

Small mammal declines in the Top End: Feral cats, dingoes, feral herbivores and habitat complexity

Science summary

Alyson Stobo-Wilson (Charles Darwin University) & Graeme Gillespie (NT Department of Environment, Parks and Water Security)

Summary of:

- Stobo-Wilson, A.M., Stokeld, D., Einoder, L.D., Davies, H.F., Fisher, A., Hill, B.M., Mahney, T., Murphy, B.P., Stevens, A., Woinarski, J.C.Z., Bawinanga Rangers, Warddeken Rangers, & Gillespie, G.R. 2020. Habitat structural complexity explains patterns of feral cat and dingo occurrence in monsoonal Australia. *Diversity and Distributions* 26, 832–842. <https://doi.org/10.1111/ddi.13065>
- Stobo-Wilson, A.M., Stokeld, D., Einoder, L.D., Davies, H.F., Fisher, A., Hill, B.M., Mahney, T., Murphy, B.P., Scroggie, M.P., Stevens, A., Woinarski, J.C.Z., Bawinanga Rangers, Warddeken Rangers, and Gillespie, G.R. 2020. Bottom-up and top-down processes influence contemporary patterns of mammal species richness in Australia's monsoonal tropics. *Biological Conservation* 247, 108638. <https://doi.org/10.1016/j.biocon.2020.108638>



Dr Stobo-Wilson with a northern savanna glider during fauna surveys. Photo: Alyson Stobo-Wilson.

Protecting and restoring habitat key to protecting mammals

In recent decades, there have been major declines of once common small- and medium-sized mammals in northern Australia. Likely causes include frequent hot fires, feral cats, cane toads, and habitat degradation caused by weeds and feral livestock (e.g. buffalo, horse, donkey and cattle). Yet it was unclear which of these factors poses the greatest threat, and how and where to target management efforts.

We used camera-trapping and live-trapping survey data from over 300 sites across northern Australia's 'Top End' to identify where small mammals are persisting, and to better understand causes of decline.

We found that most parts of the Top End have very few native mammals left. Offshore islands and coastal regions with higher rainfall and intact habitat (with dense, complex understorey vegetation) now support the greatest number of threatened small mammals.

We recorded fewer mammals at sites with more feral livestock, feral cats and dingoes. The presence of both feral cats and dingoes did not vary with native mammal numbers, but rather with habitat type. Both predators were more likely to be found in areas where it is likely easier for them to hunt. Feral cats preferred open areas with simple vegetation, while dingoes preferred areas with less rugged terrain.

Our results suggest that an effective way to conserve small and medium-sized mammals in the Top End will be to protect and restore their habitat quality. Controlling feral livestock and improving fire regimes are the key ways to achieve this and will likely be more effective in halting the decline of small mammals than focusing on the more difficult challenge of controlling cats.

Research aims

The aim of our research was to increase our understanding of the relative role of feral cats, dingoes, feral livestock, land clearing, fire frequency and size, habitat productivity, and ruggedness of the terrain on the current distribution and persistence of small- and medium-sized mammals in northern Australia.

We also investigated where feral cats and dingoes are found throughout the landscape and which environmental factors best explain why they are found there.

Overgrazing and frequent, hot fires have reduced habitat complexity

There is evidence that the decline in the numbers of small- and medium- sized mammals (less than 5 kg) has been greater in the lower-rainfall areas of the Top End. Areas of higher rainfall that support more plant growth (known as productive landscapes) tend to have a greater number of plant species and thicker groundcover and shrub layers, which creates complex habitat.

Complex habitat provides more places for small mammals to shelter from predators and a greater abundance of food. This suggests that mammal species are more likely to persist in productive northern Australian landscapes that contain more complex habitat.

However, increases in the frequency and severity of fire, and overgrazing by cattle and feral livestock have greatly reduced habitat complexity across northern Australia since the arrival of Europeans. Frequent, hot fires remove ground cover and reduce the shrub layer. Lower-rainfall areas, which already had a more open and simple habitat structure, have been especially affected by these changes in fire. Heavy grazing by cattle and feral livestock further removes the grassy understorey.



A feral cat recorded by a camera at one of the study sites in the Top End of the Northern Territory. Photo: Northern Territory Government.

These disturbances remove food sources and shelter for small- to medium-sized mammals and make them more vulnerable to predators like feral cats and dingoes.

Research has shown that feral cats tend to favour areas with an open understorey, and they have been recorded choosing to hunt in recently burnt areas, most likely because they can hunt more efficiently there. Yet, an unresolved question has been whether Top End mammal declines have been caused by the degradation of habitat itself, or the increase in predation by feral cats after habitat was lost. This lack of clarity was partly because we did not know whether the numbers of feral cats differed between areas with higher and lower rainfall, or between areas with more complex and less complex habitat.

