Grazing for Healthy Coastal Wetlands:

Guidelines for managing coastal wetlands in grazing systems

This technical report has been previously published by the Queensland Government. The technical information in this publication is still current, however it may contain references to former departmental names. Please refer to the Department of Agriculture, Fisheries and Forestry's website at www.daff.qld.gov.au for up-to-date contact details.

Australian Government

Queensland Wetlands Program

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Guidelines for managing coastal wetlands in grazing systems

Prepared by

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The Queensland Wetlands Program is a joint initiative of the Australian and Queensland Governments established in 2003 to protect and conserve Queensland's wetlands. More information on the Queensland Wetlands Program and resources can be found at <www.derm.qld.gov.au/wetlandinfo>

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Introduction

Grazing for Healthy Coastal Wetlands has been developed to provide graziers, landowners and extension officers with information on managing grazing in and around Queensland's coastal wetlands to maintain healthy coastal wetlands and productive grazing enterprises.

It provides practical advice on how grazing and associated land management practices can be implemented to support the long-term health of coastal wetlands whilst maintaining production.

The guidelines have been compiled from published literature, grazier knowledge, wetlands managers and the experience of extension and natural resource management professionals. They reflect the current knowledge of suitable management practices for coastal wetlands. They are designed to complement and be considered in conjunction with existing information resources including the EDGE*network* Grazing Land Management series and best management practice guidelines from regional Natural Resource Management (NRM) groups.

While the recommendations apply broadly to Queensland's coastal wetlands, regional, catchment and landscape-scale variations in wetland characteristics and the objectives of the individual grazing enterprise should be taken into account in planning and deciding management actions for wetlands. An individual grazing property may even have a range of wetland types with different management needs and objectives which should be identified during whole of property planning. Specific land and wetland management advice should also be sought from local grazing extension officers and NRM professionals (see Contacts, page 112).

Grazing for Healthy Coastal Wetlands was developed by the Department of Employment, Economic Development and Innovation (DEEDI) as part of the Queensland Wetlands Program with funding from the Queensland Government. DEEDI has developed and delivered a range of resources and extension support to landowners and allied extension staff on improving wetland management in agriculture. These guidelines and other resources, including guidelines for managing wetlands in intensive agriculture can be found online on Wetland*Info* (www.derm.qld.gov.au/wetlandinfo).

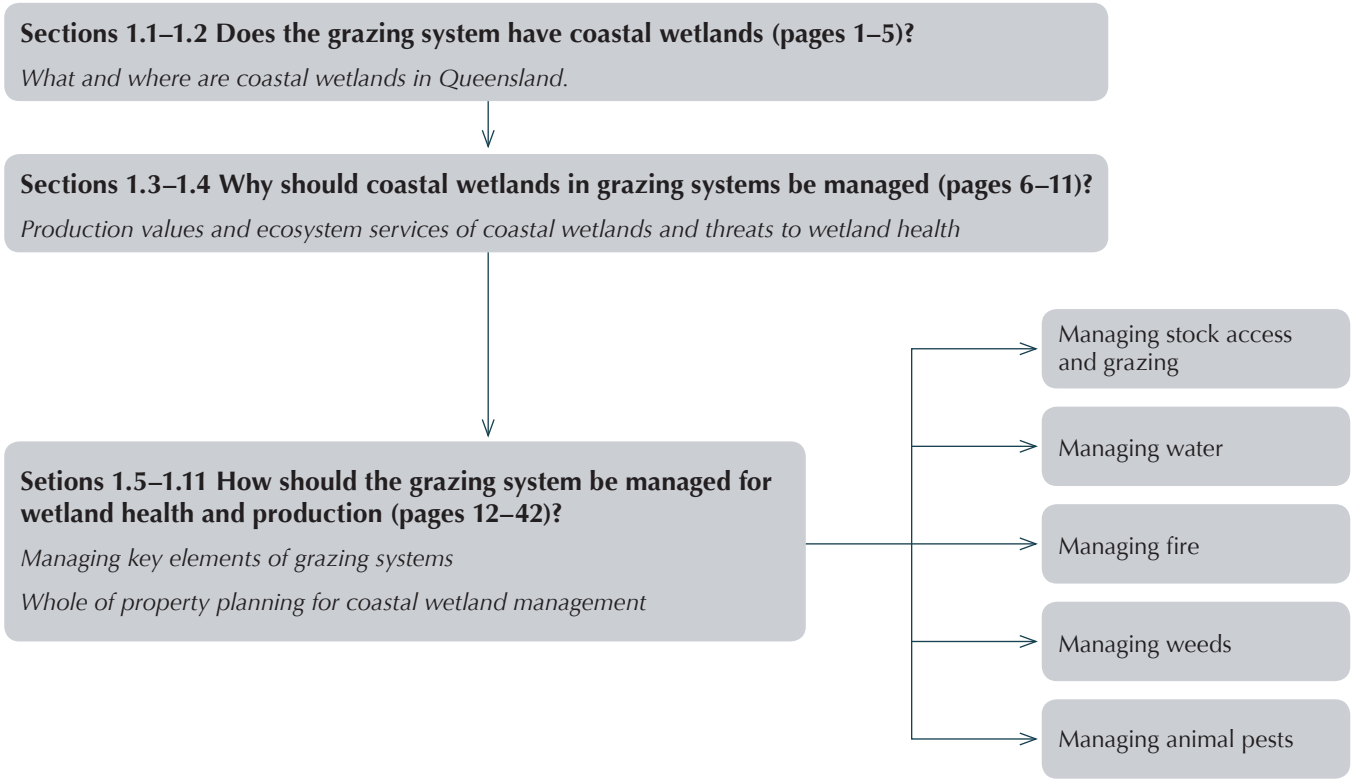
Figure 1 Wetland on a coastal grazing property near Giru

Using the guidelines

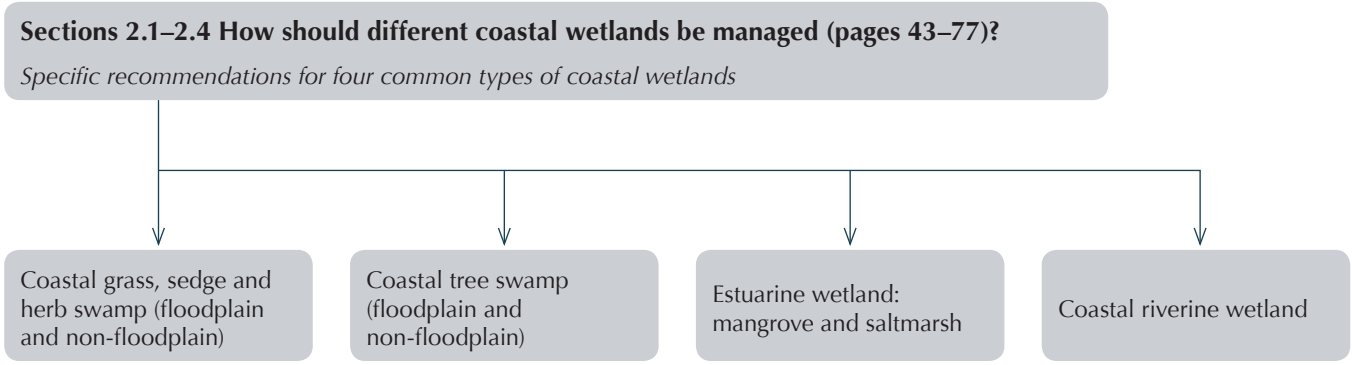
Grazing for Healthy Coastal Wetlands consists of two parts:

- **Part 1 outlines broad considerations and guidelines for planning and managing different elements of a grazing system for production and wetland health; this part comprises of five main management areas and includes a section on whole of property planning.**
- **Part 2 provides specific wetland management recommendations for the four main coastal wetland types in Queensland.**

Part 1



Part 2



Part 1: Managing coastal wetlands in grazing systems

1.1 What is a wetland?

Wetlands are areas covered permanently or intermittently with water. They can be natural or artificial, have static or flowing water or be fresh, brackish or salty.

To be a wetland they also need to have one or more of the following attributes:

- periodically the land supports plants or animals that are adapted to or dependent on living in wet conditions for at least part of their life cycle, or
- the substratum consists predominately of undrained soils that are saturated, flooded or ponded for long enough so that they become anaerobic, or
- the substratum is not soil and is saturated with water, or covered with water at some time.[1]

Wetlands are found throughout Queensland and come in a wide variety of forms, including:

- rivers and creeks
- lakes, lagoons and billabongs
- swamps, marshes and bogs
- saltmarsh and mangrove communities
- springs and underground systems
- inshore reefs and coastal waters
- artificial dams and drains.

Did you know?

When the water is not there they do not cease to be wetlands they are just 'dry wetlands'.

Wetlands do not have to be wet all the time and wetting and drying cycles are natural for most wetlands. Water regimes in wetlands can be:

Episodic/intermittent – contains water intermittently or rarely, these wetlands typically occur in the arid parts of Queensland.

Figure 2 Lake Numala, Currawinya National Park. Source: C.Chilcott, DEEDI

Periodic – contains water on a seasonal basis, such as many natural wetlands in the seasonally dry tropics or subtropics or during tidal cycles, such as mangrove and saltmarsh wetlands.

Figure 3 Periodic tree swamp in the seasonal dry tropics

1 Due to the broad range of habitats, the difficulties in identifying wetlands, and the wide range of purposes for which policy and legislation has been developed, there are currently a variety of wetland definitions in use in Queensland. The definition used in this guideline is based on the definition used in the Strategy for the Conservation and Management of Queensland Wetlands and modified by the Queensland Wetlands Program to provide further clarity.

Perennial/permanent – contains water most of the time, but the water level can be variable, such as many wetlands in the high rainfall areas of north-east Queensland.

Figure 4 Permanent wetland in the wet tropics region

1.2 Coastal wetlands in Queensland

Wetlands are estimated to cover over four percent of Queensland's land area. Differences in climate, substrate, topography and position in the catchment mean that wetlands vary greatly throughout Queensland. Not only does this affect how wetlands look, it has implications for land and wetland management.

Defining coastal wetlands in Queensland

Queensland's coastal strip has a distinct climate to the arid and semi-arid inland parts of the state. These guidelines deal specifically with wetlands in coastal Queensland (figure 5), where the higher, more regular rainfall supports more periodic or permanent inundation of wetlands. This presents production opportunities and management challenges for grazing systems containing these wetlands.

Grazing land and wetland management in coastal Queensland needs to take into account:

- wetlands can cover a large part of a grazing property providing fodder and water resources
- landowners and land managers have a crucial role in sustaining the values and ecosystem services of Queensland's wetlands
- wetland flooding and drying can be dynamic and unpredictable and can impact grazing operations, but these are natural processes necessary for the ongoing health and function of wetlands
- connectivity between wetlands facilitates the movement of soil, nutrients, water, plants and animals within and between properties, so that what happens on one property can have impacts on another property
- water and animals transport nutrients from wetlands to surrounding lands, enriching the land around the wetland. They can also introduce, intensify or spread management problems, such as weeds.

Figure 5 Coastal areas in Queensland. Source: DERM

Coastal wetland types

Wetlands are found throughout the coastal landscape in areas of impeded drainage, permanent or periodic inundation, where the ground water is close to the surface or in depressions or channels or behind levees or dunes. Water is an important element in all wetlands, supporting animal and plant life and connecting different wetlands to form a network across the coastal landscape. Upper parts of catchments usually have small, flowing freshwater creeks with smaller off-stream wetlands. These creeks join to form larger rivers in the lower catchment before merging with tidal estuaries of mangrove and saltmarsh. Floodplain lakes and swamps are connected to rivers and creeks during floods. Other wetlands can have their own small catchment, not associated with rivers or floodplains.

Although no two wetlands are identical, they can be broadly divided into groups or 'wetland types' based on similar characteristics and ecological functions. The most common wetland types found in coastal Queensland are the focus of these guidelines and include (figure 6):

① Coastal grass, sedge and herb swamps (floodplain and non-floodplain) (figure 7)
② Coastal tree swamps (floodplain and non-floodplain): *Melaleuca* spp. and *Eucalyptus* spp. (figure 8)
③ Estuarine wetlands: mangrove and saltmarsh (figure 9)
④ Coastal riverine wetlands (figure 10).

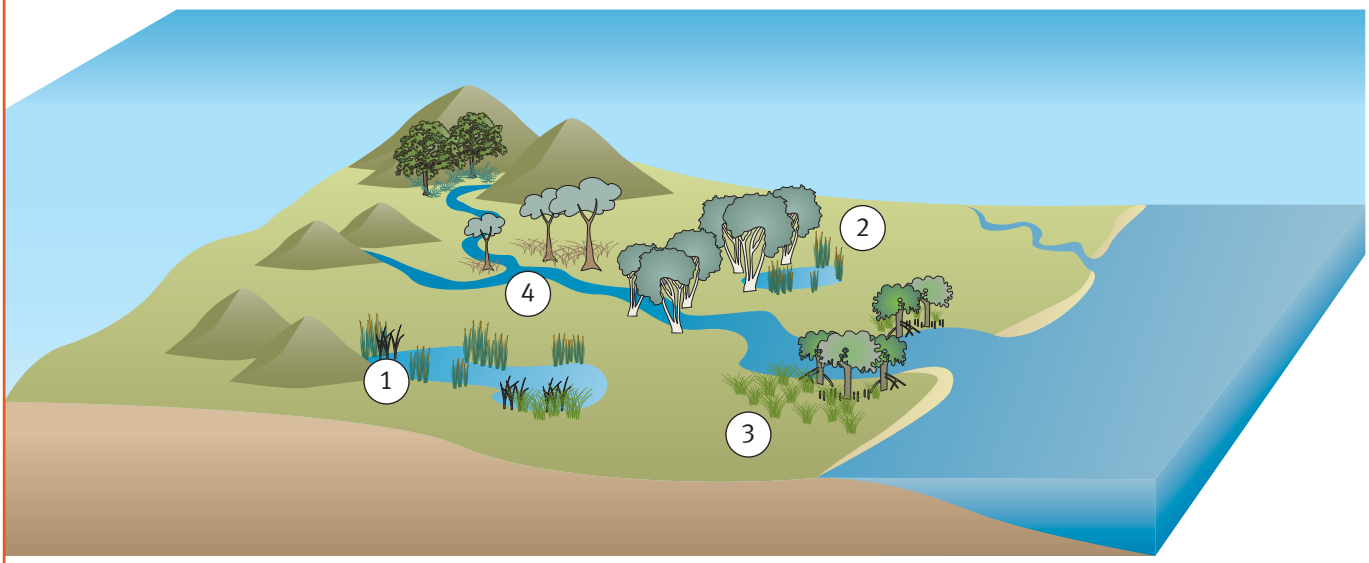


Figure 6 Common coastal wetland types

Figure 7 Coastal grass, sedge and herb swamp near Giru

Figure 8 Coastal tree swamp near Cardwell

Figure 9 Estuarine wetland near Giru

Figure 10 Coastal riverine wetland near Ayr

Want to know more?

How to find out if a property has wetlands:

- **Wetland*Info* (www.derm.qld.gov.au/wetlandinfo) has an interactive map service which displays wetlands and wetland related information.**
- **Regional NRM groups have mapping programs and information on a range of natural resource management topics.**
- **Department of Environment and Resource Management has aerial photographs and topographic maps available for purchase.**
- **Coastal Habitat Resources Information System (http://chrisweb.dpi.qld.gov.au/chris/welcome.asp) has an interactive map service which shows estuarine wetlands.**

1.3 Wetland values and ecosystem services

Wetlands provide many important functions in coastal areas due to their unique soils and water holding capacity. These functions are referred to as 'ecosystem services'. Wetlands are the boundary between two different ecosystems, dry and wet, which means they have a unique role in nutrient exchange and water supply to the surrounding lands, as well as providing habitat, food and shelter to many different plants and animals.

Many wetlands catch and filter run-off from the land or from upstream waterways which means that land management practices have a direct impact on wetland condition and ecosystem services.

Figure 11 highlights broad ecosystem services and production values provided by coastal wetlands. Just as wetlands vary in their look and characteristics, they also differ in the range of ecosystem services they provide and this must be considered in managing individual wetlands.

Some ecosystem services might be in conflict with or threaten other wetland services and it is not always possible to achieve all the outcomes wanted. Managing coastal wetlands in grazing systems is about recognising the range of ecosystem services provided by the wetland and attempting to balance the outcomes to maximise the values to both the grazing system and wetland ecosystem.

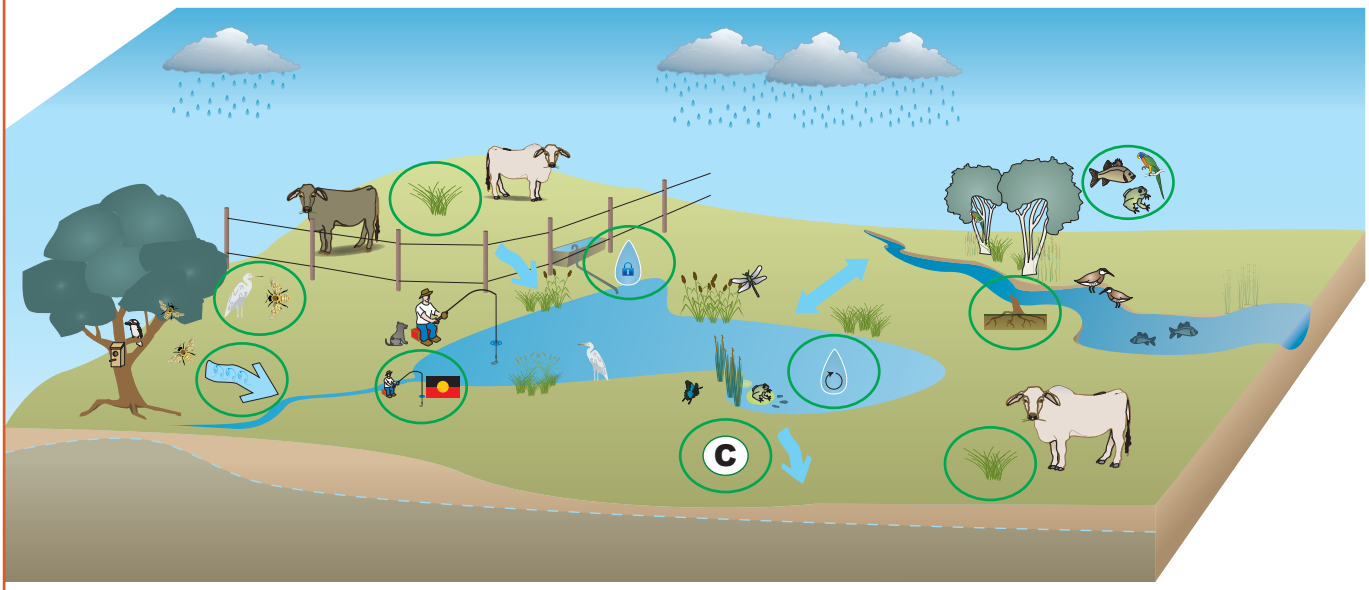


Figure 11 Conceptual model showing wetland ecosystem services and values of wetlands. The symbols represent various wetland ecosystem services and values as described.

Symbol	Descriptor	Wetland values and ecosystem services
	Water security	Important source of water for human use, stock and irrigation
		Essential water for many native animals and plants, as well as vital breeding, shelter and nursery areas for birds and a range of aquatic animals (fish and invertebrates)
		Refugia for plants and animals during drought
		Wetlands have a close association with groundwater and can act as both recharge and discharge points for aquifers

Symbol	Descriptor	Wetland values and ecosystem services
	**Food**	Wetland vegetation can be an important fodder resource for livestock providing food security during dry periods Hotspots of productivity supporting large communities of plants, insects and aquatic animals which in turn are a source of food for other wildlife Carbon and nutrients are transported to other wetlands and adjoining terrestrial land via floods and animals, forming the basis of food webs and improving productivity in terrestrial areas and downstream environments
	**Water quality**	Capture, absorb and recycle nutrients from the land into plant and animal material Wetland vegetation traps and stabilises sediments, uptakes nutrients and facilitates nutrient cycling reducing the amount of sediments and nutrients exported downstream Trap and treat a range of pollutants, including heavy metals and chemicals Wetlands can lose their filtering ability if overloaded with nutrients, sediments or pollutants, resulting in the transfer of these contaminants into downstream wetlands or the ocean. Good land management practices (i.e. maintaining good ground cover) should be implemented to minimise run-off of nutrients, sediments or other pollutants into wetlands
	**Habitat**	Hotspots of productivity, supporting a range of native plants and providing vital breeding, feeding and nursery habitat for wildlife, including many rare, threatened or endangered species Critical breeding and nursery areas for fish (e.g. barramundi, mangrove jack), crabs (e.g. mud crabs) and prawns of commercial, recreational and Indigenous fisheries value Support large populations of waterbirds, such as brolgas, magpie geese, plumed whistling-ducks, egrets and migratory waterbirds
	**Integrated pest management**	Support a range of animals (i.e. insects, spiders, insectivorous birds and reptiles) that can act as biological controls for pests and disease, assisting with Integrated pest management
	**Flood mitigation**	Buffers against storms and flooding through detention of floodwaters and minimising flood peaks. This function is usually performed in association with the surrounding floodplain Slows water flowing through the catchment, increasing groundwater recharge and the amount of water available to soils, plants and pastures
	**Stabilising soil**	Stabilise creek and river banks to prevent erosion and loss of land Estuarine wetlands protect coastlines and can buffer adjacent agricultural, industrial and urban land from the effects of floods and storms
	**Carbon storage**	Process carbon and can help in management of greenhouse gases Some wetlands store carbon, through vegetation uptake and deposition as organic matter in the anaerobic wetland soils
	**Social and cultural**	Hold spiritual and cultural importance and are valued as important sources of food and shelter by Indigenous Australians Special historical, cultural and scientific value in the community Provide recreational opportunities for people to swim, fish, boat and relax Wetlands in good condition are aesthetically pleasing and can increase land values and potentially provide tourism opportunities on grazing properties Economic values include supporting commercial and recreational fishing industries, tourism, agricultural production, providing flood and storm mitigation and water treatment services

1.4 Wetlands as grazing lands

Wetlands are an important part of many grazing properties in Queensland. Most wetlands in Queensland are on privately owned or managed freehold or leasehold lands, many of which are grazing enterprises. If they are managed as specific and sensitive land types, coastal wetlands can provide unique services to our grazing systems.

Many graziers place a high value on wetland areas for the following reasons:

- wetlands provide water for stock
- wetlands are highly productive areas providing good quality feed and food security during droughts and the dry season
- wetland trees and shrubs can provide shade and shelter for stock and habitat for animals which may be beneficial for managing pests and stock health.

Why manage wetlands?

Graziers have control over how wetlands are managed, similar to how other paddocks are managed to promote productive grazing systems.

The principles of the EDGE*network's* Grazing Land Management also apply to wetland management, whereby understanding the grazing ecosystem and managing land condition, stocking rate/utilisation and diet quality optimises production and maintains a healthy ecosystem (figure 12). For example:

- land condition: good land condition in the frontage country will help minimise sediment run-off into wetlands
- stocking and utilisation: the 'sweeter' pastures and access to water means that utilisation and evenness of grazing needs to be carefully managed around wetlands
- diet quality: well managed wetlands can provide good feed for improved animal production.

To harness their production values and maintain the ecosystem services, wetlands and frontage country should be managed as a unique land type within a grazing system (figure 13).

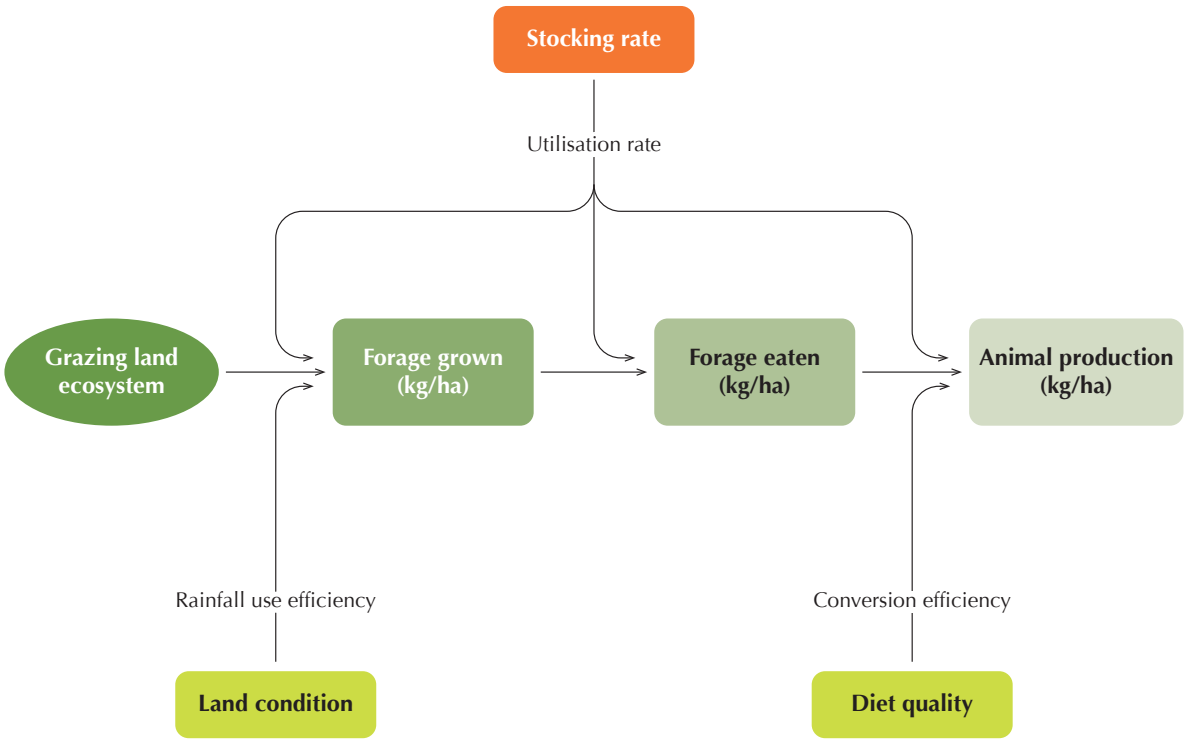


Figure 12 The grazing land ecosystem. Source: Grazing Land Management (Meat and Livestock Australia, DEEDI and NT Department of Resources)

'The wetlands are the most productive parts of the property and we have them fenced off so we can manage them as separate paddocks. Managing wetlands is all about seasonal management. The cattle go in during July and come out when the wetlands flood.

The wetlands are a good security during dry times when the surrounding pastures brown off, as they still retain green pick. In really dry years we can put the weaners in so that they can still get some green pick.'

Dugall McDougall, Station Manager, Tedlands Station, near Sarina

There are five key elements that graziers can manage in and around wetlands which in turn will impact on the production values and ecosystem services of the wetland:

- managing stock access and grazing
- managing water
- managing fire
- managing weeds
- managing animal pests.

Graziers can control the length of time, time of year and number of stock that can access wetlands. This management will determine the value of the wetland for a grazing enterprise as well as the sustainability of the wetland environment. Off-stream watering points, strategic burning and weed and pest control can complement good grazing regimes to result in productive grazing enterprises and healthy wetlands. Managing these key elements will also contribute to improving local fish, waterbird and other aquatic animal communities.

If stock access and grazing, water resources, fire, weeds and animal pests are not well managed the production value and ecosystems services of coastal wetlands can be easily degraded (figure 14).

Figure 13 The length of time and frequency of water inundation influences the resilience of a wetland to physical disturbances and water quality changes which in turn affects the management requirements. Larger wetlands are less vulnerable to impacts than smaller wetlands, as nutrient inputs are diluted and pugging or sediment disturbance takes up a relatively smaller area proportional to the wetland size. Source: DERM

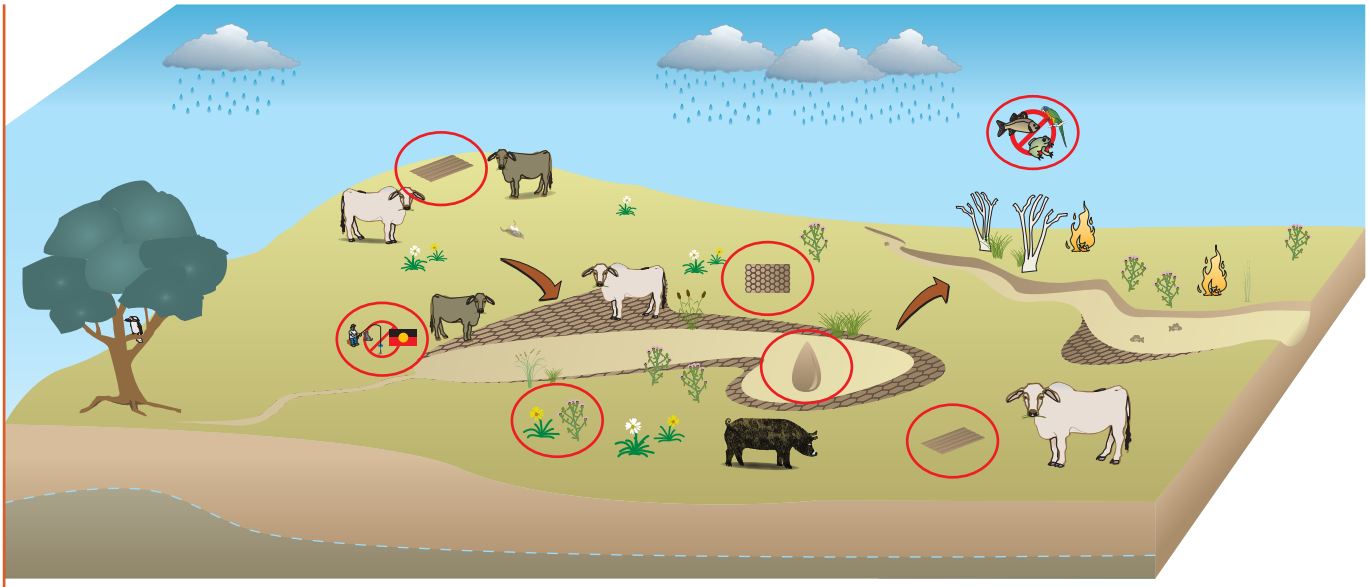


Figure 14 Conceptual model showing results of poor management of wetland ecosystems. The symbols represent various impacts of poor management as described below.

