THE CAPE RANGE BLACK-FLANKED ROCK-WALLABY (PETROGALE LATERALIS)

A report on the population status and response of remanent populations to twice yearly aerial baitings.

by
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SUMMARY AND RECOMMENDATIONS

Summary

Since 1988, the Cape Range National Park has been baited for foxes according to a specific protocol in an attempt to promote the recovery of rock-wallaby (RW) populations persisting at low numbers in gorges along the western escarpment.

The objective was to **test a cost-effective minimal baiting regime for a large area of conservation estate**. Accordingly, the baiting protocol was limited to two aerial baitings per year and was based on research carried out by the fox group (Algar *et al*. unpublished).

This baiting regime is correlated with a modest positive population response at one site only namely, Yardie Creek, for which there exists a comprehensive data set collected by eco-tour operators at our request.

Census indices based on spotlight transects for all sites (including Yardie Creek) in the park failed to produce any evidence of positive population responses. Spotlight transects, while useful elsewhere, were not consistently sensitive enough to track population trends probably because of the rugged topography of the gorges within the park.

It is argued that the frequency of baiting (twice yearly) was not sufficient enough to allow the RW population to realise their full potential for increase. Thus it is unlikely that the RW populations can ever reach carrying capacity under this baiting protocol.

Unpredictable episodes of predation, occurring during the 6 month interval between baitings, can negate gains previously achieved causing a population reversal. Data from Yardie Creek supports this conclusion and implies that a bout of predation occurred in 1994 causing a population decline. This impacts on the local eco-tourism operators utilising Yardie Creek; they readily acknowledge that rock-wallabies are the key attraction of their tours.

Two baitings per year may well be sufficient if the populations are able to attain a higher density which may only be achieveable by increasing the baiting frequency. If higher densities are not observed, then other factors are limiting density.

The experiment has produced benefits for the tourism industry exploiting the presence of rock-wallabies along Yardie Creek, for there is a strong positive correlation between baiting and population increases. One should also take note of the rapid recovery of the population in 1995 following the 1994 decline (Fig. 1). Baiting has most likely arrested the decline and facilitated the ensuing recovery that has occurred this year. This is consistent with data from the wheatbelt populations.

Recommendations

1) That the baitings be increased to 4 times per year according to this protocol:

- Number of baits — 3000
- Each bait be dosed with 3.0 mg 1080
- Distribution rate 6 baits/km^2
- Timing of baiting events:
- early Sept;
- early Feb;
- mid-April;
- mid-June.

These times would minimise the impact of baiting on perenties (if indeed, baiting is actually a genuine threat; this has not been fully researched — see Discussion).

2) That when an aerial cat bait becomes available, consideration be given to dropping a mix of cat and fox baits. And further, should aerial baiting prove to be insufficient for cats, then park rangers should be enlisted to manually bait for cats especially in the case of Yardie Creek and other sites of tourist value.

3) That monitoring be carried out every three years throughout the park and Ningaloo gorge. At higher densities, spotlighting might prove to be useful.

4) That the cooperation of the proprietors of all eco-tours utilising Yardie Creek be enlisted to keep daily records (preferably computer) of all RW sightings. (Indeed, because such data are of such high quality due to the level of replication, it might be made mandatory as part of their terms of lease/contract or whatever).

5) That these records be analysed by a scientist at least once per year or twice[1] yearly to monitor any trends in the sightings of RW.

6) That CALM acknowledge and promote the eco-tourism value of rock-wallabies, and exploit the mutual interaction between the private sector and CALM in the interests of both conservation and the tourism industry.

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[1] ideally, first & last 30-40 days of the tourist season

PREAMBLE

Current Status and Distribution

The black-flanked rock-wallaby (*P. lateralis lateralis*) prior to European settlement was widely distributed and abundant throughout much of WA. Its range extended from Pilbara Islands,[2] to the Western Desert, and south to the Recherche Archipelago. Like other mainland medium-sized mammals, it is now extinct over much of its former range and moreover, some of the extinctions have been recent.

