A guide to managing and restoring wetlands in Western Australia

Wetland vegetation and flora, part 1: Overview

In Chapter 2: **Understanding wetlands**

Australian Government

Department of Environment and Conservation

Our environment, our future

Introduction to the guide

Western Australia's unique and diverse wetlands are rich in ecological and cultural values and form an integral part of the natural environment of the state. *A guide to managing and restoring wetlands in Western Australia* (the guide) provides information about the nature of WA's wetlands, and practical guidance on how to manage and restore them for nature conservation.

The focus of the guide is natural 'standing' wetlands that retain conservation value. Wetlands not addressed in this guide include waterways, estuaries, tidal and artificial wetlands.

The guide consists of multiple topics within five chapters. These topics are available in PDF format free of charge from the Western Australian Department of Environment and Conservation (DEC) website at www.dec.wa.gov.au/wetlandsguide.

The guide is a DEC initiative. Topics of the guide have predominantly been prepared by the department's Wetlands Section with input from reviewers and contributors from a wide range of fields and sectors. Through the guide and other initiatives, DEC seeks to assist individuals, groups and organisations to manage the state's wetlands for nature conservation.

The development of the guide has received funding from the Australian Government, the Government of Western Australia, DEC and the Department of Planning. It has received the support of the Western Australian Wetlands Coordinating Committee, the state's peak wetland conservation policy coordinating body.

For more information about the guide, including scope, purpose and target audience, please refer to the topic 'Introduction to the guide'.

DEC welcomes your feedback and suggestions on the guide. A publication feedback form is available from the DEC website at www.dec.wa.gov.au/wetlandsguide.

Contents of the guide

These topics are available in PDF format free of charge from the DEC website at www.dec.wa.gov.au/wetlandsguide.

'Wetland vegetation and flora' topic

Acknowledgments

Authors: Greg Keighery, DEC, Bronwen Keighery, Office of the Environmental Protection Authority and Vanda Longman, DEC

Editor: Justine Lawn, DEC

Reviewers and contributors

Dr Ken Atkins, DEC, was consulted in the development of this topic. His valuable contribution, and those people who have contributed their photos, is gratefully acknowledged.

Project manager: Justine Lawn, DEC

Publication management: Joanna Moore, DEC

Graphic design: Sonja Schott, DEC

Cover photo: Manning Lake, Cockburn, courtesy of Prof. Jenny Davis.

FloraBase images used with the permission of the Western Australian Herbarium, Department of Environment and Conservation (florabase.dec.wa.gov.au/help/copyright).

Recommended reference

When referring to the guide in its entirety, the recommended reference is: Department of Environment and Conservation (2012). *A guide to managing and restoring wetlands in Western Australia*. Department of Environment and Conservation, Perth, Western Australia.

When specific reference is made to this topic, the recommended reference is: Department of Environment and Conservation (2012). 'Wetland vegetation and flora', in *A guide to managing and restoring wetlands in Western Australia*, Prepared by G Keighery, B Keighery and V Longman, Department of Environment and Conservation, Perth, Western Australia.

Disclaimer

Contents

Wetland profiles

Before you begin

Before embarking on management and restoration investigations and activities, you must consider and address the legal requirements, safety considerations, cultural issues and the complexity of the ecological processes which occur in wetlands to ensure that any proposed actions are legal, safe and appropriate. Note that the collection of flora, even for conservation purposes, must be consistent with state laws, and is likely to require a license from DEC. For more guidance, see the topic 'Introduction to the guide'.

Vegetation: the combinations of plant species within a given area, and the nature and extent of each area[1]

Flora: the plant species, subspecies and varieties in a given area[1]

Community: a general term applied to any grouping of populations of different organisms found living together in a particular environment

Introduction to wetland vegetation and flora

Wetland plants are plants that inhabit wetlands. Wetlands are, in summary, areas subject to permanent, seasonal or intermittent inundation or seasonal waterlogging (Figure 1, Figure 2).

Wetland **vegetation** refers more broadly to the *combinations* of wetland plants in a given area, while wetland **flora** refers more specifically to the wetland plant species, subspecies and varieties in a given area.

Vegetated wetland ecosystems are characteristic of Western Australia. This is despite the perceived and actual dryness of most of the state, of which more than 40 per cent is desert receiving less than 250 millimetres of annual rainfall. WA's environment supports a diverse range of wetland plants and plant **communities**. The reasons for this include the diverse ancient flora (a product of old landscapes and diverse geologies and soils) and the huge diversity among wetlands across the state.

Figure 1. Wetland plants in two contrasting wetlands on the Swan Coastal Plain.

(a) A claypan in the inundated phase with emergent *Melaleuca rhaphiophylla* trees and aquatics. Photo – G Keighery/DEC.

(b) A seasonally waterlogged wetland with *Melaleuca preissiana* tree. Photo – B Keighery/OEPA.

Figure 2. The highly diverse saline and freshwater wetlands and wetland plant communities of Leeman Lagoons, east of Leeman (Geraldton Sandplain). This complex of mostly saline wetlands supports *Casuarina obesa* forest, *Melaleuca cuticularis* forest and samphire shrublands. Freshwater seepages form patches of freshwater wetlands within the complex. Photo – B Keighery/OEPA.

What is covered in this topic?

This topic describes the nature, characteristics and distribution of **vascular** vegetation and flora of WA's natural, non-flowing wetlands.

Vascular plants: plants with defined tubular transport systems. Non-vascular plants include algae, liverworts and mosses.

Taxa: a taxonomic group (the singular being taxon). Depending on the context, this may be a species or their subdivisions (subspecies, varieties etc), genus or higher group.[1]

There are five parts to this topic. The first part introduces wetland vegetation and flora in a Western Australian context; and broadly describes the characteristics of WA's wetland vegetation and flora respectively (part 1). The second, third and fourth parts describe in detail the wetland vegetation and flora features of three zones: the Kimberley (part 2), the Deserts (part 3) and the Southwest (part 4). The fifth part of this topic provides more detailed information on the wetland vegetation and flora of the southern Swan Coastal Plain (part 5).

More than 500 wetland native vascular plant **taxa** are referred to in this topic. All 500 taxa are listed in Appendix 1 (in part 1) along with their family, common name, state and federal conservation ranking and which wetland zone (Kimberley/Desert/Southwest) they are discussed in within this topic (some taxa are found in more than one zone). Only widely used common names are used in the text for this topic.

This topic also includes photographs of more than 200 wetland taxa. Appendix 1 can be used to look up the figure numbers for the relevant photos for each taxon.

Wetland vegetation is highly variable, both within and between wetlands, and WA is a very large place, so while this topic can serve as a guide, any wetland-specific management should be supported by specific information on the wetland's vegetation and flora.[2] In most cases this will require a survey to be done, once informed by existing information on similar wetlands. Keighery[3], together with Lyons et al.[4], are useful guides to conducting a quadrat-based vegetation and flora survey of a wetland.

What is not covered in this topic?

Non-vascular flora including algae, mosses and liverworts are not covered in this topic, nor are cyanobacteria, fungi and freshwater sponges. Similarly, the ecological roles, adaptations and ecological water requirements of vascular wetland plants are not covered in this topic.

The guide does not cover marine and coastal zone wetlands (marine waters, coral reefs, estuarine, intertidal mud or sand flats, intertidal marshes and forests), human made wetlands (dams, ponds, waste-water treatment plants, canals, irrigated land) and channel wetlands such as rivers and streams. However, in many locations estuarine and riverine vegetation merges with other wetland systems and these are considered here. Some of the characteristics and management considerations outlined in this topic may also be common to these systems.

- For information on cyanobacteria, freshwater sponges and algae; and on the ecological roles, adaptations and ecological water requirements of wetland plants, see the topic 'Wetland ecology' in Chapter 2.
- See the topic 'Wetland weeds' in Chapter 3 for details on weeds and their control.
- For information on waterway vegetation, see the Department of Water's website, which provides resources such as the *River restoration manual: a guide to the nature, protection, rehabilitation and long-term management of waterways in Western Australia*.[5]

What is the current knowledge of WA's wetland vegetation and flora?

To date, no comprehensive state, regional or sub-regional review of wetland vegetation and flora in WA has been published. This first review of the state's wetland vegetation and flora has been compiled by reviewing published and unpublished literature and using this, together with more than forty years of field experience working on the vegetation and flora of WA. The literature reviewed includes regional floras and reports on individual wetlands and wetland groups. Only those sources from which information is directly cited are referenced. A large number of other sources have been perused but, as much of this information is of a general nature, these are not given. Examples of these sources include Halse et al.[6], Ground Water Consulting Services Pty. Ltd.[7] and Henry-Hall et al.[8]

No comprehensive list of WA's wetland flora currently exists. WA has a huge diversity of wetland plants and plant communities, and many of these require better documentation of their flora and vegetation. It is estimated that more than twenty per cent (3,000 taxa) of the currently known 12,500 flora for WA are wetland taxa, compared to the 2,000 estimated in 2001.[9] From the work done on wetlands on the Swan Coastal Plain over the past twenty years, it is certain that a large number of plants and plant communities are yet to be located and described from WA's saline and freshwater wetlands. An unusual wetland at Point Ann in Fitzgerald River National Park (Figure 3), first noted in 2010, well illustrates this.

Figure 3. A hillside wetland community in Fitzgerald River National Park (Esperance Sandplains) at Point Ann, dominated by wind-shaped prostrate *Melaleuca cuticularis*. It is unusual, being a coastal saline paluslope. Photos – B Keighery/OEPA.
(a) View of headland and community. (b) and (c) *Melaleuca cuticularis* fruit and plant.

As with dryland flora, the scientific documentation and study of wetland flora across the state's 2.5 million square kilometres continues. With WA recognised as possessing one of the most diverse and unique floras in the world, this is not a simple task. In particular, the isolated south-western corner of WA, with its Mediterranean climate, is considered among the world's thirty-four plant biodiversity hot spots.[10] Remote areas also present many new discoveries as well as challenges for researchers. There has been a steady growth in the scientific discovery of new vascular (i.e. families other than those of the algae, liverworts, mosses etc) plant taxa over the last century; from 4,166 recorded in 1912, to 5,802 in 1969, and in 2011, an amazing 11,034 – of which more than 60 per cent of the species are **endemic** to WA, indicating the unique nature of WA's flora.[11]

Endemic: naturally occurring only in a restricted geographic area

➤ For more information on flora research, see the web page of the WA Herbarium.[12]

Statistics

- It is estimated that wetland taxa form more than 20 per cent, or 3,000 of WA's approximate 12,500 flora.
- Forty-six of the 402[13] declared rare flora in WA occur in wetlands.
- More than 270 of the 2,704[13] priority species in WA occur in wetlands.
- Thirty-seven of WA's sixty-nine[14] threatened ecological communities (TECs) are wetland communities; of these thirty-three are defined or reliant on vascular plant taxa (see Table 2 for more information).

How is wetland vegetation and flora identified?

Wetland plants can be discussed in terms of whether or not they are aquatic. Aquatic plants tend to be widely recognised as wetland plants, while non-aquatic wetland plants, because they do not grow in inundated areas, tend to be less well recognised.

While there is no comprehensive list of all of WA's aquatic plant species, there is general agreement as to what constitutes an **aquatic plant**, being a plant that grows for some period of time in inundated conditions and is dependent on a given inundation regime to grow and flower (including species that flower in waterlogged soils following inundation) (Figure 4 and Figure 5). Wetlands that are inundated for a period of time—whether permanently, seasonally or intermittently—provide suitable habitat for aquatic plants. All aquatic wetland plants are considered to be wetland **obligate**, that is, they are generally restricted to wetlands under natural conditions in a particular setting. Common descriptions of aquatic plants include 'submerged', 'floating' and 'emergent'; these terms refer to the position of the plant relative to the water's surface. 'Macrophyte' is another common term, referring to aquatic vascular plants as distinct from other aquatic organisms including algae, cyanobacteria, mosses, liverworts and fungi.

Figure 4. Claypan (sumpland) in the Tuart Forest on the Swan Coastal Plain with fringing *Melaleuca rhaphiophylla* trees. Photos – B Keighery/OEPA.

(a) Filled with rainwater in winter (growing in the water are the grass *Amphibromus nervosus* and the sedge *Eleocharis keigheryi*).

(b) Summer view of dry claypan and exposed clay base that forms the water impeding layer.

Figure 5. Aquatic taxa in a Swan Coastal Plain claypan. Aquatic taxa form 61 per cent of the southern Swan Coastal Plain's wetland flora.

(a) Inundated claypan emergent *Melaleuca rhaphiophylla* trees. Photo – G Keighery/DEC.

(b) *Aponogeton hexatepalus* flowers. Photo – B Keighery/OEPA.

(c) *Aponogeton hexatepalus* (long leaves) and **Hydrocotyle lemnoides** (kidney-shaped leaves). Photo – G Keighery/DEC.

Wetland plants that are not aquatic are sometimes mistakenly identified as dryland plants. Non-aquatic wetland plants grow in wetland areas that are seasonally waterlogged rather than inundated. These areas may be on the outer edges of, or higher areas within, a wetland that holds surface water permanently, seasonally or intermittently. Alternatively, the waterlogged area may be a stand-alone wetland, one that is entirely waterlogged on a seasonal basis, such as a dampland or palusplain. Many of WA's non-aquatic wetland plants are wetland obligate, that is, only found in wetlands in a given setting. However, some non-aquatic wetland plants are considered to be **facultative**, that is, they occur in both wetlands and dryland under natural conditions in a given setting.

Again, there is no comprehensive list of WA's non-aquatic wetland plants. However, this topic does refer to more than 500 wetland native vascular plant taxa (aquatic and non-aquatic), and these are listed in Appendix 1 for ease of reference. The wetland species described in this topic have been identified using a combination of field observations, *FloraBase*[11] and an ongoing literature review as primary sources. While *FloraBase* is a useful guide to what flora may be associated with wetlands, it is not designed to be used to establish conclusively if a species is a wetland species.

Field botanists develop a working set of wetland plants from field observations of plants that regularly occur together in vegetation in wetlands. This requires good field knowledge of the vegetation and flora of a zone/region/area and a sound understanding of what constitutes a wetland, if need be with reference to wetland mapping, wetland scientists or other diagnostic tools such as soils and hydrology. A series of characteristics of wetlands in WA contribute to numerous complexities in this determination:

- gradational boundaries from inundated areas, through waterlogged soils to dry soils (where soils are only wet immediately following rainfall) (Figure 6)
- inundation/waterlogging/wetting caused by groundwater, surface water and combinations of these (Figure 7)
- wetlands that exist due to the seasonal waterlogging of soils, that is, rarely, if at all, associated with inundation (Figure 8)
- seasonal or intermittent nature of soil inundation/waterlogging/wetting (Figure 4)
- persistence of wetland plant species that were established in wetter conditions which no longer appear to prevail.

These complexities are to be expected in a dynamic natural system, especially one such as WA's with a very old flora that has been subject to a changing climate, the current patterns of seasonal and intermittent rainfall and increasingly rapid climate change.

Because of these complexities, the expertise of suitably qualified and experienced field botanists is usually required to identify the wetland and dryland vegetation and flora of a site definitively (for example, for land planning or other legal matters). Similarly, defining wetland boundaries requires expertise, with wetland scientists typically working in liaison with field botanists to establish wetland boundaries, taking into account the hydrological and soil characteristics of the site.

➤ For more information on the delineation of wetland boundaries, see the wetlands webpage on DEC's website.[15]

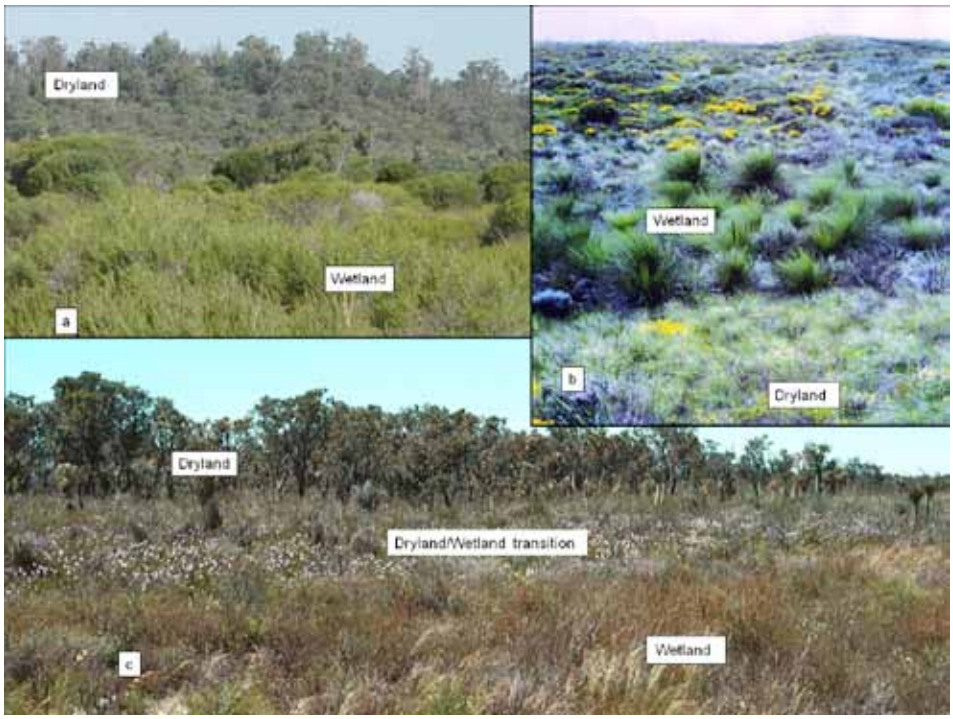


Figure 6. Three fully vegetated wetlands of the Swan Coastal Plain with a variety of wetland habitats and wetland/dryland boundaries.

(a) Defined boundary at Hay Swamp in Bunbury dominated by *Melaleuca* trees (mid-ground, palusplain) and shrubs (foreground) and tuart (*Eucalyptus gomphocephala*) and *Banksia* woodland (background) on dryland. The *Melaleuca* shrubland (foreground) is the TEC 'Shrublands on calcareous silts of the Swan Coastal Plain'. Photo – B Keighery/OEPA.

(b) Defined boundary at the TEC 'Sedgelands in Holocene dune swales of the southern Swan Coastal Plain' in the Point Becher wetlands dominated by *Xanthorrhoea preissii*. Photo – G Keighery/DEC.

(c) Gradational boundary and a portion of the Cannington or Kenwick Swamp (palusplain) in the Greater Brixton Street wetlands. The wetland in the foreground is dominated by shrubs, herbs and sedges (the grass seen in this area is only dominant after fire), and merges through a shrub-dominated band to *Banksia* woodland on dryland. The shrub-dominated band contains wetland and dryland species. The foreground wetland community is the TEC 'Shrublands on dry clay flats'. Photo – G Keighery/DEC.

Figure 7. Two Swan Coastal Plain sumplands fed by water from different sources.

(a) Lake Mount Brown just south of Perth is a groundwater-fed wetland. Photo – K Clarke/ Western Australian Local Government Association.

(b) A claypan filled with rainwater (a perched wetland) in the Tuart Forest just north of Busselton. Photo – B Keighery/OEPA.

Figure 8. Vegetation of three Swan Coastal Plain seasonally waterlogged wetlands.

(a) *Melaleuca preissiana* woodland. Photo – B Keighery/OEPA.

(b) Shrubland dominated by *Verticordia* species including *V. plumosa* var. *pleiobotrya* (pink), *V. chrysantha* (yellow) and *V. huegelii* (white). Photo – G Keighery/DEC.

(c) Shrublands dominated by *Actinostrobus pyramidalis* and *Melaleuca scabra*. Photo – B Keighery/OEPA.

Botanists and wetland scientists also use field observations to identify wetland flora as either obligate (restricted to wetlands) or facultative species (found in wetlands and drylands) within a particular setting. The setting is an important factor. A species may grow in wetlands in one region/area and in drylands in another (Figure 9). At other times, what appears to be a single species is capable of growing in both drylands and wetlands in the same region (for example *Xanthorrhoea preissii* and tuart in Figure 10 and Figure 11 respectively). Many of these taxa do have distinctive wetland and dryland **ecotypes** and a number of these ecotypes are proving to be valid taxa (Figure 12 and Figure 13).

Ecotypes: a genetically distinct geographic variety, population or race within a species which is adapted to specific environmental conditions. Typically ecotypes exhibit differences in morphology or physiology stemming from this adaptation, but are still capable of breeding with adjacent ecotypes without loss of fertility or vigour.

Figure 9. The shrub *Hypocalymma angustifolium* is found in a variety of habitats including wetlands at the west of its range (Swan Coastal Plain) and drylands in the eastern part of its range (Jarrah Forest). Photos – B Keighery/OEPA.

(a) *Hypocalymma angustifolium* in a seasonally waterlogged wetland on the Swan Coastal Plain.

(b) *Hypocalymma angustifolium* flowers.

Figure 10. *Xanthorrhoea preissii* may be a wetland or dryland species (Swan Coastal Plain).
(a) *X. preissii* dominates some occurrences of the TEC 'Sedgelands in Holocene dune swales of the southern Swan Coastal Plain'. Photo – G Keighery/DEC.
(b) *X. preissii* shrubs from the wetland. Photo – B Keighery/OEPA.

Figure 11. Tuart (*Eucalyptus gomphocephala*) may be a wetland or dryland species (Swan Coastal Plain). Photos – B Keighery/OEPA.
(a) Tuart in the wetlands beside the Moore River; *Melaleuca rhaphiophylla* forest fringes the river.
(b) Tuart in the freshwater seepages around Lake Walyungup (this is likely to be the TEC 'Shrublands on calcareous silts of the Swan Coastal Plain').

Figure 12. Members of the family Myrtaceae, such as *Melaleuca* and many other genera, are common in wetlands. A shrub of a restricted taxon from the Busselton Ironstones is illustrated here. *Calothamnus quadrifidus* shows a great deal of variation across its range; *Calothamnus quadrifidus* subsp. *teretifolius* is a newly described wetland subspecies. Photos – B Keighery/OEPA.

(a) *Calothamnus quadrifidus* subsp. *teretifolius* shrub.

(b) Flowers.

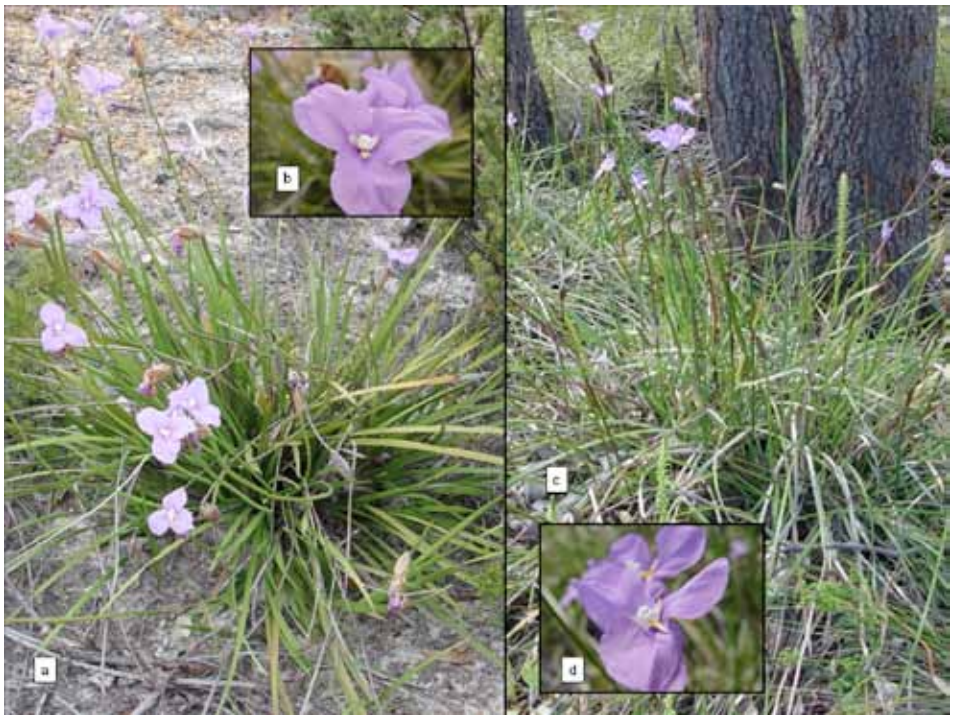


Figure 13. Dryland and wetland varieties of *Patersonia occidentalis* in the Southwest. These two photos were taken in two habitats in the same bushland patch, north-east of Perth on the Swan Coastal Plain. Photos – B Keighery/OEPA.

(a) Plant and (b) flower of *P. occidentalis* var. *occidentalis* with short thick leaves and scapes in dryland.

(c) Plant and (d) flower of *P. occidentalis* var. *angustifolia*, with longer thinner leaves and scapes in wetland.

As would be expected, water plays an important role in determining the presence/absence of species in wetlands, and the study of wetland **water regimes** and the ecological water requirements of plants helps to explain wetland plant patterning, and informs the management of vegetation in areas subject to drying or wetting that is outside of natural water regimes.

Water regime: the pattern of when, where and to what extent water is present in a wetland. The components of water regime are the timing, duration, frequency, extent and depth, and variability of water presence.

➤ For more information on ecological water requirements, refer to the 'Wetland ecology' topic in Chapter 2.

Despite the potential complexity surrounding the identification of non-aquatic wetland species, wetland managers can develop a sound understanding of the wetland vegetation and flora of a site with the help of good resources (such as those listed in the following section) and the invaluable understanding that comes with closely observing the nature of a wetland over many seasons.

Sources of information on wetland vegetation and flora

When using the below databases and literature to research wetland flora, it is important to be mindful that numerous terms are used to refer to wetlands, including moist places, damp areas, swamps, winter-wet swamps, moist swales and semi-permanent lakes.

Databases

FloraBase is a website of the Western Australian Herbarium available at florabase.dec.wa.gov.au.[11] It delivers the latest authoritative information about the Western Australian flora in an accessible and interactive manner, allowing users to browse or search for information on vascular flora, including descriptions, conservation status, photos, distribution maps and, in the case of weeds, control methods. A partner database is *Australia's Virtual Herbarium*, available at www.chah.gov.au/avh/.

NatureMap is a collaborative website of DEC and the Western Australian Museum, available at naturemap.dec.wa.gov.au. It presents the most comprehensive and authoritative source of information on the distribution of Western Australia's flora and fauna. *NatureMap* is an interactive tool designed to provide users with comprehensive and up-to-date information on plants, animals, fungi and other groups of biodiversity. It can be used to produce maps, lists and reports of WA's flora and fauna diversity.

WetlandBase is an interactive database produced by DEC, with web hosting by the Department of Agriculture and Food WA, available at spatial.agric.wa.gov.au/wetlands. *WetlandBase* provides a comprehensive online resource of information and data about Western Australian wetlands. It provides spatial data, such as wetland mapping, and point data, such as water chemistry, waterbirds, aquatic invertebrates and vegetation sampling results.

Some useful literature on wetland vegetation and flora

WA has such a diverse flora that there are no guides to the entire flora of the state. Some useful references are listed below; those listed can be used to find illustrations of wetland vegetation and flora. Those out of print are denoted by an asterisk (*), but they are available in libraries.

General

Vegetation

- * *Plant life of Western Australia*[16]
- * *A directory of important wetlands in Australia*, Third Edition[17]
- * JS Beard's *Vegetation Survey of Western Australia* series, containing maps and explanatory notes (published in the 1970s and 1980s by Vegmap Publications, Sydney)

Flora

- * *The Western Australian flora – A descriptive catalogue*[18]
- Australian rushes: biology, identification and conservation of Restionaceae and allied families[19]
- *Waterplants of Australia*[20]
- *Western Australia's threatened flora*[21]
- *Aquatic and wetland plants: a field guide for non-tropical Australia*[22]
- *Samphires in Western Australia: A field guide to* Chenopodiaceae *tribe* Salicornieae[23]

Kimberley

- *Flora of the Kimberley Region*[24]
- *Floodplain flora*[25]

Deserts

- *A guide to plants of inland Australia*[26,25]
- * *Flora of central Australia*[27]

Southwest

- * *Flora of the Perth Region*, Parts One and Two[28,29]
- *Flora of the south west: Bunbury–Augusta–Denmark*, Volumes 1 and 2[30,31]
- *Field guide to wildflowers of Australia's south west: Augusta–Margaret River Region*[32]

Reports on vegetation and flora of specific areas

These are just some examples of the region-specific vegetation and flora reports available:

- *Albany regional vegetation survey: extent, type and status*[33]
- *Flora and vegetation of the Byenup–Muir reserve system, south-west Western Australia*[34]
- *Flora and vegetation of Watheroo bentonite lakes*[35]
- *A vegetation survey of Yenyening Lakes Nature Reserve and adjoining vegetation: shires of Beverley, Brookton and Quairading for the Yenyening Lakes Management Committee*[36]
- *The remnant vegetation of the eastern side of the Swan Coastal Plain*[37]
- *A floristic survey of the southern Swan Coastal Plain*[38]
- *Bush Forever Volume 2: Directory of Bush Forever sites*[39]

Herbaria

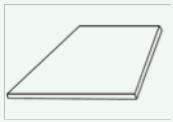
The WA Herbarium provides a public reference herbarium, a public access collection of typical specimens of all known plant species in the state. It is used widely by consultants, researchers and the public to help identify wildflowers and other plants. The WA Herbarium and associated regional herbaria can help community, industry and researchers understand and identify plants, algae and fungi. Information on services, fees and specimen collection requirements are available from the herbarium's webpage on DEC's website.[12]

Some notes on terminology used in this topic

Wetland descriptions

There are many terms used to describe groups of wetlands with similar characteristics. For example, descriptions may focus on the sediment (such as 'peatland'), the chemistry (such as 'salt lake') or the vegetation (such as 'Yate swamp'). Some terms, such as marsh and swamp, can have different meanings to different people, while some terms such as 'lake' seem to be applied to just about any wetland. WA has adopted the geomorphic classification system (Semeniuk[40] and Semeniuk and Semeniuk[41]) for use when mapping wetlands. This system groups inland (non-marine) wetlands into one of thirteen wetlands types, on the basis of their landform and hydroperiod, as shown in Table 1.

Table 1. Wetland types according to the global geomorphic classification system, adapted from Semeniuk[40] and Semeniuk and Semeniuk[41]

Water periodicity	**Landform**				
	 **Basin**	 **Flat**	 **Channel**	 **Slope**	 **Highland**
Permanently inundated	Lake	-	River	-	-
Seasonally inundated	Sumpland	Floodplain	Creek	-	-
Intermittently inundated	Playa	Barlkarra	Wadi	-	-
Seasonally waterlogged	Dampland	Palusplain	Trough	Paluslope	Palusmont

This topic does make reference to these wetland types where possible, but most of the time a much wider variety of names for wetlands is used, because the numerous studies used to compile this topic use a wide variety of descriptions for the wetlands.

Flora: names and groups

This topic employs terminology used by botanists and ecologists to describe flora. In particular, it refers to plants by their scientific names, and it compares broad trends of wetland plants of each region of WA, according to whether they are ferns and fern allies, gymnosperms, monocotyledons or dicotyledons. This terminology is briefly described below.

Plant names

Scientific (or botanical) names are used in this topic. For example *Calothamnus quadrifidus* is the scientific name of the most common one-sided bottlebrush found in the Southwest (Figure 12). Scientific names are established in accordance with the International Code of Botanical Nomenclature, and identify a plant's family; for example in the case of *Calothamnus quadrifidus* it is in the family Myrtaceae, the genus *Calothamnus* and the species *Calothamnus quadrifidus* (here you need both names).

Plants within a family share features; for example the Myrtaceae, or the myrtle family, has about 5,500 species, all with a set of common features including oil-glands in their leaves.[42] It is standard for botanical family names to end in '-aceae'. Within each family are one or more genera (or singularly 'genus') which share additional features in common, for example within the Myrtaceae family, is the *Calothamnus*, or one-sided bottlebrush genus, within which there are about forty-one species and all of these are only found in WA. Within each genus is one or more species. Although there are complexities as to what defines a species, it is commonly defined as a group of organisms capable of interbreeding and producing fertile offspring. In accordance with the International Code of Botanical Nomenclature, scientific names of plants are latinised

(written in the language of Latin as a universal standard) and italicised (although in formats such as tables this may not always be observed, for example, Appendices 1 and 2).

At times species are divided into named subspecies (subsp.) and varieties (var.). For example the Ironstone Calothamnus (Figure 12) is a subspecies of *Calothamnus quadrifidus*: *Calothamnus quadrifidus* subsp. *teretifolius* (here you need all three names). If a new species, subspecies or variety is recognised, it is initially designated by a phrase name until formally named, for example, *Calothamnus* sp. Whicher, and the particular specimen to which it is referenced is stated in brackets, for example, *Calothamnus* sp. Whicher (B.J. Keighery and N. Gibson 230). Species can also be divided into unnamed categories, generally called 'forms'. For example *Kunzea recurva* has two colour forms as shown in Figure 27.

Plant groups

Vascular plant families are grouped into two broad groups: plants that flower, and plants that do not flower. These groups and their subdivisions are used in this topic. Appendix 1 lists the group in which each taxon belongs. Information on the characteristics of each plant group is outlined below.

Vascular plants without flowers

Plants that do not flower are divided into two groups: ferns and fern allies, and gymnosperms.

Ferns and fern allies

These are plants with stems, leaves and roots like other vascular plants, but which reproduce via spores instead of seeds or flowers, such as bracken (*Pteridium esculentum*) and *Azolla pinnata*. Not all ferns have conventional fern fronds. Most ferns occur in freshwater wetlands, in inundated and dampland habitats. With approximately eighty species, WA is relatively poor in ferns. Two major groups are the highly endemic *Isoetes* species (Figure 14) which are submerged aquatics, and two species of floating aquatic fern, *Azolla* (Figure 15). *Azolla* looks like a fern frond floating on the water and may form a pink or green scum. It is reliant on nutrients in the water column and, to supplement its nutrition, *Azolla* supports a cyanobacterium called *Anabaena azollae* in the fronds of the plant. This bacterium is able to fix nitrogen from the atmosphere but, unlike other cyanobacteria, it is not toxic.

The closely related taxonomic group the fern allies is represented by *Marsilea* (Nardoo, Figure 16) and *Pilularia* (Figure 17). *Marsilea* grows in waterlogged and shallowly inundated habitats in a similar manner to water lilies and *Aponogeton*. The sporocarps (clusters of spores) of this plant are an Aboriginal food source.

Figure 14. *Isoetes drummondii*. Photo – B Keighery/OEPA.

Figure 15. *Azolla filiculoides.* (a) and (b) close up in red and green varieties; (c) at a Kemerton wetland. Photos – C Prideaux/DEC.

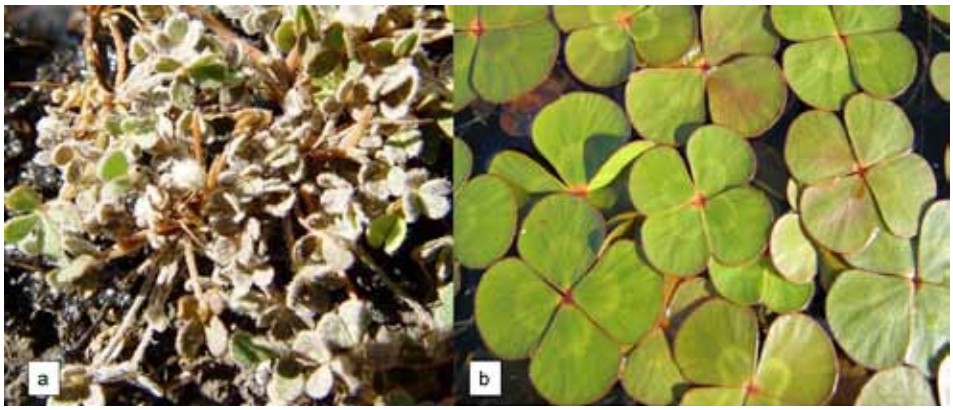


Figure 16. *Marsilea*. (a) plant. Photo – B Keighery/OEPA and (b) leaves. Photo – A Matheson/DEC.

Figure 17. *Pilularia novae-hollandiae*. Photo – B Keighery/OEPA.

Gymnosperms

These are plants with unprotected seeds, often in cones, and include the conifers and cycads. The conifers *Actinostrobus pyramidalis* (Figure 8c and Figure 166 in part 5) and *Callitris canescens* (Figure 95 in part 4) grow in wetlands. Cycads are not typically associated with wetlands. An example of a cycad is *Macrozamia riedlei* or zamia palm. There are relatively few wetland gymnosperms in WA.

Vascular plants with flowers (angiosperms)

Angiosperms are divided into two groups: monocotyledons and dicotyledons.

Monocotyledons (monocots)

These are flowering plants that typically have seedlings with one cotyledon (seed-leaf) and a fibrous root system. They do not form wood and have strappy leaves with parallel veins. These include some herbs and all grasses and sedges. All of these, except the palms, *Xanthorrhea* and *Kingia* species, are placed in the non-woody layers when describing vegetation (see below). As palms (Figure 18b) and *Xanthorrheas* (Figure 18f) have trunks they are grouped with trees or shrubs, depending upon their height.

Dicotyledons (dicots)

These flowering plants typically have seedlings with two cotyledons (seed leaves), a tap root system, and they can form wood and have network leaf venation. These include a range of herbs, shrubs and trees.

Vegetation: describing plant communities

Vegetation units (plant communities) are described according to three features of the plant community:

- plant growth form
- density of cover and height of the layers in each of these groups
- names of the species that dominate each layer.

Plant growth form

A set of terms are used to describe the plant growth forms. Firstly, plants are identified as either woody or non-woody plants. They are then divided into trees, mallees, shrubs, herbs, grasses and sedges as outlined below. The key in Appendix 2 describes these categories in further detail. The growth form of many wetland taxa of the Swan Coastal Plain is listed in Appendix 2 (in part 1).

Woody plants

Woody plants are plants with special thick-walled cells in their trunks and stems that form wood to support the plant. Most dicots are woody plants. A few monocots are considered trees and/or shrubs as outlined above. Plant growth forms of woody plants are trees, mallees and shrubs, outlined below.

- Trees: plants with a single trunk and a canopy. The canopy is less than or equal to two-thirds of the height of the trunk. No lignotuber is evident.
- Mallees: plants with many trunks (usually two to five) arising from a lignotuber. The canopy is usually well above the base of the plant. Most are from the genus *Eucalyptus*.
- Shrubs: plants with one or more woody stems and foliage all or part of the total height of the plant.

Non-woody plants

Non-woody plants are plants with no (or insufficient) special thick-walled support cells in their stems to form wood for support. These are sub-divided according to growth form, pollination method and plant family.

Non grass-like plants

These are generally not pollinated by wind. These can be monocots or dicots.

- Herbs: plants with non-woody stems that are not grasses or sedges. Generally under half a metre tall. Most monocots are herbs except for the larger ones which are classed as shrubs such as palms, grass trees (*Xanthorrhoea* and *Kingia* species) and cycads (*Zamia* species).

Grass-like plants

These plants are generally pollinated by wind and from the families Poaceae, Cyperaceae, Centrolepidaceae, Hydatellaceae, Juncaginaceae, Restionaceae, Juncaceae, Typhaceae and Xyridaceae.

- Grass: tufted or spreading plant from the family Poaceae. The leaf sheath is always split, a ligule is present, the leaf is usually flat, a stem cross-section circular and all internodes evenly spaced. Some grasses are called reeds (the *Phragmites* and *Arundo* genera).
- Sedge: tufted or spreading plant from the families Cyperaceae, Centrolepidaceae, Hydatellaceae, Juncaginaceae, Restionaceae, Juncaceae, Typhaceae and Xyridaceae. In these plants the leaf sheath is generally not split, there is usually no ligule, the leaf is not always flat and there is an extended internode below inflorescence. Some of the families in this group have widely used common names. For example, the Restionaceae are called rushes or jointed sedges; the Juncaceae are also called rushes and the Typhaceae are called bullrushes.

Vegetation layers

Vegetation is described as a set of layers with reference to the canopy cover (leaf area) and height of each layer. This topic uses a set of general terms to describe the various vegetation layers as descriptors of the general vegetation structure. For trees, reference is made to two cover classes: 'forest' has cover greater than or equal to 70 per cent, while 'woodland' has cover of 2–70 per cent.

For all other layers a single term is used:

- shrubland
- herbland
- grassland
- sedgeland.

Figure 18 shows examples of each vegetation layer. All of these layers may be present in a plant community. At times reference is made to the density of these layers using terms such as 'open' (plants not touching) and 'closed' (plants touching).

Within the literature reviewed for this topic, many different terms were used to describe the various layers. There were no consistently used terms, hence the use of the generalised terms described above. In a few instances the vegetation descriptions from a particular reference are directly quoted and specific terms are used for the vegetation units and their layers. In such examples the reference should be consulted to determine how these terms are applied. The Yalgorup wetlands example provided at the end of this topic (see 'Profile of a wetland complex: Yalgorup National Park wetlands' on page 179 in part 5) illustrates the use of a set of standard vegetation or plant community descriptions with a key (after Keighery[3]) showing how these are derived. When specific referenced terms are used for the vegetation layers, the name for a layer is capitalised, for example 'Forest' rather than 'forest'.

Figure 18. (below) Examples of the vegetation layers referred to in this topic. Photos – (a), (e), (h)–(n), (p), (r)–(v) B Keighery/OEPA; (b), (d), (f), (g), (o), (q) G Keighery/DEC; (c) M Lyons/DEC. Note: each of these photos is presented elsewhere in this topic, with full captions provided.

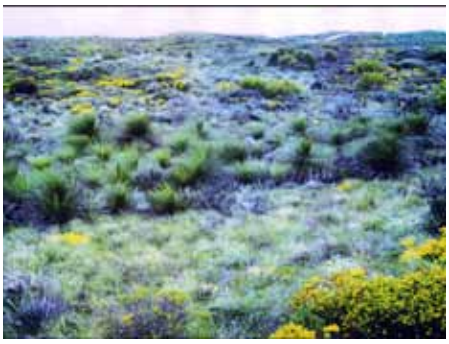
(a) forest

(b) forest

(c) woodland

(d) woodland (foreground), forest (background)

(e) shrubland



(f) shrubland

(g) shrubland

(h) shrubland

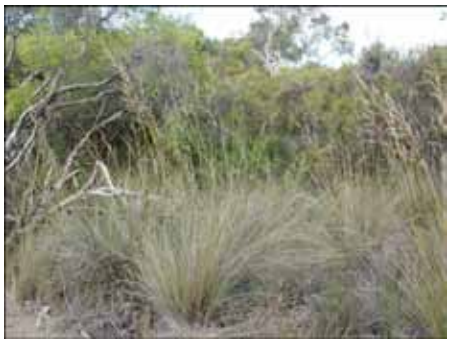
Figure 18. (continued)

(i) herblands (foreground)

(j) herbland

(k) herbland

(l) herbland



(m) grassland (foreground)

(n) grassland

(o) grassland

(p) sedgeland (foreground), grassland (mid-ground)

Figure 18. (continued)

(q) sedgeland

(r) woodland over sedgeland and grassland

(s) sedgeland, forest in background

(t) sedgeland (of annual species)

(u) sedgeland under forest

(v) sedgeland under shrubland

Bioregions

This topic refers to the regions of WA identified within the Interim Biogeographic Regionalisation for Australia[43] (IBRA). Australia has been grouped into eighty biogeographic regions (or bioregions) on the basis that the ecosystems within them have a high level of similarity. There are twenty-eight bioregions in WA (Figure 19). In this topic, each wetland described includes its bioregion in brackets after the wetland name.

The IBRA bioregions have been used to compare and group the listed nationally important wetlands[17] as well as in the consideration of the 'CAR' (comprehensive, adequate and representative) reserve system and ecosystem health in WA.[44]

FloraBase provides an informative visual guide to the main characteristics of each IBRA region. It is available at florabase.dec.wa.gov.au/help/ibra/. *FloraBase* refers to the distribution of species according to the bioregion codes in Figure 19.

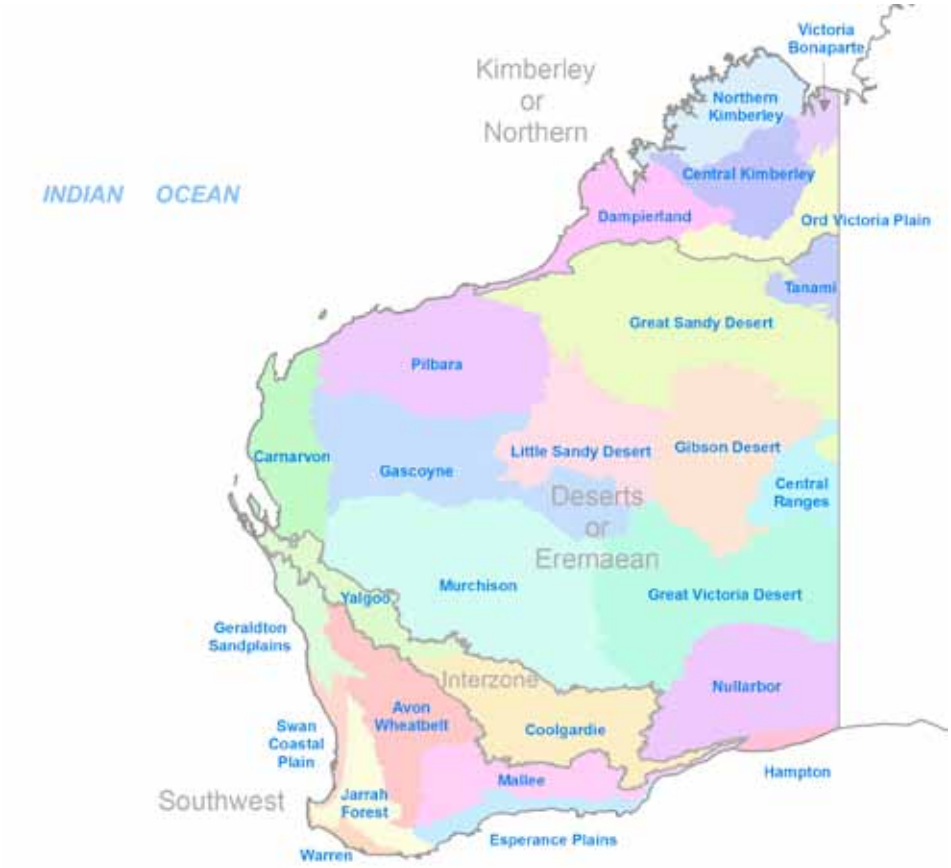


Figure 19. WA's bioregions and the three climatic zones used in this topic. Image – C. Auricht, Auricht Projects.

Nationally important wetlands (*)

Listed nationally important wetlands are marked with an asterisk (*) in this topic. To be accepted for listing as nationally important, a wetland needs to meet at least one of six criteria agreed to by the ANZECC Wetlands Network in 1994. Despite its size, only 120 of the 904 listed nationally important wetlands are from WA.[46] Of these, nineteen are from the Kimberley, forty-three from the Deserts (twenty from the Internally Drained and twenty-three from the Externally Drained) and fifty-eight from the Southwest. Since the original listings, further study has been undertaken to identify potential nationally important wetlands in under-represented bioregions.[47] Twelve of the sixty-four Australian wetland sites listed as internationally significant under the Ramsar Convention are from WA. It should be noted that a number of the nationally important sites and Ramsar sites contain multiple wetlands.

➤ For more information on nationally and internationally significant wetlands, see:

- DEC's wetlands webpage[15]
- the Australian Government's Department of Sustainability, Environment, Water, Population and Communities website[48]

Western Australia's wetland vegetation

Wetland vegetation in WA has some general characteristics:

- a generally lower species diversity compared to that of the surrounding dryland
- a small number of dominant species, sometimes with high foliar cover (Figure 20 and Figure 21)
- water-side vegetation occurs in a series of bands or zones related to degree of inundation and waterlogging (Figure 21a, Figure 22 and Figure 23)
- completely vegetated wetlands support a mosaic of vegetation units (Figure 24).

The dominant species then vary according to whether the water is saline or fresh. Saline and freshwater wetlands have distinctive floras as seen by comparing photos of saline and freshwater wetlands in this topic. However, in many wetlands and wetland complexes there may be freshwater patches within the predominantly saline area and vice versa.

Figure 20. Two forests and a woodland from a variety of wetlands across WA.
(a) *Melaleuca preissiana* forest (Swan Coastal Plain). Photo – B Keighery/OEPA.
(b) Palm (*Livistona alfredii*) forest (Pilbara). Photo – G Keighery/DEC.
(c) *Eucalyptus victrix* woodland over a herbland on a Desert claypan. Photo – W Thompson.

Figure 21. A variety of wetland plant communities from across WA with a few dominant species with high cover.

(a) *Melaleuca preissiana* forest (background) and *Baumea articulata* (Cyperaceae) sedgeland (Swan Coastal Plain). Photo – B Keighery/OEPA.

(b) *Sorghum plumosum* grassland after the wet (Pilbara). Photo – G Keighery/DEC.

(c) Samphire shrubland (Swan Coastal Plain). Photo – B Keighery/OEPA.

(d) *Stylidium longitubum* herbland (Swan Coastal Plain). Photo – B Keighery/OEPA.

Figure 22. Wetland plant community zonation at a saline lake, Rottnest (Swan Coastal Plain). Three zones are distinguished: the water fringing samphire shrubland (*Tecticornia indica* and *T. halocnemoides*), *Gahnia trifida* sedgeland and *Melaleuca lanceolata* forest. Photo – B Keighery/OEPA.

Figure 23. Wetland plant community zonation in the saline wetlands on the eastern shore of Lake Clifton in the Yalgorup wetlands (Swan Coastal Plain). Three zones are distinguished: the water-fringing *Juncus kraussii* subsp. *australiensis* sedgeland, *Melaleuca cuticularis* forest and tuart (*Eucalyptus gomphocephala*) forest. Photo – B Keighery/OEPA.

Figure 24. A mosaic of plant communities in the Brixton Street Wetlands (Swan Coastal Plain).

(a) A late spring view of the Brixton Street Wetlands including marri (*Corymbia calophylla*) woodland (background), *Viminaria juncea* shrublands, *Melaleuca lateritia* shrubland (circled), *Meeboldina cana* (Restionaceae) sedgelands (pink-brown) and *Amphibromus nervosus* grassland (pale green). Photo – G Keighery/DEC.

(b) *Melaleuca lateritia* shrubland in late spring/early summer. This community is the TEC 'Herb rich shrublands in clay pans'. Photo – B Keighery/OEPA.

Saline wetland vegetation

In this topic, the term 'saline wetland' is used to refer to wetlands that contain enough salt to significantly influence the vegetation composition. Strictly speaking, the term 'non-freshwater' is a more accurate description.

➤ For more information about wetland salinity, see the topic 'Conditions in wetland waters' in Chapter 2.

While the typical non-freshwater wetland is saline due to the presence of salt (mainly sodium chloride), two other chemicals are also naturally relatively common: gypsum (calcium sulphate) and lime (calcium carbonate). Wetlands with these chemicals present, either alone or in combination, support similar vegetation. The typical vegetation of these wetlands is **samphire** shrublands (Figure 21c and Figure 22). These have relatively low cover, being shrublands or open shrublands, and rarely closed shrublands (heaths). Woodlands dominated by species from three genera, sheoaks (*Casuarina*), paperbarks (*Melaleuca*) and eucalypts (*Eucalyptus*), are found on the outer areas of the wetlands and on low rises within the wetlands. **Perennial** sedges can form sedgelands on the margins of permanently inundated saline wetlands (Figure 23).

Generally, large areas of bare soil are associated with these wetlands (Figure 25b). However, when these wetlands are associated with soils with a significant clay component they typically support an annually renewed flora (renewed with wetting), forming areas of sedgeland and herbland (Figure 26). Such wetlands are typically perched and the growing period is extended by the time taken for the soils to dry.

Samphire: the common name for a group of succulent sub-shrubs and shrubs including *Tecticornia*, *Halosarcia*, *Sarcocornia*, *Sclerostegia*, *Tegicornia* and *Pachycornia*, belonging to the family Chenopodiaceae

Perennial: a plant that normally completes its life cycle (from germination to flowering, seed production and death of vegetative parts) in two or more growing seasons

Figure 25. Saline wetlands. Photos – B Keighery/OEPA.

(a) Rottnest Island salt lake with *Melaleuca lanceolata* and samphire shrublands (Swan Coastal Plain).

(b) Samphire shrublands in salt lake in Charles Darwin Reserve (Yalgoo).

Figure 26. Saline wetland on soils with a high clay fraction (clayflat) near Busselton (Swan Coastal Plain). Photos – B Keighery/OEPA.

(a) *Melaleuca cuticularis* woodland over annual herbland and sedgeland.

(b) *Centrolepis polygyna*, an annual sedge of saline wetlands.

(c) *Angianthus drummondii*, an annual daisy of saline wetlands.

An interesting feature of many of these saline wetlands is areas of seepage of freshwater from the groundwater, forming soaks or springs. These are significant features of these wetlands, providing a specialised habitat for flora and fauna. The soaks or springs, and the flora and fauna they support, are often destroyed either directly by their 'development' as watering points for human activities (livestock watering, agriculture, horticulture), by feral animals, or indirectly by overuse of groundwater.

Freshwater vegetation

Freshwater wetlands generally have a higher diversity of species than those of saline wetlands. All vegetation layers can be found in freshwater wetlands:

- forest and/or woodland, the common trees being eucalypts (*Eucalyptus*) and paperbarks (*Melaleuca*)
- shrubland from many families and genera, especially the Myrtaceae (including a large variety of melaleucas) (Figure 27)
- herbland from many families and genera, including families such as the Droseraceae (Figure 28) and Stylidiaceae (Figure 29)
- sedgeland, typically from the Cyperaceae (Figure 21a) and Restionaceae (Figure 24)
- grassland, the grasses (Poaceae) comprising a variety of genera (Figure 21b and Figure 24).

Some wetlands contain all of these layers, with different layers occurring in a variety of combinations forming a complex mosaic of plant communities within the one wetland (Figure 8b&c and Figure 24).

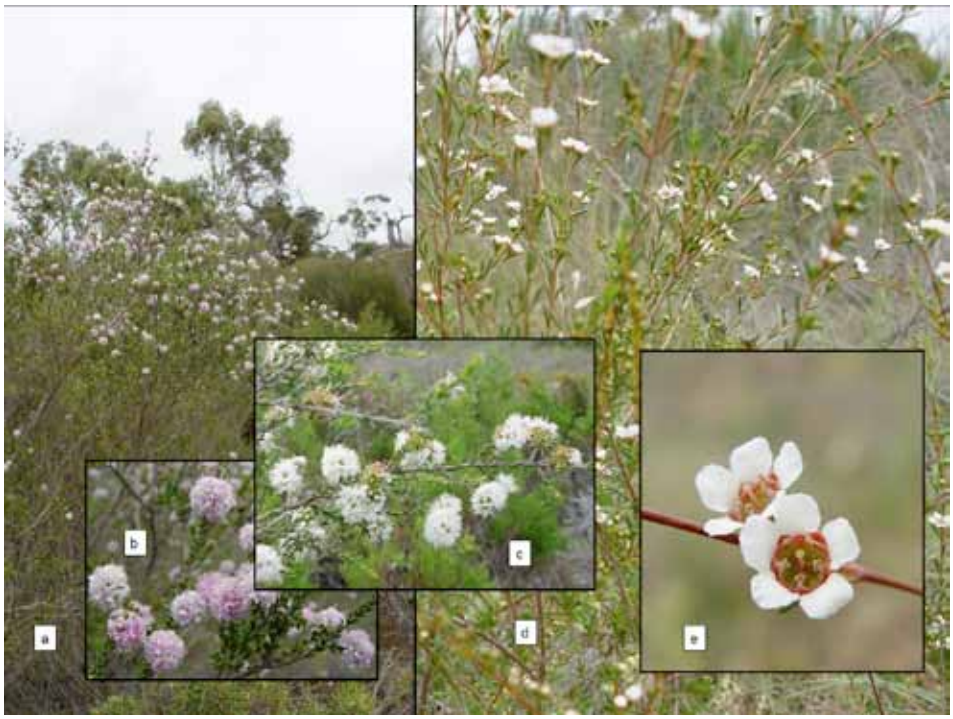


Figure 27. Members of the family Myrtaceae such as *Melaleuca* and many other genera are common in wetlands. Two examples of relatively widespread Southwest shrub taxa are illustrated here. Photos – B Keighery/OEPA.