Symbol	Descriptor	Impacts of poor management of wetland ecosystems
	Decline in pasture condition	Overgrazing can shift the vegetation community towards less native grasses and more weeds Compaction of wetland soils leads to poor soil structure, less ground cover, reduced rainfall infiltration and less water available for plant growth Frequent, high intensity fires kill native plants and reduce ground cover, which promotes weeds Feral pigs and horses destroy vegetation
	Soil erosion	Patch grazing of preferred grasses leads to bare areas and increased erosion Overgrazing causes reduced ground cover, increased water run-off and soil erosion Trampling of wetland edges and fringing vegetation leave banks susceptible to slumping and erosion Pest animals dig up vegetation, remove ground cover and disturb the soil
	Poor water quality	Stock may disturb soils or urinate and defecate in wetlands, increasing the amount of sediments, nutrients, pathogens and faecal coliforms in the water which can cause algal blooms or illness and disease. Stock drinking water should have no faecal coliforms present Overgrazing or trampling of wetland plants reduces the filtering capacity of the wetland Reduced ground cover from overgrazing or high intensity fires increases sediment and nutrient run-off Feral pigs disturb wetland soils, reducing water clarity and dissolved oxygen levels
	Weeds	Overgrazing provides opportunities for weeds to establish Exotic pasture grasses and weeds outcompete native wetland vegetation and smother the water surface of wetlands, leading to the loss of habitat, reduced availability of food for wildlife and poor water quality (e.g. low dissolved oxygen levels) Exotic pasture grasses and weeds support high intensity fires which can kill native wetland plants and encourage more weeds May be toxic, causing livestock illness or death Native and feral animals and stock can move weed seeds and plant segments between wetlands

Symbol	Descriptor	Impacts of poor management of wetland ecosystems
	**Reduced habitat value and biodiversity**	Grazing of young trees and shrubs reduces native plant recruitment and habitat complexity Frequent uncontrolled hot fires kill wetland trees and change the vegetation community Feral pigs destroy wetland vegetation and can kill wetland animals Changes in water flows and habitat condition can affect the range of animals and plants living in the wetland and connectivity with other wetlands Stock browsing and rubbing on wetland vegetation can kill native trees and shrubs and reduce the amount of shade and habitat available for wildlife and aquatic animals
	**Loss of social and cultural values**	Wetlands in poor health have less biodiversity and reduced aesthetic values which decreases their recreational use (boating, swimming and fishing), cultural significance and economic value

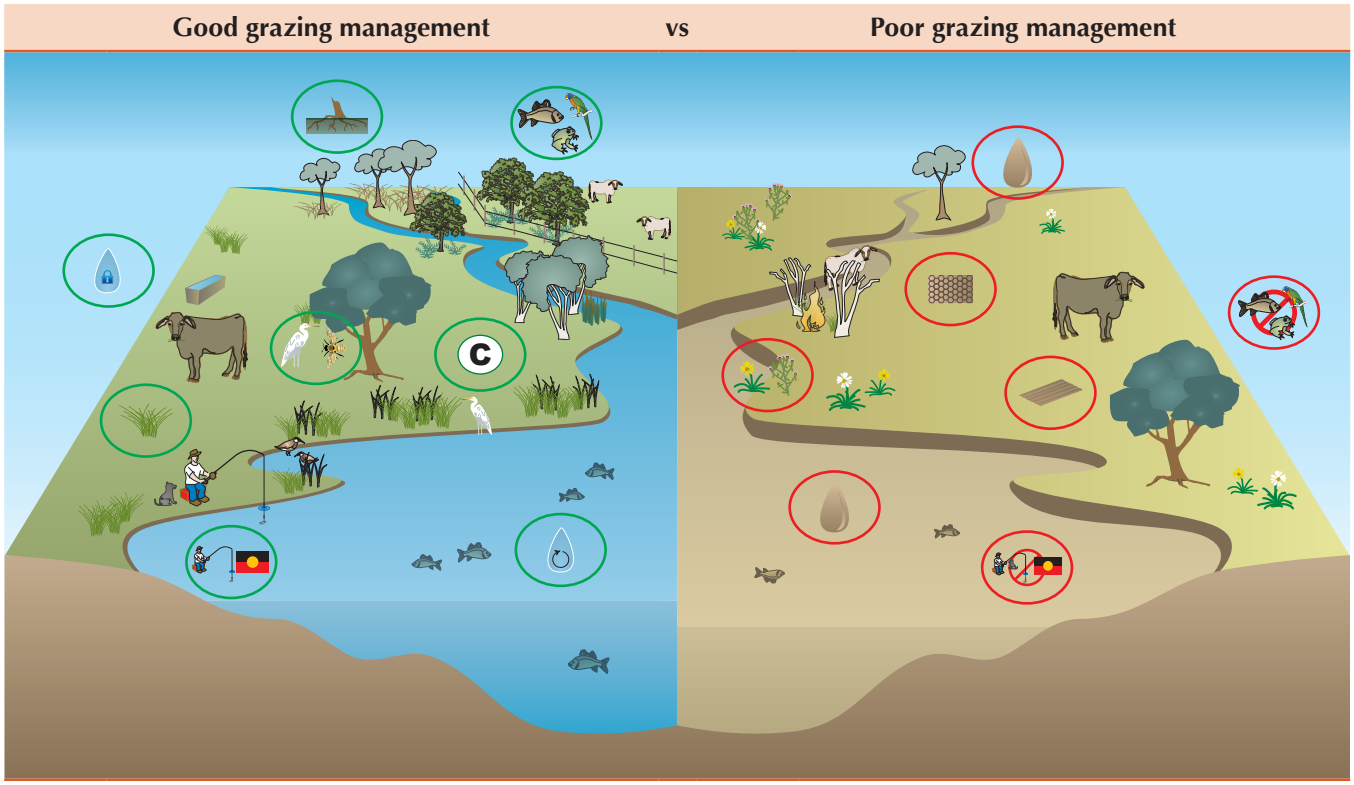
Want to know more?

More information on wetlands processes in response to different land uses and activities can be found on the Wetland*Info* website under stressor models (www.derm.qld.gov.au/wetlandinfo/site/ScienceAndResearch/ConceptualModels.html#stressor).

1.5 Managing stock access and grazing in coastal wetlands

In grazing properties, coastal wetlands retain water for longer periods of time and often have more nutrient rich soils than the surrounding paddocks. This means they often support 'sweeter', more nutritious pastures longer into the dry season, resulting in preferential grazing by stock at different times of the year. This needs to be taken into account in managing stock access and grazing to ensure the sustainable use of wetlands and even utilisation of pastures in surrounding paddocks.

Managed grazing of coastal wetlands can have production benefits whilst maintaining the health of wetlands. Figure 15 illustrates how grazing management can influence pasture condition, drinking water and other wetland ecosystem services.



- Water security (better quality water for stock)
- Habitat
- Soil stabilisation (reduce erosion, increase ground cover)
- Food (high diversity of species, even utilisation)
- Water quality (less sediment and nutrient input)
- Carbon storage
- Social and cultural (economic benefit)
- Integrated pest management
- Poor water quality
- Decline in pasture condition
- Weeds
- Reduced habitat value and biodiversity
- Soil erosion
- Loss of social and cultural values

Figure 15 Diagram showing good vs poor management of stock access and grazing. Refer to pages 6–7 and 10–11 for a more detailed description of the symbols.

Livestock health and production benefits of managed access

Managing access to coastal wetlands can benefit stock health and production, through:

1. better drinking water
2. increased feed and
3. reduced risk of injury and disease.

1. Better drinking water

Reducing the length of time livestock spend in and around wetlands significantly cuts down the amount of dung and urine entering wetlands.

High nutrient levels can cause blue-green algae blooms which can be toxic to stock and other animals, causing diarrhoea, laboured breathing and even death. Bacterial infections and disease can also be transmitted via water contaminated with dung. Better quality drinking water can lead to increased weight gains and milk production.

Managing stock access to wetlands reduces the risk of water contamination and leads to better quality water for off-stream watering points and a healthier habitat for fish and other aquatic fauna.

Did you know?

Studies (Journeaux 2005) have shown that cattle are 5 times more likely to defecate in wetlands than surrounding paddocks and the concentration of sediment, nitrogen and *E. Coli* bacteria have been shown to be 20 to 30 times higher downstream of stock access sites than upstream.

2. Increased feed

Managing wetland areas as a separate paddock allows for utilisation of the wetland pastures as a drought or dry season resource. Fencing wetland areas as discrete paddocks and grazing smaller wetland paddocks for short periods (rotational grazing) reduces overgrazing of 'sweeter' wetland pastures, allows wetland plants to recover from grazing and promotes evenness of grazing pressure in adjoining terrestrial pastures.

Having discrete wetland paddocks also enables specific management to be undertaken, such as targeted grazing of exotic pastures to reduce biomass and promote plant diversity.

Did you know?

Research (Petty and Poppi 2008) indicates that cattle grazing in muddy paddocks have a lower live weight gain and spend less time grazing than those in dry paddocks.

3. Reduced risk of injury or disease

Minimising the length of time livestock are in contact with water can reduce the risk of water borne diseases or parasites and injury from livestock bogging, falling down creek banks, drowning or being taken by crocodiles.

Leptospirosis	A disease of cattle and pigs that can be spread through water, especially when pigs use the wetlands.
Liverfluke	A parasite mainly found in high rainfall areas in southern Queensland, which requires an intermediate host snail and moist pastures to transmit to stock. It causes jaundice, anaemia and sometimes death.
Bovine ephemeral fever	Otherwise known as 3 day sickness. Can be spread by biting insects and lead to decreased herd fertility and production losses.
Clostridal bacterial infections	Can be spread through effluent contamination, causing Blackleg, Botulism or Blacks disease.
Worms	More common and persist for longer in moist pastures.
Mastitis	A bacterial infection which is more common in cattle which have access to wetlands and where teat ends are exposed to bacterial contamination.
Listeriosis	A bacteria found in soil and water and areas contaminated with infected faecal material.
Melioidosis	A bacteria which can survive in muddy water for up to 7 months.

How should stock access and grazing be managed?

The timing of grazing, stock access and stocking rate can be easily controlled by graziers to manage coastal wetlands for both production and wetland health (figure 16).

Figure 16 Grazing management of this wetland area is maintaining wetland ecosystems services and good ground cover in the frontage country. Source: DERM

'We use rotational grazing to manage our wetland and other pastures. When we first started rotational grazing (14 years ago) the pastures had a noticeable weed presence. Now since the rotational grazing the pastures are much more productive with very few weeds. We don't run any more stock but we run more kilograms, we are getting 80% weaner rates with the cows and consistently turning off bullocks at Jap Ox weights.'

Dugall McDougall, Station Manager, Tedlands Station

Timing of grazing

Grazing of coastal wetlands can be timed to allow for both utilisation of wetland pastures and maintaining natural wetland processes, such as plant recruitment (figure 17).

Here's a tip:

The condition of the coastal wetland and specific management objectives need to be considered when managing stock access and grazing. Different grazing management approaches are required to achieve specific objectives, for example:

- **maintaining the condition of a near-pristine wetland (e.g. frequent spelling and low stocking rate)**
- **restoring wetland ecosystem services in an exotic pasture grass-dominated wetland (e.g. higher stocking rate during the late dry season, maintain low stocking throughout the wet season)**
- **rehabilitating wetland vegetation in a degraded wetland (e.g. periods of grazing and spelling aimed at reducing fuel load whilst minimising grazing/trampling of young plants).**

Wet season: Jan–Apr

Allow recruitment and growth of native wetland vegetation, by managing grazing when wetland plants are flowering, seeding and germinating or after fire and floods, especially in wetlands where spelling is required for regeneration.

Minimise disturbance to breeding or nesting wildlife, such as birds and frogs.

Reduce soil compaction and pugging, especially when wetlands are flooded by rain water or high tides.

Dry season: May–Sep

Controlled grazing to make use of the wetland pastures in a manner which does not damage the health of the wetland (i.e. avoid excessive compaction of the soils, overgrazing, pugging etc.).

Reduce fire fuel loads through strategic grazing.

Reduce biomass and dominance of exotic pasture grasses in wetlands through strategic grazing (refer to Managing weeds in coastal wetlands).

Allow time for regeneration in between grazing. Rotational or flexible grazing of wetlands is preferable to set stocking rates over long time frames.

Late dry season: Oct–Dec

Closely monitor and manage grazing to minimise the risk to wetlands.

Remaining waterholes should be managed carefully through controlled grazing or spelling to avoid degradation to water quality and provide a refuge for fish and wildlife

Be aware of the risk to stock from early storms and floods..

Figure 17 Grazing management considerations in different seasons. This will depend on regional differences and management objectives.

Wet Season: Coastal wetlands in Queensland fill with water during the wet season, generally from January to April. This is when many plants flower, seed and germinate and is a period of high use by wildlife, including birds, fish, frogs and insects. Wetland soils are often saturated by either floodwaters or the king tides which occur during late summer and autumn (figures 18 and 19).

Wetland and pasture plants are generally most digestible and at their most vulnerable to grazing at the start of their annual growth cycle (Phase 1, figure 22). Spelling for a minimum of 6-8 weeks after the first significant rain of the wet season is recommended for pasture condition and productivity. Spelling of 12 weeks or the whole wet season may be required in some coastal wetlands to meet wetland management objectives or for stock safety and health where flooding occurs. This is best achieved through active stock removal from wetland paddocks. Although in some cases, spelling may not achieve desired management objectives (i.e. weed control) or is not necessary where wetland inundation prevents stock access.

Figure 18 Wetland in the wet season. Source: DERM

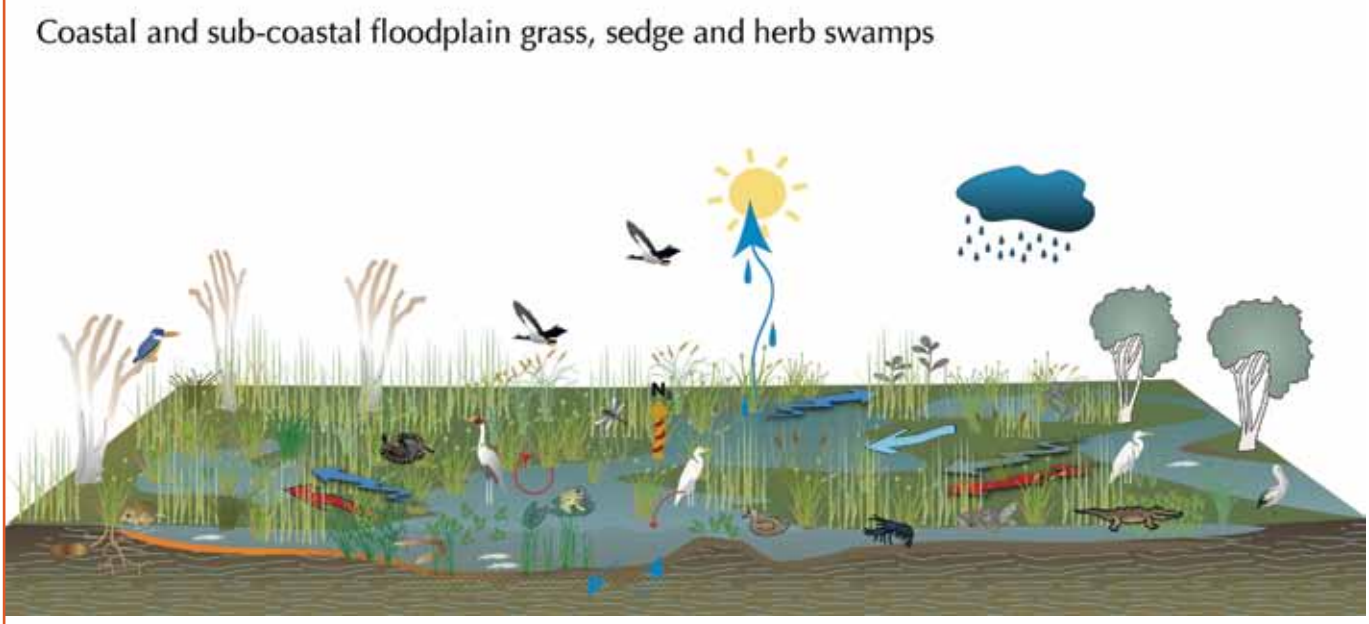


Figure 19 Illustration of wetland processes in coastal and subcoastal grass, sedge and herb swamps during wet phases. Source: Wetland*Info*, DERM

Dry Season: Many wetland grasses and sedges are dormant or die back to below ground tubers, rhizomes or corms during the dry season. This often coincides with the drying out of wetland soils. This is a time when native grasses have stopped growing and have entered a dormant phase of limited growth and reduced palatability and digestibility (exotic pastures such as olive hymenachne can be more palatable at this point). Native wetland plants are also less likely to be damaged by grazing during this phase (figures 20 and 21).

In seasonally dry climatic regions, such as the Fitzroy, Burdekin, Cape York and Gulf of Carpentaria catchments, wetlands may dry out completely, providing an opportunity for managed grazing for dry season fodder, fuel load reduction or weed control. Grazing must be carefully monitored and controlled during the dry season, especially around any remaining water holes at the end of the dry season, as these form a refuge for wildlife and many wetland animals depend on the remaining water to see them through to the next wetting event.

Figure 20 Wetland in the dry season. Source: DERM

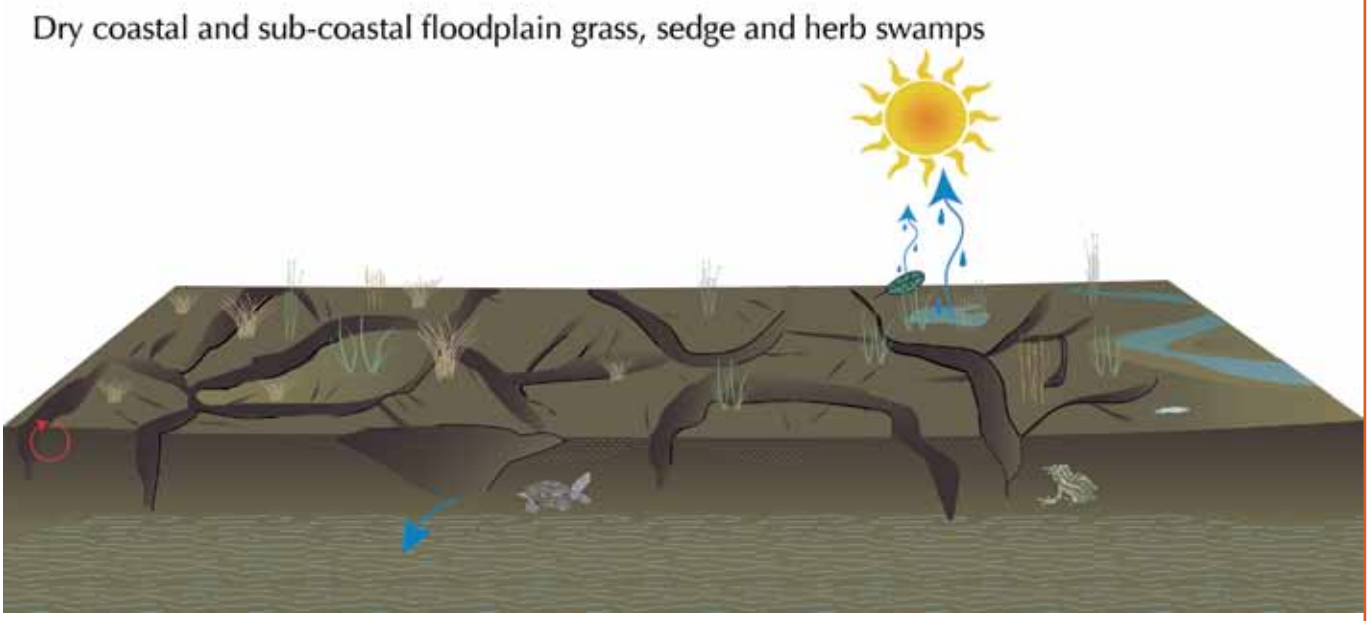
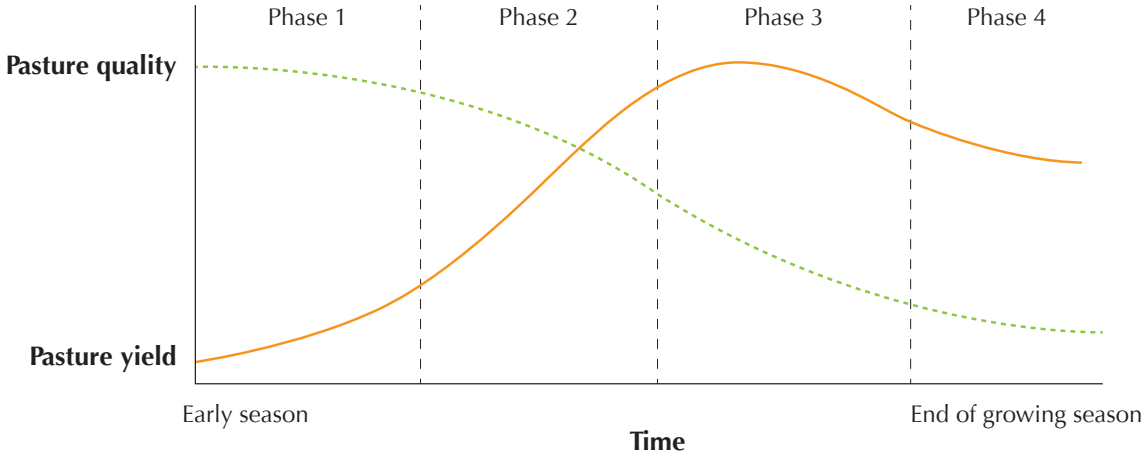


Figure 21 Illustration of wetland processes in coastal and subcoastal grass, sedge and herb swamps during dry phases. Source: Wetland*Info*, DERM



Phase 1 pastures have high quality but low yield and are most susceptible to grazing pressure
Phase 2 pastures have a high growth rate, good quality and increasing yield with moderate sensitivity to grazing pressure
Phase 3 pastures are flowering or seeding and have lower forage quality, maximum yield and less sensitivity to grazing pressure
Phase 4 pastures are dormant with little or no growth, low forage quality and low sensitivity to grazing

Figure 22 Phases of pasture growth. Source: Grazing Land Management (Meat and Livestock Australia, DEEDI and NT Department of Resources).

'Since purchasing the property we have been progressively fencing off sections of the creek (a tributary of the Mary River) and replanting native trees and shrubs with the help of Barung Landcare and as funding assistance became available. The fencing along the creek and in the paddocks has meant that we can better manage our stock and pastures as well as improve the health of the creek, with the aim of reducing bank erosion, landslip and providing shelter. This was highlighted during the recent flooding when this year there was no damage to the creek environs. It is now easier to muster and move stock between paddocks and because we regularly rest the paddocks we have noticed an improvement in our pastures throughout the property.

The fencing allows us to put cattle into the riparian area for short periods of time over winter to keep the weeds down and utilise the good pastures along the creek, as this area has some of the better soils on the property and the grass keeps growing for longer. Since the fencing and revegetation, the trees are helping to stabilise the steep banks and there are a lot more birds, frogs and wildlife using the creek.'

David Clark 'Latoona', Bellthorpe

Figure 23 Photographs of riparian land on Latoona in 1959 (left) showing landslips and in 2010 (right) showing the revegetation and stabilisation of the riparian land. Source: David Clark

Controlling stock access

Controlling stock access to coastal wetlands allows for managed grazing of wetland grasses, better drinking water for stock and minimises stock disruption of natural wetland processes. Stock access to wetlands may also need to be controlled to achieve specific management objectives such as post-fire pasture regrowth, recruitment or regeneration of riparian vegetation and weed control.

Stock access and grazing can be controlled in a variety of ways, which can be used in isolation or combination depending on individual circumstances and management requirements (figure 24). Options for managing stock access and grazing include:

① Fencing off coastal wetlands from surrounding paddocks. Fences should be located above the seasonal high water level or the high bank and on the landward side of riparian vegetation, to allow for seasonal variations in water level and minimise flood damage. Fences should be constructed on flat land or ridge lines on non-erosive soils and be designed to avoid wildlife entanglement (i.e. plain wire on the top). Electric fences, that can be removed before wet season floods are an option for flood prone areas.

② Fencing broad paddocks that contain wetlands and frontage country, so the wetland and frontage country can be managed as a unique land type.

③ Timing rotational or flexible grazing regimes based on factors including wetland condition, water quality, water inundation, pasture yield and pasture species.

④ Installing off-stream watering points to attract stock away from wetlands, as livestock will preferentially drink from troughs. These should be located on flat ground at least 200 m from wetlands if solely used to control stock access to wetlands or 100 m from wetlands if the wetlands are fenced (as a buffer between the watering point and wetland).

⑤ Creating cattle camps (i.e. an area with trees and shade) on flat ground at least 100 m away from wetlands, to encourage livestock to loaf in camps instead of wetlands.

⑥ Providing supplements/licks away from wetlands to encourage stock away from wetland areas.

⑦ Encouraging stock crossings and access points away from wetlands where possible. If crossings or access points are required these should be defined crossings located in a stable part of the wetland, with fencing and rock or gravel laid at bed level to reduce pugging and sediment disturbance and maintain fish passage.

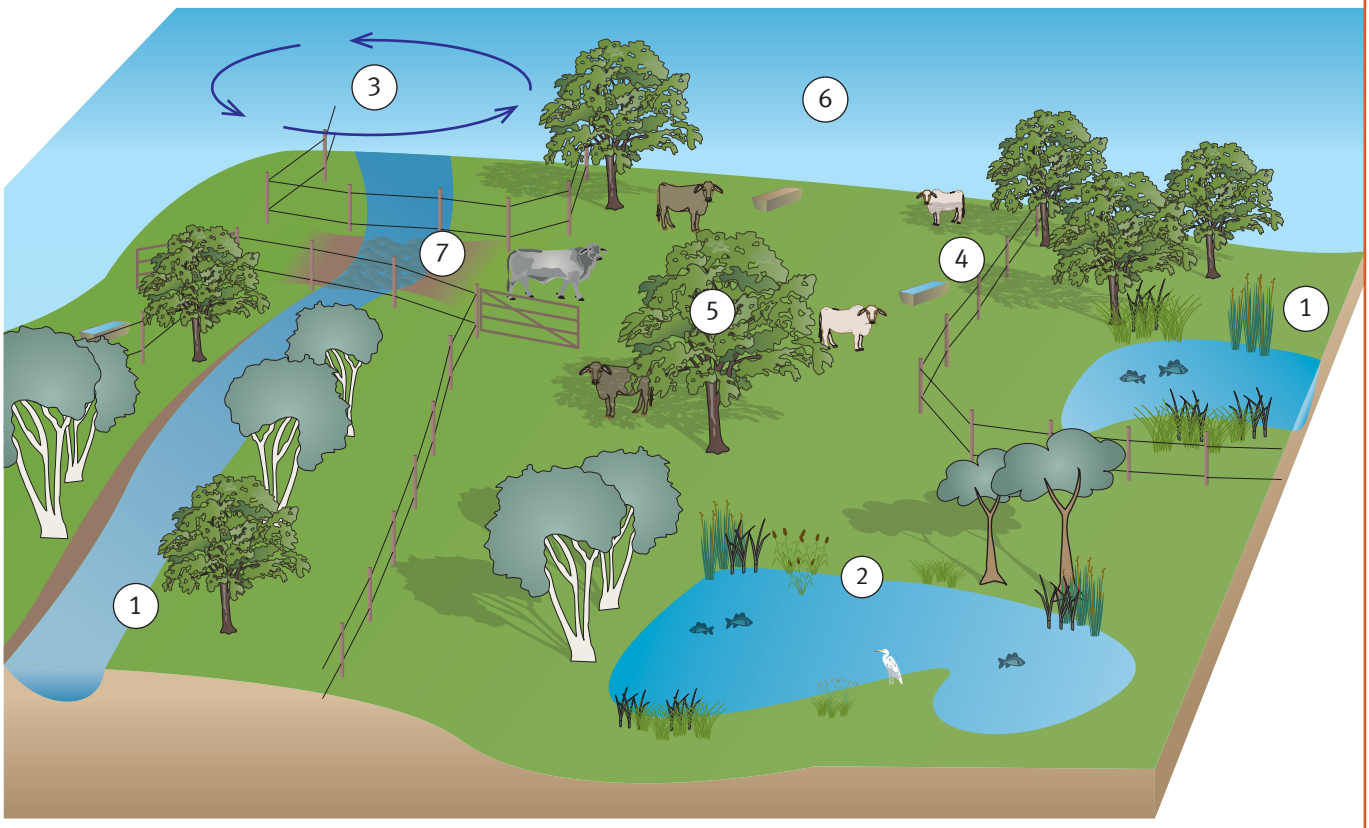


Figure 24 Options for managing stock access and grazing in coastal wetlands.

