

# Recent Surveys of the Cocos Buff-banded Rail (*Gallirallus philippensis andrewsi*)



An individual Cocos Buff-banded Rail (*Gallirallus philippensis andrewsi*)  
on the forest floor of Pulu Keeling National Park

Image R. Thorn

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## Introduction

This report describes three aspects of research into the Cocos Buff-banded Rail *Gallirallus philippensis andrewsi* (CBBR), an endemic taxon of the Cocos (Keeling) Islands, an Australian Offshore Territory in the central-eastern Indian Ocean (Fig. 1). The Cocos (Keeling) Islands consist of two atolls, located approximately 2900km north-west of Perth, 975km west-south-west of Christmas Island and 1,000km south-west of Java (lat. 12° 12'S, long. 96° 54'E). The northern atoll comprises a single island atoll, North Keeling Island or Pulu Keeling National Park, managed by Parks Australia North. The southern atoll consists of 26 islands surrounding a large lagoon (Fig. 1).

The CBBR is listed as Endangered under the *Environmental Protection and Biodiversity Conservation Act, 1999*. The research was commissioned by the Australian Government's Department of the Environment and Heritage (DEH) as part of a work program contracted to the Australian National University (ANU) to prepare a National Recovery Plan for the CBBR.

A previous survey of CBBR on North Keeling Island, conducted in 1999 (Reid 2000), led to the first quantitative estimates of the rail's population density and its island-wide population size.

### *Objectives*

Under the terms of the contract, the ANU was required to address the following two objectives:

- establish, through survey, whether CBBR still persists on the southern atoll;
- compute population densities and total population estimates for the North Keeling Island population of CBBR by the appropriate analysis of transect count data gathered since 1999 by Parks Australia North staff.

An unplanned visit to North Keeling Island allowed us to conduct a survey of the CBBR population. By using comparable survey and analytical techniques to those of Reid (2000), we were able to estimate the island's rail density in 2005. Therefore, an additional third objective of the research was to:

- survey and estimate the density of the North Keeling Island population of CBBR using comparable techniques to the original 1999 study by Reid (2000), and compare population densities and estimates derived from the various surveys between 1999 and 2005.

### *Previous Surveys of CBBR*

Surveys conducted by Reid (2000) in November 1999 led to the conclusion that the CBBR was extinct on the southern atoll. However, unconfirmed sightings on West Island and South Island have been reported to Parks Australia North (PAN) since this time (PAN staff, *personal communication*). The northern atoll is a single island - North Keeling Island. North Keeling Island was declared Pulu Keeling National Park in 1995 and provides habitat critical for continued survival of the CBBR (Reid 2000; Director of National Parks 2004). Reid (2000) devised a monitoring program for the CBBR on North Keeling Island and estimated its population size there. Using multiple distance-based line-transect counts, with the subsequent definition of a detection distance of 20m, a density of 6.1 birds per ha was determined, which translated to a population of 750-800 individuals (Reid 2000). The distance-based transect method was recommended for continued monitoring of the CBBR

population in Pulu Keeling National Park by PAN staff. Transect count data collected separately by PAN staff two weeks later (November 1999) were also analysed by Reid (2000), but these observations yielded significantly smaller population densities, which were a result of either between-observer differences or, less likely, differences in behaviour and detectability of the CBBR between island visits.



**Figure 1.** Cocos (Keeling) Islands. The northern and southern atolls are labelled as North Keeling Island and South Keeling Islands respectively.

This report describes an extensive survey and search for the CBBR on the southern atoll by the authors during May-June 2005. The results of this search are placed in the context of recent sightings of CBBR on the southern atoll. In addition, an unscheduled but opportune survey of the CBBR on North Keeling Island is described. Our analysis of transect count data, undertaken in Pulu Keeling National Park by PAN staff to allow population estimation of CBBR (density and total populations size), is also presented. The transect data gathered by the authors on North Keeling Island were also analysed in a comparable manner, and so these results are reported together and compared with the 1999 survey of Reid (2000). New observations of the behaviour, breeding, and habitat use of CBBR are also reported.

