Ectomycorrhizal fungi diversity associated with small mammals in response to urbanisation

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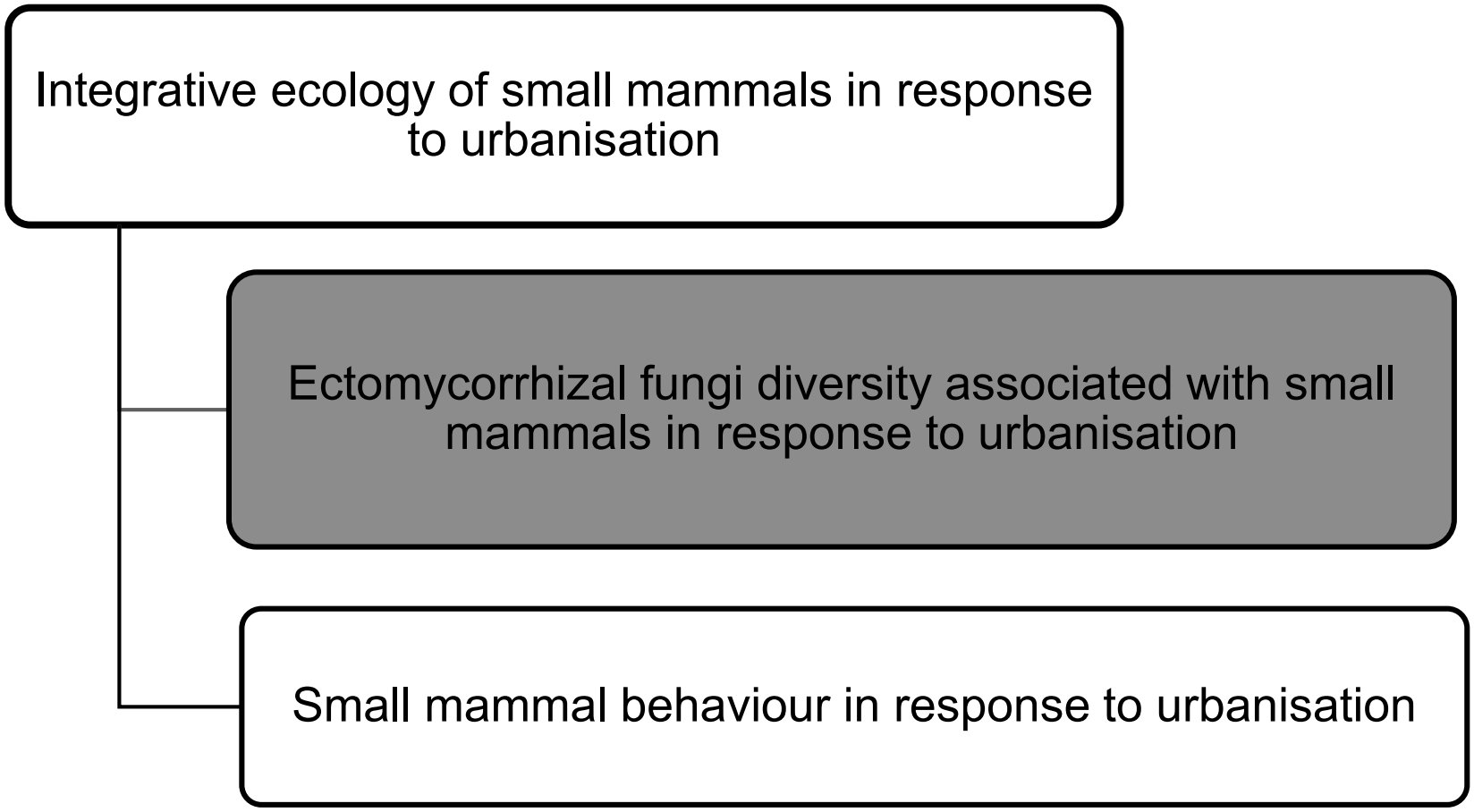
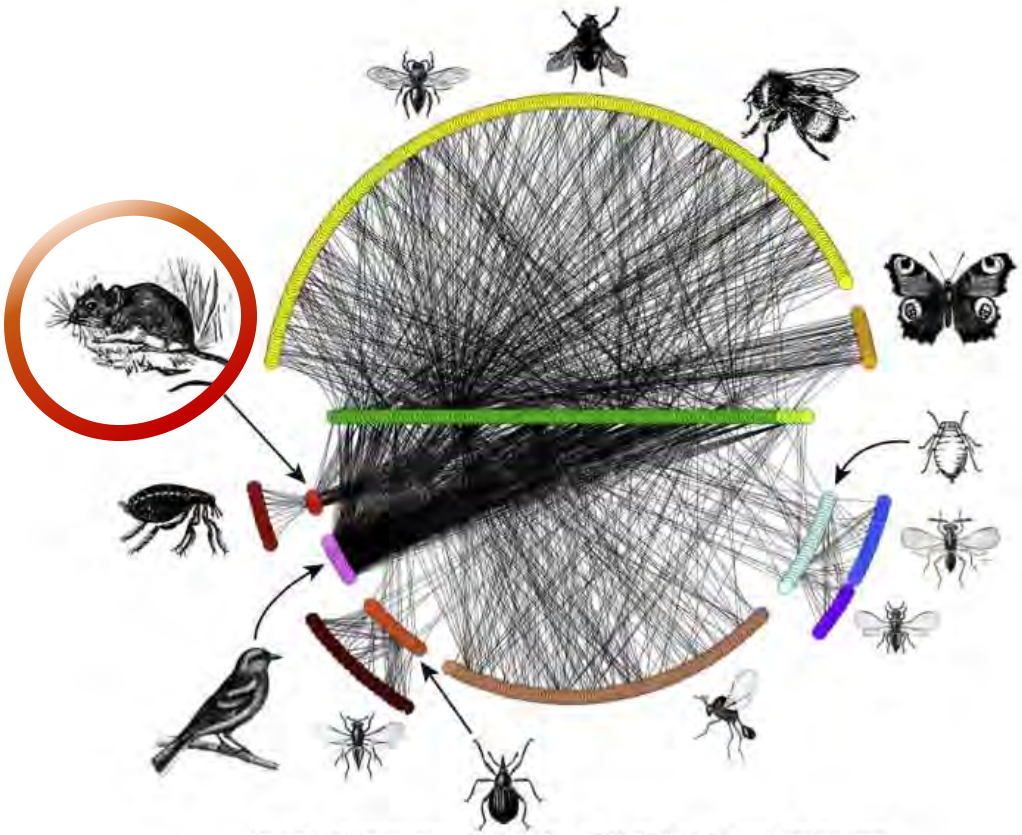
Overview


Integrative ecology of small mammals in response to urbanisation
Ectomycorrhizal fungi diversity associated with small mammals in response to urbanisation
Small mammal behaviour in response to urbanisation

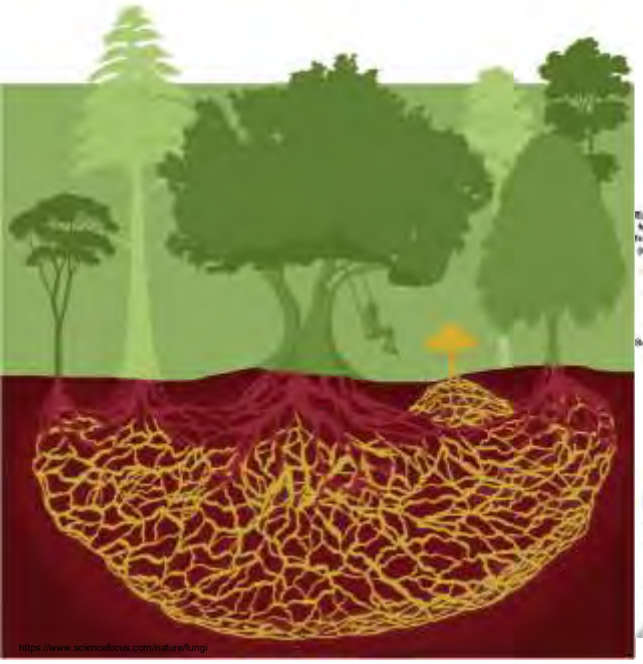
We are all interacting!

