Jarrah Forest 2 *(JF2 – Southern Jarrah Forest subregion)*

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Subregional description and biodiversity values

Description and area

Duricrusted plateau of Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part, by Wandoo - Marri woodlands on clayey soils. Eluvial and alluvial deposits support *Agonis* shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands. The climate is Warm Mediterranean and.

Southern Jarrah Forest: South of Collie the plateau broadens and slopes gently to the south coast. Drainage is still dissected in the west but broadening and leveling of the surface in the east causes poor drainage and large and small wetlands. The ironstone becomes less evident being buried beneath sands. Rainfall is from 1200 mm in the south-west to 500 mm in the east. Vegetation comprises Jarrah - Marri forest in the west grading to Marri and Wandoo woodlands in the east. There are extensive areas of swamp vegetation in the south–east, dominated by Paperbarks and Swamp Yate. The understory component of the forest and woodland reflects the more mesic nature of this area. The majority of the diversity in the communities occurs on the lower slopes or near granite soils where there are rapid changes in site conditions. Subregional area of JF2 is 3, 160, 122ha.

Dominant land use

(see Appendix B, key b)

Dominant land use is mainly grazing (improved pastures) & dry land agriculture, forestry (of native forest), and conservation. There are smaller (but still significant) areas of forestry (plantations), irrigated horticulture, mining, rural residential, and easements (for roads, power lines etc).

Continental Stress Class

The Continental Stress Class for JF2 is 3, however this is an underestimate. While substantial parts of the west in the subregion reasonably reflect the Continental Stress Class of 3, the eastern half of the subregion is cleared for dryland agriculture and is suffering the same fate as the Avon Wheatbelt. The number of threatened plants has also been seriously underestimated for the subregion (54 DRF and at least 90 P1 & P2) with many of the P1 and P2 taxa likely to move to Declared Rare Flora as their status is confirmed. A Continental Stress Class of 1 (or at least 2) would more accurately reflects the reality for the subregion overall.

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

Rare Features:
There is extensive native forest cover, but the biota is patchy considering geological & geomorphic uniformity.

- The subregion is home to rare plants (such as eastern zone Critical status orchids *Drakaea confluens,* and *Caladenia bryceana* subsp *bryceana*).
- Rare birds - Muir`s Corella (*Cacatua pastinator pastinator*), Western Whipbird (*Psophodes nigrogularis*), Western Bristlebird (*Dasyornis longirostris*), Noisy Scrub-Bird (*Atrichornis clamosus*).
- Critical Weight Range mammals – Gilbert's Potoroo (*Potorous gilbertii*), Southern Brown Bandicoot (*Isoodon obesulus*), Chuditch (*Dasyurus geoffroii*), and Red-tailed Phascogale (*Phascogale calura*).
- Rare frogs (for example, White-bellied Frog (*Geocrinia alba*), Yellow-bellied Frog (*G. vitellina*), and Sunset Frog (*Spicospina flammocaerulea*).
- Freshwater wetland *Baumea* reed beds are a unique feature in forest and adjacent areas.

Centres of Endemism:
Unlike the Warren Bioregion, no systematic analyses have been carried out on the flora of the Southern Jarrah subregion. However, analysis done for the Regional Forest Agreement identified concentrations of local endemics (species with ranges of less than 100km) in the South West Forest Region. It identified several areas that constituted centres of narrow endemism: the Blackwood Plateau, the Busselton Ironstones and Whicher Ranges, and the "Denbarker" area North East of Walpole (Department of Conservation and Land Management 1998).

At the taxonomic group level, like the whole South West, this area is rich in endemics in families such as the Orchidaceae, Papillionaceae, Myrtaceae, Restionaceae and Rutaceae.

As with the Warren, on the limited data available, the aquatic fauna of the bioregion shows a similar, if not stronger pattern of endemism than the flora (Trayler *et al.* 1996). The peat swamp communities, the fresh water and naturally saline wetland systems all contain local endemics of significance. The invertebrate fauna shows similar patterns with a significant endemic fauna in the forests and wetlands of the region.

Refugia:
Despite the impacts of climate fluctuations through the quaternary on the South-West, significant characteristics of this bioregion exist because it has to a large extent been buffered against the complete intrusion of the

eremean. Close to the south-west coastal strip and with south to south west slopes rising to the darling plateau it has benefited from proximity to the southern ocean and the rain bearing weather systems that have trailed the coast even during the driest periods of the ice ages. While more modified than the Warren bioregion, the JF2 subregion contains refugia with relict taxa of a wetter milder era with groups and species of vascular and cryptic flora and invertebrates normally associated with the rainforests / *Nothofagus* forests and wetlands of South East Australia, these species now absent from the rest of the State. For example, peat or organic wetlands are home to relictual and other aquatic invertebrates and restricted and rare frogs (such as *Spicospina flammocaerulea* and the *Geocrinia* species of the Blackwood Valley).

Three ground dwelling near flightless birds species (Noisy Scrub Bird, Western Whipbird and Western Bristlebird) and highly restricted mammals (Gilberts Potoroo and Dibbler) are found at Two Peoples Bay Nature Reserve.

The Porongurups provide refugia for *Moggridgea* species of spider and velvet worms (Oncophora) and a range of like relict taxa.

The Lake Muir – Unicup complex of wetlands are home to a range of aquatic invertebrates such the Poorginup water mites and other taxa with affinities with species groups in Tasmania and South Eastern Australia. Similar data exists for some wetlands of the Denbarker area.

High Species or Ecosystems Diversity:
Regional Forest Agreement analysis of species diversity highlighted areas of the Blackwood Plateau, and the Denmark – Mount Barker (Denbarker) area for flora. Early results of survey of aquatic invertebrates in the wetlands of the Muir-Unicup and Denbarker area indicate high species richness relative to similar systems elsewhere in the southern states.

Recent studies on the mosaic of forests, woodlands and heaths on the eastern and northeastern fringes are in the moderate range of species. As indicated above the majority of this species richness results from the rapid changes in communities on the lower slopes and on the variable soil types.

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

In 1974 and 1975 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the in the CTRC Green and Red Books, as did the System 6 study of 1981 (Environmental Protection Authority 1975; Environmental Protection Authority 1983). Some but not all of these recommendations (with modification) were implemented over the following years.

The southern and western parts of the subregion are covered by a CALM Regional Management Plan published in 1994, that provides an overview of biota, addresses land and wildlife conservation issues, but was generalised in its approach. 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 (Department of Conservation and Land Management 1994a).

South West Forests Regional Forest Agreement throughout 1997 and 1998 reviewed all but Eastern parts of the Warren Bioregion against National CAR criteria and developed a reserve system and agreed strategies to conform to National Biodiversity Conservation Objectives (Lamont *et al.* 1997; Mattiske and Havel 1997; Atkins 1997; Christensen 1997; Commonwealth and Western Australian Governments 1999). The Forest Management Plan (draft) was released in 2002 and further develops the CAR reserve system established in the RFA process (Department of Conservation and Land Management and the Conservation Commission 2002).

The South West Regional Strategy for Natural Resource Management was released as a working draft in January 2001 (South West Catchment Council 2002a). The Bush & Biodiversity section based on the same data sets used for this Biodiversity Audit identified poorly conserved vegetation associations and nodes of high value fauna conservation within all but the eastern quarter of the JF2 bioregion. Other sections of the document deal with Waterways and Wetlands, Land Resources and Coastal Environs. The final draft in March 2002 establishes strategic targeted recommendations for implementation within the NRM Region and cover a substantial part of the Bioregion (South West Catchment Council 2002b).

The South Coast NRM Region has yet to produce a similar analysis.

