Mallee 2 *(MAL2 - Western Mallee subregion)*

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Subregional description and biodiversity values

Description and area

The Mallee bioregion is the south-eastern part of Yilgarn Craton. Its landscape is gently undulating, with partially occluded drainage. Mallee over myrtaceous-proteaceous heaths on duplex (sand over clay) soils are common. Melaleuca shrublands characterise alluvia, and Halosarcia low shrublands occur on saline alluvium. A mosaic of mixed eucalypt woodlands and mallee occur on calcareous earth plains and sandplains overlying Eocene limestone strata in the east. Landscape is fragmented with particular surface-types almost completely cleared as wheat-fields.

Western Mallee (MAL2) subregion has more relief than its eastern counterpart: main surface-types comprise clays and silts underlain by Kankar, exposed granite, sandplains and laterite pavements. Salt lake systems on a granite basement. Occluded drainage system. Mallee communities occur on a variety of surfaces; *Eucalyptus* woodlands occur mainly on fine-textured soils, with scrub-heath on sands and laterite. The climate is warm Mediterranean and annual rainfall is 250-500mm. Total area of the subregion is 4,763,963 ha.

Dominant land use

Mainly (iv) dry-land agriculture, with lesser areas of (xiii) conservation, (xi) UCL and Crown reserves, (xiv) roads and other easements (see Appendix B, key b).

Continental Stress Class

MAL2 currently has a Continental Stress Class listed as 3. However, it should probably be 2, although it is difficult to identify exactly which condition attributes require amending. I would suggest that the c4 class "Degree of Connectivity" be revised to "1" not "2" because connectivity within the cleared areas of the subregion is really no better than in the Avon Wheatbelt bioregion. Overall the differences between the MAL2 and AW 1 & 2 subregions are not great. MAL2 straddles a divide between cleared and non-agricultural lands. Over three-quarters of the subregion is dominated by intensive land use with similar condition attributes to the AW1 & 2. The remaining quarter is essentially uncleared and under far fewer threats is not necessarily representative of the majority of the subregion. Therefore I believe that the continental stress class should be 2 or even 1, to better reflect the on-ground realities, and that the majority of the subregion is essentially a continuation of the AW1 and 2 subregions in terms of threats and management.

Known special values in relation to landscape, ecosystem, species and genetic values

Critical Weight Range mammals: 35-7 000 g weight range mammals threatened by fox predation. Two species are now totally extinct; the Pig-footed Bandicoot and Crescent Nailtail Wallaby. Several species are subregionally extinct, and some are still extant

Species	Current Conservation Status (WA)	Status in MAL2 Subregion
Mala (*Lagorchestes hirsutus*)	Threatened (Extinct in the wild)	Subregionally Extinct
Red-tailed Phascogale (*Phascogale calura*)	Threatened (Endangered)	Threatened (Endangered)
Western Barred Bandicoot (*Perameles b. bougainville*)	Threatened (Endangered)	Subregionally Extinct
Chuditch (*Dasyurus geoffroii*)	Threatened (Vulnerable)	Subregionally Extinct
Numbat (*Myrmecobius fasciatus*)	Threatened (Vulnerable)	Subregionally Extinct
Bilby (*Macrotis lagotis*)	Threatened (Vulnerable)	Subregionally Extinct
Boodie (*Bettongia lesueur lesueur*)	Threatened (Vulnerable)	Subregionally Extinct
Banded Hare-wallaby (*Lagostrophus f. fasciatus*)	Threatened (Vulnerable)	Subregionally Extinct
Black-flanked Rock-wallaby (*Petrogale l. lateralis*)	Threatened (Vulnerable)	Threatened (Vulnerable)
Greater Stick-nest Rat (*Leporillus conditor*)	Threatened (Vulnerable)	Subregionally Extinct
Pseudomys shortridgei	Threatened (Vulnerable)	Threatened (Vulnerable)

Species	Current Conservation Status (WA)	Status in MAL2 Subregion
Woylie (*Bettongia penicillata ogilbyi*)	Priority 4, Conservation Dependent	Subregionally Extinct
Tammar Wallaby (*Macropus eugenii derbianus*)	Priority 4, Conservation Dependent	Subregionally Extinct
Quenda (*Isoodon obesulus fusciventer*)	Priority 4, Conservation Dependent	Subregionally Extinct
Western Brush Wallaby (*Macropus irma*)	Priority 4, Conservation Dependent	Priority 4, Conservation Dependent
Pseudomys occidentalis	Priority ?	Priority ?
Common Brushtail Possum (*Trichosurus vulpecula*)	No listing	Conservation Dependent

Granite outcrops:
Important as seasonal resources and temporary refuge for fauna of surrounding habitats; Black-flanked Rock Wallaby, four species of reptiles are restricted to granite outcrops; at least 1320, and possibly 2000 plant species occur on Western Australian granite outcrops – most diverse in the southwest with individual outcrops having up to 200 species, including many endemics; the mygalomorph genus *Teyl* shows extensive radiation in the southern half of WA (Harvey and Main undated), is a Gondwanan relic of "wet" habitats (Main 1996a). They occur in meadows on many granite outcrops (Main 2000) and are restricted to granite outcrops as are the larvae chironomid fly *Archaeochlus* (Withers and Edward 1997); recent surveys in the wheatbelt have identified at least 230 species of aquatic invertebrates from granite pools, they contribute significantly to endemism of aquatic fauna of the inland south-west and have particular conservation value for about 50 species restricted to them (Pinder *et al.* 2000).

Gypsum dunes:
Plant species are generally unique to each IBRA Region and often smaller scales; several DRF and Priority flora species are restricted to gypsiferous habitats, and at least 80 species are likely to be gypsiphyllic (Mattiske Consulting 1995a).

Mallee Eucalypts and Melaleuca for Oil Production:
It is seen as vital to identify local *Eucalyptus* and *Melaleuca* species that can be introduced in commercial quantities to develop a plantation based oil mallee industry in the south west of Western Australia. The use of locally endemic species is seen as preferable to minimise the risk of eastern Australian species hybridising with local species and becoming environmental weeds. The use of local species is also seen as providing some fauna habitat benefits as well. Populations of numerous mallee *Eucalyptus* species (Series: Oleosae, Cneoripholiae, Ovulares, Erythronemae, Loxophlebae, Calycogonae and the Spathulata Group) and *Melaleuca uncinata* sens. lat. and *M. lateriflora* contain individuals that produce higher than average quantities of cineole oil. Identifying these individuals in native vegetation, and introducing their genetic material into breeding programs is critical to the success of this program. The subregion supports significant populations of many of these species.

South West Botanical Province:
Shows a very high degree of endemism, particularly in the Proteaceae family (632 spp, 99% endemic; 16 genera, 5 endemic); MAL2 in particular the genera *Grevillea and Hakea* (Cowling and Lamont 1998), *Eucalyptus* and *Acacia* (Lamont *et al.* 1984), and *Dryandra* and the Asteraceae (Keighery and Lyons 2001a) contain very high numbers of endemics.

Transitional Rainfall Zone (equivalent to the Mallee, Avon Wheatbelt and Geraldton Sandplains IBRA Regions):
- *Acacia* and *Verticordia* (Hopper *et al.* 1996)
- *Lhotskya, Eriostemon, Wehlia, Baeckea, Melaleuca, Chamelaucium, Micromyrtus* and *Thryptomene* (Hopper 1979)

Lake Bryde - East Lake Bryde:
As surrounding wetlands become salinised, the lakes form increasingly important freshwater refugia for waterbirds and aquatic invertebrates. Both Lake Bryde and East Lake Bryde are freshwater wetlands with *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* dominating the lake bed, surrounded by *Eucalyptus occidentalis* woodland with an understorey dominated by *Melaleuca* spp. The shrub-dominated lake bed community experiences intermittent freshwater inundation, and the major components of the plant community and other elements of the biota depend on relatively fresh water and frequent drying out of the lake bed for survival. The lakes are the only known occurrences of the community of this type in the Wheatbelt and this community has been classified at the State level as a Critically Endangered Threatened Ecological Community (Hamilton-Brown and Blyth 1999b; Hamilton-Brown and Blyth 2001a). Of 106 wetlands in nature reserves of the south-west of Western Australia, Lakes Bryde and East Bryde were found to be the only wetlands with beds dominated by shrubs (Halse *et al.* 1993). The Lake Bryde wetland system has been identified as a wetland of substantial ornithological importance (Raines 1994). A survey of the aquatic invertebrates of Lake Bryde has shown the fauna to be highly diverse in relation to other Wheatbelt wetlands such as Toolibin Lake (S.A.Halse pers. comm.) and probably richer than those on the Swan Coastal Plain (Davis 1993).

The lake bed is dominated by *Tecticornia verrucosa* and *Muehlenbeckia horrida* subsp. *abdita* (the latter is only known from these two wetlands and is Declared Rare Flora (Endangered) at the State level). The lake is surrounded by *Eucalyptus occidentalis* woodland and a combination of *Melaleuca strobophylla, M.*

lanceolata, *M. thyoides*, *M. adnata*, *M. lateriflora* subsp. *lateriflora* and *M. cuticularis* understorey. Sixteen bird species have been recorded on Lake Bryde, and two are listed under treaties. The sixteen include seven ducks and allies, and five wader species which were recorded only in April-May 1985, when the lake was confined to shallow pools less than 0.1m deep. Six species found breeding at Lake Bryde. In October 1983, White-faced Heron (*Egretta novaehollandiae*), Pacific Black Duck (*Anas superciliosa*), Grey Teal (*Anas gibberifrons*), Pink-eared Duck (*Malacorhynchus membranaceus*) and Musk Duck (*Biziura lobata*) were found breeding in or near tall living shrubs that had been inundated by freshwater (to a depth exceeding 0.5m). Young Australian Shelducks (*Tadorna tadornoides*) were observed in 1984. The highest count of waterbirds at Lake Bryde in one survey was 133 in July 1983. The most abundant species are Grey Teal (90 in July 1983), Australian Shelduck (70 in April 1985) and Maned Duck (*Chenonetta jubata*) (30 in February 1984). (Jaensch *et al.* 1988). Initial surveys of Lake Bryde have revealed a highly diverse aquatic invertebrate fauna (S.A.Halse pers. comm.).