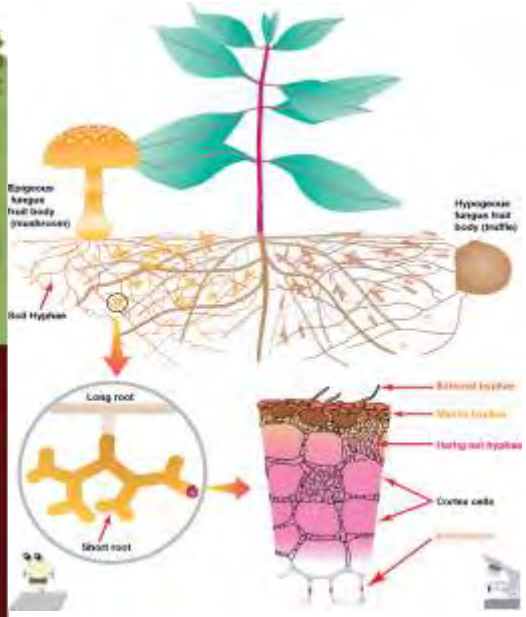


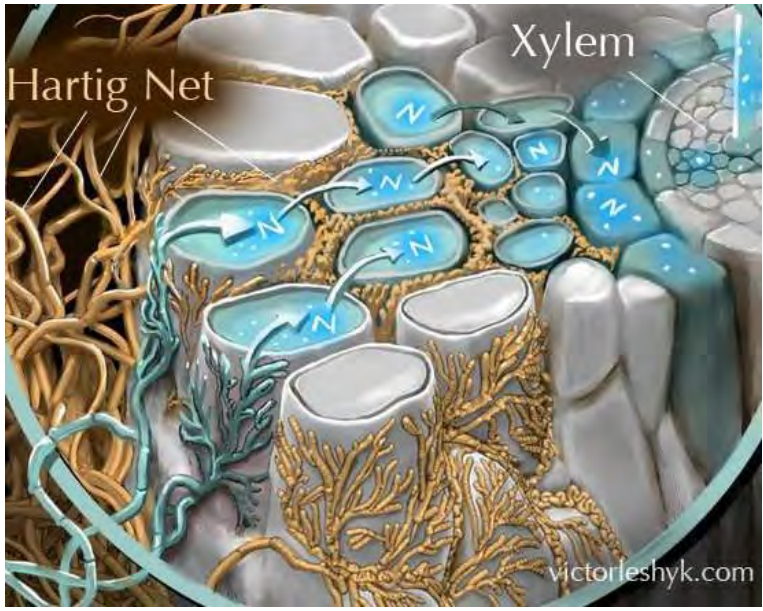
Credit: Quintessence Network DOI: 10.1016/j.tree.2015.12.003

An outstanding set of interactions

- 90% of plants depend on mycorrhizal fungi
- Ectomycorrhizal fungi (EMF) are associated with woody plants
- EMF diversity is considered a strong indicator of forest health.

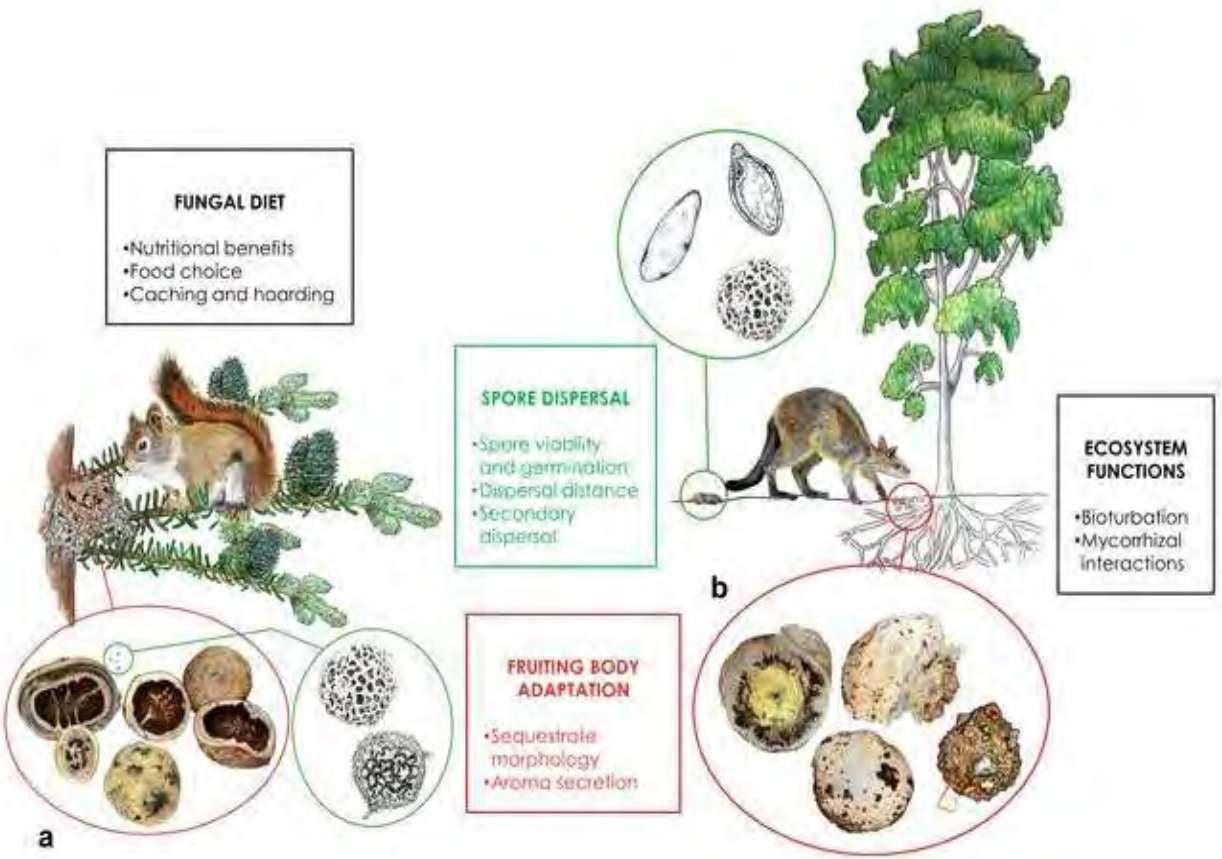






An outstanding set of interaction

- Small mammals are well-known fungivores
- Small mammals help in the dispersal of EMF spores



