Pilbara 3 *(PIL3 – Hamersley subregion)*

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Subregional description and biodiversity values

Description and area

PIL3 is the Southern section of the Pilbara Craton. Mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges. The climate is Semi-desert tropical, average 300mm rainfall, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon. Drainage into either the Fortescue (to the north), the Ashburton to the south, or the Robe to the west. Subregional area is 6,215,092ha.

Dominant land use

Dominant land uses are Grazing – (xi) (see Appendix B, key b), UCL and Crown reserves, (ix) native pastures, (xiii) conservation, (vii) mining, (i) urban.

Continental Stress Class

The Continental Stress Class for PIL3 is 6.

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

Rare Features:

- Gorges of Hamersley Range, particularly those of Karijini National Park. Deeply incised gorges, up to 100m deep, containing extensive permanent spring-fed streams and pools. Contain relictual undescribed *Bothriembryon* sp., reptiles (*Lerista zietzi)*, relictual populations of plants are highly likely. Spectacular exposures of banded iron formation, and many waterfalls and gorge features.
- Palm Spring, Duck Creek. Large stand of *Livistona alfredii* palms, growing along Duck Creek in the vicinity of a shallow calcrete aquifer and associated springs. Has a largely undescribed troglofauna associated with the calcrete.
- *Themeda* grasslands of Pilbara Region. Grassland plains dominated by the perennial *Themeda* (kangaroo grass) and many annual herbs and grasses (Hamersley Station grass plain).
- Red Hill Station mulga stands. Very isolated areas of mulga, in the extreme west of the subregion. No other biological information, as these patches have never been examined before.

Short Range Endemics

Generally very little is known about short range endemic invertebrates in the Pilbara.

Wetlands

Centres of Endemism:

- Calcrete deposits of PIL3, for troglofauna. Note that survey of troglofaunas in these localities is so far preliminary. Endemic radiations are however almost certain to be located. Area includes Newman and surrounds, localised aquifers in the Hamersley Range, and Duck Creek.

Refugia:

Note that Morton *et al.* (1995) list only the gorges of the Hamersley Range as refugia in PIL3.

- Gorges of the Hamersley Ranges. Permanent water and protected from fire. Provide refuge sites for humidophiles and fire intolerant species (e.g. *Callitris, Bothriembryon*).
- Calcrete deposits of PIL3, for troglofauna. Note that survey of troglofaunas in these localities is so far preliminary. Endemic radiations are however almost certain to be located. Areas include the Newman area, localised aquifers in the Hamersley Range, Duck Creek.
- Mountain tops of the Hamersley Range. Provide refuge from fire for a large number of restricted flora species. e.g. *Daviesia eremaea, Thysanotus manglesianus*, *Stenanthemum petraeum*, *Eriachne semiciliata*.
- Permanent spring systems, such as Weeli Wolli and Palm Spring (Duck Creek).

High Species and Ecosystem Diversity:

- *Acacia, Triodia, Ptilotus, Corymbia,* and *Sida* species within the Hamersley Range.
- Stygofaunal crustacean fauna within calcrete environments. So far poorly known, but indications are for a significantly diverse fauna.

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

In 1975 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Pilbara (System 8) (Environmental Protection Authority 1975), in the 'Red Book' reports of 1976–1984.These recommendations were reviewed in 1993 (Environmental Protection Authority 1993). Reserve recommendations for PIL3 were concerned with Karijini (then Hamersley Range) National Park. Hamersley Gorge and parts of Juna Downs (via land swaps) were added to the Karijini National Park, although the Dales Gorge area was not added to the park because of mining interests. The recommendation that the Palm Springs area of Duck Creek be examined as a potential reserve resulted in no recommendation for reservation. No other subregional or bioregional planning for biodiversity conservation has been attempted.

Wetlands of National significance (DIWA listings)

Name & Code	Description[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Karijini Gorges, PIL003WA	B17, B2	iv	iv	ii	vi (ruby dock just arrived), xii (recreational visitation has minimal impact)