Lake Cronin:
Provides a temporary refuge for waterfowl, including Freckled Duck (*Stictonetta naevosa*). Inundated closed scrub and low woodlands fringing open water; when dry, the lake bed is covered by a closed-herbland. The best example of a melaleuca-dominated freshwater lake / marsh in the bioregion. The lake is fringed by dense thickets and low woodlands of paperbarks *Melaleuca strobophylla*, *M. uncinata* and *M.* aff. *cuticularis* with low shrubs *Goodenia viscida* and lignum *Muehlenbeckia cunninghamii*. The perennial grass *Eragrostis dielsii* and annuals *Angianthus conocephalus*, *Calandrinia granulifera*, *Centrolepis polygyna*, *Myriocephalus nudus* occur. Mosses and liverworts growing in the waterlogged soil of the lake's edge include *Bryum*, *Funaria*, *Riccia* and *Tortula* spp. *Elatine gratioloides*, a rarely- collected creeping annual herb, grows submerged or in the wet mud of the drying lake bed. This population appears entirely cleistogamous (closed flowering and self-pollinating) - a habit not previously reported in this genus. When the lake dries, a dense herbland dominated by *Goodenia viscida* and *Glycyrrhiza acanthocarpa* covers the area. The site supports uncommon *Melaleuca strobophylla* tall shrublands which are much less extensive in smaller swamps to the south and west (Keighery 1984; Henry-Hall *et al.* 1990; Halse *et al.* 1993).

Fifteen species of birds have been recorded at the lake, including two grebes, two herons and allies and ten waterfowl. A report of 20-30 pairs of Freckled Duck in summer 1971-72 (P. Kennington) is unconfirmed, but an unspecified number were seen on the lake in 1975 (T. Spence). Four Red-necked Avocet (*Recurvirostra novaehollandiae*) were seen on the lake in Nov. 1989 and two Chestnut Teal (*Anas castanea*) in May 1991 (L. Silvester). Breeding by Hoary-headed Grebe (*Poliocephalus poliocephalus*), Australian Shelduck (*Tadorna tadornoides*), Grey Teal (*Anas superciliosa*), Pacific Black Duck (*A. gibberifrons*) (P. Lambert, Oct. 1978) and Pink- eared Duck (*Malacorhynchus membranaceus*) (L. Silvester) has been reported. The lake has habitat suitable for Freckled Duck breeding, but it is small and can only briefly support substantial numbers. Maximum counts are 300-400 Grey Teal (February to April 1976), 100 Hoary-headed Grebe (1981) (How *et al.* 1988; WADCALM files).

The endemic elapid Lake Cronin Snake (*Denisonia atriceps*) (Cogger 1993) has been captured in melaleuca thicket and *Eucalyptus salmonophloia* open woodland west of the lake. This species is known from only three confirmed specimens collected in the Lake Cronin area, however further surveys are required before its status can be determined. Fifteen species of bush birds have been recorded in the eucalypt woodlands and mallees surrounding the lake; 97 species have been recorded in the Nature Reserve and adjacent areas (L. Silvester pers. comm.). Western Grey Kangaroos (*Macropus fuliginosus*) have been observed grazing on the dry lake bed. Four species of bat occur in the Melaleuca tall shrublands. Three species of frog occur at the lake including a genetically and physiologically distinct population of *Crinia pseudinsignifera* which breeds in summer rather than winter. Two gecko, three dragon and three skink species have been collected in the woodland adjacent to the lake. The Lake Cronin area is well-known for its large and diverse populations of jewel beetles (Buprestidae). Over 20 species have been recorded in the nature reserve and some may utilise melaleuca woodlands of the lake when flowering (How *et al.* 1988; Henry-Hall 1990; Ehmann 1993).

Eucalypt Woodlands:
Display a particularly high floristic diversity (Table 4;Yates *et al.* 2000), they contain a high proportion of Declared Rare Flora (around 25%) (Yates *et al.* 2000; Hopper *et al.* 1990). The South-west botanical province is also very diverse in genera and numbers of species; *Acacia* (400+), *Eucalyptus* (285+), *Grevillea* (150), *Stylidium* (130), *Leucopogon* (115), *Dryandra* (95), *Caladenia* (91) (Hopper *et al.* 1996).

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Wheatbelt in the CTRC Green Book (Environmental Protection Authority 1974). Some but not all of these recommendations (with modification) were implemented over the following ten years. The southern and eastern parts of the subregion are covered by a CALM Regional

Management Plan (Department of Conservation and Land Management 1994b) that provides an overview of biota, addresses land and wildlife conservation issues, but was generalised in its attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregion, or even the bioregion.

There has been no comprehensive subregional or regional biodiversity planning process or systematic review of biodiversity or threats. Several publications have reviewed specific elements of biota at this scale, but not necessarily using IBRA boundaries:

- Beard's Vegetation Mapping at a scale of 1:250 000 – broad structural vegetation types covers all of the subregion (Beard 1972a, Beard 1972f, Beard 1973, Beard 1980c, Beard 1980e)
- Conservation status of vegetation types throughout Western Australia. (Hopkins *et al*. 1996) – based on modified Beard vegetation mapping at 1:250 000.
- Birds of Southwestern Australia: An atlas of changes in distribution and abundance of the wheatbelt fauna (Saunders and Ingram 1995)
- SAP Biodiversity Survey of the Agricultural Zone (unpublished data; Frost *et al*. 2001) – a systematic, broadscale biogeographic survey of the biota (aquatic invertebrates, waterbirds, terrestrial vascular flora, ground-dwelling arachnids, scorpions, centipedes, small mammals, reptiles and frogs) occurring low in the landscape and under threat from salinity.
- Salinity Risk Mapping completed for the agricultural zone by the Land Monitor project showing both current and predicted extent (Frost *et al*. 2001).
- The Wheatbelt Region of the Department of Conservation and Land Management is currently drafting a Regional Plan that includes a broad analysis of biodiversity values, threatening processes and management priorities (unpublished).

Several other surveys have reviewed elements of the biota and threatening processes at smaller scales within the subregion, or have reviewed the biota of a selection of reserves within the subregion (but not necessarily using IBRA boundaries). This list does not include the numerous surveys that have been completed for individual reserves or single species:

- Botanical values of gypsum dunes in the wheatbelt (Mattiske Consulting 1995a)
- Biological Survey of the Western Australian Wheatbelt Part 1 (Kitchener *et al*. 1976), Part 2 (Muir 1977), Parts 3 and 4 (Kitchener *et al*. 1977).
- Conservation values of small reserves in the wheatbelt of Western Australia (Safstrom 1995; Safstrom *et al*. 1996; Ecoscape 2000) - brief survey of biological and human use values of numerous reserves using a standard methodology to assist with land use planning.
- Management of Granite Outcrops Symposium, Hyden, April 16-18, 1999 (Withers and Hopper 2000).
- Regional Assessment of the Wheatbelt of Western Australia: Central Wheatbelt (Wooller and Moore 2000) MAL2 (part)
- Production of habitat hollows by wheatbelt eucalypts (Rose 1993) – survey of tree diameter, age and hollow formation of wandoo and salmon gum from across the major east-west rainfall gradient.
- Some nature reserves of the Western Australian wheatbelt Part 1-28 (Muir 1978-1979) – brief surveys of various reserves providing a vegetation map and description, and list of fauna, human uses and other values.
- A review of grassy woodlands in the Western Australian Wheatbelt (Mattiske Consulting 1995b) – literature review, survey of possible sites to document flora and a report detailing location and describing floristics.
- "Native Vegetation Handbook" series for various Shires in the Avon and Blackwood Basins (eg. Grein 1994) – contain basic information on and lists of native vegetation, wetlands, fauna and flora, land resources and land management and land degradation issues.

Wetlands

Wetlands of National significance (DIWA listings)

Name and Code	Description[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Lake Grace System, WA055	B8, B12	ii	iii	iii	xii (mining - a small amount of gypsum mining, also existing exploration permits; lake edges are sometimes disturbed by recreational use of vehicles)

Name and Code	Description[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Lake Bryde-East Lake Bryde, WA112	B13	ii	iii	iii	ix, x (increased levels of salinity resulting from input of saline surface water. There is potential for increased periods of inundation, resulting from increased run-off following clearing of the catchment; increased soil salinities and the threat of both inundation and salinity increasing massively if regional water tables rise to the surface within the lakes themselves or nearby in their catchments)

[1]Appendix B, key d; [2]Appendix C, rank 2; [3]Appendix C, rank 3; [4]Appendix C, rank 1; [5]Appendix B, key e;

Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description[1]	Special Values[2]	Condition[3]	Trend[4]	Reliability[5]	Threatening Processes[6]
Kondinin Salt Marsh MAL2	629000E 6393000N Zone 50	B8, B12 The best area of lowland mallees and central gypsophilous communities in very good to good condition. Very difficult to protect because it is in a major paleodrainage system.	i	ii	iii	iii	ix, x
Kent Road Braided Saline Drainage Line MAL2	659000E 6361000N Zone 50	B8 Possible alternative to the Kondinin Salt Marsh, as it is closer to the headwaters of the system.	i	ii	iii	iii	ix, x
Dunn Rock/Lake King Chain MAL2	740000E 6335000N Zone 50	B8 Headwaters of the drainage system, includes a large area of unallocated Crown land (UCL). Very extensive areas of lowland woodlands, mallees and gypsophilous communities, most are in excellent condition. Lake King gypsophilous communities are floristically different from elsewhere.	i	iii	iv	iii	No known threatening processes
Lake Magenta (UCL) MAL2	703000E 6296000N Zone 50	B8 Gypsophilous woodlands, shrublands and the rare "lawn" community, all in excellent condition.	i	iii	iv	iii	No known threatening processes
Chinocup System, MAL2	643000E 6294000N Zone 50	B8 A diverse range of gypsophilous dune communities, lacking much of the lowland woodland communities but these are similar to those in the UCL at Magenta. Melaleuca and mallee communities are potentially floristically distinct.	i	ii	iii	iii	ix, x

[1]Appendix B, key d; [2]Appendix B, key c; [3]Appendix C, rank 2; [4]Appendix C, rank 3; [5]Appendix C, rank 1; [6]Appendix B, key e

Riparian zone vegetation

According to the State of the Environment Report 1998, virtually all "fringing vegetation" along substantial streamlines (defined as any stream shown on a 1:50 000 topographic map) is in "very poor" condition (land cleared of virtually all natural vegetation) (Wallis and Higham 1998).