Wetlands

Wetlands of National significance (DIWA listings)

Name and Code	Description[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Byenup Lagoon System, JF002WA	B5, B7, B13, B14, B15	ii, iii & iv	ii, iii & iv	iii	i, v (foxes, pigs, deer, horses, cats & rabbits), vi (Watsonia, East Coast Wattles, Exotic Grasses, Blue Gums, various clovers and allies), vii, viii (particularly *Phytophthora* dieback in adjacent forests and heaths), ix, x, xi (herbicide runoff from agricultural areas and plantations), xii (eutrophication from agricultural and plantation fertilisers; plantation harvesting and return to traditional agriculture on several significant holdings; illegal Tea Tree cutting for bean sticks, cray pots and brush fencing; illegal cattle and horse grazing).
Lake Muir, JF004WA	B8, B12	iii & iv	iv	iii	v (foxes, pigs, deer, horses, cats & rabbits), vii, xi (spray drift from Blue Gum Plantations), xii (illegal use of lake surface and margins and adjacent wetlands by motor vehicles, horse riders; illegal cattle and horse grazing; adjacent peat mining).
Blackwood River (Lower Reaches) and Tributaries System to Sues Bridge WAR001WA	B1, B2	ii, iii & iv	ii, iii & iv	iii	i, v (foxes, pigs, cats & rabbits), vi (Watsonia, exotic Grasses, various clovers and allies), vii, viii (*Phytophthora* dieback in adjacent forests and heaths), ix, x, xi (herbicides - agricultural and plantation), xii (eutrophication resulting from agricultural and plantation fertilisers; plantation harvesting and return to traditional agriculture on several significant holdings; illegal Tea Tree cutting for bean sticks, cray pots and brush fencing; Contains threatened species *Geocrinia alba*, and *G. vitellina*)
Lake Pleasant View System, JF005WA	B9, B15	ii	iii	iii	vii, xii (eutrophication resulting from agricultural and plantation fertilisers), vi (Bridal Creeper, Agricultural crops), xi (herbicides - agricultural and plantation).
Moates Lake System, JF006WA	B5, B7, B9	iii	iii - iv	iii	vi (Blackberry, Bridal Creeper, Inkweed, Taylorina, East Coast Wattles, Victorian Tea Tree), v (exotic fish), iv (cattle), ix, vii.
Oyster Harbour, JF007WA	A6, A2, A7, A8	ii	iii	iii	xii (eutrophication, sedimentation)
Mt Soho Swamps, WAR007WA	B15	iii & iv	iv	iii	v (foxes, pigs, cats & rabbits), vi (East Coast Wattles, Exotic Grasses, Blue Gums, various clovers and allies, tagasaste), vii, viii (*Phytophthora* dieback in adjacent forests and heaths), xii (upslope erosion filling important swamps).

[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 and Components	Location	Description[1]	Special Values[2]	Condition[3]	Trend[4]	Reliability[5]	Threatening Processes[6]
Margaret River Swamps Wetland System	AMG (AGD84) 350000, 6252200	B4, B10.	ii	iv	iv	iii	iii (currently small scale but likely future increase due to proximity of Margaret River Townsite), v (pigs), vii, viii (*Phytophthora* sp.)
St John Brook Conservation Park	AMG (AGD84) 377500, 6247700	B1	ii	iii	iv	iii	v (pigs), vii, viii (*Phytophthora* sp.)
Name and Components	Location	Description[1]	Special Values[2]	Condition[3]	Trend[4]	Reliability[5]	Threatening Processes[6]
Milyeannup Brook and Red Gully Floodplain Systems (Headwater Swamp Systems)	AMG (AGD84) 371400, 6214100	B10, B13.	ii	iv	iv	iii	v (pigs), vii, viii (*Phytophthora* sp.)
Powlalup Nature Reserve	AMG (AGD84) 399200, 6252700	B2, B4.	ii	iii	iii	iii	v (pigs), vi (Blackberry, *Pinus radiata*), vii.
Tone River Floodplains – Talvewelup Wetland System	AMG (AGD84) 479000, 6225000	B4, B10.	ii	ii - iii	iii	iii	vi (pasture species), ix, x, xi (fertilisers, pesticides).
Perup Swamps System	AMG (AGD84) 455000, 6207000	B2, B4, B9, B10, B13, B15, B17.	ii, v	ii - iii	iv	iii	v (foxes, pigs), vi (Bridal Creeper, pasture species), vii, viii (*Phytophthora* sp.), ix, x, xi (fertiliser loads from adjacent

							agricultural lands).
Frankland River and Kent River Wetland System (South of Muirs Highway)	AMG (AGD84) 500000, 6167000	B1, B2, B4, B9, B10, B13, B15, B17.	ii, v	ii - iii	iii	iii	v (foxes, pigs), vi (pasture species), vii, viii (*Phytophthora*), ix, x, xi (fertiliser loads from adjacent agricultural lands).
Frankland/Gordon Rivers Wetland System (North of Muirs Highway)	AMG (AGD84) 500000, 6200000	B2, B4, B5, B6, B8, B10, B12.	ii, v	i - ii	iii	iii	vi (pasture species), ix, x, xi (fertilisers, pesticides).
Upper Kent River Wetland System (North of Muirs Highway)	AMG (AGD84) 532000, 6185000	B2, B4, B5, B6, B8, B10, B12.	ii, v	i - ii	iii	iii	vi (pasture species), ix, x, xi (fertilisers, pesticides).
Denmark River/Hay River System	AMG (AGD84) 544000, 6140000	B1, B2, B4, B9, B10, B13, B15, B17, C1.	ii, v	i – ii for Hay and lower Denmark; iii – iv for other areas	iv	iii	v (foxes, pigs), vi (Bridal Creeper, Gorse, pasture species), vii, viii (*Phytophthora*), ix, x, xi (fertiliser loads from adjacent agricultural lands).
Arthur River Wetland System (including Toweriring Lake, etc)	AMG (AGD84) 479900, 6284100	B7, B8, B2.	ii	ii	ii	iii	i, ii, ix, x.
Beaufort River Wetland System	AMG (AGD84) 500000, 6288000	B7, B8, B2.	ii	i - ii	ii	iii	ii, ix, x.
Mill Brook	AMG (AGD84) 576000, 6142000	B2, B4, B10	ii, v	iii	iii	iii	i, v, vi, vii, viii, ix, xi
Gull Rock/Ledge Point Wetlands	AMG (AGD84) 591000, 6126000	A11, B2, B5, B10, B13, B15	ii, iii, v	iv	iv	iii	v, vii
Lake Seppings	AMG (AGD84) 583500, 6125000	A7, A8, A9, A11	ii, iii, v	iii	iii	iii	i, v, vi, x, xi

[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

Name	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
Collie River	i	v	ii	i, ii, vi (pasture species), vii, ix, x, xi (fertilizers and pesticides), xii (existing water diversion and storage upstream; mining)
Preston River/Ferguson River	i	iv	ii	i, ii, vi (pasture species), vii, ix, x, xi (fertilizers and pesticides)
Capel River (Blackwood Plateau only)	i	iv	ii	i, ii, vi (pasture species), vii, x, xi (fertilizers and pesticides)
Ludlow River (Blackwood Plateau and Scarp only)	iii	iv	ii	vii
Abba River (Blackwood Plateau only)	i	iv	ii	i, ii, vi (pasture species), vii, x, xi (fertilizers and pesticides)
Sabina River (Blackwood Plateau only)	iii	iv	ii	vii
Vasse River (Blackwood Plateau only)	i	iv	ii	i, ii, vi (pasture species), vii, x, xi (fertilizers and pesticides)
Buayanyup River (Blackwood Plateau only)	i	iv	ii	i, ii, vi, vii, x, xi (fertilizers and pesticides)
Carbanup River(Blackwood Plateau only)	i	iv	ii	i, ii, vi (pasture species), vii, x, xi (fertilizers and pesticides)
Margaret River	ii-iii	iii-iv	ii	i, vi (Blackberry, Arum Lilly, pasture species), vii, x, xi (fertilizers and pesticides)
Blackwood River (and tributaries outside main forest belt)	i	iii	ii	i, ii, vi (Blackberry, pasture species), vii, ix, x, xi (fertilizers and pesticides), xii (recreation use; water diversion and storage upstream)
Blackwood River Tributaries within the main forest belt	ii-iii	iv	ii	v (pigs), vi (Blackberry), vii
Donnelly River (headwater floodplains)	i	iii	ii	i, ii, vi, (Blackberry, pasture species), vii, ix, x, xi (fertilizers and pesticides)
Warren River	i	iii	ii	i, ii, vi (Blackberry, pasture species), vii, ix, x, xi (fertilizers and pesticides), xii (future water diversion and storage)
Deep River	iii	iii	iv	vii
Frankland River	i	iii	ii	i, ii, vi (Blackberry, pasture species), vii, ix, x, xi (fertilizers and pesticides)
Bow River	iii	iv	ii	vii, xii (future water diversion and storage)
Kent River/Styx River	ii-iii	iv	ii	i, ii, vii, ix, x, xi (fertilizers and pesticides), xii (future water diversion and storage)

Denmark River	iii	iii	ii	vii, xii (future water diversion and storage)
Hay River	i-ii	iii	ii	i, ii, vi (pasture species), vii, x, xi (fertilizers and pesticides), xii (current water diversion and storage)
Sleeman Creek	i	iii	ii	i, ii, vi (pasture species), vii, ix, x, xi (fertilizers and pesticides)
King River/Mill Brook	i	iii	ii	i, ii, vi (pasture species), vii, ix, x, xi (fertilizers and pesticides)
Kalgan River/Napier Creek/Young River	i	iii	ii	i, ii, vi, vii, ix, x, xi (fertilizers and pesticides)

[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)