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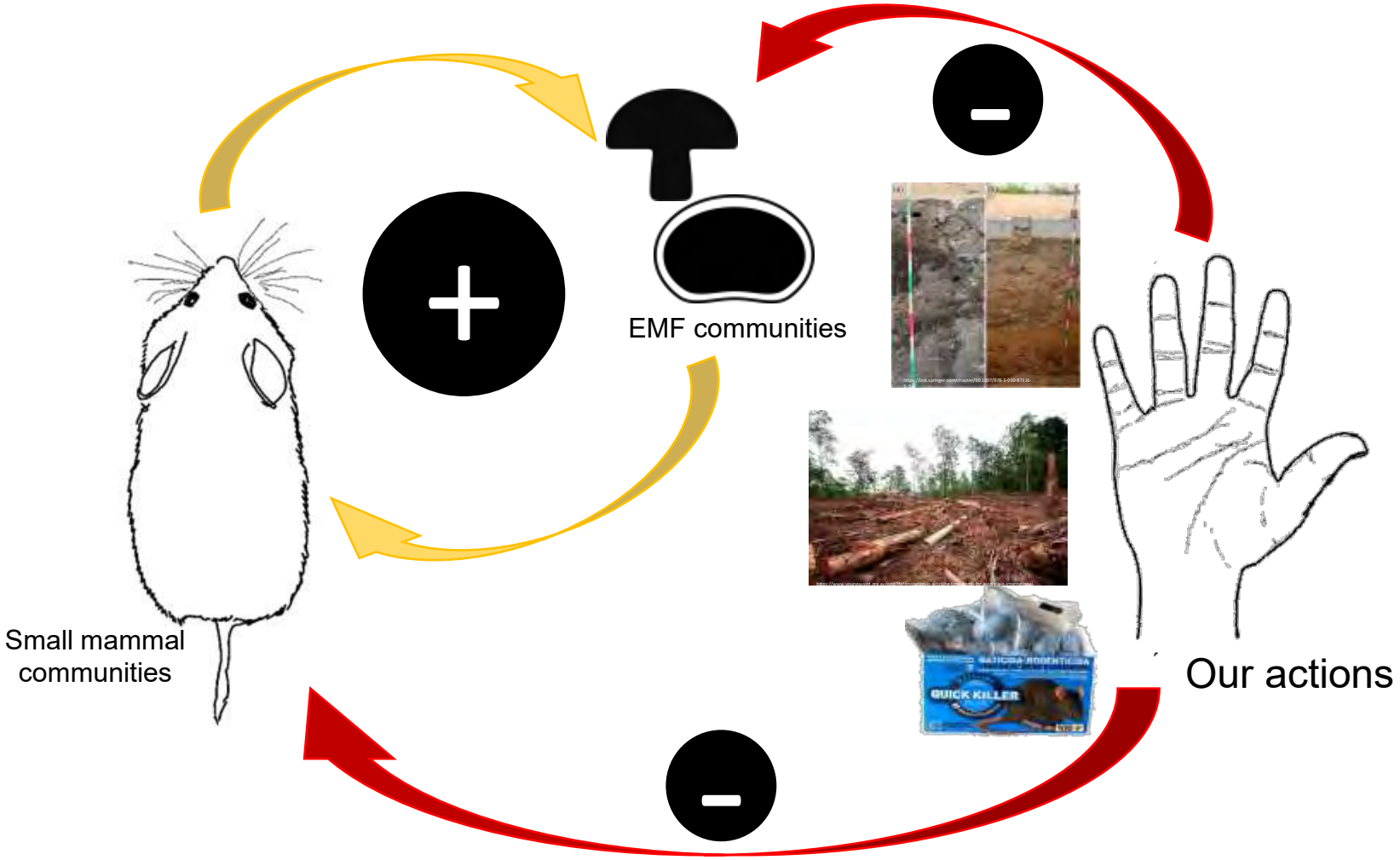
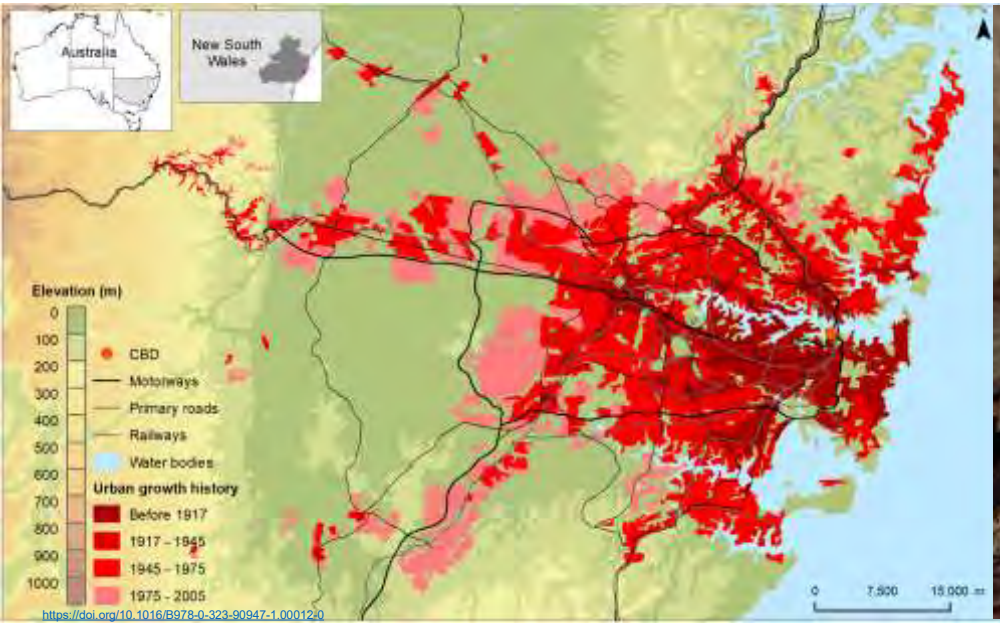

EMF communities
Small mammal communities
Our actions
QUICK KILLER

Urbanisation

- One of the most prevalent and detrimental anthropogenic disturbances to forest ecosystems globally
- Some EMF and small mammals thrive in urban settings, but they face many challenges
- In this context, urban reserves represent a refuge from these challenges



