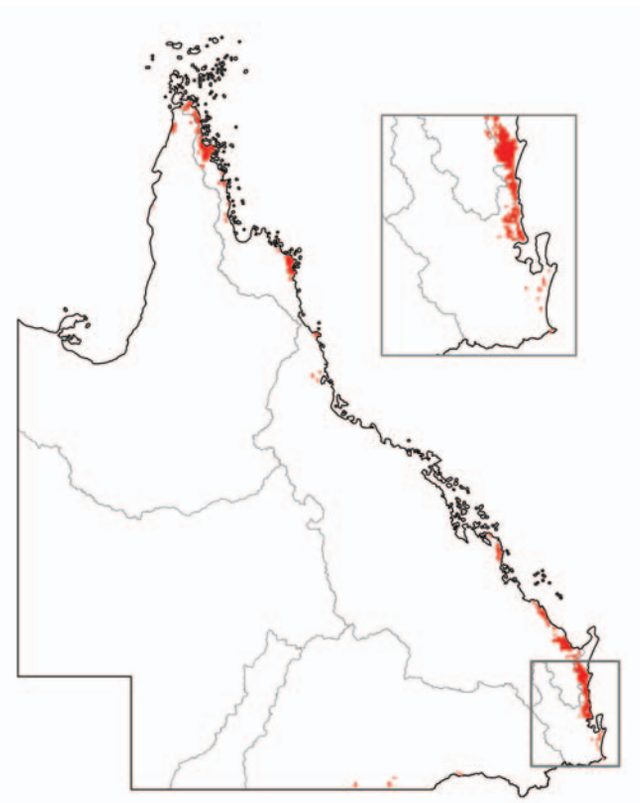
Australian Government

Queensland Government

WETLAND MANAGEMENT PROFILE

COASTAL AND SUB-COASTAL WET HEATH SWAMPS

Coastal and sub-coastal wet heath swamps often support a rich diversity of plant and animal species. Species exhibit unique adaptations and/or behavioural traits that have evolved to meet the demands of a challenging and difficult environment. Even small changes in this environment can result in marked ecological shifts. Managing this delicate balance is a constant challenge for wetland managers. Coastal development continues to threaten the ecological condition and conservation status of these wetlands. This profile covers the habitat types of wetlands termed coastal and sub-coastal non-floodplain wet heath swamps and coastal and sub-coastal floodplain wet heath swamps.



Map showing the distribution of coastal and sub-coastal wet heath swamps in Queensland; grey lines indicate drainage divisions. Map: From Queensland Wetlands Mapping v2.0 (September 2009)

*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 Wetland*Info *website <www.derm/qld.gov.au/wetlandinfo>.*

Description

Heaths are essentially treeless plant communities dominated by low shrubs and various other ground flora. Australian heaths are invariably associated with **oligotrophic** (low nutrient) soils deficient in phosphorus and nitrogen. Where the soils are well drained (for example, deep sands or skeletal sandstones or granites) non-wetland dry heathland prevails. Where the soils are subject to prolonged periods of high soil moisture a wetter type of heath develops to form **palustrine** wetland. In lowland (typically coastal and sub-coastal) situations these wetter forms of heath are simply termed 'wet heaths' or 'coastal and sub-coastal wet heath swamps'. In high altitude situations, the term 'subalpine wet heath' or 'fell field' is used.

There are **floristic** similarities shared by both 'dry' and 'wet' heaths in Australia. Plant communities are typically rich in species with the major plant families represented including: myrtles (*Myrtaceae*), proteas (*Proteaceae*), epacrids (*Epacridaceae*), boronias (*Rutaceae*), wattles (*Mimosaceae*), peas (*Fabaceae*), lilies (*Liliaceae*), grass-trees and mat-rushes (*Xanthorrhoeaceae*). In some situations, wet heaths may grade into coastal and sub-coastal grass, sedge, herb swamps dominated by rushes (*Juncaceae*), sedges (*Cyperaceae*) and node-sedges (*Restionaceae*).

Heath shrubs typically have small, evergreen, **sclerophyllous** leaves that display a number of **xeromorphic** adaptations to combat moisture stress and/or anaerobic (without oxygen) soil conditions (for example, waxy leaf surfaces, leaf hairs, thick leaves), as well as extensive root systems, often arising from **lignotuber**s. Xeromorphy is a common feature among wetland plants and there is some evidence that it may contribute towards the tolerance of plants to high soil wetness as well as drought.

Distribution

Heath distribution in Australia is generally not climatically determined, with representations being found in all mainland states and Tasmania. Edaphic conditions (soil related) are more important, with heath distributions being associated with landscapes where the soils are depleted in one or more of the essential plant elements for example, nitrogen phosphorous and potassium. In Queensland, there are no sub-alpine environments and, therefore, wet heath representations are restricted to a number of coastal and sub-coastal lowland situations found mainly across three dispersed **bioregions**—Southeast Queensland, Central Queensland Coast and Cape York Peninsula.

Wet heath swamps, in general, are non-floodplain systems. Floodplain heath swamp habitats do exist, particularly in the Cooloola region and are found within a floodplain context, with alluvial soils, and receive water from overbank flow and are therefore an exception to the general rule. Coastal and sub-coastal wet heath swamps in south-east Queensland can be found on the mainland at various locations on the Burrum, Sandy Strait, Cooloola and Sunshine coasts, as well as many of the offshore sandmass islands (for example, Fraser, Bribie, Moreton and North Stradbroke islands). In central Queensland, the best examples of this wetland type can be seen at Deepwater and Eurimbula national parks (near Agnes Water–1770) and Byfield/Corio/Shoalwater bays (north of Yeppoon).

Coastal and sub-coastal wet heath swamps in the Noosa Plain (centre of image), Cooloola National Park—fed by a constant supply of groundwater stored in the Cooloola sandmass. Photo: DERM

In the Cape York bioregion, the most expansive representations of coastal and sub-coastal wet heath wetlands are in the Jardine River/Heathlands area at the northern end of the peninsula, with lesser distributions occurring also near Cape Melville, Iron Range, Mungkan Kandju and Cape Flattery–Cape Bedford.