The Cape Range once supported rock-wallabies (RW) throughout its rocky extent (D. Bathgate, pers comm). Currently, scattered remanent populations are only found on the western escarpment mainly in gorges within the park and on Ningaloo Station.

Since 1979, we have periodically carried out RW spotlight surveys principally to map their distribution and to gain an index of their abundance. It soon became apparent that the numbers were low and that they were confined to sites that served as predation refugia — a pattern comparable to other areas such as in the wheatbelt and on Dolphin Island in the Dampier Archipelago.

A baiting program (initiated by T. Start in collaboration with the APB) to protect turtle nests from fox depredation's was implemented in 1978 mainly along the beaches. It is unlikely that these actions benefited RW.

In 1988, the baiting program was extended to protect RW. Only one aerial baiting was made for the first two years and two baitings per year thereafter. The objective was to test the effectiveness of this level of baiting effort ie, two per year, as means of promoting population recoveries of RW in a cost-effective manner.

Everywhere else at this point time (1988), baiting programs were limited to relatively small areas where the frequency of baitings were monthly — a prohibitively expensive protocol for large areas such as Cape Range NP.

This report describes our findings regarding the efficacy of the baiting protocol and makes recommendations.

METHODS

THE BAITING PROTOCOL

Baiting Frequency: rationale

The Cape Range experiment was implemented in an attempt to answer this question: How often must CALM bait the park in order to facilitate RW population increases.

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[2] The range may prove to be even more extensive and include populations in the S. Kimberley. Chromosomal studies are in progress (D. Pearson pers comm). Such a widespread distribution signifies that the *P. lateralis* is an adaptable, resilient sp capable of tolerating habitat change or disturbance.

In theory, one would expect that the baiting frequency would be, an inverse function of area. Small areas are rapidly colonised by immigrant foxes and these foxes need to be removed or "turned over" by frequent baitings before they do too much damage[3]. Larger areas theoretically, would be colonised at a slower rate because it would take longer for foxes to reach and restore previous densities. The time taken would depend on the density of foxes on the periphery of the baited area, the dispersal rate, the distance travelled by dispersing foxes and their net rate of increase[4].

Work by the Fox Group (Algar *et al.* unpublished) carried out in Watheroo National Park suggested this minimal baiting protocol:

- For large areas, bait twice yearly during:
- Aug-Oct as this baiting event would remove breeding adults and reduce the recruitment of young.

- Feb-April: this baiting would remove immigrant foxes dispersing into the area.

Bait Application Rates: rationale

How many baits per km^2 are needed to control foxes? This question has been addressed by the fox group (Algar *et al.* unpublished). It has been shown that 6 baits per km^2 is equally effective as 10-12, and moreover, aerial baiting at 6 baits/km^2 typically removes 75-85%[5] of the fox population.

Baiting Records for Cape Range National Park

Table 1. The following data was provided by the Environmental Protection Branch and the APB District Officer, Carnarvon.(Total park area 505 km^2; estimated baited area, 450)

Month	Year	Baits dropped	Baits/km^2
Nov.	1988*	4000	9
March	1989*	4000	9
Nov.	1990*	3000	7.7
March	1991	3000	7.7
Oct.	1991	3000	7.7
Mar./April	1992	6000	13
Sept.	1992	3000	7.7
Mar./May	1993	5000	11
Oct.	1993	3000	7.7
Mar.	1994	2500	5.5
Oct.	1994	2700	6
April	1995	2700	6

*The baiting protocol was limited to one baiting event per year for the years 1988-90 inclusive.

[3] A case in point occurred at Mt Caroline recently. RW had adopted the habit of feeding in a nearby paddock. A single fox killed 11 RW over a short period and most were not eaten. The killing stopped shortly after the reserve was routinely baited (monthly baitings). If the baiting interval had been longer, then more would have been killed.

4 This assumes that every fox is a threat and that the predation rate is a function of fox density. This may not be the case as individual foxes may do most of the killing.

[5] This kill rate is a robust estimate for the South West; a recent baiting (10/km^2) of the Peron Peninsula attained a higher kill rate. The higher application rate was used because the peninsula fox density index was higher than previously recorded in WA (N. Burrows, pers. comm).

