

**The 2007 Island Wide Survey Report  
Christmas Island National Park.**

***Introduction***

This report is a summary of the results of the fourth Island Wide Survey of yellow crazy ant and red crab distribution and abundance. The initial survey was undertaken in 2001, and has been repeated every two years since. The survey is a vital source of data which informs management of the crazy ant across the Island, and uses the red crab as an indicator species to measure the impact of the crazy ant, in conjunction with native species recovery post baiting.

The initial survey comprised a grid network of 980 waypoints across the island, established using the Christmas Island GIS. The first survey was conducted in 2001 to identify a systematic baseline on the distribution and abundance of *Anoplolepis gracilipes* and the red land crab. Since then the survey has been completed every second year and it has become an effective monitoring program that assesses ant impact and environmental correlates with ant supercolony formation across the island. This latest survey aimed to, (1) capture the short and longer-term effectiveness of the control program (particularly the helicopter baiting program), (2) identify areas of concern for future supercolony formation, (3) direct follow-up control, and (4) determine patterns of population recovery by the red land crab. The assessment of recovery is restricted to the red land crab because it is a documented indicator species for the status of the island's rainforest.

In addition to obtaining important information on the distribution and abundance of crazy ants and red crabs, the Island Wide Survey is a unique opportunity to collect additional distribution data relating to other taxa on the island with little additional effort. This additional data varies from survey to survey. During the 2007 survey we aimed to map the distribution of other invasive species, such as the invasive Giant African Land Snail (*Achatina fulica*) and the invasive rainforest weed *Clausena excavata*, and a number of endangered taxa such as the emerald dove (*Chalcophaps indica natalis*) and the Christmas Island Thrush (*Turdus poliocephalus perythropleurus*). This distribution data will help in the management of these species.

## ***Methods***

The 2007 survey was based upon a sampling method that was established in 2000 by Dr Peter Green and Dr Dennis O'Dowd of Monash University and implemented in modified forms in subsequent Island Wide Surveys. Waypoints are positioned on a 330 x 330 m grid across the entire island. In the 2001 survey 972 waypoints were surveyed. Since then some waypoints have been excluded due to mining or construction activity. In 2003 only 968 of the 972 waypoints were surveyed, but an additional 20 waypoints were added, including points for long-term monitoring of hand-baited sites. Thus a total of 988 waypoints were surveyed in 2003. In the 2005 survey, we monitored 980 of the 988 waypoints from the 2003 survey. Prior to the 2007 survey commencing, the Crazy Ant Steering Committee agreed to remove most of the waypoints that occurred in degraded minesites and cleared areas from the sampling regime. The decision was based on the limited crazy ant and red crab data being generated from these sites, and pressing Occupational Health and Safety issues. This amounted to the exclusion of 103 waypoints, leaving a final total of 877 waypoints for the 2007 survey. Even with the exclusion of such a large amount of waypoints, the survey took approximately 10 weeks to complete.

During the previous survey in 2005, waypoints were permanently marked to improve repeatability of data collection in subsequent surveys. Waypoints were marked with an orange plastic tag nailed to a tree or attached to the best feature in the area (e.g. pinnacle or small shrub). Each tag was inscribed with the waypoint number and the area was also marked with flagging tape (pink or orange). During the 2007 survey all but 23 of these permanent markers were relocated, generally because the marked tree had fallen over.

### **Parameters surveyed at each waypoint**

At each waypoint the presence and abundance of *Anoplolepis gracilipes* and several of its impacts were assessed. The methods to determine crazy ant and red crab abundance follow closely to those used in past surveys (see below) with one exception. In 2001 burrows were counted over a 200m<sup>2</sup> area (50 x 4 m transect), whereas in subsequent surveys burrows were counted in a 100m<sup>2</sup> area (50 x 2 m transect). For comparisons between years we have halved the number of burrows counted in 2001.

*Crab burrow density.* Crab burrow density was determined by counting intact and ant-occupied burrows within a 100 m<sup>2</sup> transect (50 x 2 m). We used a 1 m long conduit to accurately determine if burrows fell within 1m either side of a 50 m tape measure. We distinguished

between intact and ant occupied burrows. The proportion of ant-occupied crab burrows is indicative of the age of the infestation at the sampling point. The indicator of an ant-occupied burrow was no observable fresh digging around the burrow entrance and large numbers of ants were observed exiting the burrow when disturbed.

*Crazy ant density.* To determine densities of crazy ants we used a 400 cm<sup>2</sup> white laminated card with 10 cm spaced gridlines. Ground litter was cleared before placing the card on the ground. The observer then waited 15 seconds before counting all the crazy ants that crossed the boundaries of one 10 cm x 10 cm quadrat for 30 seconds. Crazy ant counts were done every 5 meters for the entire length of the 50-meter transect (11 counts in total).

