Conservation Science W. Aust. 7 (1) : 43–48 (2008)

Towards monitoring rock-wallabies on Barrow Island, Western Australia

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ABSTRACT

The Black-flanked Rock-wallaby *Petrogale lateralis lateralis* is difficult to trap consistently on Barrow Island because of the prevalence of Common Brushtail Possums *Trichosurus vulpecula* and Golden Bandicoots *Isoodon auratus* in and near its shelter habitat. Three possible methods of monitoring were trialed: daytime searching, spotlighting and dusk watching. Daytime searching produced the best results, although numbers seen were low and varied between searches. In November 2004, 37 rock-wallabies were sighted during the first search of each 'site' and in August 2005, 43 were sighted. Repeated counts will be needed to demonstrate whether daytime searching could be used as a standard monitoring method. No estimate of the total population was possible, but it is clearly very small, consistent with previous research showing unprecedented low levels of genetic variation.

INTRODUCTION

The Black-flanked Rock-wallaby *Petrogale lateralis lateralis* is a listed threatened taxon under Western Australian and Commonwealth legislation. A formerly widespread distribution in the western deserts (Great Sandy, Little Sandy and Gibson, although the subspecies/race status of some of these populations is unclear), western and southern Pilbara, Cape Range and the south west of Western Australia has shrunk to a few isolated populations, largely due to predation by the introduced European Red Fox (*Vulpes vulpes*) (Burbidge et al. 1988; Kinnear et al. 1988; Pearson 1992; Pearson & Kinnear 1997; Kinnear et al. 1998). Historically, *P. l. lateralis* occurred on three offshore islands: Depuch and Barrow in the Pilbara and Salisbury in the Southern Ocean off Cape Arid (Abbott & Burbidge 1995; Pearson & Kinnear 1997). The invasion of Depuch Island by foxes in the first half of the 20th Century led to that population becoming extinct (Hall & Kinnear 1991; Pearson & Kinnear 1997). The Salisbury Island population is extant.

P. lateralis is the least abundant of the mammals occurring on Barrow Island. Two population estimates are available. Butler (1970, p. 154) stated 'I estimate there are 500+ individuals in the multiple cliff colonies which extend over some eight miles of coast and in places go two miles inland'. Hall et al. (1993) provided an estimate of 116 to 154 based on searching, trapping and spotlighting during one week in late February and early March 1993. Hall and Kinnear (1991, p. 6) in a draft recovery plan for *P. l. lateralis* stated that the subspecies was 'conspicuously abundant in suitable habitat, which is of restricted distribution'.

Barrow Island, despite being a nature reserve, has had an operating oilfield since the 1960s and the construction of a liquefied natural gas plant is proposed. Recent monitoring of mammal populations on Barrow Island by the Department of Environment and Conservation (DEC) and Chevron Australia (e.g. Burbidge et al. 2003) has concentrated on species that are captured in Sheffield cage, Elliott Type A or pit-fall traps, or that are readily detected by observers with hand-held spotlights from vehicles at night. *P. lateralis* is not consistently detected by any of these techniques and methods of monitoring this species need development. Attempts were made to trap rock-wallabies within and adjacent to their daytime shelter habitat on the west coast of the island; however, the prevalence of other mammals, particularly Common Brushtail Possums (*Trichosurus vulpecula*) and Golden Bandicoots (*Isoodon auratus*), in this habitat meant that while rock-wallabies were occasionally trapped, most traps captured possums early in the evening. The collection of reliable trap data with repeated recaptures, allowing mark-and-recapture population estimates, seemed unachievable during short duration monitoring visits. As well, adequate sampling of the linear shelter habitat would be problematical, as access to many shelter sites in steep and crumbling limestone cliffs is difficult and dangerous.

