Recovery plan for five species of rock wallabies:

Black-footed rock wallaby (*Petrogale lateralis*)
Short-eared rock wallaby (*Petrogale brachyotis*)
Monjon (*Petrogale burbidgei*)
Nabarlek (*Petrogale concinna*)
Rothschild rock wallaby (*Petrogale rothschildi*)

Western Australian Wildlife Management Program No. 55

Prepared by David Pearson
Department of Parks and Wildlife

July 2013

Department of Parks and Wildlife
Northern Territory Government
Government of South Australia
Department of Environment and Natural Resources
Australian Government

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Foreword

Recovery plans are developed within the framework laid down in Department of Parks and Wildlife Policy Statements Nos. 44 and 50 (CALM 1992, 1994), and the Australian Government Department for Sustainability, Environment, Water, Population and Communities Recovery Planning Compliance Checklist for Legislative and Process Requirements (DEWHA 2008a). Recovery plans outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process. The attainment of objectives and the provision of funds necessary to implement actions are subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities.

This recovery plan was approved by the Department of Parks and Wildlife, Western Australia. Approved recovery plans are subject to modification as dictated by new findings, changes in status of the taxon or ecological community, and the completion of recovery actions.

Information in this recovery plan was accurate at July 2013.

Recovery plan preparation: This recovery plan was prepared by David Pearson (Department of Environment and Conservation, Science Division). Holly Raudino, Manda Page and Mia Podesta assisted with editing and formatting.

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Cover photograph: A Recherche rock wallaby (*Petrogale lateralis hacketti*) from Wilson Island, WA. Illustration: Nicole Gueho.

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Abbreviations

ALC	Anindilyakwa Land Council, the statutory authority representing Aboriginal people on Groote Eylandt and nearby islands (Northern Territory)
APY	Anangu Pitjantjatjara Yankunytjatjara
APYLMU	Anangu Pitjantjatjara Yankunytjatjara Land Management Unit
AWNRM	Alinytjara Wilurara Natural Resource Management Board
AWC	Australian Wildlife Conservancy
CALM	Department of Conservation and Land Management, Western Australia (changed to Department of Environment and Conservation in July 2006)
CLC	Central Land Council, the statutory authority representing Aboriginal people in the southern Northern Territory under the *Aboriginal Land Rights Act 1976* (Northern Territory)
CLMA	Centralian Land Management Association
DEC	Department of Environment and Conservation, Western Australia (formerly CALM)
DER	Deparmtent Environment Regulation, Western Australia (formerly part of DEC)
DMP	Department of Mines and Petroleum, Western Australia
DPaW	Department of Parks and Wildlife, Western Australia (formerly part of DEC)
EPA	Environmental Protection Authority, Western Australia
EPBC	Environment Protection and Biodiversity Conservation Act 1999
IUCN	International Union for Conservation of Nature
KJ	Kanyirninpa Jukurrpa, a Martu-controlled land and cultural management organisation
KLC	Kimberley Land Council
LRM	Department of Land Resource Management (formerly Department of Natural Resources, Environment, the Arts and Sport) of the Northern Territory
MGC	Miriuwung Gajerrong Corporation, the lead Aboriginal representative body for the east Kimberley
NgC	Ngaanyatjarra Council (Aboriginal Corporation), the administrative body for 11 Ngaanyatjarra communities in the western deserts of Western Australia
NGLMU	Ngaanyatjarra Land Management Unit
NLC	Northern Land Council, represents traditional Aboriginal landowners and other Aboriginal people with an interest in the land in the Top End of the Northern Territory
NP	National Park
NR	Nature Reserve
NT	Northern Territory
PWCNT	Parks and Wildlife Commission of the Northern Territory
SA	South Australia
DEWNR	Department of Environment, Water and Natural Resources, South Australia
DSEWPaC	(Department of, or Minister for) Sustainability, Environment, Water, Population and Communities
WA	Western Australia
WDLC	Western Desert Lands Aboriginal Corporation, the prescribed body corporate for the Martu Lands in Western Australia
UCL	Unallocated Crown Land
ZoosSA	Royal Zoological Society of South Australia

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Summary

This recovery plan addresses the conservation requirements of five species of rock wallabies that occur in the NT, SA and WA. Within these five species are a number of recognised subspecies and genetic races. The plan summarises available information relevant to the future conservation of these species and outlines a range of actions to improve their conservation status.

Taxonomy and conservation status

Short-eared rock wallaby (*Petrogale brachyotis*) occurs in WA, NT and in the federally-administered Kakadu NP. It is not listed as a threatened species in any of these jurisdictions. Three geographic races are recognized (Kimberley, Victoria River and Arnhem Land).

Monjon (*Petrogale burbidgei*) only occurs in the north-west Kimberley and is not currently listed under the *Wildlife Conservation Act 1950* (WA), or the federal EPBC Act. It is however listed as a priority 4 taxon on the DPaW priority fauna list. The DPaW priority fauna list is not legislated but seeks to include those taxa that may be considered threatened in the future with further research or if circumstances change.

Nabarlek (*Petrogale concinna*) is not listed as a threatened species under the EPBC Act nor the *Wildlife Conservation Act 1950* (WA). It is listed as 'near threatened' under the *Territory Parks and Wildlife Conservation Act 2000* (NT). Three subspecies are currently recognized based on the geographic distribution of the species (Eldridge 1997): *Petrogale c. concinna P. c. monastria*,and *P. c. canescens*. The validity of these subspecies requires further study.

Black-footed rock wallaby (*Petrogale lateralis*) has a broad geographic distribution with three subspecies and two chromosomal races with differing conservation status as outlined below:

- *P. lateralis lateralis :*
  EPBC Act: Vulnerable
  Wildlife Conservation Act 1950 (WA): Fauna that is rare or is likely to become extinct
- *P. lateralis hacketti*
  EPBC Act: Vulnerable
  Wildlife Conservation Act 1950 (WA): Fauna that is rare or is likely to become extinct
- *P. lateralis pearsoni*
  EPBC Act: Not listed - delisted from EPBC Act (Vulnerable) in July 2010, in response to a review of the number of wild and translocated populations.
  National Parks and Wildlife Act 1972 (SA): Not listed
- *P. lateralis* MacDonnell Ranges race
  EPBC Act: Vulnerable
  National Parks and Wildlife Act 1972 (SA) Schedule 7: Endangered
  Wildlife Conservation Act 1950 (WA): Fauna that is rare or is likely to become extinct
  Territory Parks and Wildlife Conservation Act 2000 (NT): Near Threatened
- *P. l.* West Kimberley race
  EPBC Act: Vulnerable
  Wildlife Conservation Act 1950 (WA): Fauna that is rare or is likely to become extinct

Rothschild's rock wallaby (*Petrogale rothschildi*) is confined to the Pilbara and northern Ashburton Regions. It is not listed as a threatened species under the EPBC Act nor the *Wildlife Conservation Act 1950* (WA).

Threats

The main known and perceived conservation threats facing the rock wallabies covered in this plan are:

- predation by foxes, feral cats and dogs
- competition for food and shelter from introduced herbivores
- changes to fire regimes since colonisation
- habitat destruction from clearing, mining and quarrying
- habitat degradation due to weed incursions
- small population sizes and population fragmentation
- disease
- disturbance by tourists
- drought and the effects of climate change.

Habitat critical for survival

Habitat critical to the survival of each taxon is summarized in Appendix 1. In general terms, rock wallabies can occur on a wide variety of rock types, but require sufficient cave and crevice development to provide shelter from extremes of temperature and predators. Free water is usually not required unless the animals are occupying sub-optimal habitat that has inferior thermal refuges. Suitable vegetation communities (with palatable grasses, herbs and forbs present) need to be in close proximity to shelter sites. Habitat critical to survival has been mapped for populations of *P. l. lateralis* in the WA Wheatbelt and for *P. l.* MacDonnell Ranges race in SA (Read and Ward 2011). It has not been mapped for any of the other taxa included in this plan.

Recovery objectives

The overall objective of the recovery program is to:

Ensure the survival of populations and maintain or, where applicable, improve the conservation status (based on IUCN criteria (IUCN 1994)) of the taxa described in this plan through increased knowledge and understanding, the protection of habitat and abatement of threats, and involving the community in recovery actions.

Recovery actions

- Assess the conservation status of poorly surveyed taxa.
- Conduct feral predator control and monitor its effectiveness.
- Manage problem herbivores.
- Maintain and enhance biosecurity actions for islands to prevent the introduction of feral predators, competitors, weeds or disease.
- Conduct translocations, captive breeding and reintroductions to establish new, or supplement existing populations.
- Survey and monitor populations and review the efficacy of management actions.
- Manage habitat to maintain or improve its carrying capacity for rock wallabies and to permit successful breeding and dispersal.
- Undertake research to improve understanding of species' biology, management and monitoring techniques.
- Communication and community education.
- Manage the recovery process.

Performance criteria

This Recovery Plan will be deemed successful if, within a ten year period, all of the following are achieved (using 2011 data as a baseline):

1. The areas or number of sites occupied by mainland *P. lateralis* populations increase.
2. The areas occupied and the number of populations of *P. rothschildi* is at least maintained.
3. The island populations of rock wallabies persist and population levels are at least maintained.
4. Distribution and status surveys are undertaken of poorly known taxa and their conservation status reassessed.
5. Monitoring techniques for rock wallabies and their associated predators are improved and applied to at least five additional populations.

This Recovery Plan will be deemed not successful if, within a ten year period, any of the following occur (using 2011 data as a baseline):

1. There is a decline in the conservation status of any taxon covered by this plan due to the action of threatening processes.
2. There is extinction of any of the currently known populations of *P. lateralis* or *P. rothschildi.*
3. There is extinction of any island population of taxa covered by this plan.
4. Surveys are not conducted and understanding of the distribution and conservation status of taxa remains at 2011 levels.
5. There is no growth in 50 per cent of the populations where feral animal control is taking place to manage this threat.
6. No new viable populations are established.

1 Species information

1.1 Introduction

This recovery plan addresses the conservation requirements of five species (and their component subspecies and genetic races) of rock wallabies occurring in the NT, WA and SA (Table 1).

Only one species (*P. lateralis*), and associated subspecies and races, is listed as threatened under federal or state/territory legislation, however all taxa have been included in this plan as some threats and management issues are in common. The maintenance of the conservation status of the non-threatened taxa is a wider biodiversity conservation objective.

Table 1: Taxa of rock wallabies covered in this recovery plan (as currently recognized, June 2012) and their conservation status under federal, state and territory legislation.

Taxon name	Common Name	EPBC (1999) status	Distribution (status)
P. l. lateralis	Black-flanked rock wallaby	V	WA (V)
P. l. hacketti	Recherche rock wallaby	V	WA (V)
P. l. MacDonnell Ranges race	Black-flanked or black-footed rock wallaby, or warru	V	NT (NT), SA (E), WA (V)
P. l. West Kimberley race	Black-flanked rock wallaby	V	WA (V)
P. l. pearsoni	Pearson Island rock wallaby	Not listed*	SA
P. brachyotis	Short-eared rock wallaby	Not listed	NT, WA
P. burbidgei	Monjon	Not listed	WA (P4)
P. c. concinna	Nabarlek	Not listed	NT (NT)
P. c. monastria	Nabarlek	Not listed	WA
P. c. canescens	Nabarlek	Not listed	NT
P. rothschildi	Rothschild's rock wallaby	Not listed	WA

EPBC- *Environment Protection and Biodiversity Conservation Act* 1999

V – vulnerable, E – endangered, NT – near threatened, P4 - DPaW Priority Fauna List priority 4 taxon[1]

* delisted from EPBC Act (V) in July 2010, in response to a review of the number of wild and translocated populations and a recommendation by the SA Threatened Species Sub-committee.

The plan summarises available information relevant to the conservation of these species and outlines actions to halt population declines and, where applicable, support recovery. These rock wallabies are distributed across a vast area of Australia, often in rugged country and on many different types of land tenure. Some threats facing rock wallaby populations are similar, however the range of threats is diverse and the geographic spread of the taxa involved makes this multi-species recovery plan complex. The management of threats facing rock wallabies is challenging and will require close co-operation between government agencies, Aboriginal communities, community groups and many land-holders.

[1] Taxa in need of monitoring; taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.

Three of the species covered in this plan have northern tropical distributions. The Monjon (*P. burbidgei*) is endemic to the Kimberley Region of WA, while the short-eared rock wallaby (*P. brachyotis*) and Nabarlek (*P. concinna*) have broader distributions including large areas of the Kimberley and the Top End of the NT.

Rothschild's rock wallaby (*P. rothschildi*) is endemic to the Pilbara and Ashburton Regions of WA. The black-footed rock wallaby (*P. lateralis*) has the largest geographic range; encompassing much of WA, northern SA and central NT. However, its populations are widely separated and/or highly fragmented and it demonstrates considerable genetic variation with three recognized subspecies and two known genetic races.

A draft recovery plan for *P. l. lateralis* was written as a project under the Australian National Parks and Wildlife Service Endangered Species Program (Project 149) by Hall and Kinnear (1991). A recovery team was formed in 2006 to develop conservation strategies for SA populations of *P. l.* MacDonnell Ranges race (warru) and a recovery plan was subsequently produced (Read and Ward 2011). Recovery plans have been written for other rock wallaby species not covered by this plan: *Petrogale persephone* (Nolan and Johnson 2001) and *Petrogale penicillata* (Department of Environment and Climate Change NSW 2008).

Profiles for each taxon covered by this recovery plan are provided in Appendix 1. These contain descriptions of taxa and information on their distribution, habitat and biology and an explanation of known and potential threats to their conservation.

1.2 Distribution and important populations

Table 2 presents information on the past and current distribution of each taxon (also refer to Appendix 1 for distribution maps). Few populations have been adequately surveyed to determine population size, or no recent estimates are available, thus Table 2 contains rough estimates (marked *).

DPaW has recently completed a biogeographic survey of some of the larger Kimberley islands which failed to locate any new rock wallaby populations, but confirmed the persistence of all those previously recorded from the islands surveyed (Gibson and McKenzie 2012). The identity of the species of rock wallaby present on Jungulu (Darcy) Island was not able to be resolved.

Populations may be considered as 'important' based on their overall conservation value for the taxon; their value for conservation within a biogeographic, administrative or other type of region; as a tourism asset or attraction; or for cultural reasons for Aboriginal people. In this plan, populations where active management (e.g. predator control, fire management) currently occurs are also considered 'important' populations as there is expenditure of resources for their conservation. Populations considered important for the taxon are highlighted in Table 2 (marked ^).

Table 2: Past and current distribution of each taxon

Past distribution	Current population locations (size estimates)
P. l. lateralis	
WA – Depuch and Barrow Islands, Cape Range, Little Sandy Desert (including Durba Hills, Calvert Range) , Wheatbelt to Avon Valley NP, southern coastline, Salisbury Island	Barrow Island^ (150-200; Hall and Kinnear 1991) Cape Range ^ (200-250)* Calvert Range^ (<50)* 7 WA Wheatbelt populations^ (<150)* Salisbury Island^ (500)* Translocated populations: • Cape Le Grand NP (<30)* • Avon Valley NP (<50)* • Paruna Sanctuary (<50)*
P. l. hacketti	
WA - Recherche Archipelago 3 islands	Mondrian Island^ (500)* Westall Island^ (300)* Wilson Island^ (300)*
***P. l.* MacDonnell Ranges race**	
Central Ranges WA, southern NT, north-western SA, Davenport Ranges SA	**NT:** Harts Range (no estimates available) George Gill Range^ (no estimates available) MacDonnell Ranges^ (no estimates available) **SA:** Tomkinson (30-50)* and Musgrave Ranges^ (150-200)*; Read and Ward 2011, Ward *et. al*. 2011) **WA:** eastern central ranges^ (100-200)* Cross-fostered captives Monarto Zoo Adelaide (22; Read and Ward 2011)
***P. l.* West Kimberley race**	
WA – Edgar, Erskine and surrounding ranges and hills	Edgar Ranges^ (<200)* Erskine Ranges^ (100)*
P. l. pearsoni	
SA – Pearson Island northern islet	Pearson Island^ (250-600) 3 translocated populations: • Thistle Island^ (350) • Wedge Island (100-200) • Pearson Island southern islet (150) (Estimates from Copley and Alexander 1997)
P. brachyotis	
NT – Top End from Victoria River across to the NT-QLD border including 19 islands	Many populations over vast area: including Kakadu NP^, Litchfield NP^ Mitchell River NP^ and Groote Eylandt (no estimates available)
P. burbidgei	
WA – north-west Kimberley mainland; 3 islands and possibly others	Mitchell River NP^, Prince Regent River NR^, Bigge^, Boongaree^ and Katers Islands^ (no population estimates available)

Past distribution	Current population locations (size estimates)
P. c. concinna	
NT – Only known from the type locality near Timber Creek in the Victoria River district of NT	Unknown; only a single specimen in 1839, but no specific surveys have been undertaken to relocate this population or to locate others.
P. c. monastria	
WA – north Kimberley mainland; 3 islands and possibly others	Mainland populations in Mitchell River NP^ and Prince Regent NR^ and Long^, Hidden^ and Augustus^ Islands (no population estimates available)
P. c. canescens	
NT- eastern Arnhem Land	Eastern Arnhem Land (no population estimates available)
P. rothschildi	
WA – Pilbara and northern Ashburton Regions	Pilbara and northern Ashburton to the edge of Great Sandy Desert, Dampier Archipelago islands (Dolphin, Enderby and Rosemary) 1 translocated population: West Lewis Island (No population estimates available)

* Rough Estimate of population size

^ Populations considered important for the taxon

1.3 Habitat

As their common name suggests, rock wallabies show a pronounced preference for rocky habitats, especially those with extensive development of caves, crevices and overhangs that allow the animals to escape extremes of weather and to hide from predators. Outcrops that have large areas of smooth rock surfaces (such as granite inselbergs or steep cliffs) typically do not support rock wallabies. However, small areas of broken outcrop in association with such rock types can support small colonies of rock wallabies. Appendix 1 details the habitat preferences for each rock wallaby taxon in this plan.

Rock wallabies occur on a wide variety of rock types including limestone, sandstone, quartzite, granite, granophyre, gabbro, ironstone and laterite. Their preference for rocky habitats results in a scattered distribution across the landscape with large areas of unsuitable habitat separating some populations. Historical and ethno-zoological information suggests that some rock wallabies ranged further from their outcrops in the past and were able to use trees and even logs for shelter. This allowed them to forage over larger areas, find breeding partners or disperse to other rock outcrops (Pearson 1992). The increased threats of predation posed by foxes and feral cats have limited the extent to which such alternative shelter sites are used.

The vegetation that occurs within the habitat of rock wallabies is diverse due to the range of geological surfaces, latitudinal extent and different climatic conditions. Rock wallabies typically do not require access to free water, but will use it if available and will drink dew or rain. On islands where some sympatric macropod species occasionally drink seawater

when under water stress, rock wallabies avoid this by selecting thermal shelter sites that reduce their water requirements and they limit activity to the cool of the late afternoon and night time (King and Bradshaw 2008).

Their close association with rocky habitats makes it relatively easy to delineate the habitat that is potentially suitable for rock wallabies to use for shelter. Their limited foraging zone (usually within 100m of outcrops) means that their effective shelter and foraging areas can be estimated. Geological maps, satellite imagery and aerial photography that indicate outcropping rock types are all useful for identifying potential habitat. However, the existence of specific microhabitats (cool, small multi-entranced crevices and caves) can only be determined by field survey.

Habitat Critical to Survival

Habitat critical to survival of each taxon is summarized in Appendix 1. In general terms, rock wallabies can occur on a wide variety of rock types, but require sufficient cave and crevice development to provide shelter from extremes of temperature and predators. Free water is usually not required unless the animals are occupying sub-optimal habitat that has inferior thermal refuges. Suitable vegetation communities (with palatable grasses, herbs and forbs present) need to be in close proximity to shelter sites. Habitat critical to survival has been mapped for populations of *P. l. lateralis* in the WA Wheatbelt and for *P. l.* MacDonnell Ranges race in SA (Read and Ward 2011). It has not been mapped for any of the other taxa included in this plan.

2 Threats

The relative importance of historic and current factors in causing the decline of rock wallaby populations are difficult to distinguish due to a lack of knowledge, research and monitoring of populations. Factors are likely to be synergistic. For example, grazing by introduced herbivores might force rock wallabies to forage further from rocky refugia thereby exposing them to increased risk of predation.

The main known and perceived conservation threats facing rock wallabies as a group include:

- predation by foxes, feral cats and other predators
- competition for food and shelter from introduced herbivores
- changes to fire regimes since colonisation
- habitat destruction from clearing, mining and quarrying
- habitat degradation due to weed incursions
- small population sizes and population fragmentation
- disease
- disturbance by tourists
- drought and the effects of climate change.

Known and potential threats to the taxa in this plan are discussed below, and outlined in the taxon profiles (Appendix 1).

2.1 Predation by foxes, feral cats and other predators

Fox predation - The work of Jack Kinnear and colleagues on the impact of foxes *(Vulpes vulpes*) on WA Wheatbelt rock wallaby populations alerted conservation agencies to their critical importance as a predator of native mammals (Kinnear *et al*. 1988, 1998). Predation by the European red fox is now listed as a key threatening process (KTP) under the EPBC Act. A threat abatement plan has been prepared (DEWHA 2008b).

The problem of episodic predation events has been raised by J. Kinnear (pers. comm. 2008). No baiting program will be 100 per cent effective at removing all foxes. Individual or small groups of foxes are capable of killing a significant number of rock wallabies in short periods; a serious threat if populations are already small. Fox predation is likely to be more severe on juveniles and the smaller female rock wallabies. The presence of foxes also alters the behaviour of rock wallabies. The presence of such predators tends to result in a reduction in time spent foraging and in foraging distance from their rocky refugia. (C. Pentland pers. comm.).

Feral cat predation - Feral cats (*Felis catus*) are listed as a KTP under the EPBC Act and a threat abatement plan has been published (DEWHA 2008c). The impact of feral cat predation on the taxa in this plan is not known and there have been no specific studies. Spencer (1991) observed feral cats eating young *Petrogale assimilis* (up to 4kg in weight as adults) in tropical Queensland and believed that feral cats had a role in limiting recruitment. Feral cats are considered to be a potential threat to rock wallabies (DEWHA 2008c). Feral cats have proven difficult to control with baits. Newly developed baits ('Eradicat') offer some hope of better control and these could be employed in conjunction with or in place of standard dried meat baits.

