



Pilbara Bioregion Conservation Action Planning Process Update: Refined Conservation Strategies and Actions January 2018



# Acknowledgements

The Pilbara Conservation Action Planning (CAP) Process involves many contributors who are thanked for their input and feedback. That includes people and organisations who took part in the initial Pilbara CAP workshop series in 2015, those who commented on the Summary Report (<u>Heydenrych et al., 2016</u>) and those who commented and had input into the process that led to this report in late 2016 and early 2017.

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Pilbara Corridors acknowledges the contributions of various stakeholders and participants to this publication; however, the views contained herein do not necessarily reflect the views of the participating organisations or individuals. Greening Australia advises that the information contained in this publication comprises general statements based on scientific research. The reader is advised and needs to be aware that such information may be incomplete or unable to be used in any specific situation. No reliance or actions must therefore be made on that information without seeking prior expert professional, scientific and technical advice.

The development of the Pilbara CAP is an ongoing process. To this end, Greening Australia looks forward to receiving further input and feedback from those with an interest in land management in the Pilbara.

Cover Photo: Storm over Coppin's Gap, Amy Doran

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# Abbreviations

BAM Act	Biosecurity and Agriculture Management Act 2007
CAP	Conservation Action Planning
CMP	Conservation Measures Partnership
DBCA	Department of Biodiversity, Conservation and Attractions
DAFWA	Department of Agriculture and Food WA
DMP	Department of Mines and Petroleum
DPIRD	Department of Primary Industries and Regional Development
EMU	Ecosystem Management Understanding
EPA	Environmental Protection Authority (WA Government)
EPBC	Environment and Biodiversity Conservation Act 1999 (Commonwealth Government)
ESRM	Ecologically Sustainable Rangeland Management
GA	Greening Australia
GIS	Geographic Information System
LGA	Local Government Areas
LMPT	Licensed Pest Management Technician
PMMC	Pilbara Mesquite Management Committee
RBG	Regional Biosecurity Group
NAFI	North Australian Fire Information
NRM	Natural Resources Management
TEC	Threatened Ecological Community
TOs	Traditional Owners
PEC	Priority Ecological Community
UCL	Unallocated Crown Land

Note:

The Department of Parks and Wildlife (DPAW) operated until 30 June 2017, after which the Parks and Wildlife Service became part of the new Department of Biodiversity Conservation and Attractions (DBCA). In this report, in general, the acronym DPAW has been replaced with DBCA, unless it is a reference to work or a publication from before 30 June 2017.

The Department of Agriculture and Food, Western Australia (DAFWA) is now part of the new Department of Primary Industries and Regional Development (DPIRD).



# 1 Pilbara CAP Overview

# 1.1 Background

The Pilbara Conservation Action Plan (CAP) is a process that seeks to provide a guiding framework for planning and implementing biodiversity conservation actions across the Pilbara bioregion (**Figure 1**), in a coordinated manner based on broadly agreed priorities and targets. Conservation Action Planning is increasingly being used at a range of scales for planning conservation actions in Australia (Carr *et al.*, 2017).

Phase 1 of the Pilbara CAP (March 2015 – June 2016) involved a series of stakeholder workshops aimed at identifying key conservation assets, threats to these assets and strategies for their protection and enhancement. The workshops were well attended and a range of stakeholder interests were represented. A draft CAP Summary Document was released for comment in December 2015, with feedback received in early 2016. A final CAP Summary Document addressing the collated feedback was released in June 2016 (Heydenrych *et al.*, 2016). This document included a high-level appraisal of landscape conservation assets and threats, and 60 preliminary strategies addressing stakeholder priorities and interests.

Phase 2 of the Pilbara CAP (July 2016 – Aug 2017) involved a review of Pilbara conservation assets, refinement of strategies to provide greater focus for conservation actions, and facilitation of collaborations and partnerships to support strategy implementation. Specific outcomes sought from Pilbara CAP Phase 2 were:

- 1. Review of the CAP Phase 1 conservation asset list;
- 2. Refinement and prioritisation of CAP Phase 1 strategies;
- 3. Development of monitoring and evaluation protocols for conservation activities, to underpin knowledge sharing and effective adaptive management; and
- 4. Identify and articulate opportunities for landscape-scale collaboration and partnership to help achieve lasting biodiversity conservation outcomes across the Pilbara bioregion.

# 1.2 Purpose

The Pilbara Conservation Action Plan (CAP) seeks to provide a guiding framework for planning and implementing biodiversity conservation actions across the bioregion in a coordinated manner based on broadly agreed priorities and targets. Some the key shortcomings of Phase 1 were that certain key fauna assets were "lost" under landform assets with regards to strategies and actions required for their protection, assets were not classified by IBRA sub-regions, there were too many strategies (60) and there was insufficient detail around priorities for action. This report provides an updated strategy and action list, with illustrative case studies and "funder-ready" examples together with monitoring guidance and additional maps.



# 2 Progress

Phase 2 of the Pilbara Conservation Action Planning process involved the following steps:

- Re-examination of conservation assets: IBRA sub-regions were used as a basis for classifying assets and key selected fauna (ie. Bilby, Northern Quoll and conservation significant bats) were included as assets in their own right (*cf.* nested assets).
- Consultation with experts to obtain information on Key Ecological Attributes (KEA), threats and strategies for conservation assets: useful feedback was provided by Pilbara technical experts and was considered when refining CAP strategies.
- Additional review of the literature regarding KEAs, threats, mapping, existing work and monitoring: this information was used to further inform strategy refinement resulting in a reduction of the initial set of 60 strategies to approximately 20.
- Interrogation of the Biodiversity Audit II Database at the DBCA Library: information regarding threats to, and management and research of, key Pilbara assets (Fauna, Flora and Threatened Ecological Communities) was examined.
- Updated strategy list: the revised list was circulated to stakeholders in December 2016 and further workshopped and refined in early 2017, resulting in the development of 18 broad strategies.
- A subset of key strategies that can be rapidly developed into proposals has been developed.
- Sharing case studies: a series of case studies covering different themes has been included in this update, showcasing examples of current or potential action by a variety of groups.
- Pilbara CAP assets spatial dataset: The EPA described Fortescue Management Area included in the initial asset GIS dataset (Heydenrych et. al, 2016) was removed, dissolving the area into its representative assets, using Rangeland Land System data (Van Vreeswyk et al., 2004). The current Pilbara CAP GIS layer has been topologically corrected, a metadata statement compiled and it is intended that this dataset will be made publicly available on an appropriate web-based platform (eg. Shared Location Information Platform, SLIP).



pilbara corridors

Figure 1: Conservation Assets for the Pilbara bioregion



# 3 Refined Strategies

# 3.1 Updated strategy list

During the initial Pilbara CAP process, 60 strategies (and numerous associated actions) were identified by the collective group (Heydenrych *et al.*, 2016). While many of these strategies remain relevant and are being implemented either wholly or partly, this set of strategies and actions was refined to:

- focus on strategies linked to on-ground action, rather than scientific research;
- remove strategies required under existing environmental regulation (eg. compliance with legislation or Ministerial Statements);
- ensure that strategies were at a similar hierarchical level, where possible;
- include updated assets (including key fauna species) in strategies; and
- reduce redundancy.

An updated strategy list was circulated to stakeholders for comment in December 2016, and further workshopped and edited in early 2017. The current list comprises 18 strategies (**Table 1**). The effective implementation of these strategies will significantly improve the condition of Pilbara biodiversity assets and/or reduce threats to these assets. Key Actions for these strategies are presented in the table overleaf, together with suggested implementation groups/agencies.

Table 1:	Refined	strategies -	- as at	September	2017
	1 Clinica	Strutegies	us ut	ocptonisor	

No.	Strategy
1	Pilbara-based conservation working/implementation group
2	Improved weed management in the Pilbara
3	Targeted introduced predator control
4	Co-ordinated fire management
5	Feral herbivore (ungulate) control
6	ESRM*/ EMU** planning and implementation for sustainable rangelands management
7	Capacity building for improved on-ground management
8	Co-ordinated water (hydrology) management
9	Coastal asset biosecurity
10	Cane Toad readiness
11	Northern Quoll protection
12	Greater Bilby protection
13	Conservation significant bats protection
14	Other fauna species – knowledge gaps and protection
15	Tussock Grassland – knowledge gaps and protection
16	Priority Ecological Communities – knowledge gaps and protection
17	IBRA Bioregion protected area targets
18	Pilbara data sharing / monitoring and evaluation "hub"

\* Ecologically Sustainable Rangeland Management; \*\* Ecosystem Management Understanding



No.	Strategy	Theme	Sub- strategy	Threat(s) addressed	Asset(s) Improved	Strategy description	Activities/actions	Lead / Coordination (key group(s), there may be others)	Strategy outline	Case study
1	Pilbara-based Conservation Working / Implementation Group	Conservation through partnerships	-	All threats	All assets	<ul> <li>Pilbara-based Conservation Working/Implementation Group for co-ordinating and streamlining on-ground actions:</li> <li>based on sub-groups with similar interests (themes such as weeds, fire, or geographic location);</li> <li>purpose would be collaboration and more effective communication (knowledge sharing and landscape-scale opportunities pursued)</li> <li>eg. engagement with various land managers; support TO groups to implement their NRM/Healthy Country Plans, guided by CAP process including asset locations;</li> <li>use existing groups and networks where possible.</li> </ul>	<ul> <li>Establish/formalise a Pilbara-wide sustainable management group (conservation groups, pastoralists, TOs, Local Government, members of the community etc.).</li> <li>Form/align Implementation groups – project specific groups with support from local expertise</li> </ul>	Greening Australia (initial establishment period, then Pilbara based group)	3.2.1	
			Targeted weed control			Undertake targeted weed control to protect conservation assets identified in the Pilbara CAP. Improved weed management techniques will ensure most effective weed control.	<ul> <li>Improve weed identification techniques:</li> <li>engage community to help with weed surveillance</li> <li>audit of effectiveness of control</li> <li>improve drone monitoring techniques</li> <li>assess recovery of native species return eg. eradicate cactus from Dampier Archipelago</li> </ul>	PMMC, GA, TO's, land managers	3.2.2 3.2.3	
	Improved weed 2 management in the Pilbara		New weeds prevention and containment	Weeds		Complete risk assessments and pre-emptive management plans for priority weed taxa as identified in the CSIRO Pilbara Weeds Strategy (pending). Risk assessments should take account of the potential influence of climate change.	Need to link to practical data collection by broader public – who can identify weeds, use of Weedwatcher App. Provide incentives for people to provide data.	PMMC, RBG, DPIRD		
2		Weeds	Improving weed management in the mining industry		Weeds All assets	eds All assets	Review the effectiveness of weed management approaches in mining areas.	TBD	PMMC, GA + Mining companies	
			Pilbara weed database					Establish a broadly agreed approach for weed data collection and storage for the Pilbara.	<ul> <li>Establish a weed database platform</li> <li>Develop guidelines/protocols for weed monitoring for Pilbara NRM practitioners so that project level monitoring can be easily aggregated to larger scales</li> </ul>	CSIRO, DPIRD, PMMC +
			Pilbara weed research plan			Prepare a Pilbara Weed Research Plan, providing a template for collaborative research. To be informed by CSIRO Pilbara Weed Strategy	ТВД	CSIRO, DPIRD, PMMC +		
Targel 3 introdu predat		Introduced predators	Integrated introduced predator control	Introduced predators	Range of native fauna species	<ul> <li>Implement integrated control of introduced predators (cat, fox, wild dog) in key areas to alleviate predation threat to a range of species including the Greater Bilby, Northern Quoll and the fauna of key coastal fauna sites. Link control to: <ul> <li>ongoing research projects</li> <li>ongoing monitoring programs</li> <li>measures of effectiveness of co-ordinated baiting by land managers.</li> </ul> </li> </ul>	<ul> <li>Increase annual aerial and ground baiting programs for wild dog (declared pest) to cover a wider area than is currently covered</li> <li>Investigate inclusion of aerial baiting for other species including cats, foxes</li> <li>Support groups like Care for Hedland</li> <li>Expand the Fortescue Marsh Feral Cat baiting program to other areas</li> </ul>	DBCA, Pilbara RBG, DPRID and off-reserve stakeholders including pastoralists, Traditional Owners	3.2.4 3.2.15 3.2.16	
	Targeted introduced predator control		Fox containment and control	Introduced predators	Range of native fauna including turtles on beaches of mainland and islands	Complete a risk assessment and prepare a management plan for containing, and where possible eliminating foxes from local areas of the Pilbara (eg. Port Hedland case study); with a focus on: • preventing migration inland • minimising damage to turtle nesting areas. Risk assessments should take account of the potential influence of climate change and ongoing management practices such as centre pivot irrigation and effect on increasing fox numbers (targeted baiting where new centre pivots are installed).	<ul> <li>Continue with fox baiting program in Port Hedland and other coastal areas</li> <li>Targeted baiting in new areas where foxes are noted</li> </ul>	Pilbara RBG, Care for Hedland, DBCA	3.2.4 3.2.5	4.2 4.3
4	Co-ordinated Fire Management	Fire	Fire modelling for land management	Inappropriate fire regimes	Primarily non coastal assets	Build on existing work to complete a Pilbara landscape fire modelling exercise to improve understanding of priority assets and high-risk areas for fire.	<ul> <li>Develop fire management guidelines for a range of assets.</li> <li>Products could include: <ul> <li>Updated fire management guidelines</li> <li>Maps of fire risk areas</li> <li>Update recommendations for fire sensitive vegetation</li> </ul> </li> </ul>	Independent fire expert, Fire Leadership Group	3.2.6	4.4

# Table 2: Detailed descriptions for refined strategies



No.	Strategy	Theme	Sub- strategy	Threat(s) addressed	Asset(s) Improved	Strategy description	Activities/actions	Lead / Coordination (key group(s), there may be others)	Strategy outline	Case study
							<ul> <li>Update recommendations for fire sensitive fauna of conservation significance</li> </ul>			
			Pilbara Fire Research Plan to inform management actions	Inappropriate fire regimes		Building on existing and ongoing work, prepare a Pilbara Fire Research Plan, providing a framework for collaborative research	Test fire research hypotheses in field	DBCA		
			Co-ordinated cross tenure fire management	Inappropriate fire regimes		<ul> <li>Develop a co-ordinated approach for cross tenure fire management to protect important conservation assets. This project relates to other strategies including the strategies below:</li> <li>targeted introduced predator control</li> <li>Northern Quoll protection</li> <li>Greater Bilby protection</li> </ul>	Station by station fire management strategy – mapping, planning and implementation of burn	DBCA, Rangelands NRM	3.2.7 3.2.8 3.2.15 3.2.16	
5	Feral herbivore (ungulate) control	Feral herbivores	Capacity upgrade for feral herbivore control	Feral herbivores (donkeys, horses, camels)	Numerous assets	Improve regional capacity for undertaking control and eradication of feral herbivores to help enable project level actions and improve the status of assets, including the Greater Bilby and Northern Quoll.	<ul> <li>Aerial control:</li> <li>Overcome policy barriers to aerial control;</li> <li>Legislation;</li> <li>Ground control: <ul> <li>Relationship management;</li> <li>Address lack of resources at DBCA;</li> </ul> </li> <li>Raise awareness and impacts of horses (not well known) and camels</li> </ul>	Pilbara RBG in conjunction with DBCA and DPIRD	3.2.9 3.2.10	4.5
		Feral herbivores	Pig control	Pigs	Rivers, Creeks and Associated Floodplains on open plains	Develop and implement a pig control plan for the De Grey River and other areas in conjunction with land managers.	<ul> <li>Surveys, both aerial and ground to establish pig distribution and abundance. Locations also identified through consultation with local pastoral stations and cattle muster helicopter pilots.</li> <li>Targeted pig baiting program using a professional Licenced Pest Management Technicians (LPMT) experienced with pig baiting;</li> <li>Follow-up control actions if required;</li> <li>Monitor and evaluate presence/absence of feral pigs.</li> </ul>	De Grey LCDC, Pilbara RBG	3.2.11	
6	ESRM*/ EMU** planning and implementation for sustainable rangelands management * Ecologically Sustainable Rangeland Management ** Ecosystem Management Understanding	Total grazing management		Unsustainable stock grazing pressure and other threats including fire	<ul> <li>Tussock grasslands</li> <li>Mulga vegetation communities</li> <li>Snakewood vegetation communities</li> <li>Chenopod shrublands</li> <li>Sand dune communities in the Fortescue Valley</li> <li>Wetlands</li> </ul>	Include detailed total grazing management planning considerations (including feral herbivores and introduced predators), fire, weeds and hydrology in the ESRM/ EMU/ Healthy Country planning and implementation process Priority target asset types include: • Native species tussock grasslands • Mulga vegetation communities • Snakewood vegetation communities • Chenopod shrublands • Sand dune communities in the Fortescue Valley • Wetlands	<ul> <li>Quick review of where plans and actions are in place;</li> <li>Rapid audit of best methodologies/case studies for landscape conservation outcomes;</li> <li>Decide which areas could be targeted;</li> <li>Undertake new plans and actions, including Landscape re-hydration (Landscape Function Analysis); Fire management and burn plan; Weed management; Feral management; Native fauna management; and Cultural management.</li> <li>Monitor and evaluate – includes measurement and documentation of outcomes.</li> <li>Communicate success.</li> </ul>	Rangelands NRM and others	3.2.12	4.6
7	Capacity building for improved on- ground management	Capacity building		All threats	All assets	Improve capacity for land managers (pastoral and TOs) and community members to manage land sustainably	<ul> <li>Identify Traditional Owners and associated ranger groups and the key people on their country;</li> <li>Identify the skills/capacity of the groups;</li> <li>Identify the issues and aspirations of each group (people and country);</li> <li>Develop a targeted training package for each ranger group linked to on-ground outcomes as per Healthy Country Planning</li> </ul>	Greening Australia with support of PMMC, DPIRD, Rangelands NRM, North Regional Tafe, DBCA, Conservation Management, Pew Charitable Trusts	3.2.14	4.7
8	Coordinated water	Hydrology		Altered hydrology from	Numerous assets	Re-establish and maintain appropriate hydrological regimes by reducing impacts on natural flows.	<ul> <li>Develop new design standards for infrastructure.</li> <li>Develop environmentally directed road grading methodology.</li> </ul>	All land managers	3.2.13	4.6



No.	Strategy	Theme	Sub- strategy	Threat(s) addressed	Asset(s) Improved	Strategy description	Activities/actions	Lead / Coordination (key group(s), there may be others)	Strategy outline	Case study
	(hydrology) management			infrastructure development and other threats including: Water Abstraction, Dams, Mine Water Discharge into Creeks and Springs, Mine Dewatering			<ul> <li>Rehydration of landscapes ecological earthwork techniques.</li> </ul>			
9	Coastal asset biosecurity	Biosecurity		Weeds (Buffel Grass, Kapok, Ruby Dock, Passiflora, etc) Introduction of mice, rats, etc (lack of biosecurity)	Offshore Islands, Sandy Beaches and Dunes	Complete a risk assessment and prepare a management plan for the protection of Pilbara coastal zone assets (including islands). Risk assessments should take account of the potential influence of climate change	eg. education of boat users on rodents and fires (islands)	DBCA, DPIRD and others	3.2.2 3.2.5	
10	Cane Toad readiness	Biosecurity		Cane Toad	Range of fauna including native Predators, many reptiles, small frogs and invertebrates	Complete a risk assessment and prepare a pre-emptive management plan for the Cane Toad in the Pilbara. Risk assessments should take account of the potential influence of climate change.	<ul> <li>Research and monitor cane toads and educate native species</li> <li>Research on biological control</li> <li>Surveillance and biosecurity to prevent spread</li> <li>Research impacts and predictions of likely distribution of cane toads</li> <li>Sub-lethal doses of toxin to educate threatened native species</li> </ul>	DBCA, DPIRD and others		
11	Northern Quoll protection	Conservation Significant Fauna		Inappropriate fire regime; Introduced predators (cats); Weeds; Clearance from Infrastructure Development; Cane Toad; Clearance from mining and mining infrastructure	Northern Quoll	Identify and protect Northern Quoll populations and their core habitat through key management interventions such as fire management, feral animal control and grazing management, as per the above strategies, informed by current research and monitoring.	<ul> <li>Habitat requirements. Define areas of critical habitat for northern quoll in the Pilbara.</li> <li>Understand how disturbance affects habitat quality and connectivity.</li> <li>Implement predator control in key locations.</li> <li>Protection of isolated ironstone mesas and granite outcrops supporting key isolated populations of Northern Quolls.</li> </ul>	Land Managers, Rangelands NRM, GA, TOs+, in collaboration with DBCA	3.2.15	4.7
12	Greater Bilby protection	Conservation Significant Fauna		Inappropriate fire regime; Introduced herbivores; Introduced predators (cats); Clearance from Infrastructure Development; Introduced predators (foxes)	Greater Bilby	Identify and protect Greater Bilby populations and their core habitat through key management interventions such as fire management, feral animal control and grazing management, as per the above strategies, informed by current research and monitoring.	<ul> <li>Develop pilot bilby management project following modelling and mapping of potential Bilby habitat at pastoral station scale.</li> <li>Implement a coordinated large- scale survey of bilby occupancy in the Pilbara using sign plot technique</li> <li>Identify bilby habitat (desktop) then ground truth (TO Traditional Owner groups);</li> <li>Identify and map all known bilby locations;</li> <li>Implement control strategies and associated monitoring program to assess effectiveness:         <ul> <li>grazing management,</li> <li>fire management,</li> <li>feral predator control.</li> </ul> </li> </ul>	Land Managers, Rangelands NRM, GA, TOs+, in collaboration with DBCA	3.2.16	4.7

#### Pilbara Conservation Action Planning Process: Updated Strategies and Actions



No.	Strategy	Theme	Sub- strategy	Threat(s) addressed	Asset(s) Improved	Strategy description	Activities/actions	Lead / Coordination (key group(s), there may be others)	Strategy outline	Case study
13	Conservation Significant Bats protection	Conservation Significant Fauna		Introduced herbivores; Inappropriate Hydrological Regime; Clearance from mining and mining infrastructure	Conservation Significant Bats	Identify and protect important roosting habitat for conservation significant bat species (Pilbara Leaf-nosed Bat; Ghost Bat)	<ul> <li>Build Effective Artificial Roosts for PLNB;</li> <li>Monitoring (camera technology) for known roost caves to make sure they are not destroyed;</li> <li>Clarify and better characterise the number and distribution of day roosts;</li> <li>Better understand habitat requirements, particularly foraging habitat, and the movement of bats between roosts;</li> <li>Provide more robust estimates of total population and colony size, and improve understanding of social behaviour;</li> <li>Investigate appropriate buffers in a range of mining contexts and protocols for artificial roost construction</li> </ul>	Land Managers, GA, in collaboration with DBCA		
14	Other fauna species - knowledge gaps and protection	Conservation Significant Fauna		All threats	Range of conservation significant fauna species	Fill knowledge gaps to improve management actions for protecting key taxa including EPBC species not listed above and Short Range Endemics (SREs), amongst others.	Desktop survey to identify gaps, on-ground surveys working with local groups (pastoral stations, rangers), identify at risk populations and develop management plans and actions.	Land Managers, Consultants, DBCA, WA Museum		
15	Tussock Grassland knowledge gaps and protection	Knowledge Management		Inappropriate fire regime; Unsustainable Stock Grazing Pressure, Introduced predators; Weeds;	Tussock Grasslands	Improve spatial delineation and condition status of Pilbara Tussock Grassland communities. Priority targets include: • Roebourne Plains gilgai grasslands PEC • Four plant assemblages of the Wona Land System PEC • Kanjenjie Land System	<ul> <li>Liaison with landholders</li> <li>Map areas and asses condition and threats</li> <li>Development of best practice pastoral management approach and/or code of practice</li> <li>Where appropriate include in Local Government Biodiversity Strategy</li> <li>Habitat management through informal or complementary conservation mechanisms</li> </ul>	Local Gov, DBCA, GA	3.2.17	
16	PEC knowledge gaps and protection	Knowledge Management		Inappropriate fire regime; Unsustainable Stock Grazing Pressure, Introduced predators; Weeds;	A range of assets, primarily: Tussock Grasslands, Fortescue Marsh, Spinifex Hummock Grasslands on Plains,	<ul> <li>Determine condition status of the following identified conservation assets:</li> <li>Peedamulla Marsh vegetation complex PEC</li> <li>Claypans of the Fortescue Valley</li> <li>Kumina Land System</li> <li>Mosquito Land System (mapping work in progress Millennium Minerals)</li> <li>Narbung Land System</li> <li>Coastal dune native tussock grassland dominated by <i>Whiteochloa airoides</i> along mainland coast</li> </ul>	<ul> <li>Liaison with landholders</li> <li>Map areas and asses condition and threats</li> <li>Development of best practice pastoral management approach and/or code of practice</li> <li>Habitat management through informal or complementary conservation mechanisms</li> <li>eg. Survey work recently undertaken by DBCA on the Fortescue wetlands that includes the Claypans and other wetland assets (Pinder et al., 2017)</li> </ul>	Various in conjunction with DBCA	3.2.17	
17	IBRA bioregion protected area targets	Comprehensive and Adequate Reserve (CAR) System - relevant to all thematic groups		All threats	All Assets	Identify conservation assets with priority for inclusion in the Western Australian conservation estate; and support processes for reservation consistent with Australia's Strategy for the National Reserve System 2009–2030 and Australia's Biodiversity Conservation Strategy 2010-2030. Note that under these strategies four types of protected areas are recognised: • Public reserves • Indigenous Protected Areas • Private protected areas • Shared management reserves	eg. Inclusion of 2015 pastoral lease relinquishment areas into protected area network. eg. Revisit the Status of the Pilbara Islands Marine Park. eg. Create Ranger Parks initiative	In collaboration with DBCA	3.2.19	
18	Pilbara data sharing / monitoring and evaluation "hub"	Knowledge management		All threats	All Assets	Undertake a scoping study of NRM data sharing opportunities in the Pilbara to assist management decisions such as identifying priority assets for project actions.	Make Pilbara data (not just reports) available for use by all for prioritising areas of focus for actions, and providing information to assess condition of conservation assets Pilbara wide.	WABSI +	3.2.18	



# 3.2 Suggested key strategies for immediate action

From the above list, and following some initial consultation and, a provisional list of "funder-ready" strategies and actions was identified (**Table 3**). Please note that this list:

- is not intended to be comprehensive and there are many strategies and actions underway beyond those on this list (**Appendix 9.1**).
- is focussed on strategies for "on-ground action", rather than strategies for research;
- excludes strategies that are subject to environmental regulation (ie. being carried out as per Ministerial Statements, environmental approvals etc).