Name	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
Pallinup River	i	iii	ii	i, ii, iv, v (foxes & rabbits), vi, ix, x, viii, xi (fertiliser load)
Fitzgerald River	ii	iii	ii	i, ii, iv, v (foxes & rabbits), vi, ix, x, viii

[1]Appendix C, rank 2; [2]Appendix C, rank 3; [3]Appendix C, rank 1; [4]Appendix B, key e

Ecosystems at risk

Threatened ecological communities (TECs)

Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Unwooded freshwater wetlands of the southern Wheatbelt of Western Australia, dominated by *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor.	CR	42	ii	ii	iii	ix, x, vii
Herblands and Bunch Grasslands on gypsum lunette dune community is located on grey sandy-clay on the top of a lake edge dune and includes the herbaceous species *Danthonia caespitosa, Lawrencia squamata, Maireana marginata, Podolepis rugosa, Senecio lautus* subsp. *maritimus, Asteridea chaetopoda, Atriplex paludosa, Halosarcia syncarpa, Scaevola spinescens* and *Stipa juncifolia*.	V	38	ii	iii	iii	v, vi, ix, x, xii (mining), vii

[1]Appendix B, key f; [2]Appendix C, rank 2; [3]Appendix C, rank 3; [4]Appendix C, rank 1; [5]Appendix B, key e

Other ecosystems at risk*

Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Plant assemblages of the Bremer Range System - *Eucalyptus rhomboidea* ms and *E. eremophila* woodland on the side slopes of low ridges; *E. flocktoniae* woodland (with *E. salubris*, *E. salmonophloia*, *E. dundasii* and *E. tenuis*) on broad flat ridges and side slopes; *E. flocktoniae* and/or *E. longicornis* woodland on saline soils on ridges and flats adjacent to large salt lake systems; *E. longicornis* and/or *E. salmonophloia* or, *E. georgei* subsp *georgei* or, *E. dundasii* woodland, on low areas; *E. livida* woodland on lateritic tops or Allocasuarina thickets on greenstone ridges of lateritic breakaways; *Acacia duriuscula*, *Allocasuarina globosa*, *E. georgei* subsp *georgei* and *E. oleosa* thickets on greenstone ridges with skeletal soils.	V	8	ii	iii	iii	i, xii (mining), vii
Eucalyptus aff. *incrassata* mallee over low scrub on gypsum dunes.	P	8	ii	iii	iii	ix, x, xii (mining), vii

[1]Appendix B, key f; [2]Appendix C, rank 2; [3]Appendix C, rank 3; [4]Appendix C, rank 1; [5]Appendix B, key e

**Specific communities are listed in the tables above, however vegetation types on dissection valley floors and lower slows are more than 90% cleared for agriculture and comprise about 1/3 of the total number of the vegetation types in the subregion. The remaining areas of valley floor woodlands are subject to secondary salinity. Therefore, a further 20 to 30 vegetation types in this subregion should be treated as "at risk"*

Species at risk

Fauna

Species	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)					
Phascogale calura	E	ii	iv	iii	v, i, ii
Dasyurus geoffroii	V	ii	v	iii	v, i, ii
Myrmecobius fasciatus	V	i	vi	ii	v, i, ii
Pseudomys shortridgei	V	ii	vi	ii	v, i, ii, vii
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)					
Calyptorhynchus latirostris	E	ii	iii	iii	i, ii, ix, x, vi

Amytornis textilis textilis	V	ii	i	iii	Regionally Extinct
Leipoa ocellata	V	ii	iii	iii	i, ii, vii, vi, iv
Psophodes nigrogularis oberon	V	ii	iii	ii	i, ii, vii
SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)					
Falco peregrinus	SP	ii	iv	iii	i, ii
SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)					
Morelia spilota imbricata	SP	ii	iv	iii	i, ii, v (fox predation)
OTHER SPECIES AT RISK WITHIN THE SUBREGION					
Pseudomys occidentalis		ii	iii	iii	v (cats, foxes, rabbits), i ii, vii
Acanthiza iredalei iredalei	V	ii	iv	iii	iv
Platycercus icterotis xanthogenys	2	ii	iii	iii	i, iv
Ninox connivens connivens	2	ii	iii	iii	i, ii
Bothriembryon bradshawi	1	ii	vi	ii	i, ii

[1]Appendix C, rank 2; [2]Appendix C, rank 3; [3]Appendix C, rank 1; [4]Appendix B, key e

Declared rare and priority flora

Species	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
DECLARED RARE FLORA					
Acacia auratiflora	CR	ii	ii	iii	i, ii, vi, vii, ix, x
Anigozanthos bicolor subsp. *minor*	CR	ii	ii	iii	i, ii, vi, vii, ix, x
Caladenia hoffmanii	CR	ii	ii	iii	i, ii, vi, vii, ix, x
Drakaea isolata	CR	ii	ii	iii	i, ii, vi, vii, ix, x
Eremophila subteretifolia	CR	ii	ii	iii	i, ii, vi, vii, ix, x
Eremophila veneta	CR	ii	ii	iii	i, ii, vii, vi, xiii (road maintenance), ix
Eremophila verticillata	CR	ii	ii	iii	i, ii, vi, vii, ix, x
Grevillea scapigera	CR	ii	ii	iii	i, ii, vi, vii, ix, x
Roycea pycnophylloides	CR	ii	ii	iii	x, i, ii, vi, vii, ix
Muehlenbeckia horrida subsp. *abdita*	CR	ii	iii	iii	ix, x
Acacia lanuginophylla	E	ii	iii	iii	i, ii, vi, vii, ix, x
Acacia leptalea	E	ii	iii	iii	i, ii, vi, vii, ix, x
Adenanthos pungens subsp. *pungens*	E	ii	iii	iii	i, ii, vi, vii, ix, x
Bentleya spinescens	E	ii	iii	iii	i, ii, vi, vii, ix, x
Boronia revoluta	E	ii	iii	iii	i, ii, vi, vii, ix, x
Caladenia bryceana subsp. *bryceana*	E	ii	iii	iii	i, ii, vi, vii, ix, x
Conostylis lepidospermoides	E	ii	iii	iii	i, ii, vi, vii, ix, x
Conostylis misera	E	ii	iii	iii	i, ii, vi, vii, ix, x
Conostylis seorsiflora subsp. *trichophylla*	E	ii	iii	iii	i, ii, vi, vii, ix, x
Grevillea dryandroides subsp. *hirsuta*	E	ii	iii	iii	i, ii, vi, vii, ix, x
Grevillea involucrata	E	ii	iii	iii	i, ii, vi, vii, ix, x
Lechenaultia pulvinaris	E	ii	iii	iii	i, ii, vi, vii, ix, x
Orthrosanthus muelleri	E	ii	iii	iii	i, ii, vi, vii, ix, x

Species	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
Ricinocarpos trichophorus	E	ii	iii	iii	viii (*Phytopthora* sp.) i, ii, vi, vii, ix, x
Thelymitra stellata	E	ii	iii	iii	i, ii, vi, vii, ix, x
Verticordia staminosa var. *cylindracea*	E	ii	iii	iii	i, ii, vi, vii, ix, x
Verticordia staminosa var. *erecta*	E	ii	iii	iii	i, ii, vi, vii, ix, x
Acacia depressa	V	ii	iii	iii	i, ii, vi, vii, ix, x
Allocasuarina tortiramula	V	ii	iii	iii	i, ii, vi, vii, ix, x
Banksia sphaerocarpa var. *dolichostyla*	V	ii	iii	iii	i, ii, vi, vii, ix, x
Calectasia arnoldii	V	ii	iii	iii	i, ii, vi, vii, ix, x
Daviesia spiralis	V	ii	iii	iii	i, ii, vi, vii, ix, x
Eremophila denticulata subsp. *denticulata*	V	ii	iii	iii	i, ii, vi, vii, ix, x
Eucalyptus merrickiae	V	ii	iii	iii	i, ii, vi, vii, ix, x
Eucalyptus olivacea	V	ii	iii	iii	i, ii, vi, vii, ix, x
Eucalyptus steedmanii	V	ii	iii	iii	i, ii, vi, vii, ix, x
Goodenia integerrima	V	ii	iii	iii	i, ii, vi, vii, ix, x
Myoporum cordifolium	V	ii	iii	iii	i, ii, vi, vii, ix, x
Stylidium merrallii	V	ii	iii	iii	i, ii, vi, vii, ix, x
Thelymitra psammophila	V	ii	iii	iii	i, ii, vi, vii, ix, x
Tribonanthes purpurea	V	ii	iii	iii	i, ii, vi, vii, ix, x
PRIORITY 1					
Acacia mutabilis subsp. *stipulifera*	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Acacia sclerophylla var. *teretiuscula*	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Acacia tetraneura	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Baeckea crispiflora subsp. Ongerup (A.Scougall & C.Garawanta E35)	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Dampiera scaevolina	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Darwinia sp. Bendering (B.Lullfitz s.n.July 1965)	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Drosera grievei	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Eucalyptus myriadena subsp. *parviflora*	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Eucalyptus subangusta subsp. *virescens*	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Frankenia glomerata	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Grevillea lullfitzii	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Hibbertia axillibarba	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Hydrocotyle hexaptera	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Hydrocotyle muriculata	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Jacksonia debilis	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Lasiopetalum sp. Ironcaps (P.G.Wilson 7024)	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Microcorys sp. Forrestania (V.English 2004)	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Neofuscelia scabrosina	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Thysanotus lavanduliflorus	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Thysanotus sabulosus	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Xanthoparmelia nashii	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
PRIORITY 2					
Acacia drewiana subsp. *minor*	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Acacia tuberculata	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Astartea clavifolia	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Baeckea preissiana	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Boronia ericifolia	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Caladenia melanema	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Conostylis seorsiflora subsp. Nyabing (A.Coates s.n.)	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Dampiera orchardii	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Drosera salina	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Dryandra conferta var. *parva*	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Dryandra drummondii var. *macrorufa*	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Species	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
Dryandra erythrocephala var. *inopinata*	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Dryandra foliosissima	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Dryandra idiogenes	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Dryandra rufistylis	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Eucalyptus angustissima subsp. *quaerenda*	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Eucalyptus sparsicoma	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Fitzwillia axilliflora	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Guichenotia asteriskos	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Haegiela tatei	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x

