 mm long, 25–80 mm wide with prominent veins, toothed margins and three pointed lobes. Flowers are yellow 20–35 mm wide on the end of stalks (pedicels) 30–150 mm long. Seeds (achenes) are elongate, brown, 4–5 mm long but are rarely produced in Australia.

Distinctive features: The native beach sunflower (*Wollastonia biflora*) has similar looking yellow daisy flowers but has broader leaves with no lobes at the tip, the flowers are borne in bunches, not singularly, and it occurs only on beachfronts, not in freshwater wetlands.

Habitat: Not restricted to wetlands, as it will often grow in a range of woodlands, rainforest margins and disturbed areas. It often forms dense infestations along drains, riverbanks, lake edges, wetlands and even on coastal beachfronts. May grow out over floating water weeds to form extensive mats.

Impacts on wetlands: Native to Central America, South America and the Caribbean, this noxious weed:

- causes dense infestations of interconnected plants and runners, including floating mats, that exclude native plants and animals, lowering biodiversity
- smothers and prevents germination and establishment of tree seedlings leading to progressive deforestation of riverside and beachfront vegetation and eventually forms a monoculture of Singapore daisy.
- invades gardens and crops, reducing crop yield.

Weed facts:

- although originally introduced for gardens and bank stabilisation, it is illegal to grow or sell as it is a declared weed in Queensland
- listed in the top 100 of the world's worst invasive species
- leaves used in traditional medicine for coughs and chest colds.

Spread and control: grows readily from seed and from broken plant fragments, which readily form roots in contact with the ground. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label. There are currently no herbicides registered for its control in or over water. For more information refer to: www.business.qld.gov.au/industry/agriculture/species/declared-pests/weeds/singapore-daisy

Specialised long thin fertile fronds and glossy green fronds of alternately arranged leaflets

Forms a dense sprawling ground cover, climbing over low woody vegetation

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	Not applicable											
Fruiting	Not applicable											

Climbing fern

***Stenochlaena palustris* – Family Blechnaceae**

Other common names: Climbing Swamp Fern. Previous scientific name: *Stenochlaena scandens*, *Polypodium palustre*

Description: Tall climbing fern with a long underground and climbing stem (rhizome), fronds alternately arranged along the stem, 0.3–1 m long comprised of numerous shiny alternate leaflets tapering to a fine point. Leaflets are tough and leathery, finely toothed or serrated along the edges, reddish-orange when young. Spores are produced on specialised fertile fronds, consisting of very long, thin leaflets 2–4 mm wide. The underside of these thin leaflets is densely covered with spores.

Distinctive Features: This is the only species of *Stenochlaena* in Australia. There are many other climbing ferns in the Wet Tropics (e.g. *Lindsaea*, *Lygodium*). However, *Stenochlaena* has a much larger frond and is the only climbing fern with different looking fertile and infertile fronds.

Habitat: Climbing fern climbing rainforest and riparian trees along the edge of permanent freshwater streams, *Melaleuca* swamps or lakes, sometimes forming thickets. In the absence of trees it can form a thick sprawling ground cover, and may dominate the ground storey around the edges of some swamps.

Value in Wetland: Fast growing pioneer that rapidly colonises and stabilises disturbed areas in appropriate habitat. Can be used as a groundcover in shady area. The dense groundcovers, thickets and upright columns of fronds provides important habitat for a range of insect, frog and reptile species.

Plant Uses:

- young shoots and leaves edible raw or cooked as soup, however, caution should be exercised if eating large amounts
- has a thick tuberous underground stem (rhizome) that is edible after roasting
- plant used as medicine for fever, ulcers and skin disease
- leaves contain a range of antifungal, antibacterial, antioxidant and alpha glucosidase inhibiting chemicals that reduce the ability to break down and absorb carbohydrates and glucose
- fibre from stems used for making ropes and tying
- grown as an ornamental plant in hanging baskets, as a ground cover or as a climber in gardens with enough space.

Propagation: Grown from spores, cuttings or by division of clumps.

Other herbs and shrubs

Angiopteris evecta (King fern) – Large native fern with a short thick stem and fronds to 5 m long, on banks of streams, gullies or seepage zones.

Blechnum indicum (Swamp waterfern) – Perennial native fern to 1 m forming extensive colonies on edges of lakes and swamps. Important traditional food source for edible rhizome.

Colocasia esculenta (Taro)*– Perennial herb to 1 m with green or purple stems, on edge of swamps and creeks. Though some forms may have been here prior to European arrival, the purple-stemmed form is an environmental weed that displaces many native water plants. Widely grown for its edible tubers.

Dentella repens (Creeping dentella) – Perennial native creeping prostrate herb to 0.2 m tall, in open areas on riverbeds, the drying margins of riverbanks, swamps and disturbed margins of wetlands.

Dicranopteris linearis (Forked fern/ Coral fern) – Perennial native fern to 1 m forming dense tangled stands around swampy plains and the edges of wetlands. Stems used to weave fish traps, baskets, chair seats, hats, rope, indicates freshwater nearby or underground.

Eriocaulon australe (Pipewort) – Perennial native tufted plant 0.23–0.8 m. Grows in open swampy areas including the wet margins of creeks and drains.

Other herbs and shrubs

Eriocaulon nanum (Pipewort) – Annual or perennial native tufted plant 0.12 m. Grows in in the open wet margins of creeks and swamps in woodland communities. This is just one of just 16 Eriocaulons in the Wet Tropics. Identification is based on the shape of the bracts in the seed head.

Freycinetia scandens (Climbing pandan) – Perennial scrambling or climbing native vine, not restricted to wetlands but often climbs or forms tangled thickets on edge of swamps, creeks and lakes.

WEED *Heliotropium indicum** (Indian heliotrope) – Annual introduced herb 0.3–0.5 m, along the bare drying margins of swamps, dams and lagoons.

Hygrophila angustifolia (Willow hygro) – Annual native herb 0.5–1 m along creeks, swamps and seasonal wetlands.

WEED *Ludwigia hyssopifolia** (Seedbox) – Annual introduced herb with erect stems 1–2 m tall, with reddish stems and small yellow flowers to 6 mm wide. On the margins of creeks and swamps, sometimes forming thickets.

Persicaria hydropiper (Water pepper) – Perennial native straggly herb 1–2 m, on sand banks and disturbed margins of rainforest creeks.

Other herbs and shrubs

Persicaria orientalis (Prince's feather) – Sturdy annual herb to 2 m tall with pink flowers and a circular membranes at the base of leaf stems. Occurs on moist, disturbed edges of creeks, dams and wetlands.

Persicaria strigosa (Prickly smartweed / Spotted knotweed) – Perennial native herb creeping or forming dense stands along the edge of swamps, lagoons and lakes. Often orange or purplish on the underside of the leaf. Spike of flowers up to 10 mm long.

Persicaria subsessilis (Bristly knotweed / Hairy knotweed) – Perennial native creeping herb. Stems and leaves covered with upward facing hairs and spike of flowers 20–25 mm long.

ENDANGERED *Phaius australis* (Lesser swamp orchid) – Perennial native ground orchid with leaves to 0.7 m and flower stems to 1.1 m. Known to grow in colonies in wet boggy areas around springs, sedgelands, open swamps, swampy grassland or swampy forest but is nearly extinct in the Wet Tropics. It is listed as Endangered under the Commonwealth EPBC Act and Queensland Nature Conservation Act *Phaius pictus* (Forest swamp orchid) also occurs in the Wet Tropics but has yellowish petals.

Thysanotus tuberosus (Common fringe-lily) – Perennial native herb 0.2–0.6 m. Grass-like leaves die back to underground tuber during dry season. Not restricted to wetlands but commonly found in poorly drained and swampy areas in broad-leaved tea tree woodlands.

GRASSES

Inflorescence comprising 3–6 spikes arranged like fingers on a hand (digitate)

Perennial, sprawling low growing grass often forming a 'lawn' to the waters' edge

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

WEED

Couch grass

Cynodon dactylon* – Family Poaceae

Declaration status: Not declared

Other common names: Green couch, Bermuda grass, swamp couch. Previous scientific name: *Panicum dactylon*

Description: Perennial, sprawling low-growing grass to 0.3 m, spreading by above-ground stems (stolons) and underground stems (rhizomes) to form dense mats. Leaves arranged alternately along stem, thin, broadest at the base, 15–90 mm long, 1–2 mm wide, hairy at the junction with the stem. Flower head (inflorescence) is borne on a stem (culm) 150–200 mm tall, comprising 3–6 spikes arranged like fingers on a hand (digitate). Spikes 25–60 mm long, each with two rows of flowers (spikelets). Fruit is a brown grain, 1.3 mm long.

Distinctive features: *Sporobolus virginicus* has narrower and more stiff and erect leaf blades and a single flower head. *Paspalum distichum* (water couch) has a flower head (inflorescence) consisting of only two arms. *Cynodon dactylon** has both above-ground stems (stolons) and below-ground stems (rhizomes) whereas *Cynodon aethiopicus** and *Cynodon nlemfuensis** both have stolons but no rhizomes.

Habitat: Usually grows on sandy to clay soils along watercourses and on flood plain margins, especially in disturbed areas. Forms a 'lawn' to the water's edge and is tolerant of short-term seasonal inundation. In areas with more frequent tidal influence it is replaced by saltwater couch (*Sporobolus virginicus*).

Impacts on wetland:

- a valuable soil binder in sandy soils associated with wetland buffers and river banks. This species also has a good tolerance to saline soils
- as this species is considered very competitive, it presents a threat to irrigated crops and is considered a weed in 80 countries.

Weed facts:

- although introduced, it is widely used in rehabilitation as it is considered a hardy pioneer plant with strong root development, which improves soil structure and recycles nutrients
- is apparently tolerant of saline and acid water so may be useful for mines with acid drainage issues
- used as a lawn and turf due to its outstanding spreading ability, where stolons are able to grow more than 7.5 cm per day
- is one of the most grazing-resistant grasses and can withstand heavy grazing once established. Tolerates frequent mowing.
- makes good quality hay, can be baled and maintains good nutritive value during storage
- may cause contact dermatitis in sensitive people and, with its high production of pollen, can be a common cause of hayfever
- regarded as a serious weed of agriculture throughout the world.

Spread and control: This grass is widely grown by seed, spread by hand or in a hydromulch. While debate continues regarding its country of origin, most commercially available seed is from overseas provenance. Sensitive to Glyphosate. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label.

Side branches arising from a central stalk with overlapping flowers (spikelets), each with a stiff bristle (awn)

Forms dense infestations in water that can be more than 2 m deep during the wet season

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

WEED

Aleman grass

Echinochloa polystachya* – Family Poaceae

Declaration status: Not declared

Other common names: Creeping rivergrass. Previous scientific names: *Echinochloa spectabilis*, *Oplismenus polystachyus*

Description: Robust, erect perennial grass 1–3 m tall with underground stems (rhizomes). Leaves borne along the stem, 200–400 mm long, 10–22 mm wide, hairless, slightly rough (scabrous). Ligule at junction of leaf base is a fringe of stiff hairs 2–5 mm long. Flower head (inflorescence) is a panicle 14–35 cm long, hairy, with side branches 2–10.5 cm long arising from a central stalk, flowers (spikelets) overlapping, dense, in pairs or clusters 3.5–5 mm long, each with a stiff bristle (awn) 2.5–8 mm long. Fruit is a grain, oblong, 2–2.5 mm long; however, aleman grass is not thought to set viable seed in Australia.

Distinctive features: Tall, robust aquatic grass, mostly hairless, dense seed head and flowers (spikelets) with long awns. Para grass (*Urochloa mutica**) has densely hairy stems.

Habitat: Grows on the margins of billabongs, in swamps and constructed wetlands, where it can grow in water that is seasonally more than 2 m deep.

Impacts on wetland: Native to North and South America, this weed was introduced for ponded pasture systems. Impacts include:

- forms monocultures that can smother native plant species, reducing biodiversity, impacts on fisheries and removes water bird breeding and foraging habitat
- modifies its environment through dense shading, generating high fuel loads and hot fires, and may impact water quality, especially dissolved oxygen
- can grow in water over 2 m deep for short periods but prefers water to 1 m
- capable of invading crops such as sugar cane and rice
- due to the large amounts of nitrogen it accumulates, it may cause nitrate or nitrite poisoning in grazing cattle following drought.

Weed facts:

- used in ponded pasture systems; however, negative impacts on wetlands significantly outweigh its value as a cattle fodder and its use is not recommended
- invades crops, including sugar cane and rice.

Spread and control: Aleman grass spreads easily vegetatively when broken stems, runners and roots are moved in water, where they can move considerable distances. Therefore, good hygiene practices, such as washing down vehicles, boats and equipment is critical in preventing spread. There are only a few herbicides registered for use of weeds in waterways. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label. For further information on control, refer to www.business.qld.gov.au/industry/agriculture/species/non-declared-pests/weeds/aleman-grass

Flower head (inflorescence) is a dense and cylindrical; leaves broad at base and clasp the stem

Dense infestations exclude all other native wetland plants and removes wildlife habitat

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering				●	●	●	●	●	●	●		
Fruiting				●	●	●	●	●	●	●		

WEED

Olive hymenachne

Hymenachne amplexicaulis* **– Family Poaceae**

Declaration status: Weed of National Significance, Restricted Category 3 plant under the *Biosecurity Act 2014*

Other common names: hymenachne, West Indian marsh grass. Previous scientific name: *Panicum amplexicaule*

Description: Robust perennial grass to 2 m tall, spreading by above-ground stems (stolons) to form dense mats. The smooth, hairless stems develop new roots at the nodes. Leaves borne along the stem, broad and triangular, 50–400 mm long, 8–60 mm wide, distinctly lobed at the base and clasping the stem. Ligule at junction of leaf base is absent or 1 mm long. Flower head (inflorescence) is a dense, cylindrical panicle 10–38 cm long, 1–1.5 cm wide, with flowers (spikelets) 4–6 mm long. Seeds are thin, elongated, 3–4 mm long (each flowering head can produce 4,000 seeds).

Distinctive features: Readily distinguished by the stem-clasping base of the blade of the leaf, which is absent in the less-robust native species *Hymenachne acutigluma*.

Habitat: Low-lying freshwater wetlands and flood plains, which are inundated during the wet season followed by a drying-out period. Factors limiting its growth include an extended drying period and higher conductivity (saline) waters. Similar to water hyacinth, floating rafts will wash into brackish areas after floods but generally do not persist.