The Wetland*Info* 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 Wetland*Info* 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 Wetland*Info* website <www.derm.qld.gov.au/wetlandinfo>.

National conservation status

The Shoalwater and Corio bays, Great Sandy Strait and Moreton Bay Ramsar sites (Wetlands of International Importance under the **Ramsar Convention**) contain coastal and sub-coastal wet heath swamps. Fraser Island also includes areas of coastal and sub-coastal wet heath swamp and is on the World Heritage List maintained by the **World Heritage Convention**. The Shoalwater Bay Military Training Area (Byfield) is a Commonwealth heritage place under the Commonwealth Heritage List and also includes areas of this wetland habitat type. There are a number of species associated with coastal and sub-coastal wet heath swamp in Queensland that are listed as threatened under the Queensland *Nature Conservation Act 1992* (NC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and/or on the **IUCN Red List**.

Ramsar wetlands, World Heritage properties, threatened species and Commonwealth heritage places 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 declared Ramsar wetland, World Heritage property, threatened species or Commonwealth heritage place will be subject to an environmental assessment and approval regime under the EPBC Act.

Recovery plans, which set out research and management actions to support the recovery of threatened species under the EPBC Act are being prepared. Management plans or equivalent are in place for each of the Ramsar wetlands though in some instances they may not apply to the entire Ramsar site.

Coastal and sub-coastal wet heath swamps in the Noosa Plain (centre of image), Cooloola National Park—fed by a constant supply of groundwater stored in the Cooloola sandmass. Photo: DERM

Cultural heritage

All wetland ecosystems are of material and cultural importance to Indigenous people and many will have profound cultural significance and values. More than 230 Aboriginal cultural heritage sites have been recorded within coastal and sub-coastal wet heath swamps in Queensland. At least one site located within a coastal and sub-coastal wet heath area dates from the late **Pleistocene** (22 000 BP) period, however, most sites date from the mid **Holocene**, being less than 4000 years. Most coastal and sub-coastal wet heath/sedgeland wetlands have not been systematically surveyed or assessed for cultural heritage significance.

COASTAL and sub-coastal wet heath swamps are often rich in plant and animal diversity and some of these species have unique adaptations and/or behavioural traits that have evolved to meet the demands of a challenging and difficult physical environment.

There is a very high likelihood of encountering cultural heritage sites within and adjacent to coastal and sub-coastal wet heath swamps. Most have significant spiritual and cultural values including evidence of occupation and use such as burials, earth arrangements, scarred trees, middens, stone artefacts and scatters, grinding grooves, food and fibre resources and historic contact sites. Some coastal and sub-coastal wet heath swamps have particular significance as story places and as sites for cultural activities.

The most commonly recorded sites associated with coastal and sub-coastal wet heath swamps are middens and stone artefact scatters associated with occupation sites (for example open camps). Occupation sites are often found in areas of higher open ground within or adjacent to wetland ecosystems. Archaeological evidence of cultural sites, such as stone artefacts and shells, is often concentrated along **ecotone**s around the margins of coastal and sub-coastal wet heath swamps, and in association with neighbouring regional ecosystems such as coastal and sub-coastal tree swamps, saltmarsh and mangrove wetlands. The clustering of sites along ecotones reflects the concentration of traditional occupation and use within areas of greatest biodiversity.

THERE is a very high likelihood of encountering cultural heritage sites within and adjacent to coastal and sub-coastal wet heath swamps, especially middens and stone artefact scatters associated with occupation sites.

Some coastal and sub-coastal wet heath swamps also have historic non-Indigenous cultural heritage significance, although most have not been assessed for historic heritage values. DERM has recorded more than 35 historic sites associated with coastal and sub-coastal wet heath swamps. The historic heritage values of coastal and sub-coastal wet heath swamps demonstrate evidence of their past occupation and use associated with the agricultural, timber and forestry industries. Sites include camps, settlements, roads, tramways, log dumps, and relics of maritime transport and communications. It is important to note that evidence of traditional occupation and use is often encountered at historic sites.

Refer to the *Coastal and sub-coastal fringe wetlands—cultural heritage* profile <www.derm.qld.gov.au> for more information on identifying, assessing and managing cultural heritage values associated with coastal and sub-coastal wet heath swamps.

Ecology

Figure 1 summarises the major ecological relationships (soil nutrient and hydrological conditions) of Australian heath plant formations that possess a heath stratum, either alone (true heaths) or as an understorey to trees and shrubs.

It is generally accepted that the sclerophyllous (heath) flora of the world has evolved under conditions of seasonally waterlogged, infertile soils in **mesothermal** climates (Specht, 1979a). Many heathland shrubs survive prolonged periods of waterlogging—for periods of up to six months, by relying onvarious root adaptations (both **morphological** and **physiological**) designed to reduce the severity of anaerobic conditions. The seasonal growth rhythms imposed on plants growing in seasonally waterlogged conditions are easily 'switched' to conditions of seasonal drought—hence the close evolutionary and floristic association between 'wet' and 'dry' heathland types.

