Geraldton Sandplains 1 *(GS1 - Edel subregion)*

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Subregional description and biodiversity values

Description and area

The Geraldton Sandplains bioregion comprises mainly proteaceous scrub-heaths, rich in endemics, on the sandy earths of an extensive, undulating, lateritic sandplain mantling Permian to Cretaceous strata. Extensive York Gum and Jam woodlands occur on outwash plains associated drainage. The Edel subregion (GS1) includes parts of the southern Carnarvon Basin (including Dirk Hartog, Bernier and Dorre Islands as well as Edel Land and the northern end of the Geraldton Sandplains (North of Kalbarri)). In terms of its flora and fauna, this is an interzone between the South-western Bioregions of WA and the Carnarvon Bioregion. It is underlain by Phanerozoic sediments and characterised by proteaceous tree-heaths and *Acacia-Casuarina* thickets on pale red Quaternary sand (white sand on the coast). The climate is semi-arid, warm, and Mediterranean and subregion area is 928, 297ha.

Dominant land use

(see Appendix B, key b)

Mainly (ix) Grazing - Native pastures (80.88%), with lesser areas of (xiii) conservation (3.04%), (xi) UCL and Crown reserves (2.81%) and (xiv) lakes and major watercourses (2.52%).

Continental Stress Class

The Continental Stress Class for GS1 is 3.

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

Rare Vertebrates Found in GS1 Are:

- CWR mammals such as Boodie (*Bettongia lesueur*), Rufous Hare-wallaby (*Lagorchestes hirsutus*), Bernier Island Banded Hare-wallaby (*Lagostrophus fasciatus*), Western Barred Bandicoot (*Perameles bougainville*), Shark Bay Mouse (*Pseudomys fieldi*).
- Birds such as the Mallee Fowl (*Leipoa ocellata*), Thick-billed Grass Wren (*Amytornis textilis*), Black and White Fairy Wren (*Malurus leucopterus*), Bernier Island Variegated Fairy-wren (*Malurus lamberti*).
- The frog species Sandhill Frog (*Arenophryne rotunda*) (endemic to the area).

The following ecosystem types have at least 85% of their total extent confined to the Geraldton Sandplains 1 subregion:

Beard Veg Assocs	Vegetation Association Description
099	Hummock grassland; shrub steppe; wattle scrub & heath *Acacia ligulata x rostellifera*
260	Mosaic: Shrublands tree-heath between sandhills; *Banksia ashbyi*, *Grevillea gordoniana*, *Acacia* spp., Melaleuca and mallee/Shrublands; scrub-heath
368	Shrublands tree-heath between sandhills; *Banksia ashbyi*, *Grevillea gordoniana*, *Acacia* spp., Melaleuca and mallee
384	Shrublands; mallee & acacia thicket on ?coastal dunes (central west)
406	Shrublands; acacia, casuarina, *Eucalyptus eudesmioides*, *Banksia ashbyi* & other mixed species thicket
984	Mosaic: Shrublands; acacia & melaleuca scrub/Succulent steppe; saltbush
1100	Hummock grassland; dwarf shrub Steppe; mixed ericoid shrubs & spinifex
1104	Mosaic: Shrublands; scrub-heath/Shrublands; *Acacia rostellifera* & *Melaleuca cardiophylla* thickets
1106	Mosaic: Shrublands; scrub-heath/Shrublands; acacia various species scrub
1107	Open low woodland; *Eucalyptus oraria*
1423	Shrublands; scrub-heath in Shark Bay Area, mainly Acacia spp.
1550	Shrublands; dwarf scrub (Dirk Hartog Island)

Centres of Endemism:

- Reptiles are highly endemic in GS1, particularly the Lerista group of skinks.
- The following reptiles are endemic to the subregion: *Ctenotus alleni, C. zastictus, Lerista axillaries, L. humphriesi, L. kendricki, L. macropisthopus galea, L. maculosa, Menetia amaura.*
- Invertebrate groups such as Mygalomorph spiders and Millipedes.

Refugia:

- Edel Land, Heirisson Prong and Peron Peninsula - refuge for endangered mammals and reptiles from exotic animals.

- Zuytdorp - refuge from land clearing - area of high botanical diversity in transition zone between Eremean and South - west botanical provinces.
- Bernier and Dorre Islands - Island refugia for endangered mammals.

