Gascoyne 3 *(GAS3 – Augustus subregion)*

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Subregional description and biodiversity values

Description and area

Rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys. Also includes the Narryera Complex and Bryah Basin of the Proterozoic Capricorn Orogen (on northern margin of the Yilgarn Craton), as well as the Archaean Marymia and Sylvania Inliers. Although the Gascoyne River System provides the main drainage of this subregion, it is also the headwaters of the Ashburton and Fortescue Rivers. There are extensive areas of alluvial valley-fill deposits. Mulga woodland with *Triodia* occur on shallow stony loams on rises, while the shallow earthy loams over hardpan on the plains are covered by Mulga parkland. A desert climate with bimodal rainfall. The subregional area for GAS3 is 10,687,739ha.

Dominant land use

(see Appendix B, key b)

Mainly (ix) native pasture grazing (84.2%), with lesser areas of (xi) UCL and Crown Reserves (9.76%), (x) Aboriginal reserves (3.37%) and (xiii) conservation - the majority of conservation estate in the subregion falls outside the IUCN I-IV categories (2.5%).

Continental Stress Class

The Continental Stress Class for GAS3 is 3.

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

Rare Features:

- Stygofauna of the calcrete aquifers of the Carnegie drainage that appear to be short range endemics. Our understanding of biogeography for these groups is very limited but work by Humphries (2001) suggests that there is significant stygofauna in the Carnegie drainage.
- Rare species for the subregion include, *Leipoa ocellata* (Mallee Fowl), *Polytelis alexandrae* (Alexandra's Parrot), *Dasycercus cristicauda* (Mulgara), and *Ctenophorus yinnietharra*.

Ecosystem Types Have at Least 85% of Their Total Extent Confined to The Gascoyne 3 Subregion:

Beard Veg Assoc	Description
21	Low woodland; waterwood
161	Hummock grasslands, low open tree & shrub steppe; scattered eucalypts, *Acacia pachycarpa* over *Triodia basedowii*
167	Shrublands; *Acacia victoriae* & snakewood open scrub
183	Low woodland; mulga, *Acacia victoriae* & snakewood
207	Hummock grasslands, shrub steppe; red mallee over hard spinifex
216	Low woodland; mulga (?with spinifex) on rises
222	Sparse low woodland; mulga & *Acacia victoriae* in scattered groups
225	Shrublands; snakewood & minnieritchie scrub
262	Shrublands; acacia & other spp on Mt Augustus
285	Mosaic: Shrublands; *Acacia victoriae* & snakewood scrub patches/Scattered groups of succulents

Centres of Endemism:

- *Eremophila* spp. on Landor Station.
- *Ctenophorus yinnietharra*, granites on Yinnietharra Station.
- *Lerista stictopleura* around base of Mount Augustus.
- Troglobitic communities in calcrete aquifers associated with palaeo-drainage lines.

Refugia:

Morton *et al.* (1995) do not list any refugia in GAS3, but potential for freshwater pools to be described as refugia for species requiring more mesic conditions. Hills may provide refuge from fire (e.g. Mount Augustus).

High Species or Ecosystem Diversity:

- Eremophila spp. on Landor Station.
- *Lerista* throughout GAS in general.

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 Pilbara Region (System 8) in the CTRC Green Book, which encompasses this subregion (Environmental Protection Authority 1974). The Collier Range National Park was established as a result.

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. 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 the article Filling the Gaps (McNamara *et al.* 2000).

Wetlands

Wetlands of National significance (DIWA listings)

There are no Wetlands of National Significance in GAS3.

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

Name and Code	Location	Description[1]	Special Values[2]	Condition[3]	Trend[4]	Reliability[5]	Threatening Processes[6]
Edithana Pool	24° 07' 25"S, 116° 29' 32"E	B5	iii	iii	iii	ii	iv (cattle), v (Tilapia, goats)
Cattle Pool	24° 17' 01"S, 116° 49' 33"E	B5	iii, v	iii	iii	ii	iv (cattle), v (Tilapia, goats)
Mibbley Pool	24° 58' 38"S, 118° 13' 43"E	B5	iii, v	iii	iii	ii	iv (cattle), v (goats)
Erong Springs	25° 28' 44"S, 116° 52' 36"E	B5	iii, v	iii	iii	ii	iv (cattle), v (goats)

[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 and Code	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
Gascoyne Rivers	i	iii	ii	iv, v (foxes, rabbits & goats), vi (Buffel grass, Athel Pine), x (increased flow), vii
Lyons Rivers	i	iii	ii	iv, v (foxes, rabbits & goats), vi (Buffel grass, Athel Pine), x (increased flow), vii

[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)

There are no Threatened Ecological Communities (TECs) in GAS3.