Buffers to wetlands

Buffers of vegetation along the edges of wetlands are highly fertile and productive areas for both agricultural production and native plants and animals. Well managed buffers provide numerous benefits including:

- **slowing water flows and promoting water infiltration**
- **capturing sediments and nutrients in run-off**
- **stabilising banks and preventing erosion**
- **providing habitat and shade for wetlands**
- **protecting production areas from erosion and flooding.**

Buffers are made up of a diversity of plants, depending on the wetland type, climate and previous land management (i.e. clearing or development). Different types of plants vary in their buffer functions as shown in the table below.

Buffer function	Effectiveness of vegetation type			Recommended buffer width
	Grass	Shrub	Tree	
Stabilise banks	Low	High	High	10–50 m
Filter sediment	High	Low	Low-medium	10–30 m
Filter nutrients & chemicals:				10–30 m
– sediment bound	High	Low	Low	
– soluble	Medium	Low	Medium	
Aquatic habitat	Low	Medium	High	30–500 m
Flood mitigation	Low	Medium	High	20–150 m

Source: Layden, I. (2009)

To be most effective at trapping sediment, grass buffers should consist of dense, spreading (not tussock) grass at a height of 10-20 cm. Grazing in buffer areas should be carefully managed to maintain good grass cover and a fringe of native riparian vegetation.

Further information on buffers can be found in the *Queensland Wetlands Buffer Planning Guidelines* <http://www.derm.qld.gov.au/wetlandinfo/site/ManagementTools/Guidelines/bufferguidelines.html> and *Fisheries Guidelines for Fish Habitat Buffer Zones* <www.deedi.qld.gov.au>.

Did you know?

Vegetation in and around wetlands is protected with restrictions on clearing or disturbance. Refer to the Legislation Toolbox for details <http://www.derm.qld.gov.au/wetlandinfo/site/PPL/WPLST.html>

Stocking rates and grazing pressure

Stocking rates influence pasture composition, pasture growth and recovery, long-term pasture production and stock performance. Graziers can control stocking rates to manage terrestrial as well as wetland pastures for sustainable production and ecosystem services. Grazing pressure is more difficult to manage as stock will preferentially graze certain pastures. This is where spelling, strategic use of fire, fencing and watering points can be used to even out grazing pressure.

Different plants have different responses to grazing and these can vary depending on the season. Many exotic pasture grasses and native terrestrial pasture species are adapted to a moderate level of grazing. Most native wetland grasses on the other hand can only tolerate light grazing, or moderate grazing for short periods of time with frequent spelling.

Set stocking at moderate to high rates will often lead to high grazing pressure on 'sweeter' wetland grasses, causing a decline in preferred wetland species and replacement with less desirable species or weeds. Set stocking at low stocking densities can work where wetland flooding and vegetation condition triggers stock movement, providing plants with a rest from grazing pressure.

Did you know?

Studies in other states (Jansen and Healey 2003, Silla 2005) have shown that frog and aquatic invertebrate communities are retained under low grazing intensities provided the condition of the wetland and associated riparian vegetation is maintained.

Under high grazing intensity and where wetland vegetation is lost and wetland condition is degraded the diversity of aquatic animals is significantly less.

Conservative stocking rates and flexible or rotational grazing, where stock are moved regularly in response to season and wetland condition, is preferable to minimise disturbance of wetland habitats and provide regular opportunities for pasture and wetland recovery. Regular monitoring of the wetland and pasture condition during grazing needs to be undertaken to enable adjustments to stocking rate or movement of stock to maintain wetland ecosystem services.

Here's a tip:

Cattle, sheep, goats and horses have different grazing and browsing habits. These need to be taken into account when managing grazing in coastal wetlands:

- **Horses are more selective grazers with a preference for exotic pastures, although where these are limited they have been observed grazing wetland sedges (figure 25).**
- **Cattle are less selective and may eat recruiting trees and shrubs.**
- **Goats have a very broad diet.**

These preferential grazing habits can influence wetland plant communities and should be considered when managing grazing in wetlands.

Figure 25 A horse has cropped the sedges in this wetland (see inset). Source: DERM

Stocking rates should be flexible to promote:

- retaining natural ground cover levels in the wetland (natural ground cover levels will vary between different wetlands)
- seasonal and inter-annual variations in pasture composition and production
- flowering, seeding and establishment of wetland plants, including trees in coastal tree swamps and coastal riverine wetlands
- a diversity of wetland plant species
- maintaining the entire wetland environment in good condition, including vegetation communities and water quality.

Stocking rates should be conservative to allow for a margin of error in case of drought or other climatic anomalies and take into consideration other grazers, such as native and feral animals, to calculate the total grazing pressure.

Here's a tip:

Smaller stock (e.g. weaners) can be grazed in wetlands instead of larger stock to reduce impacts on wetland soils and plants and promote faster stock growth.

Designing property infrastructure

Fences, off-stream watering points, cattle camps, stock crossings and tracks concentrate stock activity and are often susceptible to erosion (figure 26).

Figure 26 Stock crossings can lead to erosion

Location of this infrastructure needs to take into account soils, topography, water flows and vegetation and adequate buffers to wetlands should be provided, to minimise soil loss and run-off to wetlands.

Location and design considerations for this infrastructure are covered in Department of Environment and Resource Management fact sheets:

- **managing stock in and around waterways**
- **erosion control on fences and fire breaks**
- **erosion control on property roads and tracks – managing run-off**
- **erosion control on property roads and tracks – cross-sections and locations.**

These can be found at <www.derm.qld.gov.au> or call 137 468.

Approvals and restrictions may apply to building infrastructure. See the Legislation Toolbox <http://www.derm.qld.gov.au/wetlandinfo/site/PPL/WPLST.html>.

Road and stock crossings need to be designed and built to provide fish passage. The document *Fish Passage in Streams: Fisheries Guidelines for the design of stream crossings* (www.deedi.qld.gov.au) outlines how crossings can be designed and managed.

Want to know more?

For more information on managing stock access and grazing see:

Coughlin, T. et al. (2008) *Managing for water quality within grazing lands of the Burdekin Catchment*. Burdekin Dry Tropics NRM. (www.nqdrytropics.com.au)

Peck, G. (2006) *Property planning: Sustainable grazing on riparian lands – why and how to do it*. Fitzroy Basin Association. (www.fba.org.au/publication/factsheets/index.html)

Staton, J. and O'Sullivan, J. (2006) *Stock and Waterways: a manager's guide*. Land and Water Australia. (www.lwa.gov.au/products/pr061132)

For advice:

DEEDI grazing extension officers. Contact 13 25 23 or <www.deedi.qld.gov.au>

Your local regional NRM body <www.regionalnrm.qld.gov.au/my_region/index.html>

1.6 Managing water in coastal wetlands

Coastal wetlands provide an important source of water for grazing systems. Wetlands retain water in the landscape recharging groundwater supplies, supporting pasture growth and providing drinking water for stock (direct from wetlands or pumped from wetlands or bores). Well managed use of water resources in coastal wetlands is vital to maintain grazing system production and wetland ecosystem services (figure 27).

Figure 27 Diagram showing good vs poor water management. Refer to pages 6–7 and 10–11 for a more detailed description of the symbols.

Access to water influences stock grazing and movement, with increased grazing, soil compaction, erosion and pugging occurring around water sources. Strategic management of water sources can be used to help:

- manage grazing pressure
- even out pasture utilisation
- manage stock access to wetlands.

The following should be taken into account when managing water resources:

- wetland water quality can vary depending on wetland type, season, water flows, upstream and adjoining land uses, aquatic weeds and use by stock or other animals
- wetlands rely on natural water regimes, including flooding and seasonal draw-down
- many wetlands are naturally shallow and vegetated therefore 'desilting' and removal of wetland plants to achieve more open, lake-like or permanent wetlands will alter these wetlands unique ecosystem values and services
- infrastructure such as causeways, pipes, culverts and floodgates alter water flows, affecting the natural water regime and habitat for fish and other aquatic animals
- pumping water from wetlands for off-stream watering points or irrigation needs to be monitored and managed to ensure that it does not impact on natural wetland water levels
- use of wetland water for stock should be managed to provide for the range of other uses for the water, such as the requirements of fish and native wildlife, domestic household uses and downstream users.

Did you know?

Restrictions and approvals may apply to diverting water flows into or away from wetlands, converting wetlands to water storages, deepening or draining wetlands as these works negatively impact coastal wetlands. See the Legislation Toolbox <http://www.derm.qld.gov.au/wetlandinfo/site/PPL/WPLST.html>.

Did you know?

Any structures built in or around wetlands can impact on wetlands. New ponded pastures (earth banks built to hold water to grow fodder) are not to be developed in or near natural wetlands due to their interference with water flow. The Ponded Pasture Policy (www.derm.qld.gov.au) states that ponded pastures should only be located in areas that are not:

- **tidal areas below Highest Astronomical Tide (HAT)**
- **in or adjacent to natural wetlands**
- **of high conservation or fish habitat values.**

Fisheries Guidelines for Managing Ponded Pastures (www.deedi.qld.gov.au) recommends ways to manage ponded pastures to avoid or minimise impacts on the movement and survival of native fish.

Did you know?

Natural water regimes are not only important for the plants we can see, it is also vital for communities of micro-organisms which live on the soil surface. Communities of cyanobacteria and liverworts growing on the soil uptake carbon and fix nitrogen which supports pasture growth and productivity (Williams 2010).

Microalgae, which grow on sediments in estuarine wetlands, have an important role as one of the major primary producers that support estuarine food webs.

Off-stream watering points

Off-stream watering points, such as pipe and trough systems, provide many benefits to production and wetland health:

- grazing is not dependent on the availability of and access to wetlands
- stock don't rely on accessing wetlands for water, thereby reducing soil compaction, erosion and trampling of wetland plants
- stock spend less time in and around wetlands, reducing the amount of urine and dung which enters wetlands leading to better water quality (figure 28)
- cleaner drinking water for stock improves metabolism and feed intake which can lead to greater weight gains
- ability to manage pastures and grazing pressure is increased
- better water quality for native plants and animals and downstream environments and cleaner water for other users
- reduced risk of stock loss and health problems through bogging, falling down steep banks and water borne disease.

Figure 28 Cattle accessing a wetland for water – note the high sediment and nutrient (apparent algal growth) levels in the water. This dirty water could affect stock health. Source: DERM

Did you know?

Research in Canada by Willms (2002) has shown that animals gained up to 23% more weight drinking clean water compared to dam water.

Cattle with better quality drinking water spent more time grazing and less time resting than cattle drinking dam water.

'We had thought about fencing off the whole river boundary, but with regular flooding of the Russell River, large sections would be constantly washed away. We installed a water trough and found that our stock would walk up to 800 metres to drink from the trough rather than from the river.

We have since installed some fencing in the less flood prone areas and an extra trough for better herd management. Their access to the river has been greatly reduced, which is safer for them (avoid crocodiles) and better for the river.'

Mick Kruckow, Roper Glen, Mirriwinni.

Did you know?

A study by Godwin and Miner (1996) showed that when provided with an off-stream watering point cows spent 75% less time in the creek.

Want to know more?

For more information on managing water:

Peck, G. (2006) *Property planning: Using off-stream watering points*. Fitzroy Basin Association. (www.fba.org.au)

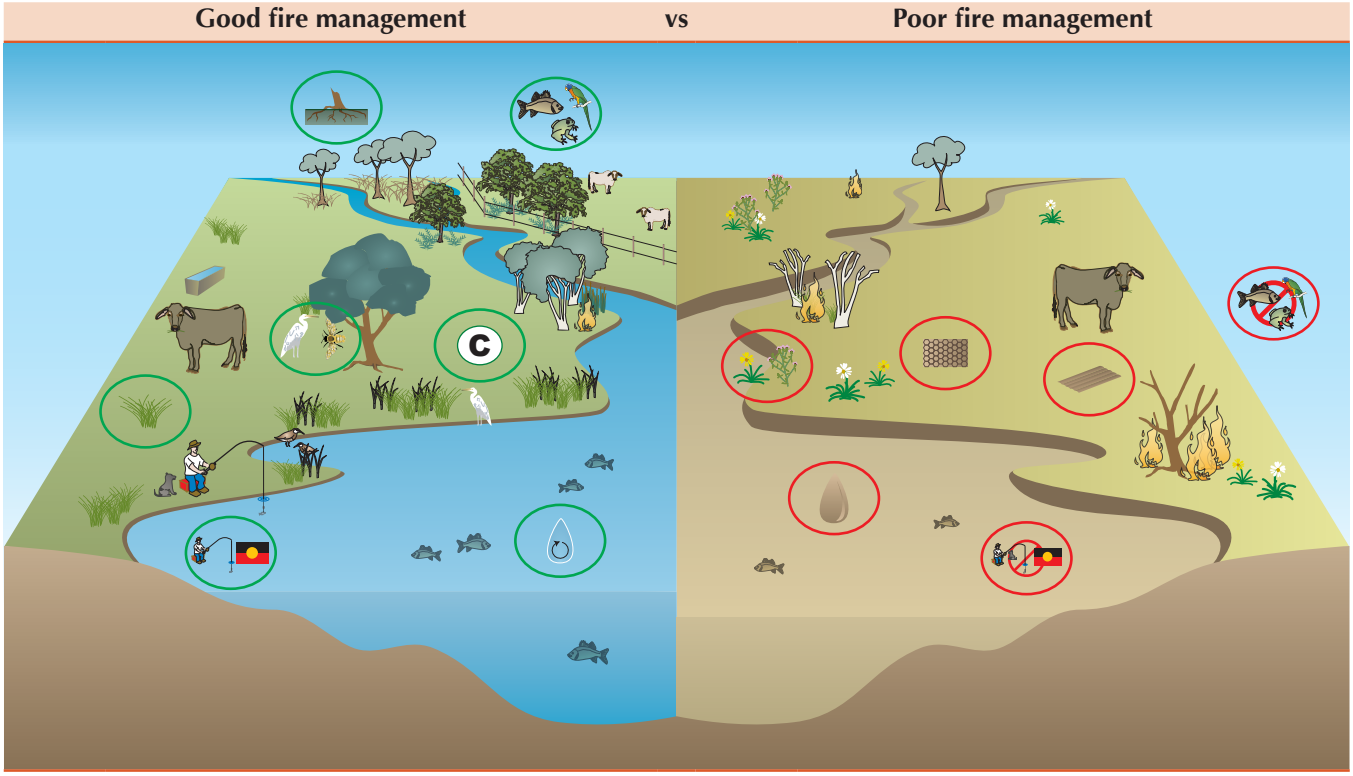
Staton, J. and O'Sullivan, J. (2006) *Stock and Waterways: a manager's guide*. Land and Water Australia. (www.lwa.gov.au/products/pr061132)

For advice:

Department of Environment and Resource Management, contact 13 74 68

1.7 Managing fire in coastal wetlands

Fire is commonly used as a management tool in grazing land management to promote new growth, influence pasture species composition, minimise patch grazing, reduce fuel loads and control weeds. Depending on how it is managed fire can be advantageous or detrimental to coastal wetlands. Fire in coastal wetlands should be designed to mimic natural or Traditional burning frequency and intensity and as such fire management will vary depending on the climatic region, landscape and wetland type. The effect of fire depends on wetland type and condition, surrounding land types, water regime, season and the frequency and intensity of the fire. Figure 29 shows the impact of good versus poor fire management on coastal wetlands.



Habitat (some plants need fire, control weeds, promotes diversity)

Food (stimulate new growth, seeding and germination)

Water quality (nutrient cycling)

Carbon storage

Social and cultural (manage weeds)

Integrated pest management

Stabilising soil

Decline in pasture condition (weeds, less desirable pastures, degradation or loss of organic-rich wetland (peat) soils)

Poor water quality (weed invasion, scorched ground leading to erosion and run-off, algal blooms)

Soil erosion

Weeds (exposed ground prone to weed invasion)

Reduced habitat value and biodiversity (destroy habitat, kill wetland plants and change vegetation community)

Loss of social and cultural values

Figure 29 Diagram showing good vs poor fire management. Refer to pages 6–7 and 10–11 for a more detailed description of the symbols.

Managing fire in coastal wetlands requires careful planning, timing and control to achieve the desired objectives and minimise impacts on wetland biodiversity and ecological functionality.

Planning for fire

Where coastal wetlands form part of a grazing property they should be considered in a property-wide fire management plan. Fire in coastal wetlands must be managed differently to surrounding land types as wetland soils and plants require different fire regimes to terrestrial environments. Wetlands should be considered when planning for fire in adjoining land types as uncontrolled fires can damage wetlands.

Planning for fire in coastal wetlands involves the following steps:

Did you know?

Restrictions may apply to the use of fire. Contact your local government or rural fire service for information on fire bans or other constraints to burning.

Restrictions and approvals may apply to burning native vegetation, including marine plants. Refer to the Legislation Toolbox for details <http://www.derm.qld.gov.au/wetlandinfo/site/PPL/WPLST.html>.

1. Identify and understand the ecology of the wetland, including soils, plants, wetland pastures, animals and water regime in different seasons and their response to fire.
2. Determine whether fire should or shouldn't be used as a management tool for the particular wetland (fire is not a natural occurrence in some coastal wetlands, such as estuarine wetlands, wetlands with fire sensitive plants or wetlands in very wet regions, such as Palm Swamps in Far North Queensland).
3. Set clear management objectives for the wetland, such as weed control, fuel load reduction or maintaining biodiversity.
4. Assess the range of management options and determine whether a burn is the most suitable option for the wetland, for example fire fuel load reduction might be better achieved through grazing or a combination of grazing and burning.
5. Speak to local and state government authorities or regional NRM groups to determine the most suitable management strategy.
6. Identify the natural fire regime and mimic this for the region, property and wetland type.
7. Determine the time of year, target wetland area and frequency of fire to achieve objectives whilst minimising impacts on wetlands.
8. Identify and prepare a map of the wetland and surrounding areas, highlighting property boundaries, fire breaks, fire sensitive plants, key wildlife breeding or nesting areas or other sensitive areas to avoid (e.g. fallen logs, branches and hollows which provide important habitat and nutrients).
9. Prepare for the fire, by locating or maintaining fire breaks and access tracks and obtaining any necessary approvals.

Figure 30 Fire can be used as a management tool where fire is a natural occurrence such as in the seasonal dry tropics

Timing of fire

If fire is determined to be a suitable management tool for the coastal wetland, correct timing of the fire is vital to achieve the objectives of the fire management and minimise damage and disruption to the wetland environment and wildlife. Timing of the fire should aim to promote cool, mosaic or patchy burns in wetlands and minimise the risk of high intensity 'hot' fires, by not burning during the middle of a hot day and complementing stock grazing, e.g. coordinate stock grazing to reduce fuel loads before a burn.

Did you know?

Research by Grice et. al. at the Townsville Town Common has shown that mid to late dry season burns, especially when followed by deep (>30 cm) inundation, reduced the abundance of para grass in the wetlands and promoted a diversity of native wetland grasses and sedges.

Trials in the lower Burdekin (Tait 2010) showed that late dry season fires (undertaken where there was minimal risk to native vegetation) produced death rates of up to 80% in para grass stands. Grazing after the burn minimised recolonisation of para grass and supported native plant recruitment.

Controlled burns should be timed to:

- avoid critical wildlife breeding, nesting and feeding periods
- avoid wetland plant flowering, seeding and germination
- avoid burning the peat layer of the wetland, by ensuring wetland soils are wet
- achieve the desired objectives of the fire management, e.g. fuel load reduction, weed control
- mimic the time of year and frequency fire would naturally have occurred in the wetland or reinstate the traditional fire management practices of local Indigenous people
- consider local climatic conditions, for example in the lower Burdekin catchment, early dry season burns can be undertaken in small sections of wetlands as they dry out. This would not be possible in wetter catchments
- minimise the amount of bare ground just prior to the wet season.

Did you know?

Traditional burning regimes have been returned to Kakadu's floodplain wetlands to control native Hymenachne (*Hymenachne acutigluma*). Repeated low intensity burns over November and December help keep the Hymenachne in check and promote a diversity of wetland plants (Davidson 2005).

Controlling fire

Fires should be controlled to avoid spreading beyond the target area or impacting on sensitive environments by:

- keeping fuel loads down by grazing down rank grass growth at the end of the growing season (March-May)
- avoiding burning on hot, windy days to reduce the risk of intense or uncontrolled wildfire
- burning only small areas at any one time, to allow wildlife to move and plants to re-establish in burnt areas
- maintaining fire breaks and access tracks
- controlling fire and fuel loads in wetland frontage country to avoid high intensity late dry season fires entering wetlands (figure 31)

- avoiding burning fire sensitive parts of wetlands or wetland types
- promoting cool, patchy/mosaic burns, but being aware of supporting selective grazing through mosaic burning. Grazing should be excluded from recently burnt areas to allow vegetation to regenerate.

Figure 31 Exotic pasture grasses can create large fuel loads which pose a threat of intense fires, in seasonally dry climatic regions

Want to know more?

For more information on managing fire see:

WetlandCare Australia (2008) *Wetland Rehabilitation Guidelines for the Great Barrier Reef Catchment*, <www.derm.qld.gov.au/wetlandinfo/site/ManagementTools/Guidelines>

Tropical Savannas CRC website: <www.savanna.cdu.edu.au>

North Australian Fire Information website: <www.firenorth.org.au>

For advice:

Your local fire warden, rural fire brigade or fire station. Contacts listed on <www.ruralfire.qld.gov.au>

1.8 Managing weeds in coastal wetlands

Most coastal wetlands in Queensland contain introduced plants, such as exotic pasture grasses and weeds, which thrive in the wet environment of wetlands. A weed is defined as a plant growing somewhere it is not wanted or is not desirable.

Exotic pasture grasses are used by graziers in terrestrial or ponded pastures and are valued for their production values. However in natural wetlands these grasses can proliferate, outcompeting native wetland plants and as such they are weeds in natural wetlands. As a result of their environmental, economic and social impacts many weeds are declared under national, state or local government legislation with associated prevention or management requirements. The impacts of weeds on wetland ecosystem services and the value of wetlands for stock production is shown in figure 32.

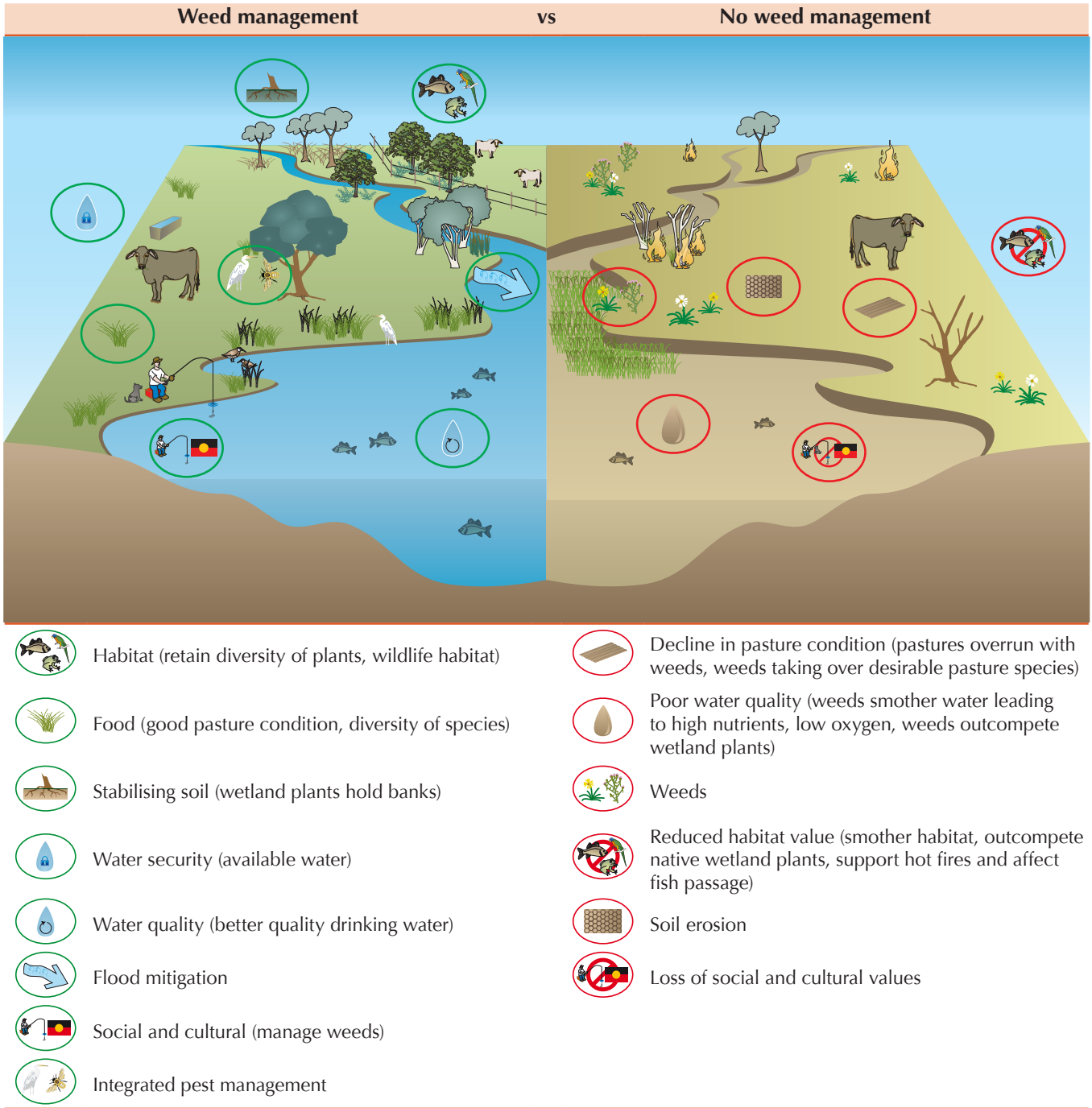


Figure 32 Diagram showing weed management vs no weed management. Refer to pages 6–7 and 10–11 for a more detailed description of the symbols.

Managing weeds in coastal wetlands can be challenging due to access constraints (soils too wet for machinery, dense vegetation), restriction in herbicides suitable for use in and around wetlands and the diversity of weeds requiring different control methods. The best approach to managing weeds in wetlands is to:

1. Prevent spread through good hygiene (wash downs, check hay or fodder, quarantine stock).
2. Monitor regularly and intervene early (weeds can be easily spread by stock, pigs or birds).
3. Work with neighbours and local government weed management officers to develop an integrated weed management strategy. This should have clear objectives, priorities, techniques and timeframes and should consider the impact of weed control on coastal wetlands and non-target plants.
4. Work in conjunction with neighbours and other stakeholders to implement the integrated weed management program.
5. Maintain or restore wetlands to their natural state (i.e. maintain natural vegetation communities and natural water regime and minimise nutrient inputs).

The four main groups of weeds in coastal wetlands include:

1. Floating aquatic weeds, such as water hyacinth, salvinia and water lettuce.
2. Submerged aquatic weeds such as cabomba.
3. Exotic pasture grasses, including olive hymenachne, para grass, guinea grass and aleman grass.
4. Riparian woody weeds, such as pond apple, rubbervine, groundsel, parkinsonia and lantana.

Did you know?

Salvinia, cabomba, olive hymenachne, parkinsonia, rubbervine and pond apple are Weeds of National Significance and declared pest plants under Queensland legislation. For more information on these weeds see <www.weeds.org.au> or <www.deedi.qld.gov.au>.

1. Floating aquatic weeds

These weeds multiple rapidly under favourable conditions of high sunlight and nutrients to smother the water surface of wetlands (figure 33). This can lead to:

- low dissolved oxygen levels and high nutrients in the water
- blocked water infrastructure
- restricted stock access to drinking water
- blue-green algae which can be harmful to stock
- reduced diversity and abundance of native wetland plants
- barriers to natural fish movement
- fish kills
- safety issues for recreational activities.