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytopthora cinnamomi*) and can be considered as ecosystems at risk. These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Subregion	Threatening Processes[5]
Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)	CR	28	iii	iii	iii	SWA2/JF2	i, ii, viii, iv, xii (mineral exploration)
Calothamnus graniticus heaths on south west coastal granites	V	32	iii	iv	iii	JF2	i, ii, vii, viii, xii (recreation), iv

[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

In general, plant communities comprised of susceptible plant species are threatened by dieback (*Phytopthora cinnamomi*) and can be considered as ecosystems at risk. These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Subregion	Threatening Processes[5]
Rimstone pools, algal nodules and cave structures formed by microbial activity on marine shorelines.	EN	41	ii	iii	iii	WAR/JF2	vi (kikuyu), x
Banksia coccinea community in dieback free area - Gull Rock (South Coast region pers. comm.)	VN	30	iii	iv	iv	JF2	vii, viii
Mount Lindesay	VN	6, 38, 41	iii	iii	iii	JF2	v (pigs), vii, viii, xii (vehicle recreation, damming river)
North Porongurup wet ironstone heath community	VN	29, 30	iii	iii	ii	JF2	xii (only small remnants remain)
Porongurup Range Karri forest	VN	3	ii	iii	iii		vi, vii
Karri community at edge of geographic range (Plantagenet District). (Ken Tinley pers. comm.)	P2	4	ii - iii	iii	ii	JF2	ii, iv, vi (pastures), ix, x
Flat wetlands Rocky Gully to Denmark (M. Graeme pers. comm.)	P2	38,42	iii	iii	ii	JF2	v (pigs, horses), vii, viii
Melaleuca lanceolata forests, Leeuwin Naturaliste Ridge	P2	15	ii	vi	ii	WAR/JF2	ii, vii, xii (recreation site development)
Taxandria linearifolia, Acacia pulchella thicket (Rosa Glen variant). South of Margaret River.	P2	28	iii	vi	i	JF2	i, ii, x (residential developments and expansion of wine industry)
Reedia spathacea peat swamps of the Blackwood River	VN	42, 43	ii	iii	ii	WAR/JF2	v (pigs), vii, xii (urban development)
Plant assemblages of primary saline wetlands (J. Buegge pers. comm.)	NE	31,43	ii - iii	ii	ii	JF2	ix, x
Perched wooded wetlands of the southern Wheatbelt (R. Brazell pers. comm.)	NE	42	ii	ii	i	JF2	ix, x,
Naturally brackish/saline coastal lakes in the south west region (S. Halse pers comm.)	NE	26,40,39	i - iii	iii	ii	JF2/WAR	ix, x
Aquatic invertebrates associated with permanent freshwater/brackish pools (S. Halse pers. comm.)	NE	42	i - iii	iii	ii	JF2/WAR	ix, x
Diatom assemblages of south-west rivers (John 1998)	NE	42	i - iii	iii	ii	WAR/JF2	ix, x
Eucalyptus occidentalis association (Robinson 1997) Lake Muir area	NE	8, 9, 16	ii	iii	iii	JF2/JF1	ix, x
Eucalyptus decipiens low woodland (Hopkins *et al.* 1996)	NE	8, 9, 16	iii	iv	iii	JF2	ix, x

Wheatbelt lowland mallet communities (G. Durrell & J. Buegge pers comm.)	NE	16	i	ii	iii	JF2	i, ii
Valley communities of *Eucalyptus wandoo* woodland (Beard 1980c, Beard 1980d, Beard 1980e)	NE	6, 8	ii	ii	iii	JF2	ix, x

[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

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)					
Potorous gilbertii	CR	ii	v	iii	v (foxes, vii)
Parantechinus apicalis	E	i	i	iii	i, v (foxes, cats), vii (presumed locally extinct)
Dasyurus geoffroii	V	iii	v	iii	v (foxes), i (especially clearing in riparian areas), xii (road traffic; poisoning; trapping; timber harvesting), vii
Myrmecobius fasciatus	V	ii	iv	iii	v (foxes), vii, i
Pseudocheirus occidentalis	V	iii	iii	iii	i, ii, v (foxes), vii, xii (logging)
Setonix brachyurus	V	iii	v	iii	v (foxes), vii
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)					
Calyptorhynchus latirostris	E	iii	iii	ii	ii, vii, ix
Pezoporus wallicus flaviventris	E	ii	iii	iii	v (foxes), vii
Atrichornis clamosus	V	iii	v	iv	vii
Botaurus poiciloptilus	V	ii	iii	iii	vii, ix
Cacatua pastinator pastinator	V	ii	iii	iii	i, xii (illegal culling)
Calyptorhynchus baudinii	V	iii	iii	ii	ii, vii, ix
Dasyornis longirostris	V	ii	iii	iii	v (foxes), vii
Leipoa ocellata	V	i	i	iii	v (foxes, cats, rabbits), vii
Psophodes nigrogularis oberon	V	ii	iii	iii	i, ii, v (foxes), vii
Psophodes nigrogularis nigrogularis	V	iii	v	iii	v (foxes), vii
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 4 (FROGS)					
Geocrinia alba	CR	ii	iii	iv	i, ii, iv, v (pigs), vii, viii, x (resulting from removal or dieback of vegetation cover in catchment area or upstream dams), xi (fertiliser and pesticide runoff)
Geocrinia vitellina	V	iii	v	iv	v (pigs), vii, viii, xi
Spicospina flammocaerulea	V	iii	iv	iv	vii, xii (physical damage to swamps; mining; collection for illegal trade), v (pigs), x (siltation; construction of dams), viii, xi (chemical and surfactant)
SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)					
Aspidites ramsayi	P1	i	vi	iii	i, ii, v (foxes and cats), vii (this is not a forest species)
OTHER SPECIES AT RISK WITHIN THE SUBREGION					
Windbalea viride	P1	i	vi	ii	vii, i, ii fire, clearing
Ninox connivens connivens	P2	i	ii	iii	Very low numbers, estimated 50 pairs in WA, xii (logging practices, reduction in tree hollows)
Ixobrychus flavicollis	P2	ii	ii	ii	i., ii, v, vii, ix, x
Austromerope poultoni	P2	i	vi	ii	i, xii (logging; mining); vii (this species has only been found from pitfall traps and never been seen alive)
Pseudohydraphantes doegi	P2	i	vi	ii	ix, x
Acercella poorginup	P2	i	vi	ii	ix, x
Hemisaga lucifer	P2	i	vi	ii	Vii

[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

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytopthora cinnamomi*) and can be considered as ecosystems at risk. These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Species Name	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
DECLARED RARE FLORA					
Adenanthos pungens subsp. *effusus*	CR	iii	iii	iii	i, ii, ix, x, viii, vi, iv, vii
Banksia brownii	CR	ii	iv	Unknown	ii, vii, viii, xii (road works)
Caladenia bryceana subsp. *bryceana*	CR	i	ii	iii	v (rabbits), vi (pasture grasses), vii, ix, x
Caladenia viridescens	CR	ii	ii	iv	i, ii, v (rabbits), vii, xii (physical disturbance)
Conostylis setigera subsp. *dasys*	CR	iii	iii	iii	i, ii, xii (single population)
Drakaea confluens ms	CR	iii	iv	iii	vii, xii (roadside disturbance)
Dryandra mucronulata subsp. *retrorsa*	CR	iii	iii	iii	vii, viii
Eucalyptus phylacis x	CR	iii	iii	iv	vii, viii (canker)
Isopogon uncinatus	CR	i	v	iii	vii, viii (*Phytopthora* sp.)
Rulingia sp. Trigwell Bridge	CR	ii	v	iv	v (rabbits), vii, xii (small populations)
Verticordia apecta	CR	i	ii	iv	vii, xii low number
Verticordia fimbrilepis subsp. *fimbrilepis*	CR	ii	iii	iii	ii, vi, ix, x, iv, xii (road maintenance), viii (*Phytopthora* sp.)
Adenanthos velutinus	E	iii	iii	iii	i, ii, vi, vii, viii (*Phytopthora* sp.)
Adenanthos x cunninghamii	E	iii	iv	iii	ix (small number of individuals), viii (*Phytopthora* sp.)
Apium prostratum subsp *phillipii*	E	ii	v	iii	vi (Dolichus pea, *Rubus fruticosus*, *Myosotis sylvatica*)
Banksia oligantha	E	iii	iii	iii	i, ii, iv, v - rabbits, vi
Boronia exilis	E	iii	iv	iii	ii, vii, viii
Caladenia caesarea subsp. *maritima*	E	ii	iv	iii	xii (low population numbers; trampling by people; urbanisation); vi
Caladenia christineae	E	iii	iii	iii	vi, ix, x
Caladenia dorrienii	E	i - ii	iii	iii	v (rodents), vi, vii
Caladenia excelsa	E	iii	vi	ii	ii, v (rabbits), vii, xii (physical disturbance)
Caladenia huegelii	E	iii	iv	iii	ii, vi, vii, xii (roadside disturbance), xii (urbanisation)
Conostylis drummondii	E	ii	iii	iii	i, ii, iv, vi, vii
Drakaea elastica	E	ii	iii	iii	i., ii, v (rabbits), vi (pasture grasses), vii, xii (roadside disturbance)
Dryandra nivea subsp. *uliginosa*	E	iii	iii	ii	i, ii, vii, viii, xii (roadside disturbance)
Dryandra squarrosa subsp. *argillacea*	E	iii	iii	iii	i, ii, v (rabbits), vii, viii, xii (roadside disturbance)
Grevillea elongata	E	ii	v	iii	i, ii, v (rabbits), vi (pasture grasses), viii
Jacksonia velveta ms	E	iii	iv	iii	xii (utility alignment maintenance)
Nemcia lehmannii	E	iii	iii	iii	i ii, (small number of individuals and populations)
Orthrosanthus muelleri	E	iii	v	iii	vi (annual grasses), ix
Sphenotoma drummondii	E	i - ii	iii - iv	iii	vii, viii
Verticordia densiflora var. *pedunculata*	E	ii	iii	iii	i., ii, v (rabbits), vi (grasses), vii, viii, xii (roadside disturbance)
Species Name	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
Verticordia fimbrilepis subsp. *australis*	E	iii	iv	iii	vii, viii, ix, x
Villarsia calthifolia	E	iii	iv	iii	xii (restricted distribution)
Andersonia pinaster	V	iii	iii	iii	vii, viii, vi
Asplenium obtusatum subsp. *northlandicum*	V	iii	iv	iii	xii (restricted distribution)
Banksia verticillata	V	ii - iii	iv		vii, viii
Brachysema modestum	V	iii	iv	iii	vii, viii, xii (plantation forestry)
Caladenia harringtoniae	V	iii	iii	iii	vii, ix, x