These strategies have been expanded on below with supporting information where available and/or relevant. Although these strategies are at slightly different stages of development, the implementation of these will contribute significantly to a reduction in key threats to Pilbara conservation assets.

Note:

- 1. In many cases, the implementation of these strategies builds on current work, including expanding existing projects that are near the end of current project funding.
- Carwardine *et al.* (in litt.), as part of the CSIRO Pilbara priority threat management report (Carwardine *et al.*, 2014) has suggested that the following are essential baseline elements of all strategies and should be incorporated into further development:
  - a. minimum research and information collection needs for implementation;
  - b. monitoring and evaluation of implementation success;
  - c. adaptive management, including monitoring responses of threatened species to management actions;
  - d. knowledge sharing; and
  - e. community awareness.



No.	Strategy/Action
1	Pilbara-based Conservation Working/Implementation Group
2	Eradicate cactus from the Dampier Archipelago
3	Reduce threat and impacts of Parkinsonia and Mesquite to key conservation assets
4	Expanded Pilbara RBG introduced predator baiting program
5	Turtle management on Pilbara beaches
6	Fire management guidelines for different vegetation types
7	Expansion of co-ordinated cross tenure fire management
8	Development of Pilbara-based Indigenous Fire Response Team(s)
9	Pilbara-wide regional feral herbivore control
10	Capacity upgrade for regional feral herbivore control
11	Targeted Pig Control in the De Grey and other catchments
12	Targeted ESRM/EMU/Healthy Country planning and implementation
13	Co-ordinated Water (Hydrology) Management
14	Improved capacity building of Ranger Groups for land management
15	Northern Quoll conservation strategy
16	Greater Bilby protection – Pilot Project
17	Knowledge acquisition for protection of Tussock grasslands and Priority Ecological Communities (PECs)
18	Knowledge management of Pilbara data
19	Spatial prioritisation of Pilbara biodiversity assets

#### Table 3: Suggested key strategies for immediate action

# **3.2.1** Pilbara-based Conservation Working/Implementation Group

# Goal

Pilbara-based Conservation Working/Implementation Group established by late 2017/early 2018 to steer and drive on-ground conservation actions and help co-ordination activities (new goal for Pilbara CAP2).

#### Strategy

Establish/formalise a Pilbara-wide sustainable management group (conservation groups, pastoralists, TOs, Local Government, members of the community etc).

Form/align implementation groups - project specific groups with support from local expertise:

- based on sub-groups with similar interests (themes such as weeds, fire, or geographic location);
- purpose would be collaboration and more effective communication (knowledge sharing and landscape-scale opportunities pursued);
- eg. engagement with various land managers; support TO groups to implement their NRM/Healthy Country Plans, guided by CAP process including asset locations;
- use existing groups and networks where possible.

#### Actions

- Seek funding for coordination support;
- Form group;
- Establish broad terms of reference in line with various plans and strategies;
- Hold regular meetings to drive and steer conservation actions;
- Establish monitoring protocols and data sharing arrangements;
- Measure, monitor and communicate successes;



- Identify gaps and opportunities for catalytic on-ground actions;
- Assist with lobbying for funding of key projects and funds.

#### Lead

Pilbara Corridors (Greening Australia, Rangelands NRM and DBCA)

#### Support

#### DPIRD, DBCA, City of Karratha, Town of Port Hedland, Shire of East Pilbara, Shire of Ashburton

#### Do

PMMC, Pilbara RBG, Traditional Owners, Greening Australia, DPIRD (Karratha Office), DBCA (Karratha Office), amongst others to be determined.

#### Monitoring and evaluation

To assess the effectiveness of the group in implementing effective conservation actions and achieving measurable change over time.

#### Key issues/problem statement

There is currently no single group that deals with landscape-scale conservation actions across the various tenures and landscapes of the Pilbara. A single forum would bring a range of sectors and interests together (who may not meet and share for other purposes) to collectively align resources and provide a peer learning and support to achieve more effective actions than is currently the case.

# **3.2.2** Eradicate cactus from the Dampier Archipelago

#### Goal

#### Overarching Draft Goal from Pilbara CAP1:

• By 2025 there are no new incursions of weeds (priority weeds) and the impact, distribution and density of weeds is reduced (by x amount) in key asset locations.

#### Specific goals:

- By 2020, cactus is eradicated from all islands in the Dampier Archipelago
- Establish monitoring regime to ensure new out breaks are detected and appropriately managed

#### Strategy

Treat all cactus in the Dampier Archipelago and implement monitoring program.

#### Activities/actions

- DPIRD to increase awareness of LGA on their declared weed management responsibilities; specifically, in this instance, City of Karratha to take responsibility for the Cactus on Jarman Island.
- PMMC to continue to promote Cactus control in Pilbara communities
- Land owners/ managers to assess and map locations of cactus infestations (and other species);
- Stakeholders (ie. landowners, PMMC, Traditional Owners) to develop a control plan;
- Secure funding for capacity building for local delivery organisations to control and monitor effectiveness (including Traditional Owners);
- Implement control plan;
- Monitor and evaluate control efforts and undertake surveillance to detect new outbreaks.

#### Lead

Responsible land owners/ managers with coordinating lead from Pilbara Mesquite Management Committee (PMMC)

### Support

DPIRD, DBCA, City of Karratha, Pilbara Mesquite Management Committee (PMMC)

#### Do

Traditional Owners (e.g. Murujuga Aboriginal Corporation) and PMMC in co-ordination with DBCA

#### Monitoring and evaluation

Following implementation and mapping of control operations, visit treated areas regularly and apply weed control if necessary; undertake survey visits to all islands in the archipelago to assess occurrence and extent of any infestations etc.

#### Key issues/problem statement



Cactus (*Opuntia* spp.) occurs as low-level infestations at approximately 30 locations in the Dampier Archipelago. Coordinated efforts and early intervention to control cactus can stop the spread of weeds in a cost-effective way.

NB - In addition to cactus species, other weed species such as Stinking Passionflower (*Passiflora foetida*) should be eradicated early as this is more cost-effective than waiting until the weed takes hold over a larger area.



Plate 1: Jo Kuiper (PMMC) spraying cactus on Sam's Island in the Dampier Archipelago (Picture: Pilbara News)

#### Current progress:

The PMMC and DBCA representatives have spent three weeks in 2017 recording and spraying an invasive cactus species threatening to gain a foothold on several of the Pilbara islands. With approximately 30 locations in the archipelago where it is known to occur, the cactus is considered a low-level infestation that can be cost-effectively eradicated (**Figure 2**).



Economic Returns (indicative only)

Figure 2: Invasion curve indicating return on investment at different stages weed infestation, (DAFWA, 2016)



## **3.2.3** Reduce threat and impacts of Parkinsonia and Mesquite to key conservation

#### assets

#### Goal

#### Overarching Draft Goals from Pilbara CAP1:

Reduce threat and impacts of Parkinsonia and Mesquite to the identified conservation assets including the Fortescue River and the associated ecosystems.

#### Specific goal relative to this strategy

By 2025 reduce and maintain densities of Parkinson to <1% in the Fortescue Catchment and undertake Parkinsonia and Mesquite surveillance and control for the protection and impact reduction for other key assets.

#### Activities/actions

- DPIRD to communicate legislative management requirements to relevant land owners/ managers regarding weeds declared as pests in the BAM Act.
- Stakeholders (regulatory agencies, industry and science) to inform and support Land managers to develop and deliver integrated, landscape scale (ie infestation - scale) best practice management programs (which could be efficiently managed by a coordinating group such as the PMMC)

#### Lead

#### PMMC

#### Support

Pilbara RBG, DPIRD, DBCA, Industry, Science (CSIRO, Universities, DBCA, DPIRD)

#### Do

Land Managers, PMMC, Contractors, TOs and Ranger Groups

#### Monitoring and evaluation

Following implementation and mapping of control operations, visit treated areas regularly and apply weed control if necessary; undertake survey visits to assess occurrence and extent of any infestations etc.

#### Key issues/problem statement

Mesquite (*Prosopis* spp.) and Parkinsonia (*Parkinsonia aculeata*) are both Weeds of National Significance, regarded as some of the worst weeds in Australia because of their invasiveness, potential for spread, and economic and environmental impacts. Mesquite's environmental impacts include land erosion resulting from the loss of grassland habitat that supports native plants and animals; and the provision of safe refuges for feral animals such as pigs and cats. The Pilbara is home to the largest populations of mesquite in Australia, with some 300,000 hectares of land known to be infested with the thorny menace. In addition to ecological problems Mesquite has economic impacts stemming from its habit of forming dense, impenetrable thickets which, combined with its large thorns, prevent stock accessing watering holes and make mustering difficult, and reduce the pastoral productivity by taking over grasslands and using valuable water resources.

Parkinsonia, another widespread weed in the Pilbara, has the potential to invade more than three quarters of mainland Australia. Parkinsonia can form dense impenetrable thickets on rangelands and wetlands, making areas of land inaccessible for people and animals. Seed pods float and are easily spread by water, and Parkinsonia thickets can be up to several kilometres across. Cattle are difficult to muster in paddocks where Parkinsonia infestations are thick, access to watering points is impaired by the thickets which also shade out valuable pastures and displaces native vegetation when left untreated. Parkinsonia can dam watercourses, cause erosion, and lower water tables and provide refuges for feral animals, especially pigs.

# 3.2.4 Expanded Pilbara RBG introduced predator baiting program

#### Overarching Draft Goals from Pilbara CAP1:

- By 2025, reduce introduced predator numbers in key areas (eg. areas of 'significant' habitat for Matters of National Environmental Significance (MNES); key source locations) by 75%. (Inland Plains Assets).
- By 2025 reduce predator pressure on populations of native fauna species (sea turtles, migratory birds, shorebirds, marsupials, reptiles etc.) to allow populations to become self-sustaining within their range. (NB Migratory species spend much of their lifecycle outside the Pilbara). (Coastal Assets).

#### Specific goal:



• Increase the capacity of the Pilbara Regional Biosecurity Group (RBG) to further its wild dog (declared pest) baiting work (aerial and ground) across tenures and to increase its scope to include baiting for cats and foxes.

#### Strategy

#### Expanded Pilbara RBG introduced predator baiting program - area covered and additional target species

#### Activities/actions

Increase annual aerial and ground baiting programs for wild dog (declared pest) to cover a wider area than is currently covered:

- Aerial baiting (and coordinated ground baiting on some pastoral stations) typically occurs in September, with 90% participation from pastoral properties. With agreement from DBCA, some UCL lands is baited where wild dog leads (known habitat areas) extend from pastoral properties into UCL.
- Regional wild dog baiting should happen in spring (pup season) and autumn (mating season). There is scope to also undertake aerial and ground baiting in April/May to be more effective.

Investigate inclusion of baiting for other species including cats, foxes (and possibly pigs):

- The charter plane used for aerial baiting can fly slowly at low altitude to accurately bait specific parts of the landscape eg. known threatened species habitat. The plane is set up with a bait hopper and chute that can be used for cat and fox baiting (in addition to larger 1080 dried meat baits for wild dogs). A Licenced Pest Management Technician is the bombardier, which addresses permit and poison handling issues to drop baits on pastoral lands.
- The Pilbara RBG is already aerial baiting on most Pilbara pastoral stations for wild dogs and the program can be expanded for conservation outcomes to target cats, foxes and possibly pigs in certain locations. Separate flights can be arranged to accommodate the timing of baiting for cats and foxes.
- The Large Feral Herbivore program, mainly the donkey Judas program, currently has 20 days per annum of helicopter time allocated for aerial culls. There is scope to also expand this program using helicopters to accurately target cat, fox and possibly pig baiting areas in specific parts of the landscape eg. known habitat of threatened species that are predated by foxes and cats.

Contract Licenced Pest Management Technicians (LPMTs) to undertake on-ground best practice for feral predator control – trapping, baiting, shooting:

- Licenced Pest Management Technicians (LPMTs) are used in other regions in the WA rangelands to control wild dogs (declared pests) using a combination of trapping, baiting and shooting.
- LPMTs can prepare and lay fox, wild dog and pig baits, set dog traps, and shoot declared pests (foxes, wild dogs, large feral herbivores).
- LPMTs can target priority conservation areas and can target feral predators on the ground throughout the year. LPMTs have the capacity to bait for cats, subject to meeting any legislative requirements to cull cats.
- LPMTs can set and use field motion sensors to monitor feral predator populations and movements, as well as monitoring large feral herbivore numbers by observation.
- LPMTs can work on both pastoral leases and DBCA managed land via agreements and permits, so can operate across tenure to control feral predators.

#### Lead

#### Pilbara RBG:

- an incorporated group operating across the entire Pilbara region, with all pastoral properties as members of the association.
- the Pilbara RBG, in partnership with DBCA, has the capacity to operate across tenure to implement coordinated management actions for the entire Pilbara region.

#### Support DBCA, DPIRD

# Do

#### Do

DPIRD and contractors under direction of Pilbara RBG and DBCA

#### Monitoring and evaluation

Establish long-term feral predator monitoring sites across the Pilbara region

- spanning across tenure and land uses, aiming to benchmark feral predator populations then monitor and evaluate population changes over time. Methodology would include using field motion sensor cameras to detect presence of feral predators and estimate local feral predator abundance. Impacts of control programs will be measured over time at these sites (mix of treated and untreated "control" sites).
- Use existing methodology for "output" data eg. maps of areas baited, use of data loggers.

• Link to existing monitoring programs and protocols/new opportunities for pest fauna and native fauna monitoring to obtain "outcome" data measured by improvements in populations of native fauna over time.

#### Key issues/problem statement

The Pilbara RBG's aerial wild dog baiting program covers a large area of the Pilbara (**Figure 3**) and could be expanded program to include a wider area and cost-effective baiting for other species (in particular cats). The Pilbara RBG's main source of funding is from Declared Pest Rates paid by pastoral leases that are matched equally by the WA State Government. It also partners with other organisations including DBCA and DPIRD. The broadening of the scope of the Pilbara RBG has the potential for greater conservation and pastoral production outcomes and social benefits to local communities.





Figure 3: Extent of wild dog aerial baiting by the Pilbara RBG in 2015



# **3.2.5** Turtle management on Pilbara beaches

#### Goal

#### Overarching Draft Goals from Pilbara CAP1:

• By 2025, reduce predator pressure on populations of native fauna species (sea turtles, migratory birds, shorebirds, marsupials, reptiles etc.) to allow populations to become self-sustaining within their range. (NB Migratory species spend much of their lifecycle outside the Pilbara). (Sandy Beaches and Dunes).

#### Specific goal:

• Improve success of turtle nesting on Pilbara beaches by reducing local threats via direct (eg. fox control) and indirect means (eg. education of people) and raising awareness of turtle nesting in the area.

#### Strategy

#### Turtle management on Pilbara beaches

#### Activities/actions

- Monitor numbers of nesting marine turtles by identifying and counting tracks at key known nesting locations.
- Record evidence of impacts from human interference, foxes and cats on local beaches.
- Determine nesting success.
- Undertake targeted fox baiting in key nesting locations.
- Increase awareness of marine turtles on nesting Pilbara beaches.

#### Lead

#### DBCA, Care for Hedland, West Pilbara Turtle Program

Support

#### Rio Tinto, BHP, Pilbara Ports

#### Do

#### DBCA, Care for Hedland and volunteers

#### Monitoring and evaluation

Volunteers walk defined sections of beach at sunrise every morning during the peak turtle nesting period, recording:

- total number and location of nests per species;
- number of false crawls per species;
- number and location of disturbed nests and potential causes of disturbance;
- presence of foxes, dogs and cats;
- tagged turtle sightings;
- marine fauna stranding and mortality reports.

Data is entered into a database that allows for analysis. A summary report is generated at the end of each season to monitor trends and focus on management issues of nesting turtles in these areas.

#### Key issues/problem statement

Flatback turtles (*Natator depressus*, listed under WA Biodiversity Act and EPBC Act) – the main species monitored by The West Pilbara Turtle Program and Care for Hedland – are endemic to Australia and breeding is only known from Australian beaches. There is a lack of published time series data on flatback turtles from Western Australia, which is needed for local and regional management of WA's population. Monitoring near port infrastructure is important to assess impacts from pressures such as light pollution and ship traffic and turtle nests on Pilbara beaches require protection from predators (eg. foxes) and human-induced threats (eg. beach driving, campfires, raiding of nests).



# **3.2.6** Fire management guidelines for different vegetation types

Goal
Overarching Draft Goals from Pilbara CAP1:
<ul> <li>By 2020, patchy, cool, early season fire regimes are in place across 10% of the asset annually to protect fire-sensitive ecosystems, maximise habitat diversity and minimise the risk to threatened flora and fauna populations. (Inland Mountain Ranges, Rocky Hills, Breakaways and Mesas).</li> <li>By 2020 actively manage (using agreed metrics TBD) regionally significant areas to protect (X%) of key fire-sensitive ecosystems, maximise habitat diversity and minimise the risk to threatened flora and fauna populations. (Spinifex Hummock Grassland on Plains with Shrubs and Trees; Tussock Grasslands on Plains, Mulga Woodlands and Acacia Shrubland Communities).</li> </ul>
<ul> <li>Specific goal:</li> <li>Develop/update fire management guidelines for a range of vegetation types across the Pilbara to assist land managers to implement ecologically sustainable burn plans.</li> </ul>
Strategy
Fire management guidelines produced for different vegetation types (ie assets) in the Pilbara as per DEC (2008a) Fire Management Guideline No. E6, Mulga Communities.
Activities/actions
Updated fire management guidelines;     Mans of fire risk areas;
<ul> <li>Naps of fire recommendations for fire sensitive vegetation:</li> </ul>
<ul> <li>Update recommendations for fire sensitive fauna of conservation significance.</li> </ul>
Lead
Rangelands Fire Leadership Group (DBCA, Department of Fire and Emergency Services, Kanyirninpa Jukurrpa Aboriginal Corporation and Pastoralists, Graziers Association of Western Australia and Rangelands NRM, Kanyirninpa Jukurrpa and the Pastoralists and Graziers Association of Western Australia (PGA) )
Support
Land Managers, Traditional Owners
Do
Fire experts in consultation with key stakeholders
Monitoring and evaluation
Number/proportion of key vegetation groups in addition to Mulga for which guidelines are produced and the practical use of these for fire strategies and prescribed burning.
Key issues/problem statement
<ul> <li>Although there is a wealth of information regarding fire in the Pilbara, there are few concise guidelines with clear fire ecology information and specific management recommendations for different vegetation types, apart from DEC (2008a) for Mulga Communities. It is suggested that a series of these be developed so that land managers have a specific guiding reference when considering undertaking prescribed burning on their properties.</li> <li>The following are key references to consult in this regard, in addition to information from DBCA on their extensive Pilbara fire work from various vegetation systems:</li> <li>DAFWA (2006). Broad best management practice guidelines that cover Spinifex pastures and Tussock Grassland and Extensive River Floodplain Pastures;</li> <li>Rangelands Fire Leadership Group (2015). "Guiding Principles for fire management in the WA rangelands" - useful guide but not suited for vegetation system level of detail; and</li> <li>Robinson <i>et al.</i> (2016) "Protocols for Indigenous fire management partnerships".</li> </ul>
Supporting Information
<ul> <li>DEC (2008b) notes several features of interest to conservation that may be affected by fire management decisions:</li> <li>Gorges of Hamersley and Chichester Ranges contain extensive permanent spring-fed streams and pools. These contain relictual fauna including snails (<i>Bothriembryon</i> sp) and reptiles (<i>Lerista zietzi</i>), and low mobility species with restricted geographic ranges (Camaenid landsnails and <i>Quistrachia</i> spp.). Fire sensitive flora includes <i>Callitris</i> pine, <i>Ficus</i>, <i>Terminalia</i>, snakewood etc.</li> </ul>



- Mulga (*Acacia aneura*) communities are fire sensitive, particularly on mid and lower slopes, and contain fire sensitive fauna communities such as long lived, short range endemic invertebrates (eg. *Bothriembryon* sp)
- Grassland plains dominated by the perennial *Themeda* (kangaroo grass) and many annual herbs and grasses (Hamersley Station grass plain). Fire sensitivity unknown.
- Very isolated areas of mulga, in the extreme west of the sub-bioregion. No other biological information is available, as these communities have not been described.
- Mountain tops of the Hamersley Range contain numerous restricted flora species. eg. *Daviesia eremaea*, *Thysanotus manglesianus, Stenanthemum petraeum, Eriachne semiciliata*. Fire sensitivity is unknown.
- Vegetation associated with permanent spring systems are fire sensitive.
- Fortescue Marsh: An extensive, episodically inundated samphire marsh, approximately 100 km long and 10 km wide and surrounded by extensive fire sensitive mulga communities.
- Spectacled Hare-wallabies (*Lagorchestes conspicillatus leichardti*) require long unburnt large spinifex clumps for shelter (Chichester Range sub-region). May also apply to other vertebrate fauna.

These notes above can be used to help decide which vegetation types should be prioritised for updated fire management guidelines.

# 3.2.7 Expansion of co-ordinated cross tenure fire management

#### Goal

#### Overarching Draft Goals from Pilbara CAP1:

- By 2020, patchy, cool, early season fire regimes are in place across 10% of the asset annually to protect firesensitive ecosystems, maximise habitat diversity and minimise the risk to threatened flora and fauna populations. (Inland Mountain Ranges, Rocky Hills, Breakaways and Mesas).
- By 2020 actively manage (using agreed metrics TBD) regionally significant areas to protect (X%) of key firesensitive ecosystems, maximise habitat diversity and minimise the risk to threatened flora and fauna populations. (Spinifex Hummock Grassland on Plains with Shrubs and Trees; Tussock Grasslands on Plains, Mulga Woodlands and Acacia Shrubland Communities).

#### Specific goal:

• Develop/expand a coordinated approach for cross tenure fire management, including prescribed burning across the Pilbara, informed by monitoring and research, to create a mosaic of different aged habitats (ie. ensure maximum habitat variety (pyro-diversity) for a range of fire regimes).

#### Strategy

Expansion of coordinated cross tenure fire management in key areas, guided by an updated Pilbara Fire Management Strategy and local Fire Management Plans.

#### Activities/actions

- Take learnings from ongoing fire management in the Hamersley, Chichester and Fortescue areas and other areas such as De Grey Catchment, Priority Areas being undertaken by DBCA, Pastoralists, Ranger Groups, Rangelands NRM to inform further work and priority areas.
- Revisit DEC 2008b Pilbara Regional Fire Management Plan.
- Develop/update fire management strategies and burn plans (operational plan) for a range of cross-tenure landscapes

#### Lead

#### DBCA and Fire Leadership Group

Support

#### Land managers, Traditional Owners

#### Do

Land Managers, TOs in consultation with fire experts and other key stakeholders

#### Monitoring and evaluation

Use existing techniques including remote sensing information via NAFI (Northern Australian Fire Information) to map and quantify changes in burn history (ie. timing, extent, patchiness) across key assets.

