

WETLAND MANAGEMENT PROFILE

SEMI-ARID SWAMPS

Occurring statewide in the semi-arid zone, semi-arid swamps are mostly confined to minor basins and small depressions, temporarily inundated and dominated by trees and shrubs. Their conservation values are poorly known but they enrich the biodiversity of this intermediate zone because they support wetland plants and animals within landscapes that are otherwise occupied by dry woodlands or that are cleared. Management issues include tree clearing, assurance of water flows, and woody weeds.

This profile covers the habitat types of wetlands termed semi-arid tree swamps; arid and semi-arid lignum swamps; arid and semi-arid grass, sedge, herb swamps; and arid and semi-arid saline swamps.

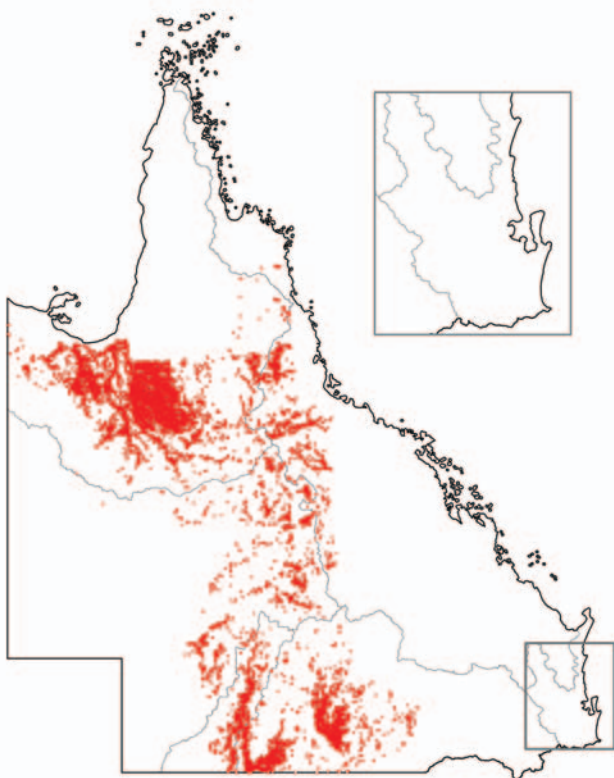
This typology, developed by the Queensland Wetlands Program, also forms the basis for a set of conceptual models that are linked to dynamic wetlands mapping, both of which can be accessed through the WetlandInfo website <www.derm/qld.gov.au/wetlandinfo>.

Description

This profile addresses a suite of wetlands in the semi-arid climate zone of Queensland. Apart from some of the northernmost wetlands, the majority of these wetlands are located hundreds of kilometres from the coast. This management profile covers freshwater to saline, floodplain and non-floodplain swamps that might be vegetated with trees, shrubs and/or grasses, sedges and herbs.

SEMI-ARID swamps are non-tidal and are subject to temporary but frequent inundation (invariably by freshwater) but are shallow or dry by the mid- to late dry season.

The semi-arid swamps are mostly situated in **land zone 3 (alluvial plains)**. They are classified as palustrine (swamps), which means they are dominated by trees, shrubs and/or other persistent **emergent** plants and are non-tidal. The **palustrine** definition also includes wetlands lacking such vegetation which have the following three characteristics: where active waves are formed or bedrock features are lacking; where the water depth in the deepest part of basin is less than 2 m at low water; and the salinity due to ocean-derived salts is still less than 0.5 per cent.



Map showing the distribution of semi-arid swamps in Queensland; grey lines indicate drainage divisions.

Map: From Queensland Wetlands Mapping v2.0 (September 2009)



Semi-arid swamps are dominated by vegetation and are subject to temporary but frequent inundation—a dry coolabah swamp, a wet coolabah and spiny mudgrass swamp, and a wet gidgee swamp.

Photos: Roger Jaensch, Wetlands International

regularly (some may be inundated once every three years at the most). Water in these wetlands tends to be fresh and is typically supplied by wet season (October to April) thunderstorms and/or monsoonal rains, via overbank flow from rivers (floodplain swamps) creeks or local runoff (floodplain and non-floodplain swamps) and in some cases by groundwater. By the mid- to late dry season (for example in August and September) the wetlands are dry, or are mostly shallow but with some persistent deeper water. Wetlands that are normally permanent, such as lagoons with mostly deep, permanent open water, generally fall into the lacustrine category, depending on their size (greater than 8 ha and/or deeper than 2 m in parts).

Semi-arid swamps occur in a wide sweep of **bioregions**, from the Gulf Plains through the Einasleigh Uplands to the Brigalow Belt, Mulga Lands and (with only a few small sites) the New England Tableland. Accordingly, they are situated in a range of landscapes. Alluvial deposits are a common element and where the wetlands lie within extensive alluvial plains the wetland substrate is deep, cracking grey clays, commonly with minor relief of **gilgai** hollows. Non-floodplain semi-arid swamps tend to lie within sand plains in depressions that are often circular in shape, the substrate tends to be lighter clay or sandy clay of yellow or brown colour or exposed underlying grey clay. Rarer examples of semi-arid swamps are on plateau surfaces or basalt plains/flows; in these situations they may be on overlying alluvium or bare rock.

THERE are three main vegetation categories of semi-arid swamps: treed swamps, shrub swamps and grass, sedge, herb swamps.

Wetlands that are classified as strictly riverine (river channels and banks, in channel waterholes) or **lacustrine** (lakes and large claypans) are excluded (see the *Arid and semi-arid lakes* management profile on the *WetlandInfo* website). Some semi-arid swamps are connected to or are within complexes that include riverine and/or lacustrine wetlands, and some wetlands exhibit characteristics of all three types at different phases of their wetting/drying cycle.