Melaleuca pritzelii	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Melaleuca pungens	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Millotia steetziana	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Nemcia effusa	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Opercularia rubioides	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Persoonia brevirhachis	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Persoonia hakeiformis	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Pimelea halophila	2	ii	vi	ii	x, i, ii, iv, vi, vii, ix
Rinzia affinis	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Synaphea canaliculata	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Synaphea cervifolia	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Synaphea flexuosa	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Synaphea parviflora	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Synaphea tripartita	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
Thysanotus acerosifolius	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x

[1]Appendix C, rank 2; [2]Appendix C, rank 3; [3]Appendix C, rank 1; [4]Appendix B, key e

Analysis of appropriate management scenarios

Reservation priorities of ecosystems

Beard Veg Assoc	Vegetation Association Description	% of total extent in IBRA subregion	Area in IBRA subregion (ha)	% in IUCN Reserve	% in Non-IUCN Reserve	Total % Area in CALM Estate	Priority
	Plant assemblages of the Bremer Range System	?	65000?	0	0	0	M
	Unwooded freshwater wetlands of the southern Wheatbelt of Western Australia, dominated by *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor.	100	145	50 (34%)	95 (66%)	34	H
	Herblands and Bunch Grasslands on gypsum lunette dunes.	100	3.5	0	0	0	H
	Chinocup Eucalyptus aff. incrassata mallee over low scrub on gypsum dunes.	100	100	100%	0	100%	H
7	Medium woodland; York gum (*E. loxophleba*) & wandoo	0.5	140.3	0.0	0.0	0.0	H
25	Low woodland; *Allocasuarina huegeliana* & York gum	3.9	52.4	0.0	0.0	0.0	H
126	Bare areas; freshwater lakes	0.0	14.7	0.0	0.0	0.0	M
141	Medium woodland; York gum, salmon gum & gimlet	0.0	22.7	0.0	0.0	0.0	M
352	Medium woodland; York gum	0.4	487.2	0.0	0.0	0.0	H

Beard Veg Assoc	Vegetation Association Description	% of total extent in IBRA subregion	Area in IBRA subregion (ha)	% in IUCN Reserve	% in Non-IUCN Reserve	Total % Area in CALM Estate	Priority
368	Shrublands tree-heath between sandhills; *Banksia ashbyi, Grevillea gordoniana, Acacia* spp., *Melaleuca* and mallee	0.0	8.9	0.0	0.0	0.0	M
468	Medium woodland; salmon gum & goldfields blackbutt	0.1	622.3	0.0	0.0	0.0	M
522	Medium woodland; redwood (*E. transcontinentalis*) & merrit (*E. flocktoniae*)	0.4	3,055.9	0.0	0.0	0.0	L
552	Shrublands; *Casuarina acutivalvus* & calothamnus (also melaleuca) thicket on greenstone hills	31.0	11,711.7	0.0	0.0	0.0	L
934	Shrublands; mallee scrub *Eucalyptus nutans*	0.4	255.7	0.0	0.0	0.0	M
939	Succulent steppe with woodland; york gum, sparse teatree scrub & samphire	100.0	10.4	0.0	0.0	0.0	H
940	Mosaic: Shrublands; mallee scrub, black marlock/Shrublands; tallerack mallee-heath	0.0	61.8	0.0	0.0	0.0	M
942	Mosaic: Medium woodland; yate/Shrublands; mallee scrub, black marlock	13.2	1,298.3	0.0	9.8	9.8	M
966	Succulent steppe with sparse woodland & thicket; salmon gum & morrell over teatree & samphire	83.6	157.1	0.0	0.0	0.0	H
974	Medium woodland; York gum, salmon gum & morrel	82.6	584.2	0.0	0.0	0.0	H
981	Medium woodland; wandoo, York gum & yate	71.6	1,036.2	0.0	0.0	0.0	H
993	Medium woodland; York gum & *Allocasuarina huegeliana*	82.6	693.6	0.0	0.0	0.0	H
1005	Low woodland; *Allocasuarina huegeliana*	25.7	61.5	0.0	0.0	0.0	H
1068	Medium woodland; salmon gum, morrel, gimlet & *Eucalyptus sheathiana*	0.0	28.6	0.0	0.0	0.0	M
1093	Succulent steppe with open woodland & thicket; eucalypts & *Allocasuarina obesa* over teatree & samphire	1.5	13.6	0.0	0.0	0.0	M
1095	Medium woodland; York gum, yate & salmon gum	72.5	247.6	0.0	0.0	0.0	H
1096	Medium woodland; yate & salmon gum	82.9	177.4	0.0	0.0	0.0	H

Subregional constraints in order of priority

(see Appendix B, key g)

Irreplacibility & Limited Opportunity to Meet CAR Criteria: The majority of ecosystems have been extensively cleared well below CAR thresholds. Within the agricultural zone virtually all remnants are important for biodiversity conservation and building towards CAR thresholds.

Other: Many ecosystems low in the landscape are under threat from rising watertables. Most lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline wetland systems will be lost. These systems support over 1,500 plant species, of which 450 are endemic to the agricultural zone and in danger of extinction due to rising saline groundwaters.

Economic Constraints: Insufficient resources to acquire and manage an increased conservation estate.

Competing Land Uses: Whilst some opportunities exist to add to the conservation estate through the vesting of unallocated Crown land and the re-vesting of other Crown reserves, there is some competition with other government agencies and local government for these areas. The process is also lengthy and somewhat ad hoc.

Other: Inadequate systematic knowledge of biodiversity values at an appropriately fine scale.

Bioregional and subregional priority for reserve consolidation

MAL is currently listed as IBRA Reservation Class 5 (>15% of its area reserved in any CALM tenure) (see Appendix D, and Appendix C, rank 4).

MAL2 should be reservation Class 3a because 5-10% (9.97%) of its area is reserved (any tenure) and approximately 33% of native vegetation cover remains. However in the cleared western and central parts of

the subregion only 17.3% of native vegetation cover remains, and widespread threats such as salinity are ubiquitous. This leaves a biased reserve system across the region, and therefore at least Class 3 is appropriate (bordering on Class 2 depending on the accuracy of the various figures supplied – eg. the biodiversity assessment spreadsheet claims the MAL2 subregion is about 4,764,000 ha, whilst the GIS file supplied by CALM lists it as approximately 3,990,000 ha in area). This discrepancy could have a significant impact on the final percentages calculated for the various indices.

Reserve management standard

The Reserve Management Standard is poor (see Appendix C, rank 5). Many nature reserves in the western portion of the region are under significant threat from rising saline groundwater levels that at present are unmanaged (except in very localised circumstances) and are currently and projected to cause major declines and extinctions in many lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline wetland systems. Several major reserves are routinely fox baited - Lake Magenta Nature Reserve, Dragon Rocks Nature Reserve, Bendering Nature Reserve, Roe Nature Reserve, North Karlgarin Nature Reserve and Cape Arid National Park. Within MAL2 approximately 34% (136 400 ha) of the conservation estate is baited; much less in MAL1. Biodiversity values are generally poorly identified. There is no overview of the region's biota - the recent Salinity Action Plan Biodiversity Survey project was the first systematic overview of a significant portion of the region's biota, but was largely confined to MAL2 within this region. There is no systematic fine scale vegetation mapping (1:25 000 or better); the best available is Beard's at 1:250 000. Some reserves have vegetation maps, but there is little consistency between methodologies. Inappropriate fire regimes are also a major threat to biodiversity, but little is known of the response of individual species to fire. Fire histories for all reserves are also poorly known and documented.

Off reserve conservation

Priority species or groups

CWR mammals

Species	Current Conservation Status (WA)	Status in MAL2 Subregion	Recovery Plan
Mala (*Lagorchestes hirsutus*)	Threatened (Extinct in the wild)	Regionally Extinct	No
Red-tailed Phascogale (*Phascogale calura*)	Threatened (Endangered)	Threatened (Endangered)	No
Western Barred Bandicoot (*Perameles b. bougainville*)	Threatened (Endangered)	Regionally Extinct	National
Chuditch (*Dasyurus geoffroii*)	Threatened (Vulnerable)	Threatened (Vulnerable)	State
Numbat (*Myrmecobius fasciatus*)	Threatened (Vulnerable)	Threatened (Vulnerable)	National & State
Bilby (*Macrotis lagotis*)	Threatened (Vulnerable)	Regionally Extinct	National
Boodie (*Bettongia lesueur lesueur*)	Threatened (Vulnerable)	Regionally Extinct	No
Banded Hare-wallaby (*Lagostrophus f. fasciatus*)	Threatened (Vulnerable)	Regionally Extinct	No
Black-flanked Rock-wallaby (*Petrogale l. lateralis*)	Threatened (Vulnerable)	Regionally Extinct	No
Greater Stick-nest Rat (*Leporillus conditor*)	Threatened (Vulnerable)	Regionally Extinct	No
Heath Mouse (*Pseudomys shortridgei*)	Threatened (Vulnerable)	Threatened (Vulnerable)	No

Species	Current Conservation Status (WA)	Status in MAL2 Subregion	Recovery Plan
Woylie (*Bettongia penicillata ogilbyi*)	Priority 4, Conservation Dependent	Priority 4, Conservation Dependent	No
Tammar Wallaby (*Macropus eugenii derbianus*)	Priority 4, Conservation Dependent	Regionally Extinct?	No
Quenda (*Isoodon obesulus fusciventer*)	Priority 4, Conservation Dependent	Threatened	No
Western Brush Wallaby (*Macropus irma*)	Priority 4, Conservation Dependent	Priority 4, Conservation Dependent	No
Western Mouse (*Pseudomys occidentalis*)	Priority? Conservation Dependent	Priority 4, Conservation Dependent	No (draft?)
Common Brushtail Possum (*Trichosurus vulpecula*)	No listing	Conservation Dependent	No

Other priority species and groups:

Western Wheatbelt Coordinated Conservation Plan for 14 bird species (Garnett and Crowley, 2000)

Flora and fauna of granite outcrops – numerous species including *Teyl* spp., *Caladenia hoffmanii* subsp. *graniticola*, *Daphnia jollyi*