High Species and Ecosystem Diversity:

- Reptiles record high diversity in the area.
- Tree heath on Victoria Sand Plain District at base of Peron Peninsula has high floristic diversity.

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 Geraldton Sandplains (System 5) in the CTRC Green Book (Environmental Protection Authority 1974). In 1976 these recommendations were further developed by the Environmental Protection Authority as the Red Book recommendations Environmental Protection Authority 1976). Some but not all of these recommendations (with modification) were implemented over the following ten years. No other systematic assessment of biodiversity has been undertaken in the subregion.

In 2000 a report on the Biodiversity of the Southern Carnarvon Basin (McKenzie *et al.* 2000) was written and included a paper on reserve system gaps. The State Government's policy statement, Managing the Rangelands, broadly outlines the need to implement a CAR reserve system although no specific areas are targeted for reservation.

Other ecosystems at risk

An unpublished report by Department of Conservation and Land Management - "Gascoyne - Murchison Strategy, Establishment and Management of a Conservation Reserve System" outlines the broad techniques to implement a CAR reserve system but does not target any specific areas. An outline of this report is given in McNamara *et al.* (2000). Although no systematic assessment of biodiversity was undertaken, recommendations on reserve status of the Shark Bay area are included in the Shark Bay Terrestrial Reserves Management Plan (Department of Conservation and Land Management and National Parks and Nature Conservation Authority 2000).

Wetlands

Wetlands of National significance (DIWA listings)

There are no Wetlands of National Significance are recorded in GS1.

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

There are no Wetlands of Subregional Significance are recorded in GS1.

Riparian zone vegetation

There are no riparian areas in GS1.

Ecosystems at risk

Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) listed in GS1.

Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Coastal heath communities at Steep Point (P. Brown pers. comm.)	V	32	iii	iii	i	iv, v (goats), xii (clearance for proposed developments)
Reptile assemblages of islands, gulfs and peninsulas, Shark Bay (Storr and Harold 1990)	V	Various	iii	iii	i	v (cats, foxes, goats), iv, vii

[1]Appendix B, key f; [2]Appendix C, rank ;; [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)					
Perameles bougainville bougainville	E	i	iv	iv	v, viii
Pseudomys fieldi	E	i	iv	iv	v
Bettongia lesueur lesueur	V	i	iv	iv	v
Lagorchestes hirsutus bernieri	V	i	iv	iv	v
Lagorchestes hirsutus dorreae	V	i	iv	iv	v
Lagostrophus fasciatus fasciatus	V	i	iv	iv	v
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)					
Malurus leucopterus leucopterus	E	iii	iii	iii	iv, v (cats), ii
Acanthiza iredalei iredalei	V	i	iv	iii	iv, v (goats, rabbits, foxes, cats), ii
Calamanthus campestris dorrei	V	iii	iv	iii	iv, ii
Calamanthus campestris hartogi	V	iii	iii	iii	iv, v (cats), ii
Leipoa ocellata	V	i	iii	iii	v (foxes, cats), ii, iv
Stipiturus malachurus	V	ii	iii	iii	iv, v (cats), ii
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)					
Caretta caretta	E	i	iii	ii	v (foxes, cats), xi, xii (sand blowouts on Dirk Hartog Island have potential to interfere with nesting sites)
Chelonia mydas	E	ii	iii	ii	v (foxes, cats), xi, xii (sand blowouts on Dirk Hartog Island have potential to interfere with nesting sites)
Dermochelys coriacea	E	i	iii	ii	v (foxes, cats), xi, viii (sand blowouts on Dirk Hartog Island have potential to interfere with nesting sites)
Egernia stokesii badia	V	ii	iii	ii	v (foxes, cats), ii
Egernia stokesii aethiops	V	iii	iv	ii	v (foxes, cats), ii
SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)					
Aspidites ramsayi	SP	i	iii	ii	v (foxes, cats), ii
OTHER SPECIES AT RISK WITHIN THE SUBREGION					
Malurus lamberti	V	ii	iv	iii	iv, v (goats, rabbits, foxes, cats), ii