*Giant African Land Snails.* Giant African Land Snails (GALS) are listed in the top 100 of the world's worst invasive alien species by ISSG (<http://www.issg.org/database/species>). It was probably introduced to Christmas Island during the second world war as a food source (Sproul 1983). Despite being present on the island for over 50 years, their population has remained relatively localized, potentially because red crabs prey upon them. However, the decimation of the crab population by the crazy ants has facilitated fears that the snails' population will increase. To determine the GALS current distribution, we noted its presence or absence at each waypoint during the survey. This was also done in past surveys.

*Emerald Dove and Thrush.* The endemic Emerald Dove and Christmas Island Thrush were both listed as critically endangered under the EPBC Act in 2005. Crazy ants were listed as the main threat to both of these species. To determine these birds current distribution and the impact that crazy ants are having on them, we noted the presence or absence of the emerald dove and thrush at each waypoint. The presence of the thrush was also noted in past surveys. However, during the 2005 and this survey we distinguished between visually observing these birds or hearing their call.

### **Parameters recorded in transit**

In previous surveys it was often found that supercolonies were observed between waypoints. Because it is imperative that we do not overlook supercolonies detected between waypoints, we recorded observations of heavy crazy ants, dead crabs and anted burrows while in transit. At a later date, these areas will be revisited and surveyed at a finer scale.

To determine the distribution of a number of rare or restricted species it was imperative to record all of those observed at waypoints and while transiting between waypoints. For this reason we recorded by GPS the UTM of any sighting of the following: Jackson's crab (*Sesarmoides jacksoni*), Forest skinks (*Emoia nativitatis*), blue tail skinks (*Cryptoblepharus egeriae*), coastal skinks, Christmas Island Flying fox (*Pteropus melanotus natalis*), Hawkowls (*Ninox natalis*), Goshawk (*Accipiter fasciatus natalis*) and Cycads (*Cycas rumphii*).

In addition we recorded the location of a number of more common taxa in which distribution information is lacking, but important for management purposes. These species were: Blue crabs (*Discoplax hirtipes*), Little Nipper crabs (*Geograpsus grayi*), Yellow Nipper Crab (*Geograpsus crinipes*) and Hermit crabs.

Sightings of Wolf snakes (*Lycodon aulicus capucinus*) and feral bees, two non-native species that are a potential threat to the local native fauna, were also recorded at waypoints and if seen in transit between waypoints.

Finally, a weed species which is highly invasive in both disturbed and undisturbed rainforest, *Clausena excavata*, was also noted whenever it was encountered. Isolated satellite infestations of this weed will be targeted for control by the Invasive Species Team during the wet season.

## ***Results and Discussion***

### **Parameters surveyed at each waypoint**

During the 2001 survey 255 waypoints did not have GPS coverage. In 2003 only 49 survey points were not covered by GPS, while in the 2005 survey all waypoints had GPS coverage. With the establishment of permanent transects in 2005, the need for having an exact GPS record at each waypoint was not as critical. As mentioned, all but 23 permanent waypoint markers were relocated.

Results in this report focus on the crazy ants and red land crabs. Additional reports will focus on other data collected during this survey.

### **Yellow crazy ants**

*Crazy ants in 2007*

The estimated size of supercolonies in 2007 range from 1 to 85 hectare with approximately 800 hectares of crazy ant supercolonies on Christmas Island (Map 1). Locations exhibiting high crazy ant density were also sighted at 55 sites while in transit between waypoints. These sightings helped considerably in determining supercolony boundaries and locating supercolonies that are not positioned at waypoints.

Just over half of the identified supercolonies can be accessed for ground baiting, but fifteen supercolonies (approximately 381 ha) are inaccessible due to the terrain or vegetation. Cost effective methods for containing and treating these inaccessible supercolonies need to be considered.

A total of 56 sites have been listed as high priority hand-baiting sites based on a number of factors: (1) the density of crazy ants, (2) location relative to conservation values of Christmas Island – e.g. Pipistrelle roosting sites, endemic reptiles or blue crabs, (3) location relative to crab migratory pathways, (4) presence of dead crabs or anted burrows, (5) location relative to other supercolonies and, (6) accessibility. Particular areas of the island are displaying expansions of ants and overall increases in numbers. The North coast of the island, the Winifred/ Egeria and Middle Point areas are of most concern.