#### Key issues/problem statement



It is believed that Aboriginal burning practices in the Pilbara involved burning patches of vegetation creating of a mosaic of burnt and unburnt areas, a practice that regulates fuel loads and manages against large intense fires. Changes in land cover and development of infrastructure may lead to more frequent and/or intense wildfires. Frequent, hot fires threaten infrastructure, cause significant effort to be spent controlling fires, disturb pastoral production and threaten biodiversity. A co-ordinated approach for cross tenure fire management, including prescribed burning across the Pilbara, informed by monitoring and research can create a mosaic of different aged habitats for biodiversity outcomes and increase pastoral lease profitability by protecting pastoral infrastructure and productive land systems from late season wildfire by reduction in sedimentation and improved soil cover in key catchments, thereby improving in land condition over time.



Figure 4: Fire frequency (2006-2017) for Pilbara conservation assets (data sourced from NAFI, Aug 2017)





Figure 5: Fire frequency (2006-2017) for the Pilbara IBRA region (NAFI, Aug 2017)



# **3.2.8** Development of Pilbara-based Indigenous Fire Response Team(s)

#### Goal

#### Overarching Draft Goals from Pilbara CAP1:

- By 2020, patchy, cool, early season fire regimes are in place across 10% of the asset annually to protect firesensitive ecosystems, maximise habitat diversity and minimise the risk to threatened flora and fauna populations. (Inland Mountain Ranges, Rocky Hills, Breakaways and Mesas).
- By 2020 actively manage (using agreed metrics TBD) regionally significant areas to protect (X%) of key firesensitive ecosystems, maximise habitat diversity and minimise the risk to threatened flora and fauna populations. (Spinifex Hummock Grassland on Plains with Shrubs and Trees; Tussock Grasslands on Plains, Mulga Woodlands and Acacia Shrubland Communities).

#### Specific goal:

Development of Pilbara-based Indigenous Fire Response Team(s)

#### Strategy

#### Development of Pilbara-based Indigenous Fire Response Team(s)

#### Activities/actions

- Identify areas where there is a need (for fire response) and interest by Traditional Owners;
- Core team undertakes fire training with DBCA/Department of Fire and Emergency Services (DFES), repeated regularly to maintain skills, standards and pool of team members;
- Work towards being fully equipped and operational for next (TBD 2017-18 or 2018-19) fire season onwards;
- Participate in development and implementation of Pilbara Fire Management Strategy and local Fire Management Plans;
- Build and maintain links with other organisations, including various ranger groups, DFES, DBCA, Local Government, Mining Companies, volunteer fire brigades;
- Work with DBCA, other members Fire Leadership Group and others to implement prescribed burning at priority sites guided by available fire ecology information and best practice;
- In time (trained, experienced and operational) provide fee for service fire services to a range of land managers including controlled burning to protect critical infrastructure;
- In time (trained, experienced and operational) provide fire-fighting services to assist with the defence of key infrastructure from wildfire in conjunction with other agencies and land managers;
- Participate in and monitor fire impacts, with fire and fauna/flora ecologists where possible.

#### Lead

DBCA, DFES

#### Support

Mining Companies, Local Government, Rangelands NRM

#### Do

#### Traditional Owners (Ranger Groups)

#### Monitoring and evaluation

Strategy effectiveness regarding development of Indigenous Fire Response Teams (eg. how many personnel trained, resourced teams in key areas of need), and long-term condition monitoring (eg. fewer and smaller hot wildfires in dry season, as measured by on-ground mapping and remote imagery (ie. NAFI).

#### Key issues/problem statement

Large areas of the Pilbara are subject to inappropriate fire regimes (large, high intensity burns occurring too frequently). Aboriginal people have been involved in managing fire in this area for thousands of years. The development of indigenous people to support existing fire response units and form units of their own has multiple benefits including ownership and management of country, job creation and employment opportunities, a shift towards appropriate fire regimes resulting in improved habitat and conservation values.

The Ngadju people in the Great Western Woodlands have established the Dundas Rural Bushfire Brigade with the support of the Shire of Dundas to respond early to future wildfires (Ngadju Conservation Action Plan Version 1.0 May 2015), and learnings from this process could be used in establishment of similar teams in the Pilbara.



# 3.2.9 Pilbara-wide regional feral herbivore control

#### Goal

#### Overarching Draft Goals from Pilbara CAP1:

• By 2020 manage for feral herbivores over X ha to reduce adverse impacts to an agreed, acceptable threshold levels

#### Specific goal:

- Locally eradicate where possible or maintain at low numbers feral donkeys, camels, horses, unmanaged cattle and pigs.
- Help enable project level actions and improve the status of assets, including the Greater Bilby and Northern Quoll.

#### Strategy

#### Pilbara-wide regional feral herbivore control

#### Activities/actions

#### Aerial control:

- Donkey "Judas" telemetry collaring program continues to successfully operate across the east Pilbara, with
  opportunistic aerial management culls of camels and feral horses on pastoral land. Partnership with DBCA for
  coordinated aerial control on DBCA managed lands. Program currently operates on 16 Pastoral stations and
  four DBCA managed estate (two reserves, two UCL). From 1998 to 2015 there have been over 17,000
  donkeys culled by this program. Eight properties have achieved local eradication status. This program needs
  to continue to achieve and maintain local eradication on additional properties. (Estimated 20 days helicopter
  days per annum).
- Expansion of the donkey "Judas" telemetry collaring program continues to successfully operate across the west/southern Pilbara (an additional 20 pastoral properties plus DBCA managed lands), with opportunistic aerial management culls of camels and feral horses on pastoral land. Some stations in the west Pilbara have estimated they have around 1,000 donkeys on their property, with neighbouring properties having at least 500 donkeys present. The last aerial management shoot (not a collaring Judas program) occurred in 2004 in the west Pilbara. Partnership with DBCA for coordinated aerial control on DBCA managed lands. (Estimated 30 days helicopter days per annum, additional start up time required to establish a collar network prior to start aerial culling).
- Continuation of recent DBCA feral horse collaring trials to evaluate the viability of a feral horse "Judas" collaring program for efficient aerial control of feral horses initial focus on the Fortescue Marshes and surrounding landscapes. (Estimated 10 days helicopter days per annum for trial).

Ground control:

- Provide incentives or reimbursement for ground shooting of large feral herbivores where numbers are low eg. contract a professional shooter to target low population areas to prevent numbers getting out of control.
- Raise awareness and impacts of horses (not well known) and camels

#### Lead

Pilbara Regional Biosecurity Group (RBG), which is an incorporated group operating across the entire Pilbara, with all pastoral properties as members of the association. The Pilbara RBG, in partnership with DBCA, has the capacity to operate across tenure to implement coordinated management actions across the entire Pilbara landscape.

#### Support

#### DBCA, DPIRD

#### Do

#### Pilbara RBG, contractors

#### Monitoring and evaluation

- Identify the distribution and impacts of introduced herbivores;
- Records numbers and locations of culled large feral heribivores;
- Continually refine and revise the location and effectiveness of collars eg. move collars when local eradication is achieved, and rely on pastoralist and helicopter pilot observations to report if numbers are building up again. (1.0 EFT for program planning, logistics, operations management, monitoring, evaluation and communication/reporting results).

#### Key issues/problem statement



Introduced herbivores in the Pilbara cause compaction and erosion of soil, loss of grazing-sensitive plant species, reduced native grass biomass, introduction of weed seeds and trampling of plants. Where pronounced, this can lead to a reduction in vegetation structure and therefore habitat and food resources for native animals, and exposure of small native animals to increased predation risk. High total grazing pressure may also lead to eutrophication of waterways, and sedimentation of wetlands and riparian habitats.





Figure 6: Donkey tracking locations 1998 – 2017 (data courtesy Pilbara RBG, 2017)



# **3.2.10** Capacity upgrade for regional feral herbivore control

Goal
Overarching Draft Goals from Pilbara CAP1:
By 2020 manage for feral herbivores over X ha to reduce adverse impacts to an agreed, acceptable threshold
level;
Specific goal:
<ul> <li>Adequate trained people in the region with sufficient skills, capability and capacity to undertake ellective lefal berbivore control:</li> </ul>
Fradicate where possible or maintain at low numbers feral donkeys, camels, horses, unmanaged cattle and
pias:
<ul> <li>Help enable project level actions and improve the status of assets, including the Greater Bilby and Northern</li> </ul>
Quoll.
Strategy
Capacity upgrade for regional feral herbivore control
Activities/actions
Aerial control:
Overcome policy barriers to aerial control;
Legislation;
Ground control:
Address lack of resources at DBCA:
<ul> <li>Raise awareness and impacts of borses (not well known) and camels</li> </ul>
Pilbara Regional Biosecurity Group (RBG)
Support
DBCA. DPIRD
Do
Pilbara RBG, contractors
Monitoring and evaluation
Identify the distribution and impacts of introduced herbivores.
Key issues/problem statement
Introduced herbivores in the Pilbara cause compaction and erosion of soil, loss of grazing-sensitive plant species,
reduced native grass biomass, introduction of weed seeds and trampling of plants. Where pronounced, this can lead
to a reduction in vegetation structure and therefore habitat and food resources for native animals, and exposure of
small native animals to increased predation risk. High total grazing pressure may also lead to eutrophication of

# **3.2.11** Targeted Pig Control in the De Grey and other catchments

#### Goal Overarching Draft Goals from Pilbara CAP1: • By 2020 manage for feral herbivores over X ha to

waterways, and sedimentation of wetlands and riparian habitats.

 By 2020 manage for feral herbivores over X ha to reduce adverse impacts to an agreed, acceptable threshold level (Rivers, Creeks and Associated Floodplains on open plains; Springs, Pools and Watercourses associated with Gorges and Ranges);

Specific goal:

• Eradication of feral pigs from the De Grey River catchment to reduce habitat alteration and predation of native species.

Strategy

#### Targeted Pig Control in the De Grey and other catchments

#### Activities/actions

• Surveys, both aerial and ground to establish pig distribution and abundance. Locations also identified through consultation with local pastoral stations and cattle muster helicopter pilots.



- Targeted pig baiting program using a professional Licenced Pest Management Technicians (LPMT) experienced with pig baiting;
- Follow-up control actions if required;
- Monitor and evaluate presence/absence of feral pigs.

Lead

#### Pilbara RBG and De Grey LCDC

Support

DPIRD

Do

Pilbara RBG, De Grey LCDC and others including the Yandeyarra Rangers

#### Monitoring and evaluation

There are a range of resources on feral pig control and monitoring and evaluation techniques (eg.

http://www.pestsmart.org.au/pest-animal-species/feral-pig/).

#### Key issues/problem statement

Pigs are not currently ranked highly as a threat to the conservation assets of the Pilbara. However, timely action has the potential to address the problem cost effectively. Feral pigs are in the De Grey River delta/floodplain, the Yule and have the potential to spread upstream.

### 3.2.12 Targeted ESRM/EMU/Healthy Country planning and implementation

Goal
------

#### **Overarching Draft Goals from Pilbara CAP1:**

- By 2025, manage grazing pressure to the asset to protect grazing-sensitive ecosystems and species (TBD), retain habitat structure and minimise the risk to threatened flora and fauna populations and cultural assets (TBD = to be determined) (Coastal Assets);
- By 2025 actively manage total grazing pressure in regionally significant areas to protect sensitive ecosystems and maintain sustainability. (Plains assets).

#### Specific goal:

 Expand, implement and integrate actions across the wider landscape those actions from pastoral-scale plans (ESRM, EMU, Healthy Country) that consider dynamic processes including fauna and hydrological processes and ferals, weeds and fire.

#### Strategy

Continue and expand existing land management plans and actions, and target priority asset types for future plans. Include detailed total grazing management planning considerations (including feral herbivores and introduced predators), fire, weeds and hydrology in the ESRM/ EMU/ Healthy Country planning and implementation process. Priority target asset types include:

- Native species tussock grasslands;
- Mulga vegetation communities;
- Snakewood vegetation communities;
- Chenopod shrublands;
- Sand dune communities in the Fortescue Valley;
- Wetlands.

#### Activities/actions

- Quick review of where plans and actions are in place;
- Rapid audit of best methodologies/case studies for landscape conservation outcomes;
- Decide which areas could be targeted;
- Undertake new plans and actions, including Landscape re-hydration (Landscape Function Analysis); Fire management and burn plan; Weed management; Feral management; Native fauna management; and Cultural management.
- Monitor and evaluate includes measurement and documentation of outcomes.
- Communicate success.

#### Lead



#### Rangelands NRM

#### Support

#### Traditional Owners, Greening Australia

#### Do

ESRM, EMU and Healthy Country contractors in partnership with Pastoralists and Traditional Owners

#### Monitoring and evaluation

- Western Australian Rangeland Monitoring System (WARMS);
- EMU reporting system;
- AusPlots (see Section 4 for more detail);
- Remote sensing using MODIS and NDVI (Watson and Thomas, 2016).

#### Key issues/problem statement

Point data from WARMS shows overall grazing condition of the Pilbara as mostly good (64%), with 24% fair and 12% poor, although this has been trending downwards since 1994. MODIS satellite cover data and NDVI analyses suggest parts of the Ashburton and Roebourne - Port Hedland LCDs are declining (Watson and Thomas, 2016). ESRM, EMU, Healthy Country Planning and Implementation can assist land managers with best practice management to achieve production and conservation outcomes, and deal with landscape issues related to fauna, hydrological processes and ferals, weeds and fire. Certain assets are at particular risk and could be targeted for any expanded roll out of plans and actions.

- ESRM = Ecologically Sustainable Rangeland Management (eg. http://www.rangelands.globalagencies.com.au/pages/1135/ESRM )
- EMU = Ecosystem Management Understanding (eg. http://www.emulandrecovery.org.au/home)
- Healthy Country planning (eg. <u>http://www.conservationmanagement.com.au/</u> and <u>http://www.natureaustralia.org.au/science-in-action/conservation-planning/healthy-country/</u>

## 3.2.13 Co-ordinated Water (Hydrology) Management

#### Goal

#### **Overarching Draft Goals from Pilbara CAP1:**

 By 2025, re-establish and maintain appropriate hydrological regimes by reducing impacts on natural flows from infrastructure barriers in priority waterways and aquifers (Spinifex Hummock Grassland on Plains with shrubs and trees (eg. Acacia); Tussock Grasslands on Plains; Mulga Woodlands and Acacia Shrubland Communities; Rivers, Creeks and Associated Floodplains on Open Plains; Springs, Pools and Watercourses associated with Gorges and Ranges; Subterranean Fauna Habitat; Inland Mountain Ranges, Rocky Hills, Breakaways and Mesas;

#### Specific goal:

· Re-establish and maintain appropriate hydrological regimes by reducing impacts on natural flows.

#### Strategy

Re-establish and maintain natural hydrological regimes through timeous planning and action, primarily earthworks and appropriate infrastructure.

#### Activities/actions

- Develop new design standards for infrastructure;
- Develop environmentally directed road grading methodology;
- Rehydration of landscapes using ecological earthwork techniques (aerial survey to locate best position for contour banks, implementation of earth banks and other works, monitoring and evaluation).

#### Lead

Land managers (including mining companies)

#### Support

Rangelands NRM

#### Do

Local Government, Mining sector, LCDCs (De Grey and others)

Monitoring and evaluation

• Western Australian Rangeland Monitoring System (WARMS);



- EMU reporting system;
- AusPlots (see Section 4 for more detail);
- Remote sensing using MODIS and NDVI (Watson and Thomas, 2016).

#### Key issues/problem statement

Water and hydrology are significant driving forces in the Pilbara. Changing climate and multiple threats are interacting with altered hydrological flows impacting on biodiversity and sustainable land use. Taking action to reinstate natural hydrological regimes will help to improve health of many of the Pilbara's assets and biodiversity.

## **3.2.14** Improved capacity building of Ranger Groups for land management

#### Goal

Support the capacity development of Ranger Groups to have the skills, knowledge and authority to work on country (new Goal for Pilbara CAP2).

#### Strategy

Improved capacity building of Ranger Groups for land management

#### Activities/actions

- Identify Traditional Owners and associated ranger groups and the key people on their country;
- Identify the skills/capacity of the groups;
- Identify the issues and aspirations of each group (people and country);
- Develop a targeted training package for each ranger group linked to on-ground outcomes as per Healthy Country Planning

#### Lead

Greening Australia

#### Support

PMMC, DPIRD, Rangelands NRM, North Regional TAFE (NRT), DBCA, Conservation Management, Pew Charitable Trusts

Do

All interested Traditional Owner and Indigenous Ranger groups

Monitoring and evaluation

Number of ranger groups trained and active, undertaking key tasks on country including fee for service work.

#### Key issues/problem statement

There are several ranger groups that have been established in the Pilbara to date. They vary widely in their capacity, skills, and current and future funding security. Capacity building in those ranger groups (including new groups) would assist with upskilling groups to be able to provide a range of land management services. Additional benefits would include peer-to-peer leaning (Cross Ranger Training), cross-cultural learnings (western scientific and cultural approaches) and inter-generational training (Elders sharing their knowledge with younger people).

## **3.2.15** Northern Quoll conservation strategy

#### Goal

#### Draft - Overall High-level Goal (new goal for Pilbara CAP2):

The persistence of a wild population that requires only a low level of management.

- No reduction in area of occupancy compared to 2015.
- An increase in area of occupancy compared to 2015.
- An increase in overall abundance compared to 2015.

Formal acknowledgement of the cultural and spiritual significance of the Northern Quoll to Traditional Owners and their engagement as partners in recovery.

#### Specific goal relative to this strategy:

• Priority Northern Quoll populations in the Pilbara are identified and monitored for area of occupancy and abundance.



 Key threats to priority Northern Quoll populations are actively managed where necessary to ensure persistence, area of occupancy and abundance.

#### Strategy

Identify and protect Northern Quoll populations and their core habitat in key locations through management interventions following modelling (incl. field validation), and mapping of potential Northern Quoll habitat at pastoral station scale.

#### Activities/actions

- Habitat requirements. Define areas of critical habitat for northern quoll in the Pilbara. Understand how disturbance affects habitat quality and connectivity (Cramer *et al.*, 2016a);
- Ground truth Northern Quoll habitat modelling (in collaboration with Traditional Owner groups) and identify
  priority Northern Quoll populations in the Pilbara;
- Protect key habitat and priority populations, as informed by habitat modelling and ground-truthing (eg. isolated ironstone mesas and granite outcrops supporting key populations of Northern Quolls);
- Implement control strategies and associated monitoring program to assess effectiveness: grazing management, fire management, feral predator control etc.
- Habitat management through informal or complementary conservation mechanisms (eg Indigenous Ranger teams) – off reserve conservation, habitat management (DBCA Biodiversity Audit II)
- Habitat management through informal or complementary conservation mechanisms in liaison with land holders, mining proponents and pastoral lease holders (DBCA Biodiversity Audit II)

#### Lead

DBCA

#### Support

#### Mining Companies, Greening Australia

#### Do

#### Pastoralists, Traditional Owners, Ranger Groups

#### Monitoring and evaluation

Active monitoring is being undertaken for the Northern Quoll in the Pilbara (Dunlop *et al.*, 2016) as described below: **Presence survey and distribution modelling** 

• To inform species distribution modelling, DBCA has commenced a survey of quoll presence at 100 sites throughout the Pilbara. At each site, staff will undertake scat searches and deploy transects of baited remote motion sensor cameras in rocky areas to detect quoll presence.

#### Long term monitoring sites

 DBCA is also undertaking annual trapping at ten sites throughout the Pilbara to collect information on population demographics and abundance. Sites comprise Indee Station, Millstream Chichester National Park, Mt Florance Station, Karratha environs, De Grey Station, Mardie Station, Yarrie Station, Red Hill Station, Dolphin Island Nature Reserve and Karijini National Park.

#### Methods

- Trapping
- Camera trapping
- Habitat monitoring and distribution modelling:
- Genetic analysis of tissue samples (collected across the Pilbara between 2011 and 2015 for analysis of Pilbara population genetics) from: Cane River CP, Robe River Valley, Yarraloola Station, Red Hill Station, Pannawonica, Dolphin Island NR, Karratha Townsite, Mt Anketell, Millstream -Chichester NP, Coolawanyah Station, Hamersley, Mt Florance Station, Mallina Station, Mt Dove, Indee Station, BHP Rail Sites, Wodgina Mine, Roy Hill rail corridor, Hooley Station, Tom Price, Poondano, Port Hedland, ,Koodaideri, Woodstock, Turner River, Abydos Station, De Grey Station, Mt Webber mine, McPhee Creek, Yarrie Station, Nullagine, Meentheena CP.
- Dunlop *et al.* (2016) list sites where introduced and threatened species information has been collected under the Northern Quoll program.

#### Key issues/problem statement

An ongoing Pilbara research program led by DBCA (Dunlop *et al.*, 2016) is investigating the ecology of the EPBC listed Northern Quoll. Information from sites outside the protected area network that are linked to different management actions can help:

• define areas of critical habitat and how disturbance affects habitat quality;



- improve communication about this species; and
- improve our understanding of population dynamics and threats to the species (including interactions eg. weeds, fire, predators).

# **3.2.16** Greater Bilby Protection – Pilot Project

# Overarching Bilby 25 year "High Level" Goals (Bradley et al. 2015) (new goal for Pilbara CAP2) The persistence of a wild population that requires only a low level of management; No reduction in area of occupancy - compared to 2015; An increase in area of occupancy - compared to 2015; An increase in overall abundance - compared to 2015; Formal acknowledgement of the cultural and spiritual significance of the bilby to Traditional Owners and their engagement as partners in the recovery program.

#### Specific goals relative to this strategy:

- All known bilby populations are actively managed and monitored in the Pilbara.
- Enduring bilby havens created in 50% of their known range.

#### Strategy

Goal

Identify and protect Greater Bilby populations and their core habitat in key locations through management interventions following modelling and mapping of potential Bilby habitat at pastoral station scale.

#### Activities/actions

- Implement a coordinated large-scale survey of bilby occupancy in the Pilbara using sign plot technique perhaps similar to the indigenous ranger "Bilby Blitz" that is currently underway in the desert country <a href="http://indigenousdesertalliance.com/regional-projects/2017-bilby-blitz/">http://indigenousdesertalliance.com/regional-projects/2017-bilby-blitz/</a> that could occur once every few years;
- Identify bilby habitat (desktop) then ground truth (Traditional Owner groups);
- Identify and map all known bilby locations;
- Implement control strategies and associated monitoring program to assess effectiveness: grazing management, fire management, feral predator control.

#### Lead

#### DBCA

#### Support

Mining Companies, Greening Australia, Rangelands NRM, Community, Researchers, Pastoralists, Traditional Owners

Do

Ranger groups, Pastoralists, volunteers

#### Monitoring and evaluation

Survey techniques are currently under review (Dziminski and Carpenter, 2016) but are likely to include:

- two hectare plot method to record tracks, scats and multiples digging into the bases of Acacia shrubs where grubs are accessed; and
- use of drones mounted with cameras.

#### Key issues/problem statement

The Greater Bilby (*Macrotis lagotis*) is a burrowing marsupial that was once widespread across most of mainland Australia. Since European colonisation, the range and abundance of greater bilbies have contracted severely and bilbies have disappeared from at least 80 % of their former range (Dziminski and Carpenter, 2016; Cramer *et al.* 2016b). Bilby distribution is primarily confined to pastoral stations outside of the conservation estate. The implementation of pilot projects to protect Bilbies will raise awareness of this EPBC listed species and assist in better understanding their distribution and demographics in the Pilbara and appropriate management to ensure their persistence (Dziminski and Carpenter, 2016).




Figure 7: Current and potential bilby monitoring sites in the Pilbara (Dziminski and Carpenter, 2016)



# **3.2.17** Knowledge acquisition for protection of Tussock Grasslands and Priority Ecological Communities (PECs)

Increase knowledge of Tussock Grassland and other key PEC assets in key areas and manage and restore conservation values (new goal for Pilbara CAP2).

#### Strategy

Goal

Knowledge acquisition for protection of Tussock grasslands and PECs

#### Activities/actions

Improve understanding of extent and condition of Pilbara Tussock Grassland communities. Priority targets include:

- Roebourne Plains gilgai grasslands PEC;
- Four plant assemblages of the Wona Land System PEC;
- Kanjenjie Land System;
- Peedamulla Marsh vegetation complex PEC;
- Claypans of the Fortescue Valley (recently surveyed by DBCA);
- Kumina Land System;
- Mosquito Land System (mapping work in progress Millennium Minerals);
- Narbung Land System; and
- Coastal dune native tussock grassland dominated by Whiteochloa airoides along mainland coast.

#### Lead

DBCA, Greening Australia

#### Support

City of Karratha/other local government, mining companies, pastoralists

Do

#### DBCA, consultants, mining companies

Monitoring and evaluation

Adopt monitoring and evaluation techniques developed by DBCA, including mapping the extent of the areas, undertaking condition monitoring, and fauna sampling within these systems

#### Key issues/problem statement

Tussock grasslands occur mostly on alluvial plains, gilgai plains and drainage tracts. Most tussock grassland sites were in good condition (75%), 17% were fair and 8% were poor (van Vreeswyk *et al.*, 2004). Tussock grasslands are susceptible to grazing as they are palatable and preferentially grazed, particularly when they are green. They support high numbers of Priority flora species; however, many of these areas have not been adequately assessed. Detailed mapping is needed to guide management and restoration.