(a) *Kunzea recurva* shrub, (b) pink-flowered *K. recurva*, and (c) white-flowered *K. recurva*, which has been called *K. limnicola*.

(d) *Astartea affinis* shrub and (e) detail flowers.

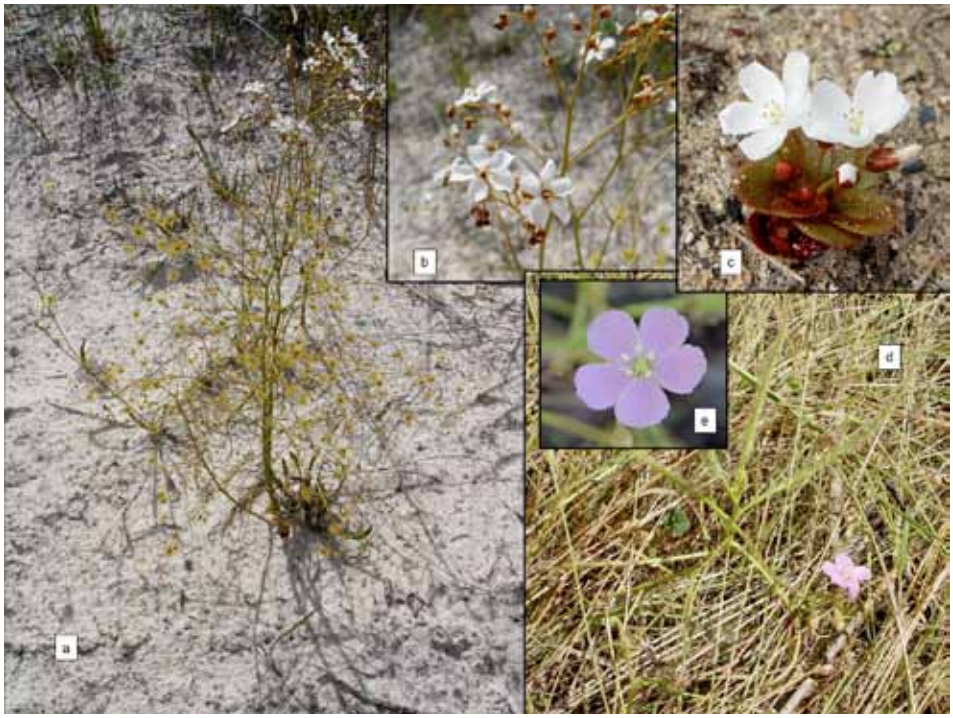


Figure 28. A selection of *Drosera* species found in wetland habitats. The genus *Drosera* is species diverse in the Kimberley and Southwest. Disjunct populations of some species are found in Desert wetlands. Photos – B Keighery/OEPA.

(a) and (b) *Drosera gigantea* from the Southwest.

(c) *D. tubaestylis* from the Southwest.

(d) and (e) *D. indica* from the Kimberley.

Figure 29. A selection of *Stylidium* species found in wetland habitats. The genus *Stylidium* is species diverse in the Kimberley (central and right boxes) and Southwest (two left boxes). Disjunct populations of some species are found in the Desert wetlands. Photos – B Keighery/ OEPA.

Areas of bare soil are less common in freshwater wetlands than in saline wetlands but areas subject to long periods of inundation are typically bare on drying. However, as with saline wetlands, the freshwater wetlands that have soils with a significant clay component typically support patches of annual sedgelands and herblands, dominated by a diversity of annually renewed species (Figure 29 and Figure 30). Such wetlands are typically perched and the growing period is extended by the time taken for the pools, and then soils, to dry. The drying period may be extensive enough for a series of species to grow and flower, each of these species being dominant at different times of the wetting/drying cycle (Figure 30, Figure 31 and Figure 32). Wetlands that support a number of structural layers including combinations of woodland, shrubland, sedgeland, grassland and herbland are the most species diverse and have greater species diversity than some dryland communities.

Figure 30. A dense herbland patch is seen in this freshwater claypan in a late spring view of the Brixton Street Wetlands (Swan Coastal Plain). This community is the TEC 'Herb rich shrublands in clay pans'.

(a) *Melaleuca lateritia* shrubland (background) over annual herblands and sedgelands. Photo – B Keighery/OEPA.

(b) Two annual herbs *Stylidium longitubum* (pink) and *Hyalosperma cotula* (white). Photo – B Keighery/OEPA.

(c) Two annual sedges *Trithuria submersa* (left) and *Aphelia drummondii* (right). Photo – G Keighery/DEC.

Figure 31. Freshwater wetlands on soils with a high clay fraction (claypan) on the Ashburton River plains near Onslow (Gascoyne). Photos – B Keighery/OEPA.

(a) Claypan with annual herbland surrounded by red sand dunes.

(b) A variety of annual daisy species in the claypan.

(c) *Myriocephalus oldfieldii* ms, an annual daisy of claypans.

Figure 32. Barracca Nature Reserve (Swan Coastal Plain)

(a) A mosaic of plant communities with scattered *Eucalyptus wandoo* over *Melaleuca viminea* shrubland and herblands with *Brachycome pusilla* (white daisy), *Drosera menziesii* subsp. *menziesii* (pink) and *Utricularia multifida* (pink). These herbs are typical plants of the herblands of both claypans and granite rocks in the Southwest. Photos – B Keighery/OEPA.

(b) Close-up *Brachycome pusilla*.

(c) Close-up *Thelymitra antennifera*, a wetland orchid found in this herbland community.

(d) Close-up *Drosera menziesii* subsp. *menziesii*.

Rare plant communities

A number of wetland plant communities and mosaics of wetland plant communities are formally listed as threatened ecological communities (TECs) because they have been found to be vulnerable, endangered, critically endangered or presumed totally destroyed. At the time of publication, thirty-seven of WA's sixty-nine TECs are wetland communities, with thirty-three of these defined or reliant on vascular plant taxa; these thirty-three TECs are presented in Table 2. Note that Table 2 only includes TECs associated with wetland types covered in this guide. The wetlands in Figure 6a&c, Figure 24b and Figure 30 are TECs and other TECs are described and illustrated below.

➤ For more information, go to the threatened ecological communities webpage on DEC's website.[49] Further information regarding the Commonwealth process for listing TECs can be found on the Australian Government's Department for Sustainability, Environment, Water, Population and Communities website.[50]

Table 2: WA's wetland threatened ecological communities that are defined or reliant on vascular plant taxa

Source: DEC's Threatened Ecological Community Database endorsed by the Minister for the Environment (DEC, sourced August 2010)

Community identifier	Community name	General location (IBRA regions)	Category of threat and criteria met under WA criteria	Category under Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
2. Toolibin	Perched wetlands of the Wheatbelt region with extensive stands of living swamp sheoak (*Casuarina obesa*) and paperbark (*Melaleuca strobophylla*) across the lake floor	Avon Wheatbelt	CR A) i); CR A) ii); CR C)	EN
3. SCP10b	Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)	Swan Coastal Plain	CR B) ii)	EN
4. SCP19	Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	Swan Coastal Plain	CR B) ii)	EN
7. Mound Springs SCP	Communities of tumulus springs (organic mound springs, Swan Coastal Plain)	Swan Coastal Plain	CR A) i), CR A) ii), CR B) i), CR B) ii)	EN
10. Nthiron	Perth to Gingin ironstone association	Swan Coastal Plain	CR A) ii), CR B) ii), CR C)	EN
11. Muchea Limestone	Shrublands and woodlands on Muchea limestone	Swan Coastal Plain	EN B) ii)	EN
14. SCP18	Shrublands on calcareous silts of the Swan Coastal Plain	Swan Coastal Plain	VU B)	N/A
15. SCP02	Southern wet shrublands, Swan Coastal Plain	Swan Coastal Plain	EN B) ii)	N/A
17. SCP3c	*Eucalyptus calophylla – Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain	Swan Coastal Plain	CR B) ii)	EN
19. Scott Ironstone	Scott River Ironstone Association	Warren	EN B) i), EN B) ii)	N/A
21. SCP15	Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain	Swan Coastal Plain	VU C)	N/A
32. SCP07	Herb rich saline shrublands in clay pans	Swan Coastal Plain	VU B)	N/A
33. SCP08	Herb rich shrublands in clay pans	Swan Coastal Plain	VU B)	N/A
34. SCP09	Dense shrublands on clay flats	Swan Coastal Plain	VU B)	N/A
35. SCP10a	Shrublands on dry clay flats	Swan Coastal Plain	EN B) ii)	N/A
38. Morilla swamp	Perched fresh-water wetlands of the northern Wheatbelt dominated by extensive stands of living *Eucalyptus camaldulensis* (river red gum) across the lake floor	Avon Wheatbelt	PD B)	N/A
40. Bryde	Unwooded freshwater wetlands of the southern Wheatbelt of Western Australia, dominated by *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor	Avon Wheatbelt	CR B) i), CR B) ii)	N/A
42. Greenough River Flats	*Acacia rostellifera* low forest with scattered *Eucalyptus camaldulensis* on Greenough alluvial flats	Geraldton Sandplain	CR C)	N/A
46. Themeda Grasslands	Themeda grasslands on cracking clays (Hamersley Station, Pilbara). Grassland plains dominated by the perennial themeda (kangaroo grass) and many annual herbs and grasses	Pilbara	VU A)	N/A
49. Bentonite Lakes	Herbaceous plant assemblages on Bentonite Lakes	Avon Wheatbelt	EN B) iii)	N/A

Community identifier	Community name	General location (IBRA regions)	Category of threat and criteria met under WA criteria	Category under Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
63. Irwin River Clay Flats	Clay flats assemblages of the Irwin River: Sedgelands and grasslands with patches of *Eucalyptus loxophleba* and scattered *E. camaldulensis* over *Acacia acuminata* and *A. rostellifera* shrubland on brown sand/loam over clay flats of the Irwin River	Avon Wheatbelt	PD A), PD B)	N/A
72. Ferricrete	Ferricrete floristic community (Rocky Springs type)	Geraldton Sandplain	VU B)	N/A
74. Herblands and Bunch Grasslands	Herblands and Bunch Grasslands on gypsum lunette dunes alongside saline playa lakes	Esperance Sandplain	VU B)	N/A
80. Theda Soak	Assemblages of Theda Soak rainforest swamp	North Kimberley	VU A), VU B)	N/A
81. Walcott Inlet	Assemblages of Walcott Inlet rainforest swamps	North Kimberley	VU B)	N/A
82. Roe River	Assemblages of Roe River rainforest swamp	North Kimberley	VU B)	N/A
84. Dragon Tree Soak	Assemblages of Dragon Tree Soak organic mound spring	Kimberley Region, Great Sandy Desert Bioregion	EN B) i)	N/A
85. Bunda Bunda	Assemblages of Bunda Bunda organic mound spring	West Kimberley, Dampierland Bioregion	VU A), VU B)	N/A
86. Big Springs	Assemblages of Big Springs organic mound springs	West Kimberley, Dampierland Bioregion	VU A), VU B)	N/A
89. North Kimberley mounds	Organic mound spring sedgeland community of the North Kimberley Bioregion	North Kimberley	VU A), VU B)	N/A
92. Black Spring	Black Spring organic mound spring community	North Kimberley	EN B) i), EN B) ii)	N/A
95. Mandora Mounds	Assemblages of the organic springs and mound springs of the Mandora Marsh area	West Kimberley, Dampierland and Greats Sandy Desert Bioregions	EN B) iii)	N/A
97. Mound Springs (Three Springs area)	Assemblages of the organic mound springs of the Three Springs area	Avon Wheatbelt	EN B) i), EN B) ii)	N/A

Western Australia's wetland flora

It is not possible currently to comprehensively document the wetland flora for the state, due to the incomplete knowledge of wetlands and their flora across the state as well as the biology and ecology of most species in WA. In some areas of the state, there are significant numbers of naturally uncommon species in wetlands, adding to the task of cataloguing the state's wetland flora. It is estimated that more than twenty per cent (3,000 taxa) of the currently known 12,500 flora for WA are wetland taxa (based on available data on regional and subregional floras). This compares with the 2,000 WA wetland taxa estimated in 2001.[9]

All taxa in some groups (families or genera) are found in wetlands but more commonly the occurrence in a wetland is taxon specific. Groups such as the grass genus *Amphibromus* and the family Aponogetonaceae are all wetland plants, while many members of the genus *Melaleuca* and the Orchidaceae are wetland species but many are not. For example, when 377 taxa in the Orchidaceae[51] are considered, 199 are dryland taxa, 105 are wetland taxa and seventy-three can occur in both habitats. As a general rule, orchid species in more arid areas, for example *Caladenia remota*, *C. incensa* and *C. cruscula*, are normally found in wetland habitats such as swamps or granite rock aprons. This is also true for other groups of Southwest Australian taxa at the inland margins of their ranges.[4]

Patterns of diversity of wetland vegetation and flora

Typically, Western Australian vegetation has high species diversity and a rapid turnover of different species from one plant community to another, even over very short distances. This is considered to be related to a series of factors including the ancient landscapes, soils, water availability and temperature/light. Overlaying this with wetland habitats is the wetting and drying climatic patterns and the sporadic nature of the distribution of many wetland plants. Many wetland plants rely on regimes of flooding to distribute the plants, so distribution is initially determined by a chance introduction through flooding then the possible loss of the plant after a drying period. For example, *Aponogeton hexatepalus* seeds germinate in the season they form and float to new locations when water is available. Within the one area this can result in the area sharing a group of taxa but having different taxa dominating in different wetlands, resulting in the typically disjunct distribution of a significant number of wetland taxa (see Figure 28 and Figure 29 for examples). Further adding to these disjunctions is the distribution of small-seeded taxa by wetland birds (such as with many sedge species including *Juncus kraussii* subsp. *australiensis*). The wetlands effectively form islands within the drier landscape and long distance dispersal accounts for such major disjunctions (Figure 33). At times some of these disjunct populations of native taxa are listed as weeds rather than native populations that have resulted from long distance dispersal.

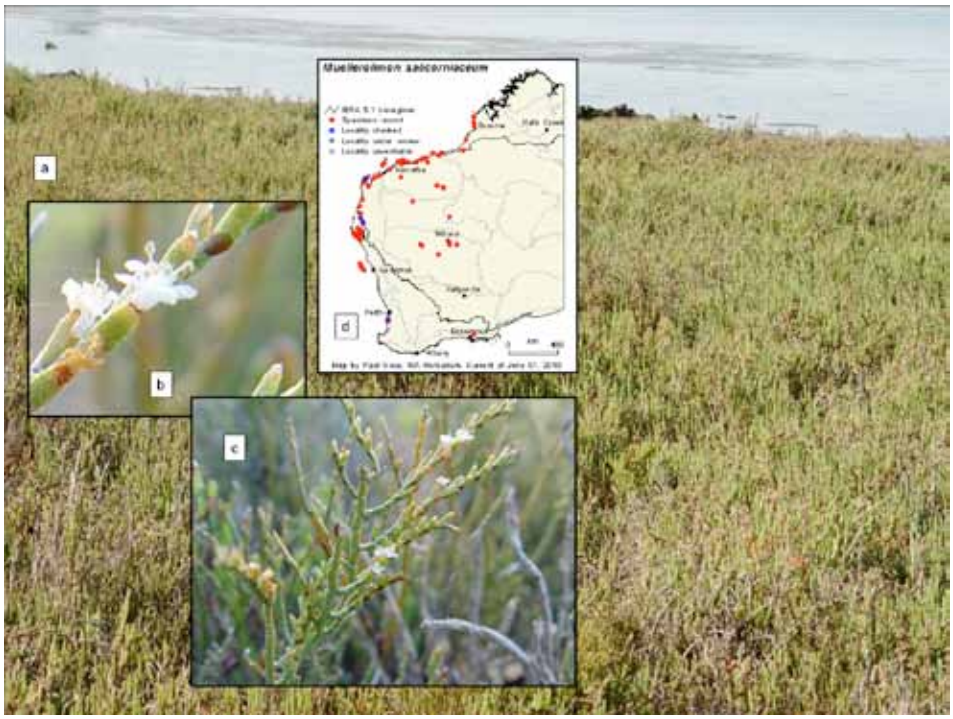


Figure 33. An example of a species, native status (*Muellerolimon salicorniaceum*), with a number of highly disjunct populations. Photos (a)–(c) – B Keighery/OEPA.

(a) *M. salicorniaceum* in the samphire shrublands of the Peel Harvey Estuary near Mandurah (Swan Coastal Plain).

(b) & (c) Detail of *M. salicorniaceum* branches and flowers.

(d) Recorded distribution, mostly Desert and Kimberley regions. Mapping – P Gioia. Image used with the permission of the Western Australian Herbarium, DEC. Accessed 21/06/2011.

Rare wetland flora

As at 2010, WA has 402 taxa that are declared rare flora (DRF).[52] These taxa have been determined to be in danger of extinction, rare or otherwise in need of special protection and accordingly the Minister for Environment has declared them to be 'rare flora'. The forty-six taxa of DRF after Smith[13] that are found in wetlands are included in Appendix 1, together with the wetland zones they occur in. In addition to DRF, there are many species that are known from only a few collections, or a few sites, but which have not been adequately surveyed. Such flora may be rare or threatened, but cannot be considered for declaration as rare flora until such survey has been undertaken. These flora are included on a supplementary conservation list called the Priority Flora List. The Priority Flora List is dynamic – as new information comes to light the species' conservation status is reviewed and changes to the listing may result. Of the currently listed 2,704 priority taxa (M. Smith, pers. comm.) more than 270 are wetland plants and sixty-three of these are referred to in this topic, and listed in Appendix 1 (in part 1).

➤ For information on declared rare and priority flora, see the threatened flora webpage on DEC's website.[53]

Western Australia's wetland vegetation zones: the Kimberley, Deserts and Southwest

WA is a very large state and there is a great deal of variability in wetland vegetation and flora across it. To consider the wetland vegetation in more detail in this topic, the state is firstly divided into its three major climatic and biogeographical zones (Figure 34):

- Kimberley – tropical, warm to hot all year, summer rainfall and a dry winter
- Deserts – hot desert, infrequent erratic rainfall
- Southwest – Mediterranean, warm to hot dry summer, cool wet winter.

The differing climate of these three regions drives important variations in wetland vegetation.

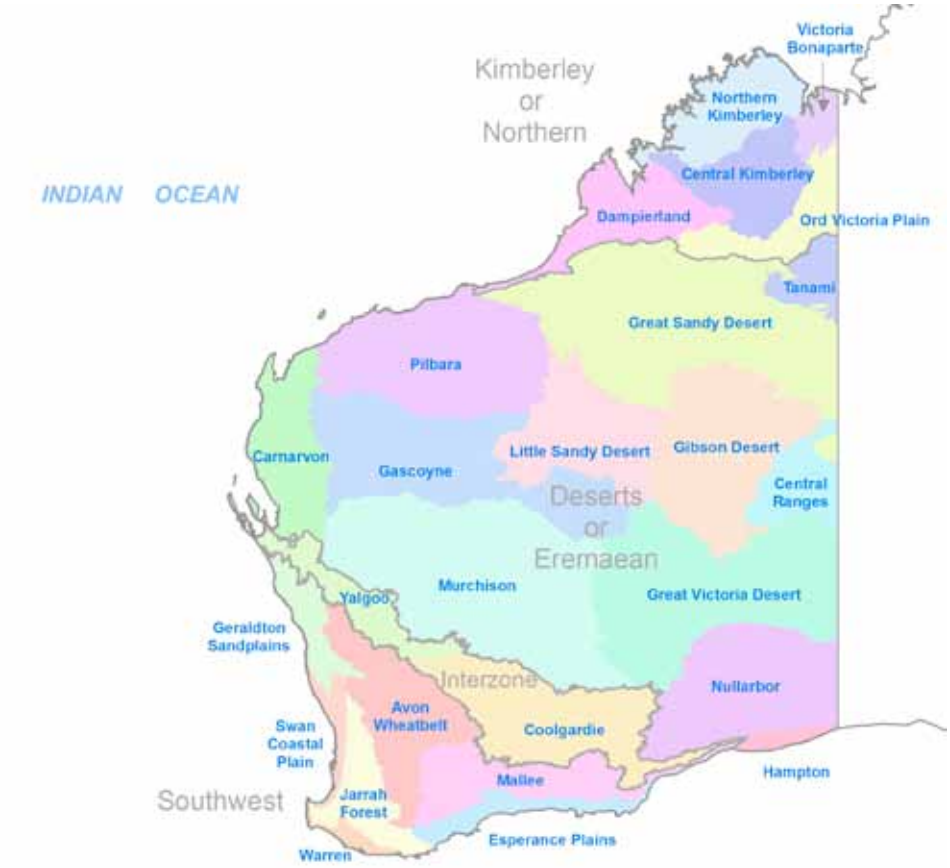


Figure 34. WA's bioregions and the three climatic zones used in this topic. Image – C. Auricht, Auricht Projects.

Within each of these zones is a second division of saline and freshwater wetlands. Wetland plant communities are distinctive of the zone and water chemistry, contributing both to the local and state identity and contributing greatly to the uniqueness of WA and Australia. Thirdly, in addition to zone and water chemistry divisions, this topic recognises various additional wetland groups that share similar vegetation characteristics. The following parts of this topic (parts 2 to 5) cover the wetland vegetation and flora of the Kimberley, Deserts and Southwest zones.

Glossary

Alluvial soil: soil deposited by flowing water on floodplains, in river beds, and in estuaries

Aquatic plant: a plant that grows for some period of time in inundated conditions and depends on inundation to grow and, where applicable, flower

Bentonite: a type of clay (aluminium phyllosilicate)

Birrida: a local Aboriginal name for a seasonally inundated gypsum saltpan wetland in sand dunes in the Shark Bay area. Some have a distinctive central raised platform and moat feature.

Community: a general term applied to any grouping of populations of different organisms found living together in a particular environment

Cosmopolitan: can be found almost anywhere in the world

Diatom: a microscopic, single-celled alga with cell walls made of hard silica, forming fossil deposits

Dicotyledons (dicots): flowering plants that typically have seedlings with two cotyledons (seed leaves), a tap root system, and they can form wood and have network leaf venation. Dicots include a range of herbs, shrubs and trees.

Dongas: playas (intermittently inundated basins) in the Nullarbor, usually 2–3 metres deep and up to 800 metres in diameter, supporting trees. They hold water for a short time after rain due to their hard clay surface.

Ecotype: a genetically distinct geographic variety, population or race within a species which is adapted to specific environmental conditions. Typically ecotypes exhibit differences in morphology or physiology stemming from this adaptation, but are still capable of breeding with adjacent ecotypes without loss of fertility or vigour.

Endemic: naturally occurring only in a restricted geographic area

Ephemeral (plant): marked by short life cycles, usually a single season

Facultative plants: plants that can occur in both wetlands and dryland under natural conditions in a given setting

Ferns, fern allies: plants with stems, leaves and roots like other vascular plants, but which reproduce via spores instead of seeds or flowers

Flora: plant species, subspecies and varieties in a given area[1]

Gnamma: a hole (commonly granite) that collects rainwater, forming a wetland. This word is of Nyoongar origin.

Grass: tufted or spreading plant from the family Poaceae. The leaf sheath is always split, a ligule is present, the leaf is usually flat, a stem cross-section circular and all internodes evenly spaced. Some grasses are called reeds (the *Phragmites* and *Arundo* genera).

Gymnosperms: plants with unprotected seeds, often in cones, including the conifers and cycads

Herbs: plants with non-woody stems that are not grasses or sedges. Generally under half a metre tall. Most monocots are herbs.

Mallees: plants with many trunks (usually 2–5) arising from a lignotuber. The canopy is usually well above the base of the plant. In WA, most are from the genus *Eucalyptus*.

Mangrove: any of various tropical or semi-temperate trees or shrubs of the genera *Rhizophora*, *Bruguiera* and *Avicennia* growing in intertidal shore mud with many tangled roots above the ground

Mesa: an isolated flat-topped hill with steep sides

Monocotyledons (monocots): flowering plants that typically have seedlings with one cotyledon (seed-leaf) and a fibrous root system. They do not form wood and have strappy leaves with parallel veins. Some herbs and all grasses and sedges are monocots.

Monotypic: a genus with only one species

Obligate wetland plants: plants that are generally restricted to wetlands under natural conditions in a given setting

Pan-tropical: distributed throughout the tropical regions of the Earth

Perennial: a plant that normally completes its life cycle (from germination to flowering, seed production and death of vegetative parts) in two or more growing seasons

Range ends: populations at the margins of the area to which a species is native

Rush: see 'sedge'

Samphire: the common name for a group of succulent sub-shrubs and shrubs including *Tecticornia*, *Halosarcia*, *Sarcocornia*, *Sclerostegia*, *Tegicornia* and *Pachycornia*, belonging to the family Chenopodiaceae

Savanna: a grassy woodland; grassland with small or widely spaced trees so that the canopy is always open allowing a continuous layer of grasses underneath

Sedge: tufted or spreading plant from the families Cyperaceae, Centrolepidaceae, Hydatellaceae, Juncaginaceae Restionaceae, Juncaceae, Typhaceae and Xyridaceae. In these plants the leaf sheath generally not split, there is usually no ligule, the leaf is not always flat and there is an extended internode below inflorescence. Some sedges are also known as rushes.

Shrubs: plants with one or more woody stems and foliage all or part of the total height of the plant

Taxa: a taxonomic group (the singular being taxon). Depending on the context, this may be a species or their subdivisions (subspecies, varieties etc), genus or higher group.[1]

Trees: plants with a single trunk and a canopy. The canopy is less than or equal to two-thirds of the height of the trunk. No lignotuber is evident.

Tufa: a porous rock composed of calcium carbonate and formed round mineral springs

Vascular plants: plants with defined tubular transport systems. Non-vascular plants include algae, liverworts and mosses.

Vegetation: combinations of plant species within a given area, and the nature and extent of each area[1]

Water regime: the pattern of when, where and to what extent water is present in a wetland. The components of water regime are the timing, duration, frequency, extent and depth, and variability of water presence.

Wetland flora: wetland plant species, subspecies and varieties in a given area

Wetland plants: plants that inhabit wetlands

Wetland vegetation: combinations of wetland plants in a given area, and the nature and extent of each area

References (for parts 1–5)

1. Environmental Protection Authority (2008). *Environmental guidance for planning and development: Guidance statement No. 33*. Environmental Protection Authority, Perth, Western Australia. www.epa.wa.gov.au/GS33.asp.
2. Keighery, BJ, Keighery, GJ, Gibson, N, and Gunness, AG (1999). 'Knowing and understanding the plants in our bushland', in Tullis, K and McLean, K (Eds), *Proceedings of a 1998 conference on the protection and management of urban bushland*. Urban Bushland Council (Inc), Perth, Western Australia.
3. Keighery, B (1994). *Bushland plant survey: a guide to plant community survey for the community*. Wildflower Society of WA, Nedlands, WA.
4. Lyons, MN, Gibson, N, Keighery, GJ, and Lyons, SD (2004). 'Wetland flora and vegetation of the Western Australian Wheatbelt', *Records of the Western Australian Museum*, Supplement No. 67, pp. 39-89.
5. Water and Rivers Commission/Department of Environment (1999). *River restoration manual: a guide to the nature, protection, rehabilitation and long-term management of waterways in Western Australia*. Water and Rivers Commission/Department of Environment, Perth, Western Australia.
6. Halse, SA, Pearson, GB, and Patrick, S (1993). Technical report no. 30: *Vegetation of depth gauged wetlands in nature reserves of south-west Western Australia*. Department of Conservation and Land Management, Perth, Western Australia.
7. Ground Water Consulting Services Pty Ltd (2003). *Preliminary Hydrological Investigation Arinya Springs, Dowerin, Western Australia*. Department of Conservation and Land Management, Perth, Western Australia.
8. Henry-Hall, N, Hopper, SD, McKenzie, NL, and Keighery, GJ (1990). *Nature conservation reserves of the Eastern Goldfields, Western Australia*. Department of Conservation and Land Management, Perth, Western Australia.
9. Lane, J, Jaensch, R, Lynch, R, and Elscot, S (2001). '12. Western Australia', pp. 103–115, in Environment Australia (Ed.), *A directory of important wetlands in Western Australia*, 3 edn. Environment Australia, Canberra, Australian Capital Territory.
10. Conservation International (2011). *Biodiversity Hotspots*. Conservation International, www.biodiversityhotspots.org.
11. Western Australian Herbarium (1998). *Florabase – the Western Australian flora*. Department of Environment and Conservation, Perth, Western Australia. florabase.dec.wa.gov.au.
12. Department of Environment and Conservation (2011). *WA Herbarium webpage, DEC website*. Department of Environment and Conservation, Perth, Western Australia. www.dec.wa.gov.au/content/category/41/831/1821/.
13. Smith, M G (2010). *Declared rare and priority flora list for Western Australia*, 16 September 2010. Department of Environment and Conservation, Perth, Western Australia.
14. Department of Environment and Conservation (2010). *Threatened ecological communities endorsed by the Minister for the Environment*. Department of Environment and Conservation, Perth, Western Australia. www.dec.wa.gov.au/content/view/849/2017.
15. Department of Environment and Conservation (2011). *Wetlands webpage, DEC website*. Department of Environment and Conservation, Perth, Western Australia. www.dec.wa.gov.au/wetlands.
16. Beard, JS (1990). *Plant life of Western Australia*. Kangaroo Press, New South Wales.
17. Environment Australia (2001). *A directory of important wetlands in Australia*, Third Edition. Environment Australia, Canberra, ACT.
18. Paczkowska, G and Chapman, AR (2000). *The Western Australian flora: A descriptive catalogue*. Wildflower Society of Western Australia, the Western Australian Herbarium, CALM, and the Botanic Gardens and Parks Authority, Perth, Western Australia.
19. Meney, KA and Pate, JS (eds) (1999). *Australian rushes: biology, identification and conservation of Restionaceae and allied families*. University of Western Australia Press, Perth, Western Australia.

20. Sainty, GR and Jacobs, SWL (1994). *Waterplants of Australia*. Sainty and Associates, New South Wales.
21. Brown, A, Thomson-Dans, C, and Marchant, N (eds) (1998). *Western Australia's threatened flora*. Department of Conservation and Land Management, Perth, Western Australia.
22. Romanowski, N (1998). *Aquatic and wetland plants: a field guide for non-tropical Australia*. University of New South Wales Press, New South Wales.
23. Datson, B (2002). *Samphires in Western Australia: A field guide to Chenopodiaceae Tribe Salicornieae*. Department of Conservation and Land Management, Perth, Western Australia.
24. Wheeler, JR (ed.) (1992). *Flora of the Kimberley Region*. Department of Conservation and Land Management, Perth, Western Australia.
25. Cowie, ID, Short, PS, and Osterkamp Madsen, M (2001). Flora of Australia Supplementary Series No. 10, Australian Biological Resources Study: *Floodplain flora*. Canberra.
26. Moore, P (2005). *A guide to plants of inland Australia*. New Holland Publishers, New South Wales.
27. Jessop, J (ed.) (1985). *Flora of central Australia*. Reed, Sydney, New South Wales.
28. Marchant, NG, Wheeler, JR, Rye, BL, Bennett, EM, Lander, NS, and Macfarlane, TD (1987). *Flora of the Perth region: Part One*. Western Australian Herbarium, Department of Agriculture, Perth, Western Australia.
29. Marchant, NG, Wheeler, JR, Rye, BL, Bennett, EM, Lander, NS, and Macfarlane, TD (1987). *Flora of the Perth region: Part Two*. Western Australian Herbarium, Department of Agriculture, Perth, Western Australia.
30. Wheeler, J, Marchant, N, and Lewington, M (2002). *Flora of the South West: Bunbury, Augusta, Denmark - Volume 1*. Australian Biological Resources Study and Western Australian Herbarium, CALM, Perth, Western Australia.
31. Wheeler, J, Marchant, N, and Lewington, M (2002). *Flora of the South West: Bunbury, Augusta, Denmark - Volume 2*. Australian Biological Resources Study and Western Australian Herbarium, CALM, Perth, Western Australia.
32. Scott, J and Negus, P (2002). *Field guide to the wildflowers of WA's south west: Augusta - Margaret River region*. Cape to Cape Publishing, North Fremantle, Western Australia.
33. Sandiford, EM and Barrett, S (2010). *Albany regional vegetation survey: extent, type and status*. Unpublished report of the Department of Environment and Conservation.
34. Gibson, N and Keighery, GJ (2000). 'Flora and vegetation of the Byenup-Muir reserve system, south-west Western Australia', *CALMScience*, vol. 3, pp. 323–402.
35. Griffin, EA and Associates (1991). *Flora and vegetation of Watheroo bentonite lakes*. Unpublished report for Bentonite Australia Pty. Ltd.
36. Gunness, AG, Yenyening Lakes Management Committee (WA), Bushland Plant Survey Project (WA), and Western Australian Department of Conservation and Land Management (2003). *A vegetation survey of Yenyening Lakes Nature Reserve and adjoining vegetation: shires of Beverley, Brookton and Quarading for the Yenyening Lakes Management Committee*. Wildflower Society of WA, Nedlands, Western Australia.
37. Keighery, BJ and Trudgen, ME (1992). *The remnant vegetation of the eastern side of the Swan Coastal Plain*. A report to the Department of Conservation and Land Management for the National Estate Program, Perth, Western Australia.
38. Gibson, N, Keighery, BJ, Keighery, GJ, Burbidge, AH, and Lyons, MN (1994). *A floristic survey of the southern Swan Coastal Plain*. Unpublished report for the Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)
39. Government of Western Australia (2000). *Bush Forever Volume 2: Directory of Bush Forever sites*. Department of Environmental Protection, Perth, Western Australia.
40. Semeniuk, CA (1987). 'Wetlands of the Darling System - a geomorphic approach to habitat classification', *Journal of the Royal Society of Western Australia*, vol. 69, pp. 95–111.

41. Semeniuk, CA and Semeniuk, V (1995). 'A geomorphic approach to global classification for inland wetlands', *Vegetatio*, vol. 118, pp. 103–124.
42. Powell, R (2009). *Leaf and branch: Trees and tall shrubs of Perth*, 2 edn. Department of Environment and Conservation, Perth, Western Australia.
43. Environment Australia (2000). *Revision of the interim biogeographic regionalisation of Australia (IBRA) and development of version 5.1*. Environment Australia, Canberra, ACT.
44. May, JE and McKenzie, NL (eds) (2003). *A biodiversity audit of Western Australia's 53 biogeographical subregions in 2002*. Department of Conservation and Land Management, Perth, Western Australia.
45. McKenzie, NL, May JE and McKenna, S (eds) (2003). *Bioregional summary of the 2002 biodiversity audit for Western Australia*. Department of Conservation and Land Management, Perth, Western Australia.
46. Department of the Environment and Heritage (2006). *A directory of important wetlands in Australia: factsheet*. Department of the Environment and Heritage, Canberra, Australian Capital Territory. www.environment.gov.au/water/publications/environmental/wetlands/diwa.html.
47. Elscot, SV, Lane, JAK, Clark AG, and Muir, WP (2009). *Nomination and improved documentation of nationally important wetlands in under-represented IBRA regions in Western Australia*. Department of Environment and Conservation, Perth, Western Australia.
48. Department of Sustainability, Environment, Water, Population and Communities (2011). *Wetlands webpage, Australian Govt website*. www.environment.gov.au/water/topics/wetlands/index.html.
49. Department of Environment and Conservation (2011). *Threatened ecological communities webpage, DEC website*. Department of Environment and Conservation, Perth, Western Australia. www.dec.wa.gov.au/content/view/849/2017.
50. Department of Sustainability, Environment, Water, Population and Communities (2011). *Threatened species and ecological communities webpage, Australian Govt website*. Department of Sustainability,Environment,Water,Populations and Communities, Canberra, Australian Capital Territory. www.environment.gov.au/biodiversity/threatened/index.html.
51. Hoffman, N and Brown, A (1998). *Orchids of South-West Australia*. University of Western Australia Press, Nedlands, Western Australia.
52. State of Western Australia (2010). 'Wildlife Conservation (Rare Flora) Notice 2010(2)', *Government Gazette*, vol. 161, pp. 4039–4044.
53. Department of Environment and Conservation (2011). *Threatened flora webpage, DEC website*. Department of Environment and Conservation, Perth, Western Australia. www.dec.wa.gov.au/content/view/5385/2233/.
54. Department of Sustainability, Environment, Water, Population and Communities (2011). *Australian Wetlands Database*. Department of Sustainability, Environment, Water, Population and Communities, Canberra, Australian Capital Territory. www.environment.gov.au/water/topics/wetlands/database/index.html.
55. Semeniuk, V, Kenneally, KF, and Wilson, PG (1978). Western Australian Naturalists Handbook 12: *Mangroves of Western Australia*. Western Australian Naturalists, Perth, Western Australia.
56. Forbes, SJ and Kenneally, KF (1986). 'A botanical survey of Bungle Bungle and Osmond Range, south-eastern Kimberley, Western Australia', *Western Australian Naturalist*, vol. 16, pp. 93–169.
57. Daniel, G, Kern, S, Pinder, A, and Nowicki, A (2009). *Resource condition report for a significant Western Australian wetland: Lake Eda*. Department of Environment and Conservation, Perth, Western Australia.
58. McKenzie, NL (ed.) (1983). *Wildlife of the Dampier Peninsula, South-West Kimberley, Western Australia*. Department of Fisheries and Wildlife, Western Australia.
59. Kenneally, KF, Keighery, GJ, and Hyland, BPM (1991). 'Floristics and phytogeography of Kimberley rainforests, Western Australia', pp. 93–131, in McKenzie, NL, Johnston, RB, and Kendrick, PG (Eds), *Kimberley rainforests of Australia*. Surrey Beatty, Sydney.

60. McKenzie N.L. (ed.) (1981). *Wildlife of the Edgar Ranges area, South-west Kimberley, Western Australia*. Department of Fisheries and Wildlife, Perth, Western Australia.
61. Daniel, G, Kern, S, Pinder, A, and Nowicki, A (2008). *Resource condition report for a significant Western Australian wetland: Airfield Swamp (Nguyarri)*. Department of Environment and Conservation, Perth, Western Australia.
62. Dell, J (2003). 'Lake Gladstone, an important Kimberley bird habitat: with notes on birds recorded during the WA Naturalists' Club excursion', *Western Australian Naturalist*, vol. 24, pp. 89–100.
63. Morton, SR, Short, J, and Barker, RD (1995). *Refugia for biological diversity in arid and semi-arid Australia. Biodiversity Series No. 4*. Department for Environment, Sport and Territories, Canberra, Australian Capital Territory. www.environment.gov.au/archive/biodiversity/publications/series/paper4/index.html.
64. Blackwell, MI and Trudgen, M (1980). *Report on the flora and vegetation of the Lake Way Joint Venture uranium project area: together with an assessment of the impact of this project upon the landscape, flora and vegetation of this area and its regeneration potential – Lake Way joint venture. Appendix 3, flora and vegetation survey*. Unpublished report.
65. Payne, AL, Van Vreeswyk, AME, Pringle, HJR, Leighton, KA, and Hennig, P. *An inventory and condition survey of the Sandstone-Yalgoo-Paynes Find area, Western Australia*. Technical bulletin No. 90. Western Australian Department of Agriculture, Perth, Western Australia.
66. Coates, KH, Johnstone, RE, and Lodge, GA (1998). 'Birds of the Gardner and Denison Ranges and Lake Willson area south-east Kimberley, Western Australia', *Western Australian Naturalist*, vol. 22, pp. 25–53.
67. Kenneally, K F and Edinger, D (1999). *Craters and creatures of the Tanami Desert.* LANDSCOPE *Expeditions Report No. 27*. Department of Conservation and Land Management, Perth, Western Australia.
68. Pringle, HJR, Van Vreeswyk, AME, and Gilligan, S (1995). *An inventory and condition survey of the Rangelands in the north-eastern goldfields, Western Australia. Technical bulletin No. 87*. Western Australian Department of Agriculture, Perth, Western Australia.
69. Monroe, MH (2011). *Australia: The land where time began – a biography of the Australian continent*. www.austhrutime.com/nullarbor_plain.htm.
70. Davy, AG, Gray, MR, Grimes, KG, Hamilton-Smith, E, James, JM, and Spate, AP (1992). *World heritage significance of karst and other landforms in the Nullarbor region*. Department of the Arts, the Environment and Territories, Commonwealth of Australia, Canberra, Australian Capital Territory.
71. Department of Environment and Conservation (2011). *Biological surveys webpage, DEC website*. Department of Environment and Conservation, Perth, Western Australia. www.dec.wa.gov.au/content/category/41/834/1814/.
72. Jackson, J, Kern, S, Pinder, A, Nowicki, A, and Daniel, G (2009). *Resource condition report for a significant Western Australian wetland: wetlands of the Fortescue River system*. Department of Environment and Conservation, Perth, Western Australia.
73. Curry, PJ, Payne, AL, Leighton, KA, Hennig, P, and Blood, DA (1984). *An inventory and condition survey of the Murchison River catchment and surrounds, Western Australia. Technical bulletin no. 84.* Department of Agriculture, Perth, Western Australia.
74. Payne, AL, Mitchell, AA, and Holman, WF (1975). *An inventory and condition survey of the Rangelands in the Ashburton River Catchment and surrounds, Western Australia. Technical bulletin No. 62*. Western Australian Department of Agriculture, Perth, Western Australia.
75. Payne, AL, Curry, PJ, and Spencer, GF (1980). *An inventory and condition survey of the Rangelands in the Canarvon Basin, Western Australia. Technical bulletin No. 73*. Western Australian Department of Agriculture, Perth, Western Australia.
76. Van Vreeswyk, AME, Payne, AL, Leighton, KA, and Hennig, P (2004). *An inventory and condition survey of the Pilbara region, Western Australia. Technical bulletin No. 92*. Western Australian Department of Agriculture, Perth, Western Australia.
77. Trudgen, ME and Casson, N (1998). *Flora and vegetation of the ore bodies in the West Angela Hills area*. A report for the Robe River Iron Associates.

78. Kendrick, P and Stanley, F (2003). 'Pilbara 4 (PIL4 – Roebourne synopsis)', pp. 581–593, in McKenzie, NL and May, JE (Eds), *A biodiversity audit of Western Australia's 53 biogeographical subregions in 2002*. Department of Conservation and Land Management, Perth, Western Australia.
79. Keighery, GJ and Gibson, N (1993). 'Biogeography and composition of flora of the Cape Range Peninsula, Western Australia', *Records of the Western Australian Museum*, vol. Supplement No. 45, pp. 51–85.
80. Desmond, A, Kendrick, P, and Chant, A (2003). 'Gascoyne 3 (GAS3 - Augustus subregion)', pp. 240–252, in McKenzie, NL and May, JE (Eds), *A biodiversity audit of Western Australia's 53 biogeographical subregions in 2002*. Department of Conservation and Land Management, Perth, Western Australia.
81. Western Australian Herbarium (2010). *Western Australian Plant Census Database*. Department of Environment and Conservation, Perth, Western Australia. www.dec.wa.gov.au/content/view/5817/1819/.
82. Gibson, N, Keighery, G, and Lyons, M (2000). 'The flora and vegetation of the seasonal and perennial wetlands of the southern Canarvon Basin, Western Australia', *Records of the Western Australian Museum*, vol. Supplement No. 61, pp. 175–199.
83. Brearley, A (2005). *Ernest Hodgkin's Swanland: Estuaries and Coastal Lagoons of South-western Australia*. University of Western Australia Press, Nedlands, Western Australia.
84. Nowicki, A, Pinder, A, Kern, S, and Daniel, G (2009). *Resource condition report for a significant Western Australian wetland: Hutt Lagoon*. Department of Environment and Conservation, Perth, Western Australia.
85. Susac, R, Kern, S, Pinder, A, and Daniel, G (2008). *Resource condition report for a significant Western Australian wetland: Leeman Lagoon*. Department of Environment and Conservation, Perth, Western Australia.
86. Department of Minerals and Energy (1992). Fact Sheet 15. *The Geology of Perth in a Regional Setting*. Department of Minerals and Energy, Perth, Western Australia.
87. Nowicki, A, Pinder, A, Kern, S, and Daniel, G (2009). *Resource condition report for a significant Western Australian wetland: Balicup Lake*. Department of Environment and Conservation, Perth, Western Australia.
88. Nowicki, A, Kern, S, Pinder, A, and Daniel, G (2008). *Resource condition report for a significant Western Australian wetland: Lake Guraga*. Department of Environment and Conservation, Perth, Western Australia.
89. Department of Environment and Conservation (2011). *Natural Diversity Recovery Catchments webpage, DEC website*. www.dec.wa.gov.au/content/view/449/1620/.
90. Harvey, J and Keighery, G (2009). *Avon baseline project: benchmarking wheatbelt vegetation communities. Part 1, classification of Eucalypt woodlands*. Department of Environment and Conservation, Perth, Western Australia.
91. McKenzie, NL and Hall, NJ (1992). 'The biological survey of the eastern goldfields of Western Australia. Part 8, Kurnalpi-Kalgoorlie study area', *Records of the Western Australian Museum*, vol. Supplement No. 41.
92. Smith, GG (1969). '*Sphagnum subsecundum* in Western Australia', *Journal of the Royal Society of Western Australia*, vol. 45, pp. 26–59.
93. Robinson, CJ (1992). *Survey and inventory of the wetland flora of the south coast of Western Australia*. Unpublished report to the Department of Conservation and Land Management.
94. Gibson, N, Keighery, GJ, Lyons, MN, and Keighery, BJ (2005). 'Threatened plant communities of Western Australia. 2. The seasonal clay-based wetland communities of the south west', *Pacific Conservation Biology*, vol. 11, pp. 287–301.
95. Keighery, BJ, Dell, J, Keighery, GJ, Madden, S, Longman, VM, Green, B, Webb, A, McKenzie, B, Hyder, B, Ryan, R, Clarke, KA, Harris, E, Whisson, G, Olejnik, C, and Richardson, A (2006). *The vegetation, flora, fauna and natural areas of the Peel Harvey Eastern Estuary Area Catchment (Swan Coastal Plain)*. A report for the Department of Environment and Conservation as a contribution to the Peel Harvey Eastern Estuary Area Catchment Environmental Assessment Project and Swan Bioplan Project. Perth, Western Australia.

96. Hickman, JC (ed.) (1993). *The Jepson manual of higher plants in California*. University of California Press, Berkeley, California.
97. Keighery, GJ and Keighery, BJ (2000). 'Flora of the Greater Brixton St Wetlands', in Marshal, J (Ed.), *The Greater Brixton St Wetlands Management Guidelines, Natural History and Research*. A report for the Friends of Brixton St Wetlands and the World Wide Fund for Nature.
98. Keighery, BJ, Pieroni, M, and Friends of Brixton Street Wetlands (1996). *The Brixton Street Wetlands*. Brochure. Wildflower Society of WA Perth Branch and Friends of Brixton Street Wetlands, Nedlands, Western Australia.
99. Walker, BA and Pater, JS (1986). 'Morphological variation between seedling progenies of *Viminaria juncea* (Schrad. & Wendl.) Hoffmans (Fabaceae) and its physiological significance', *Australian Journal of Plant Physiology*, vol. 13, pp. 305–319.
100. Walker, BA, Pater, JS, and Kuo, J (1983). 'Nitrogen fixation by nodulated roots of *Viminaria juncea* (Schrad. & Wendl.) Hoffmans. (Fabaceae) when submerged in water.', *Australian Journal of Plant Physiology*, vol. 10, pp. 409–421.
101. Keighery, G (2005). *Status of the vegetation of the Greenough alluvial flats*. Department of Conservation and Land Management, Perth, Western Australia.
102. Gibson, N, Keighery, G, and Keighery, B (2000). 'Threatened plant communities of Western Australia. 1. The ironstone communities of the Swan and Scott Coastal Plains', *Journal of the Royal Society of Western Australia*, vol. 83, pp. 1–11.
103. Webb, A, Keighery B, Keighery, G, Longman, V, Black, A, and O'Connor, A (2009). *The flora and vegetation of the Busselton Plain (Swan Coastal Plain)*. A report for the Department of Environment and Conservation (Western Australia) as part of the Swan Bioplan Project.
104. Keighery GJ and Keighery BJ (1995). *Muchea limestones - floristics report for ANCA national reserves network*. Report to the Australian Nature Conservation Authority National Reserves Network and the Department of Conservation and Land Management, Western Australia.
105. Moody, ML and Les, DH (2010). 'Systematics of the aquatic angiosperm genus Myriophyllum (Haloragaceae)', *Systematic Botany*, vol. 35, pp. 121–139.
106. Royal Society of Western Australia (1996). 'Proceedings of Granite Rock Symposium', *The Journal of the Royal Society of Western Australia*, vol. 80, issue Part 3.
107. Jones, SM, Pinder, AM, Sim, LL, and Halse, SA (2008). *Evaluating the conservation significance of basin and granite outcrop wetlands in the Avon natural resource management region: Stage One Assessment Method*. Prepared for the Avon Catchment Council by the Department of Environment and Conservation.
108. Keighery, GJ (2006). 'Systematics and biology of the southern Western Australian Centrolepidaceae', *Western Australian Naturalist*, vol. 25, pp. 25–36.
109. Commonwealth of Australia (1994). Biodiversity series, paper no. 2: *Australia's biodiversity: an overview of selected significant components*. Department of Environment, Sport and Territories, Canberra, Australian Capital Territory.
110. McDonald, RC, Isbell RF, Speight JG, Walker J, Hopkins MS (1998). *Australian Soil and Land Survey Field Handbook*. Australia Collaborative Land Evaluation Program, CSIRO Land and Water, Canberra, Australian Capital Territory.
111. Executive Steering Committee for Australian Vegetation Information (2003). *Australian vegetation attribute manual. National vegetation information system, Version 6.0*. Department of the Environment and Heritage, Canberra, Australian Capital Territory.

Key to Appendix 1.

Native wetland vascular plant taxa of Western Australia referred to in this topic.

