

Jarrah Forest 1 (*JF1 – Northern 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 woodlands of Wandoo - Marri 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.

Northern Jarrah Forest incorporates the area east of the Darling Scarp, overlying Archaean granite and metamorphic rocks of an average elevation of 300 m, capped by an extensive lateritic duricrust, dissected by later drainage and broken by occasional granite hills. In the east the laterite becomes deeply dissected until it compresses isolated remnants. Rainfall is from 1300 mm on the scarp to approximately 700 mm in the east and north. Vegetation comprises Jarrah - Marri forest in the west with Bullich and Blackbutt in the valleys grading to Wandoo and Marri woodlands in the east with Powder bark on breakaways. There are extensive but localised sand sheets with *Banksia* low woodlands. Heath is found on granite rocks and as a common understorey of forests and woodlands in the north and east. 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 for JF1 is 2, 255, 904 ha.

Dominant land use

(see Appendix B, key b)

Dominant land uses mainly include forestry (native forests), conservation, grazing (improved pastures), cultivation (dry land agriculture), forestry (plantations), and mining. There are lesser areas of rural residential, easements for roads, power lines etc, and urban land use.

Continental Stress Class

The Continental Stress Class for JF1 is 3.

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

Rare Features:

Extensive native forest cover, however the biota is patchy considering geological & geomorphic uniformity.

Refugia:

- Threatened bird translocation sites for Noisy Scrub-Bird (*Atrichornis clamosus*).

- Primary populations of Critical Weight Range mammals such as Southern Brown Bandicoot (*Isodon obesulus fusciventer*), Chuditch (*Dasyurus geoffroyi*), Woylie (*Bettongia penicillata ogilbyi*) and Brush-tailed Phascogale (*Phascogale tapoatafa*). Some species such as Quokka (*Setonix brachyurus*) and Western Ring-tailed Possum (*Pseudocheirus occidentalis*) are often restricted to riparian habitat.
- Freshwater wetland: Baumea reed beds in forest areas.
- Granite outcrops and associated flora/fauna.
- Wandoo and Wandoo/Powderbark woodlands in the eastern zone such as Dryandra supporting species: Numbat (*Myrmecobius fasciatus*), Woylie (*Bettongia penicillata ogilbyi*) and the Tamar (*Macropus eugenii derbianus*).
- The RFA process identified other refugia (Commonwealth and Western Australian Regional Forest Agreement Steering Committee 1998c - including map 2 of report, and the non-National Estate thresholded map of refugia (IMB plot identifier - rfa_980119_01))

Centres of Endemism:

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: near the northern boundary of the RFA region between Gingin and New Norcia mostly on non-CALM managed lands but also including the Udumung Nature Reserve; near the eastern boundary of the RFA region between Great Eastern Highway and the Great Southern Highway mostly on non-CALM managed lands; near the eastern boundary of the RFA region including the eastern part of the proposed Wandoo National Park, and non-CALM managed lands to the east; to the east of Perth in the area of the John Forrest National Park and the proposed Mundaring, Pickering Brook, Canning and Helena Valley National Parks and adjacent areas of State Forest; along the Darling Scarp between Kelmscott and Jarrahdale in State forest (Hearn *et al.* 2003, Commonwealth and Western Australian Regional Forest Agreement Steering Committee 1998c).

High Species and Ecosystem Diversity:

The Northern Jarrah Forest region has moderate species richness (400 – 600 species per km). Although the western and central zones reflected higher richness in the RFA (Map 5 Species Richness), recent studies on the mosaic of forests, woodlands and heaths on the eastern and northeastern fringes are in the moderate range of species (Department of Conservation and Land Management 1998). 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. Other analysis has been done using data sets at a more regional scale (Gioia and Pigott 2000).

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 Jarrah Forest in the CTRC Red Book (Environmental Protection Authority 1974). Some but not all of these recommendations (with modification) were implemented over the following ten years. All but the south eastern corner (approx 30km width x 105km length) of the subregion are covered by the Department of CALM's Regional Management Plans (Department of Conservation and Land Management 1987b), that provides an overview of biota, addresses land and wildlife

conservation issues. However these plans were generalised in their 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 biodiversity conservation needs of the subregion, or even the bioregion.

The 1999 Regional Forest Agreement (RFA) systematically reviewed biodiversity values and the adequacy of the CAR reserve system over an area incorporating most of the JF1 subregion (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.

Wetlands

Wetlands of National significance (DIWA listings)

Name and Code	Description ¹	Condition ²	Trend ³	Reliability ⁴	Threatening Processes ⁵
Avon River Valley WA045	B2	ii	iii	iii	ix, xii (erosion, siltation and eutrophication), xi
Chittering-Needonqa WA047	B7, B14	iii	iii	iii	ix, xii (erosion and eutrophication), xi

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

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

There are no Wetlands of Subregional Significance except rivers listed under Riparian Zone Vegetation below.

Riparian zone vegetation

Rivers are the only wetlands of subregional significance in JF1. The water courses of the subregion are dominated by the creation of water storage structures (dams and

reservoirs) within the forested catchment primarily to provide:

- potable water to the metropolitan area of Perth and outlying suburbs, and
- irrigation water for the intensive horticulture and irrigation needs of agricultural users on the coastal plain.

All major rivers with the exception of the Avon, Swan and Murray have existing water storage structures in place. Issues arising from damming include: loss of riparian vegetation, modified flow patterns, introduction of exotic fish species.