While evidence is mixed, many ecologists have argued that dingoes, as the ‘top predator’ in many Australian ecosystems, limit numbers of feral cats and thereby reduce the impact of cats on wildlife. Dingoes also eat small- and medium-sized mammals, yet little consideration has been given to their impact on wildlife in northern Australia. A better understanding of where both of these predators are found in Top End landscapes will help determine the reasons for the declines of small- to medium-sized native mammals.

The Top End was surveyed for native and feral mammals, habitat, and fire history

We used motion-activated cameras (camera traps) and cage traps to survey 312 sites across 370,000 km² of the Northern Territory’s Top End. Surveys took place between August 2013 and June 2016. The sites covered all major vegetation types (except floodplains) and a range of land tenures, including national parks (Kakadu, Litchfield, Nitmiluk, Garig Gunak Barlu and Judbarra/Gregory), Indigenous Protected Areas (Groote Eylandt, Wardaman, Warddeken and Djelk), privately owned conservation reserves (Fish River Station) and Indigenous freehold land (Melville Island and Bathurst Island, known as the Tiwi Islands). No targeted management of feral cats or dingoes has taken place in the vicinity of our survey sites.

The surveys ran for more than 85,000 camera-trap nights and collected almost 30,000 images of mammals. This extremely large dataset was analysed to investigate where feral cats and dingoes were found, and to understand how the presence of dingoes influenced the presence of feral cats. We used this information to identify the locations with the greatest number of mammal species, and which environmental factors best explained the reasons why more mammal species were persisting in certain locations and not others.

Key findings

Feral cats preferred open, simple habitat while dingoes were found in flat, lowland areas

Two key results emerged from our research. First, we found that the presence of feral cats and dingoes is strongly influenced by how dense and complex the habitat is.

Feral cats avoid higher rainfall areas with denser and more complex vegetation – unless those areas have experienced frequent and large fires which tend to reduce habitat complexity.

Dingoes avoid rugged terrain and are found more often in flat, lowland woodlands.

Our findings add to the growing body of evidence that, in northern Australia, feral cats are more likely to use open and disturbed habitats, which are typically caused by frequent, hot fires and feral livestock.

Second, we found no evidence that feral cats avoid dingoes in the landscape. The presence or absence of dingoes in an area did not change how likely we were to detect feral cats.

Feral livestock, feral cat and dingoes all impacted negatively on small mammals

As the numbers of feral livestock, feral cats and dingoes increased, the number of small- and

medium-sized native mammal species declined. Additionally, we found that those species that have declined most substantially (e.g. the black-footed tree-rat and brush-tailed rabbit-rat) are now mostly restricted to more productive areas with complex habitat and few cats.

