

Movement ecology hackathon: A dingo case-study



Photo by Alexander Babych

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Rhys Cairncross
Sally Burgemeestre
Thomas Newsome
Lily Bentley
Mitchell Cowan
Scott Forrest



Acknowledgement of Traditional Owners

Kaurna people as the Traditional Owner and Custodians of the Adelaide Plains.

Walpiri and Ngarti country where the data was collected.

Organisers and facilitators

- Members of the Movement Ecology Special Interest Network (MoveSIN)



Mitchell
Cowan



Niraj
Meisuria



Rhys
Cairncross



Sally
Burgemeestre



Thomas
Newsome



Lily Bentley



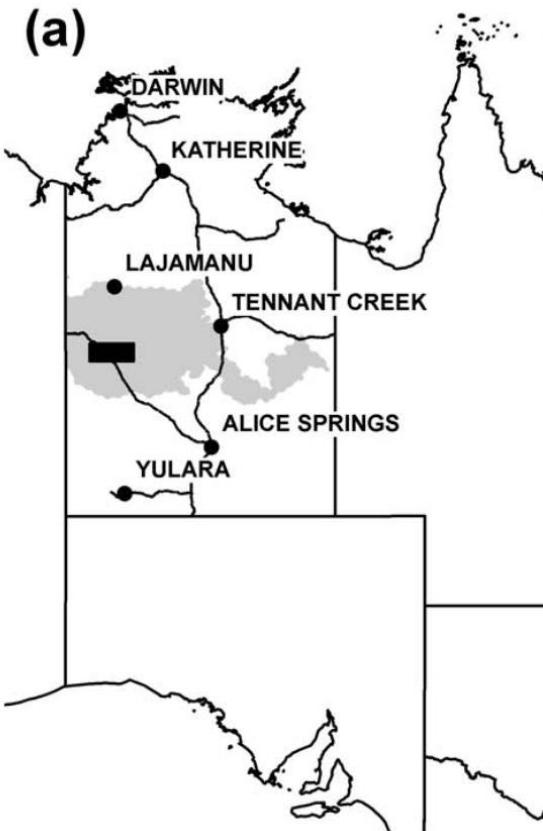
Scott Forrest

Purpose of the workshop

- Hackathon-style workshop
 - self-directed learning to tackle a research question of interest
- Try out some different movement ecology methods
- Hands-on experience with a new dataset

Time	Duration	Activity
9:00 am	15 mins	Overview of workshop - introductions
9:15 am	15 mins	Introduction to data and study system
09:30 am	15 mins	Some possible research questions
09:45 am	15 mins	Brief introduction to different movement ecology tools
10:00 am	30 mins	Break into groups and get started!
10:30 am	15 mins	Morning tea + coffee
10:45 am	1 hour 15 mins	Working in groups
12:00 pm	1 hour	Lunch
1:00 pm	2 hours	Working in groups
3:00 pm	15 mins	Afternoon tea
3:15 pm	1 hour	Group presentations (5-10 mins each)
4:15 pm	15 mins	Wrap-up
4:30 pm		Finish (post-workshop food/drink?)

Study system - Tanami Desert



From Newsome et al. (2013)



Photo © John Lovett

Tanami mine sites



Tanami mine sites

Mine sites

- food resources are spatially clumped and very rich
- increase interactions with humans and possibly each other

Spatially distant areas (non-mine sites)