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

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

Name	Location	Description[1]	Special Values[2]	Condition[3]	Trend[4]	Reliability[5]	Threatening Processes[6]
Weeli Wolli Spring,	80 km NW of Newman, flows northward into the Fortescue Marsh	B2, B17	ii, iii (Large running spring wetlands, with associated stygofauna)	iii	iii-iv	iii	iv (grazing pressure), v (cattle), vi (buffel grass, date palms), xii (possible mining upstream, de-watering; tourism)
Palm Spring, Duck Creek	100 km WNW of Tom Price, flows westward into the Ashburton	B2, B17	ii, iii (Large running spring wetlands, with associated stygofauna. Outlying population of *Livistona alfredii*)	iii	iii-iv	iii	v (cattle), vi (weeds; buffel grass), xii (possible mining upstream, de-watering)
Mount Bruce coolibah claypan	Eastern foot of Mt Bruce, Karijini National Park	B14	ii (Unique community of *E. victrix* over ???)	iii	iv	iii	vi, vii, x (mine dewatering)
Springs and pools of the Robe River.	From 40 km E of Pannawonica, downstream to North West Coastal Highway.	B2, B17	ii (Running spring ecosystems, with large deep permanent pools. Possibly stygofauna in shingle of river bed)	ii	iii-iv	iii	iv (grazing pressure), v (cattle), vi (buffel grass, water fern *Ceratopteris thalictroides*), xii (mining upstream, de-watering discharge)

[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]
Fortescue and Robe Rivers	ii (Buffel grass very common, permanent and semi-permanent pools affected by cattle and feral animals, mining impacts can be locally severe, major potential problems with acid leaching from pyritic shale waste dumps)	iv	ii	iv (grazing pressure, cattle, horse), v (donkey, horse), vi (buffel grass, date palm, water fern, ruby dock), x (mine de-watering; input to systems and drawdown around systems)

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

Ecosystems at risk

Threatened Ecological Communities (TECs)

Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Themeda grasslands of Pilbara Region. Grassland plains dominated by the perennial *Themeda* (kangaroo grass) and many annual herbs and grasses.	V	37, 38	ii - iii	iii	ii	iv, v (stock), vi, vii, 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

Other ecosystems at risk

Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Grove/inter-grove mulga, eastern Hamersley Range	V	23, 24	ii	iii	iii	iv (cattle), v (donkey, horse and cattle), vi (ruby dock), x (water shadow from linear infrastructure)
Valley floor mulga	V	23, 24	ii	iii	iii	iv (cattle), v (donkey, horse and cattle), vi (ruby dock), vii (large fires killing big mulga stands), x (water shadow from linear infrastructure)
Lower-slope mulga	E	23	i	ii	iii	vii (frequent fires preventing regeneration)
Marillana Station dunefields, adjacent to the Hancock Ranges (dunes support some desert fauna elements such as *Ningui ridei* and *Ctenotus quattuordecimlineatus*)		43	Unknown	vi	i	vi (buffel grass), xii (mining infrastructure)
Coolibah Swamp, Mount Bruce, Karijini	V	9	iii	iii-iv	iii	iv (cattle), v (donkey, horse and cattle), vi (ruby

National Park						dock)
Munjina Claypan and associated mulga community	V	36	i	iii	ii	iv (cattle), vii, x (dewatering from mining)
Hill-top floras, Hamersley Range	V	32, 33	iii	iii-iv	iii	vii (frequent fires preventing regeneration, and deliberate burning of buffers)
All major ephemeral water courses	V	4	ii	iii	ii	iv (cattle), v (donkey, horse and cattle), vi (buffel grass, ruby dock)
Wetland community, Weeli Wolli Spring	V	8, 9, 15	iii	iii	ii	iv (cattle), v (donkey, horse and cattle), vi (buffel grass, ruby dock, date palm)
Wetland community, Palm Spring, Duck Creek	V	8, 9, 15	ii	iii	ii	iv (cattle), v (donkey, horse and cattle), vi (buffel grass)
Stygofauna communities, Ore Body 23	-	N/A	iii	vi	iii	x (dewatering from mining)
Other stygofauna associated with aquifers near mining below water table	-	N/A	unknown	vi	ii	x (dewatering from mining)
Lake Robinson-Coondewanna Flats	-		iii	vi	ii	iv, vii, xii (mining infrastructure), x (mine dewatering)
West Angelas Cracking-Clays		43	iii	iii	ii	i, iv
Coolibah-Lignum Flats		43	ii	iii	ii	iv, xii (ground water drawdown)

[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)					
Rhinonicteris aurantius	V	ii	vi	iii	Unknown threatening processes
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)					
Liasis olivaceus barroni	V	iii	iv	iii	Not threatened, or likely to be. Shouldn't be on list, common and widespread
SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)					
Falco peregrinus	SP	iii	iv	ii	Unknown threatening processes
OTHER SPECIES AT RISK WITHIN THE SUBREGION					
Ramphotyphlops gaini	P1	unknown	vi	ii	Unknown threatening processes
Leioptherapon ahenius	P4	iii	vi	ii	Unknown threatening processes
Macroderma gigas	P4	unknown	iv	ii	xii (barb-wire fences)
Pseudomys chapmani	P4	iii	iv	iii	Not threatened, or likely to be.
Sminthopsis longicaudata	P4	unknown	vi	i	v (possibly feral predators - cats)