Figure 33 Salvinia can multiply rapidly to cover the surface of coastal wetlands

Control: An integrated control program, using a range of methods suited to the individual wetland and target weed. Mechanical removal of these weeds can be effective and allows the nutrients and organic matter within the weeds to be removed from the wetland system. The weeds should be disposed of at least 50 m from the wetland to avoid washing back into the wetland and can be spread to enrich pastures. Weed material must not be transported into new catchments. In some areas biological control is successful. In coastal riverine wetlands and coastal tree swamps, restoration of the tree canopy, to shade the aquatic weeds can assist in longer term control.

2. Submerged aquatic weeds

Growing underwater these weeds may go unnoticed until they have choked the wetland. They thrive in nutrient rich conditions in still or slow flowing wetlands. These weeds can:

- obstruct water flow
- block infrastructure (pipes, culverts etc.)
- outcompete native wetland plants
- degrade the habitat of fish and other aquatic animals
- interfere with recreational use of wetlands (boating, swimming and fishing).

Control: Due to their nature, submerged weeds are difficult to control. Physical removal is challenging and requires regular, on-going effort and there are no suitable herbicides registered for control of these weeds. Maintaining natural seasonal draw down or drying of wetlands, shading by wetland vegetation and reducing nutrient inputs into wetlands are the best options for controlling submerged weeds.

3. Exotic pasture grasses

A number of exotic pasture grasses have been introduced to improve the production of coastal grazing enterprises in Queensland. Ponded pasture species, including olive hymenachne, para grass and aleman grass were introduced to specially constructed bunded areas (called ponded pastures) throughout Queensland's coastal fringe, to provide dry season fodder reserves. Olive hymenachne was declared a Weed of National Significance (WONS) in 1999 for its impacts on natural environments, particularly wetlands (figure 34).

Exotic pasture grasses can have the following impacts on wetlands:

- readily outcompete native vegetation
- create large fuel loads and frequent intense fires which kill native wetland plants
- smother the water surface of wetlands, growing out across wetlands in water up to 2 m deep
- degrade water quality by reducing oxygen levels and increasing nutrient and organic matter loads
- remove habitat for birds, fish and other animals.

Figure 34 Olive hymenachne is affecting water flow and fish passage in this riverine wetland

Control: Once established these grasses are generally cost prohibitive to eliminate. Therefore management should focus on controlling their biomass so that the wetland can still function and support biodiversity. To achieve this involves an integrated program of managed grazing, mechanical removal, fire and herbicides suitable for use in watercourses. Fire and herbicide use needs to be carefully managed to avoid impacts on non-target plants and animals and advice should first be sought from local government weed management officers. Shading by restoring tree cover in coastal tree swamps and coastal riverine wetlands may assist in reducing exotic pasture grass dominance.

Exotic pasture grasses, particularly para grass, are grazed by cattle. Grazing can be used as a broad acre tool for reducing exotic pasture grasses in and around wetlands. Grazing will not eliminate the weed but can help to restore biodiversity and ecological functionality in the wetland.

Did you know?

Shading experiments, conducted by Bunn et al. (1998), simulating the shading effect of riparian vegetation on para grass growth resulted in a significant (50%) reduction in para grass biomass under 90% shade.

A reduction in the dominance of exotic pasture grasses, to maintain some native wetland plant diversity, can be achieved with a combination of control measures, including:

- heavy grazing of exotic pasture grasses late in the dry season to reduce the biomass and stem length
- controlled burn in the late dry season to reduce grass energy reserves
- subsequent water inundation during the wet season to drown the leaves
- maintained low stocking rate during the wet season to minimise reinfestation.

Exotic pasture grass control through grazing needs to be assessed on a case-by-case basis and carefully managed as it may not be suitable on erosion prone soils, steep banks and areas with grazing sensitive vegetation or wildlife.

Did you know?

Research and trials at Tedlands Station, south of Sarina (Adams, E.) have shown that late dry season grazing as wetland water levels draw down can be successful in reducing hymenachne biomass and dominance.

Figure 35 Olive hymenachne can completely dominate wetlands, outcompeting native wetland plants.

Want to know more?

For information on managing exotic pasture grasses through grazing in the seasonally dry tropics see:

Tait, J. (2010) *Guidelines for the use of grazing for management of exotic pasture weeds in wetland and riparian habitats*.

'Seasonal draw down in the wetlands is important to allow the cattle to access and graze the hymenachne as the water level drops. I've noticed it is not until early July onwards that the cattle will really chase the hymenachne and aleman grass, as the other pastures dry off and the ponded pastures are maybe more palatable at that time.

During the dry season the cattle will graze down the hymenachne and if there is wetland flooding which completely submerges the hymenachne it does not grow as quick.'

Dugall McDougall, Station Manager, Tedlands Station.

4. Riparian woody weeds

A variety of woody weeds thrive in the moist conditions associated with wetlands, including vines (rubber vine, cats claw creeper), trees (pond apple, parkinsonia) and shrubs (lantana, groundsel). These can multiply rapidly and outcompete wetland plants (figure 36).

Figure 36 Rubber vine can smother wetland trees

Control: The control method, or combination of methods used depends of the type of weed, weed characteristics, infestation and wetland condition. Possible management techniques include:

- mechanical removal and mulching
- herbicide
- fire
- biological control
- grazing (including browse grazing with camels).

In some cases, grazing can restrict the effectiveness of other control measures. For example in thick rubber vine infestations, grazing reduces the biomass of grass and affects the ability to use a fire effectively to control the rubber vine.

Did you know?

Coastal grazing properties may adjoin declared Fish Habitat Areas. A Code of Practice (FHACoP01) is in place for the management of weeds within declared Fish Habitat Areas.

See <www.deedi.qld.gov.au> for more information.

Want to know more?

For more information on weeds and weed management, see:

www.weeds.org.au
www.weeds.gov.au
www.deedi.qld.gov.au/4790_8331
WetlandCare (2008) *Wetland Rehabilitation Guidelines for the Great Barrier Reef Catchments*. (www.derm.qld.gov.au/wetlandinfo/site/ManagementTools/Guidelines)

For advice:

Local government weed management officers
Biosecurity Queensland (DEEDI). Ph: 13 25 23

1.9 Managing animal pests in coastal wetlands

Coastal wetlands not only provide habitat for a diversity of native animals, they can also support pest animals such as feral pigs, cane toads and pest fish. These pests can disrupt wetland ecological functions and biodiversity, as shown in figure 37.

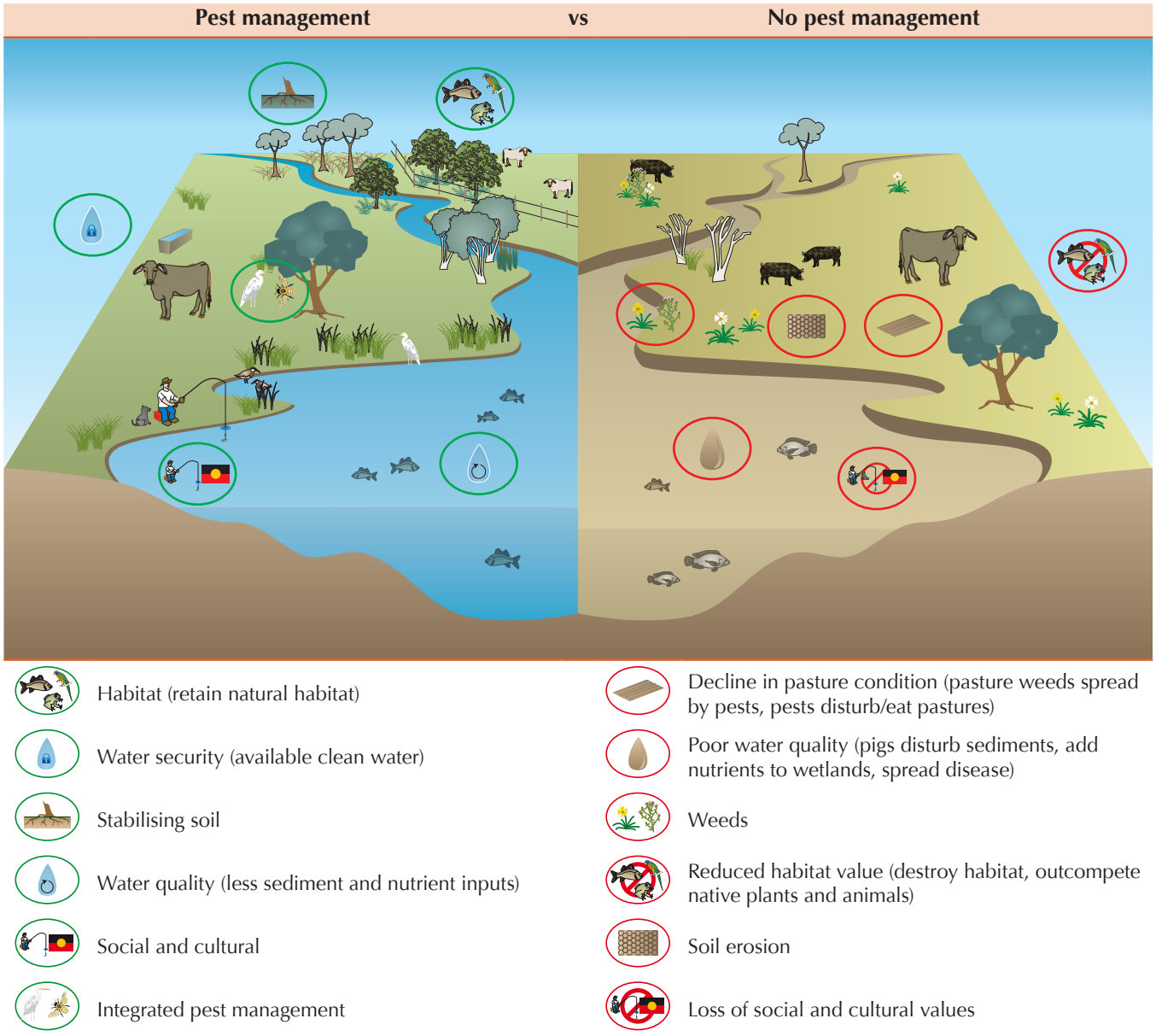


Figure 37 Diagram showing pest management vs no pest management. Refer to pages 6–7 and 10–11 for a more detailed description of the symbols.

Pest animals can be controlled through an integrated pest management strategy including management controls such as fencing, shooting, baiting and trapping. The strategy depends on the type of pest, pest numbers and wetland condition. Advice on control should be sought from local government pest management officers and implemented in conjunction with neighbouring land managers.

Want to know more?

For information on animal pest management see:

DEEDI website: www.deedi.qld.gov.au

Layden, I (2008) *Wetland Management Handbook: Farm Management Systems guidelines for managing wetlands in intensive agriculture*. (www.derm.qld.gov.au/wetlandinfo)

WetlandCare (2008) *Wetland Rehabilitation Guidelines for the Great Barrier Reef Catchments* (www.derm.qld.gov.au/wetlandinfo)

For advice:

Local government pest management officers

Biosecurity Queensland (DEEDI). Ph: 13 25 23

Figure 38 Damage caused by pigs is evidenced by the difference between a pig exclusion area (right) and adjacent area accessible by pigs (left). Source: DERM

1.10 Planning for coastal wetland management

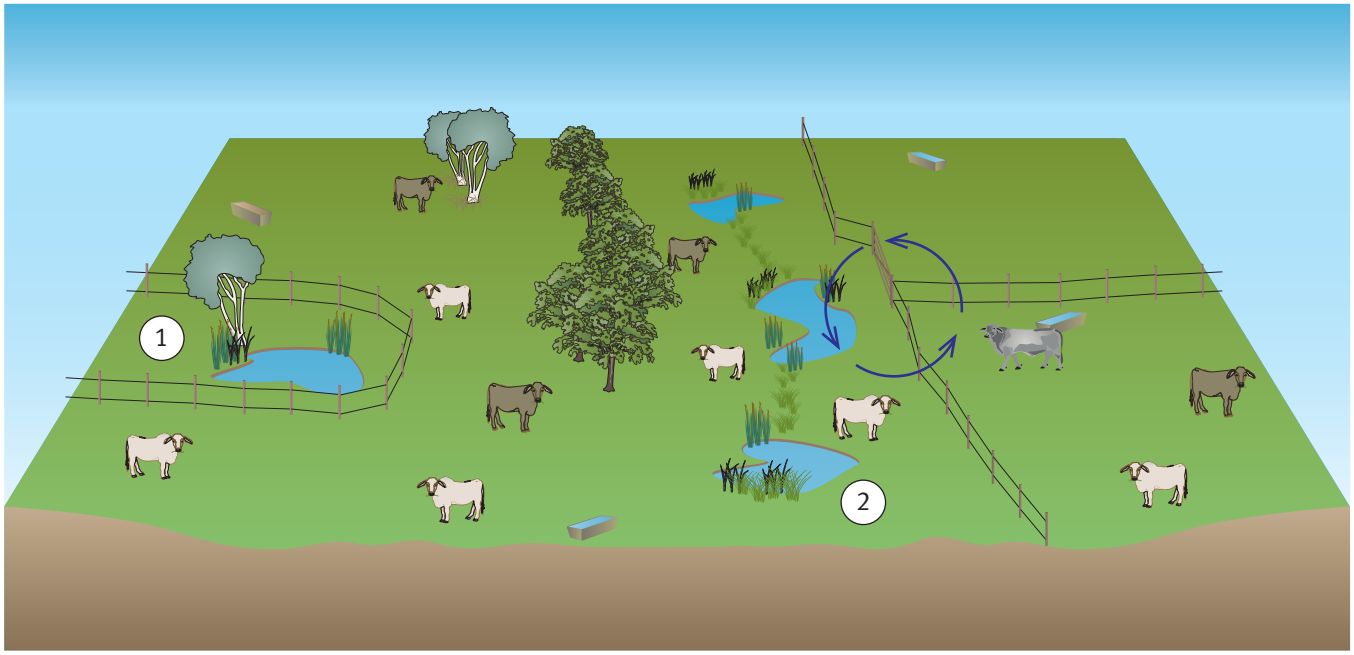
Planning is an important part of managing grazing enterprises, for sustainable production and profitability. Whole of property planning is a way to document property resources and management practices and identify areas for improvement. This planning can assist land managers to manage a property more sustainably and profitably and demonstrate the sustainable management of natural resources to regulators, markets or the community.

Grazing production relies on good land condition to support productive pastures, making land management planning a critical element to a successful grazing enterprise. Coastal wetlands form an important part of many grazing properties in Queensland and should be included in grazing land management planning.

As with grazing land management in general, a 'one size fits all' approach does not apply to wetland management. Planning allows land managers to identify features and values of the grazing environment and prioritise management actions accordingly. Figure 39 shows different alternatives to fencing wetlands depending on wetland size and management objectives.

Here's a tip:

The Edge*Network* Grazing Land Management workshops provide detailed information on land management, including planning. For more information see <www.deedi.qld.gov.au>.



① Fencing off a wetland by itself. Isolated wetland management, best for small wetland on grazing property. Specific weed and fire management.

② Fencing off whole paddocks containing large wetland and frontage country or multiple wetlands to manage separately from other paddocks. Weed and fire management coordinated with adjoining lands.

Figure 39 Diagram showing scenarios for managing coastal wetlands as part of a grazing property.

Planning grazing land and wetland management involves the following steps:

1. **Set clear objectives and property goals:**
   - identify the vision for the grazing enterprise and natural resource management goals for the property.

2. **Assess the property in its current state and evaluate resources available:**
   - obtain a base map for the property (aerial photograph or satellite image)
   - identify wetlands on the property based on existing knowledge and by using Wetland*Info* (www.derm.qld.gov.au/wetlandinfo)
   - identify different land and wetland types, paddocks, infrastructure (fences, watering points) and current management
   - assess the condition of wetlands and surrounding land and determine threats or degrading factors (weeds, erosion, death of wetland vegetation)
   - set objectives for each wetland or wetland type.

3. **Analyse available information and explore alternatives:**
   - review relevant legislation and regional, district and catchment plans (e.g. water use plans, local pest management plans, water quality management plans)
   - obtain advice from local government, regional NRM groups and DEEDI
   - identify different management options for wetlands and surrounding lands relevant to the region.

4. **Assess options through cost-benefit analysis, risk assessment and objectives:**
   - assess the costs and benefits of different management options to address threats
   - assess the ability of the different management options to achieve the objectives
   - assess the risks associated with different management options.

5. **Prioritise management options and create an action plan:**
   - prioritise management options based on feasibility, cost-effectiveness and ability to achieve objectives
   - list the management options in order of priority and allocate tasks, resources, responsible personnel and timeframes for implementation.

6. **Implement actions:**
   - implement management practices set out in the action plan. Note that management actions could be ongoing, such as weed control or spelling
   - record the actions implemented.

7. **Monitor, review and revise the plan:**
   - monitor the condition of wetlands and surrounding lands
   - review the effectiveness of the management and any problems or opportunities that arise
   - revise the plan accordingly.

Figure 40 This wetland is managed through seasonal grazing and weed control

Planning should identify the unique values and production benefits of coastal wetlands and the interaction with adjoining land types, with management actions identified accordingly (figure 40).

A grazing property may have a range of wetlands or wetland types, which differ in their values, existing condition and threats. Whole of property planning allows these discrete values to be identified, different objectives set and appropriate management applied.

Table 1 Example of how different wetlands on a property can be managed to achieve various objectives.

Wetland name	Type	Key values	Condition and threats	Objectives	Current management	Action required
Lily lagoon	Grass, sedge, herb swamp	Used by many birds and fish, with some birds nesting. Different types of native plants. Visually attractive.	Good condition. Some salvinia and exotic pasture grasses growing across water and on wetland edges. Large fire fuel load.	Maximise biodiversity and habitat values for fish and birds and a nice place for picnic (close to house).	Small wetland currently fenced off from cattle.	Introduce a few weaners for a few weeks at a time during the dry season and use herbicides to reduce weeds and fuel load.
Lagoon paddock	Grass, sedge, herb swamp	Large wetland. Good grazing country in the dry season, floods during the wet season. Used by birds in the wet season.	Dominated by exotic pasture grasses, smothering the water surface of the wetland. Regular fish kills due to low oxygen levels in water.	Maintain value for production but restore water quality and open water for fish.	Wetland and frontage country fenced. Lightly stocked May–Nov.	Increase stocking at the end of the dry season to reduce biomass of exotic pasture. Controlled, mosaic burn at end of dry season Wet season spell.
Woodland swamp	Tree swamp	Used by birds and bats. Source of water for stock. Crocodile habitat during the wet season.	High sediment and algae levels in water. Soil disturbance and pugging by cattle around remaining water hole at the end of the dry season. Healthy overstorey trees but lack of young recruiting trees.	Improve water quality in wetland for stock. Minimise risk of cattle being taken by crocodile.	Cattle access not controlled.	New paddock including wetland and frontage country. Off-stream watering point for new paddock and adjacent paddocks (pipe from wetland). Dry season grazing (low stocking) and monitor impact. Controlled, cool mosaic burn to promote native plant recruitment.

Legislative requirements

To maintain the integrity and ecosystem values of coastal wetlands the Australian and Queensland Governments and many local authorities have put in place regulations and legislation to protect them. Works and some management activities in and around wetlands may be subject to legislative controls and restrictions. These need to be identified during the planning phase.

Activities occurring in or around wetlands that may be subject to legislative controls or requirements include:

- removing or disturbing vegetation
- earthworks (filling or excavation)
- construction of infrastructure such as levees, causeways, weirs, roads, culverts
- works to alter water flows in wetlands, such as drainage works or construction of water storages
- taking or interfering with water
- disturbance of or tampering with animal breeding places, such as nests or hollows, where protected wildlife breed or raise their young
- works within protected areas, such as declared Fish Habitat Areas, Ramsar listed wetlands, declared Wild Rivers and High Ecological Significance wetlands.

Other restrictions or requirements may apply to managing grazing enterprises, such as maintaining ground cover and land condition and managing weeds and pests. It is the responsibility of the land manager to identify and obtain any relevant approvals prior to commencing works or activities.

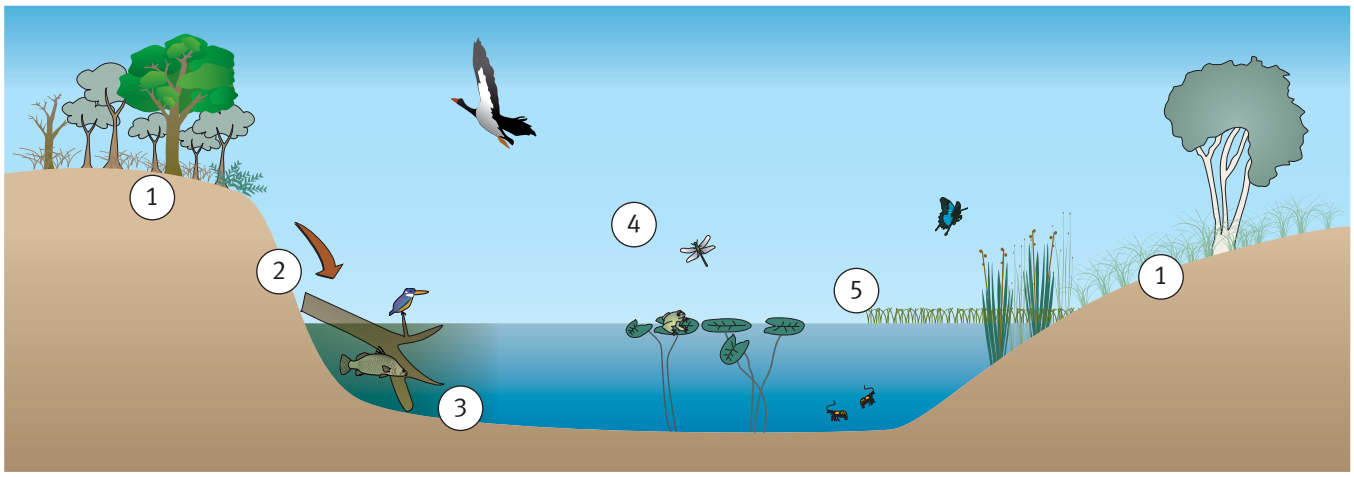
Want to know more?

For information and guidance on relevant legislation and requirements, refer to the Legislation Toolbox on Wetland*Info*: <http://www.derm.qld.gov.au/wetlandinfo/site/PPL/WPLST.html>

Figure 41 Legislative restrictions apply to works or activities in wetlands. This wetland contains saltcouch, a protected marine plant.

1.11 Monitoring and assessing coastal wetlands

Regular monitoring to assess the condition and health of wetlands is a good way to ensure that management practices are working or to identify when intervention is required. Wetlands and their associated animal and plant communities naturally vary according to wetting and drying cycles, so this needs to be taken into account when assessing wetlands. Figure 42 illustrates some key wetland condition indicators that can be easily monitored.



① **Vegetation:** width, health and continuity of riparian vegetation, vegetation recruitment, ground cover adjacent to wetland

② **Soil:** bare areas, erosion, slumping, disturbance or pugging

③ **Water quality:** turbidity, algal blooms, presence of aquatic plants and animals

④ **Biodiversity:** habitat (logs, leaf litter, hollows), presence of native birds, frogs, insects

⑤ **Exotic plants:** presence of weeds, extent of wetland surface covered, number of native species vs exotic species

Figure 42 Key indicators to monitor wetland health.

Monitoring should be carried out regularly (e.g. at least four times per year) to:

- gauge how a wetland changes during the year and between years
- assess impacts from natural events (floods or fire)
- assess impacts from management (controlled burn, stock grazing, spelling)
- identify any threats to allow early intervention.

A simple monitoring program involves set monitoring points where photographs are taken and observations recorded during each season and after events. This enables comparison across seasons and years and assessment of the effectiveness of management actions to inform future planning and management.

Want to know more?

Refer to Monitoring and Assessment on Wetland*Info* for additional information: <http://www.derm.qld.gov.au/wetlandinfo/site/SupportTools.html>

A framework for monitoring riverine wetlands is provided in: Jansen, A. et al. (2005) *Rapid Appraisal of Riparian Condition version 2*. River management technical guideline 4A. Land and Water Australia, Canberra. <http://lwa.gov.au/files/products/river-landscapes/pr050994/pr050994.pdf>

Here's a tip:

StockTake workshops provide information and skills on assessing land condition, pasture yields and forage budgeting, aimed at terrestrial pastures, but could be applied to pasture management in coastal wetlands. For more information on StockTake see <www.deedi.qld.gov.au>.

Part 2: Wetland profiles

Queensland's coastal catchments contain a diversity of wetlands from tea tree swamps in south-east Queensland, to palm-fringed creek lines in central Queensland and extensive saltpan wetlands in the Gulf of Carpentaria. The four most common types of wetlands which are found in Queensland's coastal grazing systems are:

- **coastal grass, sedge and herb swamps (floodplain and non-floodplain)**
- **coastal tree swamps (floodplain and non-floodplain): *Melaleuca* spp. and *Eucalyptus* spp.**
- **estuarine wetlands: Mangrove and saltmarsh**
- **coastal riverine wetlands.**

These wetlands differ in their water regimes, vegetation communities and the wildlife that they support. As such they provide different values to grazing enterprises and have different management needs. Many grazing properties will contain more than one of these coastal wetland types and management will need to account for these differences.

Part 1 of Grazing for Healthy Coastal Wetlands provided information on managing coastal wetlands in grazing systems and Part 2 specifies the production, biodiversity and ecological values and management considerations for each of these four coastal wetland types.

Figure 43 Coastal grass, sedge and herb swamp wetland near Cooktown

2.1 Coastal grass, sedge and herb swamps (floodplain and non-floodplain)

Description

- Temporarily or periodically waterlogged, from a period of a few weeks to months.
- Dominated by grasses and sedges, with little or no tree cover.
- Predominantly fresh water, but can have saline influence.
- Often associated with other wetlands through surface water flow or groundwater exchange.
- These wetlands naturally dry or draw down during the dry season. Wetland vegetation and fauna may also become dormant at this time, making these wetlands hard to distinguish during the dry season.

Grazing value:

Good grazing value

Wetland values and ecosystem services:

Food | Water security | Flood mitigation | Water quality | Integrated pest management | Social and cultural | Carbon storage | Habitat

Figure 44 Grass, sedge and herb swamp near Giru

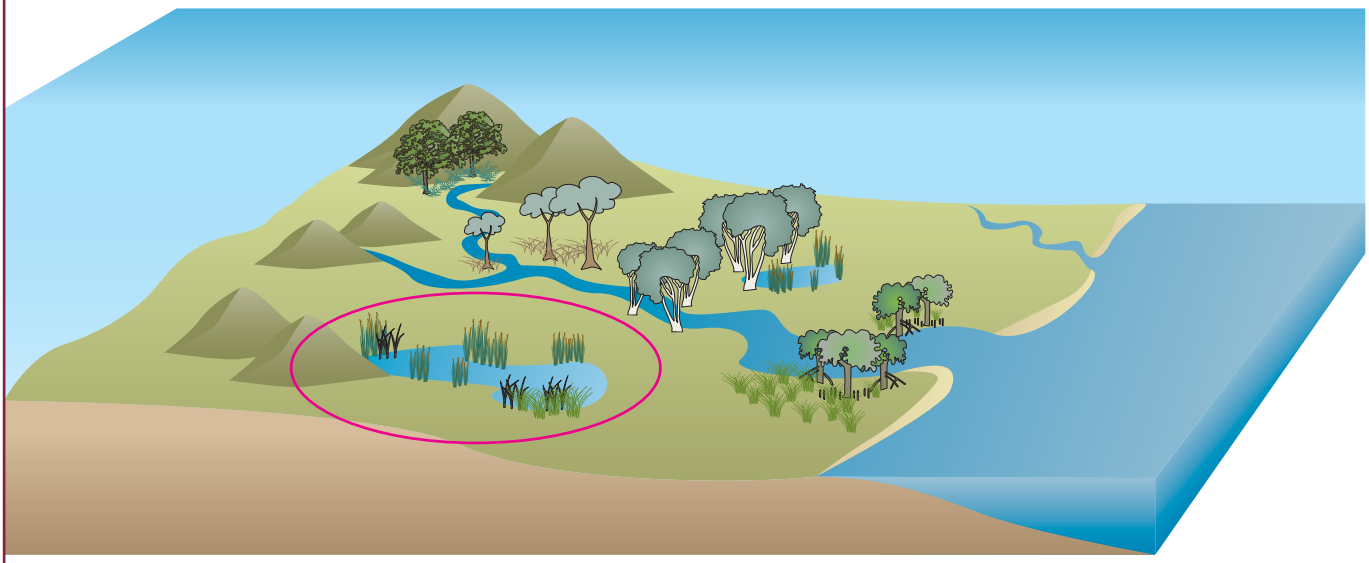


Figure 45 Coastal grass, sedge and herb swamp in the landscape

Landform

Minor basins, small depressions and poorly drained flats on marine or alluvial plains with a gentle or negligible slope.