PECs are ecological communities that are likely to be under threat but do not meet survey criteria or that are not adequately defined (**Appendix 9.3**). Many are infrequently assessed for status/condition owing to lack of resources, especially for those not encompassed by biological survey and monitoring as per regulatory approvals and compliance (eg. for mining activities). Survey of wetlands of the Fortescue Valley (includes claypans) has recently been completed by DBCA (Pinder et al., 2017) and a Local Biodiversity Strategy is being prepared for the City of Karratha; these will examine some of the systems listed above.



#### **3.2.18** Knowledge management of Pilbara data

#### Goal

#### Specific goal relative to this strategy:

Development of a roadmap to deliver the Western Australian Biodiversity Science Institute (WABSI) information management vision - *An inclusive culture where biodiversity data is easily found, openly accessible, and able to be used for multiple applications', with a Pilbara-focused case study by 2019* (new goal for Pilbara CAP2).

#### Strategy

Knowledge management of Pilbara data.

Develop options to enable the systematic capture and sharing of Pilbara biodiversity data to:

- make this data discoverable and available to government, industry, and the community as a valuable resource in the short term, and
- to expand our knowledge base of flora and fauna information and support more informed and efficient decision making and policy formulation.

#### Activities/actions

Data sharing would improve knowledge of species ranges and critical habitats and could be used to design more effective targeted management strategies. This would have the added benefit of reducing the cost of some management actions by focusing management in areas where target species are present. WABSI is collaboratively developing a roadmap (as adopted from the Global Biodiversity Information Outlook, 2013) to support the enhancement of:

- open access and re-use culture: make open sharing of data standard practice through public funding and other incentives and through proper attribution and recognition of primary data resources, data creators and curators, including individuals as well as institutions;
- data standards: deliver a flexible set of data standards that support the re-use and interoperability of all biodiversity data;
- persistent storage and archives: provide a distributed network of data repositories for all types of biodiversity data, along with consistent handling of metadata, identifiers, licences, tools and services;
- policy incentives: ensure that public policies, legislation and funding initiatives at all scales combine to reinforce this strategy and support its individual components;
- biodiversity knowledge network: create the technical infrastructure to support curation and annotation of data
  using the best-available community expertise, in a way that makes such curation immediately visible to future
  users as well as providing feedback to data holders.

#### Lead

WABSI

Support

DBCA, Greening Australia, Mining Companies, Rangelands NRM

Do

WABSI

#### Monitoring and evaluation

The WABSI roadmap will develop options to enable the systematic capture and sharing of the biodiversity data captured in the Pilbara and assess how in the short-term we can make this data discoverable and available to government, industry, and the community as a valuable resource to expand our knowledge base of flora and fauna information and support more informed and efficient decision making and policy formulation.

#### Key issues/problem statement

During recent Pilbara workshops, there has been broad agreement on the need to improve data collation and knowledge sharing amongst stakeholders in the Pilbara (Carwardine *et al.*, 2014; Cramer et al., 2016a, 2016b, 2016c; Heydenrych *et al.*, 2016). Surveys and research projects associated with regulatory approvals and compliance (eg. mining development and monitoring) are generating a substantial and valuable body of biodiversity data. Most of these data are not readily accessible and there is a need to collate this information and make it publicly available. Data sharing would improve knowledge of species ranges and critical habitats and could be used to design more effective targeted management strategies and provide information on the status (condition) of a range of biota. This would have the added benefit of reducing the cost of some management actions by focusing management in areas where target species and systems are present and or require it most.



### **3.2.19** Spatial prioritisation of Pilbara biodiversity assets

#### Goal

#### Specific goal relative to this strategy:

Develop a publicly available, Pilbara-wide digital map of biodiversity assets which can be interrogated for use in a wide variety of applications including spatial prioritisation mapping for conservation outcomes (new goal for Pilbara CAP2).

#### Strategy

- Systematically capture the spatial biodiversity data of the Pilbara
- Through a consultative process with ecological experts, develop a series of biodiversity map layers for the Pilbara, based on a range of factors including biodiversity value/uniqueness and condition
- Develop a user-friendly interface for the use of this spatial database by a wide audience.

#### Activities/actions

- Align this project with proposed WABSI "Knowledge management of Pilbara data" above.
- Seek funding and ownership by a range of stakeholders.
- Appoint consultants to run the project, starting with wide consultation.
- Capture spatial data as a subset of other data captured and shared and ensure data standards allow for all spatial data files to be capture, and where appropriate and necessary, digitised.
- Consult with Pilbara ecolocial experts in the development and synthesis of final layers and methods used to provide data to map biodiversity value/uniqueness and condition.
- Road test the spatial layers for known pilot areas (include both those data rich and data poor subsets) to calibrate algorithms until experts are confident that the maps are sufficiently rigorous.
- Develop ways to incorporate data sets in an ongoing way, thereby ensuring that this project's data is continually improving.
- Ensure that the models and algorithms that underpin the front end of the mapping interface are flexible and able to be altered as more knowledge and data become available (not a "black box" approach)
- Develop a user-friendly web based platform and publish the maps electronically and in a short report.
- Undertake a road show to showcase the GIS layers and train people in its use.

#### Lead

#### WABSI, DBCA, Greening Australia, CSIRO

#### Support

#### Mining Companies, Rangelands NRM, DPIRD

#### Do

#### Consultants in conjunction with WABSI, DBCA, Greening Australia, CSIRO

#### Monitoring and evaluation

The Pilbara Spatial Prioritisation Project will develop tools which can be used by a range of people in the fields of conservation, industry, government/ policy makers and provide good scientific spatial data to expand our knowledge base and support more informed and efficient decision making and policy formulation. Monitoring and evaluation of the project should be built into the project roll-out and a suggested one year and two year review be undertaken to assess the value of the project relative to current spatial data layers and systems.

#### Key issues/problem statement

A spatial GIS layer was generated during the process of the Pilbara Conservation Action Plan (**Figure 1**), and a GIS data base of a range of surveys and reports undertaken in the Pilbara was compiled in 2015 (see <a href="https://www.gaiaresources.com.au/project/pilbara-corridors/">https://www.gaiaresources.com.au/project/pilbara-corridors/</a> and <a href="https://pilbaracorridors.com.au/the-pilbara/knowledge-management/">https://pilbaracorridors.com.au/the-pilbara/knowledge-management/</a>). In addition, a number of spatial map layers were examined during the process of the Pilbara CAP.

There remains a lack of a spatially prioritised map of biodiversity assets across the region which can be readily used by decision makers seeking to undertake actions. A request for mapping of biodiversity priorities has been identified in various Pilbara workshop processes, including during the Pilbara Conservation Action Planning process.

A project on spatial prioritisation using updated data sets, including data currently not publicly available and new data sets currently being compiled (e.g. the CSIRO weeds database), will be extremely useful in identifying areas for focus



of future conservation action. Carr *et al.*, (2017) noted that many organisations are currently looking at how spatial information and tools can be integrated into the Conservation Action Planning framework.

Pilbara-wide maps showing biodiversity significance for different taxa using community level modelling was undertaken (Williams *et al.*, 2013), as part of BHP Billiton Iron Ore's strategic assessment to assess potential effects of disturbance and management on biodiversity. A series of modelled maps was produced during this process, and limitations in available data and future recommendations suggested. The report recommended that the use of biodiversity significance based be based on two equations based on natural uniqueness and incorporating regional condition as part of the (then) current (BHP Billiton Iron Ore) regional assessment process (Williams et al., 2013). See overleaf.

It may be useful to use some of the techniques developed during this process in future prioritisation process for the Pilbara. MCAS-S (Multi-Criteria Analysis Shell for Spatial Decision Support could be considered for this purpose <a href="http://www.agriculture.gov.au/abares/aclump/multi-criteria-analysis">http://www.agriculture.gov.au/abares/aclump/multi-criteria-analysis</a>. MCAS-S is a freely available software tool developed by the Australian Bureau of Agricultural and Resource Economics and Sciences that brings the multi-criteria analysis (MCA) process into the decision-makers' realm. If this project were to be developed it would complement "Knowledge management of Pilbara data" to be led by WABSI, proposed above.







Significance is calculated as the species-area scaled effect of removing each cell as if the entire region were still in pristine condition. Darker green areas have a lower significance for biodiversity than yellow or red areas. Whiter areas are more uncertain than transparent areas





Figure 9: Biodiversity significance based on community-level modelling across the Pilbara, (Williams et al., 2013)

Significance is calculated as the species-area scaled effect of removing each cell (as if local condition were still pristine) from the region in its present state. Darker green areas have a lower significance for biodiversity than yellow or red areas. Whiter areas are more uncertain than transparent areas



## 4 Case Studies – Current Pilbara Activities

Included in this section are a selection of case studies detailing a range of important strategies and actions that are currently being implemented in the Pilbara region. These have been included as they represent:

- sound, cost-effective examples of existing on-ground actions that can be replicated elsewhere;
- examples of predominantly community led projects/initiatives that are working well and can be used as models for further on-ground actions;
- strategic actions that can be monitored to inform us whether our strategies are working or not (a critical part of the Conservation Action Planning (CAP)/Open Standards adaptive management cycle); and
- clear examples where actions have been documented and communicated (part of the capturing and sharing learning components of the CAP/Open Standards cycle).

## 4.1 PMMC West Pilbara Aerial Weed Survey – June 2017

#### 4.1.1 Overview

The PMMC is partly funded by multiple Pilbara Stakeholders including the Pilbara RBG, mining companies and Rangelands NRM, to undertake regional coordination of declared weed control programs across the region with a focus on high value pastoral landscapes and threatened species habitats. Priorities include strategic control programs, seeking funding to deliver on-ground activities and evaluating effectiveness of program activities.

Aerial surveillance is a key component of evaluating the effectiveness of our control work. Previously aerial surveillance efforts have been undertaken by the PMMC (2004, 2010, 2014) to detect the presence of declared weeds, particularly Mesquite and Parkinsonia.

In June 2017, threatened species habitats where PMMC coordinates declared weed management were surveyed in the West Pilbara to assess presence and density of key declared weed infestations, evaluate weed control efforts to date and prioritise for the future.

## 4.1.2 Outcomes

The survey, conducted using two spotters in an R44 helicopter recorded presence of plants using a multichannel data logger and GPS. Distinction between weed species, single plants and thickets of plants was achieved using different GPS markers. Key aspects of the survey included:

- the survey covered multiple tenures including sections of the Ngurrawaana Lease, Yalleen, Mardie, Yarraloola and Karratha pastoral leases, DBCA conservation estate, City of Karratha recreational estate, major highways, roads and access tracks;
  - habitats surveyed included Roebourne Plains coastal grasslands with gilgai microrelief on deep cracking clays (Roebourne Plains gilgai grasslands) (a PEC), a variety of river, creek line and riparian habitats, flood plains, a wide range of shrub



lands including Snakewood (*Acacia xiphophylla*) shrublands, gilgai cracking clay grasslands, and various ecotones and mixed habitats.

- The total length of the search transect was 1,488 km.
- The survey took two days with 17 hours flying time.
- the surveillance team included volunteers (36 hours of voluntary time from local ecologists) and the work was supported by in-kind support from Mardie Station.

This survey was conducted in accordance methods employed in previous PMMC surveys to ensure that results were comparable across survey years.

#### 4.1.3 Learnings

The results from the aerial survey are available from the PMMC on request and the key results are discussed below.

#### 4.1.3.1 Biological and chemical control - Ngurrawaana lease

For several years the Ngurrawaana Rangers have been actively managing the Parkinsonia infestation along the Fortescue River on their lease with best practice chemical control methods. The PMMC helped train the Rangers in the use of a new biological control method in 2017 and the Rangers recently (November 2016) employed this method in their integrated control of the Parkinsonia. The Rangers inoculated Parkinsonia along the Fortescue River on their lease with the Parkinsonia DiBak fungus biological control that had been developed by the University of Queensland and Bioherbicides Australia. During the aerial survey it was noted that the Parkinsonia plants on the Ngurrawaana lease were in low density but the plants still seemed healthy.

The GPS points and maps of the Parkinsonia plants recorded during this aerial survey have been cross referenced with the treatment points from the Ngurrawaana Rangers control efforts. This information has been discussed with the Ngurrawaana ranger coordinator and they will be able to target their future control and monitoring efforts based on the information gained.

#### 4.1.3.2 Biological and chemical control - Robe River, Mardie Station

The Parkinsonia infestation on Mardie Station on the Robe River was surveyed; the infestation is very dense and extends from the Yarraloola - Mardie Boundary to the coast line. This infestation has had no active management given that the area is remote and this dense infestation is situated in the last 25 kms of the river catchment and the seed is highly likely to be washing downstream from the infestation further up the river. The infestation further up the Robe River (on Yarraloola Station) is actively controlled with chemical methods and has secure funding (from Rio Tinto) to continue the on-going control work.

Knowledge gained from this survey has been incorporated into future prioritisation and control technique selection. Additionally, the PMMC arranged to take representatives from CSIRO Biological control group through the infestation to assess it's potential as a release site for the "Looper" control agent. The PMMC will also be investigating the potential to use this site in the broader testing of multiple biological control agents releases in the same location in the coming months. This work will likely include CSIRO,



University of Queensland and the Bioherbicides Australia group and include the "Looper" (a caterpillar that exclusively eats Parkinsonia leaves), a seed Borer and the Parkinsonia DiBak fungus.

## 4.1.3.3 Biological and chemical control - Maitland River, DBCA estate, Karratha Station

The Biological control agent (the "Looper") had previously been released at the Maitland River and this survey further supported the understanding that the release had not been successful given the density and extent of the Parkinsonia infestation. This survey added to the understanding of the specific areas of high-density patches of Parkinsonia where chemical control is physically excluded.

The information, data and photos gathered during the survey has been incorporated into the DBCA and PMMC plans to utilise fire as part of the integrated weed control program on this section of the Maitland River. The survey has also allowed the timing and specific spatial parameters of the planned fire to be more accurately defined.

#### 4.1.3.4 Infestation extension and outliers

The survey has enabled the assessment of an extensive range of habitats that are within, or adjacent to, the known infestations of the declared weeds. This survey has recorded single plants and small groups of plants that are:

- outside the known infestations and outside current management zones and/ or
- in areas where the infestations are managed and are currently in low to very low densities.

This information will be used to specifically target single plants and low density infestations during the 2017 PMMC coordinated declared weed on-ground control season before they establish or spred further through the habitats. This information has also been discussed with the relevant land managers with review of (and support to improve) biosecurity hygiene and seed dispersal risks.

## 4.1.3.5 Effectiveness of control efforts

The survey covered several key, on-going weed management areas where the PMMC currently conducts work. The areas targeted were those that also include threatened species habitats and/ or are known to support threatened species.

At all locations where on-going weed control is undertaken a reduction in the density of those infestations was recorded. Two examples are provided below:

- Aerial surveys of the Fortescue River from Gregory Gorge on the Ngurrawaana Lease through to Yalleen Station where sustained Parkinsonia control has been undertaken Between 2010 and 2017 showed that the density of the Parkinsonia has been considerably reduced.
- Control efforts along buffer zones between Yarraloola and Mardie Stations have resulted in a reduction of Mesquite and Parkinsonia, representing a significant effort given the extent and density of the infestations, also suggesting that current methods are working to contain the infestations.

The evaluation of the effectiveness of the PMMC coordinated declared weed program allows the continued refinement of the integrated program, particularly in terms of spatial priorities. This data and



information also provides invaluable motivation and positive feedback to those land mangers that are committed to this effort which is expensive, time consuming and laborious.

#### 4.1.4 Costs

The costs of the survey were covered by contracts between PMMC and Rangelands NRM and other partners. Other support included volunteers (36 hours of voluntary time from local ecologists) and the work was supported by in-kind support from Mardie Station.

### 4.1.5 Benefits

The PMMC and its partners will continue to deliver integrated declared weed management in the Pilbara region to support sustainability of our pastoral industry, conservation of our biodiversity and the protection of cultural values. On-going evaluation and critique of the control methods employed is an integral component of the work; this aerial survey has added extensive understanding to the current status of declared weeds in the West Pilbara Region.

## 4.2 Fortescue Marsh Feral Cat Baiting Program

#### 4.2.1 Overview

(adapted from Clausen et al., 2016).

Investigations into the use of the toxic Eradicat® cat bait to control the feral cat (*Felis catus*) is being undertaken at several locations in Western Australia (Australian Pesticides and Veterinary Medicines Authority research permit PER14102ver2). The work conducted on the Fortescue Marsh was implemented in an adaptive framework to determine the most efficient and cost-effective method to target feral cats in this environment.

Fortescue Metals Group (Fortescue) is aiming to reduce feral cat abundance on the Fortescue Marsh as part of environmental conditions under the EPBC Act. In doing so, this program aimed to reduce predation of native fauna by feral cats with an emphasis on threatened species listed under the EPBC Act. This program began in 2012 with monitoring of baiting efficacy through camera surveillance and use of radio-telemetry collars with an additional measure through genetic analysis conducted in 2016.

#### 4.2.2 Outcomes

In late July 2016, Eradicat® baits were aerially distributed over a 998 km<sup>2</sup> area of the Fortescue Marsh. Seventeen feral cats trapped within the treatment area were monitored with radio collars and the probability of occupancy was assessed prior to, and following baiting using camera traps at 64 treatment and 30 control sites using remote cameras.

Eradicat® baiting of the Fortescue Marsh resulted in an 82% knockdown of radio-collared feral cats. This impact was supported by occupancy modelling using remote camera data, which also demonstrated a significant effect of baiting in the treatment cell when compared to a control. Both the random and spatial models detected a decline in occupancy of approximately 50%.



Over the life of the project, annual baiting had a statistically significant impact on the population of feral cats (**Table 4**) with the level of impact influenced by the timing of the bait delivery and the environmental conditions (ie. drier conditions result in a greater knockdown). The 2012 results differed from this trend as remote cameras were positioned south of the Marsh where personnel were camped due to wet conditions limiting access to the north.

Incidental records of birds in 2016 produced a total of 91 species, the lowest recorded in the five-year study. Low richness may be due to low summer rainfall and dry conditions in and around the Marsh leading to reduced abundance of waterbirds and other nomadic species.

Year		% impact		
	Collars	Random Model	Spatial Model	
2012	-	75	60	
2013	-	30	30	
2014	70	10	25	
2015	37	20	15	
2016	82	50	50	

Table 4: Baiting impact determined from radio- collars and occupancy modelling, 2012-2016

#### 4.2.3 Learnings, benefits and opportunities

Genetic analysis of the feral cats sampled from in and around Fortescue Marsh demonstrated that, while the population on the Marsh (FM) has relatively high genetic diversity, cats around areas of mining infrastructure have relatively low genetic diversity and potentially significant levels of inbreeding. However, while the sample size for the FM population was adequate to sample most of the available genetic diversity, the sample size for Fortescue Camps (FC) (n = 14) was insufficient. Incorporating more samples from these areas would be valuable to provide a more accurate assessment of the genetics of this population. Nevertheless, it is probable that the FC population is less genetically diverse and is experiencing some inbreeding. Although no geographic population structure was predicted, some clustering of genotypes was observed for animals captured around Christmas Creek, suggesting a high degree of relatedness, further supporting predictions of inbreeding in this population.

This work shows that Autonomous Recording Units (ARUs) may have the potential to become useful tools for monitoring bird populations in the future. However, the Fortescue study flags a number of potential confounding issues and there is clearly need for refinement of both the software and hardware components before this method can be used reliably to accurately detect fluctuations in the abundance of individual species.



# 4.3 Fox Control at Flatback Turtle Nesting Rookery at Pretty Pool Beach4.3.1 Overview

Collection of Flatback Turtle (*Natator depressus*) nesting data, disturbance and beach information along Pretty Pool Beach, Port Hedland commenced in October 2005. From 2005-2008, data indicated that the level of predation by foxes was threatening the long-term survival of the Pretty Pool nesting population. Typically, only one in 1,000 turtle hatchlings survive to maturity. Unchecked fox activity was further impacting upon this ratio, placing the Pretty Pool Flatback Turtle population at risk.

During the 2007/2008 nesting season, 172 of 195 nests laid (88%) had succumbed to fox predation. Foxes were observed moving to Pretty Pool in late November/early December and began preying upon nests once the hatchlings first broke from their shells. Attracted by odour, foxes dug to the bottom of nests (approximately 60-80 cm below the sand surface) to eat hatchlings and egg remains. For those hatchlings not directly predated, their likelihood of survival is much reduced as they are not strong enough to swim, having been brought to the surface much earlier than they would have naturally. This leaves them vulnerable to predation by Silver Gulls and other beach predators.



Plate 2: Fox disturbed flat back turtle nest at Pretty Pool





Plate 3: Fox tracks on turtle nesting beach, Port Hedland

To reduce nest predation by foxes, Care For Hedland Environmental Association (Care for Hedland) instigated a fox trapping program at Pretty Pool Beach in October 2008, with financial support from BHP and LandCorp and land access via Town of Port Hedland. An adjoining program was also conducted at the Dampier Salt evaporation pond holdings.

Since October 2008, Animal Pest Management Services have conducted fox trapping at Pretty Pool Beach, with each session comprising 5-7 nights using 12 soft capture padded jaw foot hold traps. Due to the proximity to residential areas high visibility signage, radio and newspaper advertisements and letterbox drops are used to alert residents to trapping activities.

In October of each year, fox trapping is conducted at Pretty Pool, the adjoining Six Mile area and Dampier Salt evaporation ponds. The Pilbara Port Authority (Port Hedland) also undertakes fox control. Should any nest destruction from foxes be observed, additional sessions are instigated during hatchling emergence season.





#### 4.3.2 Outcomes

In 2008, two fox trapping sessions were conducted at Pretty Pool (one early October and one late November), yielding three fox captures. Although these foxes were removed from the population, 30 nests were destroyed during the 2008/2009 nesting season.

In 2009, three foxes were trapped between Pretty Pool and Six Mile Creek, with an additional six foxes trapped on BHP land and Pilbara Port Authority (ie nine foxes over six nights in the Port Hedland area). Of the foxes captured, four were female and five were male with all being adults.

Collaborative fox trapping across the Port Hedland area each October and late November from 2011-2014 coincided with no loss of turtle nests to fox predation during this time. However, in 2015/2016, 12 nests were destroyed by foxes, despite three fox trapping sessions being conducted, resulting in the removal of seven individuals (13 – 17 October: 1 adult and 4 juveniles; 30 November – 4 December: 2 juveniles; 15 –19 December: 0 captures).

In 2016, one fox trapping session was conducted at Pretty Pool and no foxes were caught. In 2016/2017, no turtle nests were lost due to fox predation.

#### 4.3.3 Learnings

Foxes migrate to Pretty Pool Beach in late November/early December, coinciding with first hatchling emergences of the year. Therefore, it is critical that fox control be conducted in October each year to intercept fox pups moving away from dens. If foxes remain and continue to disturb nests, subsequent campaigns are needed. To maximise the effectiveness of control efforts, it is important that all adjoining landholders conduct fox control concurrently (Dampier Salt, Town of Port Hedland and Pilbara Port Authority).

#### 4.3.4 Costs

Each fox control session at Pretty Pool Beach costs approximately \$3,000. This does not include the costs of undertaking fox control at Six Mile, Pilbara Port Authority (Port Hedland) areas and/or at the Dampier Salt Evaporation Pond holdings.

#### 4.3.5 Benefits

Prior to 2008, no successful Flatback turtle hatchling emergence tracks (ie from beach to the ocean) were observed. From 2011-2014, no turtle nests were recorded as having been lost to fox predation. In 2016/2017, 48 nests were recorded as having successful hatchling nest emergences.

## 4.3.6 Future plans/opportunities

Care for Hedland intends to continue the current annual fox trapping campaigns at Pretty Pool Beach and surrounding areas. There may be opportunities to collaborate with Universities to investigate stomach contents of captured foxes and undertake DNA analysis of the foxes caught to provide insight into diet and population dynamics, respectively.



## 4.4 Yarrie Fire Project

## 4.4.1 Overview

The Yarrie Fire Project is a partnership between Yarrie Station, landscape scientist Richard Glover and fire ecologist Dr Sarah Legge, funded by Rangelands NRM. Annabelle Coppin (Owner, Yarrie Station) aims to reduce the percentage of 'hot' fires at Yarrie each year and increase the amount of 'cool', controlled burns and the team has developed a fire strategy to achieve this. The main objectives of the fire project are to:

- support ecological health of country and wildlife;
- protect life and infrastructure; and
- support long term pastoral sustainability.