Impacts on wetland: Native to South America, this noxious weed was introduced in 1988 for grazing ponded pasture systems. Impacts to wetlands include:

- forms thick monocultures which exclude other native plants and palatable forage grasses, suppresses tree recruitment, removes water bird breeding and foraging habitat, blocks fish passage, changes soil properties, smothers and generates organic loading of wetlands that reduces dissolved oxygen levels and water quality, potentially leading to fish kills
- poses a significant threat to biodiversity of Wet Tropics coastal wetlands
- hybrids (named *H. x calamitosa*) of this species and the native *H. acutigluma* have been recorded, e.g. at Abattoir Swamp near Mt Molloy
- generates massive fuel loads that produce very hot wildfires, damaging ecosystems such as riparian forests.

Weed facts:

- although imported for ponded pasture-grazing systems too deep for para grass*, its significant negative impacts on wetlands led to it being declared a noxious weed and Weed of National Significance. It is illegal to sell or deliberately cultivate a declared weed.
- listed in the top 10 priority weeds in Wet Tropics and in the top 20 priority weeds in Cairns.

Spread and control: Reproduces from seed and broken stem fragments. There are only a few herbicides registered for use of weeds in waterways. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label. For further information on control, refer to www.business.qld.gov.au/industry/agriculture/species/declared-pests/weeds/hymenachne

Inflorescence is a dense cylindrical panicle appearing like a dense mat of silky white hairs

May form monocultures on poor nutrient soils but coastal wetlands dominated by blady grass are now extremely rare in the Wet Tropics

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●				●	●
Fruiting	●	●	●	●	●	●	●				●	●

Blady grass

***Imperata cylindrica* – Family Blechnaceae**

Other common names: Lalang, cogon grass, kunai grass, sword grass. Previous scientific names: *Lagurus cylindricus*, *Saccharum cylindricum*

Description: Perennial native tussock grass with a branching underground stem (rhizome), 0.4–1.5 m tall. Erect stem (culm) with bearded tufts of hair at the nodes. Leaves mostly arising from base of plant, 30–1000 mm long, 2–20 mm wide, with an obvious pale midrib and a rough leaf margin with microscopic sharp teeth. Ligule at junction of leaf base is a membrane with a small fringe of hairs. Flower head (inflorescence) is a dense cylindrical panicle 30–250 mm long, appearing like a dense mat of silky white hairs.

Distinctive features: Unmistakable when plants are flowering or seeding, but sterile plants can be mistaken for Guinea grass (*Megathyrsus maximus*), which is taller, lacks an underground rhizome and has an open branched flower head (inflorescence).

Habitat: Not restricted to wetlands; it can occur in the understorey of woodlands and wet sclerophyll forest, particularly on sand or sandy loams subject to periodic burning. Also found on alluvial flats, margins of rivers (including riparian forests), swamps and floodplains, and in coastal seasonal swamps where it is often out-competed by para grass (*Urochloa mutica**) or cleared for sugar cane production. Coastal wetlands dominated by blady grass are now extremely rare in the Wet Tropics. Although regarded as an indicator of poor nutrient soils, disturbance and/or periodic burning, it is tolerant of a very broad range of environmental conditions, including pH, soil fertility and moisture. Intolerant of heavy shade.

Value in wetland:

- the ecological role of blady grass in coastal wetlands is poorly known due to its scarcity
- seeds eaten by birds including finches
- provides habitat and food for a range of wildlife, including refuge and nesting habitat for the eastern grass owl
- important larval food plant for a range of skipper butterfly species including white-banded grass-dart, greenish grass-dart, dark grass-dart, greenish darter, and scrub darter
- rhizomes provide soil stability, rosion control and competition against weed invasion
- produces allelopathic chemicals that can limit germination and growth of other plants
- native to Australia, blady grass is a significant agricultural weed in Asia, Africa and the USA
- wind dispersed: plumed seeds are capable of travelling long distances in the wind, with an average flight path of 15 to 100 m.

Plant uses:

- underground stem (rhizome) is sweet and edible raw, containing starch and sugars
- used in traditional Chinese medicine for coughing blood (hemoptysis), blood in urine (hematuria) and nose bleeding
- stems used as toy spears by children
- leaves used to thatch roofs, or woven into baskets or mats
- leaves have high cellulose and have been used in production of paper pulp
- cattle eat young leaves, but is only considered a decent stock feed for the first 6 weeks of regrowth
- used in revegetation, water sensitive urban design and in garden beds in landscaping, and several colourful cultivars are available.

Propagation: Clumps can be transplanted. Plants produce up to 3,000 wind dispersed seed that germinate easily.

Inflorescence has 1–5 branches each with 3–10 flowers (spikelets), each with a distinct row of curved teeth.

Forms dense stands that excludes weeds and stabilise edges of waterways

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Swamp rice grass

***Leersia hexandra* – Family Poaceae**

Other common names: Native rice grass, cutgrass. Previous scientific name: *Leersia australis*

Description: Erect perennial grass 1–2 m tall. Nodes covered with downward-facing hairs. Leaves arranged alternately along the stem, 40–200 mm long and about 3–10 mm wide, erect, blue-green in colour, with rough or sharp margins and lower mid-rib. Ligule at junction of leaf base is a membrane 3 mm long. Flower head (inflorescence) is a loose panicle 50–120 mm long, with 1–5 side branches, each with 3–10 flowers (spikelets) 3.5–5 mm long. Each spikelet with a distinct row of curved teeth. Fruit is a grain, rarely developed and remaining enclosed within the floret.

Distinctive features: Thin erect leaves, sharp along the margins and mid-ribs beneath, spikelets with distinct spines.

Habitat: Associated with margins of marshes, streams, lakes, canals, backwater swamps and billabongs, and sometimes forms floating mats that can grow in water to a depth of 1.8 m. Common in the zone between brackish and freshwater systems.

Value in wetland:

- forms thick swards, stabilising banks of waterways and wetlands, tolerating periods of flooding, drying, fire and grazing
- provides important foraging habitat for water birds, and seeds are eaten by a range of waterfowl
- food plant for grass-dart butterflies.

Plant uses:

- useful in constructed wetlands, where it has been successfully used in projects by groups such as Greening Australia
- Can be used for revegetation, where it is suitable for bank stabilisation and erosion control, as stems grown in deep water reduce flood flow velocities and thus reduce erosion
- is a hyper-accumulator of heavy metals for use in phytoremediation ponds, able to remove copper, nickel and, especially, chromium
- palatable to cattle, either grown as a pasture grass in wet areas or cut for hay.

Propagation: Can be propagated by seed and the division of rhizomes. It is produced for revegetation sites by the division of stock plants. Plants in 140 mm pots that are planted 1 m apart on the edge of the wetland have been observed to form a dense sward within one year.

Inflorescence usually consisting of two (rarely 3–4) spreading racemes

Submerged lawn on shallow margins of Lake Tinaroo

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●							●	●
Fruiting	●	●	●	●								●

Water couch

***Paspalum distichum* – Family Poaceae**

Other common names: Knotgrass, couch paspalum, eternity grass, water finger-grass, ginger grass, sea-shore paspalum, Mercer grass. Previous scientific names: *Paspalum littorale*, *P. paspalodes*, *P. vaginatum*, *Digitaria paspalodes*.

Description: Perennial creeping grass to 0.6 m tall, spreading by above-ground stems (stolons) to form dense mats. Often with short underground stems (rhizomes). Leaves arranged alternately along stem, though often crowded towards the ends of stolons. Leaves 30–120 mm long, 2–6 mm wide, smooth, tapering and generally held erect. Flower head (inflorescence) is borne on a stem (culm) 150–600 mm long, consisting of two (rarely 3–4) spreading racemes 15–80 mm long. Keeled spikelets 3.5–4 mm long, 15–50 spikelets arranged in two rows along each raceme. Fruit is a yellowish grain, 2.5–2.8 mm long, tapering to a point.

Distinctive features: There are three *Paspalum* species in the Wet Tropics, however *P. longifolium* and *P. scrobiculatum* have the racemes arranged alternately along the stem (culm).

Habitat: Not restricted to wetlands; it can occur in the understorey of wet and dry sclerophyll forests, rainforests and shrublands. Often found in seasonal wetlands (including gilgais), ditches, alluvial flats and grasslands around the margins of wetlands, sometimes persisting as an emergent grass or submerged grassland on shallow margins, and sometimes forming a component of grassy swamps. Tolerant of brackish and saline conditions.

Value in wetland:

- stabilising banks of waterways and wetlands, tolerating periods of flooding, drying, fire, grazing and high nutrient loads
- provides important foraging habitat for wildlife, and seeds are eaten by finches and a range of waterfowl including magpie geese and ducks
- food plant for several skipper butterfly species.

Plant uses:

- used in revegetation to provide erosion protection on stream banks swamps and wet sandy areas
- palatable to cattle and moderately productive, but may be toxic if infected with toxic ergot fungus
- although native to Australia, it is known as an agricultural weed in south east Asia and Europe.

Propagation:

Often grown by planting stolons directly into moist soil. Can be propagated from seed though seed dormancy may need to be broken by scarification or by alternating temperature and moisture in storage.

Phragmites australis: flowers with silky hairs

Phragmites karka: more pendulous flowering head

Often occurs as a dense monoculture around the margins of wetlands

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●							●	●
Fruiting	●	●	●	●								●

Tall reed

***Phragmites karka* – Family Poaceae**

Other common names: Tropical reed, little bamboo, cane grass. Previous scientific names: *Arundo karka*, *Phragmites vallatoria*, *Arundo vallatoria*

Description: Robust perennial grass with stout upright stems (culms) 1–10 m tall, with creeping below-ground stems (rhizomes) Leaves long to broadly spear shaped, minutely rough to touch, 200–800 mm long, 10–40 mm. Ligule at junction of leaf base is a short fringe of hairs, absent on older stems. Flower head (inflorescence) 300–500mm long, with pendulous plume-like masses of flowers (florets) 4–6 mm long with distinctive long silky hairs 12 mm long. Up to 200–500 flowers (florets), each with 3–4 florets. Produces prolific thin brown seeds, 1.1 mm long.

Distinctive features: There are two species of *Phragmites* in the Wet Tropics. P*hragmites australis* does not grow as tall, has smoother leaves, the flower head (inflorescence) is only slightly nodding, not pendulous and plume-like, and the hairs on the ligules are much longer. The introduced weed *Arundo donax* is also a tall reed and often confused but the flower head is erect, not pendulous and the leaves are broader and sheathed around the stem.

Habitat: Occurs often as a dense monoculture around the margins of freshwater wetlands, including rivers, creeks, swamps, lakes and billabongs in rainforest and woodland. May occur in coastal swales but not in areas subject to tidal influence, dense shade or areas subject to frequent fire. Has a broad tolerance to pH levels.

Value in wetland:

- used by shelter for a multitude of wetland animals, provides nesting material by magpie geese and estuarine crocodiles
- important stabiliser of river banks, capable of withstanding heavy floods.

Plant uses:

- young shoots are eaten after cooking like bamboo sprouts, or preserved by salting
- used in Chinese traditional medicines for a range of purposes, including as an aphrodisiac and diuretic, and for the treatment of vaginal and urinary complaints, bacterial skin disorders and heart disease
- stems used for making spear shafts, portable fish traps, or stems split and woven into hats, mats, baskets, chairs or rough panels for thatched huts
- flower stalks have strong fibre for rope making, and clusters of flower heads bound to a handle for making brooms
- has been used in the deep marsh zone of constructed wetlands and sedimentation basins for treating stormwater and industrial wastewater, particularly for removal of heavy metals such as chromium and arsenic
- can withstand quite heavy floods, and is a good stabilizer of eroding river banks
- can indicate areas affected by acid sulphate soils and may be useful in restoring affected areas. Plants accumulate lots of organic matter that promotes microbial activity, increasing sulfate reduction and stimulating alkalinity.

Propagation: Can be propagated by seed sown onto a tray of saturated propagating mix, or by the division of clumps when plants have new growth.

Inflorescence without secondary branches, and with alternately spaced flowers (spikelets)

Floating stems grow out across the water surface

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	•	•	●	●	●	●	●	•				
Fruiting		•	●	●	●	●	•	•				

Spiny mud grass

***Pseudoraphis spinescens* – Family Poaceae**

Other common names: Floating couch grass, mud grass, moira grass. Previous scientific name: *Panicum spinescens*

Description: Sprawling perennial grass to 0.5 m tall, with creeping above-ground stems (stolons) forming dense mats. Nodes on stem are variable, either smooth or covered in thick silky hairs, and producing roots. Smooth leaves arranged alternately along the stem, thin and tapering, 30–120 mm long, 10–40 mm wide, often held at right angles to the stem. Ligule at junction of leaf base is a membrane collar 1 mm long. Flower head (inflorescence) 40–70 mm long, with 8–20 branches (panicle), each with alternately spaced flowers (spikelets). Fruit is a pale rounded seed 1.3 mm long.

Distinctive features: Panicum paludosum can have a similar growth habit but the flower head (inflorescence) has secondary branches. Paspalum distichum (water couch) has a flower head consisting of only two arms. Pseudoraphis paradoxa looks similar but the flower head has much smaller branches, with only 1–2 flowers (spikelets) per branch.

Habitat: Common component of grass-sedge wetlands and is found in a diverse range of habitats, including shallow zones of ephemeral or permanent pools, watercourses and floodplains associated with mud, heavy clays or dark cracking clay soils. Considered to be moderately salt tolerant.

Value in wetland:

- useful role in bank stabilisation and erosion control
- contributes to the ecological function of wetlands by providing food and habitat for waterfowl and other aquatic organisms, and nutrient cycling
- considered a useful indicator of the condition and integrity of aquatic ecosystems
- can sometimes become a nuisance in water channels by reducing water flow.

Plant uses:

- Indigenous people traditionally harvested the plants to make a soft sleeping area
- successfully used in constructed wetlands in the tropics. Particularly useful on wetland verges, where it produces a close turf on drying mud and forms dense floating mats in adjacent inundated areas
- suitable for bank stabilisation and erosion control, and has been trialled in bioretention ponds
- new shoots are considered palatable and grazed by stock and kangaroos.