The semi-arid swamps are typically subject to temporary inundation and, depending on water source, climatic factors, substrate and their position in the landscape, might be inundated annually or less

There are three main vegetation categories of semi-arid swamps: treed swamps, shrub swamps and grass, sedge, herb swamps. The dominant vegetation species and common elements of the low vegetation tend to replace each other in different bioregions.

The typical fauna of semi-arid swamps is poorly known. It is predicted to vary across bioregions. Waterbirds might be a prominent feature where the wetland includes open areas. Some smaller semi-arid swamps are not connected to creeks and rivers and so would have few if any fish species. Semi-arid swamps are generally small and scattered elements within landscapes that are dominated by dryland wooded

ecosystems or cleared agricultural land. In some cases they merge with surrounding ecosystems without sharp boundaries. Therefore, management of the wetlands will require an integrated approach, taking account of all landscape elements.

SEMI-ARID swamps are generally small and unconnected elements within landscapes that are dominated by dryland wooded ecosystems or cleared agricultural land. They may merge with surrounding ecosystems without obvious boundaries—their management will require an integrated approach, taking account of all landscape elements.

Distribution

Examples of semi-arid swamps in the Gulf Plains, Einasleigh Uplands and northern Brigalow Belt bioregions are within coastward draining **catchments**. Examples in the southern Brigalow Belt, Mulga Lands and New England Tableland bioregions are in upper catchments of the Murray–Darling Basin, which drains away from the coast in Queensland.

THE quantity and frequency of rainfall determine the inundation regime of semi-arid swamps that are supplied by local run-off. Examples within floodplains tend to be more strongly influenced by river flows that can originate many tens of kilometres upriver.

The climate where semi-arid swamps occur varies; predominantly summer rainfall and a winter dry season prevail throughout but this is most pronounced in the north. The quantity and frequency of rainfall determine the inundation regime of semi-arid swamps that are supplied by local run-off; highly variable rainfall ensures that inundation is equally variable. Examples that occur within floodplains tend to be more strongly influenced by river flows that can originate many tens of kilometres upriver. Many of the semi-arid swamps are not named features on topographic maps, perhaps because they are not large in size or do not provide a resource such as significant

water supply to towns or landholders. Extensive clusters of these wetlands occur in some bioregions, for example, in the south-west of the Brigalow Belt bioregion, the central-east of the Mulga Lands bioregion, in several parts of the Gulf Plains bioregion and the centre of the Einasleigh Uplands bioregion.

The *WetlandInfo* website provides in-depth data, detailed mapping and distribution information for this wetland habitat type.

Queensland status and legislation

Wetlands have many values – not just for conservation purposes – and the range of values can vary for each wetland habitat type and location. The Queensland Government maintains several processes for establishing the significance of wetlands. These processes inform legislation and regulations to protect wetlands, for example, the status assigned to wetlands under the **regional ecosystem** (RE) framework.

A comprehensive suite of wetlands assessment methods for various purposes exists, some of which have been applied in Queensland. More information on wetland significance assessment methods and their application is available from the *WetlandInfo* website <www.derm.qld.gov.au/wetlandinfo>. Queensland has also nominated wetlands to *A Directory of Important Wetlands of Australia* (DIWA), see the appendix.

The Queensland Government has direct responsibility for the protection, conservation and management of wetlands in Queensland, a responsibility shared with local government and the Australian Government (for some wetlands of international significance). These responsibilities are found in laws passed by the Queensland parliament, laws of the Commonwealth, international obligations and in agreements between state, local and the federal governments. More information on relevant legislation is available from the *WetlandInfo* website <www.derm.qld.gov.au/wetlandinfo>.

National conservation status

Migratory shorebirds inhabit some semi-arid swamps in Queensland; these species are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (that is, they are listed under the Japan–Australia and China–Australia Migratory Bird Agreements (**JAMBA/CAMBA** respectively) and/or the **Bonn Convention**). Five animals and two plants that inhabit semi-arid swamps in Queensland are listed as threatened under the EPBC Act and/or the Queensland *Nature Conservation Act 1992* (NC Act).

Listed migratory species and threatened species are matters of national environmental significance under the EPBC Act and, as such, are afforded protection under the Act. Any action that will, or is likely to, have a significant impact on a listed migratory species or threatened species will be subject to an environmental assessment and approval regime under the EPBC Act.

Cultural heritage values

All wetland ecosystems are of material and cultural importance to Indigenous people and many will have profound cultural significance and values. Approximately 30 Indigenous cultural heritage sites have been recorded within semi-arid swamp wetlands in Queensland. However, most inland non-arid swamps have not been systematically surveyed or assessed for cultural heritage significance.

THE most common evidence of traditional occupation and use of semi-arid swamps is scarred trees such as forest and river red gums, coolabahs, poplar box and bloodwood. Food and fibre resources (such as nardoo, bulrushes and common reed) were widely used.

The available data indicate that there is a high likelihood of encountering cultural heritage sites within and adjacent to semi-arid swamps. Evidence of traditional occupation and use recorded within semi-arid swamps includes painted rock art, burials, stone arrangements, scarred trees, quarries, middens, stone artefacts and scatters, fish traps, food and fibre resources and historic contact sites (see the DERM website for further information <www.derm.qld.gov.au>). Some semi-arid swamp areas have particular significance as story places, landscape features and as sites for cultural activities.

The most commonly recorded sites associated with semi-arid swamps are stone artefact scatters and scarred trees associated with open camp occupation sites located along wetland margins. Stone artefact scatters will be encountered in open areas and in erosion zones, and also on areas of adjacent higher ground. Many tree species were used traditionally, however, species found in association with semi-arid swamps such as forest red gum *Eucalyptus tereticornis*, coolabah *E. coolabah*, northern coolabah *E. microtheca*, river red gum *E. camaldulensis*, poplar box



Scarred tree—coolabah *Eucalyptus coolabah*.
Photo: David Cameron

E. populnea and bloodwood *Corymbia polycarpa* are among the most common scarred tree species encountered in Queensland. Bark and sap-wood from these and other species (for example the broad-leaved paperbark *Melaleuca viridiflora*), were used for making fighting shields, vessels (coolamons), canoes, implements (for example digging sticks, spears and hafts), bough and bark shelters, and also the resins from some species were used as a bonding matrix.

