

National Environmental Science Programme



Mitigating cat impacts on the brush-tailed rabbit-rat

Summary of key findings

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Project partners:

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Cover image: The Tiwi Land Rangers and Hugh Davies setting up a camera trap. Image: Hugh Davies

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Executive summary

Many native animals are currently disappearing across northern Australia. Luckily, animals on the Tiwi Islands have so far remained relatively healthy compared to most other areas across Australia. However, recent research has suggested that animals on Melville Island might be starting to disappear. If we don't find ways to protect Tiwi animals, they might be lost forever.

The aim of the research presented in this document was to increase our understanding of both native and feral animals on the Tiwi Islands, in order to work out the best ways to protect Tiwi animals.

Our research found that:

- 1. Native animals on Bathurst Island remain healthy.
- 2. There are more feral cats on Melville Island compared to Bathurst Island.
- 3. Feral cats on Melville Island like areas that have frequent hot fires and lots of feral herbivores (buffalo and horse).

This new information will help us make better management decisions on the Tiwi Islands. On Bathurst Island, given the health of native mammal populations, the absence of feral herbivores and the low density of feral cats, the current application of low-intensity prescribed fire management may be enough to protect Tiwi animals. On Melville Island, the management of both fire and feral herbivores could help reduce the impact of feral cats while improving habitat quality. This approach to management should be coupled with ongoing monitoring to keep an eye on important Tiwi species.



The Tiwi Land Rangers setting up live traps. Image: Hugh Davies

1. Background - Why is this research important?

Australia has lost more animals to extinction than any other country on Earth. Sadly, many animals are currently disappearing across northern Australia. Animals that once lived across large areas of northern Australia, including bandicoot, possum and black-footed tree-rat, are now found in only a few small areas. If we don't find ways to protect these animals they will be lost forever.

Why are animals disappearing across northern Australia?

Over the past 30 years, there has been a lot of research done to try and work out why animals are disappearing across northern Australia. This research has shown that there are multiple reasons causing these animals to disappear. One of the reasons animals are disappearing are hot fires. Hot fires are bad for country as they kill the plants that animals need for food and shelter. Another reason these animals are disappearing are feral animals (animals that have been introduced from other countries). Because feral animals are not from Australia, they can cause large changes to Australian country which make it hard for native animals to survive. The feral animals that are causing animals to disappear across northern Australia include buffalo, cattle, horse, pigs, cane toads and cats. Different feral animals have different impacts on country. Large feral animals like buffalo, cattle and horse can make country less healthy by trampling and eating plants. Cane toads are poisonous, so when native animals eat them, they die. Feral cats are effective predators and can eat a lot of native animals. The more feral animals there are, the unhealthier the country will be, and the faster native animals will disappear. In areas where there are hot fires as well as feral animals, the situation for native animals is very bad, because feral animals can make the impact of hot fires even worse.

The Tiwi Islands

The Tiwi Islands remain a very special place for native animals, and are one of the last places left in Australia where no animals have disappeared. However, we know that there are sometimes hot fires on the Tiwi Islands, and there are feral animals (including buffalo, horse, pigs and cats), so there are areas where country might be unhealthy. Recent research conducted on Melville Island found evidence that Tiwi animals are starting to disappear, including bandicoot, black-footed tree-rat and brush-tailed rabbit-rat. This research found similar patterns on Melville Island to earlier research on mainland northern Australia showing animals were disappearing. This is worrying because over the 30 years since these patterns were seen on mainland northern Australia, animals continued to disappear and have not come back. This suggests that if nothing is done, Tiwi animals might also be lost forever. This would have an impact on Tiwi culture as people would no longer be able to hunt these animals. Also, the animals that are disappearing are important food for other Tiwi animals, such as carpet python and masked owl. This means that if they disappear, other important Tiwi animals might disappear.

Overall aim of this research

The research we have done on the Tiwi Islands has aimed to increase our understanding of both native and feral animals in order to work out the best ways to protect Tiwi animals.



2. Tiwi animals

To work out the best ways to protect Tiwi animals, we needed a better understanding of how healthy animals are on the Tiwi Islands. We identified two important bits of information that were missing from the Tiwi Islands that would help us achieve our aim of protecting Tiwi animals, these were 1) an understanding of how many animals there are out bush (animal density), and 2) whether animals are healthy on Bathurst Island.

