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Wildlife Research

Supplementary Material

The intact and the imperilled: contrasting mammal population trajectories between two large adjacent islands

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Supplementary Table S1. Summary of factors potentially influencing feral cat abundance on the Tiwi Islands. The inter-island differences are quantified for each factor, and an explanation of the mechanism is provided.

Factors influencing cat abundance	**Melville Island**	**Bathurst Island**	**Explanation and citations**
Fire	Mean proportion of island burnt (each year), 2000–2021: 41% (85% in the late dry season) (Darwin Centre for Bushfire Research 2023)	Mean proportion of island burnt (each year), 2000–2021: 32% (75% in the late dry season) (Darwin Centre for Bushfire Research 2023)	Feral cats prefer to hunt in burnt areas, especially when those areas have high densities of prey (McGregor et al. 2014; McGregor et al. 2016*a*). Cats can also make expeditions outside their normal home range (up to 30km) to hunt in intensely burnt areas (McGregor et al. 2016*b*), where they are more successful due to vegetation removal from fire (McGregor et al. 2015; Leahy et al. 2015). These processes could work to increase cat densities locally at a fire scar level or also increase the overall abundance of cats in the landscape due to increased predation efficacy for individuals.
Exotic megaherbivores (Buffalo and horse)	High abundance Buffalo naïve site occupancy: 60% Buffalo mean relative activity index*: 1.69 ±0.26 SE Horse naïve site occupancy: 33% Horse mean relative activity index*: 0.89 ±0.28 SE	Absent	Exotic megaherbivores consume and trample biomass and can profoundly affect the structure and density of ground-level vegetation. Often, grazing impacts can be concentrated. For example, megaherbivores will selectively graze regenerating grasses after fire and, which may prolong the low and more open vegetative state after fire (Legge *et al*. 2019). In the Kimberley region of northwestern Australia feral cats prefer to hunt in heavily grazed or heavily burnt areas, especially when those areas have high prey densities (McGregor *et al*. 2014). Cat hunting success is higher in a habitat that is open and clear compared to when the ground layer is dense (McGregor *et al*. 2015). The impacts of exotic megaherbivores and the response of feral cats to these impacts has largely been focussed in areas with high abundances of cattle, like in the Kimberley. There is limited information in areas where only buffalo and horses occur. However, work on Melville Island revealed higher feral cat activity in areas with high buffalo density and frequent fire (Davies *et al*. 2020). Therefore, we speculate that the high abundance of buffalo (and to a lesser extent horses) on Melville Island could be facilitating cats in similar ways to what is described for cattle in the Kimberley. The impacts of buffalo grazing are not only constrained to floodplains. Decreased total ground layer vegetation and shifts to higher annual grass coverage were reported in the savanna woodlands of Kakadu National Park (Petty *et al*. 2007).

	Game trail density: high	Game trail density: very low/absent	Exotic megaherbivores also trample vegetation and create large networks of game trails, which could act like roads to facilitate movement and predation by feral cats (and dingoes). Recent work on Melville Island has revealed that cats and dingoes selectively use game trails compared to nearby undisturbed vegetation (G. Neave, unpublished data). Whether or not the presence of game trails significantly increases the movement and predation efficiency enough to increase cat abundance is largely unknown.
Land use change	Land cleared for township and infrastructure: 1.4% Land cleared or modified for forestry plantation: 5%	Land cleared for township and infrastructure: 1.9% Land cleared or modified for forestry plantation: 0%	Medium-sized generalist carnivores (i.e. feral cats) are shown to be well adapted to capitalise on human-modified landscapes where food and shelter resources can be higher than in intact natural landscapes. Increased abundances in modified landscapes have been reported for invasive predators in Australia (Graham *et al*. 2012). These human modified habitats could be acting as a source for cats into surrounding intact landscapes.
Anthropogenic linear features - roads	0.36 km per km^2	0.24 km per km^2	Linear features such as roads can act as movement pathways for predators allowing them to move faster and further (energy efficiency) or improve access to structurally complex habitats (prey refuges) and increase their hunting success (Dickie *et al*. 2017). In Australia, invasive mesopredators (foxes and cats) and dingoes have been shown to preferentially use linear features like roads and cleared seismic lines (May and Norton 1996; Wysong *et al*. 2020). Again, whether or not these anthropogenic features significantly increase movement and predation efficiency enough to increase cat abundance is largely unknown in Australia.
Native predators: Dingo Other species (raptors, pythons and goannas)	High Naïve site occupancy: 51% Mean relative activity index: 0.66 ±0.11 SE Widespread and abundant	Medium Naïve site occupancy: 23% Mean relative activity index: 0.21 ±0.07 SE Widespread and abundant	Dingoes could regulate cat populations through their role as top-order predators by predating directly on cats (Moseby *et al*. 2012) or competing for prey with cats. Evidence of a negative dingo-cat interaction has been reported in tropical savannas (Kennedy *et al*. 2012). However, across Australia the relationship between dingoes and cats is inconsistent and context-dependent. Whether or not negative dingo-cat interactions contribute to larger-scale effects on cat populations or cat impacts on native prey populations remains largely unknown. Other native predator species (raptors, pythons and goannas) may suppress cat populations through predation on kittens.