- food resources are naturally dispersed and relatively sparse

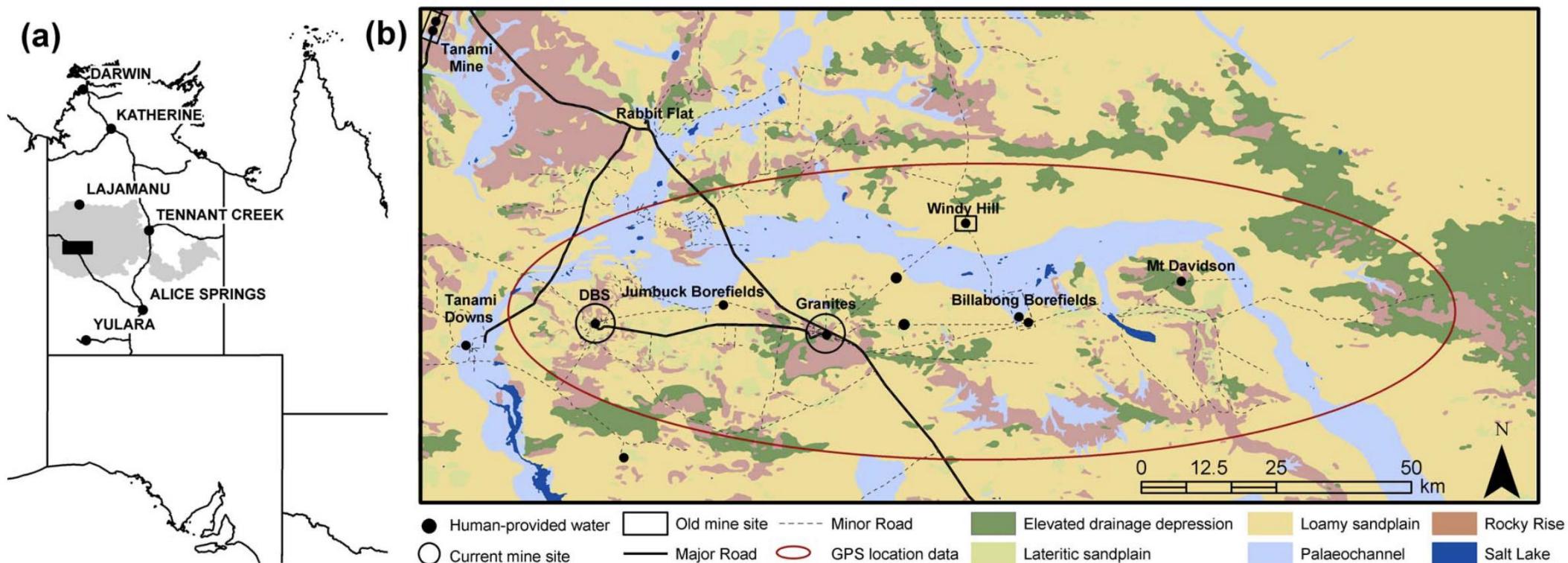
Dingo (*Canis lupus dingo*)

- Dingoes introduced to Australia ~4,000 years ago, since naturalised
- Australia's top mammalian predator
- Interact with humans through refuse and artificial water points