How many animals are there out bush?

An understanding of how many animals there are out bush (also known as animal density) is useful because it indicates how healthy animal populations are. It also gives us the ability to identify changes in animal populations. The ability to identify changes is important because we can detect if animals start to disappear, or if animals are recovering in response to management actions.

In 2019, with the help of the Tiwi Land Rangers, we conducted surveys at four locations on the Tiwi Islands: Cape Fourcroy, Ranku, Pickertaramoor and Cache Point (Figure 1). At each of these locations we set up 300 traps. For four mornings in a row, we checked each of the 300 traps for animals. Each location was surveyed twice (June and September).



Figure 1: The location of our four live-trapping sites on the Tiwi Islands (A: Cape Fourcroy; B: Ranku; C: Pickertaramoor; D: Cache Point). The background map indicates fire frequency.

We recorded a total of 365 captures of 154 individual animals, from eight species (Table 1). The northern brushtail possum (*Trichosurus vulpecula arnhemensis*) and northern brown bandicoot (*Isoodon macrourus*) were by far the most commonly trapped species, with 202 captures of 77 individual possums and 111 captures of 44 individual bandicoots (Table 1). However, there was considerable variation in the number of captures of each of these species between the four sites. For example, we recorded 81 captures of 30 individual possums at Cape Fourcroy, but only 16 captures of 6 individuals at Cache Point. Similarly, captures of the northern brown bandicoot varied from 50 at Ranku to just 3 at Pickertaramoor.

We trapped enough possum and bandicoot to be able to estimate density. Possum density varied between the islands, being higher on Bathurst Island (1.06 ha⁻¹) compared to Melville Island (0.32 ha⁻¹) (Figure 2). Bandicoot density varied across all four sites, ranging from 0.04 ha⁻¹ at Pickertaramoor to 0.34 ha⁻¹ at Ranku (Figure 3).

Table 1: A summary of the sites and species capture counts.	The number of individual animals is shown in the
parentheses. Dashes indicate where grids were located outs.	ide the range of a particular species.

	Cape Fourcroy	Ranku	Pickertaramoor	Cache Point	Total captures (individuals)
Northern brushtail possum (VU) Trichosurus vulpecula arnhemensis	81 (30)	77 (29)	28 (12)	16 (6)	202 (77)
Northern brown bandicoot Isoodon macrourus	19 (7)	50 (18)	3 (2)	39 (17)	111 (44)
Delicate mouse Pseudomys delicatulus	0 (0)	14 (5)	1 (1)	10 (8)	25 (14)
Black-footed tree-rat (VU) Mesembriomys gouldii	-	-	8 (5)	8 (7)	16 (12)
Pale field-rat Rattus tunneyi	4 (1)	3 (2)	0 (0)	0 (0)	7 (3)
Butler's dunnart (VU) Sminthopsis butleri	1 (1)	0 (0)	0 (0)	1 (1)	2 (2)
Grassland melomys Melomys burtoni	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)
Northern brush-tailed phascogale (VU) Phascogale pirata	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)
Total captures (individuals)	105 (39)	144 (54)	40 (20)	76 (41)	365 (154)



Figure 2: The density of possum on Melville and Bathurst Island.



Figure 3: The density of bandicoot at each of the four sites across the Tiwi Islands.

These estimates of possum and bandicoot density support the view that animal populations on the Tiwi Islands remain healthier than most other areas across northern Australia. Importantly, these estimates provide important information that will help us identify and understand future changes in animal populations on the Tiwi Islands. An important result from this study is that bandicoot and possums remain healthy at Ranku, an area with very frequent fire. This indicates that on the Tiwi Islands, very frequent, cool fires (like the ones lit by the Tiwi Land Rangers) can keep country healthy.

Are animals healthy on Bathurst Island?

While recent research found that animals may be disappearing on Melville Island, we did not know whether animals were also disappearing on Bathurst Island. The lack of information on how healthy animals are on Bathurst Island means we don't have a good understanding of how big the problem is. This reduces our ability to make good decisions about where to apply management actions.