From 1991 and onwards, two baitings per year have been carried out according to the recommended protocol ie, spring/autumn baitings.

The application rate has not been uniform as it has varied from 6000-2500 baits (13 - 5.5 bait/km^2). There have been occasions (1988, 89, 92, 93) where an excess of baits have been dropped. The current rate 2700-3000 baits (6-7 baits/km^2) per baiting event should be adequate.

Population Indices

Spotlight Transects: park gorges

Indices of RW abundance throughout the park were mainly based on sightings gained from spotlight transects. Sighting data tends to be variable and skewed, but experience has shown that the technique is satisfactory for measuring population changes **providing that the increase or change is substantial** eg, Dampier Archipelago RW data (Kinnear unpublished). A more precise method would be mark-recapture, but doing this in the Cape Range would be a major project requiring a large budget outlay.

Tour Operator Sightings: Yardie Creek

At our request, data on RW abundance has been collected by tour operators in Yardie Creek. For the period (1988-89), *Ningaloo Safari Tours* (N & C. McLeod, prop) routinely recorded sightings of RW in Yardie Creek Gorge as they ferried tourists along this scenic waterway. A more extensive data set of RW sightings (1990-95) has been collected by *Yardie Creek Tours* (N.& R. McGregor). The McGregor's have been diligent in maintaining their computer database, and have been most helpful and cooperative in allowing me to access their extensive records.

RESULTS

Sighting Results: spotlight surveys

Table 1. Cape Range National Park RW Sightings (Predator control and goat control)

Date	Location	Survey Time (min)	R.W Sighted	Comments
May 1985	Yardie Creek	60	6	Spotlight both Rims;RW Seen only on S.rim
June 1988	Yardie Creek	120	2	As above
June 1988	Yardie Creek	33	3	From canoe
Sept 1994	Yardie Creek	42	3	South rim
May 1995	Yardie Creek	55	4	
May 1995	Yardie Creek	45	0	
May 1995	Yardie Creek	60	1	
May 1985	Mandu Mandu	14	3	Spotlight from vehicle on R. bed

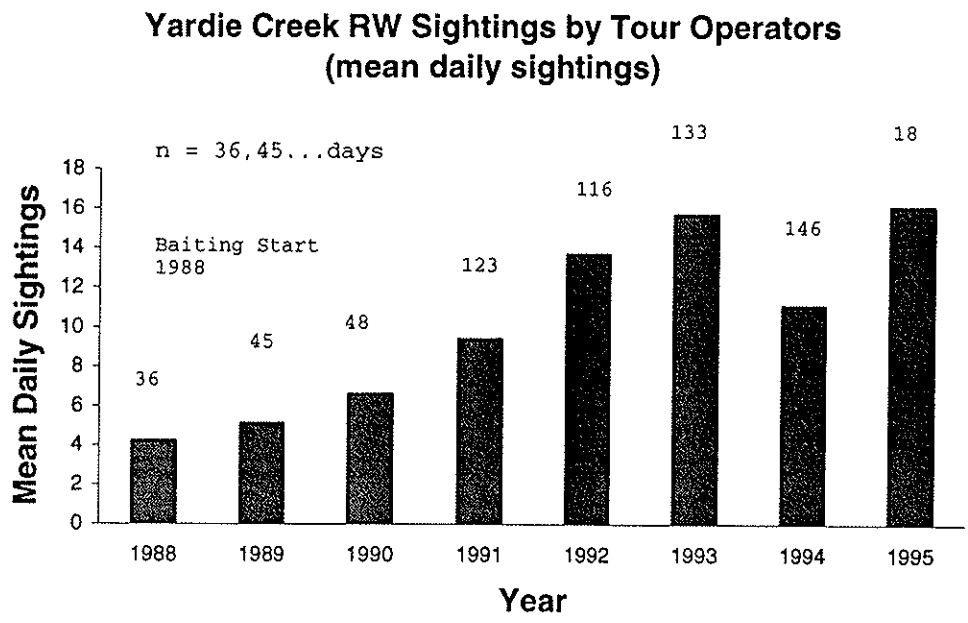
Table 2. (cont)