Conostylis misera	V	iii	iii	ii	vi, vii, ix, x, xii (verge populations)
Daviesia elongata subsp. *elongata*	V	ii	iv	iii	viii (*Phytopthora*)
Diuris drummondii	V	ii - iii	iii	iii	i, ii, v (pigs), vii, ix, x
Diuris micrantha	V	ii	iii	iii	xii (roadside disturbance, small number of populations)
Drakaea micrantha ms	V	iii	iii	iii	vii, xii (roadside disturbance, small number of populations)
Dryandra mimica	V	iii	iv	iii	vii, viii, xii (mining)
Laxmannia jamesii	V	iii	iv	ii	xii (small number of individuals)
Meziella trifida	V	iii	v	iii	i, x, xii (mining)
Microtis globula	V	i	ii	iii	vii, x
Pleurophascum occidentale	V	iii	iv	iii	vii, xii (climate change)
Tribonanthes purpurea	V	iii	iv	iii	xii (restricted distribution)
Wurmbea calcicola	V	iii	iv	iii	vii, xii (physical disturbance)
PRIORITY 1					
Andersonia ferricola ms	1	ii	iii	iii	i, viii
Andersonia sp. Mitchell River	1	iii	iii	iii	vii, viii
Austrofestuca littoralis	1	ii	iv	i	vi (marrum grass)
Boronia humifusa	1	iii	iv	iii	vii, xii (roadside disturbance)
Caladenia longicauda subsp. *clivicola*	1	iii	iv	iii	xii (roadside disturbance)
Caladenia uliginosa subsp. *patulens*	1	iii	iii	ii	vii, xii (inadequate survey)
Calothamnus sp. Whicher	1	ii	iv	iii	i, ii, vii, xii (roadside disturbance)
Carex tereticaulis	1	i	iii	ii	vi, ix, x
Caustis sp. Boyanup	1	iii	iii	iii	i, xii (potential mine site disturbance)
Conospermum caeruleum subsp. *contortum*	1	iii	iv	i.	viii, vii
Cryptandra arbutiflora var. *pygmaea*	1	iii	iii	iii	xii (small and few populations); vii
Deyeuxia inaequalis	1	i	iii	ii	vi (agricultural), vii
Eryngium sp. Lake Muir	1	iii	iv	iii	x, xii (single small population)
Eucalyptus lane-poolei var. *Whicher*	1	iii	iv	iv	vii, xii (single population)
Johnsonia inconspicua	1	iii	iii	iii	i., ii, xii, vii
Nemcia cordata ms	1	i	ii	iii	i, ii, iv
Pentapogon quadrifidus var. *quadrifidus*	1	ii	iv	ii	vi (exotic grasses), ix, x
Plumatichilos turfosus	1	iii	iv	iii	vii
Schoenus sp. Beaufort	1	iii	iv	iii	ix, x
Selliera radicans	1	ii - iii	iv	iii	x, xi
Stylidium rhipidium	1	ii	iv	ii	vi, vii, ix, x, xii (verge disturbance)
Stylidium tylosum	1	iii	iii	ii	i, ii, vi (pasture grasses), vii
Synaphea nexosa	1	ii	iii	iii	i, ii, v (rabbits), xii (roadside disturbance)
Species Name	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
Synaphea decumbens	1	iii	iii	iii	viii, ix, x, xii (verge populations at risk)
Synaphea macrophylla	1	iii	vi	iii	viii, vii
Synaphea otiostigma	1	iii	iv	iii	viii, vii
Tetratheca sp. Kent River	1	ii	iv	iii	viii, ix, x, xii (verge populations at risk)
Thomasia laxiflora	1	iii	iv	iii	i, ii, iv
Thysanotus formosus	1	iii	iv	iii	No known threatening processes
PRIORITY 2					
Acacia mooreana	2	iii	iv	ii	vii
Actinotus whicherae ms	2	iii	vi	iii	vii
Alexgeorgea ganopoda	2	iii	iv	iii	vii, x, xii (road works)
Amperea protensa	2	iii	iv	iii	xii, x
Andersonia annelsii ms	2	i	ii	iii	vii, viii

Andersonia auriculata	2	ii	iii	iii	vii, viii
Andersonia hammersleyana ms	2	iii	iv	iv	vii, viii, xii (dam construction)
Andersonia virolens ms	2	iii	iii	iii	vii, viii
Apodasmia ceramophila	2	iii	iv	iii	x
Boronia capitata subsp. *gracilis*	2	iii	vi	iii	vii
Borya longiscapa	2	iii	iv	iii	v (pigs), viii
Caladenia erythochila	2	iii	iv	iii	iv, vii
Caladenia luteola	2	iii	iv	iii	iv, vii
Caladenia starteorum	2	iii	iv	iii	iv, v (pigs), vii
Calothamnus microcarpus	2	iii	vi	iii	viii
Calothamnus sp. Mt Lindesay *[aff. crassus]*	2	iii	iv	iii	vii, viii
Cardamine paucijuga	2	iii	iv	iii	ix, x
Chamelaucium forrestii subsp. *forrestii*	2	iii	iv	ii	xii, xiii
Chordifex jacksonii ms	2	iii	iv	ii	ix, x
Cryptandra congesta	2	iii	iv	iii	vii, x (low numbers)
Dampiera orchardii	2	i	i	ii	Suspected to be extinct
Daviesia mesophylla	2	iii	iii	iii	viii, vii
Drepanocladus fluitans	2	ii	iv	ii	vii, x
Dryandra acanthopoda	2	iii	vi	iii	viii
Dryandra subpinnatifida subsp. *imberbis*	2	iii	vi	iii	vii, viii
Eucalyptus virginae ms	2	iii	iii - iv	ii	ii (lack of recruitment)
Euphrasia aff. *scabra*	2	iii	iii	iii	v (pigs), vi (pasture spp), vii, x, xii (single population left)
Gastrolobium sp. East Peak	2	iii	iv	iii	vii, viii, xii (low numbers in 2 populations)
Grevillea acropogon	2	iii	iii	iii	viii, xii (< 50 plants)
Grevillea fuscolutea	2	iii	vi	iii	vii, viii, xii (low numbers and few populations)
Hybanthus volubilis	2	iii	iv	ii	vii
Hydatella sessilis/australis	2	iii	iv	iii	x, xii (wetland silting ex road drains)
Hydrocotyle hamelinensis ms	2	iii	vi	iii	vii
Juncus meianthus ms	2	i	vi	ii	x, ix
Laxmannia grandiflora subsp. *brendae*	2	ii	iii	iii	vii, xii (very low numbers and only 2 populations)
Leptinella drummondii	2	iii	vi	iii	vi (blackberry), ix, x
Leptomeria furtiva ms	2	iii	vi	iii	xii (plant is very hard to find for surveying)
Species Name	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
Leucopogon polystachyus	2	iii	iv	iii	viii, x
Lilaeopsis polyantha	2	iii	iv	iii	x
Melaleuca ordinifolia	2	iii	vi	iii	ix
Melaleuca pritzelii	2	iii	vi	ii	x
Metzgeria decipiens	2	ii	iii	iii	vii
Millotia tenuifolia var. *laevis*	2	iii	vi	iii	No known threatening processes
Mitreola minima	2	iii	iv	iii	x
Phyllangium palustre	2	iii	vi	ii	x, v (pigs)
Pimelea cracens subsp. *glabra*	2	iii	vi	ii	No known threatening processes
Pimelea neokyrea	2	iii	vi	iii	i, ii
Rorippa dictyosperma	2	iii	vi	ii	vii
Schoenus loliaceus	2	iii	vi	ii	x
Spyridium riparium	2	iii	iv	iii	vi, ix, x, xii (road and track maintenance)
Stylidium emarginatum subsp. *exappendiculatum*	2	iii	vi	iii	ix
Stylidium paulineae	2	iii	vi	iii	No known threatening processes