Almost all plant and animal species have some form of traditional use or cultural significance (for example totemic significance). Some of the many plant species used traditionally for food and fibre include Australian rice *Oryza australiensis* and *O. rufipogon*, nardoo *Marsilea drummondii*, bulkuru or spike-rushes *Eleocharis* spp. (particularly *E. dulcis*), nutgrass sedges *Cyperus* spp., yakka grasses *Sporobolus* spp. (particularly *S. virginicus*), common bulrushes *Typha* spp., and the common swamp reed *Phragmites australis*. Typically, the seeds, fruits, leaves, shoots, stems, roots and tubers of these and other species

were processed for food, used to make implements and for medicinal purposes.

Archaeological evidence of cultural sites, such as stone artefact scatters, is often concentrated along **ecotones** around the margins of semi-arid swamp wetlands, and in association with neighbouring regional ecosystems. The clustering of sites along ecotones reflects the concentration of traditional occupation and use within areas of greatest biodiversity.



Australian rice *Oryza australiensis*.
Photo: Watson and Dallwitz



Nardoo *Marsilea drummondii* (above) and common bulrushes *Typha* spp. (below) were traditionally used for food and fibre.
Photo: Roger Jaensch, Wetlands International



Steam traction engine used to power a portable sawmill (using coolabah trees).
Photo: David Cameron



Tree marked by Ludwig Leichhardt during his party's expedition through semi-arid swamps in 1844. Photo: David Cameron

Some semi-arid swamps also have non-Indigenous (historic) cultural heritage significance, although most have not been surveyed or assessed for historic heritage values. The historic heritage values likely to be encountered within semi-arid swamps will generally be associated with pastoral and agricultural activities. Some specific semi-arid swamps have an historic association with early exploration and settlement. For example, Ludwig Leichhardt's 1844 expedition passed through the semi-arid swamps of the Valley of Lagoons on the headwaters of the Burdekin River. Typically, sites found in semi-arid swamp areas will include stock camps, stockyards, huts and blazed trees (see <www.derm.qld.gov.au> for further information). It is important to note that evidence of traditional occupation and use is often encountered at historic sites.

Ecological values

Semi-arid swamps are key components of the landscape between the coastal zone and the far inland (arid) zone and provide **ecosystem services** that include:

- **provisioning services**, such as livestock fodder and watering points;
- **regulating services**, such as sediment and nutrient retention;
- **cultural services**, such as Indigenous cultural values and sites; and
- **supporting services**, such as being important as habitat for animal taxa at a particular stage of their life cycle (for example, breeding).

No systematic assessment of species diversity has been conducted throughout semi-arid swamps in Queensland. Some individual wetlands may exhibit only moderate diversity but the collective total number of flora and fauna species in these wetlands is expected to be substantial due to the wide geographical extent of occurrence. At present, no plant or animal species is known to be **endemic** to semi-arid swamps in Queensland.

DOMINANT trees and shrubs of semi-arid swamps can vary between bioregions but may include coolabah, northern coolabah, belalie, brigalow, gidgee, river and forest red gums, gutta-percha, broad-leaved paperbark and lignum.

Trees are the prominent tall plants in many semi-arid swamps. Many of the wetlands are wooded throughout, at varying densities, while others have trees mainly around the inundated margins. Dominant species varies with bioregion to some extent. In the southern Brigalow Belt and (eastern) Mulga Lands, coolabah *Eucalyptus coolabah* dominates but some examples are characterised by poplar box *E. populnea*. Other trees or tall shrubs present at some sites include belalie *Acacia stenophylla*, yarran *A. omalophylla*, brigalow *A. harpophylla*, gidgee *A. cambagei*, creek wilga *Eremophila bignoniiflora*, and belah *Casuarina cristata*. Low to medium height shrubs such as lignum *Muehlenbeckia florulenta* are dominant or common

components in some southern examples. In the northern parts of these bioregions and in the Gulf Plains and Einasleigh Uplands, dominant trees include northern coolabah *Eucalyptus microtheca*, river red gum *E. camaldulensis*, forest red gum *E. tereticornis*, gutta-percha *Excoecaria parvifolia*, broad-leaved paperbark *Melaleuca viridiflora* and hard-barked teatree *M. clarksonii*. Other trees or tall shrubs present may include swamp mahogany *Lophostemon suaveolens*, Melaleucas *M. nervosa*, *M. saligna*, Reid River box *Eucalyptus brownii*, poplar gum *E. latyphylla*, longfruited bloodwood *Corymbia polycarpa* and *Asteromyrtus symphyocarpa*.



Belalie *Acacia stenophylla* is found in some inland non-arid swamps. Photo: Roger Jaensch, Wetlands International

Grasses are a consistent feature of most inland non-arid swamps. Taller species are more prevalent in northern areas, for example Australian rice *Oryza australiensis* and *O. rufipogon*; *Panicum trichoides*; and in some cases, sorghum *Sarga sp.*. The mat-forming spiny mudgrass *Pseudoraphis spinescens* is a common element of these northern wetlands. Other grasses of semi-arid swamps include silky browntop *Eulalia aurea*, beetle grass *Leptochloa fusca* and neverfail *Eragrostis setifolia*.

Sedges are present in some southern examples, but apparently are more prominent in northern and eastern examples of semi-arid swamps. Spike-rushes *Eleocharis* spp. are widespread; other sedges include *Cyperus* spp., *Juncus* spp., *Schoenoplectus* spp., and in a few cases cumbungi *Typha* spp. and common reed *Phragmites australis*.



Spiny mudgrass *Pseudoraphis spinescens* is common in semi-arid swamps.