To meet these objectives, the team will:

- reduce extent of single fire events relative to baseline (2004-2016); reduce intensity of fires relative to baseline (2004-2016); prevent intense fires affecting sensitive areas, including river edges, gullies in ranges with fire sensitive vegetation and fauna, areas occupied by threatened species (bilbies, quolls).
- continue to maintain graded mineral earth breaks along fence lines and around paddocks; maintain a network of graded tracks across the property; and maintain graded lines and watered gardens around the homestead.
- reduce incidence of extensive wildfire in order to prevent loss of feed and disruption to feed budget; in areas of high cattle use (river flats and holding paddocks) maintain grass cover using fine-scale fire to limit wild fire spread, encourage green pick and prevent accelerating river flows and erosion; in areas of moderate cattle density, manage fire to support health of vegetation and soil.

The main goal for Yarrie Station is for only 5% to be burnt each year (currently at 8%), with 80% of fire events being cool, controlled burns as opposed to hot wildfires.





Plate 4: The fire strategy aims to prevent fire from impacting on riverine habitat and to limit 'hot' fires on Yarrie Station

Inappropriate fire regimes (a threat identified during the Pilbara CAP process) affect a large number of key assets including the Greater Bilby, Northern Quoll, grassland systems and fire sensitive ecosystems. One of the broad strategies identified in the Pilbara CAP was Coordinated Fire Management, with a specific strategy being to develop a coordinated approach for cross tenure fire management to protect assets. The Yarrie Fire Project aligns with required actions from this strategy; ie. for each station to create a fire management strategy from mapping, planning and implementation of burns. Annabelle is currently implementing a thorough monitoring system that will provide data on the success and costs associated with this program which can then be shared with others.

#### 4.4.2 Outcomes

Whilst this project is still in early stages, the group have analysed fire history on Yarrie and developed a plan with goals and monitoring guidelines. Annabelle has also undertaken 5-6 small patch burns (approximately 200 hectares). She will continue to undertake small controlled patch burns under this program and hopes to start seeing results in a few years.

#### 4.4.3 Costs

Unfortunately, the costs of undertaking wet burns on spinifex country are more expensive than burning over the winter period. The fires don't carry as readily and as such, it is more labour intensive and a significant amount of time is spent flying in the helicopter to ensure an area burns. Being able to manage these costs or show the added financial benefit of a healthy grassland system will be important to encourage pastoralists and other land managers to undertake wet season burning as part of their management approach.



### 4.4.4 Benefits

Biodiversity should be improved if fires are kept out of sensitive areas and local populations of threatened species should improve if their habitat is being appropriately managed through fire. Productivity should increase due to the country being better managed and large areas not being eliminated by hot, uncontrolled fires and less are taken out at one time. Protection of infrastructure and life – if large, hot fires are eliminated or reduced then there should be less damage to infrastructure such as fences, bores, no loss of life (human/stock/threatened species) and therefore savings.

## 4.4.5 Future plans/opportunities

Learnings from this project should be shared with other land managers. It would also be worthwhile to encourage other land managers to undertake this level of fire planning on their property, incorporating biodiversity and threatened species as part of their management program. To achieve this, additional help should be made available to pastoralists to undertake fire management and monitor the results to demonstrate financial and environmental benefits to cool season burning.

## 4.5 Feral Donkey Control in the Pilbara – Judas Program

#### 4.5.1 Overview

The Pilbara Regional Biosecurity Group (Pilbara RBG) is an incorporated group operating across the entire Pilbara region, with all pastoral properties as members of the association. The Pilbara RBG, in partnership with DBCA, has the capacity to operate across tenure to implement coordinated management actions across the entire Pilbara landscape.

The Pilbara RBG has a service agreement with DPIRD to arrange helicopters, fuel, aerial shooters and the telemetry and collar equipment to undertake radio tracking and aerial culls of feral donkeys. The Pilbara "Judas" Donkey telemetry collaring program, started by the Department of Agriculture in 1998, continues to successfully operate across the east Pilbara, with opportunistic aerial management culls of camels and feral horses on pastoral land also taking place as part of the program. The Pilbara RBG also has a partnership with DBCA for coordinated aerial control of large feral herbivores on DBCA managed lands and the interface between pastoral properties and desert lands.

Donkeys are herd animals. Fitting a network of radio-tracking collars on "Judas" donkeys across the program area allows the helicopter and shooter to locate herds of donkeys, culling most individuals and leaving the collared donkey to herd up with others elsewhere. There has typically been around four telemetry runs across the area each year (**Figure 6**) and has proven to be more efficient than trying to visually locate donkeys from the air.





Figure 8: Photo of a sedated feral donkey fitted with a radio tracking collar

This program needs to continue to control donkey numbers and ultimately achieve and maintain local eradication on additional properties. There is scope and opportunity to expand the current program to cover the entire Pilbara region.

Large feral herbivores (LFH) have a HIGH overall threat rank in the Pilbara CAP. LFH impacts on the following assets:

- 1. Spinifex Hummock Grasslands on plains;
- 2. Tussock Grasslands on plains;
- 3. Mulga Woodlands and Acacia Shrubland communities;
- 4. Rivers, creeks and associated floodplains on open plains;
- 5. Fortescue Marsh;
- 6. Springs, pools and watercourses gorges and ranges;
- 7. Clay pans;
- 8. Inland mountain ranges, rocky hills, breakaways and mesas; and
- 9. Rock piles and granites.

LFH impacts include soil compaction and erosion, loss of grazing-sensitive plant species, reduced native plant biomass, changes to native vegetation structure and habitat/food sources for native animals, and the loss of vegetation cover can expose small native animals to an increased risk of predation. Soil erosion can impact on waterway health and habitats.





### 4.5.2 Outcomes

The Program currently operates on 16 Pastoral stations and four DBCA managed estate (two reserves, two UCL). From 1998 to 2015, there have been over 17,000 donkeys culled by this program. Eight properties have achieved local eradication status. This outcome ties in with the following CAP goals and strategies:

- Overarching Draft Goals from Pilbara CAP1: By 2020 manage for feral herbivores over X ha to reduce adverse impacts to an agreed, acceptable threshold levels;
- Specific goal relative to this strategy: Locally eradicate where possible or maintain at low numbers feral donkeys, camels, horses, unmanaged cattle and pigs. Help enable project level actions and improve the status of assets, including the Greater Bilby and Northern Quoll.

## 4.5.3 Learnings

Key learnings include a greater understanding of the required density of collared donkeys to effectively cover the program area, with additional collars recently placed in some areas. When the program started collaring was occurring in parallel with aerial shooting, whereas ideally collars need to be fitted first. This allows the Judas herding process to occur, making the aerial shooting more effective. Consideration is also being given to removing some 'sentinel' collared donkeys where numbers have been reduced to the point where the collared individual is no longer herding up with others.

## 4.5.4 Costs

The Pilbara RBG has budgeted for 20 days of aerial flying and shooting for LFH control in 2017/18, at an average cost of \$8,000 per day for chopper, DPIRD shooter, fuel, ammunition and operating costs, totalling around \$160,000. Costs are expected to increase, and these costs are not based on using commercial shooters. DPIRD currently also provide a significant amount of program planning and operational staff time that is not included in the \$8,000/day average cash expenses. Future program costs are likely to be around \$10,000 to allow for cost increases in helicopter contracts, fuel and potentially, the use of commercial aerial shooters. Expanding the current program to cover the west Pilbara will require additional start-up costs for establishing a collar network before commencing culling. There is scope to improve monitoring of LFH numbers and distribution across the Pilbara, and continuing to learn and refine the methodology and location/density of collars.

An expanded program to cover the entire Pilbara is estimated to cost around \$600,000 per annum, including a project manager responsible for operations, monitoring and evaluation, and reporting and communicating results.

## 4.5.5 Benefits

Over 17,000 donkeys have been culled since 1998 and local eradication has been achieved on eight pastoral properties to date. Additional properties where the program has been consistently operating are expected to achieve local eradication as donkey numbers continue to decrease. Culling large feral herbivores provides immediate biodiversity benefits – the grazing/native vegetation/habitat and soil compaction/erosion impact pressures are removed from the landscape.





Working in partnership with DBCA, the program operates cross tenure including pastoral lease and DBCA managed lands.

## 4.5.6 Future plans/opportunities

The west Pilbara has not had a donkey telemetry program in place, with the most recent DPIRD aerial management shoot (visual location of donkeys from the air) occurring in 2004. Pastoral stations conservatively estimate a density of around 350 to 500 donkeys on each station, totalling around 3,000 donkeys across eight pastoral properties. Neighbouring DBCA properties also have high numbers of donkeys. Should ongoing funding be available, this area would greatly benefit from an expansion of the current (east Pilbara) Judas donkey program.

DBCA, with assistance from the Pilbara RBG and DPIRD, have been trialling a feral horse Judas collaring approach. There is an opportunity for the Pilbara RBG's donkey program to also target feral horses rather than undertake separate aerial culling exercises for the two species.

## 4.6 Rangelands Rehydration Works on De Grey LCDC Stations

#### 4.6.1 Overview

Soil erosion on pastoral properties in the De Grey LCDC area is mainly caused by water movement during extreme weather events; ie. heavy rain and flooding associated with cyclones. Addressing water flow is necessary to prevent and reverse soil erosion.

Where gully erosion occurs soil drainage increases, drying out landscapes that would have naturally held soil moisture for longer periods. Furthermore, wetlands dry out more rapidly, resulting in less plant growth, leading to more erosion.

Rangelands rehydration is a term being used to describe both addressing soil erosion and management of surface water to build and retain soil moisture and healthy landscapes. The key principles of rangelands rehydration are slowing rainfall runoff, increasing water infiltration into soil, increasing groundcover plant density/regrowth, and restoring natural water movement patterns.

## 4.6.2 Outcomes, learnings and benefits

De Grey Station has completed earthworks across floodplain creeks to control erosion caused by floods, slow water flow and spread water across the floodplain. Additionally, aerial drone elevation surveys were used to explore the feasibility of diverting floodwaters in a controlled way to rehydrate a floodplain and encourage plant growth. The survey produced contour mapping (10 cm intervals), showing height differences between the river channel, the top of the river bank, and ground levels on the floodplain. The survey results concluded that a pump and a long pipe would be required to divert floodwaters as the drop in elevation to the floodplain was not sufficient to support using gravity alone. The survey also identified that slowing and diverting natural runoff from Mt Grant directly onto the floodplain was more feasible than trying to divert water from the main river channel.





Figure 9: Contour mapping from aerial drone survey along the De Grey River on De Grey Station

Limestone Station has installed earth banks at strategic locations as per recommendations from Peter Andrews, and Tim Wiley (during Landscape Function Analysis mapping). Darryl Hill was contracted by Limestone Station to provide some training and guidance on using a grader to construct banks to manage water flow and soil erosion, and Grant Brooks from Limestone Station then constructed the earth banks, following through with the Darryl Hill's training.



Figure 10: Darryl Hill demonstrating earth bank design and construction to Grant Brooks (Limestone Station). Photo: Cam Brooks



Yarrie Station has completed staged rangelands rehydration earthworks over several years, continually learning and refining bank location and construction techniques. Peter Andrews guided Annabelle Coppin and Alex (Alic) Dorrington to peg out and grade banks to divert runoff from steep country, and to slow and manage water flow on the floodplain. As part of an ESRM plan prepared for Yarrie Station, Richard Glover mapped sites for rangelands rehydration earthworks and provided detailed bank construction diagrams to follow. Coordinated with Limestone Station, Darryl Hill provided some on-site training and bank construction using Yarrie's grader.

# 4.7 Yandeyarra Pastoral ranger team, undertaking on-ground training to care for culture, country and environment

#### 4.7.1 Overview

Yandeyarra Aboriginal Reserve and Kangan Pastoral Station are run as one pastoral lease in the Pilbara, the biggest pastoral lease in the region. Most of the lease runs along the Yule River with some hilly country occurring at the southern end of the property. The leases are important as they contain a variety of different land systems and habitats types and have been identified as having suitable habitats for Greater Bilbies, Northern Quolls, Pilbara Leaf-nosed Bats, Pilbara Olive Pythons, Spectacled Hare-wallabies and even the Night Parrot. A Ranger team has been established to train local community members and pastoral workers to be able to manage their land for conservation as well as production outcomes.



Plate 5: Yandeyarra Ranger team with Jo Kuiper (PMMC) and Pip Short (GA)



Threats to these assets as identified in Pilbara CAP include inappropriate fire regimes (ie. too many fires, too hot fires), overgrazing (cattle and large feral herbivores), predation by feral cats and habitat loss and fragmentation (mining and mining infrastructure).

#### 4.7.2 Outcomes

This project commenced in 2016 and is in its early stages. To date, the group has undertaken an initial baseline mapping session with community, Rangers, Pastoral Managers and elders (TOs) to identify areas of importance on the lease and to map local knowledge. This was undertaken with Dr Hugh Pringle using the Ecosystem Management Understanding (EMU) methodology. The session resulted in a series of detailed 'maps' being produced that recorded the community's ecological, cultural and production knowledge of their country. It also helped to identify what the group wanted to achieve, how they wanted the program to be run and the tasks that would help us achieve this goal.

Rangers are working approximately one week per month on country to develop their CLM skills. To date they have surveyed and treated weeds on the lease with the guidance and direction of Jo Kuiper (PMMC); undertaken a feral animal survey and set up pig traps at known locations in readiness for a trapping exercise later in the year; learnt about the different native fauna on the lease and learnt how to track, survey and monitor for bilbies (Alicia Whittington, DPaW).

Future works include; ethnobotanical survey and training from Vicki Long (Astron Environmental); native grass identification and production and conservation values; fire; feral animal trapping; environmental assessments and surveys; and fencing for conservation.

#### 4.7.3 Costs

The initial grant received from State NRM was for \$260,000 for a duration of 18 months, with costs including ten on-country weeks paying five Rangers and the GA coordinator, as well as any consultant costs needed to achieve the goals of the group.

#### 4.7.4 Benefits

The local community and pastoral workers are being trained to manage their lease for conservation, cultural and production outcomes. Local threatened fauna is being considered and incorporated into pastoral property management decisions. Long term, it is hoped that this will area will feature a productive cattle business alongside a strong local community (Yandeyarra) who are involved in looking after their country's culture as well improving the biodiversity on the lease and managing for threatened species.

## 4.7.5 Future plans/opportunities

Greening Australia and the community are keen to see this program continue as such as are looking for partners to continue the work across a range of different sectors to address multiple outcomes.



## 4.8 City of Karratha Local Biodiversity Strategy

## 4.8.1 Overview

The project involves the preparation of a Local Biodiversity Strategy for the City of Karratha municipality, which will identify areas of locally significant bushland, habitat and biodiversity corridors. The strategy will set targets and identify land use strategies for natural resource conservation, thereby enabling the City to work towards the achievement of one of its core organisational objectives outlined in the City of Karratha Community Plan –a thriving and sustainable natural environment. The strategy will improve education on the importance of natural resource management and increase the capacity for self-management of natural areas by the community. In addition, the project will aim to improve employment prospects of the local community by employing Natural Area Rangers to undertake the on-ground assessment of the identified viable natural areas.



Plate 6: Mangrove community within the City of Karratha (Photo: Vicky Long)





Plate 7: Hummock grassland community within the City of Karratha (Photo: Vicky Long)

#### 4.8.2 Outcomes

The project seeks to produce a comprehensive strategy that identifies areas of biodiversity value within the Karratha local government area, qualifies and prioritizes areas of biodiversity according to ecological criteria and determines preservation and rehabilitation strategies for long term conservation. The strategy will be landscape-scale (ie. landscapes and associated species, not just threatened species) and will aim to represent the region's stakeholders, with a particular focus on a collaborative management approach with traditional owners.

#### 4.8.3 Learnings

The project will result in broad scale mapping of significant local natural areas (LNAs) in the Karratha municipality, with an emphasis on riparian vegetation, coastal vegetation and vegetation within 10 km of town sites (ie. areas at most risk of degradation). This mapping will include onsite validation of the location of biodiversity hotspots, such as those containing TECs, priority fauna and priority flora. The project will also result in condition assessments of the LNAs, which can be used for future on-ground conservation programs.



### 4.8.4 Costs

The significant extent of the municipality has necessitated surveying a reconnaissance scale only. The number of priority locations to be surveyed will also be limited (ie. within reasonable proximity to town sites and known hotspots) due to cost. The final strategy will contain a mosaic of surveyed areas with a very broad level of ecological information, rather than a fully comprehensive survey across natural areas within the municipality. The expenditure for the project (including CofK in kind and State NRM grant) will be approximately \$100,000.

## 4.8.5 Benefits

The project will incorporate public consultation to ensure that the community has input into sites to be surveyed. The intent is to raise awareness on the importance of biodiversity and lead to behaviour change in the use of the natural environment. The project also aims to increase training opportunities for the indigenous community through a natural area assessment training program. Areas of high biodiversity will be identified leading to informed land use planning decisions that ensure appropriate conservation of these areas.

## 4.8.6 Future plans/opportunities

The final City of Karratha Local Biodiversity Strategy will be used as a platform for application of funding of on-ground conservation programs. The Strategy will also inform future planning decisions for the municipality, thereby avoiding possible development impacts on biodiversity hotspots. The Strategy will also be a publicly available document that can be used by various agencies for help with natural area management decisions.



## 5 Monitoring framework

## 5.1 Monitoring overview

The Conservation Action Planning (CAP) process requires a monitoring and evaluation process to:

- determine whether strategies and actions are achieving their desired goals;
- show trends in the condition of assets and the levels of threat;
- demonstrate the effectiveness of investment in conservation strategies;
- link local conservation outcomes to broader programs; and
- assist in securing future funding for sustaining action.

During the first phase of the Pilbara CAP process some existing monitoring programs were outlined (some of which are detailed in **Appendix 9.1**) and limitations noted as follows:

- some are out of date (e.g. one-off projects, programmes that have ceased) or unstructured;
- some are site specific and cannot easily be applied at a landscape level;
- some lack the necessary rigour to be useful or are based on ambiguous objectives;
- some are data collection exercises, rather than monitoring and evaluation per se; and
- some may collect information that is not readily accessible (eg compliance monitoring by mining companies, Heydenrych *et al.*, 2016).

These shortcomings were taken into consideration during the Phase 2 of the Pilbara CAP when interviewing ecological experts, undertaking literature searches and investigating new data sets such as the Biodiversity Audit II. Information about Key Ecological Attributes (KEA) exists for certain assets such as the newly added mammal fauna assets but there is little collated monitoring data available for many fauna species and broader ecological systems at a sufficiently broad scale to allow for an assessment of "health" of conservation assets and status of threats.

Additionally, and not surprisingly, there is a bias towards conservation significant species and communities in the Pilbara (eg. Carwardine *et al.*, 2014; BHP Billiton Iron Ore, 2016). The Biodiversity Audit II has a focus on threatened flora or declared rare flora, threatened fauna, threatened ecological communities (TECs), priority ecological communities (PECs) and potentially threatened taxa/candidate priority ecological communities (May and Brennan, 2015). While it is important to focus on species and communities under threat, it is also important to ensure common species and communities remain common (Watson and Watson, 2015) as communities/species which may not be threatened themselves are part of the feeding/ breeding / habitat requirements of threatened species.

Good resource condition monitoring data should provide information on current status of the key ecological attributes, overall viability (health) of conservation assets, provide quantitative data to assess the current status of the key threats, establish/augment baseline data to monitor future changes of conservation assets and key threats.

Within the Pilbara region, there is a wealth of data, in particular those generated by mining companies' environmental approvals processes, that is not in the public domain but could be used to better inform



ecological decision making at scale (Carwardine *et al.*, 2014; Thompson, 2016). The Western Australian Biodiversity Science Institute (WABSI) is analysing the current state of biodiversity information, the challenges as well as the value that can be added by collecting and managing these and other data in WA. Curation of these biodiversity data would allow for querying and analysis and derivation of information products and on-line services to inform decision making and management across various sectors including NRM, industry, government and research.

Pringle *et al.* (2006) argued for both site-based quantitative information and broader scale qualitative observations in the rangelands when monitoring and assessing systems beyond the traditional site-based focus, noting that geomorphic drivers need to be considered in broad-scale assessment of ecosystem dynamics. Rangelands monitoring has focused on the identification of key indicators and techniques but advice about where to monitor in the landscape needs to be provided as well (Pringle *et al.*, 2006).

Eyre *et al.*, (2011) proposed a new a biodiversity monitoring framework for the Australian rangelands that uses a combination of direct and indirect measures of biodiversity and drivers as follows:

- targeted monitoring; involving localised field-based monitoring of target species, addressing specific management questions;
- surveillance monitoring; involving broad-scale, field-based sampling of multi-taxa and a set of habitat and condition attributes; and
- landscape-scale monitoring; providing regional to national-scale intelligence on habitat quality and trends in threats to or drivers of biodiversity, with data obtained using systematic groundbased and remote methods.

These authors recommend that a high proportion of available resources be dedicated to surveillance monitoring, as this component has the potential to yield the most informative data on biodiversity change, particularly at broad scales.

## 5.2 Pilbara wide biodiversity data sets

## 5.2.1 BHP Billiton Iron Ore Strategic Environmental Assessment

A Pilbara-wide biodiversity mapping exercise using community level modelling was undertaken by Williams *et al.* (2013) as part of BHP Billiton Iron Ore's strategic assessment to assess potential effects of disturbance and management on biodiversity. The datasets (housed by CSIRO and not currently publically available) include:

- mean percentage bare ground cover for the Pilbara region (2000-2011);
- interim biodiversity habitat condition layer, Pilbara Region;
- predicted richness and standard errors for five biological groups across the Pilbara;
- environmental predictors for compositional turnover in five biological groups across the Pilbara, and
- biodiversity significance analyses and associated uncertainty for five biological groups across the Pilbara (Williams *et al.*, 2013).



## 5.2.2 DBCA: Biodiversity Audit II

Biodiversity Audit II is an evidence-based and expert opinion assessment of components of WA's terrestrial and aquatic biodiversity, presenting a 'snap shot' in time of our knowledge of the condition of the State's biodiversity (trends between 2002 and 2013), the pressures that the State's biodiversity has endured since 2002 and forecast future threats over the next 20 years (May and Brennan, 2015). It also provides management requirements to address those threats, building on management actions from Audit I. The Audit, which uses a consistent approach for all biodiversity assets, is not restricted to DBCA management (other organisations and roles are also identified) and categories of management actions include:

- research;
- evaluation;
- conservation planning;
- direct management; and
- indirect management (May and Brennan, 2015).

Audit 1 scored the "condition" of threatened species and ecological communities according to one of four condition categories: degraded; fair; good; or near pristine and the change in the condition (ie. trend) of a species or community using five categories: extinction (no observations in 20 years); rapidly declining; static; improving; or unknown. In Biodiversity Audit II, an improved process was used, relying on a variety of sources, and IUCN metrics are attributed with a trend. Throughout Audit II, the term "current condition" or "condition" is collectively used for flora, fauna and ecological communities to describe:

- known number of evolutionary significant units (ESUs) and trends (flora and fauna only);
- known number of populations or occurrences and trend (ecological communities);
- known number of mature individuals and trend (flora and fauna only);
- extent of occurrence and trend (flora, fauna ecological communities);
- area of occupancy and trend (flora, fauna ecological communities);
- extent and severity of abiotic degradation and trend for each (ecological communities); and
- extent and severity of biotic degradation and trend for each (ecological communities) (May and Brennan, 2015).

Biodiversity Audit II has not been synthesised or published as was done for Audit 1 (McKenzie *et al.*, 2003) and is only accessible via a database within the DBCA library. It focuses on assets under threat including TECs and PECs (see **Appendix 9.2 & 9.3**), several EPBC listed fauna species and only one species of plant for the entire Pilbara, the endangered *Aluta quadrata*.

Summary statistics were calculated for Biodiversity Audit II and supporting maps produced for each of Western Australia's 55 IBRA sub-regions, with statistics including themes such as:

- area of the sub-region;
- level of intactness;
- tenure;



- land use;
- complementary conservation reserve system;
- indigenous lands;
- climate projections; and
- native vegetation (vegetation associations).

The analysis was undertaken in 2012 based on available spatial data and for some metrics, availability of historical data enabled a 10-year change analysis to be undertaken (Kinloch et al., 2014).

## 5.3 Pilbara wide vegetation condition monitoring

#### 5.3.1 DPIRD (DAFWA) Rangelands Survey

Completed in 2004 (Van Wreeswyk *et al.*, 2004), the rangelands survey included soil mapping and land systems were derived from this survey for the entire Pilbara. Land systems represent the best mapped information for land management and are the basis for the delineation of the Pilbara CAP high level assets.

During this initial survey, condition statements were made for the whole survey area and for each land system. In assessing the impact on perennial vegetation by pastoral usage, the survey found:

- 77% of survey locations indicated good or very good rangeland condition;
- 11% indicated fair rangeland condition, and
- 12% indicated poor or very poor rangeland condition (Van Vreekswyk et al., 2004).