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

Declared rare and priority flora

Species Name	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
PRIORITY 1					
Beyeria gardneri	1	ii	iii	ii	v (goats), iv
Eremophila cuneata ms	1	ii	iv	iii	xii (mining), v (goats)
Eremophila splendens ms	1	ii	iv	ii	iv
Goodenia berringbinensis	1	iii	iv	ii	v (goats), vi vii
Malleostemon sp. Nerren Nerren (A Payne 360)	1	ii	iii	ii	v (goats), iv, vii, vii
Millotia depauperata	1	ii	iii	ii	iv, v (goats), vi
Prostanthera petrophila	1	iii	iii	ii	v (goats), iv
Ptilotus stirlingii var. *pumilus*	1	ii	iii	ii	iv, i, ii, vi, vii, v (goats), ix
Tetragonia coronata	1	ii	iii	ii	iv, vi, x
Thryptomene sp. Carrarang (ME Trudgen 7420)	1	ii	iii	ii	ii, iv, vii
Thryptomene sp. Steep Point (ME Trudgen 7421)	1	ii	iii	ii	ii, iv, vii
Thryptomene sp. Tamala (ME Trudgen 7384)	1	i	iii	ii	ii, iv, vii
PRIORITY 2					
Abutilon sp. Hamelin (AM Ashby 2196)	2	iii	iv	ii	v (goats), iv, vi

Abutilon sp. Quobba (H Demarz 3858)	2	ii	iii	ii	v (goats), iv, vi
Acacia gelasina	2	ii	iii	ii	v (goats), iv
Acacia subrigida	2	ii	iii	ii	v (goats), iv, vi
Chthonocephalus muellerianus	2	ii	iii	ii	v (goats), iv, vi
Eremophila glabra subsp. *psammophora* ms	2	iii	iv	ii	v (goats), iv, vi
Eremophila occidens ms	2	iii	iv	ii	vii, v (goats)
Lepidium biplicatum	2	iii	iv	ii	v (goats), vi vii, ix
Melaleuca filifolia	2	iii	iii	ii	i, ii, iv, vii, ix, x
Melaleuca huegelii subsp. *pristicensis*	2	iii	iv	ii	iv, v (goats), vii, vi
Olearia occidentissima	2	iii	iv	ii	iv, v (goats), vi
Philotheca kalbarriensis	2	ii	iii	ii	v (goats), iv, i, ii, iv, vii
Ptilotus alexandri	2	iii	iv	ii	v (goats), iv, vii, vi
Rhodanthe oppositifolia subsp. *ornata*	2	ii	iv	ii	iv, v (goats)
Scaevola chrysopogon	2	iii	iii	ii	iv, v (goats), vii
Scaevola paludosa	2	ii	vi	ii	iv, v (goats), vii
Scholtzia sp. Eurardy (JS Beard 6886)	2	ii	vi	ii	iv, v (goats)
Scholtzia sp. Folly Hill (ME Trudgen 12097)	2	ii	vi	ii	v (goats), vii, ii
Sclerolaena stylosa	2	ii	vi	ii	iv, ii, v (goats)
Sondottia glabrata	2	ii	iii	ii	iv, ii, v (goats)
Tricoryne arenicola ms	2	ii	vi	ii	i, ii, iv, vii

[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 Reserve	CALM-Purchased Lease	Priority
17	Shrublands; *Acacia rostellifera* thicket	X	X		H
36	Shrublands; thicket, acacia-casuarina alliance ?species				H
49	Shrublands; mixed heath	X			L
112	Hummock grasslands, shrub steppe; *Acacia ligulata* over *Triodia plurinervata*	X			H
128	Bare areas; rock outcrops		X		L
129	Bare areas; drift sand	X	X		L
246	Hummock grasslands, low tree steppe; *Eucalyptus dongarraensis* & *E. foecunda* over *Triodia plurinervata*				L
260	Mosaic: Shrublands tree-heath between sandhills; *Banksia ashbyi*, *Grevillea gordoniana*, *Acacia* spp., Melaleuca and mallee/Shrublands; scrub-heath	X	X		L
364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine				L
365	Shrublands; bowgada & jam scrub with scattered York gum & red mallee				L
368	Shrublands tree-heath between sandhills; *Banksia ashbyi, Grevillea gordoniana, Acacia* spp., Melaleuca and mallee				H
380	Shrublands; scrub-heath on sandplain	X	X		L
383	Shrublands; *Acacia rostellifera* scrub-heath	X			M
384	Shrublands; mallee & acacia thicket on ?coastal dunes (central west)				H
385	Shrublands; bowgada & jam scrub with scattered York gum				H
387	Shrublands; *Melaleuca cardiophylla* thicket				L