Other predators - The role of other predators, especially dingoes (*Canis lupus dingo*) and/or wild dogs, in causing rock wallaby declines or constraining rock wallaby populations remains unclear. Dingoes are known by Western Desert Aborigines to be predators of rock wallabies (Pearson 1992). There is considerable debate about the status and role of dingoes in the Australian landscape. This has the potential to influence effective predator control, as it is not currently possible to deliver widespread fox control using baits without also killing dingoes.

Several native predators are known to take rock wallabies including birds of prey (especially wedge-tailed eagles and sea eagles), large goannas and pythons. These species provide a 'natural' background level of predation in thriving rock wallaby populations, but could potentially cause problems for small, isolated or restricted populations. In rare instances, it may be justified to move individual native predators that are impacting markedly on a rock wallaby population, such as eagles nesting alongside an outcrop or a pen containing captive-bred rock wallabies.

Interactions between predators - There is some evidence that the removal of dingoes and foxes may lead to an increase in feral cat numbers through a 'mesopredator release' mechanism (Finke and Denno 2004, Johnson 2006; but see Robley *et al.* 2004 for a review). Current research will hopefully illuminate the comparative roles of introduced predators (N. Marlow pers. comm.). In terms of rock wallaby conservation, baiting must aim

to reduce or remove overall predation pressure. When predator control is not undertaken in desert areas, rock wallaby populations have tended to decline or only persist in the most optimal habitat. This is apparent from the decline of *P. l.* MacDonnell Ranges race populations in the Little Sandy Desert and Warburton Region of WA, where there has been no control of feral predators for over 40 years and there are large numbers of dingoes (Pearson and Ngaanyatjarra Council 1997).

2.2 Competition for food and shelter from introduced herbivores

Almost all mainland populations of rock wallabies in this plan co-occur with exotic herbivores in or adjacent to their habitats.

European rabbits - Rabbits (*Oryctolagus cuniculus*) are sympatric with rock wallabies in mid and southern latitudes, they may reduce the amount of potential forage and their activities (selective grazing and burrowing) encourage weed infestations. It is not known whether rabbit grazing is limiting the carrying capacity of habitat for rock wallabies, but some rabbit control around WA Wheatbelt rock outcrops in particular would likely improve potential carrying capacity for rock wallabies. High rabbit numbers may support higher predator populations, particularly of foxes and feral cats, but this relationship is imperfectly understood (Robley *et al*. 2004).

Feral goats - Feral goats (*Capra hircus*) occur in large numbers throughout the Mid-West Region of WA. A change in the legal status of feral goats on pastoral lands that allows their exploitation as stock (*Land Administration Act 1997)* has increased the value of feral goats to pastoralists, and has reversed the motivation to control them. This limits the effectiveness of regional goat control operations, as reinvasion of goats into conservation reserves is likely to occur from surrounding pastoral lands. This is a particular problem in Kalbarri and Cape Range NPs.

In Kalbarri NP, goat grazing has resulted in vegetation communities along the Murchison River cliffs being dominated by spiny, unpalatable species with little potential forage for rock wallabies and was probably responsible for their local extinction in the 1980s. In Cape Range NP, boat operators on Yardie Creek have reported occasional aggressive behaviour by goats, forcing rock wallabies to abandon caves during daylight hours. Goats appear to be effectively controlled outside pastoral lands by a combination of lack of water sources and probably predation by dingoes.

Domestic stock and feral camels - Domestic stock (sheep and cattle) and feral camels (*Camelus dromedarius)* impact on the vegetation around rock outcrops used by many populations of rock wallabies, but usually these potential competitors are unable or unwilling to penetrate most of the habitat used by rock wallabies. Nonetheless, stock and camels may have the ability to restrict population growth of rock wallabies by confining their foraging activities close to refugia or causing them to travel further to forage.

Other macropods - Removal of predators may lead to increases in the densities of other macropods and so indirectly affect rock wallabies. The euro (*Macropus robustus*) is one species that may potentially increase under a fox baiting regime (Read and Ward 2011). An overlap with rock wallaby diets and shelter sites is likely in some areas, although the nature

and extent of competition is not known. High numbers of feral rats (*Rattus rattus*) and house mice (*Mus musculus*) occur in the WA Wheatbelt granite outcrops. Although there is no significant direct competition with rock wallabies they are likely contributing to the problems and persistence of feral predators.

2.3 Changes to fire regimes since colonisation

There is increasing evidence across northern Australia that current fire regimes are resulting in, or have a synergistic impact on, the decline of a range of mammals (Fitzsimons *et al.* 2010). However, rocky habitats often cause fire fronts to slow and reticulate. Thus, rock wallaby populations are often buffered from the worst effects of bushfires (Burbidge and McKenzie 1989, Woinarski *et al.* 2001). While fire may cause short-term loss of feeding resources, it may also remove senescent unpalatable vegetation (such as old spinifex) and stimulate regeneration of more palatable ephemeral and perennial plant species. Alternately, with less shrub cover rock wallabies may be exposed to increased predation after fire. Since their habitats are already often open, this impact is likely to be less significant for rock wallabies than for macropods dependent on sheltering under vegetation (such as hare-wallabies).

There has been no specific research on the impact of fire on rock wallabies. Although observations on the impact of a large fire on *P. l. hacketti* on Mondrain Island found that there was some mortality of individual rock wallabies, but many survived and soon began to forage through burnt areas (Pearson unpublished). A fire that burnt about 80 per cent of an outcrop occupied by a *P. l.* West Kimberley race population in the Erskine Range appeared to have little impact on the abundance of rock wallabies. Apart from some anecdotal accounts of rock wallabies vacating burnt areas for short periods, understanding of the short and long-term effects of fire is limited. Research into the most appropriate ways to manage fire around rock wallaby colonies is required (see Action 8.5).

2.4 Habitat destruction from clearing, mining and quarrying

Some small areas of rock wallaby habitat are currently under threat from clearing or from extractive industries such as mining or quarrying. Small areas of habitat for *P. l. lateralis* in Cape Range (limestone quarry) and Barrow Island (gas infrastructure) are potentially at risk. While the actual areas of habitat destroyed by these operations may be limited, indirect impacts resulting from these activities (increased traffic, greater risk of fire and elevated populations of exotic predators) are likely to affect rock wallabies over larger areas than just the immediate footprint.

2.5 Habitat degradation due to weed incursions

Little is known about the impact of weeds on rock wallaby habitats and long-term effects on rock wallabies. Concern has been raised about the spread of buffel grass (*Cenchrus ciliaris)* into rock wallaby habitat (e.g. *P. l.* MacDonnell Ranges race) in SA, NT and WA. Buffel

grass has been widely promoted as a desirable grass for pastoralism because of its ability to colonise disturbed areas and provide good forage for cattle, but it tends to form monocultures and outcompetes native grasses. It dries off quickly during low rainfall periods and provides continuous, abundant fuel for fires, resulting in changes to vegetation structure (Miller *et al*. 2010). It is eaten by rock wallabies, although its palatability and nutritional status is low as it dries off.

There are many other weeds that occur in rock wallaby habitat. It is important that management agencies are vigilant about the potential impact of weeds, particularly on islands where species such as African boxthorn (*Lycium ferocissimum*) may infest large areas forming spiky thickets. Cape weed (*Arctotheca calendula*) used to occur at high densities around many WA Wheatbelt rock wallaby populations and aids the invasion of the exotic iceplants (*Mesembryanthemum crystallinum* and *M. nodiflorum*) which both contain toxic oxalates, with the latter implicated in sheep deaths (Butler 2012).Untreated iceplant will alter the vegetation structure leading to limited forage for rock wallabies at some outcrops.

2.6 Small population sizes and population fragmentation

The increased likelihood of inbreeding when rock wallaby populations are small may result in reduced genetic variability, the expression of recessive genes or suppressed reproductive rates (Eldridge *et al.* 1998, Eldridge *et al.* 2004). As populations are fragmented, dispersal becomes less frequent or less likely to be successful. The clearing of native vegetation between rock outcrops and infrastructure such as roads and railway lines makes dispersal more hazardous.

Clearing of native vegetation around and between rock outcrops can limit both dispersal and foraging opportunities for rock wallabies. Small isolated habitat patches do not have the capacity to support large rock wallaby populations when environmental conditions deteriorate. As a consequence, boom and bust cycles occur in *P. l. lateralis* populations in the WA Wheatbelt. As their rock outcrops are surrounded by farmland, rapid population increases are not relieved by dispersal, resulting in severe over-grazing of their habitat.

Fragmentation and small population size result in increased risk of local extinctions due to stochastic events such as drought. The likelihood of recolonisation of these habitats decreases as the distance from relictual populations increases. In recent years, genetic techniques have highlighted the impact that fragmented habitat has historically had in shaping the distribution of rock wallaby species, especially *P. lateralis* and *P. brachyotis* (Telfer and Eldridge 2010). As other species are studied in more detail, it is likely that population sub-structuring will increasingly become an important aspect for consideration in rock wallaby conservation and management.

2.7 Disease

There is little specific knowledge of the diseases and parasites afflicting the species of rock wallabies covered in this plan. The potential role of disease in causing declines of native

fauna is little known and has been suggested by many authors, including Finlayson (1961) and Abbott (2006), as important in the decline and extinction of a range of native mammalian taxa. Woinarski *et al.* (2001) suggested disease as a factor in the decline of small mammal species in the NT. Within *Petrogale*, a range of diseases and parasites have been recorded. Four species of the parasite genus *Eimeria* have been identified from *P. l. pearsoni* (O'Callaghan *et al*. 1998), while the condition, bronchogenic carcinoma was identified in a lone *P. lateralis* (Willers *et al.* 2010).Toxoplasmosis and hydatidosis have been recorded in *P. persephone* (Johnson *et al.* 2003); hydatids, lice, mites, ticks, Microfilariae in *P. penicillata* (Barnes *et al.* 2010, DSEWPaC 2012, Lobert 1988), and lumpy jaw, tapeworms, nematodes, protozoans, ticks, mites and lice in *P. xanthopus* (Muranyi 2000, Miller 2001). Most internal parasites do not result in serious illness unless the rock wallabies are under stress, especially in captive situations (Miller 2001).

Toxoplasmosis is caused by the protozoan *Toxoplasmosa gondii* and can be acquired if rock wallabies come into contact with infected cat faeces. It results in often-fatal pneumonia and encephalitis. Cats are the only definite host for this parasite (Miller 2001).

2.8 Disturbance by tourists

The impact of tourists on the behaviour of rock wallabies can have localised effects that may prove significant for small populations. 1080 fox baiting may be limited in some areas around camp sites or tourist walks near rock wallaby populations and this may lead to increased predation pressures on local populations.

Supplementary feeding of rock wallabies can result in health problems and excessive levels of inter-specific aggression. In most cases, feeding of rock wallabies has now either ceased or reduced to levels that avoid their reliance on handouts. Rock wallabies at a few sites are given commercial kangaroo pellets to attract them to public viewing sites (e.g. Gap Motel in Alice Springs and Lake Argyle) but this is unlikely to have any serious impact and serves a useful role in educating the public about rock wallabies. When reaching starvation levels in a 'bust cycle', some WA wheatbelt populations are supplementary fed with lucerne hay and pellets to preserve numbers.

Concern about the potential impact of tour boats and tourists swimming and boating in Yardie Creek prompted a study by Biota (2002). They found that the rock wallabies were little affected by the few regular boat tours operated each day, but individual tourists boating or swimming up the gorge and walking around the rim of the gorge did cause rock wallabies to retreat to refuges (Biota 2002).

2.9 Drought and the effects of climate change

There have been no specific studies on the likely effects of climate change on the rock wallaby taxa covered in this plan. Climate change that leads to declines in rainfall, higher summer temperatures and more variable weather patterns, as is predicted for southern Australia (Hughes 2003, Commonwealth of Australia 2007, Garnaut 2008), could impact on the body condition, survivorship and reproduction of rock wallabies. Fragmented

populations and reduced genetic variability also limit possible evolutionary responses to climate change, such as *in situ* adaptation of populations and dispersal to other habitat.

Within the life of this plan, the effects of climate change may begin to act on some rock wallaby populations through extreme events, such as prolonged droughts and large fires. In the longer term, climate change is predicted to alter vegetation communities and hence food resources. Baiting regimes for foxes and cats will need to be adapted to rainfall variations and reflect rock wallaby population size fluctuations, probably more marked than those in the past.

2.10 Areas and populations under threat

The species and populations of rock wallabies covered by this plan face a variety of different threats which are listed in Table 3.

Table 3: Threats to populations of rock wallaby taxa

Taxon	**Population**	**Threats**
P. l. lateralis	All populations	•Fox and cat predation (risk of introduction to Barrow and Salisbury Islands)
	Barrow Island	•Infrastructure development and petroleum activities •Low genetic variation
	Cape Range NP and Ningaloo Station	•Feral goats
P. l. MacDonnell Ranges race	All populations in SA and WA (Townsend Ridges, Rawlinson Range, Walter James Range, Morgan Range, Mt Johnno, Bell Rock Range)	•Fox and cat predation •Low levels of genetic variation in small or fragmented populations
	All populations in NT	•Fox and cat predation •Fire regimes that degrade habitat (changes to food plant availability and shelter from predators) •Habitat degradation due to stock
P. l. West Kimberley race	All populations	•Potential effects from large or frequent fires •Fox (in south) and feral cat predation
P. l. hacketti	All populations	•Potential bushfire •Risk of introduction of foxes or feral cats
P. l. pearsoni	All populations	•Risk of introduction of foxes or feral cats •Small populations and response to perturbations such as fire
Taxon	**Population**	**Threats**
P. brachyotis	Populations in the southern (arid and semi-arid) NT and WA	•Predation by foxes, feral cats and dogs •Widespread cattle grazing •Fire

	Groote Eylandt	•Activities related to manganese mining
	All NT islands	•Risk of cat introductions •Large fire events
P. burbidgei	Mainland populations	•Cat predation •Fire regimes that degrade habitat (changes to food plant availability and shelter from predators)
	Island populations	•Risk of introduction of cats •Large fire events
P. concinna	All mainland populations in the NT and WA	•Cat predation •Fire regimes that degrade habitat (changes to food plant availability and shelter from predators)
	Island populations in WA	•Risk of introduction of feral cats and dogs •Small population sizes and the risks posed by large stochastic events such as bushfire
P. rothschildi	Coastal and island populations of *P. rothschildi*	•Fox predation •Possible infrastructure development related to export of minerals
	Island populations	•Risk of introduction of foxes and cats •Bushfire and arson or accidental ignition by visitors
	Populations on central plateau	•Feral cat predation of juveniles •Mining activities in some areas •Frequent and large scale fires that reduce availability of food plants and cover from predators

3 Previous and existing management

3.1 Management planning and policy

The EPBC Act is the over-arching legislative framework that guides the Australian Government's environmental policy in relation to matters including threatened species. The Act requires approval of any activity that has the potential to have a 'significant' impact on linked threatened species. A number of plans have been prepared under this legislation to deal with threatening processes relevant to rock wallabies, including:

- Threat Abatement Plan for Predation by the European Red Fox (DEWHA 2008b)
- Threat Abatement Plan for Predation by Feral Cats (DEWHA 2008c)
- Threat Abatement Plan for Competition and Land Degradation by Unmanaged Goats (DEWHA 2008d)
- Threat Abatement Plan for Competition and Land Degradation by Rabbits (DEWHA 2008e)
- Invasive Species Threat Abatement Planning - Consultation with Indigenous Communities (DEWHA 2009)

Other relevant federal government policy documents include *Survey guidelines for Australia's threatened mammals, EPBC Act survey guidelines 6.5* (DSEWPaC 2011).

A range of state and territory legislation and policy is also relevant to rock wallabies:

Western Australia

- *Wildlife Conservation Act 1950*
- *Conservation and Land Management Act 1984*
- Western Shield Fauna Recovery Program Draft Interim Strategic Plan 2009-2010 (DEC 2008)
- Aboriginal involvement in nature conservation and land management (DEC, revised draft as at Feb 2012)
- Policy Statement No. 19 *Fire Management Policy* (CALM 2005)
- Policy Statement No. 29 *Translocation of Threatened Flora and Fauna* (CALM 1995)
- Policy Statement No. 33 *Conservation of threatened and specially protected fauna in the wild* (CALM 1991)
- Policy Statement No. 44 *Wildlife Management Programs* (CALM 1992)
- Good Neighbour Policy (CALM 2007)

South Australia

- *Natural Resource Management Act 2004*
- South Australian Strategic Plan (2011), including No Species Loss Policy requiring actions to prevent the extinction of any taxon in SA.
- Department of Environment and Natural Resources Corporate Plan 2010-2014
- Alinytjara Wilurara Regional NRM Plan (2011)

Northern Territory

- *Territory Parks and Wildlife Conservation Act 2006* and regulations
- NT Integrated Natural Resources Management Plan (2010-2015)
- *Weed Management Act 2001*

In addition, there is a range of other policies/strategies administered within or by each state or territory which may influence rock wallaby conservation and cover subjects such as:

- State environmental policy documents and plans
- Acts and legislation for the exploration and extraction of minerals
- Land rights Acts and agreements
- Policies or strategies for particular parks and reserves
- Fire control plans and strategies
- Captive breeding agreements, husbandry manuals, etc.

3.2 Recovery planning

Rock wallaby taxa covered in this plan face a wide range of threats and consequently past and future management of the various taxa and individual populations will vary as local threats and circumstances dictate.

A draft recovery plan for *P. l. lateralis* was prepared under the Australian National Parks and Wildlife Service Endangered Species Program by Hall and Kinnear (1991) and some of its actions have been carried out over subsequent years. A recovery team was formed in 2006 to develop conservation strategies for SA populations of *P. l.* MacDonnell Ranges race and a recovery plan was subsequently produced (Read and Ward 2011). The Warru Recovery Team is a collaborative effort of Traditional owners, DEH, APY land management, ZoosSA/Conservation Ark, AWNRM, the University of Adelaide and consultants Ecological Horizons.

No recovery teams or plans are current for other species covered in this plan.

3.3 Management actions

Current management actions to conserve rock wallabies include: surveys and monitoring of populations, the control of exotic predators and competing herbivores, fire management, captive breeding and translocations. These activities are covered by a wide range of policy and planning documents in the two states, territory and federally administered land in Kakadu and Uluru-Kata Tjuta NP's as outlined above.

Surveys and monitoring

Since rock wallabies are very habitat-specific, populations tend to be widely dispersed and separated by large areas of unsuitable habitat. This means rock wallaby populations tend to be relatively sedentary, with typically only one species at a site. In addition, there are relatively few other macropod species in rocky areas with which rock wallabies and their signs (tracks, faecal pellets, etc.) can be confused. The open nature of some rocky habitat

favours certain survey techniques such as spotlighting. Conversely, the habitat occupied by rock wallabies is often rugged, difficult to traverse, has limited vehicle access, and occurs in some of the most remote areas of Australia. This can limit the use of some survey techniques.

Indirect techniques (such as faecal pellet counts) have been used to determine the presence or absence of animals to monitor regional trends but have limited use for site-based monitoring. Jarman and Capararo (1997) examined the use of the technique for monitoring grey kangaroos and Geelan (1999) for *P. l.* MacDonnell Ranges race. While it requires considerable repetition, it may give reasonable estimates especially when populations are small and confined to a limited area of habitat. Use of indirect techniques for rock wallaby monitoring requires further investigation.

The use of remote cameras has made the monitoring of some populations and many sites possible. It is difficult or impossible to identify individuals from photos and so determining parameters such as population numbers or densities is not possible. However, cameras do provide valuable information on population persistence, recruitment and the presence of feral predators.

A study to develop suitable monitoring techniques on Barrow Island in 2003-2004, concluded that rock wallaby numbers were low and were concentrated in a relatively small area of Barrow Island (Burbidge unpublished). Following survey work in 2005, a rock wallaby monitoring prescription was developed (Burbidge and Thomas 2005) based on daytime searching for a week between late September and November in known habitat on at least two occasions.

Trapping studies remain the most effective way to obtain robust measures of population size (Kinnear *et al*. 2010, Willers *et al*. 2011). In addition, trapping surveys are able to collect information on breeding, recruitment and health parameters of populations.

A range of potential monitoring techniques are available and their use will depend on what questions need to be answered (e.g. persistence, population trends, etc.) and resources. For instance, all captured rock wallabies in DPaWs Central Wheatbelt District are microchipped. Remote dataloggers are then used to determine movement and persistence of individuals.

Predator control

Extensive baiting around rock wallaby populations occurs at a number of sites in south-western WA, the Pilbara and the Calvert Range, WA. There is helicopter and hand baiting around several *P. l.* MacDonnell Ranges race populations in north-west SA. There is currently no feral predator baiting specifically for the protection of rock wallabies in the NT (Table 4).

Table 4: Current predator baiting operations to protect rock wallaby populations.

Taxon	Location	Type of baiting	Frequency	Notes
P. lateralis	WA Wheatbelt	ground	fortnightly; monthly at Querekin Rocks	7 colonies baited for foxes only
	Cape Range NP	aerial	quarterly	
	Calvert Range	aerial ground	annually 3 times per yr	Eradicat baits
	Kalbarri NP*	aerial	quarterly	*Population extinct - baiting as a precursor to translocation
	Avon Valley NP	ground	monthly	
	Walyunga NP	ground	monthly	
	Paruna Sanctuary	ground	monthly	predator exclusion fence
	Cape Le Grand NP	aerial	quarterly	
P. l. MacD Ranges race	Kalka, New Well	ground/aerial	quarterly	
	Central Ranges - Townsend Ridges*	ground	monthly	*discontinued 2007
P. rothschildi	northern Burrup Peninsula	ground	3 times per yr	Fox bait - Jan, Apr and July
	Dolphin and Enderby Islands	ground	monthly	

In WA baiting is undertaken with standard dried meat baits for foxes and 'Eradicat' baits for cats containing 3.0mg and 4.5mg of 1080, respectively. Their success in field trials has been variable. Broad-scale 1080 baiting for foxes and cats may also remove other potential predators of rock wallabies such as dingoes and wild dogs. This may or may not relieve pressure on feral cats (via a meso-predator release response) and lead to increases in their abundance or changes in behaviour.

In WA, dried meat fox baits can be distributed cost effectively over large areas by aircraft, such as in Cape Range NP, Kalbarri NP and the Calvert Range. Aerial baits are typically distributed at a rate of 5 per km^2, two to four times per year. In other areas, due to safety concerns for humans and domestic dogs, it is necessary to lay baits by hand, usually from a vehicle or on foot. Ground baits are generally distributed from vehicles at intervals of 100-200m, and provide localised protection, but require regular replacement. In a few areas, baits are buried or tethered to prevent re-distribution by birds, but this reduces their effectiveness and more frequent baiting is required (J. Kinnear pers. comm.).