Photo: Roger Jaensch, Wetlands International

The tall **forbs** *Sesbania* spp., budda pea *Aeschynomene indica*, *Ludwigia perennis* and *Melochia corchorifolia* may develop as thickets in semi-arid swamps after inundation, especially in northern areas. These wetlands often also support floating or partly emergent aquatic plants, notably waterlilies *Nymphaea violacea*, marshworts *Nymphoides* spp., smartweeds *Persicaria* spp., *Caldesia oligococca*, *Monochoria* spp., swamp lily *Ottelia ovalifolia* and floating pondweed *Potamogeton tricarinatus*. Submerged plants such as red water milfoil *Myriophyllum verrucosum*, *Hydrilla* spp., *Chara* spp. and *Nitella* spp. also occur. Mats of the fern, nardoo *Marsilea* spp., may occupy the beds or shallows of many of these wetlands. Minor components of the vegetation, and extent of occupancy of a site by particular species, may vary with rainfall and grazing pressure.

GRASSES are a consistent feature of most semi-arid swamps and may include Australian rice, spiny mudgrass, silky browntop, beetle grass and neverfail. Semi-arid swamps may also support sedges (such as spike-rushes), tall forbs (such as budda pea), floating or partly emergent aquatic plants (such as waterlilies and nardoo) and submerged plants (such as red water milfoil).



Sesbania peas *Sesbania* spp. are found in inland non-arid swamps.

Photo: Roger Jaensch, Wetlands International



Aquatic plants such as water snowflake *Nymphoides indica* (above) and waterlilies *Nymphaea* sp. (below) are found in some semi-arid swamps.

Photos: Roger Jaensch, Wetlands International

GUTTA-PERCHA

Two wetland REs in the Gulf Plains bioregion are dominated by or include gutta-percha *Excoecaria parvifolia*, a member of the Euphorbiaceae family. This low tree is related to the blind-your-eye mangrove *E. agallocha* (see *Mangrove wetlands management profile* <www.derm.qld.gov.au/wetlandinfo> but is quite different in appearance. Gutta-percha has sparse small leaves whereas the mangrove has abundant rounded leaves of much larger size. The common name of this plant has its origins in the name given to coagulated extract (gum) from plants of *Palaquium* spp. (Sapotaceae family) that naturally occur in south-east Asia and tropical America: in the Malay language 'getah pertja' means 'gum of the percha tree'. Overseas this gum has been used extensively in dentistry and as an insulative coating for submarine cables. It is not known if the Australian gutta-percha has the same properties though it does produce a milky latex. The explorer Ludwig Leichhardt named *E. parvifolia* the 'raspberry jam tree' on account of the smell of the wood, as he was traversing the Gulf Plains in 1845 (R. Fensham pers. comm.). Wetlands characterised by gutta-percha potentially may be overrun with thickets of woody weeds (see below).



Gutta-percha *Excoecaria parvifolia* in a seasonally dry swamp. Photo: Roger Jaensch, Wetlands International



The distinctive leaves of gutta-percha.

Photo: Roger Jaensch, Wetlands International

Relatively little is known about the animals that inhabit semi-arid swamps. Waterbirds are best known but even they have not been systematically surveyed across this wetland type. One of the reasons for this lack of knowledge may be that naturalists and professional scientists have tended not to visit these relatively inconspicuous, temporary wetlands when inundated. Also, the majority of the vertebrate fauna in semi-arid swamps would be temporary inhabitants.

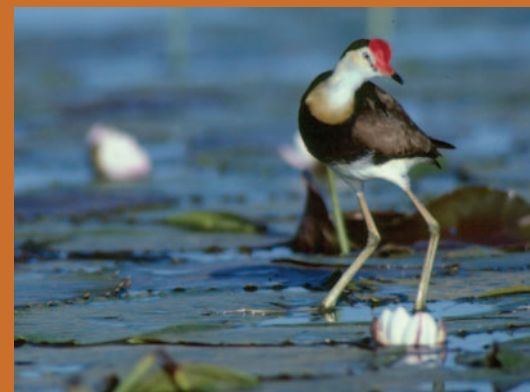
Waterbird species composition in the semi-arid swamps probably has much in common with species composition of the neighbouring arid-zone swamps and/or coastal wetlands (see the *WetlandInfo* website <www.derm.qld.gov.au/wetlandinfo> for relevant wetland management profiles). Some habitat and food elements—such as open water, muddy shallows or fish—may be scarce or absent in many semi-arid swamps, causing rarity or absence of waterbirds that require those elements. Actual species composition at a site may also be influenced by proximity to the coast versus the arid zone.

Magpie geese *Anseranas semipalmata*, plumed whistling-duck *Dendrocygna eytoni*, Pacific black duck *Anas superciliosa* and grey teal *A. gracilis* are expected to be common users of the wetlands. Wandering whistling-duck *D. arcuata* and hardhead *Aythya australis*, together with Australasian grebe *Tachybaptus novaehollandiae*, little pied cormorant *Phalacrocorax melanoleucos* and darter *Anhinga melanogaster* would occur where water is deeper, less vegetated or more persistent.



Plumed whistling-ducks *Dendrocygna eytoni* are commonly found in semi-arid zone swamps.
Photo: DERM

White-necked herons *Ardea pacifica*, white-faced herons *Egretta novaehollandiae*, intermediate egrets *A. intermedia*, glossy ibises *Plegadis falcinellus*, yellow-billed spoonbills *Platalea flavipes*, masked lapwings *Vanellus miles*, red-kneed dotterels *Erythronyx cinctus* and black-winged stilts *Himantopus himantopus* should occur in the shallow margins or drying beds of more open wetlands. Small rails such as Australian crake *Porzana fluminea* (in southern areas), white-browed crake *P. cinerea* (in some northern areas) and buff-banded rail *Gallirallus philippensis*, and the larger purple swamphen *Porphyrio porphyrio*, may be present where wet/inundated shrubs, grass, sedge and/or herbs provide dense cover. Comb-crested jacanas *Irediparra gallinacea* are likely to occur in northern areas where waterlilies or other floating cover is plentiful. Clamorous reed-warblers *Acrocephalus stentoreus* may visit wet thickets and whiskered terns *Chlidonias hybridus* may hunt over more open water surfaces.