Since the survey of Reid (2000) was conducted and its results were incorporated into the *Action Plan for Australian Birds* (Garnett & Crowley 2000), the occurrence of yellow crazy ants *Anoplolepis gracilipes* on North Keeling Island has become widely known (R. Thorn *personal communication*). Crazy ants have had a significant deleterious impact on ecosystem structure and function on Christmas Island (another Australia Offshore Territory in the Indian Ocean) where they have been able to form super colonies (O'Dowd et al. 2003). Although crazy ants have been present on North Keeling Island for many years, they have shown no sign of forming destructive super colonies (R. Thorn *personal communication*). The potential threat to the CBBR of crazy ants is briefly considered.

In April 2001, Tropical Cyclone Walter came within 40km of North Keeling Island causing significant habitat change. Sixty-one percent of the canopy was destroyed and 14% of trees were felled (Director of National Parks 2004). The potential effects of cyclone habitat disturbance on the CBBR are also briefly considered.

Several possible sightings of CBBR on West Island were reported to PAN staff in the years 2001-2004, a possible sighting on South Island was made in 2004 by PAN staff (I. Macrae *personal communication*), and downy chicks, possibly attributable to CBBR, were handed in to PAN staff in 2004 and photographed before release (R. Thorn *personal communication*). The locations where these sightings were made focussed around the airstrip, the Quarantine Station, and at the narrow point of West Island approximately 300m east of the southern tip of the airstrip.

## Methods

### *Survey of the Southern Atoll*

Seventeen islands on the southern atoll of the Cocos (Keeling) Islands were surveyed for birds, focussing on detection of the Cocos Islands Buff-banded Rail (CBBR), between 6 May and 9 June 2005. The islands were surveyed by three methods, walking, cycling and boat. The CBBR has a distinctive call that can be easily detected by observers up to 50m away, and all methods relied on observers keenly listening for calls. Walking involved observers walking along the lagoon/ocean shore or access road/track looking in to the dense vegetation for signs of movement at ground level or climbing through dense vegetation at particular points to cross through areas of larger islands. After several attempts, the technique of walked surveys through islands with extremely dense vegetation was abandoned, as the noise and disturbance created by the observer would have allowed any rails present to escape detection. Cycling was used to cover large areas of West Island at different times of the day. Observers rode slowly along roads and access tracks stopping when movement was observed at ground level in the vegetation. Particular attention was paid to areas and times of the day that CBBR had been previously reported. Due to the paucity of terrestrial animals cycling was a valid method to cover larger areas providing observers remained vigilant. The inner lagoon shore was surveyed by boat. The boat travelled slowly along the shore, whilst observers scanned slowly for movement. The motor was turned off in areas where the CBBR had been reported to allow observers to listen to the calls without the sound of the motor. This technique was useful in areas difficult to access particularly when large mudflats under shallow waters made walking unmanageable.

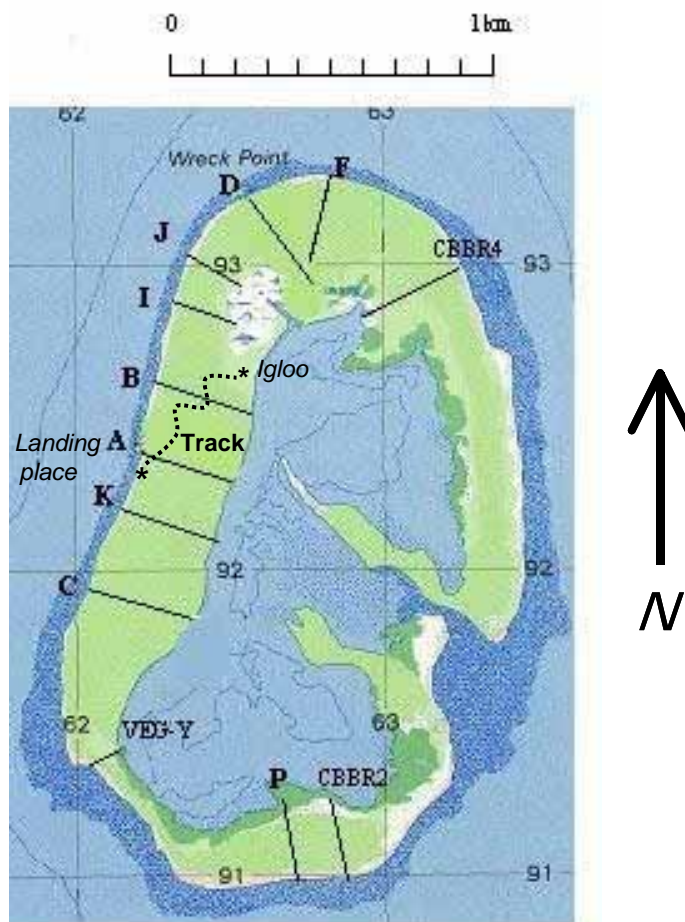
The number of times each island was surveyed depended upon the ease of access and the probability of CBBR presence. The permanently inhabited islands, Home Island (Pulu Selma) and West Island (Pulu Panjang), with regular ferry access, were more frequently surveyed. These two islands were also easier to survey as many accessible tracks are present. Because West Island was the last island in the southern atoll on which CBBR was reliably reported and because the authors were housed there, West Island was surveyed more often with at least 20 individual searches conducted. Five surveys were conducted on Home Island. South Island (Pulu Atas) could only be accessed on particular tides, and it proved impossible to access the southern end of South Island and several small islands immediately to its west during the survey period. Direction Island (Pulu Tikus), Pulu Ampang, and Prison Island (Pulu Beras) were surveyed twice, with Horsburgh (Luar) and Maria (Maraya) Islands and nine islands between Home and South Islands visited once.