Trichocline sp. Treeton	2	iii	vi	ii	viii
Verticordia endlicheriana subsp. *angustifolia*	2	iii	iv	iii	vii, viii
Wurmbea sp. Cranbrook	2	iii	iv	iii	v (pigs, rodents), vii, x
OTHER FLORA AT RISK					
Lambertia orbifolia subsp. Narrikup		ii	iv	iii	vii, viii, xii (low numbers, all populations verge and private property)

[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	IUCN Reserve I-IV	Non IUCN Reserve	CALM Leases	Priority	Notes
3	Medium forest; jarrah-marri	3%	67%		L	Main Jarrah forest and includes many community and forest types – reservation levels ex RFA to strict IUCN reserve pending for many component community types – additional reservation in Albany area possibly desirable
4	Medium woodland; marri & wandoo	4%	4%		H	Area primarily the wandoo/marri woodlands of the western wheatbelt – extensively cleared and with most remnant areas reserved or notionally protected from clearing. – Little prospect of improving reservation levels.
14	Low forest; jarrah	2%	35%		M	Low jarrah forests of the Denbarker/Kent River area – targeted for reservation as part of RFA CAR reserve system
23	Low woodland; jarrah-banksia	1%	6%		H	Jarrah-Banksia woodlands primarily coastal sands of older dune systems in WAR – either extensively cleared for agriculture, or affected by dieback. Unreserved areas in the Denbarker area are targeted for reservation.
27	Low woodland; paperbark (*Melaleuca* sp.)	12%	29%		L	A type with several communities within it differing by spatial distribution – large tracts to be reserved as a result of RFA – areas in Scott River Lower Blackwood deficient as a result of land clearing
37	Shrublands; teatree thicket	10%	84%		L	A scattered type poorly defined, but well reserved as non-strict IUCN reserve.
963	Medium woodland; yate & paperbark (*Melaleuca* spp)	0%	3%		H	Yate paperbark valleys of the upper Warren and upper Kent Rivers cleared for agriculture – no potential for reservation (see Ecosystems at risk *E. occidentalis* yet to be evaluated)
Beard Veg Assoc	Vegetation Association Description	IUCN Reserve I-IV	Non IUCN Reserve	CALM Leases	Priority	Notes
965	Medium woodland; jarrah & marri	0%	100%		L	Scattered pockets in JF2 – mostly to reserve or not reservable
969	Mosaic: Medium forest; jarrah-marri/Low forest; jarrah	0%	15%		H	Area is essentially that land east and west of Denmark considered suitable for agriculture and consequently extensively cleared or alienated; a few pockets remain and should be sought for reservation or protected from clearing
972	Medium woodland; jarrah, marri, wandoo & yate	5%	0%		H	Woodlands of Jarrah, Wandoo Marri and Yate in the upper Kent River catchment – extensively cleared for agriculture and now often salt affected - a few pockets remain, mostly in reserve – no real capacity to achieve further reservation
973	Low forest; paperbark (*Melaleuca rhaphiophylla*)	0%	0%		H	Low forest of *Melaleuca rhaphiophylla* – includes several different scattered communities, in JF2 primarily associated with the cleared valley system of the upper Kent, again with little or no capacity to improve the reservation status of the type
975	Low woodland; jarrah	0%	82%		L	Scattered pockets in JF2 – mostly to reserve or not reservable
977	Low forest; teatree & casuarina	0%	79%		L	Mostly the cleared agricultural land West of Denmark – most uncleared component to be reserved shortly
978	Low forest; jarrah, *Eucalyptus staeri* & *Allocasuarina fraseriana*	14%	0%		H	The low woodlands of Jarrah, Albany Blackbutt and casuarina West, North and East of Albany – mostly cleared for agriculture with little or no chance of improving reservation levels
979	Mosaic: Medium forest; jarrah-marri/Low forest; jarrah & casuarina (probably *Allocasuarina fraseriana*)	0%	0%		H	Extension of 978 (NE of Albany) above without the Albany blackbutt, – again mostly cleared for agriculture with little or no chance of improving reservation levels
987	Medium woodland;	0%	0%		H	A collection of unrelated communities, in JF2 really an extension of

	jarrah & wandoo					type 4 above, the wandoo/marri woodlands of the western wheatbelt – extensively cleared and with most remnant areas reserved or notionally protected from clearing. – Little prospect of improving reservation levels
992	Medium forest; jarrah & wandoo (*E. wandoo*)	2%	6%		H	An extension of type 4 above in the Boyup Brook area, the wandoo/marri woodlands of the western wheatbelt – extensively cleared and with most remnant areas reserved or notionally protected from clearing. – Little prospect of improving reservation levels.
1000	Mosaic: Medium forest; jarrah-marri/Low woodland; banksia/Low forest; teatree (*Melaleuca spp.*)	14%	0%		H	Mainly a SWA type – extensively cleared on the coastal plain and in the Dunsborough where it occurs in JF2. Little prospect of improving reservation levels
1002	Medium open woodland; jarrah	0%	100%		L	Most of type reserved as State Forest on the Blackwood Plateau with tracts for reservation as strict IUCN reserve
1034	Medium woodland; marri, wandoo & powderbark	0%	0%		H	A non JF2 type – a small pocket occurring on the Lower Blackwood – probably represents a different type of community – however is alienated and not available for reservation
1051	Shrublands; teatree thicket with scattered wandoo & yate	1%	0%		H	Valley teatree and scrub thicket associated with scattered wandoo and yate in the upper Blackwood – extensively cleared degraded agricultural land - little prospect of improving reservation levels
1073	Medium woodland; wandoo & mallet	5%	0%		H	Wandoo Mallet woodlands of the upper Blackwood - extensively cleared degraded agricultural land - little prospect of improving reservation levels
Beard Veg Assoc	Vegetation Association Description	IUCN Reserve I-IV	Non IUCN Reserve	CALM Leases	Priority	Notes
1077	Medium woodland; jarrah & river gum	9%	0%		H	Jarrah River Gum valley floor of the Gordon (upper Frankland) – cleared (and degraded) for agriculture with little prospect of improving reservation levels
1114	Shrublands tree-heath; paperbark over teatree thickets	2%	40%		L	Mostly teatree paperbark thickets in valleys east of Collie, mostly cleared for Agriculture, but other parts in State forest – some targeted for reservation
1132	Medium forest; marri	0%	89%		L	In JF2 as pockets of Marri on the Margaret and Blackwood Rivers – small areas that may end up reserved
1134	Medium woodland; jarrah (south coast)	9%	63%		L	Jarrah woodland on sandy tracts – most within JF2 reserved as SF and proposed for strict IUCN status
1157	Tall forest; jarrah & marri	0%	100%		L	Difficult to map units within the jarrah forest, but the majority is protected within SF, part to become NR with planned tenure changes
1181	Medium woodland, jarrah & *Eucalyptus haematoxylon* (Whicher Ra.)	0%	67%		L	Much cleared, but remnants in SF, some proposed as reserve in the Scarp south of Bunbury/Busselton
1182	Medium woodland; *Eucalyptus rudis* & *Melaleuca rhaphiophylla*	0%	68%		L	Mainly cleared valleys of the Preston, Capel Rivers but remnants in SF
1183	Medium woodland; *Eucalyptus rudis* & blackbutt with some bullich, jarrah & marri (fringing Blackwood R.)	0%	X		L	Blackwood River valley – a mix of cleared agricultural land and State Forest – parts to be further reserved
1184	Medium woodland-fringing; jarrah, marri, *Eucalyptus rudis* & *Agonis flexuosa*	7%	50%		M	
1185	Medium woodland; jarrah, marri & blackbutt	0%	96%		L	Medium Jarrah Marri of the hills in the Donnybrook Capel area – mostly in State Forest
2051	Sedgeland; sedges with low tree savannah woodland; paperbarks over & various sedges	8%	71%		L	Hay and Mitchell River valleys – either cleared or to be reserved as National Park (from SF)

Subregional constraints in order of priority

(see Appendix B, key g)

Other: Regional Forest Agreement reserve recommendations already in process of being implemented, and will include the above reserve consolidation priorities where feasible with existing tenures.

