NATURAL HISTORY OF THE RIVERLANDS AND MURRAYLANDS CONTINUED

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CHAPTER 9. FLORA and VEGETATION

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For tens of thousands of years the natural vegetation of the Murray Mallee and the Riverland was used by Aboriginal people for food, as firewood and for the construction of their wide range of wooden implements. Particularly in the Riverland, this exploitation by the relatively dense human population that lived on the river would have had quite a high impact. Over this long period, a point had been reached where the range of vegetation communities and their associated plants and animals were well adapted to Aboriginal land management practices.

The first European to enter this area was Captain Charles Sturt on his epic journey down the Murray River in 1830 (Sturt 1833). On what is now the South Australian part of the Murray River he was impressed by the towering river red gums on the banks and by the spectacular cliffs that lined the river along part of its length. He also had a good word to say about the country on the eastern bank of the river around present day Murray Bridge. He described it, in the fashion of the time, as follows:

'The cliffs gave way to undulating hills that were different in appearance from the country we had previously noted down. It would have been impossible for the most tasteful individual to have laid out a pleasure ground to more advantage than Nature had done in planting and disposing various groups of trees along the spine and upon the sides of the elevations that confined the river and bounded the low ground that intervened between it and their base'

Sturt was however, much less impressed with the majority of the country he encountered away from the river valley, which he described as follows:

'Again hemmed in by those sterile and sandy tracts upon which the beasts of the field could obtain neither food or water'

Further downstream he said that:

'To the north the interior was evidently depressed, it was overgrown with a low scrub and seemed to be barren in the extreme'

He summarised his impressions as follows:

'If we accept the partial and alluvial flats on the immediate border and into the neighbourhood of its tributaries and creeks, the Murray might be said to flow through a barren and sandy interior'

If only this view of the barren nature of the country away from the river had prevailed and the land away from the river valley had not been cleared for agriculture or over-grazed by sheep, the current serious salinity and land management problems of the Murray Darling Basin could have been avoided.

Much of the Murraylands and Riverland were, at the time of European settlement, covered with that most characteristic Australian vegetation community the Mallee (Noble & Bradstock 1989; Noble et al. 1990). ‗Mallee' is not easy to define and is perhaps best described as vegetation dominated by mallee growth-form eucalypts. It can also define a particular plant growth form where many stems arise from a large underground woody swelling composed of stem tissue and known as a lignotuber. Thirdly, the word ‗mallee' defines a part of Australia around the junction of the three southeastern States (also called the ‗Murray Mallee') where mallee eucalypts are a dominant landscape characteristic. Mallee growth form eucalypts also occur widely across Australia in very different vegetation communities from those in the area covered by this natural history (Hill 1989). A

further difficulty arises where even within the mallee that occurs in the Mediterranean climate areas of Australia with mean annual rainfall of 250-400 mm, mallee-form shrubs and trees can occur with a wide variety of different understorey plants making the precise definition of particular vegetation communities very difficult (Sparrow 1989, 1990). To further complicate development of a clear definition of a particular mallee vegetation community studies of the same patch of vegetation over time have demonstrated that all the component plant species are not necessarily visible above the ground in a particular year. Different species of ephemeral understorey plants will germinate following particular combinations of rainfall and temperature, and it can take a number of visits in different conditions before the complete suite of plant species that makes up a particular vegetation community is known (Fox 1990). In spite of these difficulties in recognition of mallee vegetation communities there are some patterns associated predominantly with soil type and rainfall, which can be discerned across the broad landscape (Sparrow 1989). Because of this, clearance of vegetation for agriculture in the Murray Mallee has proceeded chronologically from the best combinations of soil and rainfall for agriculture to those areas that are least suitable. For some communities at the more fertile end there has been so much large-scale clearing and grazing that even the tiny remnants that remain today have been so invaded by weeds that they can be regarded as only semi-natural and quite significantly degraded from their pre- European settlement condition. Conversely the few relatively large areas of mallee vegetation set aside for conservation represent disproportionately the vegetation associations of the poor soils and lower rainfall areas which were perceived to be of little agricultural value.

As annual rainfall further decreases to the north the mallee communities are replaced by a range of Black Oak woodlands and chenopod shrublands and it is these communities which form the basis of the rangeland sheep grazing industry in this area. Although native vegetation is still continuous across this area, there are considerable differences in the health of this vegetation and many areas have changed significantly due to past and, in some cases ongoing, levels of overgrazing by a combination of domestic stock, feral animals and kangaroos.

Cutting through the surrounding plains and dunefields of the Murraylands is the ancient floodplain of the Murray River. In South Australia it can be conveniently divided into three distinct regions. The Mallee Trench from the NSW/Vic. border to Overland Corner is a wide floodplain crossed by the river in a single well-defined channel. Large areas of the floodplain have been cleared of their original vegetation and developed for irrigation of crops of grapes, citrus and stone fruits. The area between Renmark and Morgan is the most important irrigation region in South Australia. The Mallee Gorge extends from Overland Corner to Mannum and here the river has cut down through hard limestone rocks forming a spectacular series of cliffs along the river channel. Along this stretch of the river valley the predominant land use is sheep grazing on both cleared land and areas of remnant natural vegetation. Some irrigated blocks have also been cleared to grow lucerne and vegetables. Along the Lower Murray between Mannum and Wellington much of the valley floor was formerly occupied by wetlands. Most of these have been drained and are now used for dairying. There are only a few remnants of the original vegetation remaining.

Vegetation Surveys and Mapping

From 1990 to 2003 a series of systematic vegetation surveys were carried out across the Murraylands and the Riverland (Table 1). The areas covered by the surveys are shown in Figure 1. The vegetation quadrat data from these four surveys were analysed separately to determine the floristic vegetation communities across each of the survey areas and vegetation maps were then produced from aerial photography. Where possible the floristic vegetation communities were mapped, but a proportion are too restricted or not identifiable from aerial photography. The vegetation maps therefore present a simplified set of vegetation communities when compared with the floristic analyses of the quadrat data from these biological surveys.

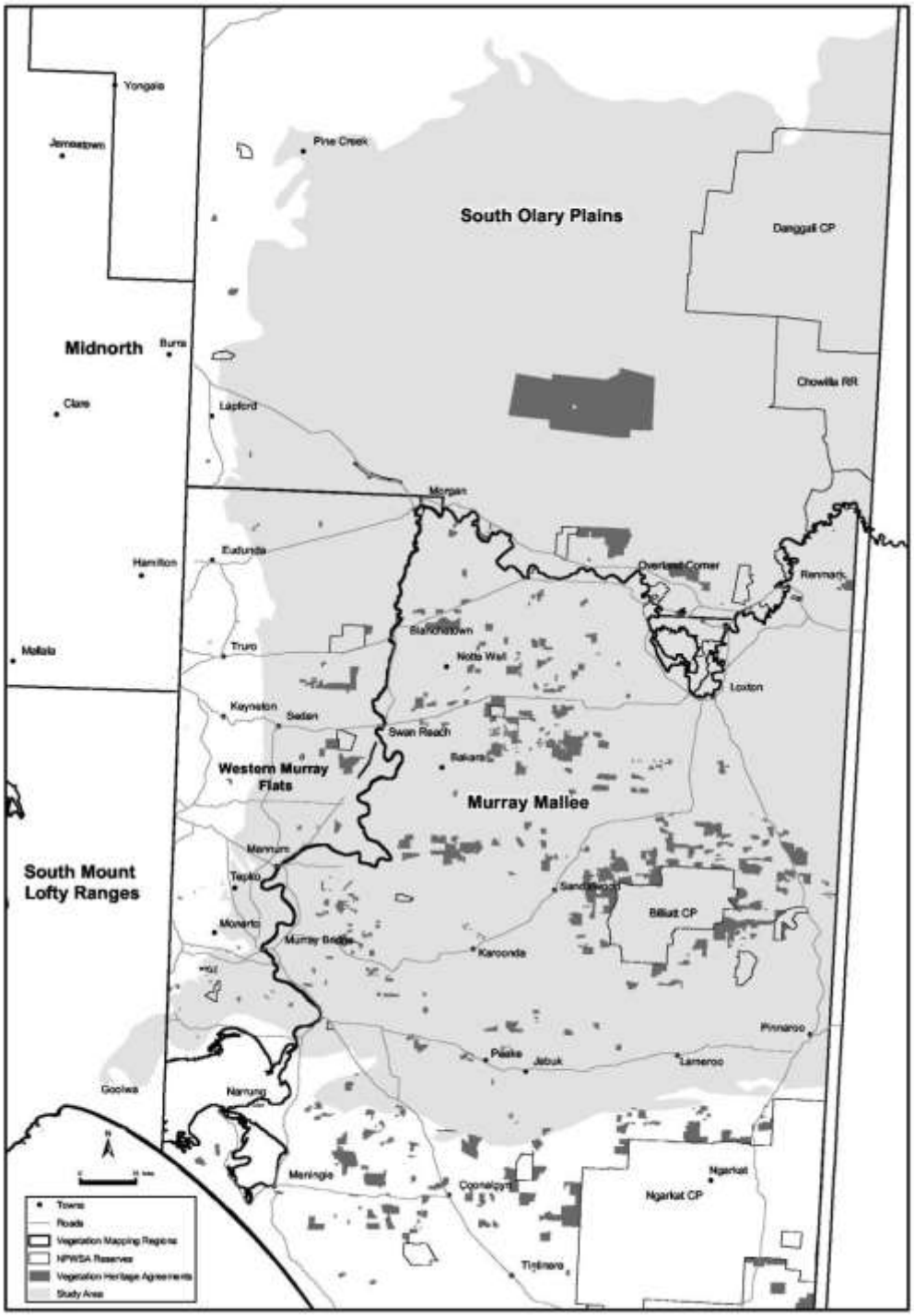


Figure 1. The Murraylands and Riverland showing areas covered by the four vegetation surveys and the Government conservation areas, private Heritage Agreement areas and other conservation tenures. Only the largest conservation areas are named.

Native vegetation of course does not really occur in discrete discernable units that can be easily mapped. It is actually a series of intergrading communities that often occur in a complex mosaic. Vegetation maps are therefore simplifications of reality and, as the scale of vegetation mapping increases so does the degree of simplification required. Having said this however, vegetation does not change randomly across the landscape and there are clearly close relationships between particular plants or groups of plants and particular soils or landforms. The skill of vegetation mapping is to reflect this variability in a way that makes sense to the observer when he confronts a group of

plants in the field that has been mapped as a particular vegetation community. The vegetation maps for the area covered by this natural history were produced at three separate scales (Table 1). To produce the vegetation mapping for the whole of the Murraylands and Riverland therefore there has been a process of further simplification and amalgamation of these earlier vegetation classifications and mapping. Areas of both existing and pre-European vegetation were calculated for each of the simplified communities. Where vegetation communities were originally mapped as mosaics of two or three communities, statistics for the area calculations were based on ratios of 50/50 or 40/30/30.

Table 1. Details of vegetation surveys conducted in the Riverland and Murraylands.

Survey	Type	Date	No of quadrats	Reference	Vegetation map scale
Murray Mallee	Existing	1990	679	Foulkes & Gillen 2000	1:50 000
South Olary Plains	Existing	1991	480	Forward & Robinson 1996	1:100 000
Western Murray Flats	Existing	1992	212	Lock & Goodwins 1993	1:50 000
Murray Valley	Existing	2003	273	Stewart *et al*. (unpubl.)	1:20 000
Murray Mallee	Pre-European	2004	N/A	Croft unpublished map	1:50 000
Western Murray Flats	Pre-European	2005	N/A	Croft unpublished map	1:50 000

Pre-European Vegetation Mapping

Mapping of the pre-European settlement vegetation involves the use of historical and current records. Sources include the notes of early explorers, the annotations on the Hundred Plans drawn up when the State was originally surveyed. Remnant trees in paddocks and remaining roadside vegetation also provide clues to what the composition of the pre-European vegetation cover may have been. This information is combined with topographic and soil maps and extrapolation from the remaining remnant natural vegetation patches to produce a vegetation map across the whole landscape. To date pre-European mapping has only been attempted in any detail in some areas of the extensively cleared agricultural regions and for the area covered by this natural history, only the Murray Mallee and the Western Murray Flats have been mapped to date. Only the existing vegetation has been mapped for the Murray River valley and the pastoral rangeland country of the South Olary Plains.

Vascular Plant Species List

The Biological Databases of South Australia incorporate data on the vascular plants recorded as part of the Biological Survey of South Australia and associated projects. This data is held in the following databases, SURVEY (species lists from all standard plant quadrats collected during standardised biological surveys using the methods outlined in Heard & Channon (1997)), OPPORTUNE (Plant records from geo-coded points across the region), RESERVES (Plant species lists compiled from a variety of sources for the conservation reserves and heritage agreement areas across the region) and PLANT POPULATION (Records of threatened plant populations in the region). In addition the State Herbarium of South Australia has a database of all its plant specimens (ADHERB). Within the boundary of the Murray Mallee and Riverland, all vascular plant records together with their locations and other associated information were extracted. The Biological Databases of South Australia provided 45 501 records while the State Herbarium Database provided 24 601. These lists have been extensively edited to ensure that the final species list produced confirms to the taxonomy in the 2004 Census of Vascular Plants of South Australia (Barker *et al*. 2005), and state and national conservation ratings have also been provided for all the threatened plant species in the area.

A total of 2153 plant taxa are known from the Riverland and Murraylands region (Appendix). 554 (26%) of these have been introduced during the period of European settlement and 64 are proclaimed as Pest Plants due largely to their impact on agricultural production. Many are considered

to be threatened with extinction with 12 species listed Nationally, and a total of 186 species threatened within SA. A selection of some of these threatened species is shown in Figures 2 and 3.

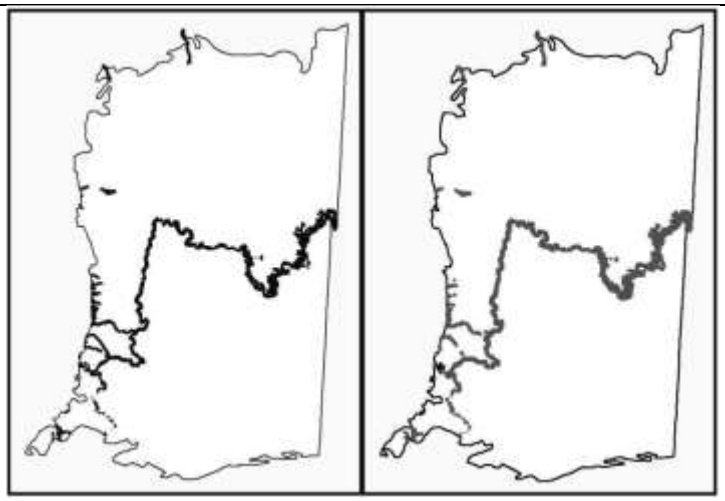
Figure 2. Some threatened plant species of the Murraylands and Riverland. Endangered in SA. **A,** Osborn's Eyebright (*Euphrasia collina* ssp. *osbornii*) (Photograph: D. Kraehenbuehl), **B,** Monarto Mintbush (*Prostanthera eurybioides*) (Photograph: L. Heard), **C,** Golden Drumsticks (*Pycnosorus chrysanthes*) (Photograph: P. Lang), **D,** Coloured Spider orchid (*Caladenia colorata*) (Photograph: D. Kraehenbuehl), **E,** Metallic Sun Orchid (*Thelymitra epipactoides*) (Photograph: D. Kraehenbuehl). Vulnerable in SA. **F,** Slender Bell Fruit (*Codonocarpus pyramidalis*) (Photograph: A. Robinson).

Figure 3. Some threatened plant species of the Murraylands and Riverland. Vulnerable in SA: **A,** Behr's Swainson-pea (*Swainsona behriana*) (Photograph: P. Lang); **B,** Broombush Templetonia (*Templetonia stenophylla*) (Photograph: P. Lang); **C,** Trailing Hopbush (*Dodonaea procumbens*) (Photograph: P. Lang); **D,** Silver Daisy-bush (*Olearia pannosa* ssp. *pannosa*) (Photograph: A. Robinson). Rare in SA: **E,** Yellow Swainson-pea (*Swainsona pyrophila*) (Photograph: D. Krahenbuehl); **F,** Australian Broomrape (*Orobanche cernua* var. *australiana*) (Photograph: A. Robinson).

Vegetation Communities

The vegetation communities over the large area of the region are quite complex and varied with 58 recognised vegetation communities. They can be broken down into three major categories, those that are widespread and therefore characteristic of the area (36 communities), those that are still characteristic but which occur over a relatively small area (4 communities) and those which are more characteristic of the surrounding areas and only have a minor intrusion into the area (14 communities). The 36 widespread, or formerly widespread, communities are described below, with a photo of a typical example a map of their pre-European and current extent (remembering that there is no pre-European vegetation mapping available as yet for the Murray Valley and South Olary Plains), a list of characteristic species, the typical landforms and soils on which they occur and some statistics on the area remaining and that conserved in protected areas.

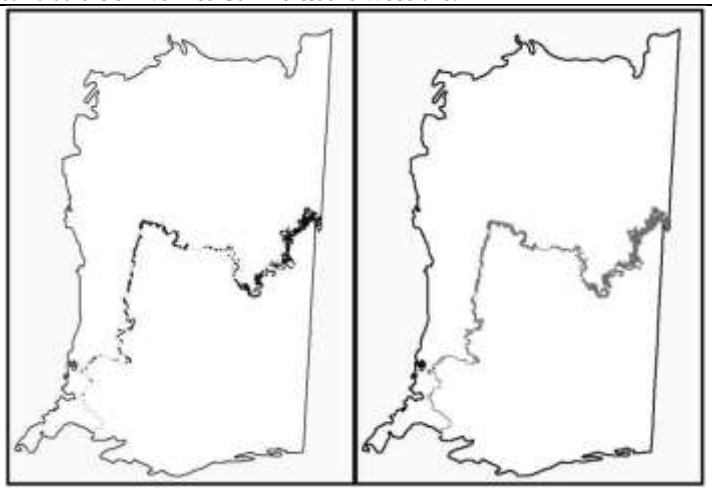
Characteristic Species
*Acacia stenophylla, Atriplex leptocarpa, *Bromus rubens, Cyperus gymnocaulos, Einadia nutans* ssp. *nutans, Enchylaena tomentosa* var. *tomentosa, Lachnagrostis filiformis, Muehlenbeckia florulenta, Senecio glossanthus, Setaria jubiflora, *Vulpia myuros* f. *myuros.*
Landform: River Edge & Floodplain
Soils: Sandy Clay Loam to Medium Clay



Area (pre-European): 14327 ha. **Area (present)**: 12080 ha **% pre-European**: 84% **Number of patches (size range)**: 2461 (<1 to 1005 ha) **Area protected (% of present)**: 2607 (22%)

Figure 4. *Eucalyptus camaldulensis* var. *camaldulensis* River Red Gum Forest and Woodland.

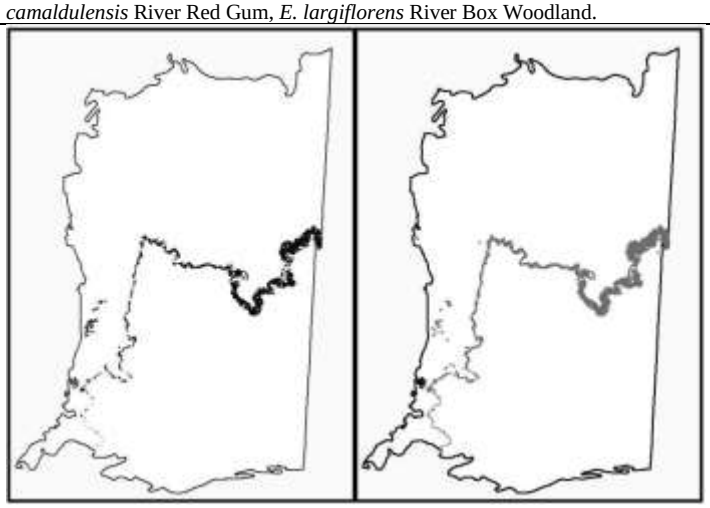
Characteristic Species
*Acacia stenophylla, *Aster subulatus, *Cirsium vulgare, Cyperus gymnocaulos, Eclipta platyglossa, Einadia nutans* ssp. *nutans, Enchylaena tomentosa* var. *tomentosa, Muehlenbeckia florulenta, Phragmites australis, Setaria jubiflora, *Sonchus oleraceus, Wahlenbergia fluminalis.*
Landform: River Flat & Floodplain
Soils: Sandy Loam to Medium Clay



Area (pre-European): 10040 ha. **Area (present)**: 10040 ha. **% pre-European**: 100% **Number of patches (size range)**: 614 (<1 to 335 ha) **Area protected (% of present)**:4057 (40%)

Figure 5. *Eucalyptus camaldulensis* var. *camaldulensis* River Red Gum, *E. largiflorens* River Box Woodland.

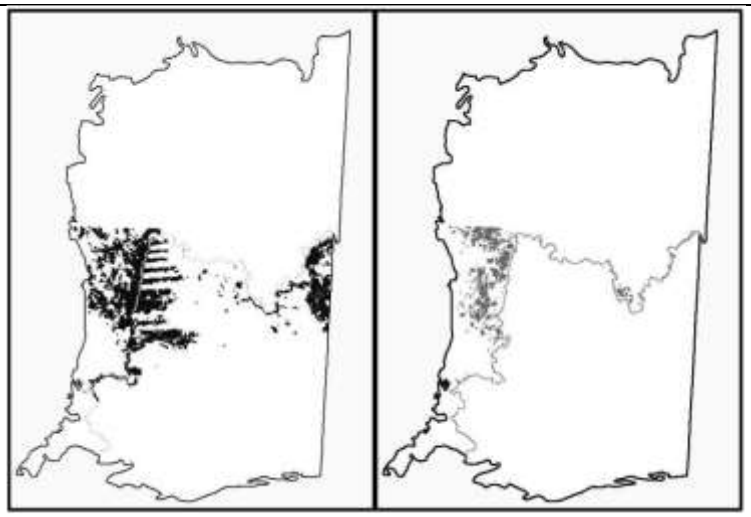
Characteristic Species
*Brachycome lineariloba, *Bromus rubens, Crassula colorata* var. *acuminata, Einadia nutans* ssp. *nutans, Enchylaena tomentosa* var. *tomentosa, Disphyma crassifolium* ssp. *clavellatum, Muehlenbeckia florulenta, Sclerolaena tricuspis, Setaria jubiflora.*
Landform: River Flat & Floodplain
Soils: Sandy Loam to Medium Clay



Area (pre-European): 17005 ha. **Area (present)**: 15824 ha **% pre-European**: 93% **Number of patches (size range)**: 16311 (<1 to 319 ha) **Area protected (% of present)**: 6561 (41%)

Figure 6. *Eucalyptus largiflorens* River Box Low Woodland.

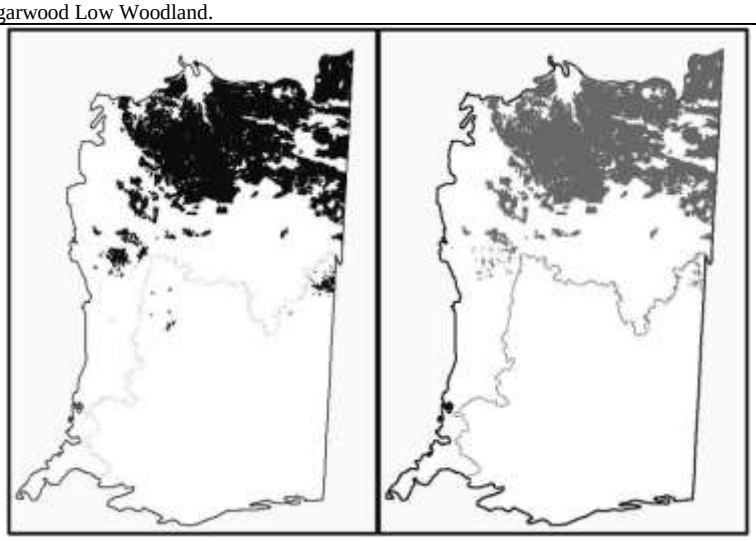
Characteristic Species
Acacia nyssophylla, Alectryon oleifolius ssp. *canescens, Austrodanthonia* sp., *Austrostipa* sp., *Enchylaena tomentosa* var. *tomentosa, Eriochiton sclerolaenoides, Geijera linearifolia, Sclerolaena obliquicuspis, Zygophyllum aurantiacum* ssp. *aurantiacum.*
Landform: Limestone Plain
Soils: Clay Loam



Area (pre-European): 184496 ha. **Area (present)**: 31110 ha **% pre-European**: 17% **Number of patches (size range)**: 396 (<1 to 2498 ha) **Area protected (% of present)**:3772 (12%)

Figure 7. *Myoporum platycarpum* ssp. Sugarwood Low Woodland.

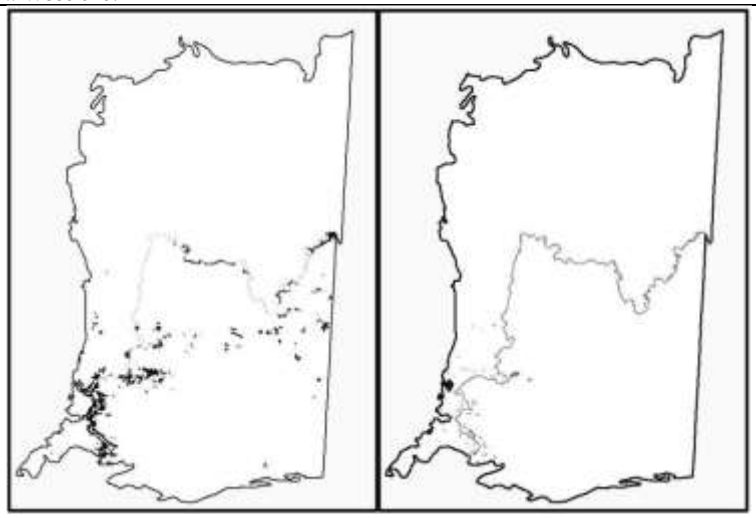
Characteristic Species
Alectryon oleifolius ssp. *canescens, *Carrichtera annua, Enchylaena tomentosa* var. *tomentosa, Eriochiton sclerolaenoides, Exocarpos aphyllus, Lycium australe, Maireana sedifolia, Rhagodia spinescens, Sclerolaena obliquicuspis, Tetragonia* sp.,
Landform: Plain
Soils: Clay Loam
Soils: Sandy Loam to Clay Loam



Area (pre-European): 432392 ha. **Area (present)**: 419750 ha **% pre-European**: 97% **Number of patches (size range)**: 535 (<1 to 25004 ha) **Area protected (% of present)**: 77219 (18%)

Figure 8. *Casuarina pauper* Black Oak Low Woodland.

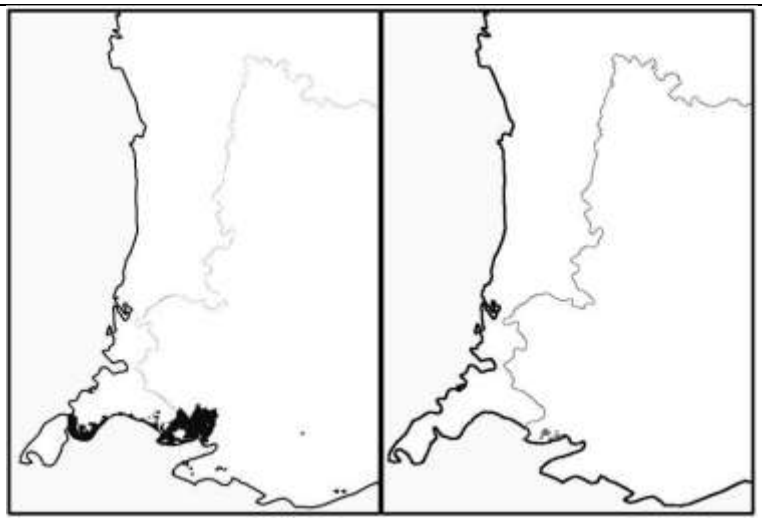
Characteristic Species
**Asparagus asparagoides, Austrostipa elegantissima, *Brassica tournefortii, Einadia nutans* ssp. *nutans, Enchylaena tomentosa* var. *tomentosa, *Erodium botrys Lomandra effusa, *Lycium ferocissimum, Helichrysum leucopsideum, Oxalis perennans, Senecio lautus.*
Landform: Plain to Dune Slope
Soils: Sandy Loam to Loam



Area (pre-European): 36096 ha. **Area (present)**: 1727 ha **% pre-European**: 5% **Number of patches (size range)**: 125 (<1 to 279 ha) **Area protected (% of present)**: 329 (19%)

Figure 9. *Callitris gracilis* Southern Cypress Pine Low Open Woodland.

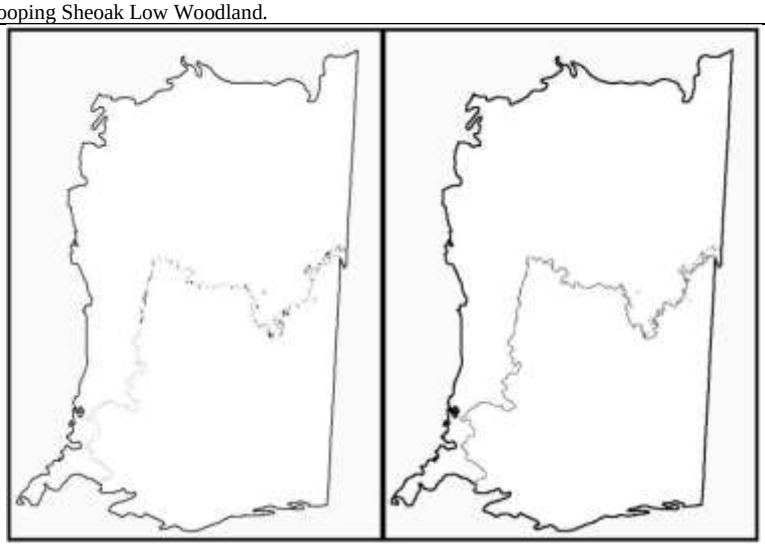
Characteristic Species
Cassinia laevis, Chrysocephalum semipapposum, Gahnia lanigera, Lomandra effusa, Enchylaena tomentosa var *tomentosa, Olearia decurrens.*
Landform: Limestone Plain
Soils: Sandy Loam



Area (pre-European): 22605 ha. **Area (present)**: 99 ha **% pre-European**: 0.4% **Number of patches (size range)**: 15 (<1 to 23 ha) **Area protected (% of present)**: 0 (0%)

Figure 10. *Allocasuarina verticillata* Drooping Sheoak Low Woodland.

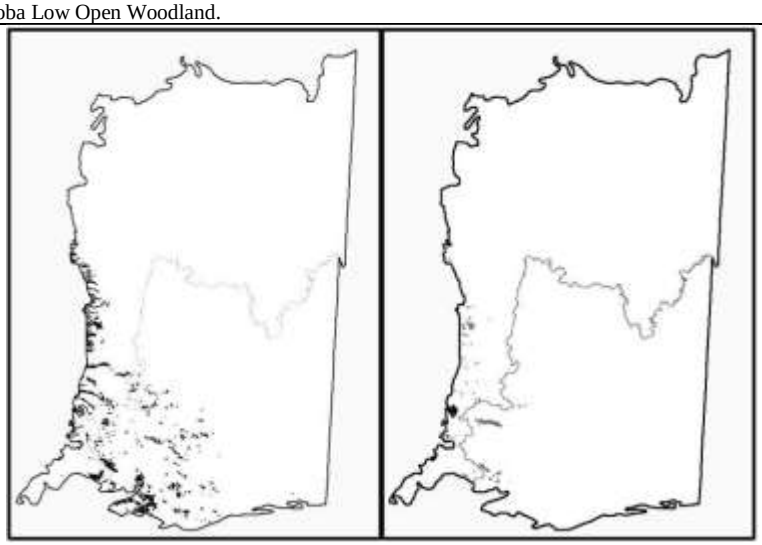
Characteristic Species
*Atriplex leptocarpa, Atriplex lindleyi ssp. lindleyi, *Brassica tournefortii, Enchylaena tomentosa* var. *tomentosa, Einadia nutans* ssp. *nutans, Muehlenbeckia florulenta, Sclerolaena tricuspis, Setaria jubiflora.*
Landform: River Flat
Soils: Loamy Sand to Sandy Loam



Area (pre-European): 678 ha. **Area (present)**: 678 ha **% pre-European**: 100% **Number of patches (size range)**: 165 (<1 to 48 ha) **Area protected (% of present)**: 255 (38%)

Figure 11. *Acacia stenophylla* River Cooba Low Open Woodland.

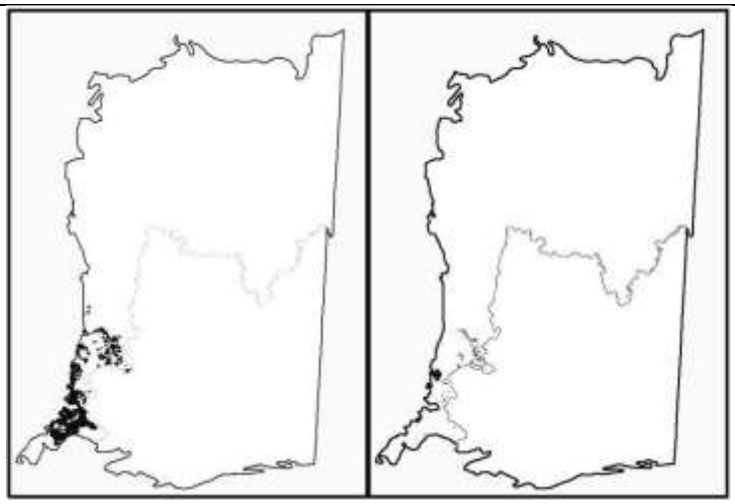
Characteristic Species
*Austrodanthonia caespitosa, *Brassica tournefortii, Clematis microphylla, Einadia nutans* ssp. *nutans, Helichrysum leucopsideum, Lomandra effusa, *Lycium ferocissimum, Pittosporum angustifolium, *Plantago bellardii, Senecio lautus.*
Landform: Plain and Hill Slope
Soils: Sandy to Clay Loam



Area (pre-European): 35655 ha. **Area (present)**: 4098 ha **% pre-European**: 11% **Number of patches (size range)**: 225 (<1 to 686 ha) **Area protected (% of present)**: 161 (4%)

Figure 12. *Eucalyptus porosa* Mallee Box Low Open Woodland.

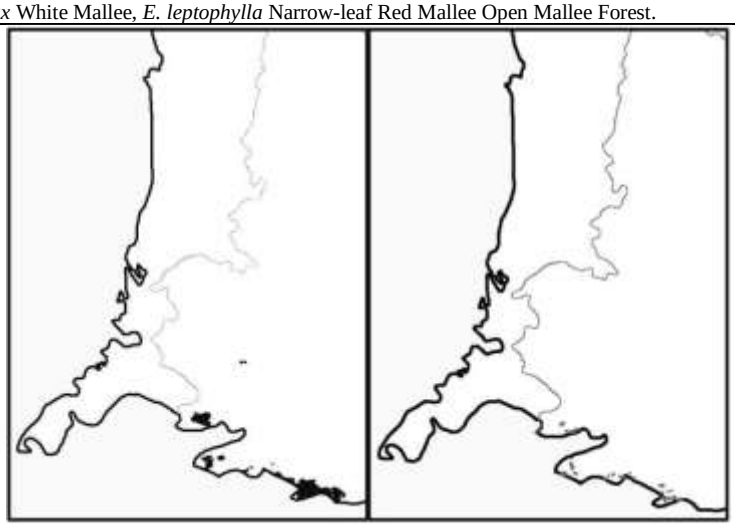
Characteristic Species
*Austrostipa elegantissima, *Brassica tournefortii, Dodonaea bursariifolia, Enchylaena tomentosa* var. *tomentosa, Helichrysum leucopsideum, Melaleuca lanceolata* ssp. *lanceolata, Rhagodia crassifolia, Sclerolaena diacantha.*
Landform: Plain & Hill Slope
Soils: Sand to Sandy Loam



Area (pre-European): 48918 ha. **Area (present)**: 2485 ha **% pre-European**: 5% **Number of patches (size range)**: 192 (1 to 165 ha) **Area protected (% of present)**: 59 (2%)

Figure 13. *Eucalyptus phenax* ssp *phenax* White Mallee, *E. leptophylla* Narrow-leaf Red Mallee Open Mallee Forest.

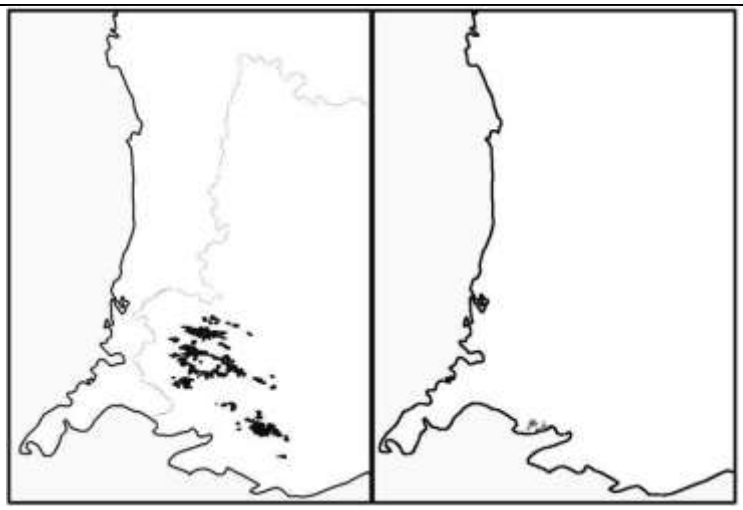
Characteristic Species
*Acacia spinescens, Acrotriche cordata, *Asparagus asparagoides, Billardiera cymosa, Gahnia deusta, Hakea vittata, Hibbertia sericea, Lasiopetalum baueri, *Silene apetala, Thomasia petalocalyx, Xanthorrhoea caespitosa.*
Landform: Limestone Plain & Hill
Soils: Sandy Loam



Area (pre-European): 7059 ha. **Area (present)**: 505 ha **% pre-European**: 7% **Number of patches (size range)**: 41 (1 to 142 ha) **Area protected (% of present)**: 88 (7%)

Figure 14. *Eucalyptus diversifolia* Coastal White Mallee Mallee Forest.

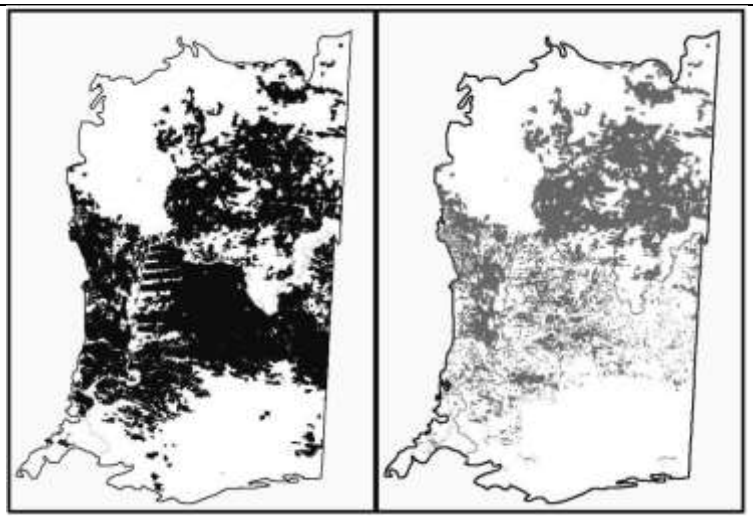
Characteristic Species
Acacia brachybotrya, Acacia rigens, Acacia spinescens, Brachyloma ericoides ssp. *ericoides, Chrysocephalum apiculatum, Eutaxia microphylla* var. *microphylla, Lepidosperma carphoides, Rhagodia crassifolia.*
Landform: Plain
Soils: Clay Loam



Area (pre-European): 20792 ha. **Area (present)**: 419 ha **% pre-European**: 2% **Number of patches (size range)**: 9 (2 to 292 ha) **Area protected (% of present)**: 0 (0%)

Figure 15. *Eucalyptus yalatensis* Yalata Mallee, *E. dumosa* White Mallee, *E. gracilis* Yorrell Mallee.

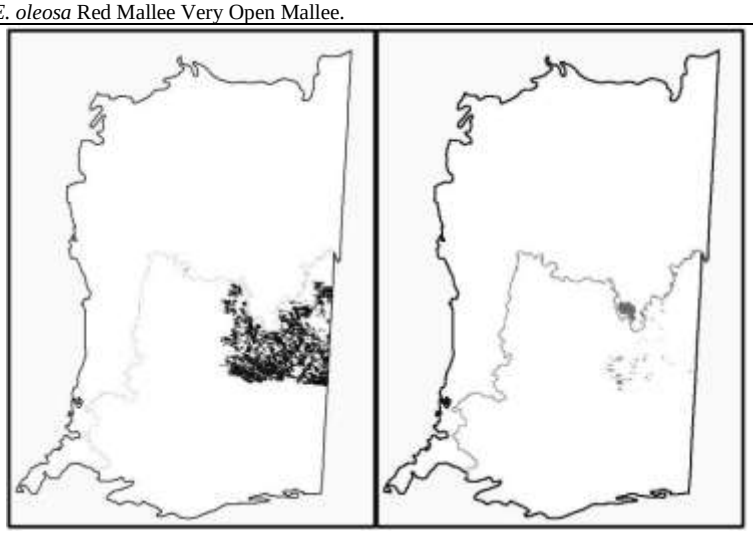
Characteristic Species
Atriplex stipitata, Enchylaena tomentosa var. *tomentosa, Exocarpos aphyllus, Geijera linearifolia, Maireana erioclada, Maireana pentatropis, Melaleuca lanceolata* ssp. *lanceolata, Olearia magniflora, O. muelleri, Sclerolaena obliquicuspis, S..diacantha, Westringia rigida, Zygophyllum apiculatum.*
Landform: Dune & Sand Plain
Soils: Sand to Loam



Area (pre-European): 1174841 ha. **Area (present)**: 460399 ha **% pre-European**: 39% **Number of patches (size range)**: 4944 (<1 to 113077 ha) **Area protected (% of present)**: 102346 (22%)

Figure 16. *Eucalyptus gracilis* Yorrell, *E. oleosa* Red Mallee Very Open Mallee.

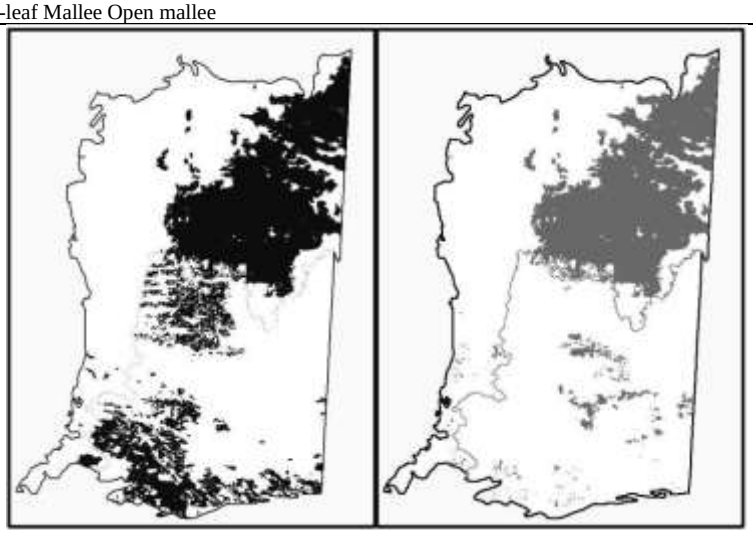
Characteristic Species
**Brassica tournefortii, Chenopodium desertorum* ssp. *desertorum, Enchylaena tomentosa* var. *tomentosa, Maireana pentatropis, Sclerolaena obliquicuspis, Triodia scariosa, Westringia rigida, Zygophyllum apiculatum.*
Landform: Dune
Soils: Sand to Loamy Sand



Area (pre-European): 49662 ha. **Area (present)**: 6860 ha **% pre-European**: 14% **Number of patches (size range)**: 108 (<1 to 6075 ha) **Area protected (% of present)**:276 (4%)

Figure 17. *Eucalyptus cyanophylla* Blue-leaf Mallee Open mallee

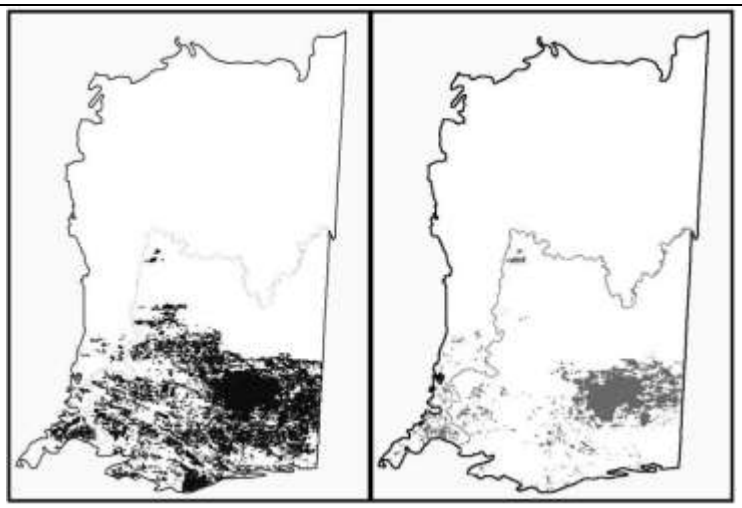
Characteristic Species
*Austrostipa elegantissima, *Brassica tournefortii, Melaleuca acuminata, Senecio lautus, Westringia rigida, Beyeria opaca, Cassytha melantha, Enchylaena tomentose* var. *tomentosa, Sclerolaena diacantha, Zygophyllum apiculatum.*
Landform: Dune & Sand Plain
Soils: Sand to Loamy Sand



Area (pre-European): 616796 ha. **Area (present)**: 394779 ha **% pre-European**: 64% **Number of patches (size range)**: 976 (<1 to 113077 ha) **Area protected (% of present)**: 143193 (36%)

Figure 18. *Eucalyptus dumosa* White Mallee, *E. socialis* Beaked Red Mallee, *E. leptophylla* Narrow-leaf Red Mallee Mallee.

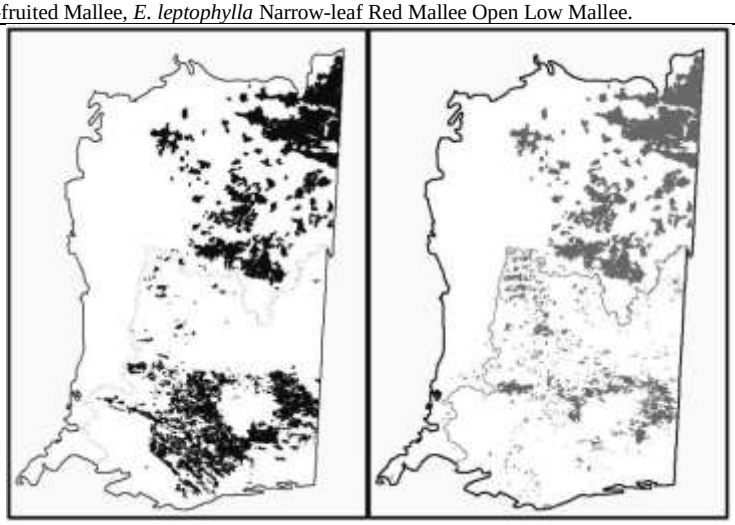
Characteristic Species
Babingtonia behrii, Bertya tasmanica ssp. *vestita, Callitris verrucosa, Glischrocaryon behrii, Grevillea pterosperma, Hakea mitchellii, Helichrysum leucopsideum, Hibbertia virgata, Leptospermum coriaceum, Lomandra leucocephala* ssp. *robusta, Melaleuca uncinata, Phebalium bullatum.*
Landform: Dune
Soils: Sand to Sandy Loam



Area (pre-European): 243112 ha. **Area (present)**: 69621 ha **% pre-European**: 29% **Number of patches (size range)**: 1287 (<1 to 31897 ha) **Area protected (% of present)**: 45084 (65%)

Figure 19. *Eucalyptus incrassata* Ridge-fruited Mallee, *E. leptophylla* Narrow-leaf Red Mallee Open Low Mallee.

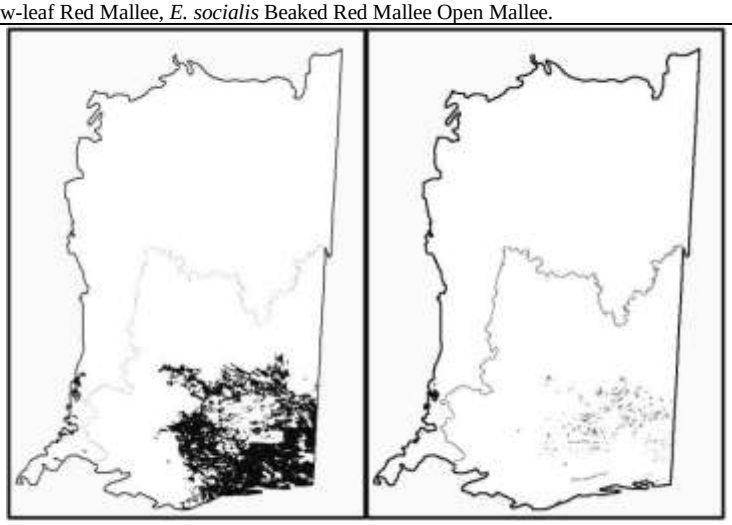
Characteristic Species
**Brassica tournefortii, Enchylaena tomentose* var. *tomentosa, Grevillea huegelii, Maireana pentatropis, Sclerolaena diacantha, Senna artemisioides* nothossp. *coriacea, Triodia scariosa.*
Landform: Dune & Sand Plain
Soils: Sand



Area (pre-European): 352356 ha. **Area (present)**: 214278 ha **% pre-European**: 61% **Number of patches (size range)**: 1491 (<1 to 33131 ha) **Area protected (% of present)**: 101528 (61%)

Figure 20. *Eucalyptus leptophylla* Narrow-leaf Red Mallee, *E. socialis* Beaked Red Mallee Open Mallee.

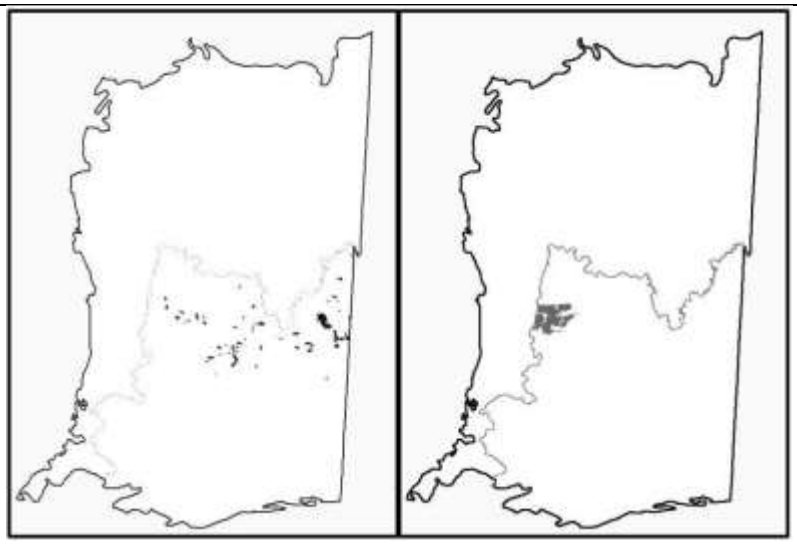
Characteristic Species
Acacia microcarpa, Austrostipa elegantissima, Enchylaena tomentosa var. *tomentosa, Dianella revoluta* var., *Ozothamnus decurrens, Rhagodia candolleana,*
Landform: Plains
Soils: Clay Loam to Sandy Loam



Area (pre-European): 254371 ha. **Area (present)**: 5428 ha **% pre-European**: 2% **Number of patches (size range)**: 475 (<1 to 212 ha) **Area protected (% of present)**: 3563 (66%)

Figure 21. *Eucalyptus calycogona* Square-fruit Mallee, *E. dumosa* White Mallee Very Open Mallee.

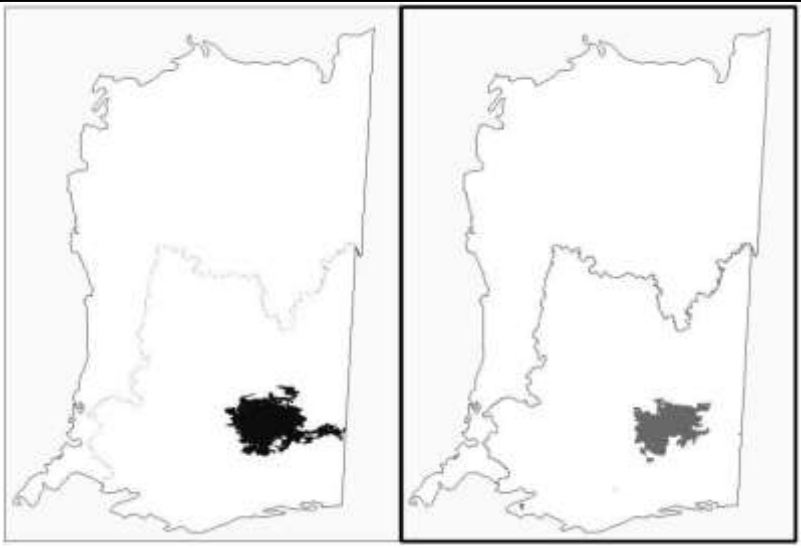
Characteristic Species
Austrostipa sp., *Austrodanthonia* sp. **Brassica tournefortii*, *Chenopodium desertorum* ssp. *microphyllum*, *Enchylaena tomentosa* var. *tomentosa*, *Senna artemisioides* nothossp.
Landform: Dune and Sandplain
Soils: Sand



Area (pre-European): 7930 ha. **Area (present)**: 5851 ha **% pre-European**: 74% **Number of patches (size range)**: 6 (3-5789) **Area protected (% of present)**: 164 (74%)

Figure 22. *Alectryon oleifolius* ssp. *canescens* Bullock Bush Tall Shrubland.

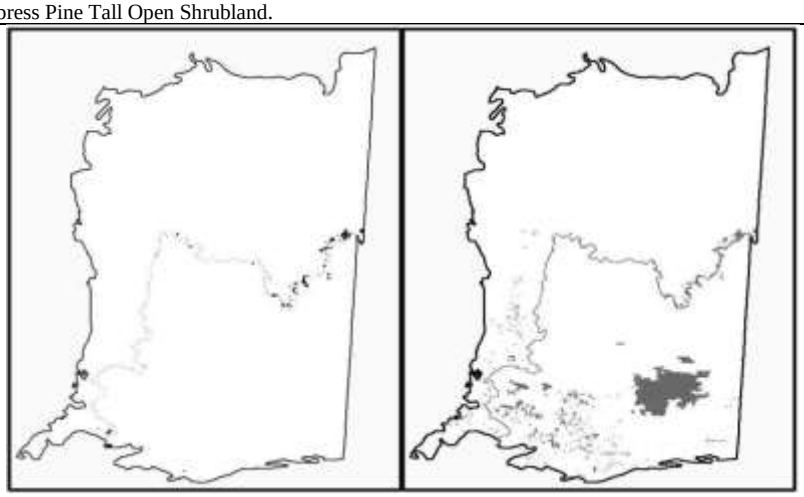
Characteristic Species
**Brassica tournefortii*, *Carpobrotus modestus*, *Leptospermum coriaceum*, *Melaleuca uncinata*, *Millotia tenuifolia* var., **Pentaschistis airoides*, *Podotheca angustifolia.*
Landform: Dune
Soils: Sand



Area (pre-European): 53851 ha. **Area (present)**: 24857 ha **% pre-European**: 46% **Number of patches (size range)**: 13 (<1 to 23923 ha) **Area protected (% of present)**: 22143 (46%)

Figure 23. *Callitris verrucosa* Scrub Cypress Pine Tall Open Shrubland.