In addition to the survey work, extensive consultation was carried out with the local residents to gain information on recent possible sightings of CBBR as described in the Introduction. The

locations where recent sightings had been made (airstrip, Quarantine Station, narrow point of West Island) were repeatedly visited and searched for CBBR.

*Surveys of the Northern Atoll*

Transect counting methods used were the same as those described in Reid (2000). In years 2000 and 2004, PAN staff walked the track from the landing site to the campsite ('Igloo' site) and counted rails as if this were a transect (this transect called 'Track': Figure 2). In addition, nine of Reid's (2000) original 13 transects were surveyed by PAN in August 2004. On 5 May 2005, eight transects were surveyed by the authors. See Table 1 for transect details.



**Figure 2.** North Keeling Island showing CBBR transect locations. Base map from Royal Australian Survey Corp, AG Department of Defence (1979). Transect K was labelled as 'CBBR1' in Reid (2000: Figure 2), while Transect 'CBBR3' used by Reid (2000), and not shown here, runs between Transects J & F behind the island's ocean shore.

**Table 1.** Dates, observer and identity of CBBR transect counts conducted on North Keeling Island, 1999-2005.

9-10 Nov 1999		24 Nov 1999		2000			10-11 Aug 2004		10 May 2005	
Transect	ID	Transect	ID	Transect	Obs	Month	Transect	Obs	Transect	Obs
A	JR	A	PAN	Track	PAN	Jun	A	PAN	A	JR
B	JR	B	PAN	Track	PAN	Sep	B	PAN	B	BH
C	JR	C	PAN	Track	PAN	Oct	C	PAN	C	JR
CBBR1=K	JR	CBBR1=K	PAN	CBBR1=K	PAN	Dec	CBBR1=K	PAN	D	JR
CBBR2	JR	D	PAN	P	PAN	Dec	D	PAN	F	JR
CBBR3	JR	F	PAN	Track	PAN	Dec	F	PAN	I	JR
CBBR4	JR						I	PAN	J	BH
F	JR						J	PAN	L	BH
I	JR						P	PAN		
J	JR						Track	PAN		
L	JR									
P	JR									
Veg-Y	JR									

### *Density Estimation*

CBBR population densities on North Keeling Island were calculated for the PAN data from 2000 and 2004, and for the authors' 2005 data. Data for all transects were grouped by year. During the 2005 visit, it was learnt that the length of each transect had been determined by PAN to the nearest 10m, and that these distances varied from the estimates of their length made by Reid (2000) during the 1999 survey. Also minor mathematical errors in Reid's original calculations with the 1999 data have since been detected, and so the 1999 transect data were re-analysed and the corrected density estimates are presented here.

Reid (2000) used a 20m detection distance cut-off for his density analyses after consideration of the frequency histogram of individual rail observations. Because 1999 was a drought year, visibility was greater than in May 2005. Detection distances of each observation of rails during the current survey were plotted to determine the most appropriate detection distance for calculating densities using the 2005 data. The distance frequency histograms for 1999 and 2005 observations are presented in the *Results*. Note that the detection distance needs to be doubled for density estimation using fixed band widths.