Vegetation description

Trees are generally sparse with vegetation mainly consisting of grasses, rushes and sedges. Sedges and rushes dominate grass-sedge wetlands in the east coast catchments and grasses tend to dominate wetlands in the Gulf of Carpentaria catchments. The composition of wetland plant species varies depending on the catchment, saline influence, water regime and association with other land types.

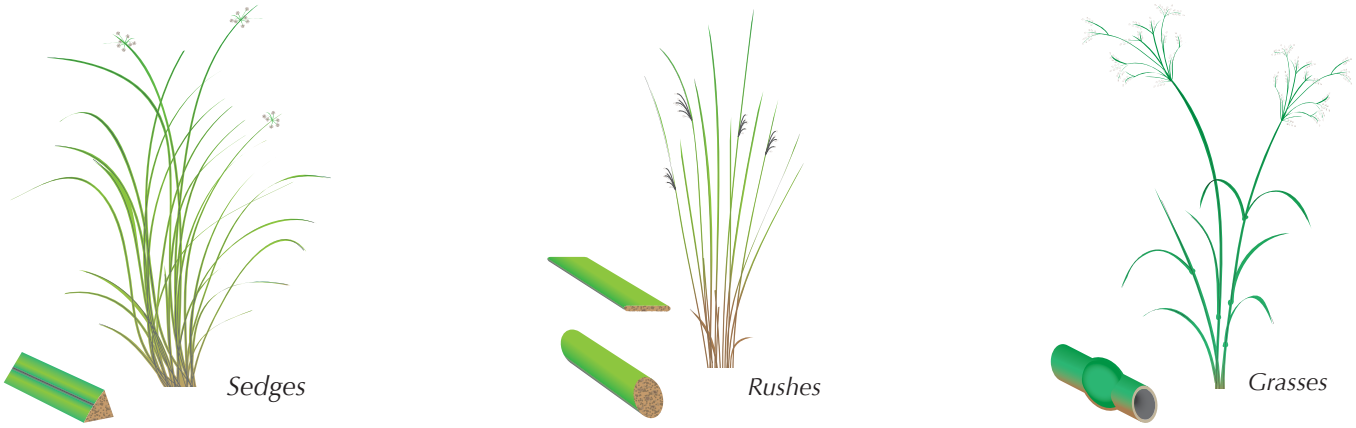


Figure 46 Identification of sedges, rushes and grasses

Native pastures

Queensland bluegrass, green couch, cup grass, swamp rice grass, wild rice, brown beetle grass, water couch, native millet, windmill grass and curly windmill grass.

The nutritional (energy, protein and mineral) values of wetland plants vary significantly between different plant species and seasons. Visual monitoring of stock health, stock grazing patterns and measuring the nutritional value of the pastures for stock, for example through Near Infrared Reflectance Spectroscopy (NIRS) of dung, could help evaluate the feed quality of wetland plants.

Sown pastures

It is not recommended that any pasture species be sown in these wetlands.

Exotic pasture grasses and weeds

Olive hymenachne, paragrass, aleman grass, giant rat's tail grass, awnless barnyard grass, lippia, pond apple, water hyacinth, salvinia, cabomba and water lettuce.

Exotic pasture grasses are well established in many coastal grass, sedge and herb swamps and must not be introduced into new wetland areas due to their invasive nature.

Soil

Deep, gradational clay soils. Main soil types include hydrosols, organosols, vertosols and dermosols.

Heavy, dark clays originally deposited by streams or the ocean, through to loamy soils.

Surface soils are dark, containing organic material and may crack.

Underlying soil may be Potential Acid Sulfate Soil (PASS) as peat, sand or mud.

Land use and management recommendations

Managing stock access and grazing

Well managed grazing can provide production benefits whilst maintaining biodiversity. Most wetland plants flower and set seed during summer and autumn and some rushes and sedges die back during the dry season. Seasonal grazing with a flexible or rotational grazing regime during the dry season can:

- provide useful feed during the dry season
- help to control exotic pasture grasses
- promote desirable native pasture species.

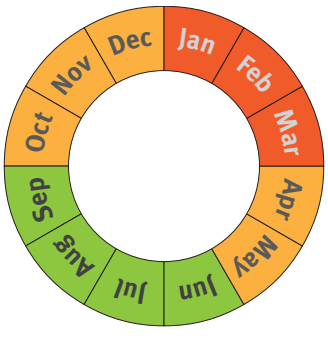
Spelling or very light stocking in and around these wetlands during the wet season will reduce pugging of wetland soils, allow wetland plants to seed and wildlife to breed. Grazing regimes should be determined depending on key management objectives, such as maintaining biodiversity, weed control or fire management.

Figure 47 A rotational grazing strategy is applied to this grass, sedge and herb swamp paddock

Grazing can be managed through:

- fencing to allow specific grazing management in wetland paddocks and/or
- rotational grazing, seasonal spelling and seasonally light stocking rates and/or
- stocking with lighter livestock, e.g. weaners and/or
- strategically placed off-stream watering points, cattle camps and supplements.

Indicative grazing seasonality diagram (green managed grazing, red spelling, amber limited grazing). This may vary depending on wetland condition, climate and key management objectives*:



* For example, if the management objective is to control exotic pasture grasses in the seasonal dry tropics, light stocking over the wet season could be appropriate.

Managing water

Drainage works, roads, levee-banks, floodgates, ponded pastures and dams can cause significant changes to wetland vegetation communities, their grazing value and the animals that these wetlands support.

Changes to water flow can make some areas of a wetland wetter while other areas get drier. This impacts plant and animal communities, water quality and natural fish movement between wetlands.

Ponded pastures to create dry season forage areas must not be constructed in or near natural wetlands.

Small, shallow water holes remaining at the end of the dry season are more susceptible to water quality degradation from stock congregating at the waterhole, defecating, urinating and pugging the wetland soils. These residual pools provide vital refuges for fish and wildlife and the use of these wetlands by stock should be closely monitored and controlled to minimise habitat disturbance and maintain water quality.

Figure 48 Cattle congregate around remaining water holes at the end of the dry season. Source: DERM

Managing fire

Using fire as a management tool requires careful planning and management to ensure both grazing and biodiversity objectives are achieved. The frequency, intensity and seasonality of burns will depend on the climatic region and management intent, for example to control weeds, promote desirable grazing species or even out grazing pressure.

Cool mosaic fires early in the dry season will ensure that peat soils remain moist and the bases of wetland plants are not damaged. In bulkuru and wild rice dominated wetlands, burning during the mid-late dry season (June to October) minimises fire damage, as the reeds and sedges have died back to subsoil bulbs or seeds.

Managing weeds

Exotic pasture grasses and weeds dominate many of these wetlands, especially in areas with high nutrient inputs and/or where saline water has been excluded through levees or bunds.

Exotic pasture grasses, particularly para grass and olive hymenachne can completely dominate wetlands, causing:

- exclusion of native reeds, sedges and grasses which provide important food and habitat for native fauna
- degradation of water quality and habitat for fish and aquatic animals and
- smothering of the water surface preventing access for boating and fishing.

An appropriate level of grazing pressure, combined with fire (in seasonally dry regions), can help reduce the dominance of these grasses. The effectiveness of this strategy varies between the type of pasture grass, climatic region and grazing management.

Complete grazing exclusion is not recommended in wetlands with exotic pasture grasses. A lack of grazing pressure allows exotic pasture grasses to smother the wetland degrading the wetlands' ecosystem services and values. Maintaining grazing pressure by light stocking throughout the wet season and moderate-heavy grazing pressure at the end of the dry season can be effective in controlling the dominance of exotic pasture grasses, particularly where there is seasonal draw down of water levels.

Control of weeds requires an integrated management approach using a range of weed prevention and control techniques. The Pest Management Officer from your local government should be contacted for advice. For more information see <www.deedi.qld.gov.au>.

Figure 49 Grazing can help reduce the dominance of exotic pastures to maintain wetland ecosystem services and values.

Managing animal pests

Feral pigs can cause significant damage to wetlands by disturbing soils, polluting the water and eating tubers and seeds of native wetland plants. Pigs can carry bacteria that may cause vibriosis and leptospirosis, which can be passed on to cattle through water. Pigs can also introduce weed seeds from neighbouring properties.

A strategic pig control program to reduce numbers is recommended. For advice, see <www.deedi.qld.gov.au>.

Figure 50 Pig damage, Lakefield National Park. Source: DERM

Other land use limitations

Regulations and approvals may apply to works or activities in and around these wetlands, such as:

- removing or disturbing vegetation
- earthworks (filling or excavation)
- construction of infrastructure such as levees, causeways, weirs, roads, culverts or works that alter water flows (drainage works or water storages)
- taking or interfering with water
- disturbance of or tampering with animal breeding places, such as nests or hollows, where protected wildlife breed or raise their young
- works within protected areas, such as declared Fish Habitat Areas, Ramsar listed wetlands and declared Wild Rivers areas.

There may be other requirements for grazing enterprises, such as maintaining ground cover and land condition and managing weeds and pests. Refer to the Legislation Toolbox for information (www.derm.qld.gov.au/wetlandinfo/site/PPL/WPLST.html).

Underlying soils are often PASS. When excavated or drained PASS reacts to air to produce sulphuric acid, which can cause significant environmental and economic impacts.

Crocodiles are a safety consideration for humans and stock in central and north Queensland.

Conservation features

Five plant species occurring in these wetlands are listed as vulnerable or endangered. The grasses, sedges and rushes that dominate these wetlands provide food (seeds and tubers) as well as vital nesting and breeding sites for many waterbirds, such as magpie geese, brolga and ducks. Egrets and insects inhabiting these wetlands may play a role in integrated pest management.

Numerous fish species, including barramundi and mullet, utilise these wetlands as nursery areas. Eels, frogs, turtles and crayfish are also common.

Relevant land types

Coastal grass, sedge and herb swamps can occur in various land types, however the only land type specific to this wetland is: Coastal wetlands (MW05).

Regional ecosystems

There are 16 Regional Ecosystems (RE's) that contain coastal grass, sedge and herb swamps:

- Gulf Plains – 2.3.1, ***2.3.2****, 2.3.34×31
- Cape York Peninsula – 3.3.58, 3.3.61, 3.3.63, 3.3.65
- Wet Tropics – ***7.1.3****, ***7.3.1****
- Central Queensland Coast – ***8.1.4****, ***8.3.4****
- Brigalow Belt – ***11.1.3****, ***11.3.27×1a, b & c****
- South-east Queensland – ***12.3.8****

* Classified as 'of concern' or 'endangered'.

Further information and references

For information on the use of late dry season grazing and fire to manage exotic pasture grasses in the seasonal dry tropics see:

- Tait, J. (2010) *Guidelines for the use of grazing for management of exotic pasture weeds in wetland and riparian habitats*. WetlandCare Australia, NSW
- Adams, E. *Tedlands Station Wetlands Project – Grazing and Fire Regime Management*. Information Bulletin No. 1 for the GBR Coastal Wetland Protection Program. Mackay Whitsunday NRM Group.

- Department of Primary Industries and Fisheries (2009) *Land types of Queensland*. State of Queensland (Department of Primary Industries and Fisheries), Brisbane.
- Holmes, S., Speirs, S., Berney, P. and Rose, H. (2009) *Guidelines for grazing in the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries, NSW.
- Grice, T. (2009) *Protection and restoration of degraded seasonal wetlands in northern Australia*. Final Report to NQ Dry Tropics.
- Jaensch, R. (2005) *Wetland Management Profile – Coastal Grass-sedge Wetlands*. Queensland Wetlands Program, Brisbane.

Plant species commonly found in coastal grass, sedge and herb swamps (floodplain and non-floodplain)

Scientific name	Common Name
Grasses	
Chloris spp.	Windmill grass
Cynodon dactylon	Green couch
Dichanthium sericeum	Queensland bluegrass
Echinochloa inundata	Marsh/channel millet
Enteropogon acicularis	Curly windmill grass
Eriochloa spp.	Cup or spring grass
Heteropogon spp.	Speargrass
Hymenachne acutigluma	Hymenachne
Ischaemum spp.	
Leersia hexandra	Swamp rice grass
Leptochloa digitata	Umbrella cane grass
Leptocholoa fusca formerly *Diplachne fusca*	Brown beetle grass
Oryza meridionalis	Wild rice
Panicum decompositum	Native millet
Paspalidium jubiflorum	Warrego (summer) grass
Paspalum distichum	Water couch
Paspalum vaginatum	Salt water couch
Phragmites australis	Common reed
Pseudoraphis spinescens	Spiny mudgrass
Sporobolus caroli	Fairy grass
Sporobolus virginicus	Saltwater/marine couch
Xerochloa imberbis	Swamp rice grass
Sedges and Rushes	
Baumea articulata	Jointed twigrush
Baumea rubiginosa	Soft twigrush
Bolboschoenus fluviatilis	Marsh club-rush
Carex appressa	Tall sedge
Cyperus difformis	Dirty dora/ rice sedge
Cyperus digitatus	Sedge
Cyperus exaltatus	Tall flatsedge/giant sedge
Cyperus polystachyos	Bunchy sedge
Cyperus trinervis	Sedge
Cyperus victoriensis	Yelka, flat-sedge
Cyperus spp.	Sedge
Eleocharis dulcis	Bulkuru
Eleocharis plana	Ribbed spikerush
Eleocharis sphacelata	Tall spikerush
Eleocharis spp.	Spikerush
Fimbristylis spp.	Rusty sedge
Juncus kraussii	Jointed rush
Juncus bufonius	Toad rush
Lepironia articulata	
Philydrum lanuginosum	Frogsmouth
Schoenoplectus spp.	Schoenoplectus
Scleria spp.	
Triglochin striata	Streaked arrow grass
Typha domingensis	Cumbungi, bulrush

Scientific name	Common Name
Legumes	
Aeschynomene indica	Buddha pea
Medicago spp.	Burr/Barrel medic
Sesbania cannabina	Sesbania pea
Succulents	
Salsola kali	Prickly saltwort/soft roly-poly
Broadleaf herbs and shrubs	
Ludwigia peploides	Water primrose
Trees	
Corypha utan	Palm
Eucalyptus spp.	Gum tree
Excoecaria parvifolia	Gutta-percha
Lophostemon spp.	Swamp box
Melaleuca spp.	Paperbark or tea-tree
Pandanus spp.	Screw pine
Xanthorrhoea spp.	Grass tree
Waterlillies and other aquatic plants	
Blyxa spp.	Blyxa
Ceratophyllum demersum	Hornwort
Ceratopteris thalictroides	Water fern
Hydrilla verticillata	Hydrilla
Marsilea spp.	Nardoo
Monochoria cyanea	Bog lily
Myriophyllum spp.	Water milfoil
Nelumbo nucifera	Pink lotus
Nymphaea spp.	Waterlillies
Nymphoides spp.	Marshworts
Ottelia alismoides	Ottelia
Ottelia ovalifolia	Swamp lily
Potamogeton spp.	Curly pondweed
Utricularia gibba	Yellow bladderwort
Vallisneria spp.	Ribbonweed
Introduced species and weeds	
Annona glabra	Pond apple
Brachiaria mutica	Paragrass
Cabomba caroliniana	Cabomba
Echinochloa colona	Awnless barnyard grass
Echinochloa polystachya	Aleman grass
Eichhornia crassipes	Water hyacinth
Hymenachne amplexicaulis	Olive hymenachne
Phyla canescens	Lippia
Pistia stratiotes	Water lettuce
Salvinia molesta	Salvinia
Sporobolus natalensis	Giant rats tail grass

2.2 Coastal tree swamp (floodplain and non-floodplain): *Melaleuca* spp. and *Eucalyptus* spp.

Description

- Temporarily inundated with fresh water for three to six months of the year.
- Heavily to sparsely wooded, dominated by melaleucas, eucalypts or other water-tolerant tree species.
- Native pastures are generally sparse, except in more open tree swamps of the seasonal dry tropics.
- Often associated with other coastal wetland types, such as estuarine wetlands and grass, sedge and herb swamps.

Grazing value:

Moderate grazing value

Wetland values and ecosystem services:

Water security | Food | Flood mitigation | Water quality | Stabilising soil | Social and cultural | Carbon storage | Integrated pest management | Habitat

Figure 51 Coastal tree swamp near Townsville

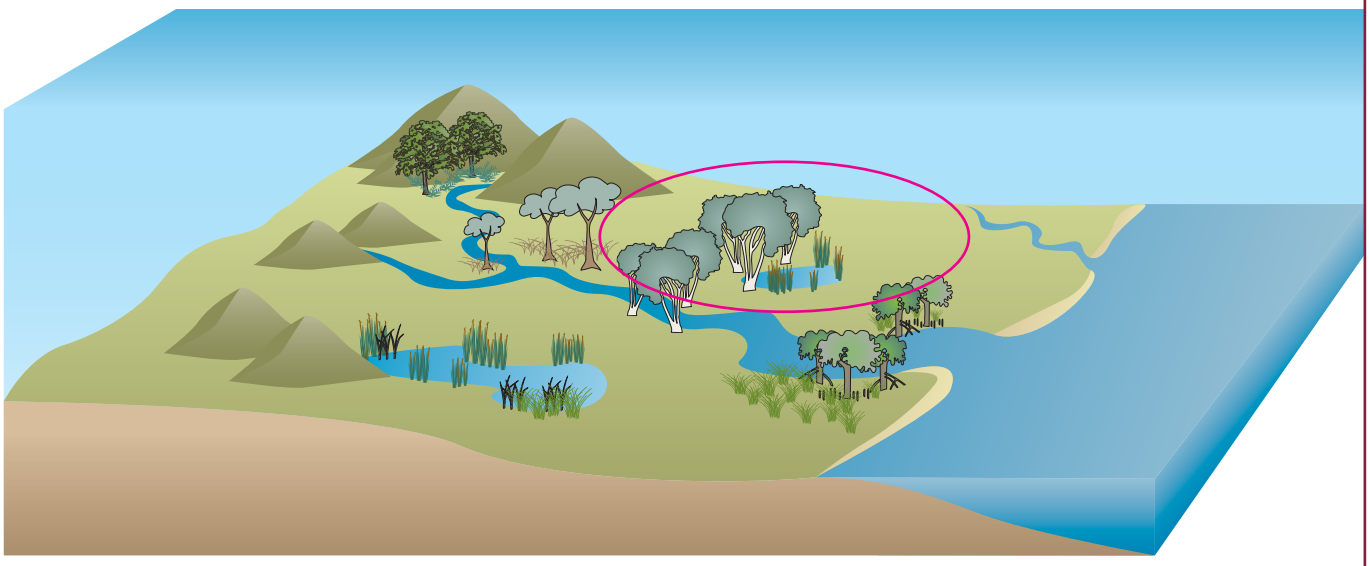


Figure 52 Coastal tree swamp in the landscape

Landform

Depressions on flat, broad floodplains, in the swales between coastal dunes, in the back levees of stream channels or on the inland side of saline wetlands.

Vegetation description

These wetlands are dominated by tea-trees *Melaleuca* spp. with an understorey of grasses, sedges, ferns, herbs and aquatic plants.

Native pastures

Ischaemum spp., swamp rice grass, blady grass, black and giant speargrass, saltwater/marine couch and kangaroo grass.

Suitable sown pastures

It is not recommended that pasture species be sown in these wetlands.

Exotic pasture grasses and weeds

Olive hymenachne, paragrass, aleman grass, pond apple, groundsel bush, rubbervine, lantana, papyrus, devil's fig and water hyacinth.

Soil

A broad range of soil types depending on the position in the landscape, from silty to loamy clays, siliceous sands to poorly oxygenated marine clays. Soil originally from estuarine, stream or floodplain deposits. Main soil types include hydrosols, vertosols, sodosols, organosols and chromosols.

Surface soils are hard-setting and underlying soil may be Potential Acid Sulfate Soil (PASS) as peat, sand or mud.

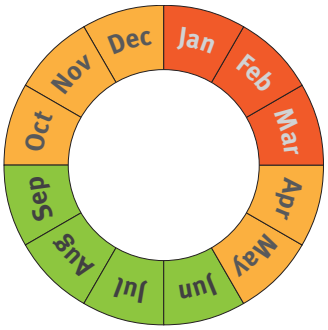
Land use and management recommendations

Managing stock access and grazing

Well managed grazing over the dry season, through light stocking rates, lighter stock (e.g. weaners) and/or rotational or flexible grazing can provide production benefits whilst maintaining biodiversity.
Wet season spelling and flexible/rotational grazing regimes provides a respite from grazing and disturbance, allowing wetland plants to set seed and germinate and for young plants to grow. Spelling also provides opportunities for frogs, birds and other wildlife to breed.

Grazing regimes should be determined based on the management objectives, condition, weed threat and water flows in the wetland.

Indicative grazing seasonality diagram (green managed grazing, red spelling, amber limited grazing). This may vary depending on wetland condition, climate and key management objectives*:



* For example, if the management objective is to control exotic pasture grasses in seasonally dry climates, light stocking over the wet season could be appropriate).

Managing water

Road crossings, floodgates, levee-banks, ponded pastures and dams can modify water regimes, as can draining wetlands for development. This impacts vegetation communities and the wildlife that these wetlands can support. Changes in water flow can also seriously impact fish movement within and between wetlands.

Ponded pastures, levees and bunds must not be constructed in or adjacent to coastal tree swamps.

Coastal tree swamps are fairly tolerant to nutrient loads, but overloading the wetland will eventually lead to dieback of wetland trees and invasion by weeds. Cattle camps should be located away from these wetlands to reduce nutrient input from stock urine and faeces.

Managing fire

In their natural state, coastal tree swamps are relatively fire tolerant due to the high moisture levels and low fuel loads supporting low intensity, mosaic burns. Fire also has a role in encouraging the recruitment of *Melaleuca* spp. These wetlands can act as natural firebreaks and a refuge for animals during fire in adjacent terrestrial areas.

To maintain the integrity of coastal tree swamps burns should only be:

- low to moderate intensity
- patchy or mosaic, creating a mosaic of burnt and unburnt areas
- carried out when the wetland soil is saturated
- carried out at intervals at which fire would have naturally occurred or been used by Traditional Owners (e.g. recommendations vary from 15-30 years for fire sensitive wetlands to 3-8 years for more open wetlands in seasonally dry climatic regions).

Figure 53 Ungrazed exotic pasture grasses can create large fuel loads which pose a risk of intense fires in seasonally dry climates

Too frequent fires can result in a net loss of nutrients from the system.

Different burn regimes may be required to meet specific management objectives, such as weed control.

Managing weeds

Exotic pasture grasses and weeds can dominate the understorey causing major changes to the vegetation community and wetland ecosystem services by:

- outcompeting and excluding native grasses and sedges, important for native animals
- smothering the water surface and degrading water quality and habitat for fish and other aquatic animals
- increasing fuel loads leading to frequent, intense fires that kill wetland trees and alter the vegetation composition to a grass dominated open-forest (particularly in seasonally dry climates).

Weeds are spread by animals, water and vehicles and will often dominate areas that have been disturbed by machinery, frequent fires or overgrazing. For example, the presence of Devil's fig can be a sign of heavy grazing pressure.

In wetlands invaded by exotic pasture grasses, the exclusion of stock can allow exotic pasture grasses to smother the wetland leading to the loss of wetland ecosystem services and values. Grazing can help reduce the dominance of exotic pasture grasses and maintain wetland values.

Figure 54 Dry season grazing is keeping olive hymenachne cropped in this wetland near Mackay.

In the seasonal dry tropics trials have shown that light grazing throughout the wet season (to prevent exotic pasture dominance over the growing season) and moderate grazing pressure at the end of the dry season (to crop down exotic pastures) can be an effective grazing regime for controlling the dominance of exotic pasture grasses.

An integrated program of controlled grazing, carefully planned and managed burns and natural water level fluctuations can help control weeds and exotic pasture grasses. Refer to <www.deedi.qld.gov.au> or your local government weed management officer for more information and guidance.

Managing animal pests

Feral pigs can cause extensive damage to coastal tree swamps, by fouling and muddying the water, digging up plants, destabilising banks and destroying the nests of native animals.

Pig control programs are recommended to reduce numbers, refer to <www.deedi.qld.gov.au> for advice.

Figure 55 Pigs have caused sediment disturbance and destroyed native plants in this wetland in Lakefield National Park. Source: DERM

Other land use limitations

Regulations and approvals may apply to works or activities in and around these wetlands, such as:

- removing or disturbing vegetation
- earthworks (filling or excavation)
- construction of infrastructure such as levees, causeways, weirs, roads, culverts or works that alter water flows (drainage works or water storages)
- taking or interfering with water
- disturbance of or tampering with animal breeding places, such as nests or hollows, where protected wildlife breed or raise their young
- works within protected areas, such as declared Fish Habitat Areas, Ramsar listed wetlands and declared Wild Rivers areas.

Figure 56 Tree swamps are often associated with grass, sedge and herb swamps

There may be other requirements for grazing enterprises, such as maintaining ground cover and land condition and managing weeds and pests. Refer to the Legislation Toolbox for information (www.derm.qld.gov.au/wetlandinfo/site/PPL/WPLST.html).

Coastal tree swamps are key contributors to primary production which is then exported to adjacent tidal habitats. The association with other wetland types means that the management of coastal tree swamps should be undertaken in conjunction with adjacent wetlands.

Underlying soils are often PASS. When excavated or drained PASS reacts with air to produce sulphuric acid, which can cause significant environmental and economic impacts.

Crocodiles may be a safety consideration for humans and stock in central and north Queensland.

Conservation features

Many vulnerable and endangered plants occur in coastal tree swamps, including species of orchid, wattle and grevillea.

Melaleuca spp. trees provide an important source of nectar and pollen for insects, birds and bats and are used for nesting and roosting. Frogs are common in the understorey vegetation and fish use these wetlands when they are seasonally inundated.

Relevant land types

Tea-tree flats (CB12), Coastal teatree plains (FT10), Coastal tea-tree plains (MW04), Sandy forest (NG13), Coastal country (SG03).

Regional Ecosystems

There are 29 Regional Ecosystems (RE's) that contain coastal tree swamps:

- Gulf plains: 2.3.28×11
- Cape York Peninsula: ***3.2.3****, ***3.2.4****, ***3.2.14****, ***3.3.12****
- Wet tropics: ***7.2.8****, ***7.2.9****, ***7.3.5****, ***7.3.34****
- Central Queensland coast: ***8.1.5****, ***8.2.4****, ***8.2.7a,b&e****, ***8.2.11****, ***8.2.13b****, ***8.3.11****, ***8.3.13a&b****, ***8.5.2****, ***8.5.6****
- Brigalow belt: 11.3.12
- Southeast Queensland: ***12.1.1****, 12.2.5a, 12.2.7, ***12.3.4****, 12.3.5, 12.3.6, 12.5.4

* Classified as 'of concern' or 'endangered'

Further information and references

For information on the use of late dry season grazing and fire to manage exotic pasture grasses in the seasonal dry tropics see:

- Tait, J. (2010) *Guidelines for the use of grazing for management of exotic pasture weeds in wetland and riparian habitats*. WetlandCare Australia, NSW
- Adams, E. *Tedlands Station Wetlands Project – Grazing and Fire Regime Management*. Information Bulletin No. 1 for the GBR Coastal Wetland Protection Program. Mackay Whitsunday NRM Group.
- Bloor, M. and Tait, J. *Tedlands Station Wetlands*. Mackay Whitsunday NRM Group. Australia.
- Department of Environment and Resource Management (2009) *Regional Ecosystems*. Viewed 4 November 2010. (www.derm.qld.gov.au/wildlife-ecosystems/biodiversity/regional_ecosystems/index)
- Department of Primary Industries and Fisheries (2009) *Land types of Queensland*. State of Queensland (Department of Primary Industries and Fisheries), Brisbane.
- Joyce, K. (2006) *Wetland Management Profile – Coastal Melaleuca Swamp Wetlands*. Queensland Wetlands Program, Brisbane.

Plant species commonly found in coastal tree swamps (floodplain and non-floodplain): *Melaleuca* spp. and *Eucalyptus* spp.