Irreplacibility, Limited Opportunity Remains to Meet CAR Criteria, Economic Constraints, and Competing Land Uses: Major components of the landscape are covered by mines, mining tenements, exploration leases and already cleared land.

Bioregional and subregional priority for reserve consolidation

JF2 has 54.7% of the subregion in CALM estate. However the table shown in Appendix D shows the IBRA region JF as being in 2d category (see Appendix D, and Appendix C, rank 4). This is reasonable given the eastern and south-eastern portions of the JF2 subregion, below the 700mm isohyet are very poorly represented in conservation reserves. This is the woolbelt and wheatbelt portions of the subregion which have been extensively cleared for agriculture. The 800 – 600mm rainfall zone is exhibiting rapid rises in ground water levels up to 1m per year which is changing the distribution of riparian vegetation and contributing to accelerated *Phytophthora* (and *Armillaria* in Karri regrowth) disease impacts. It could be argued that this part of the subregion should actually be treated as Reserve Consolidation Rank of 1 (given table and notes above).

Reserve management standard

There are 89 nature reserves, 5 national parks, and no conservation parks occur within JF2. There are current government proposals for an additional 30 national parks are in the early stages of implementation, but have been excluded from this discussion.

Nature Reserves: Reserve Management standards is (i) Poor (see Appendix C, rank 5), for majority of reserves in the eastern zone, and (ii) Fair, for other reserves. The bulk of the nature reserves are small (<150 ha) and scattered across the subregion. There are no resident staff for these reserves, and management visitation varies, with a minimum of once per year. Very few of these reserves have formal approved management plans or interim management guidelines.

The small size, and in many cases remnant vegetation function, most reserves have significant weed invasion especially pasture grasses. Reserves containing drainage lines and water courses are increasingly impacted by salinity and / or rising water tables. Feral animals (foxes, rabbits and increasingly in the western sections, pigs) are not controlled in all but the largest reserves. In the western and middle parts of the subregion, *Phytophthora* disease is impacting on vegetation communities in the reserves. This is compounded by the rising water tables. Understory species composition is often depauperate and in a degraded state resulting from grazing impacts and extended fire frequencies.

National Parks: Reserve Management standards is (iii) Good for Leeuwin Naturaliste, Porongurup and Waychinicup, (ii) Fair for Scott and Hassell. JF2 contains 2 national parks in their entirety (Porongurup & Waychinicup National Parks) and parts of 2 others (Leeuwin Naturaliste and Hassell National Parks). Staff are resident and management plans exist for Leeuwin Naturaliste & Porongurup National Parks. Other parks being serviced by staff as needed.

Primary factors impacting on conservation values are: 1) linear design of Leeuwin Naturaliste, Hassell, and Scott National Parks. Hassell is effectively two strips of remnant roadside vegetation totaling 150m in width along its length. Leeuwin Naturaliste is restricted to 150m width at its narrowest points and is comprised of numerous fragmented reserves. 2) Semi rural land developments and an intensification of agricultural practices on adjoining lands is impacting on surface water flows into the Leeuwin Naturaliste and Scott National Parks. 3) Regular and routine feral animal (fox, some limited rabbit) control undertaken in Leeuwin Naturaliste and Scott National Parks. Declared weeds and selected environmental weeds are subjected to annual control programs. Spread of some weeds (african thistle) is being exacerbated by high recreational visitor numbers. Both feral animal and weed control programs constrained by funding limitations. Fire regimes are strongly influenced by high visitation numbers and protection of adjoining land uses.

Off reserve conservation

Priority species or groups and existing recovery plans

Species	Specific Recovery Plan	General Recovery Plan
Potorous gilbertii	Yes - Interim Wildlife Management Guidelines (Recovery Plan currently in draft stage)	Action Plan For Australian Marsupials and Monotremes
Parantechinus apicalis	Yes - IRP	Action Plan For Australian Marsupials and Monotremes
Dasyurus geoffroii	Yes - RP	Action Plan For Australian Marsupials and Monotremes
Myrmecobius fasciatus	Yes – draft RP	Action Plan For Australian Marsupials and Monotremes
Pseudocheirus occidentalis	Yes - IRP	Action Plan For Australian Marsupials and Monotremes
Setonix brachyurus	No	Action Plan For Australian Marsupials and Monotremes
Phascogale calura	No	Action Plan For Australian Marsupials and Monotremes
Calyptorhynchus latirostris	Yes - RP	Action Plan for Australian Birds
Pezoporus wallicus flaviventris	Yes - IRP	Action Plan for Australian Birds
Atrichornis clamosus	Yes - RP	Action Plan for Australian Birds
Botaurus poiciloptilus	No	Action Plan for Australian Birds
Cacatua pastinator pastinator	Yes – currently in preparation	Action Plan for Australian Birds

Species	Specific Recovery Plan	General Recovery Plan
Calyptorhynchus baudinii	No	Action Plan for Australian Birds
Dasyornis longirostris	No	Action Plan for Australian Birds
Leipoa ocellata	Yes - Malleefowl Preservation Society have current Action Plan and ongoing research	Action Plan for Australian Birds
Psophodes nigrogularis oberon	No	Action Plan for Australian Birds
Psophodes nigrogularis nigrogularis	No	Action Plan for Australian Birds
Geocrinia alba	Yes - IRP	Action Plan for Australian Frogs
Geocrinia vitellina	Yes - IRP	Action Plan for Australian Frogs
Spicospina flammocaerulea	Yes - RP	Action Plan for Australian Frogs
Rare and Priority listed (P1 to P4) plants associated with wetlands subject to salinisation, eutrophication and inundation, and competition from weeds, primarily within the agricultural area in the Eastern parts of the bioregion.	No	Declared Rare and Poorly Known Flora in the Central Forest Region; Declared Rare and Poorly Known Flora of the Albany Region.
Caladenia bryceana subsp. *bryceana*	Yes - IRP	Declared Rare and Poorly Known Flora in the Central Forest Region
Caladenia viridescens	No	Declared Rare and Poorly Known Flora in the Central Forest Region
Drakaea confluens ms	Yes - IRP	Declared Rare and Poorly Known Flora in the Central Forest Region
Rulingia sp Trigwell Bridge	Yes - IRP	Declared Rare and Poorly Known Flora in the Central Forest Region
Boronia exilis	Yes - IRP	Declared Rare and Poorly Known Flora in the Central Forest Region

Appropriate species recovery actions

Species	Recovery Actions[1]	Recovery Descriptions
Potorous gilbertii	ix, xiv, vii	Exclusion of fire from site where species is found. Other - Establishment of captive breeding colony in case of deaths in wild population. Other - Dieback affects habitat vegetation and fungi food source, so prevention of infection of site and phosphate may need to be applied to infected areas. Feral animal control via fox bating.
Parantechinus apicalis	xii, vii, ix	Continue studying island and mainland populations and survey for new populations. Feral animal control, with special emphasis on not allowing feral predators to be introduced to island populations. Fire management by excluding fire from dibbler habitats (fire history is unknown but appears to be long unburnt).
Dasyurus geoffroii	xii, xiv, x	Research about the impact of fire regimes on diet. Research into effects of foxes and fox baiting. Population and habitat monitoring. Further surveys on distribution and habitat requirements, especially in eastern part of subregion. Other -Maintenance of adequate refuge and den logs. Rehabilitation after mining. Prevention of further clearing, especially in riparian areas. Captive breeding and translocations.
Myrmecobius fasciatus	xiv, xii, x, xiii	Other - Management of existing populations and habitat. Research - Genetic survey of existing populations and habitat. Further translocations to establish at least six further self-sustaining populations. Captive breeding to provide animals for display and supplement translocations. Capacity building – establishment and support of public awareness and sponsorship programmes.
Pseudocheirus occidentalis	ii, iii, xiv, x, xiii,	Conservation on public lands managed by CALM. Other - Research into impacts of logging and minimise impacts of land developments. Management of injured, displaced or nuisance possums. Translocations into areas of fox control. Capacity building with community and landholders including education, liaison and communication.