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

Declared rare and priority flora

Species Name	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
DECLARED RARE FLORA					
Lepidium catapycnon	V	iii	v	iii	No known threatening processes, disturbance specialist
Thryptomene wittweri	V	iii	v	iii	No known threatening processes
PRIORITY 1					
Aluta quadrata	1	Unknown	vi	i	xii (mine expansion; surveys being conducted to find locations of new populations)
Barbula ehrenbergii	1	Unknown	vi	i	Unknown threatening processes
Calotis squamigera	1	Unknown	vi	i	iv
Eucalyptus sp. Marandoo (M Trudgen 10362) aff. *coolibah* var. *rhodoclada*	1	iii	iv	i	No known threatening processes
Goodenia lyrata	1	Unknown	vi	i	iv
Goodenia omearana ms	1	Unknown	vi	i	iv (minimal)
Gunniopsis sp. Fortescue (M Trudgen 11019)	1	Unknown	vi	i	Unknown threatening processes
Josephinia sp. Marandoo (M Trudgen 1554)	1	Unknown	vi	i	Unknown threatening processes
Mimulus clementii	1	Unknown	vi	i	Unknown threatening processes
Ptilotus trichocephalus	1	Unknown	vi	i	Unknown threatening processes
Swainsona sp. Millstream (AA Mitchell PRP 798	1	Unknown	vi	i	Unknown threatening processes
PRIORITY 2					

Acacia daweana	2	Unknown	iv	iii	vii, xii (hybrid plant)
Acacia effusa	2	Unknown	vi	i	Unknown threatening processes
Dampiera metallorum ms	2	Unknown	vi	i	Unknown threatening processes
Dicladanthera glabra	2	Unknown	vi	i	Unknown threatening processes
Gonocarpus ephemerus	2	Unknown	vi	i	Unknown threatening processes
Hibbertia glaberrima	2	Unknown	vi	i	No known threatening processes
Indigofera ixocarpa ms	2	Unknown	vi	i	Unknown threatening processes
Olearia fluvialis	2	Unknown	vi	i	No known threatening processes
Olearia mucronata	2	Unknown	vi	i	No known threatening processes
Ptilotus mollis	2	Unknown	vi	i	xii (mining)
Rostellularia adscendens subsp. *adscendens* var. *latifolia*	2	Unknown	vi	i	Unknown threatening processes
Spartothamnella puberula	2	Unknown	vi	i	Unknown threatening processes
Stylidium weeliwolli	2	Unknown	vi	i	Unknown threatening processes
Thysanotus solitaster ms	2	Unknown	vi	i	Unknown threatening processes
Triodia biflora	2	Unknown	vi	i	Unknown threatening processes

[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	Ecosystem Description	IUCN I-IV	Non-IUCN	CALM-Purchased Lease	Priority
18	Low woodland; mulga (*Acacia aneura*)	123,445.2	3,184.2	0.0	M
29	Sparse low woodland; mulga, discontinuous in scattered groups	21,016.8	1,015.4	0.0	M
82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	260,508.3	6,215.7	0.0	L
93	Hummock grasslands, shrub steppe; kanji over soft spinifex	0.0	0.0	0.0	M
94	Hummock grasslands, shrub steppe; kanji over soft spinifex between sand ridges	0.0	0.0	0.0	H
98	Hummock grasslands, shrub steppe; kanji over soft spinifex & *T. basedowii*	0.0	0.0	0.0	M
103	Hummock grasslands, shrub steppe; snakewood over soft spinifex & *T. wiseana*	12810.1	0.0	20,758.3	L
111	Hummock grasslands, shrub steppe; *Eucalyptus gamophylla* over hard spinifex	80.0	0.0	0.0	H
118	Hummock grasslands, grass steppe; spinifex *Triodia wiseana*, *T. basedowii* & *Triodia bitextura*	0.0	0.0	0.0	M
152	Hummock grasslands, grass steppe; soft & hard spinifex soft spinifex	1222.3	0.0	5,238.7	M
157	Hummock grasslands, grass steppe; hard spinifex *Triodia wiseana*	12,124.6	0.0	0.0	L
158	Hummock grasslands, shrub steppe; kanji over *Triodia basedowii*	11157.7	0.0	17,586.9	L
160	Shrublands; snakewood & *Acacia victoriae* scrub	0.0	0.0	0.0	H
162	Shrublands; snakewood scrub	0.0	0.0	0.0	H
163	Shrublands; eremophila and cassia dwarf scrub	0.0	0.0	0.0	H
169	Shrublands; mulga & minnieritchie scrub	32,426.2	0.0	0.0	L
173	Hummock grasslands, shrub steppe; kanji over soft spinifex & *T. wiseana* on basalt	0.0	0.0	0.0	H
175	Short bunch grassland - savannah/grass plain (Pilbara)	2.4	0.0	0.0	H
178	Hummock grasslands, grass steppe; hard spinifex *Triodia basedowii*	1,946.2	0.0	0.0	M
181	Shrublands; mulga & snakewood scrub	3,488.8	0.0	0.0	M
264	Low woodland; *Acacia victoriae* & snakewood	0.0	0.0	3,444.4	M
565	Hummock grasslands, low tree steppe; bloodwood over soft spinifex	0.0	0.0	0.0	M
567	Hummock grasslands, shrub steppe; mulga & kanji over soft spinifex & *T. basedowii*	189,578.0	1,715.8	0.0	L
568	Hummock grasslands, shrub steppe; mulga & snakewood over *Triodia wiseana*	0.0	0.0	0.0	H
569	Hummock grasslands, low tree steppe; bloodwood over soft spinifex & *T. wiseana*	0.0	0.0	0.0	H
580	Mosaic: Shrublands; eremophila and cassia dwarf scrub/Hummock grasslands, grass steppe; hard spinifex *Triodia wiseana*	0.0	0.0	0.0	H
583	Hummock grasslands, sparse shrub steppe; kanji & Acacia bivenosa over hard spinifex *Triodia basedowii* & *T. wiseana*	108,267.7	0.0	0.0	L
584	Open low woodland; *Eucalyptus* sp. aff. *aspera*	0.0	0.0	0.0	H
585	Mosaic: Shrublands; snakewood & *Acacia victoriae* scrub/Hummock grasslands, shrub-steppe; kanji over soft spinifex & *T. basedowii*	0.4	0.0	0.0	H
600	Sedgeland; sedges with open low tree savannah; *Eucalyptus* sp. aff. *aspera* over various sedges	0.0	0.0	0.0	H