Scientific name	Common Name
Grasses	
Chrysopogon fallax	Golden beard grass
Heteropogon spp.	Speargrass
Imperata cylindrica	Blady grass
Ischaemum spp.	
Leersia hexandra	Swamp rice grass
Phragmites australis	Common reed
Sporobolus virginicus	Saltwater/marine couch
Themeda triandra	Kangaroo grass
Sedges and Rushes	
Baumea articulata	Jointed twigrush
Baumea rubiginosa	Soft twigrush
Cyperus difformis	Dirty dora/ rice sedge
Cyperus trinervis	Sedge
Cyperus spp.	Sedge
Dapsilanthus ramosus	Saw-Sedge
Gahnia sieberiana	Saw-Sedge
Isolepis nodosa	Knobby club rush
Lepironia articulata	
Schoenus brevifolius	Bogrush
Broadleaf herbs and shrubs	
Acrostichum speciosum	Mangrove fern
Blechnum spp.	Ferns
Boronia spp.	Boronia
Crinum pedunculatum	Mangrove lily
Durringtonia paludosa	Durringtonia
Broadleaf herbs and shrubs (continued)	
Lycopodiella serpentina	Bog clubmoss
Lygodium microphyllum	Climbing maidenhair
Phaius spp.	Swamp orchid
Sprengelia sprengelioides	Sprengelia
Stenochlaena palustris	Climbing swamp fern
Trees	
Acacia spp.	Wattle
Casuarina spp.	She-oak
Corymbia spp.	Bloodwood
Eucalyptus spp.	Gum tree
Excoecaria parvifolia	Gutta-percha
Grevillea spp.	Grevillea

Scientific name	Common Name
Trees (continued)	
Livistona spp.	Cabbage tree palm
Lophostemon spp.	Swamp box
Melaleuca spp.	Paperbark or tea-tree
Pandanus spp.	Screw pine
Xanthorrhoea spp.	Grass tree
Waterlillies and other aquatic plants	
Nymphaea spp.	Waterlillies
Introduced species and weeds	
Annona glabra	Pond apple
Baccharis halimifolia	Groundsel Bush
Brachiaria mutica	Paragrass
Cryptostegia grandiflora	Rubber vine
Cyperus papyrus	Papyrus
Echinochloa polystachya	Aleman grass
Eichhornia crassipes	Water hyacinth
Hymenachne amplexicaulis	Olive hymenachne
Lantana camara	Lantana
Solanum torvum	Devil's fig

2.3 Estuarine wetlands: Mangrove and saltmarsh

Description

- Estuarine wetlands include both mangrove and saltmarsh wetlands.
- Occur in the intertidal zone between the highest astronomical tide level and average sea level.
- Mangrove wetlands are dominated by trees.
- Saltmarsh wetlands are dominated by salt- tolerant grasses and succulents with bare areas of saltpan.
- Subject to regular saltwater inundation for short periods of time, and freshwater runoff from land or other wetlands.

Grazing value:

Moderate–poor grazing value

Wetland values and ecosystem services:

Food | Habitat | Water quality | Stabilising soil | Flood mitigation | Social and cultural | Carbon storage

Figure 57 Estuarine wetland with saltmarsh (foreground) and mangrove communities

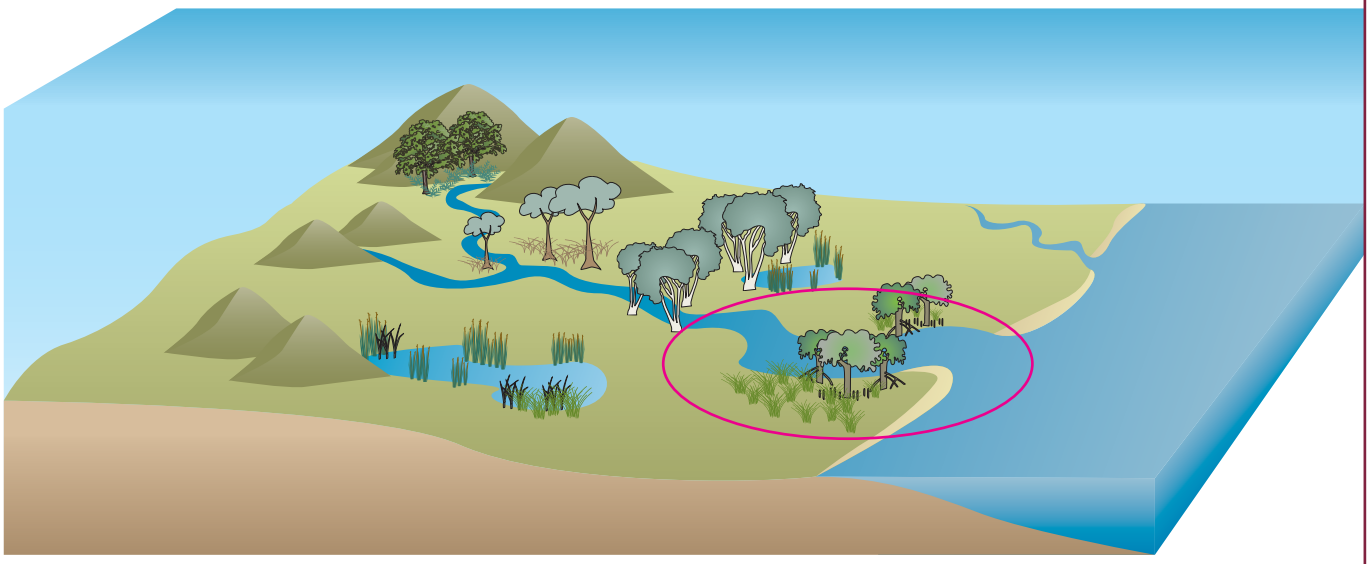


Figure 58 Estuarine wetlands in the landscape

Landform

Low gradient marine and estuarine plains which may have complex patterns of small tidal channels and Gilgai depressions.

Vegetation description

Due to regular saltwater inundation and oxygen-limited soils, the vegetation growing in estuarine wetlands is limited to those plants that are adapted to these harsh conditions.

Mangrove wetlands are dominated by mangrove trees, of which there are 34 different species and 3 hybrids in Queensland. The diversity of mangrove species is greater in the north of the state than the south.

Figure 59 Mangrove wetlands have limited grazing value

Saltmarsh wetlands have few or no trees and mainly consist of grasses and a variety of succulent plants, called samphires. Sedges and rushes, mangrove ferns, mangrove lilies also inhabit estuarine wetlands.

Native pastures

Saltwater/marine couch, water couch, salt water couch, *Ischaemum* spp.

Sown pastures

Pasture species must not be sown in these wetlands.

Weeds

The saline, oxygen-poor soils characteristic of estuarine wetlands limit the types of plants, including weeds that can grow in these wetlands. Weeds include pond apple, rubbervine and groundsel bush.

Soil

Soils are usually deep grey or black clay of marine origin that are highly saline and oxygen-poor, limiting the types of vegetation that can grow. Some estuarine wetlands may occur on sandy or rocky carbonate sediments. The dominant soil types are hydrosols, vertosols and sodosols.

Soil salinities may reach two to three times those of seawater. Surface soils of saltmarsh wetlands are hard and cracking and may have obvious salt crusts. Underlying soil is likely to be Potential Acid Sulfate Soil (PASS) as mud or sand.

Land use and management recommendations

Managing stock access and grazing

Saltmarsh wetlands can be an important part of grazing systems in the coastal areas of North Queensland, providing useful fodder for stock during the dry season. Stock should only graze these wetlands for short periods of time, as freshwater is sparse and to avoid damage to these wetlands.

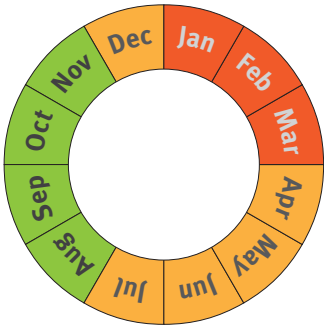
Figure 60 Succulent saltmarsh plants, called samphires, are sensitive to grazing and trampling.

Stock access to estuarine wetlands when wetland soils are moist can lead to soil compaction, pugging, trampling of vegetation and changes to water flow. Grazing should be managed to prevent stock access to estuarine wetlands during the wet season and periods of high tides (generally summer-autumn). Seasonal spelling during this time is also recommended to minimise disturbance of migratory bird feeding and roosting, enable fish movement to breeding and nursery habitats and allow time for vegetation communities to regenerate.

Figure 61 Saltmarsh wetlands are often dominated by saltcouch

Succulent samphire vegetation is sensitive to grazing and trampling and can be slow to recover. Monitoring the vegetation condition and active management of stock access is required to ensure that these vegetation communities are not degraded by grazing.

Indicative grazing seasonality diagram (green managed grazing, red spelling, amber limited grazing). This may vary depending on wetland condition, climate and key management objectives:



Managing water

In estuarine wetlands, different plants grow in different zones depending on the frequency and depth of tidal inundation. Changes to water flow by blocking drainage paths, building levees, constructing access tracks, increasing freshwater inputs and raising or lowering of the soil level can affect tidal inundation and permanently change the plant community. This in turn affects the biodiversity and production values of the wetland.

Access tracks, bunds/levees, watering points and farm infrastructure should be located away from estuarine wetlands to avoid changing water flow.

Estuarine wetlands are regularly flushed with seawater as such the water quality is determined by land use activities in the broader catchment and all land managers have a role in managing sediment and nutrient runoff from their land.

Managing fire

The natural occurrence of fire in estuarine wetlands is low and recovery from fire damage can be slow. As such these wetlands should not be regularly burnt.

Burning adjacent terrestrial land and pastures should be carried out during or after high tide when the wetland soils are moist to minimise damage to these wetlands.

Managing weeds

Weeds tend to occur on the landward edge and areas of higher land in estuarine wetlands. Difficulty of access can make weed identification and control challenging.

Weed control through grazing is of limited benefit as most of the weeds are not grasses, although para grass can be a problem in areas with more freshwater input. Weed control needs to be undertaken in a way that minimises soil compaction and disturbance and prevents any changes in ground level and water flow.

A well planned and managed integrated weed control program is required for the specific weed being targeted. See <www.deedi.qld.gov.au> for more information or contact your local government weed management officer.

Managing animal pests

Feral pigs can disturb estuarine wetlands by digging up and trampling plant material, disturbing wetland soils and predating upon frogs and fish. Pig control programs are recommended in these wetlands to reduce numbers, for advice see <www.deedi.qld.gov.au>.

Other land use limitations

Regulations and approvals apply to works or activities in and around these wetlands, such as:

- removing or disturbing vegetation
- earthworks (filling or excavation)
- construction of infrastructure such as levees, causeways, weirs, roads, culverts or works that alter water flows (drainage works or water storages)
- taking or interfering with water
- disturbance of or tampering with animal breeding places, such as nests or hollows, where protected wildlife breed or raise their young
- works within protected areas, such as declared Fish Habitat Areas, Ramsar listed wetlands and declared Wild Rivers areas.

Figure 62 Earthworks and access tracks in or adjacent to estuarine wetlands can affect water flow, fish passage and wetland plants and as such these works are regulated with approvals required.

There may be other requirements for grazing enterprises, such as maintaining ground cover and land condition and managing weeds and pests. Refer to the Legislation Toolbox for information (www.derm.qld.gov.au/wetlandinfo/site/PPL/WPLST.html).

Underlying soils are PASS. When excavated or drained PASS reacts to air to produce sulphuric acid, which can cause significant environmental and economic impacts.

In Central and North Queensland crocodiles inhabit estuarine wetlands which can pose a threat to humans and stock entering these wetlands.

Conservation features

The vulnerable ant plant and endangered mangrove orchid inhabit estuarine wetlands.

These wetlands provide essential feeding and breeding grounds for water birds and migratory shore birds.

Mangroves and saltmarsh provide vital habitat for fish to breed, grow, feed and shelter. Over 70% of commercially caught fish species as well as most of the fish targeted by recreational fishers use these wetlands at some stage of their lifecycle (Quinn, R.H. 1992).

Relevant land types

Marine plains (FT18), Marine plains and tidal flats (MW07), Marine plains (NG06), Marine plains (SG09).

Regional Ecosystems

There are 29 Regional Ecosystems (RE's) that contain estuarine wetlands: mangrove and saltmarsh:

- Gulf Plains – 2.1.2, 2.1.3, 2.1.4
- Cape York Peninsula – 3.1.1, 3.1.1a-c, ***3.1.2****, 3.1.3, ***3.1.4****, 3.1.5, 3.1.6, ***3.1.7****, ***3.2.30****
- Wet Tropics – 7.1.1, ***7.1.2****
- Central Queensland Coast – 8.1.1, ***8.1.2****, ***8.1.3****
- Brigalow Belt – 11.1.1, 11.1.2, 11.1.4, 11.1.4a-e
- South-east Queensland – 12.1.2, 12.1.3

* Classified as 'of concern' or 'endangered'

References

- Department of Primary Industries and Fisheries (2009) *Land types of Queensland*. State of Queensland (Department of Primary Industries and Fisheries), Brisbane.
- Jaensch, R. (2005) *Wetland Management Profile – Saltmarsh Wetlands*. Queensland Wetlands Program, Brisbane.
- Johns, L. (2006) *Field guide to common saltmarsh plants of Queensland*. State of Queensland (Department of Primary Industries and Fisheries), Brisbane.
- Joyce, K. (2006) *Wetland Management Profile – Mangrove Wetlands*. Queensland Wetlands Program, Brisbane.
- Lovelock, C. (1993) *Field guide to the mangroves of Queensland*. Australian Institute of Marine Science, Australia.
- Quinn, R.H. (1992) *Fisheries Resources of the Moreton Bay region*. Queensland Fish Management Authority, Brisbane

Plant species commonly found in estuarine wetlands: Mangrove and saltmarsh

Scientific name	Common Name
Grasses	
Cynodon dactylon	Green couch
Ischaemum spp.	
Leptocholoa fusca formerly *Diplachne fusca*	Brown beetle grass
Panicum decompositum	Native millet
Paspalum distichum	Water couch
Paspalum vaginatum	Salt water couch
Phragmites australis	Common reed
Sporobolus virginicus	Saltwater/marine couch
Xerochloa imberbis	Swamp rice grass
Zoysia macrantha	Prickly couch
Sedges and Rushes	
Cyperus polystachyos	Bunchy sedge
Cyperus victoriensis	Yelka, flat-sedge
Cyperus spp.	Sedge
Eleocharis dulcis	Bulkuru
Fimbristylis spp.	Rusty sedge
Isolepis cernua	Nodding club rush
Isolepis nodosa	Knobby club rush
Juncus kraussii	Jointed rush
Juncus bufonius	Toad rush
Schoenoplectus spp.	Schoenoplectus
Triglochin striata	Streaked arrow grass
Typha domingensis	Cumbungi, bulrush
Succulents	
Batis argillicola	Batis
Carpobrotus glaucescens	Pigface
Dissocarpus biflorus	Twin flower saltbush
Dysphania littoralis	Red crumbweed
Enchylaena tomentosa	Ruby saltbush
Halosarcia spp.	Glassworts
Portulaca spp.	Pigweed
Salsola kali	Prickly saltwort/soft roly-poly
Sarcocornia quinqueflora	Bead weed
Sesuvium potulacastrum	Sea purslane
Suaeda spp.	Seablite
Tecticornia australasica	Grey samphire
Broadleaf herbs and shrubs	
Acrostichum speciosum	Mangrove fern
Atriplex semibaccata	Creeping saltbush

Scientific name	Common Name
Broadleaf herbs and shrubs (continued)	
Crinum pedunculatum	Mangrove lily
Limonium spp	Native sea lavender
Samolus repens	Creeping bushweed
Trees	
Aegialitis annulata	Club mangrove
Aegiceras corniculatum	River mangrove
Avicennia marina	Grey mangrove
Bruguiera spp.	Orange mangrove
Ceriops spp.	Yellow mangrove
Excoecaria agallocha	Blind-your-eye mangrove
Lumnitzera spp.	Black mangrove
Osbornia octodonta	Myrtle mangrove
Rhizophora spp.	Red or tall-stilted mangrove
Xylocarpus spp	Cedar or cannonball mangrove
Introduced species and weeds	
Annona glabra	Pond apple
Baccharis halimifolia	Groundsel Bush
Cryptostegia grandiflora	Rubber vine

2.4 Coastal riverine wetlands

Description

- Occur as rivers, creeks, channels, drainage lines and streams.
- Have defined bed and banks and possibly an adjoining floodplain.
- Has permanent or ephemeral water flow or water holes.
- Generally freshwater but may have saltwater influence.
- Banks (the 'riparian area') are vegetated, usually with an understorey, shrub and tree layers although in drier areas, vegetation can be grass with an open woodland canopy.
- Often have a close association with groundwater.

Grazing value:

Moderate grazing value

Wetland values and ecosystem services:

Water security | Water quality | Stabilising soil | Flood mitigation | Integrated pest management | Social and cultural | Carbon storage | Habitat

Figure 63 Coastal riverine wetland north of Townsville

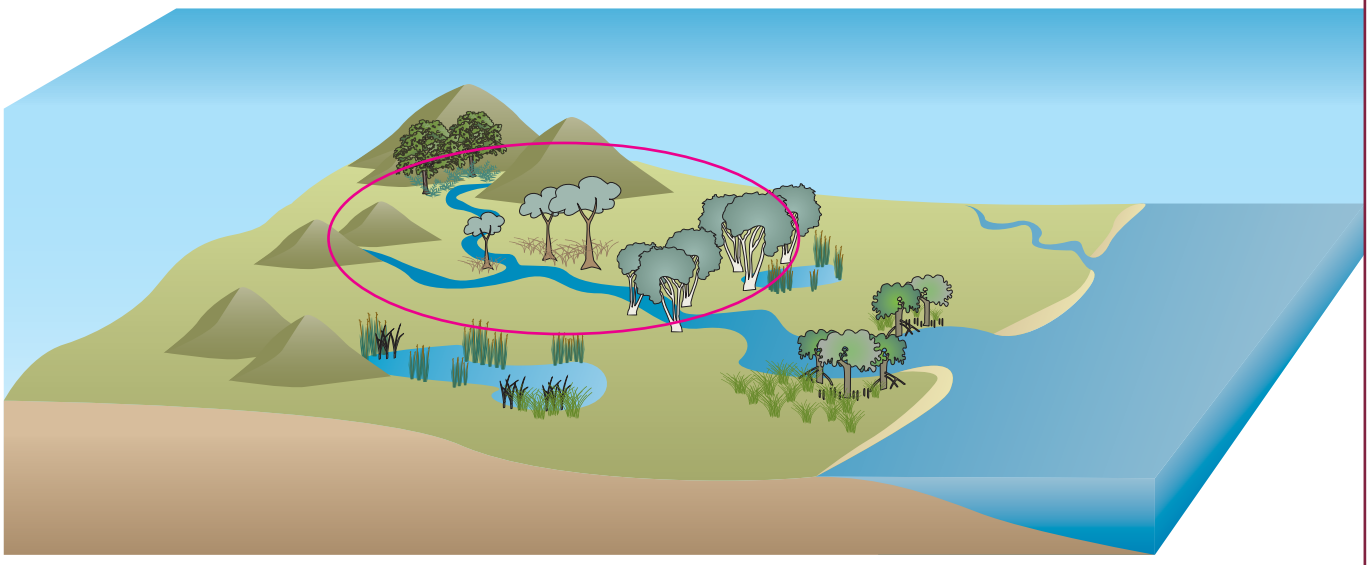


Figure 64 Coastal riverine wetlands in the landscape

Landform

Occur on a wide range of landforms, from broad channels through floodplains to narrow drainage lines on steep land.

Vegetation description

Healthy coastal riverine wetlands generally have a good structural diversity with trees and shrubs of different ages, heights and forms and an understorey of groundcovers such as grasses, sedges and herbs. Vegetation types and structure vary depending on the climate, region, position in the landscape, water regime, droughts and disturbance. In drier areas, riparian vegetation can be more grass-dominated with a sparse, open tree canopy.

Figure 65 Healthy coastal riverine wetland with a diversity of trees, shrubs and ground covers

Native pastures

Black and giant speargrass, golden beard grass, fairy grass, blady grass, umbrella cane grass and marsh/channel millet.

Sown pastures

Many riparian areas will have improved pastures, including rhodes grass, signal grass, pangola grass, guinea grass, para grass and tulley grass.

Exotic pasture grasses and weeds

Paragrass, olive hymenachne, aleman grass, pond apple, grounsel bush, rubbervine, lantana, parkinsonia, noogoora burr, papyrus, water hyacinth, water lettuce, salvinia and cabomba.

Exotic pasture grasses are well established in many coastal riverine wetlands and should not be introduced into new wetland areas.

Soil

A broad range of soil types depending on the position in the landscape, including black cracking clays, loams, sands and even bedrock. Soil originally from alluvial deposits.

Potential Acid Sulfate Soil (PASS) may be present in underlying soils in the coastal floodplain.

Land use and management recommendations

Managing stock access and grazing

Coastal riverine wetlands and the adjacent frontage country (the land occurring from the riparian area usually to the extent of the floodplain) are very productive areas. Well managed stock access and regular spelling can provide stock with valuable fodder and water and minimise impacts from water fouling, erosion and degradation of riparian vegetation.

Figure 66 Riparian area and frontage country with good ground cover on a coastal grazing property.

Stock access and grazing should be managed:

- through strategic fencing and rotational/flexible grazing to provide regular breaks from grazing pressure
- by locating watering points and cattle camps away from wetlands to reduce the time stock spend wallowing and defecating in the water
- through light stocking rates or lighter stock (e.g. weaners)
- through exclusion when stream banks are saturated to avoid bank slumping and pugging
- by minimising access to small, isolated water holes remaining after extended dry periods to reduce water fouling and algal blooms
- through wet season spelling to provide opportunities for vegetation to germinate and establish. Wet season spelling recommendations for coastal riverine wetlands and frontage country vary from 6-8 weeks to the entire wet season, depending on the region, climate, landscape variables and management objectives (e.g. weed control).

Grazing regimes need to be flexible and decided based on regular monitoring and assessment of wetland condition and frontage country ground cover targets (see monitoring and assessing coastal wetlands on page 42).

Maintaining good ground cover in the frontage country is essential to minimise erosion and increase sediment trapping. Grass buffers on flat land have been shown to trap 80% of incoming sediment in runoff, even under heavy rainfall (McKergow et. al. 1999). Ground cover targets for frontage country differ depending on the region, rainfall and the site attributes including topography, soil and existing vegetation. Advice for a specific property should be sought from Regional NRM bodies or local Department of Employment, Economic Development and Innovation (DEEDI) grazing extension staff.

Managing water

Impoundments, causeways, floodgates and bunds across coastal riverine wetlands alter water flows impacting vegetation, downstream water regimes, water quality and fish passage.

Figure 67 Crossings and culverts such as this, alter water flows and prevent fish passage.

Nutrients, from dung and urine, can lead to algae blooms and low oxygen levels in the water. These wetlands are particularly susceptible during the dry season and times of drought, when there is little or no water flow and only isolated water holes. These residual pools provide vital refuges for fish and wildlife. Stock use of these wetlands needs to be closely monitored and controlled to minimise impacts on water quality (for both stock drinking water and wildlife).

Structures built across riverine wetlands should be designed to allow natural water flow and fish passage.

Contact DEEDI on 13 25 23 for information on designing crossings. Guidelines are also available at http://www.jcu.edu.au/fishpassagedesign/pub/cfpdg/index.htm

Managing fire

Fringing riparian communities are not adapted to regular fire. Burns are not recommended unless there is a specific management issue to address, such as weeds. Intense and extensive fires degrade riparian vegetation structure and destroy critical wildlife habitats. Exotic pasture grasses, such as guinea grass, can support these frequent intense fires and should be managed through strategic grazing to reduce the biomass of these grasses.

If controlled burns are required (e.g. for weed control) they should only occur when the water level is deep enough to protect the bases of aquatic plants. Fires in adjoining terrestrial paddocks must also be carefully managed and timed to when wetland soils are saturated to prevent the fire entering wetlands.

Grazing should be restricted immediately after a burn as cattle will preferentially eat the new shoots (unless the key objective is exotic pasture control, whereby grazing may help control the regrowth).

Managing weeds

Coastal riverine wetlands are prone to invasion by weeds and exotic pasture grasses which can alter the vegetation communities and degrade the vital ecosystem services provided by these wetlands.

Figure 68 Ungrazed exotic pasture grasses can create large fuel loads and a threat of intense fire in seasonally dry climates

Exotic pasture grasses:

- outcompete and exclude native plants which provide food and habitat for wildlife
- grow across the water surface, affecting water flow and degrading water quality and habitat
- create high fuel loads in seasonally dry climates which support intense and frequent fires that can kill wetland trees.

Where exotic pasture grasses are present, grazing should be used strategically to reduce the dominance of these grasses, allow recruitment and growth of native plants and help reduce fire fuel loads.

Control of weeds requires an integrated management approach using a range of weed prevention and control techniques. The Pest Management Officer from your local government should be contacted for advice. For more information see <www.deedi.qld.gov.au>.

Managing animal pests

Feral pigs can cause extensive damage to coastal riverine wetlands, by destroying vegetation, spreading weeds, disturbing soils, fouling and muddying water and causing bank erosion and slumping. Feral horses are also prevalent in some areas of Queensland, causing overgrazing, soil compaction and water quality degradation in wetlands. For information on controlling pests, refer to <www.deedi.qld.gov.au>.

Other land use limitations

Regulations and approvals may apply to works or activities in and around these wetlands, such as:

- removing or disturbing vegetation
- earthworks (filling or excavation)
- construction of infrastructure such as levees, causeways, weirs, roads, culverts or works that alter water flows (drainage works or water storages)
- taking or interfering with water
- disturbance of or tampering with animal breeding places, such as nests or hollows, where protected wildlife breed or raise their young
- works within protected areas, such as declared Fish Habitat Areas and Ramsar listed wetlands
- agricultural activities within declared Wild Rivers areas.

There may be other requirements for grazing enterprises, such as maintaining ground cover and land condition and managing weeds and pests. Refer to the Legislation Toolbox for information (www.derm.qld.gov.au/wetlandinfo/site/PPL/WPLST.html).

Many coastal riverine wetlands in Queensland form the boundary between properties, requiring joint management.

Underlying soils may be PASS. When excavated or drained PASS reacts to air to produce sulphuric acid, which can cause significant environmental and economic impacts.

Crocodiles may be a safety consideration for humans and stock in coastal riverine wetlands in central and north Queensland.

Conservation features

Riparian vegetation provides habitat and food for wildlife, shade, nutrient and sediment trapping and bank stabilisation. Riparian areas with vegetation cover are more resistant to erosion and are more effective at trapping sediments and nutrients than bare areas. Research (Butler, D.M. 2007) has shown that riparian areas with vegetation cover exported 85% less total Nitrogen (from cattle urine and dung) than bare ground.
Standing dead trees with hollows, fallen logs and leaf litter are an essential part of riparian areas, providing shelter and nesting sites for birds, mammals, reptiles and insects, including species that can assist in integrated pest management. Snags in the wetland are a habitat for fish, turtles and other aquatic animals.

Coastal riverine wetlands provide corridors for wildlife movement and are vital for fish movement and connectivity between freshwater wetlands and estuaries.

Relevant land types

Coastal riverine wetlands can occur in any coastal land type, commonly: Blue gum on alluvial plains (MO01), Blue gum flats (CB02), Blue gum/river red gum flats (FT02), Coastal flats with mixed Eucalypts on grey clays (FT08), Coolibah floodplains (FT11), Alluvial flats and plains (MW01), Clayey alluvials (BD08), Loamy alluvials (BD13), Alluvial (WT01), Frontage (NG03), Coastal country (SG03), Frontage (SG04).

Regional Ecosystems

There are 28 Regional Ecosystems (RE's) that contain coastal riverine wetlands:

- Gulf plains: 2.3.1×30, 2.3.7, ***2.3.17*, 2.3.24*, 2.3.25*, 2.3.26****
- Cape York Peninsula: 3.3.1, 3.3.5, 3.3.10, 3.3.25, ***3.3.66×1a&b****
- Wet tropics: ***7.1.4*, 7.3.16*, 7.3.23*, 7.3.25*, 7.3.26*, 7.3.28*, 7.3.49*, 7.3.50*, 7.11.42****
- Central Queensland coast: ***8.3.1*, 8.3.3****
- Brigalow belt: ***11.3.3*, 11.3.25*, 11.3.38****
- South-east Queensland: ***12.3.2****, 12.3.7

* Classified as 'of concern' or 'endangered'

Further information and references

For more information on managing grazing around coastal riverine wetlands see:

- Coughlin, T., O'Reagain, P., Nelson, B., Butler, B. and Burrows, D. (2008) *Managing for water quality within grazing lands of the Burdekin Catchment – Guidelines for Land Managers*. Burdekin Solutions Ltd, Townsville (www.nqdrytropics.com.au)
- Tait, J. (2010) *Guidelines for the use of grazing for management of exotic pasture weeds in wetland and riparian habitats*. WetlandCare Australia, NSW.
- Staton, J. and O'Sullivan, J. (2006) *Stock and waterways: a manager's guide*. Land and Water Australia, Canberra.
- Peck, G. (2006) *Property Planning: Fencing to landtype – Riparian lands*. Fitzroy Basin Association, Rockhampton (www.fba.org.au)
- Peck, G. (2006) *Property planning: Sustainable grazing on riparian lands – why and how to do it*. Fitzroy Basin Association, Rockhampton. (www.fba.org.au)
- Butler, D.M., Ranells, N.N., Franklin, D.H., Poore, M.H. and Green, J.T. (2007) Ground cover impacts on nitrogen export from manured riparian pasture. *Journal of Environmental Quality* Vol 36(1). Pg. 155-162.
- Department of Environment and Resource Management (2009) *Regional Ecosystems*. Viewed 4 November 2010. (www.derm.qld.gov.au/wildlife-ecosystems/biodiversity/regional_ecosystems/index)
- Department of Primary Industries and Fisheries (2009), *Landtypes of Queensland*. State of Queensland, Brisbane.
- McKergow, L., Prosser, I. and Heiner, D. (1999) *Preliminary results on the effectiveness of riparian buffers in Far North Queensland*. Second Australian Stream Management Conference. Adelaide.