https://doi.org/10.1016/B978-0-323-90947-1.00012-0


https://fortune.com/2015/04/29/chicago-big-data/

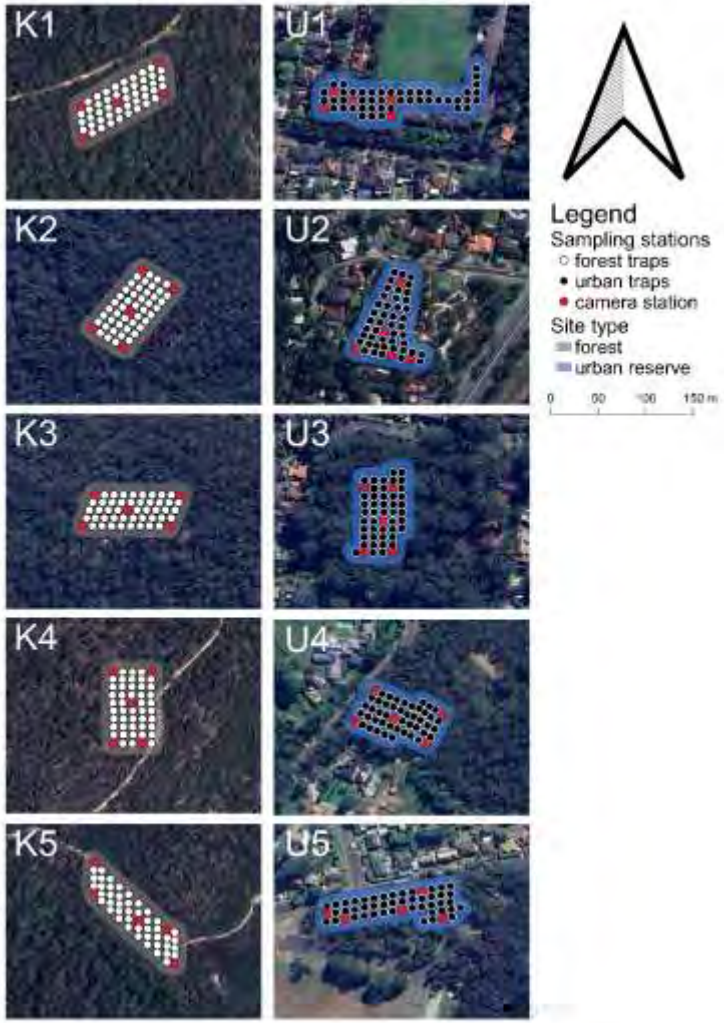

https://www.unsw.edu.au/newsroom/news/2024/04/park-life-urban-green-spaces-just-important-natural-reserves

Aims

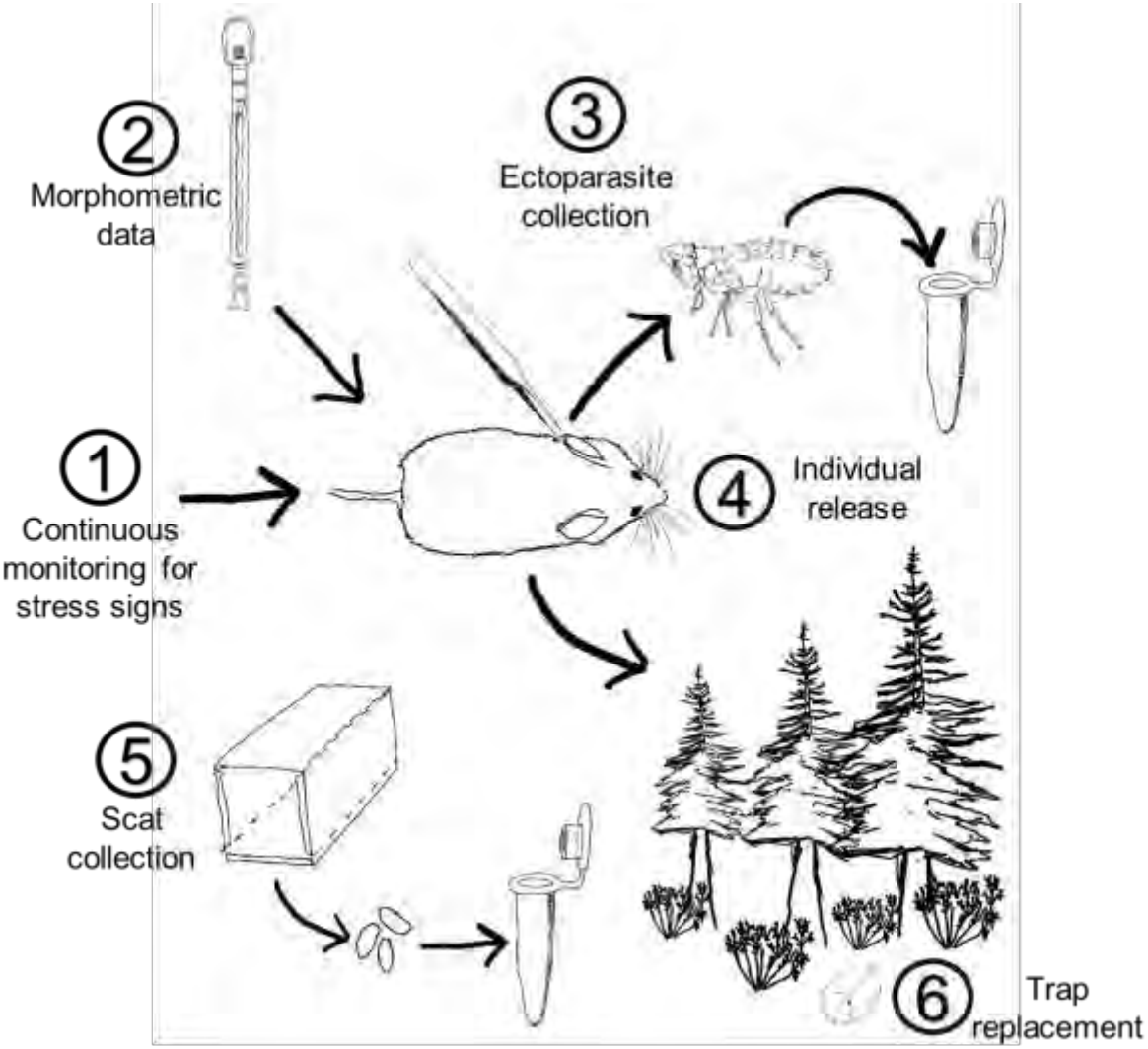
- Compare the **EMF community diversity** in small mammal scat and soil samples from **urban reserves** and **forest sites** around Ku-ring-gai Chase National Park, NSW, Australia.
- Assess the effects of **seasonality** (spring *vs.* autumn) and different species of small mammal **dispersal vectors** (i.e., *Antechinus stuartii vs Rattus fuscipes*) on EMF community diversity.

Methods

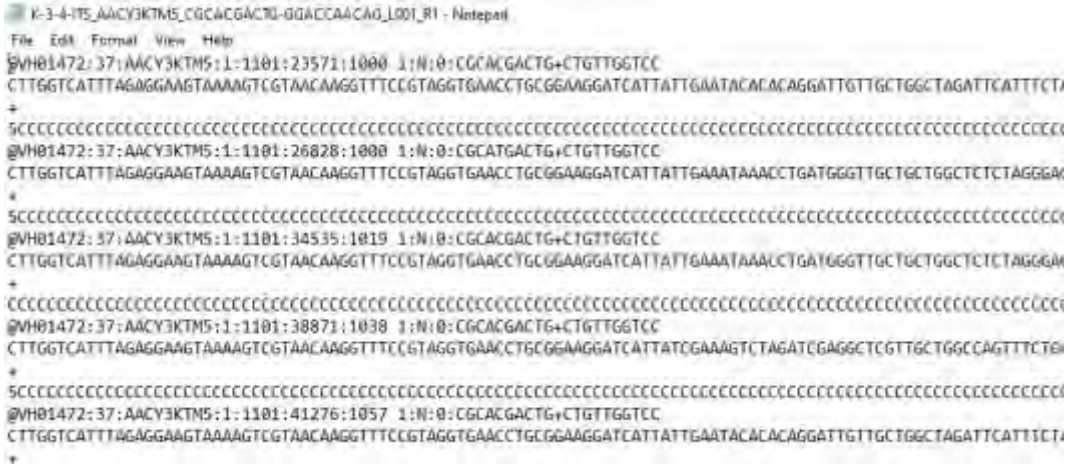
Study sites



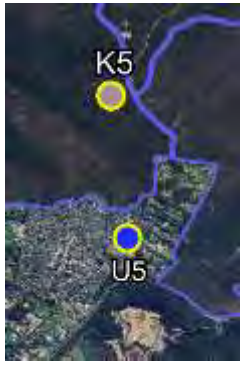
Methods


2
Morphometric data
3
Ectoparasite collection
1
Continuous monitoring for stress signs
4
Individual release
5
Scat collection
6
Trap replacement