Photo by Alexander Babych

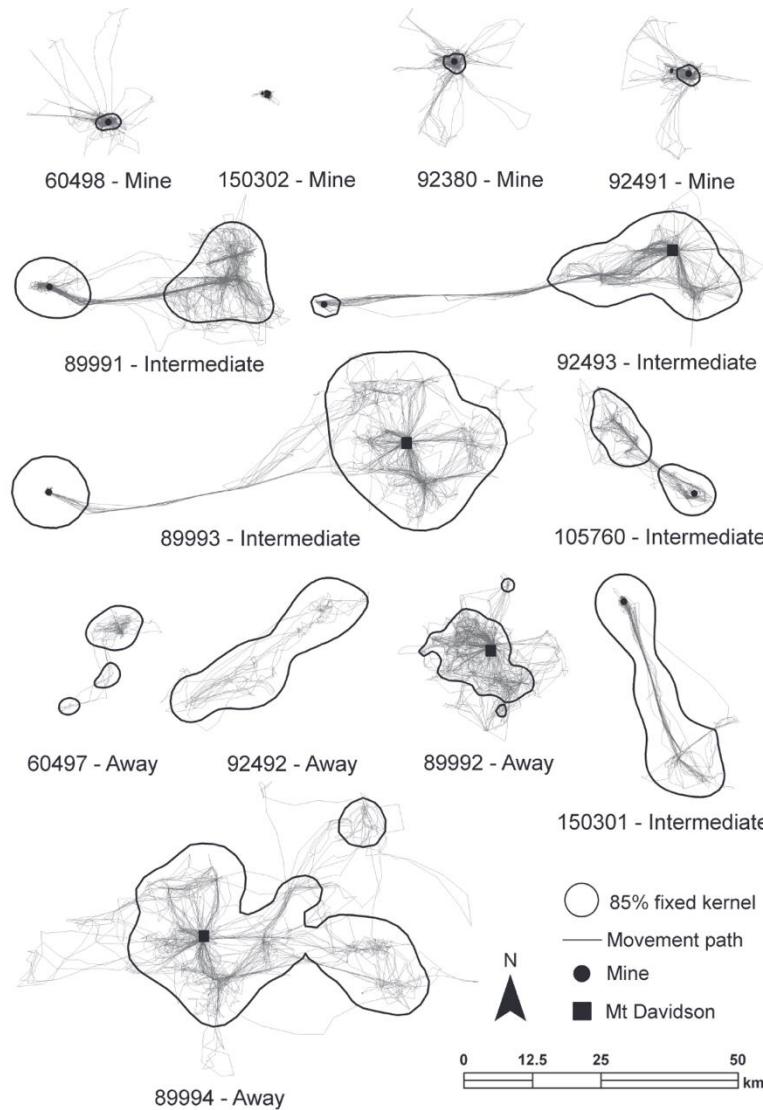
Dingo GPS data collection



Previous research with this dataset

- Newsome, T. M., Ballard, G.-A., Dickman, C. R., Fleming, P. J. S., & van de Ven, R. (2013). **Home range, activity and sociality of a top predator, the dingo: a test of the Resource Dispersion Hypothesis.** *Ecography*, 36(8), 914–925. <https://doi.org/10.1111/j.1600-0587.2013.00056.x>
- Newsome, T. M., Ballard, G.-A., Dickman, C. R., Fleming, P. J. S., & Howden, C. (2013). **Anthropogenic resource subsidies determine space use by Australian arid zone dingoes: an improved resource selection modelling approach.** *PLoS One*, 8(5), e63931. <https://doi.org/10.1371/journal.pone.0063931>

Home range, activity and sociality



home range estimates

home range overlap

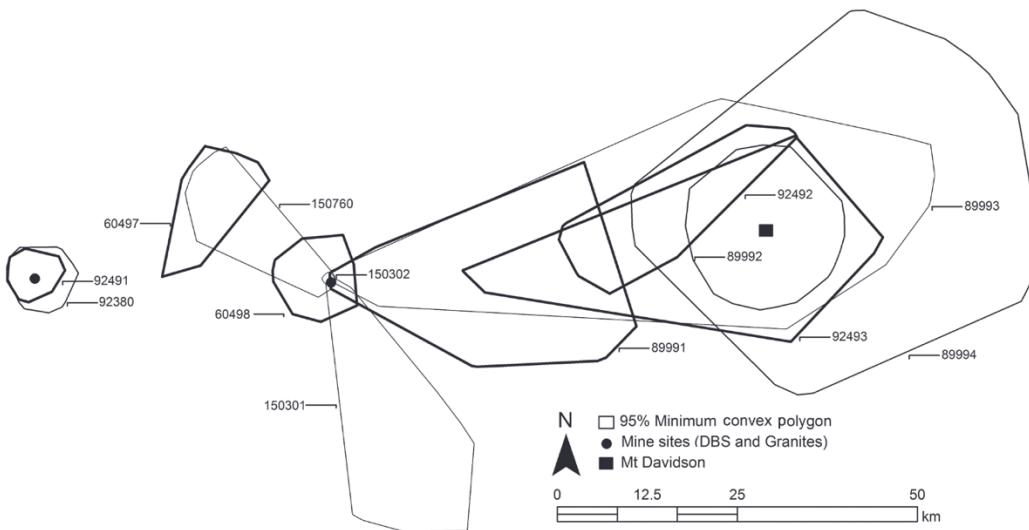


Figure 5. Overlapping minimum convex polygon (95%) home ranges for 13 adult dingoes fitted with GPS collars in the Tanami Desert.