Propagation: In natural conditions seeds are dispersed by water and germinate on saturated soils where water depth is about 2 cm. Germination can occur over prolong periods, up to 40 weeks. Can also establish vegetatively or by fragmentation. Should not be allowed to dry out during establishment phase.

Long hairy stems up to 5 m long

Inflorescence is roughly pyramid shaped with alternate arms

Forms dense swards in water up to 1.5 m deep, excluding other native wetland plants

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering		●	●	●	●	●	●	●	●			
Fruiting				●	●	●	●	●				

WEED

Para grass

Urochloa mutica* – Family Poaceae

Declaration status: Not declared

Other common names: Mauritius signal grass. Previous scientific names: *Brachiaria mutica*, *Panicum muticum*

Description: Perennial grass, 0.6–3 m tall but producing long, hairy above-ground stems (stolons) running up to 5 m long. Leaves are arranged alternately along stem, 60–300 mm long, 5–20 mm wide, often hairy. Flower head (inflorescence) is roughly pyramid shaped and consists of several alternate arms, each with numerous spikelets, 3–3.5 mm long.

Distinctive features: The long, running hairy stems (stolons) are distinctive of this grass.

Habitat: Occurs in permanent or ephemeral rivers and wetlands, anchored in water up to 1.5 m deep, but may trail long distances over the top of floating weeds to form a solid dense mat. It may also occur on floating rafts.

Impacts on wetland: Native to Africa, this noxious weed:

- forms monocultures, excluding other native plants and suppressing their seed germination
- causes a reduction in diversity of plants, birds (especially brolgas and magpie geese) and fish species
- modifies its environment through dense shading, generating high fuel loads and hot fires, and may impact water quality, especially dissolved oxygen.

Weed facts:

- formerly introduced for use in 'ponded pastures' for cattle grazing, but the benefits are outweighed by negative impacts on biodiversity, agriculture (by choking irrigation drains) and fishing
- still widely used for grazing – maintaining appropriate grazing pressure is often necessary to prevent para grass dominating the wetland.

Spread and control: Seeds have a low viability, and para grass is mostly spread vegetatively. Slashing, grazing and/or hot fires can be used in conjunction with herbicides to manage infestations. It is highly tolerant to fire and can generate high fuel loads, leading to destructive fires, but hot late-season fires can kill para grass, allowing other grasses to recolonise. It is highly palatable to cattle, and excluding cattle may cause para grass to expand, but grazing is not a permanent solution. It has a low tolerance to salinity, and restoring tidal influence has been effective in eradicating infestations in the Ingham region. There are only a few herbicides registered for use on weeds in waterways. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label. For further information on control, refer to www.business.qld.gov.au/industry/agriculture/species/non-declared-pests/weeds/para-grass

Other grasses

Arundinella setosa (Reed grass) – Perennial native grass 0.5–1.2 m tall. Not restricted to wetlands, but commonly occurs along the margins of seasonal and perennial creeks in woodland communities.

WEED *Arundo donax** (Giant reed) – Perennial introduced grass 3–6 m tall, rarely 10m tall. Grows on moist, sunny and disturbed banks of rivers and creeks prone to flooding.

Centotheca lappacea (Centotheca) – Perennial native grass 0.3–1 m, growing in clumps that spread from above-ground stems (stolons). Grows on the margins of lowland rainforest creeks and swamps.

WEED *Echinochloa colona** (Awnless barnyard grass) – Perennial introduced grass to 0.6 m. Grows in moist areas on edges of swamps, in poorly drained woodland and in disturbed areas such as drains and ditches.

Hemarthria uncinata (Mat grass) – Perennial native grass to 1 m, bulk of the plant creeping across the ground with above-ground stems (stolons) so is being trialled as a lawn. Often forms large stands in swamps, sedgelands and wet grasslands.

Hymenachne acutigluma (Native hymenachne) – Perennial native grass 0.3–2 m, less robust than the introduced hymenachne and leaves not clasping stems. Occurs in shallow swamps, lagoons and seasonally flooded grasslands, sometimes forming monocultures.

Other grasses

Ischaemum australe (Large bluegrass / Zipper grass) – Perennial native tufted grass to 1.5 m, sometimes with creeping underground stem (rhizome). Grows in moist areas on low nutrient sandy soils, including depressions in Melaleuca woodlands, gullies and edges of swamps.

Lophatherum gracile (Bamboo Leaf) – Perennial native grass 0.5–1 m, grows on the edges of creeks, swamps or other seasonally wet areas.

Mnesithea rottboellioides (Northern canegrass) – Perennial native clumping grass 1–3 m tall. Grows in a range of grasslands and woodlands including seasonally flooded grassy swamps where it can become dominant.

Panicum paludosum (Swamp panic) – Perennial native to 1.3 m tall. Not restricted to wetlands but often found in and around the margins of wetlands in wet sclerophyll forests and rainforests.

WEED *Pennisetum purpureum** (Elephant grass / cow cane) – Perennial introduced tufted grass up to 4 m tall. This African grass grows in disturbed areas and river banks where it outcompetes other native plants.

WEED *Urochloa humidicola** (Humidicola) – Perennial introduced grass to 0.6 m, with spreading above-ground stems (stolons). Not restricted to wetlands but usually in poorly drained areas, or subject to seasonal flooding. Widely grown as a cattle fodder throughout the Wet Tropics region.

SEDGES AND RUSHES

Forms pure, dense stands in water up to 1 m deep on the edges of lakes, and slow-flowing watercourses

Inflorescence is a drooping, branched panicle

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering		●	●	●	●	●	●	●	●			
Fruiting				●	●	●	●	●				

Jointed twig-rush

***Baumea articulata* – Family Cyperaceae**

Other common names: Twigrush. Previous scientific name: *Cladium articulatum*, *Machaerina articulata*

Description: Perennial sedge to 2–2.5 m with a creeping underground stem (rhizome). Leaves and stems rigid, cylindrical, 4–10 mm diameter, separated into sections by transverse partitions (septa). Flower head (inflorescence) is a branched panicle, drooping 0.3–0.4 m long, each branch consisting of multiple reddish-brown spikelets 3.5–5 mm long. Fruit is a pale or dark reddish brown nut 1.8–2.3 mm long.

Distinctive features: Several other sedges also have rigid cylindrical stems. *Eleocharis* species have an unbranched terminal flower head (inflorescence). *Schoenoplectus subulatus* has spikelets arranged spirally, compared to *Baumea articulata* where spikelets are arranged in one plane (distichous). Other species of *Baumea* don't have the partitions (septa) within their stems.

Habitat: Forms pure, dense stands up to 2 m tall in water up to 1 m deep on the edges of lakes, dams, lagoons, deeper swamps and slow-flowing watercourses. Usually in freshwater but may tolerate slight or moderate salinity. Some stands may be clones and are interconnected by a network of underground stems (rhizomes). Plants are apparently very long lived.

Value in wetland:

- important food and habitat for water birds including ducks and magpie geese, which crush down the stems to build nests
- important habitat for macroinvertebrates, freshwater fish, frogs and amethystine pythons which may bask on mats of crushed stems
- provides a substratum for algal epiphytes and biofilms to enhance soluble pollutant uptake
- contributes to the ecological function of wetlands by reducing excess nutrient levels.

Plant uses:

- fibre from some *Baumea* species was twined into rope, and made into baskets or dilly bags
- considered one of the best native species for nutrient removal. Shown to bioaccumulate nitrogen and phosphorus, it has been used to treat waste water with high nutrient levels. Often used in deep marsh zone of constructed (treatment) wetlands and sedimentation basins
- used for aerating aquatic sediment, stabilising banks and to provide fauna habitat in constructed wetlands.

Propagation:

Propagate by division of the underground stem (rhizome). Seed germination may be sporadic and apparently benefits from six months storage prior to planting, though some populations may not produce viable seed. Use bog method for seed. Tissue culture has been used for mass production.

Large spreading bracts around flower clusters gives it an umbrella-like appearance

Forms dense impenetrable tangles, especially along seasonally dry creeks

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●		●	●	●	●	●	●	●	●	●	●
Fruiting				●	●	●	●	●	●	●		

WEED

Umbrella sedge

Cyperus involucratus* **– Family Cyperaceae**

Declaration status: Not declared

Other common names: umbrella plant, African sedge. Previous scientific name: *Cyperus flabelliformis, Cyperus alternifolius*

Description: Perennial, tall clumping sedge, up to 1.5 m tall, with large spreading bracts giving it an umbrella-like appearance. Leaves are inconspicuous, reduced to sheaths wrapped around the stems. Stems are rigid and erect, 3–5 mm wide, smooth, smooth and hairless, with longitudinal ridges. Flower head (inflorescence) consists of numerous unequal length stalks 50–100 mm long, branching into secondary stalks 10–20 mm long. Flowers (spikelets) are arranged into dense clusters 20 mm wide, reddish-brown at maturity. The inflorescence is surrounded by a spiralling ring of 12–22 leafy bracts (involucral bracts) 100–300 mm long, 10–15 mm wide. Fruit is a yellowish-brown nut, 0.6 mm long.

Distinctive features: At 1.2–1.5 m tall and forming large clumps, this is a much larger species than most other sedges. The numerous green leafy bracts under the flower heads give the plant an unmistakable umbrella-like appearance.

Habitat: Generally occurs in seasonal (ephemeral) swamps and seasonally dry creek beds, particularly those with sandy creek beds. Often grows as a weed in irrigation and drainage channels, in water up to 0.4 m deep.

Impacts on wetland: Native to Madagascar and Africa, this is an invasive weed and can grow vigorously forming dense colonies which can:

- impact on water quality
- outcompete other semi-aquatic plants
- interfere with movement of fish and wildlife
- be toxic to stock and may cause skin irritations in sensitive persons
- becomes a nuisance weed in irrigation channels and drains, and within natural wetlands.

Weed facts:

- stems woven into mats
- tolerant of dry conditions so persists in seasonally dry water courses
- widely used as an ornamental plant for landscaping, water gardens and flower arrangements but should not be grown near drains where seeds can wash into natural waterways.

Spread and control: This species can reproduce by seed and stem segments (i.e. pieces of rhizome) that are commonly dispersed by water and dumped garden waste. Develops a dormant seed bank. There are only a few herbicides registered for use of weeds in waterways. It is a legal requirement that all herbicides be applied in strict accordance with the directions on the label.

Inflorescence consists of 6–10 stems of different lengths, developing clusters of reddish-brown spikelets

Clumping sedge with sharp, spiny leaves develops impenetrable thickets

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●		●	●	●	●	●	●	●	●	●	●
Fruiting				●	●	●	●	●	●	●		

Common leaf-rush

***Cyperus lucidus* – Family Cyperaceae**

Other common names: Leafy flat-sedge, candelabra sedge. Previous scientific name: *Mariscus lucidus*, *Cyperus haematodes*

Description: Perennial clumping sedge 1.5–2 m tall with a woody underground stem (rhizome), and robust triangular stems. Leaves arising from base of plant, 1–2 m long, 5–40 mm wide, broadly V-shaped in cross section with very sharp spines on edges and midrib, flower head (inflorescence) consists of 6–10 stems of different lengths, each with clusters of 1–30 reddish-brown flowers (spikelets) 4–20 mm long. Flower head surrounded by a ring of 5–10 leafy bracts (involucral bracts) up to 1.5 mm long. Fruit is an angular nut, dark brown to black, 5–3 mm long.

Distinctive features: This is one of many *Cyperus* species in the Wet Tropics. Its large tussock growth form, spiny leaves, long involucral bracts and reddish brown flowers are a distinctive feature of this plant.

Habitat: Occurs in swamps and along the damp margins of creek banks and rivers, on the margins of rainforest and in full sun.

Value in wetland:

- provides valuable habitat for frogs, reptiles and small birds
- food plant for the caterpillars of several moth and butterfly species
- valuable for providing bank stability and reducing erosion.

Plant uses:

- popular ornamental garden plant for use around ponds and dams, tolerates slashing, cut leaves back in early dry season
- used in wetland revegetation and bank stabilisation projects
- flowers used in cut flower arrangements.

Propagation: Plants can be propagated from fresh seed grown using the bog method. It has been recommended for direct seeding trials. Plants may also be produced by dividing clumps early in the dry season, though new clumps may be slow to recover.

Distinctive rusty brown flower heads (inflorescence) consists of 3–8 stalks

Loosely clumping sedge often forms dense stands along waters' edge

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Bunchy sedge

***Cyperus polystachyos* – Family Cyperaceae**

Other common names: Giant sedge, flat sedge, many-spiked sedge. Previous scientific name: *Cyperus venustus*

Description: Perennial (sometimes annual), loosely clumping sedge, 0.6 m tall with underground stems (rhizomes). Leaves mostly arising from base of plant, rough to the touch, 200 mm long, 2–5 mm wide. Flower head (inflorescence) is borne on stems (culms) 100–600 mm long, with 3–6 leafy bracts (involucral bracts) 20–100 mm long. Inflorescence consists of 3–8 stalks, 30 mm long, bearing clusters of 2–15 yellowish or reddish-brown flowers (spikelets). Fruit a reddish-brown to black nut 1–1.2 mm long.

Distinctive features: Usually in dense stands, with distinctive rusty brown flower heads (inflorescence). The female flower parts (styles) are divided in two, unlike most other sedges, which are divided into three.

Habitat: Usually occurs on moist margins of wetlands such as swamps, lagoons and creek banks, usually freshwater but sometimes in more saline areas such as saltwater couch grassland. Often grows in distinctively thick swards, particularly in previously disturbed areas. Often occurs along moist road-side ditches after grading and slashing. May grow under tree canopies in riparian areas.

Value in wetland:

- a valuable fast-growing pioneer species for bare, disturbed sand, loam or clay wetland margins, including areas subject to occasional tidal influence
- dense cover provides good habitat for frogs and invertebrates
- dense colonisation of disturbed areas reduces rate of weed invasion by competitive exclusion.

Plant uses:

- used as a filtering plant in constructed wetlands including batters, swales, and buffer strips, creating better fauna habitat than turf species
- recommended for investigation as a direct seeding dense cover for bare wetland margins
- may become too abundant and vigorous for small back yard ponds
- establishes a long-lived seed bank
- leaves used for weaving mats and baskets
- indicator of disturbance.