Methods



Three sampling nights x site x season



DNA extraction

- 110 scat samples
- 49 soil samples

NGS barcoding

- ITS1-2 primers
- DADA2 pipeline

EMF fungal diversity

- Species richness
- Community composition
- Indicator species

agrf

DADA2 Amplicon Sequencing. Exactly.

unite

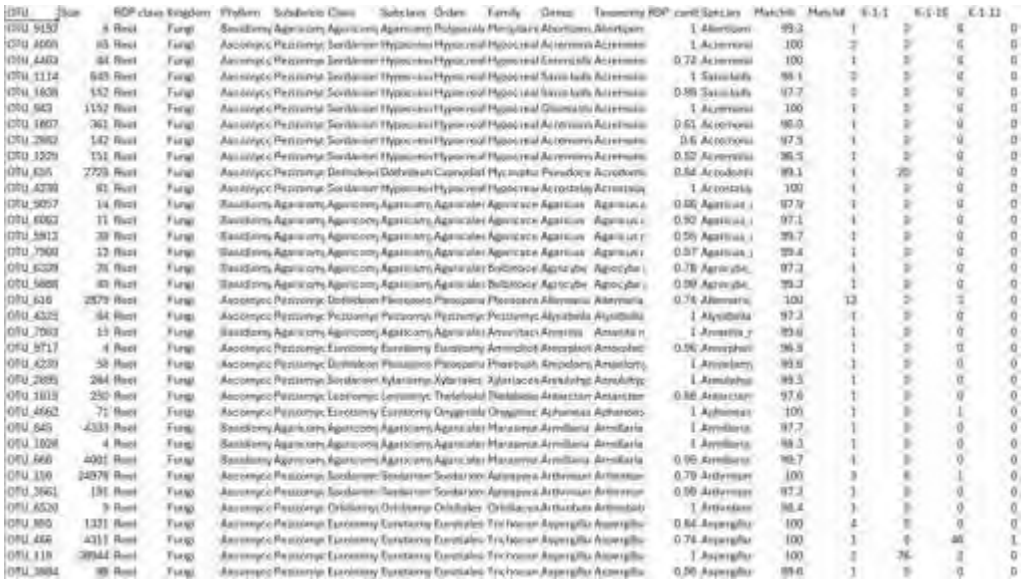
Results

- We obtained 100 scat samples in forest sites, while only 10 scat samples were collected in urban reserves.

23,880 ASVs → 357 ASVs ID → 75 EMF

- 63 recorded in Australia

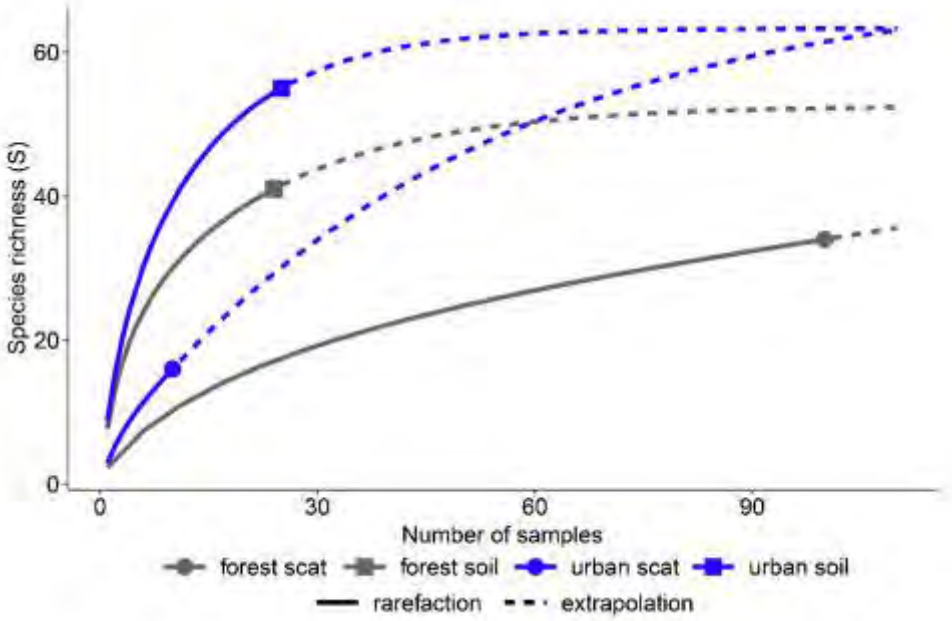
- 51 mushrooms
- 12 truffle like fungi
- 4 puff ball fungi
- 4 crust fungi
- 1 microfungus
- 1 polyporoid

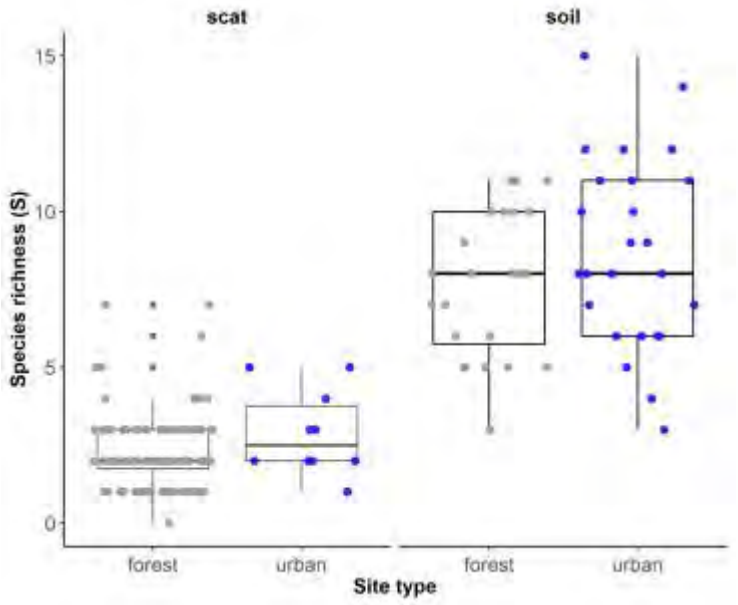


brendanf/
FUNGuildR

Diversity of EMF in response to urbanisation

- Soil samples are more diverse than scat samples
- Urban samples are more diverse than forest samples





Indicator taxa

Forest scat samples

Ionosporus australis

Rossbeevera pachydermis

Urban scat samples

Descomyces albus

Hysteragium

Forest soil (7 taxa)