Other ecosystems at risk

Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Invertebrate assemblages of Edithana Pool (-240725S, 1162932E) High quality river pool on the Lyons River. High invertebrate diversity. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	V	NA	iii	iv	ii	iv (cattle), v (Tilapia, goats)
Invertebrate assemblages of Cattle Pool (-241701S, 1164933E). High quality river pool on the Lyons River adjacent to Mt Augustus National Park. High invertebrate diversity. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	V	NA	iii	iv	ii	iv (cattle), v (Tilapia, goats)

Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Invertebrate assemblages of Yinnietharra Cattle Pool (-243627S, 1160303E). Permanent freshwater pool on the middle Gascoyne. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	V	NA	Unknown	vi	ii	iv (cattle), v (goats)
Invertebrate assemblages of Mibbley pool (-245838, 1181343). Large relatively undisturbed freshwater pool on the upper Gascoyne River (therefore unusual). Until recently protected from stock by thick riparian vegetation. Shire has recently cleared a track to the pool which has allowed stock access (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	V	NA	iv	iii	ii	iv (cattle), v (goats)
Invertebrate assemblages of Erong Springs (-252844, 1165236). High aquatic invertebrate diversity site in the Gascoyne area. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	V	NA	iii	iv	ii	iv (cattle), v (goats)
Vegetation communities dominated by Eremophila species. Landor Station, North of racetrack. 26 *Eremophila* species in this area, one undescribed *Eremophila* occurs in a unique community (A.Brown pers. comm.).	V	32	Unknown	vi	ii	iv (sheep and cattle), v (goats)
Plant assemblages of Robinson Range. Has populations of DRFs (*Pityrodia augustensis*) and several endemic *Eremophila*. Includes Mt Fraser and higher peaks. Is currently in very good condition but potentially subject to mining (A.Brown pers comm.).	V	32	iv	vi	i	xii (mining and exploration), v (sheep and cattle), v (goats)
Jeeaila River Downs vegetation complexes. East of Mount Augustus (proposed Nature Reserve) (B.Barton pers. comm.).	V		Unknown	vi	ii	v (sheep and cattle), v (goats)
Mulga short grass-forb association of non-saline tributary drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	V	19	Variable	iii	ii	v (sheep and cattle), v (goats), vii
Stony short grass-forb association of the undulating terrain of the Gascoyne catchment (Wilcox and McKinnon 1992)	V	37	Variable	iii	ii	v (sheep and cattle), v (goats)
Stony chenopod association of strew covered drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	V	31	Variable	iii	ii	v (sheep and cattle), v (goats)
Chenopod association of tributaries and major drainage lines of the Gascoyne catchment (Wilcox and McKinnon 1992)	V	31	Variable	vi	ii	v (sheep and cattle), v (goats)
Wanderrie association on sandy alluvial drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	V	37	Variable	vi	ii	v (sheep and cattle), v (goats), vii
Plant assemblages of high diversity landscapes and unusual landforms being studied for the Ecological Management Unit, Gascoyne-Murchison Strategy e.g. Mt Arapiles (Milgun)	V		Unknown	vi	ii	v (sheep and cattle), v (goats)
Stygofauna of the Carnegie Drainage system (Humphries)	V	N/A	Unknown	vi	ii	xi, x (siltation etc of catchment areas)
Critical Weight Range Mammals such as *Macrotis lagotis, Dasycercus crassicaudata, Dasyurids.*	V	N/A	ii	vi	ii	v (foxes, cats), vii
Chenopod community of Weelarana Station. Heavily grazed and trampled by cattle, camel, and rabbits. (Stephen van Leeuwen, pers comm.).	V	31	ii	iii	i	iv, v (camel, rabbits)
Clay pan dominated by *Nymphoides indica*. One occurrence, located 70 km south of Newman. Others probably occur, and are also threatened by grazing.	V	38	iii	iii	i	iv, v (rabbits, goats)
Eucalyptus ferriticola over trees on drainage lines in Gascoyne e.g. Doolgunna Station (K.Tinley pers. comm.)	V	8	ii	iv	i	No known threatening processes