Conservation biologists are often presented with requests for quick, relatively cheap answers to conservation-related questions. Developing monitoring procedures for rock-wallabies on Barrow Island is one such example – neither the State conservation agency nor the oil company have biologists allocated primarily to monitoring mammals on Barrow Island and working on the island is expensive; yet rock-wallaby monitoring has been identified as important. This paper reports attempts to develop a basis for monitoring techniques where field time is limited, and discusses how best to proceed towards a monitoring method that can report on rock-wallaby relative abundance at selected time intervals.

There have been only limited studies on the biology and ecology of *P. lateralis*. Research in the southwest of Western Australia showed that breeding commences at

18 months and that some individuals may live longer than 12 years (Kinnear et al. 1988). Pearson (1992) reported that, in central Australia, *P. lateralis* 'MacDonnell Ranges race' was capable of moving long distances between rock outcrops, with Aboriginal informants reporting tracks up to 4 km from the nearest rockpile. In central Australia, there has been research on the diet, dietary competition with stock and euros and ranging behaviour of the related taxon, *P. lateralis* MacDonnell Ranges race (Blackbourn 1991; Capararo 1994).

METHODS

Short visits were made to Barrow Island in November 2003, November 2004 and August 2005 to trial three non-trapping methods of measuring rock-wallaby relative abundance:

- daytime searching of shelter habitat,
- dusk watching, and
- night time spotlight transects.

During the 2003 visit, only night time spotlighting was conducted. In the 2004 visit all three monitoring techniques were trialed and the first two were repeated in 2005.

Daytime searching

All prospective shelter habitat on and near the west coast was visited by two (occasionally three) people from 2–9 November 2004. To see whether more rock-wallabies would be sighted at a cooler time of the year, this method was repeated by two people from 3–10 August 2005. Search methods depended on the local topography: where possible one person walked below the cliff or scree while the other walked on the plateau above. Where topography prevented access below the cliff top, both persons walked near the cliff edge and, when safe to do so, looked below the cliff top. Search 'sites' were defined arbitrarily and marked onto colour air photographs (1:15 000, 7 August 1980). Digital copies of the air photographs with the sites marked on them are available in Burbidge and Thomas (2005) lodged in the Department of Environment and Conservation Western Australia, Wildlife Science library.

In 2004, all sites from Obe's Beach (20°42'25"S, 115°24'17"E) to Biggada Creek (20°46'52"S, 115°20'48"E) were visited twice. Areas north of Obe's Beach and south of Biggada Creek were visited once, as these areas showed little or no sign of rock-wallaby activity, as evidenced by the presence of only a few, scattered, mainly old scats, or none at all. In 2005, two searches were made of 'sites' south of Biggada Creek as far as Boggs Beach (20 47'30"E, 115 20'15"E). Searching commenced as soon as there was sufficient light to safely see when walking; this was usually at or near local sunrise. More effort was put into searching in the morning. Searchers left the search area at about 1130 hrs and restarted searching at about 1300 hrs; however, on some days searching did not recommence until about 1500 hrs. Searching ceased at about 1700 hrs. The time a rock-wallaby was first sighted was recorded only in 2005.

Because more rock-wallabies were usually sighted early in the morning (from about 0700 to about 1030 hrs), areas that were first searched late in the morning or during the afternoon were revisited in the early morning.

Dusk watching

At the isolated colony near Well Q21 (20°46'36"S, 115° 22'24"E, Site 27), we watched for rock-wallabies emerging from shelter to feed in the late afternoon and evening. On 7 November 2004 four people sat 150–200 m below the cliff face and watched from 1615 to 1900 (local sunset was at 1831 hrs), using 10x40 binoculars and a 20x–40x spotting telescope. On 8 November two people watched from the same position and one person watched from above the cliff from 1620 to 1900. This method was repeated on 4, 5 and 7 August 2005 by two people watching from below the cliff from 1600, 1625 and 1700 hrs respectively until 1825 by when it was too dark to see (local sunset was at 1801 hrs).