Cortinarius durifoliorum

Hydnoplicata convoluta

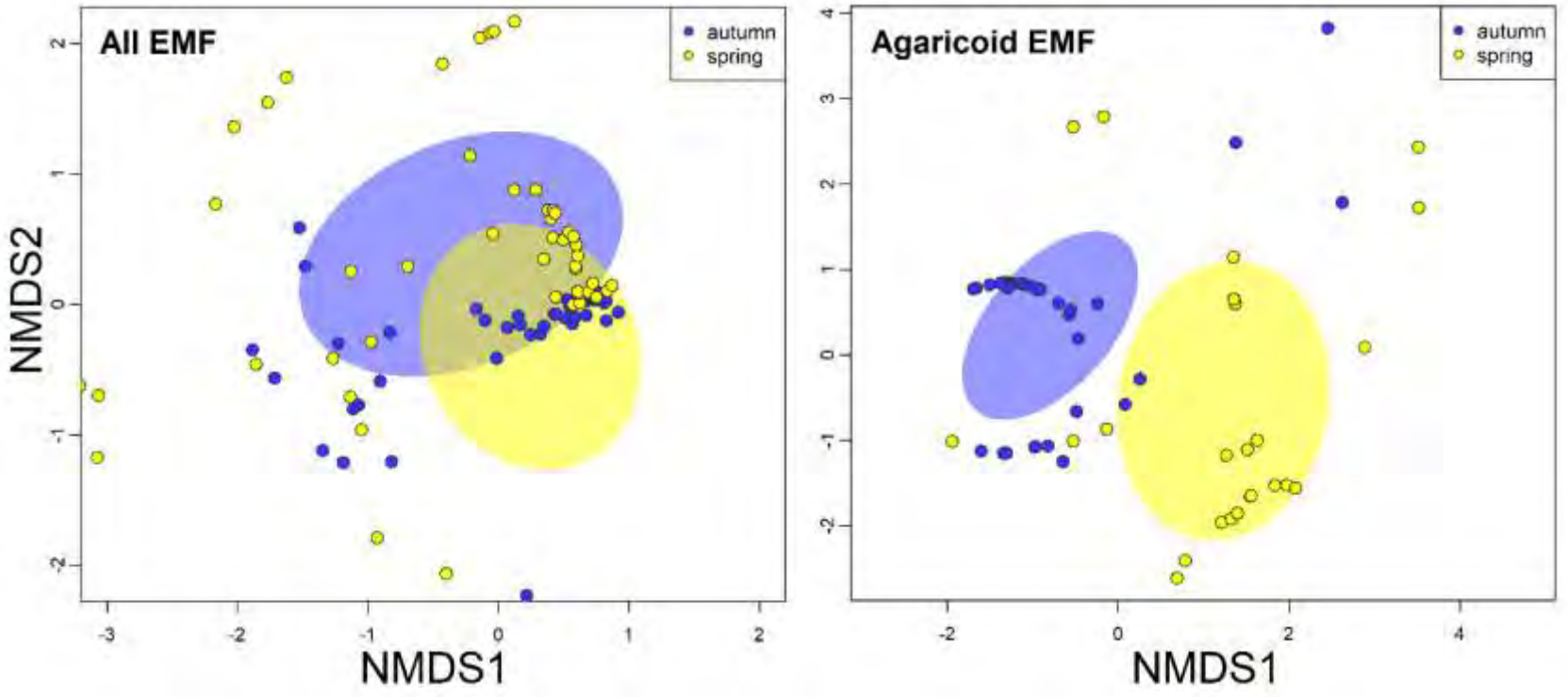
Urban soil (13 taxa)

Russula pseudoareolata

Scleroderma albidum

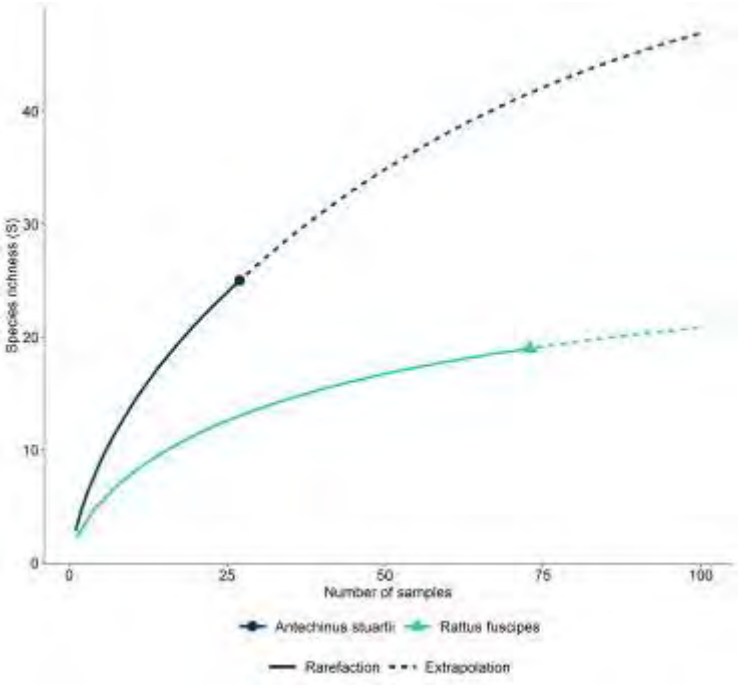
Seasonal variation in EMF diversity in scats

- Significant differences in diversity (H') but not in richness.
- Significant difference in the composition of agaricoid EMF.