A number of density estimates are derived for the 2005 data. Transect J was the first survey count conducted by B. Hill and yielded few birds, therefore estimates were derived with and without using data from this transect. Also, because the length of transects used for density estimates differed between 1999 and 2004, the 2005 distances were also retrospectively applied to the 1999 data for comparison. Two-tailed t-tests assuming unequal variance were used to compare density estimates between 1999 and 2005, specifically to examine the null hypothesis of no difference in rail density between surveys. An estimate of total island population size is calculated.

## Results

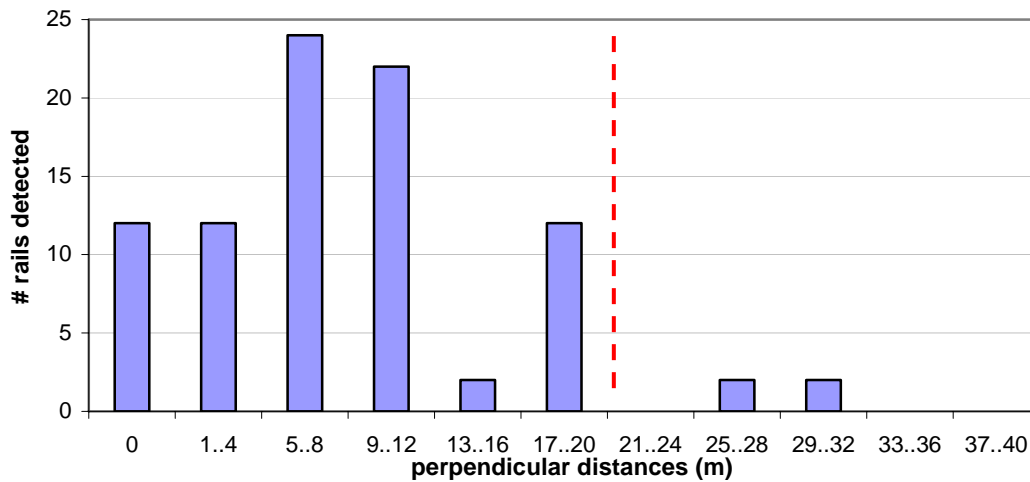
### *Survey of the Southern Atoll*

No CBBR were found on any of the 17 islands surveyed (Appendix 1). Individual CBBR sightings on West and South Islands were reported to PAN staff in 2002 (W. Murray *in* Director of National Parks 2004). PAN also received several reliable reports from a birdwatcher working for the RAAF on the southern end of West Island in the period 2001-03 (R. Thorn *personal communication*). Repeated surveys of this area (narrow part 300m E airstrip) did not reveal any CBBR at or around the site, where they had been reported as commonly seen. There was some confusion among local residents between the CBBR and another species of similar-sized rail, the White breasted Waterhen *Amaurornis phoenicurus*, a migrant from Indonesia which has self-established on West Island in the past six years (J. Reid, unpubl. data; Johnstone & Darnell 2004). A pair of chicks suspected to be CBBR were handed in to PAN staff in 2004. They had been gathered near the southern end of the airstrip. Photographs of the small black downy chicks taken at the time did not permit specific identification, as both CBBR and the White-breasted Waterhen have black downy young. Furthermore, juvenile White-breasted Waterhens were seen in this general location during May 2005 surveys, increasing the likelihood that the photographed chicks were actually waterhens and not CBBR. Small downy chicks of the White-breasted Waterhen were seen in early June 2005 in the vicinity of the Quarantine Station, and larger juveniles of this species were seen elsewhere in the northern section of West Island in May and June, leading us to conclude that most if not all of the recently reported CBBR observations from West Island were actually attributable to the White-breasted Waterhen. The White-breasted Waterhen is now firmly established as a breeding resident on West Island.