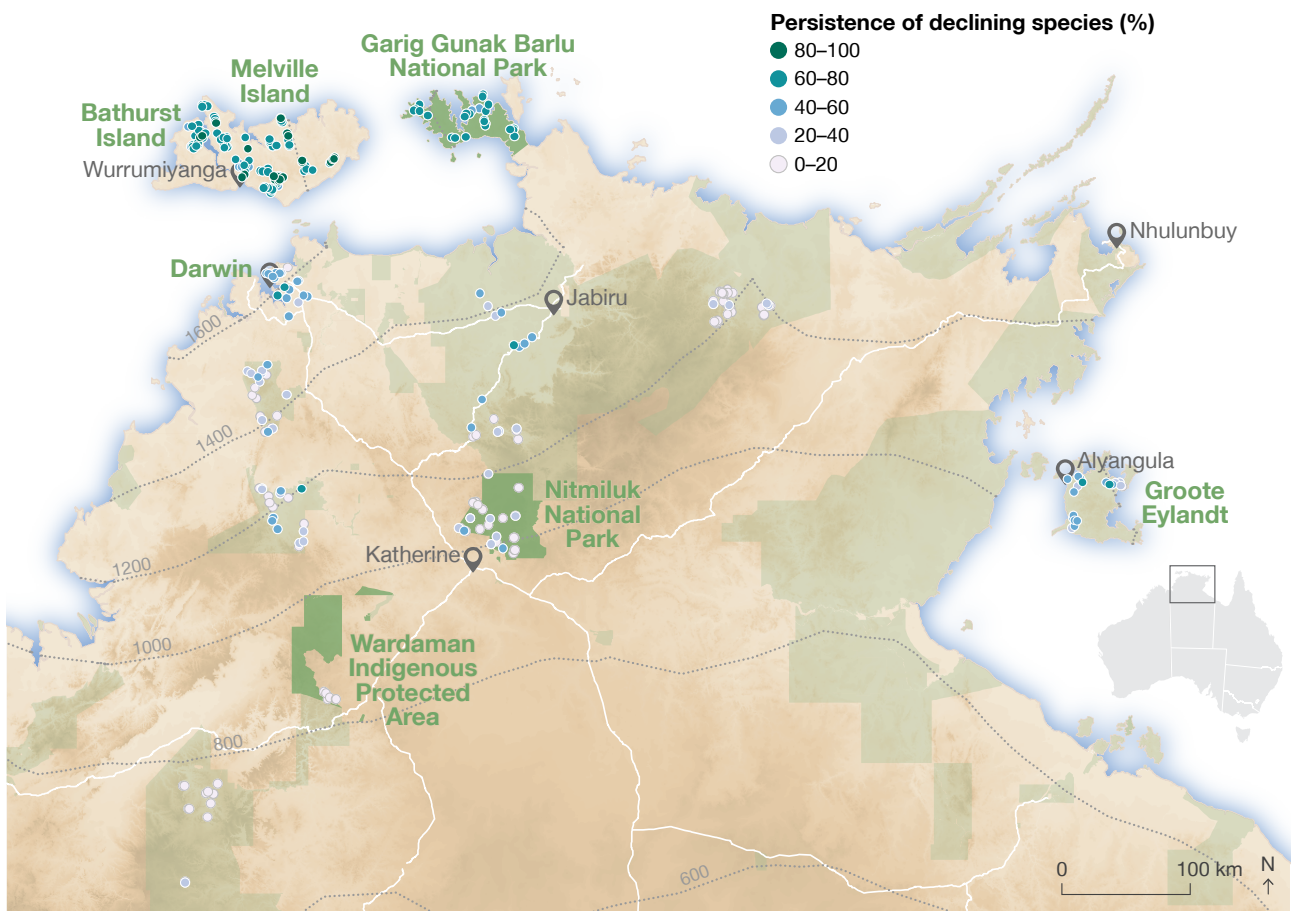
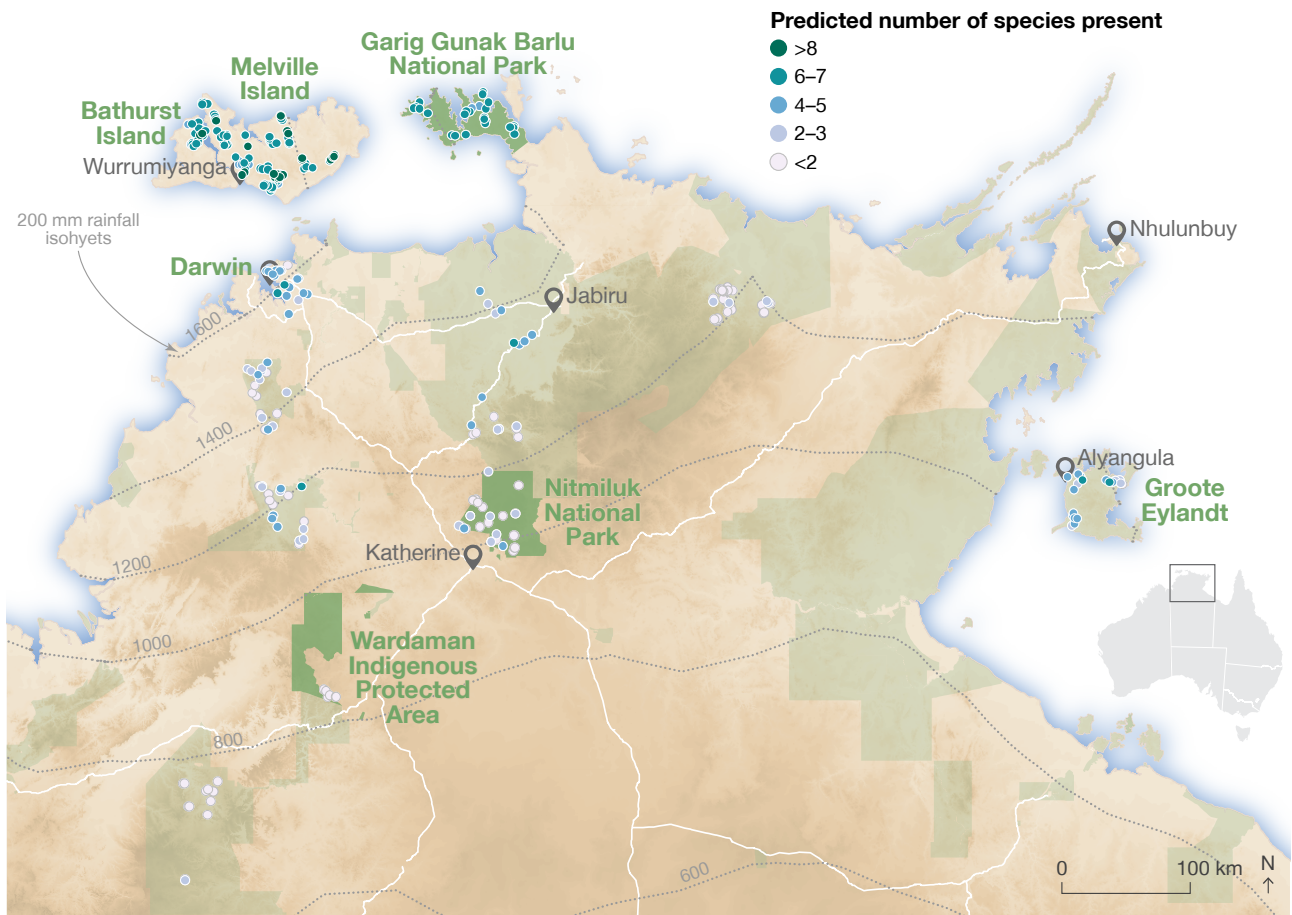
Our results show that the loss of complex and productive habitat caused by the over-grazing of feral livestock and by frequent and large fires has been a major contributor to mammal declines in northern Australia. These disturbances create landscapes with a simple habitat structure, typically with a lower variety of plants, which provide less food and shelter for native mammals and benefit the hunting activities of dingoes and feral cats.