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN	CALM-Purchased Lease	Priority
601	Mosaic: Sedgeland; various sedges with very sparse snakewood/Hummock grasslands, shrub-steppe; kanji over soft spinifex	0.0	0.0	0.0	H
603	Hummock grasslands, sparse shrub steppe; *Acacia bivenosa* over hard spinifex	0.0	0.0	0.0	M
604	Hummock grasslands, shrub steppe; kanji & snakewood over soft spinifex	0.0	0.0	0.0	H
605	Hummock grasslands, shrub steppe; *Acacia pachycarpa* & waterwood over soft spinifex	0.0.	0.0	0.0	H
608	Mosaic: Shrublands; *Acacia victoriae* & snakewood scrub patches/Short bunch grassland - savannah /grass plain (Pilbara)	0.0	0.0	0.0	H
609	Mosaic: Hummock grasslands, open low tree steppe; bloodwood with sparse kanji shrubs over soft spinifex /Hummock grasslands, open low tree steppe; snappy gum over *Triodia wiseana* lateritic crust	0.0	0.0	0.0	H
612	Low woodland; *Eucalyptus* sp. aff. *aspera*	0.0	0.0	0.0	H
620	Hummock grasslands, shrub steppe; snakewood over soft spinifex	0.0	0.0	0.0	M
624	Hummock grasslands, shrub steppe; mulga over soft spinifex & *T. basedowii*	25,559.8	0.0	0.0	L
625	Shrublands; mulga & minnieritchie sparse groups	1,094.6	0.0	0.0	M
629	Mosaic: Short bunch grassland - savannah/grass plain (Pilbara)/Hummock grasslands, grass steppe; hard spinifex *Triodia wiseana*	0.0	0.0	0.0	H
641	Medium woodland; coolibah & river gum	0.0	0.0	0.0	H
644	Hummock grasslands, open low tree steppe; mulga & snakewood over soft spinifex & *T. basedowii*	0.0	0.0	0.0	H
645	Hummock grasslands, shrub steppe; kanji & snakewood over soft spinifex & *T. wiseana*	0.0	0.0	0.0	H
646	Hummock grasslands, shrub steppe; snakewood over *Triodia basedowii*	0.0	0.0	12,626.5	L
674	Hummock grasslands, shrub steppe; bowgada & snakewood over *Triodia basedowii*	0.0	0.0	0.0	H
1162	Hummock grasslands, grass steppe; hard spinifex *Triodia wiseana* & *T. basedowii*	0.0	0.0	0.0	H
1602	Mosaic: Shrublands; snakewood scrub/Hummock grasslands; grass steppe, hard spinifex *Triodia basedowii* & *T. wiseana*	0.0	0.0	0.0	H

Subregional constraints in order of priority

(see Appendix B, key g)

Economic Constraints: In terms of the cost of land acquisition as well as constraints in terms of implementing management. Most land is pastoral lease, and productive systems are of high value.