*Baiting effectiveness:*

Since baiting commenced in 2000, approximately 3835 ha have been treated (2309 aerial baited in 2002 and 1526 hand baited since 2000). On average Parks Australia North, Christmas Island has hand baited 210 ha of supercolony per year (maximum 320 ha in 2004). Up until the end of 2007, approximately 16% of the hand baited sites have been re-treated and 3% of the heli-baited sites. The current Island Wide Survey indicates that 15% of the heli-baited sites (approx. 345 ha) now require re-baiting (Map 2). At hand baited sites, this survey indicates that crazy ants have redeveloped to supercolony levels (>38 ants on card counts) at two waypoints that were hand baited in 2001 (wpts 345 & 373), three that were handbaited in 2004 (wpts 5, 206 & 1027), and two that were handbaited in 2005 (wpts 184 & 197).

Reinvasion of hand baited sites could be mainly due to (1) the inability to hand bait some areas within the supercolony, (2) the current bait (Fipronil) does not eradicate every nest within a supercolony, particularly the low nest density areas surrounding the supercolonies, allowing redevelopment or (3) alates may recolonise sites which have been previously treated.

Currently, there are approximately 419 ha of supercolonies accessible for hand baiting and 381 ha of inaccessible supercolonies. This survey has seen a considerable growth in the supercolony area in inaccessible regions of the island. Most of these supercolonies are located in former helicopter baited sites, and indicate that after five years, these supercolonies are beginning to recover. As the ground teams cannot effectively bait these sites, the supercolonies can only be left to grow in size and density until another aerial baiting program is initiated. Also, based on the average annual hand baiting rate achieved by Parks Australia North of 210 ha, it appears that the current baiting protocol is inappropriate to control the rate of supercolony growth in accessible areas of Christmas Island.

*Comparison between years:*

The number of waypoints where crazy ant numbers were in supercolony proportions ( $\geq 38$  ants counted) increased from 47 in 2005 to 71 in this survey (Table 1).

Level of Ants	2001 Survey	2003 Survey	2005 Survey	2007 Survey
	Points	Points	Points	Points
Supercolony ( $\geq 38$ ants)	188	30	47	71
Medium (20-37 ants)	30	19	36	43
Low (1-19)	110	143	215	214
Present (in area, not on card)	62	147	209	74*
Nil	582	649	473	475
<b>TOTAL POINTS</b>	<b>972</b>	<b>988</b>	<b>980</b>	<b>877</b>

Table 1: Comparison of ant counts between survey years.

\* This large reduction is mainly due to the exclusion of 103 minefield waypoints from the 2007 survey.

Across all survey years, crazy ants remain undetected at only 283 waypoints (Map 3) This includes 49 minefield points which did not have ants from 2001- 2005, but were not re-surveyed in 2007. This is a reduction of 32 undetected points since the last survey, indicating an ongoing increase in crazy ant distribution across the Island. Of the 2007 survey points, only 21% of waypoints have no history of crazy ant presence. The mean number of crazy ants on waypoints dropped significantly in 2003 following heli-baiting in 2002 (Mean number of workers on card counts at wpts in 2001 =  $68.10 \pm 5.96$ , 2003 =  $3.82 \pm 0.56$ , 2005 =  $7.05 \pm 0.85$ , and 2007 =  $12.48$

$\pm 1.45$ ). The mean number of crazy ants at waypoints in 2007 still remains much lower than that observed in 2001 (around 18%). The 2007 mean ant density will also be skewed higher than previous surveys, as 103 waypoints in minefields which normally register very low ant counts, have been excluded from this survey.

### Red Crabs

We calculated a red land crab population estimate for each IWS using burrow densities at each waypoint. We did this using two methods that categorized waypoints differently. For the first method we placed each waypoint into one of six categories based on forest type using a geology based vegetation map located on the CINP GIS system: Evergreen forest, Semi-deciduous closed forest, Open forest, Coastal fringe, Minefield and rehabilitated minefields. The second method placed each waypoint into one of two categories based on altitude; above 200m and below 200m. The height of 200 m was used, as there appears to be a transition zone between terraces and plateaus around this altitude and burrow densities below 200 m are significantly higher than burrow densities above 200 m (Table 4). We placed waypoints that were in minefields, cleared areas and rehabilitated fields into a separate category as these areas are usually depleted of crabs.

For both methods, we then extrapolated the number of burrows upward to each category based on transect area and the area encompassed by that particular category (eg. Minefield area). Summing all categories for that particular survey resulted in an estimated population size (Tables 2 & 3).

Results from the vegetation method suggest that the red land crab population has increased by 2.6% since 2001. Although both methods result in slightly different conclusions, they do illustrate that the crab population has fluctuated slightly over the five years of the four island wide surveys.