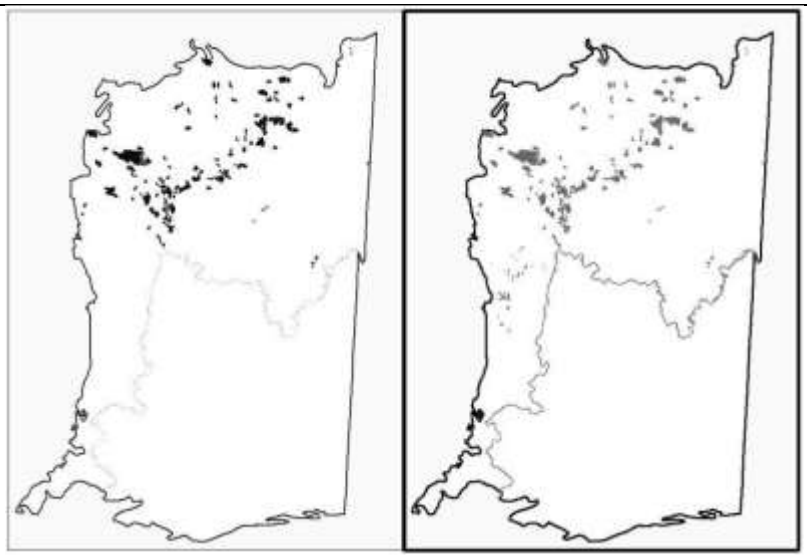
Characteristic Species
Austrostipa elegantissima, **Brassica tournefortii*, *Carpobrotus modestus*, *Clematis microphylla*, *Goodenia willisiana*, *Helichrysum leucopsideum*, *Melaleuca acuminata*, *Senecio lautus.*
Landform: Limestone Plain
Soils: Sand to Loam



Area (pre-European): 2215 ha. **Area (present)**: 36227 ha **% pre-European**: 1635% **Number of patches (size range)**: 810 (<1 to 23923 ha) **Area protected (% of present)**: 25570 (71%)

Figure 24. *Melaleuca lanceolata* Dryland Tea-tree Tall Open Shrubland.

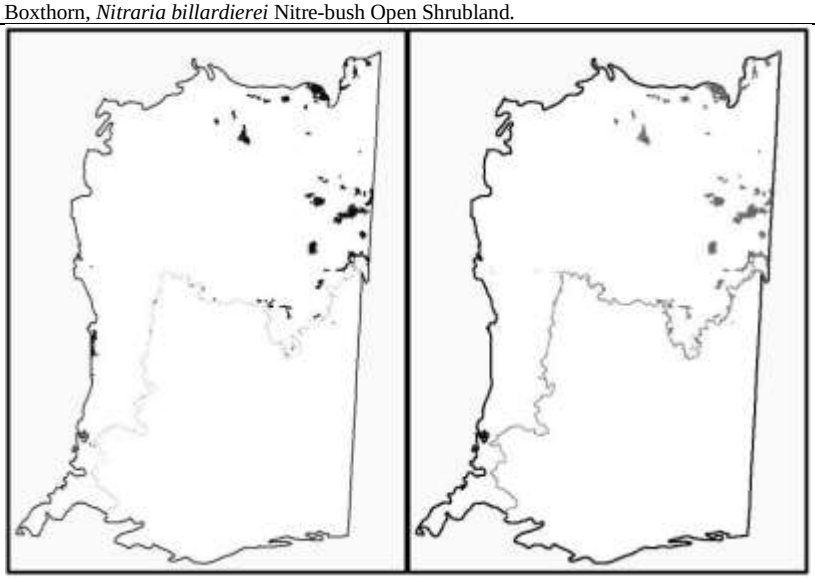
Characteristic Species
*Brachycome lineariloba, *Carrichtera annua, Disphyma crassifolium* ssp. *clavellatum, Enchylaena tomentosa var. tomentosa, *Erodium cicutarium, Maireana sedifolia, Minuria cunninghamii, Sclerolaena diacantha, Sclerostegia tenuis.*
Landform: Clay Pan
Soils: Light to Medium Clay



Area (pre-European): 31938 ha. **Area (present)**: 33329 ha **% pre-European**: 104% **Number of patches (size range)**: 181 (<1 to 2156 ha) **Area protected (% of present)**:691 (2%)

Figure 25. *Lycium australe* Australian Boxthorn, *Nitraria billardierei* Nitre-bush Open Shrubland.

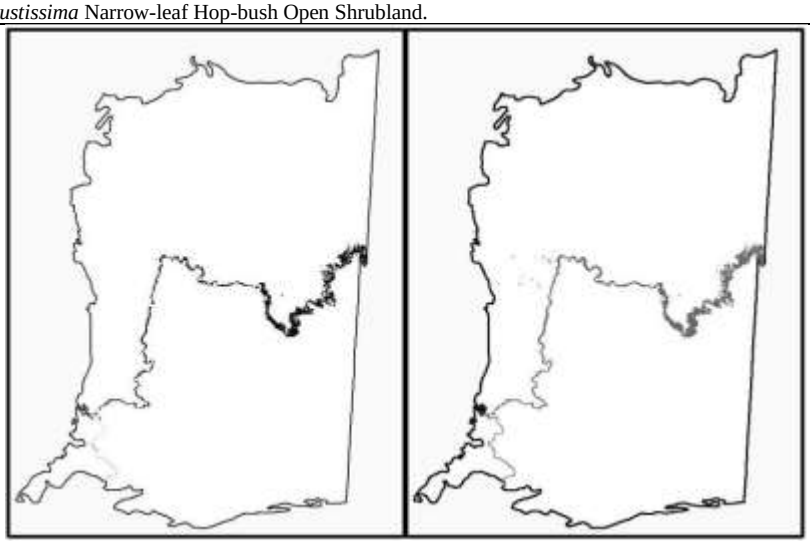
Characteristic Species
*Actinobole uliginosum, Brachycome lineariloba, *Brassica tournefortii, Calotis hispidula, Daucus glochidiatus, Eremophila sturtii, Maireana pyramidata, Olearia pimeleoides* ssp. *pimeleoides, Rhodanthe pygmaea, *Schismus barbatus, *Sisymbrium erysimoides.*
Landform: Dune
Soils: Sand to Sandy Loam



Area (pre-European): 17438 ha. **Area (present)**: 15549 ha **% pre-European**: 89% **Number of patches (size range)**: 232 (<1 to 1613 ha) **Area protected (% of present)**:5319 (34%)

Figure 26. *Dodonaea viscosa* ssp. *angustissima* Narrow-leaf Hop-bush Open Shrubland.

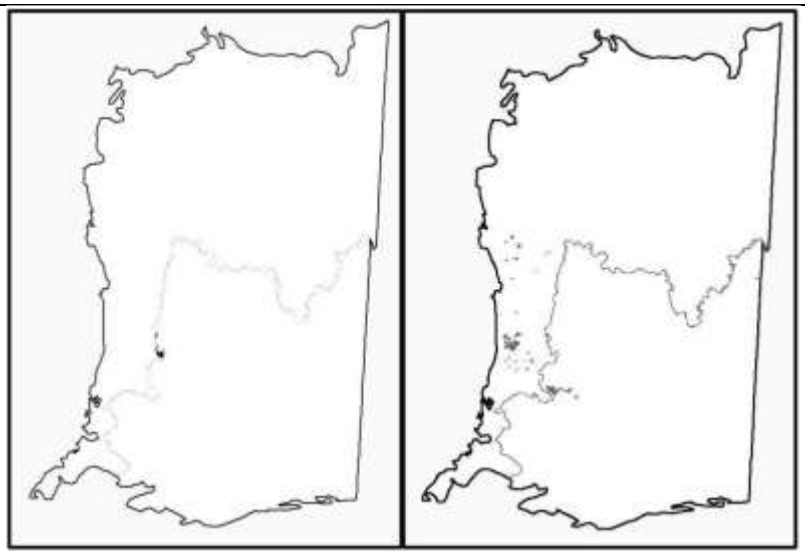
Characteristic Species
Atriplex leptocarpa, Atriplex lindleyi ssp. *lindleyi, *Bromus rubens, Einadia nutans* ssp. *nutans, Enchylaena tomentosa* var. *tomentosa, Eremophila divaricata* ssp. *divaricata, Sporobolus mitchellii.*
Landform: Floodplain
Soils: Silty Clay Loam to Clay Loam



Area (pre-European): 12488 ha. **Area (present)**: 12617 ha **% pre-European**: 101% **Number of patches (size range)**: 2229 (<1 to 230 ha) **Area protected (% of present)**: 5283 (42%)

Figure 27. *Muehlenbeckia florulenta* Lignum Shrubland.

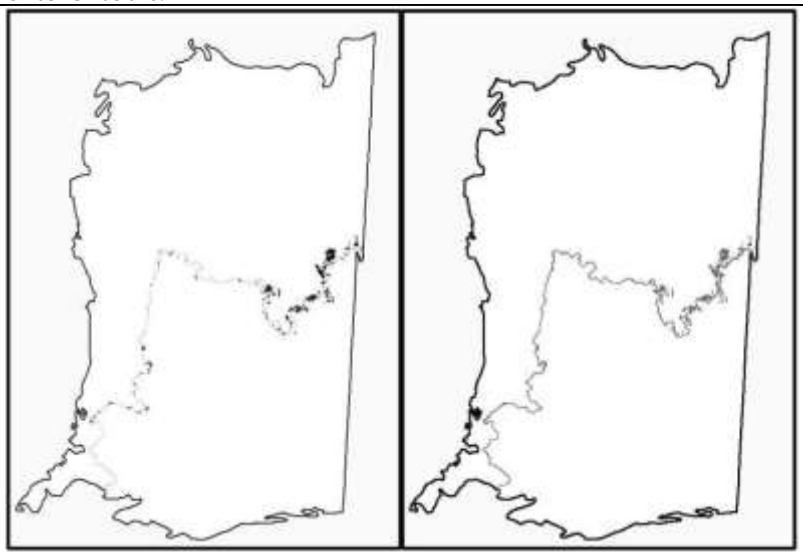
Characteristic Species
Amyema preissii, Asteridea athrixioides forma *athrixioides, Bupleurum semicompositum, *Centaurea melitensis, Chenopodium curvispicatum, Exocarpos aphyllus, Goodenia pinnatifida, Rhagodia parabolica, R. spinescens*
Landform: Plain
Soils: Loam



Area (pre-European): 1026 ha. **Area (present)**: 5729 ha **% pre-European**: 558% **Number of patches (size range)**: 106 (1 to 1607 ha) **Area protected (% of present)**: 264 (5%)

Figure 28. *Acacia nyssophylla* Spine Bush Shrubland.

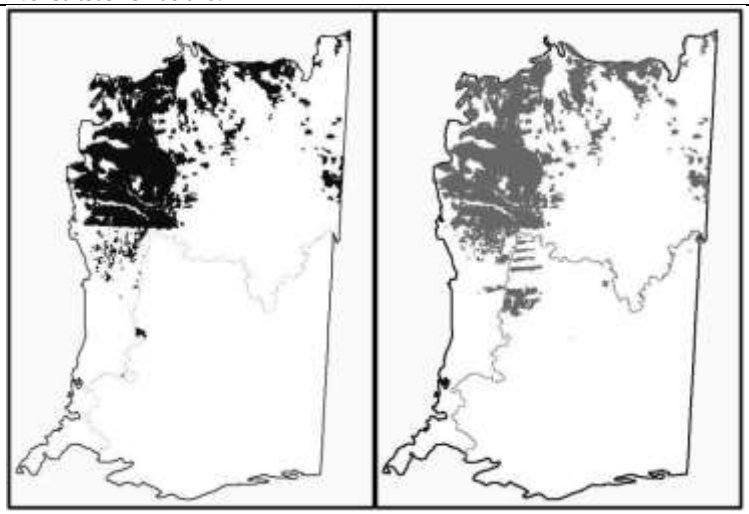
Characteristic Species
Crassula colorata var. *acuminata, Disphyma crassifolium* ssp. *clavellatum, Einadia nutans* ssp. *nutans, Enchylaena tomentosa* var. *tomentosa, *Medicago polymorpha* var. *polymorpha, Sclerolaena muricata* var. *muricata, *Vulpia myuros* forma *myuros*
Landform: Floodplain
Soils: Sandy Loam to Medium Clay



Area (pre-European): 2844 ha. **Area (present)**: 2844 ha **% pre-European**: 100% **Number of patches (size range)**: 366 (<1 to 234 ha) **Area protected (% of present)**: 1079 (38%)

Figure 29. *Atriplex rhagodioides* River Saltbush Shrubland.

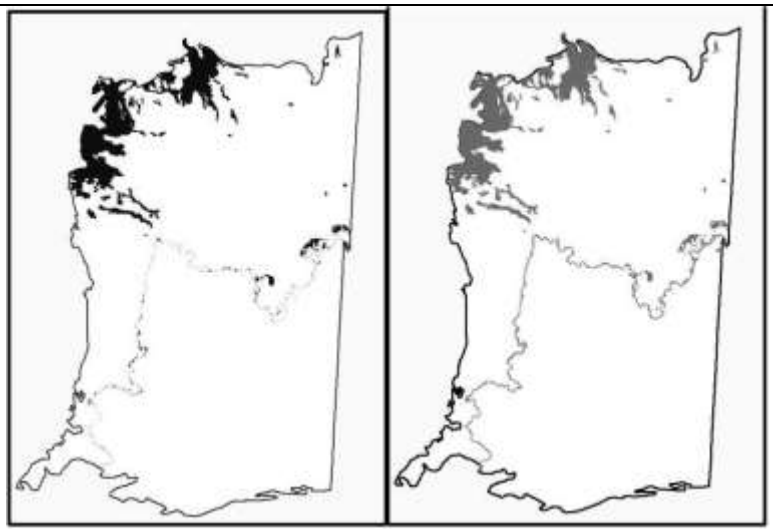
Characteristic Species
Austrostipa sp., *Brachycome lineariloba, *Carrichtera annua, Enchylaena tomentose* var. *tomentosa, Erodium cygnorum, Maireana pyramidata, Sclerolaena obliquicuspis, Solanum petrophilum.*
Landform: Plain
Soils: Sandy to Clay Loam



Area (pre-European): 366477 ha. **Area (present)**: 387092 ha **% pre-European**: 106% **Number of patches (size range)**: 588 (<1 to 122060 ha) **Area protected (% of present)**: 12735 (3%)

Figure 30. *Maireana sedifolia* Bluebush Low Open Shrubland.

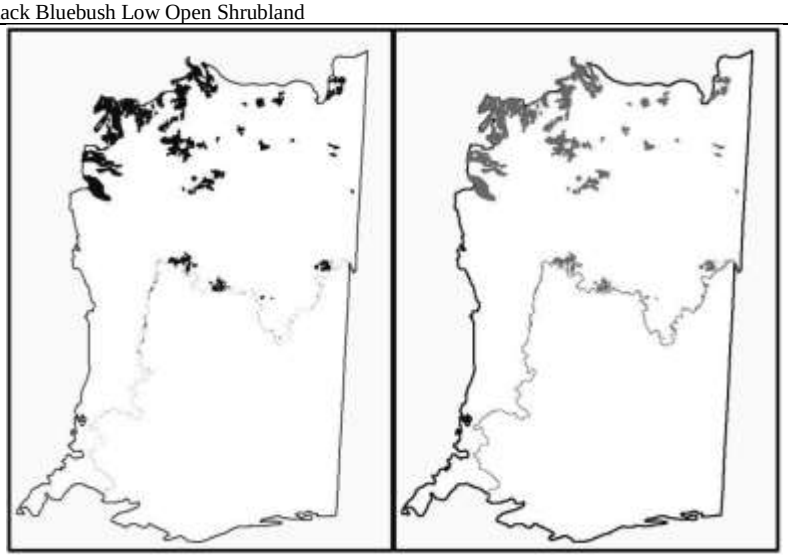
Characteristic Species
Austrostipa sp., **Bromus rubens*, **Carrichtera annua*, **Hordeum marinum* ssp. *glaucum*, *Enchylaena tomentosa* var. *tomentosa*, *Maireana sedifolia*, **Medicago minima* var. *minima*, *Sclerolaena obliquicuspis*, **Sonchus oleraceus*, *Tetragonia* sp.
Landform: Plain
Soils: Clay Loam



Area (pre-European): 128598 ha. **Area (present)**: 129063 ha **% pre-European**: 100% **Number of patches (size range)**: 487 (<1 to 26422 ha) **Area protected (% of present)**: 487 (2%)

Figure 31. *Maireana pyramidata* Black Bluebush Low Open Shrubland

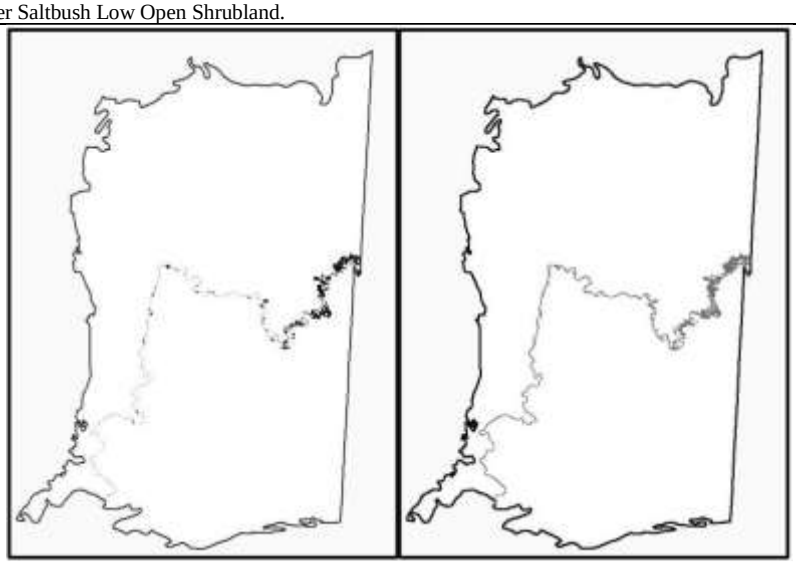
Characteristic Species
Brachycome lineariloba, **Carrichtera annua*, *Enchylaena tomentosa* var. *tomentosa*, **Erodium cicutarium*, *Maireana georgei*, *Maireana pyramidata*, *Maireana sedifolia*, *Sclerolaena obliquicuspis*, **Sonchus oleraceus.*
Landform: Plain
Soils: Sandy to Clay Loam



Area (pre-European): 58778 ha. **Area (present)**: 58794 ha **% pre-European**: 100% **Number of patches (size range)**: 340 (<1 to 1005 ha) **Area protected (% of present)**: 1181 (2%)

Figure 32. *Atriplex vesicaria* Bladder Saltbush Low Open Shrubland.

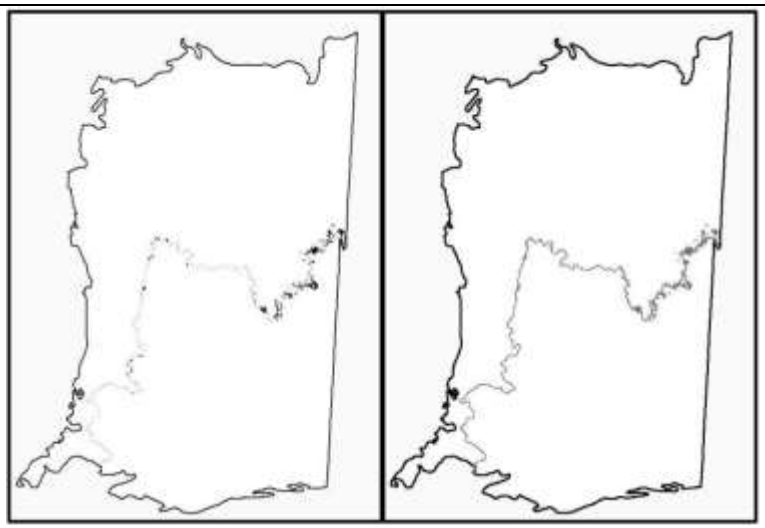
Characteristic Species
Atriplex leptocarpa, *Atriplex lindleyi* ssp. *lindleyi*, *Brachycome lineariloba*, *Bulbine semibarbata*, *Cressa cretica*, *Enchylaena tomentosa* var. *tomentosa*, *Muehlenbeckia florulenta*, *Plantago cunninghamii*, *Sclerolaena brachyptera*, *S. muricata* var. *muricata*, *Senecio glossanthus.*
Landform: River Flat
Soils: Medium Heavy Clay



Area (pre-European): 3819 ha. **Area (present)**: 3819 ha **% pre-European**: 100% **Number of patches (size range)**: 477 (<1 to 206 ha) **Area protected (% of present)**: 1977 (52%)

Figure 33. *Atriplex lindleyi* ssp. *lindleyi* Baldoo Low Shrubland.

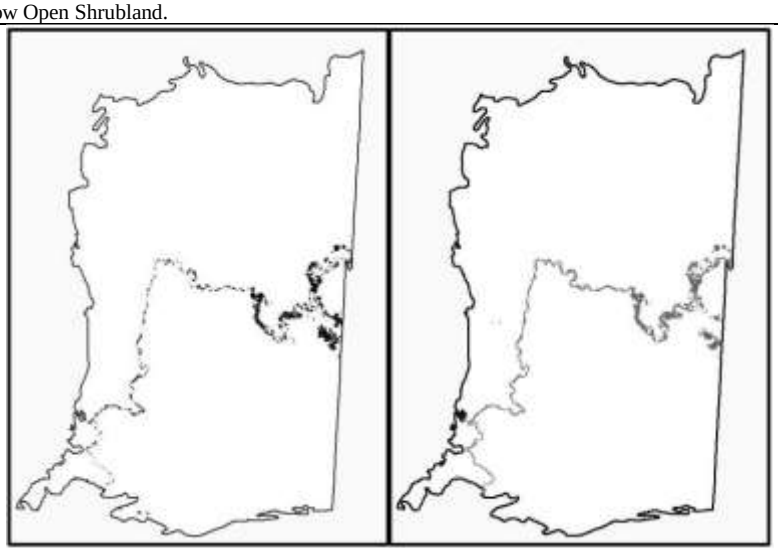
Characteristic Species
Angianthus tomentosus, Atriplex lindleyi ssp. *lindleyi*, *A. semibaccata, Brachycome lineariloba, Goodenia glauca, Plantago cunninghamii, Sclerolaena brachyptera, Sclerolaena tricuspis, Senecio glossanthus.*
Landform: Plain
Soils: Medium Clay



Area (pre-European): 1727 ha. **Area (present)**: 1727 ha **% pre-European**: 100% **Number of patches (size range)**: 247 (<1 to 165 ha) **Area protected (% of present)**: 745 (43%)

Figure 34. *Sclerolaena* spp. Bindyi Low Open Shrubland.

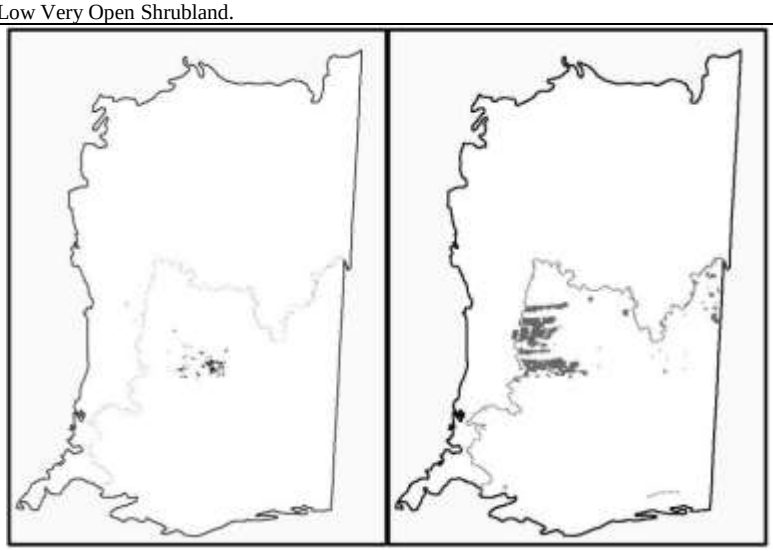
Characteristic Species
Disphyma crassifolium ssp. *clavellatum, Halosarcia indica* ssp. *leiostachya, Halosarcia pergranulata* ssp. *pergranulata, *Mesembryanthemum nodiflorum, Muehlenbeckia florulenta, Spergularia marina, Suaeda australis.*
Landform: Saltmarsh
Soils: Silty Clay Loam



Area (pre-European): 13795 ha. **Area (present)**: 11800 ha **% pre-European**: 86% **Number of patches (size range)**: 1183 (<1 to 1784 ha) **Area protected (% of present)**: 1931 (16%)

Figure 35. *Halosarcia* spp. Samphire Low Very Open Shrubland.

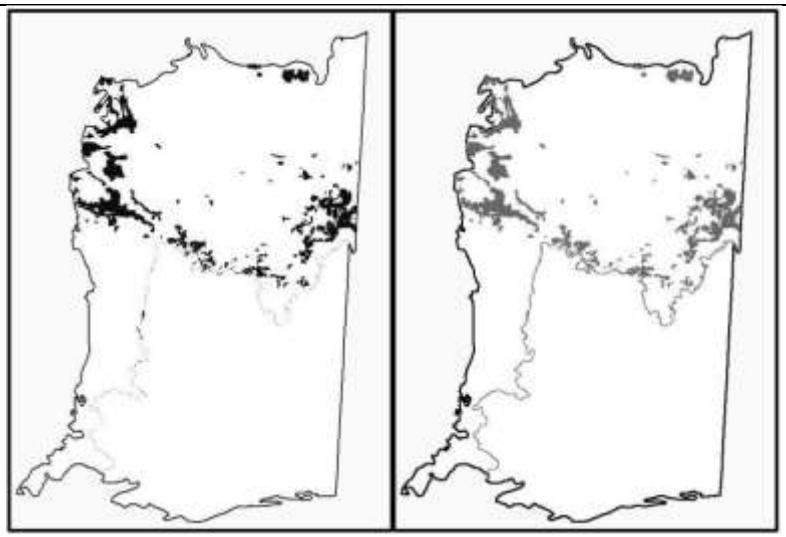
Characteristic Species
*Austrostipa nitida, *Brassica tournefortii, *Carrichtera annua, Enchylaena tomentose* var. *tomentosa, Lawrencia squamata, Maireana brevifolia, Sclerolaena obliquicuspis, Sclerolaena diacantha.*
Landform: Plain
Soils: Loam to Clay Loam



Area (pre-European): 1833 ha. **Area (present)**: 40502 ha **% pre-European**: 2210% **Number of patches (size range)**: 105 (<1 to 11606 ha) **Area protected (% of present)**: 844 (2%)

Figure 36. *Austrostipa* spp. Spear-grass Tussock Grassland.

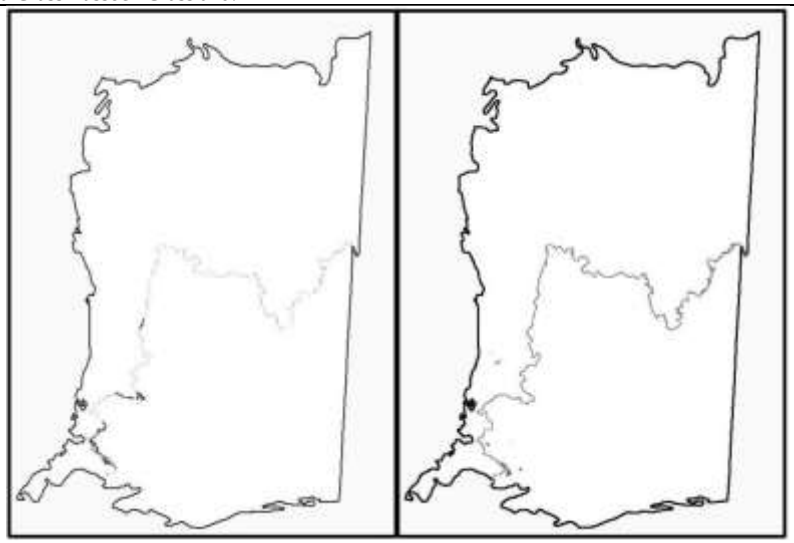
Characteristic Species
Actinobole uliginosum, Alectryon oleifolius ssp. *canescens, Atriplex stipitata, Enchylaena tomentosa* var. *tomentosa, *Erodium cicutarium, *Erodium crinitum, Lachnagrostis filiformis, Maireana sedifolia, Myoporum platycarpum* ssp. *platycarpum.*
Landform: Depression
Soils: Sandy Loam



Area (pre-European): 79227 ha. **Area (present)**: 79227 ha **% pre-European**: 100% **Number of patches (size range)**: 327 (<1 to 9361 ha) **Area protected (% of present)**: 10519 (13%)

Figure 37. *Enneapogon* sp. Umbrella Grass Tussock Grassland.

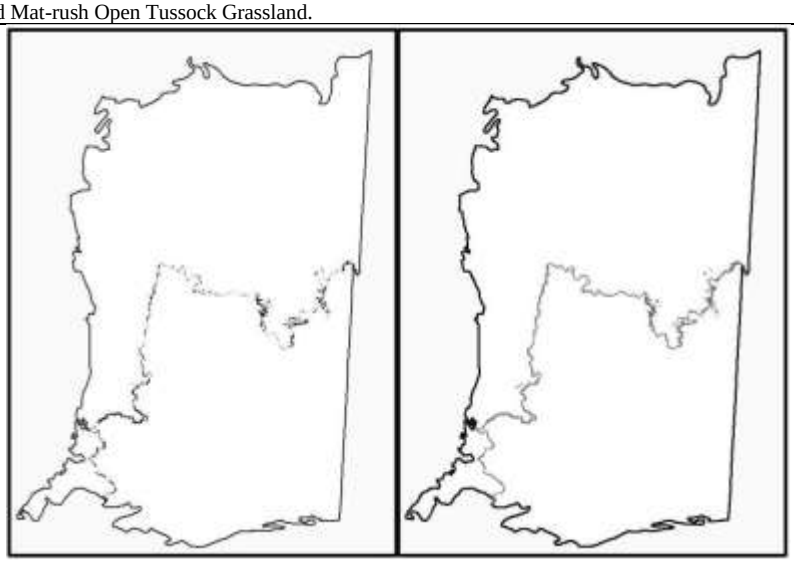
Characteristic Species
*Austrodanthonia caespitosa, Austrostipa eremophila, Austrostipa nitida, *Asphodelus fistulosus, *Avena barbata, *Bromus rubens, *Bupleurum semicompositum, *Erodium botrys, Goodenia pusilliflora, *Gynandriris setifolia, *Medicago minima* var. *minima, *Plantago bellardii.*
Landform: Plain to Hillslope
Soils: Loam



Area (pre-European): 2009 ha. **Area (present)**: 1730 ha **% pre-European**: 86% **Number of patches (size range)**: 31 (<1 to 774 ha) **Area protected (% of present)**: 228 (13%)

Figure 38. *Lomandra effusa* Scented Mat-rush Open Tussock Grassland.

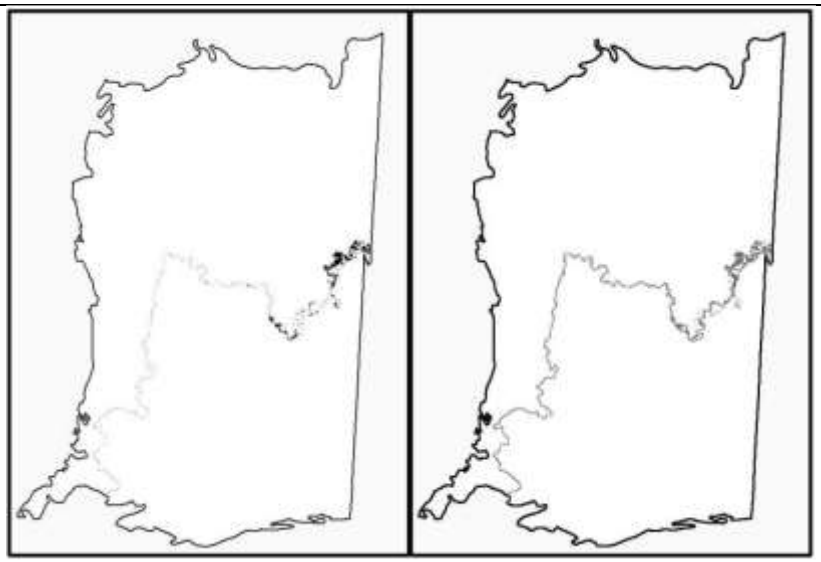
Characteristic Species
**Aster subulatus, Berula erecta, Eleocharis acuta, Eucalyptus camaldulensis var. camaldulensis, Hydrocotyle verticillata, Lycopus australis, Muehlenbeckia florulenta,, Schoenoplectus validus, Triglochin procerum, Typha domingensis.*
Landform: River & Lake Edge
Soils: Silty Clay Loam



Area (pre-European): 1650 ha. **Area (present)**: 1692 ha **% pre-European**: 103% **Number of patches (size range)**: 1194 (<1 to 1005 ha) **Area protected (% of present)**: 178 (11%)

Figure 39. *Phragmites australis* Common Reed, *Typha* spp. Bullrush Sedgeland.

Characteristic Species
Atriplex lindleyi ssp. *lindleyi, Brachycome lineariloba, Cotula australis, Cressa cretica, Disphyma crassifolium* ssp. *clavellatum, Eriochiton sclerolaenoides, Isoetopsis graminifolia, Maireana ciliata, Pachycornia triandra, Plantago cunninghamii, Sporobolus virginicus.*
Landform: Closed Depression
Soils: Light to Medium Clay



Area (pre-European): 2158 ha. **Area (present)**: 2158 ha **% pre-European**: 100%
Number of patches (size range): 234 (<1 to 808 ha) **Area protected (% of present)**: 802 (37%)

Figure 40. Herbland.

DISCUSSION

Since European settlement, the vegetation of the Murray Mallee has dramatically changed. A comparison between current and pre-European vegetation cover in Figures 4-40 indicates more favourable agricultural areas, such as those of higher rainfall, more lightly wooded areas or soils of more favourable fertility, have been selectively developed for agriculture (e.g. *Eucalyptus calycogona*, *E. dumosa* Mallee; *E. dumosa*, *E. socialis*, *E. leptophylla* Mallee; and *E. socialis*, *E. leptophylla* Mallee).

Within the pastoral area, the extensive areas of former *Myoporum platycarpum* Woodland noted in the Pre-European mapping have in turn been largely reduced to *Austrostipa* Grassland, *Maireana sedifolia* Low Shrubland or *Alectryon oleifolius* ssp. *canescens* Tall Shrubland, through grazing of domestic stock and rabbits. Some of these badly over-grazed areas have subsequently been re-colonised by spiny and unpalatable shrubs reflected in the expansion of areas of *Acacia nyssophylla* Shrubland.

Along much of the Murray Valley, the former natural vegetation has been completely replaced by areas now utilised for irrigated agriculture, while much of what remains of the once beautiful and extensive areas of *Eucalyptus camaldulensis* var. *camaldulensis* and *E. largiflorens* Forests and Woodlands that so impressed Charles Sturt in 1830 are now either dead from the effects of salinity and altered flood regimes, or are in serious decline. This has also led to a significant expansion of the salt-tolerant vegetation communities such as *Halosarcia* spp. Low Very Open Shrubland and various forms of Herbland.

We are now at a point where much of the native vegetation still remaining is threatened by fragmentation and isolation in unsustainable small blocks. Many areas have salinity problems, environmental weeds and over-grazing by feral animals, domestic stock and the very large numbers of kangaroos that this altered landscape now sustains. The remaining Mallee communities in particular are also threatened by changed fire regimes. As described in the Regional Biodiversity Plan (Kahrimanis et al. 2001), we are now at the point where every tiny remnant of the original natural vegetation of this extensive area must be valued and actively managed. This must be part of a major effort to restore some semblance of connectivity and ecological integrity across the whole landscape by a massive effort at re-vegetation using local native species to reconnect the fragments. Priority should be given to expanding, and where possible, reconnecting the few remaining plant communities on the more fertile agricultural lands before they are lost from the area forever.

ACKNOWLEDGEMENTS

Our thanks to the hundreds of professional and volunteer biologists who participated in the four major biological surveys in the area covered by this natural history. Without the large number of systematic vegetation quadrats sampled and the subsequent vegetation mapping, the analysis described in this chapter could not have been attempted.

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APPENDIX. A LIST OF VASCULAR PLANTS RECORDED FROM THE MURRAYLANDS AND RIVERLAND REGIONS

Plant taxonomy follows the Census of South Australian Vascular Plants (Barker et al. 2005). Introduced species are preceded with an asterisk (*).

Common names are from Jessop and Toelken (1986) and/or the SAFLORA database.

Proclaimed Pest Plants under the Animal and Plant Control (Agricultural Protection and other Purposes) Act 1986 are indicated with a Y.

Conservation Status codes: V = Vulnerable, R = Rare. Codes for Australia are based on the December 2000 listing of species under the Environment Protection and Biodiversity Conservation Act 1999; those for South Australia are based on Schedules of the National Parks and Wildlife Act 1972 (SA) as amended in 2000. There have however been some modifications to the current legislated listings to incorporate more recent taxonomic changes and increases in knowledge of some species status.

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
LYCOPODIACEAE				
Phylloglossum drummondii Kunze	Pygmy Clubmoss			R
**Phyllopodium cordatum* (Thunb.)O.M.Hilliard				
ISOETACEAE				
Isoetes drummondii A.Braun ssp. *drummondii*	Plain Quillwort			
OPHIOGLOSSACEAE				
Ophioglossum lusitanicum L.	Austral Adder's-tongue			
ADIANTACEAE				
Adiantum aethiopicum L.	Common Maiden-hair			
Adiantum capillus-veneris L	Dainty Maiden-hair			V
Cheilanthes austrotenuifolia H.M.Quirk & T.C.Chambers	Annual Rock-fern			
Cheilanthes distans (R.Br.)Mett.	Bristly Cloak-fern			
Cheilanthes lasiophylla Pic.Serm.	Woolly Cloak-fern			
Cheilanthes sieberi Kunze ssp.*sieberi*	Narrow Rock-fern			
PTERIDACEAE				
Pteridium esculentum (G.Forst.)Cockayne	Bracken			
Pteris tremula R.Br.	Tender Brake			R
ASPLENIACEAE				
Asplenium flabellifolium Cav.	Necklace Fern			
Pleurosorus rutifolius (R.Br.)Fee	Blanket Fern			
Pleurosorus subglandulosus (Hook. & Grev.)Tindale	Clubbed Blanket Fern			
THELYPTERIDACEAE				
Christella dentata (Forssk.)Brownsey & Jermy	Soft Shield-fern			R
MARSILEACEAE				
Marsilea costulifera D.L.Jones	Narrow-leaf Nardoo			
Marsilea drummondii A.Braun	Common Nardoo			
Marsilea hirsuta R.Br.	Short-fruit Nardoo			
Marsilea mutica Mett.	Variable Nardoo			E
Pilularia novae-hollandiae A.Braun	Austral Pillwort			R

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
AZOLLACEAE				
Azolla filiculoides	Pacific Azolla			
Azolla pinnata	Ferny Azolla			
PINACEAE				
**Pinus canariensis* C.Smith	Canary Pine			
**Pinus halepensis* Mill	Aleppo Pine	Y		
**Pinus pinaster* Aiton	Maritime Pine			
**Pinus ponderosa* Douglas	Ponderosa Pine			
**Pinus radiata* D.Don	Radiata Pine			
CUPRESSACEAE				
Callitris canescens (Parl.)S.T.Blake	Scrubby Cypress Pine			
Callitris glaucophylla Joy Thomps. & L.A.S.Johnson	White Cypress-pine			
Callitris gracilis R.T.Baker	Southern Cypress Pine			
Callitris verrucosa (A.Cunn. ex Endl.)F.Muell.	Scrub Cypress Pine			
Cupressus macrocarpa Hartw. ex Gordon	Monterey Cypress			
CASUARINACEAE				
Allocasuarina luehmannii (R.T.Baker)L.A.S.Johnson	Bull Oak			
Allocasuarina muelleriana (Miq.)L.A.S.Johnson ssp. *muelleriana*	Common Oak-bush			
Allocasuarina pusilla (Macklin)L.A.S.Johnson	Dwarf Oak-bush			
Allocasuarina verticillata (Lam.)L.A.S.Johnson	Drooping Sheoak			
**Casuarina glauca* Sieber ex Spreng.	River Oak			
Casuarina pauper F.Muell. ex L.A.S.Johnson	Black Oak			
SALICACEAE				
**Populus alba* L.	White Poplar			
**Salix babylonica* L.	Weeping Willow			
**Salix* X *rubens* Schrank	Willow	Y		
CANNABACEAE				
**Cannabis sativa* L.	Indian Hemp			
URTICACEAE				
Parietaria cardiostegia Greuter	Mallee Smooth-nettle			
Parietaria debilis G.Forst.	Smooth-nettle			
**Parietaria judaica* L.	Wall Pellitory			
Urtica incisa Poir.	Scrub Nettle			
**Urtica urens* L.	Small Nettle			
PROTEACEAE				
Adenanthos terminalis R.Br.	Yellow Gland-flower			
Banksia marginata Cav.	Silver Banksia			
Banksia ornata F.Muell. ex Meisn.	Desert Banksia			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Conospermum patens Schltdl.	Slender Smoke-bush			
Grevillea huegelii Meisn.	Comb Grevillea			
Grevillea ilicifolia (R.Br.)R.Br. ssp. *ilicifolia*	Holly-leaf Grevillea			
Grevillea ilicifolia R.Br. ssp. *lobata* (F.Muell.)T.L.Downing	Lobed Holly-leaf Grevillea			
Grevillea lavandulacea Schltdl. ssp. *lavandulacea*	Spider-flower			
Grevillea pterosperma F.Muell.	Dune Grevillea			
Hakea carinata F.Muell. ex Meisn.	Erect Hakea			
**Hakea laurina* R.Br.	Pincushion Hakea			
Hakea leucoptera R.Br. ssp. *leucoptera*	Silver Needlewood			
Hakea mitchellii Meisn.	Silver Needlewood			
Hakea rostrata F.Muell. ex Meisn.	Beaked Hakea			
Hakea rugosa R.Br.	Dwarf Hakea			
Hakea tephrosperma R.Br	Hooked Needlewood			R
Hakea vittata R.Br.	Limestone Needlebush			
Isopogon ceratophyllus R.Br.	Horny Cone-bush			
Persoonia juniperina Labill.	Prickly Geebung			
SANTALACEAE				
Choretrum glomeratum R.Br. var. *chrysanthum* (F.Muell.)Benth.	Yellow-flower Sour-bush			R
Choretrum glomeratum R.Br. var. *glomeratum*	White Sour-bush			
Exocarpos aphyllus R.Br.	Leafless Cherry			
Exocarpos cupressiformis Labill.	Native Cherry			
Exocarpos sparteus R.Br.	Slender Cherry			
Exocarpos strictus R.Br.	Pale-fruit Cherry			R
Leptomeria aphylla R.Br.	Leafless Currant-bush			
Santalum acuminatum (R.Br.)A.DC.	Quandong			
Santalum lanceolatum R.Br.	Plumbush			
Santalum murrayanum (T.L.Mitch.)C.A.Gardner	Bitter Quandong			
LORANTHACEAE				
Amyema linophylla (Fenzl)Tiegh. ssp. *orientale* Barlow	Casuarina Mistletoe			
Amyema melaleucae (Lehm.ex Miq.)Tiegh.	Tea-tree Mistletoe			
Amyema miquelii (Lehm.ex Miq.)Tiegh.	Box Mistletoe			
Amyema miraculosa (Miq.)Tiegh. ssp. *boormanii* (Blakely)Barlow	Fleshy Mistletoe			
Amyema pendula (Sieber ex Spreng.)Tiegh. ssp. *pendula*	Drooping Mistletoe			
Amyema preissii (Miq.)Tiegh.	Wire-leaf Mistletoe			
Lysiana exocarpi (Behr)Tiegh. ssp. *exocarpi*	Harlequin Mistletoe			
POLYGONACEAE				
**Acetosa vesicaria* (L.)A.Love	Rosy Dock			
**Acetosella vulgaris* Fourr.	Sorrel			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
**Emex australis* Steinh.	Three-corner Jack	Y		
Muehlenbeckia adpressa (Labill.)Meisn.	Climbing Lignum			
Muehlenbeckia diclina (F.Muell.)F.Muell. ssp. *diclina*	Twiggy Lignum			
Muehlenbeckia florulenta Meisn.	Lignum			
Muehlenbeckia gunnii (Hook.f.)Endl.	Coastal Climbing Lignum			
Muehlenbeckia horrida H.Gross ssp. *horrida*	Spiny Lignum			R
**Persicaria capitata* (Buch.-Ham. ex D.Don)H.Gross	Japanese Knotweed			
Persicaria decipiens (R.Br.)K.L.Wilson	Slender Knotweed			
Persicaria lapathifolia (L.)Gray	Pale Knotweed			
Persicaria prostrata (R.Br.)Sojak	Creeping Knotweed			
Polygonum aviculare L.	Wireweed			
**Polygonum bellardii* All.				
Polygonum plebeium R.Br.	Small Knotweed			
Rumex bidens R.Br.	Mud Dock			
Rumex brownii Campd.	Slender Dock			
**Rumex conglomeratus* Murray	Clustered Dock			
**Rumex crispus* L.	Curled Dock			
Rumex crystallinus Lange	Glistening Dock			
Rumex dumosus A.Cunn. ex Meisn.	Wiry Dock			R
**Rumex obtusifolius* L.	Broad-leaf Dock			
**Rumex pulcher* L. ssp. *pulcher*	Fiddle Dock			
Rumex tenax Rech.f.	Shiny Dock			
GYROSTEMONACEAE				
Codonocarpus cotinifolius (Desf.)F.Muell.	Desert Poplar			
Codonocarpus pyramidalis (F.Muell.)F.Muell.	Slender Bell-fruit		V	E
Gyrostemon australasicus (Moq.)Heimerl Buckbush	Wheel-fruit			
Gyrostemon thesioides (Hook.f.)A.S.George	Broom Wheel-fruit			
NYCTAGINACEAE				
Boerhavia coccinea Mill.	Tar-vine			
Boerhavia dominii Meikle & Hewson	Tar-vine			
Boerhavia schomburgkiana Oliv.	Schomburgk's Tar-vine			
AIZOACEAE				
Carpobrotus modestus S.T.Blake	Inland Pigface			
Carpobrotus rossii (Haw.)Schwantes	Native Pigface			
Carpobrotus sp. Short calyx (S.T.Blake 20451) Toelken				
**Cleretum papulosum* (L.f.)L.Bolus ssp. *papulosum*				
Disphyma crassifolium (L.)L.Bolus ssp. *clavellatum* (Haw.)Chinnock	Round-leaf Pigface			
**Galenia pubescens* (Eckl. & Zeyh.)Druce var. *pubescens*	Coastal Galenia			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
**Galenia secunda* (L.f.)Sond.	Galenia			
Disphyma crassifolium (L.)L.Bolus ssp.*clavellatum (*Haw.)Chinnock	Round-leaf Pigface			
Glinus lotoides L.	Hairy Carpet-weed			
Glinus oppositifolia (L.)A.DC.	Slender Carpet-weed			
**Mesembryanthemum aitonis* Jacq.	Angled Iceplant			
**Mesembryanthemum crystallinum* L.	Common Iceplant			
**Mesembryanthemum nodiflorum* L.	Slender Iceplant			
**Psilocaulon granulicaule* (Haw.)Schwantes	Match-head Plant			
**Ruschia tumidula* (Haw.)Schwantes	Pigface			
Sarcozona praecox (F.Muell.)S.T.Blake ex H.Eichler	Sarcozona			
Tetragonia eremaea Ostenf.	Desert Spinach			
Tetragonia implexicoma (Miq.)Hook.f.	Bower Spinach			
Tetragonia moorii M.Gray				
Tetragonia tetragonioides (Pall.)Kuntze	New Zealand Spinach			
Zaleya galericulata (Melville)H.Eichler ssp. *australis* (Melville)S.W.L.Jacobs	Hogweed			
PORTULACACEAE				
Calandrinia calyptrata Hook.f.	Pink Purslane			
Calandrinia corrigioloides F.Muell. ex Benth.	Strap Purslane			
Calandrinia eremaea Ewart	Dryland Purslane			
Calandrinia granulifera Benth.	Pigmy Purslane			
Calandrinia volubilis Benth.	Twining Purslane			
Montia australasica (Hook.f.)Pax & K.Hoffm.	White Purslane			R
Portulaca oleracea L.	Common Purslane			
CARYOPHYLLACEAE				
**Arenaria leptoclados* (Rchb.)Guss.	Lesser Thyme-leaved Sandwort			
**Cerastium balearicum* F.Herm.	Chickweed			
**Cerastium glomeratum* Thuill.	Common Mouse-ear Chickweed			
**Gypsophila tubulosa* (Jaub. & Spach)Boiss.	Annual Chalkwort			
**Herniaria cinerea* DC.	Rupturewort			
**Minuartia mediterranea* (Link)K.Maly	Slender Sandwort			
**Moenchia erecta* (L.)Gaertn.	Erect Chickweed			
**Paronychia argentea* Lam.	Silver Whitlow			
**Petrorhagia dubia* (Rafin)G.Lopez & Romo				
**Petrorhagia nanteuilii* (Burnat)P.W.Ball & Heywood				
**Polycarpon tetraphyllum* (L.)L.	Four-leaf Allseed			
**Sagina apetala* Ard.	Annual Pearlwort			
Sagina maritima G.Don	Sea Pearlwort			
**Sagina procumbens* L.	Spreading Pearlwort			

Species.	Common name	Proclaimed Pest Plant	PBC Act Status	NPW Act Status
Scleranthus minusculus F.Muell.	Cushion Knawel			
Scleranthus pungens R.Br.	Prickly Knawel			
**Silene apetala* Willd.	Sand Catchfly			
**Silene armeria* L.	Sweet-william Catchfly			
**Silene gallica* L. var. *gallica*	French Catchfly			
**Silene longicaulis* Pourr. ex Lag.	Portuguese Catchfly			
**Silene nocturna* L.	Mediterranean Catchfly			
**Silene tridentata* Desf.				
**Silene vulgaris* (Moench)Garcke	Bladder Campion	Y		
**Spergula arvensis* L.	Corn Spurrey			
**Spergularia bocconii* (Scheele)Graebn.				
**Spergularia diandra* (Guss.)Heldr. & Sartori	Lesser Sand-spurrey			
Spergularia marina (L.)Griseb.	Salt Sand-spurrey			
**Spergularia media* (L.)C.Presl mCoast Sand-spurrey				
**Spergularia rubra* (L.)J. & C.Presl	Red Sand-spurrey			
Spergularia sp. Butchers Gap (P.Gibbons 234) L.G.Adams & J.G.West				
Spergularia sp. Mt Mulyah (C.W.E.Moore 7046) L.G.Adams				
Stellaria angustifolia Hook.				
Stellaria filiformis (Benth.)Mattf.	Thread Starwort			
**Stellaria media* (L.)Vill.	Chickweed			
Stellaria multiflora Hook.	Rayless Starwort			R
**Stellaria pallida* (Dumort.)Crep.	Lesser Starwort			
Stellaria 'tenella'	Swamp Starwort			R
**Vaccaria hispanica* (Mill.)Rauschert	Cow Soapwort			
CHENOPODIACEAE				
Atriplex acutibractea R.H.Anderson ssp. *acutibractea*	Pointed Saltbush			
Atriplex acutibractea R.H.Anderson ssp.*karoniensis* Aellen Pointed Saltbush				
Atriplex acutiloba R.H.Anderson				
Atriplex angulata Benth.	Fan Saltbush			
Atriplex australasica Moq.	Green Saltbush			R
Atriplex eardleyae Aellen	Eardley's Saltbush			
Atriplex elachophylla F.Muell.				
Atriplex holocarpa F.Muell.	Pop Saltbush			
Atriplex leptocarpa F.Muell.	Slender-fruit Saltbush			
Atriplex limbata Benth.	Spreading Saltbush			
Atriplex lindleyi Moq. ssp. *inflata* (F.Muell.)Paul G.Wilson	Corky Saltbush			
Atriplex lindleyi Moq. ssp. *lindleyi*	Baldoo			
Atriplex nummularia Lindl. ssp. *nummularia*	Old-man Saltbush			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW ActStatus
Atriplex paludosa R.Br. ssp.*cordata* (Benth.)Aellen	Marsh Saltbush			
Atriplex papillata J.H.Willis Coral	Saltbush			E
Atriplex prostrata Boucher ex DC.	Creeping Saltbush			
Atriplex pseudocampanulata Aellen	Spreading Saltbush			
Atriplex pumilio R.Br.	Mat Saltbush			
Atriplex rhagodioides F.Muell.	River Saltbush			
Atriplex semibaccata R.Br.	Berry Saltbush			
Atriplex spongiosa F.Muell.	Pop Saltbush			
Atriplex stipitata Benth.	Bitter Saltbush			
Atriplex suberecta I.Verd.	Lagoon Saltbush			
Atriplex velutinella F.Muell.	Sandhill Saltbush			
Atriplex vesicaria Heward ex Benth.	Bladder Saltbush			
Chenopodium album L.	Fat Hen			
**Chenopodium ambrosioides* L. var. *ambrosioides*	Mexican Tea			
Chenopodium auricomum Lindl.	Golden Goosefoot			
Chenopodium cristatum (F.Muell.)F.Muell.	Crested Goosefoot			
Chenopodium curvispicatum Paul G.Wilson	Cottony Goosefoot			
*Chenopodium desertorum (*J.M.Black)J.M.Black ssp. *desertorum*	Mallee Goosefoot			
Chenopodium desertorum (J.M.Black)J.M.Black ssp. *microphyllum* Paul G.Wilson	Frosted Goosefoot			
Chenopodium desertorum (J.M.Black)J.M.Black ssp. *rectum* Paul G.Wilson	Erect Goosefoot			
Chenopodium glaucum L.	Glaucous Goosefoot			
Chenopodium melanocarpum (J.M.Black)J.M.Black f. *melanocarpum*	Black-fruit Goosefoot			
Chenopodium multifidum L.	Scented Goosefoot			
**Chenopodium murale* L.	Nettle-leaf Goosefoot			
Chenopodium nitrariaceum (F.Muell.)F.Muell.ex Benth.	Nitre Goosefoot			
Chenopodium pumilio R.Br.	Clammy Goosefoot			
Chenopodium truncatum Paul G.Wilson				
Dissocarpus biflorus F.Muell. var. *biflorus*	Two-horn Saltbush			
*Dissocarpus latifolius (*J.M.Black)	Paul G.Wilson			
Dissocarpus paradoxus (R.Br.)F.Muell. ex Ulbr.	Ball Bindyi			
Dysphania glomulifera (Nees)Paul G.Wilson ssp. *glomulifera*	Globular Crumbweed			
Dysphania platycarpa Paul G.Wilson	Flat-fruit Crumbweed			
Einadia nutans (R.Br.)A.J.Scott ssp. *nutans*	Climbing Saltbush			
Einadia nutans (R.Br.)A.J.Scott ssp. *oxycarpa (*Gauba)Paul G.Wilson	Pointed-fruit Climbing Saltbush			
Enchylaena tomentosa R.Br. var. *tomentosa*	Ruby Saltbush			
Eriochiton sclerolaenoides (F.Muell.)F.Muell. ex A.J.Scott	Woolly-fruit Bluebush			
*Halosarcia halocnemoides (*Nees)Paul G.Wilson ssp. *halocnemoides*	Grey Samphire			
*Halosarcia indica (*Willd.)Paul G.Wilson ssp. *bidens (*Nees)Paul G.Wilson	Brown-head Samphire			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Halosarcia indica (Willd.)Paul G.Wilson ssp. *leiostachya* (Benth.)Paul G.Wilson	Brown-head Samphire			
Halosarcia pergranulata (J.M.Black)Paul G.Wilson ssp. *divaricata* Paul G.Wilson	Black-seed Samphire			
Halosarcia pergranulata (J.M.Black)Paul G.Wilson ssp. *elongata* Paul G.Wilson	Black-seed Samphire			
Halosarcia pergranulata (J.M.Black)Paul G.Wilson ssp. *pergranulata*	Black-seed Samphire			
Halosarcia pruinosa (Paulsen)Paul G.Wilson	Bluish Samphire			
Halosarcia pterygosperma (J.M.Black)Paul G.Wilson ssp. *pterygosperma*	Winged-seed Samphire			
Halosarcia syncarpa Paul G.Wilson	Fused Samphire			
**Kochia scoparia* (L.)Schrad.		Y		
Maireana aphylla (R.Br.)Paul G.Wilson	Cotton-bush			
Maireana appressa Paul G.Wilson	Pale-fruit Bluebush			
Maireana astrotricha (L.A.S.Johnson)Paul G.Wilson	Low Bluebush			
Maireana brevifolia (R.Br.)Paul G.Wilson	Short-leaf Bluebush			
Maireana carnosa (Moq.)Paul G.Wilson	Cottony Bluebush			
Maireana ciliata (F.Muell.)Paul G.Wilson	Hairy Fissure-plant			
Maireana decalvans (Gand.)Paul G.Wilson	Black Cotton-bush			E
Maireana enchylaenoides (F.Muell.)Paul G.Wilson	Wingless Fissure-plant			
Maireana erioclada (Benth.)Paul G.Wilson	Rosy Bluebush			
Maireana excavata (J.M.Black)Paul G.Wilson	Bottle Fissure-plant			V
Maireana georgei (Diels)Paul G.Wilson S	atiny Bluebush			
*Maireana integra (*Paul G.Wilson)Paul G.Wilson	Entire-wing Bluebush			
Maireana lobiflora (F.Muell.ex Benth.)Paul G.Wilson	Lobed Bluebush			
Maireana oppositifolia (F.Muell.)Paul G.Wilson	Salt Bluebush			
Maireana ovata (Ising)Paul G.Wilson				
Maireana pentagona (R.H.Anderson)Paul G.Wilson	Slender Fissure-plant			R
Maireana pentatropis (Tate)Paul G.Wilson	Erect Mallee Bluebush			
Maireana pyramidata (Benth.)Paul G.Wilson	Black Bluebush			
Maireana radiata (Paul G.Wilson)Paul G.Wilson	Radiate Bluebush			
Maireana rohrlachii (Paul G.Wilson)Paul G.Wilson	Rohrlach's Bluebush			R
Maireana sedifolia (F.Muell.)Paul G.Wilson	Bluebush			
Maireana spongiocarpa (F.Muell.)Paul G.Wilson	Spongy-fruit Bluebush			
Maireana suaedifolia (Paul G.Wilson)Paul G.Wilson Lax	Bluebush			R
Maireana trichoptera (J.M.Black)Paul G.Wilson	Hairy-fruit Bluebush			
Maireana triptera (Benth.)Paul G.Wilson	Three-wing Bluebush			
Maireana turbinata Paul G.Wilson	Top-fruit Bluebush			
Malacocera tricornis (Benth.)R.H.Anderson	Goat-head Soft-horns			
*Osteocarpum acropterum (*F.Muell. & Tate)Volkens var. *acropterum*	Tuberculate Bonefruit			
*Osteocarpum acropterum (*F.Muell. & Tate)Volkens var. *deminutum (*J.M.Black)Paul G.Wilson	Wingless Bonefruit			R
Osteocarpum salsuginosum F.Muell.	Inland Bonefruit			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Pachycornia triandra (F.Muell.)J.M.	Black Desert Glasswort			
Rhagodia candolleana Moq. ssp. *candolleana*	Sea-berry Saltbush			
Rhagodia crassifolia R.Br.	Fleshy Saltbush			
Rhagodia parabolica R.Br.	Mealy Saltbush			
Rhagodia preissii Moq. ssp. *preissii*	Mallee Saltbush			
Rhagodia spinescens R.Br.	Spiny Saltbush			
Rhagodia ulicina (Gand.)Paul G.Wilson	Intricate Saltbush			
Salsola kali L.	Buckbush			
Sarcocornia quinqueflora (Bunge ex Ung.-Sternb.)A.J.Scott	Beaded Samphire			
Scleroblitum atriplicinum (F.Muell.)Ulbr.	Starry Goosefoot			
Sclerolaena articulata (J.M.Black)A.J.Scott	Jointed Bindyi			
*Sclerolaena birchii (*F.Muell.)Domin	Galvanised Burr	Y		
Sclerolaena brachyptera (F.Muell.)S.W.L.Jacobs	Short-wing Bindyi			
Sclerolaena brevifolia (Ising)A.J.Scott	Small-leaf Bindyi			
Sclerolaena constricta (Ising)A.J.Scott				
Sclerolaena convexula (R.H.Anderson)A.J.Scott	Tall Bindyi			
Sclerolaena cuneata Paul G.Wilson	Tangled Bindyi			
Sclerolaena decurrens (J.M.Black)A.J.Scott	Green Bindyi			
Sclerolaena diacantha (Nees)Benth.	Grey Bindyi			
Sclerolaena divaricata (R.Br.)Sm.	Tangled Bindyi			
Sclerolaena glabra (F.Muell.)Domin				
Sclerolaena holtiana (Ising)A.J.Scott	Holt's Bindyi			R
Sclerolaena intricata (R.H.Anderson)A.J.Scott	Tangled Bindyi			
Sclerolaena limbata (J.M.Black)Ulbr.	Pearl Bindyi			
Sclerolaena muricata (Moq.)Domin var. *muricata*	Five-spine Bindyi			
Sclerolaena muricata (Moq.)Domin var. *semiglabra* (Ising)A.J.Scott	Five-spine Bindyi			
Sclerolaena muricata (Moq.)Domin var. *villosa* (Benth.)Ulbr.	Five-spine Bindyi			R
Sclerolaena obliquicuspis (R.H.Anderson)Ulbr.	Oblique-spined Bindyi			
Sclerolaena parviflora (R.H.Anderson)A.J.Scott	Small-flower Bindyi			
Sclerolaena patenticuspis (R.H.Anderson)Ulbr.	Spear-fruit Bindyi			
Sclerolaena stelligera (F.Muell.)S.W.L.Jacobs	Star Bindyi			
Sclerolaena tricuspis (F.Muell.)Ulbr.	Three-spine Bindyi			
Sclerolaena uniflora R.Br.	Small-spine Bindyi			
Sclerostegia tenuis (Benth.)Paul G.Wilson	Slender Samphire			
Suaeda australis (R.Br.)Moq.	Austral Seablite			
Threlkeldia diffusa R.Br.	Coast Bonefruit			
AMARANTHACEAE				
Alternanthera denticulata R.Br.	Lesser Joyweed			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Alternanthera nana R.Br.	Hairy Joyweed			
Alternanthera nodiflora R.Br.	Common Joyweed			
**Alternanthera pungens* Kunth	Khaki Weed	Y		
**Amaranthus albus* L.	Stiff Tumbleweed			
**Amaranthus caudatus* L.	Love-lies-bleeding			
Amaranthus grandiflorus (J.M.Black)J.M.Black	Large-flower Amaranth			
Amaranthus macrocarpus Benth. var. *macrocarpus*				
**Amaranthus muricatus* (Moq.)Hieron.	Rough-fruit Amaranth			
**Amaranthus retroflexus* L.	Red-root Amaranth			
**Amaranthus viridis* L.	Green Amaranth			
**Gomphrena celosioides* Mart.				
**Guilleminea densa* (Humb. & Bonpl. ex Schult.)Moq.	Small Matweed			
Hemichroa pentandra R.Br.	Trailing Hemichroa			
Ptilotus erubescens Schltdl.	Hairy-tails			R
Ptilotus exaltatus Nees var. *exaltatus*	Pink Mulla Mulla			
Ptilotus gaudichaudii (Steud.)J.M.Black var. *parviflorus* (Benth.)Benl	Paper Fox-tail			
Ptilotus nobilis (Lindl.)F.Muell. var.*nobilis*	Yellow-tails			
Ptilotus obovatus (Gaudich.)F.Muell. var. *obovatus*	Silver Mulla Mulla			
Ptilotus polystachyus (Gaudich.)F.Muell. var. *polystachyus*	Long-tails			
Ptilotus seminudus (J.M.Black)J.M.Black	Rabbit-tails			
Ptilotus sessilifolius (Lindl.)Benl var. *sessilifolius*	Crimson-tails			
Ptilotus spathulatus (R.Br.)Poir. f. *spathulatus*	Pussy-tails			
CACTACEAE				
**Austrocylindropuntia cylindrica (*Lam.)Backeb.		Y		
**Austrocylindropuntia subulata* (Muehlenpf.)Backeb.	Eve's-pin Cactus	Y		
**Cylindropuntia imbricata* (Haw.)F.M.Knuth	Devil's Rope Pear	Y		
**Cylindropuntia leptocaulis* (DC.)F.M.Knuth		Y		
**Cylindropuntia tunicata* (Lehm.)F.M.Knuth		Y		
**Opuntia elata* Salm-Dyck		Y		
**Opuntia elatior* Mill.		Y		
**Opuntia engelmannii* Salm-Dyck ex Engelm.		Y		
**Opuntia ficus-indica* (L.)Mill.	Indian Fig	Y		
**Opuntia linguiformis* Griffiths		Y		
**Opuntia microdasys* (Lehm.)Pfeiff.	Bunny-ears	Y		
**Opuntia monacantha* Haw.		Y		
**Opuntia paraguayensis* K.Schum.	Riverina Pear	Y		
**Opuntia polyacantha* Haw.		Y		
**Opuntia stricta* (Haw.)Haw.	Erect Prickly Pear	Y		