Propagation: Plants can be propagated vegetatively from pieces of rhizome or from seed. Plants often produce many empty seeds. Viable seeds are often dormant. Seed germination best using the 'bog method'– sown shallow in a waterlogged pot in bright light.

Flower head (inflorescence) is cylindrical and borne on the tip of the stem

Often dominates on seasonally dry wetlands with occasional tidal influence

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering			●	●	●	●	●	●	●			
Fruiting				●	●	●	●	●	●	●	●	●

Bulkuru sedge

***Eleocharis dulcis* – Family Cyperaceae**

Other common names: Water chestnut. Previous scientific name: *Eleocharis tuberosa*

Description: Perennials or annual sedge with erect cylindrical stems to 1 m tall. Thin underground stems (rhizomes) produce numerous rounded tubers 5–11 mm wide. Leaves absent. The thin-walled hollow stems (culms) are separated into sections by transverse partitions (septa). Flower head (inflorescence) is cylindrical and borne on the tip of the stem, 20–70 mm long, 3–5 mm wide, sometimes wider than the stem, bearing 3–7 rows of flowers. Fruit is a pale brown, glossy nut 1.3–1.5 mm long.

Distinctive features: Stems (culms) divided by septa and the flower spike (inflorescence) gradually tapers to a blunt end. *E. equisetina* inflorescence is very sharply pointed. Stems (culms) are not divided by septa in *E. spiralis*, *E. setifolia* and *E. plana*.

Habitat: Often forms large swards in shallow lagoons and swamps, especially those under some tidal influence but generally experiencing seasonal drying. Prefers wetlands that are acidic and low in nutrients. It is used to define a particular Regional Ecosystem (RE 7.3.1: '*Eleocharis dulcis* (bulkuru) closed sedgelands').

Value in wetland:

- important food and habitat for magpie geese and brolgas, which dig up the tubers. Magpie geese squash the stems flat for nesting. Feral pigs also dig up the tubers, causing significant damage.
- important plant for stabilising the bank and bed of wetlands
- valuable for removing nutrients and heavy metals, improving water and soil quality
- an increasingly rare community due to changes in hydrology, weeds and feral animals.

Plant uses:

- used in constructed wetlands and phytoremediation ponds to remove nutrients (especially nitrogen) and heavy metals, including uranium. Has been used successfully in the Wet Tropics region
- tubers were eaten by Indigenous people as a staple food. Widely eaten in Asia (Chinese water chestnuts). May be eaten raw, but the skin may transmit parasitic flukes. Tubers are usually cooked by being boiled, grilled or added to stir-fries. Has higher protein and carbohydrates than potatoes. Also a good source of dietary fibre, riboflavin, vitamin B6, potassium, copper, and manganese.
- tubers are dried and ground into flour to thicken sauces or made into batter for deep-fried food
- the juice extracted from tubers contains puchiin, a strong antibiotic
- green stems are woven into mats, bags and 'grass' skirts
- eaten by cattle and resilient to light grazing.

Propagation: Plants can be propagated by seed or vegetatively from the tubers or culms. Seed should not be dry-stored as this significantly reduces seed viability. Seed should be planted into moist pots. Germination is sporadic but best in high light and high oxygen conditions. Usually propagated vegetatively from tubers, which are harvested in June-July, and then planted in the late dry season.

Perennial sedge with distinctive square stems and pleated leaves

Usually occurs in among other grass and sedges, and never abundant

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●			
Fruiting	●	●	●	●	●	●	●	●	●			

Pleated umbrella sedge

***Fuirena umbellata* – Family Cyperaceae**

Other common names: Yefen, tropical umbrella sedge. Previous scientific name: *Scirpus umbellatus*

Description: Tall perennial sedge with a creeping underground stem (rhizome), upright to 1 m, sometimes becoming bulbous at the base. Erect stem (culm) hollow, sharply angular with 4–5 sides (pentagonal). Leaves arranged alternately along stem, with 5–7 leaves along most stems. Leaves 100–200 mm long, 5–15 mm wide, pleated with 5 distinctive longitudinal veins and sheathing around the stem at the base. Stiff hairs along leaf margins and veins. Flower head (inflorescence) consists of 3–12 round clusters of flowers arranged alternately along end of the stem, with 5–10 flowers (spikelets) per cluster, brownish-green or dark brownish-green colour. Fruit a nut, yellowish green to brown, 0.8 mm long.

Distinctive features: There are four species of *Fuirena* in the Wet Tropics; with all other species being smaller annual plants, leaves not pleated.

Habitat: Occurs in a range of vegetated swamps, including gallery forest, *Melaleuca* swamps and grassland/ sedgeland on the boggy margins of creeks, lakes and swamps. Seasonally aquatic or semi aquatic. Occurs on sandy, alluvial, clay or muddy substrates.

Value in wetland:

- although widespread, it is never an abundant plant in most places
- used to bind mud to prevent erosion and scouring.

Plant uses:

- bulbous rhizomes apparently edible though preparation is unknown
- plants burnt and ash used as a salt substitute
- used in Africa to treat muscle weakness or prepared into a tea to wash newborn babies and make toddlers walk
- Indigenous people used the stems as paintbrushes
- an appealing plant with attractive foliage, it would make an interesting addition to water gardens
- used in revegetation projects to bind mud and reduce erosion.

Propagation:

Seeds germinate easily in wet soil. Often spreads by producing shoots from along the underground stem (rhizome) so division of the rhizome would be an effective method of propagation.

Gahnia sieberiana with long inflorescence of small nuts 3–4 mm long

Gahnia aspera with a short, dense inflorescence of larger red nuts 4–6 mm long

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●		●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Red-fruited saw sedge

***Gahnia sieberiana* – Family Cyperaceae**

Other common names: Small-seeded Gahnia, sword grass, saw sedge. Previous scientific names: *Gahnia psittacorum*, *G. arbuscula*, *G. tetragonocarpa*, *Cladium tetragonocarpum*

Description: Perennial native sedge 1–2 m tall, tending to form large tussocks. Erect stem (culm) smooth, hollow, 5–12 mm thick. Leaves mostly arising from base of plant, and alternately along the flowering stem, leaves 300–1200 mm long, 20 mm wide, with small sharp teeth along the edge of the leaf. Flower head (inflorescence) 300–950 mm long, consisting of numerous side branches alternating green with darker sheaths. Spikelets consist of two small yellow-brown to black flowers. Fruit a hard smooth nut, reddish brown, 3–4 mm long.

Distinctive features: There are six species of *Gahnia* in Queensland but only three occur in the Wet Tropics. *Gahnia* aspera has a denser fruiting body with larger red pendulous seeds 4–6 mm long. *Gahnia insignis* (near-threatened) is not a wetland plant and only grows 0.3 m tall.

Habitat: Not restricted to wetlands; can be found in the understorey of moist eucalypt forest, rainforest or *Melaleuca quinquenervia* forests. Often occurs along the edges of coastal swamps, creek banks, lakes and other areas that are damp or subject to periodic inundation. Occurs on a range of soils including silt, clay or sand.

Value in wetland:

- often forms extensive populations around the edges of wetlands
- responds quickly to disturbance, and seeds germinate after bushfires
- deep roots provide bank stabilisation and limits soil erosion
- provides habitat for many species of reptile, bird and mammals. Seeds eaten by a variety of bird and mammal species.
- important larval food plant for a range of butterfly species including dingy grass-skipper (*Toxidia peron*), spotted sedge-skipper (*Hesperilla ornata*), and northern sword-grass brown (*Tisiphone helena*).

Plant uses:

- indigenous Australians ground and pounded the seeds to make flour, leaf bases and leaf buds chewed
- used in dried flower arrangements; the flower and seed heads can last for decades
- has been recommended for use on the margins of stormwater management wetlands
- strongly recommended for revegetation and landscaping in areas where people can't be cut by the sharp leaves, but rarely used due to problems with propagation.

Propagation:

Propagation is notoriously difficult and division from clumps is often unsuccessful. Seeds have a dormancy period of 12–18 months, after which seeds should be treated either by scarification, or by heat treatment and smoked water before being sown onto most, but not wet soil. Cultivars have been developed that are apparently easier to germinate than wild forms. The potential role of symbiotic mycorrhizal fungi in germination should be investigated.

Plants form tussock-like clumps

Flowers and fruit are on cone-shaped spikes

The silver colour makes this species unmistakable at Eubenangee Swamp

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Grey rush

***Lepironia articulata* – Family Cyperaceae**

Other common names: Grey sedge, cigar rush, giant sedge, krajood. Previous scientific names: *Lepironia mucronata, Restio articulatus*

Description: Perennial sedge with erect cylindrical stems 0.6–2.5 m tall, with an elongated underground stem (rhizome), spreading from rhizomes into loose clumps but sometimes appear tussock-like. Leaves are reduced to bracts sheathing around the smooth cylindrical stems. Stems hollow, 0.6–2 m tall, 2–8 mm wide, silver-grey colour. Old stems turn brown and collapse, forming a skirt-like fringe around growing plants. Flower head (inflorescence) is a single cone-shaped spike 6–22 mm long, reddish-brown, containing 5–15 spikelets, borne on the side of the stems (culms) below the tip. Fruit is a brown, smooth nut, 3–6 mm long.

Distinctive features: The silver colour of the cylindrical stems, and reddish-brown flower head borne below the tops of the stems is characteristic. Only one species of *Lepironia* occurs in the Wet Tropics and Australia.

Habitat: Occurs primarily in slightly acidic, open, permanent, freshwater swamps dominated by grasses and sedges, but also occurs along the wet margins of perennial creeks, lakes and dams. Occurs in coastal and upland wetlands, including drier areas inland of the Wet Tropics. Plants regenerate quickly after fire.

Value in wetland:

- forms significant thickets in and along the edges of some wetlands, providing critical habitat and food for a range of wildlife, including freshwater fish (e.g. honey blue eye), aquatic invertebrates and birds including the elusive little bittern
- provides bed stabilisation and erosion protection, including on acid sulphate soils
- may occur in large swards (e.g. Eubenangee Swamp National Park), acting as an important regulator of nutrient loads on flood plain systems.

Plant uses:

- rhizomes edible raw or after roasting
- leaves and stems (culms) produce a valuable fibre, used for making sails and packing mats
- used in treatment of grey water, stormwater and industrial waste water, including for the selective accumulation of chromium
- has been recommended for use in the deep marsh zone of constructed wetlands and sedimentation basins
- used as an ornamental feature plants around ponds and lakes. Select cultivars have been developed.

Propagation: Can be propagated by seed sown onto a tray of saturated propagating mix, and by the division of clumps, allowing sufficient depth to ensure that buried rhizomes are transplanted (approx 300 mm deep).

Inflorescence with four branches per node

Leaf tips on *L. longifolia* (top) and *L. hystrix*

Clumping tussock grass-like plants are popular for stream bank stabilisation

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering									●	●	●	●
Fruiting	●	●	●	●	●				●	●	●	●

Long-leaved mat-rush

***Lomandra hystrix* – Family Laxmanniaceae (formerly Xanthorrhoeaceae)**

Other common names: Creek matrush, tall matrush, basket grass. Previous scientific names: *Lomandra longifolia subsp. hystrix*, *Xerotes hystrix*

Description: Perennial, clumping tussock grass-like plant to 1.3 m tall. Leaves are long, flat and strap-like, glossy green, 900–1300 mm long, 5–10.5 mm wide. Erect at base then becoming arching, leaf tips with 2–4 teeth; one of which is longer and more prominent than the others. Flower heads (inflorescence) of male and female are separate but similar, consisting of an erect branched yellow-green spike 800–1300 mm long, with four side branches at each node. Whorls or clusters of perfumed cream or yellowish flowers at nodes along the spike and side branches. Flower clusters are protected by a whorl of sharp bracts. Male flowers 3–3.5mm long, female flowers 4.5 mm long. Fruit is a 3-lobed capsule, containing three seeds 4 mm long.

Distinctive features: There are eight species of *Lomandra* in the Wet Tropics of which *L. hystrix* is the largest plant and has the longest leaves. *Lomandra banksii* develops a woody stem up to 3 metres tall. Leaf tips of *Lomandra filiformis*, *L. laxa* and *L. multiflora* not distinctly toothed. *L. hystrix* has a much wider leaf than all the other *Lomandra* species except *L. spicata* which is not a rainforest plant and has much shorter leaves. The most commonly confused species is *L. longifolia*. *L. hystrix* has four branches at each node of the inflorescence, compared to two branches in *L. longifolia*. The leaf tip of *L. hystrix* has one tooth much longer than others; *L. longifolia* has 2–3 prominent teeth.

Habitat: Not restricted to wetlands; it can occur in the understorey of riparian forest, wet sclerophyll forest, and disturbed rainforest margins. Also found on margins of freshwater creeks and rivers on rocky, sandy or loam soils.

Value in wetland:

- provides important habitat for wildlife, including frogs, birds and butterflies. A larval food plant for several species of skipper butterfly.
- deep root systems provide excellent stream bank stabilisation.

Plant uses:

- Indigenous people roasted and ground the seed into flour for making damper, and chewed the tender base of leaves
- long flat leaves dried and woven into bags and baskets
- widely used for bank stabilisation and weed control in revegetation and road construction projects,
- commonly used in constructed wetlands, especially bioretention basins
- very popular in cultivation as a low-maintenance ornamental plant. Many different cultivars are now widely available in the nursery trade, including dwarf and variegated forms.

Propagation: Propagate by seed or clump division. Mature capsules should be dried to extract the seeds, which are then sown onto moist soil for 4–6 weeks in the greenhouse or outdoors. Can be propagated by dividing the plant in half and planting in moist soil.

Inflorescence a cluster of 3–30 cone-shaped spikelets with an erect involucral bract above, appearing superficially as part of the stem

Erect sedge with angular stems spreading from shallow rhizomes into dense clumps

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting	●	●	●	●	●	●	●	●	●	●	●	●

Triangular sedge

***Schoenoplectiella mucronatus* – Family Cyperaceae**

Other common names: Bog bulrush, three-cornered rush, star club rush, rough-seed bulrush, ricefield bulrush. Previous scientific name: *Schoenoplectus mucronatus*, *Scirpus mucronatus*

Description: Erect perennial sedge 0.5–1 m tall, with thin, wiry underground stem (rhizome), spreading from shallow rhizomes into dense clumps. Leaves are reduced to sheaths wrapped around the base of the rigid 3-angled stems. Stems glossy green, 500–1000 mm high, 2–8 mm wide. Flower head (inflorescence) occurs as a cluster of 3–30 cone-shaped flowers (spikelets), each 8–20 mm long, 4–6 mm wide. Above the inflorescence is a single stiffly erect bract (involucral bract), appearing superficially as part of the stem. Fruit is a broad dark brown to black nut 1.7–2.2 mm long, smooth or finely wrinkled texture (rugulose).