[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)					
Macrotis lagotis	V	i	iii	iii	v (foxes), vii
Dasycercus cristicauda	V	ii	iii	iii	v (foxes, cats), vii
Schedule 1; Rare/likely to become extinct, Div 2 (Birds)					
Polytelis alexandrae	V	i	iii	iii	vii
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)					
Ctenophorus yinnietharra	V	iii	iv	ii	v (foxes, cats), vii
SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)					
Falco peregrinus	SP	iii	iv	ii	ii
OTHER SPECIES AT RISK WITHIN THE SUBREGION					
Acanthiza iredalei iredalei	Commonwealth	iii	iii	ii	vii

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

Declared rare and priority flora

Species Name	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
DECLARED RARE FLORA					
Pityrodia augustensis	V	unknown	vi	ii	v (goats), iv, vii
PRIORITY 1					
Acacia wilcoxii	1	unknown	vi	ii	v (goats), iv, vi
Eremophila arguta ms	1	unknown	vi	ii	v (goats), iv, vi
Eremophila flaccida subsp. *attenuata* ms	1	unknown	vi	ii	v (goats), iv, vi
Eremophila gracillima ms	1	unknown	vi	ii	iv, v (goats), vi, vii
Eremophila lanata ms	1	unknown	vi	ii	iv, v (goats), vi, vii
Eremophila micrantha ms	1	unknown	vi	ii	iv, v (goats), vi, vii
Eremophila prolata ms	1	unknown	vi	ii	iv, v (goats), vi, vii
Eremophila rigida ms	1	unknown	vi	ii	iv, v (goats), vi, vii
Goodenia berringbinensis	1	unknown	vi	ii	v (goats), vi, vii
Hemigenia sp. Glenburgh (RJ Cranfield 9725)	1	unknown	vi	ii	v (goats), iv, vi, vii
Homalocalyx chapmanii	1	unknown	vi	ii	v (goats), iv, vi, vii
Ptilotus astrolasius var. *luteolus*	1	unknown	vi	ii	iv, v (goats), vii, vi
Ptilotus lazaridis	1	unknown	vi	ii	iv, v (goats), x
Ptilotus trichocephalus	1	unknown	vi	ii	iv, v (goats)
Rhodanthe sphaerocephala	1	unknown	vi	ii	iv, v (goats), vii, vi
PRIORITY 2					
Gonocarpus ephemerus	2	unknown	vi	ii	v, vi, vii
Rhodanthe frenchii	2	unknown	vi	ii	iv, v (goats), x
Stylidium weeliwolli	2	unknown	vi	ii	iv, vi

[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 Code	Ecosystem Description	IUCN I-IV	Non-IUCN	CALM-Purchased Lease	Priority
11	Medium woodland; coolibah (*E. microtheca*)				M
18	Low woodland; mulga (*Acacia aneura*)	X			M
21	Low woodland; waterwood				H
28	Open low woodland; mulga				H
29	Sparse low woodland; mulga, discontinuous in scattered groups	X		X	H
39	Shrublands; mulga scrub	X		X	M
82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*				L
107	Hummock grasslands, shrub steppe; mulga and *Eucalyptus kingsmillii* over hard spinifex				L
111	Hummock grasslands, shrub steppe; *Eucalyptus gamophylla* over hard spinifex	X			M
117	Hummock grasslands, grass steppe; soft spinifex				L
125	Bare areas; salt lakes				L
128	Bare areas; rock outcrops				L
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills				L
157	Hummock grasslands, grass steppe; hard spinifex *Triodia wiseana*				L
160	Shrublands; snakewood & *Acacia victoriae* scrub			X	M
161	Hummock grasslands, low open tree & shrub steppe; scattered eucalypts, *Acacia pachycarpa* over *Triodia basedowii*				H
162	Shrublands; snakewood scrub				L
163	Shrublands; eremophila and cassia dwarf scrub			X	H
165	Low woodland; mulga & snakewood (*A. eremaea*)			X	H
166	Low woodland; mulga & *Acacia victoriae*	X		X	H
167	Shrublands; *Acacia victoriae* & snakewood open scrub				H
168	Shrublands; mulga, *Acacia victoriae* & snakewood scrub				H
169	Shrublands; mulga & minnieritchie scrub				H
175	Short bunch grassland - savannah/grass plain (Pilbara)				L
178	Hummock grasslands, grass steppe; hard spinifex *Triodia basedowii*				L
181	Shrublands; mulga & snakewood scrub			X	L
182	Low woodland; mulga & bowgada (*A. ramulosa*)	X		X	M
183	Low woodland; mulga, *Acacia victoriae* & snakewood				L
184	Shrublands; mulga & bowgada scrub				H
185	Sedgeland; sedges with medium woodland; sedges with coolibah over various sedges				L
186	Shrublands; *Acacia sclerosperma* & *A. victoriae* open scrub				H
197	Sedgeland; sedges with scattered medium trees; coolibah over various sedges & forbes				H
199	Hummock grasslands, shrub steppe; mulga over soft spinifex Triodia on rises				H
202	Shrublands; mulga & *Acacia quadrimarginea* scrub				M
207	Hummock grasslands, shrub steppe; red mallee over hard spinifex				H
216	Low woodland; mulga (?with spinifex) on rises				H
222	Sparse low woodland; mulga & *Acacia victoriae* in scattered groups	X		X	L
225	Shrublands; snakewood & minnieritchie scrub				H
228	Shrublands; *Acacia quadrimarginea* scrub				H
262	Shrublands; acacia & other spp on Mt Augustus				L
264	Low woodland; *Acacia victoriae* & snakewood				H
265	Low woodland; *Acacia sclerosperma* & *A. victoriae*				H
Beard Veg Code	Ecosystem Description	IUCN I-IV	Non-IUCN	CALM-Purchased Lease	Priority
266	Mosaic: Shrublands; bowgada scrub/Succulent steppe; saltbush & bluebush				M
269	Low woodland over scrub; mulga over bowgada scrub				H
285	Mosaic: Shrublands; *Acacia victoriae* & snakewood scrub patches / Scattered groups of succulents				H
676	Succulent steppe; samphire				L
2081	Shrublands; bowgada and associated spp. scrub				L
	Invertebrate assemblages of Edithana Pool				H
	Invertebrate assemblages of Cattle Pool	X			L
	Invertebrate assemblages of Yinnietharra Cattle Pool				H
	Invertebrate assemblages of Mibbley pool				H
	Invertebrate assemblages of Erong Springs				H