District Threatened Flora Recovery Team – the Katanning District TFRT already covers the following species with IRPs - *Acacia auratiflora, Adenanthos pungens subsp. Effusus, Drakaea isolata, Eremophila veneta, Eremophila verticillata,* and *Muehlenbeckia horrida* subsp. *abdita.*

Threatened flora of roadsides – for example *Acacia auratiflora* and *Grevillea involucrata.*

Threatened flora of lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline wetland systems. Eg. *Drakaea isolata, Muehlenbeckia horrida* subsp. *abdita*

Threatened flora

Species	Status EPBC Act	Status WA
Acacia auratiflora	E	CR
Acacia depressa	V	V
Acacia lanuginophylla	E	E
Acacia leptalea	E	E
Adenanthos pungens subsp. *pungens*	V	E
Allocasuarina tortiramula	V	V
Anigozanthos bicolor subsp. *minor*	E	CR
Banksia sphaerocarpa var. *dolichostyla*	V	V
Bentleya spinescens	E	E
Boronia revoluta	E	E
Caladenia bryceana subsp. *bryceana*	E	-
Caladenia hoffmanii	E	CR
Calectasia arnoldii	V	-
Conostylis lepidospermoides	E	E
Conostylis misera	E	-
Conostylis seorsiflora subsp. *trichophylla*	E	-
Daviesia spiralis	V	-
Drakaea isolata	E	CR
Eremophila denticulata subsp. *denticulata*	V	-
Eremophila subteretifolia	E	CR
Eremophila veneta	E	CR
Eremophila verticillata	E	CR
Species	Status EPBC Act	Status WA
Eucalyptus merrickiae	V	-
Eucalyptus olivacea	V	V

Eucalyptus steedmanii	V	V
Goodenia integerrima	V	V
Grevillea dryandroides subsp. *hirsuta*	E	E
Grevillea involucrata	E	E
Grevillea scapigera	E	CR
Lechenaultia pulvinaris	E	E
Muehlenbeckia horrida subsp. *abdita*	-	CR?
Myoporum cordifolium	V	-
Orthrosanthus muelleri	E	-
Ricinocarpos trichophorus	E	-
Stylidium merrallii	V	V
Thelymitra psammophila	V	-
Thelymitra stellata	E	E
Tribonanthes purpurea	V	V
Verticordia staminosa var. *cylindracea*	E	E
Verticordia staminosa var. *erecta*	-	E

Priority 1 and 2 flora

Species	Priority
Acacia mutabilis subsp. *stipulifera*	1
Acacia sclerophylla var. *teretiuscula*	1
Acacia tetraneura	1
Baeckea crispiflora subsp. Ongerup (A.Scougall & C.Garawanta E35)	1
Dampiera scaevolina	1
Darwinia sp. Bendering (B.Lullfitz s.n.July 1965)	1
Drosera grievei	1
Eucalyptus myriadena subsp. *parviflora*	1
Eucalyptus subangusta subsp. *virescens*	1
Frankenia glomerata	1
Grevillea lullfitzii	1
Hibbertia axillibarba	1
Hydrocotyle hexaptera	1
Hydrocotyle muriculata	1
Jacksonia debilis	1
Lasiopetalum sp. Ironcaps (P.G.Wilson 7024)	1
Microcorys sp. Forrestania (V.English 2004)	1
Neofuscelia scabrosina	1
Thysanotus lavanduliflorus	1
Thysanotus sabulosus	1
Xanthoparmelia nashii	1
Acacia drewiana subsp. *minor*	2
Acacia tuberculata	2
Astartea clavifolia	2
Baeckea preissiana	2
Species	Priority
Caladenia melanema	2
Conostylis seorsiflora subsp. Nyabing (A.Coates s.n.)	2

Dampiera orchardii	2
Drosera salina	2
Dryandra conferta var. *parva*	2
Dryandra drummondii var. *macrorufa*	2
Dryandra erythrocephala var. *inopinata*	2
Dryandra foliosissima	2
Dryandra idiogenes	2
Dryandra rufistylis	2
Eucalyptus angustissima subsp. *quaerenda*	2
Eucalyptus sparsicoma	2
Fitzwillia axilliflora	2
Gastrolobium rigidum	2
Goodenia sp. Lake King (M.Gustafsson et K.Bremer 132)	2
Guichenotia asteriskos	2
Haegiela tatei	2
Melaleuca pritzelii	2
Melaleuca pungens	2
Millotia steetziana	2
Nemcia effusa	2
Opercularia rubioides	2
Persoonia brevirhachis	2
Persoonia hakeiformis	2
Pimelea halophila	2
Rinzia affinis	2
Synaphea canaliculata	2
Synaphea cervifolia	2
Synaphea flexuosa	2
Synaphea parviflora	2
Synaphea tripartita	2
Thysanotus acerosifolius	2

Priority species or groups and existing recovery plans

Species or Group	Specific Recovery Plan	General Recovery Plan (Action Plans)	Other Management Plans
Western Barred Bandicoot (*Perameles bougainville bougainville*)	Yes – unpublished IRP	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Chuditch (*Dasyurus geoffroii*)	Yes – State	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Numbat (*Myrmecobius fasciatus*)	Yes – National (unpublished)	Action Plan for Australian Marsupials and Monotremes -Recovery Outline	Western Shield Fauna Recovery Program
Bilby (*Macrotis lagotis*)	Yes – National	Action Plan for Australian Marsupials and Monotremes -Recovery Outline	Western Shield Fauna Recovery Program

Species or Group	Specific Recovery Plan	General Recovery Plan (Action Plans)	Species or Group
Boodie (*Bettongia lesueur lesueur*)	No (Draft Interim Recovery Plan)	Action Plan for Australian Marsupials and Monotremes -Recovery Outline	Western Shield Fauna Recovery Program
Banded Hare-wallaby (*Lagostrophus fasciatus fasciatus*)	No	Action Plan for Australian Marsupials and Monotremes -Recovery Outline	Western Shield Fauna Recovery Program
Woylie (*Bettongia penicillata ogilbyi*)	No (no longer current)	Action Plan for Australian Marsupials and Monotremes -Taxon Summary	Western Shield Fauna Recovery Program
Tammar Wallaby (*Macropus eugenii derbianus*)	No (old draft)	Action Plan for Australian Marsupials and Monotremes -Taxon Summary	Western Shield Fauna Recovery Program
Quenda (*Isoodon obesulus fusciventer*)	No (old draft)	Action Plan for Australian Marsupials and Monotremes -Taxon Summary	Western Shield Fauna Recovery Program
Red-tailed Phascogale (*Phascogale calura*)	No	Action Plan for Australian Marsupials and Monotremes -Recovery Outline	Western Shield Fauna Recovery Program
Common Brushtail Possum (*Trichosurus vulpecula*)	No	Action Plan for Australian Marsupials and Monotremes -Taxon Summary	Western Shield Fauna Recovery Program
Heath Mouse (*Pseudomys shortridgei*)	No	Action Plan for Australian Rodents	No
Western Mouse (*Pseudomys occidentalis*)	No (draft?)	Action Plan for Australian Rodents	No
Thick-billed Grasswren (western) (*Amytornis textilis textilis*)	Yes – Interim Recovery Plan	Action Plan for Australian Birds - Coordinated Conservation Plan and Action plan	No
Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	Yes - State	Action Plan for Australian Birds - Coordinated Conservation Plan and Action Plan	No
Western Whipbird (western mallee) (*Psophodes nigrogularis*)	No	Action Plan for Australian Birds - Taxon Summary	Research Plan for the Western Ground Parrot, Western Whipbird and Western Bristlebird.
Western Rosella (wheatbelt) (*Platycercus icterotis*)	No	Action Plan for Australian Birds - Taxon Summary	No
Barking Owl (southern) (*Ninox connivens*)	No	Action Plan for Australian Birds - Taxon Summary	No
Malleefowl (*Leipoa ocellata*)	National Recovery Plan for Malleefowl	Action Plan for Australian Birds - Coordinated Conservation Plan and Action Plan	No
Western Wheatbelt Birds	Some	Action Plan for Australian Birds - Coordinated Conservation Plan	No
Flora and fauna of granite outcrops Eg. *Teyl* spp., *Caladenia hoffmanii* subsp. *graniticola*, *Daphnia jollyi*	Some	N/A	No
450 flora species endemic to the agricultural zone and in danger of extinction due to rising saline groundwaters.	No	N/A	Salinity Action Plan Biological Survey of the Agricultural Zone
Threatened Flora on roadsides Eg. *Acacia auratiflora, Grevillea involucrata*	Few	N/A	Roadside Conservation Strategies (Roadside Conservation Committee and Shires)
Species or Group	Specific Recovery Plan	General Recovery Plan (Action Plans)	Species or Group
Threatened flora of lowland communities	Few	N/A	Eg. Lake Bryde Recovery Catchment
Priority 1 and 2 flora	No	N/A	No
Threatened Flora (general)	No	N/A	District Recovery Teams
Acacia auratiflora	Yes IRP	N/A	No
Acacia depressa	No	N/A	No
Acacia lanuginophylla	No	N/A	No
Acacia leptalea	No	N/A	No
Adenanthos pungens subsp. *pungens*	No	N/A	No
Allocasuarina tortiramula	No	N/A	No
Anigozanthos bicolor subsp. *minor*	No	N/A	No
Banksia sphaerocarpa var. *dolichostyla*	No	N/A	No