(a)	Vegetation type	Vegetation area m <sup>2</sup>	Number of Burrows	Number of Transects	Transect area m <sup>2</sup>	Burrow Density	Total number of burrows
	Evergreen Forest	35084677	10252	257	25700	0.40	13995646
	Semi-deciduous closed forest	69717977	21305	482	48200	0.44	30816214
	Rehab	2317764	31	14	1400	0.02	51322
	Open Forest, scrubby forest, vine forest	1515794	1250	29	2900	0.43	653359
	Coastal Fringe	3748251	100	12	1200	0.08	312354
	Mine	20608876	2443	174	17400	0.14	2893534
						TOTAL	48722429

  

(b)	Vegetation type	Vegetation area m <sup>2</sup>	Number of Burrows	Number of Transects	Transect area m <sup>2</sup>	Burrow Density	Total number of burrows
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Evergreen Forest	35084677	11117	264	26400	0.42	14774104
Semi-deciduous closed forest	69717977	20273	487	48700	0.42	29022434
Rehab	2317764	88	14	1400	0.06	145688
Open Forest, scrubby forest, vine forest	1515794	1045	29	2900	0.36	546209
Coastal Fringe	3748251	172	12	1200	0.14	537249
Mine	20608876	1978	173	17300	0.11	2356321
<b>TOTAL</b>						<b>47382006</b>

(c) Vegetation type	Vegetation area m <sup>2</sup>	Number of Burrows	Number of Transects	Transect area m <sup>2</sup>	Burrow Density	Total number of burrows
Evergreen Forest	35084677	9527	264	26400	0.36	12661050
Semi-deciduous closed forest	69717977	20672	488	48800	0.42	29532992
Rehab	2317764	47	14	1400	0.03	77811
Open Forest, scrubby forest, vine forest	1515794	1092	29	2900	0.38	570775
Coastal Fringe	3748251	565	12	1200	0.47	1764802
Mine	20608876	2459	173	17300	0.14	2929319
<b>TOTAL</b>						<b>47536749</b>

(d) Vegetation type	Vegetation area m <sup>2</sup>	Number of Burrows	Number of Transects	Transect area m <sup>2</sup>	Burrow Density	Total number of burrows
Evergreen Forest	35084677	8775	264	26400	0.33	11661668
Semi-deciduous closed forest	69717977	23804	485	48500	0.49	34217871
Rehab	2590546	54	14	1400	0.04	99921
Open Forest, scrubby forest, vine forest	1515794	971	32	3200	0.30	459949
Coastal Fringe	3748251	408	12	1200	0.34	1274405
Mine/ Cleared*	20242153	1964	172	17200	0.11	2311371
<b>TOTAL</b>						<b>50025185</b>

\*Note - Figures for mined & cleared areas taken from 2005 survey.

Table 2: Estimated population size of the red crab (a) 2001, (b) 2003, (c) 2005 and (d) 2007 island wide surveys.

Note: the number of transects completed will vary from the number of waypoints, particularly in the 2001 data, as often transects were not physically possible.

(a) 2001 Island Wide Survey	Area m <sup>2</sup>	Number of Burrows	Number of Transects	Transect area m <sup>2</sup>	Burrow Density	Total number of burrows
Above 200 m	44553548.5	10978	371	37100	0.30	13183527
Below 200 m	67830914.5	21943	410	41000	0.54	36302775
Minefield/ Rehab/Cleared	20608876	2456	193	19300	0.13	2622560
<b>TOTAL</b>						<b>52108861</b>

(b) 2003 Island Wide Survey	Vegetation area m <sup>2</sup>	Number of Burrows	Number of Transects	Transect area m <sup>2</sup>	Burrow Density	Total number of burrows
Above 200 m	44553548.5	11449	372	37200	0.31	13712193



Below 200 m	67830914.5	19156	422	42200	0.45	30790735
Minefield/Rehab/Cleared	20608876	2092	192	19200	0.11	2245509
<b>TOTAL</b>						<b>46748436</b>

(c)	2005 Island Wide Survey	Vegetation area m <sup>2</sup>	Number of Burrows	Number of Transects	Transect area m <sup>2</sup>	Burrow Density	Total number of burrows
	Above 200 m	44553548.5	10352	372	37200	0.28	12398342
	Below 200 m	67830914.5	21470	420	42000	0.51	34674517
	Minefield/Rehab/Cleared	20608876	2539	188	18800	0.14	2783294
<b>TOTAL</b>							<b>49856154</b>

(d)	2007 Island Wide Survey	Vegetation area m <sup>2</sup>	Number of Burrows	Number of Transects	Transect area m <sup>2</sup>	Burrow Density	Total number of burrows
	Above 200 m	44553548.5	9087	372	37200	0.24	10883282
	Below 200 m	67830914.5	24846	420	42000	0.59	40126831
	Minefield/ Rehab/ Cleared*	20608876	2539	188	18800	0.14	2783294
<b>TOTAL</b>							<b>53793408</b>

\*Note - Figures for mined & cleared areas taken from 2005 survey.