#### **5.3.2** Western Australian Rangeland Monitoring System (WARMS)

Western Australian Rangeland Monitoring System (WARMS) sites are designed to provide defined areas for repeated photography and collection of vegetation composition, shrub/tree cover and landscape function (soil surface assessment) data (Craig and Thomas, 2008). Sites exist on all pastoral leases, and the programme is managed by DPIRD. WARMS provides high reliability for reporting change, with a large number of well distributed sites, quantitative data, and a focus on perennial plant species (which helps to filter short-term seasonal variability.

#### 5.3.3 DPIRD (DAFWA) report - condition trend of the WA pastoral resource base

Watson and Thomas (2016) investigated the current condition of land under pastoral lease from analysis of WARMS data (see above), MODIS satellite plant cover data and greenness (NDVI) for four Land Conservation District Committee (LCDC) areas of the Pilbara (different to the Pilbara Bioregion). They suggest that caution is needed when interpreting the report as this summary data may mask the variation in condition evident on leases within a Land Conservation District. The baseline for condition of the rangelands in the Pilbara as a whole using 2001-09 traverse data was: Good 64% Fair 24% Poor 12%.

Since the 2001-09 traverse assessment of rangeland condition, the frequency of desirable perennial grasses on WARMS sites has increased in some LCDs suggesting some improvement in current condition of rangelands under pastoral lease in this region. However, since monitoring commenced in 1994, there has been a downward trend in desirable perennial grasses across the Pilbara (Watson and



Thomas (2016). A second indicator – plant cover estimated from the CSIRO MODIS fractional cover data archive – shows downward trends since 2006, with the exception of the East Pilbara LCD.

## 5.3.4 AusPlots

Between April 2015 and August 2016, AusPlots (part of the Terrestrial Ecosystems Research Network, TERN), conducted surveys in the Pilbara. Surveys of vegetation and soils at 37 plots followed the AusPlots Rangelands methodology, and data can be accessed online (<u>http://www.aekos.org.au</u>). Many of the sites were combined with existing biological survey sites previously established by DBCA.

Uses for this information within the Pilbara include: assessing vegetation change; detecting the impact of invasive species; ground-truthing satellite-derived vegetation and soil data; soil carbon analysis using the soil bulk density samples; mapping soil phosphorus; nitrogen and other nutrients; assessing fuel loading using the basal area and leaf area data and the use of the leaf tissue samples for genetic and isotopic analysis (TERN, no date).

Although AusPlot sites are resource-intensive to establish (White *et al.*, 2012), they provide long-term comprehensive and comparable datasets that can be used to assess management interventions. To date, AusPlots in the Pilbara are largely confined to the Fortescue and Hamersley sub-regions. It is recommended to extend the program to other sub-regions and there is an aim for up to 70 sites to be established within the Pilbara bioregion (Ian Cotton, 2015, pers. comm.)

## 5.3.5 DBCA Baseline Inventory Sites

The Pilbara Region Biological Survey (2002-2013) was undertaken to gain greater knowledge about the biodiversity of the Pilbara region (see <u>https://www.dpaw.wa.gov.au/about-us/science-and-research/biological-surveys/115-pilbara-biological-survey?showall=1</u>) and assist with developing a framework to guide sustainable land-use and conservation planning in the Pilbara. This framework aimed to:

- assess the region's national parks and other conservation reserves;
- improve the environmental impact assessment process;
- verify where threatened species and ecological communities occur;
- provide detailed information on stygofauna; and
- document new information about the plant and animal communities of the Pilbara.

The results of the survey have been published in a series of papers described in an overview by McKenzie *et al.*, (2009). There is also a database website associated with earlier survey work up until approximately 2004 that aimed to document all terrestrial biological surveys in the Pilbara (Higgs, 2005) and can be found here: <u>https://science.dpaw.wa.gov.au/projects/pilbaradb/</u>.

Over 400 permanently marked baseline inventory sites were established across the Pilbara to record floristic and vegetation data. Some of these sites have been paired with other monitoring approaches such as the AusPlots data as described above.



### 5.4 Other monitoring programs

#### 5.4.1 Local scale vegetation monitoring

Local scale vegetation monitoring is conducted primarily by mining companies, via environmental consultants. Documentation may be available via compliance reporting to the State Government.

#### 5.4.2 Fauna monitoring

#### 5.4.2.1 Kangaroo counts

Managed by DBCA and contributes to Australian Commonwealth Rangelands Information System). This count includes feral species and is conducted every 3-5 years.

#### 5.4.2.2 EPBC listed species

Typically includes Northern Quolls, Pilbara Leaf-nosed Bats, Greater Bilby and turtle species. These and other EPBC listed species are often monitored on a local scale for mining projects as a matter of compliance. Local environmental groups including Care for Hedland and West Pilbara Turtle Program, in conjunction with DBCA undertake regular turtle surveys.

#### 5.4.2.3 Other local scale monitoring

Wedge-tailed Shearwater – some project work on offshore islands; Dampier Salt bird surveys – via Birdlife Australia; Fortescue Marsh – national bird survey through UNSW; Freshwater Fish –Dave Morgan, Murdoch University (Morgan *et al*, 2009).

#### 5.4.3 Feral animals

#### 5.4.3.1 Judas donkey program

Not monitoring per se but provides a regular index of abundance (**Figure 6**). Additionally, some satellite collars are being put on horses around the Fortescue Marsh area with the aim of monitoring movements.

#### 5.4.4 Weeds

#### 5.4.4.1 Mesquite, Parkinsonia and other species

Weed sightings and control areas are spatially mapped by groups such as the Pilbara Mesquite Management Committee. This includes both ground and aerial survey techniques and includes a recent helicopter-based weed mapping exercise over the large area of the Western Pilbara to record weed infestations. Information is spatially captured in a GIS database and has been incorporated into a Pilbara-wide CSIRO weed database (Webber *et al.*, 2016a; 2016b).

This CSIRO database aims to aggregate all available weed data across the Pilbara using a variety of sources including scans from reports and electronic records (Webber *et al.*, 2016a; 2016b). Webber *et al* (2016a) note that the weeds of the Pilbara are relatively well known, and have been reviewed in at least three publications:

- the checklist of weeds per IBRA region (Keighery and Longman 2004 in Webber *et al.*, 2016a) (86 taxa);
- 2. a list of weeds found in the region's pastoral lands (Van Vreeswyk et al. 2004) (44 taxa); and



3. the naturalised vascular plants of the Pilbara region (Keighery 2010, in Webber *et al.*, 2016a) (103 taxa).

DBCA produced a priority weed list for the Pilbara, which considered 150 taxa (<u>http://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds</u>). Online databases Naturemap and Florabase show the distribution of these weeds based on herbarium collections.

A source of weed information not captured in current online databases or herbaria is the significant volume of unpublished flora and vegetation reports compiled by botanical consultants for Pilbara mines seeking a Native Vegetation Clearing Permit or an activity subject to the EPBC Act or for compliance. The collating and synthesis of this weed data will allow for a greater understanding of distribution and prioritisation of threats (Webber *et al.*, 2016a).

## 5.4.5 Fire regime

#### 5.4.5.1 North Australia Fire Information (NAFI)

NAFI has been extended for the WA rangelands, including the Pilbara. This data provides combined fire scar histories, remote sensing and fire monitoring, and reporting capabilities. http://www.firenorth.org.au/nafi3/

#### 5.4.5.2 CSIRO Sentinel Hot Spots Satellite data

This webpage shows real-time hot spot information to show the location of active fires across the country. (<u>https://sentinel.ga.gov.au/#/</u>).

#### 5.4.5.3 Landgate Firewatch

FireWatch uses satellite instruments to detect current fire hotspots on the ground across Australia, providing the most up to date information to both fire management agencies and the general public for remote sensing and fire monitoring. (<u>http://firewatch-pro.landgate.wa.gov.au/home.php#</u><u>http://firewatch.landgate.wa.gov.au/landgate\_firewatch\_public.asp</u>).



## 6 Additional information to inform strategies

## 6.1 Refinement of the CAP Stage 1 conservation assets

The categorisation of landscape assets that was used in Pilbara Phase 1 (Heydenrych *et. al.*, 2016) is similar to groupings that were used to define ecosystem types in an analysis of priority threat management requirements for the Kimberley (Carwardine *et al.*, 2011).

Following team discussions and meetings with Technical Experts, Pilbara-wide landscape assets were re-classified into IBRA subregions, as per definition within DBCA's biodiversity audit (May and Brennan, 2015). The subregional scale was also considered to be more suitable for practical conservation planning and management for the purposes of the Pilbara CAP.

In addition to the reclassification of landscape assets, several key conservation significant fauna species were elevated to the status of Pilbara-wide assets:

- Northern Quoll;
- Greater Bilby; and
- Pilbara Leaf-nosed Bat (Note: the Ghost Bat is to be included in threats and management with this species).

Each of these species has a widespread distribution in the Pilbara (ie. crossing multiple landscape types), are widely recognised has having a strong need for ongoing conservation effort, and are better suited to targeted conservation planning rather than being nested within landscape assets, based on their ecological requirements.

Upon revision, 33 conservation assets were identified for the Pilbara region (**Table 5**). Within each IBRA subregion, nested assets have also been identified. An investigation of the spatial allocation of Pilbara Priority Ecological Communities (PECs), Threatened Ecological Communities (TECs) and Important Bird Areas (IBAs) was done to help classify these important nested assets into their component ecosystem asset groupings, and to see where these areas are located spatially with regards subregions and land tenures. Details of current Pilbara PECs and TECs are provided in **Appendix 9.2 & 9.3**.



#### Table 5: Reclassified landscape conservation assets and a subset of key nested assets

Asset #	Landscape Conservation Asset (as per CAP Stage 1)	Nested Assets		
Chichester sub-region (PIL1)				
1	Chichester (PIL1) Spinifex Hummock Grassland on Plains with Shrubs and Trees	Mosquito Land System PEC		
2	Chichester (PII 1) Tussock Grasslands on Plains	Cracking Clays near Marble Bar		
		Four plant assemblages of the Wona Land System PEC		
3	Chichester (PIL1) Mulga Woodlands and Acacia Shrubland Communities	Narbung Land System		
4	Chichester (PII 1) Inland Mountain Ranges, Rocky Hills	Spectacled Hare wallaby		
	Breakaways and Mesas	NOTE: interfaces with tussock grassland communities e.g. at Yarri, De Grey and Warrawagine stations.		
5	Chichester (PIL1) Rivers, Creeks and Associated Floodplains	Numerous permanent and persistent river pools (e.g. Coppins Gap, Carawine Gorge, Skull Springs, Running Waters, Pelican Pool in Meentheena CP)		
	on Open Plains	Livistona alfredii populations in the Chichester escarpment (Sherlock River drainage).		
6	Chichester (PIL1) Springs, Pools and Watercourses	Millstream wetlands		
	Associated with Gorges and Ranges	Invertebrate assemblages (Errawallana Spring type) Coolawanyah Station PEC		
7	Chichester (PIL1) Rock Piles and Granites	Abydos Granite Field; Black Range; Spear Hill Priority Flora – e.g. Acacia leeuweniana		
Fortescue sub-region (PIL2)				
8 F v	Fortescue (PIL2) Spinifex Hummock Grassland on Plains	Astrebla, Sorghum and Themeda grasslands on flood plain of Fortescue River between Marsh and Millstream (Mulga Downs, Mt Florence and Coolawanyah Stns)		
	with Shrubs and Trees	Vegetation of sand dunes of the Hamersley Range/Fortescue Valley (PEC)		
9	Fortescue (PIL2) Tussock Grasslands on Plains	Acacia vegetation communities of the Christmas, Cowra and Marillana land systems (restricted to the Fortescue Valley).		
10 For Cor				
		Subterranean fauna Riparian forests/woodlands		
	Fortescue (PIL2) Mulga Woodlands and Acacia Shrubland	Millstream fan palm - <i>Livistona alfredii</i>		
	Communities	Coolibah-lignum flats: <i>Eucalyptus victrix</i> over Duma sp. community PEC (nested within the Coolibah Land System)		
		Ethel Gorge aquifer stygobiont community TEC		
11		Turbid Creek Pools		


Asset #	Landscape Conservation Asset (as per CAP Stage 1)	Nested Assets		
	Fortescue (PIL2) Rivers, Creeks and Associated Floodplains on Open Plains	Stygofaunal communities of the Western Fortescue Plains freshwater aquifer PEC		
		Clay pans in the Upper Fortescue Catchment.		
		Freshwater claypans of the Fortescue Valley PEC.		
10	Fortoscuo (PII 2) Clay Plans	Numerous – as per EPA Report 1484:		
12	Fortescue (FILZ) Glay Flans	Pools - present for prolonged periods following flow events Fresh/brackish springs		
		Samphire vegetation communities Aquatic invertebrates		
		Waterbirds		
		Flora of conservation significance Fauna of conservation significance		
		Aquatic invertebrates Waterbirds		
		Vegetation communities		
13	Fortescue (PIL2) Fortescue Marsh Land System	As per EPA Report 1484 Subterranean fauna Aquatic invertebrates Vegetation communities		
		Flora of conservation significance		
		Fortescue Marshes IBA		
14	Fortescue (PIL2) Calcrete Flats (south of Fortescue Marsh – Calcrete Land System)			
Hamers	sley sub-region (PIL3)			
15	Hamersley (PIL3) Spinifex Hummock Grassland on Plains with Shrubs and Trees	Sand Sheet vegetation (Robe Valley) PEC		
		Themeda grasslands on cracking clays (Hamersley Station, Pilbara) TEC		
16	Hamersley (PIL3) Tussock Grasslands on Plains	West Angelas Cracking-Clays PEC		
10		Brockman Iron cracking clay communities of the Hamersley Range PEC		
		Red Hill Station - very isolated areas of Mulga in the extreme west of the subregion		
17		Grove/inter-grove mulga communities eastern Hamersley Range Mulgalands Reserve proposal		
	Communities	Mulga woodland associated with Munjina Claypans, Wunna Munna Flats, Mt Bruce flats and Coondewanna Flats.		
		Triodia sp. Robe River assemblages of mesas of the West Pilbara PEC		
18		Other subterranean fauna habitat		



Asset #	Landscape Conservation Asset (as per CAP Stage 1)	Nested Assets
		Mountain tops of the Hamersley Range – rare and restricted flora
		Weeli Wolli Spring community PEC
	Hamersley (PIL3) Inland Mountain Ranges, Rocky Hills,	Stygofaunal community of the Bungaroo Aquifer PEC
	breakaways and mesas	Invertebrate assemblages (Nyeetberry Pool type) PEC
		Palm Spring on Duck Creek
		Other subterranean fauna habitat
	Hamersley (PII 3) Springs, Pools and Watercourses	Springs and pools of the Karijini (Hamersley Range) Gorges
19	Associated with Gorges and Ranges	Coolibah-lignum flats: <i>Eucalyptus victrix</i> over lignum community PEC (at Coondewanna Flats, Wanna Munna Flats and Mt Bruce Flats)
		Munjina clay pan Mulga
20	Hamersley (PIL3) Clay Pans and flood-out areas	Lake Robinson on Coondewanna Flats
		Endemic flora at Tom Price on a few rock piles (Basalt – Jerrinah formation)
	Hamersley (PIL3) Inland Mountain Ranges, Rocky Hills,	Subterranean invertebrate communities of mesas in the Robe Valley region PEC
21	Breakaways and Mesas	Subterranean invertebrate community of pisolitic deposits in the Pilbara PEC
22	Hamersley (PIL3) Rock Piles and Granites	
Roebo	urne sub-region (PIL 4)	
		Seabirds (Dampier Archipelago, Bedout Island)
		Northern Quoll (Dolphin Island)
23	Roebourne (Pil4) Offshore Islands	Turtles (Rosemary Island)
		Land snails, Rock Wallaby (Depuch Island)
		Others as per advice from Cheryl Lhor
	Roebourne (Pil4) Coastal Mangroves and Intertidal Mudflats	Dampier Saltworks IBA
	NOTE Key locations include: Mouth of Do Grey, Turner	Port Hedland Saltworks IBA
24	Yule. Harding and Cane Rivers. Port Hedland. Balla. Dixon	Pilbara Mangrove Bat Assemblage
	Island, West Intercourse Island, Nickol Bay, Fortescue River delta, Maitland River delta, Robe River delta, Cossack to Harding Delta complex (highest diversity of mangrove plant species), Sherlock Bay, Ronsard Island	Dampier Archipelago – West Intercourse Island Mangrove community Floristically diversity Mangrove community – Cossack - Harding River
25	Roebourne (Pil4) Sandy Beaches and Dunes	Turtles near Port Headland



Asset #	Landscape Conservation Asset (as per CAP Stage 1)	Nested Assets		
	NOTE - Key locations include: Munda; Port Hedland; Point Sampson beaches; 40 mile beach (South of Karratha); Wickham; and Cape Preston	Declared Fauna - <i>Lerista nevinae</i> at Cape Lambert – Port Walcott		
26	26 Roebourne (Pil4) Spinifex Hummock Grassland on Plains with Shrubs and Trees Tanpool Land System PEC			
		Horseflats Land System PEC		
27	Roebourne (Pil4) Tussock Grasslands on Plains	Roebourne Plains coastal grasslands PEC		
		Stony Chenopod association of the Roebourne Plains area PEC		
		De Grey River		
28	on Open Plains	Permanent pools of coastal rivers: Turner, Yule, Sherlock, Harding, Maitland, Fortescue		
		Peedamulla Marsh vegetation complex PEC		
29	Roebourne (Pil4) Clay Pans and flood-outs	Burrup Peninsula rock pile communities PEC		
20	Bachaurna (Bild) Back Biles and Cranitas	Burrup Peninsula rock pool communities PEC		
30	Roebourne (Pil4) Rock Piles and Graniles	Pilbara Olive Python ( <i>Liasis olivaceus barroni</i> )		
Whole	of Pilbara			
31	Northern Quoll (Dasyurus hallucatus)			
32	Greater Bilby ( <i>Macrotis lagotis</i> )			
33	Pilbara Leaf Nosed Bat (Rhinonicteris aurantia)			

NB: the table shows the re-classification of assets identified in the first phase of the Pilbara CAP process by sub-region, with a range of nested assets. There are numerous nested assets not listed here; for details, refer to descriptions in the Pilbara CAP summary report (Heydenrych *et al.*, 2016).



# 6.2 Fauna assets

Summary information for significant fauna assets is provided in the following sections, based on advice received from Technical Experts and information contained in the Pilbara Biodiversity Audit II. This includes possible strategies for addressing threats to these species.

### 6.2.1 Pilbara Leaf Nosed Bat

### 6.2.1.1 Distribution

Pilbara Leaf-nosed Bats (and Ghost Bats) occur within the following assets:

- Chichester (PIL1) and Hamersley PIL3
  - o Inland Mountain Ranges
  - o Rocky Hills, Breakaways and Mesas
  - Springs, Pools and Watercourses Associated with Gorges and Ranges.

The modelled distribution of the species is available within EPBC Act Conservation Advice and approximate locations of day roosts are detailed by Cramer *et al.* (2016c).

Threat	Scope	Severity	Irreversibility	Summary Threat Rating
Introduced herbivores	Not Specified	Not Specified	Not Specified	Not Specified
Inappropriate hydrological regime	Low	Very High	High	Low
Clearance from mining and mining infrastructure	High	Very High	Very High	Very High

#### 6.2.1.3 *Priorities for applied research*

- 1. Collate existing data contained within unpublished environmental surveys;
- 2. Clarify and better characterise the number and distribution of day roosts;
- 3. Better understand habitat requirements, particularly foraging habitat, and the movement of bats between roosts;
- 4. Provide more robust estimates of total population and colony size, and improve understanding of social behaviour; and
- 5. Investigate appropriate buffers in a range of mining contexts and protocols for artificial roost construction (Cramer *et al*, 2016c).

## 6.2.2 Northern Quoll

#### 6.2.2.1 Distribution

Northern Quolls occur within the following assets:

- Chichester (PIL1), Hamersley (PIL3)
  - Inland Mountain Ranges



- o Rocky Hills, Breakaways and Mesas
- Springs, Pools and Watercourses Associated with Gorges and Ranges
- o Rivers, Creeks and Associated Floodplains on Open Plains
- Rock Piles and Granites
- Roebourne (PIL4)
  - Rock Piles and Granites (Burrup and Pardoo).





Figure 11: Locations of Northern Quoll within the Pilbara bioregion

The background image indicates probability of northern quoll presence, created using a Species Distribution Model (Molloy et al., 2015 in Dunlop et al., 2016).



### 6.2.2.2 Threats

Threat	Scope	Severity	Irreversibility	Summary Threat Rating
Inappropriate fire regime	Very High	High	Medium	High
Introduced predators (cats)	Very High	High	High	High
Weeds	High	Medium	Medium	Medium
Clearance from infrastructure development	Medium	Medium	Very High	High
Cane Toad	Low	Very High	High	Low
Clearance from mining and mining infrastructure	Medium	High	Very High	High

### 6.2.2.3 *Priorities for applied research*

- 1. Develop appropriate and standardised survey and monitoring methods;
- 2. Define areas of critical habitat and better understand how disturbance affects habitat quality;
- 3. Improve our understanding of population dynamics;
- 4. Better understand the key threats to the northern quoll and the interactions between these threats in the Pilbara; and
- 5. Determine whether the northern quoll will colonise restored areas or artificial habitat. (Cramer *et al.*, 2016a).



### 6.2.3 The Greater Bilby

#### 6.2.3.1 Distribution

Occur in Sandy Spinifex Plans (and margins of rivers) primarily within the eastern part of the Chichester (Pil1) sub-region of the Pilbara and in part of the Roebourne and Fortescue sub-regions.







#### 6.2.3.2 Threats

Threat	Scope	Severity	Irreversibility	Summary Threat Rating
Inappropriate fire regime	Very High	Very High Very High		Very High
Introduced herbivores	Very High	High	Medium	High
Introduced predators (cats)	Very High	High	Medium	High
Clearance from infrastructure development	Medium	Medium	Very High	High
Introduced predators (foxes)	Low	Very High	High	Low

### 6.2.3.3 Priorities for applied research

- 1 Refine survey methods,
- 2 Improve understanding of habitat use,
- 3 Improve understanding of the genetic structure of (meta)populations,
- 4 Improve understanding of the threat posed by introduced predators and herbivores, and
- 5 Improve understanding of how fire regimes affect bilby conservation (Cramer *et al.*, 2016b)



# 7 Conclusions and next steps

# 7.1 Find funds for key strategies, develop proposals

Several strategies listed in **Section 3** are sufficiently scoped and ready for implementation whereas others other need to be scoped out further. Scoped strategies addressing threats to conservation significant species exist already (Carwardine *et al.*, 2014) and there is further information including costing of strategies that should be examined and integrated with the Pilbara Conservation Action Plan (Carwardine, 2014, unpublished).

# 7.2 Seek opportunities for collaboration with existing projects, NRM partners and industry

Several strategies that are working well, many of which are showcased in this report, require extra funding to continue or allow for expansion. For example, initiatives previously supported under the Australian Government-funded Pilbara Corridors programme no longer have this support available, including fire management, feral herbivore control, weed control, working with traditional owners, working with pastoralists and research and education.

A range of other funding sources may be pursued to continue important on-ground works via local, state and Australian government (eg. WA State NRM grants, National Landcare Program). Industry also has a significant interest in effective environmental management in the region, both as part of and beyond their compliance obligations.

## 7.3 Pilbara Environmental Offsets Fund

In 2014, the Environmental Protection Authority (EPA) (now part of The Department of Water and Environmental Regulation (DWER)) proposed that a Pilbara strategic conservation initiative be established to provide a mechanism for pooling offset contributions from proponents and to undertake coordinated conservation actions across the Pilbara IBRA bioregion (EPA, 2014). This strategic conservation initiative intended to ensure a consistent and transparent approach for offset projects (ie. clear outcomes for each offset project, clear linkage between outcomes and significant residual impacts of individual proposals) and contribute to longer term strategic outcomes (EPA, 2014). It is the EPA's view that most funds should be used for landscape-scale on-ground actions in the Pilbara and if funds are to be used for indirect actions (eg. research), they should only be expended on actions that will directly contribute to conservation outcomes in the Pilbara (EPA, 2014). Project funding for offsets should not be used to provide substitute funding for existing government programs or company obligations (EPA, 2014).

In July 2016, the Western Australian Government approved the establishment of the Pilbara Strategic Conservation Initiative, now known as the Pilbara Environmental Offsets Fund (DPAW, 2017). The mechanism to be employed by the Pilbara Environmental Offsets Fund is still being developed but implementation will likely be guided by the Pilbara Conservation Strategy (DPAW, 2017) and other documents containing a landscape scale, co-ordinated approach to biodiversity conservation (ie. this Pilbara Conservation Action Planning process and Carwardine *et al.*, 2014).