Distinctive features: Formerly included in *Schoenoplectus*, it differs from members of that genus in the Wet Tropics by its three-cornered stem.

Habitat: Commonly found on the wet muddy margins of freshwater wetlands, including swamps, creek banks, rivers, dams and lagoons, as an emergent in water up to 50 cm deep, particularly where water is still or slow flowing.

Value in wetland:

- provides habitat for aquatic macroinvertebrates, small fish and waterbirds
- provides bank stability in flooded or permanently wet areas, but its dominance is reduced in areas subject to periodic drying.

Plant uses:

- Indigenous people used the stems as paintbrushes
- fibres from stems (culms) used to make string, or culms woven to make mats or bags
- has been recommended for use in revegetation, and on the shallow marsh zone of artificial ponds, constructed wetlands and sedimentation basins, in water to 10–30 cm
- shown to bioaccumulate nitrogen and phosphorus, it has been used to remove excess nutrients from wastewater
- grown as an ornamental in tubs or ponds
- although native to Australia, it has become a weed of rice in California.

Propagation: Can be propagated by seed sown onto a tray of saturated propagating mix, or by the division of clumps or sections of the rhizome.

Flowers in clusters on branched stems are followed by brown to black nuts

Forms dense swards where wetlands have occasional tidal influence

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●	●	●	●	●
Fruiting			●	●	●	●	●	●	●	●	●	●

Bulrush

***Schoenoplectus subulatus* – Family Cyperaceae**

Other common names: Mangrove club rush. Previous scientific names: *Schoenoplectus litoralis*, *Scirpus litoralis*

Description: Erect perennial sedge forming tussocks to 2 m tall, with rigid striated stems to 10 mm wide and underground stems (rhizomes). Leaves are often reduced to sheaths wrapped around the stem, though narrow leaves to 200 mm may sometimes be present. Flower head (inflorescence) occurs as a cluster of three or more drooping cigar-shaped flowers (spikelets), 6–25 mm long, on branched stems to 45 mm long. Above the inflorescence is a single stiffly erect bract (involucral bract) to 95 mm long, appearing superficially as part of the stem. Fruit is a brown to black nut 1.8–2.3 mm long, 1.3–1.6 mm wide.

Distinctive features: Of the nine *Schoenoplectus* species in the region, only *S. subulatus* and *S. mucronatus* grow to more than 0.5 m height. *S. subulatus* stems are round in cross-section, while *Schoenoplectiella mucronatus* has three distinct corners.

Habitat: Usually grows in slow-moving brackish or saline water along the edges of tidally influenced rivers, creeks, channels and swamps, where it can form very large pure stands. It may be found in areas with a higher salinity than seawater. Broad tolerance to pH and shade. In freshwater with very low electrical conductivity (EC), it tends to be replaced by *Schoenoplectiella mucronatus*.

Value in wetland:

- important food and wildlife habitat for water birds including the endangered painted snipe, moorhens, swamphens, and magpie geese, which crush down the stems to build nests
- provides a substratum for algal epiphytes and biofilms to enhance soluble pollutant uptake
- valuable for stabilising erosion-prone banks.

Plant uses:

- underground rhizomes are apparently edible after roasting and hammering to remove the starch
- inner part of stems (culms) edible raw, or after culms are roasted and peeled
- used in traditional medicine to reduce fever, increases urination (diuretic) and anti-parasitic (anthelminthic)
- useful for restoring erosion-prone and disturbed areas, and as an ornamental in ponds or dams
- has been established easily and quickly in local constructed wetland projects
- leaves / stems used to weave baskets and mats or to stuff mattresses
- young submerged plants grown as an ornamental in aquariums
- used overseas to remove nutrients and pathogens from wastewater, it has the ability to remove heavy metals from phytoremediation ponds, including nickel, manganese, copper, zinc and lead.

Propagation: Seeds may be dormant. Dormancy can apparently be broken by exposure to ethylene or by chilling at 2°C for 30 days and then propagated uncovered in well-lit trays of wet soil. Usually propagated by division of a clump.

Inflorescence is an erect spike

Leaves are pleated and 'M' shaped in cross-section

Often dominates large areas of freshwater swamps and floodplains

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	●	●	●	●				
Fruiting	●	●	●	●	●	●	●	●				

Pleated nutrush

***Scleria poiformis* – Family Cyperaceae**

Other common names: Scleria. Previous scientific name: *Scleria poaeformis*, *S. oryzoides*

Description: Perennial sedge forming tussocks to 2.2 m tall with a thick underground stem (rhizome). Leaves mostly arising from base of plant, sheathing around the central stem, 1.8 m long, 35 mm wide, 'M' shaped in cross-section, no teeth on the leaf margin or midrib. Flowers are borne on the ends of tall robust stems, triangular in cross-section, 0.7–2.0 mm long. Flower head (inflorescence) is a spike 200 mm long, containing 30–50 separate male and female flowers. Fruit is a smooth white nut, 2.7–3 mm long, 2.5–3 mm wide

Distinctive features: There are 18 *Scleria* species in the Wet Tropics, however, *S. poiformis* is unique in being a very tall and robust perennial sedge with pleated leaves that are not winged or in whorls. Often forms large pure stands.

Habitat: Occurs in a range of vegetated freshwater swamps, permanently and seasonally flooded grasslands, sedgelands and floodplains, or the margins of open lakes. Also occurs along creek banks and permanent drains, often in disturbed areas. May grow in small restricted clumps or dominate over large areas. Plants go dormant if wetlands dry out, and die back to the underground rhizome.

Value in wetland:

- provides refuge and habitat for a range of wetland wildlife, including white-browed crake, black bittern and the elusive little bittern
- seeds eaten by a number of bird species including crimson finches.

Plant uses:

- flower heads boiled and used to reduce inflammation of the abdomen
- leaves used for weaving mats or polishing wood
- has been recommended for revegetation and use in stormwater management wetlands in the deep marsh zone.

Propagation:

Generally propagated by division of clumps. Potted plants should be kept permanently moist and are intolerant of drying out.

Female flowers form a dense brown rod that splits to release masses of dry fluffy seeds

Cumbungi forms dense swards where wetlands receive freshwater with high nutrients

	J	F	M	A	M	J	J	A	S	O	N	D
Flowering	●	●	●	●	•	•			•	●	●	●
Fruiting	●	●	●	●	●	●	•	•	•	●	●	●

Cumbungi

***Typha domingensis* – Family Typhaceae**

Other common names: bulrush, narrow-leaf cumbungi, cats tail. Previous scientific names: *Typha brownii*, *Typha angustifolia*

Description: Perennial erect herb to 2–3 m tall, with stiff and rigid stems and underground stems (rhizomes). Leaves are long and erect, sheathed at the base of the stem, 2 m long, 5–15 mm wide. Flower head (inflorescence) occurs as a spike on the tip of the stem. Male and female flowers are separate; short-lived male flowers are on top but soon disintegrate after pollen is shed. Female flowers form a dense brown rod 85–260 mm long, persisting for a long time. Fruit is a dry, single seed with a whorl of long silky hairs.

Distinctive features: *Typha orientalis* is very similar, sometimes with a slightly broader leaf but with a distinct collar where the leaf sheath separates from the main stem.

Habitat: Usually grows in still or slow-moving water up to 2 m deep in freshwater swamps and streams, extending into seasonally brackish bulkuru swamps. Often dominates as dense colonies where saline areas are bunded and receive freshwater with high nutrients, and where water-logged areas are heavily disturbed. Prefers permanent and relatively stable water levels, tending to die off where wetlands are subject to seasonal drying.

Value in wetland:

- important wildlife habitat for birds such as Australian reed warblers and Australian little bittern, and water birds such as ducks and moorhens, frogs, tadpoles and fish fingerlings. An overabundance can lead to reduced diversity of bird habitat and biodiversity by reducing open water and mud banks
- valuable for removing suspended solids and nutrients, particularly nitrogen and phosphorus
- reduces evaporation, stabilises banks, reduces flood energy, reducing stream and gully erosion
- often considered a weed in irrigation channels and drains, altering hydrology, creating anoxic conditions and blocking fish passage
- considered an indicator of disturbance, excess nutrients and changed hydrology, particularly where tidal areas have been bunded and/or supplemented with irrigation or stormwater runoff.

Plant uses:

- Indigenous people ate the rhizome after peeling, separating starch from the fibres, roasting, baking and pounding, where they either chewed it or made it into bread. New shoots were eaten raw like asparagus.
- pollen is edible either steamed or used as flour, and has a very high carbohydrate content
- starch from rhizomes is used for dysentery and gonorrhoea, the pollen to dry wounds. Masses of fluff from seeds may be used for bandaging wounds, and the sap used to protect from leech bites
- fluff from seeds used to start fires or stuff pillows
- long straight stems used as light spears for hunting waterfowl
- fibre from rhizomes used to make twine for fishing nets, and leaves to weave baskets and mats
- *Typha* colonisation can be prevented by competitive exclusion – densely revegetating bare banks prevents *Typha* seedlings establishing
- control at the end of the dry season by slashing 150 mm below water level or drying and burning, then allowing water levels to drown the regrowth. Herbicide is known to be effective.

Propagation: Is propagated from seed and requires high light conditions. Plants produce up to 222,000 seeds per spike.

Other sedges and rushes

Cyperus aquatilis (Water nutgrass) – Annual native tufted sedge 0.07–0.5 m tall, in swamps, creek banks and often in the water itself.

WEED *Cyperus aromaticus* * (Navua sedge) – Perennial introduced weed with aromatic leaves 0.3–0.7 m tall, in open damp areas, sand beds in creeks, drains and irrigated crops.

WEED *Cyperus compressus* * (Poorland flatsedge) – Annual introduced tufted sedge to 0.4 m, grows as a suburban weed in high rainfall areas or on the disturbed damp margins of creeks and floodplains.

Cyperus difformis (Dirty dora) – Annual native sedge to 0.5 m, grows in masses in permanently wet open areas.

Cyperus digitatus (Finger flatsedge) – Perennial native clumping sedge to 1.5 m, in the open margins of swamps, lakes and water courses.

Cyperus gracilis (Slender flat sedge) – Perennial native sedge 0.3–0.4 m. Not restricted to wetlands but often found along the edges of small creeks and gullies.

Other sedges and rushes

Cyperus gunnii subsp. *novae-hollandiae* (Flecked flatsedge) – Perennial native sedge 0.75–1.5 m. Usually found in and around margins of swamps, in rainforest, palm forests and *Melaleuca* forests.

Cyperus iria (Rice flatsedge) – Annual native sedge 0.3–0.6 m. Grows on the margins of rivers, creeks and swamps, in seasonal coastal wetlands, open drains and as a weed of irrigated crops.

Cyperus javanicus (Javanese flat sedge) – Perennial native sedge to 1.2 m, grows in swamps, riparian forest, woodland – stems used to produce string for making fishing nets and dilly bags, attracts butterflies.

Cyperus platystylis (Bunchy sedge) – Perennial native sedge to 0.8 m, often as a dense floating mat in swamps and lagoons, seedlings often establish themselves on floating weed mats.

Cyperus scariosus (Cypriol) – Perennial native sedge to 0.8 m with underground stem (rhizome). Often dies back during dry season. Often occurs in pure stands in seasonal swamps on the edge of tidal areas.

Eleocharis equisetina (Spikerush) – Perennial native sedge with cylindrical stems to 1 m, shorter and more slender than *E. dulcis*. Occurs in shallow margins of swamps, dams and lakes.

Other sedges and rushes

Eleocharis geniculata (Spike-rush) – Annual or weak perennial native small tufted sedge 0.3–0.4 m tall, can occur as an aquatic plant or in the saturated margins of creeks, swamps and lagoons, including brackish water.

Eleocharis philippinensis (Five-cornered spike rush) – Perennial native sedge to 0.6 m with 4–5 angled stems in shallow water or on the wet margins of swamps, dams and seasonally wet areas.

Eleocharis retroflexa (Queensland hairgrass) – Vulnerable – Perennial native small tufted sedge to 0.1 m. Grows in colonies in shallow drains and seasonal wetlands, often threatened by weed invasion. It is listed as Vulnerable under the Commonwealth EPBC Act and Queensland Nature Conservation Act.

Fimbristylis aestivalis (Summer fringe-rush) – Annual or weak perennial native sedge to 0.2 m with finely hairy leaves. Grows on the open, damp margins of swamps and streams.

Fimbristylis dichotoma (Common fringe sedge) – Perennial native sedge 0.1–0.75 m on wetland margins and moist areas or depressions in woodland.

Fimbristylis tetragona (Brown head pins) – Perennial native sedge to 0.6 m in swamps, creek banks and poorly drained *Melaleuca* woodlands.

Other sedges and rushes

Fuirena ciliaris (Eyelash sedge) – Native annual sedge to 0.4 m, in seasonally flooded river and creek beds, swamp margins and moist woodland areas, but rarely dominates a site.

Hypolytrum nemorum (Dwarf pandan sedge) – Perennial native tussock sedge to 1 m, along margins of streams in rainforest or edges of table drains

Juncus usitatus (Common rush) – Perennial native tussock sedge to 1.2 m, in seasonally shallow water and the damp margins of swamps and lagoons

Rhynchospora corymbosa (Golden beak sedge) – Perennial native sedge 1.5–2 m with short, thick underground stems (rhizomes), grows in swamps or along stream banks on the edge of rainforest or dry inland areas.

Rhynchospora heterochaeta (Beak-sedge) – Annual native tussock sedge to 0.45 m, in poorly drained *Melaleuca* forests

*Scleria brownii (*Brown's nutrush) – Perennial native sedge 0.2–0.6 m, not restricted to wetlands but often found in shallow depressions and seasonal swamps in poorly drained coastal broad-leaved tea tree forests.