Column 1	**Scientific plant name**	
	Genus + species + infra species rank + infra species name + informal name. Some taxa yet to be formally described and named may have a reference collection number from the relevant collector. Names follow Western Australian Herbarium[81] except for those indicated as not having a current name (see column 4).	
	subsp.	Subspecies
	var.	Variety
	ms	A manuscript name yet to be published
	PN	A phrase name for a taxon yet to be described and published.
Column 2	**Supra code**	
	Indicates broad supra-family classification.	
Column 3	**Family name**	
Column 4	**Current**	
	Scientific plant names are current (Western Australian Herbarium[81]) unless indicated with 'N'. In these cases, the authors prefer to use the names chosen.	
Column 5	**Common names**	
	Sources for common names are the Western Australian Herbarium[81] and others as applied in references for this section.	
Columns 6–8	**Listed conservation taxa**	
Column 6	**Consv code = Western Australian-listed taxa**	
	Significant plant taxa (species, sub-species and varieties) listed under the *Wildlife Conservation Act 1950* (Government of Western Australia[52]) and by the Department of Environment and Conservation.[13] Priority taxa conservation code listings are current as at July 2010 (Western Australian Herbarium[81]). See Appendix 2 for further descriptions of the categories below.	
	R	Declared rare flora: extant taxa
	X	Declared rare flora: presumed extinct taxa
	1	Priority 1: poorly known taxa
	2	Priority 2: poorly known taxa
	3	Priority 3: poorly known taxa
	4	Priority 4: rare taxa
Column 7	**WA IUCN rank = Internationally listed taxa**	
	Significant plant taxa (species, subspecies and varieties) listed from the IUCN Red List of Threatened Species according to Smith[13]	
	CR	Taxa that are critically endangered
	E	Taxa that are endangered
	V	Taxa that are vulnerable

Column 8	**EPBC rank = Commonwealth-listed taxa**	
	Significant plant taxa (species, subspecies and varieties) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* according to Smith.[13] Taxa are listed by the Department of Sustainability, Environment, Water, Population and Communities[50]	
	E	Taxa that are endangered
	V	Taxa that are vulnerable
	In some instances, the codes for the Commonwealth and the internationally listed taxa differ; in these cases, the discrepancy is indicated by an asterisk.	
Column 9–11	**Wetland zone**	
	Zones listed are only those mentioned in the text or captions in this section.	
	K	Kimberley
	D	Deserts
	SW	Southwest
Column 12	**Figure no.**	
Column 13	**Name ID**	
	Positive name IDs are from the Western Australian Plant Census Database (Western Australian Herbarium[11, 81])	

Appendix 1. Native wetland vascular plant taxa of Western Australia referred to in this topic

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Acacia acuminata	DIC	Fabaceae		Jam						SW		3200
Acacia ampliceps	DIC	Fabaceae							D			3209
Acacia aneura	DIC	Fabaceae		Mulga					D			3217
Acacia blakelyi	DIC	Fabaceae								SW		3242
Acacia citrinoviridis	DIC	Fabaceae							D			3260
Acacia cyclops	DIC	Fabaceae		Coastal wattle, Red-eyed wattle						SW		3282
Acacia dictyophleba	DIC	Fabaceae		Sandhill wattle					D			3300
Acacia distans	DIC	Fabaceae		Black mulga					D			3305
Acacia eriopoda	DIC	Fabaceae		Broome pindan wattle					D			3326
Acacia flagelliformis	DIC	Fabaceae		Rush wattle	4					SW	149a, 149b	3339
Acacia holosericea	DIC	Fabaceae		Candelbra wattle					D			3372
Acacia maconochieana	DIC	Fabaceae							D			3433
Acacia monticola	DIC	Fabaceae		Gawar					D			3447
Acacia neurocarpa	DIC	Fabaceae						K	D		41	13401
Acacia rostellifera	DIC	Fabaceae		Summer-scented wattle						SW		3525
Acacia saligna	DIC	Fabaceae		Orange wattle, Coojong						SW		3527
Acacia spp.	DIC	Fabaceae							D			-20987
Acacia xiphophylla	DIC	Fabaceae		Snakewood					D			3606
Achyranthes aspera	DIC	Amaranthaceae		Chaff flower					D			2645
Acidonia microcarpa	DIC	Proteaceae		Acidonia						SW		10824
Acrostichum speciosum	FER	Pteridaceae		Mangrove fern					D			44
Actinostrobus acuminatus	GYM	Cupressaceae	N	Dwarf cypress, Creeping cypress						SW	166a, 166b, 166c	89
Actinostrobus pyramidalis	GYM	Cupressaceae	N	Swamp cypress						SW	8c, 106a, 110	91
Adenanthos meisneri	DIC	Proteaceae		Meisner's jugflower						SW		1790
Adiantum capillus-veneris	FER	Pteridaceae		Maidenhair	2			K	D			26
Aeschynomene indica	DIC	Fabaceae		Budda pea				K				3680
Agonis flexuosa var. flexuosa	DIC	Myrtaceae		Peppermint						SW		17202
Aldrovanda vesiculosa	DIC	Droseraceae			2					SW		11098

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Allocasuarina campestris	DIC	Casuarinaceae		Tamma						SW		1721
Alyogyne huegelii	DIC	Malvaceae		Lilac hibiscus						SW		4906
Amblysperma minor	DIC	Asteraceae	N	Swamp native gerbera						SW		25842
Amphibromus nervosus	MON	Poaceae		Swamp wallaby grass						SW	24a, 105a, 112	13380
Amphibromus vickeryae	MON	Poaceae		Swamp wallaby grass	1					SW		10758
Anarthria scabra	MON	Anarthriaceae		Anarthria						SW		1063
Andersonia ferricola	DIC	Ericaceae		Ironstone andersonia	1					SW		18102
Andersonia gracilis	DIC	Ericaceae		Slender andersonia	R	V	E*			SW		6309
Angianthus drummondii	DIC	Asteraceae		Star angianthus	3					SW	26c, 92c	7829
Angianthus preissianus	DIC	Asteraceae		Preiss's angianthus						SW		7833
Angianthus tomentosus	DIC	Asteraceae		Hairy angianthus, camel-grass						SW		7836
Anigozanthos bicolor subsp. minor	MON	Haemodoraceae			R	V	E*			SW		12102
Anigozanthos viridis subsp. terraspectans	MON	Haemodoraceae		Dwarf green kangaroo paw	R	V	V			SW		13891
Anthotium junciforme	DIC	Goodeniaceae		Anthotium	4					SW	148	12724
Aotus cordifolia	DIC	Fabaceae		Swamp aotus	3					SW		3686
Aphelia drummondii	MON	Centrolepidaceae		Drummond's aphelia						SW	30c	1118
Aphelia spp.	MON	Centrolepidaceae								SW		-21440
Aponogeton hexatepalus	MON	Aponogetonaceae		Stalked water ribbons	4					SW	5	141
Aponogeton spp.	MON	Aponogetonaceae						K				-21409
Argyroglottis turbinata	DIC	Asteraceae								SW	94b, 94c	7842
Aristida spp.	MON	Poaceae		Feathertop grass				K	D			-21362
Arthropodium sp.	MON	Asparagaceae								SW		-21388
Astartea affinis	DIC	Myrtaceae		Brixton astartea						SW	27d	20350
Asteridea athrixioides	DIC	Asteraceae		Bristle daisy						SW		7846
Astrebla elymoides	MON	Poaceae		Weeping mitchell grass					D			227
Astrebla pectinata	MON	Poaceae		Barley mitchell grass					D			229
Astrebla spp.	MON	Poaceae		Mitchell grass				K	D		81a, 82a	-21381
Astrebla squarrosa	MON	Poaceae		Bull mitchell grass					D			230
Atriplex amnicola	DIC	Chenopodiaceae		Swamp saltbush					D			2450

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Atriplex bunburyana	DIC	Chenopodiaceae		Silver saltbush					D		65a	2451
Atriplex paludosa	DIC	Chenopodiaceae		Marsh saltbush					D			2470
Atriplex semilunaris	DIC	Chenopodiaceae		Annual saltbush					D		76	2476
Atriplex spp.	DIC	Chenopodiaceae		Saltbush					D	SW		-21370
Atriplex vesicaria	DIC	Chenopodiaceae		Bladder saltbush					D			2481
Austrostipa juncifolia	MON	Poaceae								SW		17242
Austrostipa juncifolia subsp. Southern River (B.J. Keighery 2160) PN	MON	Poaceae			1					SW	127a, 127b	20733
Austrostipa sp. Harvey (B.J. Keighery GWAL/1) PN	MON	Poaceae								SW		34356
Avicennia marina	DIC	Acanthaceae		White mangrove					D	SW		6828
Azolla filiculoides	FER	Salviniaceae		Pacific azolla						SW	15	80
Azolla pinnata	FER	Salviniaceae		Azolla						SW		17737
Banksia dentata	DIC	Proteaceae		Tropical banksia				K			52	1813
Banksia littoralis	DIC	Proteaceae		Swamp banksia						SW	99, 125a	1830
Banksia nivea subsp. uliginosa	DIC	Proteaceae			R	E	E			SW	123e	32204
Banksia squarrosa subsp. argillacea	DIC	Proteaceae			R	V	V			SW	122a, 122b	32046
Banksia strictifolia	DIC	Proteaceae								SW		32042
Barringtonia acutangula	DIC	Lecythidaceae		Freshwater mangrove				K			39	5289
Baumea articulata	MON	Cyperaceae		Jointed rush					D	SW	21a, 97	741
Baumea juncea	MON	Cyperaceae		Bare twigrush						SW		743
Baumea preissii	MON	Cyperaceae		Preiss's baumea						SW		745
Baumea riparia	MON	Cyperaceae		River baumea						SW		746
Baumea rubiginosa	MON	Cyperaceae		Baumea					D	SW		747
Baumea vaginalis	MON	Cyperaceae		Sheath twigrush						SW		748
Beaufortia sparsa	DIC	Myrtaceae		Swamp bottlebrush, swamp beaufortia						SW		5392
Blennospora doliiformis	DIC	Asteraceae		Golden blennospora	3					SW	92b	20026
Blyxa sp.	MON	Hydrocharitaceae						K			47	-21430
Boronia capitata subsp. gracilis	DIC	Rutaceae		Slender boronia	2					SW		11612
Boronia exilis	DIC	Rutaceae			R	E	E*			SW		16318

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Boronia juncea subsp. juncea	DIC	Rutaceae			1					SW	102	16633
Boronia megastigma	DIC	Rutaceae		Scented boronia, brown boronia						SW		4428
Borya constricta	MON	Boryaceae		Palm pincushions						SW	128b	1267
Borya sp.	MON	Boryaceae								SW	108	-21159
Bossiaea cucullata	DIC	Fabaceae								SW	95c	18427
Brachyscias verecundus	DIC	Apiaceae		Brachyscias	R	CR	CR			SW		18492
Brachyscome bellidioides	DIC	Asteraceae		Brachyscome						SW		7867
Brachyscome pusilla	DIC	Asteraceae		Brachyscome						SW	32a, 32b	7883
Burchardia bairdiae	MON	Colchicaceae		Baird's kara						SW	137a, 137b	1383
Burchardia multiflora	MON	Colchicaceae		Dwarf burchardia, kara						SW	137c	1385
Byblis filifolia	DIC	Byblidaceae							D			18073
Byblis guehoi	DIC	Byblidaceae						K			54	33487
Caladenia cruscula	MON	Orchidaceae								SW		15342
Caladenia incensa	MON	Orchidaceae							D	SW		15356
Caladenia paludosa	MON	Orchidaceae		Swamp spider orchid						SW		15503
Caladenia remota	MON	Orchidaceae							D	SW		18028
Calandrinia granulifera	DIC	Portulacaceae		Pygmy purslane						SW	118a	2854
Calandrinia sp. Kemerton (B.J. Keighery s.n.) PN	DIC	Portulacaceae		Tiny clay calandrinia						SW	118a, 118b	-21246
Callistachys lanceolata	DIC	Fabaceae		Wonnich, native willow						SW		10861
Callistemon phoeniceus	DIC	Myrtaceae		Lesser bottlebrush					D	SW		5395
Callitris canescens	GYM	Cupressaceae								SW	95b	92
Callitris verrucosa	GYM	Cupressaceae								SW		8637
Calocephalus sp.	DIC	Asteraceae							D			-21421
Calothamnus hirsutus	DIC	Myrtaceae		Hairy calothamnus						SW	108	5411
Calothamnus lateralis	DIC	Myrtaceae		Swamp calothamnus						SW		5415
Calothamnus lateralis var. crassus ms	DIC	Myrtaceae			3					SW		35799
Calothamnus quadrifidus subsp. teretifolius ms	DIC	Myrtaceae			4					SW	12	35796
Calytrix breviseta subsp. breviseta	DIC	Myrtaceae		Rare starflower	R	CR	E*			SW		13653

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Calytrix sp. Tutunup (G.J. Keighery & N. Gibson 2953) PN	DIC	Myrtaceae		Ironstone starflower	2					SW	124e, 124f	19974
Canarium australianum	DIC	Burseraceae		Jalkay				K				4512
Carallia brachiata	DIC	Rhizophoraceae						K				5293
Cartonema spicatum	MON	Commelinaceae						K			50b	1163
Casuarina obesa	DIC	Casuarinaceae		Swamp sheoak					D	SW	2, 104, 119	1742
Casuarina pauper	DIC	Casuarinaceae		Black oak					D		60a	12658
Caustis dioica	MON	Cyperaceae		Caustis						SW		760
Celtis philippensis	DIC	Cannabaceae						K				1744
Centella asiatica	DIC	Apiaceae		Centella						SW		6214
Centrolepis polygyna	MON	Centrolepidaceae		Wiry centrolepis						SW	26b, 92a	1134
Cephalotus follicularis	DIC	Cephalotaceae		Albany pitcher plant						SW		3148
Chaetanthus aristatus	MON	Restionaceae		Chaetanthus						SW	106a	17685
Chamaescilla gibsonii	MON	Asparagaceae		Blue squill	3					SW	114c, 114d	19338
Chamelaucium sp. C Coastal Plain (R.D. Royce 4872) PN (Chamelaucium roycei ms)	DIC	Myrtaceae	N	Royce's wax	R	V	V			SW	124c, 124d	13627
Chenopodium auricomum	DIC	Chenopodiaceae		Swamp bluebush, Queensland bluebush					D			2485
Chordifex isomorphus	MON	Restionaceae		Chordifex	4					SW		17828
Chorizandra enodis	MON	Cyperaceae		Black bristlerush						SW		763
Chrysocephalum sp. Pilbara (H. Demarz 2852) PN	DIC	Asteraceae							D		82a, 82b	35017
Chrysopogon fallax	MON	Poaceae		Ribbon grass, golden beard grass				K	D			273
Cladium procerum	MON	Cyperaceae			2				D			766
Corybas sp.	MON	Orchidaceae								SW		-20761
Corymbia calophylla	DIC	Myrtaceae		Marri						SW	24a	17104
Corymbia confertiflora	DIC	Myrtaceae						K				17080
Corymbia greeniana	DIC	Myrtaceae						K				17089
Cosmelia rubra	DIC	Ericaceae		Spindle heath						SW		6352
Craspedia argillicola ms	DIC	Asteraceae		Swamp bachelor's buttons	2					SW	141	19858

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Cratystylis spp.	DIC	Asteraceae							D			-21372
Cyathochaeta teretifolia	MON	Cyperaceae		Terete leaved swamp cyathochaeta	3					SW	103a, 103b, 103c	16245
Cyclosorus interruptus	FER	Thelypteridaceae		Cyclosorus						SW		54
Cyperus aquatilis	MON	Cyperaceae						K			56a, 56b	773
Cyperus laevigatus	MON	Cyperaceae								SW	88b, 88c	-21433
Cyperus vaginatus	MON	Cyperaceae		Stiffleaf sedge					D		68a, 68b	818
Cyrtostylis sp.	MON	Orchidaceae								SW		-20616
Darwinia ferricola	DIC	Myrtaceae			R	E	E			SW	124a	34774
Darwinia foetida	DIC	Myrtaceae			R	E	CR*			SW		34773
Darwinia whicherensis	DIC	Myrtaceae			R	CR	E*			SW	124b	34765
Dichanthium sericeum	MON	Poaceae		Queensland blue grass				K	D		48	304
Dillwynia dillwynioides	DIC	Fabaceae		Swamp dillwynia	3					SW	101a, 101b	3863
Disphyma crassifolium subsp. clavellatum	DIC	Aizoaceae								SW	91b	11681
Diuris drummondii	MON	Orchidaceae		Tall donkey orchid	R	V	V			SW		10796
Diuris micrantha	MON	Orchidaceae		Dwarf bee orchid	R	V	V			SW		12938
Drosera burmanni	DIC	Droseraceae		Tropical sundew					D			3093
Drosera derbyensis	DIC	Droseraceae							D			17215
Drosera gigantea	DIC	Droseraceae		Giant sundew						SW	28a, 28b, 100a	3097
Drosera glanduligera	DIC	Droseraceae		Pimpernel sundew						SW		3098
Drosera hartmeyerorum	DIC	Droseraceae							D			19964
Drosera indica	DIC	Droseraceae		Indian sundew				K			28d, 28e	3103
Drosera menziesii	DIC	Droseraceae		Pink rainbow						SW		3109
Drosera menziesii subsp. menziesii	DIC	Droseraceae		Menzies' rainbow						SW	32a, 32d	11853
Drosera occidentalis	DIC	Droseraceae		Western sundew						SW		3115
Drosera spp.	DIC	Droseraceae								SW		-21406
Drosera tubaestylis	DIC	Droseraceae		Sundew						SW	28c	13205
Elatine spp.	DIC	Elatinaceae							D			-21415
Eleocharis acuta	MON	Cyperaceae		Common spikerush						SW		822

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Eleocharis brassii	MON	Cyperaceae						K				824
Eleocharis dulcis	MON	Cyperaceae		Spike rush, chinese water chestnut				K			53	826
Eleocharis geniculata	MON	Cyperaceae							D			827
Eleocharis keigheryi	MON	Cyperaceae		Keighery's spikerush	R	V	V			SW	104	17605
Eleocharis sphacelata	MON	Cyperaceae		Tall spikerush					D			831
Eleocharis spiralis	MON	Cyperaceae						K			51	832
Enneapogon purpurascens	MON	Poaceae		Purple nineawn				K				12749
Epiblema grandiflorum	MON	Orchidaceae		Babe-in-a-cradle						SW		1645
Epiblema grandiflorum var. cyaneum ms (this taxon is no longer recognised by the WA Herbarium)	MON	Orchidaceae		Blue babe-in-a-cradle	R	CR	E*			SW		17347
Eragrostis australasica	MON	Poaceae		Canegrass					D	SW		369
Eragrostis desertorum	MON	Poaceae		Desert lovegrass					D			377
Eragrostis dielsii	MON	Poaceae		Mallee lovegrass					D			378
Eragrostis falcata	MON	Poaceae		Sickle lovegrass					D		74c	381
Eragrostis setifolia	MON	Poaceae		Neverfail grass					D			393
Eragrostis speciosa	MON	Poaceae		Handsome lovegrass					D			395
Eragrostis xerophila	MON	Poaceae		Knotty-butt neverfail					D			399
Eremophila glabra subsp. chlorella	DIC	Scrophulariaceae			R	CR	*			SW	146a	17150
Eremophila lactea	DIC	Scrophulariaceae			R	CR	E*			SW		7229
Eremophila spongiocarpa	DIC	Scrophulariaceae			1				D		7bc	17363
Eremophila youngii subsp. lepidota	DIC	Scrophulariaceae			4				D		75a	16040
Eriachne benthamii	MON	Poaceae		Swamp wanderrie grass, swamp grass, swamp wanderrie					D		73b, 77, 78	403
Eriachne festucacea	MON	Poaceae		Wanderrie grass, plains wandarrie grass				K				407
Eriachne flaccida	MON	Poaceae		Claypan grass					D			408
Eriachne obtusa	MON	Poaceae		Northern wandarrie grass					D			414
Eriocaulon setaceum	MON	Eriocaulaceae		Water pincushions				K	D		46a	1160
Eryngium ferox ms	DIC	Apiaceae		Spiky devil	3					SW	116c	19602

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Eryngium pinnatifidum subsp. palustre ms	DIC	Apiaceae		Swamp devil	3					SW	116a, 116b	14553
Eryngium subdecumbens ms	DIC	Apiaceae		Prickly swamp devil	3					SW		14720
Erythrina vespertilio	DIC	Fabaceae		Yulbah					D			3871
Erythrophleum chlorostachys	DIC	Fabaceae		Ironwood				K				3662
Eucalyptus camaldulensis	DIC	Myrtaceae		River gum				K	D	SW	38a, 38b, 60c, 68a	5580
Eucalyptus clelandii	DIC	Myrtaceae		Cleland's blackbutt					D			5592
Eucalyptus coolabah	DIC	Myrtaceae		Coolibah					D			5603
Eucalyptus decipiens	DIC	Myrtaceae								SW	125a	5615
Eucalyptus dolorosa	DIC	Myrtaceae			R	CR	E*			SW		13546
Eucalyptus foecunda	DIC	Myrtaceae		Fremantle mallee, narrow-leaved red mallee						SW		5649
Eucalyptus gomphocephala	DIC	Myrtaceae		Tuart						SW	6a, 11, 23, 98, 154a, 159a	5659
Eucalyptus kondininensis	DIC	Myrtaceae		Kondinin blackbutt						SW		5686
Eucalyptus lesouefii	DIC	Myrtaceae		Goldfields blackbutt					D			5697
Eucalyptus loxophleba	DIC	Myrtaceae		York gum						SW		5702
Eucalyptus microtheca	DIC	Myrtaceae		Coolibah				K	D			5714
Eucalyptus occidentalis	DIC	Myrtaceae		Yate, flat-topped yate						SW		5723
Eucalyptus orthostemon	DIC	Myrtaceae								SW		20047
Eucalyptus rudis	DIC	Myrtaceae		Flooded gum						SW		5763
Eucalyptus rudis subsp. cratyantha	DIC	Myrtaceae		Swamp flooded gum	4					SW		13512
Eucalyptus salicola	DIC	Myrtaceae		Salt gum						SW		12693
Eucalyptus sargentii	DIC	Myrtaceae		Salt river gum						SW		5768
Eucalyptus striaticalyx	DIC	Myrtaceae		Cue york gum					D		60b	5779
Eucalyptus tectifica	DIC	Myrtaceae		Darwin box				K				5785
Eucalyptus victrix	DIC	Myrtaceae		Coolibah					D		20c, 67a, 78	14548
Eucalyptus wandoo	DIC	Myrtaceae		Wandoo						SW	32a	5797
Euchilopsis linearis	DIC	Fabaceae		Swamp pea						SW	101c	3872
Eulalia aurea	MON	Poaceae		Silky browntop					D			11011

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Evandra aristata	MON	Cyperaceae		Graceful evandra						SW		834
Ficinia nodosa	MON	Cyperaceae		Knotted club rush						SW		20216
Ficus brachypoda	DIC	Moraceae							D			19648
Ficus racemosa	DIC	Moraceae		Stem-fruit fig				K				1755
Ficus virens	DIC	Moraceae		Albayi				K				1759
Fimbristylis caespitosa	MON	Cyperaceae						K			56c, 56d	841
Fimbristylis ferruginea	MON	Cyperaceae							D			855
Fimbristylis velata	MON	Cyperaceae		Fimbristylis						SW		894
Flaveria australasica subsp. gilgai	DIC	Asteraceae	N						D		81b	33621
Frankenia cinerea	DIC	Frankeniaceae							D		61a	5191
Frankenia parvula	DIC	Frankeniaceae		Short-leaved frankenia	R	E	E			SW		5208
Frankenia pauciflora	DIC	Frankeniaceae		Seaheath						SW		5209
Fuirena ciliaris	MON	Cyperaceae						K				896
Gahnia trifida	MON	Cyperaceae		Coast saw-sedge						SW	22, 88a, 136a, 136b, 155b, 161b	907
Gardenia megasperma	DIC	Rubiaceae		Wild gardenia				K				7327
Gastrolobium ebracteolatum	DIC	Fabaceae		River gastrolobium						SW	150a, 150b	20473
Gastrolobium papilio	DIC	Fabaceae		Butterfly gastrolobium	R	CR	E*			SW		20509
Gastrolobium sp. Harvey (G.J. Keighery 16821) PN	DIC	Fabaceae			2					SW	150c, 150d	30295
Glossostigma diandrum	DIC	Phrymaceae		Mudmat						SW	117b	7060
Glossostigma drummondii	DIC	Phrymaceae		Mudmat						SW		7061
Glossostigma spp.	DIC	Phrymaceae							D	SW		-21404
Glyceria drummondii	MON	Poaceae		Nangetty grass	R	E	E			SW		436
Glycyrrhiza acanthocarpa	DIC	Fabaceae		Native liquorice						SW		3943
Goodenia viscida	DIC	Goodeniaceae		Viscid goodenia						SW		7562
Grevillea curviloba	DIC	Proteaceae								SW		1984
Grevillea curviloba subsp. curviloba	DIC	Proteaceae		Freeway grevillea	R	CR	E*			SW		14408
Grevillea curviloba subsp. incurva	DIC	Proteaceae		Freeway grevillea	R	E	E			SW		14409

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Grevillea elongata	DIC	Proteaceae		White ironstone grevillea	R	E	V*			SW		14526
Grevillea maccutcheonii	DIC	Proteaceae		Maccutcheon's grevillea	R	CR	E*			SW		17112
Grevillea obtusifolia	DIC	Proteaceae		Obtuse leaved grevillea, blunt-leaved grevillea						SW	151a	8836
Grevillea sp. Gillingarra (R.J. Cranfield 4087) PN	DIC	Proteaceae								SW	151c	31354
Grevillea thelemanniana subsp. Coojarloo (B.J. Keighery 28 B) PN	DIC	Proteaceae			1					SW	151b	31353
Haemodorum simplex	MON	Haemodoraceae		Haemodorum						SW	109a	1472
Hakea ceratophylla	DIC	Proteaceae		Horned leaf hakea						SW		2137
Hakea lasiocarpha	DIC	Proteaceae			3					SW		12229
Hakea oldfieldii	DIC	Proteaceae		Oldfield's hakea	3					SW	122c, 122d	2190
Hakea tuberculata	DIC	Proteaceae			3					SW		16640
Hakea varia	DIC	Proteaceae		Variable-leaved hakea						SW	165a, 165b	2216
Haloragis platycarpa	DIC	Haloragaceae			R	CR	CR			SW		6177
Heliotropium sp.	DIC	Boraginaceae							D			-20828
Hemiandra sp. Ironstone (B.J. Keighery & N. Gibson 614) PN	DIC	Lamiaceae		Ironstone snakebush						SW		-21245
Hemichroa diandra	DIC	Amaranthaceae		Hemichroa						SW	157c, 157d	2688
Heteropogon contortus	MON	Poaceae		Spear grass, bunch speargrass				K				443
Hibbertia perfoliata	DIC	Dilleniaceae								SW		5154
Hibbertia stellaris	DIC	Dilleniaceae		Orange stars, swamp hibbertia						SW	152	5172
Homalospermum firmum	DIC	Myrtaceae								SW		5816
Hopkinsia anoectocolea	MON	Anarthriaceae			3					SW		17742
Hyalosperma cotula	DIC	Asteraceae		Hyalosperma						SW	30b, 109	12741
Hydrocotyle lemnoides	DIC	Araliaceae		Aquatic pennywort	4					SW	5c	6233
Hydrocotyle tetragonocarpa	DIC	Araliaceae		Pennywort						SW	156c	6241
Hypocalymma angustifolium	DIC	Myrtaceae		White myrtle						SW	9	5817
Hypolaena exsulca	MON	Restionaceae		Common hypolaena						SW		1070
Hypoxis occidentalis	MON	Hypoxidaceae		Yellow star						SW	114b	1503
Ischaemum albovillosum	MON	Poaceae		Tableland white grass					D			12663

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Isoetes drummondii	FER	Isoetaceae		Quillwort, isoetes						SW	14, 130b	11
Isolepis cernua	MON	Cyperaceae		Nodding club-rush						SW	113b	910
Isolepis cernua var. cernua	MON	Cyperaceae								SW	157b	20199
Isopogon formosus subsp. dasylepis	DIC	Proteaceae		Rose coneflower	3					SW	123d	16522
Isotoma pusilla	DIC	Campanulaceae		Small isotome						SW	117d	7398
Isotoma scapigera	DIC	Campanulaceae		Long-scaped isotome						SW	118a	7399
Isotropis cuneifolia subsp. glabra	DIC	Fabaceae		Swamp granny's bonnets	2					SW		16317
Jacksonia gracillima	DIC	Fabaceae		Swamp jacksonia	3					SW	147d, 147e	20462
Juncus kraussii subsp. australiensis	MON	Juncaceae		Salt rush						SW	23, 90, 159a	11922
Juncus pallidus	MON	Juncaceae		Giant rush, pale rush						SW	97	1188
Kennedia coccinea	DIC	Fabaceae		Coral vine, coral kennedia						SW	161c	4037
Kippistia suaedifolia	DIC	Asteraceae							D	SW	93b	8094
Kunzea aff. micrantha	DIC	Myrtaceae								SW		-21275
Kunzea limnicola	DIC	Myrtaceae	N							SW	27a	-20122
Kunzea micrantha	DIC	Myrtaceae		Clay kunzea						SW		5835
Kunzea recurva	DIC	Myrtaceae		Purple swamp kunzea						SW	27a, 121	5841
Labichea lanceolata	DIC	Fabaceae		Tall labichea						SW		3667
Lambertia echinata subsp. occidentalis	DIC	Proteaceae		Ironstone lambertia	R	CR	E*			SW	123c	17734
Lambertia orbifolia subsp. Scott River Plains (L.W. Sage 684) PN	DIC	Proteaceae			R	E	E			SW		19186
Lawrencia glomerata	DIC	Malvaceae								SW		4955
Lawrencia squamata	DIC	Malvaceae		Lawrencia					D	SW	93c, 93d	4959
Lepidosperma gladiatum	MON	Cyperaceae		Coast sword-sedge						SW	90, 161a	933
Lepidosperma longitudinale	MON	Cyperaceae		Pithy sword-sedge, swamp swordsedge						SW		937
Lepidosperma rostratum	MON	Cyperaceae			R	E	E			SW		942
Lepilaena bilocularis	MON	Potamogetonaceae		Water mat					D			119
Leptochloa fusca	MON	Poaceae		Brown beetle grass				K	D			19061
Leptomeria ellytes	DIC	Santalaceae		Currant bush						SW	167b, 167c	17703
Lepyrodia monoica	MON	Restionaceae		Lepyrodia						SW		1089
Lindernia sp.	DIC	Linderniaceae						K			50d	-21422

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Livistona alfredii	MON	Arecaceae		Millstream palm, millstream fan-palm	4				D		20b, 79	1039
Livistonia sp.	MON	Arecaceae							D			-20833
Lobelia quadrangularis	DIC	Campanulaceae							D			7404
Lophostemon grandiflorus	DIC	Myrtaceae						K				5859
Loxocarya magna	MON	Restionaceae		Tall ironstone loxocarya	3					SW		13779
Loxocarya striata subsp. implexa	MON	Restionaceae		Tangled ironstone loxocarya						SW		-21148
Lycopodiella serpentina	FER	Lycopodiaceae		Clubmoss						SW		12783
Maireana aphylla	DIC	Chenopodiaceae		Spiny bluebush, cotton bush					D			2534
Maireana platycarpa	DIC	Chenopodiaceae		Shy bluebush					D			2557
Maireana polypterygia	DIC	Chenopodiaceae		Gascoyne bluebush					D			2558
Maireana pyramidata	DIC	Chenopodiaceae		Sago bush					D			2560
Marsilea drummondii	FER	Marsileaceae		Common nardoo, nardoo						SW	16	74
Marsilea sp.	FER	Marsileaceae						K	D	SW	77	-20834
Meeboldina cana	MON	Restionaceae		Meeboldina						SW	24a, 105a, 112	17683
Meeboldina coangustata	MON	Restionaceae		Meeboldina						SW		17679
Meeboldina scariosa	MON	Restionaceae		Meeboldina						SW		17694
Melaleuca acuminata	DIC	Myrtaceae								SW		5869
Melaleuca alsophila	DIC	Myrtaceae						K	D			9178
Melaleuca argentea	DIC	Myrtaceae		Cadjeput, silver cadjeput				K	D		37	5875
Melaleuca atroviridis	DIC	Myrtaceae								SW	120a	20284
Melaleuca bracteata	DIC	Myrtaceae		River teatree					D			5879
Melaleuca brevifolia	DIC	Myrtaceae		Swamp melaleuca						SW		5881
Melaleuca brophyi	DIC	Myrtaceae								SW		18527
Melaleuca cajuputi	DIC	Myrtaceae						K	D			5883
Melaleuca croxfordiae	DIC	Myrtaceae								SW		18184
Melaleuca cuticularis	DIC	Myrtaceae		Saltwater paperbark						SW	2, 3, 23, 26a, 154a, 159a, 160	5900
Melaleuca densa	DIC	Myrtaceae								SW		5902
Melaleuca glomerata	DIC	Myrtaceae							D			5915

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Melaleuca halmaturorum	DIC	Myrtaceae								SW		5916
Melaleuca hamata	DIC	Myrtaceae								SW		19486
Melaleuca huegelii	DIC	Myrtaceae		Chenille honeymyrtle						SW		5920
Melaleuca incana	DIC	Myrtaceae		Grey honeymyrtle						SW	164a, 164b, 167a	5921
Melaleuca incana subsp. incana	DIC	Myrtaceae		Grey honeymyrtle						SW		13273
Melaleuca interioris	DIC	Myrtaceae							D			20288
Melaleuca lanceolata	DIC	Myrtaceae		Rottnest teatree						SW	22, 25a, 87, 162a, 162b	5922
Melaleuca lasiandra	DIC	Myrtaceae						K	D		68b	5923
Melaleuca lateriflora	DIC	Myrtaceae		Gorada						SW		5925
Melaleuca lateritia	DIC	Myrtaceae		Robin redbreast bush						SW	24, 30a, 107a	5926
Melaleuca leucadendra	DIC	Myrtaceae						K	D			5932
Melaleuca linophylla	DIC	Myrtaceae							D			5933
Melaleuca nervosa	DIC	Myrtaceae		Fibrebark				K	D			5942
Melaleuca osullivanii	DIC	Myrtaceae		O'sullivan's melaleuca						SW		20297
Melaleuca preissiana	DIC	Myrtaceae		Moonah, preiss's paperbark						SW	1b, 8a, 20a, 21a, 97, 100a	5952
Melaleuca rhaphiophylla	DIC	Myrtaceae		Swamp paperbark, freshwater paperbark						SW	1a, 4, 5a, 11a, 98, 161a	5959
Melaleuca scabra	DIC	Myrtaceae		Rough honeymyrtle						SW	8c, 110	5961
Melaleuca scalena	DIC	Myrtaceae								SW		20290
Melaleuca sp. Kemerton (B.J. Keighery 2907) PN	DIC	Myrtaceae								SW	125a, 125b	-21264
Melaleuca spp.	DIC	Myrtaceae						K	D	SW		-20996
Melaleuca strobophylla	DIC	Myrtaceae								SW		5972
Melaleuca systena (unnamed variant)	DIC	Myrtaceae								SW		-21418
Melaleuca teretifolia	DIC	Myrtaceae		Banbar, swamp honeymyrtle						SW		5978
Melaleuca thyoides	DIC	Myrtaceae		Scale-leaved honeymyrtle						SW		5981

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Melaleuca viminea	DIC	Myrtaceae		Mohan						SW	32a, 105a, 120a, 121, 126, 127a, 163a, 163b, 164a, 167a	5987
Melaleuca viridiflora	DIC	Myrtaceae		Broadleaf paperbark				K			53	5989
Melaleuca xerophila	DIC	Myrtaceae							D	SW		5991
Melicope elleryana	DIC	Rutaceae						K				12361
Mesomelaena tetragona	MON	Cyperaceae		Large semaphore sedge, semaphore sedge						SW		957
Meziella trifida	DIC	Haloragaceae			R	V	V			SW		6184
Mimulus gracilis	DIC	Phrymaceae							D		66a	7082
Mimulus uvedaliae	DIC	Phrymaceae							D			13721
Montia australasica	DIC	Portulacaceae		Montia	2					SW		2874
Muehlenbeckia adpressa	DIC	Polygonaceae		Climbing lignum, muehlenbeckia						SW	98	2412
Muehlenbeckia florulenta	DIC	Polygonaceae		Lignum					D	SW	61c	16982
Muehlenbeckia horrida subsp. abdita	DIC	Polygonaceae		Lignum	R	E	CR*			SW		17050
Muellerolimon salicorniaceum	DIC	Plumbaginaceae		Mueller's native statice					D	SW	33, 72, 73a	6490
Myoporum turbinatum	DIC	Scrophulariaceae		Salt myoporum	R	CR	E*			SW		7296
Myriocephalus helichrysoides	DIC	Asteraceae		Woolly-heads						SW		8117
Myriocephalus oldfieldii	DIC	Asteraceae							D		31	17925
Myriocephalus rudallii	DIC	Asteraceae							D		67b, 83c	8121
Myriocephalus sp.	DIC	Asteraceae							D			-21290
Myriophyllum balladoniense	DIC	Haloragaceae			4					SW		6186
Myriophyllum crispatum	DIC	Haloragaceae		Myriophyllum						SW	145a, 145b	6189
Myriophyllum lapidicola	DIC	Haloragaceae			R	V	E*			SW		13082
Myriophyllum petraeum	DIC	Haloragaceae		Granite myriophyllum	4					SW		6197
Myriophyllum verrucosum	DIC	Haloragaceae		Red water milfoil					D			6201
Najas marina	MON	Hydrocharitaceae		Prickly water nymph					D			138
Nauclea orientalis	DIC	Rubiaceae		Leichardt pine				K				7337
Nesaea muelleri	DIC	Lythraceae							D			12369

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Nicotiana heterantha	DIC	Solanaceae			1				D			14817
Nymphaea hastifolia	DIC	Nymphaeaceae						K			44a, 44b	13915
Nymphaea ondinea subsp. ondinea	DIC	Nymphaeaceae						K				36377
Nymphaea ondinea subsp. petaloidea	DIC	Nymphaeaceae			1			K				36378
Nymphaea violacea	DIC	Nymphaeaceae						K			44c	13916
Nymphoides aurantiaca	DIC	Menyanthaceae		Marshwort				K			45a, 45b	6545
Nymphoides beaglensis	DIC	Menyanthaceae			2			K				6546
Nymphoides crenata	DIC	Menyanthaceae		Wavy marshwort				K	D		46c	6547
Nymphoides indica	DIC	Menyanthaceae		Marshwort				K	D		46b	6549
Oldenlandia sp. nov.	DIC	Rubiaceae							D			-21385
Opercularia vaginata	DIC	Rubiaceae		Dog weed, opercularia						SW		18255
Ornduffia spp.	DIC	Menyanthaceae						K		SW		-21432
Ornduffia submersa	DIC	Menyanthaceae			4					SW	115	36200
Oryza spp.	MON	Poaceae		Native rice				K				-21360
Ottelia ovalifolia	MON	Hydrocharitaceae		Swamp lily						SW	143	168
Oxalis sp. Greenough (G.J. Keighery & B.J. Keighery 1566) PN	DIC	Oxalidaceae								SW		-21401
Pandanus aquaticus	MON	Pandanaceae						K			40	100
Pandanus spiralis	MON	Pandanaceae		Screwpine				K			55a	104
Pandanus spiralis var. flammeus	MON	Pandanaceae		Edgar range pandanus	R	E	E	K				11511
Patersonia occidentalis var. angustifolia	MON	Iridaceae		Swamp flag						SW	13c, 13d	30471
Peplidium sp. fortescue marsh (S. van Leeuwen 4865) PN	DIC	Phrymaceae			1				D			20810
Pericalymma ellipticum	DIC	Myrtaceae		Swamp teatree						SW	100a	6006
Petrophile latericola	DIC	Proteaceae		Ironstone petrophile	R	CR	E*			SW	123a, 123b	14085
Phragmites karka	MON	Poaceae		Tropical reed	3			K	D			556
Pilularia novae-hollandiae	FER	Marsileaceae		Austral pillwort						SW	17, 130a	78
Pimelea imbricata var. major	DIC	Thymelaeaceae		Swamp banjine						SW	109a	11404
Podolepis capillaris	DIC	Asteraceae		Wiry podolepis						SW		8173

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Pogonolepis stricta	DIC	Asteraceae		Pogonolepis						SW	92b	8188
Potamogeton crispus	MON	Potamogetonaceae		Curly pondweed					D			109
Potamogeton tricarinatus	MON	Potamogetonaceae		Floating pondweed					D			113
Pteridium esculentum	FER	Dennstaedtiaceae		Bracken						SW		57
Pteris vittata	FER	Pteridaceae		Chinese brake				K	D			45
Pterostylis sp. Northampton (S.D. Hopper 3349) PN	MON	Orchidaceae			R	CR	E*			SW		13868
Ptilotus polakii	DIC	Amaranthaceae							D			2750
Puccinellia stricta	MON	Poaceae		Marsh grass						SW		592
Reedia spathacea	MON	Cyperaceae			R	E	CR*			SW		958
Regelia ciliata	DIC	Myrtaceae		Mouse plant						SW		6012
Regelia inops	DIC	Myrtaceae		Mouse plant						SW		6014
Rhagodia eremaea	DIC	Chenopodiaceae		Tall saltbush, thorny saltbush					D			2582
Rhodanthe manglesii	DIC	Asteraceae		Mangles's rhodanthe						SW	121	13234
Rhodanthe pyrethrum	DIC	Asteraceae		Claypan rhodanthe	3					SW	117c	13312
Ricinocarpos trichophorus	DIC	Euphorbiaceae			R	V	E*			SW		4702
Roycea pycnophylloides	DIC	Chenopodiaceae		Saltmat	R	V	E*			SW		2588
Ruppia polycarpa	MON	Ruppiaceae		Ruppia					D			116
Ruppia tuberosa	MON	Ruppiaceae		Ruppia					D	SW		117
Salsola australis	DIC	Chenopodiaceae							D		76, 85	30434
Samolus junceus	DIC	Primulaceae		Reed samolus					D			6483
Samolus repens var. paucifolius	DIC	Primulaceae								SW	89b, 158	14107
Samolus sp. Clay Flats (G.J. & B.J. Keighery 718) PN	DIC	Primulaceae		Clay samolus						SW		29911
Sarcocornia quinqueflora	DIC	Chenopodiaceae		Beaded samphire						SW	154a	2593
Scaevola collaris	DIC	Goodeniaceae							D		65c	7604
Scaevola spinescens	DIC	Goodeniaceae		Currant bush					D			7644
Schoenolaena sp.	DIC	Apiaceae								SW		-21420
Schoenoplectus litoralis	MON	Cyperaceae							D			965
Schoenoplectus subulatus	MON	Cyperaceae							D			16257

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Schoenoplectus validus	MON	Cyperaceae		Lake club-rush						SW		969
Schoenus falcatus	MON	Cyperaceae						K			55a, 55b	989
Schoenus natans	MON	Cyperaceae		Floating schoenus, floating bog-rush	4					SW	115	1003
Schoenus plumosus	MON	Cyperaceae		Schoenus						SW		17614
Schoenus tenellus	MON	Cyperaceae		Schoenus						SW	113b	1023
Sclerolaena bicornis	DIC	Chenopodiaceae		Goathead burr					D		76	2597
Sesbania cannabina	DIC	Fabaceae		Sesbania pea				K	D			4196
Sesbania erubescens	DIC	Fabaceae						K			51	4197
Sesbania formosa	DIC	Fabaceae		White dragon tree				K	D		38c, 38d	4198
Sida trichopoda	DIC	Malvaceae							D			16923
Sonchus hydrophilus	DIC	Asteraceae		Native sowthistle					D	SW	159b	9367
Sorghum plumosum	MON	Poaceae		Sorghum, plume canegrass					D		21b, 80	619
Spermacoce sp.	DIC	Rubiaceae						K			50e	-21435
Sphagnum novozelandicum	MOS	Sphagnaceae			2					SW		30807
Sporobolus mitchellii	MON	Poaceae		Ratstail couch					D			633
Sporobolus virginicus	MON	Poaceae		Native couch, marine couch, salt couch				K	D	SW	42	635
Spyridium globulosum	DIC	Rhamnaceae		Basket bush						SW		4828
Stemodia florulenta	DIC	Plantaginaceae								SW		12487
Stylidium adenophorum	DIC	Stylidiaceae							D			17445
Stylidium brunonianum	DIC	Stylidiaceae		Pink fountain triggerplant						SW	100a, 100b	7693
Stylidium ceratophorum	DIC	Stylidiaceae						K			50c	7700
Stylidium divaricatum	DIC	Stylidiaceae		Daddy-long-legs						SW	108	7717
Stylidium ferricola	DIC	Stylidiaceae			1					SW		31872
Stylidium fissilobum	DIC	Stylidiaceae							D			7726
Stylidium fluminense	DIC	Stylidiaceae						K	D			7729
Stylidium inaequipetalum	DIC	Stylidiaceae							D		66c	7739
Stylidium leptorrhizum	DIC	Stylidiaceae							D			7750
Stylidium longitubum	DIC	Stylidiaceae		Jumping jacks	3					SW	21d, 30b, 107a	7756
Stylidium schizanthum	DIC	Stylidiaceae							D			7797
Stylidium spp.	DIC	Stylidiaceae							D	SW		-20795

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Stylidium weeliwolli	DIC	Stylidiaceae			2				D			18123
Syzygium angophoroides	DIC	Myrtaceae						K				6042
Taxandria juniperina	DIC	Myrtaceae		River peppermint						SW		20115
Taxandria linearifolia	DIC	Myrtaceae		Creek peppermint						SW		20135
Tecticornia arborea	DIC	Chenopodiaceae		Bulli bulli					D			2641
Tecticornia auriculata	DIC	Chenopodiaceae							D		72, 74a	31616
Tecticornia bibenda	DIC	Chenopodiaceae			3				D			31677
Tecticornia bulbosa	DIC	Chenopodiaceae		Large-articled samphire	R	V	V			SW		31617
Tecticornia calyptrata	DIC	Chenopodiaceae							D		70a	31917
Tecticornia chartacea	DIC	Chenopodiaceae							D		70c	31719
Tecticornia doleiformis	DIC	Chenopodiaceae		Samphire					D			31918
Tecticornia flabelliformis	DIC	Chenopodiaceae			1				D			31834
Tecticornia halocnemoides	DIC	Chenopodiaceae		Shrubby samphire					D	SW	22	33236
Tecticornia indica	DIC	Chenopodiaceae							D	SW	22	33317
Tecticornia indica subsp. bidens	DIC	Chenopodiaceae		Samphire					D			33319
Tecticornia indica subsp. leiostachya	DIC	Chenopodiaceae		Samphire					D			33318
Tecticornia pergranulata	DIC	Chenopodiaceae								SW	72	33296
Tecticornia pergranulata subsp. pergranulata	DIC	Chenopodiaceae		Blackseed samphire					D			33297
Tecticornia sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063) PN	DIC	Chenopodiaceae			1				D			34177
Tecticornia sp. Fortescue Marsh (K.A. Shepherd et al. KS 1055) PN	DIC	Chenopodiaceae			1				D			31842
Tecticornia sp. Roy Hill (H. Pringle 62) PN	DIC	Chenopodiaceae			3				D			31843
Tecticornia spp.	DIC	Chenopodiaceae						K	D			-21369
Tecticornia syncarpa	DIC	Chenopodiaceae		Samphire						SW		31716
Tecticornia triandra	DIC	Chenopodiaceae		Desert glasswort					D			31494
Tecticornia undulata	DIC	Chenopodiaceae							D	SW	72	31717
Tecticornia uniflora	DIC	Chenopodiaceae		Mat samphire	4					SW		31493

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Tecticornia verrucosa	DIC	Chenopodiaceae							D	SW		2642
Templetonia retusa	DIC	Fabaceae		Cockies tongues						SW		4256
Terminalia canescens	DIC	Combretaceae		Joolal				K				5300
Thelymitra antennifera	MON	Orchidaceae		Vanilla orchid, lemon-scented sun orchid						SW	32c	1701
Themeda triandra	MON	Poaceae		Kangaroo grass					D			673
Thomasia triphylla	DIC	Malvaceae		Thomasia						SW		5105
Thysanotus chinensis	MON	Asparagaceae							D			1326
Timonius timon	DIC	Rubiaceae						K				7364
Trachymene pilosa	DIC	Araliaceae		Small laceflower, native parsnip						SW		6280
Trianthema oxycalyptra	DIC	Aizoaceae		Star pigweed					D			2827
Trianthema triquetra	DIC	Aizoaceae		Red spinach					D			2832
Tribonanthes aff. longipetala	MON	Haemodoraceae								SW	131	-21431
Tribonanthes purpurea	MON	Haemodoraceae		Granite pink	R	V	V			SW		1484
Tribonanthes uniflora	MON	Haemodoraceae	N	Tribonanthes						SW	114	8798
Trichanthodium exile	DIC	Asteraceae								SW		12650
Triglochin mucronata	MON	Juncaginaceae		Triglochin						SW	157b	147
Triglochin muelleri	MON	Juncaginaceae		Mueller's triglochin						SW		148
Triglochin striata	MON	Juncaginaceae		Triglochin						SW		151
Triodia pungens	MON	Poaceae		Soft spinifex					D			696
Triraphis mollis	MON	Poaceae		Needle grass				K				706
Trithuria occidentalis	MON	Hydatellaceae		Swan hydatella	R	CR	E*			SW		32658
Trithuria submersa	MON	Hydatellaceae		Trithuria						SW	30c	1141
Typha domingensis	MON	Typhaceae		Bulrush, native bulrush					D	SW		98
Typha sp.	MON	Typhaceae						K				-21357
Utricularia chrysantha	DIC	Lentibulariaceae		Sun bladderwort				K			50g	7130
Utricularia fulva	DIC	Lentibulariaceae						K			50f	-21424
Utricularia gibba	DIC	Lentibulariaceae		Yellowcoats					D			12493
Utricularia menziesii	DIC	Lentibulariaceae		Redcoats						SW	129a, 129b	7145
Utricularia multifida	DIC	Lentibulariaceae		Pink petticoats						SW	32a, 120a, 126	7148

Scientific plant name	Supra code	Family name	Current	Common names	Listed conservation taxa			Wetland zone			Figure no.	Name ID
					Consv code	WA IUCN rank	EPBC rank	K	D	SW		
Utricularia volubilis	DIC	Lentibulariaceae		Twining bladderwort						SW		7158
Utricularia westonii	DIC	Lentibulariaceae								SW		7159
Verticordia chrysantha	DIC	Myrtaceae		Yellow featherflower						SW	8b, 108	6073
Verticordia huegelii	DIC	Myrtaceae		Variegated featherflower						SW	8b, 108	6088
Verticordia plumosa var. pleiobotrya	DIC	Myrtaceae		Mundijong featherflower	R	V	E			SW	8b, 106a, 106b, 108	12452
Verticordia spp.	DIC	Myrtaceae								SW		-21439
Viminaria juncea	DIC	Fabaceae		Swishbush						SW	24a, 109a, 111a, 111b, 125	4325
Wahlenbergia queenslandica	DIC	Campanulaceae							D			7390
Whiteochloa cymbiformis	MON	Poaceae							D			728
Wilsonia backhousei	DIC	Convolvulaceae		Narrow-leaf wilsonia						SW	154a, 156b	6658
Wilsonia humilis	DIC	Convolvulaceae		Silky wilsonia						SW	89a	6659
Wurmbea dioica subsp. alba	MON	Colchicaceae		Early nancy						SW		12072
Wurmbea dioica subsp. Brixton (G.J. Keighery 12803) PN	MON	Colchicaceae	N	Swamp wurmbea						SW	120a, 120b	-20194
Wurmbea monantha	MON	Colchicaceae		Wurmbea						SW		1398
Wurmbea saccata	MON	Colchicaceae			3				D			16813
Wurmbea tubulosa	MON	Colchicaceae		Long-flowered nancy	R	V	E*			SW		1404
Xanthorrhoea brunonis	MON	Xanthorrhoeaceae		Squat balga						SW	100a	1251
Xanthorrhoea preissii	MON	Xanthorrhoeaceae		Balga, grass tree						SW	6, 10	1256
Xerochloa barbata	MON	Poaceae		Rice grass				K				729
Xerochloa laniflora	MON	Poaceae		Rice grass				K				731
Xyris complanata	MON	Xyridaceae						K			57	1142
Xyris exilis	MON	Xyridaceae			R	E	V*			SW		17482
Xyris lanata	MON	Xyridaceae								SW	135a, 135b	1150
Xyris maxima	MON	Xyridaceae			2					SW		17481
Zygophyllum simile	DIC	Zygophyllaceae		Little twinleaf					D			12359

Key to Appendix 2.

Native wetland vascular plant taxa of the Southern Swan Coastal Plain (Moore River–Dunsborough) referred to in this topic, or otherwise common to the region.

Column 1	**Scientific plant name**	
	Genus + species + infra species rank + infra species name + informal name. Some taxa yet to be formally described and named may have a reference collection number from the relevant collector. Taxa (genera, species, subspecies and varieties) are listed alphabetically within families. Names follow Western Australian Herbarium[81] except for those indicated as not having a current name (see column 4)	
	subsp.	Subspecies
	var.	Variety
	ms	A manuscript name yet to be published
	PN	A phrase name for a taxon yet to be described and published.
Column 2	**Supra code**	
	Indicates broad supra-family classification.	
	FER	Ferns
	GYM	Gymnosperms
	MON	Monocotyledons
	DIC	Dicotyledons
Column 3	**Family name**	
Column 4	**Current**	
	Scientific plant names are current (Western Australian Herbarium[81]) unless indicated with 'N'. In these cases, the authors prefer to use the names chosen.	
Column 5	**Endemic (state)**	
	Sources for common names are the Western Australian Herbarium[81] and others as applied in references for this section.	
Column 6	**Growth form 1** (See key to growth forms at the end of this key for definitions)	
	Woody plants	
	T	Tree
	M	Mallee
	SH/T	Shrub/tree
	SH	Shrub
	SH-H	Shrub which is often called a herb
	Non-woody plants: non-grass-like	
	H	Herb
	H-SH	Herb which is often called a shrub
	Non-woody plants: grass-like	
	G	Grass
	S-C	Sedge – Cyperaceae and others
	S-R	Sedge – Restionaceae
	S-J	Sedge – Juncaceae and others

Column 7	**Growth form 2** (See key to growth forms at the end of this key for definitions)	
	CL	Climber
	PR	Prostrate

Column 8	**Life form**	
	A	Annual
	A2	Biennial
	P	Perennial
	PAA	Perennial annually renewed from above ground part
	PAB	Perennial annually renewed from below ground part
	A-PAR	Annual – parasite or semi-parasite
	P-PAR	Perennial – parasite or semi-parasite

Column 9	**Life form aquatic**	
	AQD	Aquatic – damp flowering. Grows in water, flowers in damp mud
	AQE	Aquatic – emergent. Grows and flowers in water with some parts emergent above water (e.g. leaves, flowers)
	AQF	Aquatic – floating. Whole plant floats on water
	AQS	Aquatic – supported. Grows and flowers in water with most parts supported by water (e.g. leaves); flowers may be emergent above water

Column 10	**Common SSWA wetland species**
	From an analysis of more than 1,000 plots on the southern Swan Coastal Plain, there were 166 most commonly encountered wetland species (150 native species). Commonly encountered species were determined to be those that occurred in ten or more plots of wetland floristic community types 75 per cent or more of the time.

Column 11	**Name ID**
	Positive name IDs are from the Census of Western Australian Plants (Western Australian Herbarium[11, 81])

Key to growth form defintions

Definitions adapted from BJ Keighery[3], McDonald et al.[110] and Executive Steering Committee for Australian Vegetation Information[111]

Growth form 1

Woody plants

Plants with special thick-walled cells in their trunks and stems that form wood to support the plant. Trees are able to build up layer upon layer of this woody support tissue to form trunks and branches. All woody plants are perennial.

Tree	Plants with a single trunk and a canopy. The canopy is less than or equal to two-thirds of the height of the trunk. No lignotuber is evident.
Shrub/tree	Shrub or tree
Mallee	Plants with many trunks (usually 2–5) arising from a lignotuber. The canopy is usually well above the base of the plant. Most are from the genus *Eucalyptus*.
Shrub-herb	Shrub that appears herb-like. Plants with a woody stem/s that is lax enough to give the shrub a non-woody herb-like appearance, often called sub-shrubs.

Non-woody plants

Plants with no (or insufficient) special thick-walled support cells in their stems to form wood for support. May be either annuals or perennials. Sub-divided according to growth form, pollination method and plant family.

Non-woody plants – non grass-like

Generally not pollinated by wind; monocots and dicots

Herb	Plants with non-woody stems that are not grasses or sedges. Generally under half a metre tall. Most monocots are herbs except for the larger ones which are classed as shrubs such as palms, grass trees (*Xanthorrhoea* and *Kingia* species) and cycads (*Zamia* species).
Herb-shrub	Herb that appears shrub-like. Plants with non-woody stems that are stiff enough to give the herb a woody shrub-like appearance, often called sub-shrubs.

Non-woody plants – grass-like

Generally pollinated by wind; from the families Poaceae, Cyperaceae, Centrolepidaceae, Hydatellaceae, Juncaginaceae, Restionaceae, Juncaceae, Typhaceae or Xyridaceae

Grasses	Leaf sheath always split, ligule present, leaf usually flat, stem cross-section circular, evenly spaced internodes.
Grass	Tufted or spreading plants from the family Poaceae. Some species form hummocks but none of these occur in south-west WA.
Sedges	Leaf sheath never split (except in some Restionaceae), usually no ligule, leaf not always flat, extended internode below inflorescence.
Sedge – Cyperaceae and others	Tufted or spreading plants from the families Cyperaceae, Centrolepidaceae, Hydatellaceae or Juncaginaceae.
Sedge – Restionaceae	Tufted or spreading plants from the family Restionaceae. Commonly called rushes.
Sedge – Juncaceae and others	Tufted or spreading plants from the families Juncaceae, Typhaceae or Xyridaceae. Some of these are also called rushes.

Growth form 2

Climber	Plants in need of other plants or objects for support.
Prostrate	Spreading plants, often supported by the ground.