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**Opuntia tomentosa* Salm-Dyck	Velvet Pear	Y		
LAURACEAE				
Cassytha glabella R.Br. f. *dispar* (Schltdl.)J.Z.Weber	Slender Dodder-laurel			
Cassytha melantha R.Br.	Coarse Dodder-laurel			
Cassytha pubescens R.Br.	Downy Dodder-laurel			
RANUNCULACEAE				
**Adonis microcarpa* DC.	Pheasant's Eye	Y		
**Batrachium trichophyllum* (Chaix)Bosch	Water Buttercup			
**Clematis flammula* L.				
Clematis microphylla DC. var. *microphylla*	Old Man's beard			
Myosurus minimus L. var. *australis* (F.Muell.)Huth	Mousetail			
Ranunculus amphitrichus Colenso S	mall River Buttercup			
Ranunculus inundatus R.Br. ex DC	River Buttercup			R
Ranunculus lappaceus Sm.	Native Buttercup			
**Ranunculus muricatus* L.	Pricklefruit Buttercup			
Ranunculus pachycarpus B.G.Briggs	Thick-fruit Buttercup			
Ranunculus papulentus Melville	Large River Buttercup			V
Ranunculus pentandrus J.M.Black var. *platycarpus* (F.Muell.)H.Eichler	Smooth Buttercup			
Ranunculus pumilio R.Br. ex DC. var. *politus* Melville	Smooth-fruit Ferny Buttercup			V
Ranunculus pumilio R.Br. ex DC. var.*pumilio*	Ferny Buttercup			
**Ranunculus sceleratus* L. ssp. *sceleratus*	Celery Buttercup	Y		
Ranunculus sessiliflorus R.Br. ex DC. var. *pilulifer* (Hook.)Melville	Annual Buttercup			V
Ranunculus sessiliflorus R.Br. ex DC. var. *sessiliflorus*	Annual Buttercup			
**Ranunculus trilobus* Desf.	Three-lobed Buttercup			
NYMPHAEACEAE				
**Nymphaea alba* L.	White Water-lily			
CERATOPHYLLACEAE				
Ceratophyllum demersum L.	Hornwort			R
DILLENIACEAE				
Hibbertia crinita Toelken				
Hibbertia sp. Glabriuscula (D.J.Whibley 9012) Toelken				
Hibbertia sericea (R.Br. ex DC.)Benth.	Silky Guinea-flower			
Hibbertia virgata R.Br. ex DC.	Twiggy Guinea-flower			
GUTTIFERAE				
Hypericum gramineum G.Forst.	Small St John's Wort			
Hypericum japonicum Thunb.	Matted St John's Wort			R
**Hypericum perforatum* L.	St John's Wort			
DROSERACEAE				

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Drosera auriculata Backh. ex Planch.	Tall Sundew			
Drosera glanduligera Lehm.	Scarlet Sundew			
Drosera macrantha Endl. ssp. *planchonii* (Hook.f. ex Planch.)N.G.Marchant	Climbing Sundew			
Drosera peltata Thunb.	Pale Sundew			
Drosera pygmaea DC.	Tiny Sundew			
Drosera whittakeri ssp. *whittakeri*	Scented Sundew			
PAPAVERACEAE				
**Eschscholzia californica* Cham.	Californian Poppy			
**Glaucium corniculatum* (L.)Rudolph	Horned Poppy			
**Papaver aculeatum* Thunb.	Bristle Poppy			
**Papaver dubium* L.	Long-headed Poppy			
**Papaver hybridum* L.	Rough Poppy			
**Papaver rhoeas* L.	Field Poppy			
**Papaver somniferum* L.	Small-flower Opium Poppy			
FUMARIACEAE				
**Fumaria bastardii* Boreau	Bastard Fumitory			
**Fumaria capreolata* L.	White-flower Fumitory			
**Fumaria densiflora* DC.	Dense Fumitory			
**Fumaria muralis* Sond. ex W.D.J.Koch ssp. *muralis*	Wall Fumitory			
**Fumaria officinalis* L. ssp. *officinalis*	Common Fumitory			
Fumaria parviflora Lam. var. *parviflora*	Small-flower Fumitory			
CRUCIFERAE				
**Alyssum linifolium* Stephan ex Willd.	Flax-leaf Alyssum			
Arabidella eremigena (F.Muell.)E.A.Shaw	Priddiwalkatji			
Arabidella filifolia (F.Muell.)E.A.Shaw	Thread-leaf Cress			
Arabidella nasturtium (F.Muell.)E.A.Shaw	Yellow Cress			
Arabidella procumbens (Tate)E.A.Shaw	Creeping Cress			
Arabidella trisecta (F.Muell.)O.E.Schulz	Shrubby Cress			
**Brassica elongata* Ehrh.				
**Brassica oleracea* L.	Cabbage			
**Brassica rapa* L. ssp. *oleifolia DC.*	Turnip Rape			
**Brassica tournefortii* Gouan	Wild Turnip			
**Brassica* X *napus* L.				
**Cakile maritima* Scop. ssp *.maritima*	Sea Rocket			
**Capsella bursapastoris* (L.)Medik.	Shepherd's Purse			
**Cardamine flexuosa* With.	Wood Bitter-cress			
Cardamine moirensis I.Thomps.				
**Carrichtera annua* (L.)DC.	Ward's Weed			

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**Diplotaxis muralis* (L.)DC. var. *muralis*	Wall Rocket			
**Diplotaxis tenuifolia* (L.)DC.	Lincoln Weed	Y		
**Erophila verna* (L.)Chevall. ssp. *praecox* (Steven)Walters	Whitlow Grass			
**Erophila verna* (L.)Chevall. ssp. *verna*	Whitlow Grass			
**Eruca sativa* Mill.	Purple-vein Rocket			
Geococcus pusillus J.L.Drumm. ex Harvey	Earth Cress			
Harmsiodoxa blennodioides (F.Muell.)O.E.Schulz	Hairy-pod Cress			
Harmsiodoxa brevipes (F.Muell.)O.E.Schulz var. *brevipes*	Short Cress			
**Hirschfeldia incana* (L.)Lagr.-Foss.	Hoary Mustard	Y		
**Hornungia procumbens* (L.)Hayek	Oval Purse			
Joycea clelandii (Vickery)H.P.Linder				
**Lepidium africanum* (Burm.f.)DC.	Common Peppercress			
**Lepidium bonariense* L.	Cut-leaf Peppercress			
**Lepidium didymum* L.				
**Lepidium draba* L.		Y		
Lepidium fasciculatum Thell.	Bundled Peppercress			
Lepidium hyssopifolium Desv.	Small Peppercress			
Lepidium leptopetalum (F.Muell.)F.Muell.	Shrubby Peppercress			
Lepidium monoplocoides F.Muell.	Winged Peppercress		E	E
Lepidium oxytrichum Sprague	Green Peppercress			
Lepidium papillosum F.Muell.	Warty Peppercress			
Lepidium phlebopetalum (F.Muell.)F.Muell.	Veined Peppercress			
Lepidium pseudohyssopifolium Hewson				
Lepidium pseudoruderale Thell.				R
Lepidium pseudotasmanicum Thell.	Shade Peppercress			V
Lepidium pubescens Desv.	Matted Peppercress			
Lepidium sagittulatum Thell.	Fine-leaf Peppercress			
**Lepidium strictum* (S.Watson)Rattan				
**Malcolmia flexuosa* (Sibth. & Sm.)Sibth. & Sm.				
Menkea australis Lehm.	Fairy Spectacles			
Microlepidium pilosulum F.Muell.	Hairy Shepherd's-purse			R
Pachymitus cardaminoides (F.Muell.)O.E.Schulz	Sand Cress			
Phlegmatospermum eremaeum (J.M.Black)E.A.Shaw	Spreading Cress			R
**Raphanus raphanistrum* L.	Wild Radish			
**Rapistrum rugosum* (L.)All. ssp. *rugosum*	Turnip Weed			
Rorippa eustylis (F.Muell.)L.A.S.Johnson	River Bitter-cress			
Rorippa laciniata (F.Muell.)L.A.S.Johnson	Jagged Bitter-cress			R
Rorippa nasturtium-aquaticum (L.)Hayek	Watercress			

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Rorippa palustris (L.)Besser	Yellow Marsh-cress			
**Rorippa sylvestris* (L.)Besser ssp. *sylvestris*	Creeping Yellow-cress			
**Sisymbrium erysimoides* Desf.	Smooth Mustard			
**Sisymbrium irio* L.	London Mustard			
**Sisymbrium officinale*	Hedge Mustard			
**Sisymbrium orientale*	Indian Hedge Mustard			
Stenopetalum lineare R.Br. ex DC.	Narrow Thread-petal			
Stenopetalum sphaerocarpum F.Muell.	Round-fruit Thread-petal			
RESEDACEAE				
**Reseda lutea* L. Cut-leaf Mignonette		Y		
**Reseda luteola* L.	Wild Mignonette			
CRASSULACEAE				
**Cotyledon orbiculata* L. var. *oblonga* (Haw.)DC.	Cotyledon			
Crassula colligata Toelken ssp. *Colligate*				
Crassula colorata (Nees)Ostenf. var. *acuminata* (Reader)Toelken	Dense Crassula			
Crassula colorata (Nees)Ostenf. var. *colorata*	Dense Crassula			
Crassula decumbens Thunb. var. *decumbens*	Spreading Crassula			
Crassula helmsii (Kirk)Cockayne	Swamp Crassula			
**Crassula natans* Thunb. var. *minus (*Eckl. & Zeyh.)G.D.Rowley	Water Crassula			
Crassula peduncularis)	Purple Crassula			R
**Crassula tetragona* L. ssp. *robusta* (Toelken)Toelken	Crassula			
Crassula tetramera (Toelken)A.P.Druce & Sykes	Australian Stonecrop			
PITTOSPORACEAE				
Marianthus bignoniaceus F.Muell.	Orange Bell-climber			
Billardiera cymosa F.Muell.	Sweet Apple-berry			
Billardiera versicolor F.Muell. ex Klatt	Yellow-flower Apple-berry			
Bursaria spinosa Cav. ssp. *lasiophylla* (E.M.Benn.)L.Cayzer, Crisp & I.Telford	Downy Bursaria			
Bursaria spinosa Cav. ssp. *spinosa*	Sweet Bursaria			
Cheiranthera alternifolia E.M.Benn.	Hand-flower			
Pittosporum angustifolium Lodd.	Native Apricot			
ROSACEAE				
Acaena echinata Nees				
Acaena novae-zelandiae Kirk	Biddy-biddy			
Acaena ovina A.Cunn.	Downy Sheep‘s-burr			
*Aphanes australiana (*Rothm.)Rothm.	Australian Piert			
**Malus pumila* Mill.				
**Prunus armeniaca* L.	Apricot			
**Prunus cerasifera* Ehrh.	Cherry-plum			

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**Prunus persica* (L.)Batsch var. *nectarina* (R.Br.)Maxim.	Nectarine			
**Prunus persica* (L.)Batsch var. *persica*	Peach			
**Pyrus communis* L.	Pear			
**Rosa canina L.*	Dog Rose	Y		
**Rosa rubiginosa L.*	Sweet Briar	Y		
Rubus parvifolius L.	Native Raspberry			
**Rubus ulmifolius Schott* var. *anoplothyrsus* Sudre	Blackberry	Y		
**Sanguisorba minor* Scop. ssp. *muricata* Briq.	Sheep's Burnet			
LEGUMINOSAE				
Acacia acanthoclada F.Muell. ssp. *acanthoclada*	Harrow Wattle			
Acacia acinacea Lindl.	Wreath Wattle			
Acacia ancistrophylla C.R.P.Andrews var. *lissophylla* (J.M.Black)R.S.Cowan & Maslin	Hook-leaf Wattle			
Acacia aneura F.Muell. ex Benth. var. *aneura*	Mulga			
Acacia argyrophylla Hook.	Silver Mulga-bush			
Acacia beckleri Tindale	Beckler's Rock Wattle			
Acacia brachybotrya Benth.	Grey Mulga-bush			
Acacia burkittii F.Muell. ex Benth.	Pin-bush Wattle			
Acacia calamifolia Sweet ex Lindl.	Wallowa			
Acacia colletioides Benth.	Veined Wait-a-while			
Acacia continua Benth.	Thorn Wattle			
Acacia cupularis Domin	Cup Wattle			
Acacia dodonaeifolia (Pers.)Balb.	Hop-bush Wattle			R
Acacia euthycarpa (J.M.Black)J.M.Black				
Acacia farinosa Lindl.	Mealy Wattle			
Acacia glandulicarpa Reader	Hairy-pod Wattle			
Acacia hakeoides A.Cunn. ex Benth.	Hakea Wattle			
Acacia halliana Maslin	Hall's Wattle			
Acacia ligulata A.Cunn. ex Benth.	Umbrella Bush			E
Acacia lineata A.Cunn. ex G.Don	Streaked Wattle			R
Acacia loderi Maiden	Nealie			R
Acacia longifolia (Andrews)Willd. ssp. *sophorae* (Labill.)Court	Coastal Wattle			
Acacia melanoxylon R.Br.	Blackwood			
Acacia menzelii J.M.Black	Menzel's Wattle		V	V
Acacia microcarpa F.Muell.	Manna Wattle			
Acacia montana Benth.	Mallee Wattle			R
Acacia myrtifolia (Sm.)Willd. var. *myrtifolia*	Myrtle Wattle			
Acacia notabilis F.Muell.	Notable Wattle			
Acacia nyssophylla F.Muell.	Spine Bush			

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Acacia oswaldii F.Muell.	Umbrella Wattle			
Acacia paradoxa DC.	Kangaroo Thorn			
Acacia pendula A.Cunn. ex G.Don	Weeping Myall			V
Acacia pravifolia F.Muell.	Coil-pod Wattle			
Acacia pycnantha Benth.	Golden Wattle			
Acacia retinodes Schltdl. var. *retinodes*	Wirilda			
Acacia rhetinocarpa J.M.Black	Resin Wattle		V	V
Acacia rhigiophylla F.Muell. ex Benth.	Dagger-leaf Wattle			R
Acacia rigens A.Cunn. ex G.Don	Nealie			
Acacia rupicola F.Muell. ex Benth.	Rock Wattle			
Acacia salicina Lindl.	Willow Wattle			
**Acacia saligna* (Labill.)H.L.Wendl.	Golden Wreath Wattle			
Acacia sclerophylla Lindl. var. *sclerophylla*	Hard-leaf Wattle			
Acacia simmonsiana O'Leary & Maslin				R
Acacia spilleriana J.E.Br.	Spiller's Wattle			V
Acacia spinescens Benth.	Spiny Wattle			
Acacia stenophylla A.Cunn. ex Benth.	River Cooba			
Acacia Swamp (N.M.Smith 3022) O'Leary	Swamp Wattle			
Acacia trineura F.Muell.	Three-nerve Wattle			E
Acacia verniciflua A.Cunn.	Varnish Wattle			
Acacia verticillata (L'Her.)Willd. ssp. *ovoidea* (Benth.)Court	Prickly Moses			
Acacia victoriae Benth. ssp. *victoriae*	Elegant Wattle			
Acacia wilhelmiana F.Muell.	Dwarf Nealie			
Acacia X *grayana* J.H.Willis				
**Alhagi maurorum* Medik.	Camel Thorn			
Aotus subspinescens (Benth.)Crisp	Mallee Aotus			
**Astragalus sesameus* L.	Purple Milk-vetch			
Bossiaea prostrata R.Br.	Creeping Bossiaea			
Bossiaea walkeri F.Muell.	Cactus Pea			
**Caesalpinia gilliesii* (Wall. ex Hook.)Benth.				
**Chamaecytisus palmensis* (H.Christ)F.A.Bisby & K.Nicholls	Tree Lucerne			
**Coronilla varia* L.				
Cullen australasicum (Schltdl.)J.W.Grimes	Tall Scurf-pea			
Cullen cinereum (Lindl.)J.W.Grimes	Annual Scurf-pea			
Cullen discolor (Domin)J.W.Grimes	Prostrate Scurf-pea			
Cullen pallidum (N.T.Burb.)J.W.Grimes	White Scurf-pea			
Cullen parvum (F.Muell.)J.W.Grimes				V
Daviesia arenaria Crisp	Sand Bitter-pea			

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Daviesia benthamii Meisn. ssp *.acanthoclona* (F.Muell.)Crisp	Dryland Bitter-pea			
Daviesia benthamii Meisn. ssp. *humilis* Crisp	Mallee Bitter-pea			R
Daviesia brevifolia Lindl.	Leafless Bitter-pea			
Daviesia leptophylla A.Cunn. ex G.Don	Narrow-leaf Bitter-pea			
Daviesia ulicifolia Andrews ssp. *aridicola* G.Chandler & Crisp	Gorse Bitter-pea			
Daviesia ulicifolia Andrews ssp. *incarnata* G.Chandler & Crisp	Gorse Bitter-pea			
Dillwynia hispida Lindl.	Red Parrot-pea			
Dillwynia sericea A.Cunn.	Showy Parrot-pea			
*Dillwynia uncinata (*Turcz.)J.M.Black	Silky Parrot-pea			
**Erythrina acanthocarpa* E.Mey.	Thorny Coral Tree			
Eutaxia diffusa F.Muell.	Large-leaf Eutaxia			
Eutaxia microphylla (R.Br.)C.H.Wright & Dewar	Common Eutaxia			
Glycine canescens F.J.Herm.	Silky Glycine			
Glycine rubiginosa Tindale & B.E.Pfeil				
Glycyrrhiza acanthocarpa (Lindl.)J.M.Black	Native Liquorice			
**Glycyrrhiza glabra* L.	Liquorice			
Gompholobium ecostatum Kuchel	Dwarf Wedge-pea			
Goodia medicaginea F.Muell.	Western Golden-tip			
Hardenbergia violacea (Schneev.)Stearn	Native Lilac			
Indigofera australis Willd. var *.australis*	Austral Indigo			
Kennedia prorepens (F.Muell.)F.Muell.	Desert Runner			
Kennedia prostrata R.Br.	Scarlet Runner			
Lotus australis Andrews	Austral Trefoil			
Lotus cruentus Court	Red-flower Lotus			
**Lotus preslii* Ten.				
**Medicago arabica* (L.)Huds.	Spotted Medic			
**Medicago italica* (Mill.)Fiori				
**Medicago laciniata* (L.)Mill.	Cut-leaf Medic			
**Medicago littoralis* Rohde ex Loisel.	Strand Medic			
**Medicago minima* (L.)Bartal. var. *minima*	Little Medic			
**Medicago polymorpha* L. var. *polymorpha*	Burr-medic			
**Medicago praecox* DC.	Small-leaf Burr-medic			
**Medicago rugosa* Desr.	Gamma Medic			
**Medicago sativa* L.	Lucerne			
**Medicago truncatula* Gaertn.	Barrel Medic			
**Melilotus albus* Medik.	Bokhara Clover			
**Melilotus indicus* (L.)All.	King Island Melilot			
Phyllota pleurandroides F.Muell.	Heathy Phyllota			

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Phyllota remota J.H.Willis	Slender Phyllota			
Platylobium obtusangulum Hook.	Holly Flat-pea			
Pultenaea daphnoides J.C.Wendl.	Large-leaf Bush Pea			
Pultenaea densifolia F.Muell.	Dense Bush-pea			
Pultenaea hispidula R.Br. ex Benth.	Rusty Bush-pea			
Pultenaea largiflorens F.Muell. ex Benth.	Twiggy Bush-pea			
Pultenaea pedunculata Hook.	Matted Bush-pea			
Pultenaea prostrata Benth. ex Hook.f.	Silky Bush-pea			
Pultenaea tenuifolia R.Br. & Sims	Narrow-leaf Bush-pea			
**Retama raetam* (Forssk.)Webb	White Weeping Broom			
**Robinia pseudoacacia* L.	Black Locust			
Senna artemisioides (Gaudich. ex DC.)Randell ssp. X *artemisioides*	Silver Senna			
Senna artemisioides (Gaudich. ex DC.)Randell ssp. X *coriacea* (Benth.)Randell	Desert Senna			
*Senna artemisioides (Gaudich. ex DC.)*Randell ssp. *filifolia* Randell	Desert Senna			
Senna artemisioides (Gaudich. ex DC.)Randell ssp. *petiolaris* Randell	Flat-stalk Senna			
Senna artemisioides (Gaudich. ex DC.)Randell ssp. *zygophylla (*Benth.)Randell	Twin-leaf Desert Senna			
Senna cardiosperma (F.Muell.)Randell ssp. *gawlerensis*	Randell Gawler Ranges Senna			
Sphaerolobium minus Labill. Leafless	Globe-pea			R
**Sutherlandia frutescens* (L.)R.Br.	Bladder Senna			
Swainsona behriana F.Muell. ex J.M.Black	Behr's Swainson-pea			V
Swainsona colutoides F.Muell.	Bladder Swainson-pea			
Swainsona greyana Lindl.	Darling Pea			
Swainsona lessertiifolia DC.	Coast Swainson-pea			
Swainsona microphylla A.Gray	Small-leaf Swainson-pea			
Swainsona oroboides F.Muell. ex Benth.	Variable Swainson-pea			
Swainsona oroboides F.Muell. ex Benth.	Dwarf Swainson-pea			
Swainsona purpurea (A.T.Lee)Joy Thomps.	Purple Swainson-pea			
Swainsona pyrophila Joy Thomps.	Yellow Swainson-pea		V	R
Swainsona reticulata J.M.Black				
Swainsona sericea (A.T.Lee)H.Eichler	Silky Swainson-pea			E
Swainsona stipularis F.Muell.	Orange Swainson-pea			
Swainsona tephrotricha F.Muell.	Ashy-haired Swainson-pea			R
Templetonia egena (F.Muell.)Benth.	Broombush Templetonia			
Templetonia stenophylla (F.Muell.)J.M.Black	Broombush Templetonia			
Templetonia sulcata (Meisn.)Benth.	Flat Mallee-pea			
**Trifolium angustifolium* L.	Narrow-leaf Clover			
**Trifolium arvense* L. var. *arvense*	Hare's-foot Clover			
**Trifolium campestre* Schreb.	Hop Clover			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
**Trifolium cernuum* Brot.	Drooping-flower Clover			
**Trifolium cherleri* L.	Cupped Clover			
**Trifolium dubium* Sibth.	Suckling Clover			
**Trifolium fragiferum* L. var. *fragiferum*	Strawberry Clover			
**Trifolium glomeratum* L.	Cluster Clover			
**Trifolium hirtum* All.	Rose Clover			
**Trifolium ornithopodioides* L.	Bird's-foot Trefoil			
**Trifolium repens* L.	White Clover			
**Trifolium scabrum* L.	Rough Clover			
**Trifolium striatum* L.	Knotted Clover			
**Trifolium subterraneum* L. S	ubterranean Clover			
**Trifolium tomentosum* L.	Woolly Clover			
Trigonella suavissima Lindl.	Sweet Fenugreek			
**Ulex europaeus* L.	Gorse	Y		
**Vicia monantha* Retz. ssp. *triflora (*Ten.)B.L.Burtt & P.Lewis	Spurred Vetch			
**Vicia sativa* L. ssp. *nigra* (L.)Ehrh.	Narrow-leaf Vetch			
OXALIDACEAE				
**Oxalis bowiei* Ait. ex G.Don Bowie	Wood-sorrel			
**Oxalis flava* L.	Finger-leaf Oxalis			
**Oxalis hirta* L.	Hairy Wood-sorrel			
Oxalis perennans Haw.	Native Sorrel			
**Oxalis pes-caprae* L.	Soursob	Y		
**Oxalis purpurea* L.	Downy Wood-sorrel			
Oxalis radicosa A.Rich.	Downy Native Sorrel			
Oxalis thompsoniae B.J.Conn & P.G.Richards				
GERANIACEAE				
**Erodium aureum* Carolin				
**Erodium botrys* (Cav.)Bertol.	Long Heron's-bill			
**Erodium brachycarpum* (Godr.)Thell.	Short-fruit Heron's-bill			
**Erodium cicutarium* (L.)L'Her. ex Aiton	Cut-leaf Heron's-bill			
Erodium crinitum Carolin	Blue Heron's-bill			
**Erodium moschatum* (L.)L'Her. ex Aiton	Musky Herons-bill			
**Geranium dissectum* L.	Cut-leaf Geranium			
**Geranium molle* L. var. *molle*	Soft Geranium			
Geranium potentilloides L'Her. ex DC. var. *potentilloides*	Downy Geranium			
Geranium retrorsum L'Her. ex DC.	Grassland Geranium			
Geranium solanderi Carolin var. *solanderi*	Austral Geranium			
Geranium sp. Linear segments (K.Preiss 128) W.R.Barker				R

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Pelargonium australe Willd.	Australian Pelargonium			
ZYGOPHYLLACEAE				
Nitraria billardierei DC.	Nitre-bush			
**Peganum harmala* L.	African Rue	Y		
Tribulus minutus Leichh. ex Benth.				
**Tribulus terrestris* L.	Caltrop	Y		
Zygophyllum ammophilum F.Muell.	Sand Twinleaf			
Zygophyllum angustifolium H.Eichler	Scrambling Twinleaf			
Zygophyllum apiculatum F.Muell.	Pointed Twinleaf			
Zygophyllum aurantiacum (Lindl.)F.Muell. ssp. *simplicifolium* H.Eichler ex R.M.Barker				
Zygophyllum aurantiacum (Lindl.)F.Muell. ssp. *aurantiacum*	Shrubby Twinleaf			
Zygophyllum compressum J.M.Black	Rabbit-ears Twinleaf			
Zygophyllum confluens H.Eichler	Forked Twinleaf			
Zygophyllum crenatum F.Muell.	Notched Twinleaf			
Zygophyllum eremaeum (Diels)Ostenf.	Pale-flower Twinleaf			
Zygophyllum glaucum F.Muell.	Pale Twinleaf			
Zygophyllum iodocarpum F.Muell.	Violet Twinleaf			
Zygophyllum ovatum Ewart & Jean White	Dwarf Twinleaf			
Zygophyllum simile H.Eichler	White Twinleaf			
LINACEAE				
Linum marginale A.Cunn.	Native Flax			
EUPHORBIACEAE				
Adriana quadripartita (Labill.)Mull.Arg.	Coast Bitter-bush			
Adriana tomentosa Gaudich. var. *hookeri* (F.Muell.)C.L.Gross & M.A.Whalen	Rare Bitter-bush			
Bertya tasmanica (Sond. & F.Muell.)Mull.Arg. ssp. *vestita* Halford & R.J.F.Hend.	Mitchell's Bertya			
Bertya tasmanica (Sond. & F.Muell.)Mull.Arg. ssp *.vestita* Halford & R.J.F.Hend.				
Beyeria lechenaultii (DC.)Baill.	Pale Turpentine Bush			
Beyeria opaca F.Muell.	Dark Turpentine Bush			
Chamaesyce australis (Boiss.)D.C.Hassall				
Chamaesyce dallachyana (Boiss.)D.C.Hassall				
Chamaesyce drummondii (Boiss.)D.C.Hassall				
**Eremocarpus setigerus* (Hook.)Benth.	Doveweed			
**Euphorbia dendroides* L.	Tree Spurge			
Euphorbia parvicaruncula D.C.Hassall	Tree Spurge			
**Euphorbia peplus* L.	Petty Spurge			
Euphorbia tannensis Spreng. ssp *.eremophila* (A.Cunn.)D.C.Hassall	Desert Spurge			
**Euphorbia terracina* L.	False Caper	Y		
Phyllanthus fuernrohrii F.Muell.	Sand Spurge			

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Phyllanthus lacunarius F.Muell.	Lagoon Spurge			
Phyllanthus lacunellus Airy Shaw				
Phyllanthus maderaspatensis L. var. *angustifolius* Benth.				
Phyllanthus saxosus F.Muell.	Rock Spurge			
Poranthera microphylla Brongn.	Small Poranthera			
Poranthera triandra J.M.Black	Three-petal Poranthera			
**Ricinus communis* L.	Castor Oil Plant			
Sauropus rigens (F.Muell.)Airy Shaw	Stiff Spurge			
Sauropus trachyspermus (F.Muell.)Airy Shaw	Rough-seed Spurge			
RUTACEAE				
Boronia coerulescens F.Muell. ssp. *Coerulescens*	Blue Boronia			
Boronia edwardsii Benth.	Edwards' Boronia			
Boronia inornata Turcz. ssp. *leptophylla* (Turcz.)Burgman	Dryland Boronia			
Correa aemula (Lindl.)F.Muell.	Hairy Correa			R
Correa glabra Lindl. var. *turnbullii* (Ashby) Paul G.Wilson	Rock Correa			
Correa reflexa (Labill.)Vent. var. *scabridula* Paul G.Wilson				
Philotheca angustifolia (Paul G.Wilson)Paul G.Wilson ssp. *angustifolia*	Narrow-leaf Wax-flower			R
Philotheca pungens (Lindl.)Paul G.	Wilson Prickly Wax-flower			
Geijera linearifolia (DC.)J.M.Black	Sheep Bush			
Geijera parviflora Lindl.	Wilga			R
Leionema microphyllum (F.Muell.)Paul G.Wilson	Limestone Phebalium			R
Microcybe multiflora Turcz. ssp. *baccharoides* (F.Muell.)Paul G.Wilson	Scale-leaf Microcybe			
Microcybe multiflora Turcz. ssp. *multiflora*	Small-leaf Microcybe			
Microcybe pauciflora Turcz. ssp. *pauciflora*	Yellow Microcybe			
Phebalium bullatum J.M.Black	Silvery Phebalium			
Zieria veronicea (F.Muell.)Benth. ssp. *veronicea*	Pink Zieria			R
MELIACEAE				
**Melia azedarach* L. var. *australasica* (A.Juss.)C.DC.	White Cedar			
TREMANDRACEAE				
Tetratheca pilosa Labill. ssp. *pilosa*	Hairy Pink-bells			
POLYGALACEAE				
Comesperma calymega Labill.	Blue-spike Milkwort			
Comesperma polygaloides F.Muell.	Mauve Milkwort			
Comesperma scoparium J.Drumm.	Broom Milkwort			
Comesperma volubile Labill.	Love Creeper			
ANACARDIACEAE				
**Schinus molle* L.	Pepper-tree			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Alectryon oleifolius (Desf.)S.T.Reynolds ssp. *canescens* S.T.Reynolds	Bullock Bush			
Dodonaea baueri Endl.	Crinkled Hop-bush			
Dodonaea bursariifolia F.Muell.	Small Hop-bush			
Dodonaea hexandra F.Muell.	Horned Hop-bush			
Dodonaea hexandra F.Muell. x *Dodonaea humilis* Endl.				
Dodonaea humilis Endl.	Dwarf Hop-bush			
Dodonaea lobulata F.Muell.	Lobed-leaf Hop-bush			
Dodonaea procumbens F.Muell.	Trailing Hopbush			V
Dodonaea stenozyga F.Muell.	Desert Hop-bush			
Dodonaea subglandulifera J.G.West			E	E
Dodonaea tepperi F.Muell. ex Tepper	Streaked Hop-bush			
Dodonaea viscosa Jacq. ssp. *angustissima* (DC.)J.G.West	Narrow-leaf Hop-bush			
Dodonaea viscosa Jacq. ssp. *cuneata* (Sm.)J.G.West	Wedge-leaf Hop-bush			
Dodonaea viscosa Jacq. ssp. *spatulata* (Sm.)J.G.West	Sticky Hop-bush			
STACKHOUSIACEAE				
Stackhousia annua W.R.Barker	Annual Candles			V
Stackhousia aspericocca Schuch. ssp. Cylindrical inflorescence (W.R.Barker 1418) *W.R.Barker*	Bushy Candles			
Stackhousia aspericocca Schuch. ssp. One-sided inflorescence (W.R.Barker 697) W.R.Barker	One-sided Candles			
Stackhousia megaloptera F.Muell.	Dune Candles			
Stackhousia monogyna Labill.	Creamy Candles			
RHAMNACEAE				
Cryptandra propinqua A.Cunn. ex Fenzl	Silky Cryptandra			
Cryptandra sp. Floriferous (W.R.Barker 4131) W.R.Barker				
Cryptandra sp. Long hypanthium (C.R. Alcock 10626) W.R.Barker				R
Cryptandra tomentosa Lindl.	Heath Cryptandra			
Pomaderris obcordata Fenzl	Wedge-leaf Pomaderris			
Pomaderris paniculosa F.Muell. ex Reissek ssp *.paniculosa*	Mallee Pomaderris			
**Rhamnus alaternus* L.	Blowfly Bush			
Spyridium bifidum (F.Muell.)F.Muell. ex Benth. var. *bifidum*	Forked Spyridium			
Spyridium eriocephalum Fenzl var *.eriocephalum*	Heath Spyridium			
Spyridium parvifolium (Hook.)Benth. ex F.Muell.	Dusty Miller			
Spyridium phylicoides Reissek	Narrow-leaf Spyridium			
*Spyridium subochreatum (*F.Muell.)Reissek var. *laxiusculum* J.M.Black	Velvet Spyridium			
Spyridium subochreatum (F.Muell.)Reissek var. *subochreatum*	Velvet Spyridium			
*Stenanthemum leucophractum (*Schltdl.)Reissek	White Cryptandra			
Stenanthemum notiale Rye ssp. *Notiale*				
Trymalium wayae F.Muell. & Tate	Grey Trymalium			
MALVACEAE				

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
*Abutilon fraseri (*Hook.)Hook. ex Walp.	Dwarf Lantern-bush			
Abutilon malvaefolium (Benth.)J.M.Black	Scrambling Lantern-bush			
Abutilon otocarpum F.Muell.	Desert Lantern-bush			
Abutilon theophrasti Medik.	Swamp Lantern-bush			
**Alcea rosea* L.	Hollyhock			
Hibiscus krichauffianus F.Muell.	Velvet-leaf Hibiscus			
**Hibiscus trionum* L. var .*trionum*	Bladder Ketmia			
Lawrencia berthae (F.Muell.)Melville	Showy Lawrencia			R
Lawrencia glomerata Hook.	Clustered Lawrencia			
Lawrencia squamata Nees	Thorny Lawrencia			
Malva behriana Schltdl.	Australian Hollyhock			
**Malva dendromorpha* M.F.Ray	Tree Mallow			
**Malva parviflora* L.	Small-flower Marshmallow			
Malvastrum americanum (L.)Torr. var. *americanum*	Malvastrum			
**Malvella leprosa* (Ortega)Krapov.	Alkali Sida	Y		
**Modiola caroliniana* (L.)G.Don	Red-flowered Mallow			
**Pavonia hastata* Cav.	Pink Pavonia			
Radyera farragei (F.Muell.)Fryxell & S.H.Hashmi	Desert Rose Mallow			
Sida ammophila F.Muell. ex J.H. Willis	Sand Sida			
Sida corrugata Lindl. var.A (N.N.Donner 7573) : W.R.Barker				
Sida corrugata Lindl. var. *angustifolia* Benth.	Grassland Sida			
Sida corrugata Lindl. var. *corrugata*	Corrugated Sida			
Sida fibulifera Lindl.	Pin Sida			
Sida intricata F.Muell.	Twiggy Sida			
Sida petrophila F.Muell.	Rock Sida			
Sida sp. Paringa (R.Bates 13800) W.R.Barker				
Sida spodochroma F.Muell.				
Sida trichopoda F.Muell.	High Sida			
STERCULIACEAE				
**Brachychiton populneus* (Schott & Endl.)R.Br. ssp. *Populneus*				
Lasiopetalum baueri Steetz	Slender Velvet-bush			
Lasiopetalum behrii F.Muell.	Pink Velvet-bush			
Rulingia loxophylla F.Muell.	Pur-ar-purpa			
Thomasia petalocalyx F.Muell.	Paper-flower			
THYMELAEACEAE				
Pimelea flava R.Br. ssp. *dichotoma* (Schltdl.)Threlfall	Diosma Riceflower			
Pimelea glauca R.Br.	Smooth Riceflower			
Pimelea humilis R.Br.	Low Riceflower			

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Pimelea imbricata R.Br. var. *petraea* (Meisn.)Rye	Rock Woolly Riceflower			
Pimelea micrantha F.Muell. ex Meisn.	Silky Riceflower			
Pimelea microcephala R.Br. ssp. *microcephala*	Shrubby Riceflower			
Pimelea octophylla R.Br.	Woolly Riceflower			
Pimelea phylicoides Meisn.	Heath Riceflower			
Pimelea serpyllifolia R.Br. ssp. *serpyllifolia*	Thyme Riceflower			
Pimelea simplex F.Muell. ssp. *continua* (J.M.Black)Threlfall	Desert Riceflower			
Pimelea simplex F.Muell. ssp. *Simplex*	Desert Riceflower			
Pimelea stricta Meisn.	Erect Riceflower			
Pimelea trichostachya Lindl.	Spiked Riceflower			
Pimelea williamsonii J.M.Black	Williamson's Riceflower			R
**Thymelaea passerina* (L.)Coss. & Germ.	Thymelaea			
VIOLACEAE				
*Hybanthus floribundus (*Lindl.)F.Muell. ssp. *floribundus*	Shrub Violet			
Hybanthus monopetalus (Schult.)Domin	Slender Violet			
Hymenanthera dentata R.Br. ex DC.	Tree Violet			
Viola eminens K.R.Thiele & Prober				
Viola sieberiana Spreng.	Tiny Violet			
TAMARICACEAE				
**Tamarix aphylla* (L.)H.Karst.	Athel Pine			
**Tamarix parviflora* DC.				
FRANKENIACEAE				
Frankenia foliosa J.M.Black	Leafy Sea-heath			
Frankenia pauciflora DC. var. *gunnii* Summerh.	Southern Sea-heath			
**Frankenia pulverulenta* L.	Mediterranean Sea-heath			
Frankenia serpyllifolia Lindl.	Thyme Sea-heath			
Frankenia sessilis Summerh.	Small-leaf Sea-heath			
ELATINACEAE				
Bergia trimera Fisch. & C.A.Mey.	Three-part Water-fire			
Elatine gratioloides A.Cunn.	Waterwort			R
CUCURBITACEAE				
**Citrullus colocynthis* (L.)Schrad.	Colocynth			
**Citrullus lanatus* (Thunb.)Matsum. & Nakai	Bitter Melon			
Cucumis melo L.	Ulcardo Melon			
**Cucumis myriocarpus* Naudin	Paddy Melon			
**Ecballium elaterium* (L.)A.Rich.	Squirting Cucumber			
Mukia micrantha (F.Muell.)F.Muell.	Desert Cucumber			
LYTHRACEAE				

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW ActStatus
Ammannia multiflora Roxb.	Jerry-jerry			
Lythrum hyssopifolia L.	Lesser Loosestrife			
Lythrum salicaria L.	Purple Loosestrife			R
MYRTACEAE				
Babingtonia behrii (Schltdl.)A.R.Bean	Silver Broombush			
Baeckea crassifolia Lindl.	Desert Baeckea			
Baeckea ericaea (F.Muell.)Benth.	Mat Baeckea			
Callistemon brachyandrus Lindl.	Prickly Bottlebrush			R
Callistemon rugulosus (D.F.K.Schltdl. ex Link)DC.	Scarlet Bottlebrush			
Callistemon sieberi DC.	River Bottlebrush			
Callistemon teretifolius F.Muell.	Needle Bottlebrush			
Calytrix alpestris (Lindl.)Court	Snow Heath-myrtle			
Calytrix involucrata J.M.Black	Cup Fringe-myrtle			
Calytrix tetragona Labill.	Common Fringe-myrtle			
Eucalyptus arenacea Marginson & Ladiges	Dune Stringybark			
Eucalyptus behriana F.Muell.	Broad-leaf Box			R
Eucalyptus brachycalyx Blakely	Gilja			
Eucalyptus calycogona Turcz. ssp. *trachybasis* D.Nicolle	Square-fruit Mallee			
Eucalyptus camaldulensis Dehnh. var. *camaldulensis*	River Red Gum			
Eucalyptus cyanophylla Brooker	Blue-leaf Mallee			
Eucalyptus diversifolia Bonpl. ssp. *diversifolia*	Coastal White Mallee			
Eucalyptus dumosa A.Cunn. ex Oxley	White Mallee			
Eucalyptus fasciculosa F.Muell.	Pink Gum			R
Eucalyptus gracilis F.Muell.	Yorrell			
Eucalyptus incrassata Labill.	Ridge-fruited Mallee			
Eucalyptus largiflorens F.Muell.	River Box			
Eucalyptus leptophylla F.Muell. ex Miq.	Narrow-leaf Red Mallee			
Eucalyptus leucoxylon F.Muell. ssp. *leucoxylon*	South Australian Blue Gum			
Eucalyptus leucoxylon F.Muell. ssp *pruinosa* (F.Muell. ex Miq.)Boland	Inland South Australian Blue Gum			
Eucalyptus leucoxylon F.Muell. ssp. *stephaniae Rule*	Scrubby Blue Gum			
Eucalyptus microcarpa (Maiden)Maiden	Grey Box			
Eucalyptus odorata Behr	Peppermint Box			
Eucalyptus oleosa F.Muell. ex Miq. ssp. *oleosa*	Red Mallee			
Eucalyptus phenax Brooker & Slee ssp *.phenax*				
Eucalyptus porosa F.Muell. ex Miq.	Mallee Box			
Eucalyptus rugosa R.Br. ex Blakely	Coastal White Mallee			
Eucalyptus socialis F.Muell. ex Miq. ssp. Glossy green (P.J.Lang 804) D.Nicolle				
Eucalyptus socialis F.Muell. ex Miq. ssp. *socialis*	Beaked Red Mallee			

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Eucalyptus viminalis Labill. ssp. *cygnetensis* Boomsma	Rough-bark Manna Gum			
Eucalyptus viridis R.T.Baker ssp. *wimmerensis* (Rule) Brooker & Slee				R
Eucalyptus yalatensis Boomsma	Yalata Mallee			
Kunzea pomifera F.Muell.	Muntries			
Leptospermum coriaceum (F.Muell. ex Miq.)Cheel	Dune Tea-tree			
Leptospermum lanigerum (Sol. ex Aiton)Sm.	Silky Tea-tree			
Leptospermum myrsinoides Schltdl.	Heath Tea-tree			
Melaleuca brevifolia Turcz.	Short-leaf Honey-myrtle			
Melaleuca halmaturorum F.Muell. ex Miq.	Swamp Paper-bark			
Melaleuca lanceolata Otto	Dryland Tea-tree			
Melaleuca pauperiflora F.Muell. ssp. *mutica* Barlow	Boree			
Melaleuca uncinata R.Br.	Broombush			
Melaleuca xerophila Barlow	Boree			
Micromyrtus ciliata (Sm.)Druce	Fringed Heath-myrtle			R
*Thryptomene calycina (*Lindl.)Stapf	Grampians Thryptomene			
ONAGRACEAE				
Epilobium billardierianum Ser. ssp. X *intermedium* P.H.Raven & Engelhorn	Variable Willow-herb			
Epilobium billardierianum Ser. ssp. *billardierianum*	Robust Willow-herb			
Epilobium hirtigerum A.Cunn.	Hairy Willow-herb			
Epilobium pallidiflorum Sol. ex A.Cunn.	Showy Willow-herb			
**Ludwigia peploides (*Kunth)P.H.Raven ssp. *montevidensis* (Spreng.)P.H.Raven	Water Primrose			
**Oenothera stricta* Ledeb. ex Link ssp. *stricta*	Common Evening Primrose			
HALORAGACEAE				
Glischrocaryon behrii (Schltdl.)Orchard	Golden Pennants			
Glischrocaryon flavescens (J.Drumm.)Orchard	Yellow Pennants			
Gonocarpus elatus (A.Cunn. ex Fenzl)Orchard	Hill Raspwort			
Gonocarpus tetragynus Labill.	Small-leaf Raspwort			
Haloragis acutangula F.Muell. f. *acutangula*	Smooth Raspwort			
Haloragis acutangula F.Muell. f *inflata* Orchard	Smooth Raspwort			
Haloragis acutangula F.Muell. f .*tetraptera* Orchard	Smooth Raspwort			
Haloragis acutangula F.Muell. f. *turbinata* Orchard	Smooth Raspwort			
Haloragis aspera Lindl.	Rough Raspwort			
Haloragis eichleri Orchard	Eichler's Raspwort			R
Haloragis glauca Lindl. f. *glauca*	Bluish Raspwort			
Haloragis heterophylla Brongn.	Variable Raspwort			
Haloragis odontocarpa F.Muell. f. *pterocarpa* Orchard	Mulga Nettle			
**Myriophyllum aquaticum* (Vell.)Verdc.				
Myriophyllum caput-medusae Orchard	Coarse Milfoil			

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Myriophyllum crispatum Orchard	Upright Milfoil			V
Myriophyllum integrifolium (Hook.f.)Hook.f.	Tiny Milfoil			R
Myriophyllum papillosum Orchard	Robust Milfoil			R
Myriophyllum simulans Orchard	Amphibious Milfoil			
Myriophyllum variifolium Hook.f.	Varied Milfoil			R
Myriophyllum verrucosum Lindl.	Red Milfoil			
UMBELLIFERAE				
**Ammi majus* L.	False Bishop's Weed			
Apium annuum P.S.Short	Annual Celery			
**Apium graveolens* L.	Celery			
Apium prostratum Labill. ex Vent. var. *filiforme* (A.Rich.)Kirk	Native Celery			
Apium prostratum Labill. ex Vent. var. *prostratum*	Native Celery			
**Berula erecta* (Huds.)Coville	Water Parsnip			
**Bupleurum semicompositum* L.	Hare's Ear			
Centella asiatica (L.)Urb.	Asian Centella			
**Ciclospermum leptophyllum* (Pers.)Sprague	Narrow-leaf Celery			
**Conium maculatum* L.	Hemlock			
**Coriandrum sativum* L.	Coriander			
**Daucus carota* L.	Carrot	Y		
**Foeniculum vulgare* Mill.	Fennel			
Hydrocotyle callicarpa Bunge	Tiny Pennywort			
Hydrocotyle capillaris F.Muell. ex Klatt	Thread Pennywort			
Hydrocotyle foveolata H.Eichler	Yellow Pennywort			
Hydrocotyle hirta R.Br. ex A.Rich.	Hairy Pennywort			
Hydrocotyle laxiflora DC.	Stinking Pennywort			
Hydrocotyle pilifera Turcz. var. *glabrata* Benth.	Buttercup Pennywort			
Hydrocotyle rugulosa Turcz.	Mallee Pennywort			
Hydrocotyle verticillata Thunb.	Shield Pennywort			
Lilaeopsis polyantha (Gand.)H.Eichler	Australian Lilaeopsis			
Trachymene anisocarpa (Turcz.)B.L.Burtt	Native Parsnip			R
Trachymene cyanopetala (F.Muell.)Benth.	Purple Trachymene			
Trachymene pilosa Sm.	Dwarf Trachymene			
Xanthosia huegelii (Benth.)Steud.				
Xanthosia leiophylla Klatt				
EPACRIDACEAE				
Acrotriche affinis DC.	Ridged Ground-berry			
Acrotriche cordata (Labill.)R.Br.	Blunt-leaf Ground-berry			
Acrotriche depressa R.Br.	Native Currant			

Species	Common name	Proclaimed Pest Plant	EPBC Act tatus	NPW Act Status
Acrotriche patula R.Br.	Prickly Ground-berry			
Acrotriche serrulata (Labill.)R.Br.	Cranberry Heath			
Brachyloma daphnoides (Sm.)Benth.	Daphne Heath			
Brachyloma ericoides (Schltdl.)Sond. ssp. *ericoides*	Brush Heath			
Leucopogon clelandii Cheel	Cleland's Beard-heath			R
Leucopogon cordifolius Lindl.	Heart-leaf Beard-heath			
Leucopogon costatus (F.Muell.)F.Muell.ex J.M.Black	Twiggy Beard-heath			
Leucopogon ericoides (Sm.)R.Br.	Pink Beard-heath			
Leucopogon rufus Lindl.	Ruddy Beard-heath			
Leucopogon virgatus (Labill.)R.Br. var. *virgatus*	Common Beard-heath			
Leucopogon woodsii F.Muell.	Nodding Beard-heath			
Lissanthe strigosa (Sm.)R.Br. ssp. *subulata* (R.Br.)J.M.Powell	Peach Heath			
Styphelia exarrhena (F.Muell.)F.Muell.	Desert Heath			
PRIMULACEAE				
**Anagallis minima* (L.)K.Krause	Chaffweed			
**Anchusa arvensis* (L.)M.Bieb.	Pimpernel			
**Asterolinon linum-stellatum (*L.)Duby	Asterolinon			
Samolus repens (J.R.Forst. & G.Forst.)Pers.	Creeping Brookweed			
LIMONIACEAE				
**Limonium binervosum (*G.E.Sm.)C.E.Salmon	Dwarf Sea-lavender			
**Limonium companyonis (*Gren. & Billot)Kuntze	Sea-lavender			
**Limonium hyblaeum* Brullo				
**Limonium lobatum* (L.f.)Kuntze	Winged Sea-lavender			
**Limonium myrianthum* (Schrenk)Kuntze				
**Limonium sinuatum* (L.)Mill.	Notch-leaf Sea-lavender			
OLEACEAE				
**Fraxinus angustifolia Vahl*	Desert Ash			
Jasminum didymum G.Forst. ssp.lineare (R.Br.) P.Green	Native Jasmine			
**Olea europaea* L. ssp. *europaea*	Olive	Y		
LOGANIACEAE				
Logania linifolia Schltdl.	Flax-leaf Logania			
Logania nuda F.Muell.	Leafless Logania			
Logania saxatilis G.Perry ex B.J.Conn	Rock Logania			R
Phyllangium distylis (F.Muell.)Dunlop				R
Phyllangium divergens (Hook.f.)Dunlop	Wiry Mitrewort			
BUDDLEJACEAE				
**Buddleja madagascariensis* Lam.	Summer Lilac			
GENTIANACEAE				