Competing Land Uses: In particular current and prospective mining interests and pastoral values.

Bioregional and subregional priority for reserve consolidation

PIL has 7.75% of its surface under some form of conservation tenure and therefore has a reservation class of 3 (see Appendix D, and Appendix C, rank 4). Within the bioregion, PIL1 has 6.56% or its area reserved, PIL2 has 0.79%, PIL3 has 14.10%, and PIL4 has 9.56%.

However, there is considerable bias at the subregional level. Higher priority areas for reservation include bunch grass plains and lowland mulga, particularly east of Karijini National Park.

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Reserve management standard

PIL3 contains virtually all of Karijini National Park and part of the Cane River Conservation Park. There are no other areas of conservation estate.

National Park: Reserve Management Rank (iii) (see Appendix C, rank 5). Karijini National Park has a management plan, ongoing weed control, and fire management has been implemented. Eradication of cattle, donkeys, horses is underway.

Conservation Park: Reserve Management Rank (ii). The Eastern half of Cane River Conservation Park is included in the subregion. Managed under Interim Managemen Guidelines. Weed and feral animal control is underway, and limited fire management is done. Biological inventory survey underway and 250 pit traps are installed.

Class	Purpose	Name	Category	Reserve Management[1]
A	Conservation of fauna and flora & Recreation	Karijini National Park	National Park	iii
	Conservation of fauna and flora & Recreation	Cane River Conservation Park	Conservation Park	ii

[1]Appendix C, rank 5

Off reserve conservation

Priority species or groups and existing recovery plans

Species	Threats/Info	Specific Recovery Plans	General Recovery Plans
Rhinonicteris aurantius	No records or other data confirm the presence of this species in PIL3. However, only brief surveys of gorge habitats within Karijini National Park or elsewhere in the Hamersleys have been conducted. It seems likely that this species may be present in PIL3, given that the species occurs in GAS1 and PIL1. Needs further survey.	No	Action Plan for Australian Bats
Sminthopsis longicaudata	No records or other data confirm the presence of this species in PIL3. However, no surveys of suitable habitats within Karijini National Park or elsewhere in the Hamersleys have been conducted. It seems likely that this species may be present in PIL3, given that it occurs in LSD1, GAS3 (???) and GAS1. Needs further survey.	No	Action Plan for Australian Marsupials and Monotremes
Macroderma gigas	Not uncommon; periodic records of individuals being tangled on barbed wire stock fences on stations near Karijini National Park. Few natural maternity roosts known. Removal or modification of fences required.	No	Action Plan for Australian Bats
Pseudomys chapmani	Widespread and abundant in PIL3. Not requiring any further management action	No	Action Plan for Australian Marsupials and Monotremes
Liasis olivaceus barroni	Known mainly from rocky areas, particularly along water courses. It is not threatened, and should not be listed as such. Not requiring any further management action.	No	The Action Plan for Australian Reptiles
Ramphotyphlops gaini	Known from very few collections, Pannawonica area. Not thought to be threatened but requires further survey.	No	The Action Plan for Australian Reptiles
Falco peregrinus	Uncommon resident. Very little data apart from occasional sightings. No information on local PIL3 population.	No	Action Plan for Australian Birds
Leioptherapon ahenius	Present in the Fortescue and Ashburton drainages. Probably not threatened, but requires more survey, and research into tolerance of disturbance from cattle.	No	No
Livistona alfredii	Confined mainly to the Fortescue River valley, mostly near the Millstream aquifer. Also found in Caves Creek (Ashburton drainage), and at Tanberry (Sherlock drainage). Large population present at Millstream (hundreds of thousands of individuals), but are potentially threatened by weeds (date palms).	No	No
Acacia daweana	Little information on this species. Known to occur within Karijini National Park, but wider status and threatening processes are unknown.	No	No
Acacia effusa	Little information on this species. Known to occur within Karijini National Park, but wider status and threatening processes are unknown.	No	No
Aluta quadrata	No data	No	No
Barbula ehrenbergii	Very little information available on this species. Known to occur within PIL3, but status and threatening processes are unknown.	No	No
Calotis squamigera	No data	No	No
Dampiera metallorum ms	Many populations known within Karijini National Park, and outside National Park. Not uncommonly located on Hamersley hilltops (hilltop flora survey). No information on threatening processes, but a downgrading of status to P3 or P4 is warranted.	No	No