Table3: Estimated population size of the red crab (a) 2001, (b) 2003, (c) 2005 and (d) 2007 island wide surveys using altitude to categorize transects.

Year	Height	N	Mean	SD	SE
2001	<200m	481	48.03	61.65	2.83
	>200m	493	24.9	31.18	1.4
2003	<200m	492	41.146	55.983	2.52
	>200m	494	27.797	29.089	1.309
2005	<200m	486	47.428	53.191	2.413
	>200m	494	22.897	21.707	0.977
2007	<200m	465	56.022	64.802	3.005
	>200m	412	23.357	22.64	1.115

Table 4. The number of crab burrows found below or above 200m. Significantly more crab burrows were found on transects below 200m for all surveys.

### Yellow Crazy ants and red land crabs

We found a lower number of crab burrows at waypoints where yellow crazy ant supercolonies were present  $\geq 38$  ants counted on cards) (Supercolony present, N = 71 waypoints, Mean =  $29.3 \pm 4.7$  burrows; Supercolony absent, N = 806 waypoints, Mean =  $41.68 \pm 1.87$  burrows). Suggesting that crazy ant supercolonies are negatively impacting on crab densities.

Crab burrow numbers appear to be recovering slowly at waypoints that were helibaited in 2002 (Mean number of crab burrows per transect, N = 168, 2001 =  $25.75 \pm 4.08$ , 2003 =  $27.46 \pm 4.44$ , 2005 =  $30.92 \pm 2.68$  and 2007 =  $34.98 \pm 3.43$ ). However, a number of these are now reinfested with crazy ants, so the crab population could decline again at these sites. Sample sizes are too small to do a similar analysis on handbaited sites.

## Conclusions

- The estimated crazy ant supercolony area has increased from 670 to 800 hectares since the 2005 survey, despite 370 hectares of supercolonies being Fipronil baited since that survey.
- An increasingly larger proportion of supercolonies are falling into the inaccessible category for baiting. This generally reflects an ongoing recovery of supercolonies which were aerial baited in 2002, and the inability of ground baiting teams to access these areas to reduce the growth in size and density of these supercolonies.
- Helicopter baiting or an alternative baiting strategy is urgently required to abate this increase.
- The low number of supercolonies above the 200m contour appears to be due to (a) successful control of plateau supercolonies by Parks staff, and (b) the preference of crazy ants to form new colonies by budding from adjacent colonies.
- Crazy ant distribution has continued to increase, with over 75% of the Island where crazy ants have been detected.
- Ant densities are still much lower than the average 2001 mean ant numbers at waypoints (only 18% of 2001 numbers), but are progressively increasing.
- The red crab population has increased by 2.6% since 2001, with a current population estimate of 50 million red crabs on the island (excluding crabs too small to make a visible burrow).
- Although crab numbers appear to be increasing slowly in the 2002 helicopter baited sites, this increase is thwarted by the redevelopment of crazy ant supercolonies in some of these areas.

## **Maps**

*Map 1.* Supercolony estimates for 2007 based on waypoints with  $\geq 38$  ants on card counts during the Island Wide Survey. Red polygons represent supercolonies. Transit data has been incorporated to estimate supercolony size. This estimate is from December 2007 with has reduced the original estimated supercolony area after ground truthing.

*Map 2.* Heli-baited and hand baited sites with the 2007 supercolony estimates overlaid. Sites were helibaited in 2002 and handbaited from 2001 to 2007. This map illustrates the need to reapply bait at some sites.

*Map 3.* Crazy ants remain undetected at 234 waypoints for all four surveys (2001, 2003, 2005 & 2007). The red dots on the map illustrate these waypoints. Blue dots represent waypoints located in minefields which were not surveyed in 2007, but had not detected crazy ants from 2001 to 2005.

*Map 4.* Waypoints (red dots) where burrow numbers have increased since 2001. A bigger dot represents a larger increase in burrow numbers.

*Map 5.* Waypoints (red dots) where burrow numbers have decreased since 2001. A bigger dot represents a larger decrease in burrow numbers.