In 2020, we conducted surveys at 40 sites across Bathurst Island (Figure 4). These sites were first surveyed in 2000 i.e. 20 years ago. We resurveyed these sites using the exact same method by deploying 24 traps (20 small traps and 4 large traps) for three nights. To understand if animals have remained healthy on Bathurst Island we:

- 1. Compared the number of animals trapped at each site in 2000 with the number of animals we trapped at each site in 2020 this gives us an understanding of how the number of animals might have changed over this time.
- 2. Compared the number of different animal species recorded at each site in 2000 with the number of animal species recorded at each site in 2020 this lets us understand whether some species have disappeared from some areas, or whether some animals now live in new areas.



Figure 4: The location of 40 historical sites (black dots) across Bathurst Island that were resurveyed in 2020.

The original surveys conducted in 2000 detected seven different species of native animal. In 2020, we detected a total of four species, failing to detect grassland melomys (*Melomys burtoni*), pale field-rat (Rattus tunneyi) or western chestnut mouse (*Pseudomys nanus*) (Table 2). The total number of native animal captures increased from 116 in 2000, to 150 in 2020. Overall, there was no significant change in the total number of animals, or the number of different species richness between 2000 and 2020 (Figure 5). Northern brushtail possum (*Trichosurus vulpecula arnhemensis*) trap-success was 186% higher in 2020 than in 2000, while grassland melomys (*Melomys burtoni*) trap-success dropped significantly over this time. For the northern brown bandicoot (*Isoodon macrourus*), brush-tailed rabbit-rat (*Conilurus penicillatus*), western chestnut mouse (*Pseudomys nanus*), delicate mouse (*Pseudomys delicatulus*) and pale field-rat (*Rattus tunneyi*) there was no significant change in the number of animals being trapped between 2000 and 2020 (Table 2).

Table 2: Summary of the changes in native mammal live-	trapping results at 40 sites ad	cross Bathurst Island in 2000
and 2020.		

Species	% of sites detected at in 2000	% of sites detected at in 2020	Change in the % of sites detected at	Trap- success 2000 (%) (<u>+</u> SE)	Trap- success 2020 (%) (<u>+</u> SE)	Change in trap success (%)
Northern brown bandicoot (Isoodon macrourus)	57.5	42.5	-15	8.96 (1.59)	6.25 (1.42)	-30.25
Northern brushtail possum (Trichosurus vulpecula arnhemensis)	47.5	82.5	+35	7.5 (2.19)	21.46 (2.65)	+186.13
Grassland melomys (Melomys burtoni)	15	0	-15	0.88 (0.48)	0	-100
Brush-tailed rabbit-rat (Conilurus penicillatus)	7.5	10	+2.5	0.21 (0.13)	0.24 (0.15)	+14.29
Western chestnut mouse (Pseudomys nanus)	7.5	0	-7.5	0.21 (0.12)	0	-100
Delicate mouse (Pseudomys delicatulus)	2.5	15	+12.5	0.04 (0.04)	0.42 (0.22)	+950
Pale field-rat (<i>Rattus tunneyi</i>)	10	0	-10	0.17 (0.08)	0	-100



Figure 5: Summarises changes in a) trap-success (number of animals trapped) and b) species richness (number of different animal species trapped) between 2000 and 2020 at 40 sites across Bathurst Island. Faint lines demonstrate changes at individual sites.

Between 2000 and 2020, we found no change in trap-success (i.e. the number of animals being trapped) or species richness (i.e. the number of different species) on Bathurst Island. This suggests that native animal populations on Bathurst remain healthy. It is very good news that we did not detect the same patterns of decline that recent research found on Melville Island. However, it is important to note that we failed to detect three species recorded in the original trapping: grassland melomys (*Melomys burtoni*), pale field rat (*Rattus tunneyi*) or western chestnut mouse (*Pseudomys nanus*). The healthy state of native animals on Bathurst Island suggests that there may not be a need for additional management actions on this island. However, it is still important we keep an eye out for future changes in animal populations.

3. Feral animals

Feral cat population density on the Tiwi Islands

To work out the best ways to protect Tiwi animals, we also needed a better understanding of feral cats on the Tiwi Islands. We identified two important bits of information that were missing from the Tiwi Islands that would help us reduce the impact of feral cats on Tiwi animals, these were 1) an understanding of how many feral cats there are out bush (feral cat density), and 2) an understanding of what areas feral cats like.