Name	Location	Description ¹	Condition ²	Trend ³	Reliability ⁴	Threatening Processes ⁵	Water Storage
Avon River	425200 E, 6502400 N, zone 50	B2	ii	iii	iv	i, v, ix,	No
Brockman River	412587 E, 6523196 N zone 50	B2	ii	iii	iii	i, iv, v, ix, x	No
Swan River	427972 E, 6484700 N zone 50	B2	ii	iii	iii	i, ix, x,	No
Helena River	425000 E, 6461000 N zone 50	C1	iv	iv	iii	v (pigs)	Yes
Canning River	433000 E, 6425000 N zone 50	C1	iv	iv	iii	v (pigs)	Yes
Serpentine River	418000 E, 6413800 N zone 50	C1	iv	iv	iii	v (pigs)	Yes
Name and Code	Location	Description ¹	Condition ²	Trend ³	Reliability ⁴	Threatening Processes ⁵	Water Storage
South Dandalup River	414140 E, 6385710 N zone 50	C1	iv	iv	iii	v (pigs)	Yes
North Dandalup River	408021 E, 6402038 N zone 50	C1	iv	iv	iii	v (pigs)	Yes
Murray River	428529 E, 6349132 N zone 50	B2	iv	iv	iii	ix, v (pigs)	No
Wungong Brook	412395 E, 6435750 N zone 50	C1	iv	iv	iii	Unknown threatening processes	Yes
Harvey River	411000 E, 6337000 N zone 50	B2, C1	iv	iv	iii	v (pigs)	Yes
Harris River	420000 E, 6323000 N zone 50	B2, C1	iv	iv	iii	v (pigs)	Yes
Collie River	409100 E, 6309900 N	B2, C1	ii	v	iii	i, ii, v, ix,	Yes

	zone 50						
Brunswick River	409900 E, 6323000 N zone 50	C1	iii	iii	iii	ii, iv,	Yes
Logue Brook	404125 E, 6348334 N zone 50	C1	iii	iv	iii	v (pigs)	Yes
Samson Brook	408800 E, 6361700 N zone 50	C1	iii	iv	iii	v (pigs)	Yes
Drakes Brook	405517 E, 6364899 N zone 50	C1	iii	iv	iii	v (pigs)	Yes
Moore River	417000 E, 6569000 N zone 50	B2	ii	iii	iii	i, ix,	No

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

Ecosystems at risk

Threatened ecological communities (TECs)

In general, plant communities comprised of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered 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	Threatening Processes ⁵
<i>Eucalyptus calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands, Swan Coastal Plain	CR	8	ii	iii	iii	i, ii, vi, vii, xii (urbanisation)
<i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands of the eastern side of the Swan Coastal Plain	EN	30	ii	iii	iii	i, ii, vi, vii, xii (urbanisation), viii
<i>Eucalyptus calophylla</i> - <i>Eucalyptus marginata</i> woodlands on sandy clay soils of the southern Swan Coastal Plain	VU	8	ii	iii	iii	i, ii, vi, vii, xii (urbanisation)

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

Other ecosystems at risk

In general, plant communities comprised of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Beard Veg Assoc	Community	Status	NVIS ¹	Condition ²	Trend ³	Reliability ⁴	Threatening Processes ⁵
973	Low forest: paperbark (<i>Melaleuca raphiophylla</i>)	V	15	iii	iii	iii	i, vii, x
1021	Mosaic: Medium open woodland; wandoo/Shrublands; dryandra heath	E	8	iii	vi	iii	i, ii, ix, x (upland section in good condition, lowland section subject to clearing and salinity)
7	Medium woodland: York gum (<i>E. loxophleba</i>) & wandoo	V	8	Variable	iii	iii	i, ii, ix, x, vii, vi
1043	Mosaic: Medium open woodland; wandoo & powderbark wandoo/Shrublands; dryandra heath	V	8	iii	vi	iii	i, ii, ix, x (upland section in good condition, lowland section subject to clearing and salinity)

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

Analysis of the pre-european and remaining extent of Beard's vegetation associations (spreadsheet supplied by Angas Hopkins), shows that of the 39 vegetation associations that covered greater than 0.1% (i.e. 2256 ha) of the subregion in pre-european times (ie covering in total over 99.98% of original area) there are:

- Two vegetation associations (973 and 1182) with less than 10% of their original JF1 area remaining, and so could be considered threatened.
- Association 1182 is distributed across 3 subregions. JF1 contains only the smallest occurrences representing 0.2% of the total current extent of this association. Conservation of this association would be better achieved in other subregions.
- In JF1 vegetation association 1182 is not contained in the CALM estate. However 64.4% of the current total extent representing 30.1% of the pre-european extent in other subregions is contained in the CALM estate. Reservation of the JF1 occurrences of 1182 is not a priority for the conservation of this vegetation association.
- Association 973 is distributed across 4 subregions. JF1 contains only 1.1% of the total current extent of this association. While conservation of this association should be sought in the other subregions, to date this has not been achieved with only 6.6% of the total current extent (3.8% of the pre-european extent) contained in the CALM estate.
- 22.9% (4.7 ha) of the occurrence of 973 in the JF1 subregion is contained in CALM estate. Priority should be given to reserving further occurrences of this association across its distribution including those contained in JF1.

There are 11 vegetation associations that have between 10% and 30% of their pre-european JF1 area remaining, and so could be considered threatened. All eleven have <10% of their JF1 pre-European area contained in CALM reserves. However only three (1021, 4, 7) have greater than 10% of their total extent in JF1 and thus may be of priority for conservation in this subregion.