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
401	Mosaic: Shrublands; scrub-heath on coastal association on yellow sandplain/Shrublands; acacia patchy scrub				H
402	Shrublands; heath on coastal limestone	X			L
405	Shrublands; *Acacia sclerosperma*, bowgada & jam scrub				L
406	Shrublands; acacia, casuarina, *Eucalyptus eudesmioides*, *Banksia ashbyi* & other mixed species thicket	X			H
676	Succulent steppe; samphire	X	X		L
984	Mosaic: Shrublands; acacia & melaleuca scrub/Succulent steppe; saltbush	X			H
1099	Hummock grassland; shrub steppe; wattle scrub & heath *Acacia ligulata x rostellifera*	X			H
1100	Hummock grassland; dwarf shrub Steppe; mixed ericoid shrubs & spinifex	X	X		H
1101	Shrublands; *Acacia ligulata x rostellifera* thicket		X		L
1102	Mosaic: Shrublands; mixed heath/Shrublands; acacia patchy scrub				H
1104	Mosaic: Shrublands; scrub-heath/Shrublands; *Acacia rostellifera* & *Melaleuca cardiophylla* thickets				H
1106	Mosaic: Shrublands; scrub-heath/Shrublands; acacia various species scrub	X			H
1107	Open low woodland; *Eucalyptus oraria*				H
1423	Shrublands; scrub-heath in Shark Bay Area, mainly Acacia spp.	X			H
1550	Shrublands; dwarf scrub (Dirk Hartog Island)	X	X		L?
2081	Shrublands; bowgada and associated spp. scrub	X			L
371	*Acacia rostellifera* low forest with scattered *Eucalyptus camaldulensis* on Greenough Alluvia Flats.				H
1100	Coastal heath communities at Steep Point (P. Brown pers. comm.)				H
Various	Reptile assemblages of islands, gulfs and peninsulas, Shark Bay (Storr and Harold 1990)	X			L

L=Low, M=Medium, H=High.

Subregional constraints in order of priority

(see Appendix B, key g)

Competing Land Use: The primary issue in that pastoralism occupies more than 85% of the region.

Economic Constraints: The cost of land and the cost of subsequent management.

Other: Difficulties in identifying biodiversity values in some areas due to lack of resolution of data.

Bioregional and subregional priority for reserve consolidation

GS is reservation Class 4 (see Appendix D, and Appendix C, rank 4) because 10-15% of its area reserved (any tenure). GS1 has 3.04% of the subregion in conservation reserves. GS2 has 13.84% of the subregion in conservation reserves. GS3 has 17.67% of the subregion in conservation reserves. GS2 has been extensively cleared for agricultural purposes leaving a biased reserve system and salinity problems are ubiquitous so Class 1 is more appropriate. Two reserves in the northern extremity of GS2 make up over 88% of the conservation estate. GS3 has also been extensively cleared in the eastern portion of the subregion and has salinity problems however reservation levels are higher and more widely spread over the landscape so Class 2 is more appropriate. GS1 has very little conservation estate however threats are less urgent (mainly relating to stock and feral animals) so Class 2 is more appropriate.

Reserve management standard

Many GS reserves in the agricultural zone are becoming saline or encountering rising water tables; wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks which are installed and maintained except on Zuytdorp Nature Reserve, areas of Beekeepers Nature Reserve and Nature Reserves smaller than 200ha; feral herbivore grazing activities now widespread (e.g. Callicivirus hasn't made a observable difference to rabbit numbers, goats are common in north and east, pigs are undergoing drastic increases in numbers and spread), and feral predator control systems are in place only on Kalbarri, Badgingarra and Nambung National Parks. The Reserve Management rank is i (poor) (see Appendix C, rank 5).