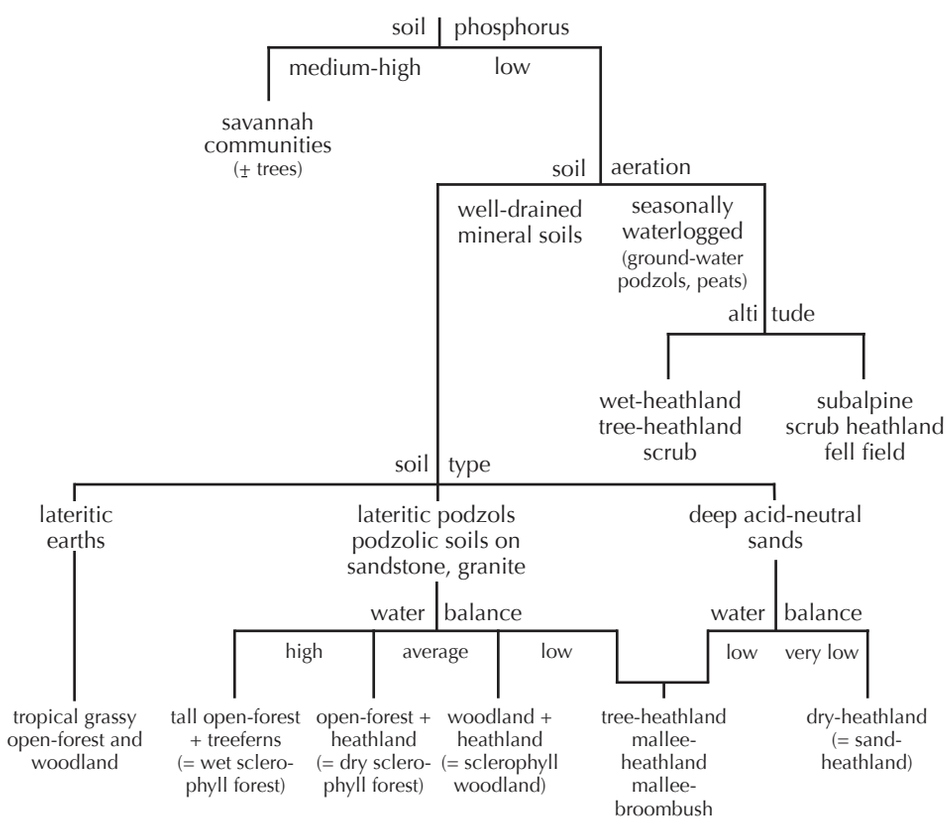


Figure 1: Schematic diagram showing the major ecological relationships (soil fertility and hydrology) of Australian plant formations with a heath stratum. Source: Specht 1979b

Analysis of soil types representative of heathlands in many locations throughout the world shows they are invariably low in one or more essential plant nutrient,in particular, phosphorus and nitrogen. This is not to suggest that individual heath plants do not show a growth response to the addition of limiting nutrients. When applied more liberally to whole communities under field experimental conditions, marked changes can be induced. Heddle and Specht (1975) reported changes in heathland over 22 years after application of a range of fertilisers. Application of phosphorus sped up the life cycle of heath plants causing them to die earlier. Spring-growing herbaceous species were able to compete successfully with heath plants, leading to floristic changes in plant species composition. Similar changes were repeated when fertilisers were added to a range of 'wet' and 'dry' heaths growing in subtropical south-east Queensland (Specht *et al.*, 1977).

The leaves of heathland species show a variety of adaptations to high levels of direct sunlight and periodic moisture stress (for example, thick leaves with highly reflective, waxy or hairy surfaces). High oil content is also a common characteristic that may have evolved to assist plants to reduce the levels of animal herbivory and the subsequent requirement for tissue replacement. High plant oil content in turn influences the flammability of vegetation and this has flow-on effects for fauna, which use the vegetation as habitat, and the ecosystem as a whole.

Major climatic types (Köppen 1923) in which heathland vegetation is found in Australia. Source: Specht 1979b

- **A hot climate with no month below 180C**
  - Aw climate with a dry winter
  - Awg climate with a temperature maximum before the summer solstice
  - Awgi climate with a small annual temperature range (below 50C)
- **B dry climate**
  - BS semi-arid climate
  - BSk mean annual temperature cool (below 180C)
- **C warm climate with at least one month below 180C**
  - Cf climate with uniform rain
  - Cfa climate with hot summer (hottest month above 220C)
  - Cfb climate with long mild summer (hottest month below 220C and at best four months above 100C)
  - Cfc climate with short mild summer (with less than four months above 100C)
  - Cs climate with a dry summer
  - Csa climate with hot summer (hottest month above 220C)
  - Csb climate with long mild summer (hottest month below 220C and at least four months above 100C)
  - Cw climate with a dry winter
  - Cwb climate with long mild summer (hottest month below 220C and at least four months above 100C)

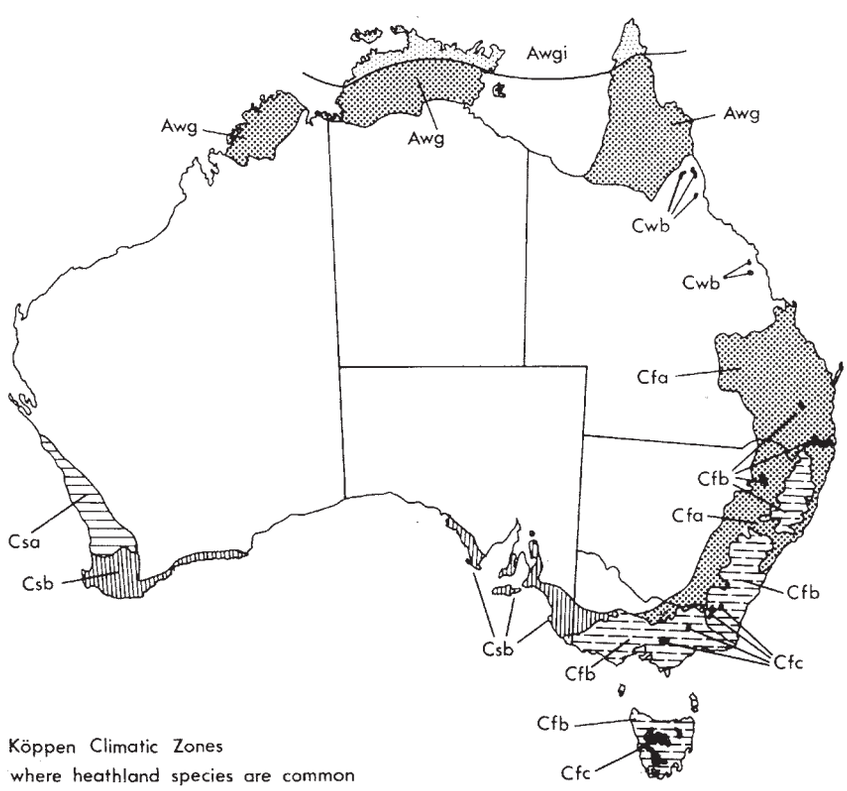


Figure 2: Major climatic types (Köppen 1923) in which heathland vegetation is found in Australia. Source: Specht 1979b