Appendix 2. Native wetland vascular plant taxa of the southern Swan Coastal Plain (Moore River–Dunsborough) referred to in this topic, or otherwise common to the region

Scientific plant name	Supra code	Family name	Current	Endemic	Growth form 1	Growth form 2	Life form	Life form aquatic	Common SSWA wetland species	Name ID
Acacia acuminata	DIC	Fabaceae	Y	WA	SH/T		P			3200
Acacia cyclops	DIC	Fabaceae	Y	AUST	SH		P			3282
Acacia flagelliformis	DIC	Fabaceae	Y	WA	SH		P			3339
Acacia rostellifera	DIC	Fabaceae	Y	WA	SH/T		P			3525
Acacia saligna	DIC	Fabaceae	Y	WA	SH		P			3527
Acidonia microcarpa	DIC	Proteaceae	Y	WA	SH		P			10824
Actinostrobus acuminatus	GYM	Cupressaceae	N	WA	SH	PR	P			89
Actinostrobus pyramidalis	GYM	Cupressaceae	N	WA	T		P		y	91
Adenanthos meisneri	DIC	Proteaceae	Y	WA	SH	PR	P			1790
Allocasuarina campestris	DIC	Casuarinaceae	Y	WA	SH		P			1721
Amblysperma minor	DIC	Asteraceae	N	WA	H		PAB	AQD		25842
Amphibromus nervosus	MON	Poaceae	Y	WA	G		P	AQD	y	13380
Amphibromus vickeryae	MON	Poaceae	Y	WA	G		P			10758
Anarthria scabra	MON	Anarthriaceae	Y	WA	S-R		P			1063
Andersonia ferricola	DIC	Ericaceae	Y	WA	SH		P	AQD		18102
Andersonia gracilis	DIC	Ericaceae	Y	WA	SH		P	AQD		6309
Angianthus drummondii	DIC	Asteraceae	Y	WA	H		A	AQD		7829
Angianthus preissianus	DIC	Asteraceae	Y	AUST	H		A	AQD	y	7833
Angianthus tomentosus	DIC	Asteraceae	Y	WA	H		A			7836
Anthotium junciforme	DIC	Goodeniaceae	Y	WA	H		A/P			12724
Aotus cordifolia	DIC	Fabaceae	Y	WA	SH		P			3686
Aphelia drummondii	MON	Centrolepidaceae	Y	WA	S-C		A	AQD		1118
Aponogeton hexatepalus	MON	Aponogetonaceae	Y	WA	H		PAB	AQF	y	141
Astartea affinis	DIC	Myrtaceae	Y	WA	SH		P	AQD	y	20350
Asteridea athrixioides	DIC	Asteraceae	Y	WA	H		A			7846
Avicennia marina	DIC	Acanthaceae	Y	>AUST	T		P	AQE		6828
Azolla filiculoides	FER	Salviniaceae	Y	AUST	H		P	AQF		80
Azolla pinnata	FER	Salviniaceae	Y	AUST	H		P	AQF		17737
Banksia littoralis	DIC	Proteaceae	Y	WA	T		P		y	1830

Scientific plant name	Supra code	Family name	Current	Endemic	Growth form 1	Growth form 2	Life form	Life form aquatic	Common SSWA wetland species	Name ID
Baumea articulata	MON	Cyperaceae	Y	>AUST	S-C		P	AQE	y	741
Baumea juncea	MON	Cyperaceae	Y	>AUST	S-C		P		y	743
Baumea riparia	MON	Cyperaceae	Y	WA	S-C		P	AQE		746
Baumea rubiginosa	MON	Cyperaceae	Y	WA	S-C		P	AQE		747
Baumea vaginalis	MON	Cyperaceae	Y	WA	S-C		P	AQE	y	748
Beaufortia sparsa	DIC	Myrtaceae	Y	WA	SH		P			5392
Blennospora doliiformis	DIC	Asteraceae	Y	WA	H		A	AQD	y	20026
Borya constricta	MON	Boryaceae	Y	WA	H		P			1267
Brachyscome bellidioides	DIC	Asteraceae	Y	WA	H		A		y	7867
Brachyscome pusilla	DIC	Asteraceae	Y	WA	H		A			7883
Burchardia bairdiae	MON	Colchicaceae	Y	WA	H		PAB		y	1383
Burchardia multiflora	MON	Colchicaceae	Y	WA	H		PAB		y	1385
Caladenia paludosa	MON	Orchidaceae	Y	WA	H		PAB	AQD		15503
Calandrinia granulifera	DIC	Portulacaceae	Y	AUST	H		A			2854
Callistachys lanceolata	DIC	Fabaceae	Y	WA	SH/T		P			10861
Calothamnus hirsutus	DIC	Myrtaceae	Y	WA	SH		P		y	5411
Calothamnus lateralis	DIC	Myrtaceae	Y	WA	SH		P		y	5415
Casuarina obesa	DIC	Casuarinaceae	Y	WA	T		P	AQE	y	1742
Caustis dioica	MON	Cyperaceae	Y	WA	S-C		P			760
Centella asiatica	DIC	Apiaceae	Y	>AUST	H	PR	P			6214
Centrolepis polygyna	MON	Centrolepidaceae	Y	AUST	S-C		A			1134
Chaetanthus aristatus	MON	Restionaceae	Y	WA	S-R		P	AQD/AQE	y	17685
Chamaescilla gibsonii	MON	Asparagaceae	Y	WA	H		PAB	AQD		19338
Chamelaucium sp. C Coastal Plain (Chamelaucium roycei ms)	DIC	Myrtaceae	N	WA	SH		P			13627
Chordifex isomorphus	MON	Restionaceae	Y	WA	S-R		P	AQD		17828
Chorizandra enodis	MON	Cyperaceae	Y	AUST	S-C		P	AQD	y	763
Cyathochaeta teretifolia	MON	Cyperaceae	Y	WA	S-C		P	AQD/AQE		16245
Cyclosorus interruptus	FER	Thelypteridaceae	Y	AUST	H	PR	P	AQD/AQE		54
Darwinia foetida	DIC	Myrtaceae	Y	WA	SH		P			34773
Darwinia whicherensis	DIC	Myrtaceae	Y	WA	SH		P	AQD		34765

Scientific plant name	Supra code	Family name	Current	Endemic	Growth form 1	Growth form 2	Life form	Life form aquatic	Common SSWA wetland species	Name ID
Dillwynia dillwynioides	DIC	Fabaceae	Y	WA	SH		P	AQD		3863
Diuris micrantha	MON	Orchidaceae	Y	WA	H		PAB			12938
Drosera gigantea subsp. gigantea	DIC	Droseraceae	Y	WA	H		PAB	AQD	y	15453
Drosera glanduligera	DIC	Droseraceae	Y	AUST	H		A		y	3098
Drosera menziesii subsp. menziesii	DIC	Droseraceae	Y	WA	H		PAB	AQD		11853
Drosera tubaestylis	DIC	Droseraceae	Y	WA	H		PAB	AQD		13205
Eleocharis acuta	MON	Cyperaceae	Y	AUST	S-C		PAB	AQE		822
Eleocharis keigheryi	MON	Cyperaceae	Y	WA	S-C		PAB	AQE		17605
Eleocharis sphacelata	MON	Cyperaceae	Y	>AUST	S-C		P	AQE		831
Eremophila glabra subsp. chlorella	DIC	Scrophulariaceae	Y	WA	SH		P	AQD		17150
Eryngium ferox ms	DIC	Apiaceae	Y	WA	H		PAB			19602
Eryngium pinnatifidum subsp. palustre ms	DIC	Apiaceae	Y	WA	H		PAB	AQE	y	14553
Eryngium subdecumbens ms	DIC	Apiaceae	Y	WA	H		PAB	AQD		14720
Eucalyptus foecunda	DIC	Myrtaceae	Y	WA	M		P			5649
Eucalyptus rudis subsp. cratyantha	DIC	Myrtaceae	Y	WA	T/M		P	AQD		13512
Eucalyptus rudis subsp. rudis	DIC	Myrtaceae	Y	WA	T		P	AQD	y	13511
Euchilopsis linearis	DIC	Fabaceae	Y	WA	SH		P			3872
Evandra aristata	MON	Cyperaceae	Y	WA	S-C		P			834
Ficinia nodosa	MON	Cyperaceae	Y	>AUST	S-C		P			20216
Fimbristylis velata	MON	Cyperaceae	Y	>AUST	S-C		P			894
Frankenia pauciflora	DIC	Frankeniaceae	Y	AUST	SH		P			5209
Gahnia trifida	MON	Cyperaceae	Y	AUST	S-C		P		y	907
Gastrolobium ebracteolatum	DIC	Fabaceae	Y	WA	SH/T		P			20473
Gastrolobium papilio	DIC	Fabaceae	Y	WA	SH		P	AQE		20509
Glossostigma diandrum	DIC	Phrymaceae	Y	AUST	H		A	AQD		7060
Glossostigma drummondii	DIC	Phrymaceae	Y	AUST	H		A	AQD		7061
Grevillea curviloba subsp. curviloba	DIC	Proteaceae	Y	WA	SH	PR	P			14408
Grevillea curviloba subsp. incurva	DIC	Proteaceae	Y	WA	SH	PR	P			14409
Grevillea elongata	DIC	Proteaceae	Y	WA	SH		P			14526
Grevillea maccutcheonii	DIC	Proteaceae	Y	WA	SH		P			17112
Grevillea obtusifolia	DIC	Proteaceae	Y	WA	SH	PR	P			8836

Scientific plant name	Supra code	Family name	Current	Endemic	Growth form 1	Growth form 2	Life form	Life form aquatic	Common SSWA wetland species	Name ID
Haemodorum simplex	MON	Haemodoraceae	Y	WA	H		PAB		y	1472
Hakea ceratophylla	DIC	Proteaceae	Y	WA	SH		P		y	2137
Hakea oldfieldii	DIC	Proteaceae	Y	WA	SH		P			2190
Hakea varia	DIC	Proteaceae	Y	WA	SH		P		y	2216
Hemichroa diandra	DIC	Amaranthaceae	Y	AUST	H	PR	P			2688
Hibbertia perfoliata	DIC	Dilleniaceae	Y	WA	SH	CL	P			5154
Hibbertia stellaris	DIC	Dilleniaceae	Y	WA	SH		P	AQD	y	5172
Homalospermum firmum	DIC	Myrtaceae	Y	WA	SH		P			5816
Hyalosperma cotula	DIC	Asteraceae	Y	WA	H		A			12741
Hydrocotyle lemnoides	DIC	Araliaceae	Y	WA	H		A	AQF		6233
Hydrocotyle tetragonocarpa	DIC	Araliaceae	Y	WA	H		A			6241
Hypocalymma angustifolium	DIC	Myrtaceae	Y	WA	SH		P			5817
Hypolaena exsulca	MON	Restionaceae	Y	WA	S-R		P			1070
Hypoxis occidentalis var. occidentalis	MON	Hypoxidaceae	Y	WA	H		PAB		y	11736
Isoetes drummondii	FER	Isoetaceae	Y	AUST	H		PAB	AQD		11
Isolepis cernua	MON	Cyperaceae	Y	>AUST	S-C		A		y	910
Isopogon formosus subsp. dasylepis	DIC	Proteaceae	Y	WA	SH		P		y	16522
Isotoma pusilla	DIC	Campanulaceae	Y	WA	H		A			7398
Isotoma scapigera	DIC	Campanulaceae	Y	WA	H		A			7399
Isotropis cuneifolia subsp. glabra	DIC	Fabaceae	Y	WA	H-SH		P	AQD		16317
Jacksonia gracillima	DIC	Fabaceae	Y	WA	SH/T		P			20462
Juncus kraussii subsp. australiensis	MON	Juncaceae	Y	>AUST	S-J		P	AQD/AQE	y	11922
Juncus pallidus	MON	Juncaceae	Y	>AUST	S-J		P		y	1188
Kennedia coccinea	DIC	Fabaceae	Y	WA	H	PR	P			4037
Kunzea recurva	DIC	Myrtaceae	Y	WA	SH		P		y	5841
Lambertia echinata subsp. occidentalis	DIC	Proteaceae	Y	WA	SH		P			17734
Lawrencia squamata	DIC	Malvaceae	Y	AUST	SH		P			4959
Lepidosperma gladiatum	MON	Cyperaceae	Y	AUST	S-C		P			933
Lepidosperma longitudinale	MON	Cyperaceae	Y	AUST	S-C		P		y	937
Leptomeria ellytes	DIC	Santalaceae	Y	WA	SH		P-PAR			17703
Loxocarya magna	MON	Restionaceae	Y	WA	S-R		P	AQD/AQE		13779

Scientific plant name	Supra code	Family name	Current	Endemic	Growth form 1	Growth form 2	Life form	Life form aquatic	Common SSWA wetland species	Name ID
Lycopodiella serpentina	FER	Lycopodiaceae	Y	>AUST	H		P	AQD		12783
Marsilea drummondii	FER	Marsileaceae	Y	AUST	H		PAB	AQF		74
Meeboldina cana	MON	Restionaceae	Y	WA	S-R		P	AQD/AQE	y	17683
Meeboldina coangustata	MON	Restionaceae	Y	WA	S-R		P	AQD/AQE	y	17679
Meeboldina scariosa	MON	Restionaceae	Y	WA	S-R		P	AQD/AQE	y	17694
Melaleuca brevifolia	DIC	Myrtaceae	Y	WA	SH		P			5881
Melaleuca cuticularis	DIC	Myrtaceae	Y	WA	T		P	AQD	y	5900
Melaleuca incana subsp. incana	DIC	Myrtaceae	Y	WA	SH		P	AQD	y	13273
Melaleuca lanceolata	DIC	Myrtaceae	Y	AUST	SH/T		P			5922
Melaleuca lateritia	DIC	Myrtaceae	Y	WA	SH		P	AQD	y	5926
Melaleuca osullivanii	DIC	Myrtaceae	Y	WA	SH		P		y	20297
Melaleuca preissiana	DIC	Myrtaceae	Y	WA	T		P		y	5952
Melaleuca rhaphiophylla	DIC	Myrtaceae	Y	WA	SH		P	AQD	y	5959
Melaleuca scabra	DIC	Myrtaceae	Y	WA	SH		P			5961
Melaleuca teretifolia	DIC	Myrtaceae	Y	WA	SH		P		y	5978
Melaleuca thyoides	DIC	Myrtaceae	Y	WA	SH		P			5981
Melaleuca viminea subsp. viminea	DIC	Myrtaceae	Y	WA	SH		P	AQD	y	13280
Mesomelaena tetragona	MON	Cyperaceae	Y	WA	S-C		P			957
Montia australasica	DIC	Portulacaceae	Y	>AUST	H		PAB	AQE		2874
Muehlenbeckia adpressa	DIC	Polygonaceae	Y	AUST	SH	CL	P			2412
Muellerolimon salicorniaceum	DIC	Plumbaginaceae	Y	AUST	H-SH		P			6490
Myriocephalus helichrysoides	DIC	Asteraceae	Y	WA	H		A	AQD	y	8117
Myriophyllum crispatum	DIC	Haloragaceae	Y	AUST	H		A	AQE		6189
Myriophyllum verrucosum	DIC	Haloragaceae	Y	AUST	H		P	AQE		6201
Najas marina	MON	Hydrocharitaceae	Y	>AUST	H		P	AQS		138
Opercularia vaginata	DIC	Rubiaceae	Y	WA	SH-H		P			18255
Ornduffia submersa	DIC	Menyanthaceae	Y	WA	H		PAB	AQS		36200
Ottelia ovalifolia subsp. ovalifolia	MON	Hydrocharitaceae	Y	>AUST	H		PAB	AQS		14531
Patersonia occidentalis var. angustifolia	MON	Iridaceae	Y	WA	H		P		y	30471
Pericalymma ellipticum	DIC	Myrtaceae	Y	WA	SH		P		y	6006
Petrophile latericola	DIC	Proteaceae	Y	WA	SH		P	AQD		14085

Scientific plant name	Supra code	Family name	Current	Endemic	Growth form 1	Growth form 2	Life form	Life form aquatic	Common SSWA wetland species	Name ID
Pilularia novae-hollandiae	FER	Marsileaceae	Y	AUST	H		PAB	AQD		78
Pimelea imbricata var. major	DIC	Thymelaeaceae	Y	WA	SH		P	AQD	y	11404
Podolepis capillaris	DIC	Asteraceae	Y	AUST	H		P			8173
Pogonolepis stricta	DIC	Asteraceae	Y	AUST	H		A		y	8188
Pteridium esculentum	FER	Dennstaedtiaceae	Y	AUST	H		P			57
Pteris vittata	FER	Pteridaceae	Y	AUST	H	PR	P	AQD/AQE		45
Regelia ciliata	DIC	Myrtaceae	Y	WA	SH		P		y	6012
Regelia inops	DIC	Myrtaceae	Y	WA	SH		P			6014
Rhodanthe manglesii	DIC	Asteraceae	Y	WA	H		A			13234
Rhodanthe pyrethrum	DIC	Asteraceae	Y	WA	H		A	AQD		13312
Ruppia polycarpa	MON	Ruppiaceae	Y	>AUST	H		A/P	AQS		116
Ruppia tuberosa	MON	Ruppiaceae	Y	AUST	H		PAB	AQS		117
Samolus junceus	DIC	Primulaceae	Y	WA	H		P	AQD/AQE	y	6483
Sarcocornia quinqueflora	DIC	Chenopodiaceae	Y	>AUST	SH		P	AQD	y	2593
Schoenoplectus validus	MON	Cyperaceae	Y	>AUST	S-C		P	AQE		969
Schoenus natans	MON	Cyperaceae	Y	WA	S-C		A	AQS		1003
Schoenus plumosus	MON	Cyperaceae	Y	WA	S-C		A		y	17614
Schoenus tenellus	MON	Cyperaceae	Y	WA	S-C		A	AQE	y	1023
Sonchus hydrophilus	DIC	Asteraceae	Y	AUST	H		A/P	AQD/AQE		9367
Sporobolus virginicus	MON	Poaceae	Y	>AUST	G		P	AQD	y	635
Spyridium globulosum	DIC	Rhamnaceae	Y	AUST	SH		P			4828
Stylidium divaricatum	DIC	Stylidiaceae	Y	WA	H		P		y	7717
Stylidium longitubum	DIC	Stylidiaceae	Y	WA	H		A	AQD	y	7756
Taxandria juniperina	DIC	Myrtaceae	Y	WA	SH		P			20115
Taxandria linearifolia	DIC	Myrtaceae	Y	WA	SH		P		y	20135
Tecticornia indica subsp. bidens	DIC	Chenopodiaceae	Y	>AUST	SH		P	AQD		33319
Tecticornia pergranulata subsp. pergranulata	DIC	Chenopodiaceae	Y	AUST	SH		P	AQD		33297
Tecticornia syncarpa	DIC	Chenopodiaceae	Y	WA	SH		P			31716
Templetonia retusa	DIC	Fabaceae	Y	AUST	SH		P			4256
Thelymitra antennifera	MON	Orchidaceae	Y	WA	H		PAB		y	1701
Themeda triandra	MON	Poaceae	Y	>AUST	G		P			673

Scientific plant name	Supra code	Family name	Current	Endemic	Growth form 1	Growth form 2	Life form	Life form aquatic	Common SSWA wetland species	Name ID
Thomasia triphylla	DIC	Malvaceae	Y	WA	SH		P			5105
Trachymene pilosa	DIC	Araliaceae	Y	AUST	H		A			6280
Tribonanthes uniflora	MON	Haemodoraceae	N	WA	H		PAB	AQD		8798
Triglochin mucronata	MON	Juncaginaceae	Y	AUST	S-C		A		y	147
Triglochin striata	MON	Juncaginaceae	Y	>AUST	S-C		P			151
Trithuria occidentalis	MON	Hydatellaceae	Y	WA	S-C		A	AQE		32658
Trithuria submersa	MON	Hydatellaceae	Y	WA	S-C		A	AQD/AQE		1141
Typha domingensis	MON	Typhaceae	Y	>AUST	S-J		PAB	AQE		98
Utricularia gibba	DIC	Lentibulariaceae	Y	>AUST	H		P	AQS		12493
Utricularia menziesii	DIC	Lentibulariaceae	Y	WA	H		PAB	AQD		7145
Utricularia multifida	DIC	Lentibulariaceae	Y	WA	H		A	AQD	y	7148
Utricularia volubilis	DIC	Lentibulariaceae	Y	WA	H	CL	PAB	AQE		7158
Verticordia chrysantha	DIC	Myrtaceae	Y	WA	SH		P			6073
Verticordia plumosa var. pleiobotrya	DIC	Myrtaceae	Y	WA	SH		P			12452
Viminaria juncea	DIC	Fabaceae	Y	AUST	SH/T		P		y	4325
Wilsonia backhousei	DIC	Convolvulaceae	Y	AUST	H	PR	P	AQD		6658
Wurmbea dioica subsp. alba	MON	Colchicaceae	Y	AUST	H		PAB		y	12072
Wurmbea dioica subsp. Brixton (G.J. Keighery 12803) PN	MON	Colchicaceae	N	WA	H		PAB	AQD		-20194
Wurmbea monantha	MON	Colchicaceae	Y	WA	H		PAB			1398
Xanthorrhoea brunonis	MON	Xanthorrhoeaceae	Y	WA	SH		P			1251
Xanthorrhoea preissii	MON	Xanthorrhoeaceae	Y	WA	SH		P			1256
Xyris lanata	MON	Xyridaceae	Y	WA	S-J		P	AQE		1150

Appendix 3. Data used in graphs and charts in this topic

Table 1. Data used for Figure 69: Internally Drained Desert wetland and dryland vascular plant taxa found in various plant groups (after Jessop[27])

Group	Wetland	Dryland
Ferns	12	6
Gymnosperms	0	3
Monocotyledons	30	133
Dicotyledons	114	1,245
Total (% total flora)	**156 (10.1%)**	**1,387 (89.9%)**

Table 2. Data used for Figure 84: Pilbara wetland and dryland vascular plant taxa found in various plant groups (after Western Australian Herbarium[75])

Group	Wetland (% wetland flora)	Dryland
Mangroves (saline)	8 (2%)	
Saline	31 (8%)	
Freshwater	103 (26.5%)	
Seasonally waterlogged freshwater	246 (63.4%)	
Total (% total flora)	**388 (25.7%)**	**1,121 (74.3%)**

Table 3. Data used for Figure 133: Endemism of wetland and dryland vascular plant taxa of the southern Swan Coastal Plain

Group	Wetland	Dryland	Total
>Australia	49 (11.1%)	30 (2.1%)	79
Australian Endemic	67 (15.1%)	179 (12.6%)	256
WA Endemic	327 (73.8%)	1,224 (85.4%)	1,551
Total	**443**	**1,434**	**1,877**

Table 4. Data used for Figure 134: Plant groups of the wetland and dryland vascular plant taxa of the southern Swan Coastal Plain

Group	Wetland	Dryland	Total
Ferns	15 (3.4%)	5 (0.3%)	20
Gymnosperms	1 (0.2%)	6 (0.4%)	7
Monocotyledons	207 (46.7%)	337 (26.3%)	544
Dicotyledons	220 (49.7%)	1,046 (72.9%)	1,266
Total	**443 (24%)**	**1,434 (76%)**	**1,877**

Table 5. Data used for Figure 138: Growth forms groups of wetland and dryland vascular plants of the southern Swan Coastal Plain

Group	Wetland	Dryland	Total
Trees	9 (2%)	26 (1.8%)	35
Mallees	0 (0%)	5 (0.3%)	5
Shrubs	85 (19.2%)	727 (50.7%)	812
Grasses	14 (3.2%)	35 (2.4%)	49
Sedges	123 (27.8%)	105 (7.3%)	228
Herbs	212 (47.9%)	536 (37.4%)	748

Table 6. Data used for Figure 139: Life forms of wetland and dryland vascular plants of the southern Swan Coastal Plain

Group	Wetland	Dryland	Total
Annual	95 (21.4%)	131 (9.1%)	226
Annual or Perennial	8 (1.8%)	8 (0.6%)	16
Perennial	340 (76.7%)	1,295 (90.3%)	1,635
Total	**443**	**1,434**	**1,877**

Table 7. Data used for Figure 140: Life form groups of wetland and dryland vascular plants of the southern Swan Coastal Plain

Habitat	Annual (A)	Annual or Perennial (A/P)	Perennial (P)	Perennial annually renewed, above ground part (PAA)	Perennial annually renewed from storage organ (PAB)	Perennial Parasite (P-PAR)
Wetland	95 (21.4%)	8 (1.8%)	237 (53.5%)	4 (0.9%)	98 (22.1%)	1 (0.2%)
Dryland	131 (9.1%)	8 (0.6%)	1,095 (76.4%)	11 (0.8%)	162 (11.3%)	27 (1.9%)

Table 8. Data used for Figure 142: Life form of annually renewed groups of wetland and dryland plants of the southern Swan Coastal Plain

Habitat	Annually renewed (A, PAA, PAB)	Perennial annually renewed, above ground part (PAA)	Perennial annually renewed from storage organ (PAB)	Total (% total wetland or dryland plants)
Wetland	95 (48.2%)	4 (2%)	98 (49.8%)	197 (44.5%)
Dryland	131 (43.1%)	11 (3.7%)	162 (53.3%)	304 (21.2%)

Table 9. Data used for Figure 144: Life forms of aquatic vascular plants of the southern Swan Coastal Plain (443 total)

Post inundation (AQD)	Dampland/emergent (AQD/AQE)	Emergent (AQE)	Floating (AQF)	Submerged (AQS)	Total aquatic taxa (% total wetland plants)
163 (60.2%)	35 (12.9%)	51 (18.8%)	9 (3.3%)	13 (4.8%)	271 (61%)

A guide to managing and restoring wetlands in Western Australia

Wetland vegetation and flora, part 2: Kimberley

In Chapter 2: **Understanding wetlands**

Australian Government

Department of Environment and Conservation

Our environment, our future

Contents

Wetland profiles

Introduction

Western Australia is a very large state and there is a great deal of variability in wetland vegetation and flora across it. The Kimberley is one of three major climatic and biogeographical zones (Figure 35):

- Kimberley – tropical, warm to hot all year, summer rainfall and a dry winter
- Deserts – hot desert, infrequent erratic rainfall
- Southwest – Mediterranean, warm to hot dry summer, cool wet winter.

The differing climate of these three regions drives important variations in wetland vegetation.

The next major driver of Kimberley wetland vegetation and flora characteristics is whether they inhabit freshwater or saline wetlands. Wetland plant communities are distinctive of the zone and water chemistry, contributing both to the local and state identity and contributing greatly to the uniqueness of WA and Australia.

Thirdly, in addition to zone and freshwater/saline divisions, the Kimberley wetlands can be grouped according to the similarity of their vegetation characteristics. In the Kimberley zone, these groups are:

- coastal and estuarine saline wetlands
- alluvial flats
- dune swamps of truncated drainage lines
- springs
- perched wetlands.

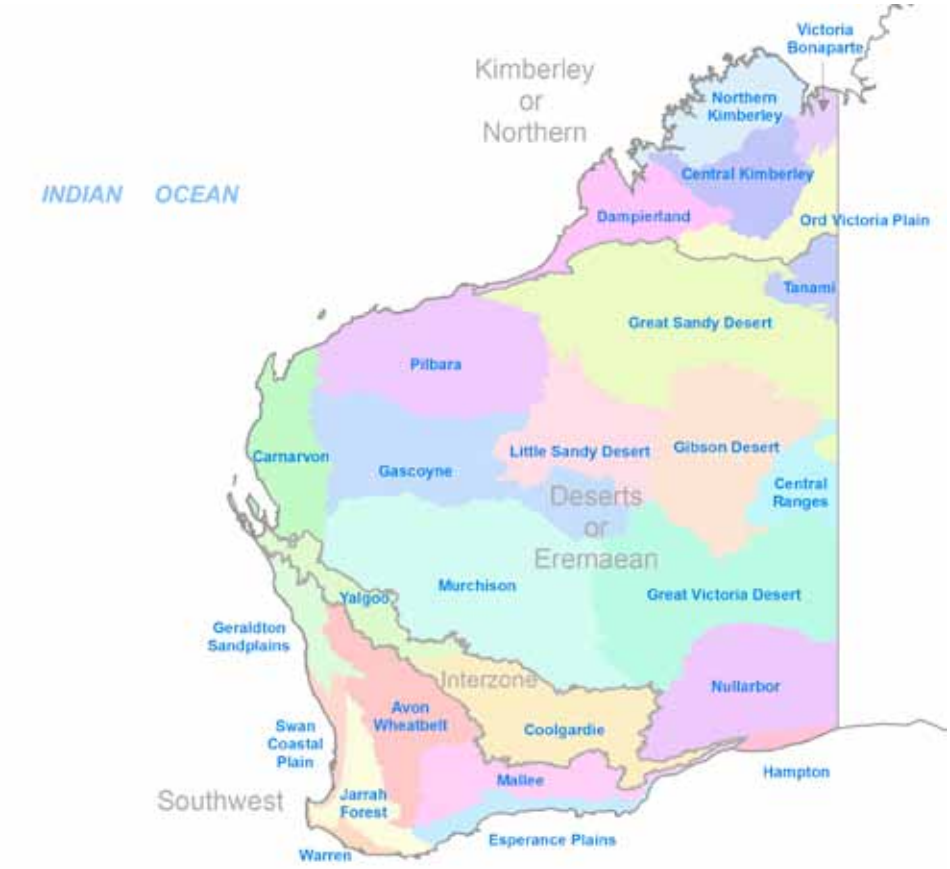


Figure 35. WA's bioregions and the three climatic zones used in this topic. Image – C. Auricht, Auricht Projects.

Kimberley

The summer rainfall Kimberley (or Northern Province) of WA comprises five natural regions: the Central Kimberley, Dampierland, Northern Kimberley, Ord-Victoria Plains and part of the Victoria-Bonaparte (the remainder is in the Northern Territory).

Kimberley wetlands are largely fresh and generally associated with the large river systems (Figure 36). These wetlands have a large number of species only evident during the wet season, being annually renewed from seed or underground storage organs. These annually renewed species contribute greatly to the species richness of the communities. These wetlands are largely intact.

Figure 36. Kimberley landscape-scale nationally significant wetlands of the Ord River in the North Kimberley. Photos – G Keighery/DEC.

(a), (b) and (d) Ord Estuary; (c) Parry Lagoons.

Wetland vegetation of the Kimberley

Savanna: a grassy woodland; grassland with small or widely spaced trees so that the canopy is always open allowing a continuous layer of grasses underneath

More than one hundred Kimberley wetland plant communities have been described in literature. Except for a set of perched wetlands, most of the Kimberley wetlands are associated with rivers and/or the coast; however, these wetlands can be so extensive they should be described as wetlands in this treatment. Coastal and river fringing vegetation is not covered here.

Most of the Kimberley is dryland covered in tropical **savanna** grasslands with an overstorey of trees and/or shrubs with variable cover. The principal dominant genera are *Eucalyptus* or *Acacia*. Besides this, the Kimberley is vegetated with forests, woodlands, samphire shrublands, shrublands, bunch grasslands (dominated by perennial grasses, other than spinifex), tropical savanna grasslands (dominated by a complex of species including spinifex), sedgelands and herblands. The samphire shrublands are confined to wetlands, and the forests, sedgelands and herblands are rare outside of wetlands. Common dominant plants of the wetlands include the trees *Melaleuca argentea* (Figure 37), *M. cajuputi*, *M. leucadendra*, *M. viridiflora*, *Eucalyptus camaldulensis* and *Sesbania formosa* (Figure 38), *Barringtonia acutangula* (Figure 39) and the shrub *Pandanus aquaticus* (Figure 40). While not dominant, *Acacia neurocarpa* (Figure 41) is notable as it is virtually confined to the Kimberley, with only a few occurrences in the Internally Drained Deserts.

There are nineteen listed nationally significant wetlands in the Kimberley.[54] However, as with the other zones, the Kimberley supports significant wetlands that have not yet been considered for listing as nationally significant.

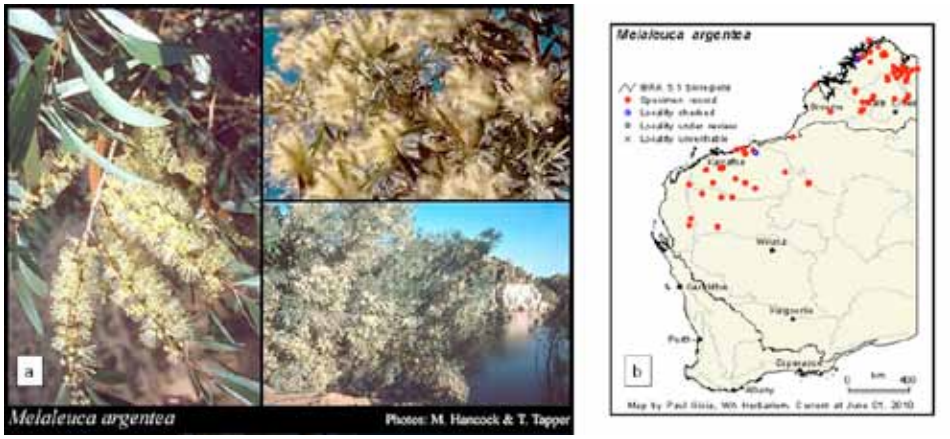


Figure 37. (a) and (b) *Melaleuca argentea* is a widespread wetland species in the Kimberley and Externally Drained Deserts. Photos – M Hancock and T Tapper. Mapping – P Gioia.

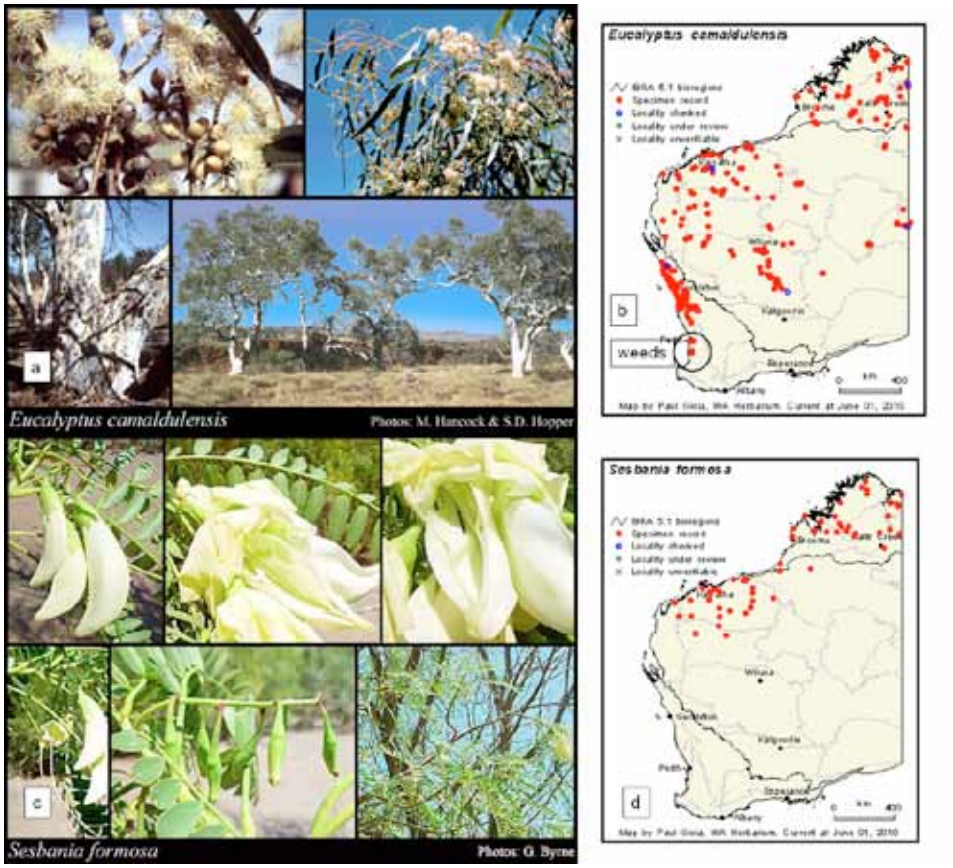
Images used with the permission of the Western Australian Herbarium, DEC.
Accessed 21/06/2011.

Figure 38 (below). Two widespread wetland trees found in wetlands in the Kimberley.

(a) and (b) *Eucalyptus camaldulensis* is a widespread wetland species in the Kimberley, Deserts and northern Southwest (changes over to *E. rudis* south of Geraldton; the original Perth area population was introduced (planted) and many weed populations now exist in Perth). Photos – M Hancock and SD Hopper. Mapping – P Gioia.

(c) and (d) *Sesbania formosa* is widespread in the Kimberley and Externally Drained Deserts with outliers in the Internally Drained Deserts. Photos – G Byrne. Mapping – P Gioia.

Images used with the permission of the Western Australian Herbarium, DEC.
Accessed 21/06/2011.



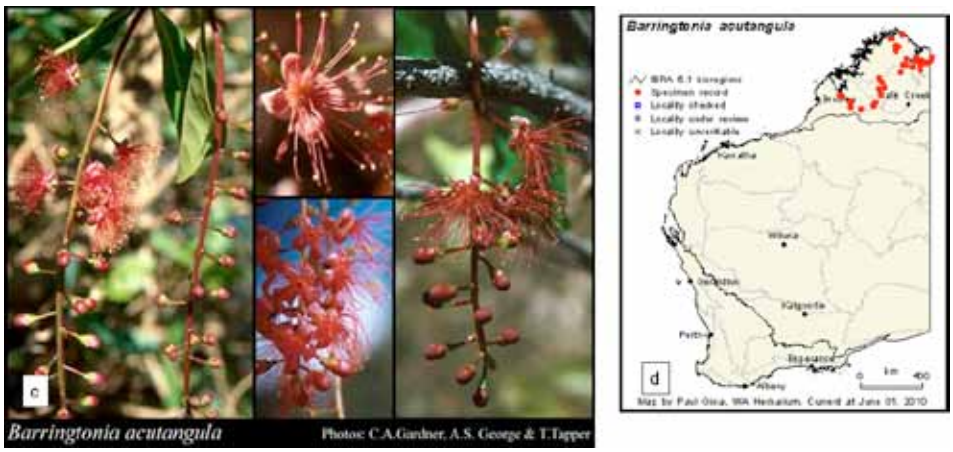


Figure 39. *Barringtonia acutangula* is a common dominant wetland tree that is virtually confined to the Kimberley. Photos – CA Gardner, AS George and T Tapper. Mapping – P Gioia.
Images used with the permission of the Western Australian Herbarium, DEC.
Accessed 21/06/2011.

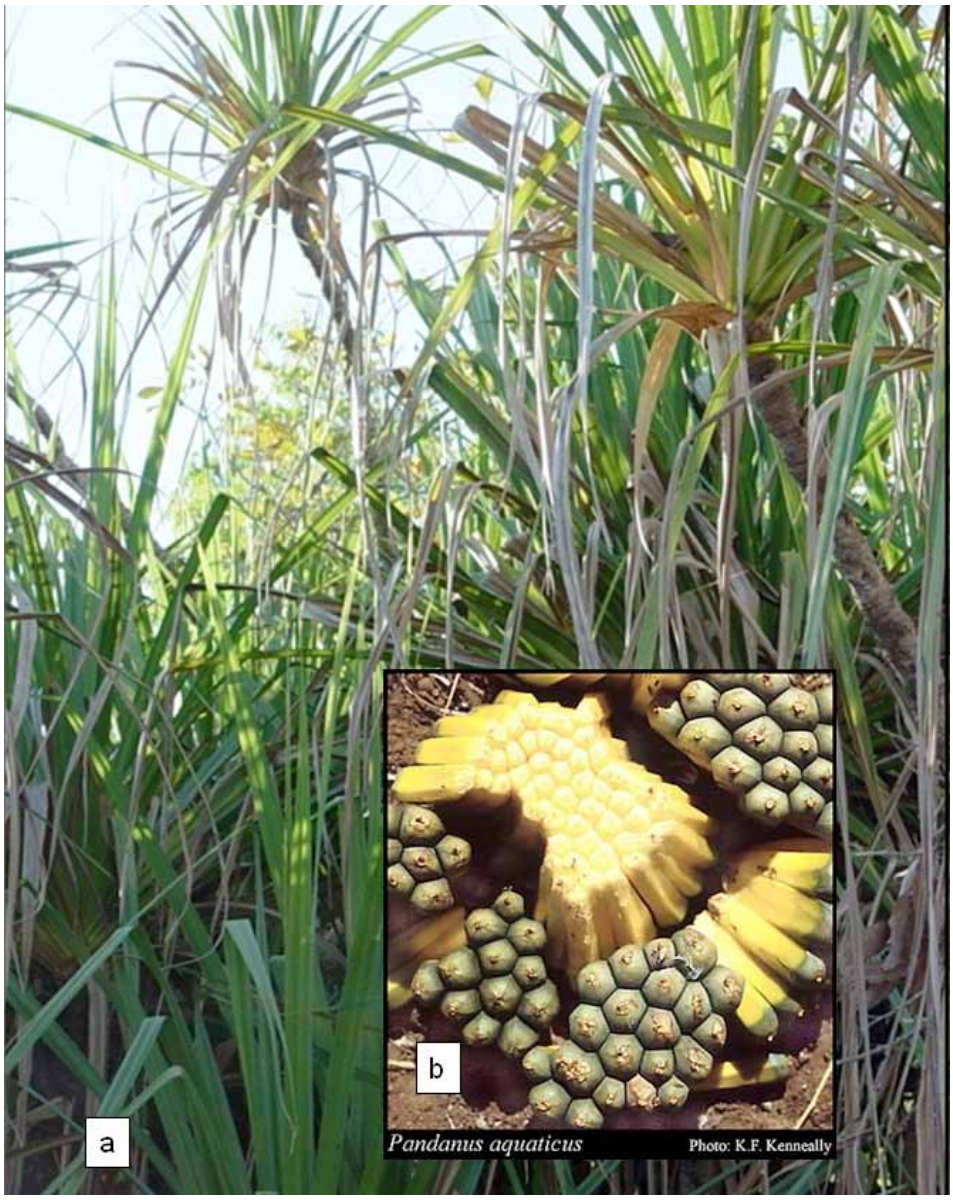


Figure 40. *Pandanus aquaticus* is a widespread tropical wetland shrub (a) with conspicuous fruit (b). Photo (a) taken in the Northern Territory. Photos – (a) B Keighery/OEPA (b) KF Kenneally. Image used with the permission of the Western Australian Herbarium, DEC. Accessed 21/06/2011.

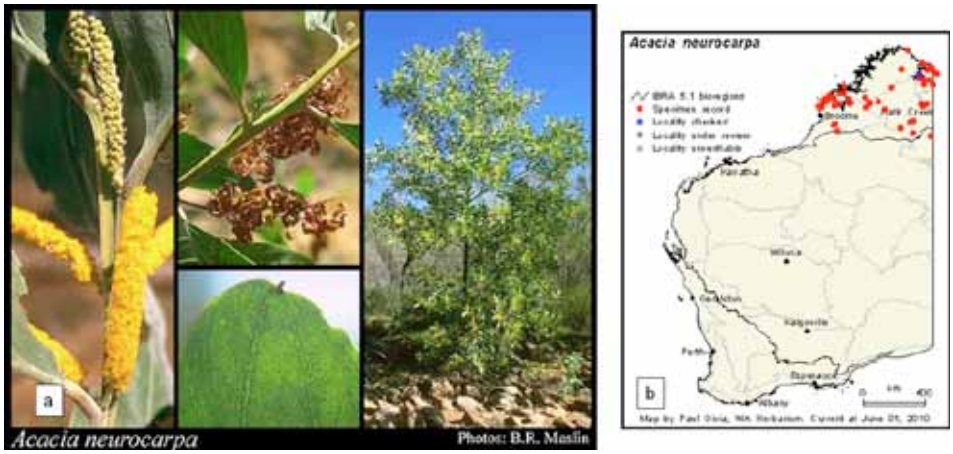


Figure 41. *Acacia neurocarpa* (a) is virtually confined to the Kimberley (b). Photo – BR Maslin. Mapping – P Gioia. Images used with the permission of the Western Australian Herbarium, DEC. Accessed 21/06/2011.

Saline wetlands of the Kimberley

The Kimberley contains only coastal and estuarine saline wetlands; there are no known saline lakes. These saline wetlands are dominated by **mangrove** forests and woodlands, which form rich and diverse habitats and are described in Semeniuk et al.[55]

Mangrove: any of various tropical or semi-temperate trees or shrubs of the genera *Rhizophora*, *Bruguiera* and *Avicennia* growing in intertidal shore mud with many tangled roots above the ground

The largest areas of saline wetlands are found along the edges of Roebuck Bay (south-east of Broome, Dampierland) and extend along Eighty Mile Beach to the De Grey River. The typical pattern is a sequence of communities from sea to dry land with, from the sea, mangrove forests and woodlands, samphire shrublands and then grasslands typically dominated by *Sporobolus virginicus* (Figure 42).

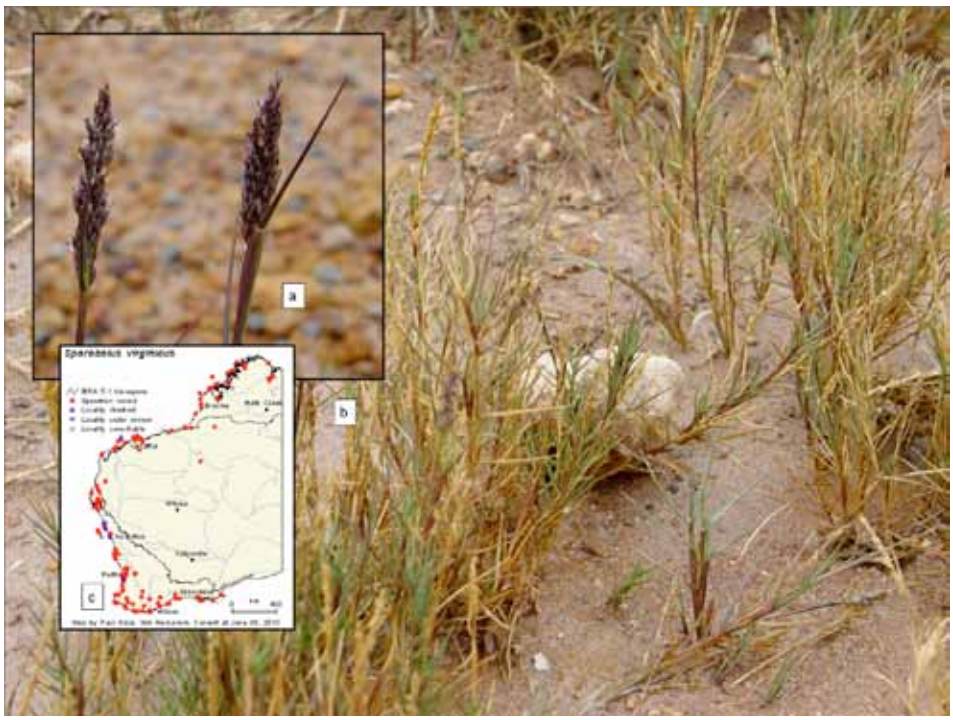


Figure 42. *Sporobolus virginicus* flowers (a) and habit (b), a widespread, virtually cosmopolitan, generally coastal species of saline wetlands (c) in WA. Photos – B Keighery/OEPA. Mapping – P Gioia. Images used with the permission of the Western Australian Herbarium, DEC. Accessed 21/06/2011.

The saline wetlands of the Roebuck Plains along Eighty Mile Beach are very complex wetlands with the more inland freshwater areas merging with the adjacent tidally inundated coastal saline wetlands. This vast wetland system covers 48,000 hectares, an area almost as large as the adjacent mudflats. The plains flood every 5–10 years and were formerly dominated by perennial grasslands composed mainly of *Sporobolus virginicus*, *Xerochloa barbata*, *Enneapogon purpurascens* and *Triraphis mollis* and combinations of these species. However, the weed buffel grass (*Cenchrus ciliaris*) has invaded these wetlands and now forms the dominant cover. Buffel grass (Figure 43) was introduced as livestock forage. It is shade and fire tolerant, and adapted to frequent defoliation. It reproduces by seed and short rhizome and is dispersed primarily by wind and water, also mammals (on skin and fur), birds and vehicles. It has developed resistance to some post-emergent herbicides.[11] In the wet season a rich and diverse suite of annual herbs are associated with the grasslands, especially when they flood.

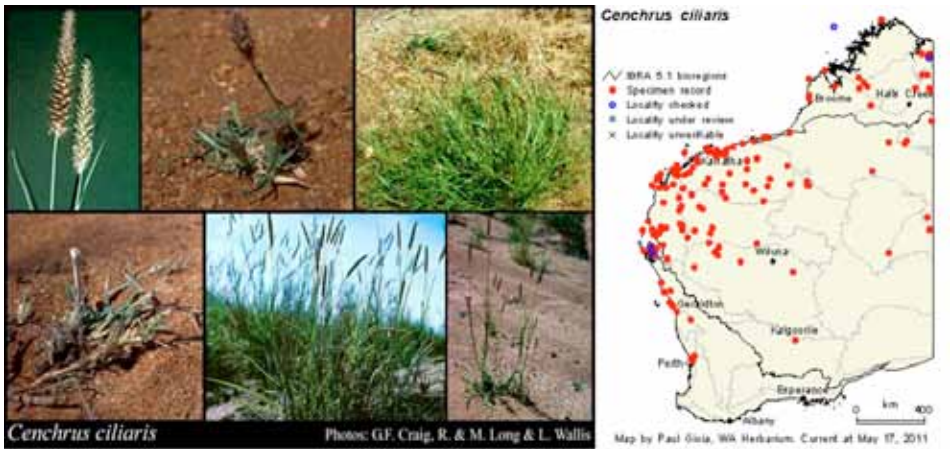


Figure 43. Buffel grass (*Cenchrus ciliaris*) (a) is a widespread weed (b) which has replaced a suite of perennial grasses in the saline wetlands of the Roebuck Plains. Photos – GF Craig, R & M Long and L Wallis. Mapping – P Gioia. Images used with the permission of the Western Australian Herbarium, DEC. Accessed 21/06/2011.

Alluvial soil: soil deposited by flowing water on floodplains, in river beds, and in estuaries

Other areas of saline, brackish and freshwater wetlands are the poorly documented coastal grasslands and wetlands found on the eastern side of the false mouths of the Ord River, and, further east, those on the Chenier Beach ridges and flats (north of Kununurra). These back and adjoin the Ord River Floodplain*, a saline estuarine wetland of tidal flats and mangrove swamps.

Freshwater wetlands of the Kimberley

The vegetation of the freshwater Kimberley wetlands is described under a set of principal wetland groups: alluvial flats, dune swamps of truncated drainage lines, springs and perched wetlands.

Permanently and seasonally inundated basin wetlands (that is, lakes and sumplands) are rare in the Kimberley. The largest permanently inundated freshwater wetlands in the Kimberley, Lake Argyle* and Lake Kununurra* (100,000–200,000 hectares) (Victoria Bonaparte), are human made. These support fringing vegetation and aquatics identical to that of the permanent river pools. Lake Kununurra is eutrophic and also supports a series of weeds such as *Leucaena leucocephala* in the forest vegetation fringing the water.

Alluvial flats

The Kimberley's high rainfall supports a set of very significant large river systems being the Drysdale*, Fitzroy, Lennard, Mitchell*, Ord* (Figure 36) and Prince Regent rivers. These rivers and their associated wetlands constitute the majority of the listed nationally important wetlands in the region.[9] There is no discrete boundary between the 'river' vegetation and the vegetation of these wetlands. The largest and most complex freshwater wetlands have developed on the **alluvial soils** deposited by these rivers, either along their course or at their mouths. These wetlands include the Parry Floodplain* (c. 9,000 hectares) of the Ord River and the Camballin Floodplain* (Le Lievre Swamp System, c. 30,000 hectares) on the Fitzroy. The different river systems support a diverse suite of plant communities, some of which are described below.

Other freshwater wetlands are creeks with their fringing vegetation and the riverine/creek pools that often remain during the dry. A variety of trees fringe and/or cover the pools including *Melaleuca argentea*, *M. cajuputi*, *M. leucadendra*, *Eucalyptus camaldulensis*, *Barringtonia acutangula*, *Sesbania formosa* and *Pandanus aquaticus*. Numerous floating aquatics grow in the pools, especially the genera *Nymphaea* (Figure 44), *Aponogeton*, *Nymphoides* (Figure 45 and Figure 46), *Ornduffia* (previously *Villarsia*), and *Eriocaulon* (Figure 46).

Figure 44. Aquatic waterlilies. *Nymphaea hastifolia* (a and b) and *N. violacea* (c). These photos were taken in the Northern Territory. Photos – B Keighery/OEPA.

Figure 45. A tropical wetland with *Melaleuca* forest over an aquatic herbland dominated by *Nymphoides aurantiaca* (a), with detail of the *Nymphoides* flower (b). This photo was taken in the Northern Territory. Photos – B Keighery/OEPA.

Figure 46. Three tropical aquatic species: *Eriocaulon setaceum* (a), *Nymphoides indica* (b), and *N. crenata* (c). The aquatic *Nymphoides* and *Eriocaulon* genera are almost confined to the Kimberley in WA but have outliers in the Deserts. *Nymphoides* has nine species in WA and Eriocaulon eighteen.[11] These photos were taken in the Northern Territory. Photos – B Keighery/ OEPA.

The Parry Floodplain* (Victoria Bonaparte) supports a complex mosaic of floodplain, billabongs, seasonal marshes and wooded swamps and is the largest of the few substantial tropical floodplains in WA. As well as being listed as a nationally important wetland, Parry Floodplain is listed jointly with the Ord Estuary System as a Wetland of International Importance under the Ramsar Convention. Rarely recorded communities such as native rice (*Oryza* species) and brown beetle grass (*Leptochloa fusca*) grasslands, budda pea (*Aeschynomene indica*) herblands and sedgelands dominated by *Eleocharis brassii*, and the reed *Phragmites karka* occur here. The rare *Pandanus spiralis* closed forest community is associated with the Parry Floodplain's Palm Spring. Numerous aquatics are found in the inundated areas (Figure 44 to Figure 48).

Figure 47. *Blyxa* sp., a common submerged aquatic from the Kimberley. Photo – B Keighery/ OEPA.

Two principal wetland types, basins and flats, are found in the Camballin Wetlands (Dampierland). The basins are covered with forests of *Eucalyptus* and *Melaleuca* and fresh water mangroves (*Barringtonia acutangula*), *Typha* sedgelands and herblands of *Sesbania cannabina*. The flats are grasslands dominated by mitchell grass (*Astrebla* species), *Chrysopogon fallax* and *Dichanthium* species (Figure 48). In the wet season these flats support a rich annual flora in both the periods of inundation and drying (Figure 44 to Figure 46, Figure 49 and Figure 50).

Figure 48. A tropical wetland grassland dominated by *Dichanthium sericeum* (a), and detail of the *Dichanthium inflorescence* (b). This photo was taken in the Northern Territory. Photos – B Keighery/OEPA.

Figure 49. A tropical wetland annual sedgeland and herbland in soils with a clay fraction. This photo was taken in the Northern Territory. Photo – B Keighery/OEPA.

Figure 50. (a) A tropical wetland annually renewed sedgeland and herbland in soils with a clay fraction, with inserts of species from these communities: (b) *Cartonema spicatum*, (c) *Stylidium ceratophorum*, (d) a *Lindernia* species, (e) a *Spermacoce* species, (f) *Utricularia fulva*, and (g) *U. chrysantha* detail. These photos were taken in the Northern Territory. Photos – B Keighery/ OEPA.

Another alluvial flat wetland group is the elongate estuarine wetlands complex associated with drowned river valleys. The best examples of this group are in Walcott Inlet (North Kimberley) at the mouths of the Isdell, Calder and Charnley rivers. The wetlands include areas of estuary, river, riverine floodplain and scarp-foot seepage rainforests. Part of this complex is the Munja Lagoon, a freshwater swamp which supports a diverse aquatic flora including waterlilies (*Nymphaea violacea*, Figure 44) and dense fringing beds of the sedge *Eleocharis dulcis* (the largest known stands in the Kimberley). Another interesting community occurs in the small areas of Seepage Swamp Rainforest dominated by *Melaleuca*, *Ficus* species, *Nauclea orientalis* and *Celtis philippensis*. This community is floristically unique and is listed as the TEC 'Assemblages of Walcott Inlet rainforest swamps'. Another TEC of a similar type is the 'Assemblages of Roe River rainforest swamp' (North Kimberley).

Alluvial flats subject to seasonal flooding are found throughout the Kimberley. These are associated with all soil/rock types and support a diverse range of grasses and herbs. Examples include the grasslands dominated by mitchell (*Astrebla* species) or feathertop (*Aristida* species) grasses on black cracking clay soils in Bungle Bungles[56] (north-east of Halls Creek, Ord Victoria Plains) and those dominated by *Leptochloa fusca* and *Xerochloa laniflora* on claypans with cracking clays in the Edgar Ranges (south-east of Broome, Dampierland). These alluvial soil communities are more diverse in the wetter north, central and east Kimberley but they are poorly documented. An example from the north, on the Walcott Inlet, is the extensive grasslands dominated by spear grass (*Heteropogon contortus*) and wanderrie grass (*Eriachne festucacea*) with scattered trees of *Eucalyptus tectifica*, *Corymbia greeniana*, *C. confertiflora*, *Terminalia canescens*, *Gardenia megasperma* and *Erythrophleum chlorostachys*.

As noted previously, the coastal section of the Roebuck Plains* (Dampierland) is saline influenced; the plains themselves are an extensive floodplain that, interestingly, now lacks any major riverine input. These plains contain many types of freshwater wetlands, including seasonally flooded grassland, permanently inundated freshwater lakes, seasonally inundated freshwater lakes and marshes. The permanently inundated[57] Lake Eda supports emergent *Sesbania erubescens* shrubs and a sedgeland dominated by *Eleocharis spiralis* (Figure 51) over the herb *Phyla nodiflora* and the grass *Cynodon dactylon*. It is yet to be determined if *Phyla nodiflora* and *Cynodon dactylon* are native or weed taxa in this wetland.

Figure 51. *Sesbania erubescens* (foreground) and a sedgeland dominated by *Eleocharis spiralis* at Lake Eda. Photo – Wetlands Section/DEC.

Dune swamps of truncated drainage lines

In sandy areas such as the Dampier Peninsula (Dampierland), coastal dunes truncate (that is, cut off/terminate) drainage lines to form freshwater swamps.[58] These typically support low woodlands of *Lophostemon grandiflorus*, *Melaleuca alsophila* and *M. viridiflora*. As these swamps dry a rich annual herb/grassland develops. Rarely, these result in permanently inundated wetlands, such as at Beagle Bay (Dampierland) where the lakes have a range of unusual aquatics including *Nymphaea violacea* and *Nymphoides indica*, at their southern limits, and the endemic *Nymphoides beaglensis*.

Springs

Freshwater seepages forming springs are found throughout the region and are typically associated with drainage lines or impeded groundwater flow. Many of these support rainforest communities, being woodlands or forests not dominated by the *Eucalyptus* or *Acacia* genera.[59] These communities are fire sensitive and are now restricted to relatively fire-protected sites, including wetlands.

An example is the unique Willie Creek Wetlands* found north of Broome on the tidally inundated mudflats (Dampierland). Here are two spring-fed wetlands, Nimalaica Swamp and an unnamed lake. These are vegetated with spike rush (*Eleocharis dulcis*) sedgelands, *Melaleuca cajuputi*, *Timonius timon* and *Pandanus spiralis* forest. Many of the species found here are at their southern range limits or are disjunct populations.

Another type of spring is found in the east Kimberley. An example of this type is Point Springs (north-east of Kununurra, Victoria Bonaparte) which supports a closed canopy rainforest dominated by *Canarium australianum*, *Carallia brachiata*, *Melicope elleryana*, *Ficus racemosa* and *F. virens* and combinations of these. Rainforest patches are rare in the lowland east Kimberley, this area normally being dominated by open savanna woodlands.

Similar rainforest communities are associated with the cliff-foot springs in the Devonian limestone ranges (Oscar and Napier ranges of the Central Kimberley and Nimbing Ranges of the Victoria Bonaparte). It is reported that many of these are drying through dewatering of the karst system, by bores for livestock water and irrigation. One rainforest community is listed as the TEC 'Assemblages of Theda Soak rainforest swamp' (Northern Kimberley).

In places the seepages form organic mound springs. Each mound spring appears to support a unique community, with a forest of *Melaleuca cajuputi* and/or *Timonius timon*, and spike rush (*Eleocharis dulcis*) sedgelands being key elements. Black Springs (North Kimberley), Big Springs* (Dampierland), Lolly Well (Dampierland) and Bunda Bunda Springs* (Dampierland) support such communities. Of these three are listed as TECs: 'Black Spring organic mound spring community', 'Assemblages of Big Springs organic mound springs' and 'Assemblages of Bunda Bunda organic mound spring'. Another five mound springs are associated with the Drysdale River (North Kimberley) and have been listed as the TEC 'Organic mound spring communities of the North Kimberley Bioregion'. These are generally covered in sedgeland with a sparse overstorey of *Melaleuca nervosa*, *Pandanus spiralis* and *Banksia dentata* (Figure 52), or in the case of the Black Spring, a forest of *Melaleuca viridiflora*, *Ficus* species, *Timonius timon* and *Pandanus spiralis* with fringing *Phragmites karka* grassland.