Plant species commonly found in coastal riverine wetlands

Scientific name	Common Name
Grasses	
Chrysopogon fallax	Golden beard grass
Echinochloa inundata	Marsh/channel millet
Heteropogon spp.	Speargrass
Hymenachne acutigluma	Hymenachne
Imperata cylindrica	Blady grass
Leptochloa digitata	Umbrella cane grass
Paspalidium jubiflorum	Warrego (summer) grass
Phragmites australis	Common reed
Pseudoraphis spinescens	Spiny mudgrass
Sporobolus caroli	Fairy grass
Sedges and Rushes	
Bolboschoenus fluviatilis	Marsh club-rush
Cyperus exaltatus	Tall flatsedge/giant sedge
Eleocharis sphacelata	Tall spikerush
Philydrum lanuginosum	Frogsmouth
Typha domingensis	Cumbungi, bulrush
Legumes	
Sesbania cannabina	Sesbania pea
Vachellia farnesiana	Mimosa bush
Broadleaf herbs and shrubs	
Crinum pedunculatum	Mangrove lily
Ludwigia peploides	Water primrose
Muehlenbeckia florulenta	Lignum
Trees	
Acacia spp.	Wattle
Callistemon spp.	Bottlebrush
Casuarina spp.	She-oak
Corymbia spp.	Bloodwood
Corypha utan	Palm
Eucalyptus spp.	Gum tree
Grevillea spp.	Grevillea
Livistona spp.	Cabbage tree palm
Lophostemon spp.	Swamp box
Melaleuca spp.	Paperbark or tea-tree
Pandanus spp.	Screw pine
Waterlillies and other aquatic plants	
Blyxa spp.	Blyxa
Ceratophyllum demersum	Hornwort
Hydrilla verticillata	Hydrilla

Scientific name	Common Name
Waterlillies and other aquatic plants (continued)	
Marsilea spp.	Nardoo
Monochoria cyanea	Bog lily
Myriophyllum spp.	Water milfoil
Nelumbo nucifera	Pink lotus
Nymphaea spp.	Waterlillies
Nymphoides spp.	Marshworts
Ottelia alismoides	Ottelia
Ottelia ovalifolia	Swamp lily
Potamogeton spp.	Curly pondweed
Utricularia gibba	Yellow bladderwort
Vallisneria spp.	Ribbonweed
Introduced species and weeds	
Annona glabra	Pond apple
Baccharis halimifolia	Groundsel Bush
Brachiaria mutica	Paragrass
Cabomba caroliniana	Cabomba
Cryptostegia grandiflora	Rubber vine
Cyperus papyrus	Papyrus
Echinochloa polystachya	Aleman grass
Eichhornia crassipes	Water hyacinth
Hymenachne amplexicaulis	Olive hymenachne
Lantana camara	Lantana
Parkinsonia aculeata	Parkinsonia
Pistia stratiotes	Water lettuce
Salvinia molesta	Salvinia
Xanthium occidentale	Noogoora burr

Part 3: Appendixes

3.1 Wetland plant species list

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Grasses				
Chloris spp.	Windmill grass	Coastal grass, sedge, herb swamp	Throughout Queensland	Mainly summer, into autumn
Chrysopogon fallax	Golden beard grass	Coastal tree swamp wetlands, Coastal riverine wetlands	Throughout Queensland	Summer
Cynodon dactylon	Green couch	Estuarine wetlands, Coastal grass, sedge, herb swamp	Throughout Queensland	Primarily March to October but can flower most of year
Dichanthium sericeum	Queensland bluegrass	Coastal grass, sedge, herb swamp	Throughout most of Queensland	Late spring to autumn
Echinochloa inundata	Marsh/channel millet	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Occurs in the Leichardt, Burnett, Darling Downs and Warrego regions in QLD	Summer to autumn
Enteropogon acicularis	Curly windmill grass	Coastal grass, sedge, herb swamp	Throughout Queensland	Summer to Autumn in response to rain
Eriochloa spp.	Cup or spring grass	Coastal grass, sedge, herb swamp	Throughout Queensland	Spring to summer
Heteropogon spp.	Speargrass	Coastal grass, sedge, herb swamp, Coastal tree swamp wetlands, Coastal riverine wetlands	Throughout northern and eastern Queensland	Summer

	Grazing value	Longevity	Other notes	More information and photographs
	Young leaves sought after by stock	Perennial	Good for stabilising eroded and scalded areas	http://www.agric.wa.gov.au/objtwr/imported_assets/content/past/windmill%20grass.pdf
	Moderately to highly palatable when young and green. Digestibility and crude protein is moderate but declines during the dry season.	Perennial	Copes well with grazing, but does not provide enough feed in heavy grazing regimes. It responds rapidly to rain	http://www.nt.gov.au/d/Content/File/p/Pasture/431.pdf http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Chrysopogon~fallax
	Useful source of fodder, is palatable and nutritious and recovers quickly from grazing	Perennial	Can be invasive under heavy grazing regime	http://www.fao.org/ag/AGP/agpc/doc/gbase/data/Pf000208.HTM http://www.saltlandgenie.org.au/resources/saltdeck.htm http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/grasses-rushes-and-sedge-plants/greencouch
	Moderate grazing value, provides good quality feed and is palatable when young and green. A high yield species in wet years or conditions.	Perennial	It can tolerate moderate grazing, but declines under set stocking. Spell pastures when flowering and setting seeds.	http://www.pasturepicker.com.au/Html/Queensland_Bluegrass.htm Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries. http://www.fao.org/ag/AGP/agpc/doc/gbase/data/pf000216.htm http://www.dpi.nsw.gov.au/agriculture/field/pastures-and-rangelands/rangelands/publications/grassedup/species/bluegrass
	Productive, palatable, high quality grass.	Annual	Best suited to light-moderate stocking and spelling.	http://www.anbg.gov.au/apii/ump.show_public_image?v_umo=5810755&quality=ORIGINAL Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Young growth is moderately palatable and produces good growth after rain.	Perennial	Common in areas of light grazing.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Enteropogon~acicularis Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Useful green feed for stock as it is palatable and nutritious and is preferentially grazed in some instances.	Perennial	Continual grazing is not recommended and ideally would be rested during flowering. Populations decline under constant stocking and if grazed too low.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Eriochloa Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Palatable, with crude protein levels around 10% in early growth stages, but this declines rapidly with age.	Perennial	Relatively tolerant of grazing but will decline under heavy grazing pressure. It is especially suseptible to grazing pressure in the early part of the wet season. Fire can increase the proportion of this grass in pastures.	http://www.dpi.nsw.gov.au/agriculture/field/pastures-and-rangelands/rangelands/publications/grassedup/species/speargrass http://www.tropicalforages.info/key/Forages/Media/Html/Heteropogon_contortus.htm

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Grasses (continued)				
Hymenachne acutigluma	Hymenachne	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Northern Queensland	All year
Imperata cylindrica	Blady grass	Coastal tree swamp wetlands, Coastal riverine wetlands	Throughout coastal Queensland	Mostly summer
Ischaemum spp.		Coastal tree swamp wetlands, Estuarine wetlands, Coastal grass, sedge, herb swamp	Throughout coastal Queensland	Mostly summer
Leersia hexandra	Swamp rice grass	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp	Throughout coastal Queensland	All year
Leptochloa digitata	Umbrella cane grass	Coastal grass-sedge wetland, Coastal riverine wetlands	Throughout Queensland	Spring to autumn
Leptocholoa fusca formerly *Diplachne fusca*	Brown beetle grass	Estuarine wetlands, Coastal grass, sedge, herb swamp	Thoughout Queensland	Summer and autumn
Oryza meridionalis	Wild rice	Coastal grass, sedge, herb swamp	Northern Queensland	Summer to autumn
Panicum decompositum	Native millet	Coastal grass-sedge wetland, Estuarine wetlands	Throughout Queensland	Summer to autumn
Paspalidium jubiflorum	Warrego (summer) grass	Coastal grass-sedge wetland, Coastal riverine wetlands	Throughout Queensland	Summer to autum in response to rain

	Grazing value	Longevity	Other notes	More information and photographs
	Can withstand grazing and is a useful fodder. Often contains higher nutrients than other floodplain grasses during the dry season.	Perennial	A similar species, H. amplexicaulis has been introduced to Australia and is an invasive weed in Queensland wetlands.	Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Eaten by stock in the early stages of growth	Perennial	Fire is used to promote new green growth.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Imperata~cylindrica http://www.tropicalgrasslands.asn.au/Tropical%20Grasslands%20Journal%20archive/PDFs/Vol_15_1981/Vol_15_01_81_pp52_56.pdf
	Palatable, moderate nutritional value	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Ischaemum http://www.agbiz.com.au/Library/beefeconomics_cq_LowRes.pdf
	Eaten by stock, a valuable native pasture in floodplains providing dry season feed.	Perennial	Suitable for bank stabilisation and preventing erosion	http://www.nt.gov.au/d/Content/File/p/Technote/TN104.pdf Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Young plants eaten by stock. Older plants are unpalatable.	Perennial	Leaf production is best when growing in water. An abundance of this species, may indicate overgrazing. Good for stabilising creek banks.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Leptochloa~digitata Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Very palatable, productive and of moderate diet quality. Moderate energy and high crude protein levels.	Annual or perennial	Recovers from grazing, but requires some spelling. Stays green well after the water has receded.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Diplachne~fusca Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Grazed, more heavily late in the season.	Annual	Dormant as seed during mid-late dry season. It is important food for magpie geese, brolga and other native animals. Magpie geese time breeding cooincides with seeding of wild rice (March-April)	http://www.knowledgebank.irri.org/wildricetaxonomy/meridionalis/Oryza_meridionalis.htm http://www.publish.csiro.au/?act=view_file&file_id=WR9860433.pdf
	Valuable forage, high bulk and highly palatable	Perennial	Manage pasture with moderate stocking and rotational grazing to prevent plants becoming tall and rank. Decreases under heavy stocking.	http://www.tropicalgrasslands.asn.au/Tropical%20Grasslands%20Journal%20archive/PDFs/Vol_39_2005/Vol_39_03_2005_pp160_170.pdf http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Panicum~decompositum Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Palatable and favoured by stock. It has a high feed quality when green and also provides useful forage when hayed off.	Perennial	Will thicken up if rested over summer.	http://www.dpi.nsw.gov.au/agriculture/field/pastures-and-rangelands/rangelands/publications/grassedup/species/warrego http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Paspalidium~jubiflorum Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Grasses (continued)				
Paspalum distichum	Water couch	Estuarine wetlands, Coastal grass, sedge, herb swamp	Throughout Queensland	Late spring to autumn
Paspalum vaginatum	Salt water couch	Estuarine wetlands, Coastal grass-sedge wetland	Throughout coastal Queensland	Late spring to autumn
Phragmites australis	Common reed	Coastal tree swamp wetlands, Estuarine wetlands, Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Summer to autumn, mainly spreads via rhizomes
Pseudoraphis spinescens	Spiny mudgrass	Coastal grass-sedge wetland, Coastal riverine wetlands	Throughout Queensland	Throughout the year, mainly after summer rains
Sporobolus caroli	Fairy grass	Coastal grass-sedge wetland, Coastal riverine wetlands	Throughout Queensland	Late spring to autumn, in response to rain
Sporobolus virginicus	Saltwater/marine couch	Coastal tree swamp wetlands, Estuarine wetlands, Coastal grass, sedge, herb swamp	Throughout Queensland	All year, mostly early summer to autumn
Themeda triandra	Kangaroo grass	Coastal tree swamp wetlands	Throughout Queensland	Summer to autumn
Xerochloa imberbis	Swamp rice grass	Estuarine wetlands, Coastal grass, sedge, herb swamp	Northern Queensland, north of Cardwell	April to October
Zoysia macrantha	Prickly couch	Estuarine wetlands	Southern Queensland coastal areas	Summer

	Grazing value	Longevity	Other notes	More information and photographs
	Valuable pasture, good energy levels but low protein. The leaf and stem is both palatable.	Perennial	Can grow rapidly, especially in wet conditions. Avoid grazing if the soil is wet. Provides valuable feed for a variety of native animals.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Paspalum~distichum Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Palatable	Perennial	Persists with heavy grazing	http://www.agric.wa.gov.au/objtwr/imported_assets/content/past/salt%20water%20couch.pdf http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Paspalum~vaginatum
	Useful fodder when young, older leaves have lower palatability. High leaf production and crude protein levels	Perennial	Cool winter burning, when soils are moist, is good for maintaining reed beds. It requires spelling at least every second year.	http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/grasses-rushes-and-sedge-plants/common-reed Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Grazed by stock.	Perennial	Important in the diet of ducks in late summer to autumn	http://www.publish.csiro.au/?act=view_file&file_id=WR9790319.pdf Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Nutritious and palatable, but provides little bulk	Annual or perennial	Can provide good feed for short periods. Population declines with continual grazing due to high palatability. Important food for wallabies during summer	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Sporobolus~caroli http://www.publish.csiro.au/?act=view_file&file_id=WR9910403.pdf Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Narrow-leaved forms can provide useful grazing fodder and is important for cattle during the dry season in north QLD. High in protein and minerals	Perennial	Excellent plant for rehabilitating estuarine wetlands	http://www.saltlandgenie.org.au/resources/saltdeck.htm http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/grasses-rushes-and-sedge-plants/saltcouch
	Excellent fodder. Very palatable when young but is only moderately nutritious	Perennial	Requires frequent spelling or low stocking as it will not tolerate continuous grazing	http://www.dpi.nsw.gov.au/agriculture/field/pastures-and-rangelands/rangelands/publications/grassedup/species/kangaroo-grass http://www.florabank.org.au/lucid/key/Species%20Navigator/Media/Html/Themeda_triandra.htm
	Unknown	Perennial which can die back to rhizomes during the dry season.	Important food source for star finches during the early wet season. Inappropriate fire and grazing regimes are a threat to the population through removal of this important food source.	http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/grasses-rushes-and-sedge-plants/rice-grass http://www.publish.csiro.au/?act=view_file&file_id=MU04020.pdf
	Unknown	Perennial	Used as a turf grass, and is able to withstand cropping	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Zoysia~macrantha

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Sedges and Rushes				
Baumea articulata	Jointed twigrush	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp	Eastern coast of Queensland	November–April
Baumea rubiginosa	Soft twigrush	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp	Eastern Queensland	Spring to summer
Bolboschoenus fluviatilis	Marsh club-rush	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Eastern Queensland	Spring to summer
Carex appressa	Tall sedge	Coastal grass, sedge, herb swamp	Eastern Queensland	Late winter to summer
Cyperus difformis	Dirty dora/ rice sedge	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp	Throughout Queensland	All year
Cyperus digitatus	Sedge	Coastal grass, sedge, herb swamp	Throughout coastal Queensland	All year
Cyperus exaltatus	Tall flatsedge/giant sedge	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	All year
Cyperus polystachyos	Bunchy sedge	Estuarine wetlands, Coastal grass, sedge, herb swamp	Throughout Queensland	All year
Cyperus trinervis	Sedge	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp	Throughout coastal Queensland	Spring and autumn
Cyperus victoriensis	Yelka, flat-sedge	Estuarine wetlands, Coastal grass, sedge, herb swamp	Throughout Queensland	Spring to autumn

	Grazing value	Longevity	Other notes	More information and photographs
	Unknown	Perennial	Provides bird nesting sites, shelter and food in the form of nuts	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Baumea~articulata Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Unknown	Perennial	Provides important food source and nesting sites for water birds	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Baumea~rubiginosa
	Young, leafy plants eaten by stock providing a good maintanince feed.	Perennial	Requires low stocking rates or frequent, long spelling and avoid grazing when soil is likely to pug. Some grazing prevents a monoculture of this species. Good shelter and breeding sites for native wildlife.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Bolboschoenus~fluviatilis Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Rarely grazed by stock. Low energy and protein levels in winter.	Perennial	Good for stabilising banks and provides some habitat value for wildlife.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Carex~appressa Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Rarely grazed. Young plants have moderate feed quality. But the plant is generally of low nutritional value.	Annual	Useful for bank stabilisation. Food for waterbirds.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Cyperus~difformis Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Edible and can be eaten by cattle.	Perennial		Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Unknown	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Cyperus~exaltatus Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Unknown	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Cyperus~polystachyos Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Unknown	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Cyperus~trinervis Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Not readily grazed, but may be grazed when young. Has some nutritional value.	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Cyperus~victoriensis

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Sedges and rushes (continued)				
Cyperus spp.	Sedge	Coastal tree swamp wetlands, Estuarine wetlands, Coastal grass, sedge, herb swamp	Throughout Queensland	All year
Dapsilanthus ramosus	Saw-Sedge	Coastal tree swamp wetland	Northern Queensland	
Eleocharis dulcis	Bulkuru	Estuarine wetlands, Coastal grass, sedge, herb swamp	Throughout coastal Queensland	Summer
Eleocharis plana	Ribbed spikerush	Coastal grass, sedge, herb swamp	Southern and central Queensland, south of Townsville	All year
Eleocharis sphacelata	Tall spikerush	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout coastal Queensland	Spring to autumn
Eleocharis spp.	Spikerush	Coastal grass, sedge, herb swamp	Throughout Queensland, except the far west	Spring to autumn
Fimbristylis spp.	Rusty sedge	Estuarine wetlands, Coastal grass, sedge, herb swamp	Throughout Queensland	May–July
Gahnia sieberiana	Saw-Sedge	Coastal tree swamp wetlands	Throughout eastern Queensland	Spring to summer
Isolepis cernua	Nodding club rush	Estuarine wetlands	South-east Queensland	September–March
Isolepis nodosa	Knobby club rush	Estuarine wetlands, Coastal tree swamp wetlands	South-east Queensland	All year
Juncus kraussii	Jointed rush	Estuarine wetlands, Coastal grass, sedge, herb swamp	South-east Queensland	All year
Juncus bufonius	Toad rush	Estuarine wetlands, Coastal grass, sedge, herb swamp	South-east Queensland	Spring to summer

	Grazing value	Longevity	Other notes	More information and photographs
	Unknown	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Cyperus
	Unknown	Perennial		
	Foliage eaten by cattle. Nutritionally adequate protein concentration.	Annual. Dormant as below ground bulbs during mid-late dry season	Bulkuru is a resilient species in grazed areas as the sedge regrows from below ground parts in the wet season when inundation restricts stock access. Fruits are important food for magpie geese and brolga	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Eleocharis~dulcis
	Grazed. Good protein levels when green	Perennial	Able to withstand grazing pressure if regularly flooded. Used by waterbirds for nesting sites. Good for stabilising the banks of dams.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Eleocharis~plana Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Palatable when green. Good for maintaining dry stock only. Low energy and protein levels.	Perennial	Cattle often push over plants and use as a resting area. Declines if it is grazed below the water level. Used by waterbirds for nesting sites, food and shelter.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Eleocharis~sphacelata Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Occasionally grazed	Perennial or annual	Used by waterbirds for nesting sites. Good for stabilising the banks of dams.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Eleocharis Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Unknown	Perennial		http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/grasses-rushes-and-sedge-plants/rusty-sedge
	Unknown	Perennial	Valuable species for birds and insects.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Gahnia~sieberiana
	Low bulk.	Both annual and perennial	Good ground cover, although short lived.	http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/grasses-rushes-and-sedge-plants/nodding-club-rush
	Unlikely to be heavily grazed.	Perennial	Good ground cover	http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/grasses-rushes-and-sedge-plants/knobby-club-rush
	Unlikely to be heavily grazed.	Perennial	Good for stabilising banks and treating runoff.	http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/grasses-rushes-and-sedge-plants/jointed-rush
	Grazed by stock, little bulk	Annual - short lived when conditions become dry		http://www.saltlandgenie.org.au/resources/saltdeck.htm http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/grasses-rushes-and-sedge-plants/toad-rush

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Sedges and rushes (continued)				
Lepironia articulata		Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp	Throughout coastal Queensland	All year
Philydrum lanuginosum	Frogsmouth	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout coastal Queensland	September–May
Schoenoplectus spp.	Schoenoplectus	Estuarine wetlands, Coastal grass, sedge, herb swamp	Eastern and northern Queensland	All year
Schoenus brevifolius	Bogrush	Coastal tree swamp wetlands	Throughout eastern Queensland	Spring to summer
Scleria spp.		Coastal grass, sedge, herb swamp	Throughout coastal Queensland	Summer
Triglochin striata	Streaked arrow grass	Estuarine wetlands, Coastal grass, sedge, herb swamp	Southern and central Queensland, south of Mackay	Spring to autumn
Typha domingensis	Cumbungi, bulrush	Estuarine wetlands, Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Most of year, but predominantly September–May
Legumes				
Aeschynomene indica	Buddha pea	Coastal grass, sedge, herb swamp	Throughout Queensland	Summer and autumn
Medicago spp.	Burr/Barrel medic	Coastal grass, sedge, herb swamp	Southern and central Queensland	Spring to summer
Sesbania cannabina	Sesbania pea	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Late spring to autumn

	Grazing value	Longevity	Other notes	More information and photographs
	Unknown	Perennial	Good for bank stabilisation and providing habitat for wildlife.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Lepironia~articulata Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Potentially unpalatable	Perennial	Suspected of poisoning stock	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Philydrum~lanuginosum Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Unknown	Perennial	Useful for bank stabilisation	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Schoenoplectus Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Unknown	Perennial	Often grows in tree swamp and heath habitats which have little grazing value, but are very important habitats for a variety of native animals.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Schoenus~brevifolius
	Unknown	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Scleria
	Palatable to sheep, moderate feed energy value	Perennial	Recovers slowly from grazing	http://www.saltlandgenie.org.au/resources/saltdeck.htm http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/grasses-rushes-and-sedge-plants/streaked-arrow-grass
	Young growth grazed by cattle, mainly during feed shortages. Low palatability, energy and protein levels.	Perennial	Useful for preventing erosion of creek banks. Control, where necessary, can be achieved by cutting plants below the waterline in Autumn, heavy grazing, mechanical removal or herbicide.	Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Protein rich and productive high quality feed.	Annual	Not readily eaten while green and can even be toxic. Graze when plants have dried off.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Aeschynomene~indica Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Palatable and nutritious, providing a good early or winter feed. High nutritive value and high protein content.	Annual	May cause animal health problems in pure stands.	http://www.pasturepicker.com.au/Html/Barrel_medic.htm http://www.saltlandgenie.org.au/resources/saltdeck.htm Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Palatable, good quality feed when young. Good energy and protein levels.	Annual	Nitrogen fixing, therefore can help support the growth of other plants.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Sesbania~cannabina Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Legumes (continued)				
Vachellia farnesiana	Mimosa bush	Coastal riverine wetlands	Throughout Queensland	All year
Succulent plants				
Batis argillicola	Batis	Estuarine wetlands	Northern Queensland	June–October
Carpobrotus glaucescens	Pigface	Estuarine wetlands	South-east Queensland	March to August
Dissocarpus biflorus	Twin flower saltbush	Estuarine wetlands	Central Queensland, between Bundaberg and Cardwell	May–July
Dysphania littoralis	Red crumbweed	Estuarine wetlands	Southern and Central Queensland south of Cardwell	All year
Enchylaena tomentosa	Ruby saltbush	Estuarine wetlands	Throughout Queensland	Primarily September–May but can flower most of year
Halosarcia spp.	Glassworts	Estuarine wetlands	Throughout coastal Queensland	Southern QLD: December–march, North QLD: June–July
Portulaca spp.	Pigweed	Estuarine wetlands	Throughout Queensland	Most species summer, some all year
Salsola kali	Prickly saltwort/soft roly-poly	Estuarine wetlands, Coastal grass, sedge, herb swamp	Most of coastal Queensland, except Cape York peninsula	September–March
Sarcocornia quinqueflora	Bead weed	Estuarine wetlands	Throughout coastal Queensland	November–february
Sesuvium potulacastrum	Sea purslane	Estuarine wetlands	Throughout coastal Queensland	All year
Suaeda spp.	Seablite	Estuarine wetlands	Along the eastern Queensland coast	September–May
Tecticornia australasica	Grey samphire	Estuarine wetlands	Northern Queensland, north of Mackay	June to December

	Grazing value	Longevity	Other notes	More information and photographs
	Has some feed value, especially the protein-rich pod. Valuable feed for sheep and goats	Perennial	Despite being native, it can become weedy and may need to be controlled via sheep/goat grazing or herbicides, in keeping with state legislation.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Vachellia~farnesiana Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Very salty, so fodder value is limited.	Perennial		http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/batis
	Edible but salty	Perennial	Useful for sandy dune stabilisation.	http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/pigface
	Unknown	Short-lived perennial		http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/twin-flower-saltbush
	Only grazed when stock are hungry. Toxic to cattle, sheep and horses.	Annual	Prevent hungry stock having access to this plant.	http://www.weeds.mangrovemountain.net/data/Dysphania%20spp%20-%20Red%20crumbweed.pdf http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/red-crumbweed
	Palatability varies and it may be grazed, but is not suitable as a sole food source	Perennial	Sensitive to overgrazing and may contain high levels of oxalates	http://www.pasturepicker.com.au/Html/Ruby_saltbush.htm http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/ruby-saltbush
	Young plants are palatable but limited grazing value due to extreme salt accumulation. High crude protein.	Perennial	Slow growing and suseptible to trampling by stock	http://www.saltlandgenie.org.au/resources/saltdeck.htm http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/glasswort
	Very palatable	Annual or short-lived perennial	If eaten excessively by hungry sheep or cattle, may cause problems from oxalate and nitrate poisoning	http://www.saltlandgenie.org.au/resources/saltdeck.htm http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/pigweed
	Young plants are grazed, moderate palatability.	Annual or biennial	Accumulates nitrates when young, can also contain oxalates and may be toxic to stock. May be an indicator of overgrazing or other degradation.	http://www.weeds.mangrovemountain.net/data/Salsola%20kali%20-%20Soft%20roly%20poly.pdf http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/prickly-saltwort Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Moderate forage energy and crude protein levels	Perennial	Prone to defoliation and trampling from cattle and is slow to recover	http://www.saltlandgenie.org.au/resources/saltdeck.htm http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/bead-weed
	Unknown	Perennial		http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/sea-purslane
	Unknown	Perennial		http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/seablite
	Unknown	Annual - germinates March to April and after heavy rainfall		http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/succulent/grey-samphire

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Broadleaf herbs and shrubs				
Acrostichum speciosum	Mangrove fern	Estuarine wetlands, Coastal tree swamp wetlands	Throughout eastern Queensland	Reproduces via spores all year
Atriplex semibaccata	Creeping saltbush	Estuarine wetlands	Southern and central Queensland, south of Cardwell	All year
Blechnum spp.	Ferns	Coastal tree swamp wetlands	Throughout Queensland	Reproduces via spores all year
Boronia spp.	Boronia	Coastal tree swamp wetlands	Throughout Queensland	Varies
Crinum pedunculatum	Mangrove lily	Estuarine wetlands, Coastal tree swamp wetlands, Coastal riverine wetlands	Throughout eastern Queensland	Spring–summer
Durringtonia paludosa	Durringtonia	Coastal tree swamp wetlands	Southern Queensland	Spring-summer
Limonium spp	Native sea lavender	Estuarine wetlands	Southern and central Queensland, south of Townsville	September–March
Ludwigia peploides	Water primrose	Coastal grass, sedge, herb swamp, coastal riverine wetlands	Throughout Queensland	October–April
Lycopodiella serpentina	Bog clubmoss	Coastal tree swamp wetlands	Throughout eastern Queensland	Reproduces via spores
Lygodium microphyllum	Climbing maidenhair	Coastal tree swamp wetlands	Throughout coastal Queensland	Reproduces via spores
Muehlenbeckia florulenta	Lignum	Coastal riverine wetlands	Throughout Queensland	Summer
Phaius spp.	Swamp orchid	Coastal tree swamp wetlands	Eastern Queensland	Spring

	Grazing value	Longevity	Other notes	More information and photographs
	Edible.	Perennial	Dominates in areas that have been cleared or disturbed.	http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-2425.html http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Acrostichum~speciosum
	Good crude protein and low energy value. Very palatable when young. Leaves contain up to 25% salt so good drinking water and supplements are required.	Perennial	Easily overgrazed if set stocked	http://www.saltlandgenie.org.au/resources/saltdeck.htm http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/other-plant-types/creeping-saltbush
	Unknown	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Blechnum
	Grazed.	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Boronia
	Unknown	Perennial		http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-2829.html http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Crinum~pedunculatum
	Unknown	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Durringtonia~paludosa
	Unknown	Perennial		http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/other-plant-types/native-sea-lavender
	Foliage may be rarely eaten by cattle. Feed quality is fairly good.	Perennial	Can become a weed in high nutrient areas. Has been suspected in causing gastro-enteritis in stock.	http://www.weeds.mangrovemountain.net/data/Ludwegia%20peruviana%20-%20Ludwegia.pdf Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	May be grazed by cattle.	Perennial	Can be easily damaged by grazing and trampling by stock.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Lycopodiella~serpentina http://florabase.calm.wa.gov.au/browse/profile/12783
	Unknown	Perennial		http://florabase.calm.wa.gov.au/browse/profile/21 http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Lygodium~microphyllum
	Not often grazed. Leaves have moderate feed value, but generally low energy and protein.	Perennial	Can make mustering difficult when very dense. Regenerates rapidly after fire or overgrazing and prevents erosion.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Muehlenbeckia~florulenta Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries. Sainty, G.R. and Jacobs, S.W.L. (2003) *Waterplants in Australia*. Sainty and Associates,
	May be grazed by cattle.	Perennial	Many species listed as endangered. Threatened by frequent fire and trampling and grazing by stock and feral pigs.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Phaius http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10610 http://asgap.org.au/p-tan.html