Animals surviving in heathland can tolerate fire due to the patchy nature of destruction caused by burning, and their ability to avoid the effects of fire. The intensity, extent and periodicity of fire are crucial to animals avoiding the harmful effects of fire and/or in influencing recolonisation patterns. The patterns of post-fire animal grazing exert an important influence on early plant succession which can have long term effects on plant community species composition (Main, 1981).

THE major threats to coastal and sub-coastal wet heath swamps include vegetation clearing and fragmentation, changes to drainage and water flow regimes, changes associated with managing stormwater and wastewater, inappropriate fire management regimes, grazing impacts (trampling) and introducing weeds and feral animals (especially pigs).

Species of conservation significance

Preserving coastal and sub-coastal wet heath swamp habitat is crucial to protect species of conservation significance, particularly species that are threatened with extinction. Species of conservation significance in coastal and sub-coastal wet heath swamps are shown below.

Wetland*Info* provides full species lists of wetlands animals and plants.

Fauna

Mammals

– water mouse *Xeromys myoides*

Birds

– ground parrot *Pezoporus wallicus*

Fish

– Oxleyan pygmy perch *Nannoperca oxleyana*

– honey blue eye *Pseudomugil mellis*

Honey blue eye *Pseudomugil mellis*.
Photo: Gunther Schmida

The vulnerable (NC Act) honey blue eye *Pseudomugil mellis* is endemic to Queensland, occurring in slow flowing, slightly acidic, **tannin**-stained lakes, streams and swamps (including coastal and sub-coastal wet heath swamps) of south-east Queensland. It is often found along grassy banks and among reeds and waterlilies. At 3 cm long, it is one of the smallest threatened species in Queensland. In addition to its characteristic blue eyes, the fish has a distinctive amber to orange colour.

Large areas of coastal and sub-coastal habitat have been cleared for residential development, forestry and agriculture. Honey blue eyes are also collected for aquariums, which poses an added threat. It is likely that the introduced mosquito fish *Gambusia holbrooki* could out-compete the blue eye where the two co-exist. Habitat protection is the key measure for ensuring the survival of this fish. It is also important to maintain the genetic diversity of the species by protecting individual populations and ensuring that breeding can occur between adjoining populations. Small breeding populations are also being maintained in captivity.

Amphibians

– **wallum** froglet *Crinia tinnula*

– wallum rocketfrog *Litoria freycineti*

– wallum sedgefrog *Litoria olongburensis*

– Cooloola sedgefrog *Litoria cooloolensis*

The ground parrot *Pezoporus wallicus* is a largely terrestrial bird, being diurnally active (during the daytime) but showing voluntary flight only during short periods (20–25 minutes) immediately pre-sunrise and post-sunset. The species is vulnerable in Queensland (NC Act) with **extant** populations in several Australian states (Qld, NSW, Vic, Tas and WA). Tasmania is the species' island stronghold with population estimates of 100 000 birds. Elsewhere, on mainland Australia, ground parrot populations are much reduced with state population estimates varying from fewer than 500 birds in Western Australia (a distinct subspecies) to about 3000 birds in Queensland. Known threats include habitat loss and degradation (resulting, for example, from drainage/clearing, inappropriate fire regimes and grazing impacts), increased predation pressures (dingoes, domestic dogs and cats) and increased mortality from roadkills, especially in urbanised areas (McFarland, 1991a; Blakers et al., 1984).

In Queensland, the ground parrot mainly inhabits lowland dry and wet heaths and sedgelands (excluding permanent waterbodies) between Maryborough and Coolum on the mainland, and along the west coast of Fraser Island. Parrot distribution, when compared to historical data, shows a decline from habitat destruction or degradation in the northern and southern limits of the species range (McFarland, 1991a). There is a seasonal shift in **microhabitat** preference from dry heath (in late autumn–early summer) to wet heath (in summer) (McFarland, 1991a, b; Higgins, 1999). The species feeds principally on the seeds of more than 40 species of plants, including both **monocot**s and **dicot**s. Habitat quality appears to be strongly influenced by fire regime (especially fire frequency), with bird densities peaking at sites with a five to eight year post-fire interval. Whether or not populations persist in older heaths (more than 15 years postfire) requires further study (McFarland, 1991a; Baker and Whelan, 1994).

A bird in the hand...ground parrot *Pezoporus wallicus* in breeding plumage.
Photo: David McFarland

The **wallum** rocketfrog *Litoria freycineti* is a ground-dwelling frog that breeds in temporary or permanent still water. It is known as an 'acid frog' and is one of several frogs in south-east Queensland and New South Wales that undergo tadpole development in soft waters of high acidity and low nutrient content. Its main habitat includes heathlands, sedgelands, acid bogs and **peats**, and wallum banksia *Banksia aemula* dominated shrublands. It has also been recorded from rushes and sedges surrounding freshwater lakes and coastal scribbly gum *Eucalyptus racemosa* forest adjacent to heathlands. Recent records indicate this species still occurs throughout its previous range, but has suffered from habitat loss and disturbance.