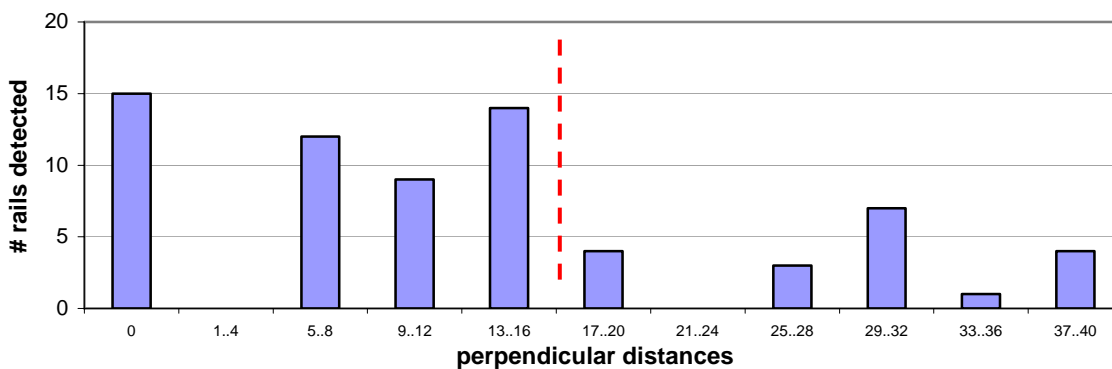
Three Cocos-Malay residents of Home Island reported seeing CBBR on the southern end of Home Island occasionally in the early mornings. Another resident reported that he had seen an unusual bird at his kampong on Pulu Ampang that looked very much like the picture shown to him of CBBR. We were unable to verify these sightings during our survey, despite three visits to the southern end of Home Island and a two visits to the kampong on Pulu Ampang.

### *Density Estimates of the Northern Atoll Population*

The perpendicular distance from the observer that rails were detected frequently was shorter in 2005 than in 1999 (compare Figs 3 & 4). The 1999 surveys were conducted in a drought year that had led to considerable canopy thinning (R. Thorn & W. Murray *personal communication*), allowing better visibility for observers. Inspection of the 2005 data indicated that a 16m (Fig. 4: indicated by red line) width band from the observer should be used for density estimation in 2005, compared to the 20m width band from the observer (Fig 3) used for analysis of 1999 data (Reid 2000).



**Figure 3.** CBBR transect detection distances from November 1999 surveys. The red line indicates the cut off point used for fixed-width density estimates.



**Figure 4.** CBBR transect detection distances from May 2005 surveys. The red line indicates the cut off point used for fixed-width density estimation.

Density estimates derived from the PAN data were highly variable, yielding lower (November 1999) and higher (2000) estimates of rail density than those derived from both the 1999 data of Reid (2000) and the newly gathered data (May 2005; Table 2). Corrected transect length measurements were generally shorter than those used by Reid (2000), giving higher densities than those originally presented (Reid 2000). Removing transect J from the 2005 data yielded a higher density estimate. However, other surveys of transect J (from 2004) have yielded low numbers of rails, and so it is debatable whether the transect J observation should be removed. With J's data included, a *t*-test comparing densities between 1999 (J. Reid's observations, not PAN) and 2005 (Reid & Hill's data) is not significant ( $P > 0.05$ ). However, with J's data removed, a similar *t*-test returns a marginally significant result ( $P \approx 0.05$ ).

**Table 2.** Population density estimates (birds per ha) for CBBR on North Keeling Island, using both original and corrected measurements of transect length, where comparable.

Year and Observers	#	#	mean density $\pm$ SE	
	surveys	transect s	original	corrected
2005 Reid and Hill all	8	8	5.982 $\pm$ 0.707	6.994 $\pm$ 0.868
2005 Reid and Hill, no J	7	7	6.658 $\pm$ 0.238	7.770 $\pm$ 0.449
2004 PAN	10	10	6.795 $\pm$ 1.329	
2000 PAN	5	3	8.833 $\pm$ 2.333	9.352 $\pm$ 2.274
Nov 1999 PAN	6	6	3.558 $\pm$ 0.503	4.100 $\pm$ 0.612
Nov 1999 Reid (2000)	13	13	6.122 $\pm$ 0.760	
Nov 1999 Reid - corrected	13	13	5.994 $\pm$ 0.739	6.774 $\pm$ 0.930

A *t*-test on density estimates of Reid’s November 1999 vs PAN’s November 1999 observations, gathered two weeks apart, is highly significant ( $P < 0.001$ ), with the latter density being almost half that of the former (Table 2).