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Broadleaf herbs and shrubs (continued)				
Samolus repens	Creeping bushweed	Estuarine wetlands	South-East Queensland	September–March
Sprengelia sprengelioides	Sprengelia	Coastal tree swamp wetlands	Southern Queensland	June-September
Stenochlaena palustris	Climbing swamp fern	Coastal tree swamp wetlands	North-eastern Queensland	Reproduces via spores
Trees				
Acacia spp.	Wattle	Coastal tree swamp wetlands, Coastal riverine wetlands	Throughout Queensland	Varies
Aegialitis annulata	Club mangrove	Estuarine wetlands	Coastal Queensland	November-March
Aegiceras corniculatum	River mangrove	Estuarine wetlands	Coastal Queensland	June-September
Avicennia marina	Grey mangrove	Estuarine wetlands	Coastal Queensland	January-May
Bruguiera spp.	Orange mangrove	Estuarine wetlands	Coastal Queensland	Spring-summer
Callistemon spp.	Bottlebrush	Coastal riverine wetlands	Throughout Queensland	Varies
Casuarina spp.	She-oak	Coastal tree swamp wetlands, Coastal riverine wetlands	Throughout Queensland	Varies
Ceriops spp.	Yellow mangrove	Estuarine wetlands	Coastal Queensland	November-March
Corymbia spp.	Bloodwood	Coastal tree swamp wetlands, Coastal riverine wetlands	Throughout Queensland	Varies
Corypha utan	Palm	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Far north Queensland	Only flower at the end of their life.
Eucalyptus spp.	Gum tree	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Varies
Excoecaria agallocha	Blind-your-eye mangrove	Estuarine wetlands	Coastal Queensland	November-February

	Grazing value	Longevity	Other notes	More information and photographs
	Generally not eaten by stock	Perennial		http://www.saltlandgenie.org.au/resources/saltdeck.htm http://www.alocasia.com.au/qld_saltmarsh_plants/herbarium/other-plant-types/creeping-bushweed
	Unknown	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Sprengelia~sprengelioides
	Edible.	Perennial	Eaten by humans as a vegetable.	http://www.anbg.gov.au/fern/aquatic/blechnaceae.html
	Grazed.	Perennial	A useful forage during drought. Improves soil health by fixing nitrogen.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Acacia http://www.daff.gov.au/brs/publications/series/forest-profiles/australian_forest_profiles_acacia
	Seedlings or young leaves may be grazed when other food not available.	Perennial	Salt secreted through glands on the leaves	http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-3031.html http://www.mycapricorncoast.com/plants/clubmyrtlemangrove.html
	Seedlings or young leaves may be grazed when other food not available.	Perennial	Salt secreted through glands on the leaves	http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-3233.html
	Seedlings or young leaves may be grazed when other food not available.	Perennial	Salt secreted through glands on the leaves	http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-5051.html http://www.mycapricorncoast.com/plants/greymangrove.html
	Seedlings or young leaves may be grazed when other food not available.	Perennial		http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-5657.html http://www.mycapricorncoast.com/plants/lorangemangrove.html
	Seedlings or young leaves may be grazed when other food not available.	Perennial	Useful for bank stabilisation.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Callistemon
	Cattle may graze new shoots. It is high in tannins.	Perennial	A useful forage during drought. Improves soil health by fixing nitrogen.	http://www.mycapricorncoast.com/plants/casuarina%20pandanus.html http://www.daff.gov.au/brs/publications/series/forest-profiles/australian_forest_profiles_casuarina
	Seedlings or young leaves may be grazed when other food not available.	Perennial		http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-6061.html http://www.mycapricorncoast.com/plants/red-yellowmangroves.html
	Seedlings or leaves may be grazed.	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Corymbia
	Unknown	Perennial		http://www.pacsoa.org.au/palms/Corypha/utan.html
	Seedlings or leaves may be grazed.	Perennial	Grazing of young trees usually only occurs when stock are starved of other forage.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Eucalyptus
	Unlikely, due to toxic sap.	Perennial	Milky white sap is toxic	http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-3637.html

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Trees (continued)				
Excoecaria parvifolia	Gutta-percha	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp	Northern Queensland	
Grevillea spp.	Grevillea	Coastal tree swamp wetlands, Coastal riverine wetlands	Throughout Queensland	Varies
Livistona spp.	Cabbage tree palm	Coastal tree swamp wetlands, Coastal riverine wetlands	East coast of Queensland	Summer
Lophostemon spp.	Swamp box	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Spring-summer
Lumnitzera spp.	Black mangrove	Estuarine wetlands	Coastal Queensland	November-February
Melaleuca spp.	Paperbark or tea-tree	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Varies
Osbornia octodonta	Myrtle mangrove	Estuarine wetlands	Coastal Queensland	December-February
Pandanus spp.	Screw pine	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	All year
Rhizophora spp.	Red or tall-stilted mangrove	Estuarine wetlands	Coastal Queensland	February-April
Xanthorrhoea spp.	Grass tree	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp	Throughout Queensland	Sporadic
Xylocarpus spp	Cedar or cannonball mangrove	Estuarine wetlands	Coastal Queensland	Spring-summer
Waterlillies and other aquatic plants				
Blyxa spp.	Blyxa	Coastal grass, sedge, herb swamp, coastal riverine wetlands	Throughout north Queensland	Varies
Ceratophyllum demersum	Hornwort	Coastal grass, sedge, herb swamp, coastal riverine wetlands	Throughout Queensland	Flowers underwater
Ceratopteris thalictroides	Water fern	Coastal grass, sedge, herb swamp	Throughout coastal Queensland	Reproduces via spores

	Grazing value	Longevity	Other notes	More information and photographs
	Unlikely, due to toxic sap.	Perennial	Milky white sap is an irritant	http://www.anbg.gov.au/images/photo_cd/9J18G113797/063.html
	May be grazed by cattle.	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Grevillea
	Young plants may be grazed.	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Livistona~australis
	Seedlings or leaves may be grazed.	Perennial		http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Lophostemon
	Seedlings or young leaves may be grazed when other food not available.	Perennial		http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-4041.html
	Seedlings or leaves may be grazed.	Perennial		http://www.daff.gov.au/brs/publications/series/forest-profiles/australian_forest_profiles_melaleuca http://www.epa.qld.gov.au/wetlandinfo/resources/static/pdf/Profiles/p01781aa.pdf
	Seedlings or young leaves may be grazed when other food not available.	Perennial		http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-3435.html http://www.mycapricorncoast.com/plants/clubmyrtlemangrove.html
	Young plants are grazed	Perennial		http://www.mycapricorncoast.com/plants/casuarina%20pandanus.html
	Seedlings or young leaves may be grazed when other food not available.	Perennial	Distinctive large stilt (prop) roots.	http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-4647.html http://www.mycapricorncoast.com/plants/red-yellowmangroves.html
	Not normally eaten.	Perennial	The young flower spike can be toxic to cattle. Poisoning tends to occur autumn to early winter, in poor country and when fodder protein levels are low.	http://www.weeds.mangrovemountain.net/data/Xanthorrhoea%20spp.pdf
	Seedlings or young leaves may be grazed when other food not available.	Perennial	Deciduous over the dry season, large fruits	http://www.aims.gov.au/pages/reflib/fg-mangroves/pages/fgm-5455.html
	Edible	Annual		Sainty, G.R. and Jacobs, S.W.L. (2003) *Waterplants in Australia*. Sainty and Associates,
	Edible	Perennial	Food source for birds and other aquatic animals	Sainty, G.R. and Jacobs, S.W.L. (2003) *Waterplants in Australia*. Sainty and Associates, http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Ceratophyllum~demersum
	Edible	Perennial	Edible to humans	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Ceratopteris~thalictroides http://www.epa.qld.gov.au/wetlandinfo/resources/static/pdf/Profiles/p01781aa.pdf

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Waterlillies and other aquatic plants (continued)				
Hydrilla verticillata	Hydrilla	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Summer
Marsilea spp.	Nardoo	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Reproduce via spores, all year
Monochoria cyanea	Bog lily	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	December–April
Myriophyllum spp.	Water milfoil	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	September–December
Nelumbo nucifera	Pink lotus	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Northern Queensland	Spring to autumn
Nymphaea spp.	Waterlillies	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Spring to autumn
Nymphoides spp.	Marshworts	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Mostly spring to autumn
Ottelia alismoides	Ottelia	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout coastal Queensland	Spring to autumn

	Grazing value	Longevity	Other notes	More information and photographs
	Good crude protein levels, but low palatability.	Perennial	Provides good habitat for fish	Sainty, G.R. and Jacobs, S.W.L. (2003) *Waterplants in Australia*. Sainty and Associates, http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Hydrilla~verticillata http://www.vetscan.co.in/v5n1/study_on_nutritional_potential_of_aquatic_plants.htm
	Grazed occasionally by cattle and sheep. High in starch, tannins and fibre.	Perennial	Can be toxic to stock under certain conditions, e.g. inland floodplains in years of heavy rain fall as the new growth is more toxic than old material	Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Marsilea Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Palatable.	Perennial	Fruits and seeds eaten by waterbirds.	Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Monochoria~cyanea
	Readily eaten by stock and provides bulk during summer. Low fibre content but high in crude protein.	Perennial	It contains hydrogen cyanide in varying concentrations, from zero to strong and may cause cattle health problems and scour.	Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Myriophyllum Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Edible.	Perennial	The flowers, seeds, young leaves and roots are edible.	Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Edible.	Annual or perennial	Indigenous Australians ate the roots, fruit and flower stalks of waterlillies.	Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Nymphaea~gigantea
	Foliage may be occasionally grazed by cattle	Perennial, but may die back in winter	Provides shelter and food for birds and aquatic animals.	Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Nymphoides Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Possibly grazed.	Annual or perennial	Provides habitat for aquatic wildlife.	Sainty, G.R. and Jacobs, S.W.L. (2003) *Waterplants in Australia*. Sainty and Associates,

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Waterlillies and other aquatic plants (continued)				
Ottelia ovalifolia	Swamp lily	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Spring to autumn
Potamogeton spp.	Curly pondweed	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Spring to autumn
Utricularia gibba	Yellow bladderwort	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Spring to Summer
Vallisneria spp.	Ribbonweed	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Summer
Introduced species and weeds				
Annona glabra	Pond apple*	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp, Estuarine wetlands, Coastal riverine wetlands	North-eastern Queensland	December–February
Baccharis halimifolia	Groundsel Bush*	Coastal tree swamp wetlands, Estuarine wetlands, Coastal riverine wetlands	South-east Queensland	Mostly autumn
Brachiaria mutica	Paragrass*	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	Summer–Autumn

	Grazing value	Longevity	Other notes	More information and photographs
	Foliage grazed by cattle but not very palatable. Eaten by stock during periods of drought.	Annual or perennial	Provides habitat for aquatic wildlife. It can completely cover wetlands, affecting stock access to water.	Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Ottelia~ovalifolia Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Edible	Annual or perennial	Provides food for waterbirds and habitat for fish	Sainty, G.R. and Jacobs, S.W.L. (2003) *Waterplants in Australia*. Sainty and Associates, http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Potamogeton
	Unknown	Perennial		Sainty, G.R. and Jacobs, S.W.L. (2003) *Waterplants in Australia*. Sainty and Associates, http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Utricularia~gibba
	Unknown	Annual or perennial	Habitat for aquatic animals	Sainty, G.R. and Jacobs, S.W.L. (2003) *Waterplants in Australia*. Sainty and Associates, http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&showsyn=&dist=&constat=&lvl=sp&name=Vallisneria~gigantea
	Low feed value and is suspected of poisoning stock.	Perennial	A highly invasive Weed of National Significance. It can rapidly dominate wetland habitats outcompeting native plants and altering habitat values for fish and wildlife and has the potential to invade agricultural areas. Control can be difficult as pond apple occurs in often inaccessible areas where machinery, fire and herbicide use is not appropriate.	http://www.weeds.org.au/WoNS/pondapple/docs/pond_apple_MM.pdf http://www.dpi.qld.gov.au/4790_7341.htm
	Low feed value and is suspected of poisoning stock.	Perennial	Rapidly colonises disturbed areas, especially overgrazed pastures. Can outcompete native plants in tree swamp wetlands. Control with a combination of fire, slashing, revegetation and biological control.	http://www.weeds.org.au/cgi-bin/weedident.cgi?tpl=plant.tpl&ibra=all&card=S16 http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Groundsel-Bush-PP13.pdf
	Vigorous, productive and very palatable. Moderate to high feed quality.	Perennial	Introduced for its use as a ponded pasture species, it is tolerant of heavy grazing. It readily invades natural wetlands, outcompeting native species and degrading water quality. It can be controlled, although not eliminated, through an integrated program of fire and grazing.	http://www.tropicalforages.info/key/Forages/Media/Html/Brachiaria_mutica.htm Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Introduced species and weeds (continued)				
Cabomba caroliniana	Cabomba*	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout coastal Queensland	All year
Cryptostegia grandiflora	Rubber vine*	Coastal tree swamp wetlands, Coastal riverine wetlands, estuarine wetlands	Throughout Queensland	October–April
Cyperus papyrus	Papyrus*	Coastal tree swamp wetlands, Coastal riverine wetlands	South-east Queensland	Most of the year
Echinochloa colona	Awnless barnyard grass*	Coastal grass, sedge, herb swamp	Throughout Queensland	All year
Echinochloa polystachya	Aleman grass*	Coastal grass, sedge, herb swamp, Coastal tree swamp wetlands, Coastal riverine wetlands	Coastal Queensland	Spreads mainly through vegetative reproduction.
Eichhornia crassipes	Water hyacinth*	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout Queensland	October–July
Hymenachne amplexicaulis	Olive hymenachne*	Coastal tree swamp wetlands, Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout coastal Queensland	Can be throughout the growing season, but peaks March-June
Lantana camara	Lantana*	Coastal tree swamp wetlands, Coastal riverine wetlands	Throughout eastern Queensland	October–April

	Grazing value	Longevity	Other notes	More information and photographs
	Unlikely to be grazed	Perennial	Obstructs waterflow and dominates in nutrient-rich wetlands. It has little value to wildlife.	http://www.weeds.gov.au/publications/guidelines/wons/pubs/c-caroliniana.pdf Sainty, G.R. and Jacobs, S.W.L. (2003) *Waterplants in Australia*. Sainty and Associates,
	Poisonous to stock	Perennial	A weed of National Significance which smothers native vegetation and causes loss of pastures and grazing land. Can be controlled through an integrated program of biological control, fire and herbicide.	http://www.weeds.org.au/WoNS/rubbervine/ http://www.dpi.qld.gov.au/4790_7348.htm
	Young shoots may be grazed by cattle. The crude protein and digestibility of the plant decreases with increasing age.	Perennial	Introduced species which can displace native species	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Cyperus~papyrus Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria http://www.jstor.org/stable/4255129
	Useful fodder, palatable and nutritious	Annual	Introduced from Asia and Africa and has become naturalised in Queensland. Potential to become weedy in disturbed areas.	http://cms.jcu.edu.au/discovernature/weedscommon/JCUDEV_011751 Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Productive and very palatable.	Perennial	Introduced from America as a ponded pasture species. It can grow in water over 2m deep, which makes it a threat to open water areas, fish habitat and breeding habitats for waterbirds. An integrated control program is required.	http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Aleman-Grass-Risk-Assessment.pdf http://www.dpi.qld.gov.au/4790_12756.htm
	Leaves and flowers can be grazed, but is less palatable than other wetland plants. Good energy, low protein.	Perennial	Declared weed as it can rapidly divide and choke wetlands. Can restrict stock access to water and lead to a decline in water quality. An integrated management plan is required to control this weed, through a combination of mechanical removal, biological treatment or herbicide.	http://www.dpi.qld.gov.au/4790_7386.htm Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Not as palatable as some other tropical forages. It is a nutritious, high quality feed, especially during the dry season.	Perennial	A weed of national significance, due to its rapid invasion and dominance in wetlands, drainage channels and other wet areas. Control is difficult, but an integrated program of fire, herbicide and grazing can help to reduce the impacts of hymenachne. Shade, through tree cover, can also assist with control.	http://www.tropicalforages.info/key/Forages/Media/Html/Hymenachne_amplexicaulis.htm http://www.weeds.gov.au/publications/guidelines/wons/h-amplexicaulis.html
	May be toxic to stock	Perennial	A weed of national significance it degrades wetland environments and production areas. Integrated control should involve mechanical removal, fire, biological and chemical control and revegetation.	http://www.weeds.org.au/WoNS/lantana/docs/30_CRC_wmg_lantana.pdf http://www.dpi.qld.gov.au/4790_7309.htm

Scientific name	Common name	Wetland type found in	Distribution	Flowering
Introduced species and weeds (continued)				
Parkinsonia aculeata	Parkinsonia*	Coastal riverine wetlands	Central and northern Queensland	Mainly spring to summer
Phyla canescens	Lippia*	Coastal grass, sedge, herb swamp	South-east Queensland	Spring to autumn
Pistia stratiotes	Water lettuce*	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout eastern Queensland	January–March
Salvinia molesta	Salvinia*	Coastal grass, sedge, herb swamp, Coastal riverine wetlands	Throughout coastal Queensland	Spores produced all year
Solanum torvum	Devil's fig*	Coastal tree swamp wetlands	Throughout eastern coastal Queensland	All year
Sporobolus natalensis	Giant rats tail grass*	Coastal grass, sedge, herb swamp	Throughout eastern coastal Queensland	All year
Xanthium occidentale	Noogoora burr*	Coastal riverine wetlands	Throughout Queensland	Late summer to autumn

	Grazing value	Longevity	Other notes	More information and photographs
	Cattle may browse on foliage when preferred browse plants are not available	Perennial	A weed of national significance, it rapidly spreads in wetlands and affects stock access to water, makes mustering difficult and outcompetes other plants and pastures. Cattle may browse on and kill young seedlings, however broad scale control through cattle grazing is unlikely. Camels are more effective at controlling this weed.	http://www.weeds.org.au/WoNS/Parkinsonia/ http://www.dpi.qld.gov.au/4790_7332.htm
	Unpalatable, but can provide useful feed in some seasons. Good energy value, low protein.	Perennial	Introduced plant which has become a weed. It can outcompete native species and is not a good pasture. High magnesium and sulfur levels can cause scour.	http://www.weeds.org.au/cgi-bin/weedident.cgi?tpl=plant.tpl&ibra=all&card=H59 Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.
	Unknown	Perennial	Introduced to Queensland, it is now a declared weed. Grows rapidly, overtaking wetlands causing depleted oxygen levels and restricting stock access to water. Control via physical removal, biological control or herbicides.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Pistia~stratiotes Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Unknown	Perennial	A Weed of National Significance and a serious weed in wetlands as it can rapidly spread and choke the waterbody, making the waterway inaccessible to stock. Difficult to control with herbicides, but a biological control agent is having some success in parts of Queensland.	http://www.dpi.qld.gov.au/4790_7350.htm Stephens, K.M. and Dowling, R.M. (2002) *Wetland Plants of Queensland*. CSIRO publishing, Victoria
	Suspected of poisoning stock	Perennial	High levels of solanine, which can be posionous if a quantity is consumed.	http://143.216.33.102/efsa/lucid/Solanaceae/Solanum%20species/key/Australian%20Solanum%20species/Media/Html/Solanum_torvum.htm http://68.178.151.23/weed/249/
	Mature leaves are tough and difficult for stock to digest, which results in reduced weight gains.	Perennial	Will rapidly outcompete native plants and can increase the fire hazard. To prevent spread ensure cattle do not carry seed to non-infested paddocks. Herbicide control is effective for large infestations.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Sporobolus~natalensis http://68.178.151.23/weed/156/
	Toxic to livestock at seedling stage. Unpalatable, but older green plants may be a valuable feed at times	Annual	Noxious weed along waterways. Cause allergy, dermatitis and injury to stock and humans. Control is difficult and cannot be achieved through grazing alone. Mechanical removal and herbicide is the most effective control method.	http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Xanthium~occidentale Rose, H (2009) *Glove box guide to the plants of the Gwydir Wetlands and Macquarie Marshes*. NSW Department of Primary Industries.

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3.2 Wetland words

Anaerobic – without free, available oxygen

Annual – a plant that completes its lifecycle from seed to seed in one year

Aquatic – of or relating to water or living or growing in water

Aquatic invertebrates – animals which lack a backbone that live part or all of their life in water, such as water mites and spiders, shrimps, yabbies, aquatic snails, worms, bugs and dragonflies

Aquifer – an underground layer of rock, sand or gravel through which groundwater can pass or is stored

Artificial – made by human skill and labour, as opposed to natural. Within this guideline the term 'artificial wetland' refers to a wetland that is human made

Bed – the lowest substratum of a wetland; the area that the deepest section of the banks abut

Best management practices – recommended practices that reflect the current level of knowledge about management that sustain land, water and biodiversity resources

Biodiversity – the diversity of plant and animal life on earth at the genetic, species or ecosystem level

Biomass – the total mass of a living organism within a given area

Buffer zone – a wetland buffer is the transition zone between the wetland and the surrounding land use. Its purpose is to support the values and processes of the wetland and protect it from external threats

Catchment – the total area draining into a river, reservoir or other body of water (ANZECC 2000)

Channel – linear, generally sinuous open depression in parts eroded, excavated, or built up by channelled stream flow. Comprises stream bed and banks

Chromosols – soils with a clear and abrupt change between the A and B horizons, where the B horizon is pH 5.5 or greater

Community – an assemblage of organisms characterised by a distinctive combination of species occupying a common environment and interacting with one another (ANZECC 2000)

Corm – a solid, bulb-like stem

Dermosols – soils that lack strong texture changes between the A and B horizons

Draw-down – lowering of the water level within a wetland usually a natural occurrence during the dry season

Dry season – the time of year in the tropics and subtropics where little or no rain falls relative to the opposing time of year, the wet season, where most of the rainfall occurs. It is generally between May and December in Queensland

Ecosystem – the complex interaction of all living communities and the non-living environment through ecological processes as a functioning unit to maintain a dynamic, self supporting, evolving habitat

Ecosystem services – the services that people receive or obtain from the natural processes of an ecosystem. The services include fresh air, food, water, flood control, nutrient recycling and spiritual well being

Ephemeral – lasting only a short time; short lived; transitory

Episodic wetland – dry most of the time with rare and very irregular wet phases

Estuarine wetlands – with oceanic water that is at least occasionally diluted with freshwater run-off from the land

Faecal coliforms - an indicator of the amount of faecal material from warm-blooded animals (e.g. cattle, pigs, birds) present in water

Fauna – animal life

Fens – shallow, swampy, peat-forming wetlands that are fed by water sources other than precipitation, usually from upslope surface water or groundwater sources

Floodplain – alluvial plain characterised by frequently active erosion and aggradation by channelled or over-bank stream flow

Flora – plant life

Frontage country – the area of land next to a wetland, extending from the wetland to the edge of the floodplain

Gilgai depressions – shallow depressions interspersed with ridges occurring on clay soils formed by the clays expanding and contracting

Highest astronomical tide level – the highest sea level that can be predicted to occur under average meteorological conditions and any combination of astronomical conditions

Hydrosols – soils that are saturated for extended periods of time

Integrated pest management – a strategy which uses a combination of methods to sustainably control pests whilst reducing environmental, economic and health risks

Intermittent wetland – wetland is alternatively wet and dry but less frequently and regularly than annual cycles

Intertidal zone – the area between the high and low tides

Leptospirosis – a contagious disease, caused by the bacteria *Leptospira*, that can afflict both cattle and humans. It can affect cattle in a range of ways, from abortion, reduced milk production and even death in calves

Marine plant – definition of a marine plant is given in section 8 of the Fisheries Act:

> (1) 'Marine plant' includes the following:
> (a) a plant (a 'tidal plant') that usually grows on, or adjacent to, tidal land, whether it is living or dead, standing or fallen; (b) the material of a tidal plant, or other plant material on tidal land; (c) a plant, or material of a plant, prescribed under a regulation or management plant to be a marine plant.
> (2) 'Marine plant' does not include a declared plant under the *Land Protection (Pest and Stock Route Management) Act 2002*

Organosols – soils that are not regularly inundated by saltwater and have a high proportion of organic material

Pathogen – a disease causing agent

Peat – partially decomposed plant material formed under oxygen-deprived conditions in wetlands. It is a dark brown or black fibrous substance

Perennial – a plant that lives for greater than 2 years

Periodic wetland – wetland inundation events include the daily, monthly or annual tidal systems or are associated with other reasonably predictable events

Permanent wetland – a wetland that has or maintains water continuously in all seasons and all years

Ponded pastures – the construction of earth banks to impound water which will support pasture grasses adapted to those conditions

Potential Acid Sulfate Soils – are soils that contain iron sulfides, usually pyrite. When exposed to air, the iron sulfides oxidise producing sulfuric acid

Pugging – depressions formed in the soils surface created by hoofed animals when the soil is wet

Recruitment – when juvenile plants or animals survive and are added to a population

Rhizome – a horizontal plant stem, usually underground, that can send out shoots and roots

Riparian – the banks of a waterway (creek, river, stream etc.)

Sodosols – soils with a clear and abrupt textural change between the A and B horizons. The B horizon is sodic and is not strongly acid

Static – not flowing. Static water usually occurs in closed depressions, lakes, dammed water courses, marshes or other lentic waters where the water cannot flow

Substrate/substratum – land surface (soil, rock etc.) upon which plants and other organisms grow

Terrestrial – referring to the land or living on the land

Turbidity – cloudiness or haziness in water caused by suspended particles (e.g. sediment)

Vertosols – clay soils that have a tendency to crack when dry

Vibriosis – an infectious bacterial disease of the genital tract which is a major cause of infertility and abortion in cattle

Wet season – the time of the year in the tropics and subtropics when most of the average annual rainfall of that region falls. It is generally between January and April in Queensland

3.3 Contacts

Federal government

Department of Sustainability, Environment, Water, Population and Communities
Website: www.environment.gov.au
Contact: 1800 803 772

State government

Department of Employment, Economic Development and Innovation
Website: www.deedi.qld.gov.au
Contact: 13 25 23

Grazing extension services

Toowoomba office. Contact: 07 4688 1200
Roma research station. Contact: 07 4622 9999
Dalby office. Contact: 07 4669 0800
Gympie office. Contact: 07 5482 1522
Bundaberg office. Contact: 07 4131 5800
Rockhampton office. Contact: 07 4936 0211
Bowen centre for dry tropics agriculture.
Contact: 07 4761 4000
Charters Towers district office. Contact: 07 4761 5151
Kairi Research Station. Contact: 07 4091 9400

Department of Environment and Resource Management
Website: www.derm.qld.gov.au
Contact: 13 74 68

Department of Local Government and Planning
Website: www.dip.qld.gov.au
Contact: 07 3227 8548

Local government

Contact details for all Queensland local governments:
www.dip.qld.gov.au/summary-of-all-councils.html

Regional Natural Resource Management groups

SEQ Catchments
Level 2, 183 North Quay, Brisbane
Website: www.seqcatchments.com.au
Contact: 07 3211 4404

Condamine Alliance
310 Anzac Avenue, Toowoomba
Website: www.condamine alliance.com.au
Contact: 1800 181 101

Burnett Mary Regional Group
193 Bourbong Street, Bundaberg
Website: www.bmrg.org.au
Contact: 07 4181 2999

Fitzroy Basin Association
34 East Street, Rockhampton
Website: www.fba.org.au
Contact: 07 4999 2800

Reef Catchments NRM
Level 1, 174 Victoria Street, Mackay
Website: www.reefcatchments.com.au
Contact: 07 4968 4200

NQ Dry Tropics NRM
2 McIlwraith Street, Townsville
Website: www.nqdrytropics.com.au
Contact: 07 4724 3544

Terrain NRM
88 Rankin Street, Innisfail
Website: www.terrain.org.au
Contact: 07 4043 8000

Cape York Sustainable Futures
4/275 McCormack Street, Manunda
Website: www.cypda.com.au
Contact: 07 4053 2856

Northern Gulf Resource Management Group
St George Street, Georgetown
Website: www.northerngulf.com.au
Contact: 07 4062 1330

Southern Gulf Catchments
81 Miles Street, Mt Isa
Website: www.southerngulf.com.au
Contact: 07 4743 1888

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