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
**Centaurium pulchellum* (Sw.)Druce				
**Centaurium spicatum* (L.)Fritsch ex Janch.	Spike Centaury			
**Centaurium tenuiflorum* (Hoffmanns. & Link)Fritsch	Branched Centaury			
**Cicendia filiformis* (L.)Delarbre	Slender Cicendia			
Sebaea ovata (Labill.)R.Br.	Yellow Sebaea			
MENYANTHACEAE				
**Nymphaea alba* L.	White Water-lily			
Nymphoides crenata (F.Muell.)Kuntze	Wavy Marshwort			R
Villarsia umbricola Aston var. *umbricola*	Lax Marsh-flower			
APOCYNACEAE				
Alyxia buxifolia R.Br.	Sea Box			
**Vinca major* L.	Blue Periwinkle			
ASCLEPIADACEAE				
**Gomphocarpus cancellatus* (Burm.f.)Bruyns	Broad-leaf Cotton-bush			
**Gomphocarpus fruticosus* (L.)W.T.Aiton	Narrow-leaf Cotton-bush			
Marsdenia australis (R.Br.)Druce	Native Pear			
Rhyncharrhena linearis (Decne.)K.L.Wilson	Climbing Purple-star			
Sarcostemma viminale (L.)R.Br. ssp. australe (R.Br.)P.I.Forst.	Caustic Bush			
RUBIACEAE				
Asperula conferta Hook.f.	Common Woodruff			
Asperula Gemella Airy Shaw & Turnill	Twin-leaf Bedstraw			
**Galium divaricatum Lam.*	Slender Bedstraw			
Galium gaudichaudii DC.	Rough Bedstraw			
Galium migrans Ehrend. & McGill.	Loose Bedstraw			
**Galium murale (*L.)All.	Small Bedstraw			
**Galium palustre* L.				
**Galium spurium* L. ssp. *ibicinum* (Boiss. & Hausskn. ex Boiss.)Ehrend.	Bedstraw			
Opercularia ovata Hook.f.	Broad-leaf Stinkweed			
Opercularia scabrida Schltdl.	Stalked Stinkweed			
Opercularia turpis F.Muell. ex Miq.	Twiggy Stinkweed			
**Sherardia arvensis* L.	Field Madder			
CONVOLVULACEAE				
Calystegia sepium (L.)R.Br.	Large Bindweed			
Convolvulus angustissimus R.Br. ssp. *angustissimus*				
Convolvulus angustissimus R.Br. ssp. *peninsularum* R.W.Johnson				
Convolvulus clementii Domin				
Convolvulus crispifolius F.Muell.				
Convolvulus eyreanus R.W.Johnson	Silver Bindweed			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Convolvulus microsepalus R.W.Johnson	Small-flower Bindweed			
Convolvulus recurvatus R.W.Johnson ssp. *nullarborensis* R.W.Johnson				
Convolvulus recurvatus R.W.Johnson ssp. *Recurvatus*				
Convolvulus remotus R.Br.	Grassy Bindweed			
Cressa cretica L.	Rosinweed			
**Cuscuta campestris* Yunck.	Golden Dodder	Y		
**Cuscuta epithymum* (L.)L.	Lesser Dodder			
Dichondra repens J.R.Forst. & G.Forst.	Kidney Weed			
**Ipomoea indica (*Burm.)Merr.	Purple Morning-glory			
**Ipomoea pandurata* (L.)G.Mey.				
Merremia dissecta (Jacq.)Hallier f.				
Wilsonia rotundifolia Hook.	Round-leaf Wilsonia			
BORAGINACEAE				
**Amsinckia calycina* (Moris)Chater	Hairy Fiddle-neck	Y		
**Anchusa arvensis* (L.)M.Bieb.	Bugloss			
**Borago officinalis* L.	Borage			
**Buglossoides arvensis* (L.)I.M.Johnst.	Sheepweed			
Cynoglossum australe R.Br.	Australian Hound's-tongue			
**Echium italicum* L.	Italian Bugloss			
**Echium plantagineum* L.	Salvation Jane	Y		
**Eryngium campestre* L.	White Devil			
Eryngium plantagineum F.Muell.				
Eryngium vesiculosum Labill.	long Eryngium			R
Halgania andromedifolia Behr & F.Muell.	Scented Blue-flower			
Halgania cyanea Lindl.	Rough Blue-flower			
**Heliotropium amplexicaule* Vahl	Blue Heliotrope			
Heliotropium asperrimum R.Br.	Rough Heliotrope			
**Heliotropium curassavicum* L.	Smooth Heliotrope			
**Heliotropium europaeum* L.	Common Heliotrope			
**Heliotropium supinum* L.	Creeping Heliotrope			
Myosotis australis R.Br.	Austral Forget-me-not			
**Neatostema apulum* (L.)I.M.Johnst.	Hairy Sheepweed			
Omphalolappula concava (F.Muell.)Brand	Burr Stickseed			
*Plagiobothrys elachanthus (*F.Muell.)I.M.Johnst.	Hairy Forget-me-not			
Plagiobothrys plurisepaleus (F.Muell.)I.M.Johnst.	White Rochelia			
VERBENACEAE				
**Phyla canescens (*Kunth)Greene	Lippia			
**Verbena officinalis* L.	Common Verbena			

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**Verbena supina* L. var. *erecta* (Moldenke)Munir	Trailing Verbena			
**Verbena supina* L. var . *supina*	Trailing Verbena			
CHLOANTHACEAE				
Dicrastylis verticillata J.M.Black	Whorled Sand-sage			
CALLITRICHACEAE				
Callitriche sonderi Hegelm.	Matted Water Starwort			R
**Callitriche stagnalis* Scop.	Common Water Starwort			
Callitriche umbonata Hegelm.	Water Starwort			V
LABIATAE				
Ajuga australis R.Br. f.A (A.G.Spooner 9058) Toelken	Australian Bugle			
**Ajuga iva* (L.)Schreb.	Bugle			
**Lamium amplexicaule* L. var. *amplexicaule*	Deadnettle			
**Lavandula dentata* L.	French Lavender			
**Lavandula stoechas L.*	Topped Lavender			
Lycopus australis R.Br.	Australian Gipsywort			
**Marrubium vulgare* L.	Horehound	Y		
**Melissa officinalis* L.	Common Balm			
Mentha australis R.Br.	River Mint			
**Mentha pulegium* L.	Pennyroyal			
**Mentha X piperita* L. var.*citrata* (Ehrh.)Briq.	Lemon Mint			
**Mentha spicata* L. f.A (R.Bates 3655) Toelken				
**Mentha spicata* L. f.B (B.Copley 1119) Toelken				
Prostanthera aspalathoides A.Cunn. ex Benth.	Scarlet Mintbush			
Prostanthera behriana Schltdl.	Downy Mintbush			
Prostanthera chlorantha (F.Muell.)F.Muell. ex Benth.	Green Mintbush			R
Prostanthera eurybioides F.Muell.	Monarto Mintbush		E	E
Prostanthera serpyllifolia (R.Br.)Briq. ssp. *microphylla* (R.Br.)B.J.Conn	Small-leaf Mintbush			
Prostanthera striatiflora F.Muell.	Striated Mintbush			
**Salvia verbenaca* L. var. *verbenaca*	Wild Sage			
**Salvia verbenaca* L. var. *vernalis* Boiss.	Wild Sage			
Scutellaria humilis R.Br.	Dwarf Skullcap			R
**Stachys arvensis* (L.)L.	Stagger Weed			
Teucrium albicaule Toelken	Scurfy Germander			
Teucrium corymbosum R.Br.	Rock Germander			
Teucrium racemosum R.Br.	Grey Germander			
Teucrium sessiliflorum Benth.	Mallee Germander			
Westringia eremicola A.Cunn. ex Benth.	Slender Westringia			
Westringia rigida R.Br.	Stiff Westringia			

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SOLANACEAE				
**Cestrum parqui* L'Her.	Green Poison-berry			
Cyphanthera myosotidea (F.Muell.)Haegi	Small-leaf Ray-flower			
**Datura ferox* L.	Long-spine Thorn-apple			
**Datura inoxia* Mill.	Downy Thorn-apple			
**Datura stramonium* L.	Common Thorn-apple			
**Datura wrightii* Regel	Hairy Thorn-apple			
Duboisia hopwoodii (F.Muell.)F.Muell.	Pituri			
Grammosolen dixonii (F.Muell. & Tate)Haegi	Dixon's Ray-flower			
Lycium australe F.Muell.	Australian Boxthorn			
**Lycium ferocissimum* Miers	African Boxthorn	Y		
**Nicotiana glauca* Graham	Tree Tobacco			
Nicotiana goodspeedii H.-M.Wheeler	Small-flower Tobacco			
Nicotiana maritima H.-M.Wheeler	Coast Tobacco			
Nicotiana occidentalis H.-M.Wheeler ssp. *obliqua* N.T.Burb.	Western Tobacco			
Nicotiana velutina H.-M.Wheeler	Velvet Tobacco			
**Physalis viscosa* L.	Sticky Cape Gooseberry			
**Salpichroa origanifolia* (Lam.)Thell.	Pampas Lily-of-the-valley			
Solanum capsiciforme (Domin)G.T.S.Baylis	Capsicum Kangaroo-apple			
Solanum cleistogamum Symon	Shy Nightshade			
Solanum coactiliferum J.M.Black	Tomato-bush			
Solanum elaeagnifolium Cav.	Silver-leaf Nightshade	Y		
Solanum ellipticum R.Br.	Velvet Potato-bush			
Solanum esuriale Lindl.	Quena			
Solanum laciniatum Aiton	Cut-leaf Kangaroo-apple			
Solanum lacunarium F.Muell.	Lagoon Nightshade			
**Solanum linnaeanum* Hepper & P.-M.L.Jaeger	Apple Of Sodom			
**Solanum marginatum* L.f.	White-edged Nightshade			
**Solanum nigrum* L. Black	Nightshade			
Solanum opacum A.Braun & Bouche	Green-berry Nightshade			
Solanum petrophilum F.Muell.	Rock Nightshade			
**Solanum physalifolium Rusby var. nitidibaccatum* (Bitter)Edmonds				
**Solanum rostratum* Dunal	Buffalo Burr			
Solanum simile F.Muell.	Kangaroo Apple			
Solanum sturtianum F.Muell.	Sturt's Nightshade			
**Solanum triflorum* Nutt.	Three-flower Nightshade			
SCROPHULARIACEAE				
**Bartsia trixago* L.				

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Derwentia decorosa (F.Muell.)B.G.Briggs & Ehrend.	Showy Speedwell			R
**Dischisma capitatum* (Thunb.)Choisy	Wooly-head Dichisma			
Euphrasia collina R.Br. ssp. *osbornii* W.R.Barker	Osborn's Eyebright		E	E
Euphrasia collina R.Br. ssp. *tetragona* (R.Br.)W.R.Barker	Coast Eyebright			
Glossostigma cleistanthum W.R.Barker	Spoon Mud-mat			
Glossostigma diandrum (L.)Kuntze	Two-anther Mud-mat			
Glossostigma elatinoides (Benth.)Benth. ex Hook.f.	Small Mud-mat			R
Gratiola pedunculata R.Br.	Stalked brooklime			
Gratiola peruviana L.	Austral Brooklime			
Gratiola pumilo F.Muell.	Dwarf Brooklime			R
**Kickxia elatine* (L.)Dumort. ssp. *crinita* (Mabille)Greuter	Twining Toadflax			
Limosella australis R.Br.	Australian Mudwort			
Limosella curdieana F.Muell. var. *curdieana*	Large Mudwort			
Mimulus prostratus Benth.	Small Monkey-flower R			
Mimulus repens R.Br.	Creeping Monkey-flower			
**Parentucellia latifolia* (L.)Caruel	Red Bartsia			
**Parentucellia viscosa* (L.)Caruel	Yellow Bartsia			
Peplidium foecundum W.R.Barker	Dwarf Peplidium			
Stemodia florulenta W.R.Barker	Bluerod			
Verbascum virgatum Stokes	Twiggy Mullein			
**Veronica anagallis-aquatica* L.	Blue Water-speedwell			
**Veronica hederifolia* L.	Ivy-leaf Speedwell			
Veronica hillebrandii F.Muell.	Rigid Speedwell			
**Veronica peregrina* L. ssp. *xalapensis* (Kunth)Pennell	Wandering Speedwell			
**Zaluzianskya divaricata* (Thunb.)Walp.	Spreading Night-phlox			
MARTYNIACEAE				
**Proboscidea louisianica* (Mill.)Thell.	Purple-flower Devil's Claw			
OROBANCHACEAE				
Orobanche cernua Loefl. var. *australiana* (F.Muell. ex Tate)J.M.Black ex Beck	Australian Broomrape			R
Orobanche minor L.	Lesser Broomrape	Y		
Orobanche ramosa L.		Y		
LENTIBULARIACEAE				
Utricularia tenella R.Br.	Pink Bladderwort			
MYOPORACEAE				
Eremophila alternifolia R.Br.	Narrow-leaf Emubush			
Eremophila behriana (F.Muell.)F.Muell.	Rough Emubush			
Eremophila bignoniiflora (Benth.)F.Muell.	Bignonia Emubush			
Eremophila crassifolia (F.Muell.)F.Muell.	Thick-leaf Emubush			

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Eremophila deserti (A.Cunn. ex Benth.)Chinnock	Turkey-bush			
Eremophila divaricata (F.Muell.)F.Muell. ssp. *divaricata*	Spreading Emubush			
Eremophila gibbifolia (F.Muell.)F.Muell.	Coccid Emubush			R
Eremophila glabra (R.Br.)Ostenf. ssp. Glabra				
	Tar Bush			
Eremophila glabra (R.Br.)Ostenf. ssp.Murray (A.G.Spooner 14470) Chinnock	Small Tar Bush			
Eremophila longifolia (R.Br.)F.Muell.	Weeping Emubush			
Eremophila maculata (Ker Gawl.)F.Muell. ssp. *maculata*	Spotted Emubush			
Eremophila oppositifolia R.Br. ssp. *oppositifolia*	Opposite-leaved Emubush			
Eremophila polyclada (F.Muell.)F.Muell.	Twiggy Emubush			R
Eremophila scoparia (R.Br.)F.Muell.	Broom Emubush			
Eremophila serrulata (A.Cunn. ex A.DC.)Druce	Green Emubush			
Eremophila sp. Fallax (D.E.Symon 12311) Chinnock				
Eremophila sturtii R.Br.	Turpentine Bush			
Eremophila subfloccosa Benth. ssp. *Glandulosa* (R.Bates 32961) Chinnock				
Eremophila subfloccosa Benth. ssp. *Lanata* (R.Bates 33587) Chinnock				
Myoporum brevipes Benth.	Warty Boobialla			
Myoporum insulare R.Br.	Common Boobialla			
Myoporum montanum R.Br.	Native Myrtle			
Myoporum parvifolium R.Br	Creeping Boobialla			R
Myoporum platycarpum R.Br. ssp. *perbellum* Chinnock	Mallee Sandalwood			
Myoporum platycarpum R.Br. ssp. *platycarpum*	False Sandalwood			
Myoporum sp. Petiolatum (R.Taylor 484) Chinnock				
PLANTAGINACEAE				
**Plantago bellardii* All.	Hairy Plantain			
**Plantago coronopus* L. ssp. *commutata* (Guss.)Pilg.	Bucks-horn Plantain			
**Plantago coronopus* L. ssp. *coronopus*	Bucks-horn Plantain			
Plantago cunninghamii Decne.	Clay Plantain			
Plantago drummondii Decne.	Dark Plantain			
Plantago gaudichaudii Barneoud	Narrow-leaf Plantain			
Plantago hispida R.Br.	Hairy Plantain			
**Plantago lanceolata* L. var. *lanceolata*	Ribwort			
**Plantago major* L.	Greater Plantain			
**Plantago scabra* Moench	Rough Plantain			
Plantago sp. B (R.Bates 44765) Toelken	Little Plantain			
Plantago turrifera B.G.Briggs, Carolin & Pulley	Crowned Plantain			
Plantago varia R.Br.	Variable Plantain			
VALERIANACEAE				
**Valerianella discoidea* (L.)Loisel.	Lesser Corn-salad			

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DIPSACACEAE				
**Scabiosa atropurpurea* L.	Pincushion			
CAMPANULACEAE				
Isotoma petraea F.Muell.	Rock Isotome			
Lobelia alata Labill.	Angled Lobelia			
Lobelia gibbosa Labill.	Tall Lobelia			
Pratia concolor (R.Br.)Druce	Poison Pratia			R
Wahlenbergia communis Carolin	Tufted Bluebell			
Wahlenbergia fluminalis (J.M.Black)E.Wimm. ex H.Eichler	River Bluebell			
Wahlenbergia gracilenta Lothian	Annual Bluebell			
Wahlenbergia litticola P.J.Sm.	Coast Bluebell			
Wahlenbergia luteola P.J.Sm.	Yellow-wash Bluebell			
Wahlenbergia multicaulis Benth.	Tadgell's Bluebell			
Wahlenbergia stricta (R.Br.)Sweet ssp. *stricta*	Tall Bluebell			
Wahlenbergia tumidifructa P.J.Sm.	Swollen-fruit Bluebell			
GOODENIACEAE				
Dampiera dysantha (Benth.)Rajput & Carolin	Shrubby Dampiera			
Dampiera marifolia Benth.	Velvet Dampiera			
Dampiera rosmarinifolia Schltdl.	Rosemary Dampiera			
Goodenia albiflora Schltdl.	White Goodenia			
Goodenia blackiana Carolin	Native Primrose			
Goodenia fascicularis F.Muell. & Tate	Silky Goodenia			
Goodenia geniculata R.Br.	Bent Goodenia			
Goodenia glauca F.Muell.	Pale Goodenia			
Goodenia havilandii Maiden & Betche	Hill Goodenia			
Goodenia heteromera F.Muell.	Spreading Goodenia			R
Goodenia ovata Sm.	Hop Goodenia			
Goodenia pinnatifida Schltdl.	Cut-leaf Goodenia			
Goodenia pusilliflora F.Muell.	Small-flower Goodenia			
Goodenia robusta (Benth.)K.Krause	Woolly Goodenia			
Goodenia varia R.Br.	Sticky Goodenia			
Goodenia willisiana Carolin	Silver Goodenia			
Scaevola aemula R.Br.	Fairy Fanflower			
Scaevola albida (Sm.)Druce	Pale Fanflower			
*Scaevola calendulacea (*Andrews)Druce	Dune Fanflower			V
Scaevola depauperata R.Br.	Skeleton Fanflower			
Scaevola humilis R.Br.	Inland Fanflower			
Scaevola spinescens R.Br.	Spiny Fanflower			

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Selliera radicans Cav.	Shiny Swamp-mat			
Velleia arguta R.Br.	Toothed Velleia			
Velleia connata F.Muell.	Cup Velleia			
Velleia paradoxa R.Br.	Spur Velleia			
STYLIDIACEAE				
Levenhookia dubia Sond.	Hairy Stylewort			
Stylidium calcaratum R.Br.	Spurred Trigger-plant			
Stylidium graminifolium Sw. ex Willd.	Grass Trigger-plant			
Stylidium inundatum R.Br.	Hundreds and Thousands			
COMPOSITAE				
Acanthocladium dockeri F.Muell.	Spiny Everlasting		X	E
**Achillea millefolium* L.	Yarrow			
**Achillea tomentosa* L.	Woolly Yarrow			
**Acroptilon repens* (L.)DC.	Creeping Knapweed	Y		
Actinobole uliginosum (A.Gray)H.Eichler	Flannel Cudweed			
Allittia cardiocarpa (F.Muell.ex Benth.)P.S.Short				R
**Ambrosia psilostachya* DC.	Perennial Ragweed	Y		
Angianthus preissianus (Steetz)Benth.	Salt Angianthus			
Angianthus tomentosus J.C.Wendl.	Hairy Angianthus			
**Arctotheca calendula* (L.)Levyns	Cape Weed			
**Arctotis stoechadifolia* P.J.Bergius	White Arctotis			
Argentipallium blandowskianum (Steetz ex Sond.)Paul G.Wilson	Woolly Everlasting			
Argentipallium obtusifolium (F.Muell. & Sond. ex Sond.)Paul G.Wilson	Blunt Everlasting			
**Argyranthemum frutescens* (L.)Webb ex Sch.Bip. ssp. *foeniculaceum* (Pit. & Proust)Humphries	Teneriffe Daisy			
**Argyranthemum frutescens* (L.)Webb ex Sch.Bip. ssp. *frutescens*	Marguerite Daisy			
**Aster subulatus* Michx.	Aster-weed			
Asteridea athrixioides (Sond. & F.Muell.)Kroner f. *athrixioides*	Wirewort			
Asteridea athrixioides (Sond. & F.Muell.)Kroner f. *horripes* (J.M.Black)D.A.Cooke	Wirewort			
**Asteriscus spinosus* (L.)Sch.Bip.	Golden Pallensis			
**Bidens pilosa* L.	Cobbler's Pegs			
Blennospora drummondii A.Gray	Dwarf Button-flower			
Brachyscome basaltica F.Muell. var. *gracilis* Benth.	Swamp Daisy			R
Brachyscome ciliaris (Labill.)Less. var. *brachyglossa* Gauba	Rayless Variable-daisy			
Brachyscome ciliaris (Labill.)Less. var. *ciliaris*	Variable Daisy			
Brachyscome ciliaris (Labill.)Less. var. *lanuginosa* (Steetz)Benth.	Woolly Variable Daisy			
Brachyscome ciliaris (Labill.)Less. var. *subintegrifolia* G.L.R.Davis	Variable Daisy			R
Brachyscome debilis Sond.	Weak Daisy			
Brachyscome dentata Gaudich.	Lobe-seed Daisy			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Brachyscome exilis Sond.	Slender Daisy			
Brachyscome goniocarpa Sond. & F.Muell. ex Sond.	Dwarf Daisy			
Brachyscome graminea (Labill.)F.Muell.	Grass Daisy			R
Brachyscome lineariloba (DC.)Druce	Hard-head Daisy			
Brachyscome melanocarpa Sond. & F.Muell. ex Sond.	Black-seed Daisy			V
Brachyscome parvula Hook.f.	Coast Daisy			R
Brachyscome perpusilla (Steetz)J.M.Black	Tiny Daisy			
Brachyscome trachycarpa F.Muell.	Smooth Daisy			
Xerochrysum bracteatum (Vent.)Tzvelev	Golden Everlasting			
**Calendula arvensis* L.	Field Marigold			
**Calendula officinalis* L.	Garden Marigold			
Calotis cuneifolia R.Br.	Purple Burr-daisy			
Calotis cymbacantha F.Muell.	Showy Burr-daisy			
Calotis erinacea Steetz	Tangled Burr-daisy			
Calotis hispidula (F.Muell.)F.Muell.	Hairy Burr-daisy			
Calotis lappulacea Benth.	Yellow Burr-daisy			R
Calotis latiuscula F.Muell. & Tate	Leafy Burr-daisy			
Calotis scabiosifolia Sond & F.Meull ex Sond. var. *scabiosifolia*	Rough Burr-daisy			
Calotis scapigera Hook.	Tufted Burr-daisy			R
**Carduus tenuiflorus* Curtis	Slender Thistle	Y		
**Carthamus lanatus L.*	Saffron Thistle			
Cassinia arcuata R.Br.	Drooping Cassinia			
Cassinia complanata J.M.Black				
Cassinia laevis R.Br.	Curry Bush			
**Centaurea calcitrapa* L.	Star Thistle			
**Centaurea eriophora* L.				
**Centaurea melitensis* L.	Malta Thistle			
**Centaurea nigrescens* Willd. ssp. *nigrescens*				
**Centaurea solstitialis* L.	St Barnaby's Thistle			
Centipeda crateriformis N.G.Walsh ssp. *compacta* N.G.Walsh				
Centipeda crateriformis N.G.Walsh ssp. *Crateriformis*				
Centipeda cunninghamii (DC.)A.Braun & Asch.	Common Sneezeweed			
Centipeda minima (L.)A.Braun & Asch. ssp. *minima*	Spreading Sneezeweed			
Centipeda nidiformis N.G.Walsh				
Centipeda pleiocephala N.G.Walsh				
Centipeda thespidioides F.Muell.	Desert Sneezeweed			
**Chondrilla juncea* L.	Skeleton Weed	Y		
**Chrysanthemoides monilifera* (L.)Norl.	Boneseed	Y		

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**Chrysanthemum coronarium* L.				
Chrysocephalum apiculatum (Labill.)Steetz	Common Everlasting			
Chrysocephalum baxteri (A.Cunn. ex DC.)Anderb.	White Everlasting			
Chrysocephalum semipapposum (Labill.)Steetz	Clustered Everlasting			
Chthonocephalus pseudevax Steetz	Ground-heads			
**Cichorium intybus* L.	Chicory			
**Cirsium vulgare* (Savi)Ten.	Spear Thistle	Y		
**Conyza albida* Willd. ex Spreng.	Tall Fleabane			
**Conyza bonariensis* (L.)Cronquist	Flax-leaf Fleabane			
Cotula australis (Sieber ex Spreng.)Hook.f.	Common Cotula			
**Cotula bipinnata* Thunb.	Ferny Cotula			
**Cotula coronopifolia* L.	Water Buttons			
Cotula vulgaris Levyns var. *australasica* J.H.Willis	Slender Cotula			
Craspedia haplorrhiza J.Everett & Doust				
Craspedia variabilis J.Everett & Doust				
Cratystylis conocephala (F.Muell.)S.Moore	Bluebush Daisy			
Cymbonotus preissianus Steetz	Austral Bear's-ear			
**Dittrichia graveolens* (L.)Greuter	Stinkweed			
Eclipta platyglossa F.Muell.	Yellow Twin-heads			
Elachanthus pusillus F.Muell.	Elachanth			
Epaltes australis Less.	Spreading Nut-heads			
Epaltes cunninghamii (Hook.)Benth.	Tall Nut-heads			
Eriochlamys behrii Sond. & F.Muell. ex Sond.	Woolly Mantle			
Erodiophyllum elderi F.Muell.	Koonamore Daisy			
Euchiton collinus Cass.	Creeping Cudweed			
Euchiton involucratus (G.Forst.)Holub	Star Cudweed			
Euchiton sphaericus (Willd.)Holub	Annual Cudweed			
**Euryops abrotanifolius (L.)DC.*	Euryops			
**Gamochaeta americana* (Mill.)Wedd.				
**Gazania linearis* (Thunb.)Druce	Gazania			
**Gazania rigens* (L.)Gaertn.	Gazania			
Gnaphalium indutum Hook.f.	Tiny Cudweed			
**Gnaphalium polycaulon* Pers.	Indian Cudweed			
Gnephosis arachnoidea Turcz.	Spidery Button-flower			
Gnephosis tenuissima Cass.	Dwarf Golden-tip			
Haegiela tatei (F.Muell.)P.S.Short & Paul G.Wilson	Small Nut-heads			R
**Hedypnois rhagadioloides* (L.)F.W.Schmidt	Cretan Weed			
**Helianthus annuus* L.	Sunflower			

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Helichrysum adenophorum F.Muell. var. *adenophorum*	Branched Everlasting			
Helichrysum leucopsideum DC.	Satin Everlasting			
Helichrysum rutidolepis DC.	Pale Everlasting			E
Helichrysum scorpioides Labill.	Button Everlasting			
**Helminthotheca echioides* (L.)Holub	Ox-tongue			
Hyalosperma demissum (A.Gray)Paul G.Wilson	Dwarf Sunray			
Hyalosperma glutinosum Steetz ssp. *glutinosum*	Golden Sunray			
Hyalosperma semisterile (F.Muell.)Paul G.Wilson	Orange Sunray			
Hyalosperma stoveae (D.A.Cooke)Paul G.Wilson	Dwarf Sunray			R
**Hypochaeris glabra* L.	Smooth Cat's Ear			
**Hypochaeris radicata* L.	Rough Cat's Ear			
Isoetopsis graminifolia Turcz.	Grass Cushion			
Ixodia achillaeoides R.Br. ssp. *alata* (Schltdl.)Copley	Hills Daisy			
Kippistia suaedifolia F.Muell.	Fleshy Kippistia			
**Lactuca saligna* L.	Willow-leaf Lettuce			
**Lactuca serriola* L.	Prickly Lettuce			
Lagenophora huegelii Benth.	Coarse Bottle-daisy			
Lemooria burkittii (Benth.)P.S.Short	Wires-and-wool			
Leiocarpa pluriseta (Haegi)Paul G.Wilson				R
Leiocarpa tomentosa (Sond. & F.Muell. ex Sond.)Paul G.Wilson	Woolly Plover-daisy			
Leiocarpa websteri (S.Moore)Paul G.Wilson				
Leinema microphyllum (F.Muell) Paul G. Wilson				
Leptorhynchos baileyi F.Muell.	Bailey's Buttons			
Leptorhynchos elongatus DC.	Lanky Buttons			R
Leptorhynchos squamatus (Labill.)Less. ssp. *squamatus*	Scaly Buttons			
Leptorhynchos tetrachaetus (Schltdl.)J.M.Black	Little Buttons			
Leptorhynchos waitzia Sond.	Button Immortelle			
Microseris lanceolata (Walp.)Sch.Bip.	Yam Daisy			
Millotia macrocarpa Schodde	Large-fruit Millotia			
Millotia muelleri (Sond.)P.S.Short	Common Bow-flower			
Millotia myosotidifolia (Benth.)Steetz	Broad-leaf Millotia			
Millotia perpusilla (Turcz.)P.S.Short	Tiny Bow-flower			
Millotia tenuifolia Cass. var. *nudescens* Schodde	Soft Millotia			
Millotia tenuifolia Cass. var. *tenuifolia*	Soft Millotia			
Minuria cunninghamii (DC.)Benth.	Bush Minuria			
Minuria denticulata (DC.)Benth.	Woolly Minuria			
Minuria integerrima (DC.)Benth.	Smooth Minuria			
Minuria leptophylla DC.	Minnie Daisy			

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Myriocephalus pluriflorus (J.M.Black)D.A.Cooke	Inland Woolly-heads			
Myriocephalus rhizocephalus (DC.)Benth. var *rhizocephalus*	Woolly-heads			
Olearia brachyphylla (F.Muell. ex Sond.)N.A.Wakef.	Short-leaf Daisy-bush			
Olearia calcarea F.Muell. ex Benth.	Crinkle-leaf Daisy-bush			
Olearia ciliata (Benth.)F.Muell. ex Benth. var .*ciliata*	Fringed Daisy-bush			
Olearia decurrens (DC.)Benth.	Winged Daisy-bush			
Olearia floribunda (Hook.f.)Benth. var. *floribunda*	Heath Daisy-bush			
Olearia lanuginosa (J.H.Willis)N.A.Wakef.	Woolly Daisy-bush			
Olearia lepidophylla (Pers.)Benth.	Clubmoss Daisy-bush			
Olearia magniflora (F.Muell.)F.Muell. ex Benth.	Splendid Daisy-bush			
Olearia minor (Benth.)Lander	Heath Daisy-bush			
Olearia muelleri (Sond.)Benth.	Mueller's Daisy-bush			
Olearia pannosa Hook. ssp. *pannosa*	Silver Daisy-bush		V	V
Olearia passerinoides (Turcz.)Benth. ssp. *glutescens* (Sond.)D.A.Cooke	Sticky Daisy-bush			R
Olearia passerinoides (Turcz.)Benth. ssp. *passerinoides*	Feather Daisy-bush			
Olearia picridifolia (F.Muell.)Benth.	Rasp Daisy-bush			R
Olearia pimeleoides (DC.)Benth. ssp. *pimeleoides*	Pimelea Daisy-bush			
Olearia rudis (Benth.)F.Muell. ex Benth.	Azure Daisy-bush			
Olearia subspicata (Hook.)Benth.	Spiked Daisy-bush			
Olearia teretifolia (Sond.)F.Muell. ex Benth.	Cypress Daisy-bush			
Olearia tubuliflora (Sond. & F.Muell. ex Sond.)Benth.	Rayless Daisy-bush			
**Onopordum acanthium* L.	Scotch Thistle			
**Onopordum acaulon* L.	Horse Thistle			
**Onopordum illyricum* L. ssp. *illyricum*	Illyrian Thistle			
**Osteospermum clandestinum* (Less.)Norl.	Tripteris			
Ozothamnus decurrens F.Muell.	Ridged Bush-everlasting			
Ozothamnus pholidotus F.Muell.	Scaly Haeckeria			V
Ozothamnus retusus Sond. & F.Muell	Notched Bush-everlasting			
**Picnomon acarna* (L.)Cass.	Soldier Thistle	Y		
Picris angustifolia DC spp. *angustifolia*	Coast Picris			
Picris squarrosa Steetz	Squat Picris			R
Pleuropappus phyllocalymmeus F.Muell.	Silver Candles			V
Podolepis canescens A.Cunn. ex DC.	Grey Copper-wire Daisy			
Podolepis capillaris (Steetz)Diels	Wiry Podolepis			
Podolepis jaceoides (Sims)W.Voss	Showy Copper-wire Daisy			R
Podolepis rugata Labill. var. *rugata*	Pleated Copper-wire Daisy			
Podolepis tepperi (F.Muell.)D.A.Cooke	Delicate Copper-wire Daisy			
Podotheca angustifolia (Labill.)Less.	Sticky Long-heads			

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Pogonolepis muelleriana (Sond.)P.S.Short	Stiff Cup-flower			
Polycalymma stuartii F.Muell.& Sond. ex Sond.	Poached-egg Daisy			
Pseudognaphalium luteoalbum (L.)Hilliard & B.L.Burtt	Jersey Cudweed			
Pterocaulon sphacelatum (Labill.)Benth. & Hook.f. ex F.Muell.	Apple-bush			
Pycnosorus globosus F.L.Bauer ex Benth.				V
Quinetia urvillei Cass.	Quinetia			
**Reichardia tingitana* (L.)Roth	False Sowthistle			
Rhodanthe corymbiflora (Schltdl.)Paul G.Wilson	Paper Everlasting			
Rhodanthe floribunda (DC.)Paul G.Wilson	White Everlasting			
Rhodanthe laevis (A.Gray)Paul G.Wilson	Smooth Daisy			
Rhodanthe microglossa (Maiden & Betche)Paul G.Wilson	Clustered Everlasting			
Rhodanthe moschata (A.Cunn. ex DC.)Benth.	Musk Daisy			
Rhodanthe polygalifolia (A.Cunn. ex DC.)Paul G.Wilson	Milkwort Everlasting			
Rhodanthe pygmaea (DC.)Paul G.Wilson	Pigmy Daisy			
Rhodanthe stricta (Lindl.)Paul G.Wilson	Slender Everlasting			
Rhodanthe stuartiana (Sond. & F.Muell. ex Sond.)Paul G.Wilson	Clay Everlasting			
Rhodanthe tietkensii (F.Muell.)Paul G.Wilson	Tietken's Daisy			
Rhodanthe uniflora (J.M.Black)Paul G.Wilson	Woolly Daisy			
Rutidosis helichrysoides DC. ssp. *helichrysoides*	Grey Wrinklewort			
Senecio anethifolius A.Cunn. ex DC. ssp. *anethifolius*	Feathery Groundsel			
**Senecio angulatus* L.	Cape Ivy			
Senecio behrianus Sond. & F.Muell. ex Sond. Behr's	Grounsel			E
Senecio cunninghamii DC. var. *cunninghamii*	Shrubby Groundsel			
Senecio dolichocephalus I.Thomps.				
**Senecio elegans* L.	Purple Grounsel			
Senecio glomeratus Desf. ex Poir. ssp. *longifructus* I.Thomps.	Swamp Groundsel			
Senecio glomeratus Desf. ex Poir. ssp. *glomeratus*	Swamp Groundsel			
Senecio glossanthus (Sond.)Belcher	Annual Groundsel			
Senecio gregorii F.Muell.	Fleshy Groundsel			
Senecio helichrysoides F.Muell.				E
Senecio hypoleucus F.Muell. ex Benth.	Pale Groundsel			
Senecio longicollaris I.Thomps.				
Senecio macrocarpus F.Muell. ex Belcher	Large-fruit Groundsel			V
Senecio magnificus F.Muell.	Showy Groundsel			
Senecio megaglossus F.Muell.	Superb Groundsel			E
Senecio odoratus Hornem.	Scented Goundsel			
Senecio phelleus I.Thomps.				
Senecio picridioides (Turcz.)M.E.Lawr.	Purple-leaf Groundsel			

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Senecio pilosicristus I.Thomps.				
Senecio pinnatifolius A.Rich.				
**Senecio pterophorus* DC. var. *pterophorus*	African Daisy			
Senecio quadridentatus Labill.	Cotton Groundsel			
Senecio runcinifolius J.H.Willis	Thistle-leaf Groundsel			
Senecio squarrosus A.Rich.	Squarrose Groundsel			
Siloxerus multiflorus Nees	Small Wrinklewort			
Solenogyne dominii L.G.Adams	Smooth Solenogyne			
**Solidago canadensis* L.	Golden Rod			
**Soliva anthemifolia* (Juss.)R.Br. ex Less.	Jo Jo			
**Soliva pterosperma* (Juss.)Less.	Jo-jo			
**Sonchus asper* (L.)Hill ssp. *asper*	Rough Sow-thistle			
Sonchus hydrophilus Boulos	Native Sow-thistle			
**Sonchus oleraceus* L.	Common Sow-thistle			
Stuartina muelleri Sond. Spoon	Cudweed			
**Tagetes minuta* L.	Stinking Roger			
**Taraxacum officinale* Weber	Red-seed Dandelion			
**Tolpis barbata* (L.)Gaertn.	Yellow Hawkweed			
**Tragopogon porrifolius* L.	Salsify			
Trichanthodium skirrophorum Sond. & F.Muell. ex Sond.	Woolly Yellow-heads			
Triptilodiscus pygmaeus Turcz.	Small Yellow-heads			
**Urospermum picroides* (L.)F.W.Schmidt	False Hawkbit			
**Vellereophyton dealbatum* (Thunb.)Hilliard & B.L.Burtt	White Cudweed			
**Verbesina encelioides* (Cav.)Benth. & Hook. ex A.Gray	Crownbeard			
Vittadinia australasica (Turcz.)N.T.Burb. var. *australasica*	Sticky New Holland Daisy			
Vittadinia australasica (Turcz.)N.T.Burb. var. *oricola* N.T.Burb.	New Holland Daisy			V
Vittadinia blackii N.T.Burb.	Narrow-leaf New Holland Daisy			
Vittadinia cervicularis N.T.Burb. var. *cervicularis*	Waisted New Holland Daisy			
Vittadinia condyloides N.T.Burb.	Club-hair New Holland Daisy			
Vittadinia cuneata DC. f. *cuneata*	Fuzzy New Holland Daisy			
Vittadinia cuneata DC. var. *morrisii* N.T.Burb.	New Holland Daisy			
Vittadinia cuneata DC. var. *murrayensis* N.T.Burb.	Murray New Holland Daisy			
Vittadinia dissecta (Benth.) N.T.Burb. var.*hirta* N.T.Burb.	Dissected New Holland Daisy			
Vittadinia eremaea N.T.Burb.	Desert New Holland Daisy			
Vittadinia gracilis (Hook.f.)N.T.Burb.	Woolly New Holland Daisy			
Vittadinia megacephala (F.Muell. ex Benth.)J.M.Black	Giant New Holland Daisy			
Waitzia acuminata Steetz var. *acuminata*	Orange Immortelle			
**Xanthium californicum* Greene	Californian Burr			

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**Xanthium occidentale* Bertol.	Noogoora Burr	Y		
**Xanthium spinosum* L.	Bathurst Burr	Y		
ALISMATACEAE				
**Alisma lanceolatum* With.	Water Plantain			
Damasonium minus (R.Br.)Buchenau	Star-fruit			
**Sagittaria platyphylla* (Engelm.)J.G.Sm.	Arrowhead			
HYDROCHARITACEAE				
Hydrilla verticillata (L.f.)Royle	Waterthyme			R
Ottelia ovalifolia (R.Br.)L.Rich. ssp. *ovalifolia*	Swamp Lily			R
Vallisneria americana Michx. var. *americana*	River Eel-grass			
JUNCAGINACEAE				
Triglochin hexagonum J.M.Black	Six-point Arrowgrass			
Triglochin mucronatum R.Br.	Prickly Arrowgrass			
Triglochin nanum F.Muell.				
Triglochin procerum R.Br.	Water-ribbons			
Triglochin sp. B (J.Z.Weber 1330) Aston				
Triglochin striatum Ruiz & Pav.	Streaked Arrowgrass			
POTAMOGETONACEAE				
Potamogeton crispus L.	Curly Pondweed			
Potamogeton ochreatus Raoul	Blunt Pondweed			R
Potamogeton pectinatus L.	Fennel Pondweed			
Potamogeton tepperi A.Benn.	Tepper's Pondweed			
Potamogeton tricarinatus F.Muell. & A.Benn. ex A.Benn.	Floating Pondweed			
Ruppia maritima L.	Widgeon Grass			
Ruppia megacarpa R.Mason	Widgeon Grass			
Ruppia polycarpa R.Mason	Widgeon Grass			
ZANNICHELLIACEAE				
Lepilaena australis J.Drumm. ex Harvey	Austral Water-mat			
Lepilaena bilocularis Kirk	Small-fruit Water-mat			
Zannichellia palustris L.				R
NAJADACEAE				
Najas tenuifolia R.Br.	Water Nymph			E
LILIACEAE				
**Allium triquetrum* L.	Three-cornered Garlic	Y		
Arthropodium minus R.Br.	Small Vanilla-lily			
Arthropodium strictum R.Br.	Common Vanilla-lily			
**Asparagus asparagoides* (L.)Druce	Bridal Creeper	Y		
**Asparagus officinalis* L.	Asparagus			

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**Asparagus plumosus* Baker				
**Asphodelus fistulosus* L.	Onion Weed	Y		
Bulbine bulbosa (R.Br.)Haw.	Bulbine-lily			
Bulbine semibarbata (R.Br.)Haw.	Small Leek-lily			
Burchardia umbellata R.Br.	Milkmaids			
Caesia calliantha R.J.F.Hend.	Blue Grass-lily			
Corynotheca licrota R.J.F.Hend.	Sand Lily			R
Dianella brevicaulis (Ostenf.)G.W.Carr & P.F.	Horsfall Short-stem Flax-lily			
Dianella longifolia R.Br. var. *grandis* R.J.F.Hend.	Pale Flax-lily			R
Dianella porracea (R.J.F.Hend.)P.F.Horsfall & G.W.Carr	Pale Flax-lily			V
Dianella revoluta R.Br. var. *revoluta*	Black-anther Flax-lily			
**Ipheion uniflorum* (Graham)Raf.	Spring Star-flower			
**Lachenalia aloides* (L.f.)Hort.	Lachenalia			
Laxmannia orientalis Keighery	Dwarf Wire-lily			
Lomandra collina (R.Br.)Ewart	Sand Mat-rush			
Lomandra densiflora J.M.Black	Soft Tussock Mat-rush			
Lomandra effusa (Lindl.)Ewart	Scented Mat-rush			
Lomandra fibrata J.M.Black	Mt Lofty Mat-rush			
Lomandra juncea (F.Muell.)Ewart	Desert Mat-rush			
Lomandra leucocephala (R.Br.)Ewart ssp. *robusta* A.T.Lee	Woolly Mat-rush			
Lomandra micrantha (Endl.)Ewart ssp. *micrantha* S	mall-flower Mat-rush			
Lomandra multiflora (R.Br.)Britten ssp. *dura* (F.Muell.)T.D.Macfarl.	Hard Mat-rush			
Lomandra nana (A.T.Lee)A.T.Lee	Small Mat-rush			
Lomandra sororia (F.Muell. ex Benth.)Ewart	Sword Mat-rush			
**Nothoscordum borbonicum* Kunth				
**Ornithogalum arabicum* L.	Star Of Africa			
**Ornithogalum umbellatum* L.				
Thysanotus baueri R.Br.	Mallee Fringe-lily			
Thysanotus juncifolius (Salisb.)J.H.Willis & Court	Rush Fringe-lily			
Thysanotus patersonii R.Br.	Twining Fringe-lily			
Tricoryne elatior R.Br.	Yellow Rush-lily			
Tricoryne tenella R.Br.	Tufted Yellow Rush-lily			
Wurmbea dioica (R.Br.)F.Muell. ssp. *dioica*	Early Nancy			
Wurmbea dioica (R.Br.)F.Muell. ssp. short upper leaf (S.Williams CBP23) R.J.Bates				
Xanthorrhoea caespitosa Bedford	Sand-heath Yacca			
Xanthorrhoea quadrangulata F.Muell.	Rock Grass-tree			
Xanthorrhoea semiplana F.Muell. ssp. *semiplana*	Yacca			
AGAVACEAE				

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**Agave americana L.*	Century Plant			
AMARYLLIDACEAE				
Calostemma luteum	Sims Yellow Garland-lily			
Calostemma purpureum R.Br.	Pink Garland-lily			
Crinum flaccidum Herb.	Murray Lily			
**Sternbergia lutea* (L.)Ker Gawl. ex Spreng. ssp. *lutea*	Autumn Crocus			
HYPOXIDACEAE				
Hypoxis glabella R.Br. var. *glabella*	Tiny Star			
Hypoxis vaginata Schltdl. var. *vaginata*	Yellow Star			
PONTEDERIACEAE				
**Eichhornia crassipes* (Mart.)Solms	Water Hyacinth	Y		
IRIDACEAE				
**Crocosmia* X *crocosmiiflora* (Lemoine ex E.Morren)N.E.Br.	Montbretia			
**Freesia* cultivar	Freesia			
**Gladiolus undulatus* L.	Wild Gladiolus			
**Iris albicans Lange*				
**Iris foetidissima* L.				
**Moraea flaccida* (Sweet)Steud.		Y		
**Moraea miniata* Andrews		Y		
**Moraea setifolia* (L.f.)Druce	Thread Iris			
Patersonia occidentalis R.Br.	Long Purple-flag			
**Romulea minutiflora* Klatt	Small-flower Onion-grass			
**Romulea rosea (*L.)Eckl. var. *australis* (Ewart)M.P.de Vos	Common Onion-grass			
**Sparaxis tricolor* (Schneev.)Ker Gawl.	Tricolor Harlequin Flower			
**Tritonia squalida* (Aiton)Ker Gawl.	Tritonia			
JUNCACEAE				
**Juncus acutus* L.	Sharp Rush			
Juncus aridicola L.A.S.Johnson	Inland Rush			
**Juncus articulatus* L.	Jointed Rush			
Juncus bufonius L.	Toad Rush			
Juncus caespiticius E.Mey.	Grassy Rush			
**Juncus capitatus* Weigel	Dwarf Rush			
Juncus flavidus L.A.S.Johnson	Yellow Rush			
Juncus holoschoenus R.Br.	Joint-leaf Rush			
Juncus homalocaulis F.Muell.ex Benth.	Wiry Rush			V
Juncus kraussii Hochst.	Sea Rush			
Juncus pallidus R.Br.	Pale Rush			
Juncus pauciflorus R.Br.	Loose-flower Rush			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Juncus planifolius R.Br.	Broad-leaf Rush			
Juncus prismatocarpus R.Br.	Branching Rush			E
Juncus sarophorus L.A.S.Johnson				
Juncus subsecundus N.A.Wakef.	Finger Rush			
Juncus usitatus L.A.S.Johnson	Common Rush			
Luzula meridionalis H.Nordensk.	Common Wood-rush			
Luzula ovata Edgar	Clustered Wood-rush			R
RESTIONACEAE				
Apodasmia brownii (Hook.f.)B.G.Briggs & L.A.S.Johnson	Coarse Twine-rush			
Hypolaena fastigiata R.Br.	Tassel Rope-rush			
Lepidobolus drapetocoleus F.Muell.	Scale Shedder			
Leptocarpus tenax (Labill.)R.Br.	Slender Twine-rush			
CENTROLEPIDACEAE				
Aphelia gracilis Sond.	Slender Aphelia			
Aphelia pumilio F.Muell.ex Sond.	Dwarf Aphelia			
Centrolepis aristata (R.Br.)Roem. & Schult.	Pointed Centrolepis			
Centrolepis cephaloformis Reader ssp. *cephaloformis*	Cushion Centrolepis			R
Centrolepis glabra (F.Muell.ex Sond.)Hieron.	Smooth Centrolepis			R
Centrolepis polygyna (R.Br.)Hieron.	Wiry Centrolepis			
Centrolepis strigosa (R.Br.)Roem. & Schult. ssp. *strigosa*	Hairy Centrolepis			
Trithuria submersa Hook.f.	Trithuria			
GRAMINEAE				
**Agrostis capillaris* L.	Brown Top-bent			
Agrostis venusta Trin.				
**Aira cupaniana* Guss.	Small Hair-grass			
**Aira elegantissima* Schur	Delicate Hair-grass			
**Alopecurus geniculatus* L.	Marsh Fox-tail			
**Alopecurus pratensis* L.	Meadow Fox-tail			
Amphibromus archeri (Hook.f.)P.Morris	Pointed Swamp Wallaby-grass			R
Amphibromus nervosus (Hook.f.)Baill.	Veined Swamp Wallaby-grass			
Amphipogon caricinus F.Muell. var. *caricinus*	Long Grey-beard Grass			
Amphipogon strictus R.Br. var. *setifer* Benth.	Spreading Grey-beard Grass			
**Anthoxanthum odoratum* L.	Sweet Vernal Grass			
Aristida behriana F.Muell.	Brush Wire-grass			
Aristida contorta F.Muell.	Curly Wire-grass			
Aristida holathera Domin var. *holathera*	Tall Kerosene Grass			
Aristida personata Henrard	Purple Wire-grass			
Austrodanthonia auriculata (J.M.Black)H.P.Linder	Lobed Wallaby-grass			

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Austrodanthonia caespitosa (Gaudich.)H.P.Linder	Common Wallaby-grass			
Austrodanthonia carphoides (F.Muell. ex Benth.)Zotov	Short Wallaby-grass			
Austrodanthonia duttoniana (Cashmore)H.P.Linder	Brown-back Wallaby-grass			R
*Austrodanthonia eriantha (*Lindl.)H.P.Linder Hill	Wallaby-grass			
Austrodanthonia fulva (Vickery)H.P.Linder	Leafy Wallaby-grass			
Austrodanthonia geniculata (J.M.Black)H.P.Linder	Kneed Wallaby-grass			
Austrodanthonia laevis (Vickery)H.P.Linder	Smooth Wallaby-grass			R
Austrodanthonia pilosa (R.Br.)H.P.Linder	Velvet Wallaby-grass			
Austrodanthonia racemosa (R.Br.)H.P.Linder var. *racemosa*	Slender Wallaby-grass			
Austrodanthonia setacea (R.Br.)H.P.Linder	Small-flower Wallaby-grass			
Austrodanthonia tenuior (Steud.)Connor & Edgar S	hort-awn Wallaby-grass			R
Austrostipa acrociliata (Reader)S.W.L.Jacobs & J.Everett	Branched Spear-grass			
Austrostipa blackii (C.E.Hubb.)S.W.L.Jacobs & J.Everett	Crested Spear-grass			
Austrostipa curticoma (Vickery)S.W.L.Jacobs & J.Everett	Short-crest Spear-grass			
Austrostipa densiflora (Hughes)S.W.L.Jacobs & J.Everett	Foxtail Spear-grass			R
Austrostipa drummondii (Steud.)S.W.L.Jacobs & J.Everett	Cottony Spear-grass			
Austrostipa elegantissima (Labill.)S.W.L.Jacobs & J.Everett	Feather Spear-grass			
Austrostipa eremophila (Reader)S.W.L.Jacobs & J.Everett	Rusty Spear-grass			
Austrostipa exilis (Vickery)S.W.L.Jacobs & J.Everett	Heath Spear-grass			
Austrostipa flavescens (Labill.)S.W.L.Jacobs & J.Everett	Coast Spear-grass			
Austrostipa gibbosa (Vickery)S.W.L.Jacobs & J.Everett	Swollen Spear-grass			R
Austrostipa hemipogon (Benth.)S.W.L.Jacobs & J.Everett	Half-beard Spear-grass			
Austrostipa macalpinei (Reader)S.W.L.Jacobs & J.Everett	Annual Spear-grass			
Austrostipa mollis (R.Br.)S.W.L.Jacobs & J.Everett	Soft Spear-grass			
Austrostipa multispiculis (J.M.Black)S.W.L.Jacobs & J.Everett	Small-seed Spear-grass			R
*Austrostipa mundula (*J.M.Black)S.W.L.Jacobs & J.Everett	Neat Spear-grass			
Austrostipa nitida (Summerh. & C.E.Hubb.)S.W.L.Jacobs & J.Everett	Balcarra Spear-grass			
Austrostipa nodosa (S.T.Blake)S.W.L.Jacobs & J.Everett	Tall Spear-grass			
Austrostipa nullanulla (J.Everett & S.W.L.Jacobs)S.W.L.Jacobs & J.Everett	Club Spear-grass			V
Austrostipa pilata (S.W.L.Jacobs & J.Everett)S.W.L.Jacobs & J.Everett	Prickly Spear-grass			V
Austrostipa platychaeta (Hughes)S.W.L.Jacobs & J.Everett	Flat-awn Spear-grass			
Austrostipa puberula (Steud.)S.W.L.Jacobs & J.Everett	Fine-hairy Spear-grass			R
Austrostipa pubinodis (Trin. & Rupr.)S.W.L.Jacobs & J.Everett	Long-shaft grass			
Austrostipa scabra (Lindl.)S.W.L.Jacobs & J.Everett ssp. *falcata* (Hughes)S.W.L.Jacobs & J.Everett	Slender Spear-grass			
Austrostipa scabra (Lindl.)S.W.L.Jacobs & J.Everett ssp. *scabra*	Rough Spear-grass			
*Austrostipa semibarbata (*R.Br.)S.W.L.Jacobs & J.Everett	Fibrous Spear-grass			
Austrostipa setacea (R.Br.)S.W.L.Jacobs & J.Everett	Corkscrew Spear-grass			
Austrostipa stipoides (Hook.f.)S.W.L.Jacobs & J.Everett	Coast Spear-grass			

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Austrostipa tenuifolia (Steud.)S.W.L.Jacobs & J.Everett				R
Austrostipa trichophylla (Benth.)S.W.L.Jacobs & J.Everett				
Austrostipa tuckeri (F.Muell.)S.W.L.Jacobs & J.Everett	Tucker's Spear-grass			R
**Avellinia michelii* (Savi)Parl.	Avellinia			
**Avena barbata* Pott ex Link	Bearded Oat			
**Avena fatua* L.	Wild Oat			
**Avena sativa* L.	Cultivated Oat			
Bothriochloa macra (Steud.)S.T.Blake	Red-leg Grass			R
*Brachiaria notochthona (*Domin)Stapf				
Brachiaria piligera (F.Muell. ex Benth.) Hughes				
**Briza maxima* L.	Large Quaking-grass			
**Briza minor* L.	Lesser Quaking-grass			
**Bromus alopecuros* Poir.				
Bromus arenarius Labill.	Sand Brome			
**Bromus catharticus* Vahl	Prairie Grass			
**Bromus diandrus* Roth	Great Brome			
**Bromus hordeaceus* L. ssp. *hordeaceus*	Soft Brome			
**Bromus madritensis* L.	Compact Brome			
**Bromus rubens* L.	Red Brome			
Catapodium rigidum (L.)C.E.Hubb.	Rigid Fescue			
**Cenchrus ciliaris* L.	Buffel Grass			
**Cenchrus incertus* M.A.Curtis	Spiny Burr-grass	Y		
**Cenchrus longispinus* (Hack.)Fernald S	piny Burr-grass	Y		
**Chloris gayana* Kunth	Rhodes Grass			
Chloris truncata R.Br.	Windmill Grass			
**Chloris virgata* Sw.	Feather-top Rhodes Grass			
**Cortaderia selloana* (Schult. & Schult.f.)Asch. & Graebn.	Common Pampas Grass			
Cymbopogon ambiguus A.Camus	Lemon-grass			
Cymbopogon obtectus S.T.Blake	Silky-head Lemon-grass			
**Cynodon dactylon* (L.) Pers. var. *dactylon*	Couch			
Cynodon dactylon (L.) Pers. var. *pulchellus* Benth.	Couch			
**Cynodon nlemfuensis* Vanderyst var. *nlemfuensis*				
**Cynosurus echinatus* L.	Rough Dog's-tail Grass			
**Dactylis glomerata* L.	Cocksfoot			
Deyeuxia quadriseta (Labill.)Benth.	Reed bent-grass			
Dichelachne crinita (L.f.)Hook.f.	Long-hair Plume-grass			
Dichelachne inaequiglumis (Hack. ex Cheeseman)Edgar & Connor	Long Plume-grass			
Digitaria ammophila (Benth.)Hughes	Spider Grass			