Figure 52. *Banksia dentata* is a widespread tropical wetland tree. This photo was taken in the Northern Territory. Photo – B Keighery/OEPA.

In a deeply incised gully in the Edgar Ranges (south-west of Broome, Dampierland) a series of pools fed by the permanent Logues Spring are vegetated with a woodland of *Eucalyptus microtheca* and an endemic variety of pandanus, *Pandanus spiralis* var. *flammeus*.[60] Gorges in the Bungle Bungles (Ord Victoria Plains) contain permanent pools with rare aquatics and lined by relict disjunct rainforest of *Melaleuca leucadendra*, *Melicope elleryana* and *Syzygium angophoroides*.

Perched wetlands

Perched wetlands are relatively uncommon in the region but they are typically quite similar to the wetlands of the alluvial flats. Seasonally inundated freshwater basins and swamps include Airfield Swamp[61] on the Mitchell Plateau (North Kimberley) with forests of *Melaleuca* species (Figure 53) over a diverse annually renewed aquatic flora (Figure 44) and herblands as the wetlands dry (Figure 49 and Figure 50). Lake Gladstone* (Central Kimberley) is covered with a sedgeland of *Eleocharis dulcis* and fringed by woodlands of *Barringtonia acutangula* and *Eucalyptus camaldulensis*.[62] Rarely, some are even found on offshore islands; for example on the Sir Graham Moore Islands (North Kimberley) there is a large swamp with woodlands of *Melaleuca viridiflora* and sedgelands of *Fuirena ciliaris*. Herblands on basalt were recorded on Wargul Island (North Kimberley, Figure 54), and these are also common on the adjacent mainland. A dampland (seasonally waterlogged basin) on Mary Island (North Kimberley) also appears to be perched and has scattered *Pandanus spiralis* over *Schoenus falcatus* sedgeland (Figure 55).

Figure 53. *Melaleuca viridiflora* forest over *Eleocharis dulcis* sedgeland at Airfield Swamp. Photo – Wetlands Section/DEC.

Figure 54. A perched wetland on basalt on Wargul Island (North Kimberley) with a herbland of *Byblis guehoi* (a). *Byblis guehoi* (b) is one of six *Byblis* species currently known from wetlands in WA.[11] Photo – G Keighery/DEC.

Figure 55. A dampland on Mary Island (North Kimberley) of scattered *Pandanus spiralis* over *Schoenus falcatus* sedgeland (a) and a *Schoenus falcatus* plant (b). Annual sedges and herbs are found in the bare patches in the wet season. Photo – G Keighery/DEC.

Wetland flora of the Kimberley

Pan-tropical: distributed throughout the tropical regions of the Earth

The systematic allocation to wetland or dryland habitats of all taxa listed in the *Flora of the Kimberley*[24] results in a list of 1,977 native vascular plant taxa for the Kimberley, of which approximately 535 (27 per cent) are considered to be wetland obligates, that is, restricted to wetlands (Table 3).

Table 3. Kimberley vascular plant taxa found in various plant groups (after Wheeler et al.[24])

Group	Wetland obligate taxa					Wetland facultative & dryland
	Saline	Freshwater submerged or floating aquatic	Freshwater emergent aquatic	Freshwater seasonally waterlogged wetlands	Obligate wetlands, total	Wetland facultative & dryland
Ferns	2	1	7	22	32	15
Gymnosperms	0	0	0	0	0	5
Monocotyledons	0	24	9	190	223	281
Dicotyledons	30	30	14	206	280	1,141
Total	**32**	**55**	**30**	**418**	**535**	**1,442**

Of particular note is that thirty-two of fifty-seven ferns are confined to, or reliant on, wetlands. The composition of this wetland flora is markedly different to the dryland flora and the presence of wetland habitats contributes greatly to the richness and diversity of the flora of the Kimberley. For example, the families Aponogetonaceae, Alismataceae, Lentibulariaceae and Menyanthaceae are entirely aquatic. In addition, all of the following are wetland plants in the Kimberley: all of the Centrolepidaceae and all members of the genera *Nymphoides* (seven species, Figure 45 and Figure 46), *Utricularia* (twenty-seven species, Figure 50f&g), *Eleocharis* (thirteen species), *Cyperus* (fifty species, Figure 56a&b), *Fimbristylis* (most of the c. 60 species, Figure 56c&d) and *Xyris* (Figure 57). Interestingly, a number of genera are species diverse in wetlands in both the Kimberley and the Southwest, including the genera *Drosera* (Figure 28), *Stylidium* (Figure 29) and *Xyris* (Figure 57).

Most of the Kimberley saline and floodplain wetland taxa are either **pan-tropical** or widespread across northern Australia, as is also the case with the Northern Territory wetland flora.[25] However, in WA there is a significant endemic element, especially in those wetlands of the North Kimberley that are inundated only after unpredictable rain. Of particular note is the endemic waterlily genus *Ondinea* (sometimes placed in the genus *Nymphaea*) that occurs on the high rainfall sandstone areas of the north-western Kimberley. Two subspecies are currently recognised; both are endemic and one (*Ondinea purpurea* subsp. *petaloidea*) is highly restricted. This endemic element is also found in the dryland flora.

Figure 56 (below). Two tropical wetland sedges: *Cyperus aquatilis* (a and b) which is confined to the Kimberley and *Fimbristylis caespitosa* (c and d) which is virtually confined to the Kimberley. Photos – (a) C Budgen, D Clarke and T Whiteway; and (b) CP Campbell. Mapping – P Gioia. Images used with the permission of the Western Australian Herbarium, DEC. Accessed 21/06/2011.

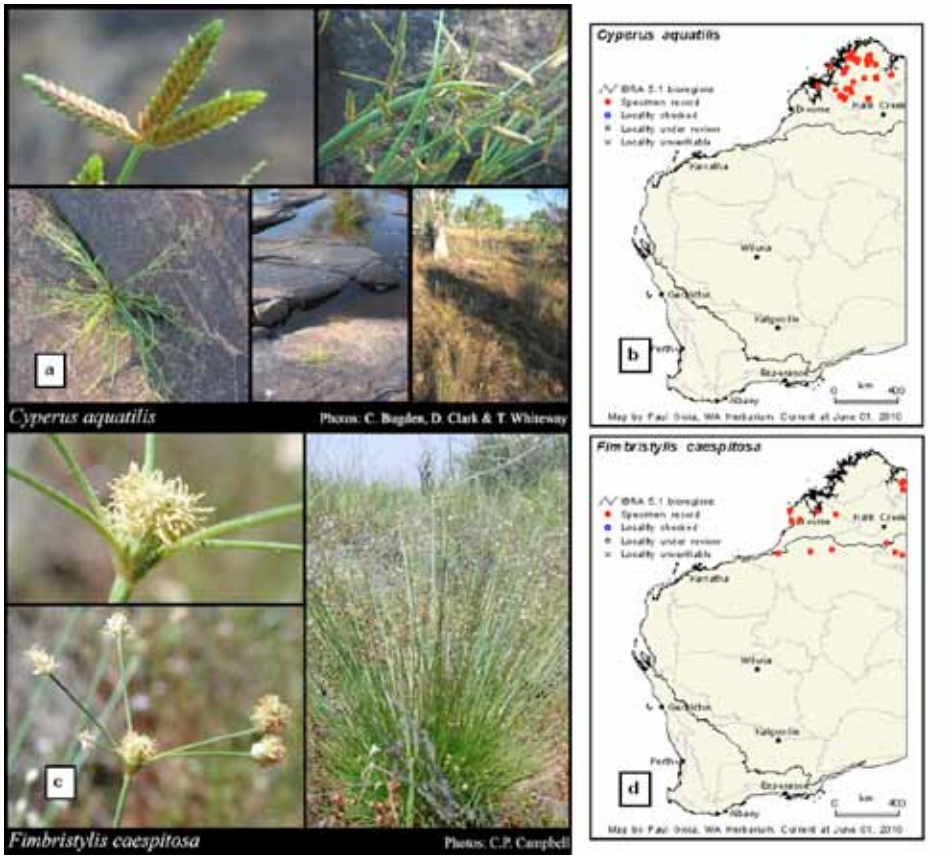


Figure 57. A tropical wetland with *Eucalyptus* forest over a sedgeland dominated by *Xyris complanata* (a), with detail of the *Xyris* flowers (b). This photo was taken in the Northern Territory. Members of the *Xyris* genus are found in Kimberley and Southwest wetlands; they all have yellow flowers. Photos – B Keighery/OEPA.

A guide to managing and restoring wetlands in Western Australia

Wetland vegetation and flora, part 3: Desert

In Chapter 2: **Understanding wetlands**

Australian Government

Department of Environment and Conservation

Our environment, our future

Contents

Wetland profiles

Introduction

Western Australia is a very large state and there is a great deal of variability in wetland vegetation and flora across it. The Deserts are one of three major climatic and biogeographical zones (Figure 58):

- Kimberley – tropical, warm to hot all year, summer rainfall and a dry winter
- Deserts – hot desert, infrequent erratic rainfall
- Southwest – Mediterranean, warm to hot dry summer, cool wet winter.

The differing climate of these three regions drives important variations in wetland vegetation.

Figure 58. WA's bioregions and the three climatic zones used in this topic. Image – C. Auricht, Auricht Projects.

The next major driver of the wetland vegetation and flora characteristics of the Deserts is whether they inhabit freshwater or saline wetlands. Wetland plant communities are distinctive of the zone and water chemistry, contributing both to the local and state identity and contributing greatly to the uniqueness of WA and Australia.

Thirdly, in addition to zone and freshwater/saline divisions, the Desert wetlands can be grouped according to the similarity of their vegetation characteristics. In the Desert zone, these groups are:

- Internally Drained Deserts
  - extensive saline wetland chains
  - playas and barlkarras
  - springs
  - claypans
  - riverine

- Externally Drained Deserts
  - saline riverine
  - saline lakes
  - alluvial flats
  - springs
  - seasonally waterlogged wetlands
  - claypans.

Deserts

The arid zone of WA encompasses most of the land area of the state. Over this huge area the erratic rainfall patterns can be tropical (summer), bixeric (erratic non-seasonal rain) or winter rainfall, and combinations of these. Generally, the majority of the Desert wetlands are saline and species poor (Figure 59). The uncommon freshwater wetlands are major refugia for plants and animals[63] at a national scale with many species showing great range disjunctions.

Figure 59. The dry salt encrusted bed of Lake Disappointment (Tanami) with a band of samphire shrubland and surrounding low dunes. Photo – W Thompson.

Two distinct forms of drainage are present in the Desert, and these influence wetland types. Accordingly, the Desert vegetation and flora is split into two key subzones:

- Internally Drained Deserts: central deserts with internal or uncoordinated drainage (occluded tertiary palaeo-drainage systems)
- Externally Drained Deserts: western externally drained deserts which extend to the coast.

The western Externally Drained Deserts are more diverse in all wetland types and contain rare endemics and communities. In both subzones the vegetation of the catchment and wetlands are largely intact. However, there are still many threatening processes affecting wetlands including water extraction, grazing and trampling by domestic and feral animals, mining activities and fire.

Internally Drained Deserts

The biogeographic regions of the Internally Drained Deserts are the Little Sandy Desert, Gibson Desert, Murchison; and parts of the Tanami, Central Ranges, Great Sandy Desert, and Great Victoria Desert. Only the Carnegie Salient part of the Gascoyne (the eastern part of the Gascoyne) is included in the Internally Drained Deserts as the western portion of the Gascoyne drains to the coast. These arid regions are typified by sandy soils with scattered rocky ranges and internal uncoordinated drainage, there being no obvious exterior drainage. Unlike the tropics and the temperate regions of WA, there are few wetlands that consistently hold water year-round in this region.

There are twenty listed nationally important wetlands in the Internally Drained Deserts[54] and May and McKenzie[44] propose that twenty-three wetlands are of state significance.

Wetland vegetation of the Internally Drained Deserts

The Internally Drained Deserts vegetation is dominated by hummock grasslands (grasslands dominated by spinifex), tussock grasslands (grasslands dominated by perennial grasses other than spinifex), *Acacia* shrublands, chenopod and samphire succulent shrublands and *Eucalyptus* dominated woodlands and mallee shrublands. In the wetlands the common vegetation is forests, sedgelands, herblands and chenopod and samphire succulent shrublands, which are normally rare elsewhere. Common wetland species include the trees *Eucalyptus camaldulensis* (Figure 60c), *E. victrix* and *E. microtheca*; the shrubs *Muehlenbeckia florulenta* (Figure 61c&d), *Frankenia* species (Figure 61a&b), samphires (*Tecticornia halocnemoides*, *T. undulata*, *T. indica*, *T. doleiformis*) and a variety of *Melaleuca* and *Acacia* species; and the freshwater grass *Eragrostis australasica*.

Figure 60 (below). Three trees from the Internally Drained Deserts.
(a) *Casuarina pauper*. Photo – R Davis.
(b) *Eucalyptus striaticalyx*. Photo – A Doley and M French.
(c) *Eucalyptus camaldulensis*. Photo – W Thompson.
Images (a) and (b) used with the permission of the Western Australian Herbarium, DEC. Accessed 21/06/2011.

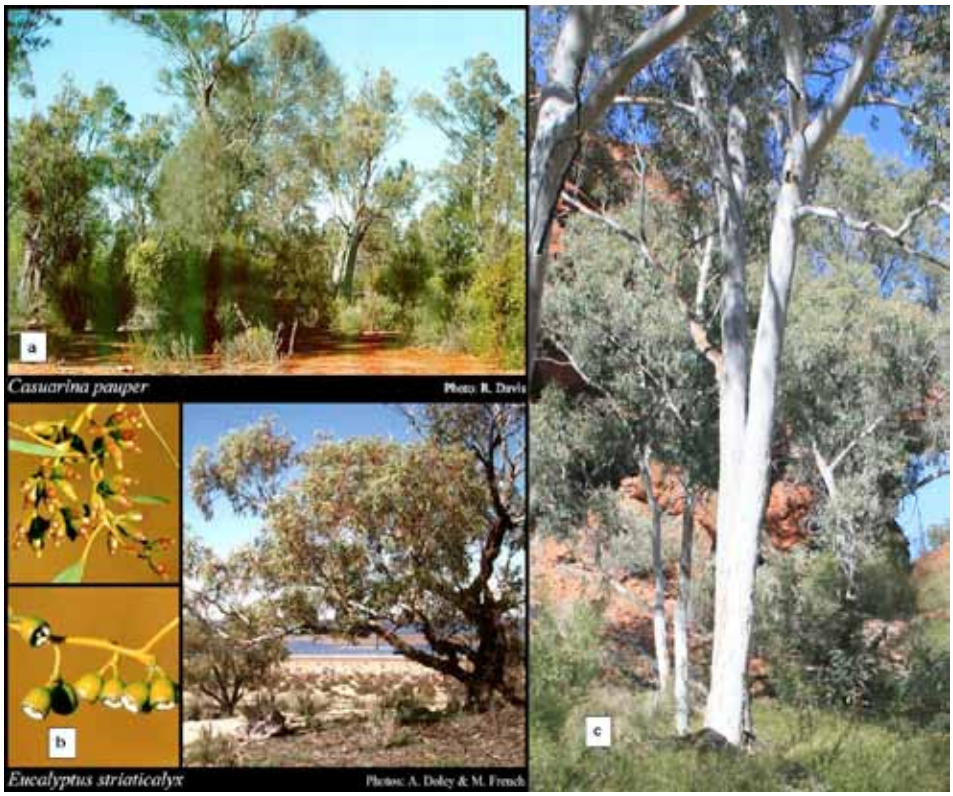
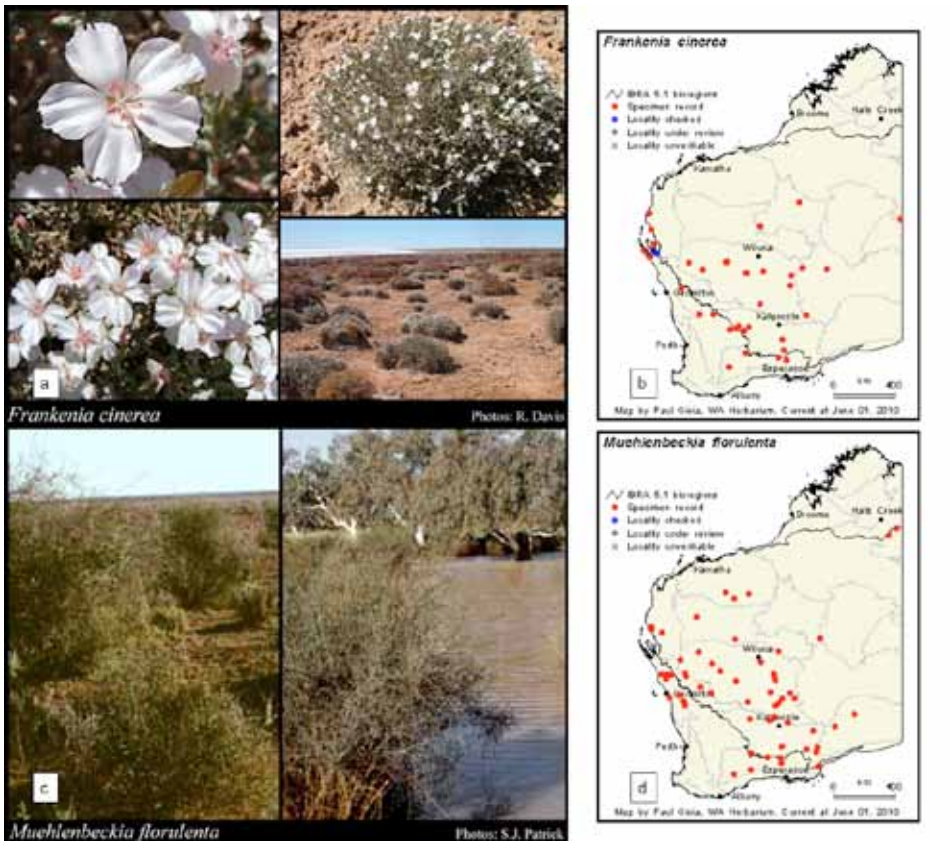


Figure 61 (below). Two shrubs of Desert wetlands.
(a) *Frankenia cinerea*. Photo – R Davis and (b) Distribution in WA. Mapping – P Gioia.
(c) *Muehlenbeckia florulenta*. Photo – SJ Patrick and (d) Distribution in WA. Mapping – P Gioia.
Images used with the permission of the Western Australian Herbarium, DEC.
Accessed 21/06/2011.



The wetland vegetation of the Internally Drained Desert is generally very poorly documented and around eighty vegetation units are described in the available publications and reports. This is obviously an underestimate as the detailed studies of Lake Way (near Wiluna, Murchison) by Blackwell and Trudgen[64] demonstrate. Here they described twenty-eight plant communities:

- twenty-two Lacustrine and Allied Halophytic Associations – eleven Chenopod Steppe Associations, mainly *Tecticornia* species Low Samphire Shrub associations; and eleven Halophytic Shrublands (dominated by *Atriplex*, *Tecticornia*, *Frankenia*, *Cratystylis* and *Samolus junceus*)
- six Strand Vegetation Types – *Muellerolimon salicorniaceum* and *Melaleuca interioris* shrubland, four mulga (*Acacia aneura*) dominated and a *Melaleuca xerophila* Low Closed Forest.

Saline wetlands of the Internally Drained Deserts

Extensive saline wetland chains are the major wetland type of the inland deserts. There are more than one hundred such wetlands (Figure 62 to Figure 64) of which the largest are listed below in the bioregions in which they are located:

- Central Ranges – Lake Christopher
- Great Sandy Desert – Lakes MacDonald, Auld, Dora*, Tobin, Mackay, Wills, Percival and Wakarlcarly
- Gibson Desert – Lakes Blair, Cohen and Hancock, and the Breaden System are considered wetlands of regional significance.[44] Other large lakes are Gillen and Newell. Figure 67 illustrates a Gibson Desert claypan
- Little Sandy Desert – Lakes Disappointment* (150,000 hectares; Figure 59, Figure 62 and Figure 63), Keene, Terminal, Sunshine, Yanneri and Wilderness
- Tanami – Lake Hopkins
- Gascoyne – these are mainly in the Carnegie Salient, being Lakes Burns, Carnegie* (153,000 hectares) and Nabberu
- Great Victoria Desert – Lakes Minigwal* (Figure 64), Throssell*, Raeside, Rason, Wells and Yeo*
- Murchison – Lakes Annean* (120,000 hectares), Austin, Ballard* (60,000 hectares), Barlee* (194,000 hectares), Carey, Cowan, Darlot, Lefroy, Marmion*, Moore (extends across several bioregions) and Rebecca. These are generally smaller than the more inland desert wetlands, although they are much better documented.

These wetlands rarely fill and are often bare or covered in a variety of samphire shrublands dominated by *Tecticornia* species (*T. halocnemoides*, *T. undulata*. *T. indica* and *T. doleiformis*) and other shrubs such as *Atriplex* species (Figure 65a) (especially Bladder Saltbush, *A. vesicaria*), *Maireana* species and/or *Frankenia* species. Despite their importance and size, remarkably few (noted by an asterisk *) are listed as nationally important wetlands and most of these are from the southern areas.

Figure 62. An area of Lake Disappointment (Tanami) with a band of samphire shrubland and surrounding low dunes. Photo – W Thompson.

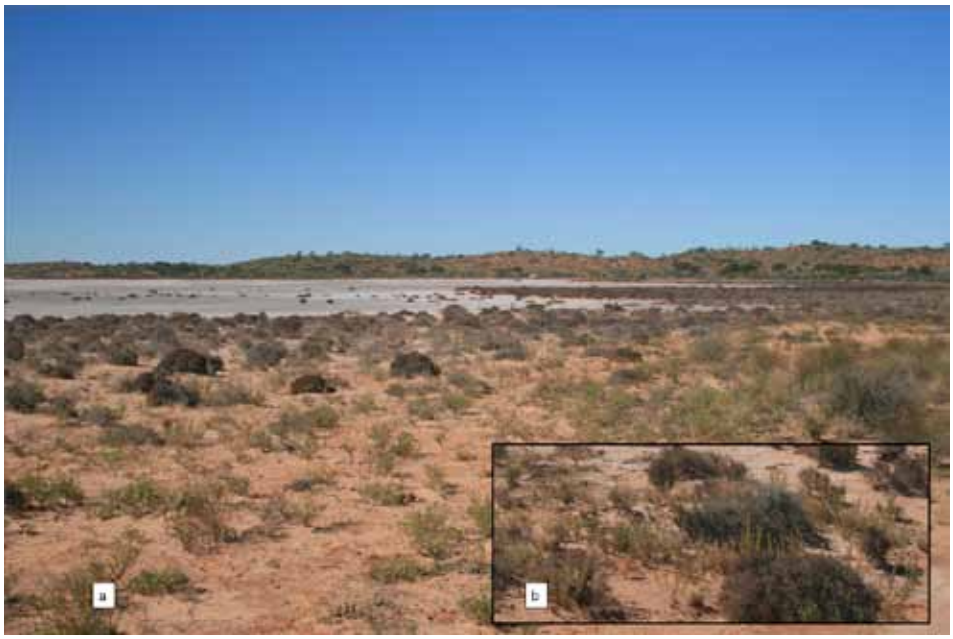
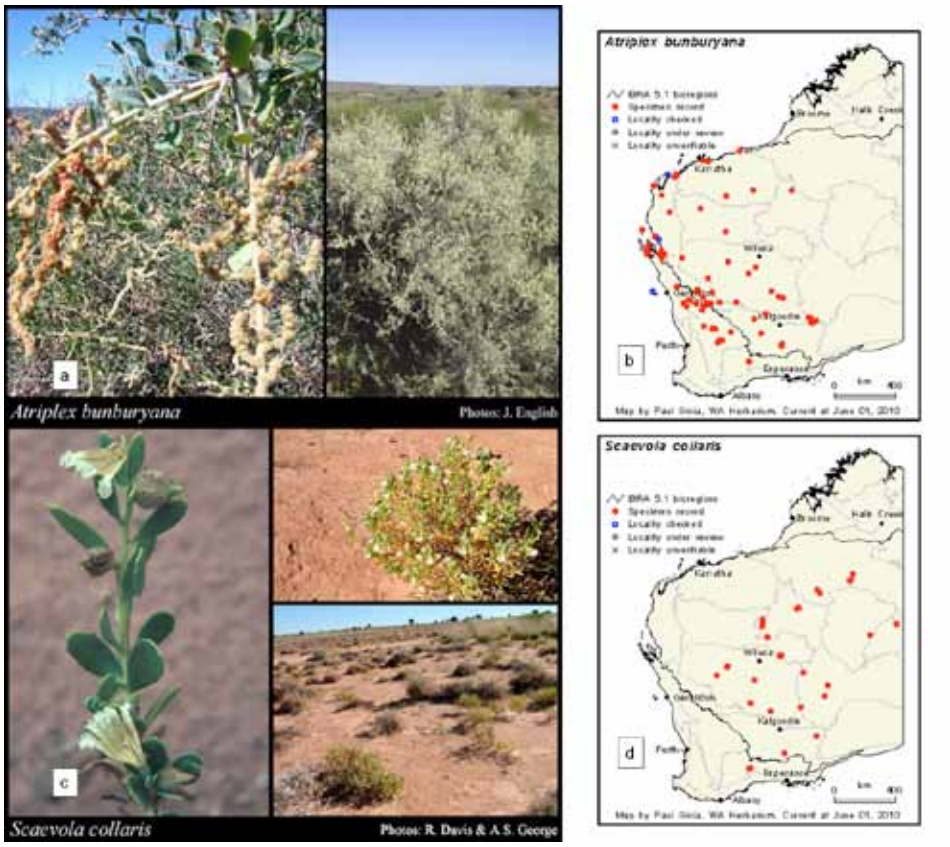


Figure 63. An area of Lake Disappointment (Tanami) showing a broader band of samphire shrubland and other salt tolerant shrubs (detail in b) and surrounding low dunes. Photo – W Thompson.

Figure 64. Lake Minigwal (Great Victoria Desert) with a dry salt encrusted lake bed, a samphire shrubland band and eucalypts on the surrounding dryland dunes. Photo - W Thompson.

Figure 65 (below). Two shrubs of Desert wetlands.
(a) *Atriplex bunburyana*. Photo – J English and (b) Distribution in WA. Mapping – P Gioia.
(c) *Scaevola collaris*. Photo – R Davis and AS George and (d) Distribution in WA. Mapping – P Gioia.
Images used with the permission of the Western Australian Herbarium, DEC.
Accessed 21/06/2011.



Associated with the salt lakes are two groups of flat wetlands subject to waterlogging.[65] The first of these are on the calcrete surfaces (hardened calcium carbonate deposits). Drainage in these areas is via sheet flow and open flow lines into the salt lakes. These are covered in 'calcrete woodlands' dominated by *Casuarina pauper* (Figure 60a) or *Eucalyptus clelandii*, usually over chenopod shrublands. The second group are the Kopi (gypsum) dunes that often fringe the desert salt lakes, and in Lake Rebecca they cover much of the lake bed. These dunes typically have *Eucalyptus striaticalyx* (Figure 60b), *E. lesouefii* or *Casuarina pauper* woodlands.

Higher on the alluvial plains are incised (that is, relatively steeply eroded) drainage lines carrying flows to the salt lakes. These apparently less saline sites support silver saltbush (*Atriplex bunburyana*, Figure 65a&b) shrublands or, rarely, *Eucalyptus camaldulensis* woodlands.

In a few instances there are salt marshes close to the coast, such as the Mandora Saltmarsh (part of the Mandora Palaeo-river, Great Sandy Desert). This wetland complex extends over 95 kilometres and covers an area of more than 200,000 hectares. This vast area supports a complex and diverse set of wetlands and plant communities including lakes that are largely bare of vegetation or have low open shrublands of samphires, grasslands and fringing alluvial flats with shrublands of *Acacia ampliceps* and *Melaleuca alsophila*. Of particular interest is Salt Creek, a permanently inundated wetland lined by white mangrove (*Avicennia marina*) and samphire shrublands. These populations of white mangroves are the second largest inland occurrence of mangroves in WA (the largest being at Lake McLeod in the externally drained deserts). Within the salt marsh are

also a series of freshwater wetlands: swamps with open forests of *Melaleuca argentea*; and a variety of mound springs such as Eil Eil Springs that supports a tall *Melaleuca leucadendra* closed forest and Saunders Springs (a sub-saline mound spring) with *Sesbania formosa* forest over mangrove fern (*Acrostichum speciosum*) on the top of the mound and *Typha domingensis* and *Fimbristylis ferruginea* sedgeland on the slopes. The springs are listed as the TEC 'Assemblages of the organic springs and mound springs of the Mandora Marsh area'.

Freshwater wetlands of the Internally Drained Deserts

Four groups of wetlands are distinguished here: playas and barlkarras, springs, claypans and riverine.

Playas and barlkarras

Rare freshwater playas and barlkarras (intermittently inundated basins and flats respectively; see Table 1 for more information) fill after rainfall events; some examples of these, from various bioregions, are listed below.

- Gibson Desert – Lake Gruszka* (up to 2,000 hectares) covered by coolibah (*E. victrix*) woodland over cane grass (*Eragrostis australasica*) grassland. A similar wetland, Boyd Lagoon, is listed as a wetland of regional significance.[44]
- Tanami Desert – Lake Gregory*, known as Paruku by the Tjurabalan traditional owners (38,700 hectares) which is filled by Sturt Creek and holds surface water for extended periods. The waterline is fringed by *Eucalyptus victrix* and *E. microtheca* (both called coolibah) woodlands, *Melaleuca* shrublands and samphire shrublands. The creeks and the outer areas of the wetland support an *Acacia maconochieana* shrubland with scattered emergent *E. camaldulensis*, *E. victrix* and *E. microtheca* woodland over *Acacia holosericea* and *A. maconochieana* shrubland. There are two additional zones: shrublands dominated by *M. glomerata* over grassland of *Eulalia aurea* and the weed buffel grass (*Cenchrus ciliaris*); and a samphire shrubland dominated by *Tecticornia indica* and *T. halocnemoides* with herbs and grasses. Aquatics include *Myriophyllum verrucosa*, *Najas marina* and *Ruppia* species. Lake Wilson (10,000 hectares when full to 200 hectares in drought) is fringed by *Melaleuca glomerata* woodland and grassland of *Eragrostis desertum*.
- Murchison – Lakes Breberle and Wooleen covered by *Eucalyptus camaldulensis* woodlands and lignum (*Muehlenbeckia florulenta*) shrublands. Lake Boonderoo* fills with freshwater when the palaeo-drainage line, Ponton Creek, flows. This large wetland at the end of the drainage line initially contains freshwater and becomes more saline as it dries. Samphire shrublands fringe the bed.

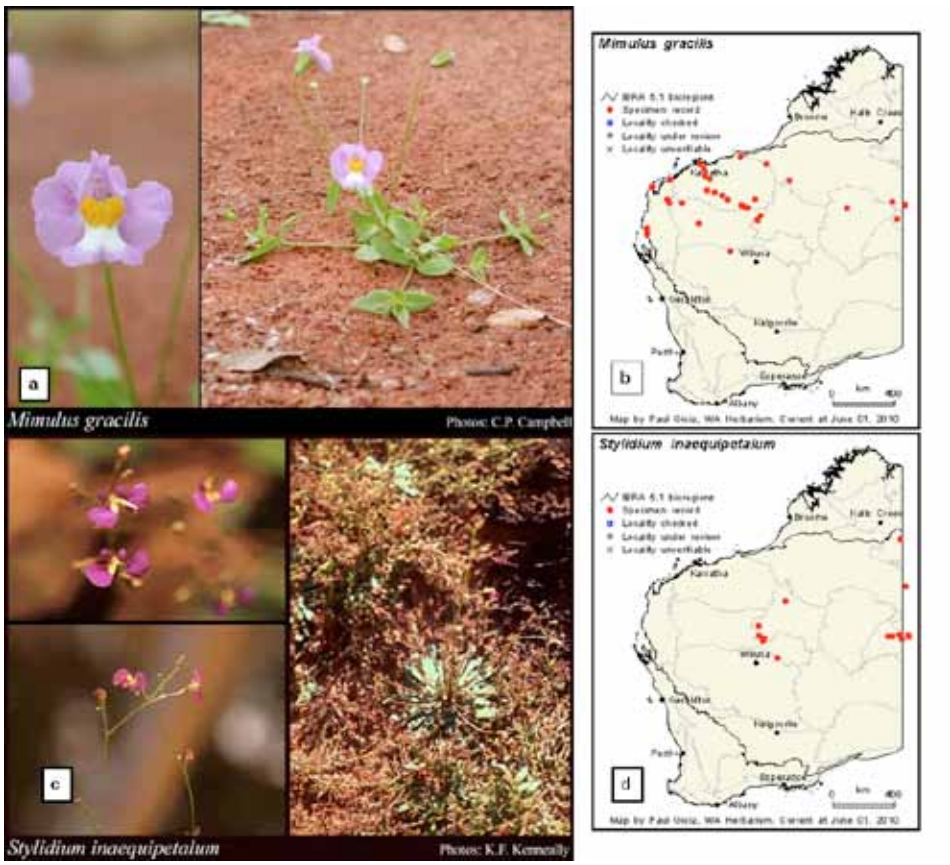
Springs

Many of the freshwater wetlands rely on seepages (natural springs); some examples of these, from various bioregions, are listed below.

- Great Sandy Desert – Dragon Tree Soak*, also called the Munro Springs, in the McLarty Hills, is a permanently inundated wetland which contains a central sedgeland of *Baumea articulata* fringed by woodlands to forests of *Sesbania formosa* over *Typha domingensis*. This spring has formed an organic peat mound and is a rare example of a true mound spring in the Western Australian deserts. Small claypan areas are also associated with this wetland; these have a cover of grasslands dominated by *Sporobolus virginicus* or samphire shrubland of *Tecticornia indica*. The entire complex is listed as the TEC 'Assemblages of Dragon Tree Soak organic mound spring'. Freshwater springs within the saline Mandora Saltmash, such as Eil Eil Springs, are discussed in the previous section on saline wetlands.
- Gascoyne (Carnegie salient portion) – Windich Springs*, a permanently inundated channel lined by *Eucalyptus camaldulensis* forest over sedgeland with aquatics such as *Lepilaena bilocularis* and *Potamogeton crispus*. *Casuarina obesa* and *Schoenoplectus subulatus* are also found in these springs.

- Tanami (Gardner and Dennison Ranges, Coates et al.[66] and Kenneally and Edinger[67]) – Mt Brophy Springs is fringed by *Eucalyptus camaldulensis* and *Acacia neurocarpa* and *Melaleuca nervosa* shrubland. A *Livistona* sp. forest has been recorded at Talbot, Palm (Tanami) and Maurice springs. These springs support a suite of typical Kimberley wetland species including *Byblis filifolia*, *Drosera derbyensis*, *D. hartmeyerorum*, *Stylidium fissilobium*, *S. leptorhizum*, *S. schizanthum*, *Thysanotus chinensis*, *Nesaea muelleri*, *Nymphoides indica* and *Utricularia gibba*. These are the most southern and disjunct populations of these plants and the only Desert populations. Other highly disjunct populations present are *Drosera burmanni*, *Mimulus uvedaliae*, *Stylidium adenophora*, *S. inaequipetalum* (Figure 66) and *Wahlenbergia queenslandica*, but these have also been recorded in wetlands in the Central Ranges.

Figure 66 (below). Two herbs of Internally Drained Desert wetlands.
(a) *Mimulus gracilis*. Photo – CP Campbell and (b) Distribution in WA. Mapping – P Gioia.
(c) *Stylidium inaequipetalum*. Photo – KF Kenneally and (d) Distribution in WA. Mapping – P Gioia.
Images used with the permission of the Western Australian Herbarium, DEC.
Accessed 21/06/2011.



Claypans

Scattered through these Deserts are many poorly documented perched claypans (Figure 67). Pringle et al.[68] record mulga shrublands with claypan grass understoreys (*Eriachne flaccida*, *Eragrostis setifolia*). Other claypans have *Tecticornia arborea* (a freshwater samphire) herblands, *Callistemon phoeniceus* shrublands, *Melaleuca interioris* shrublands, lignum (*Muehlenbeckia florulenta*) shrublands and cane grass (*Eragrostis australasica*) grasslands.

The largest are Mungilli Claypan* (Gibson Desert, also called Mangkili Claypans), fringed by *Eucalyptus victrix* woodland and covered with *Eragrostis australasica* grassland over herbs; and Mungawolagudgi Claypan (Gascoyne) with scattered *Eucalyptus victrix* and *Melaleuca interioris* shrublands. Such large claypans are uncommon; in general the claypans are small and undocumented unless associated with other features such as Dragon Tree Soak (see above under 'Springs').

Gnamma: a hole (commonly in granite) that collects rainwater, forming a wetland. This word is of Nyoongar origin.

Diatom: a microscopic, single-celled alga with cell walls made of hard silica, forming fossil deposits

Figure 67. Mina Mina soak (Gibson Desert), a Desert claypan.
(a) *Eucalyptus victrix* woodland over *Myriocephalus* herbland.
(b) *Myriocephalus rudallii* flowers.
Photos – W Thompson.

Riverine

Most of the Desert ranges contain short freshwater creek lines and pools fringed by *Eucalyptus camaldulensis* over sedges (Figure 68). A variety of different wetlands may be associated with these watercourses, including the following:

- **Gnamma** holes (for example, Gibson Desert gnamma holes*) on granitic and sandstone surfaces, generally supporting little vascular flora but supporting aquatic algae and **diatom** assemblages.
- Larger pools and springs typically having a fringing margin of seasonally waterlogged wetland that supports ferns and herbs and *Eucalyptus camaldulensis* woodlands on the outflow creeks. These are found in the West Clutterbuck Hills in the Gibson Desert; Breaden* and Southesk Tablelands, around Lake Percival in the Great Sandy Desert; Calvert, Durba (Durba and Biella springs, Figure 68) and Carnarvon Hills

(Virgin, Muirs, Yamad, Kadyara, Miringka and Wandan pools) in the Little Sandy Desert; Erong Springs in the Gascoyne (Carnegie Salient), Queen Victoria Springs in the Great Victoria Desert, Walter James Range*, Rawlinson Range and the Rebecca and Giles creek systems in the Central Ranges. Sedgelands of *Cyperus vaginatus* (Figure 68b) are a rare feature of these pools and springs, mainly where water is permanent.

Two unique channel wetlands are found in the Great Sandy Desert: the Rudall River System* (more than 300 kilometres long) and Savory Creek (more than 280 kilometres long). These are the only examples of arid zone rivers with wetlands that are almost always permanently inundated along their courses. The Rudall River flows from drylands across the desert to empty into Lake Dora, while Savory Creek empties into Lake Disappointment about 160 kilometres north of Lake Dora. The Rudall River is lined by *Eucalyptus camaldulensis* and *E. microtheca* woodlands, over a *Erythrina vespertilio* woodland, over mixed *Acacia ampliceps*, *A. dictyophleba*, *A. holosericea* and *A. eriopoda* shrublands, over grasslands dominated by *Whiteochloa cymbiformis*, *Leptochloa fusca* and *Eragrostis speciosa*. Patches of paperbark (*Melaleuca cajuputi*) woodlands are uncommon. Alluvial flats support grasslands of *Eriachne obtusa* with scattered shrubs of *Melaleuca lasiandra* and *Acacia monticola*. Closer to Lake Dora the river becomes more saline and claypans dominated by succulent shrublands occur, with *Tecticornia calyptrata*, *Trianthema oxycalyptra*, *Salsola australis* and *Frankenia* species. Savory Creek flows around every 3–4 years and is fresh in its upper reaches and supports similar vegetation to the Rudall River but with some semi-permanent pools. As it becomes more saline it forms wide braided channels, minor salt lakes, claypans and a permanently inundated saline swamp, all dominated by succulent shrublands.

Figure 68. Durba Springs (Little Sandy Desert) supports:
(a) *Eucalyptus camaldulensis* forest and fringing *Cyperus vaginatus* sedgeland
(b) *Melaleuca lasiandra* shrubland and *Cyperus vaginatus* sedgeland.
Photos – W Thompson.

Wetland flora of the Internally Drained Deserts

On the basis of the critical review of taxa allocated to wetland and dryland habitats in the *Flora of Central Australia*[27], the wetland flora of the Internally Drained Deserts comprises only about 10 per cent of the total Internally Drained Deserts flora (Figure 69). This reflects the paucity of wetlands in the area and, possibly, the limited number of detailed studies of the flora of these wetlands.

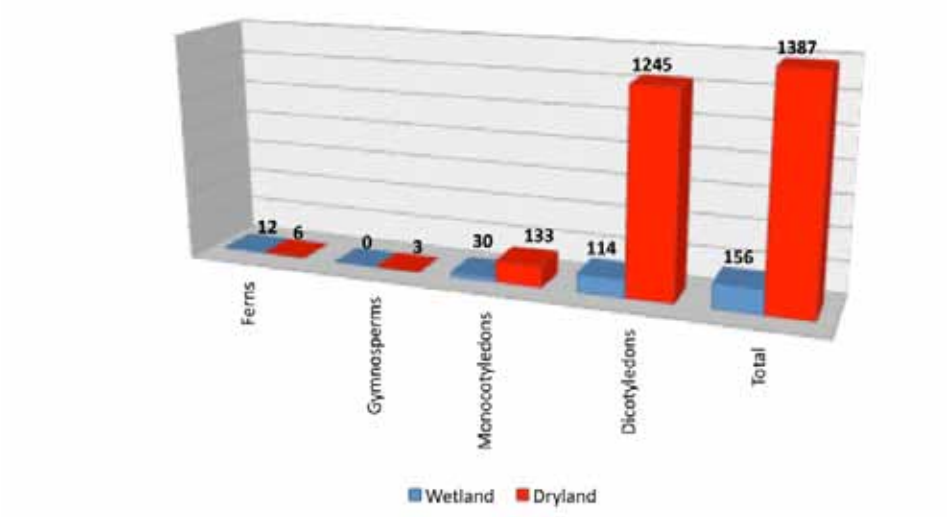
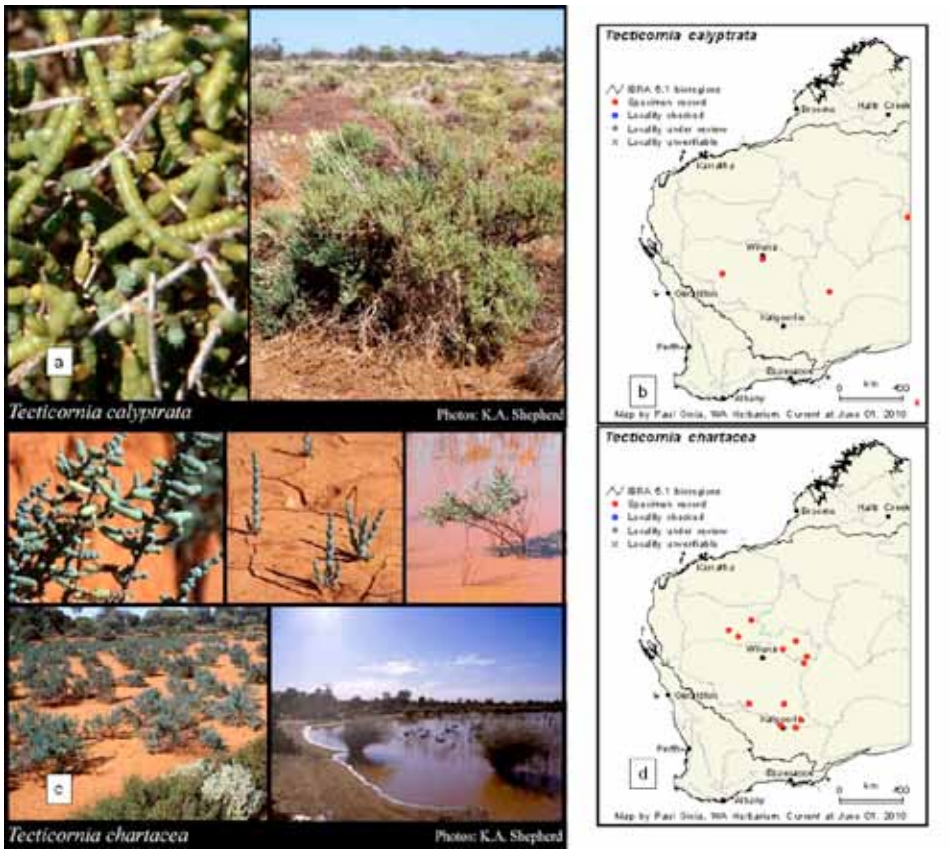


Figure 69. Internally Drained Desert wetland and dryland vascular plant taxa found in various plant groups (after Jessop[27]).

Few endemic wetland species are known from the Internally Drained Deserts and most of these are saline wetland species such as *Tecticornia* species including: *T. calyptrata* (Figure 70a&b), *T. chartacea* (Figure 70c&d), *T. flabelliformis*, *T. triandra* and the recently described *T. bibenda*. The *Livistona* species from the Talbot, Palm and Maurice springs in Tanami has never been fully documented and may be an undescribed endemic species.

Figure 70 (below). Two samphire shrubs of Internally Drained Desert wetlands.
(a) *Tecticornia calyptrata*. Photo – KA Shepherd and (b) Distribution in WA. Mapping – P Gioia.
(c) *Tecticornia chartacea*. Photo – KA Shepherd and (b) Distribution in WA. Mapping – P Gioia.
Images used with the permission of the Western Australian Herbarium, DEC.
Accessed 21/06/2011.



Typically all Desert freshwater wetlands support fringing species with a few claypan taxa from genera such as *Peplidium*, *Glossostigma* and *Elatine*. Aquatic species are also uncommon, being confined to permanently inundated sites to those inundated on a semi-permanent basis, and include *Myriophyllum verrucosum*, *Potamogeton crispus* and *Lepilaena bilocularis*.

A number of highly disjunct wetland plants are known from several permanently inundated springs:

- *Baumea articulata* and *Sesbania formosa* from Dragon Tree Soak, disjunct from the Pilbara
- a set of Kimberley species in the Talbot, Palm and Maurice springs – *Byblis filifolia*, *Drosera derbyensis*, *D. hartmeyerorum*, *Stylidium fissilobium*, *S. leptorhizum*, *S. schizanthum*, *Thysanotus chinensis*, *Nesaea muelleri*, *Nymphoides indica* and *Utricularia gibba*
- the widespread tropical and arid species *Drosera burmanni*, *Mimulus uvedaliae*, *Stylidium adenophorum*, *S. inaequipetalum* and *Wahlenbergia queenslandica*, from the Talbot, Palm and Maurice springs and wetlands in the Central Ranges.

Externally Drained Deserts

These deserts of the Pilbara, Carnarvon and western portion of the Gascoyne bioregions differ from the deserts covered above in having large rivers that flow to the sea. The main rivers of the regions are:

- Pilbara – De Grey, Fortescue and Lyons Rivers
- Gascoyne (western part) – Ashburton and upper Gascoyne Rivers (western part)
- Carnarvon – Lyndon, Gascoyne and Wooramel Rivers.

These deserts have summer rain in the north grading to winter in the south. In general, the Externally Drained Deserts have fewer salt lakes and more freshwater wetlands (especially the seasonally waterlogged wetlands of the extensive alluvial plains) than are found in the Internally Drained Deserts.

The southern-most deserts, the Nullarbor and Hampton, are included here but are highly unusual in being almost devoid of wetland flora. This is a unique feature of these bioregions. Drainage is to the sea but through underground 'rivers'. The only wetlands are small surface expressions such as rockholes (Figure 71), beach seeps and ephemeral dongas.[47] **Dongas** are found in the limestone surface of the Nullarbor. They are basin landforms usually 2–3 metres deep and up to 800 metres in diameter, containing trees. They hold water for a short time after rain due to their hard clay surface. Tree cover helps to reduce evaporation.[69,70]

There are twenty-three listed nationally important wetlands in these Deserts.[54]

Figure 71. Limestone rockhole wetlands on the Nullarbor. Photos – G Keighery/DEC.

(a) DEC staff inspecting the wetlands.

(b) Algal Community in the Cologna Rockhole, one of a series of rockhole wetlands collectively known as the Hampton Scarp Rockholes.[47]

Wetland vegetation of the Externally Drained Deserts

The vegetation of the Externally Drained Deserts is dominated by hummock grasslands, *Acacia* woodlands, forest and shrublands, tussock grasslands, chenopod and samphire succulent shrublands, heath, mangroves, *Eucalyptus* woodlands and mallee shrublands. The common vegetation units of the wetlands are mangrove forest, forests, sedgelands, herblands, chenopod and samphire succulent shrublands. All of these are normally rare, or not listed, for drylands.

More than one hundred Externally Drained Desert wetland plant communities are described in the literature. Unlike the Internally Drained Deserts, these Deserts have been the subject of both recent pastoral reports and regional biological surveys. These surveys have listed the vegetation units and described the floristics of the Carnarvon, Pilbara and Gascoyne.

➤ For more information refer to the biological surveys webpage on DEC's website.[71]

Saline wetlands of the Externally Drained Deserts

The Externally Drained Deserts have fewer saline wetlands; however, there are two very large and distinctive saline wetlands—Fortescue Marshes and Lake MacLeod—in the area, as well as a variety of smaller saline wetlands. These wetlands are described below in two groups: riverine and lakes.

Riverine

The Fortescue Marshes (Pilbara) lie in the mid-reaches of the Fortescue River and cover a vast floodplain of more than 100,000 hectares (Figure 72 and Figure 73). This huge seasonally inundated area supports a complex mosaic of plant communities.[72] The vegetation can broadly be described according to the mid- and down-slopes of the marsh. On the mid-slopes, scattered *Melaleuca lasiandra*, *M. glomerata* and *Acacia ampliceps* trees occur over *Sporobolus virginicus* and *S. mitchellii* grasslands. The scattered common shrubs are the lignums, *Muellerolimon salicorniaceum* and *Muehlenbeckia florulenta*, and less common are some unusual *Tecticornia* species. Down-slope are samphire shrublands (Figure 72) with a variety of *Tecticornia* species including *T. auriculata* (Figure 74a&b), *T. pergranulata* subsp. *pergranulata*, *T. indica* subsp. *bidens* and subsp. *leiostachya*, *T. halocnemoides* and *T. undulata*, as well as the rare priority listed *T.* sp. Christmas Creek, *T.* sp. Fortescue Marsh and *T.* sp. Roy Hill. Within the samphire shrublands are areas of grasslands dominated by *Eragrostis* (Figure 74c&d) and *Eriachne* (Figure 73b) species. The endemic shrub *Eremophila spongiocarpa* and the rare *Eremophila youngii* subsp. *lepidota* (Figure 75c&d) are also found. Patches of herbs are found in this vegetation including *Sida trichopoda* and *Zygophyllum simile* and the rare *Nicotiana heterantha* and *Peplidium* sp. fortescue marsh.

Freshwater seepages/springs and inflows are also associated with these marshes. Freshwater down-slope communities include woodlands dominated by *Eucalyptus victrix* and shrublands dominated by a variety of taxa including *Acacia xiphophylla*, *Melaleuca glomerata* and *M. bracteata*. Weeli-Wolli Spring flows into the marsh. This spring is fringed with forests and woodlands that support unique understorey assemblages of sedges and herbs, including the restricted *Stylidium weeliwolli*.

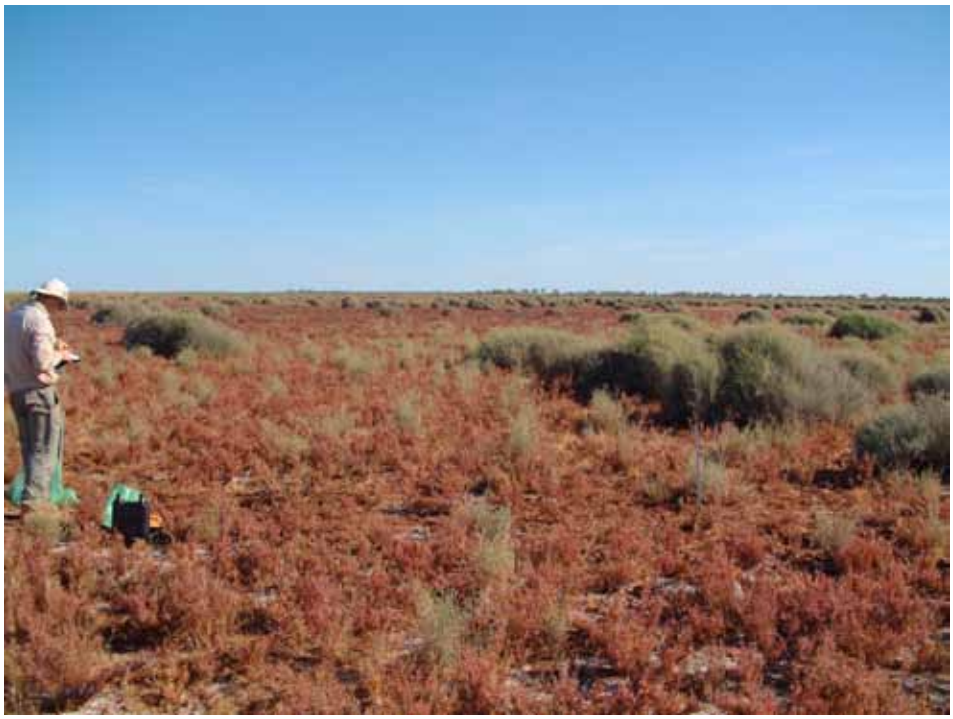


Figure 72. Samphire shrubland with *Tecticornia pergranulata*, *T. auriculata* and *T. undulata* on the outer edge of Fortescue Marsh (Pilbara), with scattered *Muellerolimon salicorniaceum*. Photo – M Lyons/DEC.

Figure 73. Fortescue Marsh (Pilbara).

(a) Fortescue Marsh edge after a major fill event. *Muellerolimon salicorniaceum* shrubland over aquatics including *Lepilaena* and *Chara* (Pilbara). Photo – M Lyons/DEC.

(b) *Eriachne benthamii* in a claypan at Fortescue Marsh (Pilbara). Photo – G Keighery/DEC.

Figure 74 (below). Two plants of the Desert wetlands.

(a) *Tecticornia auriculata*, a samphire shrub mostly found in the Externally Drained Desert. Photo – GF Craig and KA Shepherd and (b) Distribution in WA. Mapping – P Gioia.

(c) *Eragrostis falcata*, a widespread wetland grass commonly found in Desert wetlands. Photo – GF Craig and (d) Distribution in WA. Mapping – P Gioia.

Images used with the permission of the Western Australian Herbarium, DEC.
Accessed 21/06/2011.