- Association 1021 is found exclusively in JF1, yet only 10.8% (157.9 ha) of the pre-european extent survives. There is no representation of this association in the CALM estate. Conservation of

vegetation association 1021 should be a priority in the JF1 subregion.

- 73.1% of the total current extent of association 4 occurs within JF1. This subregion has reserved 23.6% (69 255.3 ha) of the total current extent across all regions in CALM estate. Reservation of further remnants of association 4 would be of low priority.
- JF1 contains 27.1% of the total current extent of association 7. Across all bioregions only 1.8% (526.4 ha) of the current extent is contained in CALM estate reserves. In JF1 only 1.6% of the subregional extent of this association is contained in the CALM estate. Further reservation of this association should be a priority in the JF1 subregion.
- Vegetation Association 1043 is also of interest though it falls outside the 10 – 30% remaining criterion. Association 1043 is found exclusively within the JF1 subregion and adjoins association 1021. Though 40.5% (1795.4 ha) of the pre-european extent remains, there is no representation of this association in the CALM estate. Reservation of this association should be a priority in the JF1 subregion.

Analysis For the RFA Shows the Following at a Regional Level:

Forest ecosystems and vegetation complexes need to be covered as these are the primary units of vegetation that have been used for reservation analysis in this region in recent processes (Department of Conservation and Land Management 1994b; Commonwealth and Western Australian Regional Forest Agreement Steering Committee 1998a, 1998b and 1998c; Department of Conservation and Land Management and Conservation Commission of Western Australia 2002).

Both the RFA and Draft Forest Management Plan (2002) identify ecosystems in terms of 'forest ecosystems'. A number of ecosystems are identified as rare and have a CAR reservation target 100% of extant area, which is not achieved (Jarrah Rates Tingle, Jarrah Red Tingle, Karri rates Tingle, Bullich and Yate). Conservation Commission (2002) recommended that Government should refuse approvals of applications for clearing in the Darling Scarp and Jarrah Leeuwin

ecosystems as these ecosystems have been extensively cleared. Additionally, reservation in the Darling Scarp ecosystems is below the 15% target for CAR reserves.

Havel (2002) identified that nearly one-third of more than 300 vegetation complexes in the RFA region are poorly reserved using the Conservation Commission (2002) threshold of (i) < 10% of pre-European area in proposed and existing formal reserves and (ii) < 15% in proposed and existing formal and informal reserves.

Havel noted that the Swan Coastal Plain and Dandaragan Plateau subregion has a large number of very poorly reserved vegetation complexes and is therefore a conservation priority area, with 13 poorly reserved vegetation complexes. Some 36 vegetation complexes in the RFA region have less than 10% of their original area remaining, and 61 vegetation complexes have between 10% and 30% of their original area remaining (from analysis of primary data - not directly from Havel 2002)

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)					
<i>Dasyurus geoffroi</i>	V	iii	v	iii	v (fox)
<i>Myrmecobius fasciatus</i>	V	ii	iv	iii	ii, v (fox, cat)
<i>Pseudocheirus occidentalis</i>	V	iii	v	iii	ii, v (fox, cat), vii
<i>Setonix brachyurus</i>	V	ii	iv	iii	v (fox), vii,
SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)					
<i>Calyptorhynchus latirostris</i>	E	ii	iii	iii	i, ii, vii
<i>Atrichornis clamosus</i>	V	ii	v	iii	v (fox, cat, pig, black rat), vii
<i>Botaurus poiciloptilus</i>	V	ii	iii	iii	i, ii, v, vii, ix, x
<i>Calyptorhynchus baudinii</i>	V	ii	iii	iii	i, ii, vii
SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 11 (NATIVE BEES)					
<i>Leioproctus douglasiellus</i>	E	Unknown	vi	ii	Unknown threatening processes
<i>Neopasiphae simplicior</i>	E	Unknown	vi	ii	Unknown threatening processes
OTHER SPECIES AT RISK WITHIN THE SUBREGION					
<i>Arbanitis inornatus</i>	P1	Unknown	vi	ii	Unknown threatening processes
<i>Trichosternus relictus</i>	P1	Unknown	vi	ii	Unknown threatening processes
<i>Throscodectes xiphos</i>	P1	Unknown	vi	ii	Unknown threatening processes
<i>Ninox connivens connivens</i>	P2	ii	iii	iii	i, ii
<i>Leioproctus bilobatus</i>	P2	Unknown	vi		Unknown threatening processes

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

Declared rare and priority flora

Susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*).

Species Name	WA Status	Number of Populations in JF1	Condition ¹	Trend ²	Reliability ³	Threatening Processes ⁴
DECLARED RARE FLORA						
<i>Chamelaucium</i> sp. Gingin (N Marchant s.n. 4.11.88) [aff. <i>pauciflorum</i>]	CR	15	iii	iv	iii	i, ii, iv, v, vi, vii, viii, x, xii (roads)
<i>Darwinia carnea</i>	CR	4	i	ii	iii	i, ii, iv, v, vi, vii
<i>Eremophila scaberula</i>	CR	2	i	v	Unknown	iv (stock)
<i>Hemigenia ramosissima</i>	CR	3	iii	iv	Unknown	xii (small population size)
<i>Thomasia</i> sp. Green Hill (Paust 1322)	CR	2	ii	iii	iii	i, ii, v, vi, vii, xii (roads)