L. freycineti has specialised breeding requirements and is particularly susceptible to changes in water chemistry. Exotic pine plantations, associated road construction and changes to burning practices have led to changes in hydrology and water chemistry that have been detrimental to the frog's breeding success. Clearing native vegetation to establish exotic pine plantations has now ceased but habitat loss continues as a result of urban development. Damage to microhabitats (reed beds and sedges) by human trampling and recreation activities has been identified as detrimental to wallum-dwelling species like *L. freycineti*. Various other potential sources of impact have been identified but, as yet, their effects are poorly studied. These impacts include the use of mosquito and weed chemical controls, grazing and feral pig impacts (feral pigs are known to prey on frogs).

Wallum rocketfrog *Litoria freycineti*.
Photo: DERM

Key management actions for the wallum rocketfrog include establishing minimum protective buffers (for example, 50 m; refer to Using buffers to protect wetlands) around known breeding sites that exclude a range of routine uses including timber harvesting and chemical use; maintaining natural drainage patterns, water tables and water quality when conducting activities adjacent to or upslope of known breeding sites; monitoring and managing grazing; and controlling feral pigs and **pine wildings**. To reduce the risk of disease transfer between frogs, handling should also be avoided.

Flora

Shrubs

Plant communities are typically rich in species with the major plant families represented including myrtles (Myrtaceae), proteas (Proteaceae), ericas (Ericaceae), boronias (Rutaceae), wattles (Mimosaceae), peas (Fabaceae), lilies (Liliaceae), and grass-trees and mat-rushes (Xanthorrhoeaceae). Characteristic species include *Melaleuca thymifolia, Banksia robur, Xanthorrhoea fulva, Hakea actites, Leptospermum spp*. and *Baeckea frutescens*.

In some situations wet heaths may grade into true sedgelands dominated by rushes (Juncaceae), sedges (Cyperaceae) and node-sedges (Restionaceae).

Other species, in addition to the dominant shrubs and sedges that can be found in these wetland habitats include:

Herbs

- swamp orchid *Phaius australis/tancarvilleae*
- Christmas bells *Blandfordia grandiflora*
- *Sowerbaea subtilis*
- *Schoenus scabripes*
- sundews, for example *Drosera auriculata, D. binata, D. spatulata*
- bladderworts, for example *Utricularia biloba, U. gibba, U. uliginosa*

Climber

- tropical pitcher plant *Nepenthes mirabilis*

The swamp orchid* (sometimes called the swamp lily) is a terrestrial (ground-dwelling) orchid that grows in coastal and sub-coastal swampy situations to a height of about one metre with flowering stems reaching up to two metres (usually 1.25–1.5 m). The flowers are the largest of any Australian orchid (10–15 cm diameter) being arranged in terminal clusters of between four and 16 individual flowers. The swamp orchid is easily propagated either from seed or vegetative buds located underneath leafy bracts on the flowering stems and is widely cultivated in Australia. In the wild, however, swamp orchids are regarded as endangered in Queensland and Australia, due to loss of available habitat and heavy illegal collection. Swamp orchids were originally distributed in coastal locations from north Queensland to north-east New South Wales.

It has been suggested that at least 95 per cent of the original populations in north-east New South Wales and south-east Queensland have suffered local extinction since European settlement. Large populations survived until the mid-1970s on the Gold Coast and the mid-1980s on the Sunshine Coast. Collecting wild plants for cultivation or for sale is an ongoing threat, as this is one of Australia's most desirable orchids. Flower stems are being removed for the apparent purpose of perfume extraction or as a misguided attempt at protecting the species. There are reports of all flower stems in the accessible areas of North Stradbroke Island being removed, substantially lowering the ability of this species to reproduce.

Other threats include weed invasion, damage by feral pigs and timber harvesting. Invasive plants such as umbrella trees, groundsel, lantana (a Weed of National Significance) and Brazilian cherry have invaded suitable habitat on North Stradbroke Island, threatening to displace the native flora by competition, shading, and altering fuel loads with a subsequent change in the fire regime.

The effect of fire on swamp orchids is poorly understood. Several orchids with exposed

Swamp orchid flowering terminal cluster.
Photo: Queensland Herbarium

pseudobulbs are known to be fire tolerant to at least low intensity fire, and regenerate rapidly after fire. However regular fuel reduction burns can have a deleterious effect and have influenced the decline of swamp orchid populations from the Sunshine Coast hinterland. Burning when the species is in its dormant phase might reduce any deleterious effects. Hot fires are known to stimulate flowering in some orchids. Fire might be a specific threat to a population occurring in a grassy open forest-rainforest ecotone in Byfield National Park. In coastal north-east Queensland, fire may maintain populations of swamp orchids by preventing the succession of their habitat to rainforest thereby increasing light levels in the understorey. Cattle are known to eat the flowering parts of orchids and severely impact on important orchid microhabitats through trampling.

* A group of Australian ground orchids with specimens variously assigned to one of three names: *Phaius tancarvillieae*, *P. australis* and *P. bernaysii*. Whilst under taxonomic review, the Queensland Herbarium recommends the use of the names *Phaius australis* (for red/ochre forms) and *P. bernaysii* (for yellow forms).

Trees*/shrubs

- swamp stringybark *Eucalyptus conglomerata* *
- Goodwood gum *Eucalyptus hillii* *
- *Acacia baueri subsp. baueri*
- Wide Bay boronia *Boronia rivularis*
- *Melaleuca cheelii* *
- durringtonia *Durringtonia paludosa*

* scattered trees might be present within or at the margins of these generally treeless communities

John Wyndham's classic British sci-fi The Day of the Triffids told the story of a world invaded by alien killer plants bent on the destruction of humankind. Such stories have fuelled a popular fascination with the lifestyle and habits of real normal nutritional requirements by capturing, digesting and absorbing small insects—these include the pitcher plants (Nepanthaceae), sundews (Droseraceae) and bladderworts (Lentibulariaceae).