Bentleya spinescens	No	N/A	No
Boronia revoluta	No	N/A	No
Caladenia bryceana subsp. *bryceana*	No	N/A	No
Caladenia hoffmanii	No	N/A	No
Calectasia arnoldii	No	N/A	No
Conostylis lepidospermoides	No	N/A	No
Conostylis misera	No	N/A	No
Conostylis seorsiflora subsp. *trichophylla*	No	N/A	No
Daviesia spiralis	No	N/A	No
Drakaea isolata	Yes IRP	N/A	No
Eremophila denticulata subsp. *denticulata*	No	N/A	No
Eremophila subteretifolia	No	N/A	No
Eremophila veneta	Yes IRP	N/A	No
Eremophila verticillata	Yes IRP	N/A	No
Eucalyptus merrickiae	No	N/A	No
Eucalyptus olivacea	No	N/A	No
Eucalyptus steedmanii	No	N/A	No
Goodenia integerrima	No	N/A	No
Grevillea dryandroides subsp. *hirsuta*	No	N/A	No
Grevillea involucrata	No	N/A	No
Grevillea scapigera	Yes RP	N/A	No
Lechenaultia pulvinaris	No	N/A	No
Muehlenbeckia horrida subsp. *abdita*	Yes IRP for TEC in which it is a component	N/A	No
Myoporum cordifolium	No	N/A	No
Orthrosanthus muelleri	Yes IRP	N/A	No
Ricinocarpos trichophorus	No	N/A	No
Stylidium merrallii	No	N/A	No
Thelymitra psammophila	No	N/A	No
Thelymitra stellata	No	N/A	No
Tribonanthes purpurea	No	N/A	No
Verticordia staminosa var. *cylindracea*	No	N/A	No
Verticordia staminosa var. *erecta*	No	N/A	No

Appropriate species recovery actions

Species or Group	Ecosystem Recovery Actions[1]	Recovery Description	Major Constraints
Western Barred Bandicoot (*Perameles bougainville bougainville*)	vii, i, x, xiv, ix, xii	Revegetation; Habitat retention through reserves; Translocation; Other – captive breeding & monitoring; Fire management; Research.	Subregionally extinct, predator control, translocation of sufficient numbers
Chuditch (*Dasyurus geoffroii*)	vii, i, x, xiv, ix	Revegetation; Habitat retention through reserves; Translocations; Other – monitoring; Fire management.	Predator control
Numbat (*Myrmecobius fasciatus*)	vii, i, x, xiv, xii, ix	Revegetation; Habitat retention through reserves; Translocations; Other – monitoring and captive breeding; Research; Fire management.	Predator control, particularly cats, translocation of sufficient numbers
Bilby (*Macrotis lagotis*)	vii, i, x, xiv, ix, xii	Revegetation; Habitat retention through reserves; Translocations; Other – monitoring & captive breeding; Fire management; Research.	Subregionally extinct, predator control particularly cats, translocation of sufficient numbers,
Boodie (*Bettongia lesueur lesueur*)	vii, i, x, xiv, ix, xii	Revegetation; Habitat retention through reserves;	Subregionally extinct, predator

		Translocations; Fire management; Research.	control, translocation of sufficient numbers
Banded Hare-wallaby (*Lagostrophus fasciatus fasciatus*)	vii, i, x, xiv, ix, xii	Revegetation; Habitat retention through reserves; Translocations; Fire management; Research.	Subregionally extinct, predator control, translocation of sufficient numbers
Woylie (*Bettongia penicillata ogilbyi*)	vii, i	Revegetation; Habitat retention through reserves;	
Tammar Wallaby (*Macropus eugenii derbianus*)	vii, i, x, xiv, ix	Revegetation; Habitat retention through reserves; Translocations; Other – monitoring; Fire management.	Subregionally extinct?, lack of survey data, predator control
Quenda (*Isoodon obesulus fusciventer*)	vii, i, ii, x	Revegetation; Habitat retention through reserves and on private lands.	Subregionally extinct?, predator control
Red-tailed Phascogale (*Phascogale calura*)	i, ii, vii, ix, x	Habitat retention through reserves and on private land; Feral animal control; Fire management; Translocation.	Lack of survey data, predator control
Common Brushtail Possum (*Trichosurus vulpecula*)	vii, i	Revegetation; Habitat retention through reserves.	Predator control, particularly cats
Heath Mouse (*Pseudomys shortridgei*)	vii, i, xiv, ix	Revegetation; Habitat retention through reserves; Other - survey and monitoring; Fire management.	Lack of knowledge of distribution. Predator control, particularly cats
Western Mouse (*Pseudomys occidentalis*)	i, vii, iii, ix, xii	Habitat retention through reserves; Feral animal control; Habitat retention on other lands; Fire management; Research.	Lack of knowledge of distribution. Predator control, particularly cats
Thick-billed Grasswren (western) (*Amytornis textilis textilis*)	x, i, iii, vii, xiv	Translocations; Habitat retention through reserves and on other state lands; Feral animal control; Other - survey and monitoring.	Subregionally extinct
Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	i, ii, iii, xiv, xii, xiv	Habitat retention through reserves, on private lands and on other State lands; Other - protect known nesting trees and breeding areas, survey & captive breeding; Research; Other - public awareness program.	Lack of survey data on breeding and habitat areas
Western Whipbird (western mallee) (*Psophodes nigrogularis*)	i, iii, ii, viii, xiv, xii	Habitat retention through reserves, on other state lands and on private lands; Revegetation; Other – monitoring; Research.	Lack of survey data

Species or Group	Ecosystem Recovery Actions[1]	Recovery Description	Major Constraints
Western Rosella (wheatbelt) (*Platycercus icterotis*)	xiv, xii, xiv, i, ii, iii, xiv	Other – monitoring; Research; Other - promote community nestbox program; Habitat retention through reserves, on private lands and on other state lands; Other - mitigate food limitations.	Lack of knowledge on habitat requirements
Barking Owl (southern) (*Ninox connivens*)	i, iii, ii, xii, xiv, xiii, viii, vii	Habitat retention through reserves, on other state lands and on private lands; Research; Other – survey; Capacity building with the community, landholders, industry and institutions to extend and promote habitat management.	Lack of survey data
Malleefowl (*Leipoa ocellata*)	ix, vii, i, iii, ii, xiv	Fire management; Feral animal control; Habitat retention through reserves, on private land and on other state lands; Other - survey and monitoring & captive breeding.	Lack of survey data, lack of resources to manage fire regimes
Western Wheatbelt Birds	i, iii, ii, vii, v, xiii, viii, xiv	Habitat retention through reserves, on other state lands and on private lands; Feral animal control; Fencing; Capacity building with community, landholders, industry and institutions; Revegetation; Other - protect breeding hollows, survey & monitoring.	High degree of habitat loss and fragmentation; many valley floor woodland now threatened by salinity; providing sufficient incentives for agricultural land to be revegetated for habitat
Flora and fauna of granite outcrops Eg. *Teyl* spp., *Caladenia hoffmanii* ssp. *graniticola*, *Daphnia jollyi*	i, iii, ii, xi, vi, vii, ix, xiii, xii	Habitat retention through reserves, on other state lands and on private lands; Reinstatement of hydrology; Weed control; Feral animal control; Fire management; Capacity building with landholders; Research.	Competing use of water for supply purposes; loss of fringing vegetation in many instances.
450 flora species endemic to the agricultural zone and in danger of extinction due to rising saline groundwaters.	xi, x, xiv, i, iii, ii	Reinstatement of hydrology; Translocation; Other - germplasm storage; Habitat retention through reserves, on other state lands and on private lands.	Response to rising groundwater is unlikely to be of the magnitude required, lack of resources to collect and store sufficient germplasm, lack of resources to propagate and lack of suitable habitat to translocate sufficient numbers of all species.
Threatened Flora on roadsides Eg. *Acacia auratiflora, Grevillea involucrata*	iii, xiii, vi, v, x, viii	Habitat protection on other state lands; Capacity building with Shire officers; Weed control; Fencing; Translocation; Revegetation.	Competing land use; loss of permanent staff and increased use of contractors makes the education process more difficult
Threatened flora of lowland communities	xi, xiii, viii, x, xiv	Reinstatement of hydrology; Capacity building with landholders; Revegetation; Translocation; Other - germplasm storage.	Response to rising groundwater is unlikely to be of the magnitude required, lack of resources to collect and store sufficient germplasm, lack of resources to propagate and lack of suitable habitat to translocate sufficient numbers of all species.
Priority 1 and 2 flora	xiv	Other - additional survey work to locate new populations.	Insufficient qualified staff to undertake the extensive fieldwork required.

Species or Group	Ecosystem Recovery Actions[1]	Recovery Description	Major Constraints
Threatened Flora (general)	General – xiv	Other - additional survey work to locate new populations.	General - Insufficient qualified staff and resources to undertake the extensive fieldwork required for survey, monitoring and management actions
Acacia auratiflora	iii, i, vii, v, xiii (Shire), x, xiv	Habitat protection on other state lands and reserves; Feral animal control; Fencing; Capacity building with the Shire; Translocation; Other – seed collection.	Refer to Threatened Flora above
Acacia depressa	i, iii, ii, xiii, vii, xiv	Habitat retention through reserves, on other state lands and on private lands; Capacity building with utility companies and the Shire; Feral animal control with fencing; Other - roadside markers.	Refer to Threatened Flora above
Acacia lanuginophylla	i, ii, iii, vii	Habitat retention through reserves, on private lands and on other state lands; Feral animal control.	Refer to Threatened Flora above
Acacia leptalea	iii, i, xiii, xiv	Habitat protection on other state lands and through reserves; Capacity building with Shire, and utility companies; Other - roadside markers.	Refer to Threatened Flora above
Adenanthos pungens subsp. *pungens*	i, xiv, x, xi, xiv	Habitat retention through reserves; Other - protection from mining & disease management *Phytophthora cinnamomi*; Translocation; Reinstatement of hydrology; Other - seed collection.	Refer to Threatened Flora above
Allocasuarina tortiramula	i	Habitat retention through reserves.	Refer to Threatened Flora above
Anigozanthos bicolor subsp. *minor*	unknown		Refer to Threatened Flora above
Banksia sphaerocarpa var. *dolichostyla*	unknown		Refer to Threatened Flora above
Bentleya spinescens	iii, xiii, xiv	Habitat protection on other state lands; Capacity building with Shire and utility companies; Other - (additional survey).	Refer to Threatened Flora above
Boronia revoluta	unknown		Refer to Threatened Flora above
Caladenia bryceana subsp. *bryceana*	unknown		Refer to Threatened Flora above
Caladenia hoffmanii	i, vii, xiv	Habitat retention through reserves; Feral animal control; Other - additional surveys.	Refer to Threatened Flora above
Calectasia arnoldii	i, xiv	Habitat retention through reserves; Other - additional surveys.	Refer to Threatened Flora above
Conostylis lepidospermoides	unknown		Refer to Threatened Flora above
Conostylis misera	unknown		Refer to Threatened Flora above
Conostylis seorsiflora subsp. *trichophylla*	iii, xiii, xiv	Habitat protection on other state lands; Capacity building with the Water Corporation; Other - additional survey.	Small population size
Daviesia spiralis	unknown		Refer to Threatened Flora above
Drakaea isolata	i, iii, xiv	Habitat retention through reserves and on other state lands; Other - additional survey.	Refer to Threatened Flora above
Eremophila denticulata subsp. *denticulata*	unknown		Refer to Threatened Flora above