Observations of the CBBR on North Keeling Island made during transect counts and at other times revealed that many individuals used preferentially the drying lagoon margins for foraging – up to 40 birds were seen along the lagoon margin in a 15-minute period. However, birds occupying the lagoon margins could not be counted on transects, because of their shyness – rails fled for cover as soon as humans were seen. The vegetated area of North Keeling Island is said to be 120ha (W. Murray *personal communication*), and another 10-20ha of lagoon margin without perennial vegetation is present since the lagoon mouth to the ocean was blocked in 2003. Based on the 2005 population densities using the corrected transect lengths, and using a range of density estimates – with and without the observation at transect J, and accounting for higher rail densities on the uncensused lagoon margin – the current population estimate of the CBBR on North Keeling Island is 850-1000 birds.

#### *Observations of the Northern Atoll CBBR Population*

At least three family parties (juveniles noticeably smaller and less brightly plumaged than nearby adults) of CBBR were observed in the *Pisonia grandis* forest by B. Hill and R. Thorn during the May 2005 visit to North Keeling Island. This indicates March-April nesting, and adds further weight to the tentative conclusion that there can be some reproduction occurring at any time of the year – certainly there are records of nesting (incubation of eggs, as directly observed or inferred through size of juveniles) from March to January (see Reid 2000).

One individual of CBBR was observed to run down the sandy oceanic shore on the north-western section of North Keeling Island, forage casually in the intertidal zone briefly, before bathing for several minutes in shallow intertidal rock pools (B. Hill & J. Reid). One other individual was observed in the sandy intertidal zone separately. Anecdotal observations of the CBBR revealed them to be prevalent in pure stands of Coconut Palm near the lagoon entrance on the eastern side of North Keeling Island, again confirming the conclusion drawn by Reid (2000) that the rails are distributed widely and fairly evenly throughout the island and in all

habitats. The only contrary observation to this statement has been referred to already and consists of the species' apparent preference for the drying lagoon margin habitat of the island's interior.

## Discussion

The current survey did not confirm any previous reported sightings of CBBR on the southern atoll. New sightings reported on Home Island by residents were also not confirmed. Rails are a highly dispersive group and are good fliers, evidenced by their radiation throughout the islands of the Pacific (Schodde & de Naurois 1982). We believe that some dispersing CBBR from North Keeling Island may make it to the southern atoll and may account for occasional sightings. However, given the lack of rail presence during two surveys/searches of the southern atoll (this work and that of Reid 2000) and the presence of threats, we conclude that CBBR has not re-established a population on the southern atoll. There is a possibility that rails may survive on South Island as it was poorly searched during both surveys, but we consider that this possibility is small as the habitat is highly modified and threats are present. Several days searching on foot on the ocean side and by canoe on the lagoon side of the Island should confirm the absence of CBBR on South Island. We consider that the removal of threats from and habitat restoration on one of the islands on the southern atoll would provide an appropriate environment for a population to re-establish.

Posters of the CBBR highlighting identifying features and our contact details were distributed and left around the Islands to raise the profile of the CBBR, reduce the confusion with the White-breasted Waterhen and to provide contact details for reporting sightings.

Variability in density estimates may reflect changes in density or the method used for surveys. They may also indicate changes in bird behaviour and/or the ability of surveyors to detect rails. In 1999 density estimates from the PAN survey data were considerably lower than those by Reid (2000) collected just two weeks earlier. There was also variability between transect counts obtained by PAN staff in 2000, indicating that the birds may have been behaving differently on different visits through the year. Another potential cause of bias in density estimation is habitat change and its effects on detectability. Canopy cover varies greatly depending on the amount of recent antecedent rainfall, and this could reduce the visibility of rails directly or by there being less light for human viewing. If this is of major concern, measurements of vegetation density could be taken to see if there is a correlation with vegetation density and the threshold rail detection distance – although it is observed that considerably more data would need to be collected to test this proposition than is possible in one to two day visits. Transects in 2000 were also conducted at different times of the year and differences may be due to this, but the highest and lowest estimates were made on the same day. Density estimates for 2004 and 2005 were fairly similar to each other and similar to those by Reid in 1999, especially if transect J's observation is included in the 2005 analysis. Transects in 2004 also had few birds detected on transect J, and so it is probably reasonable to include these data. With J's observation included, there are no significant differences between the 1999 and 2005 density estimates.