Species Name	WA Status	Number of Populations in JF1	Condition ¹	Trend ²	Reliability ³	Threatening Processes ⁴
<i>Verticordia fimbriolepis</i> subsp. <i>fimbriolepis</i>	CR	1	ii	iii	iii	i, ii, iv, v, vi, vii, xii (roads; area subject to mining)
<i>Conospermum densiflorum</i> subsp. <i>unicephalatum</i>	E	4	ii	iii	iii	i, ii, vi, xii (roads), viii (<i>Phytophthora</i> sp.)
<i>Conostylis drummondii</i>	E	1	ii	iv		xii (small population size)
<i>Darwinia acerosa</i>	E	5	iii	iii	iii	i, ii, iv, vi, vii
<i>Drakaea elastica</i>	E	1	ii	iii	iii	i, ii, iv, vi, vii, xii (roads; small population size)
<i>Dryandra mimica</i>	E	12	iii	v	iii	i, ii, vi, vii, xii (roads), viii (<i>Phytophthora</i> sp.)
<i>Eucalyptus dolorosa</i>	E	1	iii	iii	iii	i, ii, vii, xii (only one population)
<i>Eucalyptus impensa</i>	E	1	iii	iii	iii	i, ii, vii, viii, xii (sand mining)
<i>Eucalyptus pruiniramis</i>	E	2	iii	iii	iii	i, ii, vii, viii, xii (roads)
<i>Grevillea rara</i>	E	13	iii	v	iii	ii, x,
<i>Jacksonia velveta</i> ms	E	1	ii	iii		xii (small population size)
<i>Thelymitra stellata</i>	E	3	ii	ii	iii	i, ii, vi, vii, xii (roads, gravel extraction and recreation)
<i>Acacia anomala</i>	V	5	ii	iii	iii	i, ii, iii, vi, vii, viii, xii (roads; recreation; small population size)
<i>Acacia forrestiana</i>	V	3	iii	iii	iii	i, ii, vii, viii
<i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i>	V	24	iii	v	iii	vii
<i>Daviesia dielsii</i>	V	3	iii	iii	iii	i, ii, vi, xii (roads), vii
<i>Diuris micrantha</i>	V	1	iii	iv	iii	No known threatening processes
<i>Dryandra serratuloides</i> subsp. <i>serratuloides</i>	V	19	ii	iii	iii	viii (<i>Phytophthora</i> sp.)
<i>Eleocharis keigheryi</i>	V	4	iii	iv	iii	i, ii, iv, v, vi, ix, x, xii (roads)
<i>Eucalyptus olivacea</i> ms	V	2	ii	iii	iii	ii, xii (lack of recruitment)
<i>Ptychosema pusillum</i>	V	1	ii	iv	iii	i, ii, vi, vii (appears only after fire), xii (roads; only one population)
<i>Tribonanthes purpurea</i>	V	1	iii	iv	iii	i, ii, vi, vii,
PRIORITY 1						
<i>Dampiera tephrea</i>	1		iii	iv	iii	xii (very little is known about the species)
<i>Eucalyptus annuliformis</i>	1		iii	iv	iii	xii (very little is known about the species)
<i>Micromyrtus rogeri</i> ms	1		iii	iv	iii	xii (small population size)
<i>Stenanthemum introprubens</i>	1		Unknown	vi	Unknown	Unknown threatening processes
<i>Synaphea panhesya</i>	1		iii	iii	iii	viii (<i>Phytophthora</i> sp.)
<i>Verticordia huegellii</i> var. <i>tridens</i>	1		iii	iii	iii	viii (<i>Phytophthora</i> sp.)
PRIORITY 2						
<i>Andersonia carinata</i>	2		ii-iii	iv	iii	xii (populations on edge of geographic range in subregion), viii (<i>Phytophthora</i> sp.)
<i>Dryandra subpinnatifida</i> var. <i>imberbis</i>	2		ii-iii	iv	iii	xii (populations on edge of geographic range in subregion)
<i>Goodenia arthrotricha</i>	2		ii-iii	iv	iii	xii (populations on edge of geographic range in subregion)
<i>Grevillea candolleana</i>	2		ii-iii	iv	iii	xii (small population size), vii
<i>Grevillea crowleyae</i>	2		ii-iii	iv	iii	xii (populations on edge of geographic range in subregion)
<i>Leucopogon florulentus</i>	2		ii-iii	iv	iii	xii (populations on edge of geographic range in subregion)

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

Analysis of appropriate management scenarios

Reservation priorities of ecosystems

Vegetation Associations containing more than 80% of their total extent in the JF1 subregion and for which less than 30% is contained in any type of reserve are considered reservation priorities. There are 11 vegetation associations that only have between 10% and 30% of their pre-european JF1 area remaining, and so could be

considered threatened. All eleven have less than 10% of their JF1 pre-European area contained in CALM reserves. However only three (Beard Vegetation Associations 1021, 4, and 7) have greater than 10% of their total extent in JF1 and thus may be of priority for conservation in this subregion.