Species or Group	Ecosystem Recovery Actions[1]	Recovery Description	Major Constraints
Eremophila subteretifolia	i, xi, xiv	Habitat retention through reserves; Reinstatement of hydrology; Other - seed collection.	Refer to Threatened Flora above
Eremophila veneta	i, iii, xiii, ix	Habitat retention through reserves and on other state lands; Capacity building with Westrail; Fire management.	Refer to Threatened Flora above
Eucalyptus merrickiae	unknown		Refer to Threatened Flora above
Eucalyptus olivacea	i, ii, ix	Habitat retention through reserves and on private lands; Fire management.	Refer to Threatened Flora above
Eucalyptus steedmanii	unknown		Refer to Threatened Flora above
Goodenia integerrima	unknown		Refer to Threatened Flora above
Grevillea dryandroides subsp. *hirsuta*	unknown		Refer to Threatened Flora above
Grevillea involucrata	iii, ii, i, xiii, xiv, v	Habitat protection on other state lands, on private lands and through reserves; Capacity building with utility companies; Other - roadside markers; Fencing.	Refer to Threatened Flora above
Grevillea scapigera	iii, x, vi, xii	Habitat protection on other state lands; Translocation; Weed control; Research by local community groups.	Refer to Threatened Flora above
Lechenaultia pulvinaris	i, vi, vii, ii	Habitat retention through reserves; Weed control; Feral animal control; Habitat protection on private lands.	Refer to Threatened Flora above
Muehlenbeckia horrida subsp. *abdita*	xi, i, x, xiii	Reinstatement of hydrology; Habitat retention through reserves; Translocation; Capacity building with adjoining landholders.	Refer to Threatened Flora above
Myoporum cordifolium	unknown		Refer to Threatened Flora above
Orthrosanthus muelleri	iii	Habitat protection on other state lands.	Refer to Threatened Flora above
Ricinocarpos trichophorus	unknown		Refer to Threatened Flora above
Stylidium merrallii	unknown		Refer to Threatened Flora above
Thelymitra psammophila	i, ix	Habitat retention through reserves; Fire management.	Refer to Threatened Flora above
Thelymitra stellata	iii, xiii, ix	Habitat protection on other state lands; Capacity building with the Shire; Fire management.	Refer to Threatened Flora above
Tribonanthes purpurea	iii, i, ii, v	Habitat protection on other state lands through reserves, and on other state lands; Fencing.	Refer to Threatened Flora above
Verticordia staminosa var. *cylindracea*	iii, ii, v, xi	Habitat protection on other state lands and on private lands; Fencing; Reinstatement of hydrology.	Refer to Threatened Flora above
Verticordia staminosa var. *erecta*	ii, v, xiv	Habitat protection on private lands; Fencing; Other - seed collection.	Refer to Threatened Flora above

[1]Appendix B, key h

Ecosystems and existing recovery plans

Community	Specific Recovery Plan	General Recovery Plan
Plant assemblages of the Bremer Range System - *Eucalyptus rhomboidea* ms and *E. eremophila* woodland on the side slopes of low ridges; *E. flocktoniae* woodland (with *E. salubris*, *E. salmonophloia*, *E. dundasii* and *E. tenuis*) on broad flat ridges and side slopes; *E. flocktoniae* and/or *E. longicornis* woodland on saline soils on ridges and flats adjacent to large salt lake systems; *E. longicornis* and/or *E. salmonophloia* or, *E. georgei* subsp *georgei* or, *E. dundasii* woodland, on low areas; *E. livida* woodland on lateritic tops or Allocasuarina thickets on greenstone ridges of lateritic breakaways; *Acacia duriuscula*, *Allocasuarina globosa*, *E. georgei* subsp *georgei* and *E. oleosa* thickets on greenstone ridges with skeletal soils.	No	Wheatbelt Management Plan (draft)
Unwooded freshwater wetlands of the southern Wheatbelt of Western Australia, dominated by *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor.	Yes - IRP	Wheatbelt Management Plan (draft)
Herblands and Bunch Grasslands on gypsum lunette dunes community is located on grey sandy-clay on the top of a lake edge dune and includes the herbaceous species *Danthonia caespitosa*, *Lawrencia squamata*, *Maireana marginata*, *Podolepis rugosa*, *Senecio lautus* subsp. *maritimus*, *Asteridea chaetopoda*, *Atriplex paludosa*, *Halosarcia syncarpa*, *Scaevola spinescens* and *Stipa juncifolia*.	No	
Eucalyptus aff. incrassata mallee over low scrub on gypsum dunes.	No	Wheatbelt Management Plan (draft)

Appropriate ecosystem recovery actions

Community	Ecosystem Recovery Actions[1]	Ecosystem Recovery Descriptions	Constraints/Priority locations
Plant assemblages of the Bremer Range System - *Eucalyptus rhomboidea* ms and *E. eremophila* woodland on the side slopes of low ridges; *E. flocktoniae* woodland (with *E. salubris*, *E. salmonophloia*, *E. dundasii* and *E. tenuis*) on broad flat ridges and side slopes; *E. flocktoniae* and/or *E. longicornis* woodland on saline soils on ridges and flats adjacent to large salt lake systems; *E. longicornis* and/or *E. salmonophloia* or, *E. georgei* subsp *georgei* or, *E. dundasii* woodland, on low areas; *E. livida* woodland on lateritic tops or Allocasuarina thickets on greenstone ridges of lateritic breakaways; *Acacia duriuscula*, *Allocasuarina globosa*, *E. georgei* subsp *georgei* and *E. oleosa* thickets on greenstone ridges with skeletal soils.	iii, xiii	Habitat protection on other state lands; Capacity building with exploration and mining companies.	unknown
Unwooded freshwater wetlands of the southern Wheatbelt of Western Australia, dominated by *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor.	xi, i, iii, ii, viii, xiv	Reinstatement of hydrology; Habitat retention through reserves, other state lands and on private lands; Revegetation; Other - monitoring of surface and groundwater.	Significant surface and groundwater management issues
Herblands and Bunch Grasslands on gypsum lunette dunes community is located on grey sandy-clay on the top of a lake edge dune and includes the herbaceous species *Danthonia caespitosa*, *Lawrencia squamata*, *Maireana marginata*, *Podolepis rugosa*, *Senecio lautus* ssp. *maritimus*, *Asteridea chaetopoda*, *Atriplex paludosa*, *Halosarcia syncarpa*, *Scaevola spinescens* and *Stipa juncifolia*.	iii, xiii, xiv	Habitat protection on other state lands; Capacity building with a gypsum mining company; Other - seek vesting as a nature reserve.	Limited extent, only 3.5 ha known at present; the area is subject to a mining lease

Community	Ecosystem Recovery Actions[1]	Ecosystem Recovery Descriptions	Constraints/Priority locations
Eucalyptus aff. incrassata mallee over low scrub on gypsum dunes.	i, xii, xiii	Habitat retention through reserves; Research; Capacity building with a gypsum mining industry.	Only known from < 100 ha and likely to become extinct within 5 years if current threatening processes continue

[1]Appendix B, key h

For all the unreserved vegetation types listed (pages 443-4), the following recovery actions would generally apply: Habitat retention and protection through reserves, on other state lands and on private lands; reinstatement of hydrology; feral animal control; fire management; and capacity building with landholders.

Subregion priority for off reserve conservation

There are major constraints (see Appendix C, rank 6) to achieve conservation outcomes due to the level of habitat loss and degree of fragmentation leaving insufficient resources across most of the landscape to support viable populations of many species; significant landscape scale threatening processes such as salinity (affecting up to 30% of the cleared landscape) and fox / cat predation, and competing land uses i.e. broadacre cropping, grazing and mining. However the significant areas of unallocated Crown land in the eastern portion of the subregion probably require limited off-park measures to maintain biodiversity values.

Conservation actions as an integral part of NRM

Existing NRM actions

Incentives: There are incentives for a range of on-ground actions through State, Federal and some other programs. These incentives generally involve revegetation and remnant vegetation fencing, but in some cases (State government in particular) may involve earthworks. Examples include:

- State funding through recovery catchments and other components of the Salinity Program, such as the Crown Reserves Program (refer to Wallace 2001 for summary);
- Land for Wildlife Program (managed by Department of Conservation & Land Management);
- Bushcare funding, through joint projects with State government (who contribute significant dollars) projects and regional NRM groups;
- The Search Project (State-Federal program), for example, significant funding of commercially prospective native species of regional provenance;
- Other NHT programs (National Landcare, Endangered Species).

Three main options also exist to derive a financial benefit from on-farm remnant vegetation:

- Land purchase by government agencies, Australian Bush Heritage fund, interested individuals through the Bush Brokers scheme etc.
- Land revaluation as unproductive, or differential rating by covenanting, and
- Gifting of the land to a tax conservation body for taxation deductions.

Legislation: Most relevant legislation is Wildlife Conservation Act and Conservation and Land Management Act. No “duty of care” legislation, and no evidence that such legislation is practicable.

Institutional Reform: The purchase of bushland by CALM is a very real contribution to helping to re-align land use and free up money for landholders. This is a form of new tenure. Operation of regional NRM groups in a state of flux, but represents an on-going case of institutional reform.(See also recommendations in Frost *et al.* 2001 and Wallace 2001). Some State agencies in NRM area have been restructured and re-oriented over the past 12 months, and this is continuing.

Capacity Building with Landholders: In September 1999 Bush Brokers was established with a formal Memorandum of Understanding by all partners. The MOU sets out a range of projects to be undertaken within the next twelve months. These include:

- A united base for promoting improvements to government policies, particularly subdivision policies and procedures so as to streamline the separation of bush from agricultural titles and placement on a separate title.
- A web site register of properties / blocks currently for sale, and buyers seeking bushland.
- Research on the size of the bushland market, and the most cost-effective measures to stimulate that market.
- A case studies handbook of individuals and groups who have already bought bush.
- "Marketing Bushland" Information Seminars for rural agents.
- A "Marketing Bushland" component included in the accredited REIWA course.