	Vegetation communities dominated by Eremophila species.				H
	Plant assemblages of Robinson Range.				H
	Jeeaila River Downs vegetation complexes.				H
	Mulga short grass-forb association of non-saline tributary drainage plains of the Gascoyne catchment				H
	Stony short grass-forb association of the undulating terrain of the Gascoyne catchment	X			H
	Stony chenopod association of strew covered drainage plains of the Gascoyne catchment				H
	Chenopod association of tributaries and major drainage lines of the Gascoyne catchment	X			H
	Wanderrie association on sandy alluvial drainage plains of the Gascoyne catchment	X			H
	Plant assemblages of high diversity landscapes and unusual landforms				H
	Stygofauna of the Carnegie Drainage system (Humphreys)				H
	Critical Weight Range Mammals				H
	Chenopod community of Weelarana Station				H
	Clay pan dominated by *Nymphoides indica*				H
	Eucalyptus ferriticola over shrubs on drainage lines in Murchison e.g. Doolgunna Station			X	M

Subregional constraints in order of priority
(see Appendix B, key g)

Competing Land Use: Is the primary issue as pastoralism occupies nearly 85% of the region and mining also has considerable interests.

Economic Constraints: In terms of 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; level of degradation of much of the subregion is significant due to pastoral practices and the impacts of feral herbivores.

Bioregional and subregional priority for reserve consolidation

GAS is reservation class 3 (see Appendix D, and Appendix C, rank 4) with only 1.92% of area in conservation reserve (IUCN I-IV) At the subregional level GAS1 has 2.88% in reserve (IUCN I-IV), GAS2 has no conservation reserve and GAS3 has 2.5% in conservation reserve. The current reserve system is highly biased in terms of CAR criteria and is not comprehensive or representative in terms of ecosystem representation so Class 2 with possibility of changing to a higher primary classification is appropriate.

Reserve management standard

Mount Augustus National Park: Reserve Management standard is fair (ii) (see Appendix C, rank 5). There are no feral predator programs are in place. Wildfire management facilities are limited by resources (except for fire breaks and fire-access tracks which are installed and maintained). Feral herbivore grazing activities may pose a conservation risk.

Collier Range National Park: Reserve Management standard is poor (i). The park is baited annually for wild dogs (by Department of Agriculture). No management apart from occasional visits by Karratha staff. Park has significant problems with feral herbivores (donkey) and stock (cattle). At present, no fire management is taking place and weed problems are unknown. There is no detailed information on biological values.