Beard Veg Assoc	Description	IUCN I-V (ha)	IUCN V-VI (ha)	CALM Lease	Priority	Notes
1021	Mosaic: Medium open woodland; wandoo/Shrublands; dryandra heath	0	0	0	H	Found exclusively in JF1, yet only 10.8% (157.9 ha) of the pre-european extent survives. There is no representation of this association in the CALM estate.
1043	Medium woodland: York gum, wandoo & salmon gum (<i>E. salmonophloia</i>)	0	0	0	H	Found exclusively within the JF1 subregion and adjoins association 1021. Though 40.5% (1795.4 ha) of the pre-european extent remains, there is no representation of this association in the CALM estate.
973	Low forest: paperbark (<i>Melaleuca raphiophylla</i>)				H	JF1 contains only 1.1% of the total current extent of this association. While conservation of this association should be sought in the other subregions, to date this has not been achieved with only 6.6% of the total current extent (3.8% of the pre-european extent) contained in the CALM estate.
1182	Medium woodland: <i>Eucalyptus rudis</i> & <i>Melaleuca raphiophylla</i>				L	JF1 contains only the smallest occurrences representing 0.2% of the total current extent of this association. Conservation of this association would be better achieved in other subregions
4	Medium woodland: marri & wandoo	69 255.3			L	73.1% of the total current extent of association occurs within JF1. This subregion has reserved 23.6% (69 255.3 ha) of the total current extent across all regions in CALM estate.
7	Medium woodland: York gum (<i>E. loxophleba</i>) & wandoo	526.4			H	JF1 contains 27.1% of the total current extent of association. Across all bioregions only 1.8% (526.4 ha) of the current extent is contained in CALM estate reserves. In JF1 only 1.6% of the subregional extent of this association is contained in the CALM estate.

- In JF1 vegetation association 1182 is not contained in the CALM estate. However 64.4% of the current total extent representing 30.1% of the pre-european extent in other subregions is contained in the CALM estate. Reservation of the JF1 occurrences of 1182 is not a priority for the conservation of this vegetation association.
- 22.9% (4.7 ha) of the occurrence of 973 in the JF1 subregion is contained in CALM estate. Priority should be given to reserving further occurrences of this association across its distribution including those contained in JF1.
- The RFA has identified a range of ecosystems that have a high priority for reservation, including Jarrah Rates Tingle, Jarrah Red Tingle, Karri rates Tingle, Bullich and Yate, many ecosystems in the Darling Scarp and Jarrah in the Leeuwin.

Subregional constraints in order of priority

(see Appendix B, key g)

Other: Regional Forest Agreement reserve recommendations already in process of being implemented, and may supersede the above reserve consolidation priorities.

Irreplacibility: In South east and northern portions of the subregion due to extensive agricultural clearing.

Bioregional and subregional priority for reserve consolidation

(see Appendix D, and Appendix C, rank 4)

The priority for reserve consolidation can be viewed in two ways:

- 1) Considering only reserves meeting IUCN categories I - IV criteria:
 - 5.8% of the bioregion area is contained in reserves and 56.4% of the native vegetation cover remains.
 - This places the JF region into IBRA Class 3d#. ie: (5-10%) reservation and >30% remaining vegetation cover.

2) Considering all CALM estate:

- 36.4% of the area is reserved and 56.4% of the native vegetation cover remains.
- This falls into IBRA Class 5d#. ie: >15% reservation and >30% native vegetation cover.

Analysis has been based on only gazetted reserves have been used for calculations, therefore formal proposals have the potential to more than double the reserve system, however these have not yet been finalised.

The south-eastern and northern portions of the Northern Jarrah Forest region, below the 600mm isohyet are generally poorly represented in conservation reserves. This is the woolbelt and wheatbelt portions of the subregion which have had extensive clearing for agriculture. The 700 – 500mm rainfall zone is exhibiting rapid rises in ground water levels up to 1m per year which is impacting on riparian vegetation and contributing to accelerated *Phytophthora* disease impacts. *Armillaria* fungus is very critical in eastern areas of woodlands and forest.

Reserve management standard

JF1 contains 60 nature reserves, 8 National Parks and 9 Conservation Parks (including Lane Poole as a Conservation Park). At present there are government proposals for an additional five national parks, but these are in the early stages of implementation, and so have been excluded from this discussion.

Nature Reserves: Reserve Management standards is (i) Poor (see Appendix C, rank 5). Threatening Processes are not well managed and this is leading to permanent resource degradation for majority of reserves in the eastern and northern zone. Management standards are (ii) Fair (biodiversity values and/or management issues are poorly identified, resource degradation is occurring though retrievable), for other reserves.

The bulk of the nature reserves are small (<100 ha) and scattered across the subregion. There are no resident staff for these reserves, management visitation varies but is usually restricted to a minimum of once per year. None of these reserves have formal approved management plans or interim management guidelines. Their small size and often remnant vegetation function means that most reserves have significant weed invasion, especially pasture grasses. In the eastern portion of the subregion, 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

Off reserve conservation

Priority species or groups and existing recovery plans

Species	Species Recovery Plan	General Recovery Plan
<i>Pseudocheirus occidentalis</i>	IRP	Action Plan for Australian Marsupials and Monotremes
<i>Calyptorhynchus baudinii</i>	No	Action Plan for Australian Birds
<i>Calyptorhynchus latirostris</i>	RP (draft)	Action Plan for Australian Birds
<i>Chamelaucium</i> sp. Gingin (N Marchant s.n. 4.11.88) [aff. <i>pauciflorum</i>]	IRP	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)

vegetation communities in the reserves. This is compounded by the rising water tables.

In the eastern reserves understorey species composition is often depauperate and in a degraded state resulting from grass weed invasion, grazing impacts and extended fire frequencies. Fire regimes based on biodiversity outcomes area absent, and deliberately lit wildfires can and do occur frequently depending on the proximity of the reserve to urbanisation. Formalised biodiversity monitoring programs are absent.