Figure 4. Fixed kernel home range estimates (85%) and movement paths of thirteen adult dingoes fitted with GPS collars in the Tanami Desert.

Resource selection modelling

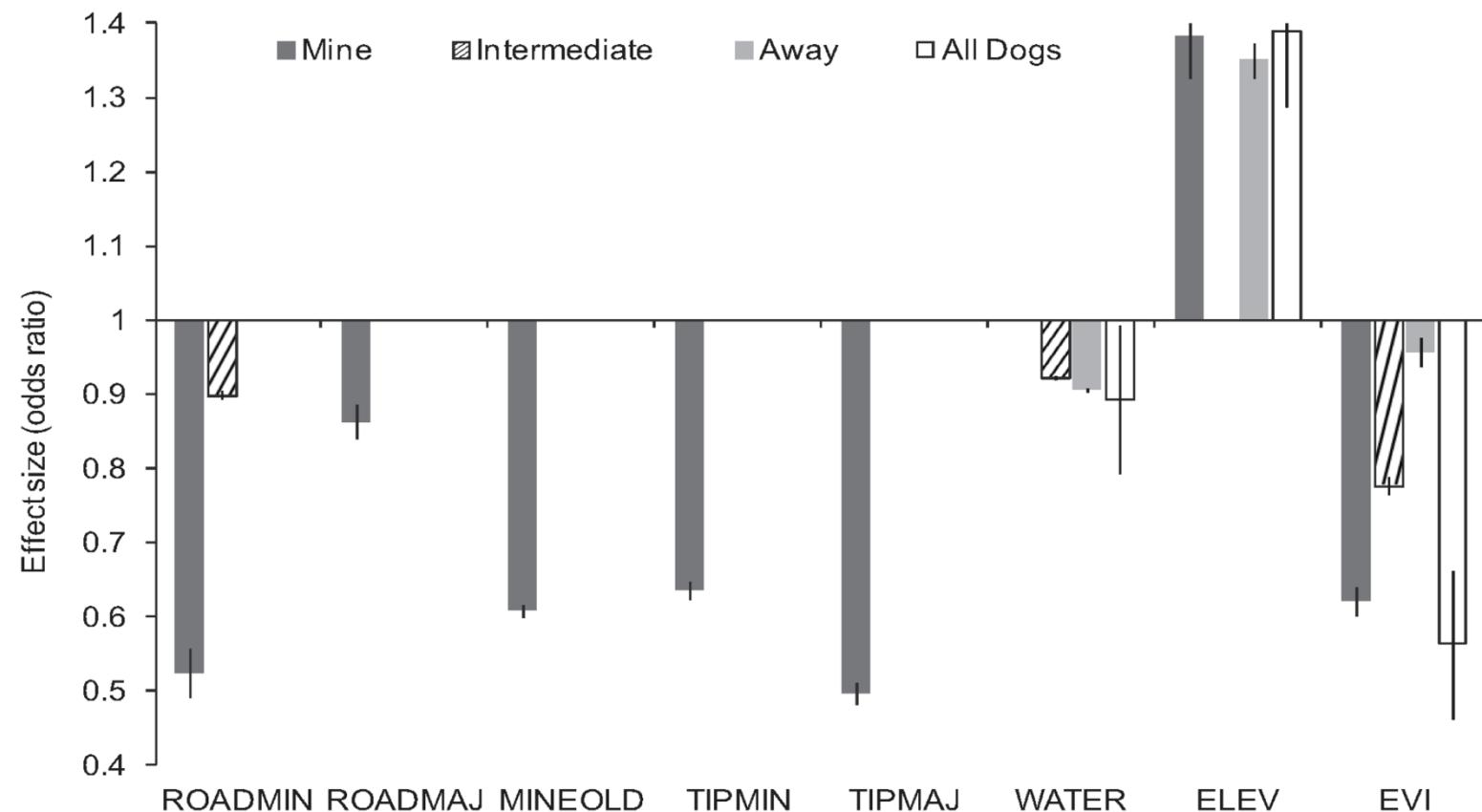


Figure 2. Effect size of continuous predictors on occurrence of dingoes in the Tanami Desert based on the results from the final generalized linear mixed model. Odds ratios are provided $\pm 95\%$ confidence intervals (CI). See Table 1 for X-axis acronyms.