Eradicat trials have been carried out at Cape Arid through the South Coast Integrated Fauna Recovery Project. This work has addressed potential non-target issues on the south coast, and once baits are registered, the baiting program should be extended to include the Cape Le Grand rock wallaby population.

Existing baiting frequencies around WA Wheatbelt rock wallaby populations appear to have been initially successful with these populations historically thriving, building in numbers and dispersing to unoccupied outcrops (B. MacMahon, P. Orell pers. comms.). However, dramatic declines over the 2011 summer were likely the result of starvation due to large populations (a result of effective fox control) leading to the overgrazing of vegetation close to critical habitat (highly fractured rocks). In addition, fear of predators confines rock wallabies in this highly grazed area and prevents extensive foraging (Kinnear *et al.* 2010). Poor seasonal conditions have exacerbated this situation (N. Moore pers. comm. 2012)

In the NT, broadscale aerial baiting is not used. There have been attempts to develop a bait station targeting foxes and cats, but with reduced risk to dingoes (G. Edwards pers. comm.). Until this bait station has been adequately tested and its effectiveness against foxes and cats demonstrated, existing baiting operations designed to protect rock wallabies should be continued.

Baiting by the NGLMU at the Townsend Ridges (NT) on a six to eight weekly timing was sufficient to promote a recovery in the abundance of rock wallabies and the expansion of the population to occupy more cliff-line habitat (J. Miller pers. comm.).

New baiting programs require extensive consultation with Aboriginal communities and sign-posting of bait trails is required. Predator baiting or other management requires monitoring to determine and assess effectiveness. Currently transects along freshly smoothed dirt roads to observe animal tracks are an appropriate technique. The use of remote cameras near bait stations also may be able to determine which species are taking baits and the extent of visitation to bait stations (N. Thomas pers. comm.).

Introduced herbivore control (rabbits and goats)

The control of rabbits around rock wallaby colonies has been limited but may be important in some environments to prevent over-grazing or an elevation in fox numbers due to prey abundance. Rabbit control is complicated by concerns about non-target species, and most techniques are expensive to continue repeatedly at sufficient intensity to provide a prolonged decrease in numbers. Diseases such as myxomatosis and calici-virus have been responsible for large reductions in rabbit populations when conditions are favourable for spread, but new strains need to be developed regularly to cope with increasing resistance of rabbits.

Integrated and committed control of goats in conservation reserves where rock wallabies did or continue to persist needs to be developed further. Helicopter shooting is a cost-effective means to rapidly reduce goats at high densities, but needs to be supplemented with other techniques such as mustering, ground-shooting, fencing off water sources and possible strategic use of goat-proof fencing. Helicopter shooting of goats was undertaken in 2007, 2008 and 2011 in Cape Range and Kalbarri NPs. While helicopter shooting provides some temporal control of goats, it is not yet clear whether a few days of shooting in each park is significantly reducing the overall impact of goats. Ground-based shooting is carried out opportunistically by DPaW staff and amateur gun clubs (Western Australian Field and Game Association).

Techniques for monitoring large introduced feral herbivores are well-established and undertaken periodically in WA and SA as part of annual kangaroo surveys. Monitoring of kangaroo numbers in the NT is carried out sporadically. Goat numbers in WA and SA are usually estimated from counts made during aerial transects flying pre-determined flight lines (Short *et al*. 1983). In the NT, feral goats are absent from the mainland, only occurring on a few offshore islands: North East, North Goulburn, Truant, and Vanderlin (LRM 2012).

Captive breeding and translocations

There are now a number of zoos that keep and breed various species of rock wallabies. In eastern Australia, the brush-tailed rock wallaby has benefited from the success of a coordinated and multi-institutional breeding program. As a result, husbandry techniques for rock wallabies are well developed (Miller 2001, Taggart *et al.* 2005, Schultz *et al.* 2006). Adelaide Zoo and the University of Adelaide have pioneered cross-fostering techniques with the brush-tailed rock wallaby and have used this method to develop a captive colony of *P. l.* MacDonnell Ranges race at Monarto Zoo (Read and Ward 2011).

Translocations can be used to increase the number of sites occupied by rock wallabies, reducing the risk of any single event; for example drought or an intense predation event causing local extinction. Translocations can also be used to remove animals from a site where predator control is not feasible and populations are heading for extinction. Table 5 provides a summary of translocation records between 1960 and 2010.

Table 5: Translocations of taxa of rock wallabies covered in this plan (py=pouch young). Only the translocation of *P. rothschildi* to West Lewis Island was unsuccessful.

Date	Taxon	Source population	Destination	No. translocated
1960	*P. l. pearsoni*	North Pearson Is	South Pearson Is	6 (unplanned release)
1974	*P. l. pearsoni*	North? Pearson Is	West Is	?
1974	*P. l. pearsoni*	North? Pearson Is	Thistle Is	15
1975	*P. l. pearsoni*	North? Pearson Is	Thistle Is	15
1975	*P. l. pearsoni*	North Pearson Is	Wedge Is	11
1982	*P. rothschildi*	Enderby Is	West Lewis Is	15 (8♂, 7♀)
1985	*P. rothschildi*	Enderby Is	West Lewis Is	?
1990	*P. l. lateralis*	Nangeen Hill	Querekin Rock	5 (+2 py)
2001	*P. l. laterals*	Mt Caroline NR	Paruna Sanctuary	10 (3♂& 7♀) (+6 py)
		Mt Caroline NR	Avon Valley NP	37 (24♂& 13♀) (+12py)
2002	*P. l. lateralis*	Querekin Rock	Avon Valley NP	9 (3♂& 6♀) (+4py)
		Querekin Rock	Paruna Sanctuary	12 (8♂& 4♀) (+2py)
		Mt Caroline NR	Walyunga NP	29 (19♂& 10♀) (+7py)
2003	*P. l. lateralis*	Querekin Rock	Avon Valley NP	16 (12♂& 4♀) (+2py)
		Mt Caroline NR	Cape Le Grand NP	14 (8♂& 6♀) (+4py)
		Mt Caroline NR	Avon Valley NP	2 (1♂& 1♀) (+1py)
		Querekin Rock	Paruna Sanctuary	20 (16♂& 4♀) (+2py)
2004	*P. l. lateralis*	Querekin Rock	Cape Le Grand NP	10 (5♂& 5♀) (+2py)
		Querekin Rock	Walyunga NP	27 (15♂& 12♀) (+8py)
		Mt Caroline NR	Cape Le Grand NP	8 (2♂& 6♀) (+2py)
2005	*P. l. lateralis*	Querekin Rock	Paruna Sanctuary	15 (5♂& 10♀) (+7 py)
2007	*P. l. lateralis*	Mt Caroline	Paruna Sanctuary	8 (all ♂)
		Querekin Rock	Paruna Sanctuary	11 [6♂& 5♀) (+4 py)
2008	*P. l. lateralis*	Querekin Rock	Avon Valley NP	5 (all ♂)
2008	*P. rothschildi*	Near Newman	Near Newman	1 (♂)
2009	*P. l. lateralis*	Querekin Rock	Avon Valley NP	3 (all ♂)
		Mt Stirling	Querekin Rock	1 (♂)
		Mt Caroline	Querekin Rock	3 (all ♂)
2009	*P. rothschildi*	Near Newman	Near Newman	8 (5♂& 3♀)
2010	*P. l. lateralis*	Querekin Rock	Paruna Sanctuary	1 (♂)
		Mt Stirling	Querekin Rock	1 (♂)
		Mt Caroline	Avon Valley NP	1 (♀)

When there were high numbers of rock wallabies in some Wheatbelt populations, resulting in overgrazing, translocations from these populations to sites in the Avon Valley and Cape Le Grand NPs were undertaken (Orell and Dans 2001, 2002, Orell 2003, Mawson 2004). All these translocations are believed to have been successful. In later years (post 2009) individuals from other locations were translocated to Querekin Rock in an attempt to increase genetic variation there.

Island biosecurity

A number of populations of rock wallabies occur on islands with no exotic mammals and it is highly desirable they remain so, especially free of exotic predators such as foxes and cats. There is increasing emphasis on island biosecurity associated with the continuing use of islands for industry and tourism (Nias *et al.* 2010). The only existing island biosecurity protocols for islands with rock wallaby populations are for Barrow Island and Groote Eylandt. The protocols on Barrow Island include inspection of all incoming equipment to the island for feral animals, soil and weed seeds, and education of staff and contractors. On Groote Eylandt the ALC has an initiative with airlines and barge companies to check all authorisations for the introduction of plants and animals.

Protocols need to be developed to cover the range of potential introduction threats and for monitoring other islands. Contingency plans need to be developed to enable quick and effective intervention should an introduction occur.

Construction of predator-proof fences around habitat

Under some circumstances where it is not possible to adequately control foxes or feral cats, the construction of predator-proof fences may be warranted to preserve some rock wallaby populations. For instance, the *P. l. lateralis* population on Nangeen Hill has declined rapidly despite intensive baiting. For an isolated reserve such as Nangeen Hill, surrounded by farmland, the construction of a fence and intensive efforts to remove any feral predators may be the most appropriate action. Careful consideration needs to be made of the complex habitat requirements of rock wallabies such as rock structure capacity, available grazing resources and the limitation of dispersal. Genetic supplementation or the translocation of animals may be required if numbers either get too small, or increase beyond the sustainable capacity of the habitat.

4 Guide for decision makers

Under the EPBC Act, any person proposing to undertake actions which may have a significant impact on any listed threatened species or ecological community should refer the action to the Minister for Environment. The Minister will then determine whether the action requires EPBC Act assessment and approval. As these provisions relate to proposed (i.e. future) actions, they can include:

- actions which may result in increased impact from existing threat/s or potential threat/s; and
- actions which may result in a new threat.

Corresponding provisions may also apply in state and territory legislation, and the protection of rock wallabies and their habitat should be taken into account in any environmental impact assessment.

Actions within habitat critical for survival that could result in any of the following may result in a significant impact on rock wallabies**:**

- a reduction in the amount of, or connectivity, of habitat used by rock wallabies
- an increase in fire frequency or loss of habitat due to fire
- an increase in human activities that leads to an increase vehicular traffic in habitat
- introduction of new weed species.

Actions that could result in any of the following may result in a significant impact:

- any decrease in, or damage to, available foraging habitat or shelter sties
- a major increase in numbers of feral cats or foxes
- an increase in fire frequency or loss of habitat due to fire
- significant increase or acceleration of extreme weather events linked to climate change events.

Management practices necessary to avoid significant adverse impacts on rock wallabies may include considerations such as:

- protection of habitat from disturbance or destruction, including direct destruction or fragmentation of habitat (e.g. a quarry or roadworks)
- effective control of feral predators such as foxes and cats
- effective control of weeds
- appropriate control and management of fire
- efficient surveillance to protect island populations from introduced predators or disease
- protocols for tourism activities.

5 Affected interests

The rock wallaby taxa and their habitat covered in this plan occur across a vast area of the western half of Australia on, and adjacent to many different land tenures, including: NPs, conservation reserves, pastoral lands, Aboriginal reserves and freehold, unallocated Crown land, mining leases, freehold land used for farming and land zoned for industry. This suggests there may be many interests potentially affected by this plan, although in most cases, little impact upon current land use is likely as a result of this recovery plan. Landholders and land management agencies may be affected when seeking to alter the landscape or undertake actions that may affect rock wallabies as outlined in *Guide to Decision Makers*. Where populations/sub-populations occur on lands other than those managed by the respective conservation agencies (federal, state or territory), permission has been, or will be, sought from the managers prior to recovery actions being undertaken.

Interests potentially affected by and/or involved in the implementation of this recovery plan include:

- Local communities
- Land owners and managers
- Non-government organisations: AWC, Cape Conservation Group
- Mining companies: Chevron-Texaco, Gorgon, Rio Tinto, BHP Billiton, Energy Resources of Australia
- Universities
- Museums: Australian Museum, SA Museum, WA Museum, Museum and Art Galleries of the NT
- Government departments and agencies: DEWNR, DER, DEREC, DPaW, DSEWPaC, EPA, DMP, LRM
- Traditional owners and managers: ALC, CLC, CLMA, KLC, MGC, NgC, NLC, WDLC, APY, APYLMU and others.

6 Role and interests of Aboriginal people

Prior to colonial settlement, rock wallabies were an important food source for many Aboriginal people. They were captured by spearing animals when basking or by cornering in caves; or by driving rock wallabies into yards of brush constructed where they could be brought down with clubs or throwing sticks (Finlayson 1935, Burbidge *et al.* 1988, Pearson 1992).

The disappearance of rock wallabies across southern Australia mirrored the fate of many other mammals in the range of 35g - 5kg (‘critical weight range’; Burbidge and McKenzie 1989) that were important to nomadic Aboriginal people. In general, rock wallabies appear to have declined more gradually than other critical weight range mammals, perhaps due to the buffering their rocky habitats provided from the impacts of fox predation or changes in fire regimes (Burbidge and McKenzie 1989). Currently, rock wallabies still occur on vast tracts of Aboriginal freehold and leasehold land. They are rarely hunted. Their cultural

importance in terms of spiritual beliefs is poorly known. The people of the Ngaanyatjarra community of Mantamaru (Jameson) have creation (tjukurrpa) stories about rock wallabies (warru) related to nearby hills (C. Munro pers. obs.). There are no doubt many other stories and beliefs about rock wallabies in other areas.

Aboriginal people have strong concerns about access to countryside for survey and baiting projects. They have ongoing obligations to sacred sites and the safety of people travelling as strangers in their lands. Consequently, thorough and ongoing liaison is required, and it is necessary for researchers and managers to be accompanied by traditional owners or to have their permission, especially when working in new or remote areas.

Efforts to save rock wallaby populations from extinction in desert areas of WA and SA have provided some employment opportunities for Aboriginal people. For instance, at the Townsend Ridges, Kalka and New Well, local Aboriginal people have been employed by state government conservation agencies or local land councils to survey for rock wallabies and to lay predator baits to help in the recovery of small rock wallaby populations (Pearson and Ngaanyatjarra Council 1997, Read and Ward 2011). Fox baiting operations are likely to have positive impacts on the populations of bush-tucker species such as some goannas, bustards and rabbits. New baiting programs require extensive consultation with Aboriginal communities and some sign-posting of bait trails have been produced in Western Desert dialects (Ngaanyatjarra and Pitjantjatjarra). Such signs are typically placed alongside standard 1080 warning signs written in English.

Captive-bred *P. l. lateralis* rock wallabies (warru) were returned to their native home on the APY lands in the remote north-west corner of SA in March 2011. Deeply concerned about its decline, the Anangu (local Aboriginal people) are actively involved in the warru's recovery program. 'Warru Rangers' are employed to undertake recovery actions as part of DSEWPaCs Land and Coasts division's 'Working on Country' ranger program. There are many more potential roles for Aboriginal people in the management of rock wallabies.

A range of Aboriginal groups and the authorities representing them provided knowledge which was incorporated into this plan and allowed access to country to survey for rock wallabies and discussed their management. These groups and authorities would be involved in the implementation of recovery actions of this plan. These include: ALC, APY lands, CLMA, CLC, Jawoyn Association, KLC, MGC, NgC, NLC and the WDLC.

7 Social and economic impacts and benefits

This plan aims to contribute positively to the range of job opportunities available to communities (especially Aboriginal communities) and increase involvement in the management of rock wallabies by remote communities on their lands and other land tenures. There are unlikely to be any adverse social or economic impacts caused by the implementation of this recovery plan.

However, in those rock wallaby populations that are highly fragmented and surrounded by agricultural lands, during periods of high population growth there is the potential for rock wallabies to graze adjacent agricultural crops. This grazing may contribute to, or compound existing grazing pressures from other local and feral herbivores. Actions outlined in this plan, such as feral predator control, should be used in combination with other management actions to avoid increases in population numbers that exceed the natural available habitat's carrying capacity.

Some proponents of particular land uses (mining, quarrying and infrastructure) may be required to take measures to reduce the impact of their activities on rock wallaby populations. Where high biosecurity standards are required for island mining operations, companies and their contractors would need to meet these standards. Similarly, where proposed development activities co-incide with rock wallaby habitat, developers may be required to demonstrate that there will be no impact on rock wallabies or that any impacts can be adequately mitigated. Such requirements would be in place irrespective of this plan, and this plan will provide some clear direction for the implementation of such measures.

8 International obligations

Australia is a signatory of the *Convention on Biological Diversity* (Biodiversity Convention). Rock wallabies are listed with all native fauna under this agreement.

This plan is consistent with the aims and recommendations of the *Convention on Biological Diversity*, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that Convention. None of the species are listed under Appendix II in the *United Nations Environment Program World Conservation Monitoring Centre* (UNEP-WCMC) *Convention on International Trade in Endangered Species* (CITES), and this plan does not affect Australia's obligations under any other international agreements.

Australia is a signatory of the *Convention concerning the Protection of the World Cultural and Natural Heritage* (the World Heritage Convention). It aims to 'promote cooperation among nations to protect heritage from around the world that is of such outstanding universal value that its conservation is important for current and future generations'. Populations of rock wallaby taxa covered in this plan occur in three World Heritage sites in Australia:

- Kakadu NP (*P. brachyotis, P. c. canescens*)
- Purnululu NP (*P. brachyotis*)
- Ningaloo coast (*P. l. lateralis*)

Petrogale. l. MacDonnell Ranges race formerly occurred at a fourth World Heritage site, Uluru Kata Tjuta NP, but became locally extinct in the 1980s.

The *United Nations Declaration on the rights of Indigenous Peoples* sets out standards in relation to how governments interact with Indigenous people and some provisions of this non-binding declaration signed by Australia may have some impact on the scope of the actions listed in this plan.

9 Benefits and impacts to other species/ecological communities

Actions in the plan that target invasive animals and plants will deliver benefits to many other species and restore health to ecological communities. Cat and fox baiting to conserve rock wallabies will have benefits locally for other threatened species such as the mallee-fowl, bilby, marsupial mole, mulgara and great desert skink. Goat control will improve the state of vegetation communities and may contribute to the conservation of threatened plant species.

Increases in the size of rock wallaby populations should in turn provide improved food resources for a variety of natural predators (pythons, birds of prey and perhaps western quolls) including threatened species such as the Pilbara olive python (*Liasis olivaceus barroni*).

There are potential impacts to declared rare flora, such as the critically endangered granite tetratheca (*Tetratheca deltoidea*) which is known only to occur at Mount Caroline. In areas where rock wallaby populations have boomed and are overgrazing, species of declared or priority flora and threatened or priority ecological communities may be negatively impacted. Management actions likely to increase rock wallaby populations need to take into consideration the presence of other flora or ecological communities, especially those that are threatened, and other management actions such as fencing, land acquisition or revegetation may need to be considered.

The Edgar Ranges contain the only two populations of the declared rare flora Edgar Ranges pandanus (*Pandanus spiralis* var. *flammeus*). This species is restricted to a narrow gorge (DSEWPaC 2012). *P. l.* West Kimberley race populations would unlikely graze the pandanus foliage but may impact on recruitment by eating the fruits.

10 RECOVERY PROGRAM

10.1 Recovery objectives

The long-term objective of the recovery program is to:

Ensure the survival of populations and maintain or improve the conservation status (based on IUCN criteria (IUCN 1994)) of the taxa described in this plan by managing threats, improving scientific knowledge to guide recovery and involving the community in recovery actions.

10.2 Performance criteria

(using 2011 data as a baseline)

Criteria for success over the life of the plan (ten years):

1. The areas or number of sites occupied by mainland *P. lateralis* populations increase.
2. The areas occupied and the number of populations of *P. rothschildi* is at least maintained.
3. The island populations of rock wallabies persist and population levels are at least maintained.
4. Distribution and status surveys are undertaken of poorly known taxa and their conservation status reassessed.
5. Monitoring techniques for rock wallabies and their associated predators are improved and applied to at least five additional populations.

Criteria for failure

1. There is a decline in the conservation status of any taxon covered by this plan due to the action of threatening processes.
2. There is extinction of any of the currently known populations of *P. lateralis* or *P. rothschildi.*
3. There is extinction of any island population of taxa covered by this plan.
4. Surveys are not conducted and understanding of the distribution and conservation status of taxa remains at 2011 levels.
5. There is no growth in 50 per cent of the populations where feral animal control is taking place to manage this threat.
6. No new viable populations are established.

10.3 Recovery actions

All of the recovery actions below are considered essential in order to meet the recovery objectives. However, in order to help allocate limited funding and resources, recovery actions have been allocated priority ratings of high, moderate, low, based on the level of threat and potential contribution of the action to meeting recovery objectives.

Action 1: Assess the conservation status of poorly surveyed taxa

While knowledge of the distribution and conservation status is well developed for southern rock wallaby taxa, understanding of the current status of tropical species remains poor. There have been no specific surveys for *P. brachyotis, P. burbidgei*, Kimberley populations of *P. concinna*, or *P. c. concinna* and inland Pilbara populations of *P. rothschildi.* In addition, some taxa have not been surveyed for long periods and there are suggestions that their populations are in decline (*P. l.* MacDonnell Ranges race WA and NT populations; *P. C. canescens* in NT). These areas and taxa need to be resurveyed to ascertain their current status, possible threats and any evidence of population contractions or declines from their known historical distributions.

1.1 Survey of the distribution, conservation status and genetic diversity of tropical rock wallabies; *P. concinna, P. burbidgei* and *P. brachyotis*.

Tasks:

- Develop methods to undertake surveys of these species across their respective ranges in northern Australia.
- With land-holder involvement, undertake surveys at strategic sites selected on the basis of geographic distribution, historical records, land-holder and Aboriginal knowledge and the existence of suitable habitat.
- Undertake surveys to determine presence/absence initially and then conduct trapping at representative sites (at the range/outcrop level) to clarify the identity of taxa, to take samples for genetic studies and to assess the general health of the population (collect samples for study of diseases/parasites).
- During surveys record and identify potential threats to each population.
- Based on this information make recommendations on representative sites to monitor populations.
- Assess conservation status and likely population trends based on past information and any monitoring and survey data.

Areas not surveyed for long periods or where the persistence of populations or the identity of a population is not known include:

P. c. canescens

- western Arnhem Land (Kakadu NP, Nabarlek minesite and Mt Borradaile)
- Mt Bundey area/Litchfield NP

P. c. concinna

- Timber Creek/Victoria River (NT) area (including Gregory NP and the Bradshaw Defence training area)

P. c. monastria

- Jungulu (Darcy) Island, WA (identity of *Petrogale* sp. unknown)
- Mitchell River NP and Prince Regent NR.