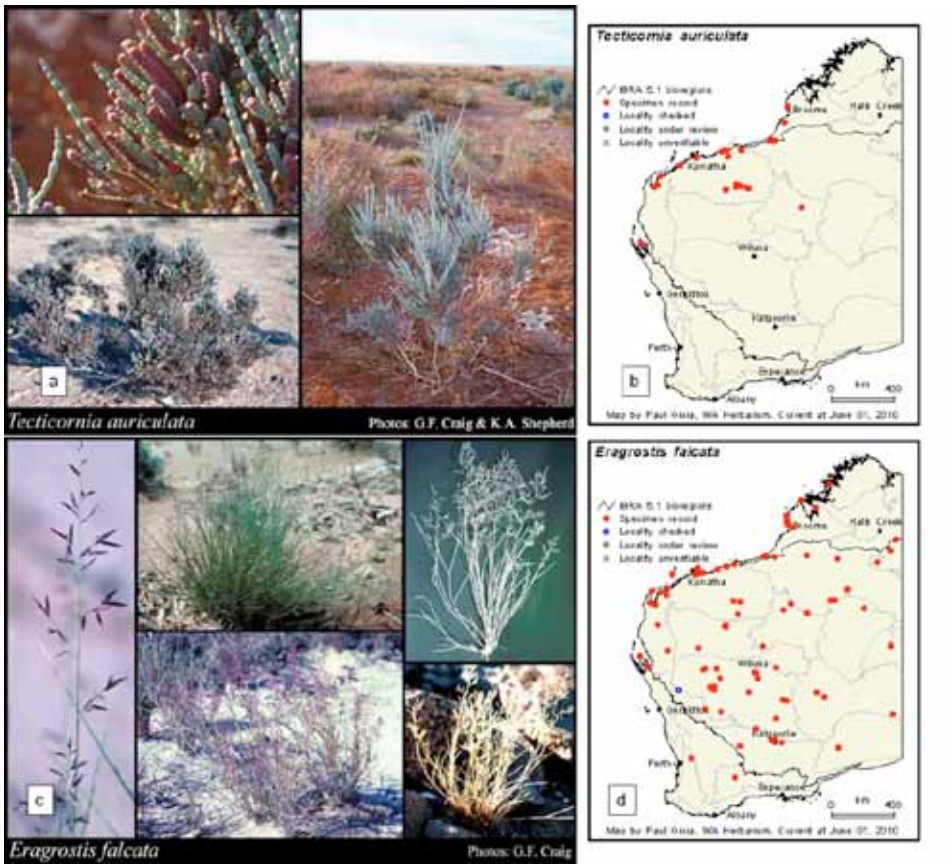
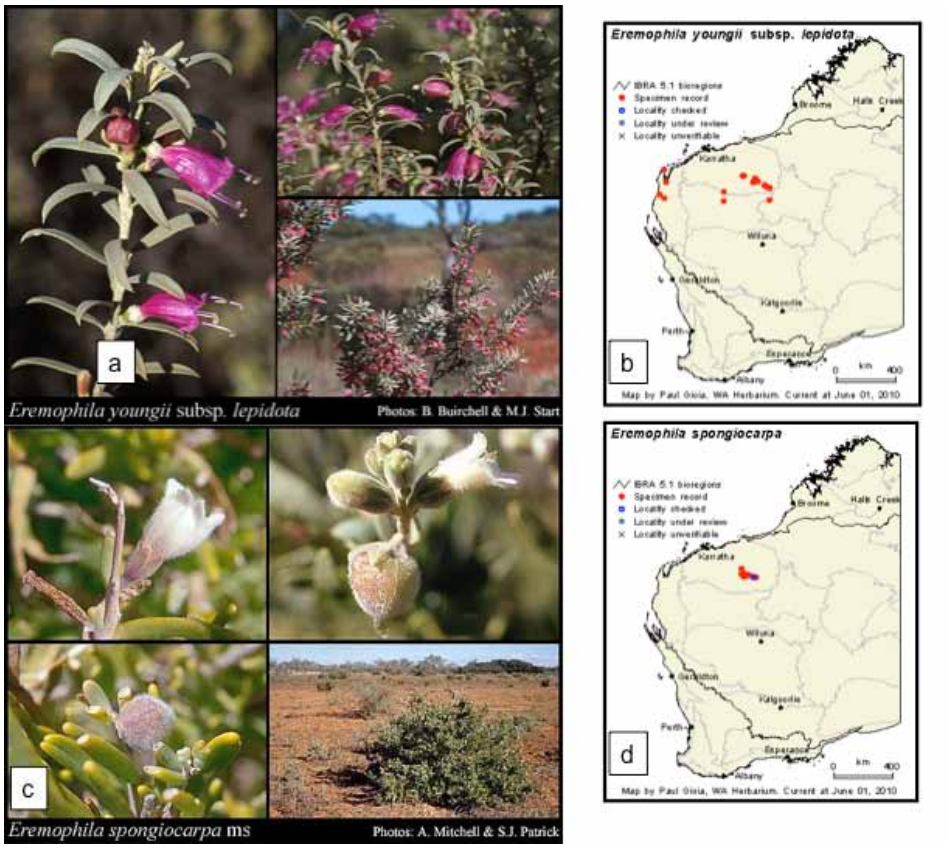


Figure 75 (below). Two restricted shrubs of the Desert wetlands.
(a) *Eremophila youngii* subsp. *lepidota* found in the Externally Drained Desert. Photo – B Buirchell and MJ Start (b) Distribution in WA. Mapping – P Gioia.
(c) *Eremophila spongiocarpa* confined to the Fortescue Saltmarsh in the Externally Drained Desert. Photo – A Mitchell and SJ Patrick (d) Distribution in WA. Mapping – P Gioia.
Images used with the permission of the Western Australian Herbarium, DEC.
Accessed 21/06/2011.



Birrida: a local Aboriginal name for a seasonally inundated, hypersaline, gypsum saltpan wetland in sand dunes in the Shark Bay area. Some have a distinctive central raised platform and moat feature.

Lakes

Lake MacLeod* (Carnarvon) is an extensive saline wetland system (150,000 hectares) associated with a permanently inundated salt lake (6,000 hectares) located north of Carnarvon. The permanently inundated lake is fringed by the largest inland occurrence of mangroves (*Avicennia marina*) known in WA. A complex of seasonally waterlogged wetland communities are found on the adjacent flats.

In the Shark Bay area (Carnarvon) there are a series of hypersaline **birridas**. These support the aquatic *Ruppia tuberosa* and are covered with samphire shrublands.

Freshwater wetlands of the Externally Drained Deserts

There is a vast variety of freshwater wetlands in these Deserts. These are described below in four groups: alluvial flats, springs, seasonally waterlogged wetlands and claypans.

Alluvial flats

Not surprisingly, alluvial flats that are subject to regular to occasional inundation are only well developed in the Externally Drained Deserts where they contribute greatly to the variety of wetlands, species richness and endemism. The Western Australian Department of Agriculture have described these areas in reports on the Pilbara, Ashburton River Catchment, Carnarvon Basin and Murchison River Catchment.[73,74,75,76] The vegetation of some of these alluvial plains is outlined below by bioregion:

- Gascoyne (western portion) – Along the Ashburton River the alluvial flats are described by Payne et al.[74] as supporting 'Bluebush Pasture Lands' which are a complex of shrubland communities dominated and/or typified by: gascoyne bluebush (*Maireana polypterygia*), sago bush (*M. pyramidata*), spiny bluebush (*M. aphylla*), tall saltbush (*Rhagodia eremaea*) and swamp bluebush (*Chenopodium auricoma*).
- Murchison – Along the Murchison River, Curry et al.[73] describe two major vegetation types: 'Non Calcareous Shrubby Grasslands' being woodlands and tall shrublands of black mulga (*Acacia distans*), *A. aneura* and *Eucalyptus coolabah* over grasslands dominated by *Eriachne benthamii* and *Eriachne flaccida*; and 'Alluvial tussock Grasslands' being grasslands dominated by *Eragrostis setifolia*, *Eriachne flaccida*, *Sporobolus virginicus* and *Eragrostis dielsii* with scattered trees and shrubs.
- Carnarvon – Similarly in the Carnarvon Basin, Payne et al.[75] describe alluvial areas along the Lyndon, Minilya, Gascoyne and Wooramel rivers as a series of complex 'pasture types' grouped after surfaces on which they occur. These are summarised below.
    - Saline loams, clays and duplex soils (Figure 76)
        - 'Bluebush' with three presentations: 'Gascoyne Bluebush community' of *Mariana polypterygia* and *M. platycarpa* shrublands; 'Gascoyne Mulla Mulla community' of *Ptilotus polakii*, *Mariana polypterygia* and *M. platycarpa* shrublands (each of these are often with occasional tall shrubs of *Acacia* species and low shrubs of *Atriplex vesicaria* and *A. bunburyana*); and 'Spiny Bluebush community' with shrublands dominated by *Maireana aphylla* with *Rhagodia eremaea*, *Atriplex bunburyana* and *Muehlenbeckia florulenta*.
        - 'Sago Bush' (*Maireana pyramidata*) community, being shrublands dominated by currant bush (*Scaevola spinescens*) and mixed shrubs. This is apparently a marginal seasonally waterlogged wetland community.
    - 'Saltbush' with four presentations being shrublands dominated by silver saltbush (*Atriplex bunburyana*), bladder saltbush (*A. vesicaria*), swamp or river saltbush (*A. amnicola*) and marsh saltbush (*A. paludosa*).
    - Alluvial loams and clays
        - 'Acacia Creek-line' being Acacia aneura and A. citrinoviridis woodlands.
        - 'Tussock Grass' being a suite of open tussock grasslands to open grassy woodlands with four forms: the 'Roebourne Plains grass community' of grasslands dominated by a variety of mitchell grasses (Astrebla squarrosa, A. elymoides, A. pectinata) and Eragrostis setifolia and three grasslands dominated by ribbon grass (Chrysopogon fallax), swamp wanderrie grass (Eriachne benthamii) or rats tail grass (Sporobolus mitchellii). The last three are considered highly local and restricted in distribution, and the mitchell grass grasslands near the Minilya River is a range end of this mainly tropical grass community.

- Pilbara – In the Pilbara, Van Vreeswyk et al.[76] list an extensive series of river floodplains as 'Alluvial Plain Tussock Grasslands' (Figure 77 and Figure 78). These grasslands occupy more than 7.5 per cent of the Pilbara (an area of more than 19,000,000 hectares), hence they cover more than 1,000,000 hectares! These wetlands are typically associated with duplex or cracking clay soils and are segregated into eleven types (Van Vreeswyk et al.76, pages 155–173). The divisions are based on the dominant grasses, including mitchell grasses (*Astrebla* sp.), ribbon grass (*Chrysopogon fallax*), neverfail grass (*Eragrostis setifolia*), swamp grass (*Eriachne benthamii*), silky browntop (*Eulalia aurea*), kangaroo grass (*Themeda triandra*), buffel grass or mixed grasses. Mixed communities include the Roebourne Plains type dominated by mitchell grasses and *Eragrostis xerophila* or rarely by *Sorghum plumosum*; plain mosaic grassland (mixture of previous species and *Triodia pungens*); stony alluvial plain snakewood grassy shrubland (*Acacia xiphophylla* shrubland over *Eragrostis xerophila* and/or *Astrebla pectinata* and *Eriachne benthamii* grassland). A form of the kangaroo grass type is listed as the TEC 'Themeda grasslands on cracking clays (Hamersley Station, Pilbara)'. Grassland plains also have a rich flora of annual herbs and grasses.

Figure 76. Saline wetland chenopod (*Sclerolaena bicornis*, *Atriplex semilunaris* and *Salsola australis*) herbland and grassland on the Roebourne Common (Pilbara). Photo – G Keighery/DEC.

Figure 77. Turbid pools in a crabhole clay flat (Pilbara). The holes filled after a summer thunderstorm. The flat is covered with *Eriachne benthamii* grassland. A *Fimbristylis* is visible in the foreground and the floating leaves of *Marsilea* sp. are visible in the pool. Photo – M Lyons/DEC.

Figure 78. Large claypan with *Eucalyptus victrix* woodland over *Eriachne benthamii* grassland (Pilbara). Photo – M Lyons/DEC.

Springs

Most of the springs are associated with riverine channels. The best known of these spring-fed wetlands are those in the Karijini gorges and the Millstream Wetlands from the Pilbara; these are described below.

Cosmopolitan: an organism that is widespread in its distribution

- Karijini gorges (Pilbara) – A series of spring fed pools are found along the Karijini gorges. These pools are fringed with river gum (*Eucalyptus camaldulensis*), *Melaleuca leucadendra* and *Sesbania formosa*; shrublands dominated by *M. linophylla* and *M. bracteata*; sedgelands dominated by *Cladium procerum*, *Schoenoplectus subulatus* and *S. littoralis*; and *Phragmites karka* grasslands. These permanently inundated, cool (shaded) habitats support disjunct populations of plants more typically located in the Kimberley and Southwest. These include:
  - ferns *Adiantum capillus-veneris* (**cosmopolitan**) and *Pteris vittata* (Kimberley)
  - aquatics such as *Schoenoplectus littoralis* (Kimberley)
  - species of seasonally waterlogged wetlands such as *Sonchus hydrophilus* (Southwest) and *Stylidium fluminense* (Kimberley).
- Millstream Wetlands (Pilbara) – This extensive set of permanently spring-fed wetlands on the Fortescue River contain pools, streams, swamps and marshes. The principal communities are: forests to woodlands dominated by silver cadjeput (*Melaleuca argentea*), river gum (*Eucalyptus camaldulensis*) and Millstream palm (*Livistona alfredii*, Figure 79); all sometimes over grasslands dominated by *Phragmites karka* and sedgelands dominated by *Cyperus vaginatus*, *Schoenoplectus subulatus*, *Typha domingensis* and *Fimbristylis ferruginea*. Submerged aquatic species of the pools include *Eleocharis geniculata*, *Potamogeton tricarinatus*, *Najas marina* and *Ruppia polycarpa*. Along the feeding creeks *Eucalyptus victrix* and *Acacia ampliceps* fringe the wetlands. A further area of Millstream Palm forest is found in Palm Spring on Duck Creek (a tributary of the Fortescue).

Figure 79. Millstream Palm (*Livistona alfredii*) forest in the Hamersley Range along a tributary of the Fortescue River (Pilbara). Photo – G Keighery/DEC.

Other less well-known spring wetlands include Mibbley, Yinnietharra and Ewrong springs on the Lyons River (Pilbara); Cattle and Edithana springs along the Gascoyne River (Ashburton); seepages along the Chichester Range in the Mount Montague area (Pilbara), dominated by *Heliotropium* and cane grass[77]; and the permanently spring-fed streams and pools of the Barlee Range Gorges (Gascoyne). The springs of the Barlee Range Gorges support the endemic *Wurmbea saccata* which is also found at Minnie Spring on the Henry River, Irragully Spring and in granite rock pools and margins of the Ashburton. The communities in which it grows are dominated by the trees *Eucalyptus victrix*, *E. camaldulensis* and *Ficus brachypoda* and/or *Melaleuca* shrublands.

A spring of particular interest is a calcareous mound spring noted at Mount Salt (Pilbara).[78] This apparently unique community is reported to be dry at the time of publication, due to lowering of the watertable by a mesquite (*Prosopis species*) invasion.

A series of specialised wetland habitats are also associated with Yardie Creek in the Cape Range (Carnarvon). Yardie Creek, with its creek system, deep gorge and permanently inundated wetlands, provides refugia for wetland and dryland species at the extremities of their ranges[79]; these include *Livistona alfredii*, *Achyranthes aspera* and *Typha domingensis*.

Seasonally waterlogged wetlands

This wetland group is also found within the alluvial flats group which has been described above. However, away from the watercourses in the Pilbara in the Chichester and Mungarroona ranges are the 'Upland Plain Tussock Grasslands' (Figure 80, Figure 81 and Figure 82). These are likely to be unique to this bioregion. These plant communities are associated with basalt soils and are typically dominated by grasses from the genera *Astrebla* (Figure 81 and Figure 82), *Aristida*, *Chrysopogon*, *Eragrostis* and *Sorghum* (Figure 80) or tableland white grass (*Ischaemum albovillosum*). These seasonally waterlogged wetlands contain a series of local endemic herbs including *Flaveria australasica* subsp. *gilgai* (Figure 81b), *Chrysocephalum* sp. Pilbara (Figure 82b), and a yet to be named *Oldenlandia* species and the tableland white grass.

Figure 80. *Sorghum* grassland on Hamersley Plateau (Pilbara). Photo – G Keighery/DEC.

Figure 81. A rocky clayflat wetland covered with Mitchell Grass grassland (including *Astrebla* species) and a mixed herbland in the Hamersley Range (Pilbara). Photos – B Keighery/OEPA.
(a) Wetland on flat between bands of rocky hills.
(b) *Flaveria australasica* subsp. *gilgai*.

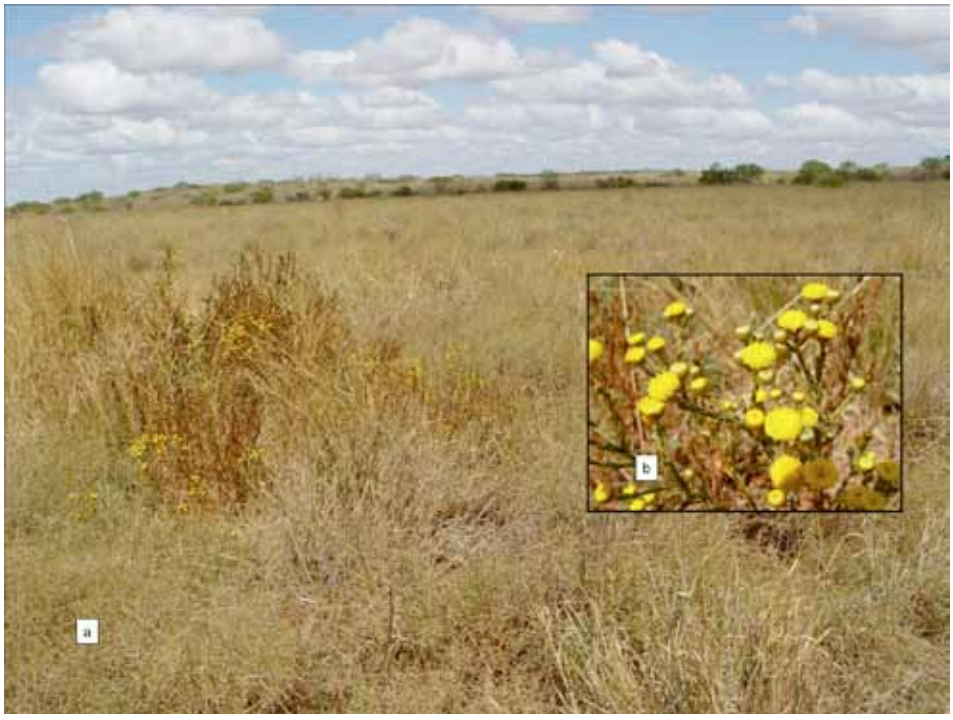


Figure 82. A rocky clayflat wetland covered with mitchell grass grassland (including *Astrebla* species) and a mixed herbland in the Hamersley Range (Pilbara). Photos – B Keighery/OEPA.
(a) Wetland on flat between bands of rocky hills with *Chrysocephalum* sp. Pilbara (yellow).
(b) *Chrysocephalum* sp. Pilbara flower heads.

Claypans

Scattered through the Externally Drained Deserts are a variety of perched claypans (Figure 83). Some specific examples of these are given below.

- McNeill Claypan (Carnarvon) – this large 2,500-hectare claypan is situated in the alluvial deposits of the Gascoyne River floodplain south-east of Carnarvon and is covered by a shrubland of lignum (*Muehlenbeckia florulenta*), herblands dominated by the semi-woody annual *Sesbania cannabina*, and sedgelands and grasslands. This is the largest known claypan in WA.
- Peedamulla Swamp (Pilbara) – this 500-hectare claypan is located on the Cane River and is dominated by *Eucalyptus victrix* woodland over a sedgeland of *Cyperus* species.
- Newman (south Pilbara) – Desmond et al.[80] record a claypan dominated by the aquatic perennial marshwort (*Nymphoides indica*) (a major disjunction from the Kimberley) 70 kilometres south of Newman.
- Yadjiyugga (Ashburton River Catchment section of Gascoyne) – this claypan supports *Eucalyptus victrix* woodlands, *Tecticornia verrucosa* shrubland and *Eriachne benthamii* grasslands.

Figure 83. Claypan on the alluvial flats of the Ashburton River near Onslow (Gascoyne). Photos – B Keighery/OEPA.

(a) Claypan surrounded by sand dunes.

(b) Annual *Asteraceae* species.

(c) Plant and flowers of *Myriocephalus rudallii*.

Wetland flora of the Externally Drained Deserts

Range ends: populations at the margins of the area to which a species is native

There is no comprehensive data for the Externally Drained Deserts. However, the Pilbara and the Carnarvon Basin have recent biological surveys available to assess the diversity and contribution of wetlands to the flora of the Externally Drained Deserts.

The Pilbara, with a recorded flora of 1,509 species[81], contains a significant wetland component of 388 species, which comprises 25.7 per cent of the flora (Figure 84). Although this includes eight species of mangrove along the coast and another thirty-one species of the saline marshes, most Pilbara wetland plants are from freshwater sites, with 246 occurring in damplands (seasonally waterlogged basin wetlands) and 103 being aquatics.

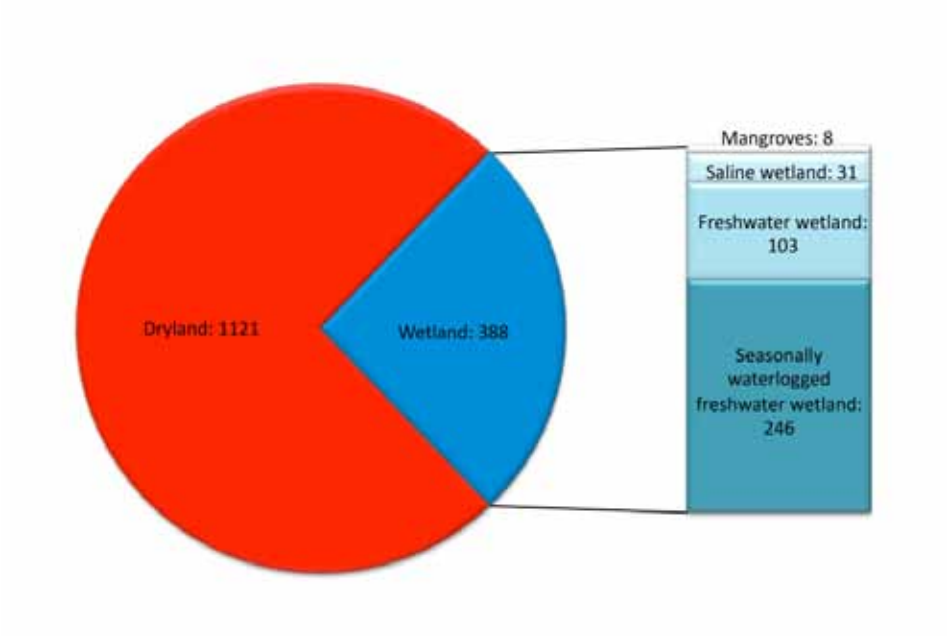


Figure 84. Pilbara wetland and dryland vascular plant taxa found in various plant groups (after Western Australian Herbarium[81]).

As with the Internally Drained Desert, there are many **range ends** and disjunct populations, including: *Adiantum capillus-veneris*, *Pteris vittata*, *Lobelia quadrangularis*, *Cladium procerum*, *Baumea rubiginosa*, *Sonchus hydrophilus* and *Eleocharis sphacelata*. Most of these species are found in the deep gorges of the Hamersley Range. All fourteen ferns and fern allies are wetland plants.

A number of local endemics are found in the seasonally inundated Fortescue Marshes and on claypans and cracking clays (see above, Figure 74a&b and Figure 75).

Gibson et al.[82] in a regional study of the wetlands of the Carnarvon Basin recorded a total of 258 species from fifty-eight wetlands; again constituting about a quarter of the total flora recorded. There were few endemics recorded, most species being widespread arid species. However, thirty-four taxa were temperate wetland taxa at their northern range ends and eighteen were tropical wetland taxa at their southern range ends. The floristics of these wetlands confirmed the major saline and freshwater divisions described above, as well as demonstrating the same trends noted in the Southwest, that is that there are significant numbers of naturally uncommon species in wetlands. The study by Gibson et al.[82] found that 25 per cent of species were recorded at only one study site and 46–55 per cent of records were recorded once (singletons). This uncommon component adds significantly to the biodiversity, but is not predictable. As a consequence, the use

of this information in ranking the conservation status of wetlands is difficult as each wetland has significant differences for a few taxa. Unlike with the Internally Drained Deserts, wetlands contribute significantly to the diversity and apparently the endemism of the flora of the Externally Drained Deserts. The endemism of the wetlands remains to be comprehensively documented (see Figure 85, for example).

Figure 85. Wetland shrubs all from the *Salsola australis* complex. Photos – B Keighery/OEPA.

A guide to managing and restoring wetlands in Western Australia

Wetland vegetation and flora, part 4: Southwest

In Chapter 2: **Understanding wetlands**

Australian Government

Department of Environment and Conservation

Our environment, our future

Contents

Wetland profiles

Introduction

Western Australia is a very large state and there is a great deal of variability in wetland vegetation and flora across it. The Southwest is one of three major climatic and biogeographical zones (Figure 86):

- Kimberley – tropical, warm to hot all year, summer rainfall and a dry winter
- Deserts – hot desert, infrequent erratic rainfall
- Southwest – Mediterranean, warm to hot dry summer, cool wet winter.

The differing climate of these three regions drives important variations in wetland vegetation.

Figure 86. WA's bioregions and the three climatic zones used in this topic. Image – C. Auricht, Auricht Projects.

The next major driver of the wetland vegetation and flora characteristics of the Southwest is whether they inhabit freshwater or saline wetlands. Wetland plant communities are distinctive of the zone and water chemistry, contributing both to the local and state identity and contributing greatly to the uniqueness of WA and Australia.

Thirdly, in addition to zone and freshwater/saline divisions, the Southwest wetlands can be grouped according to the similarity of their vegetation characteristics. In the Southwest zone, these groups are:

- saline lagoons
- saline basin wetlands
- saline riverine
- groundwater fed
- perched wetlands.

Southwest

The Southwest is world renowned for its plant diversity and large number of endemic plant species and communities. This diversity, combined with it being the wettest area of the state, has resulted in an immense variety of wetlands. Also, being in the most populous area of the state, these wetlands have suffered the greatest impacts from clearing, agriculture and urban uses, leading to loss, fragmentation and degradation.

The Southwest wetlands are the best known and most studied in WA. A substantive number of reports deal with a variety of plant-related wetland topics including: descriptions of individual wetlands, groups of wetlands and regional groups, wetland mapping; regional floristic data; and wetland management (related to various aspects such as regions, reserves, rare species and communities). However, there are no true regional overviews, databases or bibliographies on the Southwest's wetland plants.

For the purposes of this topic, the Southwest incorporates nine bioregions: Yalgoo, Geraldton Sandplains, Avon Wheatbelt, Swan Coastal Plain, Jarrah Forest, Warren, Esperance Plains, Mallee and Coolgardie. The Yalgoo and Coolgardie are generally considered to form an inter-zone between the Desert and the Southwest but, for wetland vegetation and flora, are more closely related to that of the dry Southwest. While the nine bioregions share some wetland characteristics, the overall variety of wetland vegetation and flora is great.

There are fifty-eight listed nationally important wetlands in the Southwest, the most for any of the three wetland zones.

Wetland vegetation of the Southwest

Broadly, the vegetation of the Southwest consists of *Eucalyptus*-dominated tall forest and woodlands, *Melaleuca*-dominated forest and woodlands; *Acacia* woodlands, shrublands and heath, *Casuarina* and *Banksia* low woodland; mallee woodlands and shrublands, chenopod and samphire succulent shrublands and heath. As with the Kimberley and Deserts, many of these vegetation types are present in wetlands but chenopod and samphire succulent shrublands are confined to wetlands; further, some vegetation types that are common in wetlands are rare at the broader level, including sedgelands and herblands. There are so many wetland species in the Southwest that the most common taxa cannot be listed here.

From the literature reviewed during the development of this topic, in excess of several thousand different plant communities are potentially associated with the Southwest's wetlands, depending on the scale and detail of mapping. The wetland vegetation is grouped below after a series of key features of the wetland habitats.

Many wetlands combine freshwater and saline wetland features in wetland complexes. Two examples are provided at the end of this topic: the Yalgorup National Park wetlands and Brixton Street wetlands complexes.

Saline wetlands of the Southwest

Saline wetlands are found in both coastal and inland locations throughout the region and are described below in four principal groups: lagoons, saline basin wetlands, riverine (including rejuvenated drainage and palaeo-drainage channels) and springs. The four principal groups are subdivided further.

Marl: fine-grained calcareous material (usually from dead charophyte algae that are able to biogenically precipitate calcium carbonate)

A feature of many of these saline wetlands is freshwater areas fed by seepages/springs of fresh groundwater. These are described in this section on saline wetlands as they are a significant component of these wetlands and are becoming increasingly rare as groundwater levels generally decline in the Southwest. Most seepage areas associated with salt lakes are of freshwater, forming unique communities and providing a water supply for fauna.

Lagoons

These saline wetlands are closely allied to the estuarine and marine fringing wetlands but have recently (in geological timeframes) been isolated from the estuary or ocean. A few retain seasonal linkages to the estuary or ocean and the boundaries with the saline estuarine areas are poorly defined. Brearley[83] describes the estuarine systems. A number of wetland types are distinguished in this group and a series of examples from across the bioregions are used to illustrate the vegetation of each type.

Island saline wetlands

Only three of these are known and they are all included below.

- Abrolhos Islands (Geraldton Sandplains) – These lagoons are fringed by white mangroves (*Avicennia marina*) and remain connected to the surrounding ocean.
- Rottnest Island* (Swan Coastal Plain) (Figure 87) – Located on Perth's doorstep these are the best documented and well known of the lagoon wetlands. The island's lakes are a unique wetland complex of eighteen salt lakes, sumplands and damplands, covering more than 180 hectares. Seven are permanently inundated (lakes). The three deepest lakes, Government House, Herschell and Serpentine lakes, are unique in Australia[9] having cool, low-salinity water overlying warmer higher saline water (meromictic). In these wetlands low shrublands of *Tecticornia indica*, *T. halocnemoides* and *Sarcocornia quinqueflora* with *Gahnia trifida* typically fringe the water. Patches of *Melaleuca lanceolata* occur on the slight rises over the shrubs and sedges. The aquatic *Ruppia tuberosa* found in these lakes is one of only two occurrences outside Shark Bay. Cropped grasslands dominated by native couch (*Sporobolus virginicus*) grow at the freshwater seepages found dotted around some of these lakes. These communities are maintained by quokka grazing and are true marsupial lawns. Interestingly, this complex contained some freshwater wetlands, rainfall being perched on a **marl** layer. Unfortunately, these wetlands were mined for their marl, for use in road works. Attempts are currently being made to reform these wetlands.
- Recherche Archipelago Islands (Esperance Plains) – Middle Island in the Recherche Archipelago contains Lake Hillier, a saline lake usually coloured pink with the alga *Duniellia salina*. The vegetation of the lagoon is similar to that of the Esperance Coastal Lakes (see below).

Figure 87. Rottnest Island salt lake with fringing *Melaleuca lanceolata* forest and samphire shrublands. Photo – B Keighery/OEPA.

West coast lagoonal lakes

- Hutt Lagoon* (Geraldton Sandplains) – Hutt Lagoon (Figure 88 and Figure 89) is a brackish to saline wetland covering around 3,000 hectares, and fed by rain, surface inflows and groundwater seepage. The wetland contains a complex series of fresh to saline wetlands, with more than twenty distinct wetland plant communities.[84] Low rises in the wetland are covered with *Casuarina* obesa low woodlands over *Gahnia trifida*; the flats with low succulent shrublands of *Tecticornia* species (*T. indica*, *T. undulata*, *T. syncarpa* and *T. halocnemoides*); and the lower wetter areas with *Sarcocornia* species over *Triglochin striata* and *Wilsonia humilis*. Freshwater seepages occur on the eastern side of these wetlands and support sedgelands of *Juncus kraussii* subsp. *australiensis* and *Baumea articulata*.
- Leeman Lagoons (Geraldton Sandplains) – Around Leeman there are a series of permanently and seasonally inundated saline and gypsum wetlands with low rises covered by *Casuarina obesa* woodlands over *Gahnia trifida* sedgelands[85] (Figure 2). Freshwater seeps are located on the eastern side; one of these, Etha Springs, is dominated by *Juncus kraussii* subsp. *australiensis*, *Cyperus laevigatus* and *Typha domingensis* sedgelands. Further examples of similar types of wetland are found at Coolimba (Geraldton Sandplains).
- Lake Thetis* (near Cervantes, Swan Coastal Plain) – Water in this lake is saline to hypersaline, with only the aquatic *Ruppia tuberosa* on the lake bed. Edges have succulent shrublands of *Sarcocornia quinqueflora*, *Tecticornia halocnemoides* or sedgelands of *Gahnia trifida* and *Baumea juncea*, all over herbs. The stromatolite community of Lake Thetis is a TEC.
- Lakes Walyungup and Cooloongup (Swan Coastal Plain) – Like most lakes in the Southwest, these periodically dry out and have also been called White Lakes in reference to the dazzling white salt beds exposed on drying (Figure 90). Low woodlands of *Melaleuca cuticularis* over sedgelands dominated by *Gahnia trifida* and/or *Juncus kraussii* subsp. *australiensis* and samphire shrublands are associated with these wetlands. Freshwater seepage areas on the margins of both lakes are associated with low or tall forests dominated by *Melaleuca rhaphiophylla* and/or tuart

(*Eucalyptus gomphocephala*) over sedgelands dominated by *Lepidosperma gladiatum*, *Gahnia trifida* and *Baumea juncea*. Some of these wetland communities are the TEC 'Shrublands on calcareous silts of the Swan Coastal Plain' (Figure 11).

- Yalgorup Lakes* (Swan Coastal Plain) – The waters of these lakes are seasonally hyposaline (winter) or permanently hypersaline (for more information on the Yalgorup Lakes complex, see 'Profile of a wetland complex: Yalgorup National Park wetlands', located near the end of this topic).

Figure 88. A view of the Hutt Lagoons (Geraldton Sandplains). Photos – B Keighery/OEPA.
(a) Eastern margin dominated by *Gahnia trifida* sedgelands.
(b) and (c) Habit and flowers of the native *Cyperus laevigatus*, a cosmopolitan sedge of the areas with fresher water.

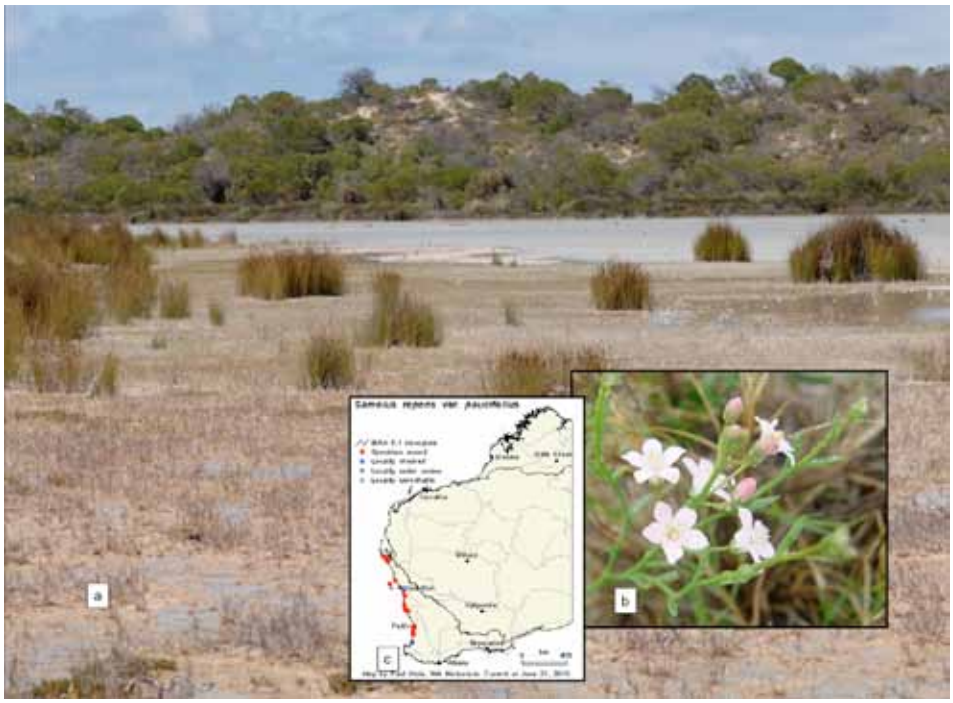


Figure 89. Another view of the Hutt Lagoons (Geraldton Sandplains). Photos – B Keighery/OEPA.

(a) Looking west towards the coastal holocene dunes across a saline flat with patches of *Juncus kraussii* subsp. *australiensis* sedgeland and *Wilsonia humilis* herbland.

(b) Flowers of *Samolus repens* var. *paucifolius*, a plant scattered through these communities.

(c) This is a plant of the coastal saline wetlands between Shark Bay and the Yalgorup Wetlands. Mapping – P Gioia. Image used with the permission of the Western Australian Herbarium, DEC. Accessed 21/06/2011.

Figure 90. Lake Walyungup, a salt lake near Rockingham (Swan Coastal Plain).

(a) The salt encrusted dry lakebed is surrounded by bands of *Juncus kraussii* subsp. *australiensis* sedgelands and samphire shrublands. Wetlands with fresher water around the outside margins are dominated by *Lepidosperma gladiatum*. *Acacia* shrublands are found on the dry rises. Photo – B Keighery/OEPA.

(b) Lake Walyungup lies to the west of a band of Quindalup Dunes, with Spearwood Dunes to the east (transect diagram reproduced and adapted from Department of Minerals and Energy[86] with permission).

South Coast lagoonal

Culham Inlet Lagoons* (Esperance Sandplains) – These wetlands are estuarine areas where the sand bar is rarely breached; they are, therefore, no longer truly estuarine and are fed by naturally saline rivers. For example, Culham Inlet, fed by the Phillips and Steere rivers, had not breached to the sea for at least 150 years before recent clearing for agriculture in the catchment. Similar systems include the Fitzgerald and Dempster inlets. These have the same vegetation as the Esperance Coastal Lakes.

Saline basin wetlands

Southern basin wetlands

These extend from near Frankland and Albany to east of Esperance (Figure 91). An example is Kwornicup Lake (Jarrah Forest), with a mosaic of vegetation units including: a *Wilsonia backhousei* herbland (on the lake bed); *Tecticornia syncarpa* and *Sarcocornia quinqueflora* (samphires) shrubland; shrublands dominated by *Melaleuca thyoides*, *M. acuminata*, *M. viminea* and *M. halmaturorum*; and woodlands of *Casuarina obesa* and/or *Eucalyptus rudis*. To the east, north of the Stirling Ranges, is the Balicup System (1,400 hectares) containing Camel, Balicup, Jebarjup and Swan lakes (Esperance Sandplains). The Balicup System is typical of naturally saline lakes around the range.[87] Although the lake beds are largely bare, the margins are covered in zones of low samphire shrubland, *Austrostipa juncifolia* grassland and *Melaleuca cuticularis* woodland. Several very unusual species are found in the samphire shrublands, including *Tecticornia uniflora*. A further example of this type is the Jerdacuttup Lakes (east of Hopetoun, Esperance Sandplains) with *Tecticornia indica* samphire shrubland and a *Melaleuca cuticularis* forest to woodland.

Figure 91. Salt lake in Truslove Nature Reserve (Esperance Sandplain). Photos – B Keighery/OEPA.

(a) *Melaleuca* shrubland on the low gypsum dunes and succulent shrubland adjacent to the bare drying lake bed.

(b) Samphire shrubs and the prostrate succulent *Disphyma crassifolium* subsp. *clavellatum*.

Esperance coastal lakes (Esperance Sandplains)

This complex includes the Lake Gore System*, Lake Warden System*, Mortijinup Lake System* and Pink Lake*. All are fringed by *Melaleuca cuticularis* woodlands often over a sedgeland dominated by *Juncus kraussii* subsp. *australiensis*, *Gahnia trifida*, *Baumea juncea* and/or *Ficinia nodosa*. Areas of samphire shrublands are also found in the system.

Swan Coastal Plain lakes/sumplands/damplands

Where groundwater is naturally saline, as in the northern Perth Basin, the lakes are saline. An example is Lake Eganu (north of Moora) which is bare in the middle then edged with zoned vegetation from *Tecticornia pergranulata* samphire shrubland to *Casuarina obesa* and *Melaleuca cuticularis* woodland. Lake Guraga (south-west of Cataby) has bands of vegetation relating to inundation and salinity.[88] The lake is bare in the centre, then fringed with a low *Wilsonia backhousei*, *Tecticornia pergranulata* and *Lawrencia glomerata* shrubland, a *Tecticornia indica* and *T. pergranulata* samphire shrubland with herbs and grasses and finally a fringing shrubland of *Melaleuca viminea*. Patches of saline wetland are found within a number of predominantly freshwater wetlands. When these saline wetlands are on clays they support a suite of annual herbs and sedges (Figure 92). These same herbs and sedges are also found in some of the saline wetlands.

Figure 92. Some annual species renewed from seed found in the herblands of saline clayflats. Photos – B Keighery/OEPA.

(a) The sedge *Centrolepis polygyna*.

(b) Two daisies, the newly described *Blennospora doliiformis* (left) and *Pogonolepis stricta*.

(c) *Angianthus drummondii*, one of the wetland species recently separated from the species complex.

Riverine

Rejuvenated drainage

Much of southern WA is composed of a low relief lateritised plateau with active drainage. In the higher rainfall areas (including the Jarrah Forest and Avon Wheatbelt) the rejuvenated drainage lines still connect to the sea and flow most years. Further inland, as rainfall decreases, flows decline and occur only in wet periods, forming braided saline drainage systems. Extensive braided drainage systems are found on all of the major rivers. These often have high vegetation and flora values, especially those of the Mortlock River and the Yenyening System on the Avon River (Avon Wheatbelt). Work on mapping the vegetation of the Yenyening System[36] has distinguished twenty-two vegetation units, ten of these being wetland units. The saline wetland units occur in a mosaic and include: saline wetlands with three types of samphire shrublands, *Casuarina obesa* forest over *Juncus kraussii* subsp. *australiensis* sedgeland, *Hopkinsia anaectocolea* sedgeland, herblands, *Eucalyptus sargentii* woodland over chenopod shrubland, *Eucalyptus orthostemon* mallee, *Melaleuca atroviridis* shrubland and shrublands dominated by mixes of *Melaleuca hamata*, *M. brophyi*, *M. halmaturorum* and *M. lateriflora*. Scattered through the area are perched, mostly freshwater, wetlands that support *Callistemon phoeniceus* and *Melaleuca thyoides* shrubland and *M. brevifolia* shrubland over *Baumea riparia* and *Juncus kraussii* subsp. *australiensis* sedgelands. Eight species of uncommon flora (priority flora) are located in the wetlands, including the only known populations of a new *Arthropodium* species. All of the braided systems are threatened by hydrological changes.

Palaeo-river systems

Inland from the rejuvenated drainage area in the Avon Wheatbelt, Mallee, Coolgardie and Yalgoo, there is no connected drainage. In these areas, salt lake chains occur (Figure 93, Figure 94 and Figure 95). They are remnants of ancient drainage systems (palaeo-drainage lines) and only function as connected systems in very wet years. These include Lake Goorly, Lake Deborah, Lake Moore, Lake Dumbleyung*, Johnston Lakes, Lake King (Figure 95), Mollerin Lakes and Cowcowing Lakes. Normally the lakes are bare of vegetation then have zones of vegetation from the water body outwards being: samphire shrublands, saltbush (*Atriplex* species) shrublands, *Melaleuca* shrublands and mallee shrublands to woodlands over saltbush shrublands. Rises are covered by samphire shrublands or saltbush shrublands, and rarely *Eucalyptus kondininensis* and *E. salicola* woodlands and *Callitris verrucosa* over samphire shrubland.

Fringing many of these inland lakes are areas of gypsum wetland flats and associated dunes, which contain many unusual to rare species. For example Lake Tay (Mallee) has *Anigozanthos bicolor* subsp. *minor, Eremophila lactea*, *Ricinocarpus trichophorus* and *Myoporum turbinatum*. There are eighty species endemic to the Southwest confined to gypsum rich soils. Gypsum dunes and flats are found in the Lake Grace* system (Mallee), Chinnocup System (Mallee), Kondinin Salt Marsh (Avon Wheatbelt), Kent Road braided saline drainage lines (Mallee), Lake King (Mallee, Figure 95) and in the Buntine-Marchagee area (Avon Wheatbelt).

Figure 93. Samphire shrubland on a lake bed in Charles Darwin Reserve (Yalgoo). Similar wetlands are also located in the adjacent Murchison. Photos – B Keighery/OEPA.

(a) Wetland between sand dunes.

(b) *Kippistia suaedifolia* in samphires.

(c) and (d) *Lawrencia squamata* bush and flowers.

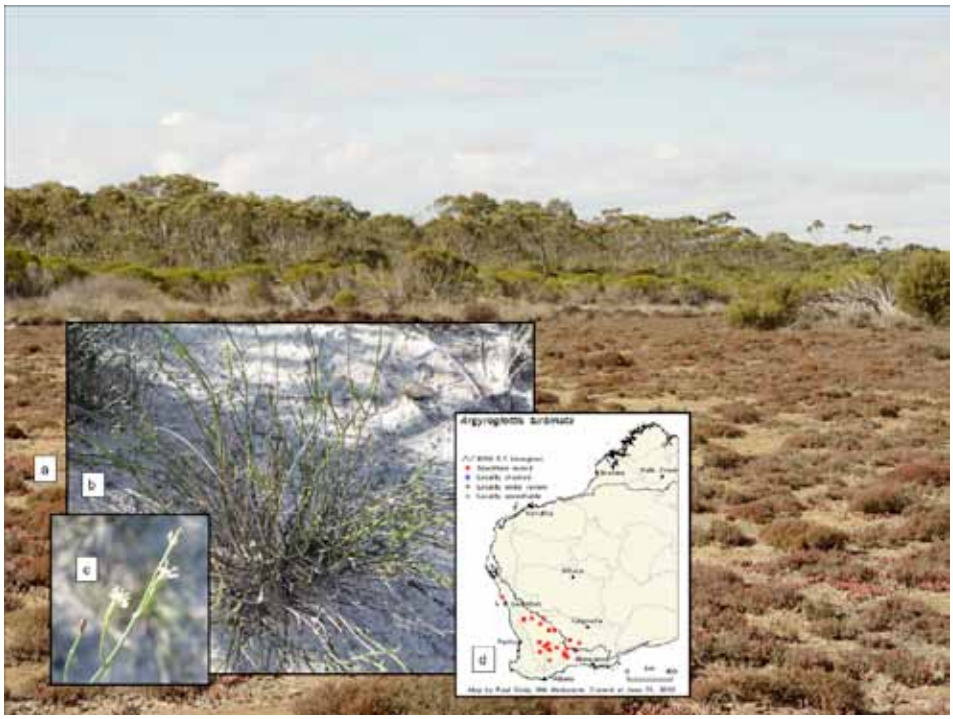


Figure 94. A saline wetland in Truslove Nature Reserve (Esperance Sandplain). Photos – B Keighery/OEPA.

(a) Saline wet flat between dunes, covered with a samphire shrubland.

(b) and (c) A wetland daisy *Argyroglottis turbinata*.

(d) In Truslove Nature Reserve this species is at the eastern end of its range. Mapping – P Gioia. Image used with the permission of the Western Australian Herbarium, DEC. Accessed 21/06/2011.

Figure 95. A gypsum dune alongside Lake King (Mallee). Photos – B Keighery/OEPA.
(a) The flat lake bed between gypsum dunes with a shrubland of samphires and other shrubs.
(b) A gnarled native conifer, *Callitris canescens*.
(c) A flower of the pea *Bossiaea cucullata*, which grows on the gypsum dune (green bush central foreground).

Springs

A unique saline system is Arinya Springs near Dowerin (Avon Wheatbelt), first described by John Septimus Roe in the nineteenth century. This is a natural permanent saline seep covered with succulent shrubland of *Sarcocornia quinqueflora*, *Tecticornia halocnemoides* and *Wilsonia backhousei* with scattered sedges of *Juncus kraussii* subsp. *australiensis* and shrubs of *Frankenia pauciflora* on quaking deep organic soils.

Freshwater wetlands of the Southwest

Freshwater wetlands are found in both coastal and inland locations throughout the zone. They are separated into two main groups based on the principal source of water: groundwater or rainfall held by an impeding layer (perched wetlands). Of course, most wetland systems contain wetlands from both groups and some individual wetlands are fed by water from both sources.

Groundwater fed

This wetland group is further divided into inundated basin wetlands, seasonally waterlogged wetlands and springs where water is actively discharged. Again, many wetlands have water from both sources.

Inundated basin wetlands

The vegetation of inundated basin wetlands is very much related to the period of inundation. Groundwater changes are leading to widespread drying of these wetlands. With changing hydrological conditions many lakes and sumplands are developing characteristics of seasonally waterlogged wetlands, and at times the opposite changes prevail.

Lakes and sumplands

The Southwest contains numerous permanently inundated basins (lakes) and seasonally inundated basins (sumplands) (Figure 96, Figure 97 and Figure 98). As outlined previously these are shallow by world standards, usually being less than 3 metres deep. Changes in land use throughout the Southwest have influenced the seasonality and the salinity of many water bodies.

Figure 96. Lake Mount Brown (Spearwood Dunes, Swan Coastal Plain), a brackish sumpland with fresh inflows. Zones of sedgelands and *Melaleuca* forest can be seen on far shore. Photo – K Clarke/Western Australian Local Government Association.

Figure 97. Shirley Balla Lake (Bassendean Dunes, Swan Coastal Plain), a sumpland with sedgeland dominated by *Juncus pallidus* and *Baumea articulata* then a band of *Melaleuca preissiana* forest. Photo – G Keighery/DEC.

Figure 98. Minninup Swamp (Quindalup/Spearwood Dune interface, Swan Coastal Plain) south of Bunbury, a freshwater wetland supporting a mosaic of communities including Tuart (*Eucalyptus gomphocephala*) forest (background), *Melaleuca rhaphiophylla* forest (mid-ground) and sedgeland. *Muehlenbeckia adpressa* (broad leaf) can be seen in among the sedges (foreground). The TEC 'Sedgelands in Holocene dune swales of the southern Swan Coastal Plain' is found in parts of this wetland. Freshwater wetlands in the Quindalup/ Spearwood Dune interface are uncommon. Photo – B Keighery/OEPA.

Most freshwater wetlands of the heavily cleared agricultural areas (principally the Avon Wheatbelt) have become secondarily salinised and have lost most of their original vegetation. The original vegetation may be replaced by samphire shrublands and/ or completely lost in the permanently inundated areas. These changes are particularly evident at Lakes Dumbleyung*, Taarblin and Wannamal*. Lake Toolibin* (297 hectares) is one of the last remaining wooded freshwater wetlands of the Avon Wheatbelt. This group of wetlands was usually covered by *Casuarina obesa* woodlands over *Melaleuca strobophylla*. The Lake Toolibin example of this community, together with another occurrence at Dowerin (13 hectares), are listed as the TEC 'Perched wetlands of the Wheatbelt region with extensive stands of living Swamp Sheoak (*Casuarina obesa*) and Paperbark (*Melaleuca strobophylla*) across the lake floor'. The catchment of Lake Toolibin is a natural diversity recovery catchment.

➤ For information on natural diversity recovery catchments, see the DEC website.[89]

➤ For more information on secondary salinisation and its management, see the topic 'Secondary salinity' in Chapter 3.

Outside these heavily cleared areas a large number of lakes and sumplands remain. These typically have a central water body fringed by zoned wetland vegetation. A series of these wetlands is described below, grouped according to development of organic layers as this drives the type of vegetation associated with the wetland.

Poorly developed organic layers

Some key groups are described below to illustrate the variation in the group.

- Yate (*Eucalyptus occidentalis*) Swamps
  These extend from east of Esperance, north to Kojonup and west to the Tone River (Esperance Sandplains, Avon Wheatbelt and Jarrah Forest), and can be segregated into six types.[90] Some examples from the Esperance Sandplains are Yellilup Yate

Swamp*, Bremer Bay and Pabellup Swamp, Fitzgerald River National Park, which have Yate woodland over *Melaleuca cuticularis* and *M. rhaphiophylla* woodlands. Other types have *Baumea* sedgelands, shrublands dominated by combinations of *Melaleuca strobophylla*, *M. lateritia* and *M. atroviridis*.

- Lake Bryde and East Lake Bryde* (Mallee)
  These seasonally inundated wetlands are completely vegetated. The wetland bed is covered with shrublands dominated by lignum (*Muehlenbeckia horrida* subsp. *abdita*) and/or *Tecticornia verrucosa*, surrounded by *Eucalyptus occidentalis* woodland over *Melaleuca* species shrublands. These are the only wetlands dominated by shrubs in the mallee part of the agricultural zone. Interestingly, *Muehlenbeckia horrida* subsp. *abdita* is declared rare flora (DRF) and its community is the TEC 'Unwooded freshwater wetlands of the southern Wheatbelt of WA, dominated by *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor'. The entire system is a natural diversity recovery catchment.
- Lake Cronin* (Mallee)
  This sumpland supports the largest and best examples of a *Melaleuca*-dominated wetland in the eastern Wheatbelt.[8] The sumpland is fringed by shrublands and woodlands of *Melaleuca strobophylla*, *M. cuticularis*, and *M. atroviridis* over lignum (*Muehlenbeckia florulenta*). When flooded, the sumpland supports mixtures of the grass *Amphibromus vickeryae*, the sedge *Eleocharis acuta* and the herb *Stemodia florulenta*. As the sumpland dries, a herbland dominated by *Goodenia viscida* and *Glycyrrhiza acanthocarpa* develops.
- Lake Logue* (fresh) and Lake Indoon* (brackish) (Geraldton Sandplains)
  These are most similar to the coastal saline lakes of Coolimba-Jurien Bay. The Lake Logue bed has areas of cane grass (*Eragrostis australasica)*, *Casuarina obesa* woodland and fringing *Eucalyptus rudis* or *Melaleuca rhaphiophylla* woodlands. Lake Indoon is similar but the bed is bare.
- Rowles Lagoon System* (Coolgardie)
  This system north-west of Kalgoorlie includes Rowles Lagoon[91] (150 hectares), Clear Lake and Brown Lagoon (20 hectares each), Carnage and Muddy lakes (100 hectares each) and many smaller lakes and lagoons, including Canegrass Lagoon. This freshwater complex, with both seasonally inundated and near-permanently inundated wetlands, can cover more than 200 hectares when flooded. The lake beds have lignum (*Muehlenbeckia florulenta*) shrubland or cane grass (*Eragrostis australasica*) grasslands, with a fringe of *Melaleuca xerophila* shrubland.

Well developed organic layers ('peat lakes')

The peat of these wetlands is typically formed from sedges, principally *Baumea articulata* (Figure 97). There are no true sphagnum swamps in WA though sphagnum (formed from the moss *Sphagnum novozelandicum*) is present in the Warren.[92] Many of the lakes around the Perth area (Swan Coastal Plain) are of this type including Benger Swamp*, Herdsman Lake* and Lake Joondalup*. Some examples from across the Southwest are described below.

- Byenup Lagoon System* (5,000 hectares) and Lake Muir* (4,600 hectares) (Jarrah Forest)
  The vegetation of these systems has been mapped[34] and thirty structural vegetation units have been distinguished. Both freshwater and saline wetlands are found in the system. The freshwater plant communities include: *Eucalyptus rudis* woodland, forest or woodland dominated by *Melaleuca preissiana* and *Banksia littoralis* (Figure 99) or *M. preissiana* and *E. rudis* or *Melaleuca rhaphiophylla*; shrublands dominated by *Pericalymma ellipticum* and/or *Taxandria* species; and sedgelands dominated by *Baumea articulata*, *B. vaginalis* and/or *Lepidosperma longitudinale*. Within these freshwater areas are clayflats with shrublands dominated by *Melaleuca lateritia* or *M. viminea* and *M. densa* and *Meeboldina* species sedgeland. The partly saline areas in

Lake Muir have: *Melaleuca cuticularis* woodland; shrublands dominated by a variety of shrubs including *Kunzea* and *Melaleuca* species; samphire shrublands; and *Gahnia trifida* sedgeland. The sedgelands in these wetlands are often dominated by trees and shrubs. Within these saline communities *Taxandria juniperina* and *Callistachys lanceolata* woodland is found in freshwater inflow areas.

Figure 99. *Banksia littoralis*, a Southwest wetland tree. Forest and woodlands dominated by this tree are becoming rare as wetlands dry, are infested with *Phytophthora* and are more frequently burnt. Photos – B Keighery/OEPA.

(a) Tree.

(b) Flowers.

- South Coast coastal plain wetlands (including Mount Soho Swamps, Maringup Lakes System, Owingup Swamp System, Doggerup Creek System in the Warren)
  This suite of wetlands supports a similar set of vegetation units: mosaics of sedgeland dominated by combinations of *Baumea articulata*, *B. preissii* and sixteen species of *Chaetanthus* and *Meeboldina*. The margins of the sedgelands have *Taxandria juniperina* forest or shrublands dominated by *Homalospermum firmum* and/or *Beaufortia sparsa*. The nearby Gingilup-Jasper wetland system is similar to the Doggerup system, and includes Lake Jasper. At 10 metres, Lake Jasper is considerably deeper than most wetlands in the Southwest. The vegetation and flora of these wetlands have been well documented.[93]
- South Coast freshwater wetlands
  There are a large number of these wetlands in the areas between Albany and the Esperance area and then north to the Stirling Ranges. Some typical examples are Moates Lagoon* and Shark Lake. Moates Lagoon (Jarrah Forest) has a series of zones: sedgelands of *Baumea articulata* and *Baumea juncea*, followed by sedgelands dominated by *Meeboldina coangustata*, *M. scariosa*, *Anarthria scabra* and *Evandra aristata*, and lastly *Taxandria juniperina* woodlands. East of Esperance, Shark Lake (Esperance Sandplains) has a central *Baumea articulata* sedgeland and sedgeland of *Ficinia nodosa* and *Juncus* species over *Centella asiatica* herbland. A distinctive set of similar wetlands are the Cape le Grand Swamps. These are deep almost permanently inundated freshwater wetlands, also covered with *Baumea articulata* sedgelands, but

supporting several rare aquatic taxa, *Utricularia westonii* and *Aldrovanda vesiculosa*. Many wetland species in the Cape le Grand swamps (Esperance Sandplains) are at their eastern range limits.