How many feral cats are there out bush?

An understanding of how many feral cats there are out bush (i.e. feral cat density) is useful because it indicates how big the problem is for native Tiwi animals that are eaten by cats. It also gives us the ability to identify changes in feral cat populations. The ability to identify changes is important because we can identify if feral cats start to increase in numbers, as well as measure the decrease in feral cat abundance in response to management actions.

In 2017 and 2018, with the help of the Tiwi Land Rangers, we conducted surveys of feral cats at four locations on the Tiwi Islands: Cape Fourcroy, Ranku, Pickertaramoor and Cache Point (Figure 1). At each of these four locations we set up 70 camera-traps, spaced 500 m apart. These cameras were left in the bush for eight weeks, taking photos of animals when they walked past.



Figure 6: The location of the four grids of camera-traps deployed to estimate the density of feral cats on the Tiwi Islands. The MODIS satellite-derived fire frequency across the Tiwi Islands (number of times burnt in the 17-year period 2000–2016, inclusive).

We identified individual feral cats based on their unique coat patterns (Figure 7). We recorded 26 detections of 10 individual cats on Melville Island, but did not detect any cats on Bathurst Island. Overall, the rate of feral cat detection was very low. From a total of 17,360 camera-trap nights, feral cats were detected at a rate of only 1 cat detection per 667 camera-trap nights. Of these cat detections on Melville Island, 21 (81%) were recorded on the Pickertaramoor grid, with the remaining five (19%) recorded at Cache Point (Table 3). Of the 21 cat detections at Pickertaramoor, there was a total of 18 detections of seven individually identifiable cats. Of the cat detections at Cache Point, there were three individually identifiable cats that were each only recorded once.

We estimated feral cat density on Melville Island to be 0.15 cats km⁻², or one cat every 6–7 km². We were unable to estimate feral cat density on Bathurst Island because we did not detect any. However, it is an important result that we did not detect any feral cats on Bathurst Island, which suggests feral cat density is very low on this island. The conclusion that feral cat density is very low on Bathurst Island is supported by recent island wide surveys, which also failed to detect a single feral cat. By increasing our understanding of feral cat density on the Tiwi Islands, we can now make better decisions about where to apply management actions. For example, management aimed at reducing the impact of cats on Tiwi animals might be more important on Melville Island (compared to Bathurst Island).



Figure 7: Individual feral cats were identified from their unique coat patterns. The difference in the dark rings on the tail of the above feral cats tells us that these are two different individuals.

Table 3: A summary of the camera-trap survey data recorded at each of the four grids across the Tiwi Islands. Dashes indicate where grids are located outside of the current range of a particular feral species.

	Pickertaramoor	Cache Point	Ranku	Cape Fourcroy
Island	Melville	Melville	Bathurst	Bathurst
Fire frequency	High	Low	High	Low
Other feral animals detected	Horse, buffalo	Buffalo	Pig	Pig
Feral herbivore nightly detections	214 (134 buffalo, 80 horse)	156 (all buffalo)	-	-
Dingo nightly detections	51	25	36	12
Pig nightly detections	-	-	1	23
Number of cameras	70	70	70	70
Survey duration (days)	62	61	61	64
Number of cat detections	21	5	0	0
Number of identifiable cat detections	18	3	0	0
Number of unidentifiable cat detections	3	2	0	0
Number of identifiable cats	7	3	0	0



What areas do feral cats like?

Surveys conducted across Melville Island in 2015 recorded feral cats at 26 out of 88 sites. Most of these feral cat detections were recorded through the middle of the island. We analysed this data to work out what areas feral cats like to live. We did this because if we understand why feral cats are in some areas and not others, we might be able to manage country in a way that disadvantages feral cats. This might help protect Tiwi animals.

We found that feral cat activity and abundance on Melville Island was higher in areas that had experienced lots of hot/ severe fires and lots of feral herbivores (buffalo and horse) (Figures 8 and 9). This suggests that frequent hot/severe fires and feral herbivores (buffalo and horse) can change the country in a way that helps feral cats. This is probably because hot fires and feral herbivores open up the country by reducing the grass cover and shrub layer, making it easier for feral cats to hunt. Importantly, hot fires and feral herbivores can both be effectively managed. When it comes to reducing the impact of feral cats, managing fire and feral herbivores might be a more effective approach than trying to manage cats directly (by shooting, trapping, toxic baiting) which can be very difficult and expensive.