Semi-arid swamps attract birds such as white-necked herons *Ardea pacifica* (above) and comb-crested jacanas *Irediparra gallinacea* (below). Photos: DERM



Buff-banded rail *Gallirallus philippensis* (above) and purple swamphen *Porphyrio porphyrio* (below) prefer areas of dense vegetation in inland non-arid swamp wetlands. Photos: DERM

Fishes in the semi-arid swamps are expected to be similar to those in arid swamps, except where other or additional species occur in coastal catchments. Many sites are likely to lack fish due to their isolation from rivers but may temporarily gain some fish in especially wet years when **hydrological** connections briefly occur.

Frogs that occur in the semi-arid regions of Queensland and that can be expected to inhabit semi-arid swamps include salmon striped frog *Limnodynastes salmini*, greenstripe frog *Cyclorana alboguttata*, broad palmed rocketfrog *Litoria latopalmata* and *Crinia* spp.. Small mammals such as planigale *Planigale* spp. and dunnart *Sminthopsis* spp. may occur in these wetlands especially where the soil exhibits deep cracking. Freshwater turtles and freshwater crayfish and crabs can be expected to occur in semi-arid swamps that are connected to rivers.

WetlandInfo provides full species lists of wetlands animals and plants.

SALMON STRIPED FROG

The salmon striped frog *Limnodynastes salmini* is a relatively large frog (head and body length to approximately 75 mm) that can be found in and around flooded swamps and also in periodically inundated open forests and grasslands in south-east and mid-east Queensland and northern New South Wales. Salmon striped frogs are striking in appearance, and, as the name suggests, are characterised by a series of salmon to pale pink stripes on the back and side of the body. The rest of the upper body is greyish-brown with darker variegations that form spots, blotches or irregular lines. A dark stripe runs from the snout through the eye to the shoulder.

Salmon striped frogs are listed as being of least concern under the Queensland *Nature Conservation Act 1994* and are relatively common in areas of suitable habitat throughout their distribution. During dry periods salmon striped frogs burrow into the ground and await the onset of rain. After flooding rains, they become active and prepare to breed in swamps and inundated woodlands.

Males call loudly from vegetation near the water's edge with females laying a floating foam nest of eggs under the cover of vegetation. Salmon striped frogs are commonly encountered at night when they feed



Salmon striped frog *Limnodynastes salmini*. Photo: DERM

on invertebrates and other frogs. During the day they can be found sheltering in or under logs or other ground debris. The population trend is not well known but is thought to be stable, although the species may be declining in some areas due to the modification of wetland habitats from land clearing and wetland drainage. Other suspected threats include overgrazing of swamps, trampling of wetland margins and predation by feral animals, particularly pigs, although there is little information available to quantify the severity of these threats. Management regimes (such as sustainable grazing, land clearing controls, feral animal management and maintaining water quality) that support and protect the ecological processes of swamps will help maintain critical habitats for salmon striped frogs and associated biota.

Species of conservation significance

One of the few threatened species known to use semi-arid swamps is the Australian painted snipe *Rostratula australis* (vulnerable under EPBC Act and NC Act). It typically inhabits swamps that offer a mix of medium to dense low shelter as well as open muddy or marshy shallows for feeding (see below).

The wooded and/or densely vegetated habitat of most semi-arid swamps does not provide ideal habitat for migratory shorebirds. Latham's snipe *Gallinago hardwickii* can occur at the shallow margins of some sites, mainly in March–April during northward migration (many sites would be dry during southward migration).

Others likely to occur occasionally are the sharp-tailed sandpiper *Calidris acuminata* and common greenshank *Tringa nebularia*. The vulnerable grass *Paspalidium udum* has been recorded from semi-arid swamps in the Valley of Lagoons area. *Sesbania erubescens* (Gulf Plains) and *Aponogeton queenslandicus* (widespread) are rare plants that occur in semi-arid swamps. Waterbird species listed as rare in Queensland and that use semi-arid swamps are the cotton pygmy-goose *Nettapus coromandelianus* (where open water occurs) and black-necked stork *Ephippiorhynchus asiaticus*.

AUSTRALIAN PAINTED SNIPE

The plumage of the Australian painted snipe *Rostratula australis* (vulnerable, EPBC and NC Acts) provides good camouflage: green-brown upper parts, barred or spotted wings and grey or dark brown hood. Because of its secretive habits, the species is not often reported. Nests and/or young have been recorded from about December to May. There is no robust estimate of the population size of this species but a decline in numbers across Australia has been documented. The nomadic Australian painted snipe apparently depends on networks of inland and coastal, small and large wetlands and reduction in inundation of inland floodplains (due to river regulation and water harvesting) and loss of many coastal wetlands through drainage and agricultural development are major threats to its survival.



Nest and eggs of the vulnerable Australian painted snipe *Rostratula australis*.

Photo: Roger Jaensch, Wetlands International

Landholders can assist by halting wetland loss, optimising diversity of habitats in wetlands, and controlling the access of cattle to swamps during inundation events, thereby minimising the risk of trampling of nests by livestock.

Aponogeton queenslandicus

This plant is an aquatic species that is rooted in the substrate by a tuberous stem, has floating elliptical-elongated leaves and small yellow flowers on a short erect stalk. It is seasonally emergent and has been recorded at scattered localities in eastern Queensland and is gazetted as rare (NC Act). Indigenous people used the tuberous stems of this plant as a source of food.