P. burbidgei

- Mitchell River NP
- Prince Regent NR
- Wollaston Island (identity of *Petrogale* sp. unknown)
- Artesian Range Sanctuary

Responsibility:

- DPaW - Mitchell River NP, Prince Regent NR
- AWC - Artesian Range Sanctuary
- DPaW/NLC - Jungulu (Darcy) and Wollaston Islands
- LRM/Dept of Defence - Mt Bundey, Timber Creek, Gregory NP, Bradshaw Defence training Area
- LRM/private leaseholders - Nabarlek minesite and Mt Borradaile
- DSEWPaC - Kakadu NP

Priority: High (*P. concinna*), Moderate (*P. burbidgei, P. brachyotis*)
Timeframe: Year 1 to 3

1.2 Survey populations of *P. l.* MacDonnell Ranges race in WA and NT and *P. l.* West Kimberley race in WA.

Tasks:

- Revisit sites of past surveys of these taxa surveyed by Pearson (1992) and Gibson (2000) to assess changes in distribution.
- Select other potential areas of habitat based on local knowledge and examination of remote sensing data; survey these sites and collect genetic material and information on potential threats.
- Survey of APY lands for new populations of *P. l.* MacDonnell Ranges race.
- Assess current conservation status in light of previous surveys and make recommendations on sites requiring management intervention and those sites suitable for monitoring.

Responsibility:
P. l. MacDonnell Ranges race
- DSEWPaC, LRM, DPaW, AWC, CLC, APY, WDLC

P. l. West Kimberley race
- DPaW, KLC

Priority: High
Timeframe: By year 5

1.3 Survey of island and mainland Pilbara for Rothschild's rock wallaby to determine current status and establishment of monitoring sites.

Tasks:
- Revisit sites of past surveys to assess changes in distribution and abundance.
- With land-holder involvement, undertake surveys at strategic sites selected on the basis of geographic distribution, historical records, land-holder and Aboriginal knowledge and the existence of suitable habitat.
- Collect genetic material and information on potential threats.
- Assess current conservation status in light of previous surveys and make recommendations on sites requiring management intervention and those sites suitable for monitoring.

Responsibility: DPaW

Priority: Moderate
Timeframe: By year 5

Action 2: Conduct feral predator control

2.1. Continue existing exotic predator control programs.

Predation by foxes has been demonstrated to be a major threat to rock wallabies. Baiting with dried meat baits has been implemented at a number of sites to maintain populations.

Task:
- Continue current feral predator control activities to protect populations of *P. lateralis* and *P. rothschildi.*

Taxa and populations involved are listed previously in Table 4.

Responsibility:

- DPaW - WA Central Wheatbelt District, Cape Range NP, Kalbarri NP, Avon Valley NP, Walyunga NP, Cape Le Grand NP, Northern Burrup Peninsula, Dolphin Island
- WDLC/DPaW - Calvert Range
- APYLMU/DEWNR - Kalka, New Well
- AWC - Paruna Sanctuary

Priority: High
Timeframe: Ongoing

2.2 Expand introduced predator control operations to other rock wallaby populations constrained by predation (*P. l. lateralis, P. l.* MacDonnell Ranges race, *P. rothschildi).*

Tasks:

- Investigate the potential for expansion of collaborative predator baiting operations with Aboriginal communities to protect rock wallaby populations in the Central Ranges (Bell Rock, Cavenagh, Rawlinson, Morgan and Musgrave Ranges), southern Burrup Peninsula and coastal Pilbara.
- Bait target areas using known suitable methods, at the most appropriate frequency based on current knowledge.
- Resume feral predator baiting at the Townsend Ridges.
- Predator baiting at Durba Hills in advance of proposed translocation of *P. l. lateralis* (see action item 5.1).

Responsibility:

- NGLMU/DPaW - Cavenagh Range, Bell Rock Range, Rawlinson Range, Morgan Range, Townsend Ridges
- APY lands/DEWNR - Musgrave Ranges
- DPaW - southern Burrup Peninsula and coastal Pilbara
- DPaW/KJ- Durba Hills

Priority: High
Timeframe: Ongoing

2.3 Construction of a predator proof fence around Nangeen Hill (WA Wheatbelt) and monitoring its effectiveness.

Tasks:

- Construct a predator-proof (fox and feral cat) fence around Nangeen Hill NR to protect the much reduced population of *P. l. lateralis* and its unique genetics.
- Control rabbits and investigate the removal/control of feral rodents (*R. rattus* and *M. musculus)* from granite rocks.
- Manage populations of western grey kangaroos and euros from within the reserve.
- Undertake intensive predator control to remove all foxes and cats.
- Control iceplant infestation and revegetate the meadow below the granite outcrop.
- Review the effectiveness of the fence as a possible solution for other small threatened populations.

Responsibility: DPaW

Priority: High
Timeframe: By year 5

Action 3: Manage and monitor problem herbivores

3.1 Implement long-term goat control strategies in Kalbarri, Cape Range and Avon Valley NP's in WA (*P. l. lateralis).*

Tasks:

- Survey goat populations at key locations annually.
- Continue helicopter shooting program in Kalbarri and Cape Range NPs to keep goat numbers at a low level.
- Ground-based shooting to supplement helicopter operations and provide better temporal and local control of goats, especially around proposed translocation sites.
- Conduct goat control operations in Avon Valley NP, Walyunga NP.
- Determine feasibility of a goat-proof fence to isolate Cape Range NP and the Learmonth Air Weapons Range from neighbouring pastoral properties to assist in the integrated control of goats.
- Investigate the purchase of Murchison House Station and de-stock it of goats to minimise goats entering Kalbarri NP and surrounding conservation lands.

Responsibility:

- DPaW - Cape Range NP, Kalbarri NP, Avon Valley NP, Walyunga NP
- DPaW/Dept of Defence - Learmonth Air Weapons Range

Priority: High
Timeframe: Ongoing

3.2 Implement a long-term rabbit control operation around WA Wheatbelt and APY lands populations.

Tasks:

- Control rabbit populations on WA Wheatbelt *P. l. lateralis* sites to reduce habitat degradation and grazing competition with rock wallabies.
- Consult with APY lands traditional owners on controlling rabbits within 1km of populations of *P. l.* MacDonnell Ranges, as rabbits are an important food source for traditional owners.

Responsibility:

P. l. lateralis

- DPaW

P. l. MacDonnell Ranges race

- APY/DEWNR (*P. l.* MacDonnell Ranges race)

Priority: Moderate
Timeframe: Ongoing

3.3 Continue camel control operations on APY lands and around WA desert populations.

Task:

- Control camels around rock wallaby populations in the Townsend Ridges, Morgan Range and Calvert Range in WA, and the APY lands, by ground-based shooting and strategic fencing as required.

Responsibility:

P. l. MacDonnell Ranges race

- DPaW, NGLMU

P. l. MacDonnell Ranges race

- APY, DEWNR

Priority: Moderate
Timeframe: Ongoing

3.4 Assess the impact of euros on rock wallaby habitat.

Task:

- Investigate the relative contribution of euros to total grazing pressure on rock wallaby habitat.

Responsibility:

P. l. lateralis

- DPaW - Cape Range NP
- DPaW - Central Wheatbelt (Nangeen Hill Nature Reserve, Mt Caroline Nature Reserve)

Priority: Low

Timeframe: Ongoing

Action 4: Maintain and enhance biosecurity actions for islands to prevent the introduction of feral predators, competitors, weeds or disease

4.1 Prepare and disseminate biosecurity protocols.

Tasks:

- Continue existing biosecurity programs (Barrow Island, Groote Eylandt) and expand to other islands.
- Develop, implement and monitor rigorous quarantine protocols and standards appropriate for other islands.
- Disseminate quarantine protocols and associated information to government agencies, contractors and the public who may visit islands inhabited by rock wallabies, such as the Australian Maritime Service (light station maintenance), Customs, Volunteer Sea Rescue groups and fishing clubs.

Responsibility:

- Chevron/DPaW/Gorgon - Barrow Island
- DPaW - Recherche Archipelago: Mondrain, Westall, Wilson, Salisbury Islands
- DPaW - Dampier Archipelago: Dolphin, Enderby, Rosemary Islands
- DPaW/KLC - Kimberley islands: Boongaree, Jungulu (Darcy), Wollaston, Katers, Bigge, Long, Hidden, Augustus Islands
- DEWNR - North and South Pearson Islands
- DEWNR/private land-holders - Thistle and Wedge Islands
- LRM/NLC - 19 islands off Arnhem Land coast, NT
- LRM/ALC/GEMCO - Groote Eylandt Mining Company (Groote Eylandt)
- LRM/ALC - Bickerton Island

Priority: High

Timeframe: Ongoing

4.2 Install signage at boat ramps.

Task:

- Install signage or improve existing public information boards at boat ramps, wharfs and barge landings to include :
    - Prohibition of bringing pets (cats and dogs) onto the islands
    - Avoiding the introduction of plant weed species via seeds in clothes and camping equipment
    - Fire safety and restrictions.

Responsibility:

- DPaW, Dept of Transport (WA)
- DEWNR, Dept of Planning Transport and Infrastructure (SA)
- LRM, Dept of Primary Industries, Fisheries and Resources (NT)

Priority: Moderate
Timeframe: Ongoing

4.3 Build networks with government agencies and public to improve surveillance of islands.

Task:

- Build networks with local police, fisheries, Indigenous sea rangers, sea rescue organisations and fishermen to enhance surveillance of islands, to report or intervene and prevent any activity likely to endanger rock wallaby populations.

Responsibility:

- DPaW (WA)
- DEWNR (SA)
- LRM (NT)

Priority: Moderate
Timeframe: Ongoing

4.4 Plan emergency responses to incursion of predators, competitors, weeds and diseases on islands.

Task:

- Prepare emergency response plans for individual islands or groups of islands to outline the course of action to be taken if incursions of introduced predators or environmental weeds are detected.

Responsibility:

- DPaW - Recherche Archipelago: Mondrain, Westall, Wilson, Salisbury Islands
- DPaW - Dampier Archipelago: Dolphin, Enderby, Rosemary Islands

- DPaW/KLC - Kimberley islands: Boongaree, Jungulu (Darcy), Wollaston, Katers, Bigge, Long, Hidden, Augustus Islands
- DEWNR - North and South Pearson Islands
- DEWNR/private land-holders - Thistle and Wedge Islands
- LRM/NLC - 19 islands off Arnhem Land coast, NT
- LRM/ALC - Bickerton Island

Priority: High
Timeframe: Year 1 and 2

Action 5: Conduct translocations, captive breeding and reintroductions to establish new, or supplement existing populations

Translocations are highly dependent on successful predator and introduced herbivore control, and should not be conducted until these threats can be adequately managed as per action items 2 and 3.

5.1 Conduct further translocations of *P. lateralis* to areas within its known range where populations have become extinct.

Tasks:

- Undertake translocations of *P. l. lateralis* from the WA Wheatbelt to Kalbarri NP and Knungajin Rocks (near Merredin) when it is possible to do so without endangering these populations.
- Survey the genetic diversity of the Nangeen Hill population and supplement periodically from other populations if required.
- Undertake translocations of *P. l. lateralis* from the Calvert Range to the Durba Hills and other sites in the Little Sandy Desert and adjoining areas.
    - Prepare a translocation plan for Durba Hills with the assistance and consultation of local Aboriginal communities.
    - If the above is successful, investigate the possibility of further translocations to other former habitat in the Little Sandy Desert and Depuch Island.

Responsibility:

- DPaW - WA Wheatbelt, Kalbarri NP, Knungajin Rocks
- DPaW/KJ- Durba Hills, Depuch Island

Priority: High
Timeframe: Ongoing

5.2 Use captive breeding, cross-fostering and translocation to recover populations of *P. l.* MacDonnell Ranges race following control of threatening processes.

Tasks:

- Continue cross-fostering and captive-breeding of *P. l.* MacDonnell Ranges race animals at Monarto Zoo, SA to build numbers for reintroductions.
- Establish and maintain a predator-proof compound in the APY lands to aid with the reintroduction of rock wallabies.
- Undertake translocations of captive bred *P. l.* MacDonnell Ranges race animals to sites within the APY lands in SA.
- Based on the success of captive releases in APY lands, locate suitable sites and undertake translocation of *P. l.* MacDonnell Ranges race animals to the Davenport Ranges, SA.
- Investigate the feasibility of translocating some *P. l.* MacDonnell Ranges race animals back to Uluru-Kata Tjuta NP.

Responsibility:

- APYLMU/DEWNR/AWNRM - APY lands and Davenport Ranges
- DSEWPaC/CLC - Uluru Kata Tjuta NP

Priority: Moderate-High
Timeframe: Ongoing

Action 6: Monitor populations and review the efficacy of management actions

6.1 Monitor the effectiveness of introduced animal control programs, by assessing presence/absence of rock wallabies and predators, calculating activity indices of introduced predators and/or habitat use by rock wallabies and introduced predators.

Tasks:

- Intensively monitor specific and representative populations (mark-recapture trapping and/or with microchipping/transponders) of the threatened taxa (within *P. lateralis*) to determine population size and trends; and less intensive systematic surveys for persistence and gross population changes in other taxa/populations (fresh faecal pellet searches, remote cameras and spotlight counts).
- Survey selected populations (across the range and habitat types of each taxon) of non-threatened taxa at least once every five years.
- Where predator or herbivore control is being conducted or translocations have been undertaken, monitor the response of predators or herbivores (e.g. sand pads/activity indexes) and rock wallabies to assess the effectiveness of the programs.
- Monitor the response of rock wallabies and their habitat to the construction of predator proof fences and the relaxation of predator pressure (as per action item 2.3).
- Analyse monitoring results promptly and incorporate into an adaptive management framework. Make timely alterations to predator/herbivore control programs as required

and commence management actions if significant population declines or new threats are detected.

Responsibility:

P. l. lateralis

- DPaW - WA Central Wheatbelt District, Avon Valley/Walyunga NP, Cape Range NP
- AWC - Paruna Sanctuary

P. l. MacDonnell Ranges race

- LRM/CLC - MacDonnell Ranges, Petermann Ranges
- NGLMU/DPaW - Townsend Ridges, Rawlinson, Cavenagh, Bell Rock, Walter James, Dixon and Morgan Ranges, Mt Johnno
- APYLMU/DEWNR - Musgrave, Tomkinson, Hickley Ranges

P. l. West Kimberley race

- DPaW - Edgar Ranges, Erskine Range, Mt Anderson and hills near Mt Wynne

P. brachyotis

- DPaW - Mirima NP, Lake Argyle, Windjana Gorge, Bungle Bungle NP
- LRM - Litchfield NP
- LRM/NLC - central/eastern Arnhem Land
- DSEWPaC/NLC/Gagadju Association - Kakadu NP

P. burbidgei

- DPaW/KLC - Mitchell River NP, Prince Regent NR

P. concinna

- DPaW/KLC - Mitchell River NP, Prince Regent NR
- LRM/NLC - central Arnhem Land
- DSEWPaC - Kakadu NP

P. rothschildi

- DPaW - Karijini and Millstream-Chichester NP, Burrup Peninsula

Priority: Low (*P. brachyotis*); High (other taxa)
Timeframe: Ongoing

6.2 Monitor island populations of rock wallabies and their habitats to maintain biosecurity of islands and to enable rapid intervention if an exotic introduction is detected.

Tasks:

- Monitor all island populations of *P. lateralis*, *P. rothschildi, P. concinna* and *P. burbidgei* for population persistence and the potential arrival of any biosecurity risks, annually at least (such as inspection of beaches for feral animal tracks).
- Monitor populations on selected islands occupied by *P. brachyotis* (as it occurs on at least 19 islands in the NT), focusing on those islands most at risk of introduction of feral animals or weed species (e.g. those with outstations, fishing camps or other human activity).

Responsibility:

P. l. lateralis

- DPaW - Barrow and Salisbury Islands

P. lateralis hacketti

- DPaW - Mondrain, Westall and Wilson Islands

P. brachyotis

- LRM/NLC - Arnhem Land Islands
- LRM/ALC - Groote Eylandt and Bickerton Island

P. burbidgei

- DPaW/KLC - Bigge, Boongaree, Wollaston and Katers Islands

P. concinna

- DPaW/KLC - Long, Hidden, Jungulu (Darcy) and Augustus Islands

P. rothschildi

- DPaW - Dolphin, Enderby, Rosemary and West Lewis Islands

Priority: Low (*P. brachyotis*); High (other taxa)
Timeframe: Ongoing

6.3 Monitor rock wallaby populations subject to industrial or tourism impacts and review management if population size is negatively impacted or distribution shifts are detected.

Tasks:

- Monitor impacts on *P. l. lateralis* of industrial development on Barrow Island and any techniques employed to mitigate any impacts.
- Monitor the impact of any expansion of manganese mining into *P. brachyotis* habitat on Groote Eylandt.
- Monitor the effectiveness of fox baiting on the Burrup Peninsula and islands of the Dampier Archipelago in close proximity to infrastructure and industrial development (e.g. Dolphin Island).
- Monitor and document the impacts of the development of Kokerbin NR on *P. l. lateralis.*

Responsibility:

- Gorgon/Woodside/DPaW - Barrow Island, Burrup Peninsula
- LRM/GEMCO - Groote Eylandt
- DPaW - Dampier Peninsula, Dolphin Island, Kokerbin NR

Priority: High (WA); Low (*P. brachyotis*, NT)
Timeframe: Ongoing

Action 7: Manage habitat to maintain or improve its carrying capacity for rock wallabies and to permit successful breeding and dispersal

7.1 Improve security of tenure of off-reserve rock wallaby populations.

Tasks:

- Negotiate conservation covenants or other binding management agreements for lands that are important for sustaining rock wallaby populations. Off-reserve sites containing important populations of listed threatened taxa, including WA Wheatbelt *P. l. lateralis* sites should be the highest priority.
- Increase areas of protected rock wallaby habitat by negotiating strategic land purchases.
- Assist land-holders to adequately manage rock wallaby populations currently on private property, leasehold land or other tenures, especially with feral predator control.
- Connect existing populations by creating corridors of native vegetation to increase dispersal opportunities by land purchase or management arrangements with other land-holders.

Responsibility:

P. l. lateralis

- DPaW - WA Wheatbelt populations, Avon and Walyunga NPs
- AWC - Paruna Sanctuary

P. l. MacDonnell Ranges race

- APYLMU/DEWNR, DPaW/NGLMU

P. rothschildi

- DPaW - Burrup Peninsula

P. concinna, P. burbidgei, P. brachyotis

- DPaW/KLC, LRM/NLC

Priority: High (*P. lateralis*), Moderate (*P. rothschildi*), Low (*P. brachyotis, P. concinna*)
Timeframe: Ongoing

7.2 Rehabilitate habitat by controlling weeds and planting native vegetation to increase foraging habitat.

Tasks:

- Undertake weed control around WA Wheatbelt rock wallaby populations and monitor its effectiveness and changes in rock wallaby habitat use.
- Implement the APY Lands Buffel Management Plan to restrict the spread and extent of buffel grass.

Responsibility:

P. l. lateralis

- DPaW - WA Wheatbelt populations

P. l. MacDonnell Ranges race

- APYLMU/DEWNR

Priority: High (*P. lateralis*), Moderate (*P. rothschildi*)
Timeframe: Ongoing

7.3 Minimise the impacts of fire.

Tasks:

- Implement the APY Lands Fire Management Plan to reduce the size and extent of bushfires, and to manage fires around rock wallabies at New Well and Kalka.
- Plan, implement and monitor precautionary fire practices around *P. concinna* and *P. burbidgei* habitat in the Kimberley to prevent or reticulate large bushfires.
- Plan, implement and monitor prescribed burning in Pilbara reserves that ensures patchy and low intensity fires in areas occupied by *P. rothschildi*.
- Plan, implement and monitor prescribed burning in the Edgar Ranges NR that ensures patchy and low intensity fire in areas occupied by *P. l.* West Kimberley race.
- Develop protocols and readiness to intervene as required should a large bushfire occur on an island occupied by rock wallabies.
- Implement fire management around translocated populations to reduce the likelihood of large fires and to enhance habitat.

Responsibility:

P. l. lateralis

- DPaW/Chevron - WA Wheatbelt populations, Avon Valley and Walyunga NPs, Barrow Island
- AWC - Paruna Sanctuary

P. l. MacDonnell Ranges race

- APYLMU/DEWNR, DPaW/NGLMU

P. rothschildi

- DPaW- Burrup Peninsula, Dolphin Island

P. concinna, P. burbidgei, P. brachyotis

- DPaW/KLC, LRM/NLC

Priority: High (*P. l.* MacD race, *P. burbidgei*, *P. concinna*), Moderate (*P. rothschildi*), Low (*P. l. lateralis, P. brachyotis*)

Timeframe: Ongoing

Action 8: Undertake research to improve understanding of species biology, management and monitoring techniques

8.1 Conduct population viability analysis for those populations of rock wallabies where appropriate trapping data are available.

Tasks:

- Collate available trapping data for *P. lateralis* at long-term sites and conduct population viability analysis to assess their current status, population sizes and trends, and so guide decisions on how large populations need to be to ensure their persistence.
- Use these analyses to guide the recovery of other populations, translocations and determine the minimum data sets required to accurately estimate population trends.

Responsibility:

P. l. lateralis

- DPaW/UWA/Murdoch University - WA Wheatbelt populations

P. l. MacDonnell Ranges race

- APYLMU/DEWNR, University of Adelaide

Priority: High

Timeframe: Year 1 and 2

8.2 Assist with studies to refine existing and develop new predator control techniques.

Tasks:

- Provide field and other assistance for research into new or improved predator baiting technology, including the use of alternative toxins to 1080.
- Review of baiting techniques suitable for controlling feral predators around rock wallaby populations and their trialling in an experimental framework.
- Undertake a trapping or scat distribution survey prior to and after the implementation of new baiting at populations previously unbaited (as per action item 2.2).
- Estimate the numbers and densities of predators and use this information to assess the potential effectiveness of baiting over time.

Responsibility:

- DPaW, LRM, DEWNR with universities

Priority: High (WA & SA) Moderate (NT)

Timeframe: Ongoing

8.3 Test, improve existing, and develop new monitoring techniques for rock wallabies and predators.

Tasks:

- Undertake comprehensive and comparative testing of techniques to monitor rock wallabies as well as predators that will allow more accurate population estimations and display improved sensitivity to population trends. Some of these techniques would include scat counts, remote cameras, genetic typing from scat samples, sand plots, mark-recapture studies and remote dataloggers detecting microchipped individuals.
- Investigate the usefulness of new technologies when they become available.