Species	Threats/Info	Specific Recovery Plans	General Recovery Plans
Dicladanthera glabra	Several populations known from near Karijini National Park, and several known from close to Karijini National Park. No information on threatening processes or wider status.	No	No
Eucalyptus sp. Marandoo (M Trudgen 10362) aff. *coolibah* var. *rhodoclada*	No data	No	No
Gonocarpus ephemerus	No data	No	No
Goodenia lyrata	No data	No	No
Goodenia omearana ms	No data	No	No
Gunniopsis sp. Fortescue (M Trudgen 11019)	No data	No	No
Hibbertia glaberrima	No data	No	No
Indigofera ixocarpa ms	Several populations known within Karijini National Park, and several outside National Park. No information on threatening processes or wider status.	No	No
Josephinia sp. Marandoo (M Trudgen 1554)	No data	No	No
Lepidium catapycnon	Many populations have been identified in the Hamersley Ranges, mainly as a result work done for the mining industry. DRF status is being reviewed. Populations are known within the Karijini National Park, as well as outside the National Park. Threatening processes are not known, but status is better than once thought.	No	No
Mimulus clementii	No data	No	No
Olearia fluvialis	Very little information on this species. Known to occur within PIL3, but status and threatening processes are unknown.	No	No
Olearia mucronata	Very little information available on this species. Known to occur within PIL3, but status and threatening processes are unknown.	No	No
Ptilotus mollis	Very little information on this species. Known to occur within the Channar mining area (south of Karijini National Park), but status and threatening processes are unknown.	No	No
Ptilotus trichocephalus	No data	No	No
Rostellularia adscendens subsp. *adscendens* var. *latifolia*	No data	No	No
Spartothamnella puberula	No data	No	No
Stylidium weeliwolli	No data	No	No
Swainsona sp. Millstream (AA Mitchell PRP 798).	No data	No	No
Thryptomene wittweri	Very little information on this species. Recorded as occurring close to Karijini National Park (in adjacent pastoral lease), but status and threatening processes in PIL3 are unknown..	No	No
Thysanotus solitaster ms	No data	No	No
Triodia biflora	Very little information on this species. Known to occur within Karijini National Park, but status and threatening processes are unknown.	No	No

Appropriate species recovery actions

Species	Recovery Actions[1]	Recovery Descriptions
Falco peregrinus	xii	Little data on status of Pilbara population. Unlikely that specific recovery actions are required.
Sminthopsis longicaudata	xii	Status of this species in PIL3 is uncertain. More survey work is required, as habitat appears highly suitable.
Macroderma gigas	xii, xiv	Status of population is uncertain. More survey work is required. Barbed wire fences are a known source of mortality.
Pseudomys chapmani	None required	Status of species is secure; widespread and abundant. No further action necessary.
Ramphotyphlops gaini	xii	Poorly known species, needs basic definition of range and status before other actions.
Leioptherapon ahenius	xii	Status of population is uncertain. Needs basic documentation of distribution and abundance, and threatening processes.
Declared Rare and Priority 1 and 2 species including: *Acacia daweana, Acacia effusa, Aluta quadrata, Barbula ehrenbergii, Calotis squamigera, Dampiera metallorum* ms, *Dampiera* sp. Mt Meharry (M Trudgen 1178), *Dicladanthera glabra, Eucalyptus* sp. Marandoo (M Trudgen 10362) aff. *coolibah* var. *rhodoclada, Goodenia lyrata, Goodenia omearana* ms, *Gunniopsis* sp. Fortescue (M Trudgen 11019), *Hibbertia glaberrima, Indigofera ixocarpa, Josephinia* sp Marandoo (M Trudgen 1554), *Lepidium catapycnon, Mimulus clementii, Olearia fluvialis, Olearia mucronata, Ptilotus mollis, Ptilotus trichocephalus, Rostellularia adscendens* subsp. *adscendens* var. *latifolia, Spartothamnella puberula, Stylidium weeliwolli, Swainsona* sp. Millstream (AA Mitchell PRP 798, *Thryptomene wittweri, Thysanotus solitaster* ms, *Triodia biflora.*	xii	Status of species is uncertain. Needs basic documentation of distribution and abundance, and threatening processes.