June 1988	Mandu Mandu	11	0	as above
May 1995	Mandu Mandu	20	0	as above
June 1988	Tulki	45	0	
May 1985	Pilgramunna Gorge	18	1	Spotlight
May 1995	Pilgramunna Gorge	43	4	Spotlight
June 1988	Milyering Gorge	125	0	Spotlight
June 1988	Milyering Gorge	90	0	Spotlight
June 1995	Milyering Gorge	65	2	Spotlight

NINGALOO STATION RW Sightings(NO PREDATOR CONTROL OR GOAT CONTROL)

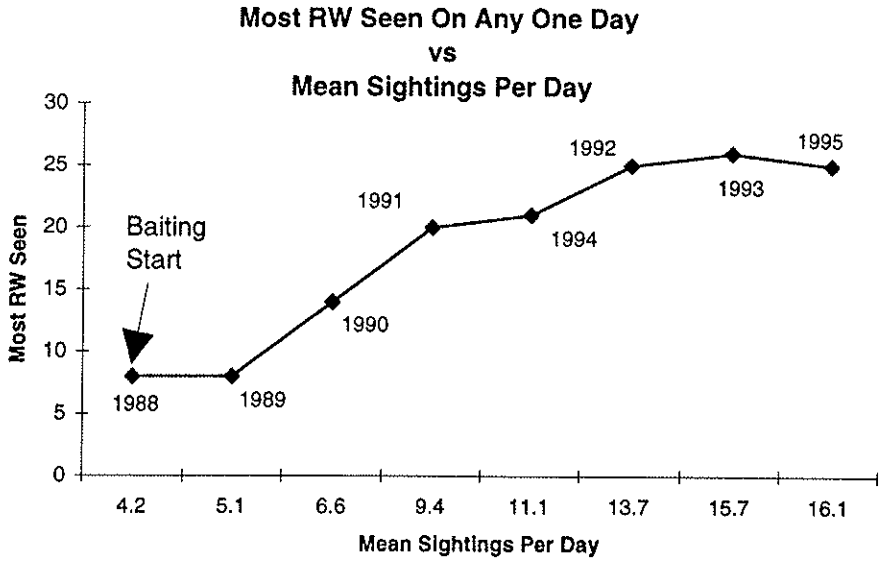
June 1979	Ningaloo Gorge	90	1	Spotlight
June 1987	Ningaloo Gorge	59	9	Spotlight
June 1988	Ningaloo Gorge	53	17	Spotlight
June 1991	Ningaloo Gorge	40	22	Spotlight (16 RW during daylight)
May 1995	Ningaloo Gorge	50	34	Spotlight
May 1995	Ningaloo Gorge	43	25	Spotlight (17 06:00 next day)
May 1995	Ningaloo Gorge	39	32	Spotlight(16 06:00 next day)

Fig. 1. Sighting Data from Tour Operators 1988-95



The above chart illustrates the average number of RW seen during each excursion along Yardie Creek. Only one baiting occurred during the years 1988-90; two baitings were carried out subsequently.

Fig 2. below is a plot of maximum number of RW sighted for any given day vs the mean daily sightings for the year.



This graph reflects a strong correlation between the mean daily sightings and the maximum number of RW seen on any given day for any particular year. The most RW seen is a measure of the total sightable population. On average, the tour operators are sighting 55% ± 07 (sd) of the sightable population. At the higher end of the range of the mean values, the relationship becomes asymptotic which suggests that Yardie Creek **may** have reached its carrying capacity with regards to sightable animals. Alternatively, and more likely, the upper bound may be the result of insufficient predator control.

At the lower end of the range of mean daily sightings, the correlation becomes more meaningful for managers. As the mean declines, then so does the maximum sighted; this suggests that the sightings recorded by the Yardie Creek Tour operators could serve as a data set for flagging population declines, and thus alert park management (see Table 2).

Table 2. Statistical analyses (ANOVA) comparing the mean daily RW sightings for years 1992-95.