Responsibility:

- DPaW, PWCNT, DEWNR with universities

Priority: High (WA & SA) Moderate (NT)
Timeframe: Ongoing

8.4 Undertake genetic analyses to delineate taxon boundaries, to test the validity of sub-species, inform translocations and clarify priorities for conservation actions.

Tasks:

- Clarify the taxonomic status of the subspecies of *P. brachyotis* and *P. concinna.*
- Encourage the routine collection of tissue and fresh faecal samples, photos of head, upper body, hips and tail from those species where possible in the field.
- Examine variation in Cape Range NP/Ningaloo Station *P. l. lateralis*; and *P. l.* MacDonnell Ranges race populations in NT, SA and unsampled populations in the Central Ranges Region of WA.
- Compare the various populations of *P. rothschildi* on islands in the Dampier Archipelago, the Burrup Peninsula and upland Pilbara sites to determine if there is significant population structuring.
- Clarify population numbers, distribution and health of translocated *P. l. lateralis.*

Responsibility:

- Australian Museum, SA Museum, WA Museum (housing of samples), LRM, DPaW, DEWNR (collection of samples)

Priority: High (*P. concinna, P. l.* MacDonnell Ranges race); Moderate (*P. brachyotis, P. burbidgei* and *P. rothschildi*)
Timeframe: Year 3 onwards

8.5 Undertake landscape-scale research projects to understand the impact of fires on habitat, predation risks and population parameters.

Tasks:

- Undertake studies examining the possible benefits of patch burning around *P. lateralis* populations to determine changes in activity or habitat use; shifts in diet; changes in body condition before and after fire, and survivorship/recruitment related to predation.
- Ascertain the extent and population impacts of feral cat predation on *P. burbidgei* and *P. concinna.*
- Conduct a study examining the response of *P. concinna* and *P. burbidgei* to fire-induced changes to their habitats.
- Research the field biology and ecology of *P. l.* West Kimberley race and *P. rothschildi* at selected sites in the southern Kimberley and Pilbara respectively.
- Assess the role predation may have in determining current population size and distribution and habitat use.
- Make recommendations for the most appropriate fire regimes to implement around populations on the basis of the observation of behaviour and habitat use in and around existing and future fire scars.

Responsibility:

- LRM/CLC - MacDonnell Ranges
- DPaW, NGLMU - Central Ranges of WA

P. burbidgei and *P. concinna*

- DPaW/AWC/NLC - Kimberley

P. l. West Kimberley race and *P. rothschildi*

- DPaW/Universities

Priority: High (WA & SA) Moderate (NT)
Timeframe: By year 5

8.6 Determine the impact of habitat enhancement (provision of water, supplementary feeding) on rock wallaby populations.

Task:

- Investigate whether the provision of water and supplementary feed around translocated populations or those at very low densities can assist with their rapid recovery in population size and expansion of their habitat use.

Responsibility:

- DEWNR/APY

Priority: High
Timeframe: End of year 3

8.7 Ascertain the factors preventing successful recruitment and dispersal.

Tasks:

- Undertake a radio-tracking/trapping study of translocated rock wallabies to understand the reasons for limited recruitment and dispersal.
- Trial strategies for more effective translocation and release of rock wallabies.

Responsibility:

- DEWNR/APY - SA translocated populations (when released)
- DPaW – Wheatbelt, Kalbarri NP

Priority: High
Timeframe: Year 5

8.8 Assist with the development of techniques to control buffel grass and research its impact on rock wallabies.

Tasks:

- Document the response of rock wallabies to the invasion of buffel grass in terms of its importance in the diet and its relative nutritional value compared to alternative plants.
- Assist with any field trials relating to the control of buffel grass and limiting its spread. Trials may involve land management techniques (such as the use of fire), but also the use of herbicides.

Responsibility:

- DEWNR/APY - SA populations of *P. l.* MacDonnell Ranges race

Priority: Moderate
Timeframe: Ongoing

8.9 Investigate the prevalence of toxoplasmosis and other diseases and parasites in rock wallabies.

Tasks:

- Collate samples and data from past and present projects containing information on rock wallaby diseases.
- Encourage researchers and managers to collect samples and observe/document the health of rock wallabies they handle.
- Document disease and parasite profiles of all the rock wallaby taxa in this plan and provide this information in a format that can be readily updated.

Responsibility:

- DPaW/Murdoch University, LRM, DEWNR

Priority: Moderate
Timeframe: Ongoing

8.10 Continue to develop and improve methods of captive care and translocation of rock wallabies.

Tasks:

- Continue to develop more efficient and effective methods to breed and care for rock wallabies and improve handling techniques for translocations.
- Review techniques and discuss at the five yearly rock wallaby scientific and management meeting (action 10.1)

Responsibility:

P. l. lateralis

- DPaW/Perth Zoo

P. l. MacDonnell Ranges race

- DEWNR/Monarto Zoo

Priority: Moderate

Timeframe: Ongoing

Action 9: Communication and community education

9.1 Provide a range of information and interpretative materials about rock wallabies for the community and tourism operators.

Tasks:

- Provide up-to-date information on rock wallabies to the public via agency websites.
- Assist tour guides and rangers working at rock wallaby sites to develop and present interpretative material on rock wallabies in their area.
- Encourage tour leaders on private property to use interpretative material related to rock wallaby conservation.
- Maximise opportunities to impart the conservation message through interpretive signs on rock wallaby pens in participating zoos.
- Provide signage at strategic sites to explain conservation issues pertaining to rock wallabies.

Responsibility:

- DPaW, Perth Zoo, LRM, DEWNR, Monarto Zoo

Priority: Moderate

Timeframe: By year 3

9.2 Involve the community, especially Aboriginal people, in the survey and management of rock wallabies.

Tasks:

- Develop and plan rock wallaby conservation and research projects with Aboriginal communities so they are involved in the management of rock wallabies on their lands.
- Plan for the involvement of land-holders and the local community in conservation actions (e.g. predator control and fire management), ensure the management of rock wallabies is incorporated into 'Working on Country' projects/plans for Indigenous Protected Areas.
- Develop culturally appropriate protocols to ensure the timely reporting of the results of conservation actions to Aboriginal groups and to the wider public.

Responsibility:

- LRM/CLC - MacDonnell Ranges
- LRM/NLC - Arnhem Land
- DSEWPaC - Kakadu NP
- DPaW/NGLMU - Central Ranges of WA
- DPaW/AWC/NLC - Kimberley
- DEWNR/APY - SA populations
- NRM groups for Indigenous Protected Areas

Priority: High
Timeframe: Ongoing

9.3 Provide updates on progress to community groups and the general public via newspaper articles, radio interviews, etc.

Task:

- Produce regular communication via various media (newspapers, magazines, radio interviews, television news) to update local land-holders and the wider community of progress in the recovery of rock wallabies.

Responsibility:

- LRM, DPaW, DEWNR, AWC

Priority: Moderate
Timeframe: Ongoing

Action 10: Manage the recovery process

10.1 Establish recovery teams or similar forums to plan and oversee actions to maintain, and where applicable, recover populations of *P. lateralis, P. rothschildi* and *P. concinna.*

Tasks:

- Continue regular meetings of the Warru Recovery Team in SA.
- Form a recovery team in WA to coordinate the recovery process for *P. lateralis*, with regular meetings to review actions related to *P. l.* MacDonnell Ranges race (with LRM/NGLMU).
- Investigate the potential to establish a tropical mammal recovery team to combine the recovery of *P. concinna* with other species affected by similar threats within a wider recovery process.
- Report annually on the progress of implementation of recovery actions, and success in meeting the recovery plan objectives.
- Organise a workshop every three years to bring together Aboriginal people, researchers and managers to share results and ideas, review and plan ongoing actions.

Responsibility:

- LRM, DPaW, DEWNR

Priority: High

Timeframe: Ongoing

A summary of the recovery actions relevant to each rock wallaby taxon included in this plan is presented in Table 6.

Table 6: Recovery actions relevant to each rock wallaby taxon

	Recovery Action									
Taxon	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
P. l. lateralis	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
P. l. hacketti				✓		✓	✓	✓	✓	✓
P. l. MacDonnell Ranges race	✓	✓	✓		✓	✓	✓	✓	✓	✓
P. l. West Kimberley race	✓					✓		✓	✓	✓
P. l. pearsoni				✓		✓	✓	✓	✓	✓
P. brachyotis	✓			✓		✓	✓	✓	✓	✓
P. burbidgei	✓			✓		✓	✓	✓	✓	✓
P. c. canescens	✓			✓		✓	✓	✓	✓	✓
P. c. concinna	✓						✓	✓	✓	✓
P.c. monastria	✓			✓		✓	✓	✓	✓	✓
P. rothschildi	✓	✓		✓		✓	✓	✓	✓	✓

11 IMPLEMENTATION AND EVALUATION

The timing and costs of recovery actions for the first five years of this recovery plan are summarized in Table 7. The costings were derived from existing estimates in the Warru Recovery Plan for the SA populations of *P. l.* MacDonnell Ranges race (Read and Ward 2011), the Action Plan for Threatened Australian Macropods (Roache 2011) or estimated at the time of preparation and are indicative only. These costings will also be indicative of the out years of this plan.

Actions such as the commencement of feral animal baiting to increase the size of a rock wallaby population takes time to establish and a number of years for the rock wallabies to respond to the relaxation of predator pressure. This means that actions commenced during this plan may deliver incremental results within the life of the plan with the full benefits (in terms of population responses) occurring over subsequent years. Actions commenced such as predator baiting and monitoring will need to be ongoing beyond the life of the plan.

Most of the taxa in this plan are not listed as endangered or threatened, although several are thought to have declining populations across some part of their range as a consequence of land use changes or other threatening processes. Recovery and population management tasks for such taxa are the responsibility of state, territory and federal conservation agencies as part of their ongoing conservation programs and can best be managed through state/territory-based recovery teams in the first instance, with periodic communication between different recovery teams dealing with the same taxa in different jurisdictions.

Funding will be required from state and territory conservation agencies and associated bodies to undertake the recovery actions. Some of these funds may be derived from co-operative projects with community or Aboriginal groups and through a range of other funding sources.

This plan will run for a minimum of ten years from the date of its adoption under the EPBC Act, or until replaced. The recovery team (or similar) will produce an annual report of achievements against the actions. The plan will be reviewed by state and territory conservation agencies, in consultation with the recovery team/s within five years of the date of its adoption, or sooner if necessary, and again after ten years.

Table 7: Costs ($000), priority and timing of recovery actions for the first five years of this plan

Action	Species	Priority	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1. Assess the conservation status of poorly surveyed taxa								
1.1 Survey of the distribution, conservation status and genetic diversity of tropical rock wallabies	*P. concinna*	High	170	170	50			390
	P. burbidgei	Moderate						
	P. brachyotis	Moderate						
1.2 Survey populations of *P. l.* MacDonnell Ranges race in WA and NT and *P. l.* West Kimberley race in WA	*P. l.* MacD race	High	100	100	50	50	50	350
	P. l. West Kimb race	High	15	15	5			35
1.3 Survey of island and mainland Pilbara for Rothschild's rock wallaby to determine current status and establishment of monitoring sites	*P. rothschildi*	Moderate	50	50			20	120
2. Conduct feral predator control								
2.1 WA Wheatbelt	*P. l. lateralis*	High	40	40	40	40	40	200
2.1 Cape Range NP/Learmonth Air Weapons Range	*P. l. lateralis*	High	32	32	32	32	32	160
2.1 Calvert Range	*P. l. lateralis*	High	30	30	30	30	30	150
2.1 Kalbarri NP (translocation site, baiting underway)	*P. l. lateralis*	High	20	20	20	20	20	100
2.1 Avon Valley NP	*P. l. lateralis*	High	15	15	15	15	15	75
2.1 Walyunga NP	*P. l. lateralis*	High	15	15	15	15	15	75
2.1 Paruna Sanctuary	*P. l. lateralis*	High	10	10	10	10	10	50
2.1 Cape Le Grand NP (translocated population)	*P. l. lateralis*	High	20	20	20	20	20	100

Action	Species	Priority	Year 1	Year 2	Year 3	Year 4	Year 5	Total
2.1 Kalka, New Well (includes Eradicat trial)	*P. l.* MacD race	High	58	58	58	58	58	290
2.1 Northern Burrup Peninsula, Dolphin and Rosemary Islands	*P. rothschildi*	High	15	15	15	15	15	75
2.1 Dampier Archipelago Islands (Dolphin Is)	*P. rothschildi*	High	15	15	15	15	15	75
2.2 Central Ranges of WA (new baiting)	*P. l.* MacD race	High		80	80	80	80	320
2.2 Southern Burrup Peninsula	*P. rothschildi*	Med	5	5	5	5	5	25
2.2 Townsend Ridges (resume baiting)	?*P. l.* MacD race[1]	High	40	30	30	30	30	160
2.2 Durba Hills (proposed translocation)	*P. l. lateralis*	High		40	40	40	40	160
2.3 Construction of a predator proof fence around Nangeen Hill and monitoring its effectiveness	*P. l. lateralis*	High	100	25	25	25	25	200
3. Manage and monitor problem herbivores								
3.1 Goat control Kalbarri NP	*P. l. lateralis*	High	50	50	50	50	50	250
3.1 Goat control Cape Range NP	*P. l. lateralis*	High	70	70	70	70	70	350
3.1 Goat control Avon Valley NP, Walyunga NP	*P. l. lateralis*	High	5	5	5	5	5	25
3.2 Rabbit control WA Wheatbelt	*P. l. lateralis*	Moderate	15	15	15	15	15	75
3.2 Rabbit control within 1km of rock wallaby colonies-APY lands	*P. l.* MacD race	Moderate	20	20	20	20	20	100
3.3 Camel control APY lands	*P. l.* MacD race	Moderate	8	8	8	8	8	40
3.3 Undertake survey and plan camel control in Central Ranges WA	*P. l.* MacD race	Moderate	20	10	10	10	10	60
3.4 Assess impact of euros on rock wallaby habitat	*P. l. lateralis*	Low	30	30	30	30	30	150

Action	Species	Priority	Year 1	Year 2	Year 3	Year 4	Year 5	Total
4. Maintain and enhance biosecurity actions for islands to prevent the introduction of feral predators, competitors, weeds or disease								
4.1 Prepare and disseminate biosecurity protocols	All island pop's[2]	High	20	2	2	2	2	28
4.2 Install signage at boat ramps	All island pop's[2]	Moderate	10	4	4	4	4	26
4.3 Build networks with gov't agencies and public to improve surveillance of islands	All island pop's[2]	Moderate	2	2	2	2	2	10
4.4 Plan emergency responses to incursion of predators, competitors, weeds and diseases on islands	All island pop's[2]	High	20	10				30
5. Conduct translocations, captive breeding and reintroductions to establish new, or supplement existing populations								
5.1 Translocation to Kalbarri NP and monitoring	*P. l. lateralis*	High			40		20	60
5.1 Translocation to Knungajin Rocks and monitoring	*P. l. lateralis*	High			15		10	25
5.1 Translocation to Durba Hills	*P. l. lateralis*	High		60		20		80
5.2 Cross-fostering/captive breeding at Monarto Zoo	*P. l.* MacD race	High	150	90	95	100	105	540
5.2 Establish and maintain predator-proof compound APY lands	*P. l.* MacD race	High	150	150	100	100	100	600
5.2 Translocations to APY lands from Monarto Zoo	*P. l.* MacD race	High					200	200
5.2 Investigate translocation sites in Davenport Range	*P. l.* MacD race	Moderate				10	10	20
5.2 Investigate feasibility to translocate to Uluru-Kata Tjuta NP	*P. l.* MacD race	Moderate				10	10	20

Action	Species	Priority	Year 1	Year 2	Year 3	Year 4	Year 5	Total
6. Monitor populations and review the efficacy of management actions								
6.1 Monitor WA Wheatbelt populations - annual trapping, cameras and scat searches	*P. l. lateralis*	High	50	50	50	50	50	250
6.1 Monitor Calvert Range/Durba Hills rock wallabies- annual trapping and scat searches	*P. l. lateralis*	High	40	40	40	40	40	200
6.1 Monitor Cape Range NP rock wallabies- boat transects, observation, scat searches	*P. l. lateralis*	High	15	15	15	15	15	75
6.1 Monitor rock wallabies- Avon Valley/Walyunga NPs	*P. l. lateralis*	High	5	5	5	5	5	25
6.1 Monitor rock wallabies- Paruna Sanctuary	*P. l. lateralis*	High	5	5	5	5	5	25
6.1 Monitor rock wallabies- Cape Le Grand NP	*P. l. lateralis*	High	5	5	5	5	5	25
6.1 Monitor rock wallabies- 4 x Recherche islands	*P. l. hacketti*	High	15				15	30
	P. l. lateralis	Moderate	10				10	20
6.1 Monitor rock wallabies- APY lands	*P. l.* MacD race	High	80	42	42	42	42	248
6.1 Monitor rock wallabies- Central Ranges WA	*P. l.* MacD race	Moderate	15	15	15	15	15	75
6.1 Monitor rock wallabies- Dampier Archipelago	*P. rothschildi*	Moderate	10	10	10	10	10	50
6.2 Monitor island populations to maintain biosecurity	P. brachyotis	Low	10	10	10	10	10	50
	other island pop's[2]	High						
6.3 Monitor populations subject to impact by industry or tourism	*P. l. lateralis*	High	10	10	10	10	10	50
	P. brachyotis	Low						
7. Manage habitat to maintain or improve its								

Action	Species	Priority	Year 1	Year 2	Year 3	Year 4	Year 5	Total
carrying capacity for rock wallabies and to permit successful breeding and dispersal								
7.1 Improve security of tenure of off-reserve rock wallaby populations	*P. l. lateralis*	High	5	5	5	5	5	25
	P. l. MacD race	High						
	P. rothschildi	Moderate						
	P. brachyotis	Low						
	P. concinna	Low						
7.2 Undertake weed control around WA Wheatbelt rock wallaby populations and monitor its effectiveness and changes in rock wallaby habitat use	*P. l. lateralis*	High	20	10	10	10	10	60
7.2 Implement APY Lands Buffel Grass Management Plan	*P. l.* MacD race	High	40	40	40	40	40	200
	P. rothschildi	Moderate						
7.3 Implement APY Lands Fire Management Plan around rock wallabies at New Well and Kalka	*P. l.* MacD race	High	4	4	4	4	4	20
7.3 Plan, implement and monitor precautionary fire practices around *P. concinna* and *P. burbidgei* habitat in the Kimberley to prevent or reticulate large bushfires	*P. burbidgei*	High	50	50	50	50	50	250
	P. c. monastria	High						
7.3 Plan, implement and monitor prescribed burning in Pilbara reserves that ensures patchy and low intensity fires in areas occupied by *P. rothschildi*	*P. rothschildi*	Moderate	20	20	20	20	20	100
7.3 Plan, implement and monitor prescribed burning in the Edgar Ranges NR that ensures patchy and low intensity fire in areas occupied by *P. l.* West Kimberley race	*P. l.* West Kimberley race	Low	20	15	15	15	15	80
7.3 Develop protocols and readiness if required to	All (except *P. l.*	High	40	10		10		60

Action	Species	Priority	Year 1	Year 2	Year 3	Year 4	Year 5	Total
potentially intervene if a large bushfire occurs on an island occupied by rock wallabies	West Kimb/MacD race)							
8. Undertake research to improve understanding of species biology, management and monitoring techniques								
8.1 Conduct population viability analysis for those populations where appropriate trapping data are available	*P. l. lateralis*	High	20					20
	P. l. MacD race	High						
8.2 Assist with studies to refine existing and develop new predator control techniques	All	High/Mod	50	50				100
8.3 Test, improve existing and develop new monitoring techniques for rock wallabies and predators	All	High/Mod	50	50				100
8.4 Undertake genetic analyses to delineate taxon boundaries, to test the validity of sub-species, and so clarify priorities for conservation actions	*P. concinna*	High			70	70	70	210
	P. l. MacD race	High						
	P. brachyotis	Moderate						
	P. burbidgei	Moderate						
	P. rothschildi	Moderate						
8.5 Undertake landscape-scale research projects to understand the impact of fires on habitat, predation risks and population parameters	*P. concinna*	High/Mod	200	200	200	200	200	1,000
	P. burbidgei	High						
	P. lateralis	High/Mod						
	P. l. West Kimb race	High						
	P. rothschildi	High						

Action	Species	Priority	Year 1	Year 2	Year 3	Year 4	Year 5	Total
8.6 Determine the impact of habitat enhancement (provision of water, supplementary feeding) on rock wallaby populations	*P. l. lateralis* *P. l.* MacD race	High	30	30	30			90
8.7 Ascertain the factors preventing successful recruitment and dispersal	*P. l. lateralis* *P. l.* MacD race	High			100	100	100	300
8.8 Assist with development of techniques to control buffel grass and research its impact on rock wallabies	*P. l.* MacD race	Moderate	40	40	40	40	40	200
8.9 Investigate the prevalence of toxoplasmosis and other diseases and parasites in rock wallabies	All	Moderate	20	20	20			60
8.10 Continue to develop and improve methods for captive care and translocation of rock wallabies	*P. l. lateralis* *P. l.* MacD race	Moderate	10			10		20
9. Communication and community education								
9.1 Provide a range of information and interpretative materials about rock wallabies for the community and tourism operators	All	Moderate	10	10				20
9 .2 Involve the community, especially Aboriginal people, in the survey and management of rock wallabies	All	High	60	60	50	50	50	270
9.3 Provide updates on progress to community groups and the general public via newspaper articles, radio interviews, etc.	All	Moderate	15	15	15	15	15	75
10. Manage the recovery process								

Action	Species	Priority	Year 1	Year 2	Year 3	Year 4	Year 5	Total
10.1 Establish recovery teams to plan and oversee actions to maintain and recover populations of *P. lateralis*, *P. rothschildi* and *P. concinna*	All	High	30	30	30	30	30	150
TOTALS			2324	2177	1927	1832	2072	10332

Notes: Costs indicative only. Some are drawn from Read and Ward (2011), Roache (2011) or calculated approximately at 2011 rates.

[1] this population is a unique genetic entity; Eldridge and Pearson (1997).