[1]Appendix B, key h

Ecosystems and existing recovery plans

Ecosystem	Location	Specific Recovery Plans	General Recovery Plans
Themeda grasslands of Pilbara Region. Grassland plains dominated by the perennial *Themeda* (kangaroo grass) and many annual herbs and grasses.	PIL3	No	No
Troglofaunas (stygo- and terrestrial) populations	PIL 1, PIL 2, PIL 3	No	No
Various reptiles (new or restricted) *Ramphotyphlops pilbarensis, Heteronotia planiceps, Ctenotus angusticeps, Lerista zietzi*	Mostly not monitored, and additional collections are needed	No	Action Plan for Australian Reptiles
Grove/inter-grove mulga, eastern Hamersley Range	PIL3	No	No
Valley floor mulga	PIL3	No	No
Lower-slope mulga	PIL3	No	No
Marillana Station dunefields, adjacent to the Hancock Range	PIL3		
Coolibah Swamp, Mount Bruce, Karijini National Park	PIL3	No	No
Munjina Claypan and associated mulga community	PIL3	No	No
Ecosystem	Location	Specific Recovery Plans	General Recovery Plans
Hill-top floras, Hamersley Range	PIL3	No	No
All major ephemeral water courses	PIL3	No	No
Ecosystem	Location	Specific Recovery Plans	General Recovery Plans
Wetland community, Weeli Wolli Spring	PIL3	No	No
Wetland community, Palm Spring, Duck Creek	PIL3	No	No
Stygofauna communities, Ore Body 23	PIL3	No	No
Other stygofauna associated with aquifers near mining below water table	PIL3	No	No
Lake Robinson-Coondewanna Flats	PIL3	No	No

[1]Appendix B, key f; [2]Appendix B, key e

Appropriate ecosystem recovery actions

Ecosystem	Recovery	Recovery Descriptions

	Actions[1]	
Themeda grasslands of Pilbara Region. Grassland plains dominated by the perennial *Themeda* (kangaroo grass) and many annual herbs and grasses.	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Troglofaunas (stygo- and terrestrial) populations	i, ii, iii, viii, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Revegetation of mining areas, particularly waste dumps and decommissioned pits. Reinstatement of hydrology, especially around mining below water table situations in decommissioned pits. Research into species distributions, requirements and threatening processes, particularly troglofaunas.
Various reptiles (new or restricted) *Ramphotyphlops pilbarensis, Heteronotia planiceps, Ctenotus angusticeps, Lerista zietzi*	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Needs basic documentation of distribution and abundance, and threatening processes.
Grove/inter-grove mulga, eastern Hamersley Range	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Valley floor mulga	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Lower-slope mulga	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Marillana Station dunefields, adjacent to the Hancock Range	i, iii, v, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Needs basic documentation of distribution and abundance, and threatening processes.
Coolibah Swamp, Mount Bruce, Karijini National Park	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Munjina Claypan and associated mulga community	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Hill-top floras, Hamersley Range	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.

Ecosystem	Recovery Actions[1]	Recovery Descriptions
All major ephemeral water courses	i, ii, iii, v, vi, vii, ix, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal, especially of date palms, cotton palms, parkinsonia. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Reinstatement of hydrology. Needs basic documentation of distribution and abundance, and threatening processes.
Wetland community, Weeli Wolli Spring	i, ii, iii, v, vi, ix, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal, especially of date palms. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Reinstatement of hydrology. Needs basic documentation of distribution and abundance, and threatening processes.
Wetland community, Palm Spring, Duck Creek	i, ii, iii, v, vi, vii, ix, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal, especially of date palms, cotton palms and parkinsonia. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Reinstatement of hydrology. Needs basic documentation of distribution and abundance, and threatening processes.
Stygofauna communities, Ore Body 23	i, ii, iii, viii, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Revegetation of mining areas, particularly waste dumps and decommissioned pits. Reinstatement of hydrology, especially around mining below water table situations in decommissioned pits. Research into species distributions, requirements and threatening processes, particularly troglofaunas.
Other stygofauna associated with aquifers near mining below water table	i, ii, iii, viii, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Revegetation of mining areas, particularly waste dumps and decommissioned pits. Reinstatement of hydrology, especially around mining below water table situations in decommissioned pits. Research into species distributions, requirements and threatening processes, particularly troglofaunas.
Lake Robinson-Coondewanna Flats	i, ii, iii, v, vi, vii, ix, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Reinstatement of hydrology. Needs basic documentation of distribution and abundance, and threatening processes.

[1]Appendix B, key h

Subregion priority for off reserve conservation

Subregional priority for off park conservation is (iii) (see Appendix C, rank 6), indicating that there are a range of off park measures required.

Conservation actions as an integral part of NRM

Existing NRM actions

Industry Codes of Practice: Particularly within the mining industry.

Threat Abatement Planning: Feral animal control, mainly feral herbivores.

Capacity Building: Revegetation of mining sites and decommissioned mining areas; Land Conservation District Committees are in place for local land-holder liaison.

Other Planning Opportunities: Fire management, especially buffer burning and wildfire suppression. Also some use of patch burning.

Capacity Building: Further capacity building in resource and pastoral industries, particularly possibility for joint or compatible management of pastoral leases owned by mining companies.

Feasible opportunities for NRM

Legislation: Including duty of care for leasehold and other lands, especially pastoral and aboriginal leases, and mining areas.