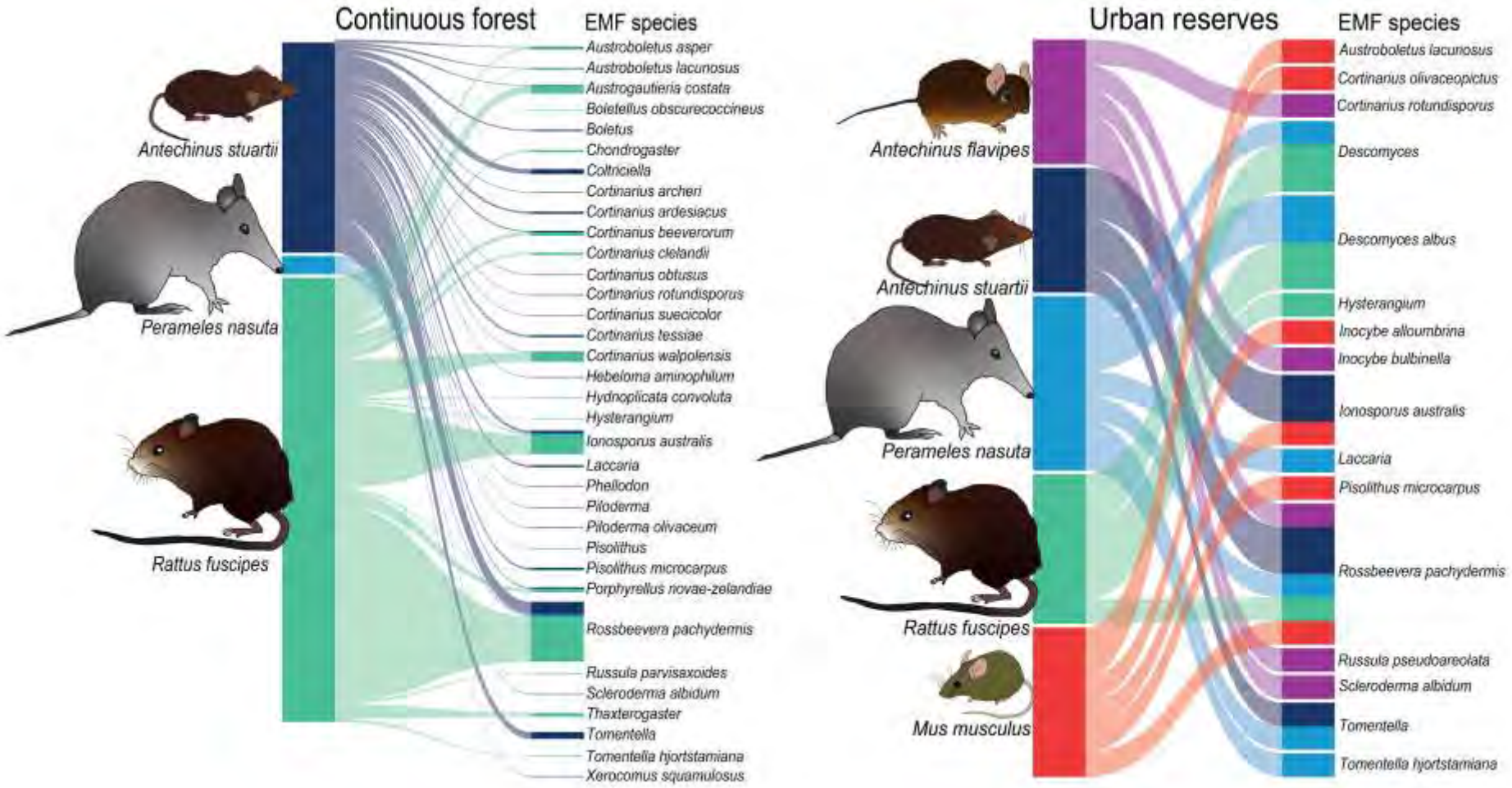


Small mammal vectors and EMF diversity

- Our sample: *Antechinus flavipes* (n = 1), ***A. stuartii* (n = 27)**, *Perameles nasuta* (n = 5), ***Rattus fuscipes* (n = 73)**, and *Mus musculus* (n = 2)
- Only one of the scat samples did not contain EMF
- *A. stuartii* had a higher diversity of EMF

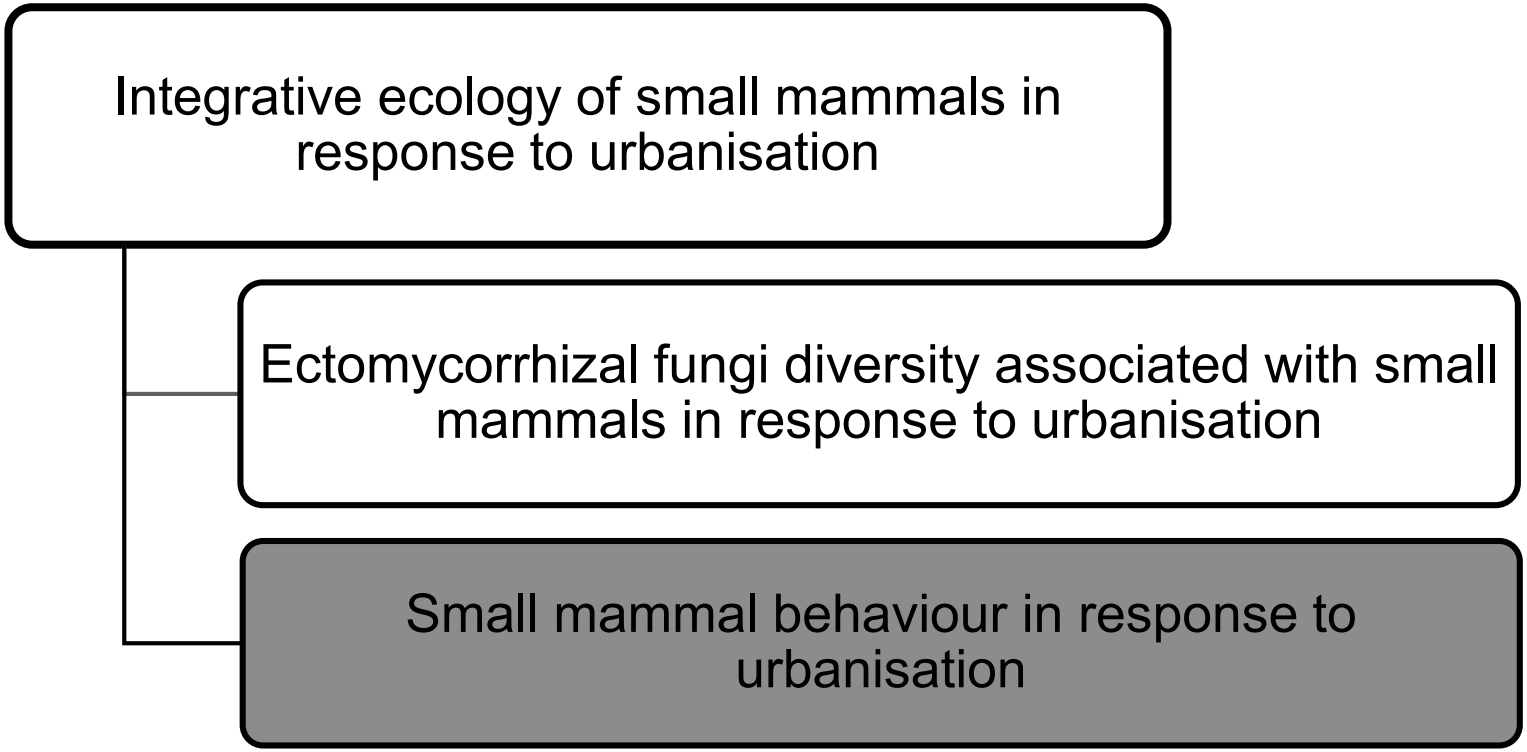


Small mammal vectors and EMF diversity



Conclusions

- **Urban reserves** provide a refuge for EMF diversity
- Soil samples are highly informative, but scat samples tell us more about the **phenology** of EMF
- **Small mammals** are strongly associated with EMF
- Protecting soil and small mammals from disturbance can enhance EMF diversity, and **forest resilience**.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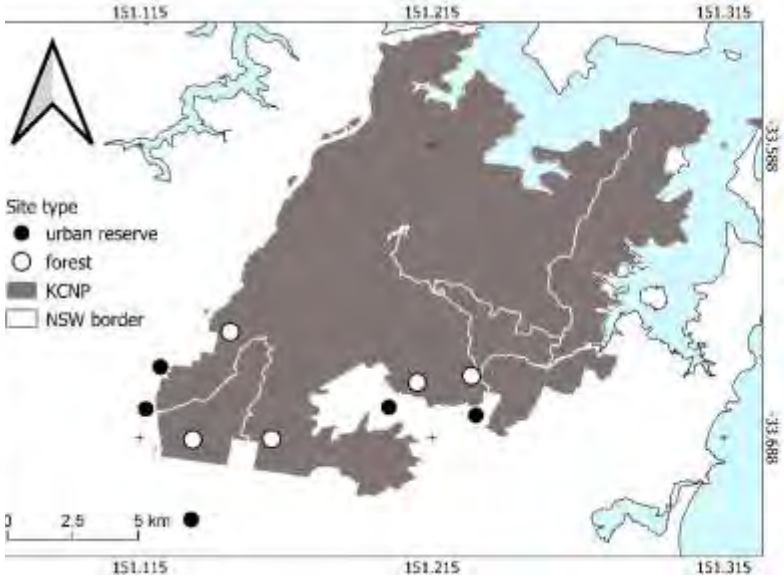
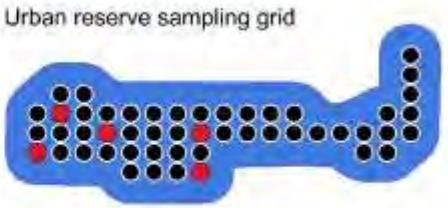
Small mammal behaviour in urban areas

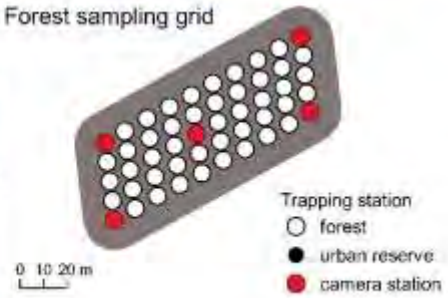
- The behaviour of small mammals has a strong influence in the ecosystem services they deliver
- Small mammal diversity estimates obtained by live-trapping are strongly influenced by animal behaviour
- Small mammal face unique challenges in urban areas; they adapt through their behaviour
- We aimed to analyse the influence of urbanisation on **activity, boldness and trappability** of small mammals.