Glossary

Achenes	small one-seeded fruit that doesn't split at maturity
Acute	tapering to a narrow point
Allelopathic	where one plant suppresses the growth of another, often by the release of a toxin
Annual	a plant that lives for one year or less (c.f. perennial)
Anther	the sac at the end of a stamen that contains pollen
Asexual	reproduction not involving the fusion of male pollen with the female ovule but may involve budding, fission or spore formation
Attenuated	tapered
Awn	hair or bristle-like structure
Axil	the upper angle between the stem and a leaf, branch or petiole
Bioretention basin	vegetated basins used to slow and treat on-site stormwater runoff
Bract	modified leaf underneath (subtending) a flower cluster (inflorescence)
Capitula	dense cluster of flowers or foliage
Compound leaf	a leaf divided into multiple smaller leaflets
Cordate	heart-shaped
Cilia	stiff hairs
Cleistogamous	plants with non-opening, self-pollinating flowers
Corm	underground plant stem that can act as a vegetative reproductive structure
Crenate	where the margin of the leaf is scalloped or has rounded teeth
Culm	stem of a grass
Digitate	branching from the same point-like fingers
Diuretic	a substance that increases passing urine
Ephemeral	wetlands that do not have surface water for the entire year
Eutrophic	a process where a water body receives excess nutrients
Evapotranspiration	loss of water from plants including both evaporation and active transpiration through the leaf surface
Floret	a small or reduced flower
Glabrous	without hairs
Hydromulch	application of mulch in wet slurry
Hypanthium	a cup-shaped structure formed by fusion of several flower parts
Inflorescence	group or cluster of flowers
Involucral bract	modified leaf or bract located below a flower or inflorescence
Lacustrine	large, open, water-dominated systems (eg. lakes) larger than 8 hectares. This definition also applies to modified systems (eg. dams), which are similar to lacustrine systems (eg. deep, standing or slow-moving waters)
Ligule	a small appendage at the base of a grass leaf, made of hairs and/or a membrane
Lobe	a blunt segment or division that is not entirely separate from each other
Macrophyte	water plant that grows in or near water, including plants that are submerged, emergent or floating
Megaspore	larger of two kinds of spores

Microspores	smaller of two kinds of spores
Obtuse	blunt or rounded
Ochrea	basal leaf sheath
Palustrine	primarily vegetated non-channel environments of less than 8 hectares. They include billabongs, swamps, bogs, springs, soaks etc, and have more than 30% emergent vegetation
Panicle	an inflorescence with multiple branches each bearing multiple flowers, and each with their own individual stalk (pedicel)
Pappus	tuft of hairs or bristles on the seeds of daisies
Pedicel	the stalk of an individual flower
Peduncle	the stalk of an inflorescence
Perennial	plant that lives for more than one year (c.f. annual)
Petiole	stalk of a leaf
Phytoremediation	use of plants to reduce the concentration of contaminants in the environment
Rachilla	the central stem (axis) of a spikelet
Receptacle	the expanded base of a flower where some or all of the flower parts are attached
Rhizome	underground stem that often sends out roots and shoots from its nodes
Riparian	occurring on the bank of a watercourse
Riverine	all wetlands and deepwater habitats within a channel. The channels are naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water
Scabrous	rough to touch (often caused by stiff hairs)
Scarification	the cutting or abrasion of the seed coat to promote germination
Septum	a dividing wall membrane (plural – septa)
Serrated	toothed
Sessile	lacking a stalk, joining directly onto another structure such as the stem
Spathe	sheath
Spathulate	spatula-shaped
Spikelet	a flower of a grass or sedge
Sporangium	structure producing and containing spores (plural – sporangium)
Spore	asexual reproductive body that gives rise to a new individual
Sporocarp	spore capsule
Stamen	male reproductive part of a flower, consisting of a filament and anther
Stipe	stem of a fern
Stipule	leaf like structure found at the base of a leaf stalk (petiole)
Stolon	a stem growing above ground which forms roots at the nodes
Style	slender column joining the ovary to the stigma (female flower parts)
Umbel	an inflorescence in which the rays all arise from a common point
Utricle	bladder-like one-seeded fruit
Whorl	an arrangement of three or more leaves or other plant parts at a single point

Recommendations for constructed wetlands

Species	Common name
Acrostichum aureum	golden mangrove fern
Azolla pinnata	water fern
Baumea articulata	jointed twig-rush
Blyxa aubertii	roundfruit blyxa
Centella asiatica	pennywort
Ceratophyllum demersum	hornwort
Ceratopteris thalictroides	water fern
*Cynodon dactylon**	couch grass
Cyperus lucidus	common leaf-rush
Cyperus conicus	cone flatsedge
Cyperus difformis	dirty Dora
Cyperus haspan	dwarf papyrus sedge
Cyperus javanicus	Javanese flat sedge
Cyperus platystylis	bunchy sedge
Cyperus polystachyos	bunchy sedge
Eclipta prostrata	white eclipta
Eleocharis dulcis	bulkuru sedge
Eleocharis philippinensis	five-cornered spike rush
Eriocaulon setaceum	water pincushions
Fimbristylis bisumbellata	fringe sedge
Fuirena ciliaris	eyelash sedge
Fuirena umbellata	pleated umbrella sedge
Gahnia sieberiana	red-fruited saw sedge
Hydrilla verticillata	water thyme
Imperata cylindrica	blady grass
Ipomoea aquatica	Kang kong
Leersia hexandra	swamp ricegrass
Lemna aequinoctialis	lesser duckweed

	Wetland Revegetation	Bioretention (Saturated)	Bioretention (Ephemeral)	Stormwater	Wastewater	Phyto-remediation
	●					
					●	●
	●	●		●	●	●
	●			●	●	●
	●	●				●
					●	●
		●			●	
	●					
	●					
	●		●			
	●	●				
	●	●				
	●		●			
	●	●				
	●		●	●		
	●					
	●		●		●	●
	●		●	●		
	●					
	●		●			
	●		●			
	●					
	●		●	●		
					●	
	●		●			
	●				●	
	●	●	●	●	●	●
					●	

Recommendations for constructed wetlands

Species	Common name
Lepironia articulata	grey rush
Lomandra hystrix	long-leaved mat-rush
Ludwigia octovalvis	willow primrose
Ludwigia peploides	water primrose
Lycopodiella cernua	bushy clubmoss
Marsilea mutica	smooth nardoo
Melastoma malabathricum	blue tongue
Monochoria vaginalis	bog hyacinth
Myriophyllum verrucosum	parrot's feather
Najas tenuifolia	water nymph
Nelumbo nucifera	pink lotus lily
Nymphaea gigantea	blue water lily
Nymphoides indica	water snowflake
Ottelia ovalifolia	swamp lily
Paspalum distichum	water couch
Persicaria attenuata	water pepper
Persicaria decipiens	slender knotweed
Philydrum lanuginosum	woolly frogmouth
Phragmites karka	tall reed
Potamogeton octandrus	pondweed
Potamogeton tricarinatus	floating pondweed
Pseudoraphis spinescens	spiny mud grass
Schoenoplectiella mucronatus	triangular sedge
Schoenoplectus subulatus	bulrush
Scleria poiformis	pleated nutrush
Sesbania cannabina	sesbania pea
Typha domingensis	bulrush
Vallisneria nana	ribbonweed

Wetland Revegetation	Bioretention (Saturated)	Bioretention (Ephemeral)	Stormwater	Wastewater	Phyto-remediation
●	●		●	●	●
●					
●					
●	●			●	
	●				●
●				●	
●					●
	●				
●				●	
	●				●
●					
●					
●				●	
●				●	
●		●			
●				●	●
●	●				
●	●	●		●	●
●	●	●	●	●	●
●	●		●	●	●
●				●	
●	●				
●			●	●	●
●			●	●	●
●	●		●		
					●
●			●	●	
	●			●	

References and further reading

AECOM (2011) *Water sensitive urban design (WSUD) for the Coastal Dry Tropics (Townsville): Technical Design Guidelines for Stormwater management.* Report to Townsville City Council.

Ahmad, F. (2010) *Leptochloa fusca* cultivation for utilization of salt-affected soil and water resources in Cholistan desert. *Revista Sociedade & Natureza*, Vol. 22(1), pp.141–149.

Anderson E. (1993) *Plants of Central Queensland – their identification and uses.* Department of Primary Industries, Brisbane.

Armstrong J.E. (2001) Fringe Science: are the corollas of Nymphoides (Menyanthaceae) flowers adapted for surface tension interactions? *American Journal of Botany* 89(2):362–365.

Aruna C., Chaithra D., Alekhya C., Yasodamma N. (2012) Pharmacognostic studies of A*eschynomene indica* L. *International Journal of Pharmacy and Pharmaceutical Sciences* 4(4):76–77

Aston, H.I. in George, A.S., (Ed) (1987) Pontederiaceae. *Flora of Australia* 45: 52–53, Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Azan S.S.E. (2011) *Invasive aquatic plants and the aquarium and ornamental pond industries.* Masters Thesis, Ryserson University, Toronto, Ontario, Canada.

Badejo A.A., Sridhar M.K., Coker A.O., Ndambuki J.M., Kupolati W.K. (2015) Phytoremediation of Water Using *Phragmites karka* and *Veteveria nigritana* in Constructed Wetland. I*nt J Phytoremediation.* 17(9): 847–852.

Barker R. Vestjens W. (1989) *Food of Australian birds 1. Non-passerines.* CSIRO Publishing, Lyneham ACT.

Barry, S. (2005) Appendix 1: Wetland Management Profile: Coastal wet heath/sedgeland wetlands. Description and conservation status of Queensland's coastal wet heath/sedgeland wetland regional ecosystems (REs). [Online]. Ecosystem Conservation Branch, EPA. Available from: http://wetlandinfo.ehp.qld.gov.au/resources/static/pdf/resources/fact-sheets/profiles/new-profiles/29113-08-wet-heath-swamps-web.pdf

Bellinger Landcare Inc (2010) Growing Lomandra from seed. http://www.bellingen.nsw.gov.au/sites/bellingen/files/public/images/documents/bellingen/Environment/Coastline/Growing%20Lomandra%20From%20Seed_Apr2011.pdf

Benwell, A.S. (1994) *Swamp Orchids – Phaius australis, Phaius tancarvilleae Recovery Plan.* Hurstville: NSW NPWS.

Bindon P. (1996) *Useful bush plants.* Western Australian Museum, Perth.

Blackman. J.G., Spain, A.V., Whiteley, L.A. (1992) *Provisional Handbook for the Classification and Field Assessment of Queensland Wetlands and Deep Water Habitats.* Queensland Department of Environment and Heritage.

Blake N.M., Wightman G., Williams L. (1998) Iwaidja ethnobotany: Aboriginal plant knowledge from Gurig National Park, Northern Australia. Northern Territory Botanical Bulletin No23, Parks and Wildlife Commission of the Northern Territory.

Bostock, P.D., (1998) Parkeriaceae. *Flora of Australia* 48: 287–288 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Brand J.C., Rae C., McDonnell J., Lee A., Cherikoff V, Truswell A.S. (1983) *The nutritional composition of Australian Aboriginal bushfoods 1.* Food Technology in Australia. 35: 293–298.

Breen P., Markwell K., Walsh G., Henderson C. (2012) Constructed stormwater wetland design for the dry and wet tropics. In WSUD 2012: Water sensitive urban design; Building the water sensitive community; 7th international conference on water sensitive urban design. Barton, A.C.T.: Engineers Australia, 2012: 28–37.

Briggs, B.G. in George, A.S., (Ed) (1987) Typhaceae. *Flora of Australia* 45: 9–10 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Brock J. (2001) *Native plants of northern Australia.* Reed New Holland, Sydney.

Browning C. (2003) Nutrient Removal and Plant Growth in a Subsurface Flow Constructed Wetland in Brisbane, Australia. Masters Thesis, Griffith University.

Burkill, H.M. (1998) *The useful plants of West Tropical Africa.* Vol. 4.Royal Botanic Gardens, Kew, UK.

Cairns Regional Council (2014) *Cairns: The Rainforest City Master Plan.* Part B: Design Guidelines. http://webs.cairns.qld.gov.au/filestore/planning/Part%20B%20-%20Design%20Guidelines%20CRMP%20-%20DRAFT%2021Oct2014web.pdf

Calvert G., Liessmann L. (2014) *Wetland plants of the Townsville–Burdekin flood plain.* Lower Burdekin Landcare, Ayr, Qld.

Calvert G. (2015) *Technical report & future management options for delta arrowhead (Sagittaria platyphylla) in the Burdekin Dry Tropics NRM Region.* Report to NQ Dry Tropics for the Burdekin Dry Tropics Regional Pest Management Group.

Centre for Australian National Biodiversity Research, (2010) Australian Tropical Rainforest Plants Edition 6. http://keys.trin.org.au/key-server/data/0e0f0504-0103-430d-8004-060d07080d04/media/Html/index.html

Chaffey C.H. (1999) *Australian ferns: growing them successfully.* Kangaroo Press, Australia.

Chinnock, R.J., (1998) Azollaceae. *Flora of Australia* 48: 176–177 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Chinnock, R.J. in McCarthy, P.M. (ed.) (1998) Lycopodiaceae. *Flora of Australia* 48: 71.

Clarkson, JR, Karan, M, Evans, DS (2011) A report of hybridisation in *Hymenachne* (Poaceae, Panicoideae) with description of *Hymenachne* × *calamitosa*, a new species of hybrid origin from tropical Australia. *Telopea* 13, 105–114.

Cook, C.D.K., Urmi-König, K. (1983a) A revision of the genus Blyxa (Hydrocharitaceae). *Aquatic Botany*, 15: 1–52.

Cook, C.D.K., Urmi-König, K. (1983b) A revision of the genus *Limnobium* including *Hydromystria* (Hydrocharitaceae). *Aquatic Botany* 17 (1): 1–27.

Cook, B. G. ; Pengelly, B. C. ; Brown, S. D. ; Donnelly, J. L. ; Eagles, D. A. ; Franco, M. A. ; Hanson, J. ; Mullen, B. F. ; Partridge, I. J. ; Peters, M. ; Schultze-Kraft, R., (2005) *Tropical Forages.* CSIRO, DPI&F(Qld), CIAT and ILRI, Brisbane, Australia.

Cooper W., Cooper W.T. (2004) Fruits of the Australian tropical rainforest. Nokomis Editions Pty Ltd, Melbourne.