Species	Recovery Actions[1]	Recovery Descriptions
Setonix brachyurus	ix, vii, xii	Habitat manipulation through use of fire; Fox baiting and pig control. Survey of reported occurrences outside known population range. Further surveys to asses population size, extent of immigration and emigration and assessment of range of habitat types used (and spatial analysis of current populations and potentially suitable habitat).
Phascogale calura	xii, ix,	Research to review and assess current knowledge of distribution and ecology. Predict suitable habitat for further surveys. Radio track individuals. Fire management.
Calyptorhynchus latirostris	xii, xiv	Research to determine conservation status of sub populations. Other – Retain breeding population and reverse decline in remaining breeding areas.
Pezoporus wallicus flaviventris	xii, xiv, x	Research to survey all known populations. Monitoring of subpopulations in relation to changing post fire age and fox control programme. Research into micro-habitat requirements and breeding success. Prepare IRP. Evaluation of the use of translocation for this species.
Atrichornis clamosus	ix, vii, iii, x, xii, xiii	Fire management at Two People's Bay, Waychinicup National Park, Many Peaks Nature Reserve and Gull Rock Nature Reserve. Feral animal control. Habitat protection on other state lands. Translocations. Research to monitor population numbers. Capacity building and publicity with community, education groups and sponsors.
Botaurus poiciloptilus	xii, xiv	Research to develop methods for assessing population trends. Further survey and search of historical records for information on distribution and breeding grounds. Other – Rehabilitation of some wetlands as part of Landcare.
Cacatua pastinator pastinator	xii, xiii, vii	Research to a technique to exclude birds from grain being fed to livestock. Determine the area of feeding habitat required to sustain population. Obtain a greater understanding of breeding biology, clarify taxonomic status and ongoing monitoring of population size. Capacity building to increase community involvement. Feral animal control of the introduced eastern Long-billed Corella.
Calyptorhynchus baudinii	xii, xi	Research - Develop repeatable population monitoring technique and monitor in different areas of the birds' range. Other – Help orchardists develop non-lethal damage control measures, and make shooting of birds illegal.
Dasyornis longirostris	xii, x	Research to survey known subpopulations; Monitoring of subpopulations in relation to post fire age. Research microhabitat requirements. Evaluation of translocation for management of species.
Leipoa ocellata	xii, xiii, vii, xiv,	Research and population monitoring and associated habitat surveys (including road verges). Capacity building with community, school groups and rural interest groups. Fox and feral cat eradication. Other - Establishment of wildlife corridors. Records of malleefowl and nest sightings. Newsletter production.
Psophodes nigrogularis oberon	xii	Research to survey of all known subpopulations. Assessment of taxonomic of populations in WA. Monitoring of subpopulations in relation to changing post fire age and a fox control programme. Research of microhabitat requirements.
Psophodes nigrogularis nigrogularis	xii, x	Research to survey of all known subpopulations. Assessment of taxonomic of populations in WA. Monitoring of subpopulations in relation to changing post fire age and a fox control programme. Research of microhabitat requirements. Evaluation of translocations for management.
Geocrinia alba	xii, ix, iii, xiii, x	Research to survey suitable habitat for further populations. Population monitoring and genetic studies. Fire management and research. Habitat protection on other state lands. Capacity building to encourage community participation. Translocation and captive breeding.

Species	Recovery Actions[1]	Recovery Descriptions
Geocrinia vitellina	xii, ix, xiii, x	Research to survey suitable habitat for further populations. Population monitoring and genetic studies. Fire management and research. Capacity building to encourage community participation. Translocation and captive breeding.
Spicospina flammocaerulea	xii, ix, xiii	Research into development of predictive models for calling activity. Search for new populations. Monitoring of population size. Fire management, especially prevention of burning in population areas. Capacity building with private landholders.
Rare and Priority listed (P1 to P4) plants associated with wetlands subject to salinisation, eutrophication and inundation, and competition from weeds, primarily within the agricultural area in the Eastern parts of the bioregion.	ii, iii, v, vi, vii, ix, x, xii, xiii	General recovery plans involve habitat protection on private and other state lands for those species not currently well represented in reserves. Fencing to exclude stock. Weed and feral animal control. Fire management. Plant propagation and translocation can be an option. Further research to obtain biological and ecological information. Capacity building is necessary with community, landowners, other agencies, etc.
Caladenia bryceana subsp. *bryceana*	vi, ix, xii, xiv, x,	Implement weed control. Develop a fire management strategy. Research to collect seed, conduct further surveys, monitor known populations and obtain biological and ecological information. Other – Promote awareness of the species, relocate the information bay at one of the populations and write a full recovery plan. Develop a translocation proposal.
Caladenia viridescens	xiii, ix, vi, v, i, xii, xiv, x	Capacity building with other agencies and land managers to coordinate recovery actions and to promote awareness. Finalise the fire management plan. Continue weed control. Continue control of grazing. Change land vesting and purpose. Research to conduct further surveys. Obtain biological and ecological information. Collect seed and fungal material. Investigate germination of seed in soil. Monitor populations. Other - Stimulate seed set; Artificially water populations, if statistically significant; Rehabilitate habitat, if necessary; Review the need for a full Recovery Plan. Undertake translocation.
Drakaea confluens ms	xiii, ix, xii, iii, v, vi, xiv,	Capacity building with other agencies and relevant landowners to coordinate recovery actions promote awareness. Develop and implement a fire management strategy. Research to monitor populations. Collect seed and tissue culture material. Obtain biological and ecological information. Conduct further surveys. Protect populations on private land. Monitor and control vertebrate grazing. Undertake weed control. Other - Incorporate recovery actions into the Interim Management Guidelines (IMG's) for a new conservation park; Write a full Recovery Plan; Apply phosphite as required and monitor the impact of phosphite application.
Rulingia sp Trigwell Bridge	v, vi, xiv, xii, ix, x	Fencing to control grazing. Weed control. Other – Maintain dieback hygiene; Preservation of genetic diversity of the species; Implement an approved Translocation Proposal Research to monitor wild population. Develop fire management strategy. Research to obtain biological and ecological information. Other - Information regarding the species needs to be disseminated to as many people as possible and a full recovery plan needs to be written.
Boronia exilis	xiii, xii, ix, xiv, i, x,	Capacity building with landholders and other government agencies to coordinate recovery actions and liase with land managers. Research to confirm existing populations and conduct further surveys, monitor populations, collect seed and cutting material, monitor dieback spread and implement disease hygiene measures, and obtain biological and ecological information. Develop and implement a fire management strategy. Other – Install signs and DRF markers and promote awareness of the species. Habitat retention via negotiations to alter the purpose of a reserve at which *B. exilis* grows. Start translocation process. Other – Include general recommendations for *B. exilis* in management plan for Scott River National Park and write full recovery plan.

[1]Appendix B, key h.

Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plan	General Recovery Plan
Busselton Ironstone communities and North Porongurup wet ironstone heath community	Busselton Ironstone TEC has RP	Forest Management Plan (draft)
Wetlands, rivers, cave rootmat communities and estuaries throughout the region	No	State Salinity Strategy being implemented
Wetlands, rivers and estuaries throughout the region at risk from off reserve upstream landuse, past and current, salinisation, eutrophication and inundation	No	Forest Management Plan (draft)
The Muir Unicup Recovery Catchment	No	Forest Management Plan (draft)
Remnant vegetation, specifically of poorly reserved complexes, on private property and currently crown reserves (not vested for conservation) in the eastern agricultural parts of the subregion	No	Forest Management Plan (draft)
The understory vegetation complexes in small woolbelt & wheatbelt remnant vegetation patches are threatened by weeds (grass invasion)	No	Forest Management Plan (draft)

and grazing (sheep, rabbits & kangaroos)		

Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions[1]	Recovery Descriptions
Busselton Ironstone communities and North Porongurup wet ironstone heath community	xiv, xiii, xii, ix, vi, iii, v, i	Other – Establish a recovery team; Implement dieback treatments and dieback hygiene; Disseminate information. Capacity building with landholders, management bodies and managers. Research – Monitor boundaries and encroachment of dieback; Ongoing monitoring of timing and depth of inundation events, flora, *Armillaria* fungus, and weeds; Develop strategy for in situ propagation. Implement fire management plans. Implement weed control. Habitat protection on state lands via transfer of care, control and management of road and rail reserve to the Conservation Commission and develop management plan for road and rail reserves. Fence communities on private land. Habitat retention through reserves by seeking to acquire community on private land. Other – Report on management strategies.
Wetlands, rivers, cave rootmat communities and estuaries throughout the region	xiii	Capacity building is required to integrate community and Government NRM action to abate threats and reverse trends in upstream areas.
Wetlands, rivers and estuaries throughout the region at risk from off reserve upstream landuse, past and current, salinisation, eutrophication and inundation	xiii, xi, xiv	Capacity building is required to integrate community and Government NRM action to abate threats and reverse trends in upstream areas. Reinstatement of hydrology. Other – Change in landuse upstream.
The Muir Unicup Recovery Catchment	xi, viii	This is an identified specific case of the above at crisis point where salt, inundation and acid sulphate soils are in danger of destroying a remnant, relatively healthy wetland complex of international standing. Therefore recovery actions include reinstatement of hydrology and revegetation.
Remnant vegetation, specifically of poorly reserved complexes, on private property and currently crown reserves (not vested for conservation) in the eastern agricultural parts of the subregion	i, ii, iii	Habitat retention and protection through reserves, on private land and on other state lands, with options for covenanting or acquisition being explored.
The understory vegetation complexes in small woolbelt & wheatbelt remnant vegetation patches are threatened by weeds (grass invasion) and grazing (sheep, rabbits & kangaroos)	xiii, vi, v	Capacity building is required to integrate community and Government NRM action to abate threats and reverse trends in upstream areas. Weed control. Fencing to prevent grazing.
All ecosystems within JF2	vi, vii	All ecosystems within JF2 generally face two major threats: Weeds – work with other agencies and the community to resource environmental weed control programs on and off reserve; assess potential of "exotic" taxa as weeds and develop control programs for those considered threats. Feral animals – maintain and expand existing baiting/control programs; develop techniques for cats, rabbits, etc. and integrate these into farm planning/community schemes.

[1]Appendix B, key h.

Subregion priority for off reserve conservation

The subregional priority for off park conservation is (ii) (see Appendix C, rank 6) for the Eastern Zone of JF2. There is a large off park effort needed, and resource constraints and limited community capacity exist to deal with salinity and rising water levels.

Conservation actions as an integral part of NRM

Existing NRM actions

Incentives: Farm forestry with State funded (Forest Products Commission and Water & Rivers) plantation initiatives to recover health of rivers (Tone/Warren and Collie); Farm forestry sharefarm schemes; Remnant vegetation fencing under various programs; establishment of perennial crops and revegetation on farms as part of salt and water management actions.

Institutional Reform: Hardwood timber industry restructure via the Regional Forest Agreement and post RFA process; State Planning policy now requires Rural Planning Strategies and Schemes to address NRM issues.

Threat Abatement Planning as Part of NRM: State Salinity Strategy, Muir Unicup Biodiversity Recovery Catchment, Collie and Warren River potable water recovery catchments; feral animal control programs (Western Shield – limited cooperative participation by landholders); State Weed Strategy.

Industry Codes of Practice: The Plantation industry code of practice; move to a range of Agricultural codes as facilitated by Department of Agriculture.

Environmental Management Systems: EMS for forest management (harvesting) developed.

Capacity Building: Department of Agriculture, Department of Conservation and Land Management and Water and Rivers Commission all contribute to community forums, workshops and education as part of increasing understanding processes and management actions available to landowners and community in relation to Salt and Water issues; Weed action groups are supported by the Departments of Conservation and Land Management and Agriculture.

Other Planning Opportunities: Regional NRM strategies (eg South West Catchments Council) include or will include (eg SCRIPT) Biodiversity issues; Shire Rural Strategies and Town Planning schemes now addressing biodiversity and environmental issues within an NRM context as a result of Ministry for Planning and Infrastructure requirements.

Integration With Property Management Planning: Some application at this stage mostly associated with water / salt management in eastern agricultural zone; some input to planning stage of development proposals through Ministry for Planning and Infrastructure and Local Government referrals.

Feasible opportunities for NRM

Incentives: Extend Landcare and revegetation funding options to landowners. Tax or rate relief for owners for returning or protecting native vegetation.

Institutional Reform: Finalise reservation actions pending for many years. Tax or rate relief provisions for owners for returning and protecting native vegetation. Facilitate greater input from State agencies to developing Regional NRM Strategies. Staff agencies with sufficient capable people who understand and are able to plan and implement NRM actions.

Threat Abatement Planning as Part of NRM: Extend resourcing of preparation of catchment plans.

Industry Codes of Practice: During development of codes, develop systems to contain impacts of industry to owner / operator land.

Capacity Building: Facilitate greater community education / involvement in a range of areas in conservation biology and NRM.

Other Planning Opportunities: Continued development of Regional NRM strategies; Input to Shire Rural Strategies and Town Planning.

Impediments or constraints to opportunities

Economic Constraints: Limited financial resources are a major constraint.

Other: Lack of resourcing with agency staff trained in conservation biology and NRM – numbers capability and resourcing.

Subregions where specific NRM actions are a priority to pursue

Overall, JF2 has an NRM priority of (iii) (see Appendix C, rank 7), indicating that NRM actions are in place across most of the subregion. However, the Eastern zone of JF2 is ranked as (i) because there are major constraints to NRM, and structural reform is needed owing to extent of past degradation, social and economic disruption.

Data Gaps

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

Vegetation and Regional Ecosystem Mapping: Vegetation mapping under several different systems (Beard 1974d, Beard 1979e) is available at a resolution of 1:100000 or 1:250000, whilst the mapping by Mattiske and Havel (1998a, 1998b, 1998c and 1998d) is available at a resolution of 1:50 000 and published at 1:250 000. The mapping for these systems is based on (informed and attributed) structural types or (informed and attributed) underlying geomorphic / landscape relationships with vegetation communities present. Both have strengths and weaknesses in development of a CAR reserve system. Community identification based on floristics has been done for most of the bioregion (see Mattiske and Havel 1997) but complexity of pattern on the landscape (hence cost of mapping) has prevented vegetation and ecosystem mapping based on the community types delineated, although localised areas have been mapped at the more detail local scale.

Systematic Fauna Survey: No systematic fauna surveys (vertebrate or invertebrate) have been conducted across the bioregion.

Data is sparse and patchy. Most reserves don't have long-term survey data on species presence or absence for vertebrates. Systematic vertebrate survey data is not available for 95% of subregion, most confined to Perup and Kingston.

Invertebrate studies confined to some wetlands and to selected invertebrate taxa. Area has been identified as a significant area for relict taxa and their habitat, in particular for invertebrates (Main 1996; Horwitz 1997a; Horowitz 1997b), but targeted survey and assessment only just begun.

Floristic Data: Regional survey of vascular flora has been mostly completed, but it is based on sampling quadrats positioned on widespread surface-types as well as some of the localised substrates of particular interest. There are a range of sample designs dependent on the objectives of the individual studies that combined can be considered to be the Regional Survey. Studies have been done on frogs (Wardell-Johnson and Roberts 1993 and Wardell-Johnson *et al.* 1995), South coast wetlands (Lyons *et al.* 2000), Torndirrup National Park (Keighery 1988a) and West Cape Howe National Park (Keighery 1988b). Some gaps were identified during the RFA study of the South-West forests and additional plots & quadrats established (see summary by Mattiske and Havel 1997).

Regional survey of the non-vascular flora has not been undertaken. However based on the collections made by a number of local botanists and enthusiasts and those made by international and interstate bryologists, the bioregion (and WA) has a severely depleted moss and liverwort flora compared to equivalent community types in Tasmania, Victoria and New South Wales. Climate change and land management under a changing climatic regime place a

large part (that usually associated with rainforest and wet forest ecotypes) of this remaining flora at risk.

Both qualitative and quantitative macro fungi assessment work has been undertaken in the Tingle, Karri and South Coast heath and Jarrah forests, but it is not comprehensive across the region (Bougher 1997).

Rare flora surveys and monitoring are ongoing, but the work is limited by resources. Status of many taxa remains in doubt and it is likely that many of the P1 and P2 taxa listed in this document will end up listed as Endangered or Vulnerable.

Ecological and Life History Data: Limited accessible data on population ecology and biology of persisting CWR mammals. Generally less for all other vertebrates, particularly the uncommon ones.

No accessible data on habitat requirements, life histories, ecology or distributions of virtually all invertebrate species.

Limited accessible data on population ecology and biology of the vascular flora of the bioregion limiting decision making on conservation status of and conservation management of the many rare and priority taxa. Likewise communities as reflected by the flora.

Other Priority Gaps Include:

- No consistent regolith mapping available at better than 1:250000 scale.
- No quantitative data on the affect of exotic predators, weed colonisation, fragmentation & farm clean-up, mineral-extraction on heavy metals, etc.
- Fire effect / response data is limited to few communities and taxa.
- An understanding of the effect of salinity / inundation on species and communities (including saline wetlands) is limited or lacking.
- Detailed *Phytophthora* mapping lacking for most of the region. Detail data on impacts on individual species and communities limited.
- Mapped location of Peat Communities absent.

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