Anthropogenic resources subsidy	Human population: ~800 ~255 households (Australian Bureau of Statistics, 2021c) Number of rubbish dumps: 6	Human population: ~1500 ~442 households (Australian Bureau of Statistics, 2021c) Number of rubbish dumps: 2	Cats (feral, stray and owned) have been shown to exploit abundant food resources such as rubbish dumps associated with towns, mining camps, resorts etc. (Hutchings 2003). They can reach high densities in localised areas when supported by such food resources (Denny *et al*. 2002; Denny 2005). This situation could provide cat population sources for invasion into the broader natural landscape.
Pet cat ownership	Lower total pet cat population 2021/2022 community pet cat census results: 8 cat owning households, with 1.6 cats per household (not all households surveyed) (AMRRIC and TNRM, unpublished data). Sporadic desexing programs (1-2 times max per year).	Higher total pet cat population - increased in last 10-15 years (Kennedy *et al*. 2018). 2017 community pet cat census results: ranged from 41 – 83 cats in a year (Kennedy *et al*. 2018). 2022 community cat census: 41 households containing cats, with a density of 1.9 cats per household (not all households surveyed) (AMRRIC and TNRM, unpublished data). Sporadic desexing programs (1-2 times max per year).	Australian remote Aboriginal communities commonly have large, free-roaming dog populations and relatively small cat populations. However, free-roaming cats are becoming increasingly popular pets in some communities (Kennedy *et al*. 2018) – and rates of desexing/neutering are sometimes low due to access to veterinary services. Free-ranging pet cats can become stray and contribute to increasing feral cat populations in the broader landscape. Pet cat ownership has generally increased across both Tiwi Islands in the last two decades. However, more pet cats reside on Bathurst Island due to its higher human population.

* Mean relative activity index was calculated as the number of independent detections (defined as at least a 30-minute time interval between successive camera triggers of the same species on any of the five cameras at a site) divided by the number of camera trap nights, and multiplied by 100.

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Supplementary Table S2. Summary of the changes in native mammal populations on Melville Island between 2000–2002 and 2021.

MELVILLE ISLAND							
Species	**Camera trapping naïve occupancy 2020–2021 (%)**	**Live trapping naïve occupancy 2000–2002 (%)**	**Live trapping naïve occupancy 2020–2021 (%)**	**Change in live trapping naïve occupancy (%)**	**Trap success 2000–2002 (%) (±SE)**	**Trap success 2020–2021 (%) (±SE)**	**Change in trap success (%)**
Northern brown bandicoot (*Isoodon macrourus*)	86.6	50.7	17.4	–66	1.17 (0.171)	0.322 (0.096)	–72***
Northern brushtail possum (*Trichosurus vulpecula arnhemensis*)	97.0	26.1	26.1	0	0.745 (0.191)	0.543 (0.126)	–27 *ns*
Black-footed tree-rat (*Mesembriomys gouldii melvillensis*)	71.6	44.9	26.1	–42	0.785 (0.120)	0.604 (0.156)	–23 *ns*
Brush-tailed rabbit-rat (*Conilurus penicillatus melibius*)	17.9	18.8	3.0	–84	0.584 (0.178)	0.040 (0.028)	–93**
Grassland melomys (*Melomys burtoni*)	1.5	4.3	1.5	–65	0.201 (0.123)	0.020 (0.020)	–90 *ns*
Delicate mouse (*Pseudomys delicatulus*)	43.3	5.8	2.9	–50	0.080 (0.039)	0.040 (0.028)	–50 *ns*
Pale field-rat (*Rattus tunneyi*)	10.5	4.3	5.8	+35	0.080 (0.048)	0.181 (0.099)	+126 *ns*
Western chestnut mouse (*Pseudomys nanus*)	0	0	1.5	-	0	0.020 (0.020)	-