National Parks: Reserve Management standards is (iii) Good, major biodiversity issues effectively managed. The majority of parks have management plans which are being implemented, though targeted ecological monitoring programs are either absent or inadequate. Size ranges from 20ha to 4300ha, with 7 of the 8 parks primarily servicing the recreation and day visitor requirements of the Perth metropolitan area. Five of the parks have staff in residence. Excluding Avon Valley National Park, all parks are situated on the western edge of the subregion, on or close to the Darling Escarpment and often associated with river valleys. Thus the overall diversity of vegetation communities contained across these reserves is limited. Feral animal control in these parks can be hampered by their close proximity to urbanisation. Salinity issues are generally not evident on the western side of the subregion but are impacting in the Avon Valley National Park. Fungal disease (*Phytophthora cinnamomi*) is present in all of the parks as are a range of weed species, especially species associated with riparian and moisture gaining sites. Fire regimes are often influenced by the requirement to protect adjoining land values. In most parks formalised biodiversity monitoring programs are absent.

Conservation Parks: Reserve Management standards is (ii) Fair, biodiversity values and issues are poorly identified, degradation is retrievable. Management Plans in preparation stages for only 1 reserve (Lane Poole). None of the Conservation Parks have resident staff. Size ranges from 32ha to approx 5100ha with the majority being larger than 1000 ha. Four of these reserves are located in the eastern side of the subregion and are subject to increasing salinity degradation and/or rising water tables which impacts on the riparian habitats. Weed invasion along riparian habitats and extensive pasture grass in the eastern zone is of concern. Fire regimes are yet to be optimised for biodiversity outcomes. In most parks formalised biodiversity monitoring programs are absent although the eastern zone parks may have permanent monitoring plots, established as part of the State Salinity Strategy (State Salinity Council of Western Australia 2000).

<i>Darwinia carnea</i>	IRP	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)
<i>Eremophila scaberula</i>	IRP	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)
<i>Grevillea althoferorum</i>	IRP	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)
<i>Hemigenia ramosissima</i>	No	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)
<i>Thomasia</i> sp. Green Hill (Paust 1322)	IRP	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)
<i>Verticordia fimbriolepis</i> subsp. <i>fimbriolepis</i>	No	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)

Appropriate species recovery actions

Species	Recovery Actions ¹	Recovery Descriptions
<i>Pseudocheirus occidentalis</i>	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.
<i>Calyptorhynchus baudinii</i>	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.
<i>Calyptorhynchus latirostris</i>	i, ii, iii, xii, xiv	Habitat protection through reserves, on private lands and on other state lands - Management of feeding habitat in non-breeding areas and in priority areas. Research - Population monitoring. Other - Encourage community involvement and establish captive breeding programme.
<i>Chamelaucium</i> sp. Gingin (N Marchant s.n. 4.11.88) [aff. <i>pauciflorum</i>]	xiii, xii, xiv, vi, ix, v	Capacity building with landowners and authorities. Research - Population monitoring, preservation of genetic diversity in the form of seed collection, further surveys and research of ecological and biological 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. Weed control. Fire management. Fencing as exclosures.
<i>Darwinia carnea</i>	v, ix, xii, vii, vi, xiv, i, x	Fencing of one sub-population. Fire management. Research - Preservation of genetic diversity of the species in the form of seed collection, population monitoring and conduction of further surveys. Feral animal control (rabbits). Weed control. Other - Information regarding the species needs to be disseminated to as many people as possible. Habitat retention through purchase of land for reserves. Translocation of propagated plants.
<i>Eremophila scaberula</i>	vi, xii, ix, xiv	Weed control. Research - Attempt to stimulate germination, population monitoring, conduction of further surveys and research of ecological and biological information. Fire management. Other - Information regarding the species needs to be disseminated to as many people as possible and a full recovery plan needs to be written.
<i>Grevillea althoferorum</i>	xii, xiii, ix, x, xiv	Research - Population monitoring, monitoring of the spread of dieback and implement disease hygiene procedures, preservation of genetic diversity of the species in the form of seed and cutting collection, conduction of further surveys and research of ecological and biological information. Capacity building required with adjacent land manager. Fire management. Translocation of plants, including propagation of new plants. Other - Information regarding the species needs to be disseminated to as many people as possible and a full recovery plan needs to be written.
Species	Recovery Actions ¹	Recovery Descriptions
<i>Hemigenia ramosissima</i>	xiii, xii, xiv, x, ix	Capacity building with landholders and other government departments. Research - Population monitoring, conduction of further surveys, and research 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. Weed control using proven, best practice methods. Translocation of plants, including propagation of new plants (via collect seed or cutting material). Fire management.
<i>Thomasia</i> sp. Green Hill (Paust 1322)	xiv, v, vi, ix, xii	Other - Notify all relevant land managers of species. Maintain boundary fence. Weed control. Fire management. Research - Population monitoring, preservation of genetic diversity of the species in the form of seed and cutting collection, conduction of further surveys and research 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.
<i>Verticordia fimbriolepis</i> subsp. <i>fimbriolepis</i>	ix, xii, xiv	Fire management. Research - Population monitoring, monitoring of the spread of dieback and implement disease hygiene procedures, preservation of genetic diversity of the species in the form of seed and cutting collection, conduction of further surveys and research of ecological and biological information. Other - Re-assessment of Critical ranking may be warranted since survey work revealed more populations.

¹Appendix B, key h.