Figure 8: Relationship between feral cat activity and a) the frequency of severe fires and b) herbivore activity.



Figure 9: Relationship between feral cat abundance and a) the frequency of severe fires and b) herbivore activity.

4. Summary

Compared to most other areas in Australia, the Tiwi Islands remain a very special place for native animals. However, there is evidence to suggest that animals on Melville Island are starting to disappear. If this continues, Tiwi animals could be lost forever. It is clear that more needs to be done to help protect Tiwi animals. Our research (outlined above) has increased our understanding of both native and feral animals on the Tiwi Islands. This new information will help make better management decisions to help protect animals on the Tiwi Islands.

Fire management

Fire management on the Tiwi Islands currently involves the island-wide application of low-intensity prescribed fire in the early dry season (i.e. before July 31st). Importantly, this fire management reduces the occurrence of hot fires which are very bad for country. This approach to fire management is applied across Bathurst Island where our research has shown Tiwi animals have remained healthy. This may indicate that fire management is enough to keep animals healthy on Bathurst. However, this may only be the case due to the absence of feral herbivores (buffalo and horse) and low density of feral cats on Bathurst Island. While this approach to fire management remains a critically important land management tool that will help protect Tiwi animals, due to the extra threats on Melville Island, extra management actions may be required (see below). It is also important that we keep an eye on Bathurst Island animals to make sure they stay healthy. Ongoing monitoring will let us know if extra management actions may be required in the future.

Fire management with feral herbivore control

Low intensity fire management remains a critical land management tool across the Tiwi Islands. On Bathurst Island this might be enough to keep Tiwi animals healthy. However, on Melville Island, extra management might be needed. In some areas of northern Australia, low intensity fire management has only been effective at protecting native animals when feral herbivores (buffalo and horse) have also been managed. This might also be the case on Melville Island. Our research suggests that reducing the number of buffalo and horse on Melville Island, and avoiding hot fires, could help protect Tiwi animals by reducing the impact of feral cats. Importantly, this would also improve habitat quality and keep country healthy. Feral herbivores such as buffalo are an important food source for Tiwi people. Plans to manage feral herbivores should be developed in close collaboration with Tiwi traditional owners. Potentially, feral herbivores control could be targeted towards specific areas.

Feral cat management

The direct control of feral cats (by shooting, trapping or toxic baits) can be difficult and expensive. Our research suggests that the impact of feral cats might be reduced by managing fire and feral herbivores, and this may currently be our best option for reducing the impact of feral cats on the Tiwi Islands. Currently, feral cats do not appear to be too much of a problem on Bathurst Island but we should keep an eye on feral cat populations on Bathurst Island to make sure they aren't increasing in numbers.

While feral cats are difficult to control, there are achievable actions that can be implemented in Tiwi Island communities to reduce the impact of feral cats. Stronger pet cat ownership rules and regulations could include: restricting the ability of residents to keep cats as pets, requiring pet cats to be de-sexed, and requiring pet cats to be kept indoors (i.e. restricted from roaming). This may be particularly important on Bathurst Island, where feral cats occur at very low densities, yet pet cats are kept in the main community of Wurrumiyanga. The enforcement of pet ownership rules and regulations should be preceded with community awareness campaigns to inform people of the risks that pet cats can pose to native Tiwi wildlife.

5. Conclusion

Our research has increased our understanding of both native and feral animals on the Tiwi Islands. This new information will help us make better management decisions on the Tiwi Islands. On Bathurst Island, given the health of native mammal populations, the absence of feral herbivores and the low density of feral cats, the current application of low-intensity prescribed fire management may be enough to protect Tiwi animals. On Melville Island, the management of both fire and feral herbivores could help reduce the impact of feral cats while improving habitat quality. This approach to management should be coupled with ongoing monitoring to keep an eye important Tiwi species. We hope this research will help protect Tiwi animals for future generations.



Colin Kerinaiua and Georgina Neave measuring tree diameter. Image: Hugh Davies



Further information: http://www.nespthreatenedspecies.edu.au

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