Spotlighting transects

Night time spotlight traverses were walked by two people along transects established during daytime in November 2003 and stored as 'routes' in a hand-held GPS receiver. One person carried a sealed lead acid battery on a backpack frame plus a 75 W spotlight, while the other, who walked immediately behind the spotlighter, navigated using the GPS receiver and where necessary identified any animals sighted with 10x40 binoculars. Two routes were walked: one from John Wayne Country (20°45'20"S, 115°21'55"E) to the coastal termination of a track passing well YS88 at 20°44'23"S, 115°22'56"E (ca 2.5 km long) and the other from above the Boodie Warren Cave (20°43'30"S, 115°23'26"E) to the headland just south of Obe's Beach (ca 2.0 km long). Walking time was 70–90 mins. Both transects were located a short distance inland from coastal cliffs (the northern transect) or cliffs with a narrow sandy coastal plain below (the southern transect); however, the southern transect also crossed white sand behind beaches and orange sand below cliff faces. The transects were walked south to north and searching commenced 30 minutes after local sunset. Search dates are given in Table 2. The habitat was recorded for all rock-wallabies sighted.

RESULTS

Daytime searching

Rock-wallabies were located in or near suitable shelter habitat from the headland immediately south of Obe's Beach south to near Boggs Beach, a distance of 11.2 km. Most sites where rock-wallabies were observed were very close to the coast; however, some sites south of Flacourt Bay (Site 17) and in and near John Wayne Country (Sites 19 to 22) and one site inland from Boggs Beach (Site 33)

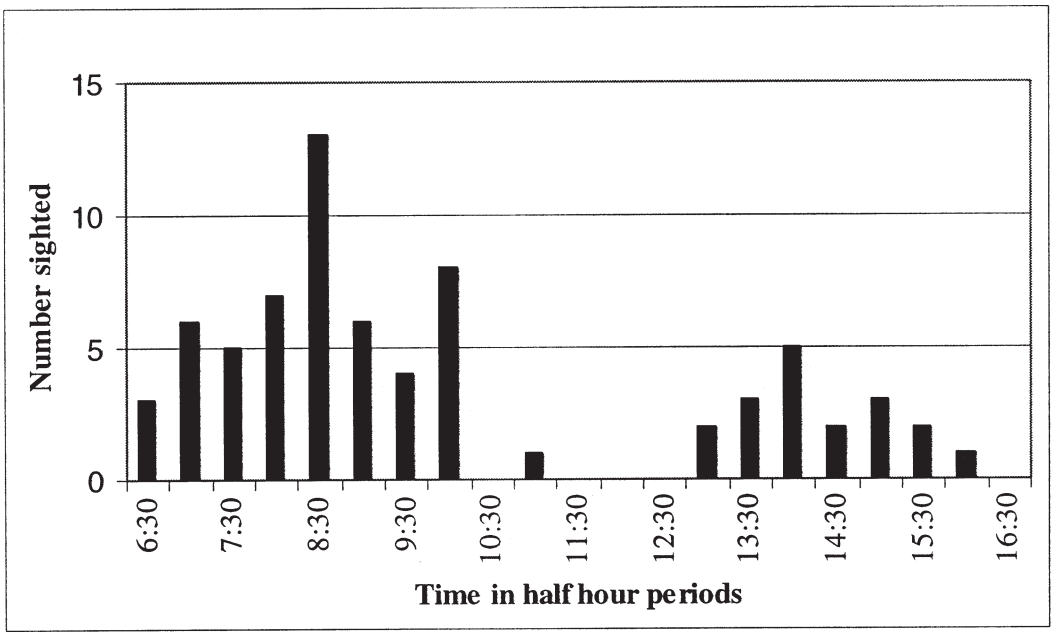

Figure 1. Number of rock-wallabies sighted in August 2005 in half-hour periods from 6:30 am to 4:30 pm. Note qualifications in text concerning searching times.

extended inland from 0.3 to 0.8 km. Rock-wallabies also shelter at an isolated cliff immediately southwest of Well Q21 (Site 27), 2.3 km from the west coast.