Methods

https://www.proshoice.com.au/products/browning-trail-cameras-recon-force-w-btc-7hd







Methods

Activity	Visitation rates
Boldness	Interaction with the traps
Trappability	Trapping success

cran/camtrapR

Results

- 317 camera-trap nights; 448 independent visits; 20 species

Results

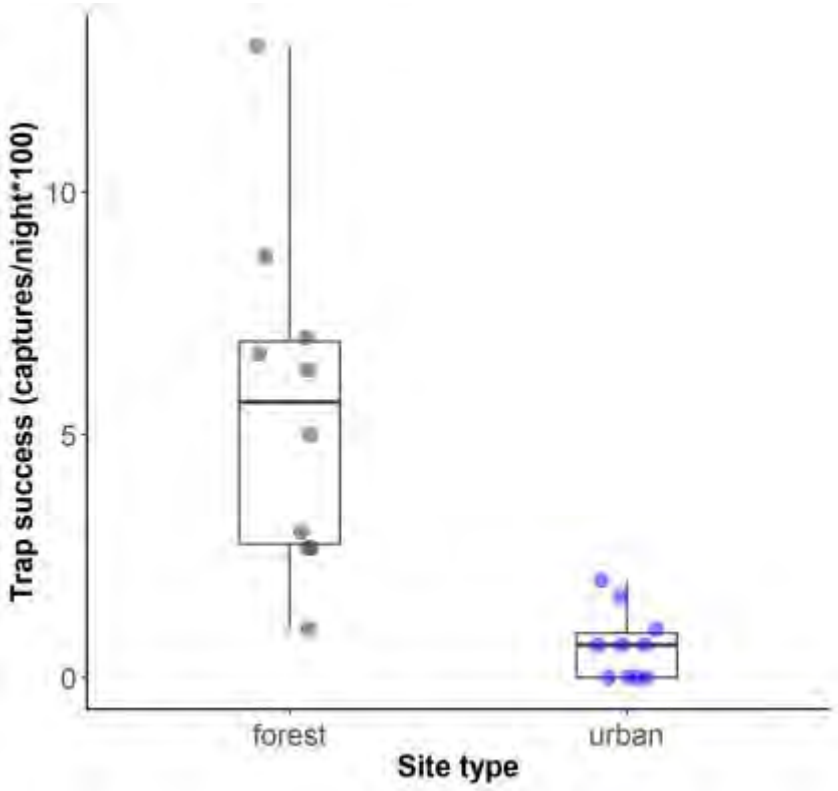
Site type	Species	Mean trap success[1] ± SD	Visitation rate[2] ± SD	Trap interaction (s) ± SD
Forest	*Antechinus stuartii*	2.33 ± 2.29	0.16 ± 0.12	14.79 ± 20.09
	Cercartetus nanus	0	0.01 ± 0.02	1
	Perameles nasuta	0.2 ± 0.3	0.08 ± 0.08	20 ± 32.31
	Rattus fuscipes	8.67 ± 5.23	0.68 ± 0.42	48.84 ± 74.16
Urban reserve	*Antechinus flavipes*	0.07 ± 0.15	0.01 ± 0.02	2.5 ± 2.12
	Antechinus stuartii	0.46 ± 0.87	0.03 ± 0.07	8.4 ± 17.13
	Perameles nasuta	0.27 ± 0.6	0.24 ± 0.22	23.53 ± 56.67
	Rattus fuscipes	0.13 ± 0.18	0.31 ± 0.43	3.1 ± 6.13
	Rattus rattus	0	0.64 ± 0.59	5.55 ± 18.46
	Mus musculus	0.27 ± 0.6	0.06 ± 0.06	23.1 ± 27.55
	Oryctolagus cuniculus	0.13 ± 0.3	0.03 ± 0.04	0

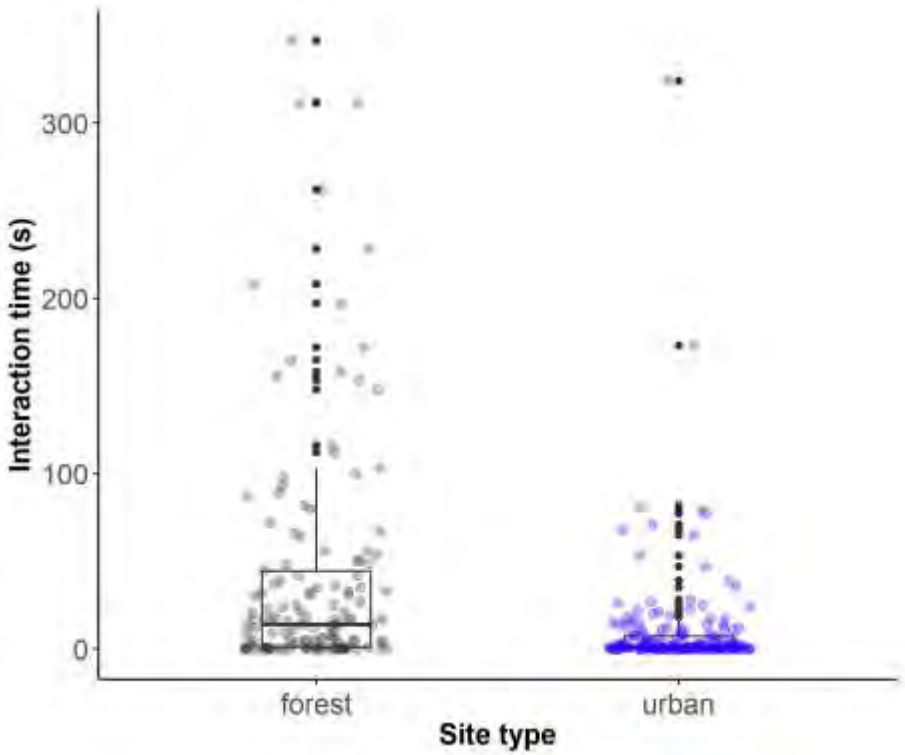
Results

Results

Results

Results


Trap success (captures/night*100)
10
5
0
forest
urban
Site type


Interaction time (s)
300
200
100
0
forest
urban
Site type

Conclusions

- Small mammals in urban reserves were less bold and had **lower trappability** (i.e., trap success) than their forest counterparts. However, this was not a result of lower small mammal activity in the urban reserves, which had similar visitation rates as the forest sites.
- Camera-trapping in conjunction with live-trapping helps assessing small mammal **behaviour towards the trapping devices**

Collaborators

Prof Jaco Le Roux

Dr Christian A. Delfín

Dr Alexandra Carthey

Dr Ryan Stephens

Dr Margarita Vargas

Dr Cristina MacSwiney

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Thank you!