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Digitaria brownii (Roem. & Schult.)Hughes	Cotton Panic-grass			
**Digitaria ciliaris* (Retz.)Koeler	Summer Grass			
Digitaria coenicola (F.Muell.)Hughes	Spider Grass			
**Digitaria ischaemum* (Schreb.)Schreb. ex Muhl.	Smooth Summer-grass			
**Digitaria sanguinalis* (L.)Scop.	Crab Grass			
Distichlis distichophylla (Labill.)Fassett	Emu-grass			
**Echinochloa colona* (L.)Link	Awnless Barnyard Grass			
**Echinochloa crus-galli* (L.)P.Beauv.	Common Barnyard Grass			
**Echinochloa crus-pavonis* (Kunth)Schult.	Barnyard Grass			
**Echinochloa esculenta* (A.Braun) H.Scholz				
*Echinochloa lacunaria (*F.Muell.)P.W.Michael & Vickery	Lake Millet			E
**Echinochloa pyramidalis* (Lam.) Hitchc. & Chase				
**Ehrharta calycina* Sm.	Perennial Veldt Grass			
**Ehrharta erecta* Lam.	Panic Veldt Grass			
**Ehrharta longiflora* Sm.	Annual Veldt Grass			
**Ehrharta villosa* (L.f.)Schult.f. ex Schult. & Schult.f. var. *maxima* Stapf	Pyp Grass			
**Eleusine indica* (L.)Gaertn.	Crowsfoot Grass			
Elymus scaber (R.Br.)A.Love var. *scaber*	Native Wheat-grass			
Elytrophorus spicatus (Willd.)A.	Camus Spike-grass			
Enneapogon avenaceus (Lindl.)C.E.Hubb.	Common Bottle-washers			
Enneapogon caerulescens (Gaudich.)N.T.Burb. var. *caerulescens*	Blue Bottle-washers			
Enneapogon nigricans (R.Br.)P.Beauv.	Black-head Grass			
Enneapogon polyphyllus (Domin)N.T.Burb.	Leafy Bottle-washers			
Enteropogon acicularis (Lindl.)Lazarides	Umbrella Grass			
Enteropogon ramosus B.K.Simon	Umbrella Grass			
Eragrostis australasica (Steud.)C.E.Hubb.	Cane-grass			
**Eragrostis barrelieri* Daveau	Pitted Love-grass			
Eragrostis brownii (Kunth)Nees ex Steud.				
**Eragrostis cilianensis* (All.)Vignolo ex Janch.	Stink Grass			
**Eragrostis curvula* (Schrad.)Nees	African Love-grass	Y		
Eragrostis dielsii Pilg. var. *dielsii*	Mulka			
Eragrostis elongata (Willd.)J.Jacq.	Clustered Love-grass			
Eragrostis exigua Lazarides				
Eragrostis falcata (Gaudich.)Gaudich. ex Steud.	Sickle Love-grass			
Eragrostis infecunda J.M.Black	Barren Cane-grass			R
Eragrostis lacunaria F.Muell. ex Benth.	Purple Love-grass			R
Eragrostis laniflora Benth.	Hairy-flower Woollybutt			
Eragrostis leptocarpa Benth.	Drooping Love-grass			

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Eragrostis minor Host	Small Stink-grass			
Eragrostis parviflora (R.Br.)Trin.	Weeping Love-grass			
Eragrostis setifolia Nees	Bristly Love-grass			
Eragrostis xerophila Domin	Knotty-butt Neverfail			
Eriochloa australiensis Stapf ex Thell.	Australian Cupgrass			
Eriochloa crebra S.T.Blake	Tall Cupgrass			
*Eriochloa pseudoacrotricha (*Stapf ex Thell.)J.M.Black	Perennial Cupgrass			
Eulalia aurea (Bory)Kunth	Silky Brown-top			
**Festuca arundinacea* Schreb.	Tall Meadow Fescue			
**Festuca pratensis* Huds.	Meadow Fescue			
**Festuca rubra* L.	Red Fescue			
**Gastridium phleoides* (Nees & Meyen)C.E.Hubb.	Nit-grass			
Glyceria australis C.E.Hubb.	Australian Sweet-grass			
**Hainardia cylindrica* (Willd.)Greuter	Common Barb-grass			
Hemarthria uncinata R.Br. var. *uncinata*	Mat Grass			
**Holcus lanatus* L.	Yorkshire Fog			
**Holcus setosus* Trin.	Annual Fog			
**Hordeum distichon* L.				
**Hordeum glaucum* Steud.	Blue Barley-grass			
**Hordeum leporinum* Link	Wall Barley-grass			
**Hordeum marinum* Huds.	Sea Barley-grass			
**Hordeum vulgare* L.	Barley			
Imperata cylindrica (L.)Raeusch.	Blady Grass			
Isachne globosa (Thunb.)Kuntze	Swamp Millet			
Lachnagrostis aemula (R.Br.)Trin.				
Lachnagrostis billardieri (R.Br.)Trin. ssp. *Billardieri*				
Lachnagrostis filiformis (G.Forst.)Trin.				
Lachnagrostis robusta (Vickery)S.W.L.Jacobs				R
**Lagurus ovatus* L.	Hare's Tail Grass			
**Lamarckia aurea* (L.)Moench	Toothbrush Grass			
Leptochloa fusca (L.)Kunth ssp. *Fusca*				
Leptochloa fusca (L.)Kunth ssp. *muelleri* (Benth.)N.Snow				
**Lolium loliaceum* (Bory & Chaub.)Hand-Mazz.	Stiff Ryegrass			
**Lolium perenne* L.	Perennial Ryegrass			
**Lolium rigidum* Gaudin	Wimmera Ryegrass			
Microlaena stipoides (Labill.)R.Br. var. *stipoides*	Weeping Rice-grass			
**Miscanthus sinensis* Anders.				
Neurachne alopecuroidea R.Br.	Fox-tail Mulga-grass			

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Notodanthonia semiannularis (Labill.)Zotov				
**Panicum antidotale* Retz.	Blue Panic			
**Panicum capillare* L. var. *brevifolium* Vasey ex Rydb. & Shear	Witch-grass			
**Panicum coloratum* L.	Coolah Grass			
Panicum decompositum R.Br. var. *decompositum*	Native Millet			
Panicum effusum R.Br. var. *effusum*	Hairy Panic			
**Panicum hillmanii* Chase	Witch-grass			
Panicum laevinode Lindl.	Broom Millet			
**Panicum maximum* Jacq. var. *trichoglume* Eyles ex Robyns				
**Panicum schinzii* Hack.	Sweet Panic			
**Parapholis incurva* (L.)C.E.Hubb.	Curly Ryegrass			
**Paspalum dilatatum Poir*.	Paspalum			
**Paspalum distichum* L.	Water Couch			
**Paspalum vaginatum* Sw.	Salt-water Couch			
**Pennisetum clandestinum* Hochst. ex Chiov.	Kikuyu			
**Pennisetum setaceum* (Forssk.)Chiov.	Fountain Grass			
**Pennisetum villosum* R.Br. ex Fresen.	Feather-top			
Pentapogon quadrifidus (Labill.)Baill. var. *quadrifidus* Five-awn	Spear-grass			R
**Pentaschistis airoides* (Nees)Stapf	False Hair-grass			
**Pentaschistis pallida* (Thunb.)H.P.Linder	Pussy Tail			
**Periballia minuta* (L.)Asch. & Graebn.				
**Phalaris aquatica* L.	Phalaris			
**Phalaris minor* Retz.	Lesser Canary-grass			
**Phalaris paradoxa* L.	Paradox Canary-grass			
**Phleum pratense* L.	Timothy Grass			
Phragmites australis (Cav.)Trin. ex Steud.	Common Reed			
**Piptatherum miliaceum* (L.)Coss.	Rice Millet			
**Poa annua* L.	Winter Grass			
**Poa bulbosa* L.	Bulbous Meadow-grass			
Poa clelandii Vickery	Matted Tussock-grass			
Poa crassicaudex Vickery	Thick-stem Tussock-grass			
Poa drummondiana Nees	Knotted Poa			R
Poa fax J.H.Willis & Court	Scaly Poa			R
Poa fordeana F.Muell.	Forde's Poa			
Poa labillardieri Steud. var. *labillardieri*	Common Tussock-grass			
Poa poiformis (Labill.)Druce var. *poiformis*	Coast Tussock-grass			
**Poa pratensis* L.	Kentucky Blue-grass			
**Polypogon maritimus* Willd.	Coast Beard-grass			

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**Polypogon monspeliensis* (L.)Desf.	Annual Beard-grass			
**Polypogon viridis* (Gouan)Breistr.	Water Bent			
Pseudoraphis spinescens (R.Br.)Vickery	Spiny Mud-grass			
**Psilurus incurvus* (Gouan)Schinz & Thell.	Bristle-tail Grass			
**Puccinellia distans* (Jacq.)Parl.	Reflexed Poa			
**Puccinellia fasciculata* (Torr.)E.P.Bicknell	Borrer's Saltmarsh-grass			
Puccinellia stricta (Hook.f.)C.H.Blom var. *stricta*	Australian Saltmarsh-grass			
**Rostraria cristata* (L.)Tzvelev	Annual Cat's-tail			
**Rostraria pumila* (Desf.)Tzvelev	Tiny Bristle-grass			
**Schismus barbatus* (L.)Thell.	Arabian Grass			
**Sclerochloa dura* (L.)P.Beauv.	Hard Meadow-grass			
**Secale cereale* L.	Rye			
Setaria basiclada (Hughes)R.D.Webster				
Setaria clementii (Domin)R.D.Webster				
Setaria constricta (Domin)R.D.Webster	Knotty-butt Paspalidium			
**Setaria italica* (L.)P.Beauv.	Fox-tail Millet			
Setaria jubiflora (Trin.)R.D.Webster	Warrego Summer-grass			
**Setaria parviflora* (Poir.)Kerguelen				
**Setaria pumila* (Poir.)Roem. & Schult. ssp. *pumila*	Pale Pigeon-grass			
**Setaria verticillata* (L.)P.Beauv.	Whorled Pigeon-grass			
**Setaria viridis* (L.)P.Beauv.	Green Pigeon-grass			
**Sorghum bicolor* (L.)Moench	Grain Sorghum			
**Sorghum halepense* (L.)Pers.	Johnson Grass			
**Sporobolus africanus* (Poir.)Robyns & Tournay				
Sporobolus mitchellii (Trin.)C.E.Hubb. ex S.T.Blake	Rat-tail Couch			
Sporobolus virginicus (L.)Kunth	Salt Couch			
Themeda triandra Forssk.	Kangaroo Grass			
**Thinopyrum elongatum* (Host)D.R.Dewey				
Tragus australianus S.T.Blake	Small Burr-grass			
Triodia bunicola (S.W.L.Jacobs)Lazarides	Flinders Ranges Spinifex			
Triodia compacta (N.T.Burb.)S.W.L.Jacobs	Spinifex			
Triodia scariosa N.T.Burb.	Spinifex			
Tripogon loliiformis (F.Muell.)C.E.Hubb.	Five-minute Grass			
Triraphis mollis R.Br.	Purple Plume Grass			
**Triticum aestivum* L.	Wheat			
**Urochloa panicoides* P.Beauv. var. *panicoides*				
**Vulpia bromoides* (L.)Gray	Squirrel-tail Fescue			
**Vulpia ciliata* Dumort.	Fringed Fescue			

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**Vulpia fasciculata (*Forssk.)Samp.	Sand Fescue			
**Vulpia muralis* (Kunth)Nees	Wall Fescue			
**Vulpia myuros* (L.)C.C.Gmelin f. *megalura (*Nutt.)Stace & R.Cotton	Fox-tail Fescue			
**Vulpia myuros* (L.)C.C.Gmelin f. *myuros*	Rat's-tail Fescue			
Whalleya proluta (F.Muell.)K.E.Wills & J.J.Bruhl	Rigid Panic			
PALMAE				
**Phoenix canariensis* Hort. ex Chabaud	Canary Island Palm			
ARACEAE				
**Zantedeschia aethiopica* (L.)Spreng.	Arum Lily			
LEMNACEAE				
Lemna disperma Hegelm.	Common Duckweed			
Lemna trisulca L.	Ivy-leaf Duckweed			
Spirodela punctata (G.Mey.)C.H.Thomps.	Thin Duckweed			
Wolffia australiana (Benth.)Hartog & Plas	Tiny Duckweed			
TYPHACEAE				
Typha domingensis Pers.	Narrow-leaf Bulrush			
Typha orientalis C.Presl	Broad-leaf Bulrush			
CYPERACEAE				
Baumea arthrophylla (Nees)Boeck.	Swamp Twig-rush			
Baumea articulata (R.Br.)S.T.Blake	Jointed Twig-rush			
Baumea juncea (R.Br.)Palla	Bare Twig-rush			
Bolboschoenus caldwellii (V.J.Cook)Sojak	Salt Club-rush			
Bolboschoenus fluviatilis (Torr)Sojak				R
Bolboschoenus medianus (V.J.Cook)Sojak	Marsh Club-rush			
Carex appressa R.Br.	Tall Sedge			
Carex bichenoviana Boott ex Hook.f.	Notched Sedge			
Carex breviculmis R.Br.	Short-stem Sedge			
Carex divisa Huds.	Divided Sedge			
Carex fascicularis Sol. ex Boott	Tassel Sedge			
Carex gaudichaudiana Kunth	Fen Sedge			
Carex inversa R.Br. var. *major* Boott	Knob Sedge			R
Carex tereticaulis F.Muell. R	ush Sedge			
Chorizandra enodis Nees	Black Bristle-rush			
Cladium procerum S.T.Blake				R
**Cyperus congestus* Vahl	Dense Flat-sedge			
Cyperus difformis L.	Variable Flat-sedge			
**Cyperus eragrostis* Lam.	Drain Flat-sedge			
Cyperus exaltatus Retz.	Splendid Flat-sedge			

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Cyperus flaccidus R.Br.	Flaccid Flat-sedge			R
Cyperus gunnii Hook.f. ssp. *gunnii*	Flecked Flat-sedge			
Cyperus gymnocaulos Steud.	Spiny Flat-sedge			
Cyperus hamulosus M.Bieb.	Curry Flat-sedge			
Cyperus involucratus Rottb.				
Cyperus laevigatus L.	Bore-drain Sedge			
Cyperus nervulosus (Kuk.)S.T.Blake				R
Cyperus pygmaeus Rottb.	Pygmy Flat-sedge			
Cyperus rigidellus (Benth.)J.M.Black	Dwarf Flat-sedge			
Cyperus rotundus L. ssp. *rotundus*	Nut-grass	Y		
Cyperus sanguinolentus Vahl	Dark Flat-sedge			R
Cyperus sphaeroideus L.A.S.Johnson & O.D.Evans				R
Cyperus squarrosus L.	Bearded Flat-sedge			
Cyperus tenellus L.f.	Tiny Flat-sedge			
Cyperus vaginatus R.Br.	Stiff Flat-sedge			
Cyperus victoriensis C.B.Clarke	Yelka			
Eleocharis acuta R.Br.	Common Spike-rush			
Eleocharis pallens S.T.Blake	Pale Spike-rush			
Eleocharis pusilla R.Br.	Small Spike-rush			
Eleocharis sphacelata R.Br.	Tall Spike-rush			
Fimbristylis aestivalis (Retz.)Vahl	Summer Fringe-rush			R
Fimbristylis dichotoma (L.)Vahl	Common Fringe-rush			
Fimbristylis velata R.Br.	Veiled Fringe-rush			
Gahnia deusta (R.Br.)Benth.	Limestone Saw-sedge			
Gahnia lanigera (R.Br.)Benth.	Black Grass Saw-sedge			
Gahnia trifida Labill.	Cutting Grass			
*Isolepis australiensis (*Maiden & Betche)K.L.Wilson	Southern Club-rush			
Isolepis cernua (Vahl)Roem. & Schult.	Nodding Club-rush			
Isolepis fluitans (L.)R.Br.	Floating Club-rush			
Isolepis hookeriana Boeck.	Grassy Club-rush			
**Isolepis hystrix* (Thunb.)Nees	Awned Club-rush			
Isolepis inundata R.Br.	Swamp Club-rush			
**Isolepis marginata* (Thunb.)A.Dietr.	Little Club-rush			
Isolepis nodosa (Rottb.)R.Br.	Knobby Club-rush			
Isolepis platycarpa (S.T.Blake)Sojak	Flat-fruit Club-rush			
**Isolepis trachysperma* Nees				
Lepidosperma aff. *congestum* R.Br.	Clustered Sword-sedge			
Lepidosperma canescens Boeck.	Hoary Rapier-sedge			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Lepidosperma carphoides F.Muell.ex Benth.	Black Rapier-sedge			
Lepidosperma concavum R.Br.	Spreading Sword-sedge			
Lepidosperma congestum R.Br.	Clustered Sword-sedge			
Lepidosperma curtisiae K.L.Wilson & D.I.Morris	Little Sword-sedge			
Lepidosperma longitudinale Labill.	Pithy Sword-sedge			
Lepidosperma semiteres F.Muell. ex Boeck.	Wire Rapier-sedge			
Lepidosperma viscidum R.Br.	Sticky Sword-sedge			
Schoenoplectus dissachanthus (S.T.Blake)J.Raynal	Inland Club-rush			
Schoenoplectus litoralis (Schrad.)Palla	Shore Club-rush			
Schoenoplectus pungens (Vahl)Palla	Spiky Club-rush			
Schoenoplectus validus (Vahl)A.Love & D.Love	River Club-rush			
Schoenus apogon Roem. & Schult.	Common Bog-rush			
Schoenus breviculmis Benth.	Matted Bog-rush			
Schoenus deformis (R.Br.)Poir. ex Roem. & Schult.	Small Bog-rush			
Schoenus latelaminatus Kuk.	Medusa Bog-rush			V
Schoenus nanus (Nees ex Lehm.)Benth.	Little Bog-rush			
Schoenus nitens (R.Br.)Poir. ex Roem. & Schult.	Shiny Bog-rush			
Schoenus racemosus J.M.Black	Sandhill Bog-rush			
Schoenus subaphyllus Kuk.	Desert Bog-rush			
ORCHIDACEAE				
Acianthus caudatus R.Br.	Mayfly Orchid			
Acianthus pusillus D.L.Jones	Mosquito Orchid			
Caladenia aff. *Denticulate*				
Caladenia argocalla D.L.Jones	White Beauty Spider-orchid			E
Caladenia bicalliata R.S.Rogers ssp. *bicalliata*	Limestone Spider-orchid			R
Caladenia capillata D.L.Jones				
Caladenia cardiochila Tate	Heart-lip Spider-orchid			
Caladenia carnea R.Br.	Pink Fingers			
Caladenia colorata D.L.Jones	Coloured Spider-orchid		E	E
Caladenia concolor Fitzg.	Crimson Spider-orchid			
Caladenia flaccida D.L.Jones	Drooping Spider-orchid			V
Caladenia fuscata (Rchb.f.)M.A.Clem. & D.L.Jones				
Caladenia latifolia R.Br.	Pink Caladenia			
Caladenia leptochila Fitzg.	Narrow-lip Spider-orchid			
Caladenia necrophylla D.L.Jones	Late Spider-orchid			R
Caladenia reticulata Fitzg.	Veined Spider-orchid			
Caladenia sp. Monarto South (H.Goldsack 163 AD97708605A) R.J.Bates				
Caladenia sp. Monarto South (H.Goldsack 163) R.J.Bates				

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Caladenia sp. White (R.Bates 41056) R.J.Bates				
Caladenia stellata D.L.Jones	Star Spider-orchid			R
Caladenia stricta (R.J.Bates)R.J.Bates	Upright Caladenia			
Caladenia tensa G.W.Carr Inland	Green-comb Spider-orchid			
Caladenia tentaculata Schltdl.	King Spider-orchid			
Caladenia toxochila Tate	Bow-lip Spider-orchid			
Caladenia verrucosa G.W.Carr	Yellow-club Spider-orchid			
Caladenia X *variabilis* Nicholls	Hybrid Spider-orchid			
Calochilus campestris R.Br.	Plains Beard-orchid			R
Calochilus robertsonii Benth.	Purplish beard-orchid			
Corybas diemenicus (Lindl.)Rchb.f.	Veined Helmet -orchid			
Corybas incurvus D.L.Jones & M.A.Clem.	Slaty Helmet-orchid			
Pheladenia deformis (R.Br.)D.L.Jones & M.A.Clem.	Bluebeard Orchid			
Cyrtostylis reniformis R.Br.	Small Gnat-orchid			
Cyrtostylis robusta D.L.Jones & M.A.Clem.	Robust Gnat-orchid			
Dipodium roseum D.L.Jones & M.A.Clem.	Pink Hyacinth-orchid			
**Disa bracteata* Sw.	Monadenia			
Diuris behrii Schltdl.	Behr's Cowslip Orchid			V
Diuris orientis D.L.Jones W	allflower Donkey-orchid			
Diuris palustris Lindl.	Little Donkey-orchid			
Diuris pardina Lindl.	Spotted Donkey-orchid			
Diuris X fastidiosa R.S.Rogers	Proud Donkey-orchid			
Diuris X palachila R.S.Rogers	Broad-lip Donkey-orchid			
Eriochilus cucullatus (Labill.)Rchb.f.	Parson's Bands			
Genoplesium nigricans (R.Br.)D.L.Jones & M.A.Clem.	Black Midge-orchid			
Genoplesium rufum (R.Br.)D.L.Jones & M.A.Clem.	Red Midge-orchid			
Glossodia major R.Br.	Purple Cockatoo			
Leporella fimbriata (Lindl.)A.S.George	Fringed Hare-orchid			
Leptoceras menziesii (R.Br.)Lindl.	Hare Orchid			
Microtis arenaria Lindl.	Notched Onion-orchid			
Microtis eremaea R.J.Bates				
Microtis frutetorum Schltdl.				
Microtis parviflora R.Br.	Slender Onion-orchid			
Microtis sp. Short-leaf (R.J.Bates 54342) R.J.Bates				
Orthoceras strictum R.Br.	Horned O rchid			
Prasophyllum constrictum R.S.Rogers	Tawny Leek-orchid			R
Prasophyllum elatum R.Br.	Tall Leek-orchid			
Prasophyllum occidentale R.S.Rogers	Plains Leek-orchid			

Species	Common name	Proclaimed Pest Plant	EPBC Act Status	NPW Act Status
Prasophyllum odoratum R.S.Rogers	Scented Leek-orchid			
Pterostylis boormanii Rupp	Boorman's Greenhood			
Pterostylis cycnocephala Fitzg.	Swan-head Greenhood			
Pterostylis dolichochila M.A.Clem. & D.L.Jones	Mallee Shell-orchid			
Pterostylis erythroconcha M.A.Clem. & D.L.Jones	Red Shell-orchid			
Pterostylis excelsa M.A.Clem.	Dryland Greenhood			
Pterostylis mutica R.Br.	Midget Greenhood			
Pterostylis nana R.Br.	Dwarf Greenhood			
Pterostylis plumosa Cady	Bearded Greenhood			
Pterostylis pusilla R.S.Rogers	Small Rusty-hood			
Pterostylis robusta R.S.Rogers	Large Shell-orchid			
Pterostylis sanguinea D.L.Jones & M.A.Clem.	Blood Greenhood			
Pterostylis setifera M.A.Clem., Matthias & D.L.Jones	Bristly Greenhood			E
Pterostylis sp. Veined leaf (R.J.Bates 59781) R.J.Bates				
Pterostylis xerophila M.A.Clem.	Desert Greenhood			V
Pyrorchis nigricans (R.Br.)D.L.Jones & M.A.Clem.	Black Fire-orchid			
Thelymitra albiflora Jeanes				
Thelymitra antennifera (Lindl.)Hook.f.	Lemon Sun-orchid			
Thelymitra arenaria Lindl.				
Thelymitra azurea R.S.Rogers				
Thelymitra bracteata J.Z.Weber ex Jeanes				
Thelymitra brevifolia Jeanes				
Thelymitra epipactoides F.Muell. Metallic	Sun-orchid		E	E
Thelymitra holmesii Nicholls	Blue-star Sun-orchid			V
Thelymitra inflata Jeanes				
Thelymitra juncifolia Lindl.	Spotted Sun-orchid			
Thelymitra luteocilium Fitzg.	Yellow-tuft Sun Orchid			
Thelymitra megcalyptra Fitzg.				
Thelymitra nuda R.Br.	Scented Sun-orchid			
Thelymitra pauciflora R.Br.	Slender Sun-orchid			
Thelymitra rubra Fitzg.	Salmon Sun-orchid			
Thelymitra X *chasmogama* R.S.Rogers	Globe-hood Sun-orchid			
Thelymitra X *macmillanii* F.Muell.	Crimson Sun-orchid			

CHAPTER 10. FRESHWATER INVERTEBRATES

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INTRODUCTION

We usually pay little heed to invertebrate animals in everyday issues of natural history and conservation. There are exceptions, including large species like crayfish and troublesome ones like mosquitoes, but most invertebrates belong to a world that, if not unseen, is often not acknowledged. They are not a formal taxonomic group, but a cluster of convenience — an immensely diverse crowd of distantly-related animals united only by the absence of a "backbone". Yet they are 99 percent of all animals, and a major part of the biological infra-structure that supports ecosystems.

Freshwater invertebrates abound in the Riverland. This chapter describes some of the major groups and selected species, and also contains short articles on some "macroinvertebrates" (those visible with the naked eye). Adventurous readers will soon discover a much larger world of cryptic, often bizarre species. Guides are available as books (e.g. Williams 1980; Hawking & Smith 1997; Gooderham & Tsyrlin 2002) and on the Internet:

http://www.mdfrc.org.au/bugguide/index.htm and www.lucidcentral.com/keys/lwrrdc/public/aquatics/

The chapter concludes with a plea that invertebrates should be given more consideration in conservation issues. In South Australia they generally are not admitted to lists of "threatened' species, although they are regarded as part of ecological communities that could receive such a designation. As the chapter unfolds, you might consider whether they warrant more recognition.

Environmental diversity

The "Lower Murray River" begins at Wentworth, New South Wales, where the Murray is joined by the Darling. Past the South Australian border, past Renmark, Berri, Loxton and Barmera, the river meanders westward across a broad floodplain with many anabranches, wetlands and woodlands. Near Overland Corner, it enters a limestone gorge before turning southward at Morgan. From Mannum, past Murray Bridge and Tailem Bend to Wellington, where once there were riparian swamplands, the river is separated from its floodplain by earthen levees. At Wellington, the Murray enters Lake Alexandrina, feeding Lake Albert and the Coorong, before meeting the ocean near Goolwa.

The course of the Lower Murray is marked by weirs, wetland regulators, riverbank levees and river-mouth barrages. There are 10 weirs below the Murray-Darling junction, six of them within South Australia (Walker 2006). They are so closely-spaced that the river really is a series of pools rather than a free-flowing stream. The weirs maintain close control over water levels, and while they have benefits for irrigators and local communities, they have disconnected the river and its floodplain, blocking the flow of water and sediment and causing salt to accumulate in the floodplain soil. Earthen levees along the lowermost reaches of the river, between Blanchetown and Wellington, are planted with alien willows (*Salix* spp.) to protect against erosion. The levees were constructed in the early 20th century to reclaim riparian swamplands, of which very little remains. The swamps were a haven for waterfowl, and duck shooters venturing into the water risked "swimmer's itch" (cercarial dermatitis), a skin irritation caused by trematode parasites whose normal hosts are waterbirds and snails (e.g. Johnston 1941). The reclaimed land is used for dairying and other agriculture.

Along the seaward margins of Lake Alexandrina there are five barrages, constructed in 1939-40 to prevent the ingress of sea water to the lower lakes. They raised the level of the lakes by about 700 mm, and backed water up along the river to Blanchetown. In 2008-2009, as part of works

intended to control the threat of acid sulphate soils (see Chapter 3), the channel linking lakes Alexandrina and Albert was closed, wiers was constructed at Clayton and across the Finnis River, and another is planned for Currency Creek. Another weir has been proposed for the Murray at Pomanda Island, near Wellington, to secure water supplies against drought. The weirs, barrages and other structures mean that no part of the Murray in South Australia is free-flowing.

In the Riverland, the main aquatic habitats are the channel of the Murray and its associated wetlands. The channel includes sparse *benthic* (bottom-living) and *pelagic* (open-water) communities and comparatively rich *littoral* (river-edge) communities that vary with proximity to weirs. Downstream of each weir, where water levels change rapidly and the sediments are unstable, there are few plants. In the middle reaches of the weir pools, there are dense stands of reeds (*Phragmites australis*) and cumbungi (*Typha* spp.), and further downstream, where water levels are held steady by the next weir, dense stands of alien willows (*Salix* spp.) overhang the water (Schulze & Walker 1997). On the floodplain there are anabranches, flood runners and ephemeral, seasonal and permanent backwaters, billabongs and lakes (Sheldon & Walker 1998). Many of the temporary wetlands become saline after flooding (Suter et al. 1993), and some have been annexed as evaporation basins for irrigation runoff (e.g. Berri, Disher Creek, Loveday and Ramco Lagoon).

BIODIVERSITY

River and floodplain species

The deep sediments in the Murray channel are sparsely populated by invertebrates, mainly annelid worms, midge larvae (Diptera: Chironomidae) and protists and other microscopic forms. In the open water there are zooplankton, described later, but it is along the margins, in the littoral zone, where most biodiversity resides (Walker et al. 1992). Curiously, the dense stands of cumbungi, reeds and other plants along the river‘s edge, and many of the animals that live among them, are “refugees” from wetlands. They colonized the channel in the aftermath of weir construction, occupying areas that were the domain of riverine species like the Murray crayfish and river mussel, described later.

More than 200 taxa of macroinvertebrates are recorded from the Murray floodplain in South Australia (e.g. Boulton & Lloyd 1991; Goonan et al. 1992; Suter et al. 1993, 1995; Sheldon & Walker 1998). The most common include prawns (*Macrobrachium australiense*), shrimps (*Paratya australiensis*), amphipods (Ceinidae, Eusiridae), corixids (*Micronecta*), midge larvae (e.g. *Cricotopus, Parachironomus, Paratanytarsus, Procladius*) and oligochaetes (e.g. *Aulodrilus pigueti, Nais bretscheri, Dero flabelliger*). Some of these common species are illustrated in Figure 1.

Wetland habitats are influenced, of course, by floods from the Murray (Suter et al. 1993, 1995). Early flood assemblages include the corixid Agraptocorixa eurynome, the midges Chironomus spp. and the alien snail Physa acuta. Late flood assemblages—and communities in permanentlyconnected wetlands—include the midge Cladotanytarsus and the shrimp Paratya australiensis. Isolated wetlands with salinities above 3000 mg L-1 attract dipteran larvae, including midges (e.g. Procladius, Tanytarsus) and brine flies (Ephydridae).

Flows from the highly turbid Darling River also affect invertebrate communities in the Lower Murray channel and wetlands (Bennison et al. 1989; Blanch et al. 1999). When the Darling‘s contribution is increased by regulation at Lake Victoria, upstream of Renmark, the abundances of many species are much reduced. This may reflect the loss of aquatic plants, and habitats for macroinvertebrates, due to low underwater light.

Tributaries entering the Murray from the Eastern Mt Lofty Ranges include the Marne River and Reedy Creek, which are fresh water, and Burra, Truro, Saunders, Preamimma, Salt, Mitchell, Dry and Rocky Gully creeks, which are episodic and saline. The freshwater streams harbour cumbungi, reeds and sedges, and the saline streams contain submerged charophytes. Most of these streams, fresh and saline, exist as pools that are joined by turbulent riffles in winter, and may flow underground in their lower reaches. They contain some 350 macroinvertebrate taxa, reflecting the diverse habitats provided by alternating pools and riffles. The pool-edge habitats include species like those found in the Murray, and the riffles (which do not occur in the Murray) support blackfly larvae (*Simulium ornatipes*), hydrobiid snails, oligochaetes and amphipods (*Austrochiltonia australis*).

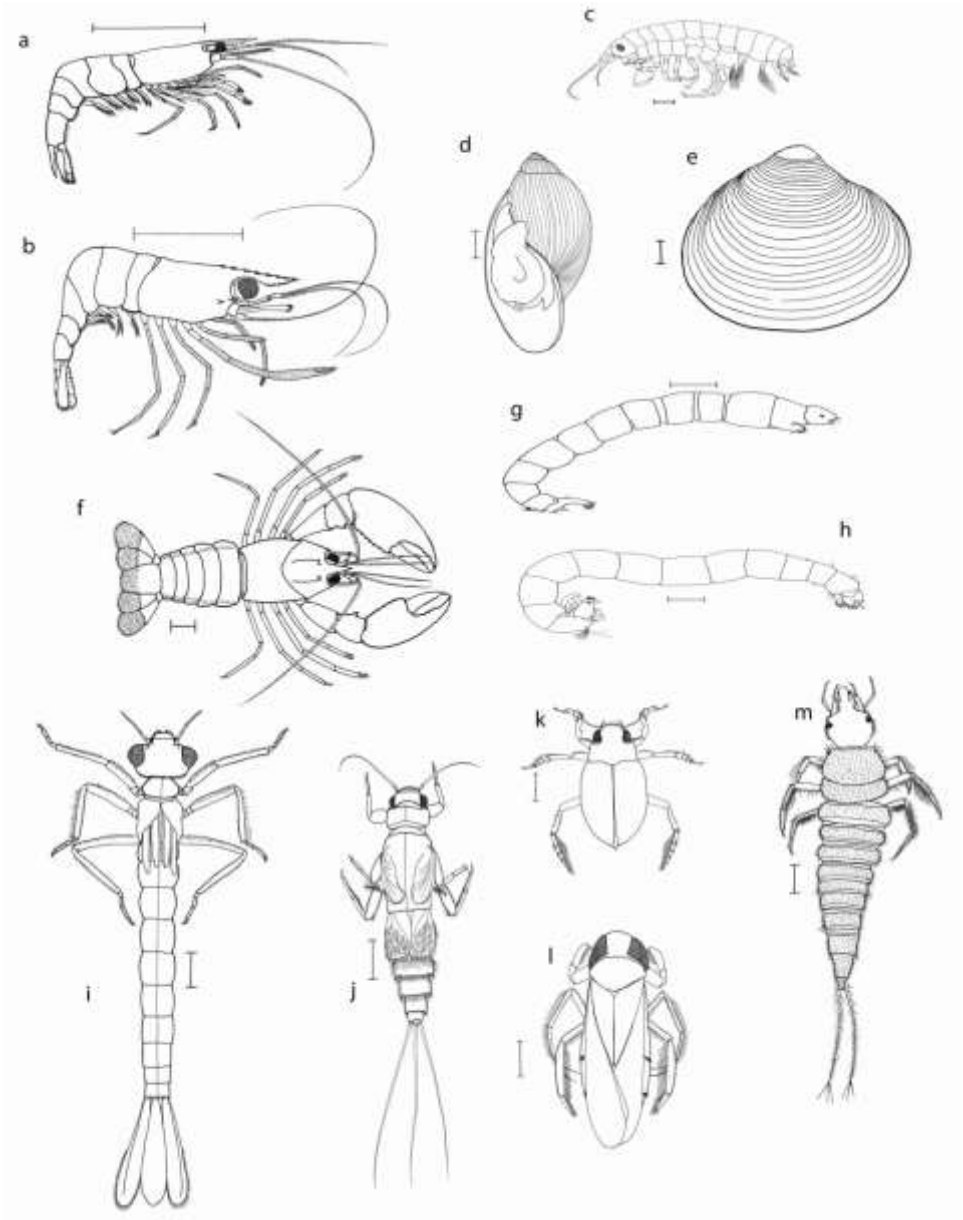

Figure 1. Common macroinvertebrates of the Riverland: (a) *Paratya australiensis* (Atyidae); (b) *Macrobrachium australiense* (Palaemonidae); (c) *Austrochiltonia australis* (Ceinidae); (d) *Glyptophysa* sp. (Planorbidae); (e) *Corbiculina australis* (Corbiculidae); (f) *Cherax destructor* (Parastacidae); (g) *Procladius* sp. (Chironomidae); (h) *Chironomus* sp. (Chironomidae); (i) *Ischnura heterosticta* (Coenagrionidae); (j) *Tasmanocoenis tillyardi* (Caenidae); (k) *Necterosoma* sp. adult (Dytiscidae); (l) *Agraptocorixa* sp. (Corixidae); (m) *Necterosoma* sp. larva (Dytiscidae). Scale bars for a,b and f = 10 mm; others = 1 mm. Montage by T. Tan of drawings by J.H. Bradbury, from Wade et al. (2004), with permission from the Environment Protection Authority of South Australia.

Porifera

Freshwater sponges (Spongillidae) are sessile, filter-feeding, colonial animals that form encrustations on submerged logs, bark, boulders and rocks, and in pipelines (Racek 1969; Williams 1980). The species are distinguished by the size, structure and arrangement of their gemmules (asexual resting propagules) and skeletal spicules.

The only sponge known from the Murray in South Australia is *Eunapius fragilis*, first recorded near Morgan in 1952 (Racek 1969). This species forms small, light tan-coloured clumps on logs and rocks. Like most spongillids, it survives floods without structural damage and is well-

adapted to turbid, sediment-laden water. Unidentified species have been collected from the Chowilla area, from Wongulla Lagoon at the mouth of the Marne River, and from some tributaries.

Nemertea

Nemerteans (proboscis worms) in Australia are represented by a single, possibly introduced freshwater species, *Prostoma graecense* (Williams 1980; Hawking & Smith 1997). They occur throughout the Riverland. They are less than 25 mm long, un-segmented, with three pairs of lateral eyespots, and glide about using cilia. They have a muscular proboscis, used to capture prey, and may be brightly coloured.

Platyhelminthes

Two plathyhelminth classes, the Temnocephalidea and Turbellaria, are represented in the Riverland. The former are ectocommensal on crustaceans, including yabbies (*Cherax destructor*). They are oval, 1-12 mm long, with 2-6 finger-like anterior tentacles, and prey on small invertebrates (Williams 1980). Undescribed species of *Temnocephala* occur in the Murray, and wetlands and anabranches from Chowilla to Mannum, and in the Marne and Somme catchments.

Turbellarians (flatworms, or planarians) are free-living, elongate, flattened platyhelminths about 2-10 mm long, found gliding over stones, bark, snags and submerged plants. They are carnivorous, and feed on live or decaying animal matter (Williams 1980). They have been neglected by taxonomists as they are difficult to preserve and identify, often requiring histological examination. Undescribed species have been found along the margins of the Murray and permanent wetlands, and in perennial pools in the creeks of the Eastern Mt Lofty Ranges.

Annelida

Annelids (segmented worms) include the common aquatic oligochaetes (relatives of earthworms), leeches, aphanoneurans and polychaetes (bristle worms).

The Riverland oligochaete fauna is rich in species of Naididae and Tubificidae, most with global or Australasian distributions, except the endemic *Slavina proceriseta* and *Antipodrilus magelensis*. Some Enchytraeidae and Phreodrilidae also may be natives. Most oligochaetes, including *Limnodrilus hoffmeisteri*, feed head-down in the sediments, extending the tail into the water for respiration. Among the Naididae, *Branchiodrilus hortensis* (Fig. 2a) has gills along the body, and species of *Dero* have gills in an anal chamber. Some species, especially members of the Naididae, swim or crawl over the bottom. They ingest mineral particles and decaying organic matter, and obtain their nutrition from the attached micro-organisms. *Chaetogaster diaphanus* is a predator on other small invertebrates, and a near-relative, *C. limnaei*, lives in the shells of certain snails, feeding on algae that grow on the shell. Some of the mobile species, including *Stylaria lacustris* and species of *Nais*, have simple eyes, making them unique among the oligochaetes.

Three families of freshwater leeches are known from South Australia, but only the Glossiphoniidae has been recorded from the Riverland. The adults are oval-shaped, often creamcoloured, and carry juveniles attached to their ventral surface (Hawking & Smith 1997). In *Helobdella papillornata*, described from the Loddon River in Victoria, the young feed on snails captured by the parent. They leave the parent after 2-4 weeks, and forage in small groups until they mature at 2-4 months (Govedich & Davies 1998).

Aphanoneurans resemble oligochaetes and live in the same habitats, but are less strongly segmented. They glide about using cilia, and have brightly-coloured oil glands in the body wall. They are tiny (<2 mm), although their chains of reproductive zooids may be as long as 10 mm. Australian species belong to the genus *Aeolosoma*.

Polychaetes (bristle worms) are mainly marine, but do occur in fresh water, including the Murray channel downstream of Walker Flat. In the lakes near the Murray mouth, the estuarine polychaete *Ficopotamus enigmaticus* has gained notoriety as it has spread rapidly, forming large masses of calcareous tubules on boats, moorings and other submerged surfaces, including the shells of turtles. Many turtles have died as a consequence.

Figure 2. **(a).** Oligochaete, *Branchiodrilus hortensis* (Naididae)*;* **(b).** water mite, *Arrenurus* sp. (male) (Arrenuridae); **(c).** micro-caddisfly larva, *Hellyethira* sp. (Hydroptilidae); **(d).** midge larva, *Zavreliella* sp. (Chironomidae); **(e).** aquatic caterpillar, Pyralidae: Nymphulinae; **(f).** caddisfly larva and case, *Oecetis* sp. (Leptoceridae). Photographs: (a) A.M. Pinder, Department of Environment and Conservation, Western Australia; (b-f) Chris Madden.

Mollusca

Two classes of molluscs, the Bivalvia and Gastropoda, are well-represented in the Riverland (Williams 1980; Smith 1996). The bivalves include the orb-shell mussels (Corbiculidae) and the freshwater mussels (Hyriidae). All are sedentary animals with bi-valved shells that house plate-like demibranchs ("gills") used for respiration, filter-feeding and reproduction. Despite their common name, "mussels", the two families are very different (see *Freshwater mussels*, below).

The Corbiculidae is represented by *Corbiculina australis* (Fig. 1e). The shell of this species is 20-25 mm across, marked with concentric ridges, and is sometimes called a "little basket shell". It occurs sparsely in the Murray and rarely in wetlands, but sometimes congregates in numbers enough to block irrigation pipes (for example, at Renmark: Woolford 1984). There are records from the Murray at Murtho, Loxton and Woods Point, from Ral Ral, Boat and Eckert creeks, from floodplain sites at Big Mussel, Irwin Flat, Big Toolunka Flat, Lake Carlet, Walker Flat and Mannum Swamp, and from the lower Marne River. Small specimens are easily confused with pea-mussels (Sphaeriidae), but there are no confirmed records of that family.

The second major group of molluscs, the gastropods, include the limpets and the familiar snails (Fig. 1d) (see *Snails*, below. The snails include *caenogastropods* (formerly "prosobranchs")

with gills and an operculum to close the shell aperture, and *pulmonates* with a vascularised "lung" to aid respiration but without an operculum. All are grazers, equipped with a *radula* to scrape algae, bacteria and detritus from submerged surfaces. In general, the operculate species prefer flowing, welloxygenated water, and the pulmonates inhabit wetlands where oxygen levels and other conditions vary.

Crustacea

The crustaceans are a diverse group of arthropods, generally with two pairs of antennae and biramous (2-branched) limbs. They include Ostracoda, Copepoda and Cladocera (see *Zooplankton*), and Anostraca, Notostraca, Syncarida, Isopoda, Amphipoda and Decapoda (Williams 1980; Pearson & Hawking 2001). Some of the more striking forms are mentioned here.

The fairy shrimps (Anostraca) are among the most primitive of all living crustaceans, and are elongate, with leaf-like trunk appendages and no carapace (Williams 1980). Regional records include the brine shrimp *Parartemia zietziana* from saline pools at Bookmark Creek, near Renmark, and Waltowa Swamp near Lake Albert, and *Australobranchipus parooensis* from Katarapko Island, near Loxton (Rogers et al. 2007).

The tadpole shrimps (Notostraca) have a prominent, shield-shaped carapace and two long caudal rami (Williams 1980). They live in rainwater pools, fresh and saline lakes, dams and ditches. The only official record from the region is *Lepidurus apus viridis* from Lake Woolpolool, a saline, seasonal swamp on the Calperum floodplain.

The syncarids (Syncarida) are another primitive group, lacking a carapace and with similarlooking thoracic and abdominal appendages (Williams 1980). They occur in permanent lakes and streams and interstitial waters. The only record from the Riverland is of a few *Koonunga* from under dense willows on the Murray at Woods Point (Madden et al. 2003). They usually are part of the hypogean (underground water) fauna.

The isopods (Isopoda) have a distinct head, no carapace, seven pairs of walking legs, a six-segmented abdomen and gills on the abdominal appendages (Williams 1980). *Heterias pusilla* (Janiridae) occurs in low numbers in still or slow-flowing fresh waters throughout the region, including the Murray, anabranch creeks, permanent floodplain wetlands and creeks in the Eastern Mt Lofty Ranges. Another isopod is *Haloniscus searlei* (Oniscidae), which resembles a terrestrial slater and occurs in permanent saline inland waters. It occurs in Logan Creek in the Eastern Mt Lofty Ranges, and in Lake Woolpolool.

Isopods of the family Cirolanidae are represented by *Tachaea caridophaga* (formerly *Austroargathona picta*), an ectoparasite of decapods (e.g. *Paratya*, *Macrobrachium*: Figs 1a-b). It occurs sparsely in the river above Blanchetown (Lock 1).

The inelegantly-named scuds (Amphipoda) are related to the Isopoda, but have gills on the thoracic appendages and their abdominal appendages are used only for swimming (Williams 1980). Four families occur in the Riverland. The most common species is *Austrochiltonia australis* (Ceinidae) (Fig. 1c), in fresh and saline, still and flowing waters. Eusiridae are common in still and slow-flowing water in the Murray and in floodplain habitats, but are less common in the Eastern Mt Lofty Ranges. Corophiidae have been found at Reedy Creek, south of Mannum, and Perthiidae are known from the Murray only at Woods Point (Taylor 2002).

The crabs, crayfish, prawns and shrimps (Decapoda) have a prominent carapace that is fused to form a cephalothorax; they also have eyes on stalks and five pairs of thoracic legs. The crayfish and shrimp-like forms have an elongated cephalothorax and an extended abdomen, and the crab-like forms have a flattened cephalothorax and a reduced abdomen (Williams 1980).

The most common decapod is the shrimp *Paratya australiensis* (Atyidae) (Fig. 1a), found in still and slow-flowing fresh water. There are also two species of *Caridina*, one from Renmark and near Murray Bridge, and a second from Renmark, Berri, Bowhill and Mannum (Page et al. 2005).

Another common decapod from the Murray, and from anabranches and wetlands connected to the river, is the prawn *Macrobrachium australiense* (Fig. 1b), a relative of larger species that are farmed throughout south-eastern Asia. These are a favourite prey for many fish, and fishermen seeking bait know that, when the water is warm, the prawns are easily lured to a tin containing a bar of soap or other fatty material.

The best known decapods are the yabbie, *Cherax destructor* (Fig. 1f) and the Murray crayfish, *Euastacus armatus* (see *Crayfish*, below).

The small spider crab *Amarinus lacustris* (Hymenosomatidae) lives in fresh and slightly saline water (Walker 1969; Johnston & Robson 2005). The crabs live under rocks and among water plants in the river and connected freshwater wetlands, mainly downstream from Walker Flat. They are also known from Mitchell Gully Creek (9000 mg L^{-1}) near Mypolonga. *Amarinus lacustris* is distinguished from its marine and estuarine relatives by having direct development, wherein the eggs are retained by the female until they hatch as miniature crabs rather than as planktonic larvae. This species has a curious geographic distribution, including parts of Victoria, Tasmania and New Zealand, King Island in Bass Strait, and Lord Howe and Norfolk Islands (Walker 1969).

Acarina

Mites are represented by four sub-orders, the Astigmata, Oribatida and Prostigmata (Acariformes) and Mesostigmata (Parasitiformes). Oribatid mites ("beetle mites") especially are common in still and flowing water. *Peza ops* (Pezidae) is also common in the Murray channel and in wetlands, but is apparently not in tributaries (cf. Harvey 1990).

The best known, most diverse group is the Hydracarina, or "water mites". These have a variety of shapes and forms, and many are brightly coloured. One genus from each of seven families (Anisitsiellidae, Arrenuridae, Eylaidae, Hydrachnidae, Hydrodromidae, Oxidae, Pionidae) has been collected. Species of *Eylais* are conspicuous, with a bright, blood-red colour and soft bodies, whereas those of *Arrenurus* are bright blue or green, with hard, densely-punctured bodies. Female *Arrenurus* generally are globular, but the males can be distorted into bizarre forms (Fig. 2b).

Other mite records include four hygrobatid genera and two genera each from the Hydryphantidae and Unionicolidae. Five local species of unionicolid mites are parasites in freshwater mussels (Viets 1980; Harvey 1998), which in turn have larvae that are parasites on fish (see *Freshwater mussels*, below).

Insecta

The insects are the most diverse group of freshwater invertebrates. Most aquatic forms are the immature stages of species with airborne adults (e.g. dragonflies, mayflies, midges), but there are aquatic adults, especially among the beetles (Coleoptera) and bugs (Hemiptera).

The Ephemeroptera (mayflies) are one of the most primitive groups. The Baetidae are represented by *Cloeon* in river and stream habitats, and the Caenidae by *Tasmanocoenis tillyardi* (Fig. 1j), mainly in wetlands and Eastern Mt Lofty Ranges tributaries, and *T. arcuata*, in the Murray. Another family, the Leptophlebiidae, is typical of cool, flowing water, and its regional representatives, *Atalophlebia* and *Koorrnonga inconspicua*, are common in tributaries.

Damselflies (Odonata) include *Austroagrion watsoni*, *Ischnura heterosticta* (Fig. 1i), *I. aurora*, *Pseudagrion aureofrons* and *Xanthagrion erythroneurum*, all members of the Coenagrionidae. Only *Ischnura* spp. and *X. erythroneurum* occur in tributaries. The Protoneuridae is represented by *Nososticta solida*, found among the root masses of riparian plants (Hawking & Theischinger 1999). The Lestidae includes the salt-tolerant *Austrolestes annulosus* in the river, and *A. analis* and *A. aridus* in tributaries.

Four families of dragonflies (Odonata) are common. Species of *Austrogomphus* (Gomphidae) occur in still waters along the Murray. *Hemicordulia tau* (Corduliidae) and *Hemianax papuensis* (Aeshnidae) and *Orthetrum caledonicum* (Libellulidae) are common in streams. Two other libellulid species, *Diplacodes haematodes* and *D. bipunctata*, also occur.

Stoneflies (Plecoptera) favour cool, flowing water and are rarely found in the Murray, but the gripopterygid *Dinotoperla* occurs in fast-flowing anabranches at Chowilla. Four species from two families are present in the eastern Mt Lofty tributaries. The Gripopterygidae is represented by *Illiesoperla mayi* and two species endemic to South Australia, *Dinotoperla evansi* and *Riekoperla naso*. The latter is unusual in that it occurs in localities prone to dry out in summer (Suter & Bishop 1990). The Notonemouridae is represented by *Austrocerca tasmanica*.

The most abundant insect group, especially in slow-moving or still water, is the bugs (Hemiptera). The Corixidae includes three species each of *Agraptocorixa* (Fig. 1l), *Micronecta* and *Sigara*. *Microvelia peramoena* and *M. oceanica* (Veliidae, Fig. 3c) are common on the water surface,

scavenging for other insects trapped in the surface film. Other surface-dwellers are the water striders (Gerridae); *Aquarius antigone*, for example, is often seen at the river margins.

The Notonectidae or backswimmers, represented by species of *Anisops*, are common in the river. *Enithares* also occurs, but is more common in the tributaries. This may be because *Anisops* (Fig. 3a) is able to attain neutral buoyancy and can rest in mid-water, whereas *Enithares* (Fig. 3b), having more air stored under the wings, readily rises to the surface and must grasp submerged objects to rest (Andersen & Weir 2004).

Other families of aquatic bugs are abundant in vegetated wetland areas rather than the channel. They include *Mesovelia hungerfordi* (Mesoveliidae), *Hydrometra strigosa* (Hydrometridae), *Ranatra dispar* (Nepidae), *Diplonychus eques* (Belostomatidae), *Naucoris congrex* (Naucoridae), *Hebrus axillaris* and *Merragata hackeri* (Hebridae) and *Paraplea* sp. (Pleidae). The semi-aquatic *Saldula* (Saldidae) is often found on the edge of saline wetlands.

Beetles (Coleoptera) are common, particularly members of the Dytiscidae and Hydrophilidae. The former include *Limbodessus* (Fig. 3d), *Antiporus*, *Rhantus*, *Necterosoma*, *Sternopriscus*, *Lancetes lanceolatus* and *Eretes australis*, although the latter is more typical of arid central Australia. The Hydrophilidae include *Berosus* (Fig. 3e), *Enochrus*, *Helochares*, *Paracymus*, *Hydrochus* (Fig. 3f) and *Limnoxenus zelandicus*. Two beetles typical of saline areas are *Necterosoma penicillatum* (Dytiscidae) (Fig. 1k,m) and *Laccobius zietzi* (Hydrophilidae). *Gymnochthebius* and *Hydraena* (Hydraenidae) are also common, especially in wetlands.

Whirligig beetles (Gyrinidae), represented by *Macrogyrus*, are remarkable for having their eyes divided into upper and lower hemispheres – as an adaptation to life on the water surface (e.g. Williams 1980). The species *Coxelmis novemnotata* and *C. v-fasciata* (Elmidae) occur on snags in the river and wetlands. Some beetle taxa occur only in the tributaries, notably two dytiscid species, *Chostonectes nebulosus* and *Platynectes decempunctatus*.

If the Hemiptera (bugs) is the most abundant group of insects in the Riverland, the Diptera (true flies) may be the most diverse. The Chironomidae (midge flies) includes the widespread, salttolerant *Procladius* (Fig. 1g) and freshwater species of *Cricotopus*, *Nanocladius* and *Parakiefferiella*. *Cladotanytarsus* and *Paratanytarsus* occur in the river, and in saline sites *Tanytarsus barbitarsis* often is the only insect present. *Chironomus tepperi* (cf. Fig. 1h) is one of the first insects to colonise newly-inundated wetlands, and *Dicrotendipes*, *Kiefferulus* and *Polypedilum* soon become abundant as food for birds and fish. The larvae of *Xenochironomus* are unusual, living in sponges, and *Zavreliella* (Fig. 2d) also is noteworthy for having a portable case (most midge larvae live in cases fixed to the substratum). The Eastern Mt Lofty Ranges streams have a similar midge fauna, but with added taxa like *Podonomopsis*, *Parametriocnemus* and *Rheotanytarsus*, typical of cool, flowing water.

The mosquitoes (Culicidae) (see *Mosquitoes*, below), are familiar pests in summer. The biting midges (Ceratopogonidae) are no less bothersome, and are represented by species of *Dasyhelea*, *Bezzia* and *Culicoides*. The Simuliidae (blackflies) require flowing water and are rare in wetlands, but *Simulium ornatipes*, *Austrosimulium furiosum* and *Paracnephia* occur in tributaries. Other dipterans are the larvae of Tipulidae, Tabanidae, Stratiomyidae, Empididae, Dolichopididae, Ephydridae and Psychodidae. Swarms of brine flies (Ephydridae) are typical of saline areas.

The larvae of Trichoptera (caddisflies) sometimes build elaborate cases that are either portable or fixed to the substratum. The Hydroptilidae (micro-caddisflies) include small (<5 mm) species of *Hellyethira* (Fig. 2c) and *Orthotrichia*, although the latter is rarely found outside the Murray. Leptoceridae is represented by *Oecetis* (Fig. 2f) and *Triplectides*. The predatory Ecnomidae also occur, with *Ecnomus pansus* in the river and *E. cygnitus* in tributaries. *Cheumatopsyche* (Hydropsychidae) builds a net to capture drifting organisms in flowing water; it is rare in the Murray but common in tributaries.

Two curiosities are aquatic caterpillars (Lepidoptera: Pyralidae) with external gills (Fig. 2e), found on wetland plants, and the lacewings (Neuroptera: Sisyridae), which live and feed on sponges.

Figure 3. (a). Backswimmer *Anisops* sp. (Notonectidae); **(b).** backswimmer *Enithares* sp. (Notonectidae); **(c).** small waterstrider *Microvelia* sp. (Veliidae); **(d).** diving beetle *Limbodessus* sp. (Dytiscidae); **(e).** water scavenger beetle *Berosus* sp. (Hydrophilidae); **(f).** water scavenger beetle *Hydrochus* sp. (Hydrochidae). Photographs: Chris Madden.