Comparison	Sample size (n)	Mean	F value
1992	115	13.8	33.3***
1993	115	15.8	
1994	115	10.9	
1992	115	13.8	8.8***
1993	115	15.8	
1994	18	6.8	74.5***
1995	18	16.1	
	(first 18 days of the tourist season)		

Note the significant decline at the beginning of the 1994 season compared to 1993; note also the recovery by 1995.

Spotlighting indices: limitations

Within the park and particularly in reference to Yardie Creek, it is clear that spotlighting is an insensitive technique as it does not reflect any changes in abundance. This is evident from the McGregor records which show an increasing trend up to 1994, and also, the 1994 mini-crash followed by a recovery in 1995. One can be very confident of this conclusion because of the depth of their data.

Accordingly, the reliability of the spotlight surveys for the park gorges is suspect. Like Yardie, no positive trends were evident from spotlighting data, but because of the Yardie spotlighting results failed to mirror the tour operator sightings, we can not conclude that there were no increases in the other gorges as implied by the spotlight data (Table 1).

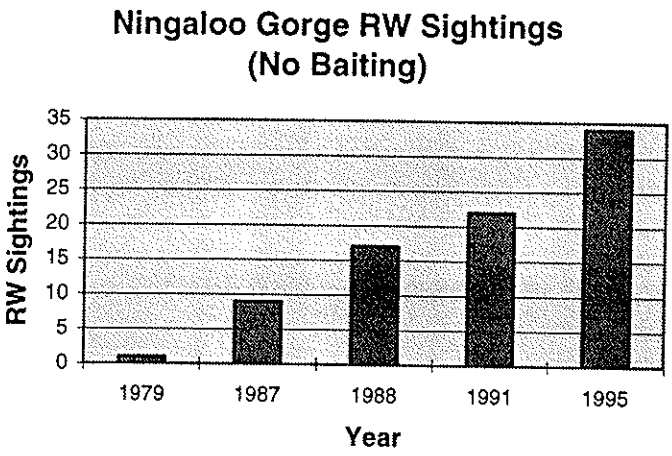
In contrast, such is not the case for Ningaloo gorge which differs in topography; spotlighting has been consistently productive and trends are readily discernible (Fig.3).

The Unbaited Control Population: Ningaloo Gorge

Visits to the gorge began in 1979 and sighting surveys have been made sporadically over the years when circumstances permitted. At this site, the escarpment is lower, less rugged and the gorge is correspondingly shallower and thus very much easier to survey. Moreover, the gorge ends abruptly at a steep face making it possible to circumnavigate the site.

The survey route follows the southern rim then crosses over to the north rim and is completed within 40-45 minutes. RW are readily seen foraging on or near the rim and within the gorge. This is not the case for most of the park gorges which are deeper and less accessible.

Goats have been invariably abundant during every visit; they feed on the coastal plain and escarpment and large mobs camp each night in the gorge. A dense carpet of goat dung practically obscures all signs of RW scats. Except for the occasional mustering no attempts are being made to control goats[6].



Daylight surveys produce fewer sightings — 50-72% of the number observed during spotlight surveys.

[6] Ningaloo Station is operated by the Lefroy family; shooting is not allowed on the property nor would baiting for foxes be looked upon favourably.

Rate of Increase

Clearly the RW have increased steadily over the 16 years. It should be emphasised however, that the rate of increase has been very slow about 2 sightable animals per year. In contrast, the baited wheatbelt RW populations doubled their numbers every 2 years.

This is an other example of a population with a positive but slow growth rate without overt predator control. I have recorded a similar situation in the wheatbelt only to be followed by a population crash. Also, it should be noted that when we first arrived in 1979, we sighted only 1 RW! Why? (see Discussion for more comments).

DISCUSSION

Efficacy of the Baiting Protocol

The baiting protocol was selected for the purpose of defining a minimum effective baiting regimen suitable for a relatively large area of conservation estate[7]. The rationale was based on unpublished research by the fox group (Algar *et al.*).