Coastal and sub-coastal wet heath swamps provide excellent habitat for a number of carnivorous or insectivorous plants as they typically involve low nutrient environments where decomposition and nutrient cycling rates are slowed. Most of these species use a passive form of insect trap (compared to the active traps used by the Venus fly trap plant) to capture their prey. A classic example is the 'pitfall trap' of pitcherplants (such as the tropical pitcher plant *Nepenthes mirabilis,* endangered under the NC Act) where an insect falls into a vase-like modified leaf. Downward-pointing hairs on the slippery walls prevent the insect from crawling out, and the hapless victim ultimately drowns in a pool of digestive enzymes. Other well-known passive traps include the adhesive traps of sundews (such as *Drosera spatulata* photo below) and bladderworts (such as the floating bladderwort *Utricularia gibba*).

The unusual pitchers which give *Nepenthes mirabilis* its common name. Nepenthes are a form of pitcher plant that evolved in the Asia Pacific region with species found from the top of Australia to Thailand.
Photo: DERM

Similar but different: *Drosera spatulata* (above) with its basal rosette of leaves looks very different from the forked sundew *Drosera binata* (above right) with its spreading, divided leaves. But both sundews share the feature of a dense covering of sticky glandular hairs which function to capture small unsuspecting insects.
Photos: DERM and Glenn Leiper

Utricularias (such as *U. gibba*) (right) have small globose bladders on their leaves or other vegetative parts. The plant pumps water from the bladder creating a vacuum inside. When an unsuspecting insect triggers the inward-opening trapdoor to open by touching one of the trigger hairs it is engulfed, digested and absorbed by the plant.
Photo: Glenn Leiper

Managing to reduce impacts

Coastal and sub-coastal wet heath swamps in Queensland have a 'mixed report card' when it comes to the conservation status of individual component regional ecosystems. Substantial gains have been made in recent decades in raising the level of reservation of these wetland ecosystems in Queensland (notably, via extensions to Cape Melville, Iron Range, Mungkan Kandju, Byfield, Burrum Coast, Great Sandy and Noosa national parks).

Elsewhere, outside the protected area estate, the status of coastal and sub-coastal wet heath swamps has generally faired more poorly, with distributions being exposed to a range of environmental impacts associated with encroachment by competing land uses (especiallycoastal and sub-coastal urban growth). These impacts are most evident in the southern parts of the range in Queensland (between the Sunshine and Gold coasts), where growth and development has been strongest.

PLANNED burns in coastal and sub-coastal wet heath swamps should be conducted when the soil is wet to avoid the risk of destructive peat fires.

Using buffers to protect wetlands

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.

Maintaining water quantity and quality is an essential part of conserving and managing coastal and sub-coastal wet heath swamps in Queensland. The complex relationships between soil water, plant productivity, nutrient cycling, species composition, and fire and grazing regimes present wetland managers with difficult and often delicate decisions which can have irreversible consequences. For example, where the length and periodicity of soil waterlogging is significantly reduced, long term and even permanent ecological changes to these wetlands can occur, including species invasion by plants less tolerant of anaerobic soil conditions, increased

WETLAND BUFFERS

Protecting wetlands in isolation from the surrounding landscape is an exercise in futility. Many fauna utilise wetland habitat incidentally—at particular stages of their life cycle. Many frogs disperse hundreds of metres from wetlands after completing their tadpole stage, only to return when it is time to reproduce the next generation. Other species rely on wetlands as refugia during prolonged dry periods. Adequate wetland buffers need to be planned and managed to ensure the healthy ecological functioning of these ecosystems. Buffers help to:

- condition water runoff (quantity and quality);
- reduce the impacts of invasive weeds;
- minimise fauna disturbance (for example from noise, light, disruptive movement);
- provide for wildlife movement between upland and lowland habitats; and
- separate wetlands from competing uses and minimise nuisance problems (for example, biting insects).
- retain connectivity between wetlands
- maintain recharge areas

Trapped between coastal residential development, golf courses, airports and agriculture—maintaining connectivity is a serious issue for this coastal and sub-coastal wet heath swamps on the Sunshine Coast of south-east Queensland (June 2004).
Photo: DERM

For further information about wetland buffer zones see the Wetland*Info* website <www.derm.qld.gov.au/wetlandinfo>.

decomposition rates of soil organic matter and increased incidence and severity of wildfire.

Altered fire regimes can cause species compositional changes as fire-tolerant species increase in relative abundance with increasing incidence and/or intensity of fire. Researchers studying coastal and sub-coastal wet heath swamps have found that plant productivity and the abundance of birds tends to peak between four and eight years post-fire (Southeast Queensland Fire and Biodiversity Consortium, 1999). Fire frequency intervals of between seven and 20 years have been recommended to maintain overall biodiversity in the coastal and sub-coastal heaths of south-east Queensland (Tran and Peacock, 2002). At the same time, fire regimes should seek to maximise variability of key parameters in the pursuit of creating fire mosaics in the landscape. Planned burns in coastal and sub-coastal wet heath swamps should be conducted when the soil is wet, to avoid the risk of destructive peat fires, and an extended period of post-fire monitoring is required to ensure re-ignition does not occur (peat layers can smoulder for several weeks before re-igniting wildfires where fuel loads are high).

MAINTAINING water quantity and quality is an essential part of conserving and managing coastal and sub-coastal wet heath swamps in Queensland.

Where coastal and sub-coastal wet heath swamps occur on or adjacent to the protected area estate in Queensland, the Queensland Parks and Wildlife Service (QPWS) is required to act in accordance with its Good neighbour policy, including cooperating with neighbours in the management of fire across boundaries of both QPWS-managed lands and adjacent lands. Contact your local QPWS office for further information (see the DERM website <www.derm.qld.gov.au> for contact details).