FEATURES

Invertebrate indicators

The *Australian River Assessment System* (AUSRIVAS), a national biological assessment of river health, is used widely in Australia. Macroinvertebrates are used as indicators because they are common, widely distributed, easily sampled and identified. River health is determined by comparing samples with those from "reference" sites in a comparatively undisturbed state (Simpson & Norris 2000). This provides a ratio of the number of families observed (O) at a site and the number expected (E). If the O/E ratio is near 1, the site earns a high rating (Band A); if the ratio is less than 1, taxa are missing. Sites missing 10-20% of expected families are considered "significantly impaired' (Band B), sites missing 20-40% families are "severely impaired" (Band C), and so on.

There is some dispute over using this system in highly regulated rivers like the Murray, partly for the lack of suitable reference sites. Further, the method works at the family level of taxonomy, not the species level, and some groups (e.g. sponges, crustaceans, molluscs) may not be sampled adequately. Work is underway to evaluate the utility of AUSRIVAS for the Murray, and to improve its value for ecosystem health assessments such as the Murray-Darling Basin Authority's *Sustainable Rivers Audit* (http://www.mdbc.gov.au/sra).

As part of the AUSRIVAS program, nearly 100 sites in the Riverland region have been sampled since 1994. Sites between the State border and Overland Corner generally are near reference condition, but most channel habitats are "significantly impaired". Among the poorest sites are the Murray at Blanchetown and Morgan, and Disher and Salt Creeks, both affected by saline irrigation drainage. Streams in the Eastern Mt Lofty Ranges are mostly near reference condition, including sites on the Marne River, Reedy, Truro and Saunders Creeks. Sites that rate poorly include Baldina, Salt, Rocky Gully and Long Gully Creeks, which are affected by saline groundwater, and parts of Reedy and Baker Creeks and the Marne River, affected by water diversions and nutrients.

Mosquitoes

Mosquito larvae (Diptera: Culicidae), or "wrigglers", are aquatic organisms that breathe atmo-spheric oxygen. This enables them to exploit habitats that are poorly-oxygenated and unattractive to predators (Lee et al. 1982, 1989). They generally use their scraping mouthparts to feed on organic detritus and biofilms, but some eat plant tissue and others are predators on smaller invertebrates. They are sometimes cannibalistic (Clements 1999). After hatching, the larvae progress through four instars and a pupal stage before emerging as adults. The adult females, of course, are usually blood-feeders ("haematophagous") and a nuisance and disease-risk to humans and other animals (Russell 1993; Russell & Kay 2004).

At least 20 of South Australia's 49 mosquito species occur in the Riverland, and eight are especially common (Fig. 4). The Riverland species have been studied by the Mosquito Research Laboratory at the University of South Australia since 1996. In 1999, a monitoring and control program was initiated in collaboration with local governments, and adult mosquitoes have been trapped at 30 sites along the Murray in September to May each year since.

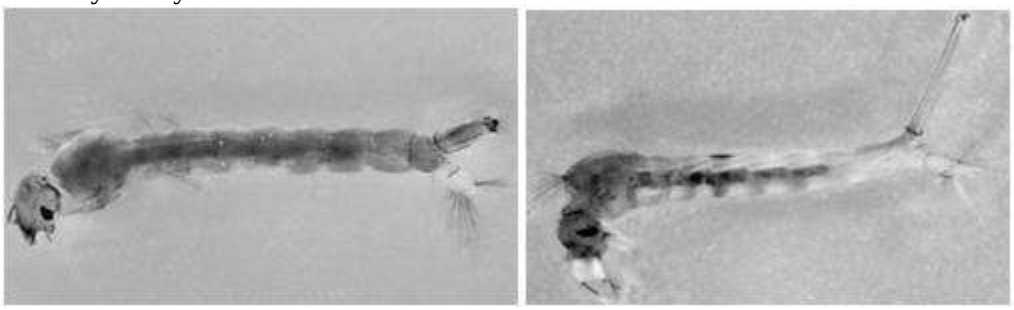

Figure 4. Common larval mosquitoes. Left: instar IV larva of *Aedes camptorhynchus*, showing the short caudal siphon typical of *Aedes* species. Right: instar IV larva of *Culex annulirostris* showing the long, thin siphon and white antennae with dark apices. Photographs: S.R. Fricker.

Keys to larvae are provided by Russell (1993), and images of larvae and adults are available from the *New South Wales Arbovirus Surveillance and Mosquito Monitoring Program* (http:// www.arbovirus.health.nsw.gov.au). Mosquito larvae are scarce in the Murray and its tributaries, owing to the presence of predatory fish and insects. Instead, they favour ephemeral and semi-permanent waters in the riparian zone, and natural and man-made habitats containing water from rain, tidal flow, stream flow, irrigation and other sources. Some species tolerate saline water. There are four main kinds of habitats:

- Groundpools (Fig. 5), or pools that collect in depressions and may contain plants;
- Phytotelmata, pools associated with living or dead plants, including pools in leaf axils and treeholes;
- Micropools, very small pools like water-filled hoof-prints created by livestock, and rock-holes that retain water from rain, stream flow or tidal action; and
- Anthropogenic pools, formed in artificial containers like rainwater tanks.

Figure 5. Common larval mosquito habitats. Left: a groundpool filled by rainfall and overbank river flow, Berri-Loxton Road: a habitat for *Aedes camptorhynchus*. Right: a water-filled roadside ditch with emergent grass, Renmark: a habitat for *Culex annulirostris*. Photographs: S.R. Fricker.

Table 1. Features of habitats for the larvae of mosquito species in the Riverland and Murrayland.

Species	Habitat	Water Source	Salinity Trophic Status	Larval Habit
Aedes alboannulatus	Riparian and non riparian groundpools, floodplains	Rainfall, river flow	Fresh, oligotrophic	Caudal siphon at surface
Aedes camptorhynchus	Non-riparian groundpools, floodplains, samphire swamps	Rainfall, river flow, irrigation, tidal inundation	Brackish, oligotrophic	Caudal siphon at surface
Aedes notoscriptus	Phytotelmata, artificial containers	Rainfall, anthropogenic flow	Fresh, oligotrophic	Caudal siphon at surface
Anopheles annulipes	Riparian groundpools	Rainfall, groundwater, river flow, irrigation	Fresh, oligotrophic	No caudal siphon, body horizontal at surface
Coquillettidia linealis	Riparian groundpools, wetlands	Groundwater, river flow	Fresh, oligotrophic	Siphon pierces submerged plants, body submerged
Culex annulirostris, *Culex australicus*	Riparian and nonriparian groundpools, floodplains, wetlands	Rainfall, river flow, irrigation	Fresh, oligotrophic	Caudal siphon at surface
Culex quinquefasciatus	Riparian and nonriparian groundpools, floodplains, wetlands, artificial containers	Rainfall, river flow, irrigation, anthropogenic flow	Fresh, oligo-/eutrophic	Caudal siphon at surface

Table 1 shows the larval habitats of the eight common mosquito species. Based on these associations, the Lower Murray Valley can be sub-divided into five sub-regions:

- *Upper Murray* (Renmark–Morgan). A meandering river and broad floodplain with many groundpools. Common species are *Anopheles annulipes* and *Coquillettidia linealis*, in fresh water, and *Cx. annulirostris* and *Aedes camptorhynchus*, in fresh and saline water.
- *Mid-Murray* (Morgan–Mannum). The channel is flanked by cliffs and a narrow floodplain. Dominated by *Ae. camptorhynchus* and, to a lesser extent, *Cx. annulirostris*.
- *Lower Murray* (Mannum–Meningie). Saline samphire swamps and irrigated dairy farms are common habitats, dominated by the salt-tolerant *Ae. camptorhynchus*.
- *Plains* (north of a line through Karoonda and Alawoona). Sandy calcareous mallee, woodlands and grassland areas with sparse numbers of *Cx. australicus* and *Ae. alboannulatus*.
- *Urban*. Cities, towns and settlements providing typical habitats for *Ae. notoscriptus* and *Cx. quinquefasciatus*.

The dominant species in these sub-regions change seasonally (Fig. 6). In cooler months, *Ae. camptorhynchus* is common in Lower Murray areas, and spreads upstream in autumn and spring. In summer, freshwater species like *Cx. annulirostris*, *Cq. linealis* and *An. annulipes* dominate in the Upper- and Mid-Murray. *Cx. annulirostris* develops in high numbers during hot, wet summers when there are overbank flows from the river.

In autumn, winter and spring, *Ae. camptorhynchus*, *Ae. alboannulatus* and other bushland species are prone to attack humans. In summer, *Ae. notoscriptus* and *Cx. annulirostris* (Upper-, Mid-Murray) or *Ae. camptorhynchus* (Lower Murray) attack outdoors, and *Cx. quinquefasciatus* attacks indoors.

Apart from their nuisance value, the main threat posed by mosquitoes to human health is the spread of zoonotic arboviruses. Historically, the most common of these in the Riverland region is Ross River Virus (RRV), which causes a debilitating fever, rash and polyarthritis. It originates in viraemic macropod reservoirs (e.g. kangaroos), and is carried to humans by infective mosquitoes. The main vectors are *Cx. annulirostris* in inland regions and *Ae. camptorhynchus* in coastal regions (Russell and Kay 2004). Local studies are needed, as the ecology of RRV varies and arboviruses have not yet been isolated from mosquitoes in South Australia.

The Riverland and Murrayland regions have overlapping seasonal and regional mosquito communities that could prove useful as indicators of environmental change. For example, salinization may favour salt-tolerant species (e.g. *Ae. camptorhynchus*), as demonstrated in Western Australia (Lindsay et al. 2007). A warmer future climate could promote *Cx. annulirostris*, which grows best in warm conditions, and discourage *Ae. camptorhynchus*, which is favoured by cool temperatures.

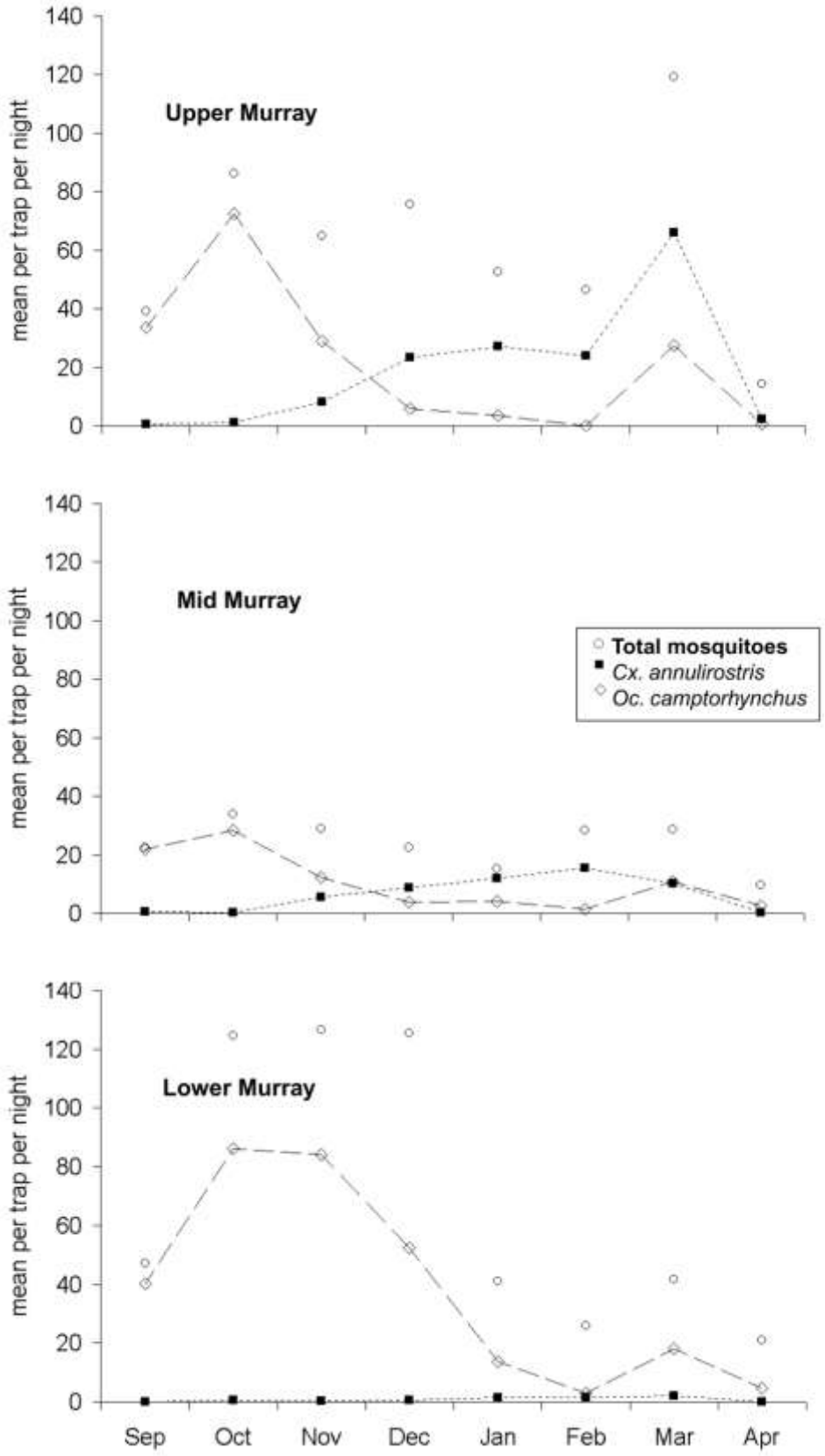

Figure 6. Mean monthly abundance (1999-2005) of adult female *Culex annulirostris* and *Aedes camptorhynchus* mosquitoes in CO_2-baited traps at 30 sites along the Murray River. Upper Murray sites are from Renmark to Waikerie, Mid Murray sites are from Morgan to Mannum and Lower Murray sites are from Mypolonga to Meningie. Source: C.R. Williams (unpubl.).

Crayfish

The Lower Murray is, or rather was, home to two species of freshwater crayfish, the ornately-spined Murray crayfish, *Euastacus armatus* (Fig. 7), and the familiar yabbie, *Cherax destructor*. The Murray crayfish, a riverine species, is now virtually extinct in South Australia, but the yabbie is very common in billabongs, back-waters, swamps, small streams and wetlands. Yabbies also occur in the river channel, in areas impounded by the weirs, but they are not a true big-river species.

Figure 7. The Murray crayfish, *Euastacus armatus*. Photograph: M.C. Geddes.

Both crayfish are members of the Parastacidae, found in Australia, New Guinea, New Zealand, South America and Madagascar, as a legacy of Gondwana (Scholtz 1999; Crandall 2002). The family attains its peak diversity in Australia, where there are over 100 species, including highlyspecialized burrowing forms and the largest crayfish in the world, the giant Tasmanian crayfish *Astacopsis gouldii*, which can attain 5 kg.

The Murray crayfish grows to 3 kg, and is second largest. The Murray crayfish is the only inland representative of more than 30 species of *Euastacus*, typical of mountain streams in eastern Australia. Like its relatives, it has little tolerance of high temperature and low oxygen. Its sensitivity to water quality is illustrated by a widespread "crawl-out' of crayfish recorded in 1992-93, in the middle Murray downstream of the Barmah-Millewa Forest, in response to low-oxygen water (<2 mg L^{-1}) (McKinnon 1995).

Murray crayfish breed in autumn (April-May), around the time that the adults moult. The males deposit a sperm package near the base of the female's second last pair of legs, and the eggs are fertilized as the female extrudes them. The eggs attach to the swimmerets of the female, and are carried for 4-5 months. They hatch in spring, and the juveniles are carried for a further 3-4 weeks. They are slow-growing, mature at about six years, weighing 300-500 g, and attain 1 kg after about 10 years. They may live for several decades.

Murray crayfish were once distributed throughout the Murray and Murrumbidgee rivers, and were an important food for aboriginal people. They have disappeared from 700 km of their former river habitat (Walker 1982; Versteegen & Lawler 1997), including the Lower Murray, although they are a protected species under South Australia's *Inland Fisheries Act 1995*. Populations remaining in Victoria and New South Wales are subject to strict fishery regulations.

In the first half of the 20th century, there was a small commercial and recreational fishery for Murray crayfish in South Australia. A survey of 20 professional fishers some years ago indicated that the crayfish once occurred as far downstream as Murray Bridge (Geddes et al. 1993). They were caught from May to August (months without an "r"), and were inactive during warmer months. Catches were good in 1940-1960, with crayfish from 0.5-2.5 kg, but declined after 1965. Occasional specimens were caught until the 1980s, and there have been no records since.

The decline of Murray crayfish may be due to a combination of agricultural pesticides, overfishing and environmental changes related to flow regulation and dislocation by weirs. A study to assess the feasibility of re-introducing them to the Lower Murray (Geddes et al. 1993) showed that 500-g berried females held in ponds may hatch up to 500 juveniles that grow to about 5 g after one year, with 30-40% survival over 18 months. This suggests that hatchery-based restocking is feasible, although this would need to be planned carefully to avoid effects on genetic variability in areas where natural populations remain (Versteegen & Lawler 1997).

The yabbie, *Cherax destructor*, is the most widespread of all Australian freshwater crayfish. Although there are taxonomic doubts (e.g. Lawrence et al. 2002), it appears that *C. destructor* is a distinctive species, and the Riverland is part of its natural distribution. It is difficult to be certain about the natural range because yabbies have been translocated by humans, perhaps over thousands of years (Horwitz & Knott 1995). They are found throughout the Murray-Darling Basin, in the Lake Eyre Basin, in western Queensland, in south-western Western Australia and Tasmania, and from coastal areas of south-eastern and eastern Australia.

Like other freshwater crayfish, yabbies are detritivores or herbivores, but may act as predators in some situations. They breed from late spring until autumn. Eggs are attached to the female‘s swimmerets and develop in 4-8 weeks, depending on temperature. The juveniles grow quickly and mature at about one year, weighing as little as 10-15 g.

One of the remarkable features of yabbies is their ability to survive in dry ponds and billabongs. They dig a burrow down to the groundwater table and live in a puddle of water where they can keep their gills moist and respire. In this way, they can survive for several years between floods. Yabbies were once the basis of an important recreational and commercial fishery in South Australia. Catches of more than 100 tonnes per year were reported from Lake Alexandrina in the early 1970s, but are now only a few tonnes. Although there may have been multiple causes for the “crash” of the fishery, it coincided with the invasion by common carp, *Cyprinus carpio*, which prey on small yabbies.

Yabbies have been one of the mainstays of the aquaculture industry in the last 30 years (Geddes & Jones 1997). Most yabbie aquaculture in South Australia has been in the south-east, and on the Fleurieu and Eyre Peninsulas, but there have been small ventures in the Riverland. Yabbies have also been introduced to South Africa, China, south-east Asia and South America. Perhaps the greatest threat to wild populations is the potential for disease and loss of genetic diversity associated with intensive aquaculture.

Freshwater mussels

There are few places along the Murray where you cannot find the shells of freshwater mussels. In some areas, middens of bleached shells attest to their importance as food for aboriginal people who once lived along the river. In others, there may be small piles of shells left by a predatory water rat, or by a fisherman.

Living mussels are common in wetlands and along the river‘s margins. They anchor themselves in the sediment, with hind-end protruding and siphons open to draw in the plankton and other organic particles that provide food. They maintain anchorage with a muscular “foot” that extends into the sediment. Within the shell, the foot and visceral mass are enclosed by plate-like demibranchs that function as gills, and also trap incoming particles and transport them, along mucousladen rows of cilia, to palps where edible particles are diverted to the mouth and the residue is expelled as “pseudofaeces”.

Although the freshwater mussels superficially resemble those on jetty pilings and seashores, they are very distant cousins. All Australian species belong to the Hyriidae, a family shared with New Guinea, New Zealand and South America, and a legacy of the super-continent of Gondwana (Walker et al. 2001). The Murray-Darling Basin harbours several species (Walker 1981), but only two are likely to be encountered in the Riverland region (Fig. 8). These are the river mussel, *Alathyria jacksoni*, and the floodplain (or billabong) mussel, *Velesunio ambiguus*. The two look similar at first glance, and some experience is needed to tell them apart because the shapes of the shells vary with the strength of the current and the nature of the sediment. Appearances aside, they have quite different ecological and physiological credentials.

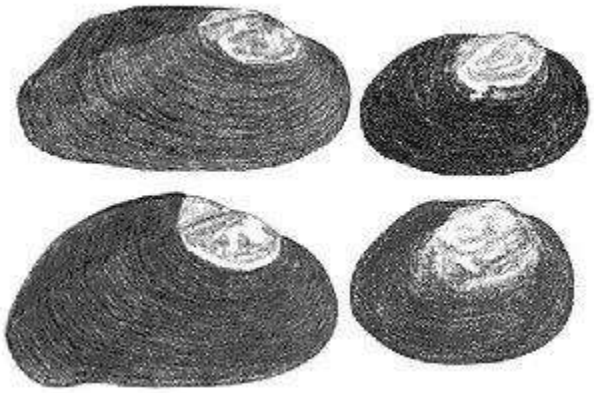

Figure 8. Four shells representing common forms of the river mussel *Alathyria jacksoni* and the floodplain mussel *Velesunio ambiguus*. At top left is the shell of a river mussel from a moderate current, and below it the arched shell typical of fast-flowing water. At top right is a typical shell of the floodplain mussel from the Murray, and below it is a variant from wetlands in the Riverland region. The *Alathyria* shell at lower left is 140 mm long; the others are scaled similarly. The shells are right valves, with the anterior end to the right. From Walker et al. (2001).

Alathyria jacksoni is the larger of the two, with a heavy, elongate shell up to 150 mm long, and may attain an age of 30 years or more. Shells from moderate currents have a straight dorsal margin, whereas those from the strongest currents have a dorsal arch that allows the foot to extend more deeply into the sediment (Fig. 8) (Balla & Walker 1991). This species is rarely found in billabongs and other still-water environments isolated from the river because it does not tolerate low oxygen, high temperatures and dehydration (Sheldon & Walker 1989). Removed from the water, river mussels die within a few days.

The shells of *V. ambiguus* attain 100 mm length and an age of 10-15 years. They may be fragile and rounded, or more elongate, with thickened, heavy valves – their protean character has caused much confusion for taxonomists, and the species well-deserves its epithet. The floodplain mussel may live out of water for a year or more, tightly closing its valves and switching to anaerobic metabolism when necessary. Its capacity to endure drought, low oxygen and high temperatures equip it for life in billabongs and other capricious wetland environments. It does not inhabit fast-flowing water because it cannot anchor itself against the current.

Notwithstanding their differences, the two mussel species often occur together at sites along the Lower Murray. The channel was once the domain of the river species, but this changed with the construction of weirs some 80 years ago. The weir pools favour the floodplain mussel more than the river species, and the former is now abundant in the shallow water along the banks. A similar invasion has occurred among the crayfish, with the common yabbie (*Cherax destructor*) having become common in the channel at the expense of the Murray crayfish (*Euastacus armatus*). The water plants that flourish along the river margins are also wetland refugees, dependent on the stable pools maintained by the weirs (e.g. Walker 2006).

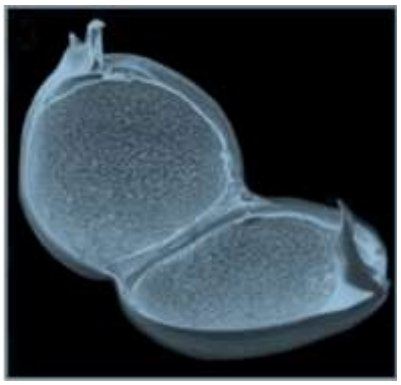

Figure 9. The shell of the glochidium of the river mussel, *Alathyria jacksoni*, measuring 0.27 mm along the hinge between the valves. From Walker et al. (2001).

A remarkable feature of the mussels is that their larvae (glochidia) (Fig. 9) are obligate parasites on fish (Walker 1981). Several native and introduced fish are suitable hosts, but it is not clear whether this is true for the common carp (*Cyprinus carpio*). The glochidia of the floodplain

mussel may also be induced to parasitize tadpoles, and that may account for the occasional discovery of this species in ponds without fish. The male mussels release sperm into the water, to be taken up by the females. Over winter, the females brood their young in a pouch formed within the innermost demibranchs. As the water warms, in spring and summer, they release thousands of tiny (0.25-0.30 mm), bivalved glochidia into the water. If the sensory hairs on a glochidium happen to touch the gills or fins of a likely host, the valves snap shut, a cyst forms and the glochidium metamorphoses, over about three weeks, to become a juvenile mussel. It then breaks free and falls to the sediment, where it burrows for anchorage and protection. After 3-4 years, the young mussel attains sexual maturity and assumes the adult‘s habit, in water 2-4 m deep, along the river banks. Fish, then, are the agents of dispersal. By comparison, an adult mussel could not move far in three weeks!

Are mussels good to eat? In fact they are bland and unlikely to appeal to most palates, although creative chefs can make chowder and similar dishes. The mussels‘ propensity to filter organic particles from the water means that they accumulate metals, pesticides and other contaminants, and they are sometimes used to purify water in aquaculture. And, although the Murray species do produce occasional pearls, those few tend to be brown and misshapen (so-called “baroque” pearls), without commercial value. Nor is the shell likely to be useful to seed “cultivated pearls”, as it is generally thin and discoloured by mineral inclusions.

Snails

The aquatic snail fauna of the Lower Murray includes about 18 native species (Walker 1998; Ponder & Walker 2003). At least, that was true years ago. Most species now have very patchy distributions, and some have disappeared entirely from this region.

The tiny freshwater limpet *Ferrissia* (Ancylidae) is scarcely bigger than an “o” printed on this page. It is still widespread and found attached to snags, rocks or submerged plants, especially the broad leaves of water ribbons, *Vallisneria americana*.

The alien European pond snail *Physa acuta* (Physidae), a pulmonate, is another common species in the river and its freshwater wetlands and tributaries. It has a left-handed coiled shell, and a mottled, pigmented mantle that is clearly seen under the thin, transparent shell. The shell is difficult to distinguish from that of the native *Glyptophysa gibbosa* (cf. Fig. 1d), which occurs in the same kinds of habitats. There is evidence that *Physa* suppresses the growth of *Glyptophysa*, and could have contributed to its decline (Zukowski & Walker 2009).

The Planorbidae are pulmonate snails, variously with high-spired, coiled shells or small, flattened shells. They are rarely abundant, and most are patchily distributed. *Glyptophysa gibbosa* occurs throughout the Murray and freshwater wetlands and streams in the region. *Glyptophysa aliciae* occurs in flowing water in the Calperum and Chowilla areas, but has been recorded from the main channel near Tailem Bend. *Isidorella* has a patchy distribution that includes Pilby Creek downstream to Woods Point, and the Marne River and Reedy Creek catchments. The flattened shelled (planospiral) forms are restricted to a few locations from the Murray floodplain below Mypolonga; they include species of *Gyraulus* and *Helicorbis*.

The Lymnaeidae have distinctive right-handed, coiled shells with a wide aperture, and are notable because some species are vectors for sheep liver fluke. Most regional records of the lymnaeids *Austropeplea* and *Pseudosuccinea* are from the Mannum to Tailem Bend area.

Operculate snails include small species of Hydrobiidae. They include the alien *Potamopyrgus antipodarum,* introduced from New Zealand and now common in still and slow-flowing waters throughout the Murray and streams of the Eastern Mt Lofty Ranges. Others include *Posticobia*, found rarely in wetlands from Murray Bridge to Woods Point and Mitchell Gully Creek, and *Austropyrgus*, from the Marne and Somme Rivers and creeks in the Eastern Mt Lofty Ranges.

Pomatiopsidae are known only from Salt Creek in the Eastern Mt Lofty Ranges. In some saline lakes, beyond the Murray Valley, the shells of *Coxiella* are so numerous that they form dunes on beaches.

Thiaridae, including *Thiara balonnensis*, were last recorded from the Murray at Morgan in 1982, although their shells remain along the river banks and, ironically, living snails have become occasional pests in irrigation pipelines. This is true of the river snail *Notopala sublineata hanleyi* (Viviparidae), described below.

The general picture for snails is drastic reductions in range and abundance and regional extinctions of native species, and a few abundant alien species. While the disappearance of a few snail species may attract little attention, the decline of an entire group is evidence of profound changes in the river environment. Possible reasons for the decline include changes in the composition of biofilms, predation by common carp and changes in connectivity between the river and its floodplain wetlands.

Biofilms are mixed communities of bacteria, algae and fungi that appear as brown-green turf on submerged surfaces, including wood, rocks, plants and sediments (Sheldon & Walker 1997). They are at the base of the food chain for grazing invertebrates, including snails, and there is evidence that their composition may have changed in the aftermath of flow regulation. According to this idea, bacterial biofilms were more common prior to regulation, but the water-level regime introduced by the weirs has caused algae to become dominant. If this is correct, it is significant because bacterial biofilms are more nutritious for grazers. This is reflected in the carbon: nitrogen ratio, as low values (say, less than 10) indicate high nutritional value. In the present-day Murray, the C:N ratios generally are high, albeit variable, and so the biofilms may be an inadequate food resource for grazing snails. This is not true of the biofilms that occur in the dark confines of irrigation pipelines, where at least one snail species has found a refuge (see below).

The common carp gained access to the Murray after illegally imported, wild-strain fish escaped to the river in the 1960s (e.g. Koehn 2004). The carp dispersed rapidly and attained very high numbers, especially after floods in 1974-1975, and now are the dominant fish in the Murray-Darling Basin. Carp are indiscriminate feeders on benthic animals, including snails.

Another factor involves lost connections between the river channel and its floodplain wetlands. In general, flows in the Murray are much depleted by diversions for irrigation and other purposes, and the seasonal pattern of flows also is affected. The changed connectivity between river and floodplain has isolated the channel, the main corridor for dispersal of flora and fauna, from the wetlands that are nurseries and refuges for many species, including some snails.

One species, the river snail *Notopala sublineata hanleyi* (Viviparidae) is symbolic of the changed river environment (Fig. 10). Shells are common along the river banks, and we might suppose that the species is common. Yet *Notopala* began to decline after about 1950, when flow regulation began to intensify dramatically, and had virtually disappeared 25 years later.

Figure 10. Shells of the river snail *Notopala sublineata hanleyi*, with an operculum for comparison. The spires are about 15 mm long. Photograph: K.F. Walker.

In 1992, river snails were "re-discovered" in the Loveday irrigation pipeline (Sheldon & Walker 1993, 1997; Walker 1997). Not only had they returned from the brink of extinction, they occurred in such numbers that they blocked pipes, pumps and sprinklers and fouled the water. Irrigators were obliged to continually unblock their systems, accumulating large mounds of shells. The irony was taken up by the media, evoking headlines like "*The Revenge of the Gastropods"*. Some seasons are worse than others, and the snails have not been troublesome in recent years.

Why has *Notopala* abandoned its natural environment? Its presence in pipelines suggests that neither salinity nor any other water-borne pollutant is responsible, because the pipelines are fed from the river. Part of the answer may be that they are protected from predatory carp, although some carp do occur in the pipelines. Another may be that the biofilms growing on the inner walls of the pipes are bacterial rather than algal (as there is no light to sustain photosynthesis). These biofilms are

nutritionally superior to those found in the river, and that is significant because *Notopala* is viviparous, energetically a more costly mode of reproduction than laying eggs. The snails may have abandoned the changed river environment because the biofilms there now are less nutritious than they require.

Zooplankton

Zooplankton, the free-floating, microscopic, animal component of aquatic food webs, includes Protista, Rotifera and "microcrustacean" (Copepoda, Cladocera). The composition and dynamics of zooplankton in the Lower Murray reflect contributions from headwater rivers, mainly the Murray and its tributaries (particularly the Goulburn), with seasonal inputs from the Darling River (Shiel et al. 1982). In the Murray above the Darling confluence, there is a cool-temperate, essentially lacustrine, microcrustacean-dominated community, drawn from numerous impoundments and backwaters. Algal populations are dominated by the diatom *Aulacoseira* (Hötzel & Croome 1996). The less regulated, highly turbid Darling River contributes a warm-temperate, rotifer-dominated riverine plankton. The turbidity restricts algal blooms, and the dominant zooplankters are bacteriovores. Below the Murray- Darling confluence, there is a mixed assemblage dominated by rotifers, with fewer cladocerans and fewer still copepods.

Plankton samples taken from the Murray near Morgan in 2002-2003 (M.C. Geddes pers. comm., R.J. Shiel unpubl.) contained virtually the same suite of protists, rotifers and microcrustaceans recorded at Mannum by Shiel et al. (1982), more than 25 years ago. The assemblage included the protists *Stenosemella lacustris* (Ciliophora) and *Difflugia gramen* (Rhizopoda), 20 species of Rotifera (*Anuraeopsis, Asplanchna, Brachionus, Conochilus, Filinia, Hexarthra, Keratella, Polyarthra, Proalides, Synchaeta, Trichocerca*) and centropagid calanoid copepods (*Boeckella, Calamoecia*).

Other studies relevant to Riverland plankton include the role of turbidity in structuring zooplankton communities in Lake Alexandrina (Geddes 1984), and the role of river backwaters in reconstituting the microfauna of Murray tributaries (Nielsen et al. 2005).

Rainpool microfauna

Rainpools are the commonest yet least-studied of all standing waters. They include water-filled hoofprints, roadside ditches and shallow depressions on floodplains or rock outcrops, and are often overlooked because they are ephemeral. In fact, they harbour a rich, diverse fauna (e.g. Bishop 1974; Williams 1975; Morton & Bayly 1977; Shiel et al. 1998).

Rainpool inhabitants cope with dry conditions by moving to permanent water, if they are mobile (e.g. insects), or by producing a desiccation-resistant resting stage (cysts, resting eggs, ephippia) which remains in the sediments (e.g. protists, rotifers, microcrustaceans), or by withstanding dehydration as adults ("anhydrobiosis") (e.g. bdelloid rotifers, nematodes, tardigrades), or by aestivating in an arrested, earlier stage of the life cycle. Some propagules remain viable in sediments for more than 300 years (Hairston et al. 1995). There have been studies on the propagules in sediments of the Murray floodplain in the Riverland (Boulton & Lloyd 1991, 1992; Skinner et al. 2001).

Virtually any dry depression contains an animal "seedbank", awaiting rain. The diversity of the seedbank depends on which organisms have reached it and survived to produce a resting stage. Resting stage densities of up to 1200 cm^{-3} have been recorded from rainpool sediments on the Murray floodplain near Wodonga, Victoria (Shiel et al. 2001). In this survey, nearly 500 taxa were recorded, over half (252) of them Rotifera, but more than half of the species occurred at only one or two sites. Thus, even nearby communities are likely to differ, given the diversity of rainpool habitats and the chance nature of dispersal by wind or water.

The speed of response to wetting is remarkable. Protists and rotifers emerge within hours, microcrustaceans and small macroinvertebrates within a day or two, and copepods or ephippial cladocerans are breeding by the third or fourth day. *Boeckella major*, a predatory calanoid copepod of rainpools on the Murray floodplain, completes its life cycle in 1-3 weeks (Green et al. 1999). Fairy shrimps, shield shrimps, ostracods and other crustaceans emerge by day five. Not all the resting stages of a particular species hatch at the same time, providing some insurance against changeable conditions (e.g. Tan & Shiel 1993).

The macrofauna of rainpools is no less diverse. Insects likely to fly in include members of the Hemiptera, Coleoptera and Odonata. Some crustaceans such as Anostraca, Conchostraca, Notostraca,

and Ostracoda, have life cycles wholly adapted to temporary waters (e.g. Williams 1980). Their eggs remain in dry sediments and are blown about by wind, explaining their tendency to appear suddenly, in pools formed after heavy rainfall.

CONSERVATION

For the most part, aquatic invertebrates have a low profile among conservation issues, reflecting our empathy with larger, more conspicuous species (the "charismatic megafauna"). This may change as resource managers become more aware of the loss of biodiversity in the Murray-Darling Basin and elsewhere, although there is a trend to identify and manage threats to entire ecological communities rather than individual species. The salient issue, however, is that we need to broaden our perceptions of "conservation" to acknowledge that invertebrates are a very large part of natural biodiversity, that they are no less fascinating than those animals with more popular appeal, and that they too are sensitive to the changing, changeable environment. The only aquatic invertebrate in the Riverland region listed as "endangered" is the Murray crayfish, although it was classed as a fishery species for the purposes of the legislation. The apparent decline of the molluscs reflects environmental changes, and the freshwater mussels in particular illustrate a common "blind spot" in our perceptions of conservation. These relatively long-lived species may fail to reproduce (strictly, to "recruit") over a number of years, so that when the older individuals die, leaving no successors, it may be too late for remedial action. This lesson has been learned from the demise of related species in other parts of the world. It challenges our tendency to look at the natural world through only a narrow window in space and time.

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CHAPTER 11. TERRESTRIAL INVERTEBRATES

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In contrast with freshwater invertebrates that are confined almost entirely to the freshwater biome along the Murray River (see Chapter 10), terrestrial invertebrates in the Riverland and Murraylands can be found in a wide variety of habitats, from soil and litter through to living on/in plants and animals.

Invertebrates affect all other forms of life by sheer weight of numbers. They make up the bulk of biodiversity and are essential for maintaining the function of ecosystems in many ways. For example, they form an integral part of the food web, they recycle organic matter, feeding on faeces or dead plants and animals, and they make up the bulk of parasitic species (along with microorganisms such as bacteria) which regulate animal and plant numbers.

Almost all species from the region have much broader distributions and can usually be found in adjacent regions of New South Wales and Victoria. Given that the number and diversity of species in the region is enormous, exemplar taxa are used to indicate the breadth and diversity of terrestrial invertebrates in the region.

PLATYHELMINTHES (flat worms)

Platyhelminthes are soft-bodied, generally flattened, worm-like, unsegmented animals, with a wide range of body forms. The phylum is divided into three classes: Turbellaria, Trematoda and Cestoda. The majority of aquatic flatworms are turbellarians. Trematodes (flukes) and cestodes (tapeworms) are parasitic although some trematodes have free-living dispersive stages. The Australian terrestrial cestode fauna is poorly documented, with the best-studied host groups being the marsupials. Overall, cestodes have been reported from only 5% of vertebrate species (Beveridge & Jones 2002). Endemism among Australian flatworms is likely to be low in birds and high in parasites of frogs, reptiles and marsupials, and in free-living freshwater forms.

Quite a few trematode and cestode parasites of domestic animals occur in the region, including liver fluke of sheep and cattle (*Fasciola hepatica*), sheep whipworm (*Trichuris ovis*), sheep tapeworm (*Moniezia expansa*), and stomach hair worm (*Trichostrongylus axei*), which occurs commonly in sheep, other ruminants, and horses. Other examples include the tapeworm *Echinococcus granulosus* (hydatids), in which humans can act as intermediate hosts. Definitive hosts of this tapeworm are carnivores such as dogs, foxes and dingoes, while intermediate hosts are usually herbivores such as sheep, cattle, kangaroos, wallabies, and wombats. Cestodes are also commonly found in reptiles, birds, and marsupials in the region, and just one of many examples is *Oochoristica trachysauri*, a tapeworm from the sleepy lizard, *Trachysaurus rugosus* (Harvey Johnson 1932).

NEMATODES (round worms)

Nematodes are unsegmented roundworms, which are not related to earthworms. They are commonly found in soil and freshwater habitats. Others are parasitic in roots and aerial parts of plants, in vertebrates, and in invertebrates such as insects. Free-living forms feed on living organisms such as bacteria rather than on dead organic matter. Discussion here is limited to terrestrial nematodes living in soil and/or parasitising plants. These nematodes are usually microscopic (most less than 3 mm long). Almost all soils contain nematodes, and in Riverland soils with high organic content there may be hundreds per gram of soil. In a survey of soil microinvertebrate assemblages, Bird (1999) found that nematodes dominated both in numbers and diversity in soils from the shores of Lake Alexandrina and the Murray River estuary at Goolwa (87 and 93% of total numbers of microinvertebrates, respectively). There is little knowledge of most Australian soil nematodes, and most species remain undescribed.

Plant parasites are the best known group of soil nematodes, due to their economic importance. These nematodes feed on plant roots, and occasionally within plant leaves. Tylenchids and aphelenchids have a hollow stylet or spear within the head, which they can insert into plant or fungal cells and through which they can suck out some of the cell contents. Other soil nematodes feed on bacteria, algae, fungal hyphae and other nematodes, and invertebrates such as protozoa, rotifers and enchytraeids (Yeates 1993). Rhabditid nematodes usually feed on bacteria, but some are predatory. They have a tube-like mouth, which may have teeth at its base. Rhabditids are important for the recycling of soil nutrients. Mononchids are predators, with teeth that they use to seize their prey. Dorylaimids include a large group of soil and freshwater nematodes, some of which feed on plants, others on bacteria and algae and possibly fungal hyphae, while some are predatory. The size and form of the spear is variable in dorylaimids; with long and slender spears in plant parasites, and short, hollow forms with wide openings in bacterial and algal feeders.

Soil nematodes are generally able to survive long periods of desiccation, important for their survival in many Riverland soils. They may survive dry periods as eggs, or they may coil and become inactive as the soil dries out, entering a state of anhydrobiosis in which metabolism is suspended. Whilst in this state, nematodes are brittle and their cuticle (body covering) is easily damaged by sharp soil particles. However, provided they are not damaged, they recover their normal functions when soil moisture rises again.

Many species of nematodes and a few genera associated with native plants are endemic to Australia, and several species are known only from South Australia. The greatest diversity of species is usually found in areas with moist soils, such as gullies. Only one study of nematodes from soils in the Riverland and Murraylands has been carried out (at Ferries MacDonald Conservation Park at Monarto; Frances Reay, unpublished data). Considering the similarity in climate, soils and vegetation, it is probable that the nematode fauna of the region is similar to that of adjoining regions in Victoria and New South Wales, where some survey work has been done (Sauer, 1985). In broad scale farming, there are many records of economically important tylenchids such as cereal cyst nematode (*Heterodera avenae*) and root lesion nematode (*Pratylenchus neglectus*). Root knot nematodes (*Meloidogyne* spp.), citrus nematode (*Tylenchulus semipenetrans*) and the dorylaimid *Xiphinema* sp. are commonly found in horticultural soils. *Sauertylenchus* sp., *Morulaimus whitei*, and *Paralongidorus eucalypti*, all widespread in Australia (McLeod et al. 1994), have been recorded from Ferries MacDonald Conservation Park. Also recorded were various rhabditids and dorylaimids, including stubby root nematode (*Paratrichodorus* sp.), which has a long stylet and feeds from outside a root, while the tylenchid genera *Radopholus* (burrowing nematodes), *Scutellonema* (spiral nematodes), *Hemicriconemoides*, *Criconemoides* (ring nematodes), and *Hemicycliophora* (sheath nematodes) are also known from this locality (Waite Insect and Nematode Collection, The University of Adelaide).

Figure 1. Shoot bud gall of *Fergusonina lockharti* (Photograph: Gary Taylor).

The river red gum *(Eucalyptus camaldulensis*) is host to at least four different combinations of cecidogenic (gall-forming) species of the nematode *Fergusobia* and fly *Fergusonina*. These nematodes and flies together form unique, species-specific mutualisms, in which the nematode relies on the fly for transport, and the fly on the nematode for gall induction (Taylor et al. 2005). Galls vary in form from large shoot bud galls (Fig. 1), which support hundreds of flies and nematodes, to flower bud galls, _stem' galls and small axial bud galls that only support a few flies and accompanying nematodes.

ANNELIDA (segmented worms; earthworms and leeches)

Apart from leeches (Hirudinea) which are treated in Chapter 10, earthworms (Oligochaeta) are found widely in the Riverland and Murraylands. Introduced earthworms (mostly Lumbrucidae), including *Aporrectodea* spp., are more likely to be encountered than native species, especially in disturbed areas such as pastures, orchards, vineyards and gardens. This was the case in a survey of citrus orchards between Waikerie, Loxton and Paringa (Dalby 1999). Lumbricids were introduced into Australia by European settlers, and are native to Britain and other European temperate regions. Once introduced into a new area, they have the ability to breed rapidly and colonise new areas, often surpassing the original native species. The tiger worm, red worm or composting worm (*Eisenia fetida*), which is widely sold for composting, also occurs in the region, although it prefers rotting vegetation, compost, and manure rather than soil.

Megascolecidae is the only indigenous family of earthworms in South Australia, and although the fauna is impoverished, species endemicity is relatively high (Jamieson 1974, 1981). Jamieson (1974) suggests that the paucity of the fauna is correlated with the low rainfall over most of the state. Unfortunately, most research in South Australia on earthworms appears to have taken place in higher rainfall areas (e.g. Mt Lofty Ranges, Fleurieu Peninsula and the South-East). Species from the Riverland and Murraylands include *Heteroporodrilus shephardi*, collected near Bordertown and extending to the Wimmera River in Victoria (Jamieson 1974; Blakemore 1999, 2000), and *Gemascolex lateralis*, collected near Tailem Bend but more widely distributed in the Mt Lofty Ranges and Fleurieu Peninsula (Jamieson 1974).

MOLLUSCA (snails and slugs)

Introduced land snails are very common in the region and are often a severe problem. These include the common white snail or vineyard snail (*Cernuella virgata* – Fig. 2), white Italian snail (*Theba pisana*), conical/pointed snails (*Cochicella acuta* and *C. barbara* – Fig. 3), and small brown snail (*Microxeromagna vestita*). The garden snail (*Helix aspersa*) is also common in areas that are regularly irrigated (e.g. orchards and gardens). *Cernuella virgata*, *T. pisana* and *Cochicella* spp. can be seen aestivating in the drier months on trees, fence posts, buildings or vegetation (Fig. 2). Aestivation is a form of dormancy where the snails seal off their aperture (opening) with a membrane and remain inactive for long periods of time.

Figures 2-3. 2 (left), Common white snail, *Cernuella virgata*, aestivating on an old headstone at Black Hill Old Cemetery SA (Photograph: Gary Taylor); **3** (right), conical snail, *Cochicella* sp. (Photograph: SARDI Entomology).

Two introduced slug species, *Lehmannia flava* and *Milax gagates*, are common in irrigated situations. The former species is larger and yellowish, whereas the latter species is smaller and black.

CRUSTACEANS (slaters and land-hoppers)

Terrestrial crustaceans such as isopods (Isopoda) (slaters) from the region are poorly known, but include the introduced European woodlouse (*Porcellio laevis*), the common woodlouse or pillbug (*Armadillidium vulgare*) and the delicate slater (*Porcellionides pruinosus*). Slaters are commonly found under debris and leaf litter in moist situations. Land-hoppers (Amphipoda) such as *Austrotriodes crenatus* are also common in shadehouses.

MYRIAPODS (millipedes and centipedes)

Millipedes (Diplopoda) are long, thin arthropods with two pairs of legs on most posterior body segments (Harvey & Yen 1989), which feed largely on decaying plant material. Native millipedes have been poorly studied in the region, however the familiar introduced black Portuguese millipede (*Ommatoiulus moreletii*) occurs throughout the region and is mostly seen during the wetter times of the year.

Centipedes (Chilopoda) are long, thin arthropods, which unlike millipedes, never have more than one pair of legs per body segment (Harvey & Yen 1989). They live in moist situations such as in rock crevices, litter or under bark, and come out only at night to hunt and feed on insects, snails, worms and other smaller centipedes. Most species inject venom into their prey and, although the bite may be painful to humans, it usually only results in localised swelling and irritation. Colloff et al. (2005) recently provided the first comprehensive key to Australian centipedes. The widespread genera *Scolopendra*, *Cormocephalus* and *Ethmostigmus* occur in the region, as does the introduced European house centipede (*Scutigera coleoptrata*).

ARACHNIDS (spiders, scorpions and their relatives)

Araneae (spiders)

The region represents a meeting point for many South Australian arachnids. Here many species from the higher rainfall south-eastern Australian region overlap in distribution with those of the semi-arid north. Additionally there is an influx of species following the riverine habitat from the eastern states and probably the most obvious of these is the common large River Murray huntsman spider (*Holconia murrayensis*) (Sparassidae) associated with the river red gums that provide adequate shelter in the form of hollows, crevices or large loose slabs of bark (Hirst 1991). Other spiders found along the river as an extension from the east include the water spider (*Dolomedes facetus*) and the jumping spider *Astia.*

In general terms most spiders are divided into the Mygalomorphae in which the fangs lie parallel and the Araneomorphae in which the fangs of most species are pincer-like. The Araneomorphae are further divided into primitive and more advanced families. Raven et al. (2002) have provided an interactive key to the identification of spider families.

The Mygalomorphae are known for their long life span and the females are often not seen unless the burrows are excavated. Males are more likely to be encountered as they wander in search of a mate in times of high humidity, usually after rain. Of the Idiopidae, *Blakistonia aurea* occurs to the west of the river and at least one species of *Aganippe* is found in the southern area. Both species have a door to a deep burrow with that of *Blakistonia* being semi-circular with a crenulated lip to both door and burrow entrance, and shaped like a clam shell. Other trapdoor spiders known from the Murraylands include at least three species of mouse spiders (Actinopodidae) which are the only mygalomorphs where the male wanders during daylight hours. The red-headed mouse spider (*Missulena insignis*) (Fig. 4) is common, whereas *M. rutraspina* is found in the extreme north-eastern sector and the smaller *M. dipsaca* is found in the mallee belt through to Western Australia (Faulder 1995). These two species have a black or blue-black head and females of all species are stout, dark brown to black, while that of *M. insignis* can be much larger than the male. Another large black conspicuous species is the brush footed trapdoor (*Idiommata scintillans*), the male of which has a coat of silvery hairs on the head (Raven 1994). The doors to their shallow burrows are well camouflaged and difficult to find.

Figure 4. Red-headed mouse spider (*Missulena insignis*) male, near Blanchetown SA (Photograph: Gary Taylor).

Aname robusta (Nemesiidae) may have the honour of being the first spider described from the Riverland and Murraylands but its status is obscure. Although the type from Mannum is in the Australian Museum, no other specimens have been attributed to the species. A pale *Aname* species occurs in the mallee country west of Morgan and other similar species are known in the southern areas. Species of *Kwonkan* are known to occur throughout the region but burrows are hard to find as a collar of loose silk is pulled together during the day to cover the entrance. Other species of Nemesiidae may spin a thin sheet of silk over the burrow entrance but none have trapdoors. The black wishbone spider group is represented by one large species, *Aname* sp., and aggressive males may be encountered after rains inciting fear that they may be the infamous funnel-web spider. In the northeastern sector the whistling or so called _bird-eating‘ spider (*Selenocosmia stirlingi*) is locally common. Grasshoppers, other large insects, frogs, small lizards and the occasional mouse are likely to be a part of its diet as they are generally nocturnal (Kotzman 1990).

Primitive araneomorph families found in the region include Segestriidae (*Ariadna* or *Segestria*) in which some species construct strong dense tubes of silk under the bark of trees with the base of the tube often firmly secured in a borer hole or crevice, while others live in silk-lined burrows in the ground. Of the Oonopidae, also known as six-eyed spiders, the pouched spider (*Grymeus robertsi*) is one of many species found in the area. All are of smooth appearance, yellow or red-brown in colour and are seldom seen due to their small size and habit of living under bark, rocks or in leaf litter (Harvey 1987b).

River red gums provide an important habitat for many tree dwelling spiders found in the region and of these a number of species can be found in large numbers. Close inspection under slabs of old bark will reveal the small cryptic *Wandella murrayensis* (Filistatidae), a small spider with an exceptionally long life and the ability to go long periods with little food or moisture. Hollowed trunks as well as rocky cliffs provide an ideal habitat for the native daddy-long-legs spider (*Wugigara kaurna*) (Pholcidae), while the introduced species *Holocnemus pluchei* and *Pholcus phalangioides*, are more likely to be found in human habitation. Webs of the black house spider (*Badumna insignis*) (Desidae) can be seen in profusion on old red gums that have a thick layer of old bark at the base. Other members of Desidae found in the region include *Forsterina* spp. in sparse webbing under stones or logs, *Phryganoporus davidleei* which usually makes webs in the branches of shrubs, and *P. candidus* which is sometimes communal and produces dense webbing on the foliage of trees and can be a nuisance in orchards (Gray 1983). The much smaller *Callevopthalmus* sp. makes a small web over a depression in the ground and the spider waits for prey in a sheltered crevice at one side. A number of very small desid species are found on tree trunks or in leaf litter, while a pale coloured species inhabits saline areas subject to ephemeral flooding.

Three species of the Nicodamidae, red and black spiders (Harvey 1995), spin sparse webs at the base of tree trunks or in similar sheltered positions. The largest is *Nicodamus peregrinus* and the long legged male is most strikingly coloured. Two smaller species are *Ambicodamus leei* and *Durodamus yeni*. Despite the red colour signifying a warning these spiders are considered harmless. The platform spider (*Corasoides* sp.) (Stiphidiidae), lives in a short burrow in the ground from which a tube of silk rises funnel-shaped into the undergrowth, where it is transformed into a large silken platform above which straggled silk threads act as a knockdown for unwary insects flying through.

The more advanced araneomorph spiders include two species of water spiders (*Dolomedes*) although one species, *D. facetus*, has only been recorded near the Victorian border. Wolf spiders of the genera *Artoria, Trochosa* and *Venatrix* commonly occur on the flood plains of the Murray River with *V. speciosa* and *V. goyderi* being found close to water (Framenau & Vink 2001). The common *V. pseudospeciosa* is often found in gardens that enjoy regular watering. *Lycosa leuckartii* is the largest common species to be encountered and often has makeshift burrows in the cracked soil of the northern part (Steggles et al. 2003), but is replaced by *L. gilberta* in the southern part of the river floodplains. In drier areas away from the river wolf spiders are prevalent with at least 20 species known. Several species, one being *Dingosa serrata,* construct a palisade at the burrow entrance either of leaves, grass stems, small twigs or of silk and soil. Another smaller wolf spider, *Venonia* sp., makes horizontal sheet silk webs amongst leaf litter on the ground which are difficult to distinguish, except perhaps for their larger size, from those made by *Callevopthalmus* sp. (Desidae).

Other spiders which make webs on or near the ground include species of *Steatoda* (Theridiidae) and one introduced species, *S. grossa*, which is associated with human habitation. The tiny *Hadrotarsus* is also often found on the ground. The web of the redback (*Latrodectus hasseltii*) is almost a reverse of *Corasoides* with a funnelled retreat above and a tangle of sticky threads below to snare insects and even small reptiles moving on the ground. The grey house spider (*Achaearanea* sp.) is generally associated with buildings while several other species in the genus can be found in more natural situations, often on tree trunks. The related *Euryopis* sp. can be seen at night hanging on a silk line from the branches of tree trunks feeding on ants much larger than itself. On seizing an ant that is walking along the branch then dropping with it on a silk line, the ant is left powerless with nothing to grip onto.

Tamopsis fickerti (Hersiliidae) employs a different tactic and, on encountering prey, circles it rapidly playing out streams of silk from long spinnerets (hence the name ‗two-tailed spiders') rendering the insect helpless. One member of the Thomisidae, *Tmarus* sp., appears to use the same technique as *Euryopis* while other family members, divided between crab spiders (*Stephanopis* and *Tharpyna*) and flower spiders (*Sidymella* and *Diaea cruentata*), are sit-and-wait predators. *Stephanopis cambridgei* (Thomisidae) is found under bark while a second species has been collected more often in leaf litter. Huntsmen spiders can similarly be divided with the sit-and-wait ambush method being employed by *Isopeda leishmanni* (south of Mannum), *Isopedella cerussata* (northern sector) and *I. saundersi* in mallee areas, while adjacent to the Victorian border is *I. frenchi. Delena cancerides* is rarely seen as it hunts under large loose slabs of bark rather than on tree trunks. This habit is somewhat emulated by *Holconia nigrigularis*, a close relative of *H. murrayensis*, but which is restricted to the drier north-eastern corner of the region and more likely to be found in stands of large *Casuarina* trees. *Pediana occidentalis* can be found north of the river in mallee vegetation and an intricate pattern of drab colours ensues that it is well camouflaged against the bark. The more active badge huntsmen (*Neosparassus* spp.) may be seen at night moving over the foliage of low shrubs in search of prey. Two species common on the east coast, *N. calligaster* and *N. punctatus*, can be found in the southern Murraylands. Another six or seven species known in the area are undescribed. Several are recorded from only one or two localities, only one is found throughout the area and all are restricted to undisturbed natural vegetation. *Keilira sparsomaculata*, one of South Australia's smallest huntsmen, with a body length of less than 1 cm, is another active species occurring in heathland in the south.