- Swan Coastal Plain lakes and sumplands
  There are a series of freshwater lakes and sumplands developed on the Swan Coastal Plain in the Bassendean and Spearwood dunes (Figure 96, Figure 97 and Figure 98) and their interfaces south from Cervantes, including Chandala Swamp*, Loch McNess*, Joondalup Lake*, Herdsman Lake*, Booragoon Lake*, Forrestdale Lake*, Spectacles Swamp*, Thompsons Lake*, Lake McLarty* and Benger Swamp*. These wetlands have been the subjects of numerous comprehensive studies. They were/are covered by *Baumea articulata* sedgeland (now often replaced by *Typha orientalis*), and fringed by woodlands of *Melaleuca rhaphiophylla* and shrublands of *Melaleuca teretifolia*, *M. viminea* and *Astartea* species. Others have *Eucalyptus rudis* and *Banksia littoralis* woodlands, and *Melaleuca preissiana* woodlands over *Pericalymma ellipticum* heath. With declining rainfall and increasing water extraction many of these wetlands, which are surface expressions of the groundwater, are becoming disconnected from the groundwater system (with some now fed by surface water via drains). This change in water regime in many wetlands is leading to a loss of the native annual species such as *Fimbristylis velata*, and replacement by weedy perennial grasses and garden escapes.
- Holocene dune wetlands: Becher Point Wetlands* and Lake Richmond
  These are the freshwater part of the Becher wetland suite on the Rockingham Beach Ridge Plain. These wetlands consist of more than 250 lakes, sumplands and damplands (130 hectares), many of which have well-developed organic layers. These wetlands support *Xanthorrhoea preissii* and *Acacia saligna* shrublands, *Muehlenbeckia adpressa* shrublands and *Baumea juncea* and *Ficinia nodosa* sedgelands. These wetlands are the state listed TEC 'Sedgelands in Holocene dune swales of the southern Swan Coastal Plain'. Similar Holocene swale communities occur at Alkimos, Jurien Bay and Bunbury. Lake Richmond also supports this TEC, with dense sedgeland dominated by *Baumea juncea* and *Ficinia nodosa*. It is the deepest wetland in the Southwest, reported to reach up to 14.4 metres. Prior to the 1960s it was saline but has become fresh following urban development of the surrounds.

Seasonally waterlogged wetlands of basins and flats (damplands and palusplains)

Seasonally waterlogged wetlands are grouped because they support similar units of vegetation. These palusplains and damplands were typically naturally extensive, but due to development many are now remnant portions, such as Hay Park palusplain (Figure 100). Similarly, there has been extensive clearing of seasonally waterlogged areas associated with lakes and sumplands, the wetland vegetation associated with these lakes and sumplands being confined to the fringe of inundated areas. As in all other areas of WA these wetlands, together with those described below under 'Claypans and clayflats' in the 'Perched wetlands', have the greatest diversity of vegetation units and often flora. Again, declining rainfall and groundwater tables are leading to widespread drying of these wetlands. With changing hydrological conditions many seasonally waterlogged wetlands are developing characteristics of the adjacent drylands.

Seasonally waterlogged wetlands typically support a mosaic of vegetation units especially woodlands, shrublands, sedgelands, herblands and rarely grasslands. Woodlands are dominated by *Eucalyptus rudis* and *Melaleuca* species including *M. preissiana* and *M. croxfordiae* and shrublands dominated by a very diverse suite of species such as *Calothamnus lateralis*, *Hakea ceratophylla*, *Melaleuca teretifolia*, *M. viminea*, *M. scabra*, *Astartea* species, *Pericalymma ellipticum*, *Euchilopsis linearis* (Figure 101c), *Regelia ciliata*, *R. inops*, *Kunzea* species, *Adenanthos meisneri* and *Hypocalymma angustifolium*. Within these shrublands there are is often a sedge layer which includes *Hypolaena*

exsulca, *Mesomelaena tetragona*, *Lepidosperma longitudinale*, *Anarthria scabra* and *Lepyrodia* species. Herbs are generally scattered rather than forming a layer and include *Drosera* species, for example *D. occidentalis* and *D. gigantea*, *Burchardia multiflora* and *Asteraceae* species such as *Hyalospermum cotula*. Uncommon species such as *Dillwynia dillywynioides* (Figure 101a&b), *Boronia juncea* subsp. *juncea* (Figure 102) and *Boronia capitata* subsp. *gracilis* are associated with these wetlands. *Boronia megastigma* is a species of these habitats.

Figure 100. A seasonally waterlogged flat (palusplain), Hay Park in Bunbury (Swan Coastal Plain). Photos – B Keighery/OEPA.

(a) Scattered *Melaleuca preissiana* over shrublands dominated by *Xanthorrhoea brunonis* and *Pericalymma ellipticum*, and herblands dominated by *Stylidium brunonianum* and *Drosera gigantea*.

(b) *Stylidium brunonianum* flowers.

Figure 101. Members of the family Fabaceae are found in wetlands, and many of these are uncommon. Photos – B Keighery/OEPA.

(a) and (b) The uncommon shrub *Dillwynia dillywynioides*.

(c) Flowers of *Euchilopsis linearis*, a monotypic wetland genus (i.e. a genus with only one species).

Figure 102. *Boronia juncea* subsp. *juncea*, an uncommon wetland shrub confined to the wetlands in the Kemerton area on the Swan Coastal Plain. Photos – B Keighery/OEPA.

(a) The *Juncus*-like plant is not very conspicuous when surrounded by sedges.

(b) Flowers.

Springs

There are a variety of wetlands fed by permanent seepages of fresh groundwater. These are often found within other wetland systems and are associated with such species as *Cyathochaeta teretifolia* and *Gastrolobium ebracteolatum* on the Swan Coastal Plain. A few distinctive wetlands of this type are listed below.

- Cape Leeuwin System* (Warren) – This is a permanently inundated coastal wetland, fed by springs covered by sedgelands of *Baumea articulata*, *Baumea juncea* and/or *Schoenoplectus validus* and patches of sedgelands dominated by the weed *Typha orientalis* or *Lepidosperma gladiatum*. In coastal locations, seepage of calcium-rich water from these wetlands over granites forms **tufa** formations that support unique microbial communities.
- Blackwood River seeps* (Warren) – Water from the deep Yarragadee groundwater aquifer surfaces along the Blackwood River and supports distinctive wetland communities. An example is Spearwood Swamps, a permanently inundated wetland with a shrubland dominated by *Homalospermum firmum* and *Taxandria linearifolia* over a *Baumea rubiginosa* and *B. articulata* sedgeland. Within the sedgeland are the rare *Xyris maxima* and *Reedia spathacea*.
- Seeps from **mesas** in the Northampton region (Geraldton Sandplains) – These are poorly documented but have a rich **ephemeral** flora and support many species at the end of their range. The rare endemic *Pterostylis* sp. Northampton is associated with these wetlands.

A particular type of spring, a **mound spring**, is associated with the development of a substantial mound of organic matter at the outlet of the water. These are all rare and three examples are given below.

- Mound springs of the Three Springs area (Geraldton Sandplains) – These are associated with the Dandaragan Scarp, west of Three Springs. At least twenty-four have been historically recorded but now only seventeen remain. These are typified by *Melaleuca preissiana*, *Eucalyptus rudis*, *E. dolorosa* and *E. camaldulensis* woodlands over *Baumea vaginalis* sedgeland. This community is the TEC 'Assemblages of the organic mound springs of the Three Springs area'.
- High altitude peat swamps of the eastern Stirling Range (Esperance Sandplains) – These have a *Homalospermum firmum* shrubland over sedgeland and support a series of endemic species, including the rare *Xyris exilis*.
- Swan Coastal Plain mound springs – These are found between Bayswater and Muchea but the Bayswater occurrence is cleared. Extant (still existing) examples support forest to woodland dominated by combinations of *Melaleuca preissiana*, *M. rhaphiophylla*, *Banksia littoralis* and *Eucalyptus rudis*, with *Taxandria linearifolia* shrubland, *Cyathochaeta teretifolia* sedgeland (Figure 103) and fernlands of *Pteridium esculentum* and/or *Cyclosorus interruptus*. These continuously wet sites contain many species outside their normal ranges, including *Hibbertia perfoliata*, *Lycopodiella serpentina* and *Utricularia volubilis*. These communities all belong to the TEC 'Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)'.

Tufa: a porous rock composed of calcium carbonate and formed around mineral springs

Mesa: an isolated flat-topped hill with steep sides

Ephemeral (plant): marked by short life cycles, usually a single season

Mound spring: an upwelling of groundwater emerging from a surface organic mound

Figure 103. The plants that define wetland sedgelands come from a variety of families including the *Cyperaceae*. An example is the perennial sedge *Cyathochaeta teretifolia*, a very large sedge (sometimes up to 2 metres tall) of freshwater seepages, especially mound springs. Photos – B Keighery/OEPA.

(a) *C. teretifolia* sedgeland under Melaleuca forest at Piney Lakes (Swan Coastal Plain).

(b) Flowers.

(c) Seeds. The seeds of the genus *Cyathochaeta* distinguish the various species.

Perched wetlands

These wetlands support the greatest diversity of vegetation and flora found in wetlands in the Southwest. This is associated with the variety of habitats formed in response to:

- the base impeding layer which can be clay or rock (ironstone, calcrete or granite and combinations of these)
- the pattern of sequential inundation and drying
- the variety of soils laid at various depths over the water impeding layer.

As a consequence, what may appear to be a very hostile environment in summer supports a rich diversity of habitats in winter and spring. These summer hard surfaces are often damaged by vehicles accessing them when the surface is dry but the underlying soils are wet. Wheel ruts in these wetlands can persist for decades.

These wetlands typically support diverse shrublands and annually renewed sedgelands and herblands. Many of the taxa in these communities are uncommon and many have only recently been recognised.

Examples of these wetlands are described below according the principal impeding layer type, i.e. clay or rock (then ironstone, calcrete or granite). However, it should be noted that all or several impeding layer types may be present in a wetland system.

Claypans or clayflats

A series of examples are listed below. These are best known from the Swan Coastal Plain but occur in many of the bioregions.[94]

- Claypans or vernal pools of the Pinjarra Plain (Swan Coastal Plain, Figure 104 to Figure 111) – These wetlands support many different wetlands and wetland plant communities.[37,95] A number of these communities are TECs: 'Herb rich saline shrublands in clay pans', 'Herb rich shrublands in clay pans', 'Dense shrublands on clay flats' and 'Shrublands on dry clay flats', as well as supporting many uncommon plant taxa. These plant communities include: forests to woodlands dominated by *Casuarina obesa* (Figure 104); woodlands dominated by Wandoo (*Eucalyptus wandoo*) and Marri (*Corymbia calophylla*); and most commonly shrublands dominated by *Melaleuca* species (including *M. osullivanii*, *M. viminea* and *M. lateritia* (Figure 107), *Viminaria juncea* (Figure 109 and Figure 111), *Astartea affinis* and *Hypocalymma angustifolium*, and combinations of these. Associated with all of these are perennial sedgelands dominated by *Meeboldina* species (including *M. cana*, (Figure 112) and *M. coangustata*), *Chorizandra enodis* and *Chaetanthus aristatus*. The deepest of the wetlands (claypans) are typically dominated by *Melaleuca lateritia* shrubland and support annually renewed grasslands, herblands and sedgelands at different times of winter and spring. For example, annual sedgelands dominated by *Centrolepis*, *Trithuria*, *Schoenus* (Figure 113) and *Aphelia* species occur in spring with the drying mud, as do herblands dominated by *Tribonanthes* (Figure 114a), *Stylidium* and *Asteraceae* species. Earlier, when the claypan is flooded, aquatic species such as *Aponogeton hexatepalus*, *Ornduffia* (previously *Villarsia*) *submersa* (Figure 115) and *Triglochin* and other *Ornduffia* species form herblands. *Amphibromus nervosus* grassland is present in early summer (Figure 105). Many taxa are confined to claypans and clayflats in the Southwest, and some of these are confined to the Swan Coastal Plain (SWA). Examples of these taxa are: *Marsilea drummondii*, *Chamaescilla gibsonii* (Figure 114c&d, endemic SWA), *Aponogeton hexatepalus*, *Eleocharis keigheryi* (DRF, Figure 104), *Schoenus natans* (Figure 115), *Triglochin muelleri* (endemic SWA), *Amphibromus nervosus* (Figure 105), *Eryngium ferox* ms (Figure 116c), *E. pinnatifidum* subsp. *palustre* (Figure 116a&b), *E. subdecumbens*, *Amblysperma minor*, *Aphelia drummondii*, *Myriocephalus helichrysoides*, *Isotoma pusilla* (Figure 117d), *Calandrinia* sp. Kemerton (Figure 118, endemic SWA), *Montia australasica*, *Samolus* sp. Clay Flats (endemic SWA), *Rhodanthe pyrethrum* (Figure

117a&c), *Pimelea imbricata* var. *major*, *Glossostigma diandrum* (Figure 117b) and *Stylidium longitubum* (Figure 107). Of particular interest in this group is the diversity of *Eryngium* taxa (Figure 116). Interestingly *Eryngium* has also speciated (i.e. new species have evolved) in the vernal pools of California.[96] A well-known example of this group of wetlands is the Brixton Street Wetlands*. The flora of these wetlands has been documented in a variety of reports, the most recent being Keighery and Keighery.[97] A few similar claypans are also found in the Jarrah Forest, for example in Drummond Nature Reserve north of Toodyay, which is a natural diversity recovery catchment.

➤ For more information on the Brixton Street Wetlands* complex, see 'Brixton Street Wetlands' profile at the end of this topic.

➤ For information on natural diversity recovery catchments, see the DEC website.[89]

Figure 104. A Pinjarra Plain (Swan Coastal Plain) claypan in late winter. Photos – G Keighery/ DEC.

(a) *Casuarina obesa* forest over a sedgeland and grassland. This community is a TEC.

(b) *Eleocharis keigheryi*, a rare sedge that inhabits claypans. Nineteen species of *Eleocharis* occur across WA; all are aquatic plants.

Figure 105. Bandicoot Creek Bushland (Swan Coastal Plain).

(a) Clayflats and claypans on the Pinjarra Plain with *Melaleuca viminea* shrublands (mid-ground and shrub in foreground), *Meeboldina cana* sedgeland (brown) and *Amphibromus nervosus* grassland. Photo – B Keighery/OEPA.

(b) Transect of the Swan Coastal Plain showing location of wetland (reproduced and adapted from Department of Minerals and Energy[86] with permission).

Figure 106. A view of the seasonally inundated flats in Bullsbrook Nature Reserve (Swan Coastal Plain). Photos – B Keighery/OEPA.

(a) *Actinostrobus pyramidalis* shrubland (background) and a sedgeland dominated by *Chaetanthus aristatus* with scattered *Verticordia plumosa* subsp. *pleiobotrya*.

(b) Flowers of *Verticordia plumosa* subsp. *pleiobotrya*, a rare wetland shrub.

Figure 107. A plant community of the seasonally inundated claypans in the Brixton Street Wetlands (Swan Coastal Plain) in late spring/early summer. Photo – B Keighery/OEPA.

(a) *Melaleuca lateritia* shrubland and *Stylidium longitubum* herbland.

(b) A transect of the seasonally inundated clayflat (illustration by M Pieroni, from Keighery et al.[98]) and seasonally inundated claypan in the Brixton Street Wetlands showing the location of this community.

Figure 108. A clayflat shrubland dominated by *Calothamnus hirsutus* (green bush), *Verticordia* species (yellow *V. chrysantha*, pink *V. plumosa* subsp. *pleiobotrya* and red/cream *V. huegelii*) and herbland with *Stylidium divaricatum* (cream) and *Borya* (gold). Photo – G Keighery/DEC.

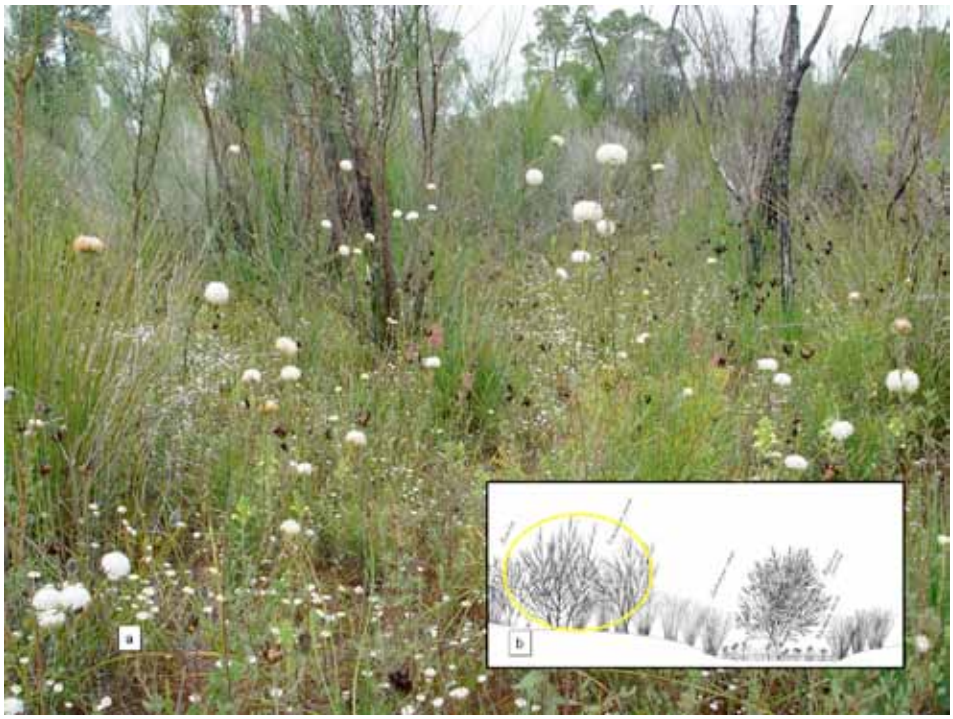


Figure 109. A plant community of the seasonally inundated clayflats in the Brixton Street Wetlands (Swan Coastal Plain) in spring.

(a) Within the *Viminaria juncea* shrubland, *Pimelea imbricata* subsp. *major* (tall white), *Haemodorum simplex* (black) and *Hyalospermum cotula* (small white) are flowering. The yellow flowered plants are *Parentucellia viscosa* which is a weed. Photo – B Keighery/OEPA.

(b) A transect (illustration by M Pieroni, from Keighery et al.[98]) of the seasonally inundated clayflat and seasonally inundated claypan in the Brixton Street Wetlands showing the location of this community.

Figure 110. A view of the seasonally waterlogged flats in Bullsbrook Nature Reserve (Swan Coastal Plain) with *Actinostrobus pyramidalis* and *Melaleuca scabra* dominated shrublands. Photo – B Keighery/OEPA.

Figure 111. *Viminaria juncea* is a widespread wetland species and represents another monotypic genus (i.e. a genus with only one species). *Viminaria* has air breathing roots (pneumatophores) for living in water.[99,100] Photos – B Keighery/OEPA.

(a) *Viminaria juncea* shrubland in the Brixton Street Wetlands.

(b) Flowers.

Figure 112. The plants that define wetland sedgelands come from a variety of families including the Restionaceae. An example is the perennial sedge *Meeboldina cana* (foreground) in Bandicoot Creek Bushland (Swan Coastal Plain). *M. cana* has male (brown plant to right) and female (two gray-white plants to left) plants, as do most Restionaceae. The bright green grass in the mid-ground is *Amphibromus nervosus*. Photo – B Keighery/OEPA.

Figure 113. Some sedgelands are formed by annual species. Photos – B Keighery/OEPA.
(a) An annual aquatic sedgeland in a claypan on the Swan Coastal Plain.
(b) *Schoenus tenellus* and (c) *Isolepis cernua* flower as the claypan water levels fall.

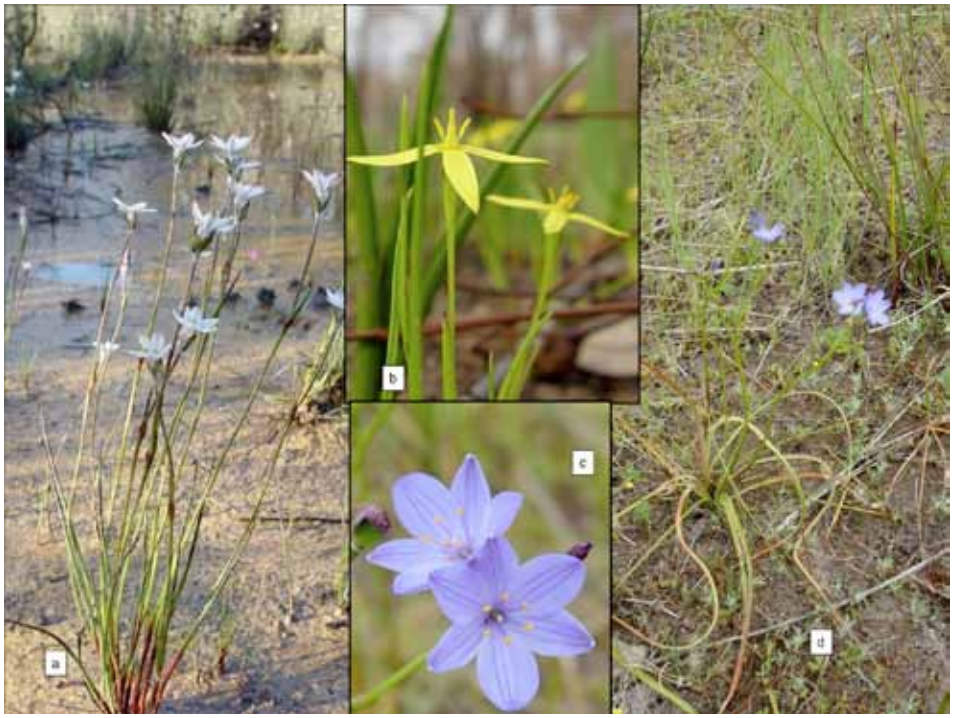


Figure 114. Three plants which, following inundation, are annually renewed from bulbs, corms, rhizomes or tubers, from wetlands on the Swan Coastal Plain. Photos – B Keighery/OEPA.
(a) *Tribonanthes uniflora* (bulbs)
(b) *Hypoxis occidentalis* (corm)
(c) *Chamaescilla gibsonii* flowers and (d) plant (tubers).

Figure 115. Some aquatic plants from a claypan in Bandicoot Creek Bushland (Swan Coastal Plain). The floating oval leaves are *Ornduffia* (previously *Villarsia*) *submersa* and the submerged brown aquatic plant is *Schoenus natans*. Photo – G Keighery/DEC.

Figure 116. Two uncommon *Eryngium* plants from wetlands on the Swan Coastal Plain annually renewed from a tuber. The *Eryngium* is species diverse in wetlands of the Swan Coastal Plain and a series of species are yet to be described. Photos – B Keighery/OEPA.

(a) and (b) *Eryngium pinnatifidum* subsp. *palustre* ms plant (a) and flowers (b).

(c) *Eryngium ferox* ms

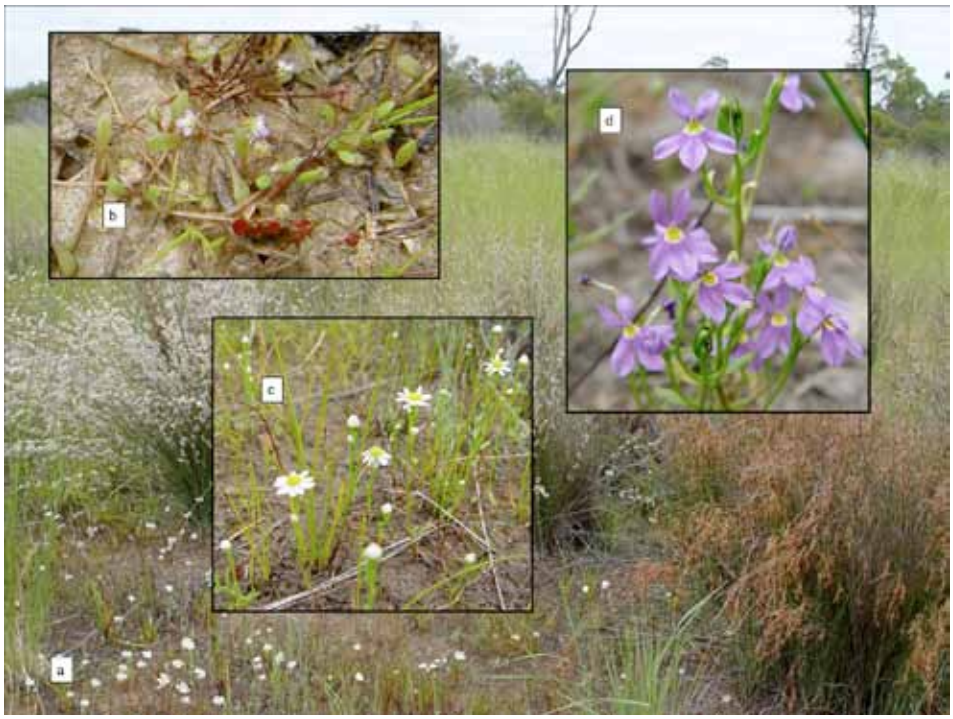


Figure 117. A large variety of annual herbs flower in the drying soils of clayflats and claypans. These are all renewed from seed. Photos – B Keighery/OEPA.

(a) Clayflats in Bandicoot Creek Bushland (Swan Coastal Plain).

(b) *Glossostigma diandrum*.

(c) *Rhodanthe pyrethrum* (and white flowers in (a)).

(d) *Isotoma pusilla*.

Figure 118. A mixture of annuals in Kemerton Nature Reserve seasonally inundated wet flats. Photos – B Keighery/OEPA.

(a) *Calandrinia* sp. Kemerton (red), *Calandrinia granulifera* (green) and *Isotoma scapigera* (single blue flower top left).

(b) *Calandrinia* sp. Kemerton.

- Geraldton area river flats (Geraldton Sandplains) – These communities are associated with the rivers of the Geraldton area such as the Greenough, Irwin and Chapman rivers. The centres of the claypans are normally bare with a fringe of *Eucalyptus camaldulensis*, but sometimes lignum (*Muehlenbeckia florulenta*) and/or cane grass (*Eragrostis australasica*) is present. *Melaleuca strobophylla* or *Casuarina obesa* woodland may be found throughout the wetlands. These wetlands were common, especially on the Greenough Flats and the lower reaches of the Irwin River, but are now largely destroyed.[101] The remaining areas are the major habitat of *Wurmbea tubulosa* and *Oxalis* sp. Greenough and they form part of the TEC 'Clay flats assemblages of the Irwin River: Sedgelands and grasslands with patches of *Eucalyptus loxophleba* and scattered *E. camaldulensis* over *Acacia acuminata* and *A. rostellifera* shrubland on brown sand/loam over clay flats of the Irwin River' (extending into the Avon Wheatbelt). Claypans are found elsewhere in the Geraldton Sandplains and these are typically fringed by *E. camaldulensis*. All remaining claypans are threatened by hydrological change.
- **Bentonite** wetlands of the Watheroo Marchagee area (Geraldton Sandplains) – These thirty intermittently inundated claypans fill by rain and water is perched upon the bentonite clay, also known as 'saponite'. When drying, these bentonite wetlands are covered by herblands dominated by combinations of *Triglochin mucronata*, *Asteridea athrixioides*, *Trichanthodium exile*, *Puccinellia stricta*, *Podolepis capillaries*, *Angianthus tomentosa* and *Pogonolepis stricta*.[35] They are listed as the TEC 'Herbaceous plant assemblages on Bentonite Lakes'.
- Avon Wheatbelt claypans – A variety of significant claypans are scattered in the Avon Wheatbelt. These are generally fringed by York Gum (*Eucalyptus loxophleba*) woodlands over *Gahnia trifida* sedgelands. An extensive area of clay-based wetlands is associated with the flats of the Beaufort River (Figure 119 and Figure 120). These support a mosaic of wetland communities including *Casuarina obesa* woodlands, mallee woodlands, shrublands dominated by *Melaleuca atroviridis*, *M. scalena* and *M. viminea*, perennial sedgelands and diverse annually renewed sedgelands and herblands. This community shares many taxa with the Swan Coastal Plain group, including *Wurmbea dioica* subsp. Brixton (Figure 120b). These communities are under considerable threat by hydrological change, including rising saline groundwater.

Bentonite: a type of clay (aluminium phyllosilicate)

Figure 119. A view of the clayflat and claypan communities at Beaufort River Flats (Avon Wheatbelt) during winter when claypans are filled with water. *Casuarina obesa* woodland over *Melaleuca* species shrublands fringe the claypan. Photo – B Keighery/OEPA.

Figure 120. Clayflat and claypan communities at Beaufort River Flats (Avon Wheatbelt). Photos – B Keighery/OEPA.

(a) Shrublands dominated by *Melaleuca atroviridis* and *M. viminea* over herblands (background) and *Meeboldina* sedgeland and herblands (foreground), with the herbs *Utricularia multifida* (pink) and *Wurmbea dioica* subsp. Brixton (white).

(b) *Wurmbea dioica* subsp. Brixton growing in the inundated phase of the wetland. This plant is most likely a new species of *Wurmbea* that renews itself from a bulb each spring. This aquatic also grows in the Brixton Street Wetlands.

Rockpans

The impeding layer of rockpans can be ironstone, calcrete or granite. The first two are sometimes found together and typically are overlaid by varying depths of loams and/or clays.

Ironstone (also called ferricrete or bog iron ore)
These perched wetlands are usually seasonally inundated and dry in summer, and normally have soils that are shallow red-brown sandy clays over ironstone. The ironstone soil type has formed due to the precipitation of iron from the groundwater, mainly in the zone of water table fluctuation. Scattered occurrences from Eneabba to the Porongurups are known to support distinctive plant communities. The plant communities are similar to those formed on the claypans and clayflats, and show the same sequence of flowering, diversity of communities and diversity of flora. However, dense shrublands tend to be the dominant community, and open patches dominated by sedgelands and herblands are generally only widespread in these communities after fire. As outlined below, a series of taxa are only found in these communities and a number of the larger occurrences are described below. The first four are listed TECs. While these surfaces are naturally rare, clearing means they are even rarer now. For example, the Scott River Ironstones originally covered 1,780 hectares and now are reduced to just 325 hectares and the Busselton Ironstones originally covered 1,100 hectares and now are under 100 hectares, mostly in small fragments.

- Rocky Springs, south east of Eneabba (Geraldton Sandplain) – These are typified by an *Acacia blakelyi*, *Allocasuarina campestris*, *Banksia* (previously *Dryandra*) *stricta* and *Labichea lanceolata* shrubland and are the TEC 'Ferricrete floristic community (Rocky Springs type)'.

- Gingin (Swan Coastal Plain) – These are typified by *Melaleuca viminea* and *Kunzea limnicola* shrublands over *Rhodanthe manglesii* herbland (Figure 121). The Declared Rare Flora (DRF) taxon *Grevillea curviloba* subsp. *incurva* and the Priority Flora species *Isotropis cuneifolia* subsp. *glabra* are associated with these habitats. These are the TEC 'Perth to Gingin Ironstone Association'.

Figure 121. The TEC 'Perth to Gingin Ironstone Association' in Timaru Nature Reserve with *Melaleuca viminea* and *Kunzea recurva* (white flowers) shrubland over *Rhodanthe manglesii* herbland. *Rhodanthe manglesii* is also associated with wetlands on granite rocks. Photo – G Keighery/DEC.

- Busselton Southern Ironstone Association (Swan Coastal Plain) – Again, a shrubland (Figure 122a&c and Figure 123e) typifies these wetlands[102,103] and is the most species-rich of the ironstone shrublands, being dominated by *Kunzea* aff. *micrantha*, *Banksia* (previously *Dryandra*) *squarrosa* subsp. *argillacea* (Figure 122a&b, DRF, endemic SWA), *Hakea oldfieldii* (Figure 122c&d), *Pericalymma ellipticum* and *Viminaria juncea*. At times *Eucalyptus rudis* subsp. *cratyantha* is scattered through the community. These communities also contain patches or layers of perennial sedgelands dominated by *Caustis dioica*, *Chordifex isomorphus*, *Lepyrodia monoica*, *Loxocarya magna* and/or *L. striata* subsp. *implexa*; annual sedgelands; and annually renewed herblands which include *Tribonanthes*, *Asteraceae* and *Apiaceae* species, *Utricularia* species (*U. menziesii*, *U. multifida*, *U. volubilis*) and *Stylidium* species. After fire the rare *Brachyscias verecundus* (DRF, endemic SWA) and *Stylidium ferricola* (endemic SWA) are common. This community supports more than fifteen endemic species, of which eleven are DRF, including: *Darwinia whicherensis* (Figure 124b, endemic SWA), *Andersonia ferricola*, *Hemiandra* sp. Ironstone, *Calothamnus lateralis* var. *crassus*, *Calothamnus quadrifidus* subsp. *teretifolius*, *Calytrix* sp. Tutunup (Figure 124e&f, endemic SWA), *Banksia* (previously *Dryandra*) *nivea* subsp. *uliginosa* (Figure 123e, endemic SWA), *Grevillea elongata*, *Grevillea maccutcheonii* (endemic SWA), *Lambertia echinata* subsp. *occidentalis* (Figure 123c, endemic SWA), *Petrophile latericola* (Figure 123a&b, endemic SWA), *Opercularia vaginata* (Ironstone form) and *Gastrolobium papilio* (endemic SWA). *Isopogon formosus* subsp. *dasylepis* (Figure 123d) and *Chamelaucium* sp. C Coastal Plain (Figure 124c&d, endemic SWA) are also found in these communities. This community is the TEC 'Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)'.

Figure 122. The TEC 'Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)' or Busselton Ironstones contain many restricted and rare plants. Photos – B Keighery/OEPA.
(a) Busselton Ironstone community with emergent *Banksia squarrosa* subsp. *argillacea*.
(b) *Banksia squarrosa* subsp. *argillacea* flowers.
(c) Busselton Ironstone community with emergent *Hakea oldfieldii*.
(d) *Hakea oldfieldii* flowering branchlet.

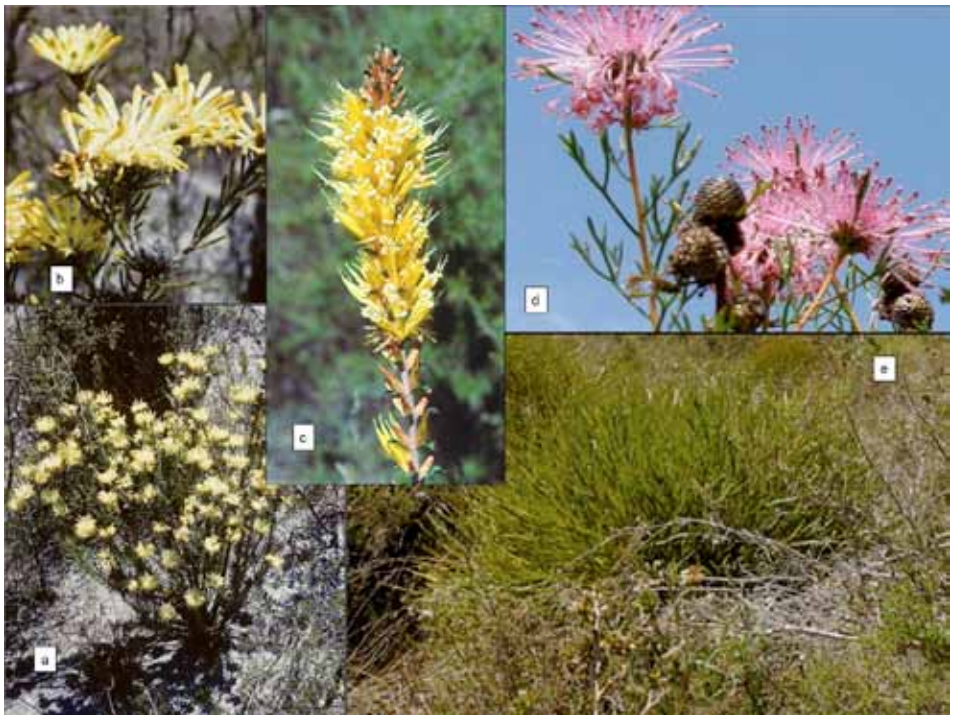


Figure 123. The TEC 'Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)' or Busselton Ironstones contain many restricted and rare plants, including a number from the Proteaceae family.
(a) and (b) *Petrophile latericola* plant (a) and flowers (b). Photos – G Keighery/DEC.
(c) *Lambertia echinata* subsp. *occidentalis* flowers. Photo – G Keighery/DEC.
(d) *Isopogon formosus* subsp. *dasylepis*. Photo – B Keighery/OEPA.
(e) *Banksia nivea* subsp. *uliginosa* plant. Photo – B Keighery/OEPA.

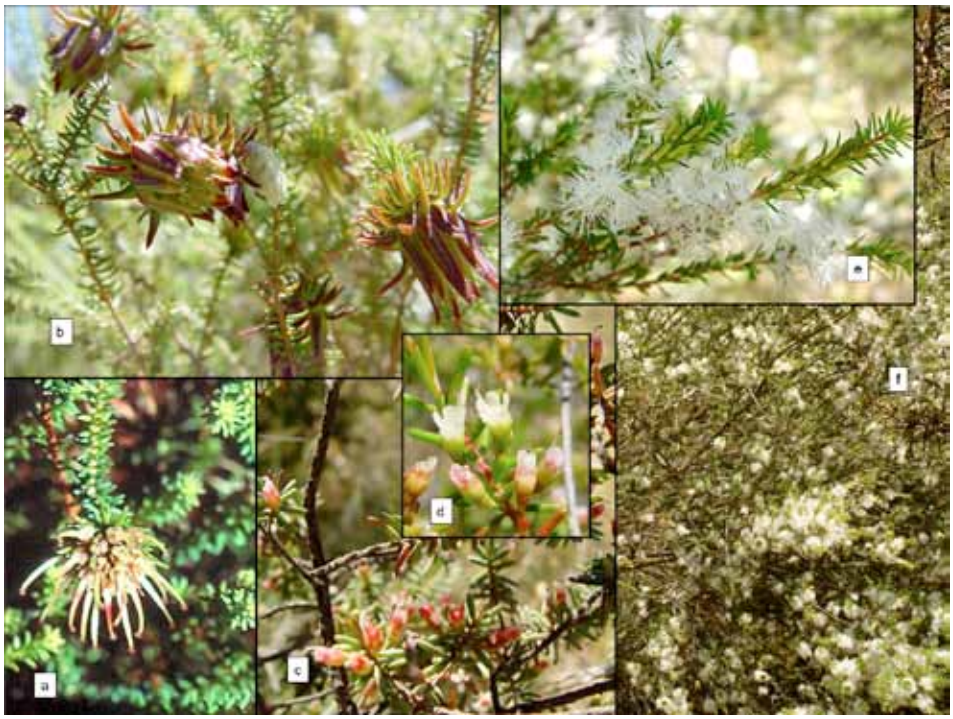


Figure 124. The TEC 'Scott River Ironstone Association' and the Busselton Ironstones contain many restricted and rare plants, including a number from the Myrtaceae family.
(a) *Darwinia ferricola* from the Scott River Ironstones. Photo – G Keighery/DEC.
(b) Busselton Ironstone *Darwinia whicherensis*. Photo – B Keighery/OEPA.
(c) and (d) Busselton Ironstone *Chamelaucium* sp. C Coastal Plain. Photos – B Keighery/OEPA.
(e) and (f) Busselton Ironstone *Calytrix* sp. Tutunup. Photos – B Keighery/OEPA.

- Scott River Ironstone Heaths (Warren) – These shrublands are dominated by *Hakea tuberculata*, *Kunzea micrantha*, *Melaleuca incana* and/or *Melaleuca preissiana* over sedgelands typically dominated by *Loxocarya magna*. This community supports six endemics and most of these are DRF including *Boronia exilis* and *Darwinia ferricola* (Figure 124a). This community is the TEC 'Scott River Ironstone Association'.
- North Porongurup Ironstone Shrubland (Jarrah Forest) – These shrublands are dominated by *Kunzea recurva*, *Hakea tuberculata* and *H. lasiocarpha*.

Calcrete

Calcrete generally refers to a cemented accumulation of carbonate minerals, such as limestone. A series of calcrete surfaces are associated with wetlands in the Southwest; these are often associated with saline wetlands. Examples are found in the Yalgorup Lakes complex (see 'Profile of a wetland complex: Yalgorup National Park wetlands' at the end of this topic for more information) and Muchea Limestones of the Swan Coastal Plain.[104] The Muchea Limestones are formed from the deposition of calcium carbonate rich water associated with springs on the eastern Swan Coastal Plain. Ironstone on the eastern Swan Coastal Plain is formed in a similar fashion from iron rich spring water.

The TEC 'Shrublands and Woodlands of the Muchea Limestones' is a variable set of communities formed on a few isolated naturally vegetated occurrences of Muchea Limestones from near Gingin to Kemerton north of Bunbury (Figure 125 and Figure 126). These support a mosaic of plant communities. On the flats where clay overlays or is mixed with the limestone, communities are similar to those of claypans and clayflats (including *Casuarina obesa* woodlands). On the rises with outcropping limestone, mallee forests and/or woodlands dominated by *Eucalyptus decipiens* and/or *E. foecunda* occur. All of the occurrences have significant differences related to the presence of a series of disjunct flora, some of which are normally associated with coastal limestones. For

example, *Melaleuca huegelii* (a coastal limestone species) and *Grevillea curviloba* are only found in the occurrences north of Perth, *Alyogyne huegelii* is scattered throughout the occurrences, and *Eucalyptus decipiens* is found in most occurrences. A number of new taxa are being found to be associated with these communities including an unnamed variant of *Melaleuca systena* associated with the Kemerton occurrence (Figure 125), a new *Austrostipa* species associated with the Perth occurrence and another new *Austrostipa* species confined to the Kemerton occurrence. The first of the new *Austrostipa* species is also found in another calcareous community in Bunbury (Figure 127).

Figure 125. Tall shrubs and trees in part of the TEC 'Shrublands and woodlands on Muchea Limestone' in Kemerton Nature Reserve. Photos – B Keighery/OEPA.

(a) *Eucalyptus decipiens*, *Viminaria juncea*, *Melaleuca* sp. Kemerton and *Banksia littoralis* dominate the community.

(b) Flowers of *Melaleuca* sp. Kemerton.

Figure 126. A view of some of the plant communities of the TEC 'Shrublands and woodlands on Muchea Limestone': *Melaleuca viminea* shrubland and *Utricularia multifida* (pink) herbland and sedgeland. Photo – B Keighery/OEPA.

Figure 127. Claypan in Hay Park in Bunbury (Swan Coastal Plain). Photos – B Keighery.

(a) *Melaleuca viminea* shrublands and *Austrostipa juncifolia* subsp. Southern River grassland in the TEC 'Shrublands on calcareous silts of the Swan Coastal Plain'.

(b) Flowers of *A. juncifolia* subsp. Southern River. This newly recognised species is related to *A. juncifolia* found in saline wetlands well to the south and east of this location. Another newly recognised species, *A.* sp. Harvey is found nearby in another TEC 'Shrublands and woodlands on Muchea Limestone' (see Figure 125).

Granite

Granite outcrops support a variety of wetlands and wetland plant communities (Figure 128 and Figure 129) which have similar characteristics to those of claypans and clayflats, sharing many species (for example *Utricularia menziesii*, Figure 129a&b). The ephemeral pools (gnamma holes, Figure 129c&d) are usually small and contain a suite of aquatics including species from the following genera: *Isoetes* (six out of eight species present in the Southwest are endemic, Figure 130b), *Glossostigma* and *Myriophyllum* (several endemic, including *M. balladoniensis*, *M. petraeum* and *M. lapidicola*[105]). A number of other granite rock wetland species are endemic (Figure 131) and some are yet to be described. The edges of the rocks and the moss pillow seepage communities on the rocks support a wide variety of annual and annually renewed herbs including members of the genera *Drosera*, *Hydrocotyle*, *Stylidium*, *Utricularia* and *Wurmbea*, members of which are also typical of the claypans and clayflats. Granite rocks have a rich flora of more than 2,000 species, many endemic to WA, but most moss pillow species are found in other intermittently inundated wetlands (Figure 129c&d). These wetlands are described in numerous publications (for example Royal Society of WA[106], Jones et al.[107]) and are not further detailed here. One, Yorkrakine Rock, supports a listed nationally significant wetland.

Figure 128. Granite rocks in Charles Darwin Reserve (Yalgoo) support a variety of wetland herbland communities. The herblands on granite rocks share many species with claypan and clayflat wetlands (see Figure 32b,c&d and Figure 117b&d). Photos – B Keighery/OEPA.

(a) Pockets of soil collect in depressions.

(b) *Borya constricta* herbland. *Borya* species are shared with claypan and clayflat wetlands.

Figure 129. Two wetland habitats restricted to granite rocks are moss pillows and rock pools.

(a) and (b) *Utricularia menziesii* growing in a moss pillow. This species also grows in clayflat and claypan communities. Photos – B Keighery/OEPA.

(c) Rock pool.

(d) Rock pools support a variety of algae and when they contain soil support herblands very similar to those on claypans. These communities both support the ferns *Pilularia novae-hollandiae* and *Isoetes drummondii*.

Figure 130. Rock pools and claypans support similar herblands. The aquatic ferns *Pilularia novae-hollandiae* (a) and *Isoetes drummondii* (b) are found in both types of communities. Photos – B Keighery/OEPA.

Figure 131. Some plants are restricted to wetlands on granite rocks. For example, on Petrudor Rocks (Yalgoo) is a population of *Tribonanthes* aff. *longipetala*. Photo – B Keighery/OEPA.

Wetland flora of the Southwest

Monotypic (genus): a genus with only one species

Despite having a Mediterranean climate with prolonged summer dry periods, the diversity of the wetland flora of the Southwest reflects the listing of the area as a world biodiversity hot spot for flowering plants. The Southwest is the world centre of diversity for a range of wetland-centred groups including the families Droseraceae, Restionaceae, Juncaginaceae, Centrolepidaceae[108] and Hydatellaceae and the samphire genus *Tecticornia*. There are a range of endemic wetland genera including *Reedia* (Cyperaceae), *Cephalotus* (Cephalotaceae), *Tribonanthes* (Haemodoraceae), *Epiblema* (Orchidaceae), *Schoenolaena* (Apiaceae), *Cosmelia* (Epacridaceae), *Euchilopsis* (Fabaceae), *Acidonia* (Proteaceae), *Homalospermum*, *Pericalymma* and *Taxandria* (Myrtaceae). The majority of rare wetland species of WA, ranging from **monotypic** genera such as *Reedia spathacea* to orchids, such as *Epiblema grandiflorum*, are found in the Southwest, as are the majority of wetland TECs.

With this background it is surprising that it has been often reported that Australian freshwater wetlands display remarkably low levels of endemism, with many genera and some species being almost cosmopolitan (for example, Commonwealth of Australia[109]). Apart perhaps for the flora of the larger lakes and freshwater swamps, this statement is incorrect for southern WA. As can be seen in the preceding information, high levels of local and regional endemism is found in nearly all perched wetlands in the Southwest, regardless of substrate (granite, clay, ironstone).

To better consider endemism and diversity in the Southwest wetlands, a detailed analysis of the wetland flora of the Southern Swan Coastal Plain (Moore River to Dunsborough) has been undertaken. This is presented in part 5: Southern Swan Coastal Plain.

A guide to managing and restoring wetlands in Western Australia

Wetland vegetation and flora, part 5: Southern Swan Coastal Plain

In Chapter 2: **Understanding wetlands**

Australian Government

Department of Environment and Conservation

Our environment, our future

Contents

Wetland profiles

Introduction

This section provides a more in-depth analysis of the characteristics of the wetland vegetation and flora of the Swan Coastal Plain bioregion (Figure 132), which is part of the Southwest climatic and biogeographical zone, described in Part 4 of this topic.

Figure 132. The Swan Coastal Plain bioregion and surrounding bioregions. Image – C. Auricht, Auricht Projects.

Features of the southern Swan Coastal Plain wetland flora

To better consider endemism and diversity in the Southwest wetlands, a detailed analysis of the wetland flora of the southern Swan Coastal Plain (Moore River to Dunsborough) has been undertaken. This region has been subject to an intensive quadrat and specific area-based floristic survey over many years. This analysis is based on 1,150 quadrats, flora lists of seventy-eight reserves and bushland areas, flora revisions, flora treatments, *FloraBase* and *Australia's Virtual Herbarium*. Taxa were allocated to drylands and wetlands, as well as being placed in a series of other categories including life form and growth form (see Appendix 2 in part 1). In total 1,877 native plant taxa were recorded.

This information highlighted some interesting features of the Swan Coastal Plain's wetland flora, summarised below. Information regarding Swan Coastal Plain wetland taxa is provided in Appendix 2, while the data used to compile the below charts is provided in Appendix 3 (in part 1).

Very high rate of endemism

The percentage of wetland species endemic to WA is very high at 74 per cent, as compared to 85 per cent for dryland taxa (Figure 133). These figures refute the notion that our wetland species are not also highly endemic (at least for vascular plants). While not determined at this stage, it is expected that around 3 per cent of the Swan Coastal Plain flora will be locally endemic to wetlands on the plain (for example *Banksia squarrosa* subsp. *argillacea* (Figure 122a&b), *Darwinia whicherensis* (Figure 124b), *Calothamnus quadrifidus* subsp. *teretifolius*, *Calytrix* sp. Tutunup (Figure 124e&f), *Banksia nivea* subsp. *uliginosa* (Figure 123e), *Lambertia echinata* subsp. *occidentalis* (Figure 123c) and *Petrophile latericola* (Figure 123a&b)).

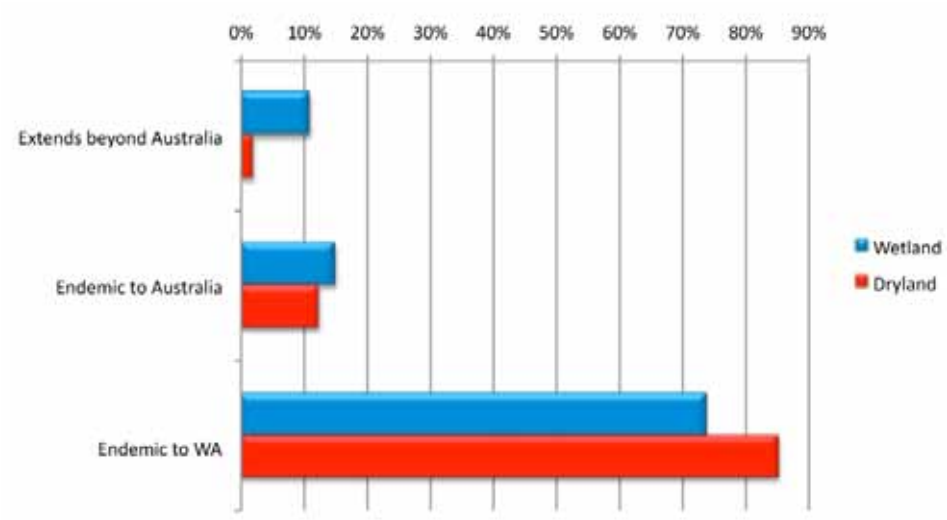


Figure 133. Endemism of wetland and dryland vascular plant taxa of the southern Swan Coastal Plain

The percentage of taxa that occur outside Australia (Figure 133) is higher for wetland species (11 per cent) than for dryland species (2 per cent). Taxa with Australia-wide distributions comprise similar percentages for both habitat types (15 per cent for wetland species and 13 per cent for dryland species).

Monocotyledons are more prevalent

Plant taxa are more likely to be monocotyledons in wetlands than dryland (Figure 135, Figure 136 and Figure 137) with 46 per cent in wetlands as compared with 26 per cent for drylands (Figure 134). This is probably a reflection of the successful life and growth forms of wetland plants. The dominance of monocotyledons is reflected in the higher percentages of sedges, grasses and herbs (Figure 138).

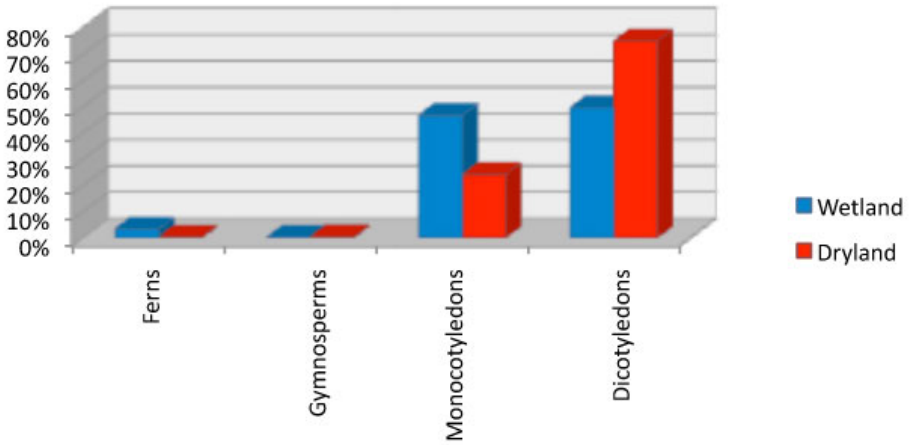


Figure 134. Plant groups of the wetland and dryland vascular plant taxa of the southern Swan Coastal Plain.

Figure 135. The plants that define sedgelands come from a variety of families including the Xyridaceae. Figure 57 shows a *Xyris* from the Kimberley; this very similar looking *Xyris lanata* is from the Southwest. Photos – B Keighery/OEPA.

(a) A seasonally inundated wetland dominated with *X. lanata* sedgeland under a *Melaleuca* shrubland.

(b) *X. lanata* flowers.

Figure 136. The plants that define sedgelands come from a variety of families including the Cyperaceae. An example is the perennial sedge *Gahnia trifida*, a large domed, widespread sedge of saline, calcareous and brackish wetlands. Photos – (a) B Keighery/OEPA (b) J Lawn/ DEC.

Figure 137. About 46 per cent of the wetland flora of the Swan Coastal Plain are annually renewed, including *Burchardia bairdiae* (a and b) and *B. multiflora* (c) which are both renewed from tubers. Photos – B Keighery/OEPA.

Shrub-rich relative to international wetlands but not shrub-rich compared to local dryland

Swan Coastal Plain wetlands are not shrub-rich with 19 per cent, as compared to drylands, where 51 per cent of the flora are shrubs (Figure 138). However, they are shrub-rich when compared with wetlands in other countries.

Herbs and sedges predominate

Herbs and sedges are the most common plant group in wetlands (48 and 29 per cent respectively) while shrubs and herbs are the most common in drylands (51 and 37 per cent respectively) (Figure 138). Examples are shown in Figure 135–137 and Figure 141.

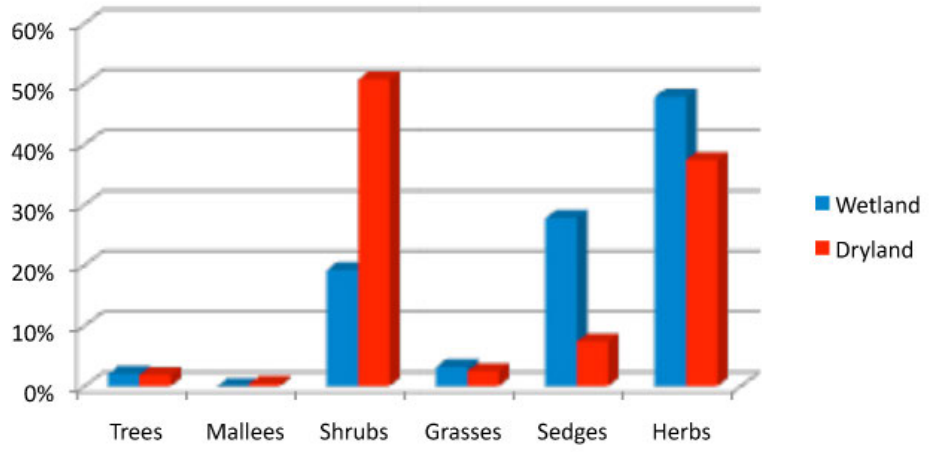


Figure 138. Growth forms groups of wetland and dryland vascular plants of the southern Swan Coastal Plain.