Off reserve conservation

Priority species or groups

Species	Ecosystem	Specific Recovery Plan	General Recovery Plan
Bettongia lesueur lesueur	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath *Acacia ligulata x rostellifera*; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: *Grevillea refracta* & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly *Acacia* spp.	No	The Action Plan for Australian Marsupials and Monotremes
Lagorchestes hirsutus bernieri	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath *Acacia ligulata x rostellifera*; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: *Grevillea refracta* & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly *Acacia* spp.	Yes - RP (Unpublished)	The Action Plan for Australian Marsupials and Monotremes
Lagorchestes hirsutus dorreae	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath *Acacia ligulata x rostellifera*; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: *Grevillea refracta* & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly *Acacia* spp.	Yes - RP (Unpublished)	The Action Plan for Australian Marsupials and Monotremes
Lagostrophus fasciatus fasciatus	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath *Acacia ligulata x rostellifera*; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: *Grevillea refracta* & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly *Acacia* spp.	No	The Action Plan for Australian Marsupials and Monotremes
Perameles bougainville bougainville	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath *Acacia ligulata x rostellifera*; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: *Grevillea refracta* & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly *Acacia* spp.	Yes – IRP (Unpublished)	The Action Plan for Australian Marsupials and Monotremes
Pseudomys fieldi	1100 - Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex	Djoongari (Shark Bay Mouse) Recovery Plan	The Action Plan for Australian Rodents
Leipoa ocellata	17 – Shrublands: *Acacia rostellifera* thicket; 260 – Mosaic: Shrublands tree heaths between sandhills. *Banksia ashbyi, Grevillea gordoniana, Acacia* spp., Melaleuca and mallee/shrublands. Scrub heath; 246 – Hummock grasslands, low tree steppe; *Eucalyptus dongarraensis* & *E. foecunda* over *Triodia plurinervata*; , 365 – Shrublands: bowgada & jam scrub with scattered York gum & red mallee; 368 – Shrublands tree-heath between sandhills: *Banksia ashbyi, Grevillea gordoniana, Acacia* spp., Melaleuca and mallee.	Recovery Plan for Mallee Fowl	The Action plan for Australian Birds
Acanthiza iredalei iredalei	676 – Succulent Steppe: samphire; 984 – Mosaic: Shrublands, acacia & melaleuca scrub/Succulent steppe, saltbush.	No	The Action plan for Australian Birds

Species	Ecosystem	Specific Recovery Plan	General Recovery Plan
Malurus lamberti	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath *Acacia ligulata x rostellifera*; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: *Grevillea refracta* & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly *Acacia* spp.; 1550 – Shrublands: dwarf scrub (Dirk Hartog Island).	The Action plan for Australian Birds including a Coordinated Conservation Plan for the Shark Bay area.	The Action plan for Australian Birds
Stipiturus malachurus	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath *Acacia ligulata x rostellifera*; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: *Grevillea refracta* & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly *Acacia* spp.; 1550 – Shrublands: dwarf scrub (Dirk Hartog Island).	The Action plan for Australian Birds including a Coordinated Conservation Plan for the Shark Bay area.	The Action plan for Australian Birds
Calamanthus campestris dorrei	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath *Acacia ligulata x rostellifera*; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: *Grevillea refracta* & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly *Acacia spp*.; 1550 – Shrublands: dwarf scrub (Dirk Hartog Island).	The Action plan for Australian Birds including a Coordinated Conservation Plan for the Shark Bay area.	The Action plan for Australian Birds
Calamanthus campestris hartogi	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath *Acacia ligulata x rostellifera*; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: *Grevillea refracta* & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly *Acacia* spp.; 1550 – Shrublands: dwarf scrub (Dirk Hartog Island).	The Action plan for Australian Birds including a Coordinated Conservation Plan for the Shark Bay area.	The Action plan for Australian Birds
Malurus leucopterus leucopterus	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath *Acacia ligulata x rostellifera*; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: *Grevillea refracta* & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly *Acacia* spp.; 1550 – Shrublands: dwarf scrub (Dirk Hartog Island).	The Action plan for Australian Birds including a Coordinated Conservation Plan for the Shark Bay area.	The Action plan for Australian Birds
Caretta caretta	Beaches for breeding	No	The Action Plan for Australian Reptiles
Chelonia mydas	Beaches for breeding	No	The Action Plan for Australian Reptiles
Dermochelys coriacea	Beaches for breeding	No	The Action Plan for Australian Reptiles
Egernia stokesii badia	205 – Shrublands; Acacia sclerosperma & bowgada scrub; 243 – Shrublands: bowgada & minnieritchie scrub; 365 - Shrublands: bowgada & jam scrub with scattered York gum & red mallee.	No	The Action Plan for Australian Reptiles
Egernia stokesii aethiops	205 – Shrublands; Acacia sclerosperma & bowgada scrub; 243 – Shrublands: bowgada & minnieritchie scrub; 365 - Shrublands: bowgada & jam scrub with scattered York gum & red mallee.	No	The Action Plan for Australian Reptiles
Aspidites ramsayi	112 – Hummock grasslands, shrub steppe: *Acacia ligulata* over *Triodia plurinervata*; 205 – Shrublands: *Acacia sclerosperma* & bowgada scrub; 243 - Shrublands: bowgada & minnieritchie scrub; 246 – Hummock grasslands, low tree steppe: *Eucalyptus dongarraensis* & *E. foecunda* over *Triodia plurinervata*; 365 - Shrublands: bowgada & jam scrub with scattered York gum & red mallee; 401 – Mosaic: Shrublands, scrub-heath on coastal association on yellow sandplain/Shrublands, acacia patchy scrub.	No	The Action Plan for Australian Reptiles
Species	Ecosystem	Specific Recovery Plan	General Recovery Plan
Threatened flora of GS1	Various	No recovery plan exist for threatened flora in the GS1 subregion. Although no Endangered flora occurs further research into the status of vulnerable species and management requirement is needed.	Declared Rare and Poorly Known Flora in the Geraldton District