Off reserve conservation

Priority species or groups and existing recovery plans

Species or System	Ecosystem	Specific Recovery Plan	General Recovery Plan
Stygofauna	Calcrete aquifers	No	No
Falco peregrinus		No	Action Plan for Australian Birds
Macrotis lagotis	18 – Low woodland: mulga (*Acacia aneura*); 28 – Open low woodland: mulga; 29 – Sparse low woodland: mulga, discontinuous in scattered groups.	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
Polytelis alexandrae		No	The Action plan for Australian Birds
Acanthiza iredalei iredalei		No	The Action plan for Australian Birds
Dasycercus cristicauda	18 - Low woodland: mulga (*Acacia aneura*); 39 – Shrublands: mulga scrub; 107 – Hummock grasslands, shrub steppe: mulga and *Eucalyptus kingsmillii* over hard spinifex.	No	Action Plan for Australian Marsupials and Monotremes

Appropriate species recovery actions

Species	Recovery Actions[1]	Recovery Descriptions
Falco peregrinus	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
Macrotis lagotis	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. CWR species that is no longer extant in the subregion. Control of feral animals, notably foxes, as well as fire management are essential. Possibility for translocation.
Polytelis alexandrae	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Possibly control of feral predators as well as habitat degradation through grazing pressure and by feral herbivores
Acanthiza iredalei iredalei	i, ii, iii, vii	Need to address the loss of habitat through grazing of chenopod shrubland by sheep and rabbits. Habitat retention through reserves or on other State lands or on private lands.
Dasycercus cristicauda	i, ii, iii, vii, ix, xii	CWR species that requires specific fire age spinifex habitat. Predated upon by foxes and cats. Ecological research currently being conducted by D.J. Pearson
Ctenophorus yinnietharra	i, ii, iii, vii, xii	Species with a restricted range. Habitat retention through reserves or on other State lands or on private lands. Possibly control of feral predators as well as habitat degradation through grazing pressure and by feral herbivores. Research into requirements of species.
Acacia wilcoxii	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire and other disturbance mechanisms as well as the species general biology.
Eremophila arguta ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Eremophila flaccida subsp. *attenuata* ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Eremophila gracillima ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Eremophila lanata ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Eremophila micrantha ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Species	Recovery Actions[1]	Recovery Descriptions
Eremophila prolata ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Eremophila rigida ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Gonocarpus ephemerus	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
Goodenia berringbinensis	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Hemigenia sp. Glenburgh (RJ Cranfield 9725)	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Homalocalyx chapmanii	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Pityrodia augustensis	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Ptilotus astrolasius var. *luteolus*	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
Ptilotus lazaridis	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
Ptilotus trichocephalus	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
Rhodanthe frenchii	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
Rhodanthe sphaerocephala	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
Stylidium weeliwolli	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive

		weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.

[1]Appendix B, key h.

Ecosystems and appropriate recovery actions

Community	Recovery Actions[1]	Recovery Descriptions
Invertebrate assemblages of Edithana Pool (-240725S, 1162932E) High quality river pool on the Lyons River. High invertebrate diversity. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	i, iii, v, vii	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Feral animal control - mainly goats and foxes.
Invertebrate assemblages of Cattle Pool (-241701S, 1164933E). High quality river pool on the Lyons River adjacent to Mt Augustus National Park. High invertebrate diversity. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	i, iii, v, vii	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Feral animal control - mainly goats and foxes.

Community	Recovery Actions[1]	Recovery Descriptions
Invertebrate assemblages of Yinnietharra Cattle Pool (-243627S, 1160303E). Permanent freshwater pool on the middle Gascoyne. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	i, iii, v, vii	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Feral animal control - mainly goats and foxes.
Invertebrate assemblages of Mibbley pool (-245838, 1181343). Large relatively undisturbed freshwater pool on the upper Gascoyne River (therefore unusual). Until recently protected from stock by thick riparian vegetation. Shire has recently cleared a track to the pool which has allowed stock access (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	i, iii, v, vii	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures).
Invertebrate assemblages of Erong Springs (-252844, 1165236). High aquatic invertebrate diversity site in the Gascoyne area. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	i, iii, v, vii	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Feral animal control - mainly goats and foxes.
Vegetation communities dominated by Eremophila species. Landor Station, North of racetrack. 26 *Eremophila* species in this area, one undescribed *Eremophila* occurs in a unique community (A.Brown pers. comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Plant assemblages of Robinson Range. Has populations of DRFs (*Pityrodia augustensis*) and several endemic *Eremophila*. Includes Mt Fraser and higher peaks. Is currently in very good condition but potentially subject to mining (A.Brown pers comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Jeeaila River Downs vegetation complexes. East of Mount Augustus (proposed Nature Reserve) (B.Barton pers. comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Mulga short grass-forb association of non-saline tributary drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Stony short grass-forb association of the undulating terrain of the Gascoyne catchment (Wilcox and McKinnon 1992)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Stony chenopod association of strew covered drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.