Underground storage organs are much more prevalent

Wetland species have a large percentage (22 per cent) renewed from underground storage organs compared with those in drylands (11 per cent) (Figure 139 and Figure 140). Examples are shown in Figure 137, Figure 141 and Figure 143.

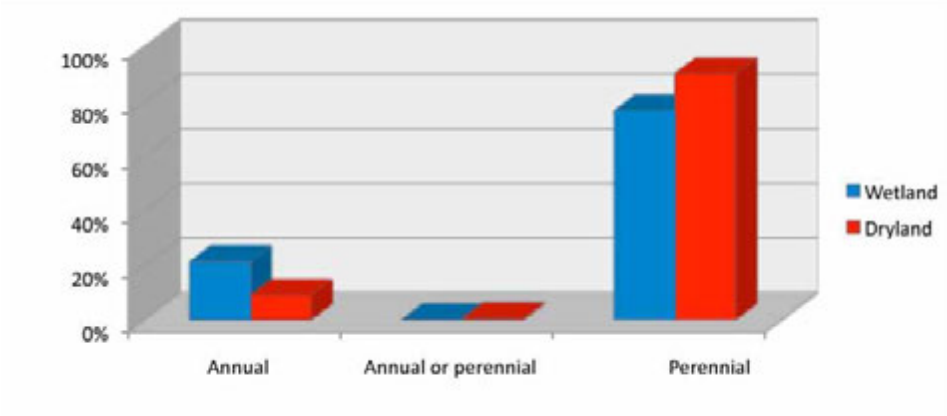


Figure 139. Life forms of wetland and dryland vascular plants of the southern Swan Coastal Plain.

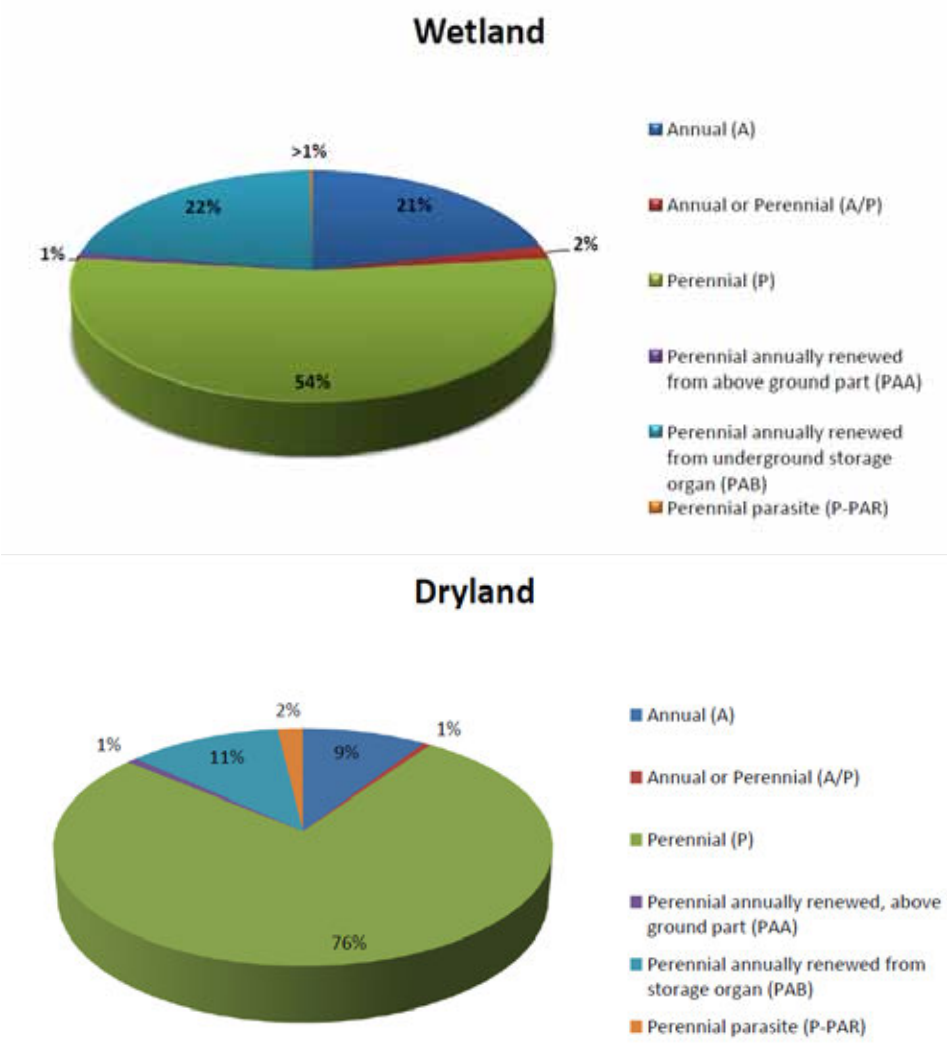


Figure 140. Life form groups of wetland and dryland vascular plants of the southern Swan Coastal Plain.

Figure 141. A newly recognised Swan Coastal Plain claypan endemic, *Craspedia argillicola* ms from Meelon Nature Reserve. Plants (a) and basal rosette (b) are annually renewed from tubers when the claypans fill with water and flower (c) as the claypan dries. Photos – B Keighery/OEPA.

Annually renewed plants are much more prevalent

Wetland species have a large percentage (45 per cent) that are annually renewed (seed, underground and above ground storage organs) compared with those in drylands (21 per cent) (Figure 142).

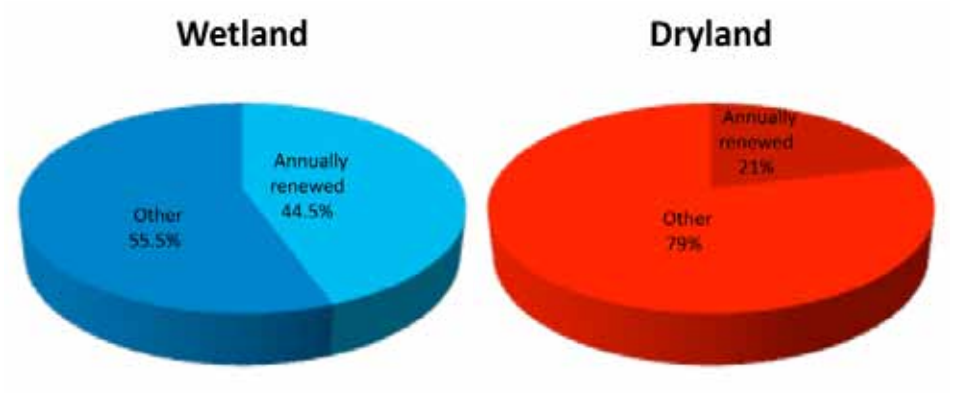


Figure 142. Life form of annually renewed groups of wetland and dryland plants of the southern Swan Coastal Plain.

Aquatics: a unique group

A unique group of wetland taxa are the aquatics (Figure 143). Aquatics taxa (as defined in the southern Swan Coastal Plain study) comprise 61 per cent (271 taxa) of the wetland flora. The majority of these, 163 taxa, or 60 per cent, grow in water and flower when the sites dry (the 'post inundation' category in Figure 144). Those plants that require inundated conditions to both grow and flower form 27 per cent (73 taxa) of the wetland flora (comprising 'emergent', 'floating' and 'submerged' categories in Figure 144; see the key in Appendix 2 in part 1 for more information on these categories). These are the flora that are generally listed as aquatic taxa in the literature. The remaining 13 per cent (35 taxa) could not be allocated to either of these groups.

Figure 143. Claypans on the Pinjarra Plain (Swan Coastal Plain) persist in the paddocks. As they are too wet for winter grazing, some native species persist in the pasture. This claypan south of Pinjarra contains the aquatic *Ottelia ovalifolia*. Other paddock claypans in the same area support populations of the bright green grass *Amphibromus nervosus*. Photo – B Keighery/ OEPA.

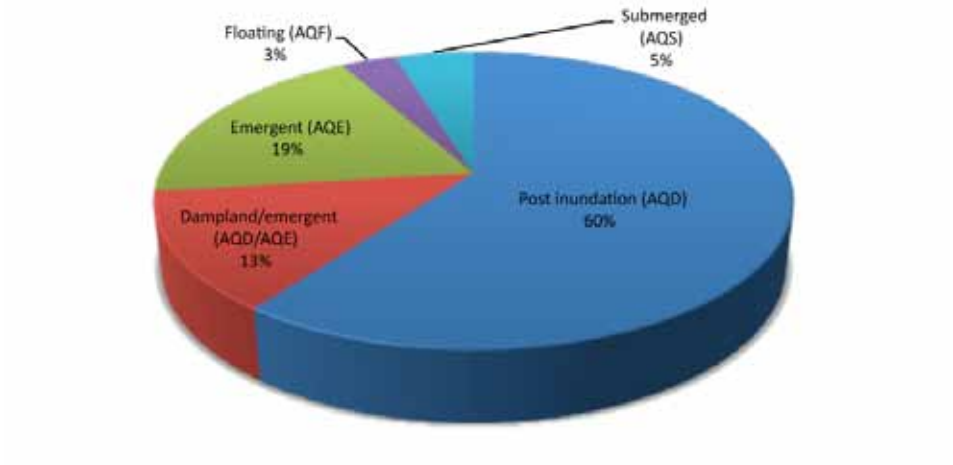


Figure 144. Life forms of aquatic vascular plants of the southern Swan Coastal Plain.

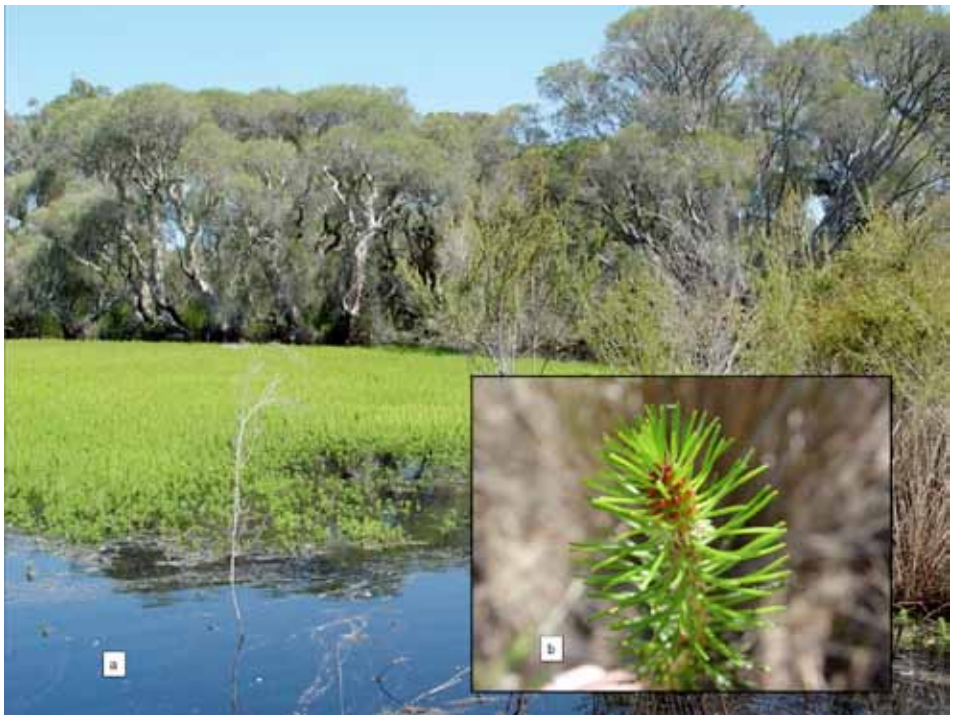


Figure 145. A lake in Harvey Flats Nature Reserve (Swan Coastal Plain) supports a population of *Myriophyllum crispatum*. The plants flower on branches above the water (b). Photos – B Keighery/OEPA.

Conclusion

These data show that wetlands contribute greatly to the richness and diversity of the unique Swan Coastal Plain and Southwest flora. Features of this rich flora (illustrated from the Swan Coastal Plain flora) include:

- wetland taxa with closely related dryland relatives (Figure 146 and Figure 147)
- taxa endemic to wetlands of the Plain (Figure 146a and Figure 147d&e)
- rare wetland taxa (Figure 146a, Figure 147d&e, Figure 148 and Figure 149)
- newly recognised taxa that are yet to be described (Figure 150c&d and Figure 151)
- different wetland forms that may prove to be separate taxa (Figure 152).

Figure 146. Many wetland plants have closely related species in the drylands. Two subspecies of *Eremophila glabra* illustrate this relationship. Photos – B Keighery/OEPA.

(a) The wetland *Eremophila glabra* subsp. *chlorella* is confined to a few wetlands on the Swan Coastal Plain and is very rare.

(b) *E. glabra* subsp. *albicans* is a common dryland plant found in near coastal dune communities.

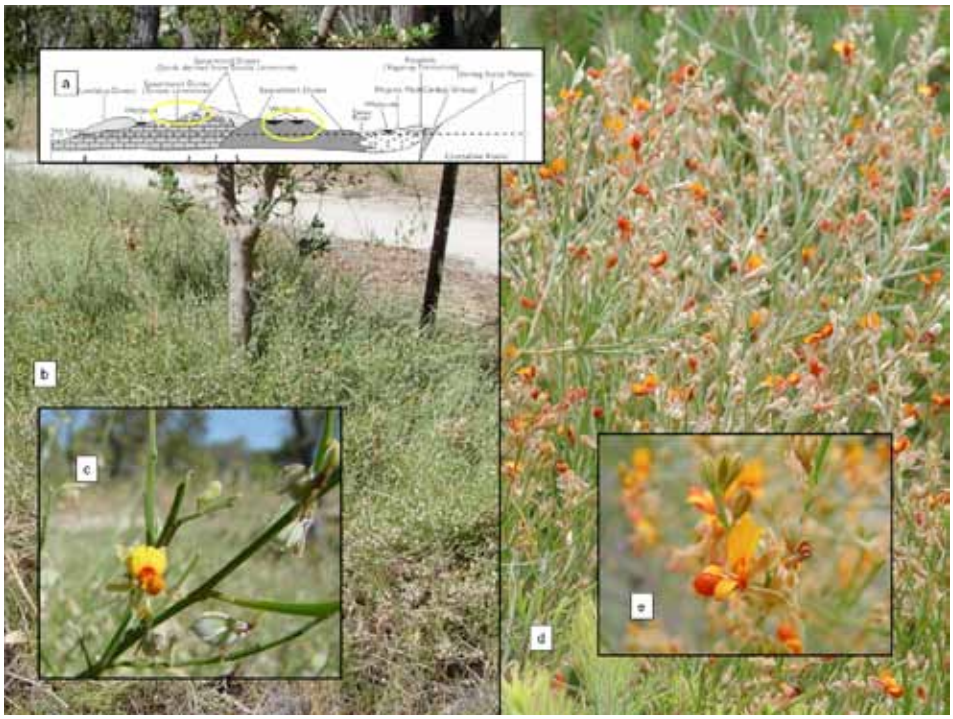


Figure 147. Many wetland plants have closely related species in the drylands. Two Swan Coastal Plain endemic *Jacksonia* species illustrate this relationship. Photos – B Keighery/OEPA.

(a) Transect (reproduced and adapted from Department of Minerals and Energy[86] with permission) of the Swan Coastal Plain showing locations of habitats of each species.

(b) and (c) The dryland Spearwood Dune *Jacksonia sericea*.

(d) and (e) The wetland Bassendean Dune *J. gracillima*.

Figure 148. *Anthotium junciforme* is a rare (Priority 4) Swan Coastal Plain species. Like many wetland plants, it persists into the dry season and is highly visible when it flowers in the dried soils in early summer, but is inconspicuous when it stops growing. Photos – B Keighery/OEPA.

Figure 149. *Acacia flagelliformis*, an uncommon wetland shrub confined to the wetlands in the Bunbury/Busselton area principally on the Swan Coastal Plain. Photos – B Keighery/OEPA.

(a) Plant.

(b) Flowers.

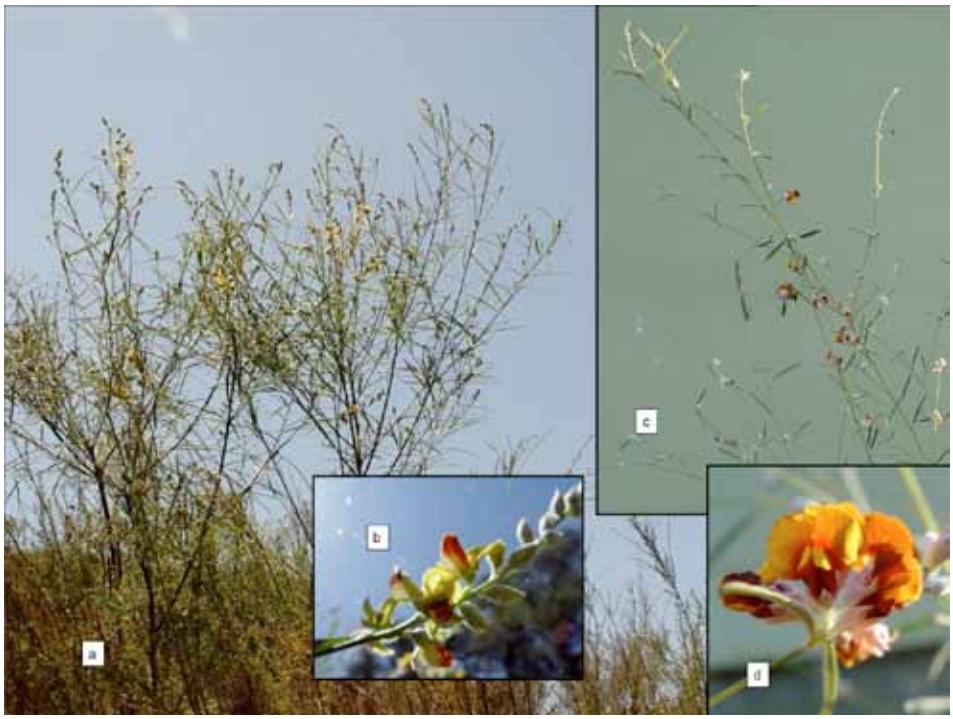


Figure 150. Members of the family Fabaceae are found in wetlands. Many of these are uncommon or rare. Photos – B Keighery/OEPA.

(a) and (b) The widespread *Gastrolobium ebracteolatum* favours freshwater seepage areas in wetlands.

(c) and (d) Another new taxon from wetland habitats near the Harvey River on the Swan Coastal Plain, *Gastrolobium* sp. Harvey.

Figure 151. Members of the family Proteaceae are found in wetlands. Three wetland shrubs of the genus *Grevillea* are illustrated here, all confined to the Swan Coastal Plain. Photos – B Keighery/OEPA.

(a) The prostrate form of *Grevillea obtusifolia* in Bullsbrook Nature Reserve.

(b) and (c) Two newly recognised grevilleas, *G. thelemanniana* subsp. Cooljarloo (b) and *Grevillea* sp. Gillingarra (c).

Figure 152. *Hibbertia stellaris*, a shrub of seasonally waterlogged wetlands in the Southwest, has two colour forms: the more restricted yellow form (a), and the bright orange form (b). Both forms are found on the Swan Coastal Plain. Photos – B Keighery.

wetland profile

Profile of a wetland complex: Yalgorup National Park wetlands

The Yalgorup National Park wetlands (Swan Coastal Plain) lie within the interface of the Quindalup and Spearwood dunes and within the Spearwood Dunes (Figure 153 and Figure 154). The wetland plant communities of Yalgorup National Park are many and varied, combining aspects of the saline and freshwater wetlands. The diversity of wetlands and associated wetland communities is related to the degree of inundation/waterlogging and the salinity of the water. Most of the wetlands in the national park are permanently inundated (that is, they are lakes). Communities beside the lakes are saline communities being heavily influenced by the saline waters of the lake. However, with increasing distance from the lakes, the saline influence decreases and freshwater seepages alongside the lakes support communities dominated by mostly freshwater species. This wetland vegetation is described below under saline and freshwater wetlands. All lake communities are annotated to indicate their position relative to the inundated area of the lake. Lake Community 1 is closest to the water and Lake Community 3 is the community adjacent to the drylands. A variety of freshwater wetland communities are also found in the park. Boundaries between these communities are gradational and, at times, the lakeside communities are a combination of all units described.

Figure 153. Yalgorup National Park and surrounding bushland, looking south-west with Lake Clifton in the foreground. Photo – G Whisson/DEC.

wetland profile

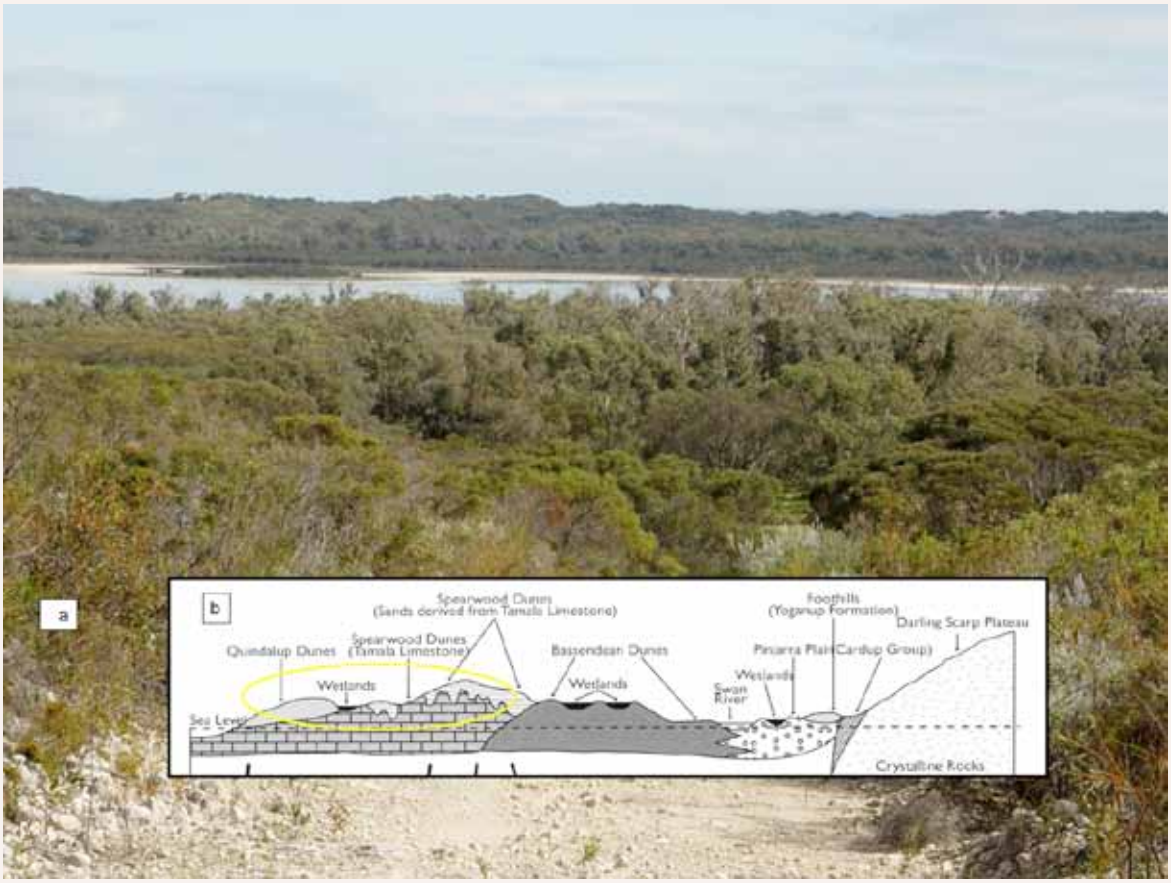


Figure 154. Quindalup and Spearwood dunes in Yalgorup National Park.

(a) Plant communities of the Quindalup and Spearwood dunes in Yalgorup National Park looking west across Lake Preston. Heaths can be seen on the Quindalup Dunes (far west) and Tamala limestone ridge of the Spearwood Dunes, with tuart (*Eucalyptus gomphocephala*) woodland on the gentler slopes of Lake Preston. On the margins of Lake Preston there is a set of zoned wetland communities from *E. gomphocephala* Woodland on the upper margin, through to *Melaleuca cuticularis* Closed Low Forest and lastly *Sarcocornia quinqueflora* and *Wilsonia backhousei* Open Low Heath on the water's margin. Photo – B Keighery/OEPA.

(b) Transect of the Swan Coastal Plain showing the location of the Quindalup and Spearwood dunes (reproduced and adapted with permission from Department of Minerals and Energy[86]).

Each of the major wetland communities are listed below, together with a standard description (after Keighery[3]; see part 1 pages 19 to 23, key to Appendix 1 and Table 4) derived from information collected from 10 by 10-metre quadrats located in each community. As discussed previously (part 1, page 20) the many sources for this topic did not use a consistent terminology to describe the vegetation layers. This profile has been included to both illustrate the complexity of plant communities in a wetland system and to illustrate the use of a set of standard vegetation or plant community descriptions with a key (after Keighery[3] and Table 4) showing how these are derived. When specific referenced terms are used for the vegetation layers the name for a layer is capitalised, for example Forest rather than forest.

wetland profile

Table 4: Vegetation structure classification system (based on Keighery[3]). Each row indicates a different vegetation layer.

Growth form/height class	Canopy cover			
	100–70%	70–30%	30–10%	10–2%
Trees over 30m	Closed Tall Forest **CTF**	Open Tall Forest **OTF**	Tall Woodland **TW**	Open Tall Woodland **OTW**
Trees 10–30m	Closed Forest **CF**	Open Forest **O**F	Woodland **W**	Open Woodland **OW**
Trees under 10m	Closed Low Forest **CLF**	Open Low Forest **OLF**	Low Woodland **LW**	Open Low Woodland **OLW**
Mallee over 8m (Tree mallee)	Closed Tree Mallee **CTM**	Tree Mallee **TM**	Open Tree Mallee **OTM**	Very Open Tree Mallee **VOTM**
Mallee under 8m (Shrub mallee)	Closed Shrub Mallee **CSM**	Shrub Mallee **SM**	Open Shrub Mallee **OSM**	Very Open Shrub Mallee **VOSM**
Shrubs over 2m	Closed Scrub **CSC**	Open Scrub **OSC**	Tall Shrubland **TS**	Open Tall Shrubland **OTS**
Shrubs 1–2m	Closed Heath **CH**	Open Heath **OH**	Shrubland **S**	Open Shrubland **OS**
Shrubs under 1m	Closed Low Heath **CLH**	Open Low Heath **OLH**	Low Shrubland **LS**	Open Low Shrubland **OLS**
Grasses	Closed Grassland **CG**	Grassland **G**	Open Grassland **OG**	Very Open Grassland **VOG**
Herbs	Closed Herbland **CHB**	Herbland **HB**	Open Herbland **OHB**	Very Open Herbland **VOHB**
Sedges	Closed Sedgeland **CSG**	Sedgeland **SG**	Open Sedgeland **OSG**	Very Open Sedgeland **VOSG**
Ferns	Closed Fernland **CFL**	Fernland **FL**	Open Fernland **OFL**	Very Open Fernland **VOFL**
Climbers	Closed Climbers **CC**	Climbers **C**	Open Climbers **OC**	Very Open Climbers **VOC**

Saline wetlands

Samphire Shrublands – Lake Community 1a

Samphire (*Sarcocornia quinqueflora*) dominated shrublands are found in the gently graded area alongside the water (Figure 155 and Figure 156). This community supports a series of species not commonly encountered on the Swan Coastal Plain such as *Isolepis cernua* var. *cernua* and *Hemichroa diandra* (Figure 157). Further study of these communities may identify more of these uncommon taxa. Of particular interest in this community is *Samolus repens* var. *paucifolius* which is at the southern extent of its range in the study area (Figure 158).

Community description: *Sarcocornia quinqueflora* and *Wilsonia backhousei* Open Low Heath over *Hydrocotyle tetragonocarpa* Very Open Herbland (Figure 156a).

wetland profile

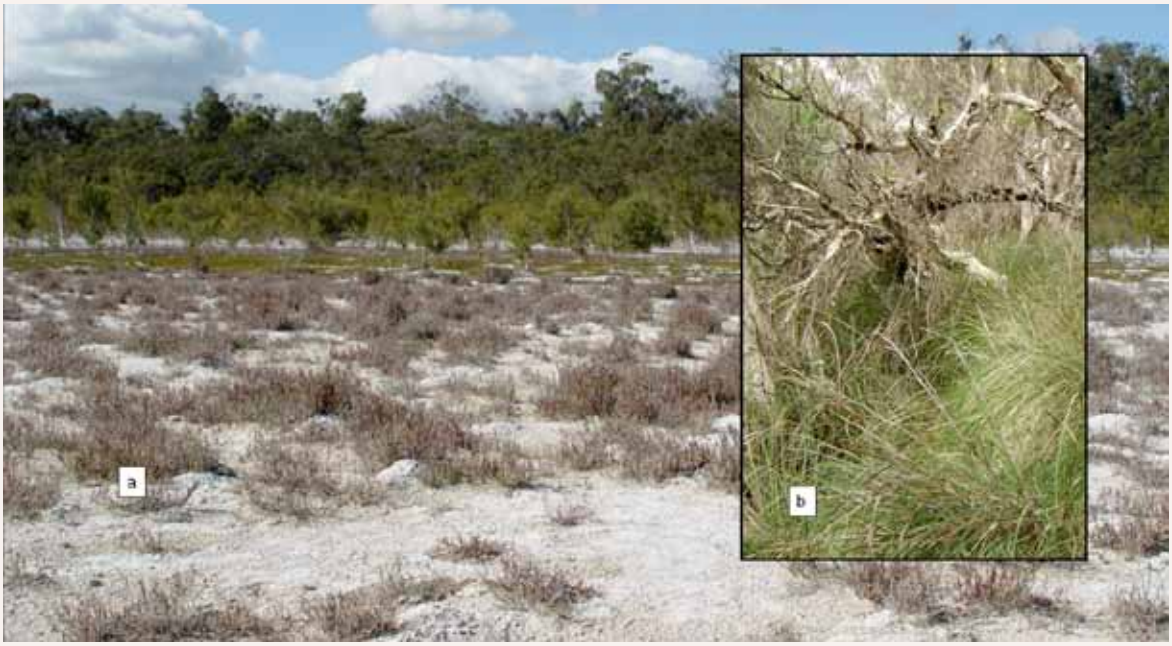


Figure 155. Plant communities visible from the water's edge.
(a) Samphire shrubland on the water margin, to *Melaleuca* forest, then tuart forest.
(b) *Melaleuca* forest underlain by a dense layer of the sedge *Gahnia trifida*, a freshwater community.
Photos – B Keighery/OEPA.

Figure 156. Plant communities on the water's edge, Lake Preston, eastern shoreline.
(a) Samphire heaths.
(b) *Wilsonia backhousei*.
(c) *Hydrocotyle tetragonocarpa*.
Photos – B Keighery/OEPA.

wetland profile

Figure 157. Plant communities on the water's edge, Lake Preston, eastern shoreline.
(a) Samphire heaths.
(b) *Triglochin mucronata* (left) and *Isolepis cernua* var. *cernua* (right).
(c) and (d) *Hemichroa diandra* plant and flowers (male).
Photos – B Keighery/OEPA.

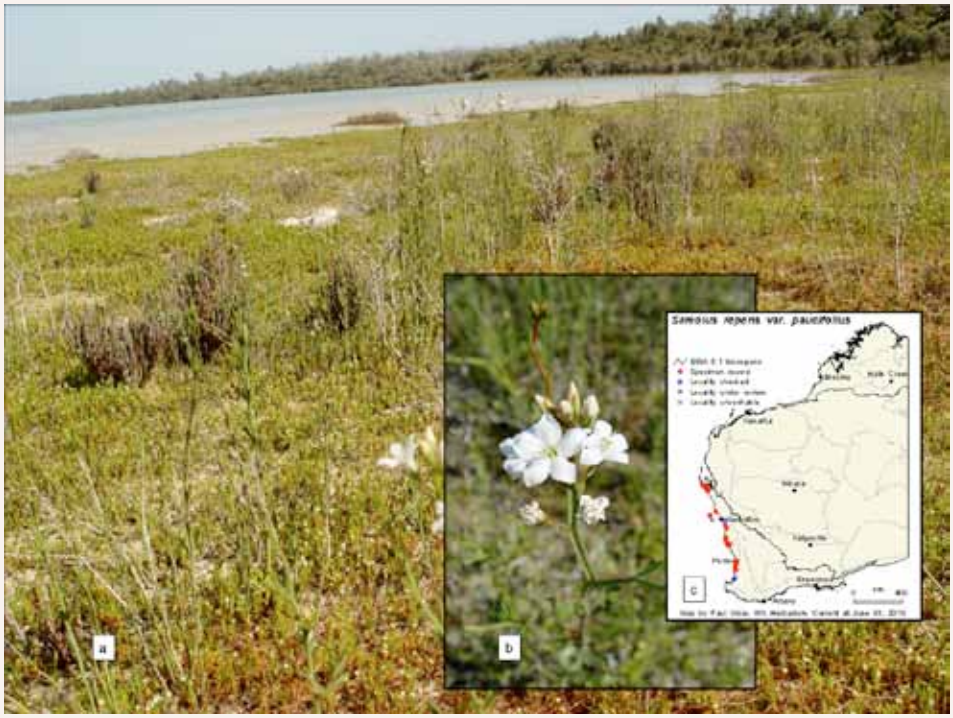


Figure 158. *Samolus repens* var. *paucifolius*. Photos – B Keighery/OEPA.
(a) Water's edge, Lake Preston (western shoreline).
(b) Flowers.
(c) The recorded distribution of *S. repens* var. *paucifolius*, showing Yalgorup Lakes as the most southern location on the plain. Mapping – P Gioia. Image used with the permission of the Western Australian Herbarium, DEC. Accessed 21/06/2011.

wetland profile

Juncus kraussii Sedgelands – Lake Community 1b

Where the lakes of the study area have a steeper grade and the margins are flooded a *Juncus kraussii* subsp. *australiensis* Sedgeland is found (Figure 159). Generally this community is found on the eastern side of Lake Clifton. Scattered in this sedgeland are *Sonchus hydrophilus* plants (Figure 159b).

Community description: *Juncus kraussii* subsp. *australiensis* and *Baumea juncea* Closed Sedgeland (Figure 159a).

Figure 159. The vegetation on the water's edge, eastern shore of Lake Clifton.

(a) Three zones are distinguished: the lake fringing *Juncus kraussii* subsp. *australiensis* sedgeland, *Melaleuca cuticularis* forest and tuart (*Eucalyptus gomphocephala*) forest.

(b) *Sonchus hydrophilus* is scattered through these communities and is found in many wetland communities of the Southwest as well as a disjunct population in Karijini Gorges (Externally Drained Deserts, Pilbara). This plant is often mistaken for a weed.

Photos – B Keighery/OEPA.

wetland profile

Melaleuca cuticularis Low Forest – Lake Community 2

This community is dominated by the tree *Melaleuca cuticularis* (Figure 160) and sometimes peppermint (*Agonis flexuosa* var. *flexuosa*). This community has an understorey intermediate between that of the communities closer to and further from the waterline which includes the sedges *Gahnia trifida*, *Juncus kraussii* subsp. *australiensis* and *Baumea juncea* and the shrubs *Sarcocornia quinqueflora* and *Wilsonia backhousei*.

Community description: *Melaleuca cuticularis* Closed Low Forest over *Trachymene pilosa* Herbland, and *Gahnia trifida*, *Juncus kraussii* subsp. *australiensis* and *Baumea juncea* Open Sedgeland (Figure 160a).

Community description: *Agonis flexuosa* var. *flexuosa* and *Melaleuca cuticularis* Open Low Forest over *Sporobolus virginicus* Open Grassland, and *Gahnia trifida*, *Juncus kraussii* subsp. *australiensis* and *Lepidosperma gladiatum* Closed Sedgeland.

Figure 160. *Melaleuca cuticularis* Low Forest on the eastern shore of Lake Clifton.
(a) *Melaleuca cuticularis* Low Forest.
(b) *Melaleuca cuticularis* flowers.
Photos – B Keighery/OEPA.

wetland profile

Freshwater wetlands

Melaleuca rhaphiophylla Low Forest - Lake Community 3a

This type of vegetated wetland community occurs on the water's edge of many of the lakes, the margins of the Mixed Shrub Calcareous Flat Wetlands and in various sumplands when the water is predominantly fresh. *Melaleuca rhaphiophylla* is the dominant tree but other co-dominants include peppermint and tuart. A sedgeland dominated by *Gahnia trifida* is found in all known occurrences and this sedge may be accompanied by *Lepidosperma gladiatum* and *Baumea juncea*.

Community description: *Melaleuca rhaphiophylla* Open Forest over *Gahnia trifida* and *Baumea juncea* Closed Sedgeland.

Community description: *Agonis flexuosa* var. *flexuosa* and *Melaleuca rhaphiophylla* Open Low Forest over *Acacia saligna*, *Acacia rostellifera* and *Templetonia retusa* Open Shrubland over *Gahnia trifida* and *Lepidosperma gladiatum* Closed Sedgeland (Figure 161a).

Figure 161. *Melaleuca rhaphiophylla* Low Forest.
(a) *Melaleuca rhaphiophylla* with *Gahnia trifida* and *Lepidosperma gladiatum* (left foreground).
(b) *Gahnia trifida*.
(c) The coastal form of *Kennedia coccinea* scrambles through these wetlands but it also grows in drylands.
Photos – B Keighery/OEPA.

wetland profile

Wet Tuart Forest – Lake Community 3b

At times a community, very similar to that described above, occurs with tuart as the dominant and with no *Melaleuca rhaphiophylla*. This community also occurs on the margins of many of the lakes and in various sumplands within the study area when the water is predominantly fresh. Of particular interest in this community, and that described above, are patches of *Cyrtostylis* and *Corybas* orchids. This community merges with the upslope dryland Tuart Forest to Woodland.

Community description: *Eucalyptus gomphocephala* Woodland over *Agonis flexuosa* var. *flexuosa* Open Low Forest over *Thomasia triphylla* and *Templetonia retusa* Closed Heath over mixed Very Open Herbland, and *Gahnia trifida* Very Open Sedgeland.

Island Vegetation

While most islands will support saline communities dominated by samphires, the large island on Preston Beach Road is unusual in supporting a *Melaleuca lanceolata* Open Low Forest (Figure 162). This location and another on the western side of Lake Preston are the only confirmed record of this species, and of this community, on the mainland Swan Coastal Plain.

Figure 162. *Melaleuca lanceolata* Open Low Forest.
(a) A patch of Low Forest on an island in Lake Preston. This is one of only two populations of this species on the Swan Coastal Plain.
(b) *Melaleuca lanceolata flowers*.
Photos – B Keighery/OEPA.

wetland profile

Mixed Shrub Calcareous Flat wetlands

This wetland plant community is dominated by a series of shrubs and shrub-like trees including: *Melaleuca incana* (Figure 164), *M. viminea* (Figure 163), *M. teretifolia*, *M. cuticularis* (Figure 160), *Acacia saligna*, *Leptomeria ellytes* (Figure 167b&c), *Xanthorrhoea preissii*, *Hakea varia* (Figure 165), *Banksia littoralis* and *Eucalyptus rudis*. These shrubs have an understorey of herbs and sedges including *Brachyscome bellidioides*, *Gahnia trifida*, *Lepidosperma longitudinale* and *Meeboldina cana*. Patches of the native cypress *Actinostrobus acuminatus* (Figure 166) are found in this wetland community.

This community is similar to the wetland communities of the Pinjarra Plain, containing open patches dominated by annually renewed species such as *Wurmbea dioica* subsp. *alba*, *W. monantha*, *Schoenus plumosus*, *Triglochin* species, *Diuris micrantha* (DRF), *Hydrocotyle* species, *Blennospora doleiformis* and *Angianthus preissianus*. While the diversity of species in this plant community is not as high as that in the Pinjarra Plain wetland communities, it is high for a Spearwood Dune community.

This community has been identified as the TEC 'Shrublands on calcareous silts of the Swan Coastal Plain' (Figure 136–167) and appears to be confined to the wetland area to the east of Lake Preston, traversed by Ellis Road and extending to Preston Beach Road in the north. This community has not been identified elsewhere in Yalgorup National Park.

Community description: *Acacia saligna*, *Leptomeria ellytes* and *Xanthorrhoea preissii* Open Heath over *Brachyscome bellidioides* Herbland and *Gahnia trifida*, *Lepidosperma longitudinale* and *Meeboldina cana* Sedgeland.

Community description: *Xanthorrhoea preissii* Open Shrubland over *Melaleuca incana* subsp. *incana* Closed Low Heath over *Gahnia trifida* Sedgeland.

Figure 163. Mixed Shrub Calcareous Flat Wetlands which are the TEC 'Shrublands on calcareous silts of the Swan Coastal Plain'.

(a) A view of the wetlands looking towards a tuart-dominated ridge to the east. During autumn the dominant *Melaleuca viminea* aestivates.

(b) *Melaleuca viminea* leaves and fruit.

Photos – B Keighery/OEPA.

wetland profile

Figure 164. Another view of the Mixed Shrub Calcareous Flat in spring.
(a) *Melaleuca incana* (foreground) and *M. viminea* (mid-ground).
(b) *Melaleuca incana* flowers.
Photos – B Keighery/OEPA.

Figure 165. Another view of the Mixed Shrub Calcareous Flat in spring.
(a) *Hakea varia* shrubs scattered through the community.
(b) *Hakea varia* flowers.
(c) Crusting mosses and lichens on wetland soils.
Photos – B Keighery/OEPA.

wetland profile

Figure 166. An isolated population of the native conifer *Actinostrobus acuminatus* found in the Mixed Shrub Calcareous Flat along Ellis Road. This species is typically found in the clay wetlands on the eastern side of the Swan Coastal Plain and flowers in spring.

(a) *A. acuminatus* plants.

(b) *A. acuminatus* female cones.

(c) *A. acuminatus* male cones releasing pollen when disturbed.

Photos – B Keighery/OEPA.

Figure 167. Another view of the Mixed Shrub Calcareous Flat in spring.

(a) *Melaleuca incana* and *M. viminea* alongside the rare community roadside marker.

(b) *Leptomeria ellytes*, a highly disjunct wetland species in the Yalgorup wetlands.

(c) Fruit of *Leptomeria ellytes*.

Photos – B Keighery/OEPA.

wetland profile

Lake Pollard Wetland Mosaic

Between Lake Pollard and Martins Tank Lake, a series of integrating wetland communities are found. These communities are dominated by tuart, peppermint, *Banksia littoralis*, *Melaleuca cuticularis* and *M. rhaphiophylla* and combinations of these. Understorey species include the shrubs T*empletonia retusa*, *Acacia cyclops* and *Spyridium globulosum* and the sedges *Gahnia trifida*, *Juncus kraussii* subsp. *australiensis* and *Baumea juncea*. While some areas of this mosaic appear similar to the Mixed Shrub Calcareous Flat Wetlands, these wetlands do not support the annually renewed herblands/sedgelands that are typical of the Mixed Shrub Calcareous Flat Wetlands. This community is expected to be a new wetland group, allied to the Mixed Shrub Calcareous Flat Wetlands.

Community description: *Melaleuca cuticularis* and *Melaleuca rhaphiophylla* Open Low Forest over *Templetonia retusa* and *Spyridium globulosum* Open Scrub over *Gahnia trifida* and *Juncus kraussii* subsp. *australiensis* Sedgeland (Figure 168).

Community description: *Templetonia retusa*, *Melaleuca cuticularis*, *Spyridium globulosum*, *Acacia cyclops* and *Melaleuca rhaphiophylla* Closed Scrub over *Baumea juncea*, *Juncus kraussii* subsp. *australiensis* and *Gahnia trifida* Open Sedgeland.

Figure 168. Lake Pollard Wetland Mosaic.
Photo – B Keighery/OEPA.

wetland profile

Profile of a wetland complex: Brixton Street Wetlands

The Brixton Street Wetlands are an amazing place of local, state, national and world renown. It is for their botanical values rather than birds or wetland fauna that the wetlands have this astounding reputation. They are part of Bush Forever Site 387, 'Greater Brixton Street Wetlands, Kenwick', which has the greatest diversity of plants (around 560) of all Bush Forever sites. This is even more astounding when considered in the context of the both the Perth metropolitan region and an area of plant mega-diversity on a world scale. The Brixton Street Wetlands make up just 15 per cent (19 hectares) of the Bush Forever site yet they support around 300 native plants. The diversity of wetlands in this small area supports this diversity of plants and plant communities.

The plant diversity of the wetlands was first comprehensively documented in the late 1980s and early 1990s. During these surveys several presumed extinct species that had not been recorded since the early twentieth century were rediscovered. A number of completely new species were located (for example, *Eleocharis keigheryi*); in fact, new species are still being located, including a new feather flower, *Ptilotus* sp. Brixton in 2010. The information from these surveys contributed to the recognition of the wetland's values as part of the assessment of a proposal to develop land, including the wetlands, for housing. The outstanding values of the wetlands were recognised in this process and the area is now protected and reserved for conservation.

The active, well-informed Friends of Brixton Street Wetlands have been part of the wetland management team since the wetlands' values were first recognised by the local community. Management guidelines for the wetlands were written in 1995 and in 2000 for Bush Forever Site 387 with funding from two community conservation grants from the Minister for the Environment to the Wildflower Society of WA (Inc). The second grant included the production of the information which is part of permanent display panel at the site and reproduced on the following pages. It was prepared in 2004 by the Friends of the Brixton Street Wetlands (text by Bronwen Keighery, Karen Clarke and Mark Brundrett, drawings by Margaret Pieroni and design by Karen Clarke and Mark Brundrett). The information is reproduced in this document with the permission from the Friends of Brixton Street Wetlands.

wetland profile

The Brixton Street Wetlands

Delicate Treasure

For its size, the Brixton St Wetlands is one of the most diverse sites on the Swan Coastal Plain. It covers only 19 hectares but is a treasure trove of native plants and animals. There are two threatened ecological plant communities and a diverse flora of over 350 different types of native plants including at least 80 types of special significance. A large variety of habitats are present, most in good condition, and these support a diverse array of fauna.

This unique and special place is now protected, saved from development as a housing estate. However, it's a fragile ecosystem and needs careful management to survive. Treat it with care and it will reward you with its many delights.

Looking south over the Brixton St Wetlands in spring

The Brixton St Wetlands is located on the very flat, waterlogged Pinjarra Plain that lies at the base of the Darling Range. Over 97% of the bushland on the Plain's waterlogged soils has been cleared for either agriculture or housing.

Robin Redbreast Bush (*Melaleuca lateritia*)

Marri (*Corymbia calophylla*)

The delicate flowers of Pink Petticoats (*Utricularia multifida*)

Partnerships for Conservation

Government of Western Australia

Department of Conservation and Land Management

Conserving the nature of WA

Friends of Brixton St Wetlands

Orchid Society of Western Australia Perth Branch

This display was made possible by a Community Conservation Grant from the Minister for the Environment to the Perth Branch of the Wildflower Society of WA (Inc.). Line drawings are by Margaret Pierroni. Display design by Karen Clarke and Mark Brundrett, May 2004.

wetland profile

The Brixton Street Wetlands

Conservation and Claypans

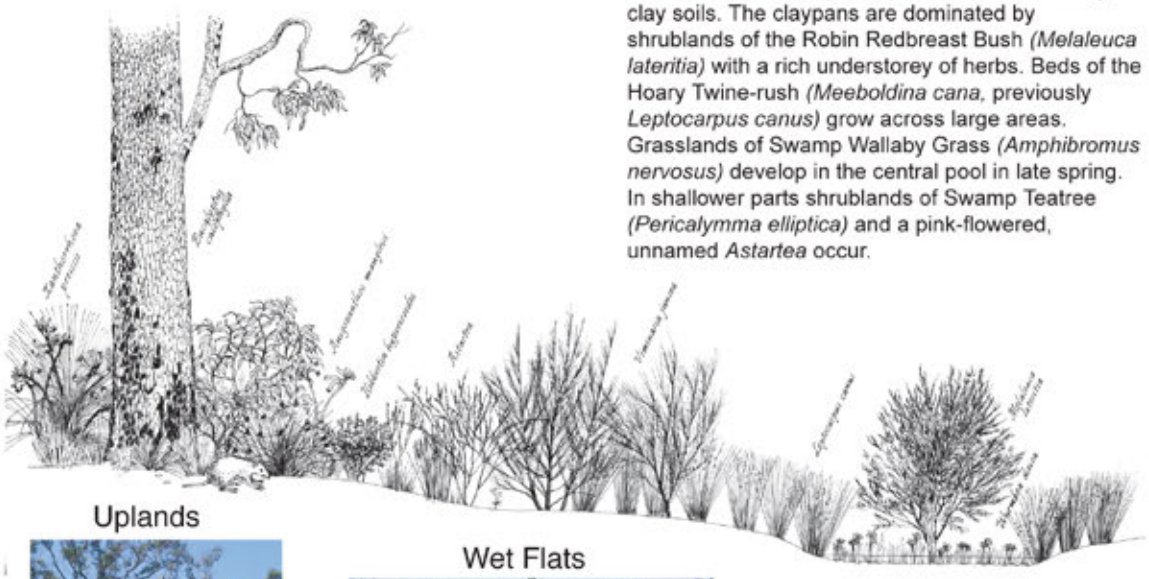
The outstanding conservation values of the Brixton St Wetlands are recognised in many ways. It is now part of the largest area of bushland remaining on the Pinjarra Plain in the Perth region. This continuous area of 126 hectares includes the Brixton Street Wetlands, the University of WA's Yule Brook Reserve, and extends north-east as far as Welshpool Road and Tonkin Hwy. Known as the "Greater Brixton Street Wetlands" this area is protected as a Bush Forever Site.

Three main plant communities occur at the Brixton St Wetlands, the Uplands, Wet Flats and Clay Pans. The Wet Flats and Clay Pans are a mosaic of many smaller plant community types with different plants dominant at different times of the year.

Uplands
These occur on slight rises between the wetlands and support a woodland of Marri *(Corymbia calophylla*, previously *Eucalyptus calophylla)* with an understorey of various shrubs, herbs and sedges.

Wet Flats
The Wet Flats surround the Clay Pans and are a series of low lying flats covered with sheets of water during winter and spring. A tall shrubland of Swish Bush *(Viminaria juncea)* grows on these flats with a rich understorey of shrubs, herbs and sedges. Dense low shrublands occur in the drier areas.

Clay Pans
The Clay Pans contain long-lived seasonal pools and occur in the deeper depressions of the heavy clay soils. The claypans are dominated by shrublands of the Robin Redbreast Bush *(Melaleuca lateritia)* with a rich understorey of herbs. Beds of the Hoary Twine-rush *(Meeboldina cana*, previously *Leptocarpus canus)* grow across large areas. Grasslands of Swamp Wallaby Grass *(Amphibromus nervosus)* develop in the central pool in late spring. In shallower parts shrublands of Swamp Teatree *(Pericalymma elliptica)* and a pink-flowered, unnamed *Astartea* occur.



Uplands

Woodland dominated by Marri (*Corymbia calophylla*, previously *Eucalyptus calophylla*) on the low lying rises between the wetlands.

Wet Flats

Swish Bush (*Viminaria juncea*) shrubland with a rich understorey of shrubs, herbs and sedges.

Clay Pans

Fields of bright green Swamp Wallaby Grass (*Amphibromus nervosus*) surrounded by clumps of the Hoary Twine-rush (*Meeboldina cana*, previously *Leptocarpus canus*) in the central part of the flooded claypans during winter.

wetland profile

The Brixton Street Wetlands

Frogs and Feather Flowers

Fauna

The Brixton St Wetlands support a diverse array of fauna, each depending on different aspects of the vegetation and surface water to provide shelter, food and suitable conditions for breeding. Many of these animals, especially the birds, are present seasonally.

Banjo Frog (*Limnodynastes dorsalis*)

Frogs

The wetlands are a frog paradise. Listen for the Banjo, Moaning, and Quacking Frogs, each named for their distinctive calls. The Crawling Frog is also common.

Birds

Over forty bird species have been recorded so far, many such as waders and waterbirds are seasonal visitors during winter and spring.

The Australian Reed-Warbler (*Acrocephalus australis*), a shy bird of reed beds with a beautiful melodious song.

A beetle with feathery antenna (*Ribeiroxia ferrocana*) resting on a Swan Bush (*Viminaria juncea*)

Invertebrates

There is also a large and diverse invertebrate fauna, including crustaceans in the pools and many bizarre and beautiful insects.

Reptiles

Rich in reptiles the wetlands contain the Spiny-tailed Gecko, five species of Legless Lizards, two Dragons, eight Skinks, two Goannas and the Dugite snake.

A Western Bearded Dragon (*Pogona minor*) sunning itself on a warm bare patch of sand

Mammals

The Southern Brown Bandicoot (Quenda) is a locally endangered species that is abundant in the wetlands. It likes the dense, undisturbed bushland for protection from predators.

Flora

Characteristic of the wetlands are carpets of wildflowers of all colours of the rainbow, each wildflower blooming at its own time of the year.

In late spring Feather Flowers of various types form a sea of pink foam across the Wet Flats.

Feather Flowers en masse in the Wet Flats during November.

There are over 20 species of threatened flora present including two aquatic plants that occur only in the clay pans in south-west Western Australia and nowhere else in the world.

Two threatened species are the Stalked Water Ribbons (*Aponogeton hexatepalus*, long lanceolate floating leaves) and Aquatic Pennywort (*Hydrocotyle lemnicoides*, small heart-shaped floating leaves). They occur in the seasonal pools of the clay pans. Both flower in early spring and are West Australian clay pan endemics.

Pink Boronia (*Boronia cymosa*) from the Marri woodlands

Southern Brown Bandicoot or Quenda (*Isoodon obesulus*)

Fire is the greatest threat to the survival of the many fauna species at the Brixton St Wetlands.

wetland profile

The Brixton Street Wetlands

Friend or Foe?

Numerous people, community groups and government agencies have contributed over many years to making sure the wetlands remain part of our natural heritage:

".....the bandicoots, birds and plants will never know the war that has been waged here so that this could remain just as it is."
Joan Payne, Waterbird Conservation Group.

The Friends of Brixton St Wetlands grew out of the campaign by the Waterbird Conservation Group and others to save the Wetlands in the late 1980s. The Friends coordinate regular guided walks and bushcare activities in the wetlands. Newcomers are always welcome.

1. Bacon and Eggs (*Wemcia capitata*) 2.Flanner Flower (*Tribonanthes uniflora*), a day pan endemic. 3. Pink Rainbow (*Drosera menziesii*) 4. Swamp Spider Orchid (*Caladenia paludosa*) 5. Pink Morning Lily (*Chamaescilla gracilis*) a day pan endemic. 6. Love Creeper (*Comesperma volubile*)

Careful removal of bulbous weeds

The Brixton Street Wetlands now has a secure future. In 2004 it was purchased by the state government for conservation and put under the management of the Department of Conservation and Land Management (CALM). However, numerous threats still remain. Our actions will determine whether it lives or slowly dies.

We all have a role to play, will you be friend or foe? Please care for the wetlands by observing the following:

* Take only photos, leave only footprints. Please keep to the paths.
* All native flora and fauna are protected by law.
* Dogs disturb both flora and fauna, please leave them at home.
* Report all fires immediately, dial 000.
* Please report any damage or vandalism as soon as possible to CALM on 9405 0700.
* Remember, dumped rubbish and garden waste introduces weeds and diseases.
* Keep cats in at night, that's when they may hunt in the bushland.

Further Information

Friends of Brixton Street Wetlands
Phone: 9459 2964

Department of Conservation and Land Management
Phone: 9405 0700

Wildflower Society of WA (Inc.) 9383 7979

City of Gosnells
Phone: 9391 3222

A selection of trigger plants and sundews that grow in the area. Trigger plants use a spring loaded "hammer" to transfer pollen onto and off of insects that visit their flowers so that the pollen gets transferred between plants. Sundews trap insects with their sticky leaves then slowly digest their catch to obtain essential food for survival.