Institutional Reform: e.g. rural reconstruction, industry reconstruction, new tenure and management arrangements; includes resumption of high quality lands for reservation from existing pastoral leases. Also of concern is the practice of pastoral lease holders (mining companies) offering leased land to third parties (Aboriginal groups) for purposes other than those allowed on the lease, for political advantage.

Threat Abatement Planning as Part of NRM: e.g. pest management; feral herbivore control on pastoral lands.

Industry Codes of Practice: Are potentially powerful, because of the large size and power of the mining companies involved. They have huge resources, and can be a very strong positive influence, particularly when directed appropriately.

Environmental Management Systems: Can be very powerful, as per comments in industry codes of practice above.

Other Planning Opportunities: Including local and State government planning for a CAR conservation reserve system.

Impediments or constraints to opportunities

Lack of funding to acquire lands on open market. Lack of funds to adequately manage our existing estate, and resulting limitations on management of further acquisitions. Impediments exist in operations of the Pastoral Lands Board (need to re-structure un-viable leases after reserve areas are removed). Need to increase awareness of conservation values through education of various industry (particularly mining and pastoral) groups and the public in general. High value conservation areas are held under pastoral leases, and the Department can't afford to purchase them, therefore resumption becomes the only option. Control of feral herbivores and weeds are inadequate, for example there is not currently enough funding to undertake effective control within Karijini National Park.

Subregions where specific NRM actions are a priority to pursue

PIL3 has a NRM priority of (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of production / development system.

Data gaps

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

Vegetation and Regional Ecosystem Mapping: No environmental geology / regolith mapping at better than 1:250 000. No broad-scale soil mapping is available at finer scale than 1:2 000 000 (Bettenay *et al.* 1967).

Quantitative Fauna Survey: Subregional survey has not been undertaken.

Floristic Data: Subregional flora is poorly known, with few intensive studies. Only small areas have been examined in detail by botanists, usually for industrial development. Quadrat-based floristic data is available from relatively few localities.

Ecological and Life History Data: There are few details known on ecological requirements and life histories of virtually all invertebrate species, plants, persisting CWR mammals, uncommon vertebrate and plant species, and ecologically dominant plant species (e.g. hummock grasses). There is little data to provide a regional context on population-trends for even ecologically significant species (e.g. native rodents, dasyurids, spinifex reptile communities, termites, ants, weeds such as buffel grass, kapok bush and ruby dock).

Other Priority Data Gaps Include:

- No quantitative data on the impact of exotic herbivores on aquatic systems, or other communities, especially effects on invertebrate and non-vascular plant communities.
- No quantitative data on the impact of changes to fire regimes in hummock grasslands, particularly upon vertebrate communities, invertebrate communities, and non-vascular plants.
- No quantitative data on the impact of weed colonisation (especially buffel grass) on riverine and other grassland communities, particularly upon recruitment of perennial species, and consequent effects on invertebrate and vertebrate communities.
- Poor understanding of the long term impact of mining below water tables, particularly with respect to leaving flooded voids subject to salination.
- Poor understanding of subregional troglofaunas, particularly stygofaunas associated with palaeo-drainage calcretes.

Sources

References cited

No.	Author	Date	Title	Publication Details	Pub. Type
091	Bettenay, E., Churchward, H.M., McArthur, W.M. and Northcote, K.H.	(1967).	Atlas of Australian Soils. Explanatory data for Sheet 6, Meekatharra - Hamersley Range area. Commonwealth Scientific and Industrial Research Organisation, and Melbourne University Press.	Cambridge University Press, London and New York.	O
181	Cogger, H., Cameron, E., Sadlier, R. and Eggler, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R

258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
278	Environmental Protection Authority	(1993).	Conservation Reserves for Western Australia. Red Book Status Report. EPA Report 15.	Environmental Protection Authority. Perth, Western Australia.	R
273	Environmental Protection Authority	(1975).	Conservation Reserves for Western Australia. Systems 4,8,9,10,11,12..	Environmental Protection Authority. Perth, Western Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	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
519	Morton S.R., Short, J. and Barker, R.D. with an Appendix by Griffin, G.F. and Pearce, G.	(1995).	Refugia for Biological Diversity in Arid and Semi Arid Australia. Biodiversity Series, Paper No 4. Biodiversity Unit.	Department of Environment Sport and Territories. Canberra	R

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

Other relevant publications

See reference numbers 012, 024, 025, 026, 094, 118, 148, 173, 182, 248, 262, 268, 281, 383, 387, 407, 419, 493, 524, 555, 620, 625, 634, 635, 636, 637, 638, 647, 648 and 699 in Appendix A.