Sac spiders (Clubionidae) are represented by two common genera. Pale sac spiders (*Cheiracanthium*) prefer foliage and seem to have a preference for prickly bushes or thistles, while *Clubiona* is found under the bark on trees and constructs short silken tube-like nests (Austin 1984). Also found on trees and shrubs are some members of Gnaphosoidea, a large group comprised of several families which include the Gnaphosidae, Gallieliienidae (*Meedo mullaroo* and *Oreo renmark*,

both of which are rarely collected) (Platnick 2002), Prodidomidae with unusual long mid ventral spinnerets (Platnick & Baehr 2006), and Trochanteriidae, members of which are referred to as ‗flat rock spiders' although the common species, *Longrita millawa*, can also be found under bark on tree trunks (Platnick 2002). Liocranidae is little known and one small species of *Orthobula* is recorded by an undescribed species. The notorious white-tailed spider (*Lampona cylindrata*) (Lamponidae) (Fig. 5), naturally occurs under bark or in sheltered rocky areas where it preys on other web building spiders such as the black house spider. There are a number of closely related but smaller relatives, *Lampona gilles*, *L. braemar*, *Lamponina loftia*, *L. asperrima*, *Bigenditia millawa*, *Notosdipus dalby*, *Asadipus bucks* and *Prionosternum nitidiceps* (Platnick 2000). The latter was described in 1909 from Western Australia and represents an element of the Riverland and Murraylands fauna that had a distribution once continuous across South Australia and into Western Australia. Aridification has now confined these once widespread species to the shrinking refuges that remain.

Figure 5. White-tailed spider (*Lampona cylindrata*) (Photograph: Mark Harvey).

The Gnaphosidae are well represented with numerous species of *Encoptarthria* and *Hemicloea*, and at least one species in both *Anzacia* and *Eilica*. Many other undescribed genera and species occur in the region. The extremely flattened species of *Hemicloea* are adapted to living between layers of bark but the other genera are found on the ground, under rocks or living in leaf litter.

Other spiders living on the ground include the large family of spotted ant spiders of which *Neostorena victoria* is a burrower and adorns its burrow entrance with a palisade of large leaves. The female is about twice the size of the male and is possibly the largest species in the family. *Storena formosa* is occasionally encountered under objects on the ground and, as with other members of the genus, has large conspicuous yellow spots on the abdomen (Baehr & Jocqué 1994). The much smaller *Pentasteron intermedium* and *P. storosoides* feed on small black ants, while *Habronestes bradleyi* is usually encountered close to nests of meat ants (*Iridomyrmex*). Little is known of the habits of other species including *Cavasteron crassicalcar* and *C. atriceps*, *Holasteron aciculare*, *H. hirsti* and *H. spinosum*, *Australutica quarens*, *Zillimata* sp. and many other undescribed species.

Numerous species of the closely related Zoridae and Miturgidae occur throughout the region but little is known about them. Zorids may be seen during the day as they move around cautiously through the leaf litter layer, but species of *Miturga* (lined spiders) are strictly nocturnal and make silken tube-like nests under stones, logs or even in dense low shrubs near the ground. The white and yellow spotted *Supunna picta* (Corinnidae) is often seen as they dart about in open areas even on sunny days. Other genera such as *Poecilipta* are more ant-like in appearance and may have metallic hues. An unnamed genus and species with a colourful reddish or even blue anterior body constructs short burrows in the ground with a palisade of silk-bound debris rising from the entrance.

Jumping spiders (Salticidae) may well be the most diverse and numerous group in the region, however most are small and grey or brown coloured and not readily seen. *Ocrisiona melancholica*, *Helpis occidentalis*, *Servaea vestita*, *Breda jovialis* and *Clynotis severus* are larger species commonly found under red gum bark. All may be seen hunting on tree trunks during the day. *Breda jovialis* has a distinctive yellow-gold patch on the abdomen and also preys on the black house spider. Small, flattened species of *Holoplatys* and *Zebraplatys* find their way into narrow crevices between the bark of mostly smaller eucalypts. One of South Australia‘s largest and brighter patterned jumping spiders, *Sandalodes superbus*, lives exclusively in rolled bark that has dislodged from a tree and been caught in shrubs below. Although recorded from both the northern and southern fringes of the Riverland and Murraylands, it no doubt would be present along the river valley. *Lycidas* is a large genus with a number of species in the area which are usually seen on the ground. The male of *L. chrysomelas* is brightly coloured and looks very unlike the drab female. Both sexes of *Jotus*, in which most species have a distinctive black stripe along the middle of the abdomen, are often seen during summer days in a variety of habitats close to the ground. A species of *Grayenulla*, though commonly collected in pitfall traps, is seldom seen and little is known of its habits. Another family of spiders that have jumping movements, particularly when disturbed, is Oxyopidae. *Oxyopes molarius*, *O. amoenus* and *O. quadrifasciata* are all of similar appearance and live in low herbaceous vegetation. The eggsac is constructed in the upper branches and the female sits astride it guarding against predators.

Many spiders are known to ‗balloon‘ or travel across country on wind-carried silken threads. This practice is not restricted to young spiderlings dispersing from the maternal nest but includes adult midget spiders (*Laetesia* and *Dunedinia* spp.) (Linyphiidae) and even small wolf spiders of the genus *Artoria*. For those species the Murray River is certainly no barrier to dispersal to new suitable habitats. It is likely that the orb-weavers (Araneidae) are also adept at ballooning as at least the larger common garden orb-weavers (*Eriophora heroine*) appears to have established in New Zealand (Court & Forster 1988). Along with *E. biapicata*, this species is found in natural areas or cultivated paddocks, although *E. biapicata* prefers to make a web higher up off the ground whereas *E. heroine* will often have a web lower to the ground in grass. Grass or low shrubs is also preferred by the teardrop spider (*Argiope protensa* and *Gea theridioides*). while the bird-dropping spider (*Celaenia kinbergi*) is more likely to be found hanging in leafy foliage of fruit trees. Orb-weaver species common along the riverbanks that rely on a more humid atmosphere are *Araneus eburnis*, the spiny spider (*Austracantha minax*) which can be seen in semi-communal webs in low shrubs, and the well camouflaged *Larinia phthisica* which makes a small orb web amongst the long grass and sedges (Framenau & Scharff 2008). *Araneus usualis* is normally found on dead trees or branches particularly near water. At least two species of the wrap-around spider (*Dolophones*) are found in the branches of trees and rest during the day with their legs partly tucked beneath the peculiar-shaped body resembling a node on a small branch. *Carepalxis* and a species of *Poltys* have a similar habit but the abdomen of the latter is much higher and its unusual shape can vary considerably (Smith 2006). Numerous orb-weavers of the family Tetragnathidae abound. The long-jawed spiders most often build their orb-webs over water amongst rushes. The golden-orb weaver (*Nephila edulis*) is widespread and can be very common in some seasons (Harvey et al. 2007), while the equally common leaf curlers (*Phonognatha graeffei* and *P. melania*) are less obvious. In borer holes of dead trees *P. dimidiata* shelters during the day emerging at night to make a web. The tiny *Pararchaea* (Pararchaeidae) has been collected from Scott Creek near Morgan. When hunting, the fang bases (chelicerae) are held at right angles to the body and on encountering prey, the fangs likely close upon it rapidly and with some force (Rix 2006).

Opiliones

The paucity of Opiliones in museum collections from the Riverland and Murraylands suggests they may be rare. In fact there have been just four specimens collected from the area. However, it may reflect more their cryptic nature as those four specimens represent three species and three families. The short legged harvestman *Dampetrus gracilis* (Triaenonychidae) was previously known only from Red Cliffs, Victoria (Forster 1949), and following a recent survey near Chowilla is now a new record for South Australia. Two long-legged Opiliones are known, *Megalopsalis* sp. (Megalopsalididae) and the tiny fragile looking *Ballarra* sp. (Neopilionidae) which is considered to be restricted to Gondwanan continental fragments (Hunt & Cokendolpher 1991).

Acari (mites and ticks)

Although many mites are predatory, there are also many species of plant feeders, fungivores, saprophytes, pollen and nectar feeders, microbial filter feeders, and internal and external parasites on a wide range of vertebrate and invertebrate hosts.

Most mites commonly encountered in extensive and intensive agricultural systems are introduced and are usually considered pest species. Among those commonly found in horticultural crops are the pest species two-spotted mite (*Tetranychus urticae*) and bryobia mite (*Bryobia rubriocolus*). Two-spotted mite has a large host range including apple, pear, peach, plum, prune, strawberry, bean, cucurbits, as well as a very wide host range among woody and herbaceous crops and weeds. Both nymphs and adults feed by piercing and sucking the lower leaf surfaces, leading to the development of yellow-green mottling and loss of vigour and yield. The beneficial mite (*Phtyoseiulus persimilis*) is common in horticultural regions where it has been introduced. It is a voracious feeder on all stages of two-spotted mite. Bryobia mite can be found on almonds, prunes, plums, pears, apples and apricots, although it is most damaging to almonds, prunes and sometimes pears. This mite damages epidermal cells by piercing the cells and sucking out the contents. The upper leaf surfaces have a stippled green grey appearance. The bronzing typical of two-spotted mite is not produced.

Eriophyid mites (Atopomelidae), grapeleaf blister mite (*Colomerus vitis*) grapeleaf rust mite (*Calepitrimerus vitis*), and bunch mite (*Brevipalpus californicus*) (Tenuipalpidae) can all be found on grape vines in the region. Grapeleaf blister mite feeds on the undersides of leaves producing yellow areas which develop into raised blister-like swellings on the upper surface. The cavities on the underside of the blister are filled with felt-like hairs. The life cycle of the grapeleaf rust mite is similar except that it mainly occurs on the upper side of the leaves, whereas bunch mites are most commonly found in the bunches and on the undersides of adjacent leaves.

A very common pasture and crop pest in the region is redlegged earth mite (*Halotodeus destructor*) (Penthaleidae). This mite feeds on a wide range of field crops, vegetables, flowers, pastures and weeds. It is mainly a pest of broad-leafed plants and feeds by puncturing plant cells and sucking up the sap, producing a mottled effect which gives the leaf a grey or white appearance.

Not all mites in the region are pest species. For example, several families including Erythraeidae and Trombidiidae have larvae that are parasitic on insects, and have terrestrial adults that are often called red velvet mites, including (*Erythrites reginae*) which is commonly seen in crops and pastures in the region.

The order Sarcoptiformes includes soil mites in the Suborder Oribatida, commonly known as oribatid mites. These are mostly slow-moving, heavily sclerotised mites that are most abundant and diverse in the upper layers of soil and associated organic litter. They feed on dead plant material and associated microfungi. The Sarcoptiformes also includes the Suborder Astigmata, including the common flour mites and cheese mites that infest stored food and which damage stored grain, the house dust mites that cause allergy and asthma in humans, and a wide range of fungivorous and saprophytic species in soil. Many of the Astigmata have a specialised immature form known as the hypopus, which attaches itself to insects for dispersal. The Astigmata also includes feather mites of birds. Domrow (1992) catalogued the species of Astigmata that parasitise Australian vertebrates or occur on their bodies. These include the mites that cause such diseases as scabies (*Sarcoptes scabiei*), scaly leg of chickens (*Knemidokoptes mutans*) and several types of mange in domestic animals (e. g. the ear mite of dogs and cats, *Otodectes cynotis*).

There are about 80 known species of hard ticks, Order Ixodida, in Australia (Roberts 1970; Keirans et al. 1994, 1996). They are all blood-feeding parasites of mammals, reptiles and birds, and are characterised by mouthparts with a large number of backward-directed hooks that are inserted into the host for feeding. Of these, the reptile tick (*Aponomma hydrosauri*), can be found parasitising sleepy lizards (*Trachydosaurus rugosus*) and bluetongues (*Tiliqua* spp.) on the north bank of the Murray River but has not yet been found more than a few kilometres beyond it. The reptile tick, *Amblyomma limbatum*, also occurs in the region north of the 400-mm isohyet (Smyth 1973). Other ticks from reptiles include the goanna ticks *Ap. jimbriatum* and *Ap. undatum* (Smyth 1973), and the common marsupial tick (*Ixodes tasmani*).

Scorpions

The scorpion fauna of southern Australia comprises representatives of three families, Buthidae, Bothriuridae and Urodacidae, all of which are found in the Riverland and Murraylands (Koch 1977). Scorpions are active predators, emerging from their burrows at night to prey upon other invertebrates.

They give birth to live young which are carried on their mothers‘ back for several weeks prior to dispersal. The buthid fauna of the Murraylands comprises several species of *Lychas* and a single species of *Isometroides*, which are characterized by their slender pedipalps and generally mottled yellowbrown colour. Species of *Isometroides* have a highly specialised diet, as they preferentially hunt burrow-dwelling spiders such as trap-door and wolf spiders. The Bothriuridae contains the single genus *Cercophonius* which tend to be best represented in forested ecosystems. *Cercophonius kershawi* occurs in the Murraylands in leaf litter of mallee trees. The Urodacidae with the sole genus *Urodacus* are restricted to mainland Australia (Koch 1977), and include the largest scorpions in the country. *Urodacus manicatus* lives in shallow depressions under rocks in south-eastern Australia, including the Murraylands. The desert-dwelling *U. yaschenkoi* has been recorded near Renmark, Berri and adjacent regions of Victoria and New South Wales, where it digs deep burrows in the soft soil of dunes (Locket 1990) (Fig. 6). *Urodacus armatus* digs shallower burrows on the dune base and interdune swales (Locket 1990).

Figure 6. Scorpion – *Urodacus yaschenkoi* (Photograph: Mark Harvey)

Pseudoscorpions

These are small arachnids, less than 1 cm in length, which resemble scorpions but lack the elongate tail and terminal sting. Although fairly common in most terrestrial ecosystems, they are rarely observed due to their secretive habits. Most research on these animals in South Australia has concentrated on cavernicolous species from the South-East and the Nullarbor Plain. The regional fauna is represented by just a few families. Several species are commonly found under the bark of trees, particularly eucalypts, including the common *Oratemnus punctatus* (Atemnidae), several species of *Conicochernes* (Chernetidae) and at least two species of *Synsphyronus*, *S. dewae* and *S. niger* (Garypidae) (Harvey 1987a). Others occur closer to the ground where they occupy leaf litter and soil habitats. The best known examples include the widespread *Geogarypus taylori* (Geogarypidae), which occurs over much of southern Australia (Harvey 1986), and *Synsphyronus mimulus*, but other families such as the Cheliferidae, Olpiidae and Chthoniidae also occur in the area.

INSECTS

Introduced and native insect pests

Introduced insects are widespread and common in the region, with most being able to be treated conveniently as occurring in either intensive or extensive agricultural systems. Whilst some of the

introduced insects such as the cabbage white butterfly (*Pieris rapae*) and honey bee (*Apis mellifera*) are ubiquitous, most are confined to the agricultural areas, tending not to be so common in natural environments where plant and animal hosts often do not occur.

The intensive agricultural systems include crops such as citrus, stone fruits, grape vines, and vegetables, and also irrigated pastures and some dairying, particularly along the lower reaches of the Murray River. In comparison, extensive systems are mostly dryland where cereals, as well as crops such as canola and field peas, and domestic stock such as sheep and cattle, are farmed.

Introduced insects associated with intensive systems

The majority of introduced insects found in intensive systems are considered pest species. Many of these can also be found in extensive systems.

There are a large number of introduced pest Hemiptera, and among the more significant are: mealybugs such as citrus mealybug (*Planococcus citri*) and the longtailed mealy bug (*Pseudococcus longispinus*); scale insects such as soft brown scale (*Coccus hesperidum*), grapevine scale (*Parthenolecanium persicae*), black scale (*Saissetia oleae*), red scale (*Aonidiella aurantii*) and yellow scale (*A. citrina*); aphids such as the black peach aphid (*Brachycaudus persicae*), green peach aphid (*Myzus persicae*), black citrus aphid (*Toxoptera aurantii* and *T. citricida*), and cabbage aphid (*Brevicoryne brassicae*); and true bugs such as the green vegetable bug (*Nezara viridula*).

Several thrip species (Thysanoptera) are significant in the region, particularly the western flower thrips (*Frankliniella occidentalis*). This thrip can attack more than 250 plant species including many vegetable and flower crops, and many weed species. Preferred hosts include capsicums, lettuce and chrysanthemums (Mound & Gillespie 1997). It causes flecking, silvering or deformation of flowers, growing tips, young foliage, stems and fruit, and can transmit tomato spotted wilt virus. Other species include Kelly‘s citrus thrip (*Pezothrips kellyanus*) (Colloff et al. 2003) and tomato thrips (*Frankliniella schultzei*).

Fuller's rose weevil (*Asynonychus cervinus*), the vegetable weevil (*Listroderes difficilis*) and whitefringed weevil (*Naupactus leucoloma*) are among the more important introduced pest beetles. The economic damage caused by Fuller's rose weevil is mainly confined to citrus, but a wide range of plants such as olive, ornamentals such as roses, some vegetables, as well as many weeds are attacked. The vegetable weevil attacks cruciferous plants, especially cabbages and turnips, celery, carrots, lettuce, silver beet and spinach, winter growing flowers such as pansies, and weeds such as marshmallow and capeweed are favoured by the larvae. Adults also damage crucifers, potatoes and tomatoes. Adult whitefringed weevils (Fig. 7) cannot fly and emerge from the soil in summer. The larvae of this weevil are highly polyphagous and chew the roots of a wide range of plants including clovers, lucerne, peas, water melons, tomatoes, potatoes, rye grass, wheat, brassicas and onions. The African black beetle (or lawn beetle) (*Heteronychus arator*) (Scarabaeidae) is also widespread and common. It has a broad host range including maize, lawns, tomato, cabbage, potato, rhubarb and various garden flowers, and other market garden plants, and a wide range of grasses, but not legumes. Most damage is caused by the last larval stage feeding on roots, while young larvae tend to feed on soil organic matter. Adult beetles chew on stems just below ground level.

A number of introduced pest moths and butterflies can be found in the region, among them cabbage white butterfly (*P. rapae*), oriental fruit moth (*Grapholita molesta*), codling moth (*Cydia pomonella*) and diamondback or cabbage moth (*Plutella xylostella*). The cabbage white butterfly is perhaps the most obvious, and its host plants include cruciferous plants, especially cabbages, cauliflowers, brussels sprouts, broccoli, turnips, radish, and mustard, as well as various weeds and garden flowers.

A wide range of beneficial insects has been introduced into the region as biological control agents. Many of these are minute parasitic wasps such as *Aphytis melinus* (Aphelinidae), which is a parasite of armoured scale insects, particularly red scale in citrus. It lays eggs under the scale cover, and the developing larva feeds on the scale insects killing it, and eventually emerging as another adult wasp.

Figure 7. Whitefringed weevil adult (*Naupactus leucoloma*) (Photograph: SARDI Entomology).

Introduced insects associated with extensive systems

The lucerne flea (*Sminthurus viridis*) (Collembola: Sminthuridae) is a native of Mediterranean areas and is well established in southern Australia. Hosts include medics, clovers, beans, cereals and a wide range of mainly broad-leaved crops and weeds. Lucerne flea causes damage by chewing, and results in the leaf surface having an exposed ‗membrane' or epidermis giving a characteristic ‗window' on the remote surface. Minute black specks of excreta are also present.

The African mole cricket (*Gryllotalpa africana*) (Gryllotalpidae) are quite distinctive. They are velvety brown, thick-set, about 25-40 mm long, and have strong forelegs well adapted for burrowing. The fore wings are very short, but they can fly quite strongly. The hind wings are large and fan-like when unfolded. Mole crickets damage grasses and sometimes tomatoes, vegetable and flower crops by tunnelling through the roots. Succulent stems may be chewed at ground level. They may occasionally chew into root crops such as carrots and turnips.

Among the various aphid (Aphididae) pests of extensive crops are bluegreen aphid (*Acyrthosiphon kondoi*), which is a native of Korea and Japan. It is chiefly a pest of lucerne, subterranean clover and medics but also peas, lentils, yellow lupins and melilotus can be hosts. The aphids suck sap from the terminal areas of plants; those parts that are tender and succulent. Stems often become severely stunted with small leaves and shortened internodes. The leaves turn yellow, curl and may drop off in severe infestations. Cowpea aphid (*Aphis craccivora*), oat or wheat aphid (*Rhopalosiphum padi*), pea aphid (*Acyrthosiphon pisum*) and spotted alfalfa aphid (*Therioaphis trifolii* f. *maculata*) are also common in extensive crops.

Various introduced beetles are pests. These include sitona weevil (*Sitona discoideus*) (Curculionidae), which was first recorded as a pest in New South Wales in the late 1950s, but now occurs across southern Australia, including Tasmania. It is a significant pest of annual medics and lucerne. The pea weevil (*Bruchus pisorum*) which, despite its common name, is not a weevil, but rather a member of the Bruchidae. It is a cosmopolitan pest of field peas, and was first recorded in South Australia in 1964.

A range of storage insect pests are commonly found in and around grain storage areas on farms, and occasionally in people's houses. These include the lesser grain borer (*Rhyzopertha dominica*), granary weevil (*Sitophilus granarius*), rice weevil (*S. oryzae*), and several species of spider beetles (Anobiidae) including the shiny spider beetle (*Mezium affine*). The Indian meal moth (*Plodia interpunctella*) is also commonplace.

Introduced insects associated with domestick stock

As well as pests associated with crops and pastures, there is a wide range of introduced pest species associated with domestic stock. These include fleas such as the cat flea (*Ctenocephalides felis*), dog flea (*C. canis*), and poultry stickfast flea (*Echidnophaga gallinacea*). A number of important lice are also found in the region as ectoparasites of domestic stock and include shortnosed cattle louse (*Haematopinus eurysternus*), longnosed cattle louse (*Linognathus vituli*), and sheep body louse (*Bovicola ovis*).

The sheep nasal botfly (*Oestrus ovis*) (Oestridae), is common and widespread. The female fly lays batches of about 50 newly hatched larvae in or on the nostrils of the sheep; the larvae crawl onto the mucous membrane of the nasal passage, where they remain for at least two weeks. Development of the first instar larva may be delayed for one to nine months, and plays a role in the over-wintering cycle. The pupal stage occurs in the ground and lasts one to two months depending upon temperature.

Sneezing and a mucopurulent nasal discharge (snotty nose) may be a result of botfly larvae. The main effects for the host are persistent annoyance and associated debility.

Introduced beneficial insects are found in the region include dung beetles, such as *Aphodius lividus*, which have been introduced to supplement the native dung beetles such as the threehorned dung beetle or Kershaw's burying beetle (*Onthophagus mniszechi*) (Tyndale-Biscoe 1990). As well, various parasitic wasps such as lucerne aphid parasite (*Aphidius ervi*), are widespread and common.

Species commonly associated with humans and their domestic pets

Apart from those insects included above which can often be found in home gardens, there are a range of insects commonly associated with humans, either in their homes and gardens, or actually attacking humans or their pets.

Several cockroach species (Blattodea) are common in the region, particularly the German cockroach (*Blatta germanica*), Oriental cockroach (*B. orientalis*), American cockroach (*Periplaneta americana*), and the native Australian cockroach (*P. australasiae*). The latter species has been spread by humans so that it is found extensively throughout Australia as well as overseas.

Termites (Isoptera) play an important role in nutrient recycling, but the feeding of some species may be of considerable economic importance with damage occurring to timber in buildings and fences. In the region, common pest termites include *Coptotermes acinaciformis* (Rhinotermitidae), with nests which are subterranean or in stumps or hollowed trunks of dead or living trees, and *Nasutitermes exitiosus*, with largely subterranean nests. Other termites include *Cryptotermes* spp., *Coptotermes frenchi* and *Heterotermes ferox* (Watson and Abbey 1993).

The most widespread introduced earwig (Dermaptera) is the European earwig (*Forficula auriculari*). Earwigs are rather cryptic, small to medium sized insects distinguished from other insects by a pair of forcep- or pincer-like cerci at the end of the abdomen. *Forficula auricularia* can be a pest of gardens and vegetable crops, and is relatively common around homes. In other areas of the state, it has caused damage to the seedlings of emerging canola crops.

The rose aphid (*Macrosiphum rosae*) is the most common insect pest of roses in Australia. Aphids damage plants by sucking sap from plant tissues using highly specialised sucking mouthparts. The usual symptoms of damage are distortion of new leaves and flowers. Aphids also excrete large amounts of honeydew, which can cover the plant, resulting in the growth of sooty moulds and the consequent reduction in photosynthesis and aesthetic appeal. Severe infestations can result in defoliation of the plant and loss of the flowers. As with most aphids, they can breed very rapidly and build up vast numbers, especially in warm, humid weather. The rose aphid parasitoid (*Aphidius rosae*), has been successfully introduced from Italy as a biological control agent (Kitt & Keller 1998).

Recently, bed bugs (*Cimex lectularius*) (Cimicidae), have undergone a dramatic resurgence and worldwide there are reports of increasing numbers of infestations. Bed bugs are wingless bloodsucking insects, oval in shape and 4-5 mm long when fully grown. They are rust brown in colour and change to a deeper red-brown following a blood meal on their human host. Bed bugs are dorsoventrally flattened and being thin means that they can hide in narrow cracks and crevices, making detection often very difficult. The mouthparts of bed bugs are especially adapted for piercing skin and sucking blood, and each nymphal stage requires a blood meal. Like most blood sucking arthropods, they inject saliva during feeding, which has anticoagulant properties. Bed bugs respond to warmth and carbon dioxide of a host and quickly locate a suitable feeding site. Most blood feeding occurs at night, and they generally seek shelter during the day and become inactive while digesting the blood meal. They can survive for long periods without feeding. While their preferred host is human, they will feed on wide variety of other warm-blooded animals including rodents, rabbits, bats, and even birds.

Many species of Muscidae are of economic importance including the cosmopolitan housefly (*Musca domestica*) which is found in association with humans or activities of humans, and was probably introduced with European settlement. It is commonly found around homes and also pig and poultry enterprises, horse stables, and farms. Not only are they a nuisance, but they also can transport disease-causing organisms. Excessive fly populations are obnoxious, and they can pose a public health problem. Other important species include the bush fly (*M. vetustissima*), and the cosmopolitan stable fly (*Stomoxys calcitrans*).

The most common blowfly (Calliphoridae) of the region is the Australian sheep blowfly (*Lucilia cuprina*), which is responsible for initiating most blowfly strikes in sheep. It is, however, not endemic to Australia and was accidentally introduced into Western Australia in the late 1860s, most likely from South Africa (Norris 1990).

Australia's early European settlers introduced honey bees (*A. mellifera*) to ensure a good supply of honey. They are now wild throughout Australia, including the Riverland and Murraylands. Honey bees play an important role as pollinators of crops and wild flowers, but some wild flowers have suffered from the presence of honey bees as these flowers can only be effectively pollinated by native bees or birds (Paton 1997, 2000). As well, by building their hives in places such as hollow tree limbs, birds and small mammals lose places in which to shelter and construct their own nests. Honey bee stings cause intense local pain and swelling, and a severe allergic reaction may occur in some people.

The European wasp (*Vespula germanica*) is native to Europe, North Africa and temperate Asia, and reached the Australian mainland (Melbourne) in 1977. It has since spread rapidly, and can now be found in many towns and cities in south-eastern Australia. Nests are located where shelter is available, with common locations being retaining walls, tree hollows, wall cavities, or underground (Kasper et al. 2008). The nest is made of grey papier mache-like material. If a European wasp is aggravated it may sting, but unlike the honey bee, it can sting multiple times. Some people are allergic to the stings. Through sheer numbers, the predation of European wasps on native insects and honey bees can be deleterious but they can also affect native animals (including birds) through competition for food. The European wasp is sometimes confused with native paper wasps, *Polistes* spp., which are very similar in colour but have antennae that contain yellow, orange or brown markings as well as black. European wasps have antennae that are entirely black. Their nests are also distinctive, being a single ‗honeycomb-like' layer which is usually horizontal. If ‗honeycomb' cells can be seen it is unlikely to be a European wasp nest.

Native insects that have pest status

When environmental conditions are right, native insects can build up in sufficient numbers to become pest species. In intensive systems, this may be a continual problem (i.e. the insect is considered a key pest) or if it occurs spasmodically, then the pest is considered an occasional pest.

The native plague thrips (*Thrips imaginis*) (Thripidae), has been recorded in all states in Australia, and has a host range that includes pears, grapes, peaches, strawberries, roses, and some vegetables. When numerous, they may be found in just about any flowers. Both nymphs and adults cluster inside the flowers and buds where they feed by rasping the surfaces and sucking the exuding sap.

The Australian plague locust (*Chortoicetes terminifera*) (Acrididae) is distributed widely across mainland Australia. Certain conditions lead to migration southward into areas not normally occupied, for example, cereal areas of South Australia. The locust has a wide host range of native grasses, but also attacks cereals, pastures and a range of horticultural crops and weeds. Other native acridid grasshoppers and locusts found in the region include the small plague grasshopper (*Austroicetes crucita*) and wingless grasshopper (*Phaulacridium vittatum*).

The black field cricket (*Teleogryllus commodus*) (Orthoptera: Gryllidae), is found in all southern Australian states, especially where soils are heavy and tend to crack on drying. Young plants of many types may be occasionally damaged. Plants attacked include ryegrass, lucerne, clovers, oat, maize, potato, bean, carrot, strawberry, cotton and sunflower.

Cottonycushion scale (*Icerya purchasi*) (Margarodidae), is considered to be native to Australia, although it was originally described in 1879 from specimens found in New Zealand. Its host range includes citrus, *Acacia* spp., climbing fig (*Ficus* spp.), roses, laburnum, and mulberry. In South Australia, control measures are seldom necessary, as this insect is kept in check by the predacious vedalia ladybird (*Rodolia cardinalis*) and their larvae, and is also parasitised by small flies (*Cryptochaetum iceryae*).

A number of Miridae occur in the region. Although their feeding behaviour is variable, some species are phytophagous and may be pests of crops such as apples, lucerne and stone fruits (e.g. green mirid, *Creontiades dilutus*), but many are beneficial as predators of small soft-bodied insects or insect eggs.

Rutherglen bug (*Nysius vinitor*) (Lygaediae) is found in all Australian states. It has a broad host range including sunflowers, potatoes, stone and pome fruits, young citrus, grapevines, strawberries, crucifers, grain sorghum, linseed, and a range of weeds as well as native plants. Both nymphs and adults feed by piercing and sucking sap from young tissues that may cause wilting, and blackening of young buds.

Another native insect that has made the transition from native plant hosts to crops is the crusader bug (*Mictis profana*). This insect is found in all Australian states. Native food plants include acacias and sennas. It also attacks citrus, grapes, roses and wisteria. Cultivated sennas, cassias, and wattles are frequently attacked. The closely related *Amorbus* bug causes similar wilting of the terminal growing tips, but this species, although similar in size to the crusader bug, lacks the distinct pale ‗cross' on the hemelytra (fore wings) and is restricted to *Eucalyptus*.

Among the commonly found Pyrrhocoridae of the region is the harlequin bug (*Dindymus versicolor*) which may attack a wide range of crop and ornamental plants. The spined citrus bug (*Biprorulus bibax*) is an invader from the eastern states. Both adults and nymphs cause damage to citrus by piercing and sucking with their mouthparts. The result of this damage is a brown stain and gumming on the fruit rind, and premature fruit drop in young fruit or internal damage in mature fruit.

Of the blowflies (Calliphoridae), the hairymaggot blowfly (*Chrysomya rufifacies*) is common, and can cause secondary strike of sheep after initiation by *L. cuprina*, although it generally breeds in animal carcases. Other blowflies include the lesser brown blowfly (*Calliphora augur*) and the eastern goldenhaired blowfly (*C. stygia*).

Among the beetles, the spinetailed weevil (*Desiantha caudata*) (Curculionidae), can be found attacking grasses, including cereals and subterranean clover, and has been reported on other plants including peas and fruit trees.

False wireworms and wireworms from the beetle families Elateridae and Tenebrionidae may be found attacking a wide range of grasses including cereals, as well as other plants including oil seed crops, grain legumes and vegetables.

Various cockchafers (Scarabaeidae) including the blackheaded pasture cockchafer (*Aphodius tasmaniae*), redheaded pasture cockchafer (*Adoryphorus couloni*), and the honey beetle (*Heteronyx flavus*), are all commonplace in the region. The blackheaded pasture cockchafer can be found in pastures and lawns, including bowling greens and golf courses. Dung of horses, cattle and sheep is the preferred food of adults and larvae. It has also been recorded as attacking wheat, where most damage is caused by the third instar larvae. Their feeding can seriously reduce the quantity of available feed during winter and spring. The larvae forage at night culling off pasture plants near ground level and placing pieces within their tunnels. Foraging occurs whilst the soil surface is moist following rain showers. With the redheaded pasture cockchafer, feeding on the roots of pasture plants results in roots being chopped off just below the soil surface. Grazing stock feeding on these plants simply uproot them. Various birds (e.g. ibis) feeding on the larvae will also uproot the pasture.

Several moths of the family Noctuidae are significant pests in the region. The native budworm (*Helicoverpa punctigera*) can destroy flowers, buds and fruit of tomatoes, maize, lupins, sorghum, beans, crucifers, sunflowers, clovers, medics, and many other field crops, pastures and vegetables, as well as many weeds and garden flowers (Fig. 8). The grapevine moth (*Phalaenoides glycine*) can be found attacking grapes, glory vine, fuchsias, Virginia creeper and some native plants. The build-up of the grapevine moth has been satisfactorily checked by predators on many properties in South Australia. The most common of these is the spined predatory shield bug (*Oechalia schellenbergii*) which spears the caterpillar with its proboscis and sucks out the body fluids. Other noctuids that are important include various armyworms, cutworms and loopers.

The lightbrown apple moth (*Epiphyas postvittana*) (Tortricidae) (Fig. 9) can be found attacking almost all cultivated fruit crops, herbs, ornamentals, *Acacia* and most legumes, as well as a wide range of weeds, including capeweed and docks. The caterpillars are usually pale green with a brown head and grow to 12-20 mm long, moving actively over the host plant and sometimes hanging by silken threads. They tunnel into the undersides of the leaves under a cover of fine webbing or web together leaves and buds whilst eating them away. They may also attack fruits that are in contact with each other or with leaves. When disturbed the caterpillars wriggle actively backwards or forwards out of their shelters. Caterpillars skeletonise the foliage, removing irregular areas to leave a ragged

appearance. Leaf margins are often rolled over. Damage to fruit is usually superficial but can provide an entry point for rotting organisms. Damage usually occurs where two fruits touch, where a leaf has been pulled down over a fruit or in the cavity around the stalk. The larvae always feed under shelter.


Figures 8-9. 8 (left) native budworm (*Helicoverpa punctigera*) larvae feeding on lupins; **9** (right) lightbrown apple moth (*Epiphyas postvittana*) (Photographs: SARDI Entomology).

The grapevine hawk moth (*Hippotion celerio*) and the vine hawk moth (*Theretra oldenlandiae*) (Sphingidae) also occur widely in the region, and are occasional pests of grapes. Other sphingid moths are occasionally reported from other plant species. The caterpillars consume the whole leaf and, if present in high numbers, may quickly defoliate the vines.

The larvae of the small citrus butterfly or dainty swallowtail (*Papilio anactus*) (Papilionidae) can be found attacking new foliage growth of citrus and many other plants in the family Rutaceae. The large citrus butterfly (*Papilio aegus aegus*) which is generally confined to New South Wales and Queensland, has been intermittently observed in the region. For example, in 1973-74, when significantly higher rainfall and more humid conditions were recorded, many butterflies were reported from the Upper Murray, Adelaide Plains and Mount Lofty Ranges, but the butterfly has not become established in South Australia.

Native insects in natural habitats

Apart from the aquatic/semi-aquatic insects described in Chapter 10, the Riverland and Murraylands have an enormous diversity of native insects which are mostly restricted to natural habitats. Given the very large numbers of taxa involved, we have not attempted to cover all orders, but have provided examples to the most common groups.

Minor orders

Collembola, Diplura and Protura, although not insects, are all hexapods, that is, they have three pairs of legs. Of these, Collembola (springtails) are the most commonly encountered in soil and leaf litter (Greenslade & Greenslade 1989). Most species of springtails feed on decaying vegetable matter, although fungi, algae and lichens are also an important food source for many species. Some species feed on decaying animal matter, such as earthworms, dead flies or other springtails. One common springtail is the purplish coloured *Hypogastrura* spp. which is often seen in large numbers on the surface of pools after rain.

Apart from the introduced cockroaches detailed above, native species include the brightly coloured *Ellipsidion australe* (Blattidae), often seen on flowers, and *Laxta granicollis* and *Calolampra irrorata* (Blaberidae), both of which can be found under bark and in leaf litter. In the latter two species, it is only the males that are winged.

Among the commonly encountered mantids (Mantodea) are *Orthodera ministralis* (green or garden mantid), *Paraoxypilus tasmaniensis* (Amorphoscelidae) and *Archimantis* spp. (large brown mantids). All three have broad distributions outside of the Riverland and Murraylands.

Several earwig species (Dermaptera) are found in the region. The common brown earwig (*Labidura truncata*) occurs, especially in sandy habitats.

Apart from the locusts and grasshoppers (Orthoptera) detailed above, many other katydids, crickets, grasshoppers and locusts occur in the region (see, for example, Rentz 2003). Conspicuous among these are the inland katydid (*Caedicia simplex*) and the yellow winged locust (*Gastrimargus*

musicus). In a recent survey of Calperum Station, three new species of raspy crickets (Gryllacrididae) were collected (Anon. 2007).

Thysanoptera (thrips) are small insects which can be leaf-, flower-, pollen-, and fungalfeeding, although some are carnivorous on small arthropods. Apart from the pest thrips mentioned above, there are many other species from the region including the giant thrips (*Idolothrips spectrum*) and *Haplothrips victoriensis*, a predatory thrips.

Although several families of Neuroptera occur in the region, the most commonly seen are Hemerobiidae (brown lacewings), Chrysopidae (green lacewings) and Myrmelontidae (antlions). The brown lacewing (*Micromus tasmaniae*), is very common; it feeds on aphids on cereal, pastures and vegetable crops. Green lacewings lay their eggs on stalks for protection, and all life-stages are common. Their larvae are generalist predators, especially of hemipterans such as aphids and scales, and many species cover themselves with debris (including the exoskeletons of their prey). Antlions are mostly ground dwelling, and the larvae of some species construct conical pits as traps for their prey. These pits can often be found in areas protected from rain, such as under raised logs, under cliff ledges along the Murray River, or under or around buildings (Fig. 10). Green lacewing and antlion adults are often attracted to lights.

Hemiptera (bugs, leafhoppers, cicadas, aphids, scale insects, lerps)

The most characteristic feature of the Hemiptera is the structure of the mouthparts which are adapted to extract the liquid contents of plants or animal prey by suction. They are mostly terrestrial and phytophagous (plant feeding), although the suborder Heteroptera includes groups which are carnivorous (e.g. assassin bugs, Reduviidae), and others which show varying degrees of adaptation to aquatic environments (see also Chapter 10).

Figures 10-11. 10 (left) Ant lion pits, Blanchetown SA (Photograph: Gary Taylor); **11** (right) Lerp of *Glycaspis brimblecombei* (Photograph: John Jennings).

Psylloidea (jumping plant lice, lerp insects) are widespread and common in the Riverland and Murraylands. Among these is the white lace lerp (*Cardiaspina albitextura*), which develops regular outbreaks on the river red gum, *E. camaldulensis* (Morgan 1984). Similar outbreaks by the closely related *C. densitexta* occur on pink gum, *E. fasciculosa*, in the South-East, upper South-East and Murraylands. Other species found on river red gums include *Glycaspis brimblecombei*, which produces edible, sugary conical lerps (Fig. 11), *Creiis corniculatus* which forms inedible horn-shaped lerps and *C. costatus* which forms distinctly flattened, white shell-shaped lerps. There are many species that do not produce lerps, most commonly *Acizzia* spp. on *Acacia* and *Cassia*, and *Trioza* spp. on false sandalwood (*Myoporum platycarpum*) and *Casuarina pauper* and various species of *Allocasuarina*. The free-living mistletoe psyllids *Acizzia loranthaceae* and *A. amyemae* feed on the mistletoe *Amyema pendulum* which commonly infests *E. camaldulensis* and black box (*E. largiflorens*) in the region (Taylor 1999).

Common eriococcids (Eriococcidae) found in the region include the gumtree scale (*Eriococcus coriaceus*) which occurs on a range of eucalypts, and *Cylindrococcus spiniferus* which causes galls on *Allocasuarina* spp. Several species of *Apiomorpha*, in which the females form spectacular species-specific galls on eucalypts, occur. *Apiomorpha karschi* is often found on *E. camaldulensis* (Gullan 1984). The woody female gall occurs on stems, with mature galls often aggregating to form large woody swellings which can easily exceed 10 cm in diameter, whereas the small tubular male galls (up to 4.2 mm long) are mostly found massed together on the upper surface of leaves. Other common species include *A. calycina*, in which the female gall is somewhat

cylindrical with a truncate apex. It occurs on *E. dumosa* (white mallee), *E. gracilis* (yorrell), and *E. oleosa* (red mallee) in the region. The female of *A. malleeacola* forms an ovoid gall which can be found on *E. dumosa*, *E. oleosa*, and *E. socialis* (red mallee). The female gall of *A. munita* is a distinctive four-sided gall usually with long extensions at each corner of the gall (Gullan 1984), and occurs on a wide range of eucalypt species. The female gall of *A. strombylosa* has a rough surface covered with small protuberances and resembles the seed cones of *Allocasuarina*/*Casuarina*. As the species name suggests, the female galls of *A. urnalis* are urn-shaped, and in the region occur on *E. dumosa*, *E. gracilis* and *E. largiflorens* (black box).

Whilst many scale insects occur, the armoured scales (Diaspididae) are perhaps more commonly observed. They include *Maskellia globosa* which is unusual in that it is a gall-former and does not produce an external scale. The male galls are small and horn-like and occur either on leaves or associated with the larger rounded female galls on twigs of various eucalypts.

Although cicadas (Cicadidae) are predominantly tropical/subtropical, a number of species have distributions which extend into the Riverland and Murraylands. These include the eastern sandgrinder (*Arenopsaltria nubivena*), the black squeaker (*Pauropsalta encastica*), and the cherrynose (*Macrotristria angularis*) (Moulds 1990). Adults of the latter species have been collected on *Callitris* and *Allocasuarina*/*Casuarina*. An interesting species is *Marteena rubricanta* which is known from only three disjunct areas; Ravensthorpe WA, Morgan SA and Eurabalong western NSW (Moulds 1990). The adults, and possibly the nymphs, appear to be associated with mallee species. Several *Cicadetta* spp., including *C. adelaida*, can also be found along the Murray River.

A number of Cicadellidae (leafhoppers) are particularly characteristic of the mallee areas of South Australia (as well as WA and western NSW) (Fletcher pers. comm.; Fletcher & Larivière 2008). The Subfamily Austroagalloidinae is endemic to Australia, and comprises eight described species, all on *Eucalyptus*, with two endemic to the Karoonda district. Deltocephalinae: Goniagnathini are arid-zone adapted species, with two of the five Australian species described from Keith. Several ant-attended treehoppers (Eurymelinae: Ipoini) have also been found in the region (Fletcher pers. comm.): *Ipelloides macleayi* from Tailem Bend – this species seems to be endemic to South Australia; *Ipoides laeta* from Lyrup Flats Reserve, west of Renmark, also been found in western NSW, western Qld and NT; and, *Anacornutipoa lignosa* from Waikerie – also found in WA and eastern Australia. Two species of treehoppers which live in ants' nests (Eurymelinae: Pogonoscopini) are also known from the region. Of the Membracidae (tree hoppers), a number of species, including *Sextius* spp., are associated with *Acacia*. *Rigula calperum* and *Undarella pulleni* were both described from Calperum Station.

Among the Suborder Heteroptera from the region is the widespread Pacific damsel bug (*Nabis kinbergii*) (Nabidae). Eggs are oviposited singly into grass stems and nymphs and adults feed on soft bodied insects, moth eggs, small larvae and mites.

The adults and nymphs of assassin bugs (Reduviidae) are predacious, almost entirely on other arthropods. They are usually solitary insects and are often conspicuous, sitting near the tips of shoots waiting for other insects to come within reach. Most are regarded as beneficial insects, for example *Coranus trabeatus*, a ferocious reduviid which feeds on a wide range of insect pests. Larger species are capable of inflicting a painful 'bite' and may eject a harmful defensive fluid if handled.

The Lygaeidae (cinch bugs) is a large family with most species being seed-feeders. They are usually brown to red with a hard, elongated body ranging from 4-20 mm in length. The coon bug (*Oxycarenus arctatus*), in which the nymphs are small (~3 mm long), black and with blood-red abdomens, is common, and can be locally abundant on fences, at the base of walls and on areas such as ovals.

Coreidae are large bugs with strong repellent odours. Several species are found in the region, including the crusader bug (*M. profana*, see above) on *Acacia*, *Senna* and *Eucalyptus*.

Figure 12. Nymph of *Poecilometis* sp. (Photograph: John Jennings).

Many different shield or stink bugs (Pentatomoidae) occur in the region. Scutelleridae include *Austrotichus rugosus*, which has been found in leaf litter at Keith, and *Solenotichus circuliferus* from Morgan and Loxton (Gross 1975). A number of *Poecilometis* spp. (Fig. 12), often found under peeling bark of *Eucalyptus* or on *Callitris* (Gross 1976), also occur. *Poecilometis alienus* has been collected from Morgan, Tailem Bend, and Karoonda to Peebinga, *P. stigatus* from along the Murray River, *P. parilis* from Sinclair Flat, upstream of Lock 1, and *P. vermiculatus* from Mercunda and Mannum (Gross 1976). Several other genera occur in the region (see Gross 1975, 1976), often associated with the common trees of the region such as *Eucualyptus, Callitris* and *Allocasuarina*/*Casuarina*.

Coleoptera (beetles)

Beetle genera are detailed in the series _A Guide to the Genera of Beetles of South Australia' (Matthews 1980-1997; Matthews & Reid 2002).

Nearly all members of the Suborder Adephaga are nocturnal predators or scavengers, and several significant families occur in the region. Amongst the predatory Carabidae is the green tiger beetle (*Megacephala australis*), which can be locally abundant and hunts prey at dawn and dusk (crepuscular) on the banks of the Murray River. Also common in the region is the iridescent green carab beetle (*Calosoma schayeri*), a large, active species which hunts lepidopteran caterpillars and other slow-moving prey. It flies at night and is attracted to lights. These beetles can give off an unpleasant smell if handled. Fox scats are sometimes composed almost entirely of the remains of these beetles. Many other carabids (ground beetles) can be found, particularly in mallee vegetation. Also, adults of the aquatic families Dytiscidae (predaceous water beetles) and Gyrinidae (whirligig beetles) are often attracted to lights at night (see also Chapter 10). Watts (2002) provided an identification guide to the genera of Australian water beetles.

About 90% of extant beetles belong to the Suborder Polyphaga, and these proportions seem to be exhibited in the beetle fauna of the Riverland and Murraylands. Several families of Staphylinoidea are found in the region, especially Staphylinidae (rove beetles). They are mostly predators or carrion feeders living in soil and leaf litter. Most are narrow elongate beetles with the posterior half of their abdomen exposed. As well, the carrion beetle (*Ptomaphila lacrymosa*) (Silphidae), is also common, and is most active in autumn and winter months (Archer 2003).

Of the Scarabaeoidea, the families Trogidae, Lucanidae and Scarabaeidae are the most commonly encountered. Several species of *Trox* (Trogidae) are known from the region. Larvae burrow in the vicinity of carcasses, and both larvae and adults feed mainly on skin, fur and feathers. The larvae of lucanids (stag beetles) feed on dead wood, with the golden stag beetle (*Lamprima aurata*) being occasionally collected from *Leptospermum*, *Acacia*, *Eucalyptus* and sometimes from exotic tree species. Scarabs, however, are far more common and abundant than the other families. Geotrupinae are commonly seen in sandy areas after rain, especially *Blackburnium* spp. They feed on buried humus and underground fungi, and adults stridulate when caught. Aphodiinae, including the pasture cockchafer (*Aphodius tasmaniae*) (see above), are mostly dung-feeding beetles. The five horned dung beetle (*Onthophagus pentacanthus*) is common throughout much of the Murray-Darling Basin and further west in South Australia. Adults construct burrows for their young and provision them with animal dung. Adults are nocturnal and often attracted to lights. Several dung beetles which were introduced to control mainly cattle dung also occur in the region (Tyndale-Biscoe 1990 – see above). Melolonthinae (chafers) have larvae which occur in the soil and feed on roots and humus, whilst adults are mostly short-lived and either do not feed at all, or feed on foliage. Of the many genera occurring in the region, the speciose *Colpochila*, *Heteronyx* and *Liparetrus* are associated with

Eucalyptus. Christmas beetles (*Anoplognathus* spp.) can be seen flying in summer. Adults feed on *Eucalyptus* leaves and the larvae feed on rotting wood, humus or grass roots.

Buprestids or jewel beetles (Buprestidae) are widespread throughout the region. Some of the more colourful jewel beetles include *Diadoxus*, whose larvae bore into *Callitris*, *Julidomorpha bakewelli* which can occasionally be encountered in late December in the mallee (Matthews 1985), and *Castiarina* spp. which are mostly collected on flowers of plants such as *Leptospermum* (Barker 2006).

Clerids (Cleridae), many of which are elongate, hairy beetles with distinctive colour patterns, are predacious as both larvae and adults (Matthews 1992). Depending on the species, these beetles can often be collected from flowers (especially *Eucalyptus*, *Bursaria* and *Leptospermum*), or by beating or sweeping vegetation.

Coccinellidae (ladybird beetles) are easily recognised due to their characteristic oval shape and usually bright, often spotted colour pattern. They range in size from 1 to 15 mm in length and have short antennae and legs, which are usually hidden beneath the body when viewed from above (Slipiński 2007). The larvae are soft-bodied, and are often variously coloured with spots, and are usually adorned with spines. Almost all ladybirds are predatory as both larvae and adults, and feed on a variety of small soft-bodied arthropods such as aphids, scales and mites. As such, most ladybirds are viewed as beneficial insects. Apart from *Rodolia cardinalis* (see above), important ladybirds in the region include the transverse ladybird (*Coccinella transversalis*) and common spotted ladybird (*Harmonia conformis*), with adults and larvae of both species being predators of soft-bodied insects. The mite-eating ladybird (*Stethorus* spp.) are also common but often overlooked because of its very small size. In contrast, both larvae and adults of the twentyeight-spotted potato ladybird (*Henosepilachna vigintisexpunctata*) feed on plants such as potato.

The Tenebrionoidea comprises some 28 families occurring in South Australia (Matthews 1987). They are predominantly associated with dead plant matter and the fungi that grow on it, although larvae of Rhipiphoridae and Meloidae are parasitic on other insects. Adults of several families (e.g. Mordellidae and Meloidae) are often collected from flowers. Of the Tenebrionidae, *Lagria grandis* is a common and widespread species with adults found feeding on *Eucalyptus* leaves. *Celibe* spp. and *Helea* spp. (pie-dish beetles) are found in leaf litter, especially in the mallee. *Chalcopteroides* spp. (darkling beetles) are conspicuous blue, green or purple metallic tenebrionids, mainly associated with eucalypts.

The Chrysomeloidea comprises two families, Cerambycidae and Chrysomelidae, both of which are speciose in the Riverland and Murraylands. Numerous longicorn beetles (Cerambycidae) are common, for example, *Phoracantha* spp. which produce oval emergence holes in eucalypts such as the sugar gum. Adults of a number of genera are often seen at lights. These include *Eurynassa* spp. whose larvae bore into the dead wood of *Acacia*. Matthews (1997) has an extensive list of longicorn beetle genera and their host plants in South Australia. Most Chrysomelidae (leaf beetles) are leaffeeding as both larvae and adults, although larvae may exhibit other habits such as stem or root boring and seed feeding. Matthews and Reid (2002) list chrysomelid beetle genera and their host plants in the state. Amongst the common species are *Paropsis* and *Paropsisterna* which feed mostly on eucalypts.

Many species of weevils (Curculionidae) are found in the region. Common weevils include the large and spectacular diamond beetle (*Chrysolopus spectabilis*) which feeds on various acacias at locations such as Monarto South, elephant weevil (*Orthorhinus cylindrirostris*), Eucalyptus snout weevils (*Gonipterus* spp.), and several species of curculio beetles (*Otiorhynchus*), some of which are considered pest species. Amongst the smallest weevils are *Misophrice* spp. which are about 2 mm long and found on *Allocasuarina/Casuarina* where they are believed to be pollen feeders.

Diptera (mosquitoes, midges, flies)

Apart from the mosquitoes (Culicidae), midges (Chironomidae) and other aquatic flies treated in Chapter 10, many other families and species are found in the region. Flies are distinguished by having a single pair of wings on the thorax and a pair of halteres or balancing organs (tiny reduced hind wings).

Tabanidae (March flies and horse flies) are medium to large biting flies, and several species are known from the region. Larvae are carnivorous, preying on insects and snails, and may be found living in damp soil or rotting logs, as well as in aquatic environments. Adults of most Australian

species are blood-suckers, but some are flower-feeders (e.g. *Scaptia*). The blood-suckers are voracious feeders, often hovering before landing and piercing the skin with their needle-like proboscis and absorbing a considerable amount of blood.

Robber flies (Asilidae) are a widely distributed group of predatory flies which are diverse in semi-arid and arid regions. Adult robber flies prey on insects, although some capture spiders. Several species of *Bathypogon*, *Cerdistus*, *Colepia* and *Mauropteron* are known from the region (Lavigne 2003).

Beeflies (Bombyliidae) and hover flies (Syrphidae) are common and widespread in the region. Amongst the more colourful beeflies (Exoprosopini) are *Balaana centrosa*, *Kapua adelaidica* and *K. irwini* collected near Calperum Station, which have distinct clear and black wing patterns (Lambkin et al. 2003). Hover flies of the region include members of the common genera *Simosyrphus* and *Eristalis*, the larvae of which prey on soft-bodied insects.

Tachinid flies (Tachinidae) can be small to large with wingspans up to 35 mm depending on the species. Most have stout bodies covered in bristles and are either grey or black, although some have a metallic appearance and, as a consequence, superficially resemble blowflies. The larvae of tachinids are parasitoids of other insects.

Lepidoptera (moths and butterflies)

Many of the moths listed for the Adelaide Region in McQuillan and Forrest (1985) occur in the Riverland and Murraylands, and here are highlighted just some of the more common species. In autumn, various ghost moths (Hepialidae) can be seen, including the Bardi (Barti) moth (*Trictena argentata*) (Fig. 13), which is common along the banks of the Murray River at Waikerie when they emerge from their pupal cases in the ground near trees. Larvae, pupae and adults were eaten by Aboriginals (see Chapter 6).

The giant wood moth (*Xyleutes liturata*) (Cossidae), is the largest moth in South Australia with a wingspan of up to 200 mm in females and 130 mm in males. Its larvae bore into the woody tissue of eucalypts, particularly the river red gum. Several species of case moth (Psychidae) occur in the region, including the faggot case moth (*Clania ignobilis*) whose older larvae form distinctive larval cases surrounded by twigs of their eucalypt food-plant.

Figure 13. *Trictena argentata* (Photograph: Claudia Taylor).

An interesting moth occurring in the region is *Stathmopoda melanochra* (Stathmopodidae), which deposits eggs amongst colonies of gum tree scales (e.g. *Eriococcus coriaceus*) where the larvae devour them. A number of geometrid moths are common including the red-lined geometrid (*Crypsiophona ocultaria*), angled satin moth (*Thalaina angulosa*) and hakea moth (*Oenochroma vinaria*). The gumleaf skeletonizer (*Uraba lugens*), often found on river red gum, is interesting in that the caterpillars have a characteristic ‘spike’ on top of their head, comprising old head capsules which are shed as they grow. One noctuid, the granny moth (*Dasypodia selenophora*), whose larvae feed on *Acacia*, is commonly seen in late spring resting during daylight hours under eaves or on ceilings.

Butterflies can generally be distinguished from moths by a number of characters, including their day-flying habits, bright colours, presence of a clubbed antenna and the ability to close their wings dorsally over the thorax (Braby 2004). However, there are exceptions! Butterflies belong to two superfamilies, Hesperioidae and Papilionoidea (several families), with most Australian species belonging to the latter. Braby (2004) covers the described butterflies of the region, providing descriptions, habits and larval food plants. As well, South Australian butterflies

are extensively treated by Grund (2008). Several skippers (Hesperidae) can be found in the Riverland and Murraylands, including the sciron ochre or mallee ochre (*Trapezites sciron*), whose males can be observed hilltopping on sand dune ridges. In addition to the small citrus butterfly (*P. anactus*) and occasionally the large citrus butterfly (*P. aegus aegus*) (see above), the only other Papilionidae seen in the region is the chequered swallowtail (*P. demoleus*). Pieridae (whites and yellows) include the cabbage white butterfly (see above), the white migrant (*Catopsilia pyranthe*), which occasionally migrates into the region but does not breed, the common small grass yellow (*Eurema smilax*) (Fig. 14), and the spotted jezebel (*Delias aganippe*).