***Aponogeton queenslandicus* is a rare aquatic plant found in semi-arid swamps.**

Photo: Roger Jaensch, Wetlands International



The rare black-necked stork (jabiru)
Ephippiorhynchus asiaticus. Photo: DERM

Though not proven to be truly **migratory**, several waterbirds of semi-arid swamps, notably the great egret and glossy ibis, are listed as migratory under the EPBC Act because they are included in the lists of JAMBA and/or CAMBA.

MOST of the semi-arid swamps are in leasehold or freehold land subject to pastoral grazing or broadacre cropping—private landholders are the principal managers of this wetland type.

Managing the semi-arid swamps

Most of the semi-arid swamps are in leasehold or freehold land subject to pastoral grazing or broadacre cropping. Private landholders therefore are the principal managers of this wetland type. Some examples are in protected areas or in forest reserves managed by DERM.

Some wetland management issues, such as water flows, weeds and feral animals, require an integrated management approach across multiple properties, if not catchment-wide.

FOR those semi-arid swamps that occur within floodplains and are dependent on river flows, the guarantee of continued flows is the greatest concern to be addressed.

Water flows

For those semi-arid swamps that occur within floodplains and are dependent on river flow for water supply, the guarantee of continued flows is the greatest concern to be addressed. Major dams or weirs are not common in some northern areas at present but southern rivers (for example, the Balonne) are regulated and large volumes are harvested for off-river storages and direct irrigation of crops such as cotton. Water is sourced from river flow and some from overbank flow on floodplains, which interrupts the natural flood regime downstream. Reduction in frequency, duration and volume of river flows and flood events reduces the availability of water in downstream wetlands and causes reduction or loss of ecological processes. Not only will fauna rarely if ever use the affected wetlands, but also the perennial vegetation may become degraded or lost due to lack of soil moisture.

REDUCTION in frequency, duration and volume of river flows and flood events reduces the availability of water in downstream wetlands and causes reduction or loss of ecological processes—wetland fauna will rarely if ever use the affected wetlands and the perennial vegetation may become degraded or lost due to lack of soil moisture.

Where the wetland occurs in an isolated depression that has a small volume of inflow, changes to water flows at the local scale are relevant. Construction of stock dams on watercourses, or low embankments (for example, raised edges of graded roads) on alluvial plains, may reduce or stop downstream or overland inflow to semi-arid swamps. Also, excavation of shallow wetlands to create more persistent water can change the wetland ecology; managers should be aware of any constraints to modifying wetlands as indicated in applicable state legislation (see Queensland conservation status).

Catchment-based planning for water allocation, led by DERM, is now addressing water flow issues in a number of catchments. Water Resource Plans, and where necessary Resource Operational Plans, are being prepared under the Queensland *Water Act 2000* in catchments where human consumptive needs have had a measurable impact or where rivers and wetlands have significant ecological or social values. A water resource plan details what the government aims to achieve for a catchment's social, economic and environmental needs, while a resource operational plan details how water resources will be managed from day to day to meet these objectives.

For further information on water resource planning in Queensland, see the DERM website <www.derm.qld.gov.au>. In addition to regulatory controls, wetland managers can protect wetland values through appropriate property-level planning.

Buffer zones

A buffer around a wetland can help maintain the environmental values of the wetland and protect it from current and future threats from adjacent land uses.

Designing an effective wetland buffer relies upon many factors, including the wetland's characteristics, environmental values, location, surrounding land uses, and the current and future impacts on the wetland.

Queensland already has legislative mechanisms that specify buffer distances. The *WetlandInfo* website <www.derm.qld.gov.au/wetlandinfo> contains the latest information on legislation and buffer guidelines.

Weeds

Woody weeds infest many of the semi-arid swamps. Parkinsonia *Parkinsonia aculeate* occurs in some wetlands in the Gulf Plains and Brigalow Belt, and rubber vine *Cryptostegia grandiflora* is present in the Einasleigh Uplands and Gulf Plains. Both parkinsonia and rubber vine are Weeds of National Significance, and are considered some of Australia's worst weeds due to their invasiveness, potential for spread, and their environmental and economic impacts. See the Weeds of Australia website <www.weeds.gov.au> for further information.

UNTREATED parkinsonia can replace native plant species, retard flow in watercourses, cause erosion, lower watertables, take over vast areas of floodplain, provide refuges for feral animals, especially pigs, and create increased costs to landholders.

Prevention of spread is more cost-effective than later removal.

These declared plants can overrun and exclude native vegetation, exclude livestock and wildlife and reduce access to land and waterways. They require control programs that are coordinated across catchments. If parkinsonia is left untreated, it can replace native plant species, leading to lower quality habitat for animals. It can retard flow in watercourses, cause erosion, lower watertables and take over vast areas of floodplain. It can also lead to increased costs to landholders through increasing the difficulty of mustering stock, a reduction in stock access to watering points and a decrease in primary production of grasses that it replaces. Infestations can also provide refuges for feral animals, especially pigs.



Parkinsonia Parkinsonia aculeata (above) and rubber vine *Cryptostegia grandiflora* (below) are Weeds of National Significance that can infest semi-arid swamps. Photos: Roger Jaensch, Wetlands International and DERM

The cost of controlling parkinsonia is expensive so prevention of spread is more cost-effective than later removal. Parkinsonia germinates readily from seed, so soil or sand from infested catchments should not be transferred into uninfested catchments, and machinery used in infested catchments should be thoroughly cleaned before moving to other areas. Any outbreaks on watercourses, particularly in upper catchments, should be controlled.

Research has shown that parkinsonia seedlings are particularly susceptible to different forms of control soon after germination. An integrated approach using several weed management techniques is the most effective way of tackling dense infestations, however control methods should be tailored to suit the landscape. Chemicals can be applied to individual

trees where parkinsonia is found on riverbanks. Fire may also be used as a control option, particularly after mechanical or chemical control (however it must be managed carefully to minimise the impact on other vegetation and the potential for erosion if heavy rains follow closely to burning, and to prevent loss of stock and property). Regardless of the method/s used, follow-up will be required to control seedlings. For more detailed information on the management of parkinsonia, see the Weeds in Australia website <www.weeds.gov.au>.