Coastal and sub-coastal wet heath swamps generally lack palatable nutritious fodder species (such as grasses) and are therefore of little or no value as grazing landsin their natural state. The combination of a typically dense shrub layer and waterlogged soil conditions creates a barrier to animal movement. Grazing managers should consider fencing these wetlands to better manage stock movements and to prevent trampling of sensitive vegetation. Fire management aspects (frequency, extent and intensity of burns) and feral animal control, especially wild pig numbers, should also be considered to ensure that the viability of fenced wetland areas is maintained.

Various covenants and agreements (both binding and non-binding on title) are now available to landholders in Queensland, to assist in the protection of wildlife and their habitat alongside production enterprises (for example, grazing, farming, horticulture and forestry). Where the biodiversity values on a property are particularly significant it may be appropriate to negotiate a nature refuge agreement. For example, Una Corbould Nature Refuge, nestled between Lake Cootharaba and the Noosa River in south-east Queensland, is helping to conserve important coastal and sub-coastal wet heath swamp vegetation, in conjunction with Great Sandy National Park. For further information on nature refuges, see the DERM website <www.derm.qld.gov.au>.

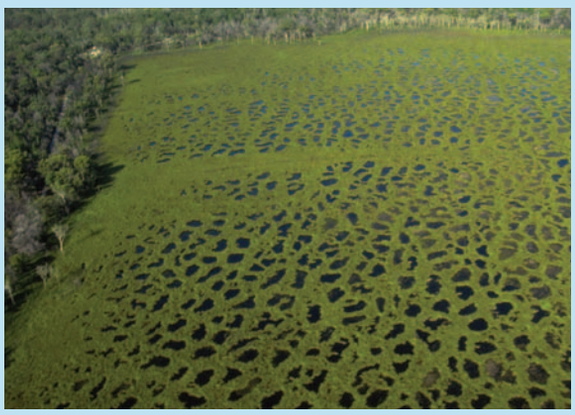
Wildfire and prescribed burns near Carlo Point Cooloola – managers aim for a mosaic burn pattern in terms of fire history, intensity and scale in a challenging fire-prone landscape.
Photos: QPWS

THE DELICATE BALANCE OF MANAGING THE FENS OF FRASER ISLAND AND THE COOLOLA COAST

The '**patterned fens**' of Fraser Island and the adjacent Cooloola Coast are a type of wetland **mire** that is thought to be globally unique. Most of the world's mires are found at higher (colder) latitudes, where low temperatures, soil waterlogging and anaerobic conditions slow the rate of organic matter decomposition, resulting in the formation of peat. The patterned fens of Fraser Island and Cooloola are unique because they occur at subtropical latitudes, where average ambient temperatures and decomposition rates are much higher. These patterned fens are also the only known examples in the world of fens flowing into tidal wetlands. They occur as an elaborate series of peat ridges (**strings**) and pools (**flarks**) formed at the base of high dunes, where there is a constant and high volume surface flow of freshwater.

The patterned fens of Fraser Island are entirely protected within the Fraser Island World Heritage Area, which is part of Great Sandy National Park. Only about half of the patterned fens on the adjacent mainland are similarly reserved, with the remainder occurring on unallocated State land. The future use of this land has recently been reviewed by the Queensland Government and action is being taken to include the remaining areas of patterned fens into the protected area estate.

The same review also recommended several nearby areas be developed for residential, commercial and/or industrial purposes. Where these recommendations are to be put into effect, establishing and maintaining adequate minimum ecological wetland buffers will be of paramount importance as a measure to ensure the ecological integrity of these unique fens is not damaged. Water supply and extraction is also a key management issue in this environment. At present, the nearby township of Rainbow Beach is predominantly reliant upon surface water



Patterned fens near Moon Point, Fraser Island.
Photo: DERM

extraction from feeder creeks associated with the patterned fens. Initial research suggests it may be beneficial to balance this surface water supply with extraction from deep **aquifer**s (that is, groundwater located well below the perched water tables upon which the fens directly rely). However, relatively little is known about the groundwater hydrology of this region, for example, how this aquifer interfaces with shallow aquifers and tidal waters of the nearby marine environment of Tin Can Bay Inlet. If there is a shift to balance surface water extraction with use of deep aquifers, close ecological monitoring will be required to ensure water-dependent ecosystems are not adversely impacted by human use of this resource.

Fire management of the Fraser Island–Cooloola patterned fens is also problematic as strategists seek to achieve a balance between the fire suppression demands associated with protecting life and property and the ecological fire requirements of plants and animals. Global warming, where it leads to increased temperatures, droughts and other major weather events, has the potential to upset this balance further, highlighting the need for a better understanding of the ecology of these unique wetlands and the factors which shape and support their survival.

Glossary

Aquifer An underground bed or layer of earth, gravel or porous stone that yields water.

Bioregions (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.

BP Before the present time.

Dicots Flowering plants characterised by having two cotyledons (seed leaves); examples include

most fruiting and flowering trees, and most annual and perennial flowering plants.

Ecotone A transition zone between two or more ecological communities.

Extant Still in existence; not destroyed, lost,or extinct.

Flarks Elongated wet depressions separated by raised ribs and patterned peatlands; the long axis is perpendicular to the direction of water flow.

Floristic Pertaining to the number, distribution and relationships of plant species in one or more areas.

Holocene The geological period of time (epoch) from about 11 000 years ago to the present, following the Ice Age (Pleistocene epoch).

IUCN Red List A list of globally threatened species assessed and maintained by the World Conservation Union (IUCN). The List provides taxonomic, conservation status and distribution information and highlights those species or groups of species that are facing a higher risk of global extinction.

Lignotuber A starchy swelling on underground stems or roots. Some plants, such as eucalypts use them as a life-support system in case of fire or animal damage. They are able to sprout back from buds on the surface of the lignotuber.

Mesothermal A climate where the winters are too cold to allow year-round photosynthesis, but not cold enough to support a fixed period of continuous snow cover every year.

Microhabitat A small area where an organism lives that has different conditions from other small surrounding areas.

Mire Wetland with vegetation that is normally peat-forming.