Table 1 shows the number of rock-wallabies recorded in each 'site' for each year for the two searches. Numbers seen were low and varied between searches. The total seen during the first search of each site was 37 in 2004 and 43 in 2005. The sum of the numbers seen during the first morning count was 50 in 2004 and 40 in 2005. The sum of the higher number of the two searches of at each site is 55 in 2004 and 50 in 2005.

Figure 1 shows the frequency of rock-wallaby sightings against the time of day in 2005. Searching effort was not uniform throughout the day (see Methods); but was similar between morning (about 0645 to 1130) and afternoon (about 1500 to 1700) on an intensity per hour basis. Even though effort was not uniform at all times of the day, Figure 1 suggests that more wallabies were sighted in the early morning (from about 7:00 am to 10:30 am) than immediately after dawn, in the late morning or in the afternoon.

Spotlighting

Table 2 shows the results of the spotlight traverses, as well as the wind and moon conditions prevailing during surveys. Numbers seen varied from zero to ten on the northern route (0 to 4/km) and from zero to three (0 to 1.5/km) on the southern route. Places where rock-wallabies were sighted were: among white sand dunes behind beaches among *Spinifex longifolius* (a rock-wallaby, possibly the same individual, was seen on consecutive nights feeding on *Cynanchum floribundum* growing among *S. longifolius*), a short distance inland among *Triodia*, and near the cliff edge with no vegetation.

Dusk watching

Five rock-wallabies were seen leaving shelter at the Q21 colony on the evening of 7 November 2004: at 1650, 1755, 1812, 1820 and 1838 hrs. On 8 November 2004 two rock-wallabies were sighted at 1725 and the same two were seen later. In 2005, two rock-wallabies were seen leaving shelter at 1800 and 1801 hrs on 5 August. No rock-wallabies were sighted on the other two nights.

DISCUSSION

Dusk watching did not produce useful results at the one site where it was trialed and the number of places where it could be used is limited. It does not appear to be a useful monitoring method.

Spotlighting also does not appear to be a useful monitoring method. When the same areas were compared, even the highest spotlighting total was lower than the number of rock-wallabies sighted during daytime searching. The spotlighting transects were located close to where rock-wallabies emerge from shelter and where they would be sighted if they moved inland to feed. Once rock-wallabies leave shelter they have been observed to move some distance inland, or in the case of the southern transect, also move towards the coast, and would not be detected by spotlighting. Daytime searching permitted all areas with shelter to be searched; this was not the case with spotlighting as some areas are too dangerous to walk at night. Spotlighting also did not produce consistent results.

Daytime searching, while locating rock-wallabies throughout almost all utilized shelter habitat on Barrow Island, resulted in low and variable numbers of animals at

each 'site', making the development of standardized monitoring techniques difficult. Because of the low density of rock-wallabies and because their shelter habitat is spread over a long, narrow strip of the island, it appears to offer a better monitoring technique than other trialed methods. However, the low numbers seen prevents the use of the daytime searching technique as a reliable monitoring method without further work. Whether it is valid to add the numbers seen on the first and second searches, or total the larger number seen during the two searches can not be discussed without further information on the site fidelity and home ranges displayed by these rock-wallabies. Work in central Australia on the closely related taxon, *P. lateralis* MacDonnell Ranges race, found that most foraging activity occurred within 100 m of their rocky refugia based on the distribution of faecal material. In summer, they ranged slightly further, but not beyond 200 m from shelter (Blackbourn 1991, Capararo 1994). Mainland populations are subject to predation by foxes and dogs which may also alter behaviour. Given the lack of these predators on Barrow Island and the apparently higher levels of grazing competition with other mammals (pers. obs.), it could be hypothesized that Barrow Island rock-wallabies forage further from their refugia. Observations of rock-wallabies 1.4 km from cliff habitat during road spotlight transects (AA Burbidge & KD Morris, unpublished data), suggests this is likely.