Community	Recovery Actions[1]	Recovery Descriptions
Chenopod association of tributaries and major drainage lines of the Gascoyne catchment (Wilcox and McKinnon 1992)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Wanderrie association on sandy alluvial drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Plant assemblages of high diversity landscapes and unusual landforms being studied for the Ecological Management Unit, Gascoyne-Murchison Strategy e.g. Mt Arapiles (Milgun)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Stygofauna of the Carnegie Drainage system (Humphries)	i, iii, v,	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Fire management.
Critical Weight Range Mammals such as *Macrotis lagotis, Dasycercus crassicaudata, Dasyurids.*	i, iii, v, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Feral animal control - mainly goats and foxes. Fire management, especially of mulgara habitat at Collier Range National Park.
Chenopod community of Weelarana Station. Heavily grazed and trampled by cattle, camel and rabbit (Stephen van Leeuwen, pers comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Clay pan dominated by *Nymphoides indica*. One occurrence, located 70 km south of Newman. Others probably occur, and are also threatened by grazing.	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Eucalyptus ferriticola over shrubs on drainage lines in Murchison e.g. Doolgunna Station	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.

[1]Appendix B, key h.

Existing ecosystem recovery plans

There are no existing recovery plans for Ecosystems at Risk in GAS3.

Subregion priority for off reserve conservation
(see Appendix C, rank 6)

The subregional priority for off park conservation in GAS3 is (ii), indicating that there is a large off-park effort required.

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 as Part of NRM: e.g. Vegetation management plans, pest management.

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

Environmental Management Systems and Ecologically Sustainable Product Marketing.

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

Feasible 0pportunities for NRM

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

Institutional Reform: e.g. 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 and Ecologically Sustainable Product Marketing: 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. Conservation Through Reserves is limited by the presence 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
(see Appendix C, rank 7)

The NRM priority for GAS3 is (i), indicating that there are major constraints to implement effective NRM actions to achieve biodiversity outcomes. Much of GAS is severely degraded through past agricultural practices (primarily sheep & cattle 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 available. Regional ecosystem mapping has been produced at the broad scale, 1:1 000 000 for Beard's vegetation, and 1:250 000 for Landsystems by the Western Australian Dept. Agriculture (Wilcox and McKinnon 1972).

Systematic Fauna Survey: Data has not been collected. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates.

Floristic Data: No regional survey of the flora has been conducted. Information on flora sparse.

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 Priority Data Gaps Include:

- No quantitative data on the effect of exotic predators, and weed colonisation.
- No quantitative data on the effect of mineral extraction, and pastoralism on landscape processes.
- 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 salinisation.
- Poor understanding of subregional troglofaunas, particularly stygofaunas associated with palaeo-drainage calcretes

Source

References cited

No.	Author	Date	Title	Publication Details	Pub. Type
717	Bellchambers, K. and Johnson, K.A.	(1991).	The Recovery Plan for the Greater Bilby *Macrotis lagotis*	Endangered Species Programme and the Conservation Commission of the Northern Territory, Alice Springs	R
271	Environmental Protection Authority	(1974).	Conservation Reserves in Western Australia - Report of the Conservation through Reserves Committee to the Environmental Protection Authority "CTRC Green Book".	Environmental Protection Authority, Perth.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
391	Humphreys, W.F.	(2001).	Groundwater calcrete aquifers in the Australian arid zone: the context to an unfolding plethora of stygal biodiversity. Pp 63 - 83 in Subterranean Biology in Australia 2000, W.F. Humphreys and M.S. Harvey (eds).	Records of the Western Australian Museum, Supplement No. 64.	B
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
498	McNamara, P., Brandis, T and Hopkins, A.	(2000).	Filling the gaps.	Landscope. 15 (4) 43 - 49.	J
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
695	Wilcox, D.G.and McKinnon, E.A.	(1992).	A Report on the Condition of the Gascoyne Catchment.	Department of Agriculture, Western Australia.	R

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

Other relevant publications

See reference numbers 012, 026, 067, 075, 082, 086, 091, 094, 100, 118, 173, 181, 182, 258, 268, 281, 372, 383, 387, 395, 402, 407, 419, 493, 634, 635, 636, 637, 638, 641, 647, 648, 679 and 699 in Appendix A.