THE four main control techniques for rubber vine are biological, chemical, mechanical and fire. A combination of control techniques should be used to maximise effectiveness.



Biological control (rubber vine rust; above) and **chemical control** (spraying; below) are two of the most effective control mechanisms for rubber vine. Photos: DERM

Rubber vine threatens to choke waterways and also leads to the loss of grazing country and increases the costs of mustering and fencing. It has the potential to occur across much of northern Queensland where the climatic conditions are suitable. Preventing the spread of rubber vine is more economical than controlling it once introduced to an area. The Rubber Vine Containment Line has been established to help prevent the spread of rubber vine and to identify priority areas for preventative control.

Control attempts should aim to kill rubber vine before it sets seed (wind and water are the main ways that seed is spread) and be targeted to suitable times of the year. The four main control techniques for rubber vine are biological, chemical, mechanical and fire. A combination of control techniques should be used to maximise effectiveness. Two biological control agents are proving effective in controlling rubber vine (rubber vine rust *Maravalia cryptostegiae* and caterpillars of the moth *Euclasta whalleyi*). Both cause damage and occasionally the death of established plants, however their effectiveness varies with climatic conditions and time of the year. A range of registered herbicides can be effective in controlling rubber vine, however their application should be tailored to particular situations. Fire can be used as part of an integrated control program to kill surface seeds, seedlings and adult plants, even when they are green, however the risks and impacts associated with fire should be considered before using this control method. Ongoing follow-up burns will be required to control regrowth and seedlings. Under appropriate circumstances, mechanical control can be used to open up infestations and give managers better access to rubber vine for herbicide application or to help provide fuel for fires. For more detailed information on the management of rubber vine, see the Weeds in Australia website <www.weeds.gov.au>.

GRAZIERS should aim to manage semi-arid swamps as a distinct land unit and limit intensive stock use of these areas especially when inundated and when quality feed is unavailable in surrounding ecosystems. Stock watering facilities should be sited away from wetlands where possible.

Sustainable grazing

Pastoral grazing of sheep (in western and southern areas) and cattle (throughout) has occurred in semi-arid swamps for, in most cases, more than a century. Natural resource managers generally agree that grazing and biodiversity values can both be sustained under appropriate regimes, though the precise carrying capacities have not been universally determined. At the very least, graziers should aim to manage wetlands as a distinct land unit and limit intensive stock use of wetlands especially when the area is inundated and when quality feed is unavailable in surrounding ecosystems. Stock watering facilities, which can result in the intensive trampling of nearby vegetation, should be sited away from wetlands where possible.

The Department of Employment, Economic Development and Innovation (DEEDI) in partnership with Meat and Livestock Australia investigated sustainable grazing regimes for inland regions. Information collected from scientific research and demonstration projects as well as grazer experience is delivered through the Grazing Land Management workshop series. For more information on the Grazing Land Management package contact the Primary Industries and Fisheries Call Centre on 132 523.

CONTROL programs coordinated across many properties, if not whole catchments, are necessary for effective control of pig populations in semi-arid swamp wetlands.

SOME semi-arid swamps are at risk of being invaded by introduced ponded pasture species such as aleman grass, olive hymenachne and para grass. It is a serious offence to introduce, keep or supply hymenachne without a permit.



Feral pig diggings Photo: Barry Nolan, DERM

Feral animals

Feral pigs *Sus scrofa* are prevalent wherever semi-arid swamps occur and cause damage to wetland vegetation by uprooting plants (looking for tubers). They also prey on native fauna. Additionally, pigs are thought to carry the bacteria that cause vibriosis and leptospirosis—diseases that can be passed on to cattle through water. Control programs coordinated across many properties, if not whole catchments, are necessary for effective control of pig populations. For information on control programs call your local Land Protection Officer or local government weeds and pests officers. For further information on feral animal management, see the DEEDI website <www.deedi.qld.gov.au>.

Ponded pastures

Some semi-arid swamps (for example, in the Einasleigh Uplands bioregion) are at risk of being invaded by introduced **ponded pasture** species such as aleman grass *Echinochloa polystachya*, olive hymenachne *Hymenachne amplexicaulis* and para grass *Brachiaria mutica*. These aggressive grasses can dominate grass and sedge areas of semi-arid swamps, even when they are being grazed.

Olive hymenachne is one of 20 pest species classified as Weeds of National Significance (WoNS), and it is a serious offence to introduce, keep or supply this plant without a permit under the Queensland Land Protection (Pest and Stock Route Management) Regulation 2003. Constant heavy grazing during the dry season can control hymenachne and possibly eradicate it if the grazed plants are completely submerged in the ensuing wet season.

Ponded pastures should not be established in or near natural wetlands due to their unacceptable impacts on these areas, as outlined under the Queensland Policy for Development and Use of Ponded Pastures (DNRM, 2001). For further information, see the DEEDI website <www.deedi.qld.gov.au>



Olive hymenachne *Hymenachne amplexicaulis* is difficult to control once established in wetlands including semi-arid swamps.

Photo: Roger Jaensch, Wetlands International

Glossary

Alluvial Soil that contains clay, silt, sand or gravel deposited by running water, for example by streams.

Bonn Convention The Convention on the Conservation of Migratory Species of Wild Animals, to which Australia is signatory, and a Range State for many migratory species.

Bioregion (biogeographic region) An area of the continent defined by a combination of particular geology, landforms, climate and vegetation. For the definition of regional ecosystems, the bioregions of Sattler and Williams (1999) are adopted.

CAMBA The Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment is a treaty that aims to protect and conserve the birds and their habitat of those species that migrate between China and Australia.