# 7.4 Locally-based Pilbara group to steer and guide on-ground actions

A Pilbara-based implementation/working group should be formed to steer and guide on-ground actions potentially comprising the following groups:

 Aboriginal organisations, Pastoralists, Mining Companies, DBCA, DPIRD, Greening Australia, Rangelands NRM, PMMC, Pilbara RBG, Conservation Management, Local Government, Key Environmental NGOs, Pilbara Ports Authority etc.

There is currently no single group that deals with landscape-scale conservation actions across the various tenures and landscapes of the Pilbara. A single forum would bring a range of sectors and interests together to collectively align resources and provide a peer learning and support to achieve effective action.

# 7.5 Inclusion of Traditional Owners in future developments

It has been suggested that engagement with Aboriginal communities across the Pilbara has not been sufficient during the Pilbara Conservation Action Planning process to date, which is a fundamental issue that requires addressing in future work.

Healthy Country planning (Conservation Management, 2017; Kanyirninpa Jukurrpa, 2017) is being undertaken within the Pilbara Bioregion by Conservation Management on Banjima and Yinhawangka Country with the Traditional Owners (Conservation Management 2017). Healthy Country planning uses the same Open Standards framework (CMP, 2013) being used for the Pilbara CAP. There is potential for Healthy Country planning in the Pilbara and future Pilbara CAP processes to be better aligned and informed both ways, and for Healthy Country representatives to form a core part of the proposed implementation/steering group.

In addition, Ranger Groups undertaking planning and management could benefit from networking across the Pilbara region (and beyond). A strategy from ranger team managers for capacity building across Ranger Groups, including peer learning between groups, is included in this report.

The Pilbara has extensive areas under Native Title claim and many that have been determined (**Figure 13**). It is therefore critical, and in some instances a requirement under Native Title determination, to consult with and actively engage with the rights of Native Title groups during land management planning and conservation activities. The Pilbara Conservation Action Planning process has identified numerous strategies and actions involving Traditional Owners and there are existing relationships with some groups. Opportunities that present themselves within the Conservation Action Planning process must incorporate consultation with the Pilbara's first land conservation 'managers'.





Figure 13: Pilbara Native Title Determination Applications and Determination Areas as per the Federal Court (October 2017)



# 7.6 Collective Impact for the Pilbara

A recent review of Conservation Action Planning and Open Standards for the practice of conservation in Australia acknowledged some limitations to these processes including insufficient scoping, planning and resourcing; subjective strategy selection with insufficient cost benefit analysis; and a lack of explicit spatial prioritisation (Carr *et al.*, 2017). While some of these limitations apply to the Pilbara Conservation Action Planning process to date, this report outlines future initiatives which aims to addresses these, which may include integrating Conservation Action Planning with other techniques and tools (Carr *et al.*, 2017).

A final concept to consider is whether it is feasible at the scale of the Pilbara to implement a Collective Impact approach (Kania and Kramer, 2011) to implementing conservation actions, or whether this approach could be used for thematic groups (eg. fire, weeds, threatened fauna or geographically-based groups). This approach involves groups aligning their goals, strategies and actions to achieve more collectively than they could if they worked in isolation from each other (**Table 6**).

### Table 6: From Isolated Impact to Collective Impact (Weaver, 2012)

Isolated Impact
Funders select individual grantees
Organizations work separately
Evaluation attempts to isolate a particular organization's impact
Large scale change is assumed to depend on scaling organizations
Corporate and government sectors are often disconnected from foundations and non-profits
Collective Impact
Funders understand that social problems – and their solutions – arise from multiple interacting factors
Cross-sector alignment with government, non-profit, philanthropic and corporate sectors as partners
Organizations actively coordinating their actions and sharing lessons learned
All working toward the same goal and measuring the same things

There are five key elements to successful impact as follows (Kania and Kramer, 2011):

- 1. all participants have a common agenda for change including a shared understanding of the problem and a joint approach to solving it through agreed upon actions;
- 2. collecting data and measuring results consistently across all the participants ensures shared measurement for alignment and accountability;
- 3. a plan of action that outlines and coordinates mutually reinforcing activities for each participant;
- 4. open and continuous communication is needed across the many players to build trust, assure mutual objectives, and create common motivation; and
- 5. a backbone organisation(s) with staff and specific set of skills to serve the entire initiative and coordinate participating organisations and agencies.

Do these elements represent an approach that can be applied by Pilbara land managers collectively? How can this approach be applied to improve environmental, social and financial outcomes for the conservation assets of the Pilbara?



# 8 References

- Bradley, K., Lees, C., Lundie-Jenkins, G., Copley, P., Paltridge, R., Dziminski, M., Southgate, R., Nally, S. and Kemp L. (Eds.) (2015). 2015 Greater Bilby Conservation Summit and Interim Conservation Plan: an Initiative of the Save the Bilby Fund. IUCN SSC Conservation Breeding Specialist Group, Apple Valley, MN.
- BHP Billiton Iron Ore (2016). Pilbara Public Environmental Review Strategic Proposal. March 2016. Available online at: <u>http://www.bhp.com/-/media/bhp/regulatory-information-media/iron-ore/western-australia-iron-ore/0000/public-environmental-review-strategic-proposal/160318 ironore waio pilbarastrategicassessment state environmentalreviewstrategicproposal executivesummary.pdf.</u> Accessed October 2017.
- Carr, B., Fitzsimons, J., Holland, N., Berkinshaw, T., Bradby, K., Cowell, S., Deegan, P., Koch, P., Looker, M., Varcoe, T., Walsh, P. and Weisenberger, F. (2017). CAPitalising on conservation knowledge: Using Conservation Action Planning, Healthy Country Planning and the Open Standards in Australia. Ecological Management and Restoration, 18(3), pp.176–189.
- Carwardine J., O'Connor T., Legge S., Mackey B., Possingham H.P. and Martin T.G. (2011). *Priority threat management to protect Kimberley wildlife.* CSIRO Ecosystem Sciences, Brisbane.
- Carwardine J., Nicol S., van Leeuwen S., Walters B., Firn J., Reeson A., Martin T.G., Chades I., (2014). *Priority threat management for Pilbara species of conservation significance.* CSIRO Ecosystem Sciences, Brisbane.
- Conservation Management (2017). Conservation Management positive change in social and environmental places. Available online at: <u>http://www.conservationmanagement.com.au/</u>. Accessed October 2017.
- Clausen, L., Cowen, S., Pinder, J., Danks, A., Thomas, A., Bell, L., Speldewinde, P., Comer, S. and Algar, D. (2016). Fortescue Marsh feral cat baiting program (Christmas Creek water management scheme). Year 5 annual report. Department of Parks and Wildlife, Kensington, WA.
- Craig, A., and Thomas, P. (2008), Western Australian rangeland monitoring system for grasslands: field manual. Department of Agriculture and Food, Western Australia, Perth. Bulletin 4741.
- Cramer, V.A., Dunlop, J., Davis, R., Ellis, R., Barnett, B., Cook, A., Morris, K., and van Leeuwen, S. (2016a).
   Research priorities for the northern quoll (*Dasyurus hallucatus*) in the Pilbara region of Western
   Australia. Australian Mammalogy 38(2), pp.135-148.
- Cramer, V.A., Dziminski, M.A., Southgate, R., Carpenter, F., Ellis, R.J., and van Leeuwen, S. (2016b). A conceptual framework for habitat use and research priorities for the greater bilby (*Macrotis lagotis*) in the north of Western Australia. Australian Mammalogy 39(2), pp137-151.

- Cramer, V.A., Armstrong, K.N., Bullen, R.D., Ellis, R., Gibson, L.A., McKenzie, L.N., O'Connell, M., Spate, A. and van Leeuwen, S. (2016c). Research priorities for the Pilbara leaf-nosed bat (*Rhinonicteris aurantia* Pilbara form). Australian Mammalogy, 38(2) 149-157.
- CMP: Conservation Measures Partnership (2013). Open standards for the practice of conservation. Available online at: <u>http://www.conservationmeasures.org/</u>. Accessed October 2017.
- DAFWA: Department of Agriculture and Food, Western Australia (2006). Fire management guidelines for southern shrubland and Pilbara pastoral rangelands: best management practice guidelines. Department of Agriculture and Food, Western Australia. Available online at: <a href="http://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1000&context=lr">http://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1000&context=lr</a> best
- DAFWA: Department of Agriculture and Food, Western Australia (2016). Western Australian Biosecurity Strategy 2016-2025. Department of Agriculture and Food, Western Australia. Available online at: <u>https://www.agric.wa.gov.au/sites/gateway/files/Strategy%20final-%20brochure.pdf</u>
- DEC: Department of Environmental and Conservation (2008a). Fire Management Guideline No. E6. Mulga Communities (*Acacia aneura*). Department of Environment and Conservation, Western Australia. Available online at: <u>https://library.dpaw.wa.gov.au/static/FullTextFiles/052301.pdf.</u>
- DEC: Department of Environmental Conservation, (2008b). Pilbara Regional Fire Management Plan. 2008-2013. Department of Environment and Conservation, Western Australia.
- DoEE: Department of the Environment and Energy (2016). Approved Conservation Advice for *Rhinonicteris aurantia* (Pilbara form) (Pilbara Leaf-nosed Bat). Threatened Species Scientific Committee. Available online at: <u>http://www.environment.gov.au/biodiversity/threatened/species/pubs/82790-conservation-</u> advice-10032016.pdf. Accessed October 2017.
- DoEE: Department of the Environment and Energy (2016). Species Profile and Threats Database: *Dasyurus hallucatus* Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu]. Available online at: <u>http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon\_id=331</u>. Accessed October 2017.
- DEC: Department of Environment and Conservation (2013). Definitions, Categories and Criteria for Threatened and Priority Ecological Communities. Available online at: <u>https://www.dpaw.wa.gov.au/images/plants-animals/threatened-</u> <u>species/definitions\_categories\_and\_criteria\_for\_threatened\_and\_priority\_ecological\_communities.pdf</u>. Accessed October 2017.
- DBCA: Department of Biodiversity, Conservation and Attractions (2017). Priority Ecological Communities for Western Australia, Version 27. Available online at: <u>https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-</u> <u>species/Listings/priority\_ecological\_communities\_list.pdf</u>. Accessed October 2017.



- DPaW: Department of Parks and Wildlife (DPAW) (2017). Pilbara Conservation Strategy. Available online at: <u>https://www.dpaw.wa.gov.au/images/documents/conservation-</u> management/pilbara/pilbara conservation strategy.pdf. Accessed October 2017.
- Dunlop, J., Rayner, K., and Morris, K.D. (2016). Pilbara Northern Quoll Research Program: Annual report 2014-2015. Department of Parks and Wildlife, Perth.
- Dziminski, M.A. and Carpenter, F. (2016). The conservation and management of the bilby (*Macrotis lagotis*) in the Pilbara: Progress Report 2016. Department of Parks and Wildlife, Perth.
- Environmental Protection Authority (EPA) (2014). Cumulative environmental impacts of development in the Pilbara region: advice of the Environmental Protection Authority to the Minister for Environment under Section 16(e) of the Environmental Protection Act 1986.
- Eyre, T.J., Fisher, A., Hunt, L.P. and Kutt, A.S. (2011). Measure it to better manage it: a biodiversity monitoring framework for the Australian rangelands. The Rangelands Journal, 33, pp.239–253.
- Heydenrych, B., Parsons, B. and Berkinshaw, T. (2016). Pilbara Bioregion Conservation Action Planning Process. Workshop Summary Document – version 2 June 2016, Prepared for Pilbara Corridors by Greening Australia, Perth. Available online at: <u>http://pilbaracorridors.com.au/wp-</u> <u>content/uploads/2016/06/PilbaraCAP\_SummaryReport\_v2-0\_FINAL\_PC\_160616.pdf</u>
- Higgs, P. (2005). Cataloguing biological surveys within Western Australia: the Pilbara experience. Journal of the Royal Society of Western Australia, 88, pp.51-56.
- Kania, J. and Kramer, M. (2011). Collective Impact. Stanford Social Innovation Review, 9(1), pp.36-41.
- Kanyirninpa Jukurrpa (2017). Martu Healthy Country Plan. Available online at: <u>http://www.kj.org.au/mhcp/</u>. Accessed October 2017.
- Kinloch, J., Pellegrino, B. and Pitt, G. (2014). 2012 IBRA Sub-Region Profiles: Intactness, Tenure, Climate and Native Vegetation, GIS Methods. Department of Parks and Wildlife Remote Sensing and Spatial Analysis Section, GIS Branch. Kensington, WA.
- May, J. and Brennan, K. (2015). Biodiversity Audit II Methodology, DRAFT November 2015. Department of Parks and Wildlife, Kensington, WA.
- McKenzie, N.L., May, J.E. and McKenna, S. (2003). Bioregional Summary of the 2002 Biodiversity Audit for Western Australia. Department of Conservation and Land Management, Perth.
- McKenzie, N.L., van Leeuwen, S. and Pinder, A.M., (2009). Introduction to the Pilbara biodiversity survey, 2002-2007. Records of the Western Australian Museum Supplement, 78, pp.3-89.
- Morgan, D., Ebner, B. and Beatty, S. (2009). Fishes in groundwater dependant pools of the Fortescue and Yule Rivers, Pilbara, Western Australia. Freshwater Fish Group, Centre for Fish and Fisheries Research, Murdoch University, Perth, WA.

NAFI: North Australian Fire Information (2017). <u>http://www.firenorth.org.au/nafi3/</u> Accessed August 2017

Ngadju Conservation (2015). Ngadju Conservation Action Plan Version 1.0 May 2015. Norseman, WA.



- Pinder A.M., Lyons M.L., Collins M., Lewis L., Quinlan K., Shiel R.J. and Coppen R. (2017). Wetland
   Biodiversity Patterning Along the Middle to Upper Fortescue Valley (Pilbara Region: Western Australia)
   to Inform Conservation Planning, Department of Biodiversity, Conservation and Attractions, Perth, WA.
- Pringle, H.J., Watson, I.W., and Tinley, K.L. (2006). Landscape improvement, or ongoing degradation reconciling apparent contradictions from the arid rangelands of Western Australia. Landscape Ecology, 21, pp.1267-1279.
- Rangelands Fire Leadership Group (Rangelands NRM, Department of Fire and Emergency Services, Department of Parks and Wildlife and Kanyirninpa Jukurrpa) (2015). Guiding Principles for fire management in the WA rangelands. Rangelands NRM, Como, WA.
- Robinson, C.J., Barber, M., Hill, R., Gerrard, E., James, G. (2016). Protocols for Indigenous fire management partnerships, CSIRO, Brisbane.
- Terrestrial Ecosystems Research Network (TERN) (2016). Summary of Sites in the Pilbara April 2015 -August 2016. Available online at: <u>https://static1.squarespace.com/static/54c18c59e4b04884b35c7843/t/59507391a5790afdb0add2d5/149</u> <u>8444781368/Pilbara\_Ausplots+Rangelands+Summary+of+Plots.pdf</u>. Accessed October 2017.
- Thompson, G. (2016). Do we need a comprehensive public fauna survey database? Available online at: <a href="https://terrestrialecosystems.com/do-we-need-a-comprehensive-public-fauna-survey-database/">https://terrestrialecosystems.com/do-we-need-a-comprehensive-public-fauna-survey-database/</a>. Accessed October 2017.
- TNC: The Nature Conservancy (2007). Conservation Action Planning Handbook: Developing Strategies, Taking Action and Measuring Success at Any Scale. The Nature Conservancy, Arlington, VA.
- Woinarski, J., Burbidge, A., and Harrison, P. (2014). Action Plan for Australian Mammals 2012. CSIRO Publishing, Canberra.
- Watson, D.M. and Watson, M.J. (2015). Wildlife restoration: Mainstreaming translocations to keep common species common. Biological Conservation. 191, pp.830-838.
- Watson, A.N. and Thomas, P.W.E. (2016). Report on the condition trend of the Western Australian pastoral resource base. Department of Agriculture and Food, Western Australia, Perth.
- Weaver, L. 2012. Putting Collective Impact into Practice in Maine Communities. Available online at: <u>http://community-concepts.org/wp-content/uploads/2011/08/collective-impact-Liz-Weaver-2.pdf</u>. Accessed October 2017.
- Webber B.L., Batchelor, K.L. and Scott J.K. (2016a). Weed data aggregation and risk assessment for the Pilbara region of Western Australia. Interim report on data aggregation and data synthesis preparation. CSIRO, Australia
- Webber BL, Batchelor, KL and Scott JK (2016b). Weed data aggregation and risk assessment for the Pilbara region of Western Australia. Interim report 2 on data aggregation and data synthesis. CSIRO, Australia.



- White, A., Sparrow, B., Leitch, E., Foulkes, J., Flitton, R., Lowe, A.J. and Caddy-Retalic, S. (2012). AusPlots
   Rangelands Survey Protocols Manual. Version 1.2.9, 2012. University of Adelaide, Adelaide, South
   Australia.
- Williams K.J., Harwood T., Perry P., Perkins G., Liu Y., Ferrier S. (2013). Using community-level modelling to map levels of biodiversity significance in the Pilbara Bioregion. Unpublished Report for BHP Billiton Iron Ore. CSIRO Ecosystem Sciences, Canberra.
- Van Vreeswyk, A M, Leighton, K A, Payne, A L, and Hennig, P. (2004). An inventory and condition survey of the Pilbara region, Western Australia. Department of Agriculture and Food, Western Australia. Technical Bulletin 92, 424p.



# 9 Appendices

# 9.1 Lists of Programs and Projects from Pilbara CAP Workshop 3 held on 28 and 29 July 2015

Note:

- These lists were presented in conceptual model diagrams in Heydenrych et al. (2016), and although not 100% current, are presented here as they provide a snapshot of the range of Pilbara Programs and Projects currently underway or recently completed.
- Some names have changed since this list was developed, in particular Western Australian State Government Departments.
- This list was cross checked with information on current programs and projects that came out of workshop 1 and 2 and discussion group meeting on 8 July 2015.
- A few of these programs and projects are from outside the Pilbara Bioregion, e.g. 80 Mile Beach, but have merit in being cited as examples that can be used in the Pilbara.

#### COASTAL ASSETS – Weeds

#### CURRENT PROGRAMS and PROJECTS

- Prickly pear control chemical and biological CSIRO (Rosemary Island first)
- Buffel in Port Hedland community development program (Greening Australia and others Ashburton Aboriginal Corporation, Botanic Gardens and Parks Authority on Airlie Island)
- Conservation Systematics of the western Pilbara fauna. NBC (Gorgon's Net Conservation Benefits program
- Decision support system for prioritising and implementing biosecurity on Western Australia's islands (> 300 islands) Islands and threatening processes. Bob Pressey James Cook University (JCU) and DPaW, funded by NBC (Gorgon's Net Conservation Benefits program)
- Shire Coastal Zone Management Strategies access mainly
- Fencing dunes from cattle Pardoo 80 Mile Beach (BHP Billiton Offset)
- BHP Draft Boodarie Management Plan include. Coastal access
- Department of Lands coastal tracks survey
- Pilbara Corridors weed app for all of Pilbara
- Pilbara Corridors, DPaW, Atlas Iron (Offset), CSIRO Fortescue and Chichester subregions weed prioritisation
- Leave no trace program (weeds) recreation induction, Fortescue River Mouth
- Educational Signage at WiFi rest stops
- Sea Ranger program (Chevron out of Onslow)
- Cactus (Prickly Pear) Control DPaW
- Information on risk analysis and visitors (Kay Dept Ag has information)
- Rangelands NRM report on impacts on coast

#### COASTAL ASSETS – Carnivores

CURRENT PROGRAMS and PROJECTS

- Pilbara Regional Coastal Access Strategy 2014
- Federal government is focussing on cats Threatened Species Commissioner
- Significant areas are being mapped and identified (Gorgon NCB Gorgon Project's Barrow Island Net Conservation Benefit Fund, which is administered and independent Board supported by DBCA)



- Fox control around turtle nesting various sites
- Dolphin Island targeting pests DPAW and Murujuga Rangers.
- BHP and Port Authority in Port Hedland fox and cat control
- Joint industry and community care of Port Hedland
- DPAW fox control on Dampier Peninsula and Dolphin Island
- DPAW in the past and currently investigation again fox control on Munda Station
- Jo King honours project on foxes
- Varanus Island quarantine protocols being enforced by Apache Energy (technically outside of Pilbara Bioregion)
- Rangelands NRM prioritisation of coastal assets (Luke)
- Other areas can provide learning to Pilbara e,g, Project Eden at Shark Bay, Fox control programs at Ningaloo
- Also out of Pilbara Bioregion, but 80 mile beach, motion sensor camera study DPAW (since 2013 for 2 years)

# COASTAL ASSETS - Unsustainable stock grazing pressure CURRENT PROGRAMS and PROJECTS

- Self-shepherding stock management De Grey LCDC (one of six rangelands trials)
- Boodarie Station BHP
- 80 Mile Beach project fencing projects over the past 10 years different funding sources
- Ecologically Sustainable Rangeland Management (ESRM) Plans
- 2015 Pastoral lease relinquishments on Mardie and Karratha Stations

# INLAND MOUNTAIN RANGES, ROCKY HILLS, BREAKAWAYS AND MESAS - Inappropriate Fire Regime CURRENT PROGRAMS and PROJECTS

- Northern Australia Fire Information (NAFI) requires funding government and private support
- Neil Burrows guiding principles document-<u>http://webadmin.communitycreative.com.au/uploads/rangelands/misc%20documents/Fire%20Forum/RangelandsFireGuidingPrinciples\_Aug15\_lowres.pdf</u>
- CSIRO (Olga Barron), Groundwater Dependent Ecosystems (GDE) /remote sensing//Landsat DOW/BHP
- Community Fire Strategy Pilbara Corridors
- Rangelands NRM Remote Sensing Fire Mapping
- AusPlots in Pilbara
- Fire / Mulga Study DPaW

# INLAND MOUNTAIN RANGES, ROCKY HILLS, BREAKAWAYS AND MESAS - Weeds CURRENT PROGRAMS and PROJECTS

- Climate change modelling CSIRO
- List of weeds ranking threat Greg Keighery
- Mandated control (e.g. some mining companies, but ad hoc)
- Mining companies current ongoing control efforts, weed hygiene
- Pilbara Mesquite Management Committee Range of activities and actions, town weeds, Cactus survey, Parkinsonia
- Indigenous rangers (not currently enough)



- Threatened species programs (facilitate action for weeds)
- CSIRO / DPaW / Pilbara Corridors week risk assessment Fortescue/Chichester
- West Australian Biodiversity Science Institute (WABSI)
- Indigenous people, weed control and working on country e.g. in the Kimberley and other places, see <a href="http://cmsdata.iucn.org/downloads/ens">http://cmsdata.iucn.org/downloads/ens</a> et al 2015 indigenous people and invasive species iucn cem ecosystems and invasiv.pdf

# INLAND MOUNTAIN RANGES, ROCKY HILLS, BREAKAWAYS AND MESAS – Clearing for mining and infrastructure CURRENT PROGRAMS and PROJECTS

- EPA offset metric/ strategic Pilbara fund
- Legislative framework (many applicable acts) State and commonwealth regulatory system approvals, offsets, clearing permits
- Pilbara completion criteria (DMP/OEPA) underway
- Pilbara Prospects, 2020 study
- Company strategic assessments (e.g. RTIO, BHPBIO)
- Data collection Nature Map, Atlas of Living Australia (ALA), Western Australian Land Information System (WALIS), AEKOS (TERN), etc.
- DPAW NatureMap and FloraBase current programs
- WAMinals BHPBIO and WA Museum

# SUBTERRANEAN FAUNA HABITAT - Clearance from mining CURRENT PROGRAMS and PROJECTS

- BHP, CSIRO, DPAW OEPA- subterranean fauna modelling project
- Ecogenomics genetic differences from water samples can determine how many spp., if not what the actual spp. are especially stygofauna being used already but early days

#### ROCK PILES and GRANITES - Clearance from infrastructure development CURRENT PROGRAMS and PROJECTS

- Murujuga Ranagers managing rock are sites on the Burrup Peninsula and islands.
- Threatened spp. Northern Quoll/ Bilby interaction with barriers DPAW, ECU, Roy Hill, Fortescue, BHPBIO
- Other Northern Quoll research is also happening Poondano, Mt Dove (et al), Judy Dunlop DPAW
- Rio Tinto / DPaW Northern Quoll feral cat bait uptake trail
- Peter Spencer Northern Quoll genetics
- Consulting literature EPBC species, Short Range Endemics (SREs)
- Mining company monitoring feral occurrence, EPBC species
- Culvert monitoring (threatened fauna) along rail Roy Hill, FMG, BHP
- Rangelands NRM work on quoll and bilby align with this (Chris Curnow)

# PLAINS, WETLANDS and OTHER WATER DEPENDENT SYSTEMS - Altered hydrology CURRENT PROGRAMS and PROJECTS

- Flood modelling of mine sites for best practise hydrological flows. CSIRO, DOW, BHPBIO
- De Grey LCDC (Peter Andrews and previously Tim Wiley) looking at landscape from helicopters using imagery changes over time to see how water flows and how it is effected by roads, which areas are dryer/channel movement, watercourse changes





- Rangelands rehydration Rangelands NRM, Greening Australia
- Existing ESRM planning and inclusion of "Catchment Function Analysis"
- CSIRO potential for ground water dependent ecosystems Mulga could feed into other assets, Pilbara-wide since 1987 (Olga Barren)
- Department of Water license requirements and bores
- PHADI https://www.agric.wa.gov.au/r4r/pilbara-hinterland-agricultural-development-initiative-phadi

#### PLAINS ASSETS - Unsustainable stock grazing pressure

CURRENT PROGRAMS and PROJECTS

- ESRM planning
- Rangelands monitoring AusPlots, pastoral lease monitoring (DoL) RF Regions. Western Australian Rangeland Monitoring System (WARMS) monitoring (DAFWA)
- Rangelands Survey carrying capacity
- Kangaroo harvesting monitoring
- DAFWA feral monitoring
- Site specific monitoring
- Pastoral education grazing land management, nutrition EGE
- BTEC Brucellosis and Tuberculosis Eradication Campaign
- Pastoral native grass identification courses Pilbara Corridors
- Pilbara Threatened Flora App Rio Tinto and DPaW
- Sustainable pastoralism (De Grey)
- Industry embedded botanist DPaW, Rio Tinto and BHPBIO
- Industry embedded entomologists WA Museum and BHPBIO and Rio Tinto
- Ashburton Aboriginal Corporation (AAC) Peedamulla Sustainable Grazing
- Irrigated Agriculture (RTIO, Marandoo, Consolidated Minerals, Bamboo Springs Warrawagine Station)
- Landscape rehydration
- Landscape restoration workshops (PCP GA, BHP)
- Proposal for Natural Capital ANU, NAB, Ernst and Young (Judy has info)
- Remote sensing DPAW trialling at ministers office Department of Lands (Wendy)
- Northern Beef Futures could increase grazing pressure

#### PLAINS ASSETS - Weeds

CURRENT PROGRAMS and PROJECTS (refer to other assets as well)

- Good existing programs for some weeds (e.g. bellyache bush, cactus)
- Good existing knowledge
- Active management by pastoralists
- DPAW internal regional weed prioritisation
- DPAW, Pilbara Corridors, CSIRO weed prioritisation
- Pilbara Regional Biosecurity Group

PLAINS ASSETS – Feral carnivores CURRENT PROGRAMS and PROJECTS (refer to other assets as well)





- Pastoralists dog baiting tied to production (Pilbara Regional Biosecurity Group), DAFWA Royalties for Regions, biosecurity dogs
- DAFWA/Pilbara Regional Biosecurity Group baiting effectiveness research
- Fortescue Marsh Feral Cat baiting (FMG Offset to DPAW))
- Eradicat used at Yarraloola Non-target evaluation (RTIO offset funded trial by DPaW)
- Non-target impacts of eradicate Northern Quoll (RTIO offset) and Fortescue Marsh (FMG) offset
- Munda (intermittent)/Mardie/Cape Preston fox baiting
- ESRM (predator control?)
- Invasive Animals CRC (IACRC) in Pilbara? (Interaction between feral predator project)
- ECU Southern Rangelands
- Mike Letnic (UNSW Centre for Ecosystem Science), John Read (Ecological Horizons). (but not in Pilbara)
- DAFWA Royalties for Regions, biosecurity dogs
- Species distribution models NERP (National Environmental Research Program) funded, Melbourne Uni, DoE and DPaW project
- Ecofire cat vs fire paper (2014) (Not in Pilbara questions about the science are emerging).