Butler's dunnart (*Sminthopsis butleri*)	NA	1.5	1.5	0	0.020 (0.020)	0.040 (0.040)	+100 *ns*
Red-cheeked dunnart (*Sminthopsis virginiae*)	NA	1.5	0	–100	0.060 (0.060)	0	–100 *ns*
Dunnart spp. (*Sminthopsis spp.)*	37.3	3.0	1.5	–50	0.080 (0.063)	0.040 (0.040)	–50 *ns*
Northern brush-tailed phascogale (*Phascogale pirata*)	3.0	3.0	0	–100	0.040 (0.028)	0	–100 *ns*

Naïve occupancy was calculated as the percentage of the camera trapping (n = 67) and live trapping (n = 69) sites where a species was detected. *ns* = not significant, * = p < 0.05, ** = p < 0.005, *** = p < 0.001. Decreases denoted by –, increases denoted by +. Species in bold indicate a body size outside the critical weight range. Dashes indicate species for which a proportional change could not be calculated. NA indicates species that could not be reliably identified to species level from camera trap images.

Supplementary Table S3. Summary of the changes in native mammal populations on Bathurst Island between 2001 and 2020.

BATHURST ISLAND							
Species	**Camera trapping naïve occupancy 2020–2021 (%)**	**Live trapping naïve occupancy 2001 (%)**	**Live trapping naïve occupancy 2020–2021 (%)**	**Change in live trapping naïve occupancy (%)**	**Trap success 2001 (%) (±SE)**	**Trap success 2020–2021 (%) (±SE)**	**Change in trap success (%)**
Northern brown bandicoot (*Isoodon macrourus*)	100	60.0	42.5	–29	1.53 (0.262)	1.04 (0.237)	–32 *ns*
Northern brushtail possum (*Trichosurus vulpecula arnhemensis*)	100	45.0	82.5	+83	1.18 (0.364)	3.58 (0.442)	+203***
Black-footed tree-rat (*Mesembriomys gouldii melvillensis*)	-	-	-	-	-	-	-
Brush-tailed rabbit-rat (*Conilurus penicillatus melibius*)	50.0	7.5	10.0	+33	0.208 (0.127)	0.243 (0.148)	+17 *ns*
Grassland melomys (*Melomys burtoni*)	2.4	15.0	0	–100	0.729 (0.404)	0	–100*
Delicate mouse (*Pseudomys delicatulus*)	64.3	0	15.0	-	0	0.347 (0.184)	-
Pale field-rat (*Rattus tunneyi*)	26.2	10.0	0	–100	0.139 (0.067)	0	–100 *ns*
Western chestnut mouse (*Pseudomys nanus*)	2.4	10.0	0	–100	0.174 (0.088)	0	–100 *ns*
Butler's dunnart (*Sminthopsis butleri*)	NA	0	0	-	0	0	-

Red-cheeked dunnart (*Sminthopsis virginiae*)	NA	0	0	-	0	0	-
Dunnart spp. (*Sminthopsis spp.)*	69.0	0	0	-	0	0	-
Northern brush-tailed phascogale (*Phascogale pirata*)	0	0	0	-	0	0	-

Naïve occupancy was calculated as the percentage of the camera trapping (n = 42) and live trapping (n = 40) sites where a species was detected. *ns* = not significant, * = p < 0.05, ** = p < 0.005, *** = p < 0.001. Decreases denoted by –, increases denoted by +. Species in bold indicate a body size outside the critical weight range. Dashes indicate species for which a proportional change could not be calculated. NA indicates species that could not be reliably identified to species level from camera trap images.