During daytime searching, many of the wallabies sighted were flushed from low clumps of figs (*Ficus brachypoda* and/or *F. virens*) growing immediately below cliffs, on the slope below cliffs or, occasionally, just above cliffs; some were sighted among large rocks just below cliffs; some were seen in rockpiles at the base of slopes below cliffs, often very close to the ocean, and a few were first seen in the open above the cliff. On the west coast of Barrow Island, fig clumps provide the only dense, shaded shelter apart from rocks.

The aim of this study was to aid the development of a method for monitoring rock-wallabies on Barrow Island, not to provide an estimate of the total population. The method described as 'daytime searching' could provide a technique for monitoring relative abundance, and standardized monitoring methodology has been prepared and made available for future workers. However, in order to show that the technique could be used for detecting population trends, many further counts need be carried out.

Hall et al. (1993) sighted 38 animals in February–March 2003 and gave an estimate of the total population on Barrow Island of 116 to 154. This was derived by assuming that between 25% and 33% of the total population was sighted, a correction factor based on work by Kinnear and others (unpublished, cited in Hall et al. 1993) on isolated granite rocks in the southwest of Western Australia, where repeated trapping and spotlighting had been conducted. It is doubtful whether this correction factor can be validly applied to Barrow Island, where conditions and habitat are different.

There are two lines of evidence for an assumption that we did not sight all animals present within an area. Firstly, different numbers were often seen in one site when conducting the two searches. Secondly, in November 2004, dusk watching revealed five rock-wallabies in Site 27 (the isolated inland cliff near Well Q21), while only a single animal was sighted on each of the two daytime searches that year. It seems likely that some rock-wallabies were sheltering in deep, well-protected locations and did not move when we walked nearby.

Elsewhere, rock-wallabies tend to bask in the sun more in cool weather than in hot weather (Lim et al. 1992), and anecdotal information suggested that this is the case on Barrow Island. If this is the case, searches in winter should result in more rock-wallaby sightings than in early summer. The similar number of rock-wallabies sighted during August 2005 compared with November 2004 suggests that daytime temperatures do not greatly affect the number of animals sighted. However, November maximum temperatures are not high on Barrow Island compared with mainland sites at the same latitude. The mean maximum temperature during our visit in early November 2004 was 28.8°C compared with the long-term monthly average of 31.6°. The hottest month on Barrow Island is March with a mean maximum temperature of 34.7° and a highest recorded temperature of 44.0°. Barrow Island, with its tropical maritime climate, does not have very low winter minimum temperatures like inland desert areas on the mainland and these higher minima may reduce the tendency to bask in winter.

Local conditions may affect daytime searching. We had several cloudy days with strong winds, particularly during the mornings of 7–9 August 2005 when fresh to strong and gusty easterly winds prevailed. Fewer rock-wallabies were sighted at these times, but with low sighting figures overall no trends could be detected. Many more searches would be necessary to detect any relationship between weather and sightability.

A white-bellied sea-eagle (*Haliaeetus leucogaster*) nest with two small chicks was located in Site 22 in August 2005. No rock-wallabies were seen at the 'site' during the two searches. A single animal was seen at the extreme northern end of this site later after searching Site 21. In 2004, the maximum count for Site 22 was seven. Whether the rock-wallabies inhabiting this area in 2004 moved to another nearby site, whether they were sheltering out of sight of the eagles (and us) or whether they had been predated, is not known; however, it is likely the lack of rock-wallaby sightings near the nest can be attributed to the presence of the eagles. There were no rock-wallaby remains at the nest; only a Wedge-tailed Shearwater *Puffinus pacificus*, despite evidence that sea-eagles do take mammals of this size elsewhere (Marchant & Higgins 2003), although birds are a more important food item.