[2] all rock wallaby taxa in this plan except *P. l.* MacDonnell Ranges race, *P. c. concinna, P. c. canescens* and *P. l.* West Kimberley race have at least one island population

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13 Appendix 1 – Rock wallaby species profiles

Black-footed rock wallaby

Petrogale lateralis (Macropodidae)

The black-footed rock wallaby, *Petrogale lateralis,* encompasses five subspecies and races: *Petrogale lateralis lateralis, Petrogale lateralis hacketti, Petrogale lateralis pearsoni, Petrogale lateralis* MacDonnell Ranges race and *Petrogale lateralis* West Kimberley race. Their distribution is shown in Fig. 1. A separate profile for each of these taxa is provided below.

At the time of colonial settlement, *P. lateralis* (in its various taxonomic forms) was patchily distributed across much of the western half of the Australian continent. Populations were scattered and restricted to sites where suitable rocky habitat with caves and crevices existed.

Knowledge of the distribution of *P. lateralis* within these areas at that time was poor. In particular, in south-western Australia and the WA Goldfields there are few museum specimens, little past collection of ethno-zoological information from Aboriginal people and few surveys have searched for sub-fossil material.

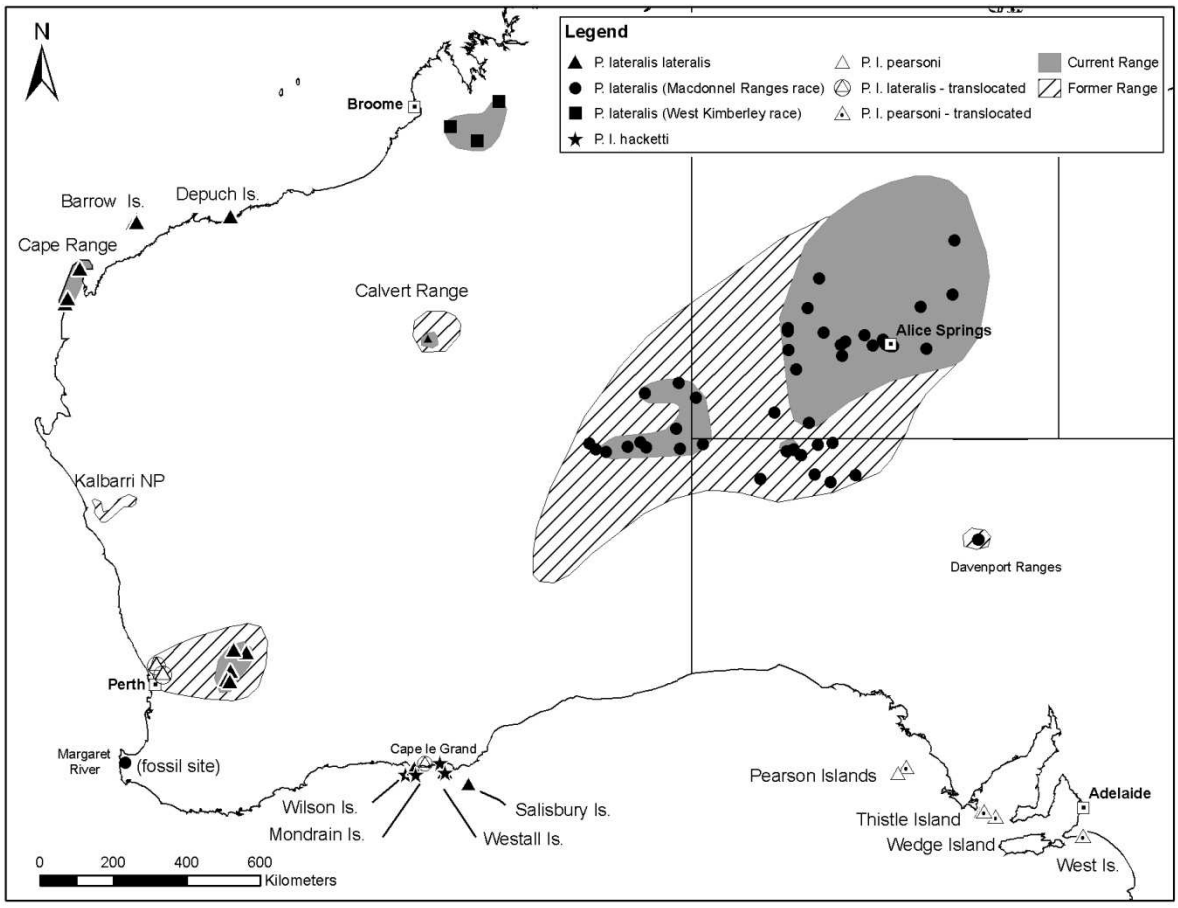

Figure 1: The distribution of the various subspecies and races of the black-footed rock wallaby (*P. lateralis*). Solid colour represents extant range and hatched areas the former range. [The Depuch Island population is now extinct. The Margaret River fossil record is presumably *P. l. lateralis*]

Black-footed rock wallaby ▪ Black-flanked rock wallaby

Petrogale lateralis lateralis (Macropodidae)

Warru (Calvert Range population), Moororong/bokal (Nyungar)

Conservation status

IUCN Red List 2011: **Near threatened**

EPBC Act: **Vulnerable**

WA Wildlife Conservation Act 1950: **Fauna that is rare or is likely to become extinct**

Photo: David Pearson - DPaW

Description

Adult males of *P. l. lateralis* weigh 4.1-5.0kg and females 3.1-3.8kg (Eldridge and Pearson 2008). It has dark grey-brown dorsal fur, with a paler chest which grades to dark brown on the belly. There are prominent black and white lateral stripes extending from the armpit to the hip. The coat is thick especially about the rump, flanks and tail. The face is dark-grey with a prominent white cheek stripe extending to the ear and edged by a dark-brown to black stripe from the snout through the eye and to the ear. There is a variably developed dark-brown to black stripe running along the midline of the head from between the eyes and ears, down the neck and onto the back. The feet and forearms are sandy yellow, darker below with dark brown to black paws. The tail is grey-brown grading to black at the distal end with a slight terminal brush (Eldridge and Pearson 2008).

Biology and ecology

They are primarily crepuscular and nocturnal emerging from their shelters to feed on grasses, forbs, browse and occasionally seeds and fruits such as figs. Typically they forage close to their rocky refuges to allow rapid retreat from predators. Known predators include foxes, dingoes/dogs, feral cats, eagles, pythons and large goannas (Eldridge and Pearson 2008). Body condition is linked to rainfall and females in good body condition tend to breed more frequently. In WA Wheatbelt populations, births are distributed throughout the year but with peaks in autumn and late winter/spring (Willers *et al.* 2011).

Distribution

At the time of colonial settlement, *P. lateralis* was distributed patchily across much of the western half of Australia. Despite this vast distribution, populations were scattered and restricted to sites where suitable rocky habitat existed. The widely disjunct current distribution suggests that there must have been intervening populations, a proposition supported by sub-fossil records from south-west WA.

The northern-most records of this subspecies are from Depuch Island on the northern margin of the Pilbara. This population is now extinct. East of the Pilbara Region in the Little Sandy Desert, *P. l. lateralis* formerly occurred in a number of ranges including the Durba Hills (Pearson 1992), Sir Fowell Headland (Burbidge and Pearson 1989), the Carnarvon Ranges (Eldridge and Pearson 2008) and the Calvert Range (Burbidge and Pearson 1989, Hall and Kinnear 1991). They are only known to still be extant in the Calvert Range (Fig. 1).

A north-western outlier of *P. l. lateralis* extends south from North-west Cape through Cape Range NP, including the Learmonth Air Weapons Range and into Ningaloo Station. Extant populations occur in several gorges through this area where suitable caves and crevices exist.

In the WA Wheatbelt, it is still extant at a total of seven sites: Nangeen Hill, Sales Rock Mount Caroline, Mount Stirling and Gundaring NRs; it was translocated to Querekin Rock; and independently dispersed to establish populations at Gardiner's Rock (now extinct) and Kokerbin NR.

To the west of the Wheatbelt populations, *P. l. lateralis* formerly occurred along the Avon Valley behind Perth (where the type specimen was collected by John Gilbert).

P. l. lateralis is known to have occurred on the southern coastline of WA (Baynes 1987) perhaps as far east as Mount Ragged (Pearson and Kinnear 1997) and there are sub-fossil records from Devil's Lair Cave near Margaret River (Dortch and Merrilees 1971, Merrilees 1979), although there are no records from this area since colonial settlement. There is also evidence (old scats) from several Wheatbelt rocks near Mukinbudin and at Knungajin Hill, 35km north-west of Merredin.

This taxon is also found on Salisbury Island (368ha) in the Recherche Archipelago, and on Barrow Island (23,483ha).

Populations

Barrow Island: Off the Pilbara coast, this island has a small population living along its west coast. Butler (1970) estimated that there were more than 500 individual rock wallabies living in "multiple cliff colonies which extend over some eight miles of coast and in some places go two miles inland". Hall and Kinnear (1991) estimated the Barrow Island population to be about 150-200 individuals. The population is probably limited by a lack of suitable diurnal shelter and the absence of surface water supplies. Suitable caves and crevices occur in limestone sea-cliffs along a limited section of the west coast and a few isolated limestone outcrops further inland.

Cape Range: A population of rock wallabies in Cape Range at Ningaloo Station was used by Kinnear (1995) as an unbaited control population in his studies on the impact of fox predation on rock wallabies. While numbers of rock wallabies were initially high, they declined during the study. By 2000, few rock wallabies were present (J. Kinnear pers. comm.). Inspection of these two gorges in 2008 found the rock wallabies to be numerous and conspicuous (D. Pearson pers. obs.); their persistence perhaps linked to honeycomb weathering of limestone resulting in extensive multi-layered caves. Ningaloo Station is a sheep property but also derives income from harvesting feral goats and tourism. Ningaloo Station remains privately owned and managed with no fox or goat control occurring on the property (M. Prophet pers. comm. 2011).

Salisbury Island (Recherche Archipelago): In 2006 rock wallabies were found to be abundant with many observed and large faecal pellet accumulations indicating a sizeable population (D. Pearson pers. obs).

WA Wheatbelt: Populations occur in five small NRs (Mount Caroline, Mount Stirling, Gundaring, Kokerbin and Nangeen Hill) in the WA Wheatbelt. Two populations are situated on private land at Querekin and Sales Rocks. A small number of wallabies were present on Gardiner's Rock until 2007. Fox control around WA Wheatbelt populations has been very successful in increasing numbers from near-extinction levels. In more recent years, boom-bust cycles have raised concerns about the effectiveness of predator control (in particular feral cats), overgrazing and impacts on neighbouring farmers' crops and threatened flora.

Translocated populations

Avon Valley, Walyunga and Paruna: Wheatbelt animals have been translocated into Avon Valley and Walyunga NPs and adjoining Paruna Sanctuary controlled by the Australian Wildlife Conservancy (Orell 2001). The species had been absent from the Avon Valley for a considerable but unknown time, an area that Gould (1842) had reported the species to be "very abundant".

Cape Le Grand NP: A translocation of rock wallabies (*P. l. lateralis*) to Cape Le Grand NP east of Esperance was carried out in 2003, with animals from Mount Caroline and Querekin Rock in the Wheatbelt (Orell 2003). Cape Le Grand NP has an area of 31,578ha and is considered to be part of the historic range of the species (Baynes 1987). It contains a large area of granite and dolerite outcrops with numerous caves. Camera trapping, begun in 2011, has confirmed this population is still extant, with an un-tagged female with young at heel observed. It was proposed to supplement this translocation with further individuals in the future.

Habitat

P. l. lateralis in the WA Wheatbelt is found in a series of granite inselbergs separated by farmland. They shelter in caves and crevices between boulders and occasionally in machinery sheds and other buildings of nearby farms. The vegetation in their habitat is typically acacia shrubland or open eucalypt woodland with areas of native and introduced grasses providing the majority of feeding sites on the apron of colluvium around the base of the outcrops.

Along the Murchison River in Kalbarri NP, *P. l. lateralis* formerly occupied sandstone cliffs with caves and overhangs and boulder piles created by cliff collapses. The vegetation in the gorge is primarily eucalypts and *Melaleuca* spp. with seasonal grasses and herbs and on the gorge sides, open shrubland of a mixture of species dominated by *Acacia* spp. and *Allocasuarina* spp.

At Cape Range, rock wallabies occur in rugged and deeply dissected limestone outcrops and gullies. Caves are usually most extensive along seasonal watercourses and rock wallabies tend to be concentrated in these sites, especially where large sections of cliff have fallen leaving jumbled house-sized rock slabs. These provide numerous multi-entranced crevices, often shaded by large figs.

The Barrow Island population seeks daytime refuge in limestone caves and overhangs. One population is known to occur further inland, alongside an operating oil well, in a large outcrop of limestone. The limestone contains several caves and protected crevices under large boulders that have dropped from the cliff-line above. The vegetation comprises native fig (*Ficus platypoda)* and scattered shrubs over spinifex (D. Pearson pers. obs.).

Translocated populations of *P. l. lateralis* in the Avon Valley were released in an area of extensive granite and dolerite outcrops and cliffs on the eastern side of the Avon River. There are numerous caves and crevices within the outcrops with adjacent open grasslands and woodland (Orell and Dans 2002). Animals were reintroduced to Cape Le Grand NP on large granite exposures with overhangs and caves, surrounded by dense heathland and low shrublands in an area characterised by winter rainfall and relatively mild summers.

Habitat critical to the survival of *P. l. lateralis* includes: rocky substrates which have extensive development of multi-entranced caves, rock-piles and crevices that provide cool refuges from extremes of heat and protection from predators.

Wheatbelt boom-bust cycles

By September 1999, such was the recovery of rock wallaby populations as a result of fox baiting that they were causing crop damage in neighbouring farms. Fencing and translocations to other sites in south-western Australia were implemented. A study was made of the potential of contraceptive chemicals to slow the growth of the rock wallaby populations (Willers *et al.* 2011). Since 2010, there have been dramatic declines in rock wallaby populations at several outcrops for reasons that are not entirely apparent, but perhaps due to changes in baiting practices and the persistence of bait-shy foxes (N. Moore pers. comm.). Dramatic declines seen over summer 2011 are thought to be the result of overgrazing (a result of good fox control) of vegetation within about 20 metres of the best habitat (extensively fractured granite) due to a predator fear behaviour (Kinnear *et al* 2010) as some foxes were still present. Poor seasonal conditions have exacerbated this situation (N. Moore pers. comm. 2012).

Threats

- Predation by foxes, dingoes, wild dogs and feral cats
- Habitat degradation due to goats, weed invasion and rabbits
- Disturbance from mining/petroleum development
- Disturbance from tourism and recreational activities.

Fox predation was found to be the major threat to the persistence of WA Wheatbelt rock wallabies (Kinnear *et al.* 1988, 1998) and it is thought to be a critical issue for *P. l. lateralis* populations in the Calvert Range and Cape Range and a primary factor in their disappearance from Kalbarri NP (in concert with feral goats) (Pearson and Kinnear 1997).

Barrow Island populations have low levels of genetic variation, and are potentially threatened by disturbance from oil and gas extraction operations or fire.

Recovery actions

- Continue existing fox and cat control operations, monitor their effectiveness and modify as required.
- Construct a predator proof fence around Nangeen Hill NR to preserve this population.
- Control goats in Kalbarri, Cape Range and Avon Valley NPs.
- Prevent exotic introductions onto Salisbury Island.
- Translocate to areas of their former distribution.
- Undertake weed control, especially iceplant (*Mesembryanthemum* spp.) and cape weed (*Arctotheca calendula)* around populations where required.
- Implement fire management around populations to reduce the likelihood of large fires and to enhance habitat.
- Research the viability of existing populations and the factors preventing successful recruitment and dispersal.
- Create a breeding catalogue of animals with known genetic details to improve management of small populations and to plan better founder populations for translocations.
- Involve land-owners including Aboriginal communities in survey and management.

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Black-footed rock wallaby ▪ Recherche subspecies

Petrogale lateralis hacketti (Macropodidae)

Conservation status

IUCN Red List 2011: **Near Threatened**
EPBC Act: **Vulnerable**
WA Wildlife Conservation Act 1950: **Fauna that is rare or is likely to become extinct**

Photo: *Lochman Transparencies®*

Description

P. l. hacketti has a similar appearance to *P. l. lateralis* although it is slightly larger (4.8-5.3kg adult weight) and has a shaggier pelage. The dorsal fur is grey-brown with a paler chest. Prominent black and white lateral stripes extend to the hip. The tail is grey-brown grading to a black slightly brushed tip (Eldridge and Pearson 2008). It was originally described by Thomas (1905) from a specimen obtained by J.T. Tunney in 1904 on Mondrain Island. It had been collected 100 years earlier by Flinders but these specimens apparently have not survived (Eldridge 1997).

Distribution

P. l. hacketti occupies three windswept granite islands in the Recherche Archipelago off the southern coastline of WA: Mondrain (810ha), Westall (70ha); and Wilson Islands (90ha) (Pearson and Kinnear 1997, Fig. 1).

Populations

Serventy (1953) found that *P. l. hacketti* was "fairly plentiful" on Mondrain and Westall Islands. The Wilson Islands populations have been visited less frequently. In January 2006, Wilson and Westall Islands were visited for a day each and the rock wallabies were found to be abundant on both islands (D. Pearson pers. obs.). No regular monitoring of these populations has occurred, and as such there is no evidence of any decline in the distribution or abundance of this subspecies.

All three populations are considered important for the survival of this subspecies.

Habitat

The habitat of *P. l. hacketti* on the Recherche Archipelago consists of steep granitic islands with tors, rock-piles and deep crevices available for shelter. The islands rise abruptly from the Southern Ocean and have low wind-pruned communities of *Acacia, Allocasuarina* and

Melaleuca spp. with large areas of skeletal soil covered by *Borya spp.* and succulents such as pigface (*Carpobrotus* spp.).

All habitat in which the subspecies currently occurs is considered habitat critical for their long-term survival.

Biology and ecology

The rock wallabies shelter in crevices and caves in the granite down to the water's edge, especially where faulting of the granite results in multi-entranced radiating passages.

Threats

There are no immediate threats as the islands are remote and difficult to land on, discouraging visits by the public (D. Pearson pers. obs.). However, the introduction of foxes or cats or a large wildfire could conceivably result in an island extinction.

Recovery actions

- Prepare and implement island biosecurity protocols to prevent the introduction of exotic animals or weeds.
- Plan emergency responses to cope with the potential arrival of exotic animals or wildfire.
- Communicate to the public the need to maintain strict quarantine on the islands.

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Black-footed rock wallaby ▪ MacDonnell Range race

Petrogale lateralis MacDonnell Ranges race (Macropodidae)
(*Warru*- several desert Aboriginal languages and dialects)

Conservation status
IUCN Red List 2011: **Near threatened**
EPBC Act: **Vulnerable**
SA National Parks and Wildlife Act 1972: **Endangered**
WA Wildlife Conservation Act 1950: **Fauna that is rare or is likely to become extinct**
Territory Parks and Wildlife Conservation Act 2006: **Near Threatened**


Photo: David Pearson - DPaW

Description
This race of *P. lateralis* was identified by Briscoe *et al.* (1982) and is generally considered an undescribed subspecies (Eldridge 1997). The appearance of this race is similar to *P. l. lateralis*, although the coat is shorter. It is dark grizzled brown on the back with grey shoulders. It changes to a predominantly sandy-brown pelage in summer. A stripe of dark brown to black runs from between the ears to below the shoulders. A white side-stripe bordered with a wider dark brown stripe extends from the axillary area to the thighs. The chest is paler and the belly is buff (Eldridge and Pearson 2008). The head is grey with a white cheek-stripe, the snout is brown while the ears are dark brown with a paler smoky brown base. The tail is dark grey, becoming browner distally with a black terminal brush which tends to be less distinct than that of *P. l. lateralis* (Eldridge and Pearson 2008).

Distribution
This taxon occurs in northern SA, the central-eastern portion of WA and southern NT. An accurate historic extent has been difficult to assess as much of the potential former range is remote and there have been limited surveys. Nonetheless, it is apparent that in SA (Ward *et al.* 2011) and WA (Pearson 1992), there has been dramatic declines in both the taxon's range and abundance. At the time of colonial settlement, it was distributed across the northern section of SA, central western WA and a vast area of southern NT (Lundie-Jenkins and Findlay 1997, Gibson 2000) (Fig. 1).

P. l. MacDonnell Range race remains widespread and common in many places in the NT, with recent records from remote areas such as the Petermann Ranges, Bloods Range and Davenport Ranges. There are no recent records from Uluru or Kata Tjuta (last record mid-1980s), but they are considered extant at Mount Conner, Harts Range, Mount Windajong and the George Gill Range. In the MacDonnell Ranges, populations are known from Glen Helen to Loves Creek (Gibson 2000).

In SA, it has disappeared from 93 per cent of its former range and extant metapopulations are now only known to persist at two sites: the eastern Musgrave Range (Pukatja to New Well) and the Tomkinson/Hinckley Ranges (three sites). A population at Wamitjara in the eastern Musgrave Ranges disappeared around 2006 (Read and Ward 2011). An isolated population in the Davenport Ranges (SA) lapsed to extinction around 1998 (Moseby *et al.* 1998).

In WA, the race is now extinct across much of its former southern range and survives in isolated pockets in the Townsend Ridges, Cavenagh, Morgan, Bell Rock, Rawlinson and Walter James Ranges (Pearson 1992, Pearson and Kinnear 1997).

Populations

There have been no estimates reported for any populations in the NT. In WA this race can be described as abundant only at Pungkulpirri Rockhole in the Walter James Range. Elsewhere, individuals are rarely observed and populations are widely fragmented (Pearson 1992).

In SA, it is estimated that the eastern Musgrave Range metapopulation numbers 150-200 animals, while the Tomkinson Range populations total between 30 and 50 individuals (Read and Ward 2011, Ward *et al.* 2011).

All populations of *P. l.* MacDonnell Range race in SA and in WA are considered important to the survival of this taxon across its existing range. It is noteworthy that considerable genetic variation is apparent (Eldridge *et al.* 1992). The MacDonnell Ranges (NT) remains the stronghold for the taxon.

Habitat

This taxon occurs in numerous extensive ranges, especially the sedimentary MacDonnell Ranges, which contains huge cliffs, numerous caves, gorges and cliff collapses with a wealth of shelter sites. Other populations occur in granite boulder piles, metamorphic schists around Alice Springs, granophyre ranges in WA and many sedimentary (quartzite and sandstone) ranges and hills. The vegetation over most of these rocky sites consists of open low shrublands with spinifex and occasional figs, often with more diverse shrublands, grasslands or herbfields on the slopes and aprons below the outcrops. Where watercourses dissect the ranges, there may be permanent or semi-permanent water and seepages that give rise to more mesic vegetation including soft grasses and herbs.