Monocot Flowering plants characterised by having a single cotyledon (seed leaf) including grasses, orchids and palms.

Morphological Relating to the physical shape, form and structure of an organism.

Oligotrophic Low nutrient; deficient in one or more essential plant elements (for example, phosphorus, nitrogen, potassium).

Palustrine Pertaining to marshes, swamps, bogs and fens.

Patterned fens Fens are a type of mire that receive water and nutrients from the surrounding catchment through the water table (compared to bogs which receive water and nutrients from rain). Patterned fens refer to the fens of Fraser Island – Cooloola where an elaborate series of peat ridges ('strings') and pool formations ('flarks') have formed in response to high volume surface water flows.

Peat Partially decomposed organic matter (mostly plant material) which accumulated in water-saturated environments, deficient in oxygen; resulting from anaerobic respiration.

Physiological Relating to the way in which the bodies of animals and plants work.

Pine wildings Young pine seedlings (which develop naturally) often establishing in native bushland adjacent to pine plantations.

Pleistocene The geological period of time (epoch) from about two million years ago to about 11 000 years ago, usually thought of as the Ice Age due to the multiple expansion and retreat of glaciers.

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).

Remnant A small surviving component of an original extent; remnant vegetation includes all intact and predominantly intact vegetation communities, excluding young regrowth.

Sclerophyllous Leathery type leaves with a thick waxy cuticle that reduces water loss in plants.
Strings A pattern of narrow, low peat ridges oriented at right angles to the direction of drainage; water and peat very low in nutrients.

Tannin A brown pigment found in leaves and other parts of plants. Tannin solutions are acidic and have an astringent taste.

Wallum Heathland that grows in sandy, low nutrient, acidic soils on the lowlands and offshore islands of south-east Queensland and northern New South Wales.

World Heritage Convention The Convention Concerning the Protection of the World Cultural and Natural Heritage is an international treaty that seeks to encourage the identification, protection and preservation of cultural and natural heritage around the world considered to be of outstanding value to humanity.

Xeromorphic Having special structural adaptations that protect a plant from drying out.

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Wetland*Info* <www.derm.qld.gov.au/wetlandinfo>

Appendixes

Appendix 1: Threatened fauna associated with Queensland's coastal and sub-coastal wet heath swamps.

Taxon group	Common name	Scientific name	NC Act status*	EPBC Act status*	IUCN Red List of threatened species status**
Mammals	water mouse	*Xeromys myoides*	vulnerable	vulnerable	vulnerable
Birds	ground parrot	*Pezoporus wallicus*	vulnerable	–	–
Fish	Oxleyan pygmy perch	*Nannoperca oxleyana*	vulnerable	endangered	endangered
	honey blue eye	*Pseudomugil mellis*	vulnerable	vulnerable	endangered
Amphibians	wallum froglet	*Crinia tinnula*	vulnerable	–	vulnerable
	wallum rocketfrog	*Litoria freycineti*	vulnerable	vulnerable	vulnerable
	wallum sedgefrog	*Litoria olongburensis*	vulnerable	vulnerable	vulnerable
	Cooloola sedgefrog	*Litoria cooloolensis*	rare	–	endangered

* 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 2: Threatened flora associated with Queensland's coastal and sub-coastal wet heath swamps.

Taxon group	Common name	Scientific name	NC Act status*	EPBC Act status*
Herbs	swamp orchid†	*Phaius australis/ tancarvilleae*	endangered	endangered
		Sowerbaea subtilis	vulnerable	vulnerable
Climber	tropical pitcher plant	*Nepenthes mirabilis*	endangered	–
Trees and shrubs		*Acacia baueri ssp. baueri*	vulnerable	–
	swampy stringybark	*Eucalyptus conglomerata*	endangered	endangered
	Goodwood gum	*Eucalyptus hallii*	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 taxonomy of swamp orchids is under review. Currently, both *Phaius australis* and *Phaius tancarvilleae* are recognised as two distinct species scheduled as endangered under the NC and EPBC Acts.

Appendix 3: Coastal and sub-coastal wet heath swamp representations in Queensland that form part of larger wetland complexes listed in *A Directory of Important Wetlands in Australia* (2001) and/or Ramsar wetlands.

Bioregion	Directory reference	Directory wetlands	Ramsar wetlands
Central Queensland Coast	QLD043	Corio Bay Wetlands	Shoalwater and Corio Bays
	QLD044	Dismal Swamp – Water Park Creek	Shoalwater and Corio Bays
	QLD048	Island Head Creek – Port Clinton Area	Shoalwater and Corio Bays
	QLD178	Shoalwater Bay Training Area Overview	Shoalwater and Corio Bays
Cape York	QLD056	Archer Bay Aggregation	–
	QLD059	Cape Flattery Dune Lakes	–
	QLD060	Cape Grenville Area	–
	QLD061	Cape Melville – Bathurst Bay	–
	QLD063	Jardine River Wetlands Aggregation	–
	QLD066	Newcastle Bay – Escape River Estuarine Complex	–
	QLD069	Olive River	–
	QLD070	Orford Bay – Sharp Point Dunefield Aggregation	–
	QLD071	Port Musgrave Aggregation	–
	QLD073	Silver Plains – Nesbitt River Aggregation	–
	QLD074	Skardon River – Cotterell River Aggregation	–
	QLD075	Somerset Dunefield Aggregation	–
	QLD076	Temple Bay	–
Southeast Queensland/ Cape York	QLD100	Great Barrier Reef Marine Park	–
Southeast Queensland	QLD126	Burrum Coast	–
	QLD127	Bustard Bay Wetlands	–
	QLD131	Fraser Island	Great Sandy Strait
	QLD132	Great Sandy Strait	Great Sandy Strait
	QLD133	Lake Weyba	–
	QLD134	Moreton Bay	Moreton Bay
	QLD135	Noosa River Wetlands	–

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For more information visit Wetland*Info* <www.derm.qld.gov.au/wetlandinfo>