Ecosystems and existing recovery plans

Ecosystem	Species Recovery Plan	General Recovery Plan
Threatened flora on farmland in the eastern and northern zone of the subregion.	Interim Recovery Plans are in place for critically endangered species. Only limited work has been undertaken for other	State Salinity Strategy being implemented.

	species.	
Understorey vegetation complexes in small woolbelt & wheatbelt remnant vegetation patches	Interim Recovery Plans are in place for critically endangered species. Only limited work has been undertaken for other species.	State Salinity Strategy being implemented.
Low Forest: paperbark (<i>Melaleuca raphiophylla</i>) (Beard Veg Assoc 973)	No	No
Mosaic: Medium open woodland/Shrublands: Dryandra heath (Beard Veg Assoc 1021)	No	No
Mosaic: Medium open woodland wandoo and powderbark wandoo/Shrublands: Dryandra heath (Beard Veg Assoc 1043)	No	No
Medium woodland: York gum (<i>E. loxophleba</i>) & wandoo (Beard Veg Assoc 7)	No	No

Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions ¹	Recovery Description
Threatened flora on farmland in the eastern and northern zone of the subregion.	Recovery Actions are detailed in the State Salinity Strategy. Suggested recovery actions could be: i, ii, iii, v, vi, vii, ix, xi, xiii.	Habitat retention through reserves, on private land and on state lands. Fencing of sensitive areas as exclosures. Weed control. Feral animal control. Fire management. Reinstatement of hydrology. Capacity building with community and landholders.
Understorey vegetation complexes in small woolbelt & wheatbelt remnant vegetation patches	Recovery Actions are detailed for some vegetation patches in the State Salinity Strategy. Recovery actions are yet to be identified for other patches. Suggested recovery actions could be: i, ii, iii, v, vi, vii, ix, xi, xiii.	Habitat retention through reserves, on private land and on state lands. Fencing of sensitive areas as exclosures. Weed control. Feral animal control. Fire management. Reinstatement of hydrology. Capacity building with community and landholders.
Low Forest: paperbark (<i>Melaleuca raphiophylla</i>) (Beard Veg Assoc 973)	i, ii, vi, viii, vii, ix	Habitat retention through reserves and on private lands. Weed control, particularly invasive pasture grasses. Revegetation. Feral animal control of cats, foxes, and rabbits. Fire management.
Mosaic: Medium open woodland/Shrublands: dryandra heath (Beard Veg Assoc 1021)	i, ii, xi, vii, ix	Habitat retention through reserves and on private lands. Reinstatement of hydrology. Feral animal control of rabbits. Fire management.
Ecosystem	Recovery Actions ¹	Recovery Description
Mosaic: Medium open woodland wandoo and powderbark wandoo/Shrublands: dryandra heath (Beard Veg Assoc 1043)	i, ii, xi, vii, ix	Habitat retention through reserves and on private lands. Reinstatement of hydrology. Feral animal control of rabbits. Fire management.
Medium woodland: York gum (<i>E. loxophleba</i>) & wandoo (Beard Veg Assoc 7)	i, ii, xi, vii, ix	Habitat retention through reserves and on private lands. Reinstatement of hydrology. Feral animal control of rabbits. Fire management.

¹Appendix B, key h.

Subregion priority for off reserve conservation

The priority for off park conservation in JF1 is (ii) (see Appendix C, rank 6), particularly in the Eastern and Northern Zones. A large off park effort needed, however resource constraints, limited community capacity to deal with salinity and rising water levels, and habitat loss or fragmentation exist.

Conservation actions as an integral part of NRM

Existing NRM actions

Institutional Reform: Hardwood timber industry via the RFA process.

Threat Abatement Planning as Part of NRM: e.g. State Salinity Strategy; feral animal control programs such as Western Shield, which has limited cooperative participation by landholders.

Industry Codes of Practice: Such as for Bluegum Plantations.

Integration With Property Management Planning: Limited application only.

Feasible opportunities for NRM

Institutional Reform: Rural reconstruction, industry reconstruction, new tenure and management arrangements in the woolbelt and wheatbelt. ie: Eastern and Northern Zones of the subregion.

Other Planning Opportunities Including Local Government Planning and National Action Plan for Water Quality and Salinity.

Integration With Property Management Planning, and Catchment Planning.

Impediments or constraints to opportunities

There are a variety of constraints to this these opportunities, such as: lack of funding; agency and community staffing resources; and the community's poorly developed understanding of biodiversity and processes of integrating conservation practises into other forms of land management.

Subregions where specific NRM actions are a priority to pursue

The NRM priority for Eastern and Northern zone of JF1 is (i) (see Appendix C, rank 7), indicating that there are major constraints to NRM, and structural reform is needed owing to extent of past degradation, social and economic disruption. The remainder of JF1 has a rank of (iii) because NRM in place. The overall rank is (iii).

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 1980a, Beard 1974d) is available at a resolution of 1:100000 or 1:250000, whilst the mapping by Matisse and Havel (1998b) 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. Other regional scale vegetation mapping has been completed to support the RFA process.

Community identification based on floristics has been done for most of the bioregion (see Matisse 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.

Sources

References cited

No.	Author	Date	Title	Publication Details	Pub. Type
822	Beard, J.S.	(1974d).	Forrest Map Scale 1:250 000	J.S. Beard	O
075	Beard, J.S.	(1980a).	A new phytogeographic map of Western Australia.	Western Australian Herbarium Research Notes 3, 37-58.	J
126	Burbidge, A.A., and de Tores, P.	(1998).	Western Ringtail Possum (<i>Pseudocheirus occidentalis</i>) Interim Recovery Plan 1997-1999. Interim Recovery Plan No. 17.	Department of Conservation and Land Management, Perth.	R
142	Cale, B.	(2000a).	Carnaby's Black-Cockatoo (<i>Calyptorhynchus latirostris</i>). Draft Recovery Plan Recovery Plan No. //.	Department of Conservation and Land Management.	R
183	Commonwealth and Western Australian Governments	(1999).	Regional Forest Agreement for the south-west forest region of Western Australia between the Commonwealth of Australia & the State of Western Australia.	Government of Western Australia, Perth.	R
184	Commonwealth and Western Australian Regional Forest Agreement Steering Committee	(1998a).	Comprehensive Regional Assessment: A Regional Forest Agreement for Western Australia. Volume 1.	The Committee, Canberra.	R
185	Commonwealth and Western Australian Regional Forest Agreement Steering Committee	(1998b).	Comprehensive Regional Assessment: A Regional Forest Agreement for Western Australia. Volume 2, Maps.	The Committee, Canberra.	R
186	Commonwealth and Western Australian Regional Forest Agreement Steering Committee	(1998c).	Comprehensive Regional Assessment: National estate identification and assessment in the south west forest	A Regional Forest Agreement for Western Australia. The Committee, Canberra.	R