While no clear benefits can be ascribed to the baiting program throughout the park due perhaps to deficiencies in the spotlight technique, it is clearly evident that the Yardie Creek RW population increased significantly. And although both Yardie Creek and the Ningaloo Gorge populations increased following the commencement of two baitings per year, Yardie creek increased at a somewhat greater rate. For example, over the period 1988-95, the Ningaloo population doubled, while the Yardie Creek population increased 3 times.

Other Limiting Factors

The factors that limit populations can be broadly categorised as abiotic factors and biotic factors.

Biotic Factors: exotic spp

Elsewhere in the wheatbelt and Dampier Archipelago, predator control implies that a biotic factor is the proximate factor controlling RW numbers namely, predation by exotics principally the fox and probably the cat as well.

Feral goats are possible competitors of RW, but there is little available evidence that suggests that competition is actually a significant factor. The RW colony increased on Ningaloo Station in the presence of a conspicuous population of feral goats. However one may argue that the slower growth rate by the Ningaloo population may be a result of competition. Goats have been controlled within the park, but we have not seen a consistent across the board population increase by RW. Here again, one must bear in mind that the census technique may be wanting.

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[7] Other field trials (FRNP; FOXGLOVE) involving 2 baitings per year are in progress.

Abiotic Factors

It is reasonable to assume that drought would be the principal abiotic factor affecting RW reproduction and survival. Nonetheless, there is little evidence to link the recent rainfall pattern (Fig 5) to the lack of population responses.

This conclusion is supported by the following evidence: during 1993 the mean daily RW sightings for Yardie for the beginning of the tourist season (April-May) was 13.5, and during the closing stages of the season (Sept.-Nov.) the value was 13.3. Rainfall was slightly above average.

However, when we compare the same statistics for 1994, we find that the mean for the beginning of the season (April-May) to be 7.9 — a highly significant 42% decline. By the end of the 1994 season, population recovery was evident as the mean daily sighting (Sept-Nov) had increased to 11.8 **despite the fact that rainfall was nearly 40% less than average.**

To summarise, RW can increase during years of below average rainfall. We note the following: in Yardie Creek, RW declined during the summer of 1993-94 a year of above average rainfall and increased during a year (1994) when the rainfall was only 62% of the average. We also note that the Ningaloo Gorge population likewise increased.

The Feral Cat: an unknown factor

An unknown factor is the control of the feral cat. In the wheatbelt we observe consistent population increases using standard fox baits, but we are now beginning to find distorted sex ratios favouring males. This may well be due to differential predation on young females by cats. **(I have submitted an SPP designed to test this hypothesis).** The McGregor's (Yardie Creek Tours) have recorded cats lurking about in Yardie and have subsequently noted that certain juvenile RW have gone missing (pers comm).

Knowledge Gaps: the predation process

The nature of predation process is poorly known. What we need to understand in more detail are the circumstances surrounding predation events. Who is doing the killing? How often? And when? Are all foxes/cats potential threats? Do foxes suddenly prey switch and focus on wildlife or is the predation pressure more or less constant?

Answers to some of these questions will dictate how often we need to bait and also, the requirements for biocontrol. Regrettably, no one is studying such matters including the CRC and CALM even though the opportunity exists.

In the wheatbelt, there is circumstantial evidence that implies that predation can be minimal for long periods thus allowing positive but slow growth rates of rock-wallaby populations. However this state can end abruptly producing a population crash due to bouts of predation and surplus killing by foxes (See footnote 1).

One should also recall that during our first survey of Ningaloo gorge in 1979, we only sighted **one RW**! Why so few? The rainfall records are below average prior