Habitat features thought to be critical to survival of this taxon include areas of rocky habitat that have numerous caves, rock-piles and crevices. These areas provide cool shelter from temperature extremes during the day and sufficient ruggedness to permit escape from

predators. Access to suitably palatable grasses, forbs, seeds and fruit close to their refuges is also required.

Biology and ecology

This taxon emerges from its daytime rocky refuges in the late afternoon or early evening and feeds on plants and shrubs on the outcrops and surrounding flats. They usually demonstrate high site fidelity but have the ability to move long distances (Ruykys *et al*. 2011). A peak in births in autumn-winter has been reported and juvenile survival has been correlated with winter rainfall (Ward *et al.* 2011)

Threats

Threats to *P. l.* MacDonnell Range race are thought to include:

- Predation by foxes, feral cats, wild dogs and dingoes
- Habitat degradation due to camels and grazing livestock
- Spread of weedy species, especially buffel grass.

Southern populations have declined dramatically (Pearson 1992, Read 2001), presumably due to fox predation. Further north, the decline of *P. lateralis* in the NT has not been as dramatic, perhaps reflecting lower fox densities as well as larger and more continuous areas of habitat. However, rock wallabies have disappeared from many areas, while in other areas of seemingly good habitat (e.g. MacDonnell Range), rock wallaby colonies are scattered and relatively small (Gibson 2000). Foxes, cats and/or dogs may have a strong role in restricting these populations.

Recovery actions

- Survey known, and search for new, populations and determine genetic variability and current conservation status.
- Expand existing fox and cat control operations and monitor their effectiveness.
- Control rabbits, camels and euros were these compete significantly with rock wallabies.
- Captive breed and translocate rock wallabies to vacant habitat.
- Undertake weed control (e.g. buffel grass) around populations where required.
- Implement fire management to reduce the likelihood of large fires and to enhance habitat condition.
- Research the viability of existing populations and the factors preventing successful recruitment and dispersal.
- Involve land-owners including Aboriginal communities in the survey and management of rock wallabies.

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Black-footed rock wallaby ▪ Pearson Island rock wallaby

Petrogale lateralis pearsoni (Macropodidae)

Conservation status

IUCN Red List 2011: **Near threatened**
EPBC Act: **Not Listed**
SA National Parks and Wildlife Act 1972: **Not Listed**

Photo: David Pearson - DPaW

Description

Thomas (1922) described *P. l. pearsoni* as "comparatively small", about the same size as *P. l. lateralis,* but smaller than *P. l. hacketti*. Adult males and females on Pearson Island are smaller (mean weights 4.08kg and 3.43kg respectively) than the translocated animals on Wedge Island (males 4.48kg and females 4.05kg) (McIlwee and Jones 2010).

It is dark grizzled grey on the back with grey-silver fur on the shoulders and neck. The coat is generally thicker and 'woollier' than *P. l. lateralis.* The chest and belly are pale yellow to buff. A distinct dark brown dorsal stripe runs from between the ears over the head and down the back to below the shoulders. There is a prominent white side-stripe running from the axillary region of the foreleg to the thigh, with a wider dark brown stripe on its distal edge. The face is dark grey-brown with a wide buff cheek stripe and a dark stripe through the eye. Ears are dark with a paler section across the base. The forearms are off-white to buff with dark brown or black paws. The digits on the feet are black or dark brown. The tail is light brown, grading to black at the distal end and there is a slight terminal brush (Eldridge and Close 1995, Eldridge and Pearson 2008).

Biology and ecology

The partly diurnal habits of *P. l. pearsoni* were noted by Wood Jones (1968) who remarked "it is a conspicuous creature readily seen from the deck of a ship passing under shelter of the eastern side of the group". He described its apparently awkward forward-leaning gait when bounding through level saltbush areas, but found it to be "a very different creature when seen upon the huge, fantastic, granite boulders. Here its movements are astonishing; there seems to be no leap it will not take, no chink between boulders into which it will not hurl itself".

Distribution

Historically, this subspecies only occurred on the northern islet of the Pearson Islands in the Investigator Group, off Elliston on the southern coastline of SA (Robinson 1980). Fossil material has been found on St Peters Island off Ceduna, but it appears to have been extinct there prior to colonial settlement (Robinson 1989, Robinson *et al.* 1996). During an expedition in 1960, although unplanned, six rock wallabies were accidentally released on the southern islet of Pearson Island. They increased in number to about 150 individuals (Copley and Alexander 1997). The total area of North and South Pearson Islands is 213ha (Fig. 1).

Populations

Two translocations of 15 *P. l. pearsoni* were undertaken to Thistle Island (3,925ha) in 1974 and 1975. The rock wallabies spread across the island and by 1979 were estimated to number over 350, making it the largest population of the taxon (Armstrong pers. comm. in Copley and Alexander 1979).

In 1975, 11 *P. l. pearsoni* were translocated to Wedge Island (947ha). By 1997, they were estimated to number 100-200 individuals (Copley and Alexander 1997). Another translocation attempt to move rock wallabies from North Pearson Island to West Island (14ha) off the Fleurieu Peninsula in 1974 was unsuccessful (Copley and Alexander 1997).

All populations are considered important to the survival of *P. l. pearsoni.*

Habitat

The habitat of *P. l. pearsoni* on the Pearson Islands is similar to that of *P. l. hacketti*, consisting of steep granitic islands with deep faults and crevices available for shelter. The vegetation is primarily low wind-swept shrubland of *Atriplex* sp. with some areas of deeper soil with *Acacia sp.*

Threats

- Introductions to the islands of foxes, feral cats or dogs
- Small population size and perturbations linked to drought or fire.

Recovery actions

- Prepare and implement biosecurity protocols for islands to prevent the introduction of exotic animals or weeds.
- Plan emergency responses to the potential arrival of exotic animals and wildfire.
- Monitor populations and islands to allow early detection of any disease or pest introduction and to determine population trends.
- Communicate to the public the need to maintain strict quarantine on the islands.

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Black-footed rock wallaby ▪ West Kimberley race

Petrogale lateralis West Kimberley race (Macropodidae)

Conservation status

IUCN Red List 2011: N**ear threatened**

EPBC Act: **Vulnerable**

WA Wildlife Conservation Act 1950: **Fauna that is rare or is likely to become extinct**

Photo: David Pearson - DPaW

Description

This taxon was identified on genetic grounds by Briscoe *et al.* (1982) and is considered an undescribed subspecies of *P. lateralis* (Eldridge 1997). It is of similar size to *P. l. lateralis* with adult males ranging from 3.5 to 6.5kg and adult females 3.3 to 4.2kg. The markings are similar to that of *P. l. lateralis*, but it is generally paler and distinctly yellowish (Eldridge and Pearson 2008).

Distribution

This taxon is known from comparatively few scattered ranges and rock outcrops and only one conservation reserve in the West Kimberley Region of WA. There is little available information on the historic range. Known historic sites include Mount Wynne (1901) Mount Anderson (undated), Mount Alexander (1911), Edgar Range (1961, 1976, 1977) (Pearson and Kinnear 1997, Youngson *et al.* 1981, M. Eldridge pers. comm.). Current sites include Erskine Range (Pearson and Kinnear 1997), Edgar Range, Grant Range, Dogspike Hill and Done Hill (Fig. 1).

Populations

The Erskine and Edgar Ranges are important to this taxon's survival due to the large area of habitat, their location at the northern and southern ends of the distribution and the likely size of the populations. There is limited information on the number and size of populations and on possible population trends. Populations exist on pastoral leases and Aboriginal reserves.

Habitat

The West Kimberley race of *P. lateralis* is known from comparatively few scattered ranges and rock outcrops. Populations occur on low flat-topped sedimentary hills and shelter in caves and crevices below boulders that have fallen from the cliffs above. The climate is arid-tropical with a strong summer bias in rainfall and the vegetation is primarily acacia shrubland or boab woodland with spinifex, but in wetter pockets there may be pandanus and eucalypts lining creeklines through rock-piles.

Features of habitat critical to survival of this species are thought to include extensive areas of rocky habitat with caves, crevices and cliff collapses that provide multi-entranced shelters from extreme daytime temperatures and predators. Suitable palatable grasses and forbs in close proximity to these shelters are also required.

Biology and ecology

There have been no specific studies of this taxon.

Threats

Foxes are known to occur infrequently along the southern side of the Edgar Ranges but their potential impact on the rock wallabies is unknown. Predation by feral cats, dingoes and wild dogs is likely. One local land-holder burns areas around the Erskine Range close to the highway (frequency unknown) but this appears to have little obvious impact on rock wallaby numbers.

Habitat degradation due to stock is probable especially around Logues Spring in the Edgar Ranges.

Recovery actions

- Resurvey known populations for any changes to regional and local rock wallaby distribution in southern Kimberley (Erskine and Edgar Ranges, Mt Alexander).
- Conduct research on the impacts of predation and fire on the species.
- Work with land-holders to implement a patch burn strategy to reduced likelihood of large fires in the Edgar and Erskine Ranges.

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Short-eared rock wallaby ▪ *Petrogale brachyotis* (Macropodidae)

Conservation status
IUCN Red List 2011: **Least Concern**
EPBC Act: **Not listed**
WA Wildlife Conservation Act 1950: **Not listed**
Territory Parks and Wildlife Act 2006: **Least Concern**


Photo: David Pearson - DPaW

Description
The short-eared rock wallaby is a moderately-sized macropod with average adult male weights of 4.4kg (range 3.2-5.6kg) and females 3.7kg (range 2.2-4.7kg). It is very variable in colour and size. Generally, the fur is fine, short and uniform greyish-brown, flecked with silver-grey hairs which may give it a "glistening appearance" (Menkhorst and Knight 2004). The legs and hips are cinnamon brown, the underparts grey and the ends of the feet black. The head is grey and the snout brownish with a white jaw stripe. The ears are less than half the length of the head, being proportionately shorter than the ears of *P. concinna* and *P. burbidgei.*

While two subspecies are currently recognized (*P. b. brachyotis* and *P. b. signata*), Sharman *et al.* (1995) questioned the validity of the latter subspecies and instead favoured the division of *brachyotis* into three interim geographic races. The 'Kimberley race' covers those populations in Western Australia, for which *P. b. brachyotis* is the appropriate name. The 'Victoria River' race includes those populations in the Victoria River district of the western Northern Territory. The 'Arnhem Land' race encompasses variable populations formerly ascribed to the three species of Thomas (1926) and extends from the Alligator Rivers region, through Arnhem Land to the western Gulf of Carpentaria including Groote Eylandt (Sharman *et al.* 1995).

Kimberley race animals have pale grey-brown backs with white to greyish-white on the belly. Markings are subtle with a small dark brown stripe from the neck to the shoulder; a white axillary patch but no side stripe, and in some individuals a faint hip-stripe (Sharman *et al.* 1995). Victoria River race animals have almost no markings with just a short white

neck stripe and small axillary patch. Arnhem Land race animals are dark grey or brown on the back, with a prominent white side-stripe, a distinct dark-brown to black stripe on the midline of the neck and down the back and sometimes with a black axillary patch and pale hip-stripe. In some populations of this race, the forearms and legs are pale to bright cinnamon (Eldridge and Telfer 2008, Sharman *et al.* 1995).

Distribution

P. brachyotis is widespread, though patchily distributed across north-western and central northern tropical regions from Windjana Gorge near Broome in WA to the NT-Queensland border on the Gulf of Carpentaria. It extends further south into lower rainfall zones than *P. burbidgei* and *P. concinna* to about the 600mm mean rainfall isohyet (Sharman *et al.* 1995, Pearson and Kinnear 1997, Eldridge and Telfer 2008).

While it is commonly observed at several locations in the Kimberley Region, such as Mirima NP alongside the town of Kununurra, Windjana Gorge and around Lake Argyle, there have been no systematic surveys of the species in WA. It is not known on any WA islands, except those formed by the flooding of Lake Argyle (Abbott and Burbidge 1995, D. Pearson unpublished data).

In the NT, *P. brachyotis* has been recorded across the Top End from the WA border to at least the Queensland border (see Fig. 2). While there are few records from central and eastern Arnhem Land, this is probably related to limited survey work rather than rarity (Lundie-Jenkins and Findlay 1997). In contrast, surveys in Kakadu NP on the western edge of Arnhem Land have resulted in many records from this area (Press 1988). It is known from 19 NT islands (see Table 8).

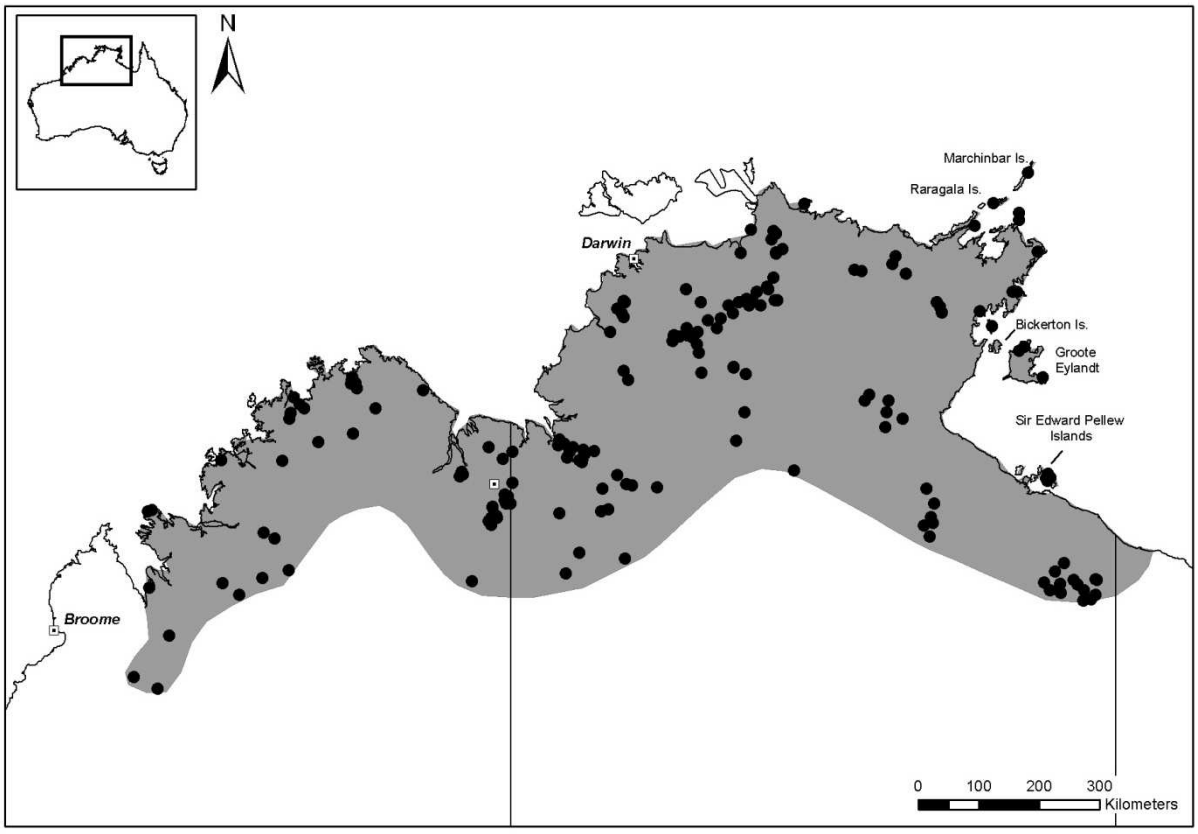

Figure 2: The distribution of the short-eared rock wallaby (*P. brachyotis*) from records in the NT and WA museum databases (dots show the locations of museum specimens).

Table 8: Islands with populations of *P. brachyotis* (information from Johnson and Kerle 1991 unpublished, Lundie-Jenkins and Findlay 1997, Menkhorst and Knight 2001, Abbott 1980, Abbott and Burbidge 1995, Woinarski *et al.* 1999). All these islands are in the NT

Island	Area (ha)	Location
Alger	778	Wessel Islands
Astell	1,143	English Company Islands
unnamed	1.3	west of Astell Island
Bickerton	22,592	15 km NW of Groote Eylandt
Bumaga	333	Cunningham Islands
Centre	9,222	Sir Edward Pellew group
Cotton	1,974	English Company Islands
Djeergaree	290	Wessel Islands
Drysdale	5,450	Wessel Islands
Graham	784	2km NE of Elcho Island
Groote Eylandt	228,520	
Guluwuru	7,625	Wessel Islands
Inglis	8,830	English Company Islands
Jirrgarri	701	Cunningham Islands
Marchinbar	20,973	Wessel Islands
North	5,778	Sir Edward Pellew group
South	42	Wessel Islands
Raragala	9,399	Wessel Islands
unnamed	8.7	southern end of Raragala Island
Rimbija	211	Wessel Islands
Vanderlin	27,690	Sir Edward Pellew group
Warnawi	194	Cunningham Islands
Wigram	2,283	English Company Islands
unnamed	0.6	just west of Wigram Island

Populations

Due to its wide and apparently fragmented distribution, difficult field identification, remote and rugged habitat, and a tendency to occur in localised populations, the abundance of *P. brachyotis* is difficult to estimate. In WA, *P. brachyotis* is generally considered to be widespread and to have stable populations, but there are no published data to support this position. In the NT, localized extinctions of populations in the southern (arid and semi-arid) parts of the range appear to be occurring (Woinarski *et al.* 2008).

Populations that may be important to the long-term survival of this species have not yet been identified.

Habitat

The broad geographic range suggests this species has wide habitat preferences (Menkhorst and Knight 2004). It has been recorded on a range of geological surfaces including sandstone, quartzite, limestone, granite and "Carson Volcanics" comprising basalts and dolerites (Kitchener *et al.* 1981, Eldridge and Telfer 2008). Landforms include areas of continuous cliff lines, gorges, rocky hills and isolated boulder piles (Lundie-Jenkins and Findlay 1997).

The vegetation in and around its rocky haunts includes savannah woodland, monsoon rainforest, acacia shrubland, sandstone heath and spinifex grassland (Eldridge and Telfer 2008).

Habitat features which may be critical to the survival of this species include rocky substrates with well-developed caves and crevices that provide shelter from predators and hot daytime temperatures.

Biology and ecology

P. brachyotis shelters in caves, crevices in boulder piles and in cliff collapses during the day; emerging at dusk to forage in nearby vegetation. Their shelters possess a range of vertical and horizontal crevices, but there is no preference for aspect (Telfer and Griffiths 2006), contrasting with temperate rock wallabies that often prefer north-facing shelters.

They display strong fidelity to refuge sites resulting in relatively small recorded home ranges of about 18ha during the dry season (Eldridge and Telfer 2008). Dietary items include grasses, browse, fruit, seeds and yams. Recorded predators include eagles, pythons and dingoes (Eldridge and Telfer 2008).

Threats

Potential threats include:

- Introduced predators - Fox predation may occur at the southern edge of its range, although there is no evidence of this yet. Feral cats may also potentially prey on juveniles and sub-adults. Dingoes/dogs may accelerate the disappearance of small populations.
- Habitat degradation due to the activities of cattle.
- Altered fire regimes resulting in changes to food plants and shelter from predators.

Conservation actions

- Survey of the distribution and conservation status across its range in northern Australia.
- Prepare and distribute biosecurity protocols for islands with *P. brachyotis* to reduce the risk of introduction of exotic species especially predators.
- Monitor changes in regional and local rock wallaby distribution.
- Develop strategies to deal with an incursion of exotic animals onto islands or the incidence of large wildfires.
- Undertake a landscape scale project to understand the impacts of fire on habitat, predation risks and population parameters.
- Carry out genetic typing to document variation and so guide the conservation of populations.
- Provide interpretative materials to tour guides in areas with *P. brachyotis* as well as interpretive material for information boards.

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Monjon ▪ *Petrogale burbidgei* (Macropodidae)

(Monjon)

Conservation status

IUCN Red List 2011: **Near Threatened**
EPBC Act: **Not listed**
WA Wildlife Conservation Act 1950: **Not listed**
DPaW Priority Fauna List: **Priority 4** (taxa in need of monitoring)

Photo: David Pearson - DPaW

Description

The Monjon is the smallest member of the genus *Petrogale*, with adult weights about 1 to 1.5kg. The ears (< 35mm long) and hind feet (pes length < 93mm) are short. The pelage colouration is subdued and lacks strongly contrasting markings (Kitchener and Sanson 1978).

The back colouration is generally olive with tawny and blackish marbling; a rufous wash on the forelegs and dark grey axillary patches. The flanks are dark olive and the undersurface is ivory-yellow. The flanks are a darker olive than the back, while the paws and feet are light greyish-olive with black undersurfaces. The tail is tawny with longer black-tipped hairs on the distal third which forms a conspicuous brush (Kitchener and Sanson 1978, Kitchener 1995, Menkhorst and Knight 2004).

The face has a rufous “clay-coloured” patch around the eye extending to the jaw. There is a light horizontal stripe from the snout, through the eye to the base of the ear. An indistinct stripe of greyish-olive runs from between the eyes along the midline of the head and onto the neck. The chin is white and the snout and ears are black (Kitchener and Sanson 1978, Kitchener 1995, Pearson *et al. 2008*).

Biology and ecology

Nothing is known about the site fidelity of Monjons. Apart from vacating daytime refuges when disturbed, they are nocturnal, emerging after dusk.

The diet has not been studied, but individuals have been observed eating dry leaves. They are rarely seen during daylight hours, only if startled in their daytime refuges. Soon after

dark they begin to forage close to their refuges and then venture onto small lens of sand between rock outcrops. On Bigge Island, they were observed foraging up to 40m from rock outcrops in spinifex grassland and eucalypt woodland (D. Pearson pers. obs.).

Distribution

The Monjon is restricted to rugged sandstone ranges in the north-west Kimberley Region where it is known from Mitchell Plateau south to the Prince Regent River (Fig. 3). It is also known to occur on at least three islands in the Bonaparte Archipelago; Bigge (18,000ha), Boongaree (4,935ha) and Katers (1,775ha). Possible sightings on Wollaston (798ha) Island need to be investigated (Maxwell *et al*. 1996, A. Burbidge pers. comm.). Further surveys are required to assess its distribution.