#### WETLANDS AND OTHER WATER DEPENDENT ASSETS - Clearance from mining and infrastructure development

- CURRENT PROGRAMS and PROJECTS (refer to other assets as well)
  - Pilbara Restoration Initiative (DMP led)
  - BHP and Kings Park and mining companies (seed, Pilbara rehab. Working group Pilbara Land Rehabilitation Group PLRG);
  - BHP and Kings Park Pilbara Restoration Initiative
  - Curtin University –ARC Training Centre for Mining Restoration
  - Western Australian Biodiversity Science Institute (WABSI) one node focused on rehabilitation
  - (also lots of work done in other areas Goldfields, SW etc.)

## WETLANDS AND OTHER WATER DEPENDENT ASSETS – Feral herbivores

CURRENT PROGRAMS and PROJECTS

- Pilbara Regional Biosecurity Group (RBG, DAFWA) donkey telemetry project, horses and other pests (Fortescue Marsh and Hamersley)
- Federal government feral camel program (DAFWA and DPAW) has now ceased concluded in 2013, now co-ordinated by Pilbara RBG
- Opportunistic shooting
- Ninti one Education/showing negative impacts
- Pig control work at De Grey river some picked up by donkey control programs
- FMG feral horse telemetry trial using collars on Fortescue marsh (Hamish Robertson DPAW Offset)
- ESRM trapyards pastoralists and Rangelands

# WETLANDS AND OTHER WATER DEPENDENT ASSETS – Weeds of National Significance (WONS) CURRENT PROGRAMS and PROJECTS

- Citic Pacific Mining control Mardie Station contracted offset arrangement (a good model)
- Alliance (PMMC) Fortescue, Mardie, Rio, Roy Hill, Pilbara Corridors
- Ngurrawaana Rangers Fortescue, McNP
- Ngurrawaana Rangers passiflora DPAW, Parkinsonia



- Leramagadu Lease funded by State NRM and Yindjibarndi Aboriginal Corporation (YAC)
- CSIRO biological control Parkinson's ongoing; Mesquite winding up Fortescue Station
- Remote sensing Curtin University ongoing paper published recently
- De Grey correctional services, Rangelands NRM, Greening Australia
- Upper Fortescue 5 year Management Plan
- Mesquite strategy for Pilbara Astron Environmental
- Monitoring 6 x Pilbara Corridors
- Training program Conservation and Land Management (CLM)
- Weed data bases different organisations not comprehensive
- Pilbara Mesquite Management Committee (+-\$ 400k DPAW, CSIRO, Pilbara Corridors and Atlas Offsets)
- Pilbara Weeds Strategy Atlas Iron CSIRO, DPaW, Pilbara Corridors)
- Karratha Environmental Group at Millstream (volunteers)
- Pastoralists in De Grey and Fortescue Catchment Parkinsonia and Mesquite via PMMC coordinating mining groups



## 9.2 Threatened ecological communities (TECs)

List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment

Species and Communities Branch (Correct as at 6 October 2016 - <u>https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/threatened\_ecological\_communities\_endorsed\_by\_the\_minister\_october\_2016.pdf</u>)

Community identifier	Community name	General Location (IBRA Regions)	Category of Threat and criteria met under WA criteria
46. Themeda Grasslands	Themeda grasslands on cracking clays (Hamersley Station, Pilbara). Grassland plains dominated by the perennial Themeda (kangaroo grass) and many annual herbs and grasses.	Pilbara	VU A)
78. Ethel Gorge	Ethel Gorge aquifer stygobiont community	Pilbara	EN B) ii)



### 9.3 **Priority ecological communities (PECs)**

DBCA describe Priority Ecological communities 1, 2 and 3 as "Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, (DEC, 2013). As most of the Pilbara PECs are either Priority 1 or 3 which are described as Poorly-known ecological communities, it suggested that the ranking of these is probably fair (see TNC, 2007), although more survey work is required for these communities (DPaW, 2016).

#### DEFINITIONS AND CRITERIA FOR PRIORITY ECOLOGICAL COMMUNITIES (DPaW 2013)

#### Priority One: Poorly-known ecological communities

- Ecological communities that are known from very few occurrences with a very restricted distribution (generally < 5 occurrences or a total area of < 100 ha).
- Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (eg. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist.
- · May include communities with occurrences on protected lands.
- Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

#### Priority Two: Poorly-known ecological communities

- Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha).
- At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation.
- Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

#### Priority Three: Poorly known ecological communities

- Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or
- communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or
- communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc.
- Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

#### Priority Four: Adequately known ecological communities



- Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.
  - Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
  - Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category.
  - Ecological communities that have been removed from the list of threatened communities during the past five years.

#### Priority Five: Conservation Dependent ecological communities

• Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

DBCA ref.	Community name and description	Category	Threats
1	West Angelas Cracking-Clays Open tussock grasslands of <i>Astrebla pectinata, A. elymoides, Aristida latifolia,</i> in combination with <i>Astrebla squarrosa</i> and low scattered shrubs of <i>Sida fibulifera,</i> on basalt derived cracking-clay loam depressions and flowlines.	P1	<ul> <li>disturbance footprints increasing from mine</li> <li>future infrastructure development</li> <li>possible weed invasion</li> <li>changes in fire regime</li> </ul>
2	Weeli Wolli Spring community Weeli Wolli Spring's riparian woodland and forest associations are unusual as a consequence of the composition of the understorey. The sedge and herbfield communities that fringe many of the pools and associated water bodies along the main channels of Weeli Wolli Creek have not been recorded from any other wetland site in the Pilbara. The spring and creekline are also noted for their relatively high diversity of stygofauna and this is probably attributed to the large-scale calcrete and alluvial aquifer system associated with the creek. The valley of Weeli Wolli Spring also supports a very rich microbat assemblage including a threatened species.	P1	<ul> <li>dewatering and re-watering,</li> <li>altering patterns of inundation</li> <li>weed invasion</li> </ul>
3	Burrup Peninsula rock pool communities         Calcareous tufa deposits. Interesting aquatic snails.	P1	<ul> <li>recreational impacts</li> <li>potential development</li> <li>possibly NOX and SOX emissions</li> <li>weed invasion including <i>Passiflora foetida</i> (stinking passion flower).</li> </ul>
4	Burrup Peninsula rock pile communities	P1	

Priority Ecological Communities for the Pilbara bioregion 24 June 2017.



DBCA ref.	Community name and description	Category	Threats	
	Pockets of vegetation in rock piles, rock pockets and outcrops. Comprise a mixture of Pilbara and Kimberley species, communities are different from those of the Hamersley and Chichester Ranges. Short-range endemic land snails.		<ul> <li>industrial development dust emissions</li> <li>Weed invasion including buffel grass, <i>Passiflora foetida</i></li> </ul>	
	Roebourne Plains coastal grasslands with gilgai microrelief on deep cracking clays (Roebourne Plains gilgai grasslands) The Roebourne Plains coastal grasslands with gilgai micro-relief occur on deep cracking clays that are self		• grazing	
5	muching and emerge on depositional surfaces. The Roebourne Plains gligal grasslands occur on microrelier of deep cracking clays, surrounded by clay plains/flats and sandy coastal and alluvial plains. The gilgai depressions supports ephemeral and perennial tussock grasslands dominated by <i>Sorghum</i> sp. and <i>Eragrostis xerophila</i> (Roebourne Plains grass) along with other native species including <i>Astrebla pectinata</i> (barley Mitchell grass), <i>Eriachne benthamii</i> (swamp wanderrie grass), <i>Chrysopogon fallax</i> (golden beard grass) and <i>Panicum</i> <i>decompositum</i> (native millet). Restricted to the Karratha area, this community differs from the surrounding clay flats of the Horseflat land system which are dominated by <i>Eragrostis xerophila</i> and other perennial tussock grass species ( <i>Eragrostis</i> mostly).	P1	<ul> <li>clearing for mining and infrastructure and urban development</li> <li>weed invasion</li> <li>basic raw material extraction</li> </ul>	
	Stony Chenopod association of the Roebourne Plains area			
6	The community is dominated by <i>Eragrostis xerophila</i> and chenopods growing in saline clay soils with dense surface strew of pebbles and cobbles. The association appears to be uncommon and is likely to be linked with the Cheerawarra land system (Unit 3 – Saline clay plains). Only one occurrence has been located to date (Roebourne Airport), however it is likely some other small areas remain.	P1	<ul> <li>grazing</li> <li>clearing</li> <li>weeds, especially buffel grass</li> </ul>	
	Subterranean invertebrate community of pisolitic hills in the Pilbara		• mining	
9	A series of isolated low undulating hills occur in the state's Pilbara region. The troglofauna are being identified as having very short range distributions.	P1		
	Peedamulla Marsh vegetation complex		• grazing	
10	Peedamulla (Cane River) Swamp Cyperaceae community, near mouth of Cane River. Plants are unusual.	P1	<ul><li>weed invasion</li><li>altered surface hydrologic flows</li></ul>	
12	Brockman Iron cracking clay communities of the Hamersley Range		• grazing	
	Rare tussock grassland dominated by <i>Astrebla lappacea</i> (not every site has presence of <i>Astrebla</i> ) in the Hamersley Range, on the Brockman land system. Tussock grassland on cracking clays- derived in valley floors, depositional floors. This is a rare community and the landform is rare. Known from near West Angeles, Newman, Tom Price and boundary of Hamersley and Brockman Stations.	P1	<ul> <li>mining and infrastructure developments</li> <li>altered hydrological flows</li> </ul>	
15	Stygofaunal community of the Bungaroo Aquifer	P1	<ul> <li>groundwater drawdown</li> </ul>	
	A unique assemblage of aquatic subterranean fauna including eels, snails and other stygofauna.		• mining	
16	Freshwater claypans of the Fortescue Valley	P1	<ul> <li>weed invasion</li> </ul>	



DBCA ref.	Community name and description	Category	Threats
	Freshwater claypans downstream of the Fortescue Marsh - Goodiadarrie Hills on Mulga Downs Station. Important for waterbirds, invertebrates and some poorly collected plants. <i>Eriachne</i> spp., <i>Eragrostis</i> spp. grasslands. Unique community, has few Coolibah.		<ul> <li>infrastructure corridors</li> <li>altered hydrological flows</li> <li>inappropriate fire regimes</li> </ul>
	Fortescue Marsh (Marsh Land System)		
17	Fortescue Marsh is an extensive, episodically inundated samphire marsh at the upper terminus of the Fortescue River and the western end of Goodiadarrie Hills. It is regarded as the largest ephemeral wetland in the Pilbara. It is a highly diverse ecosystem with fringing mulga woodlands (on the northern side), samphire shrublands and groundwater dependant riparian ecosystems. It is an arid wetland utilized by waterbirds and supports a rich diversity of restricted aquatic and terrestrial invertebrates. Recorded locality for night parrot and bilby and several other threatened vertebrate fauna. Endemic Eremophila species, populations of priority flora and several near endemic and new to science samphires.	P1	<ul> <li>mining</li> <li>altered hydrology (watering with fresh water)</li> <li>grazing</li> <li>weed invasion</li> </ul>
	Tanpool land system	-	
18	A highly restricted land system that occurs between Pannawonica and Onslow. Consists of stony plains and low ridges of sandstone and other sedimentary rocks supporting hard spinifex grasslands and snakewood shrublands.	P1	• grazing
	Coolibah-lignum flats: Eucalyptus victrix over Muehlenbeckia community		
19	<ul> <li>Woodland or forest of <i>Eucalyptus victrix</i> (coolibah) over thicket of <i>Duma florulenta</i> (lignum) on red clays in run-on zones. Associated species include <i>Eriachne benthamii, Themeda triandra, Aristida latifolia, Eulalia aurea</i> and <i>Acacia aneura</i>. A series of sub-types have been identified:</li> <li>Coolibah and mulga (<i>Acacia aneura</i>) woodland over lignum and tussock grasses on clay plains (Coondewanna Flats and Wanna Munna Flats)</li> <li>Coolibah woodlands over lignum (<i>Duma florulenta</i>) over swamp wandiree (Lake Robinson is the only known occurrence)</li> <li>Coolibah woodland over lignum and silky browntop (<i>Eulalia aurea</i>) (two occurrences known on Mt Bruce Flats)</li> </ul>	P3(i) P1 P1	<ul> <li>dewatering</li> <li>grazing</li> <li>altered hydrological regimes</li> <li>clearing associated with infrastructure corridors</li> </ul>
20	Four plant assemblages of the Wona Land System (previously 'Cracking clavs of the Chichester and Mungaroona Range')		



DBCA ref.	Community name and description	Category	Threats
	<ul> <li>A system of basalt upland gilgai plains with tussock grasslands occurs throughout the Chichester Range in the Chichester-Millstream National Park, Mungaroona Range Nature Reserve and on adjacent pastoral leases. There are a series of community types identified within the Wona Land System gilgai plains that are considered susceptible to known threats such as grazing or have constituent rare/restricted species, as follows:</li> <li>Cracking clays of the Chichester and Mungaroona Range. This grassless plain of stony gibber community occurs on the tablelands with very little vegetative cover during the dry season, however during the wet a suite of ephemerals/annuals and short-lived perennials emerge, many of which are poorly known and range-end taxa.</li> </ul>	P1 P1	
	<ul> <li>Pannawonica-Robe valley end of Chichester Range.</li> <li>Mitchell grass plains (<i>Astrebela</i> spp.) on gilgai.</li> <li>Mitchell grass and Roebourne Plain grass (<i>Eragrostis xerophila</i>) plain on gilgai (typical type, heavily grazed</li> </ul>	P3(iii) P3(iii)	
21	Riparian flora and plant communities of springs and river pools with high water permanence of the Pilbara         The community includes flora with restricted distributions or populations that are highly disjunct or are major range extensions from northern and eastern Australia. These include; Imperata cylindrica, Cladium procerum, Schoenus falcatus, Fimbristylis sieberiana (P3), and Livistona alfredii (P4). In the Pilbara these taxa are almost exclusively restricted to the riparian zones of permanent wetlands with high soil moisture maintained by groundwater flows. Occurrences are disjunct with sites typically associated with groundwater discharge in gorge and valley wetlands that are often coupled with significant shading.	P2	<ul> <li>hydrological change associated with mining</li> <li>altered fire regimes</li> <li>weed invasion (<i>Cenchrus</i> <i>ciliaris, Passiflora foetida</i>)</li> <li>grazing</li> </ul>
22	<i>Triodia</i> sp. Robe River assemblages of mesas of the West Pilbara (previously named ' <i>Triodia</i> sp. Robe River assemblages of mesas of the Robe Valley'). This community is typically restricted to mesas and cordillo landforms where the plant assemblages are dominated by or contain <i>Triodia</i> sp. Robe River and are indicative of inverted landscapes; that is, where <i>Triodia</i> sp. Robe River occurs in combination with species that are considered 'out-of-context' from their normal habitat. The community is a combination of <i>Triodia</i> sp. Robe River with <i>Acacia pruinocarpa, A. citrinoviridis</i> on slopes or peaks of mesas. These two <i>Acacias</i> are generally found associated with Pilbara creeklines, and their occurrence is probably indicative of the genesis of the mesa surfaces in wetlands, then erosion of the landscape and 'inversion of the landscape' such that the mesa slopes and peaks that were previously low in the landscape become high points.	P3(iii)	<ul> <li>Mining and associated infrastructure</li> </ul>
23	Stony saline plains of the Mosquito Land System Described as saltbush community of the duplex plains - Mosquito Creek series (Nullagine). Includes patchy hummock grassland of <i>Triodia longiceps</i> with scattered <i>Maireana</i> and <i>Sclerolaena</i> spp. dissected by drainage lines typically dominated by shrubs including <i>Melaleuca eleuterostachya</i> and <i>Acacia bivenosa</i> occurring on saline red brown non-cracking clays with a mantle of quartz gravel and neutral subsurface soil material on level to undulating plains.	P3(iii)	<ul> <li>preferential grazing</li> <li>prospecting and mining</li> <li>increasing erosion</li> </ul>
24	Sand Sheet vegetation (Robe Valley)	P3(iii)	• mining



DBCA ref.	Community name and description	Category	Threats
	<i>Corymbia zygophylla</i> scattered low trees over <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Grevillea eriostachya</i> high shrubland over <i>Triodia schinzii</i> hummock grassland. Other associated species include <i>Cleome uncifera</i> , <i>Heliotropium transforme</i> , <i>Indigofera boviperda</i> subsp. <i>boviperda</i> , and <i>Ptilotus arthrolasius</i> . Most northern example/expression of vegetation of Carnarvon Basin. Community is poorly represented type in the Pilbara Region, and not represented in the reserve system. Community contains many plant species that are at their northern limits or exist as disjunct populations. Vulnerable to invasion by weeds.		<ul> <li>basic raw material extraction</li> <li>weed invasion, especially Buffel grass</li> </ul>
	Coastal dune native tussock grassland dominated by Whiteochloa airoides		
25	Tussock grassland of <i>Whiteochloa airoides</i> occurs on the landward side of foredunes, hind dunes or remnant dunes with white or pinkish white medium sands with marine fragments. There may be occasional <i>Spinifex longifolius</i> tussock or <i>Triodia epactia</i> hummock grasses and scattered low shrubs of <i>Olearia dampierii</i> subsp. <i>dampierii</i> , <i>Scaevola spinescen</i> s, <i>S. cunninghamii, Trianthema turgidifolia</i> and <i>Corchorus</i> species ( <i>C. walcottii, C. laniflorus</i> ). Occurs on Barrow Island and possibly some unaffected littoral areas in west Pilbara.	P3	<ul> <li>weed invasion, especially buffel grass and kapok</li> <li>basic raw material extraction</li> </ul>
26	Vegetation of sand dunes of the Hamersley Range/Fortescue Valley (previously 'Fortescue Valley Sand Dunes')	P3(iii)	<ul> <li>weed invasion, especially buffel grass</li> <li>grazing by cattle</li> <li>too frequent fire</li> <li>erosion</li> <li>impacts of mining</li> </ul>
	These red linear iron-rich sand dunes lie on the Divide Land system at the junction of the Hamersley Range and Fortescue Valley, between Weeli Wolli Creek and the low hills to the west. A small number are vegetated with <i>Acacia dictyophleba</i> scattered tall shrubs over <i>Crotalaria cunninghamii, Trichodesma zeylanicum</i> var. <i>grandiflorum</i> open shrubland. They are regionally rare, small and fragile and highly susceptible to threatening processes.		
27	Riparian vegetation including phreatophytic species associated with creek lines and watercourses of Rudall River	P3(iii)	<ul> <li>weed invasion</li> <li>altered hydrological flows</li> <li>inappropriate fire regimes</li> </ul>
	Semi-permanent pools along courses of Rudall River.		
28	Horseflat land system of the Roebourne Plains (Does not include priority ecological communities 'Roebourne Plains gilgai grasslands' and the 'Chenopod association of the Roebourne Plains area') The Horseflat Land System of the Roebourne Plains are extensive, weakly gilgaied clay plains dominated by tussock grasslands on mostly alluvial non-gilgaied, red clay loams or heavy clay loams. Perennial tussock grasses include <i>Eragrostis xerophila</i> (Roebourne Plains grass) and other <i>Eragrostis</i> spp., <i>Eriachne</i> spp. and <i>Dichanthium</i> spp. The community also supports a suite of annual grasses including <i>Sorghum</i> spp. and rare <i>Astrebela</i> spp. The community extends from Cape Preston to Balla Balla surrounding the towns of Karratha and Roebourne. This community incorporates Unit 3 (Gilgai plains), Unit 5 (Alluvial Plains) with some Unit 7 (Drainage Depressions) described in Van Vreeswyk <i>et al.</i> 2004.	P3(iii)	<ul> <li>grazing</li> <li>weed invasion</li> <li>fragmentation</li> </ul>
34	Kanjenjie Land System	P3(iii)	• grazing



DBCA ref.	Community name and description	Category	Threats
	Stony clay plains supporting snakewood shrublands with tussock grasses. Supports tall shrublands of mulga, snakewood and other acacias with understorey of low shrubs or perennial grasses. Some parts support tussock grasslands of Mitchell grass or Roebourne Plains grass with few shrubs.		
35	Kumina Land System	P3(iii)	
	Ferricrete duricrust plains, uplands and plateaux remnants, relief up to 15 m. Duricrust plains and plateau remnants support hard spinifex grasslands.		
37	Narbung Land System	P3(iii)	• grazing
	Alluvial washplains with prominent internal drainage foci supporting snakewood and mulga shrublands with halophytic low shrubs.		
40	Invertebrate assemblages (Errawallana Spring type) Coolawanya Station	P4(ii)	• grazing
	Geologically distinct. Sherlock River system. Permanent spring-fed creek. Has atypical invertebrate community.		
41	Invertebrate assemblages (Nyeetberry Pool type)	P4(ii)	• mining • feral animals
	Jimmawurrada Creek. Nyeetberry pool, Robe River. Permanent River Pool in the Pilbara (groundwater fed). Blind isopod collected from this site.		
42	<b>Stygofaunal communities of the Western Fortescue Plains freshwater aquifer</b> (Previously named 'Stygofaunal communities of the Millstream freshwater aquifer').	P4(ii)	<ul><li> groundwater drawdown</li><li> salinisation</li></ul>
	A unique assemblage of subterranean invertebrate fauna.		