Offshore islands are critical refuges

We found that large offshore islands (i.e. the Tiwi Islands and Groote Eylandt) are critical refuges for northern Australia's mammals, as these areas contain complex and productive habitat and low numbers of feral cats and dingoes. These islands are essential to the protection of northern Australia's native mammals. Reducing the number of feral livestock and improving fire management on these islands is a management priority to save our mammals.



Female dingo and pup recorded by a camera at one of the study sites in the Top End of the Northern Territory. Photo: Northern Territory Government.



Top: Predicted small mammal species richness at the study sites across monsoonal Australia. Bottom: Percentage of small mammal species per site categorised as regionally declining (considered an indicator of persistence), taken from total mammal species richness estimates at each site.¹

Improve habitat by managing fire and feral livestock

These findings significantly improve our understanding of where feral cats and dingoes are found across Top End landscapes. Greater hunting success by dingoes and cats in disturbed areas with simplified habitat, rather than the amount of prey, may be the most important explanation for where feral cats or dingoes are found.

Improving habitat quality by managing fire and feral livestock will probably be more successful in halting small mammal declines than attempts to reduce predation by removing and/or controlling feral cats and dingoes.

We identified a number of sites in the Top End that support a high number of mammal species



A low-intensity early dry-season burn in tropical savanna. Photo: Jaana Dielenberg.



Feral horses in Kakadu National Park. Photo: Jaana Dielenberg.

and therefore provide a useful starting point for mammal conservation. Identified mainland sites include:

- Garig Gunak Barlu National Park
- Darwin rural region
- Nitmiluk National Park
- Wardaman Indigenous Protected Area

Additional sites located on islands that also support a high numbers of mammal species were:

- Bathurst Island
- Melville Island
- Groote Eylandt

Mammal conservation in these mammal 'hotspots' would especially benefit from management activities that reduce the frequency of fires and reduce populations of feral livestock. Across northern Australia we recommend that managers focus their efforts on both local and landscape-scale activities that improve fire management and control feral livestock, with the aim of maintaining complex and productive habitat. These management activities on the mainland are needed to ensure the survival of small mammal species in sites outside the large refuges provided by the Tiwi Islands and Groote Eylandt.

1. Reprinted from *Biological Conservation* 247, Stobo-Wilson, A.M., Stokeld, D., Einoder, L.D., Davies, H.F., Fisher, A., Hill, B.M., Mahney, T., Murphy, B.P., Scroggie, M.P., Stevens, A., Woinarski, J.C.Z., Bawinanga Rangers, Warddeken Rangers, and Gillespie, G.R., Bottom-up and top-down processes influence contemporary patterns of mammal species richness in Australia's monsoonal tropics, 108638. Copyright (2020), with permission from Elsevier.

Related information

Dr Graeme Gillespie of the Northern Territory Department of Environment, Parks and Water Security leads this project about causes of decline of small- and medium-sized mammals.

The project page can be found on the Hub website.

Contact Dr Stobo-Wilson at alyson.stobo-wilson@csiro.au



National Environmental Science Programme

nespnorthern.edu.au

nesp.northern@cdu.edu.au



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