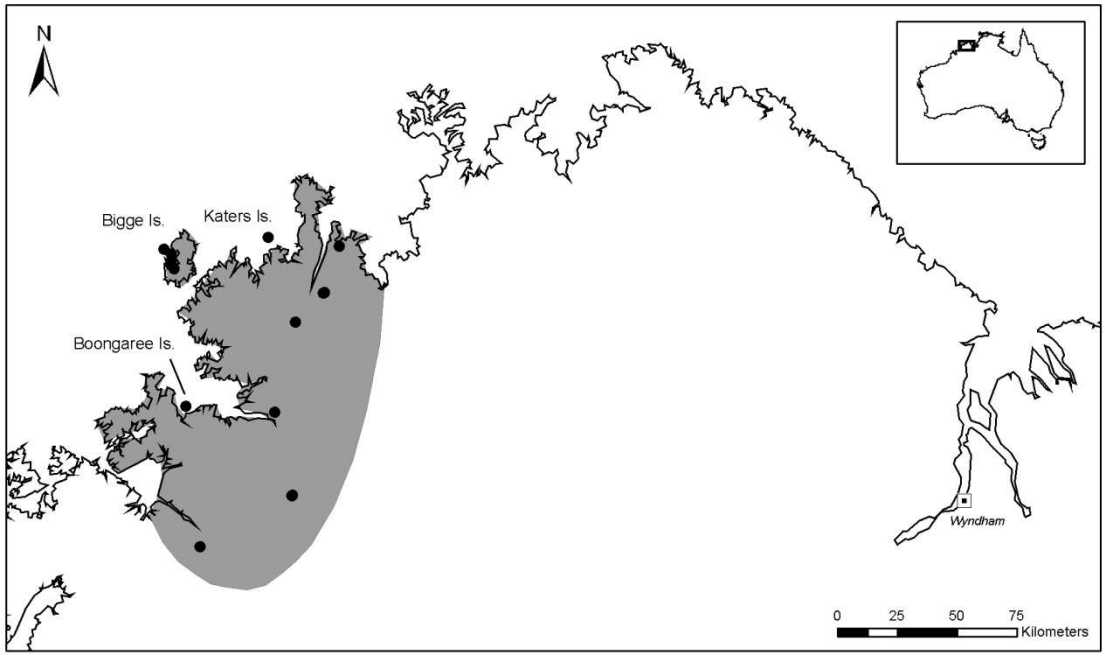

Figure 3: The distribution of Monjon, *P. burbidgei* based on museum data

Populations

Monjons are locally abundant on Bigge Island. It is possible to observe more than 10 per hour in the evening at Wary Bay on the western coast. They readily enter cage traps when present at high densities on Bigge Island (D. Pearson pers. obs.). Elsewhere, its past and present abundance are unknown due to its cryptic habits and the lack of potential observers; and on the mainland, difficulty in differentiating Monjons from *P. concinna* or juvenile *P. brachyotis* when sympatric.

Important populations occur on Bigge Island (the largest island it occupies) as well as Boongaree and Katers Islands (Pearson *et al.* 2008). Populations in the Mitchell River NP and in the Prince Regent River NR are also important for its conservation.

Habitat

Monjons occur in some of the most rocky and rugged country in the north Kimberley. They appear to favour highly fractured King Leopold sandstone with abundant multi-entranced and shaded caves and crevices. The vegetation in such areas is typically a mixture of low

eucalypt woodland or shrubland with acacia, figs, *Terminalia* spp. and *Owenia* sp. or monsoon vine thicket scrambling across boulders (Pearson *et al*. 2008).

Rocky crevices seem to be essential for shelter. Monjons can squeeze down narrow vertical crevices characteristic of the regular rectilinear faulting of King Leopold sandstones. These interlink to form complex three-dimensional tight crevices and small caves. Apart from rocky crevices, other features of habitat critical to the survival of Monjons are unknown.

Threats

- Predation from feral cats may be a significant conservation threat for mainland populations.
- The introduction of feral cats or dogs could potentially threaten island populations.
- Fire regimes that lead to frequent or extensive burns may change the availability of food plants and shelter from predators.
- Future development of bauxite deposits on Mitchell Plateau, while not within its preferred habitat, could have impacts (Burbidge *et al.* 2008).

Recovery actions

- Survey to clarify distribution, conservation status and genetic diversity.
- Establish monitoring sites on Kimberley islands and mainland.
- Prepare and disseminate biosecurity protocols to prevent the introduction of exotic species to Kimberley islands with Monjons.
- Build networks to improve surveillance of islands and plan responses to any incursion by exotic species.
- Plan, implement and monitor precautionary fire management around mainland populations to reduce the impact of large wildfires.
- Undertake research into its biology and ecology especially in relation to the effects of fire and possible cat predation.

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Nabarlek ▪ *Petrogale concinna* (Macropodidae)

(Nabarlek)

Conservation status

IUCN Red List 2011: **Data Deficient**
EPBC Act: **Not listed**
Territory Parks and Wildlife Act 2006: **Near Threatened**
WA Wildlife Conservation Act 1950: **Not listed**

Photo: *Lochman Transparencies®*

Description

Three subspecies are currently recognized based on the geographic distribution of the species (Eldridge 1997). *Petrogale c. concinna* is only known from the type locality near Timber Creek in the NT; *P. c. monastria* occurs in the north-west Kimberley and *P. c. canescens* in eastern Arnhem Land. The validity of these subspecies requires further study. It is a small species, with adults weighing 1.2-1.6kg (Menkhorst and Knight 2004). The upper pelage is a dull rufous colour with marbling of light grey and black; in *P. c. concinna*, the marbling includes a "brilliant rust-red colour" on the lower back (Sanson and Churchill 2008). The lower thigh and base of the tail is rufous. There is no stripe on the thigh. The belly is greyish-white, sometimes paler between the forelegs. A dark grey to black axillary patch may be apparent.

The head has a prominent white stripe along the upper jaw, bordered by a dark stripe running along the snout from nose to the eye. A dark-brown stripe is usually present running from between the eyes over the head and onto the neck. The tail is slightly shorter than the head-body length with a black brush tip (Sanson 1995) that has more lightly coloured hairs on its tip than *P. burbidgei* (Kitchener and Sanson 1978).

Distribution

The Nabarlek has a tropical distribution, occurring in rocky habitat in the Kimberley Region of WA and the Top End of the NT in two discrete regions (Fig. 4). Difficulties observing this

species and distinguishing it in the field from other small rock wallabies has limited understanding of its distribution and status (Churchill 1997).

Petrogale c. canescens occurs in granite and sandstone ranges in the north-western portion of the Top End of the NT from near the mouth of the Victoria River; west in an arc through the Pine Creek-Litchfield area below Darwin, into Arnhem Land from the eastern edge of Kakadu NP, as far east as the Arafura Swamp (Fig. 3, Woinarski 2002). The distribution of the species where the type specimen was collected near Timber Creek/Victoria River (NT) requires clarification. It is also reported to occur on Milingimbi (5,236ha) and Wigram (2,061ha) Islands (Abbott and Burbidge 1995).

Nabarlek populations in Arnhem Land and Kakadu NP appear to have declined markedly over at least the last two decades. There have been no recent sightings of Nabarleks in Litchfield NP. In Kakadu NP, a survey of macropods found no signs of the species, including in sites where Aboriginal informants considered it to have been common (Press 1988). It has been listed as occurring on Groote Eylandt, but there are no museum specimens and discussions with local Aboriginal people in 2006 (Pearson unpublished) suggest it was never present.

Collection of Aboriginal ecological knowledge of the distribution of the species in the NT is made more difficult by the common name for the species – Nabarlek – which means rock wallaby in several local Aboriginal languages. This can easily lead to confusion between *P. brachyotis* and *P. concinna*.

In WA, *P. c. monastria* occurs in the north-west Kimberley from Yampi Peninsula north to near Kalumburu. It is known to occur on several islands off the Kimberley coast: Long (1,356ha) and Hidden (1,974ha) in the Buccaneer Archipelago; and Augustus (19023ha) and probably Jungulu (4,925ha) in the Bonaparte Archipelago; and Borda (728ha) in the Admiralty Gulf (Maxwell *et al.* 1996). There are also populations in the Prince Regent NR and Mitchell River NP. The species formerly occurred on Sunday Island in the Buccaneer Archipelago, but was extinct by around 1940 (Abbott and Burbidge 1995).

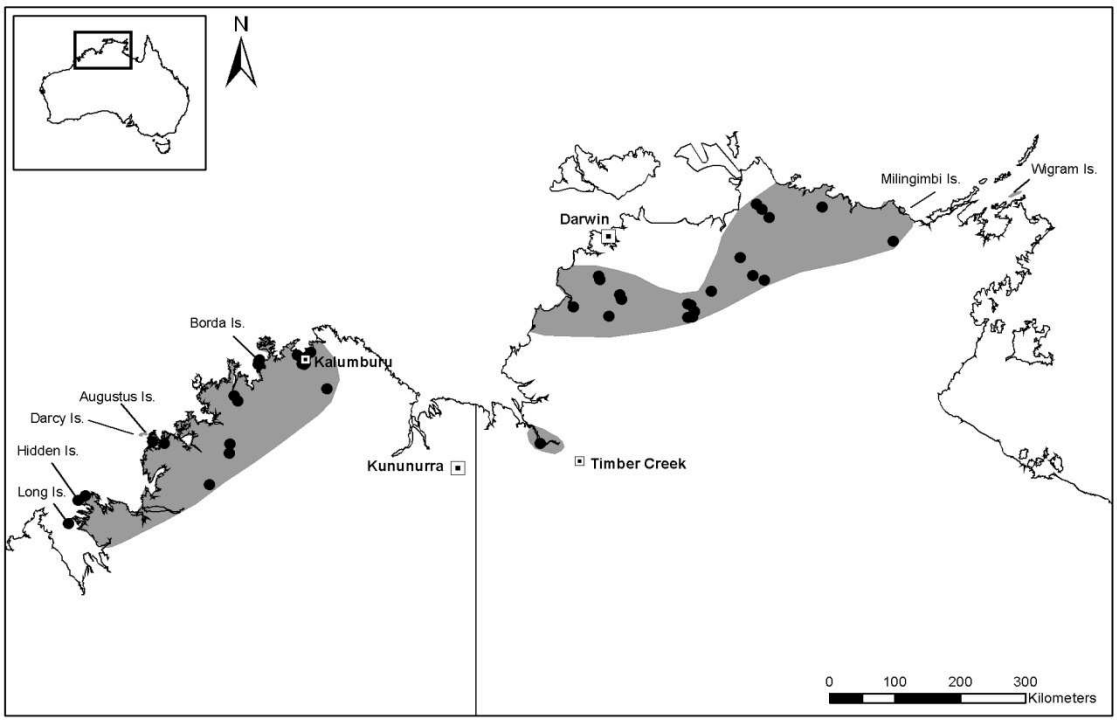

Figure 4: The distribution of the Nabarlek (*P. concinna*) based on museum data

Populations

The number and size of populations of *P. concinna* is unknown. Populations in the NT appear to have declined in the last two to three decades (Pearson in prep.). Nabarleks around Timber Creek have not been observed since the collection of the type specimen. The relative importance of populations is also unknown. In WA the populations on Long, Hidden and Augustus Islands are considered important, as is the population in the Prince Regent NR and Mitchell River NP. Populations in western Arnhem Land are also important as those to the east in the NT appear to have declined.

Habitat

The habitat preferences of the Nabarlek appear broad; ranging from low granite boulder hills in the Mary River area; lateritic breakaways in the Murwangie escarpment; steep sandstone cliffs and scree slopes in the Arnhem Land escarpment (Churchill 1997), to dissected and rugged sandstones of the north-west Kimberley (McKenzie *et al.* 1978). Churchill (1997) found that the presence of *P. c. canescens* was correlated primarily with steep slopes and numerous caves. Rock crevices, boulder piles and caves are used for shelter during the day and at night, *P. c. canescens* may move considerable distances away from rock shelters to graze (Nelson and Goldstone 1986).

The vegetation of areas occupied by Nabarleks varies substantially and includes outcrops on the edge of seasonally inundated wetlands, spinifex grasslands, monsoon vine thickets and acacia shrublands.

Habitat which is critical to the survival of the Nabarlek is not well understood, but presumably is linked to suitably complex caves and crevices to provide relief from daytime temperatures and shelter from predators.

Biology and ecology

Nabarleks are predominantly nocturnal, rarely appearing outside shelter sites until dusk and returning to refugia before dawn. However, during the wet season at Mount Borrodaile (western Arnhem Land), they were observed to be active for several hours before dusk and after dawn, grazing at these times on plants in the rock outcrops (Sanson *et al.* 1985, Churchill 1997). In the dry season Nabarleks moved up to several hundred metres away from their refugia onto the surrounding black soil plains to forage. In the wet season when the plains are inundated, the wallabies were restricted to the rock outcrops and the margins of the floodplain (Sanson *et al.* 1985).

Diet of the Nabarlek includes ferns, sedges, *Cyperus* spp. seeds, *Terminalia* spp. seeds and leaf material and small amounts of *Triodia* sp. and *Solanum* sp. (Sanson *et al.* 1985). Comparisons with the diet of *P. brachyotis* indicate clear dietary differentiation during the dry season, but in the wet season there was considerable overlap in food items (Sanson *et al.* 1985).

Threats

- Possible predation by cats
- Potential introduction of feral cats and dogs on islands occupied by *P. concinna*
- Small population sizes increasing the risk of local extinctions
- Fire regimes that lead to frequent or large scale fires changing food resources or cover from predators.

Recovery actions

- Survey the current distribution and genetic diversity to determine the conservation status of regional populations.
- Prepare and disseminate island biosecurity protocols.
- Search for populations and monitor changes in regional and local rock wallaby distribution, specifically western Arnhem Land (Kakadu NP, Nabarlek minesite and Mt Borrodaile); Mt Bundey area/Litchfield NP; Timber Creek (NT) area - Gregory NP and Bradshaw Defence training area; Mitchell River NP, Kimberley islands, Prince Regent NR.
- Plan, implement and monitor prescribed patch burning to reduce the risk of large wildfires.
- Carry out research into the biology and ecology of the species, especially the role of fire and possible predation by feral cats in affecting population parameters.
- Involve Aboriginal communities in survey and management.

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Rothschild's rock wallaby ▪ *Petrogale rothschildi* (Macropodidae)

Conservation status

IUCN Red List 2011: **Least Concern**
EPBC Act: **Not listed**
WA Wildlife Conservation Act 1950: **Not listed**

Photo: *Lochman Transparencies®*

Description

P. rothschildi is a large rock wallaby with adult weights on the mainland from 5.0 to 6.6kg for males and 3.7 to 5.3kg for females. Individuals from the Dampier Archipelago islands are smaller; weight for sexes combined ranged from 2.6 to 3.9kg (Pearson and Eldridge 2008).

Its dorsal fur is greyish to golden-brown with grey shoulders. The belly is buff to dull brown. There are no neck, dorsal or side-stripes, although a dark brown axillary patch may be present. At times, the fur on the shoulders may have a purplish hue (Menkhorst and Knight 2004). The face is grey on top with a pronounced grey-white jaw stripe which extends up to the uniformly brown ears. The tail is long and brown, becoming darker towards the tip which has brush for the last 30 to 40 per cent of its length (Pearson and Eldridge 2008).

Distribution

P. rothschildi is endemic to the Pilbara and Ashburton Regions of WA. There is little information on the extent of the historic distribution and recent sightings continue to extend its known distribution to the east and south. The species occupies major ranges such as the Hamersley and Chichester Ranges, as well as scattered smaller ranges and outcrops (Fig. 5). It extends north at least as far as Woodstock Station and as far east as a line from Marble Bar, to Nullagine and the Oakover River on the edge of the Little Sandy Desert. Southern-most records are from Barlee Range and Wanna Station and then the distribution continues eastwards to Newman. The location and nature of its historical boundary with *P. l. lateralis* on the eastern edge of the Pilbara remains unclear.

P. rothschildi occurs on the Burrup Peninsula and nearby islands of the Dampier Archipelago; Dolphin (3,203ha), Enderby (3,190ha) and Rosemary (1,152ha) (Pearson and Kinnear 1997, Pearson and Eldridge 2008).

In response to the threat of sand mining on Enderby Island, *P. rothschildi* were translocated from Enderby Island to West Lewis Island in 1982. This population has subsequently thrived (Abbott and Burbidge 1995).

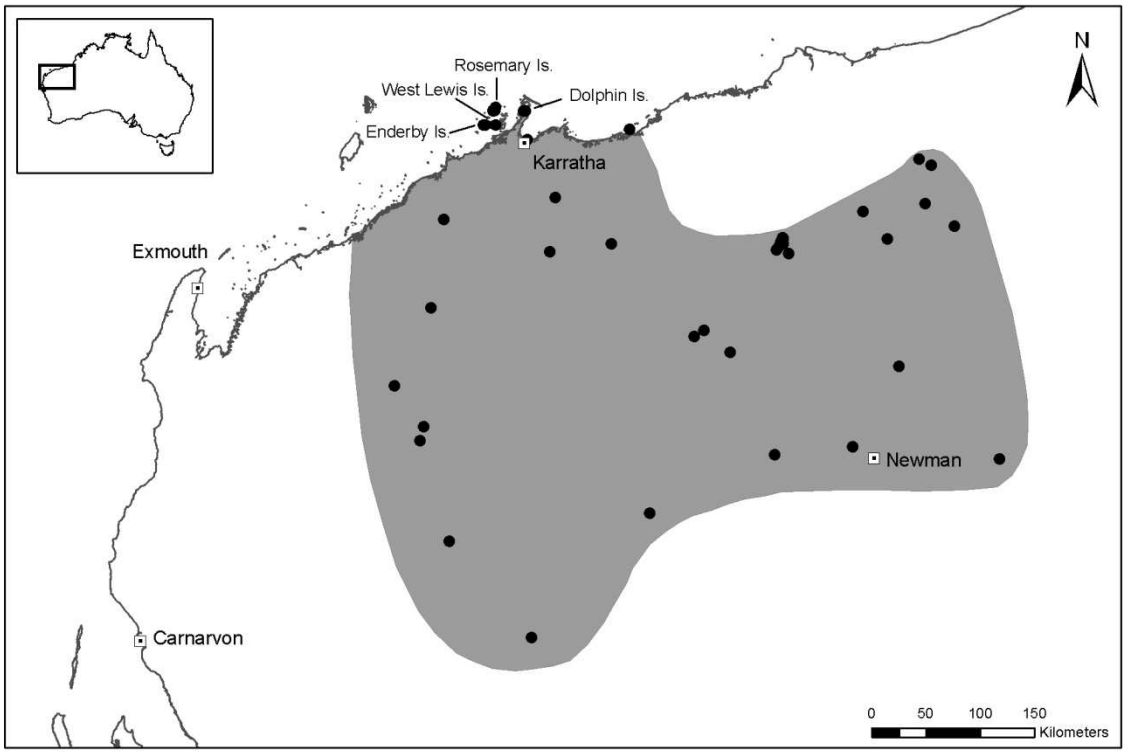

Figure 5: The distribution of Rothschild's rock wallaby (*P. rothschildi*). Dots show the location of museum specimens.

Populations

Knowledge of the number and size of populations, along with potential changes in abundance, is limited.

During the 1960s, populations on East and West Intercourse Island were driven to extinction, presumably by fox predation (J. Kinnear pers. comm.). The Dolphin Island population was at very low numbers in the mid-1980s and faced extinction prior to fox control. On the Burrup Peninsula, fox predation has greatly reduced the abundance of *P. rothschildi*. Fox baiting operations to the northern Burrup have since led to a strong increase in rock wallabies, but south of Withnell Bay outside the baited area, *P. rothschildi* are now very rare or absent.

Habitat

This species occurs on a wide range of rock types, including granophyres, granite tors, and dissected sediments. While *P. rothschildi* tends to shelter in caves, cliff-collapses and rock-piles, it may also use rocky sites around iron-ore mining activity, such as the edge of overburden dumps or railway embankments. Deep, cool shelter is important in the Pilbara

which experiences hot day-time temperatures for much of the year (Pearson and Eldridge 2008).

Pilbara rock-piles have low and often sparse vegetation dominated by spinifex, kurrajongs, *Terminalia* spp., snappy gums and figs. Creeklines are lined with gums and have more diverse vegetation communities with a variety of grasses and low shrubs. On the Dampier Archipelago islands, rock-piles with sparse or negligible vegetation are interspersed by areas of spinifex or small areas of soft grasses (native species and buffel grass) around beaches and occasional basins with deeper soil (D. Pearson pers. obs.).

Habitat features critical to the survival of *P. rothschildi* include rocky shelter sites with deep caves or crevices to escape extreme daytime temperatures and predators, and suitable palatable plants in close proximity to shelter sites.

Biology and ecology

Rothschild's rock wallabies are strongly nocturnal and generally secretive. They tend to forage close to their shelter sites, descending onto the flats below rock outcrops to feed or to drink along watercourses.

The diet is believed to include soft grasses, herbs and fruit when available (such as native figs, *Ficus* spp.). Observations suggest they do not forage far from rock-piles. On West Lewis Island, they appear to eat buffel grass and were observed eating prickly pear fruits (G. Kregor pers. comm.).

Threats

Foxes appear to be absent in the central Pilbara, possibly due to the extreme temperatures experienced in summer. However, foxes are relatively abundant in coastal Pilbara areas, and the close proximity of islands to the mainland, large tidal ranges, extensive mudflats and shallow intervening water has allowed foxes to access several islands, resulting in periodic predation events.

Populations around Newman and Pannawonica will be impacted by the removal of entire hills and mesas for iron ore. Translocation programs have moved affected rock wallabies (J. Short pers. comm.). Although the areas impacted are currently small and localised, many more areas are proposed for iron ore extraction in the Pilbara. Gas infrastructure and associated industries on the Burrup Peninsula have reduced habitat in this area and have resulted in increased road kills.

Recovery actions

- Surveys of the Dampier Archipelago islands and mainland Pilbara to determine the current conservation status and potential threats.
- Continue baiting operations on the Burrup Peninsula and the Dampier Archipelago.
- Ensure biosecurity of Dampier Archipelago, by preparing quarantine protocols and signage on boat ramps.
- Monitor rock wallabies on Dampier Archipelago and Burrup Peninsula to assess the effectiveness of fox baiting.
- Analyse the genetic variability of *P. rothschildi* to aid conservation planning.

- Ensure the involvement of Aboriginal people, mining companies and other land-holders in the management of this species.
- Undertake research on the biology and ecology of *P. rothschildi*, especially the impact of fire and predation on its populations.

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