Coops H., van der Velde (1995) Seed dispersal, germination and seedling growth of six helophyte species in relation to water-level zonation. *Freshwater Biology* 34: 13–20.

References and further reading

Connolly N., Kahler C., Mackay S., Fry S., Cameron R. (2012) *Variations in wetland condition across land zones in the Lower Burdekin: Aquatic weed distribution determined by underlying differences in water and salinity regimes.* Report by Wetlands and Healthy Waters, Planning and Assessment, North Region, Queensland Department of Environment and Heritage Protection, Townsville – for the NQ Dry Tropics NRM Pty. Ltd.

Cosgrove R., Field J., Ferrier A. (2007) The archaeology of Australia's tropical rainforests. *Palaeogeography, Palaeoclimatology, Palaeoecology* 251 (1): 150–173.

Cowie, I.D., (2000) Flood plain Flora. *A flora of the coastal flood plains of the Northern Territory, Australia.* Flora of Australia Supplementary Series Number 10, Australian Biological Resources Study (ABRS).

CRC Weed Management (2003a) *Weed management guide* – Cabomba (Cabomba caroliniana). http://www.environment.gov.au/biodiversity/invasive/weeds/publications/guidelines/wons/pubs/c-caroliniana.pdf

CRC Weed Management (2003b) *Weed management guide* – Salvinia (Salvinia molesta). http://www.environment.gov.au/biodiversity/invasive/weeds/publications/guidelines/wons/pubs/s-molesta.pdf Accessed August 2014.

Cribb A.B., Cribb J.W. (1981a) *Useful wild plants in Australia.* William Collins Pty ltd, Sydney.

Cribb A.B., Cribb J.W. (1981b) *Wild Medicine in Australia.* William Collins Pty ltd, Sydney.

Cribb A.B., Cribb J.W. (1987) *Wild Food in Australia (2nd ed)* William Collins Pty ltd, Sydney.

Crowder S., Saggers B. (2010) *Grasses of the Northern Territory Savannas: A field guide.* Greening Australia, Darwin.

Csurhes S., Markula A. (2010) Pest Plant Risk Assessment: Alligator weed *Alternanthera philoxeroides.* Biosecurity Queensland, Department of Employment, Economic Development and Innovation, Brisbane.

Dalrymple G.E. (1874) Queensland north-east coast expedition. *The Sydney morning Herald* Tues. 21 April 1874, p 6

Department of Agriculture and Fisheries (DAF) (2016a) *Weed and pest animal fact sheets* https://www.daf.qld.gov.au/plants/weeds-pest-animals-ants/educational-resources-and-careers/publications/fact-sheets. Accessed October 2016.

Department of Agriculture and Fisheries (DAF) (2013a) Fact Sheet: Alligator weed *Alternanthera philoxeroides.* https://www.daf.qld.gov.au/__data/assets/pdf_file/0007/59569/IPA-Alligator-Weed-PP4.pdf

Department of Agriculture and Fisheries (DAF) (2016a) Alligator weed *Alternanthera philoxeroides.* https://www.daf.qld.gov.au/__data/assets/pdf_file/0007/59569/IPA-Alligator-Weed-PP4.pdf

Department of Environment and Heritage Protection (DEHP) (2013) Endangered Plants: *Aponogeton bullosus.* https://www.ehp.qld.gov.au/wildlife/threatened-species/endangered/endangered-plants/aponogeton_bullosus.html

Department of Environment and Heritage Protection (DEHP) (2016a) WetlandInfo. http://wetlandinfo.ehp.qld.gov.au/wetlands/

Department of Environment and Heritage Protection (DEHP) (2016b) Wetland indicator plants of regional NRM body—Terrain NRM, WetlandInfo. http://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/wildlife/?AreaID=nrm-terrain-nrm&Kingdom=plants&SpeciesFilter=WetlandIndicator

Department of Natural Resources, Environment and the Arts (2008) *Northern Territory Cabomba Eradication Program* 2005/06. https://landresources.nt.gov.au/__data/assets/pdf_file/0010/358714/cabomba-eradication-program-2005-2006.pdf Accessed October 2016.

Department of Sustainability, Environment, Water, Population and Communities (SEWPC) (2011) Species List for NRM Region Wet Tropics, Queensland. http://environment.gov.au/system/files/pages/f25079fa-fe53-495f-bb4f-3ae556cf7a26/files/species-qld-wet-tropics.pdf

DiTomaso J.M., Kyser G.B., Oneto S.R., Wilson R.G., Orloff S.B., Anderson L.W., Wright S.D., Roncoroni J.A., Miller T.L., Prather T.S., Ransom C., Beck K.G., Duncan C., Wilson K.A., Mann J.J. (2013) Weed control in natural areas in the Western United States. Weed Research and Information Center, University of California, Davis, California.

Dunlop, C.R., Leach, G.J. & Cowie, I.D. (1995) *Flora of the Darwin Region Vol.2.* Northern Territory Herbarium, Conservation Commission of the Northern Territory.

Elliot, W.R. & Jones, D.L. (1984). *Encyclopaedia of Australian Plants suitable for Cultivation. Vol. 3.* (Lothian Publications: Melbourne).

Environment Australia (2001) *A Directory of Important Wetlands in Australia. Third Edition.* Environment Australia, Canberra.

Erickson R. (1978) Plants of prey in Australia. University of Western Australia Press, Nedlands WA.

Faithful J.W. (1996) *The fate of Phosphorus in wetlands: A review.* ACTFR Report No. 96/15 to the Queensland Department of Natural Resources.

Falvey J.L. (1981) *Imperata cylindrica* and animal production is south-east Asia: A review. *Tropical Grasslands* 15 (1): 52–56.

FAO (2012) *Grassland Index. A searchable catalogue of grass and forage legumes.* FAO, Rome, Italy.

Farooq Ahmad (2013) *Leptochloa fusca* Cultivation for Utilization of Salt-Affected Soil and Water Resources in the Cholistan Desert *Global Journal of Human Social Science Geography, Geo-Sciences, Environmental Disaster Management.* Volume 13 Issue 6 Version 1.0.

Fern K. (2015) Useful Tropical Plants Database. Accessed online http://tropical.theferns.info/

Fyson A (2000) Angiosperms in acidic waters at pH 3 and below. *Hydrobiologia* 433:129–135.

Gohil K.J., Patel J.A., Gajjar A.K. (2010) Pharmacological Review on *Centella asiatica*: A Potential Herbal Cure-all. *Indian J Pharm Sci.* 72(5): 546–556. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3116297/

Goosem S. (2002) *Wet Tropics of Queensland World Heritage Area – including an Update of the Original Wet Tropics of Queensland Nomination Dossier.* Wet Tropics Management Authority, Cairns, QLD.

Greenway M., Woolley A. (1999) Constructed wetlands in Queensland: Performance efficiency and nutrient bioaccumulation. *Ecological Engineering* 12 (1–2):39–55.

Greenway, M. (2000) Role of Constructed Wetlands for Stormwater Management. In: Proceedings of the 3rd Queensland Environmental Conference: Sustainable Environmental Solutions for Industry and Government; a Focus of Sound, Practical and Economically Viable Solutions for Industry and Government. Brisbane, Qld.: Environmental Engineering Society (Queensland Chapter): 325–331.

Greenway, M. (2003) Suitability of macrophytes for nutrient removal from surface flow constructed wetlands receiving secondary treated effluent in Queensland Australia. *Water Sci. Technol.* 48(2): 121–128.

References and further reading

Greenway M. (2005) The role of constructed wetlands in secondary effluent treatment and water reuse in subtropical and arid Australia. *Ecological Engineering* 25:501–509.

Greenway M., Woolley A. (2001) Changes in plant biomass and nutrient removal over 3 years in a constructed wetland in Cairns, Australia. *Water Science and Technology*, 44(11/12): 303–310.

Hacker J.B. (1990) *A guide to herbaceous and shrub legumes of Queensland.* University of Queensland Press, St Lucia, Qld.

Hacker, J. B.; Jank, L. (1998) Breeding tropical and subtropical grasses. In: Cherney, J. H.; Cherney, D. J. R. (Eds.). Grass for dairy cattle: 49–71. CABI Publishing, Wallingford, UK.

Haddon A.C., Rivers W.H.R. (1912) Reports of the Cambridge Anthropological Expedition to Torres Straits: Volume IV: Arts & Craft. . Cambridge University Press. https://books.google.com.au/books?id=8EAuSEn9qYwC&printsec=frontcover#v=onepage&q&f=false

Hannan-Jones, M., Weber, J. (2008) Pest Plant Risk Assessment: aleman grass (*Echinochloa polystachya*), Biosecurity Queensland, Department of Primary Industries and Fisheries, Brisbane.

Hariyadi, Yanuwiadi B., Polii B., Soemarno (2013) Phytoremediation of arsenic from geothermal power plantwaste water using *Monochoria vaginalis*, *Salvinia molesta* and *Colocasia esculenta*. *International Journal of Biosciences* 3(6):104–111.

Hart B.T., Jones M.J., Breen P. (1984) *In situ experiments to determine the uptake of copper by the aquatic macrophyte Najas tenuifolia* R.Br. Supervising Scientist for the Alligator Rivers Region, Technical Memorandum 11, Canberra.

Hay, A., (2011) Araceae. *Flora of Australia* 39: 274 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Heino, J. and H. Toivonen. (2008). Aquatic plant biodiversity at high latitudes: patterns of richness and rarity in Finnish freshwater macrophytes. *Boreal Environment Research.*Res. 13: 1–14.

Hellquist, C.B. & Jacobs, S.W.L. in Wilson, A.J.G. (Ed) (2011) Aponogetonaceae, *Flora of Australia* 39: 48 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Hellquist, C.B. & Jacobs, S.W.L. (1998) Aponogetonaceae of Australia, with descriptions of six new taxa. *Telopea* 8(1): 7–13

Hewson, H.J. & Beesley, P.L. (1990) Lythraceae. *Flora of Australia* 18: 99 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Hutchinson, G.E. (1975) *A treatise on limnology,* Volume 3. Limnology Botany. Wiley, New York.

Inglis, S.N. and Howell, S. (2009) *Aquatic Conservation Assessments (ACA), using AquaBAMM, for the non-riverine wetlands of the Great Barrier Reef catchment.* Department of Environment and Resource Management (DERM), Brisbane. http://www.southwestnrm.org.au/sites/default/files/uploads/ihub/qmdbacav14.pdf

Invasive Species Specialist Group (ISSG) (2015) The Global Invasive Species Database Version 2015.1. http://www.iucngisd.org/gisd/

Jacobs, S.W.L., Les D.H., Moody M.L., Hellquist C.B. (2006) Two new species of *Aponogeton* (Aponogetonaceae), and a key to species from Australia. *Telopea* 11(2) 129–134.

Jacobs, S.W.L. & McColl, K.A. (2011) Alismataceae. *Flora of Australia* 39: 11–12 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Jacobs, S.W.L. & McColl, K.A. in Wilson, A.J.G. (ed.) (2011) Najadaceae. *Flora of Australia* 39: 102–104 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Jacobs, S.W.L. & Porter, C.L. (2007) Nymphaeaceae. *Flora of Australia* 2: 259–275 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Jacobs, S.W.L. & McColl, K.A. (2011) Hydrocharitaceae p.p. *Flora of Australia* 39: 30 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Jaensch R., Joyce K. (2006) *Wetland Management Profile: Coastal Grass–Sedge Wetlands.* Ecosystem Conservation Branch, Department of Environment Protection Agency. http://wetlandinfo.ehp.qld.gov.au/resources/static/pdf/resources/fact-sheets/profiles/p01781aa.pdf Accessed August 2014.

Jessup L.W., Sharpe P.R. (2004) *Cyperaceae in Queensland: Descriptions, Illustrations, Identification, and Information Retrieval.* Version: 5th April 2004.

Joffry S.M., Yob N.J. Rofiee M.S., Meor Mohd. Affandi M.M.R., Suhaili Z., Othman F., Akim A., Desa M.N.M., Zakaria Z. A. (2012) *Melastoma malabathricum* (L.) Smith Ethnomedicinal Uses, Chemical Constituents, and Pharmacological Properties: A Review. *Evidence-Based Complementary and Alternative Medicine* 2012.

Jones, D.L. in McCarthy, P.M. (Ed) (1998) *Flora of Australia* 48: 167–168 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Jones, D.L., Clemesha S.C. (1993) *Australian ferns and fern allies.* The Currawong Press, Chatswood NSW.

Kirschbaum M.U.F., Gross L.J., Pearcy R.W. (1988) Observed and modelled stomatal responses to dynamic light environments in the shade plant *Alocasia macrorrhiza. Plant Cell Environ* 11:111–121.

Knights D. (2009) Water sensitive urban design vegetation selection guide. Report to Northern Territory Department of Planning and Infrastructure, Darwin. http://www.equatica.com.au/Darwin/reports-pdfs/Final%20Docs/8005_Darwin%20WSUD%20Vegetation%20Selection%20Guide%20FINAL%20_May09_.pdf

Koi S., Imaichi R., Kato M. (2005) Endogenous Leaf Initiation in the Apical□Meristemless Shoot of *Cladopus queenslandicus* (Podostemaceae) and Implications for Evolution of Shoot Morphology. *Int. J. Plant Sci*, 166 (2): 199–206.

Kramer, K.U. & McCarthy, P.M. in McCarthy, P.M. (ed.) (1998) Pteridaceae. *Flora of Australia* 48: 241–242.

Kumar G., Srivastava N. (2012) Mercury induced genomic disturbance and flowering inhibition in Sesbania Pea (*Sesbania cannabina* Poir.) Rom. *J. Biol-Plant Biol.* 57 (1):27–35.

Laiden, I. (2008) *Wetland Management Handbook Farm Management Systems (FMS) guidelines for managing wetlands in intensive agriculture. Queensland Wetlands Program.* Department of Employment, Economic Development and Innovation http://wetlandinfo.ehp.qld.gov.au/resources/static/pdf/resources/reports/fms/fms_025_handbook_web.pdf Accessed August 2014.

Landolt, E. (2011) Lemnaceae. *Flora of Australia* 39: 27 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

References and further reading

Linder, H.P. (2005) Trib. Arundineae. *Flora of Australia* 44B: 8 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Lindsay B.Y., Waliwararra K., Miljat F., Kuwarda H., Pirak R., Muyung A., Pambany E., Marruridj J., Marrfurra P., Wightman G. (2001) *Malakmalak and Matngala plants and animals: Aboriginal flora and fauna knowledge from the Daly River area. Northern Australia.* Northern Territory Botanical Bulletin No.26. Parks and Wildlife Commission of the Northern Territory, Darwin.