Overall, a very low number of rock-wallabies was sighted. This figure suggests a very small total population on Barrow Island. Eldridge et al. (1999, 2004) reported that the Barrow Island population of *P. lateralis* has unprecedented low levels of genetic variation and suffers from inbreeding depression (reduced fecundity, skewed sex ratio, increased levels of fluctuating asymmetry) and a small effective population size. Nevertheless, this population has survived a long period of isolation (*ca* 1600 generations).

CONCLUSIONS

Monitoring small wild animal populations is particularly difficult when a high proportion of the population can not be captured, marked and recaptured. The 'daytime searching' method described here may present an opportunity to develop relative abundance data between visits. However, many more searches will be necessary to ensure repeatability. Future work needs to take account of the time of year, time of day, number of repeat counts per trip needed to produce consistent data, and observation methods (number of observers, routes, walk speed and time spent in shelter habitat all need to be recorded to provide sightings/per unit time data). Standard routes may need to be documented and recorded.

Short term, low cost, reliable monitoring of rock-wallabies on Barrow Island seems not to be possible. As well as the need for many replicated counts, data on home range and whether animals move between the 'sites' designated during this study, are desirable.

ACKNOWLEDGEMENTS

This work was funded by the Western Australian Department of Conservation and Land Management (now Department of Environment and Conservation) and Chevron Australia. I particularly thank Michelle Drew for help in 2004 and Neil Thomas for help in 2005; both walked long distances with me in difficult terrain. I also thank David Pearson, who helped with the 2003 spotlighting, and Keith Morris, Peter Kendrick and Felicity Donaldson who helped with various aspects of the 2004 work. Stephan Fritz of Chevron Australia arranged our visits; while Luke Ulstrup and Les McClements of Chevron supported us on the island. Kris Holmes and Nikki Meskanen of RPS Bowman Bishaw Gorham helped prepare documentation required for heath and safety approvals.

I thank Tony Start and David Pearson for their helpful comments on a draft of this paper.

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Table 1

Number of rock-wallabies sighted in defined 'sites' at Barrow Island Nature Reserve

Site No.	Nov 2004 search 1	Nov 2004 search 2	Nov 2004 first AM count	Aug 2005 search 1	Aug 2005 search 2	Aug 2005 first AM count
1	1	0	1	0	0	0
2	0	1	0	2	0	2
3	3	2	3	2	1	2
4	1	0	1	0	0	0
5	2	1	2	0	0	0
6	1	0	1	1	0	1
7	0	0	0	2	0	2
8	1	0	1	1	0	1
9	0	1	0	0	0	0
10	1	2	2	1	0	0
11	0	0	0	0	0	0
12	2	2	2	5	3	3
13	0	0	0	0	0	0
14	1	1	1	0	0	0
15	2	3	3	2	1	1
16	1	3	3	1	0	0
17	2	0	2*	4	1	1
18	1	1	1	1	0	1
19	2	2	2	4	2	4
20	4	2	4	0	0	0
21	4	4	4	8	5	8
22	1	7	7	0	0	0
23	1	7	7	3	8	8
24	2	2	2	1	2	2
25	1	0	0	1	1	1
26	2	0	0	0	0	0
27	1	1	1	1	2	2
28	0	–	0	0	0	0
29	0	–	0	0	0	0
31	0	–	0	1	0	0
30	0	–	0	0	0	0
32	0	–	0	1	0	1
33	–	–	–	1	0	0
Total	37	42	50	43	26	40

'–' designates that a site was not searched
* site searched once in 2004, in the afternoon

Table 2

Results of spotlighting traverses on the west coast of Barrow Island.

Date	No. of rock-wallabies sighted	Wind	Moon
Southern traverse			
24 October 2003	0	W, 25–30 knots	none
2 November 2004	2	SW, 5–10 knots	none
4 November 2004	10	W <3 knots	none
Northern traverse			
29 October 2003	3	W, 25–30 knots	1st quarter, moonset at 10.41 pm
3 November 2004	3	SW, 10–15 knots	none
6 November 2004	0	W, 5 knots	none