We conclude that the population has not changed much in 5-6 years, and that Tropical Cyclone Walter had little medium-term effect on rail population size. The population apparently increased between 1999 and 2000, presumably in response to the drought breaking. If TC Walter in April 2001 had any substantial short-term impacts on population size, it is apparent that the population recovered quickly, by 2004 (when the next surveys were conducted) at the latest. The current population estimate of 850-1000 birds is only slightly larger than the previous estimate of 750-800 (Reid 2000).

The CBBR utilises all habitats equally and occurs throughout North Keeling Island (Reid 2000), even foraging occasionally in the intertidal zone and to venture into shallow rock pools to bathe. Up to 40 birds at one time have been seen foraging on the lagoon shore, and this seems to be a preferred feeding habitat (Hopton 2003; this report).

## Conclusions and Recommendations

### *Future Monitoring of CBBR Population on North Keeling Island*

In consultation with W. Murray (Cocos (Keeling) Islands Government Conservator, PAN) it was agreed that the following nine transects would be used for future monitoring (and with their correct distances shown in metres):

A (300m); B (275m); C (285m); D (310m); F (250m);  
I (125m); J (150m); K (250m) P (100m).

Also the 'Track' transect may be used intermittently, although its precise length requires measurement. The above nine transects are routinely used by PAN for red-foot booby *Sula rubripes* monitoring, and so it is rational to use them for the CBBR monitoring.

The nine transect counts should be conducted twice a year, six months apart, for the next three years, before a further statistical appraisal.

### *Securing the CBBR Population*

The population of crazy ants on North Keeling Island requires close attention. Maintaining the security of North Keeling Island from a range of threats is an ongoing priority for the park's managers (Director of National Parks 2004), and quarantine measures may require strengthening.

It is recommended that a medium-sized island in the southern atoll be targeted for threat abatement and habitat restoration ahead of reintroduction of CBBR to that island. Failure to establish a second population of CBBR across the Cocos (Keeling) Islands within the next three years should trigger the establishment of a captive breeding colony off-island, so that the subspecies' survival is not totally dependent on the North Keeling Island population's persistence.

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**Appendix 1.** Islands on the Southern Atoll of the Cocos Keeling Islands surveyed for the Cocos Island Buff-banded Rail between 5/5/05 and 11/6/05.

Island	Area (km <sup>2</sup> )	Perimeter (km)	Methods	Rails	Date/s and areas surveyed
Pulu Panjang (West Is)	6.23	38.5	Walk, cycle	No	5/5 car 6/5 N end 8/5 airstrip 11/5 Rumah Baru 12/5 Bechet Besar 14/5 S end 17/5 S end 18/5 whole is 19/5 airstrip and lagoon 20/5 S end 29/5 dawn N end 1/6 S end 7/6 Bechet Besar
Pulu Luar (Horsburgh Is)	3.63	28.5	Walk	No	28/5
Pulu Selma (Home Is)	1.04	4.4	Walk	No	13/5 whole Is 18/5 whole Is 25/5 S end lagoon side 3/6 S end
Pulu Atas (South Is)	0.95	6.7	Walk, boat	No	26/5 lagoon side of E two thirds by boat; ocean side E third
Pulu Tikus (Direction Is)	0.34	3.4	Walk	No	7/5 S side 11/6 whole island
Pulu Pandan	0.24	3.9	Walk	No	26/5
Pulu Wak Bangka	0.22	2.4	Walk	No	26/5
Pulu Siput	0.10	2.2	Walk	No	26/5
Pulu Ampang	0.06	1.8	Walk	No	26/5 3/6
Pulu Kembang	0.04	1.6	Walk	No	26/5
Pulu Cepelok	0.04	1.3	Walk	No	26/5
Pulu Blekok	0.03	1.1	Walk	No	26/5 3/6
Pulu Blan	0.03	0.8			-
Pulu Blan Madar	0.03	0.7			-
Pulu Wa-idas	0.02	0.7	Walk	No	26/5 3/6
Pulu Kepala Satu	0.02	0.5			-
Pulu Beras (Prison Is)	0.02	0.4	Walk	No	7/5 11/6
Pulu Maria	0.01	0.7	Walk	No	13/5
Pulu Jambutan			Walk	No	26/5
Pulu Kambing			Walk	No	1/6
Pulu Ampang Cecil			Walk	No	3/6
Pulu Pandan			Walk	No	26/5