Systematic Vertebrate Survey: Data is not available for approximately 80% of subregion. Invertebrate plots are confined to Noisy Scrub Bird Sites in southern sections of subregion. Fauna data sparse & patchy, limited to SAP quadrats & Operation Foxglove quadrants and roadside cage trap transects associated with Western Shield monitoring. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates. Surveys have also been undertaken on a range of research sites in the region.

Floristic Data: Although regional survey of flora has been completed, it is based on patchy sampling quadrats positioned on widespread surface-types as well as some of the localised substrates of particular interest.

Ecological and Life History Data: There is little 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 predators (foxes, cats), invertebrates and reptiles.

Other Priority Data Gaps Include:

- At present there is some quantitative data on the effect of exotic predators (Operation Foxglove) but no quantitative data on weed colonisation, fragmentation effects, fire, *Phytophthora* sp. impacts on threatened species.
- The effect of salinity/inundation on species composition of communities in the eastern zone of the region is currently being documented.

			region of Western Australia.		
859	Conservation Commission	(2002).	Conservation Commission advice and recommendations to the Minister for Environment and Heritage. A review of high conservation values in Western Australia's south-west forests. 25th March 2002.	Conservation Commission of Western Australia. http://www.conservation.wa.gov.au/files/docs/59.pdf	O
223	Department of Conservation and Land Management	(1987b).	Northern Forest Region Management Plan.	Department of Conservation and Land Management	R
225	Department of Conservation and Land Management	(1994a).	Forest Management Plan 1994 - 2003.	Department of Conservation and Land Management	R
816	Department of Conservation and Land Management	(1998).	Comprehensive Regional Assessment - Maps (Volume 2)	Commonwealth and Western Australian Regional Forest Agreement (RFA) Steering Committee	B

817	Department of Conservation and Land Management and Conservation Commission of Western Australia	(2002).	Forest Management Plan (draft)	Department of Conservation and Land Management and Conservation Commission of Western Australia	B
270	Environmental Protection Authority	(1974).	Conservation Reserves for Western Australia.	Environmental Protection Authority, Perth.	R
766	Evans, R. and English, V.	(1999).	Gingin wax (<i>Chamelaucium</i> sp. Gingin) Interim Recovery Plan 1999-2002 (IRP No 27)	Department of Conservation and Land Management	O
745	Evans, R. and English, V.	(1999).	Green Hill Thomasia (<i>Thomasia</i> sp. Green Hill) Interim Recovery Plan 1999-2002 (IRP No 26)	Department of Conservation and Land Management	O
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
858	Gioia, P. and Pigott, J. P.	(2000).	Biodiversity assessment: a case study in predicting richness from the potential distributions of plant species in the forests of south-western Australia.	Journal of Biogeography 27, 1065-1078	J
767	Hamilton-Brown, S. and English, V.	(1999).	Split-leaved grevillea (<i>Grevillea althoferorum</i>) Interim Recovery Plan 1999-2002 (IRP No 42)	Department of Conservation and Land Management	O
860	Havel, J.J.	(2002).	Review of management options for poorly represented vegetation complexes.	Prepared for Conservation Commission by Mattiske Consulting Pty Ltd. December 2002.	R
857	Hearn, R., Stoneman, G.L., Keighery, G., Burrows, N., Yates, C. and Hopper, S.	(2003).	Advice to the Conservation Commission's Forest Management Plan Steering Committee in Relation to the Management of Significant Flora Values.		R
756	Holland, E., Kershaw, K. and Brown, A.	(1996).	Mogumber bell (<i>Darwinia carnea</i>) Interim Recovery Plan 1996-1999 (IRP No 10) In: Interim recovery plans 4-16 for Western Australian critically endangered plants and animals.	Department of Conservation and Land Management	O
478	Mattiske, E.M., Havel, J.J.	(1997).	Review and integration of floristic classifications in the south-west forest region of Western Australia: a report to the Commonwealth and Western Australian governments for the Western Australian Regional Forest Agreement.	Mattiske Consulting Pty.Ltd. Perth.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
746	Stack, G. and English, V.	(1999).	Rough Emu Bush (<i>Eremophila scaberula</i>) Interim Recovery Plan 1999-2002 (IRP No 28)	Department of Conservation and Land Management	O
828	State Salinity Council of Western Australia	(2000).	Salinity: natural resource management in Western Australia. The salinity strategy Salinity actions: a guide for land managers	State Salinity Council of Western Australia	O
698	Williams, K., Horan, A., Wood, S. and Webb, A.	(2001).	Declared rare and poorly known flora in the Central Forest Region: Western Australian wildlife management program 33.	Department of Conservation and Land Management, Perth.	R

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

Other relevant publications

See reference numbers 098, 181, 221, 222, 225, 258, 351, 452, 480, 573, 614, 647 and 658 in Appendix A.