Catchment The area of land that collects rain that then flows into a waterway.

Cultural services Non-material benefits derived from ecosystems such as recreational, spiritual, religious benefits.

Ecosystem services The benefits people obtain from ecosystems including provisioning, regulating, cultural and supporting services.

Ecotone A transition zone between two or more ecological communities.

Emergent Wetland vegetation that protrudes above the water level.

Endemic Found only in one particular area.

Environmental value Under the Queensland *Environmental Protection Act 1994*, an environmental value is defined as (a) a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or (b) another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation (see www.legislation.qld.gov.au).

Forbs Small, non-woody, broad-leaved vascular plants, excluding grasses, rushes and sedges.

Gilgai Hummocky micro-relief pattern on a soil surface produced by expansion and contraction during wetting and drying (usually in regions with distinct, seasonal rainfall); common in heavy alluvial clays.

Hydrological Pertaining to water flow.

JAMBA The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment is a treaty that aims to protect and conserve the birds and their habitat of those species that migrate between Japan and Australia.

Land zone 3 Near-level alluvial plains with riverine patterns, wetlands and lakeside dunes.

Lacustrine Pertaining to lakes—includes wetlands and deepwater habitats that may be tidal or non-tidal but ocean derived salinity is less than one part per thousand (1 ppt). 1 ppt is the equivalent of one gram of sodium chloride (salt) per litre of water.

Migratory (Bonn Convention definition) 'Migratory species' means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries.

Palustrine Pertaining to marshes, bogs, swamps and fens.

Ponded pasture The practice developed by pastoralists to create an environment by either the construction of banks or the modification of naturally wet areas, in which freshwater is impounded or used primarily to grow suitably adapted plant species and produce fodder for grazing.

Provisioning services Products obtained from ecosystems such as food and water.

Ramsar Convention The Convention on Wetlands (Ramsar, Iran, 1971) is an international treaty that aims to halt the worldwide loss of wetlands and to conserve those that remain through wise use and management.

Regional ecosystem The vegetation community that is consistently associated with a particular combination of geology, landform and soil (see Sattler and Williams 1999).

Regulating services Benefits obtained from the regulation of ecosystems processes such as regulation of floods, drought, land degradation and disease.

Riparian Riparian zones are the areas adjacent to creeks, rivers, lakes and wetlands, including banks and floodplains, which exert a direct influence on the water and aquatic ecosystems.

Riverine Pertaining to rivers.

Sp./Spp. Sp. is an abbreviation for 'species' and is often used when the genus is known, but the species is not. For example, *Eucalyptus* sp. Means an undetermined species of Eucalyptus. Spp. is an abbreviation for more than one species without naming them individually.

Supporting services Ecosystem services that are necessary for the production of all other services such as soil formation, nutrient cycling and primary production.

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Appendixes

Appendix 1: Threatened and migratory fauna commonly associated with Queensland's semi-arid swamps.

Taxon group	Common name	Scientific name	NC Act status*	EPBC Act status*	IUCN Red List of threatened species status **
Birds	Australian painted snipe	<i>Rostratula australis</i>	vulnerable	vulnerable	–
	Latham's snipe	<i>Gallinago hardwickii</i>	–	listed migratory species#	–
	common greenshank	<i>Tringa nebularia</i>	–	listed migratory species#	–
	sharp-tailed sandpiper	<i>Calidris acuminata</i>	–	listed migratory species#	–
Reptiles	ornamental snake	<i>Denisonia maculata</i>	vulnerable	vulnerable	vulnerable

* Under the Queensland *Nature Conservation Act 1992* threatened wildlife are those species listed as presumed extinct, endangered or vulnerable. Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* threatened wildlife includes species listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable or conservation dependent.

**The IUCN Red List of threatened species is an internationally recognised inventory for the conservation status of plant and animal species worldwide.

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* listed migratory species include those species listed in appendices to the Bonn Convention, and in CAMBA and JAMBA.

Appendix 2: Threatened flora commonly associated with Queensland's semi-arid swamps.

Taxon group	Common name	Scientific name	NC Act status*	EPBC Act status*	IUCN Red List of threatened species status **
Aquatic plant	frogbit	<i>Hydrocharis dubia</i>	vulnerable	vulnerable	–
Grass		<i>Paspalidium udum</i>	vulnerable	–	–

* Under the Queensland *Nature Conservation Act 1992* threatened wildlife are those species listed as presumed extinct, endangered or vulnerable. Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* threatened wildlife includes species listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable or conservation dependent.

**The IUCN Red List of threatened species is an internationally recognised inventory for the conservation status of plant and animal species worldwide.

Appendix 3: Wetlands in Queensland that are listed in *A Directory of Important Wetlands in Australia* (2005) and/or are Ramsar sites and that include semi-arid swamps.

Bioregion	Directory reference	Directory wetlands	Ramsar wetlands
Brigalow Belt	QLD084	Balonne River Floodplain	–
	QLD006	Lake Dalrymple	–
Einasleigh Uplands	QLD086	Great Basalt Wall	–
	QLD089	Lake Lucy Wetlands	–
	QLD091	Minnamoolka Area	–
	QLD092	Poison Lake	–
	QLD095	Valley of Lagoons	–
	QLD096	Wairuna Lake	–
	QLD097	Walters Plains Lake	–
Gulf Plains	QLD102	Bluebush Swamp	–
	QLD103	Buffalo Lake Aggregation	–
	QLD106	Lignum Swamp	–
	QLD111	Musselbrook Creek Aggregation	–
	QLD111	Nicholson Delta Aggregation	–
	QLD112	Smithburne — Gilbert Fan Aggregation	–
	QLD113	Southeast Karumba Plain Aggregation	–
	QLD114	Southern Gulf Aggregation	–
Mulga Lands	QLD172	“Old Bando” Swamp	–
	QLD173	“Myola” — “Mulga Downs” Salt Lake and Claypans	–

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