Nymphalidae are medium to large butterflies and are commonly brown or orange. The common brown (*Heteronympha merope*) is widespread in the region and its larval food plants include *Poa* spp. and kangaroo grass (*Themeda trianda*) (Braby 2004). The meadow argus (*Junonia villida*), Australian painted lady (*Vanessa kershawi*), yellow admiral (*V. itea*), lesser admiral (*Danaus chrysippus*), and monarch or wanderer butterfly (*D. plexippus*), are all widespread and common.

Figures 14-15. 14 (left), small grass yellow, *Eurema smilax*; **15** (right), inland form of the amaryllis azure (*Ogyris amaryllis meridionalis*,) female (Photographs: Roger Grund - http://users.sa.chariot.net.au/~rbg/).

Lycaenidae (blues and azures) are small to medium-sized butterflies, often with wings which have an iridescent blue, purple or green upper and brown or white patterned underside of their wings. Numerous species occur in the region. Perhaps the most often encountered is the common grass-blue (*Zizina labradus*) which occurs throughout Australia. The larvae eat the flowers, leaves and immature seeds within developing seed pods of a wide variety of native and introduced legumes, including lucerne. Other species include the amaryllis azure (*Ogyris amaryllis meridionalis*) (Fig. 15), whose larvae feed on various mistletoes (*Amyema* spp.) growing on *Acacia* and *Casuarina*/*Allocasuarina*. They can be attended by a range of ant species, including *Iridomyrmex* and *Camponotus*. The amethyst hairstreak (*Jalmenus icilius*) also occurs in the region. Its larvae feed on *Acacia* and *Senna* and are attended by *Iridomyrmex*. Other blues include the two-spotted lined blue (*Nacaduba biocellata*) whose larvae live on flower buds and flowers of *Acacia*, wattle blue (*Theclinesthes miskini*) whose larvae feed mainly on *Acacia*, saltbush blue (*T. serpentata*) whose larvae feed on chenopods such as *Atriplex* and *Rhagodia*, and the long-tailed pea-blue (*Lampides boeticus*) whose larvae feed on Fabaceae.

Hymenoptera (sawflies, wasps, ants and bees)

As with other megadiverse orders (Coleoptera, Diptera Lepidoptera and Hemiptera), several thousand species of Hymenoptera occur in the region. Many of the parasitic wasps are 2 mm or less in length, and are difficult to observe and identify even to family level without the aid of a stereo-microscope and specialist taxonomic keys (see Stevens et al. 2007). The order is divided traditionally into Symphyta and Apocrita, with the former being the ‗primitive' sawflies. Apocritans include wasps, bees and ants, and are distinguished from the Symphyta by the narrow ‗waist' (petiole) formed between the first two segments of the actual abdomen (Stevens et al. 2007).

Of the sawfly families (symphytans), Pergidae is the most common, with members of the genus *Perga* being the most abundant. Their larvae or 'spitfires' (Fig. 16), so called because the aggregating larvae rear up when disturbed and regurgitate eucalypt oils, are common on *Eucalyptus.* Adult pergids are, however, rarely seen. Leaf blister sawflies (*Phylacteophaga*) are also common, and mine the young leaves of river red gum and other eucalypts.

Among the apocritan wasps, two families belonging to the Superfamily Evanioidea (Evaniidae and Gasteruptiidae) are widespread in the Riverland and Murraylands. Evaniidae (hatchet or ensign wasps) parasitise cockroach oothecae and adults of several species of *Acanthinevania* and *Szepligetella* can be collected on various flowers, including eucalypts, *Melaleuca* and *Bursaria*, as adults use nectar as an energy source. The larvae of Gasteruptiidae occur in the nests of solitary bees and wasps where they kill the host egg or larvae and then consume the pollen store provided by the host for its developing larvae (i.e. predator-inquilines). As with evaniid wasps, adult gasteruptiids can be found on flowers with an abundant nectar supply or can be seen searching for host nests on tree trunks, banks or ground (Fig. 17). One gasteruptiid, *Pseudofoenus morganensis*, has only been collected near Morgan (Jennings & Austin 2002).

Figures 16-17. 16 (left) 'Spitfires' of *Perga* sp. (Photograph: John Jennings); **17** (right) *Gasteruption* sp., female (Photograph: G. Weber).

Ichneumonid wasps (Ichneumonidae) can be small to very large and are commonly seen at flowers although some species are attracted to light, including *Enicospilus* spp., which are ectoparasitoids of large lepidopteran larvae or symphytan wasps. Whilst many ichneumonids parasitise lepidopteran larvae, others parasitise Hymenoptera, Neuroptera and Coleoptera. Braconids (Braconidae) are minute to large wasps, and amongst the genera in the region are *Apantales*, *Chelonus*, *Cotesia*, and *Bassus* (parasitoids of moth larvae), *Jarra* (parasitoids of beetle larvae), *Aspilota* and *Opius* (parasitoids of dipteran larvae) and *Aphidius* (parasitoids of aphids).

Platygastrid wasps (Platygastroidea) include species which parasitise Cecidomyiidae (Diptera) leaf and stem galls on various plants including *Eucalyptus* and *Acacia*. Amongst the Scelionidae, is the genus *Scelio*, which are parasitoids of locust and grasshopper eggs. Several species are known from the region, including *S. fulgidus* (Murray Bridge - bred from eggs of the Australian plague locust), *S. fulvithorax* (Renmark and Bookmark Biosphere Reserve), *S. imporcerus* (near Keith), and *S. parvicornis* (Waikerie) (Dangerfield et al. 2001).

Many of the ~19 Australian families classified in the Superfamily Chalicidoidea can be found in the region. They are mostly small to minute parasitic wasps. Of these families, species of Pteromalidae have been reared from *Apiomorpha* galls (Hemiptera), Aphelinidae including *Aphytis* (parasitoids of diaspid scales including red scale on citrus) and *Aphelinus* (aphid parasitoids), and Trichogrammatidae (*Trichogramma* spp. which parasitise moth eggs, including *Helicoverpa*) are common. Several chrysidid or cuckoo wasps (Chrysididae) (Fig. 18) occur in the region. The large metallic blue *Stilbum cyanurum* parasitises mud dauber wasps (*Sceliphron*) and potter wasps (*Abispa*) and has probably been introduced.

Figures 18-19. 18 (left) Cuckoo wasp (Chrysididae) (Photograph: John Jennings); **19** (right) *Polistes* nest (Photograph: SARDI Entomology).

The Superfamily Vespoidea (7 families) is very well represented. Pompilidae (spider wasps) are small to large predatory wasps that all hunt spiders or, more rarely, other pompiliids. Several velvet ant species (Mutillidae) occur in the region. The wingless females, which superficially resemble large hairy ants, run around on the ground, tree trunks or walls searching for nests of Vespidae and Apidae. Female velvet ants are capable of delivering a painful sting if disturbed. Numerous species of flower wasps (Tiphiidae) also occur in the region. Most are believed to be parasitic on soil-dwelling beetle larvae, and all species have wingless females. In these species, the male often carries the female from flower to flower while mating. One obvious species is the ‗blue ant' (*Diamma bicolor*) which parasitises mole crickets. The female is about 23 mm long, has a polished blue-green body and reddish legs, and can deliver a painful sting if disturbed. Some species of flower wasps are also implicated in the pollination of sexually deceptive orchids such as the endangered coloured spider orchid, *Caladenia colorata* (Anon. 2005). Vespid wasps (Vespidae) are commonly encountered, including potter wasps (*Abispa*) and paper wasps (*Polistes*). *Polistes* nests are common under ledges on the cliffs along the Murray River (e.g. at Blanchetown and Waikerie) and under eaves of buildings (Fig. 19).

Many genera and species of ants (Formicidae) are represented (Greenslade 1979; Shattuck 1999). Whilst the majority of ants are general predators or scavengers, feeding on a wide range of prey including other arthropods, many are seed feeders. Some also tend sap-sucking Hemiptera and other insects. Among the commonly encountered ants in the region are the meat ants (*Iridomyrmex* spp.), which have nests that can be of an enormous size with tens of thousands of workers. They clear vegetation from the surface around their nest and cover the area with small stones. Some *Iridomyrmex* are associated with butterflies, including the satin azure (*Ogyris amaryllis*). Another common genus is *Camponotus* (sugar ants). They can be seen foraging on the ground and on vegetation by day but more frequently by night. Adults derive their sustenance from the excreta of sap-sucking insects, floral nectaries and seeds. Several species are known to have a mutualistic relationship with *Ogyris* butterflies. Other common ant genera in the region include *Melophorus*, *Meranoplus* (especially in the mallee), *Myrmecia* (bulldog ants and inch ants – see Fig. 20), *Pheidole* and *Rhytidoponera*.

Figures 20-21. 20 (left) inch ant (*Myrmecia* sp.) (Photograph: Brett Smith); **21** (right) male bluebanded bee (*Amegilla* sp.) (Photograph: Remko Leijs). Apoidea from the region include *Sphex* (Sphecidae) which provisions its underground nest with crickets (Gryllidae) and katydids (Tettigonidae), the common mud dauber (*Sceliphron laetum*)

(Sphecidae) which provisions its mud nest with spiders, and *Bembix* (Crabrionidae) which provisions its underground nests with flies or occasionally bees or other wasps. Bees all belong to the Family Apidae, and all native bees in the region are solitary (not social as is the case with the honey bee). They are commonly seen collecting nectar and/or pollen on a wide range of flowers, and include the genera *Ctenocolletes*, *Euryglossa*, *Hylaeus*, *Leioproctus* and *Nomia*. Some of the more conspicuous bees are the solitary blue-banded bees (*Amegilla* spp.) (Fig. 21), which have pale blue bands on a black abdomen. At least one species of these bees shows potential as a pollinator of glasshouse grown tomatoes (Hogendoorn et al. 2006).

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CHAPTER 12. FISHES

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INTRODUCTION

The Murray River is a lifeline for aquatic biodiversity within a generally dry State. Its variety of freshwater habitats including deep river channel, anabranches, floodplain/wetlands, billabongs and stream tributaries has the richest freshwater fish community of the five major biogeographical (drainage) divisions within South Australia (Hammer & Walker 2004). The region under consideration here includes the Murray River and associated habitats and stream tributaries between the SA border and its confluence with Lake Alexandrina just downstream of Wellington. Treatments for nearby associated habitats of the Eastern Mount Lofty Ranges, Lakes Alexandrina and Albert and the Coorong are provided elsewhere (Eckert & Robinson 1990; Sim et al. 2000; Wedderburn & Hammer 2003; Hammer 2004).

Overall, information for the fish fauna of the region is lacking, particularly on historic composition and abundance, but also concerning changes through time and species interactions with the local environment. While the River has attracted general interest, no detailed, systematic historical surveys were undertaken for fishes and records are patchy at best (e.g. Zeitz 1902; Waite 1923). Information on population trends over the past 50 years is limited to a few large-bodied species such as Murray cod and golden perch (callop), using commercial catches as an approximate index (Reynolds 1976a; Ye 2005; Ye & Zampatti 2007). Until recent years, there has been little documented fish ecology research specific to the South Australian Murray, and much of the information is at the moment inferred from interstate studies or anecdotal information (but see Reynolds 1983; Lloyd & Walker 1986; Lloyd 1987; Puckridge 1990; Vilizzi 1998; Vilizzi & Walker 1999; Hammer 2001; Leigh 2002; Smith & Walker 2003ab, 2004ab; Bice & Zampatti 2005; Barrett 2007; Wedderburn et al. 2007; Leigh et al. 2008; Cheshire & Ye 2008ab; Wedderburn 2008; Ye et al. 2008).

Hence there is still much to be discovered about the past and present distribution, biology and status of fishes in the region. Also, in light of highly regulated flow and major modifications to habitat (e.g. river transformed to a series of weir pools), opportunities also need to be taken to conserve remaining natural values.

DIVERSITY OF FISHES

Representative native and exotic species are pictured in Figures 1, 2 & 3. For further taxonomic and general ecological information see: Lake 1971; Scott et al. 1974; Koehn & O'Connor 1990; McDowall 1996a; Young 2001; Allen et al. 2002; Lintermans 2007.

Native fishes A total of 35 native freshwater fish species representing 15 families have been recorded in the region (see Appendix, Figs 1 & 2). These fishes are predominantly temperate/subtropical species endemic to southeastern Australia and all occur more widely in the Murray-Darling Basin or nearby coastal systems; however the region forms a considerable portion of the Murray-Darling Basin range of at least seven species (see Appendix). The best-represented families are the Percichthyidae (cods, basses and pygmy perches), Eleotridae (gudgeons), Galaxiidae (galaxiids) and Atherinidae (hardyheads).

Twenty-six of the 35 listed species are exclusively freshwater forms and thus most can be expected to complete their life cycle in the region. These include the iconic Murray cod and golden perch; protected freshwater catfish, river blackfish, pygmy perches, silver perch and southern purplespotted gudgeon; historically recorded Murray galaxias, chanda perch, trout cod and Macquarie perch; and widely occurring and usually abundant bony herring, smelt and carp gudgeons. The freshwater fishes also include some occasional downstream visitors from the upper Murray-Darling Basin like the spangled perch (which as a member of the Terapontidae is more correctly known as a grunter).

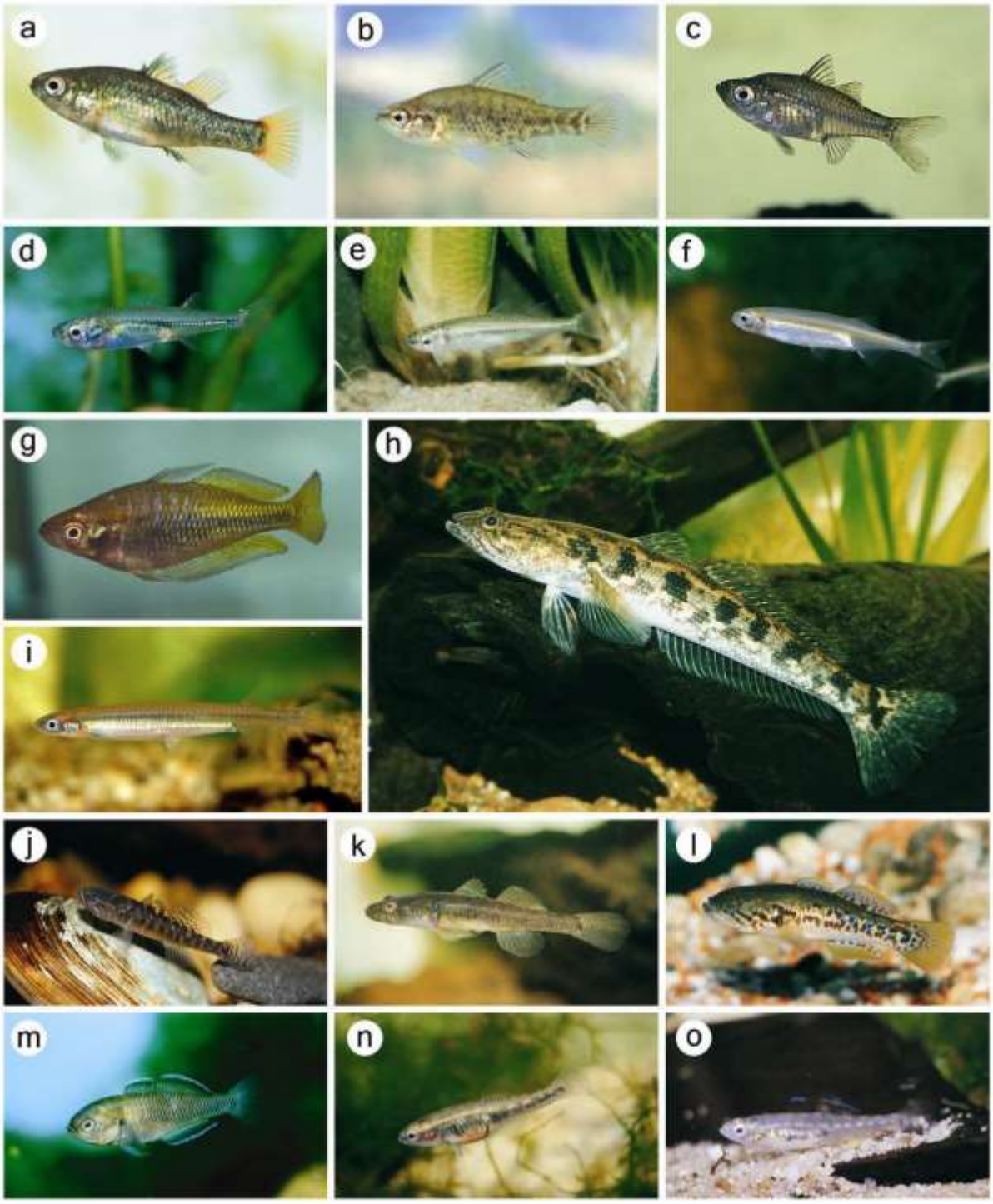

Figure 1. Small-bodied native fishes (i.e. growing no larger than 35 cm, most < 10 cm) of the Lower River Murray, South Australia with indicative common size range: **a)** southern pygmy perch, 3-6 cm; **b)** Yarra pygmy perch, 4-6 cm; **c)** chanda perch, 3-4 cm; **d)** Murray hardyhead, 3-6 cm; **e)** unspecked hardyhead, 3-6 cm; **f)** smelt, 5-7 cm; **g)** Murray rainbowfish, 3-6 cm; **h)** congolli, 11-17 cm; **i)** common galaxias, 5-13 cm; **j)** dwarf flathead gudgeon, 2-4 cm; **k)** flathead gudgeon, 3-9 cm; **l)** southern purple-spotted gudgeon, 4-7 cm; **m)** Midgley‘s carp gudgeon (male), 3-4 cm; **n)** Midgley‘s carp gudgeon (female), 3-4 cm; **o)** western carp gudgeon (male), 3-4 cm.

There are seven diadromous species which migrate between fresh and saltwater habitats for one or more life cycle components or for the purposes of reproduction: pouched lamprey, shortheaded lamprey, shortfinned eel, climbing galaxias, common galaxias, estuary perch and congolli. The remaining three species (small-mouthed hardyhead, bluespot goby and lagoon goby) are euryhaline (broad salinity tolerance), and are extended populations from downstream lentic and estuarine conditions.

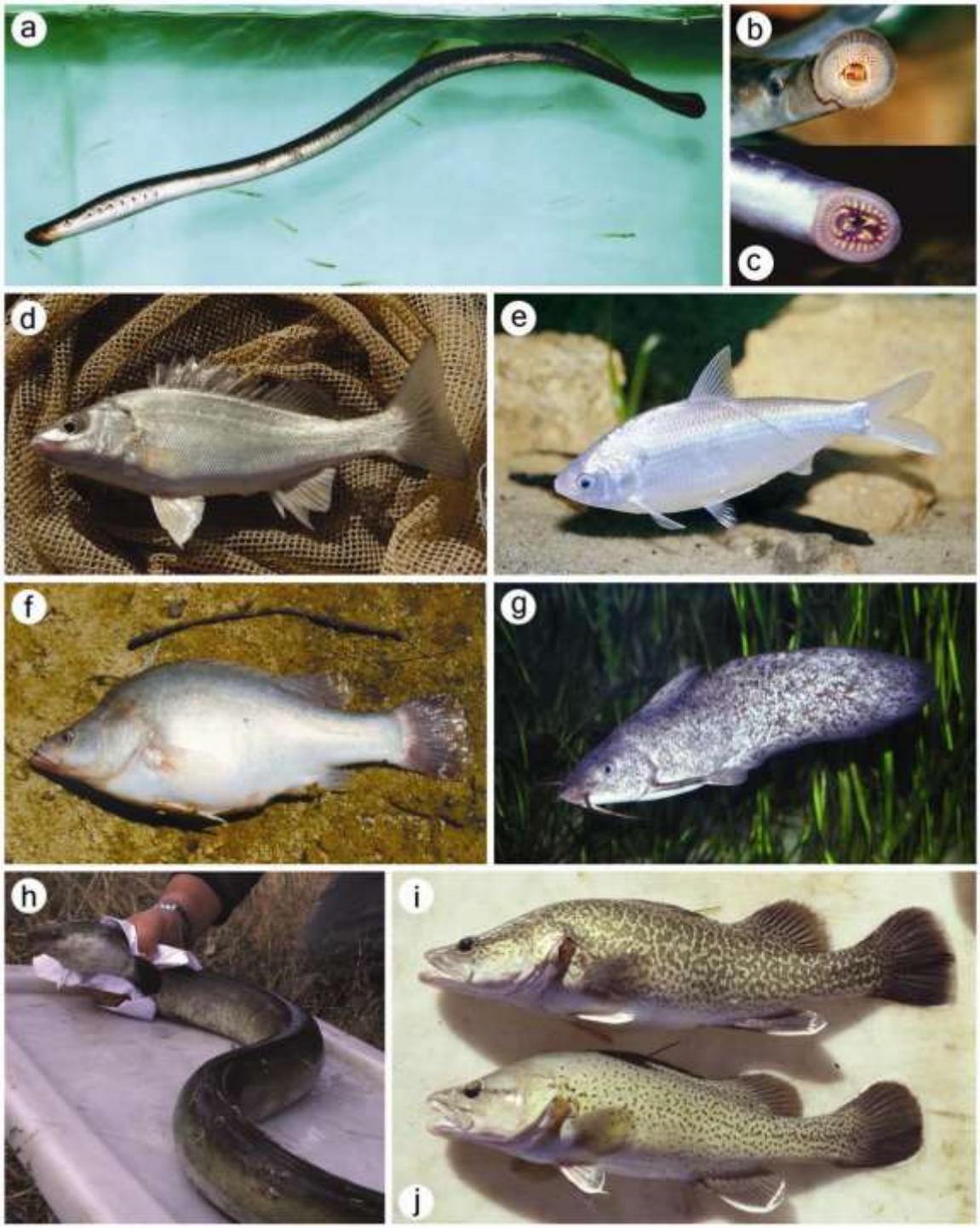

Figure 2. Large-bodied native fishes (i.e. potentially growing larger than 40 cm) of the Lower River Murray, South Australia with indicative common size range: **a)** pouched lamprey, 50-60 cm; **b)** oral disk of pouched lamprey; **c)** oral disk of shortheaded lamprey; **d)** silver perch, 15-40 cm; **e)** bony herring, 10-40 cm; **f)** Murray- Darling golden perch, 25-50 cm; **g)** freshwater catfish, 20-40 cm; **h)** shortfinned eel, 60-100 cm; **i)** Murray cod, 50-150 cm; **j)** trout cod, 40-100 cm.

Other essentially marine/estuarine species have not been specifically included here, although species such as black bream (*Acanthopagrus butcheri*), Australian salmon (*Arripis truttaceus*), mulloway (*Argyrosomus japonicus*), sea mullet (*Mugil cephalus*) and sandy sprat (*Hyperlophus vittatus*) have been reported upstream of Wellington on occasions (Scott et al. 1974; Smith et al. 2007; SARDI Fisheries Statistics; commercial fisher H. Jones pers. comm.). Such species would have had better access to the Lower Murray before the construction of barrages, although predominantly fresh water conditions prior to flow regulation (Sim & Muller 2004) suggest natural habitat would not have been that suitable.

The eventual number of native species from the region may be slightly higher, and our perceptions of conservation status and ecology are sure to change. Taxonomic issues exist with mountain galaxias, smelt and carp gudgeons (e.g. Bertozzi et al. 2000; Raadik 2001; Hammer et al. 2007), and probably other groups. For example prior to the 1980s carp gudgeons in the Murray- Darling Basin were commonly referred to a single common species the "western carp gudgeon". Recent research however, indicates that at least four taxa are actually represented and that hybrids (potential unisexual lineages) between three of these are common (Bertozzi et al. 2000). Preliminary observations suggest subtle biological and ecological differences between different taxa (Unmack 2000).

Alien species

Alien species include species exotic to Australia and Australian native species translocated outside their natural range. Eleven alien species representing seven families have so far been recorded in the region (Appendix). It is possible that more species have been introduced (e.g. via bait bucket translocations, discarded aquarium specimens, other stockings: Lintermans 2004) but captures or established populations have not been reported.

Of the exotic species, common carp have been in Australia for over a century, and have spread widely throughout the Murray-Darling Basin since the release of the "Boolara strain" near Mildura in 1968 (Brown 1996). Rapid proliferation and range expansion of carp occurred during floods in the early 1970s (the first record in South Australia was in 1970: Reynolds 1976a) and they often now dominate the biomass of inland fish communities (Gehrke et al. 1995) including the Lower Murray (Davies et al. 2008). Carp have been implicated in causing damage to riverbanks and aquatic macrophytes, and competing with native fish for food and habitat (Fletcher et al. 1985; Koehn et al. 2000, Sim et al. 2000). The related goldfish was an early introduction (also known as golden carp) and remains common, with occasional hybrids between carp and goldfish occuring. A third cyprinid, tench, was common prior to the arrival of carp (Reynolds 1976a) but is now very rare in the region.

Gambusia is a small species (< 5 cm) that was introduced to Australia in the 1920s originally for use in aquaria and released into the wild for mosquito control (McDowall 1996b). It is now widespread in many areas and is ubiquitous to warm shallow waters associated with regulated Lower Murray wetlands (Lloyd & Walker 1986; Smith et al. 2007). This species is an aggressive competitor that can multiply rapidly and is subsequently thought to have contributed to the decline of some native fish species (Lloyd 1987; Arthington & Lloyd 1989). Redfin perch, brown trout and rainbow trout are generally cooler water species, which were introduced to Australia around the mid to late 1800s (McDowall 1996a).

Redfin perch are widely distributed in the region and they appear to have cycles of abundance (e.g. Fig. 4). Trout are occasionally reported in the main stream of the Murray and have been stocked into various tributary streams in the region (see Appendix). These three large predators are implicated in the decline of small native fishes (e.g. Crowl et al. 1992; Morgan et al. 2002). Redfin perch also carry a virus damaging to some native species and in general alien fishes are potential vectors for pathogens and parasites (e.g. Langdon & Humphrey 1987). There have been isolated records of Atlantic salmon in the mid 1990s comprising large fish netted near Renmark (SA Museum records). A single unverified report of oriental weatherloach has been made in the region (Hammer & Walker 2004); however, the arrival of this extremely hardy and prolific species is likely in the near future as it spreads downstream along the Murray (already common in central Victoria).

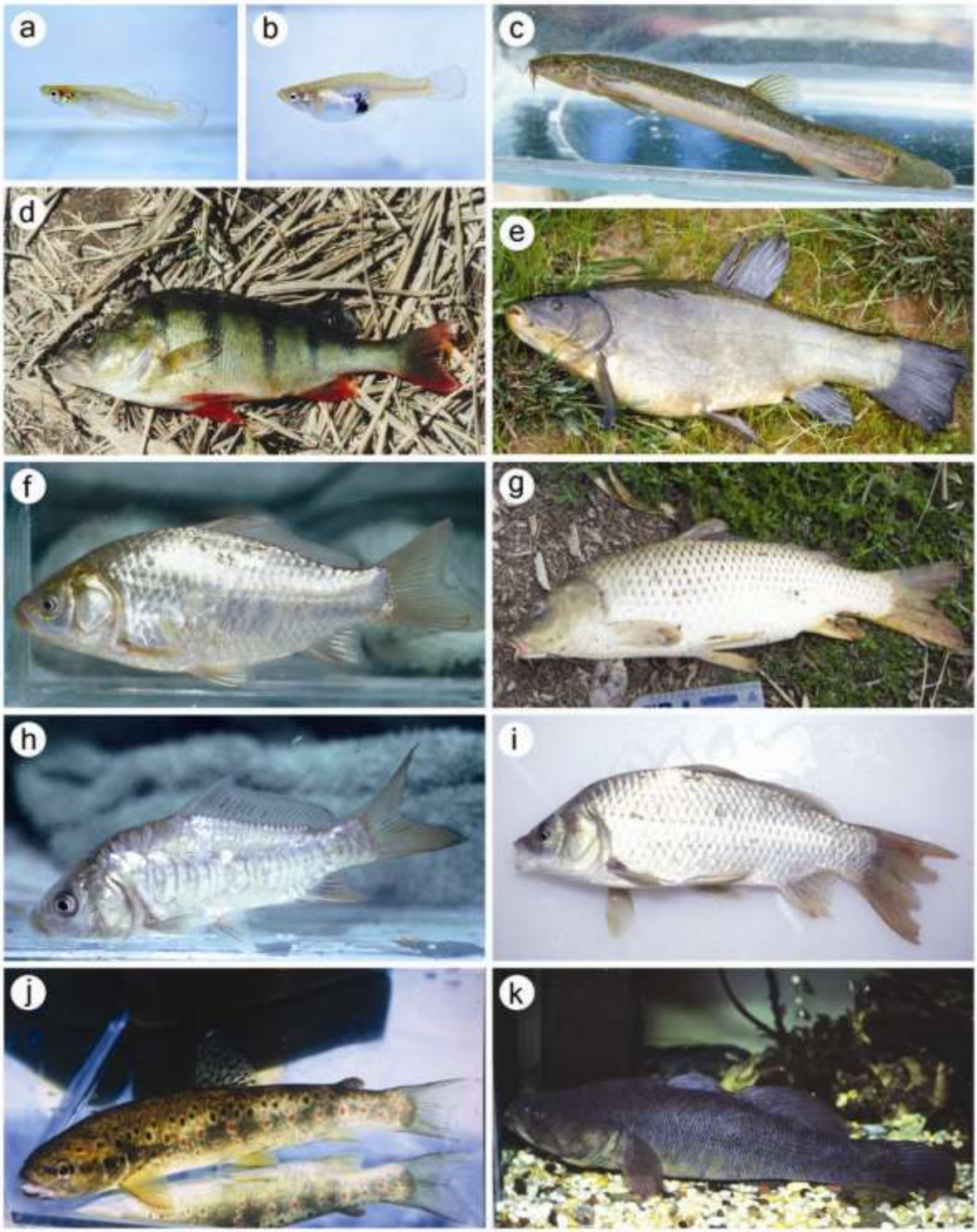

Figure 3. Alien fishes of the Lower River Murray, South Australia with indicative common size range: **a)** gambusia (male), 1.5-3 cm; **b).** gambusia (female), 2.5-4 cm; **c)** weather loach, 5-7 cm; **d)** redfin, 10-30 cm; **e)** tench, 15-40 cm; **f)** goldfish, 5-12 cm; **g)** common carp, 25-60 cm; **h)** common carp (mirror form), 25-50 cm; **i)** goldfish x common carp hybrid, 20-50 cm; **j)** brown trout, 15-40 cm; **k)** sleepy cod, 12-30 cm.

Two Australian native fishes translocated outside their natural range have been recorded in the region. Namely, Australian bass, a species endemic to coastal drainages of eastern Australia, was netted near Loxton in 1992, and sleepy cod, native to north and northeastern Australian waters, was reported near Swan Reach in the 1990s (SA Museum records; Hammer & Walker 2004). One sleepy cod captured form the River lived in a fish tank at the Swan Reach Hotel for several years (Fig. 3). Neither appears to have established populations in the region.

General ecology
The unique and variable environment of the River Murray supports a diverse fish assemblage in terms of basic body morphologies, life history modes, and idiosyncratic fish adaptations and behaviours (see Schiller & Harris 2001; Lintermans 2007 for a broader coverage).

Size and age
Fishes in the region range from the tiny (e.g. 3-4 cm adult size for carp gudgeons) to the mighty - Murray cod is Australia's, and one of the world's, largest freshwater fish reported to grow up to 1.8 m and 113 kg (Harris & Rowland 1996). Other large-bodied native fishes (i.e. potentially reaching a size of over 40 cm) include freshwater catfish, bony herring, other percichthyids (trout cod, golden perch, Macquarie perch, estuary perch) and silver perch. Most of the other species like galaxiids, smelt, Murray rainbowfish, hardyheads, gudgeons and gobies grow no larger than 10-15 cm. Longevity information is limited for many species in the region. Some large-bodied fishes such as Murray cod, golden perch and silver perch are long-lived. Murray cod has been aged up to 48 years (Anderson et al. 1992) and golden perch to 26 years (Mallen-Cooper & Stuart 2003). Many small fishes are presumably short-lived or have populations dominated by younger fish.

Habitat & movement
Within exclusively freshwater species different ecologies are displayed. Some species are pelagic, living in open water, but the majority are demersal, associated with structure and cover. The adult stages of several large fishes are river specialists, particularly Murray cod which inhabit slow flowing rivers, anabranches and creeks, often in or near deep holes, and prefer habitats containing cover (e.g. rocks, clay banks, woody debris, snags, or overhanging vegetation: see Harris & Rowland 1996; Ye et al. 2000). A number of small fishes such as Murray rainbowfish, unspecked hardyhead, and carp gudgeons are wetland specialists, but given the lentic nature of the main channel of the Lower Murray (series of weir pools) they can also be found in river edge habitats (Smith et al. 2007; Davies et al. 2008). Other species such as pelagic bony herring and smelt are more generalists, having a broad distributional range across various habitat types.

Many native fish undergo longitudinal (i.e. up or down-stream) or lateral (i.e. between the main channel and floodplains) movement. Diadromous species recorded in the region have undergone determined migrations from the sea at particular life stages to colonise or move through the region (e.g. juvenile common galaxias and congolli, adult shortheaded lamprey). Some large-bodied species undertake long-distance longitudinal migrations as demonstrated by the seminal study of Reynolds (1983) who tagged several species in SA and recorded recaptures of golden perch and silver perch at various points up to 2300 km along the Murray and Darling rivers during floods (some fish also swam downstream to the Lower Lakes). Radio telemetry data for Murray cod in Victoria indicate that upstream spawning migrations of up to 80-100 km can occur, with fish then returning to the original snag within their home range/habitat (Koehn and Nicol 1998). Studies of fish moving through or accumulated below fishways on Murray weirs provide particular insight, and suggest general mobility across different life-stages for the aforementioned large-bodied species, plus movement of smaller species (e.g. smelt, carp gudgeons), especially during small rises in river flows/height (Mallen-Cooper 1996; Stuart et al. 2008). Nevertheless several benthic or habitat specialists including freshwater catfish, southern pygmy perch and southern purple-spotted gudgeon appear relatively sedentary (Reynolds 1983; Hammer 2001; Hammer 2008).

Reproduction
The primary environmental conditions for stimulating reproduction in fishes of the Murray-Darling Basin are considered to be flow (increases for some species, low flow for others) and increasing temperature (Koehn & O'Connor 1990; Humphries et al. 1999). Many species also utilise particular habitat components for spawning within diverse breeding strategies (see Appendix). A number display parental care where the male will guard and tend to eggs while they develop inside hollow logs or other concealed places (e.g. Murray cod, river blackfish, gudgeon species). In the case of freshwater catfish they build a circular to oval nest around 0.6-2.0 m in diameter constructed from gravel and pebbles (Lake 1967b; Merrick & Midgley 1981). Other species like Murray rainbowfish and pygmy perches, attach or distribute adhesive eggs to a structure (vegetation or substratum), but do not guard the eggs/young. Golden perch and silver perch produce a large number of non-adhesive

semi-buoyant pelagic eggs which are at the disposal of currents (Lake 1967c; Rowland 1983). The sole representative of a live-bearing reproductive strategy is the exotic gambusia.

Feeding and diet

The large-bodied fishes such as freshwater catfish, Murray cod and golden perch are mostly opportunistic carnivores as adults. Their diets include crustaceans, insects, molluscs and fish (Lake 1967a; Cadwallader 1977, 1979; Davis 1977; Llewllyn & MacDonald 1980). However, the larvae and small juveniles of these fish feed primarily on zooplankton such as cladocerans, copepods, and chironomids (Lake 1967a; Arumugam & Geddes 1987, 1992; Arumugam 1990; Culver & Geddes 1993; Rowland 1992). Several smaller native fish are also either benthic or nektonic (underwater surfaces) feeding carnivores (Lloyd 1987). Smelt, Murray rainbowfish, hardyheads and silver perch are omnivores as adults (additionally consuming algae and other plant matter: Lake 1967a; Lloyd 1987). Bony herring are mainly herbivores, concentrating on attached filamentous algae, but also feed on muddy detritus and biofilms on the surface of substrates (Merrick & Schmida 1984; Puckridge and Walker 1990).

Floods provide enhanced opportunities for recruitment due to the increase in available aquatic resources (space and food). At first feeding many fish species are often restricted by mouth gape and poor swimming and pursuit abilities, and the presence of high concentrations of suitable-sized food is pivotal to larval survival and subsequent recruitment (Arumugam 1986; Arumugam & Geddes 1987; King et al. 2003).

FISHERY

Commercial fishery A commercial fishery began shortly after European settlement and was well established by 1850 (Leslie 1995). Initially the fishery was concentrated on upriver population centres (e.g. Renmark and Morgan), and the majority of production was sold to meet local demand or shipped to Adelaide markets (Pillar 1980). In about 1908 the establishment of rail linkages allowed export via shipping to the higher-value Melbourne market (Leslie 1995). A "Reach" fishery was first established in 1923 (Poole 1984) whereby commercial fishers were responsible for the administration of their own reaches. The reach system in various forms continued until June 2003 (Poole 1984; Rohan 1987, 1988, 1989; Olsen 1991; Presser 1996). Fishing techniques primarily involved drum nets and gill nets. Drum nets work more effectively during flow events which trigger directional movement of fish, whereas gill nets take fish during more static conditions. A third commercial gear involved set lines comprising multiple hook-lines baited and set almost invariably near snags.

Catch statistics of key commercial species from the South Australian Inland Waters Fishery between 1951/52 and 1975/76 are shown in Figure 4. Catches of native species varied greatly, with production generally peaking during flood years, but overall they show a declining trend over time. A dramatic decline is evident in Murray cod production from late 1950s to mid 1970s (Reynolds 1976a). A similar downward trend is shown for golden perch, although less pronounced. The catches of catfish and silver perch have also undergone a significant decline (Reynolds 1976a; Pillar 1980; Rohan 1987). In contrast, a population explosion is apparent for carp since their introduction to South Australia in 1970 and they have become a large component of the catch.

As late as 2002/03, the annual commercial catches of Murray cod and golden perch were 27 and 7 tonnes, respectively. Sizable catches of bony herring and carp were mostly sold for marine lobster bait, whereas Murray cod and golden perch were palatable top-priced freshwater fishes. Detailed fishery assessment reports for Murray cod and golden perch in later years of fishery are provided by Ye et al. (2000), Ye (2005) and Ye & Zampatti (2007).

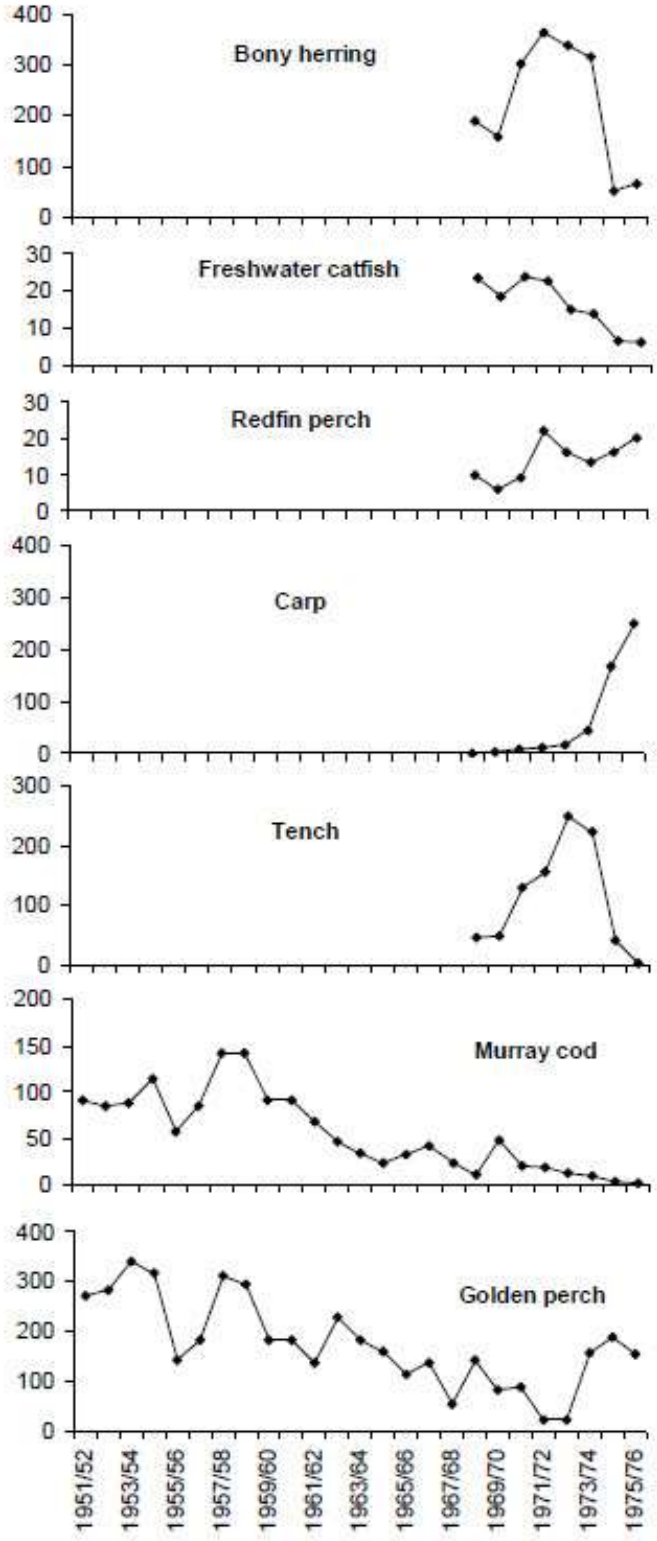

Figure 4. The annual commercial catches of key fish freshwater species from the South Australian River Murray and Lower Lakes between 1951/52 and 1975/76 (Data source: Reynolds 1976b; SA Fisheries Statistics). *Natural History of the Riverland and Murraylands* 342

Recreational fishing

The historical development of the SA inland recreational fishery has closely paralleled that of the commercial sector (Leslie 1995). Besides the practical need for protein, fishing was a sporting diversion and leisure activity for the early European settlers, and the River Murray has remained the most popular inland recreational fishing region in SA (Philipson et al. 1986). A survey of recreational fishing in 1982/83 indicated that the Murray region received 200,000 visits through that year of which 66% (132,000) were for the purpose of fishing (Philipson et al. 1986), and the National Recreational and Indigenous Fishing Survey, undertaken between May 2000 and April 2001 (Henry & Lyle 2003), estimated that the total recreational catches of Murray cod, golden perch and carp from the River Murray were 2,233, 211,299 and 421,790 in numbers, equivalent to 22, 222 and 239 tonnes, respectively. The release rates were 10% for Murray cod and 62% for golden perch.

The recreational fishery is currently restricted to rod/handline and yabby traps (drum nets and set lines were historically permitted). A number of fish species from the River Murray are totally protected including silver perch, freshwater catfish, trout cod, river blackfish, and fish of the genera *Ambassis*, *Nannoperca* and *Mogurnda*. Other current restrictions for recreational fishing include closed seasons, legal minimum/maximum size and bag limits (i.e. for Murray cod and callop).

AN ALTERED ENVIRONMENT

In various ways humans have exploited the fishes and resources of the Murray and affected its ecology. An intimate interaction with the River Murray stretches from aboriginal history and culture (e.g. Eyre 1815-1901 – Journals of Edward John Eyre, an account of the manners and customs of the aborigines and the state of their relations with Europeans: http://ibiblio.org/gutenberg/ etext04/xpcsc10.txt; Walker 1986). However, the recent and ever increasing demands on the environment have undoubtedly had a major impact on native fish populations.

Threats

Environmental degradation following European settlement has caused serious declines in native fish populations in the Murray-Darling Basin, and the impact has increased with levels of development (Cadwallader 1977; Walker 1985; Gehrke et al. 1995; Harris & Gehrke 1997). The declining productivity of the fisheries has been coincident with increased regulation of the water resource and reduced structural complexity of the ecosystem (Lake 1994; Reid et al. 1997). Abstraction for irrigation and water supply removes around 2/3 of the flow which naturally flowed to South Australia, and zero flows now occur 1 in 2 years compared with 1 in 20 under natural conditions (Maheshwari et al. 1995). A reduction in flow volume has been accompanied by a drastically altered natural flow regime including the reduced frequency and magnitude of floods, most notable in the loss of smaller floods and the altered timing of high and low flows (Walker 1993).

Broader changes are compounded by local regulation through the construction of ten lowlevel weirs in 1922-1935 (six of them within SA) and the Murray barrages in the 1940s (Walker 1985, 1992; Walker et al. 1992; Walker & Thoms 1993; Maheshwari et al. 1995). Furthermore, these major structures act as physical barriers to fish movement and migration (Mallen-Cooper 1993; Harris 2001). Recently, record drought has exacerbated the problems of regulation, and brings new potential reactions to water shortage such as another weir proposed for the Lower River reach at Wellington (DEH 2009). Some other key threats to native fish have been identified as habitat degradation and removal (e.g. de-snagging), lowered water quality, barriers, alien species, exploitation, diseases, translocation and stocking (Cadwallader 1978; Walker 1983, 2006; Lintermans 2007).

Status

Considering environmental changes, the current threatened state of native fish is not surprising. Many are conservation-listed or protected at the State and national level. Lloyd & Walker (1986) considered nine species from the Lower Murray to be under threat and that no species could be considered secure. More recent assessments list around half of the 35 fish given in the Appendix in higher extinction risk categories (DEH 2003; Hammer et al. 2007). Broadly, fish populations in the Murray- Darling Basin are currently estimated to be about 10% of their pre-European settlement levels (MDBC 2004), and for many species in the study region this figure would seem generous.

A range of species occurred historically but are now presumably long extinct from the region including Murray galaxias, trout cod, Macquarie perch, and southern and Yarra pygmy perch. A more

recent loss includes the chanda perch, last recorded in 1983 from the Marne River mouth (Lloyd & Walker 1986). The southern purple-spotted gudgeon, was in 2004 rediscovered from a single wetland near Murray Bridge after a 30 year absence of records, but now with critical habitat drying is again likely to be locally extinct in the wild (Hammer 2008). Limited information points to significant decline in larger species (see Fishery), and certainly anecdotal information suggests species commonly encountered by anglers at certain times (especially freshwater catfish) have disappeared. Diadromous species including lampreys, shortfinned eel, estuary perch and congolli were once more abundant and widespread prior to the construction of the barrages (Sim et al. 2000; H. Jones personal communication), but have also undoubtedly suffered from wider ecosystem change. Other species including river blackfish and Murray hardyhead currently display highly restricted distributions in the region (Lloyd & Walker 1986; Hammer et al. 2007; Wedderburn et al. 2007).

CONSERVATION

Native fish conservation and rehabilitation is an important part of environmental restoration as fishes are a significant yet threatened component of local biodiversity; they respond to change in aquatic habitats and hence are key indicators of ecosystem health; fishes have intrinsic value which extends from adaption to local environments, links in food chains, and a role in culture and use (angling, food, aquarium fish); and they are iconic species (e.g. Harris 1995; Jackson et al. 2001).

Any broad measures to protect and restore flows and habitats will improve the prognosis for native fish (e.g. restoration of smaller floods, re-snagging, wetland habitat rehabilitation). For example, recent research work suggests that a within channel flow pulse may be sufficient to provide suitable conditions for spawning and enhance larval survisorship and recruitment of the large-bodied native fish, such as golden perch, in the lower River Murray (Cheshire & Ye 2008b; Ye et al. 2008). Continual improvements in fish passage both along the main stem and to off-channel habitats will facilitate fish movement, migration and dispersion, and give fish greater access to habitats (e.g. Mallen-Cooper 2001; Bice and Zampatti 2005; Leigh & Zampatti 2005; Barrett 2007). Finally science based decision tools and community involvement are key drivers for sustaining fish populations into the future.

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Table 1. Freshwater fishes recorded from the Riverland and Murraylands in South Australia. Information is based largely on collections housed at the South Australian Museum as well as relevant literature (e.g. Scott et al. 1974; Lloyd & Walker 1986; Hammer & Walker 2004; Smith & Hammer 2005; Hammer *et al*. 2007) and SARDI Fisheries Statistics. Taxonomy follows Hammer & Walker (2004). * Distribution in study region forms a significant part of the Murray-Darling Range of the species. [*Life history strategy*: D; diadromous – migrates between fresh and saltwater, E; euryhaline – estuarine species comfortable in fresh and salt water, F; complete lifecycle in fresh water. *Reproductive strategy*: n; parental care – guard eggs and/or build a nest, a; use structure by attaching or distributing eggs within (e.g. aquatic vegetation), no parental care, r; distribute demersal eggs randomly, p; spawn surface drifting (pelagic) eggs, l; bear live young.].

Family	Taxon	Common name	Ecology	Comments on status in the River Murray
NATIVE SPECIES				
Geotriidae	*Geotria australis* Grey, 1851	Pouched lamprey	D, r	Declined significantly from historic abundance, endangered
Mordaciidae	*Mordacia mordax* (Richardson, 1846)	Shortheaded lamprey	D, r	Still recorded in the Lower Murray and upstream near Yarrawonga (Vic.), migrations with large numbers of individuals no longer occur, endangered
Anguillidae	*Anguilla australis* Richardson, 1841	Shortfinned eel	D, p?	The Murray-Darling Basin lies at the western edge of the species' distribution. Larval migration to the region is spasmodic – naturally rare bu`t may have declined
Plotosidae	*Tandanus tandanus* Mitchell, 1838	Freshwater catfish	F, n	Historically very common, significant declines in the 1970s & 80s. Remains at a low population level
Clupeidae	*Nematalosa erebi* (Günther, 1868)	Bony herring	F, p	One of the most common species in the region
Retropinnidae	*Retropinna semoni* (Weber, 1895)	Smelt	F, r	One of the most common species in the region
Galaxiidae	*Galaxias brevipinnis* Günther, 1866	Climbing galaxias	D, a	A migratory species that probably occasionally enters the region as juveniles
	Galaxias maculatus (Jenyns, 1842)	Common galaxias	D/F, a	Common in the lower reaches
	Galaxias olidus Günther, 1866	Mountain galaxias	F, a	A species complex. Recorded from a tributaries (Marne River and Reedy Creek) and historically from swamps near Murray Bridge
	Galaxias rostratus Klunzinger, 1872	Murray galaxias	F, r	A floodplain/wetland species, only early records from near Murray Bridge but probably occurred patchily right along the River. Likely extinct
Melanotaeniidae	*Melanotaenia fluviatilis* (Castelnau, 1878)	Murray rainbowfish	F, a	Still common in wetland environments
Atherinidae	*Atherinosoma microstoma* (Günther, 1861)	Small-mouthed hardyhead	E, a	Occasionally recorded from the lower reaches

	Craterocephalus fluviatilis McCulloch, 1912	Murray hardyhead	F, a	*Poorly known species. Historically widespread, known remaining habitats in region include wetlands near Murray Bridge and saline habitat near Renmark/Berri
	Craterocephalus stercusmuscarum fulvus Ivanstoff, Crowley & Allen, 1987	Unspecked hardyhead	F, a	Common but patchy distribution in wetland, river edge habitats
Ambassidae	*Ambassis agassizii* Steindachner, 1867	Chanda perch	F, a	Poorly known species. Does not appear to have been common historically, last record was a single individual in 1983 from the Marne R mouth
Percichthyidae	*Gadopsis marmoratus* Richardson, 1848	River blackfish	F, n	Historic reports from the main channel, now endangered and remaining only in a small pocket in a tributary (Marne R)
	Maccullochella macquariensis(Cuvier, 1829)	Trout cod	F, n	Also known as rock cod locally. Confused with Murray cod in the past, but indications that it occurred not-uncommonly prior to river regulation. Presumed extinct
	Maccullochella peelii peelii (Mitchell, 1838)	Murray cod	F, n	Historically very common. Large declines, now at a low population level
	Macquaria ambigua ambigua (Richardson, 1845)	Murray-Darling golden perch	F, p	Remains common
	Macquaria australasica Cuvier, 1830	Macquarie perch	F, a	Poorly known species in SA. Some indication that it occurred in the upper section of the region historically either as a local population or as occasional downstream immigrants. Suitable habitat no longer occurs – extinct
	Macquaria colonorum (Günther, 1863)	Estuary perch	D, p	*Poorly known species in SA. More common prior to the construction of the barrages, now only occasional records. Unknown if locally reproducing population remains or if now only migrants to the area
	Nannoperca australis Günther, 1861	Southern pygmy perch	F, a	Common in swamps downstream of Mannum historically, potentially also occurred patchily in wetland/billabong habitats along the River. Now extinct from region (still in other tributaries to Lake Alexandrina)
	Nannoperca obscura (Klunzinger, 1872)	Yarra pygmy perch	F, a	*Poorly known species in SA, confused historically with southern pygmy perch. Some early records for the lower reaches, presumed extinct

Terapontidae	*Bidyanus bidyanus* (Mitchell, 1838)	Silver perch	F, p	Historically very common. Significant declines since the 1970s, remains rare. Juveniles are common encountered by anglers in some upstream sections of the SA Murray
	Leiopotherapon unicolor (Günther, 1859)	Spangled perch	F, r	Occasional records of fish that come down the Darling R during floods
Pseudaphritidae	*Pseudaphritis urvillii* (Valenciennes, 1832)	Congolli	r?	*Historically common. Large declines in the region, now rarely recorded
Eleotridae	*Hypseleotris klunzingeri* (Ogilby, 1898)	Western carp gudgeon	F, n	Poorly known in SA. Considerable taxonomic confusion with the carp gudgeons. Mainly along river edge
	Hypseleotris sp. 1 (undescribed)	Midgley's carp gudgeon	F, n	A common species of wetlands and the river edge
	Hypseleotris sp. 3 (undescribed)	Murray-Darling carp gudgeon	F, n	A not uncommon species of wetlands, also in tributaries (Marne R, Saunders Ck)
	Hypseleotris spp. (species complex)	Hybrid forms (e.g. Lake‘s carp gudgeon)	F, n	Considerable taxonomic confusion with the carp gudgeons extends to a range of F1 hybrid forms which may prove to be unisexual lineages. Combined hybrid forms are common in the region
	Mogurnda adspersa (Castelnau, 1878)	Southern purple-spotted gudgeon	F, n *	Historically common in wetlands and sheltered river edge habitat until the early 1970s. Rediscovered from a single wetland near Murray Bridge in 2004, but has again disappeared with a major drop in river level. Captive breeding underway
	Philypnodon grandiceps (Krefft, 1864)	Flathead gudgeon	F, n	Remains common
	Philypnodon sp. (undescribed)	Dwarf flathead gudgeon	F, n	*Widespread distribution but occurs normally in low numbers
Gobiidae	*Pseudogobius olorum* (Sauvage, 1880)	Western bluespot goby	E, n	*Probably occurred in lower reaches historically, now confined to below Wellington
	Tasmanogobius lasti Hoese, 1991	Lagoon goby	E, n	*Still occasionally recorded from lower reaches (e.g. Swanport, Lake Carlet, Rocky Gully)
TRANSLOCATED AUSTRALIAN NATIVE SPECIES				
Percichthyidae	*Macquaria novemaculeata* (Steindachner, 1866)	Australian bass	D, p S	ingle specimen netted near Loxton in 1992. Native to coastal drainages of eastern Australia
Eleotridae	*Oxyeleotris lineolata* (Steindachner, 1867)	Sleepy cod	F, n	Two independent reports from near Swan Reach in the 1990s. Native to coastal drainages of northern and north east Australia

EXOTIC SPECIES				
Cyprinidae	*Carassius auratus* (Linnaeus, 1758)	Goldfish	F, a	Common since its introduction soon after European settlement (also known as golden carp)
	Cyprinus carpio Linnaeus, 1758	Common carp	F, a	Arrived in the region in early 1970s from whence its populations expanded rapidly. Remains common
	Tinca tinca (Linnaeus, 1758)	Tench	F, a	An early introduction to the region. Reportedly common until the arrival of carp
Cobitidae	*Misgurnus anguillicaudatus* (Cantor, 1842)	Oriental weatherloach	F, r	Unverified report for near Murray Bridge in the 1980s, an imminent arrival as its spreads down the Murray from Victoria and New South Wales
Salmonidae	*Oncorhynchus mykiss* (Walbaum, 1792)	Rainbow trout	F, n	Occasional records from the region (e.g. Renmark in 1917), has been stocked in tributaries like the Marne R, Burra Ck and Baldina Ck
	Salmo salar Linnaeus, 1758	Atlantic salmon	D, n	A few records from the mid 1990s of large fish netted near Renmark
	Salmo trutta Linnaeus, 1758	Brown trout	F, n	Occasional records from the region (e.g. Murray Bridge 1972), has been stocked in tributaries like the Marne R, Reedy Ck and Burra Ck
Poeciliidae	*Gambusia holbrooki* Girard, 1859	Gambusia	F, l	Present in the region since at least the 1950s, has become a dominant species in still, shallow and degraded wetland areas
Percidae	*Perca fluviatilis* Linnaeus, 1758	Redfin perch	F, a	Present since at least the 1950s, reached plague proportions at times, now less common