Appropriate species recovery actions

Species	Recovery Actions[1]	Recovery Descriptions
Bettongia lesueur lesueur	i, ii, iii, vii, x, ix	Monitoring of existing populations. Where control of feral predators has been achieved and suitable habitat occurs, reintroduction to create new mainland populations. Protection from wildfire.
Lagorchestes hirsutus bernieri	i, ii, iii, vii, x, ix	Monitoring of existing populations. Where control of feral predators has been achieved and

		suitable habitat occurs reintroduction to create new mainland populations. Protection from wildfire.
Lagorchestes hirsutus dorreae	i, ii, iii, vii, x, ix	Monitoring of existing populations. Where control of feral predators has been achieved and suitable habitat occurs reintroduction to create new mainland populations. Protection from wildfire.
Lagostrophus fasciatus fasciatus	xii, ix	Monitoring of existing population. Protection from threats such as wildfire.
Perameles bougainville bougainville	xii, vii, x, ix	Monitoring of existing populations. Where control of feral predators has been achieved and suitable habitat occurs reintroduction to create new mainland populations. Protection from wildfire.
Pseudomys fieldi	xii, vii, x, ix	Monitoring of existing populations. Where control of feral predators has been achieved and suitable habitat occurs, reintroduction to create new mainland populations. Fire management.
Leipoa ocellata	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of feral predators and herbivores (goats) required. Reduction of grazing intensity may be required. Fire management.
Acanthiza iredalei iredalei	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
Malurus lamberti	vii, xii	Control of herbivores such as rabbits and goats may be required. Monitoring of existing populations.
Stipiturus malachurus	xii, ix	Monitoring of existing population. Protection from threats such as wildfire.
Calamanthus campestris dorrei	xii, ix	Monitoring of existing population. Protection from threats such as wildfire.
Calamanthus campestris hartogi	xii, ix	Monitoring of existing population. Protection from threats such as wildfire.
Malurus leucopterus leucopterus	xii, ix	Monitoring of existing population. Protection from threats such as wildfire.
Caretta caretta	i, vii, xii, xiii	Protection of breeding sites. Control of feral predators of eggs etc (primarily foxes). Monitoring of populations and research into threats. Education of boat operators, ecotourism operators and general public
Chelonia mydas	i, vii, xii, xiii	Protection of breeding sites. Control of feral predators of eggs etc (primarily foxes). Monitoring of populations and research into threats. Education of boat operators, ecotourism operators and general public
Dermochelys coriacea	i, vii, xii, xiii	Protection of breeding sites. Control of feral predators of eggs etc (primarily foxes). Monitoring of populations and research into threats. Education of boat operators, ecotourism operators and general public
Egernia stokesii badia	xii, ix, i, x	Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands. Reintroduction to previous areas of habitat.
Egernia stokesii aethiops	vii, xii, ix, i	Control of feral predators such as foxes and cats. Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands.
Aspidites ramsayi	vii, xii, ix, i	Control of feral predators such as foxes and cats. Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands. Reintroduction to previous areas of habitat.
Abutilon sp. Hamelin (AM Ashby 2196)	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
Species	Recovery Actions[1]	Recovery Descriptions
Abutilon sp. Quobba (H Demarz 3858)	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
Acacia gelasina	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
Acacia subrigida	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
Beyeria gardneri	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
Chthonocephalus muellerianus	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
Eremophila cuneata ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
Eremophila glabra subsp. *psammophora* ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
Eremophila occidens ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
Eremophila splendens ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
Goodenia berringbinensis	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
Lepidium biplicatum	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Malleostemon sp. Nerren Nerren (A	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire

Payne 360)		as well as the species general biology.
Melaleuca filifolia	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Melaleuca huegelii subsp. *pristicensis*	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Millotia depauperata	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Olearia occidentissima	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
Philotheca kalbarriensis	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
Prostanthera petrophila	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Ptilotus alexandri	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions[1]	Recovery Descriptions
Ptilotus stirlingii var. *pumilus*	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Rhodanthe oppositifolia subsp. *ornata*	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Scaevola chrysopogon	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Scaevola paludosa	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Scholtzia sp. Eurardy (JS Beard 6886)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Scholtzia sp. Folly Hill (ME Trudgen 12097)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Sclerolaena stylosa	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Sondottia glabrata	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Tetragonia coronata	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
Thryptomene sp. Carrarang (ME Trudgen 7420)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Thryptomene sp. Steep Point (ME Trudgen 7421)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Thryptomene sp. Tamala (ME Trudgen 7384)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
Tricoryne arenicola ms	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.

[1]Appendix B, key h.

Existing species recovery plans

A coordinated conservation plan for threatened birds of the Shark Bay area was published in The Action Plan for Australian Birds (Garnett and Crowley 2000). Other Recovery Plans include: National Recovery Plan for Malleefowl (Benshemesh 2000), The Action Plan for Australian Rodents (Lee 1995), Action Plan for Australian Marsupials and Monotremes (Maxwell *et al.* 1996), and The Action Plan for Australian Reptiles (Cogger et al. 1993).

Ecosystems and existing recovery plans

One of the Ecosystems at risk (Coastal heath communities at Steep Point) is not currently held on CALM estate and is a high priority to be reserved. There are no recovery plans for ecosystems at risk or vegetation associations at risk.

Community	Specific Recovery Plan	General Recovery Plan
Coastal heath communities at Steep Point (P. Brown pers. comm.)	No	No
Reptile assemblages of islands, gulfs and peninsulas, Shark Bay (Storr and Harold 1990)	No	No

Appropriate ecosystem recovery actions

Community	Recovery Actions[1]	Recovery Descriptions
Coastal heath communities at Steep Point (P. Brown pers. comm.)	i, iii, vii, v, vi	Habitat protection through reserves and on other state lands (currently not held on CALM estate and a high priority to reserve). Feral animal control, especially goats and foxes. Fencing as exclosures where there are heavy goat numbers. Weed control.
Reptile assemblages of islands, gulfs and peninsulas, Shark Bay (Storr and Harold 1990)	i, iii, vii, v, vi	Habitat protection through reserves and on other state lands. Feral animal control, especially goats and foxes. Fencing as exclosures where there are heavy goat numbers. Weed control.

[1]Appendix B, key h.

Subregion priority for off reserve conservation

The priority for off-park conservation in GS1 is rank (ii) – large off-park effort required (see Appendix C, rank 6).

Conservation actions as an integral part of NRM

Existing NRM actions

Institutional Reform: Through the Gascoyne Murchison Strategy; purchase of leases for conservation estate.

Threat Abatement Planning: Vegetation management plans, pest management.

Industry Codes of Practice: Particularly in relation to pastoral, mining and exploration activities.

Environmental Management Systems

Integration with Property Management Planning, Catchment Planning and Landcare: Through Land Care District committees in the region.

Feasible opportunities for NRM

Legislation: Including duty of care for leasehold and other lands.

Institutional Reform: Rural reconstruction, industry reconstruction, new tenure and management arrangements.

Other Planning Opportunities: Including local government planning and National Action Plan for Water Quality and Salinity.

Environmental Management Systems: Some pastoral areas are attempting to identify and implement ecologically sustainable practices through the EMU process developed by the Rangelands Environmental Management Program of GMS. Requires a greater level of support to be successful.

Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board. Both the act and the Pastoral Land Board have requirements of Pastoral Leases that may not be consistent with conservation. CTR is somewhat limited by the presence of a small number of mining leases and tenements. There is a need to increase awareness of conservation values through education of major industries (mining, agricultural) and the public in general. Limited financial resources are also a major constraint.

Subregions where specific NRM actions are a priority to pursue

GS1 has a rank of (i) (see Appendix C, rank 7), which indicates there are major constraints to implement effective NRM actions to achieve biodiversity outcomes. Much of GS is degraded through past agricultural practices (primarily sheep grazing) and feral herbivores. Under the pastoral lands act leases are still required to maintain certain stock levels that do not necessarily fit with conservation values. Pastoral Industry reform is essential to achieve desired conservation outcomes.

Data gaps

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

Vegetation and Regional Ecosystem Mapping: No regolith mapping is available. Beards vegetation systems are at a map resolution of 1:250 000 at best. Department of Agriculture land system mapping has been conducted on a scale of 1:250 000.

Systematic Fauna Survey: Data is confined to vertebrates (but not birds) and selected invertebrate taxa, is sparse (ca. 6 terrestrial quadrats and 4 wetland quadrats across subregion), quadrats only positioned on 4 of the most widespread surface-types, and only 1-2 quadrats per surface-type, few quadrats have been sampled on more than two occasions. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates.

Floristic Data: Although regional survey of flora has been completed, it is based on very sparse sampling (about 70 quadrats across subregion), quadrats positioned on 10 most widespread surface-types.

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 is no data to provide a regional context on life-history (including population-trend) of most species, including rabbits, cat, fox and CWR mammals.

Other Data Gaps Include: There is little quantitative data on the affect of exotic predators, no quantitative data on the affect of weed colonisation, fragmentation, fire, introduced herbivores

Sources

References cited

No.	Author	Date	Title	Publication Details	Pub. Type
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
181	Cogger, H., Cameron, E., Sadlier, R. and Eggler, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
254	Department of Conservation and Land Management and National Parks and Nature Conservation Authority	(2000).	Shark Bay Terrestrial Reserves Management Plan 2000-2009, Management Plan No. 45.	Department of Conservation and Land Management.	R
274	Environmental Protection Authority	(1976).	Conservation Reserves for Western Australia. Systems 1,2,3,4.	Environment Protection Authority, Perth.	R
270	Environmental Protection Authority	(1974).	Conservation Reserves for Western Australia.	Environmental Protection Authority, Perth.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
452	Lee, A.K.	(1995).	The Action Plan for Australian Rodents	Environment Australia - Biodiversity Group, Threatened Species and Communities Section	B
761	Lundie-Jenkins, G. and Moore, G.	(1996).	Unpublished Recovery Plan for the Mala (*Lagorchestes hirsutus*)	Parks and Wildlife Commission of the Northern Territory	O
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
710	McKenzie, N.L., Halse, S.A. and Gibson, N.	(2000).	Some gaps in the reserve system of the southern Carnarvon Basin, Western Australia.	Records of the Western Australian Museum Supplement No. 61: 511-546.	R
498	McNamara, P., Brandis, T and Hopkins, A.	(2000).	Filling the gaps.	Landscope. 15 (4) 43 - 49.	J
513	Morris, K., Speldewinde, P. and Orell, P.	(2000).	Djoongari (Shark Bay Mouse) Recovery Plan.	Department of Conservation and Land Management.	R
537	Patrick, S.J.	(2001).	Declared Rare and Poorly Known Flora in the Geraldton District. Wildlife Management Program No. 26.	Department of Conservation and Land Management.	R
600	Short, J.	(1995).	Interim Recovery Plan for the Western Barred Bandicoot (*Perameles bougainville*) (unpublished).		R
631	Storr, G.M. and Harold, G.	(1990).	Amphibians and reptiles of the Shark Bay area, Western Australia. In Research in Shark Bay (Eds) P.F. Berry, S.D. Bradshaw, B.R. Wilson.	Western Australian Museum, Perth.	B

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

Other Relevant Publications

See reference numbers 026, 047, 065, 066, 075, 094, 097, 101, 114, 117, 118, 137, 177, 241, 253, 267, 268, 272, 273, 277, 278, 299, 372, 387, 405, 406, 419, 425, 429, 450, 459, 708, 505, 506, 519, 526, 540, 584, 603, 630, 646 and 647 in Appendix A.