Local Government: Draft Statement of Planning Policy made under Section 5AA of the *Town Planning and Development Act* (1928). This policy may be cited as the Draft Statement of Planning Policy: Environment and Natural Resources Policy. The purpose of this policy is to inform local governments and the Town Planning Appeals Tribunal of those aspects of State-level planning policy concerning the environment and natural resources which should be taken into account in planning decision-making. The policy will also guide the WAPC in undertaking its planning responsibilities, and in integrating and coordinating the activities of the many State agencies which influence the use and development of land. This policy includes a section on biodiversity

Valuing Ecosystem Services & Tradable Rights: Are following testing of these in the eastern states with great interest. Will await the outcome of work there.

Threat Abatement Planning: Actual action is largely through CALM, and there are internal reports and policies on threats such as dieback, feral animal control, fire, etc. However, note also:

- CALM's salinity review (Wallace 2001).
- State Salinity Strategy (State Salinity Council 2000).
- Report of the Salinity Taskforce (Frost *et al.* 2001).
- Weed management strategies (Department of Conservation and Land Management 1999b; Department of Agriculture 2001; Agriculture and Resource Management Council of Australia and New Zealand *et al.* 2000a; Agriculture and Resource Management Council of Australia and New Zealand *et al.* 2000b; Agriculture and Resource Management Council of Australia and New Zealand *et al.* 2001);
- Local government dieback guidelines document (Lewis and Colquhoun 2000).

Also, specialist plans, for example, those related to management of locust control and interaction of control measures on conservation lands.

Industry Codes of Practice: Environmental Code of Practice – Extractive Industries (Environmental Protection Authority 1991). Environmental Management in the WA Mining Industry (Chamber of Mines and Energy of Western Australia 1993). Code of Practice for Timber Plantations in Western Australia. Roadside Conservation Committee – Code of Practice for Roadside Conservation in Road Construction and Road Maintenance. The aim of this code is to balance road design and road safety requirements with all other values associated with roadsides in each Shire.

Environmental Management Systems & Ecological Sustainable Product Marketing: The Wheatbelt Region of CALM is preparing an EMS to identify values, threats, goals and prioritise management across the landscape.

Capacity Building: There is significant interaction between State agencies, regional NRM groups (eg. Avon Catchment Network), Greening Australia (WA) (for example, Living Landscapes) and Worldwide Fund for Nature (through Woodland Watch in particular). These groups are also interacting jointly and independently to contribute to capacity building amongst landholders. Other groups such as the Threatened Species Network and Malleefowl Preservation Society also make significant contributions to capacity building in the community.

Other Planning Opportunities: Examples include:

- Department for Planning and Infrastructure is developing relevant rural land use plans.
- Some local governments are acting together to produce joint programs – for example, Kondinin Bush Heritage Committee.
- Regional NRM planning processes continue.
- CALM's Wheatbelt Regional Plan in development.
- National Action Plan for Water Quality and Salinity in development.

Integration With Property Management Planning, Catchment Planning and Landcare: Integration occurring in various ways. Examples include:

- Contribution to property planning by Land for Wildlife;
- Agwest Land Management (Department of Agriculture) includes soil survey, land capability assessment and farm planning.
- Catchment planning through recovery catchments (natural diversity, water resources and rural towns);
- Rapid Catchment Appraisal process managed by Department of Agriculture;
- Regional planning through State agency plans, NRM regional group plans
- Department for Planning and Infrastructure rural land use planning.

Other: Actual on-ground actions by Department of Conservation and Land Management represent the most significant single, focussed contribution to biodiversity conservation in the subregions.

Feasible Opportunities for NRM Impediments or constraints to opportunities

Given opportunities and impediments / constraints are often different sides of the same issue, both are covered in this section.

A key constraint overall is the lack of resources – including human and infrastructure resources – for implementation. This point reflects the relative

importance of biodiversity conservation and environmental issues in general in the public and political mind. Unless there is much wider recognition that biodiversity conservation makes a vital contribution to each individual's quality of life, this situation is unlikely to change. See Burbidge and Wallace (1995) for a discussion of some of the relevant issues.

A second generic issue is that NRM is variously and poorly defined. This is a significant impediment to progress, and reflects a much wider lack of rigour in the NRM area, and the generally very poor understanding of the relevant socio-political processes. One example of these issues is documented in Wallace (submitted for publication).

A range of problems, opportunities and constraints in relation to salinity are dealt with in Wallace (2001). Many of these are relevant to the broader field of NRM.

Incentives: Potential changes in the taxation laws for philanthropy exist. It is important to note that in many important cases – such as salinity – it is not an incentive that is require, but technical solutions that are economically viable to implement. While the lack of technical solutions is a barrier, it is also an opportunity. CALM is, particularly in the case of revegetation, working hard to find economically viable technical solutions. Resources are an impediment to doing this faster. It is also essential to note that, if we do not develop economically viable solutions using regional plants and animals, there is a severe risk that new invasive weeds and pest animals (eg, through aquaculture and more aggressive grazing animals) will be introduced.

Legislation: Proposed re-writing of the Wildlife Conservation Act is a key opportunity for change. More effective legislation and regulation in relation to land clearing and drainage would assist to combat some existing threats. This is both an opportunity and a barrier. Note the existing MOU is being reviewed.

Institutional Reform: While institutional reform is an issue, even greater opportunities for progress lie in improving the current institutions and ensuring that they are staffed at a sufficient level and with appropriate people. Put simply, bad operators will still be bad irrespective of institutional reform, good operators will generally do comparatively well despite institutional structures. This does not deny the need for institutional reform in some cases. However, it has become clear that the recruitment, training and management of an effective NRM "group" is a far more significant impediment to progress than institutional structures and arrangements. Institutional reforms that would help include:

- To minimise institutional change, and certainly to avoid more frequent structural change to organisations than 8-10 year timeframes without very good reason. Significant structural changes cause organisational inefficiencies that last for a minimum of three years.
- Only implement institutional reform where there is a clearly articulated and convincing case that there is a well-identified problem to be fixed and that the proposed reform has a high probability of success.
- Wherever practicable, appoint contract officers to minimum terms of five years.
- Reverse the current trend of increasing duplication of service delivery in the NRM area.

Valuing Ecosystem Services & Tradable Rights: Are following testing of these in the eastern states with great interest. Will await the outcome of work there.

Threat abatement planning as part of NRM: The environmental management system being developed by CALM for the subregions should, for these areas, provide a greatly improved platform for threat abatement planning. Wallace and Beecham (submitted for publication) present the generalised framework for this.

Environmental Management Systems & Ecologically Sustainable Product Marketing: See comment above under threat abatement.

Capacity building: The most important opportunity here is the need to re-define capacity building, and to more clearly state goals, objectives and strategies.

Other planning opportunities: To date there has been a tendency to over-plan, for example, there are a series of over-lapping planning processes for biodiversity conservation in the south-west. This has, and remains, a barrier. A key opportunity is to proceed implement plans and monitor their value in a more strictly "adaptive management" style than has been the practice to date.

Integration with Property Management Planning, Catchment Planning and Landcare: See comment under Other Planning above.

Subregions where specific NRM actions are a priority to pursue

There are major constraints (see Appendix C, rank 7) to implement effective NRM actions to achieve biodiversity outcomes.

Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

Vegetation and Regional Ecosystem Mapping: Systematic vegetation survey and mapping of all vegetation remnants needs to be done to the sub-association level. At present little mapping has been done at this scale. To compliment this approach we also require equivalent scale mapping of soil-landscape units to facilitate revegetation of cleared lands, and to provide an alternative biodiversity surrogate, particularly for small terrestrial vertebrates and invertebrates. A standardised database and GIS application is also essential for data querying and management.

Systematic Fauna Survey: Existing systematic fauna survey data is confined to vertebrates (but not birds) and selected invertebrate taxa. Information is sparse and has not been analysed yet (ca. 40 terrestrial quadrats and 20 wetland quadrats across subregion). Study quadrats were only positioned on widespread surface-types, and only 3 – 4 quadrats were sampled per surface-type, and few quadrats have been sampled on more than two occasions. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates. Required - systematic fauna surveys of birds, small terrestrial mammals, reptiles and select invertebrate groups across the landscape; also measures of various habitat and landscape variables. A standardised database and GIS application is also essential for data querying and management. The assumption that vegetation characteristics can be used as habitat surrogates for fauna needs to be investigated more thoroughly in conjunction with vegetation and ecosystem mapping above. The continued use of the focal species approach (Lambeck 1997; Lambeck 1999) and a modified version (Lambeck 1998) for biodiversity conservation planning across the subregion requires further research and survey data to address the following:

- the validity of vegetation as a habitat surrogates for all fauna,
- the validity of using birds as indicators for all fauna,
- what constitutes a viable population (Lambeck 1998) and an understanding of metapopulation dynamics for various flora and fauna species in a fragmented landscape.

Floristic Data: Although regional survey of flora has been completed, it is based on very sparse sampling (about 130 quadrats across subregion), quadrats positioned on widespread surface-types as well as some of the localised substrates of particular interest. Required - floristic data for the structural vegetation mapping listed above. Whilst structural unit are easiest to map, it is important to also document the floristic variation within and between vegetation sub-associations, particularly for management purposes.

Ecological and Life History Data: Is critical to identifying priorities and appropriate management responses in the fragmented and largely cleared landscape of the subregion. Data on various population demographic parameters, resource requirements and landscape variables are required to model population viability for a range of species with different life history strategies. This is essential to ensure that management actions are of an appropriate magnitude to achieve the desired biodiversity conservation goals. There few data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate- and plant-species. There are no data to provide a regional context on life-history (including population-trend) of most species, including foxes, except CWR mammals on Lake Magenta Nature Reserve. See also fauna survey point above.

Other Priority Data Gaps Include:

- Fire – A knowledge of fire regimes and histories for reserves and areas of remnant vegetation, and data on the effects of fire on flora and fauna based on their life history attributes. This information is essential if the role of altered fire regimes in biodiversity conservation is to be understood and managed.

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R = Report; J = Journal article; O = Other.

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