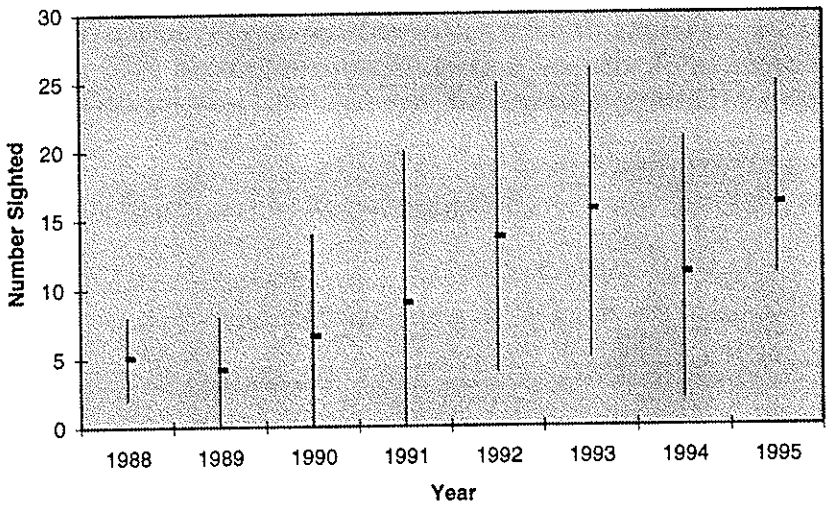
to 1979[8], but as we have shown RW can increase during low rainfall years, hence drought does not appear to be a causative factor. I suspect that a crash will occur again[9]; we should continue to monitor this population for it may provide evidence about the episodic nature of serious predation events.

Tourism and Rock-Wallabies

There is little doubt that a conspicuously abundant population of RW adds to the tourist potential of a region that is rapidly becoming dependent on tourist industry for economic survival. From discussions with the various tour operators (initially Krait Tours; Ningaloo Safari Tours; Yardie Creek Tours), the sightings of RW are the highlight and a key attraction of their tours. Perched along the face of a scenic, picture postcard gorge, the sight of an infant RW peering out the pouch or snuggled close at heel beside a proud mother warms the heart of nature-loving tourists. Likewise, the presence of RW also warms the heart of the proprietors; one tour operator claims the viability of his business is strongly linked to the presence of RW — the more the better.

However, as one would expect, the probability of sighting a RW is density dependent. This is evident from Fig. 4 below.

Yardie Creek RW Sightings
Highest, Lowest, and Mean Daily Sightings



The message here is this: When the mean daily sightings falls to approximately 10 or less, **then there are days when the tour fails to see a RW**. This is not only disappointing from a tourist's viewpoint, it is also bad for business. Likewise from the conservation viewpoint, it is also unwelcomed news because small, declining populations are more prone to extinction. There is no conflict

[8] Rain fall was below average prior to 1979; at worst this could have negatively affected recruitment, but not adult mortality.

[9] In May 1995, we arranged for Ms Juliet King, a UWA student of Prof. D. Bradshaw, to trap RW on Ningaloo Station. She observed a predation event to quote: "On one occasion, at 11.30 a.m. a fox was seen chasing an adult Rock wallaby. A few minutes later the fox was found burying a very recently killed joey (of approximately 450g).It is suspected that this was one of the large joeys that had been previously trapped with its mother, since the mother was seen later on several occasions without a pouched young. The fox was sighted on 2 more occasions at this gorge." (Letter to JEK)

here between the tourist industry and CALM's goals regarding the conservation status of a vulnerable species — the more animals about the better. Its a win-win situation for all stakeholders.

Public Perceptions About Baiting Cape Range

Hopefully the previous imbroglio regarding the risk to the perentie (*Varanus giganteus*) from baiting will not resurface. The research carried out by Nancy & Thomas Heger will help to provide a scientific basis for allaying the fears and concerns raised in the past by members of the local community.

However more could have been done about this matter. I have asked Ms Heger to write an appraisal regarding the risk to perenties and to comment on the baiting protocol. She has agreed to do this before she departs Australia.

1080 Tolerance of the Perentie

The matter of determining the tolerance of *V. giganteus* to 1080 has not yet been done and they could be at risk. It would be prudent to do this otherwise CALM could be subject to more adverse publicity without the knowledge to counter such attacks. At present, we are making a bald assumption regarding its resistance to 1080. Dr D. King of the APB said arrangements had been made for Ms Heger to supply, but he has not yet received any specimens.

ACKNOWLEDGMENTS

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