Liogier, H.A. (1995) *Descriptive flora of Puerto Rico and adjacent islands.* Vol. 4. Editorial de la Universidad de Puerto Rico, San Juan.

Lukacs G.P., Weber E. (1997) *Seed germination requirements of four emergent macrophytes in North Queensland.* Australian Centre for Tropical Freshwater Research (ACTFR) Report 97/21.

Luo Z., Zhang D., Renner S.S. (2008) Why two kinds of stamens in buzz-pollinated flowers? Experimental support for Darwin's division-of-labour hypothesis. *Functional Ecology* 22: 794–800.

Mackay, S. J., James, C. S., Arthington, A. H. (2010) Macrophytes as indicators of stream condition in the Wet Tropics region, Northern Queensland, Australia. *Ecological Indicators*, 10 (2): 330–340.

Manan F.A., Chai T-T., Samad A.A., Mamat D.D. (2015) Evaluation of the Phytoremediation Potential of Two Medicinal Plants. *Sains Malaysiana* 44(4): 503–509.

McCarthy, P.M. (1998) Salviniaceae. *Flora of Australia* 48: 173 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

McPherson S., Robinson A. (2012) *Field guide to the pitcher plants of Australia and New Guinea.* Redfern Natural History Productions, Dorset, England.

Miller J.B., James K.W., Maggiore P.M.A. (1993) *Tables of composition of Australian Aboriginal Foods.* Aboriginal Studies Press, Canberra.

Mkandawire M., Dudel E.G. (2007) Are *Lemna* spp. Effective Phytoremediation agents? *Bioremediation, Biodiversity and Bioavailability* 1 (1):56–71 http://www.globalsciencebooks.info/Online/GSBOnline/images/0706/BBB_1(1)/BBB_1(1)56-71o.pdf Accessed October 2016.

Molonglo Catchment Group (2011) Glove box guide: waterplants of the ACT Region http://www.molonglocatchment.com.au/Documents/Waterplants/Glovebox%20guide%20Waterplants%20of%20the%20ACT%20region.pdf

Neeraja P.V., Elizabeth M. (2011) *Eclipta alba* (L.) Hassk: A Valuable Medicinal herb. *International Journal of Current Pharmaceutical Review and Research*, 2(4): 188–197.

Nguyen Q.V., Hicks D. (2001) *Exporting lotus to Asia: An agronomic and physiological study.* Rural Industries Research & Development Corporation Publication No. 01/032, Gosford NSW.

Office of the Gene Technology Regulator (2005) *The biology and ecology of rice (Oryza sativa L.) in Australia.* Office of the Gene Technology Regulator, Australian Government Department of Health and Ageing, Canberra.

Ogle B.M., Tuyet H.T., Duyet H.N., Dung N.N.X. (2003) Food, Feed or Medicine: The Multiple Functions of Edible Wild Plants in Vietnam *Economic Botany* 57(1): 103–117.

Ondinea D. (1999) *Frog-friendly native pond and bog plants.* Compiled for the Frog and Tadpole Study (FATS) Group. http://www.wollicreek.org.au/static/frogplants2.pdf

Osmond R., Petroeschevsky A. (2013) *Water hyacinth control modules: Control options for water hyacinth (Eichhornia crassipes) in Australia.* NSW Department of Primary Industries. http://www.weeds.org.au/WoNS/waterhyacinth/docs/Water_hyacinth_control_options_WEB-ACCESSIBLE_VERSION_FINAL_V2.pdf Accessed August 2014.

Papassotiriou, S.E., Jacobs, S.W.L. & Hellquist, C.B. in Wilson, A.J.G. (Ed) (2011) Potamogetonaceae. *Flora of Australia* 39: 92 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Parris, B.S., Khew R., Chung R.C.K., Saw L.G. & Soepadmo E. (eds.) (2010) *Flora of Peninsular Malaysia. Series I: Ferns and Lycophytes. Vol. 1.* Malayan Forest records No. 48. Forest Research Institute of Malaysia, Kepong.

Parrotta, J.A. (2001) *Healing plants of Peninsular India.* CABI Publishing, Wallingford, UK and New York.

Price S.H., Price J.L. (2002) *Wild food, medicine and useful plants of the wet tropics.* Stephen Hugh Price, Garners Beach.

Pusey B., Pearson R., Werren G., Burrows D. (1999) *Conservation value of waterways in the Wet Tropics World Heritage Area.* Unpublished Report to the Wet Tropics Management Authority.

Quattrocchi U. (2012) *CRC World Dictionary of Medicinal and Poisonous Plants: Common names, Scientific Names, Eponyms, Synonyms and Etymology.* CRC Press.

Raj A., Jamil S., Srivastava P.K., Tripathi R.D., Sharma Y.K., Singh N. (2015) Feasibility Study of *Phragmites karka* and *Christella dentata* Grown in West Bengal as Arsenic Accumulator. *Int J Phytoremediation.* 17(9): 869–878.

Reid, R.J. and Butcher, C.S. (2011) Positive and negative impacts of plants on acid production in exposed acid sulphate soils. *Plant and Soil,* 349(1–2):183–190.

Romanowski N. (2009) *Planting wetlands and dams: A practical guide to wetland design, construction and propagation.* (2nd Ed.) Landlinks Press, Collingwood, Victoria.

Rose C., Rose H., Hirst P. (2009) Feed quality of water couch (*Paspalum distichum*) and spike rush (*Eleocharis sphacelata*) on the North Coast of NSW. *Proceedings of the 24th Annual Conference of the Grassland Society of NSW*: 115–116.

Rowlatt U. (1981) *Water plants of the Townsville Town Common.* James Cook University, Townsville.

Sainty, G.R. and Jacobs, S.W.L. (2003) *Waterplants in Australia,* Sainty and Associates Pty Ltd.

Sattler P., Williams R. (Eds) (1999) *The conservation status of Queensland's Bioregional Ecosystems.* Environmental Protection Agency, Brisbane.

Sayed H.M., Mohamed M.H., Farag S.F., Mohamed G.A., Ebel R., Omobuwajo O.R.M., Proksch P. (2006) Phenolics of Cyperus alopecuroides Rottb. Inflorescences and their biological activities. *Bull. Parm. Sci. Assiut University* 29(1):9–32.

Sharpe, P.R. (1986) *Keys to Cyperaceae, Restionaceae and Juncaceae of Queensland.* Queensland Botany Bulletin No. 5.

Shen-Miller, J.; M.B. Mudgett; J.W. Schopf; S. Clarke and R. Berger, (1995) Exceptional seed longevity and robust growth: Ancient sacred lotus from China. *American Journal of Botany* 82 (11):1367–1380.

Simpson D.A., Inglis C.A. (2001) Cyperaceae of Economic, Ethnobotanical and Horticultural Importance: A Checklist. *Kew Bulletin* 56 (2): 257–360.

References and further reading

Singh S.N., Tripathi R.D. (Eds) (2007) *Environmental Bioremediation Technologies.* Springer Verlag, Berlin.

Short P.S., Cowie I.D. (Eds) (2011) *Flora of the Darwin Region*. Northern Territory Herbarium, Department of Natural Resources, Environment, the Arts and Sport.

Smith, N.M. (2011) *Weeds of the Wet/Dry Tropics of Australia – A Field Guide.* Environment Centre NT Inc.

Srivastava N. (2014) Taxonomic characterisation and economic importance of lesser known Green manure crop *Sesbania cannabina* Poir. *Int. Research J. Biol. Sci.* 3(5):85–88.

Stanley, T.D. in George, A.S. (ed.) (1982), Nepenthaceae. *Flora of Australia* 8: 7–8.

Stanley, T.D. in Stanley, T.D. & Ross, E.M. (1989), Najadaceae. *Flora of South-eastern Queensland* 3: 19.

Stanley, T.D. (2007a) Nelumbonaceae. *Flora of Australia* 2: 258–259 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Stanley, T.D. (2007b) *Ceratophyllaceae.* Flora of Australia 2: 287– 289 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland – A field Guide*, CSIRO Publishing.

Sun J1, Su Y, Wang T. (2013) Expression, Purification and Identification of CtCVNH, a Novel Anti-HIV (Human Immunodeficiency Virus) Protein from Ceratopteris thalictroides. *Int J Mol Sci.* 14(4):7506–14.

Sutrisno Sa'ad N., Artanti R., Dewi T. (2011) Phyto-remediation for rehabilitation of agricultural land contaminated by Cadmium and Copper. *Indonesian Journal of Agriculture* 4(1): 17–21.

Sweeney M.E. (2008) *The 101 best aquarium plants*. T.F.H. Publications Inc., Neptune City, N.J., USA.

Tait J.(2013) *Coastal Ecosystem Management – Lower Burdekin flood plain* (LBF) Case Study. Report for GBRMPA.

Terrain NRM (2016) *Wet Tropics Plan for people and country.* http://www.wettropicsplan.org.au/

Tews, J., U. Brose, V. Grimm, K. Tielborger, M.C. Wichmann, M.Schwager and F. Jeltsch. (2004).Animal species diversity driven by habitat heterogeneity and diversity: the importance of keystone structures. *Journal Biogeography.* 31: 79–92.

Thompson, J. (1990) Onagraceae. *Flora of Australia* 18: 226–227 Australian Biological Resources Study (ABRS) / CSIRO Publishing.

Thozet A. (1866) *Notes on some of the roots, tubers, bulbs, and fruits, used as vegetable food by the Aboriginals of Northern Queensland, Australia.* W.H. Buzacott, "Bulletin" Office, Rockhampton.

Threatened Species Scientific Committee (2008) Approved Conservation Advice for *Aponogeton bullosus*. http://www.environment.gov.au/biodiversity/threatened/species/pubs/8299-conservation-advice.pdf

Tothill J.C., Hacker J.B. (1996) *The grasses of southern Queensland.* Tropical Grassland Society of Australia Inc., St Lucia, Qld.

Triest L. (1988) *A revision of the genus Najas L. (Najadaceae) in the Old World.* Academie Royale Des Sciences D'Outre-Mer. Mémoires in–8. Nouvelle Série, Tome 22, fasc. 1, Bruxelles. Koninklijke Academie Voor Overzeese Wetenschappen, Brussel.

UNESCO World Heritage Centre (2016) *Wet Tropics of Queensland.* http://whc.unesco.org/en/list/486

United States Department of Agriculture (2013) Weed Risk Assessment for *Limnobium laevigatum* (Humb. & Bonpl. Ex Willd.) Heine (Hydrocharitaceae) – South American spongeplant https://plants.ifas.ufl.edu/wp-content/uploads/files/caip/pdfs/WRA-Limnobium-laevigatum.pdf

University of Queensland (2011) Hygrophila: *Hygrophila costata.* Environmental Weeds of Australia, produced for Biosecurity Queensland. Accessed online http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Hygrophila_costata.htm

Walters P. (1998) *Flora Useful in Environmental Engineering Applications.* Department of Primary Industries and Water (Tasmania).

Watanabe T., Osaki M., Yoshihara T., Tadano T. (1998) Distribution and chemical speciation of aluminum in the Al accumulator plant, *Melastoma malabathricum* L. *Plant and Soil.* 201 (2):165–173.

Watanabe T., Osaki M. (2001) Influence of aluminum and phosphorus on growth and xylem sap composition in *Melastoma malabathricum* L. Plant and Soil. 237 (1): 63–70.

Werren G. (2001) *Environmental Weeds of the Wet Tropics Bioregion: Risk Assessment & Priority Ranking.* Report prepared for the Wet Tropics Management Authority, Cairns.

WetlandCare Australia (2008) *Wetland Rehabilitation Guidelines for the Great Barrier Reef catchment.* Compiled for Department of the Environment, Water Heritage and the Arts.
WetlandSummary–facts and maps, WetlandInfo, Department of Environment and Heritage Protection, Queensland. http://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/
Wetland values, WetlandInfo, Department of Environment and Heritage Protection, Queensland, http://wetlandinfo.ehp.qld.gov.au/wetlands/management/wetland-values/. Accessed August 2014.

Wet Tropics Management Authority (2014) Non-woody vegetation of the Wet Tropics bioregion: Sedgelands (vegetation codes 69a–69h). http://www.wettropics.gov.au/site/user-assets/docs/factsheets/wtmaVMWTB69a-69h.pdf

Whiffin, T. (1990) Melastomataceae. *Flora of Australia* 18: 248.

Whitehead P.J. (1998) Dynamics of habitat use by the Magpie Goose *Anseranas semipalmata*: implications for conservation management. PhD Thesis, Faculty of Science, Northern Territory University, Darwin.

Williams K. (1979) *Native plant of Queensland Vol.1.* Keith A.W. Williams, Ipswich.

Williams K. (1984) *Native plant of Queensland Vol.2.* Keith A.W. Williams, Ipswich.

Williams K. (1987) *Native plant of Queensland Vol.3.* Keith A.W. Williams, Ipswich.

Williams K. (1999) *Native plant of Queensland Vol.4.* Keith A.W. Williams, Ipswich.

Williams P.R., Collins E.M., Grice A.C. (2005) Cattle grazing for Para Grass management in a mixed species wetland of north-eastern Australia. *Ecological Management & Restoration* 6 (1): 75–76.

Wurochekke A.A., Harun N.A., Saphira R.M., Mohamed R., Kassim A.H.B. (2014) Constructed Wetland of *Lepironia articulata* for Household Greywater Treatment. *APCBEE Procedia*, Singapore 10: 103–109.

Zhang, X. H., Liu J., Huang H.T., Chen J., Zhu Y.N., Wang D.Q. (2007) Chromium accumulation by the hyperaccumulator plant *Leersia hexandra* Swartz. *Chemosphere* 67(6), 1138–43.

Index

Index

Notes

Wetland Plants of the Wet Tropics

"Wetland Plants of the Wet Tropics" is an important resource for naturalists, land managers, farmers, community groups and local councils, as it provides information (descriptions, habitat, impacts and uses) on 68 aquatic native and introduced water plants commonly found within the region. Photographs and brief descriptions are provided for an additional 65 water plants, supplying a valuable identification tool for professional and novice alike.