doi:10.1371/journal.pone.0063931.g002

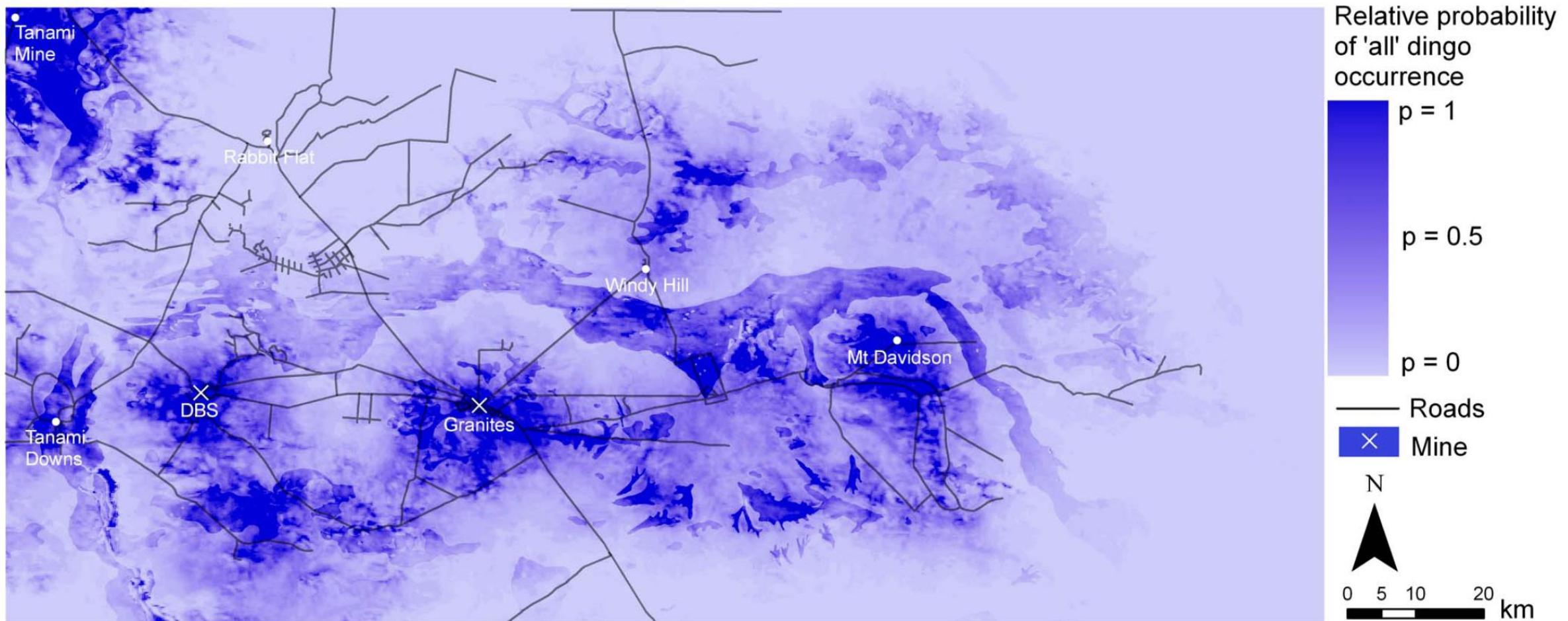


Figure 6. Predicted resource selection by 'all' dingoes in the Tanami Desert at a scale of 1 km for distance predictors and 10 m for elevation.

doi:10.1371/journal.pone.0063931.g006

Additional research questions

- How do dingo behaviours differ between individuals at mine sites and those elsewhere?
- What is the influence of the surrounding environment on the dingoes' movement?
- How do dingoes' behaviours change across the day?
- How do dingoes connect through the landscape?
- Do dingoes near mines have a higher probability of disease transmission?

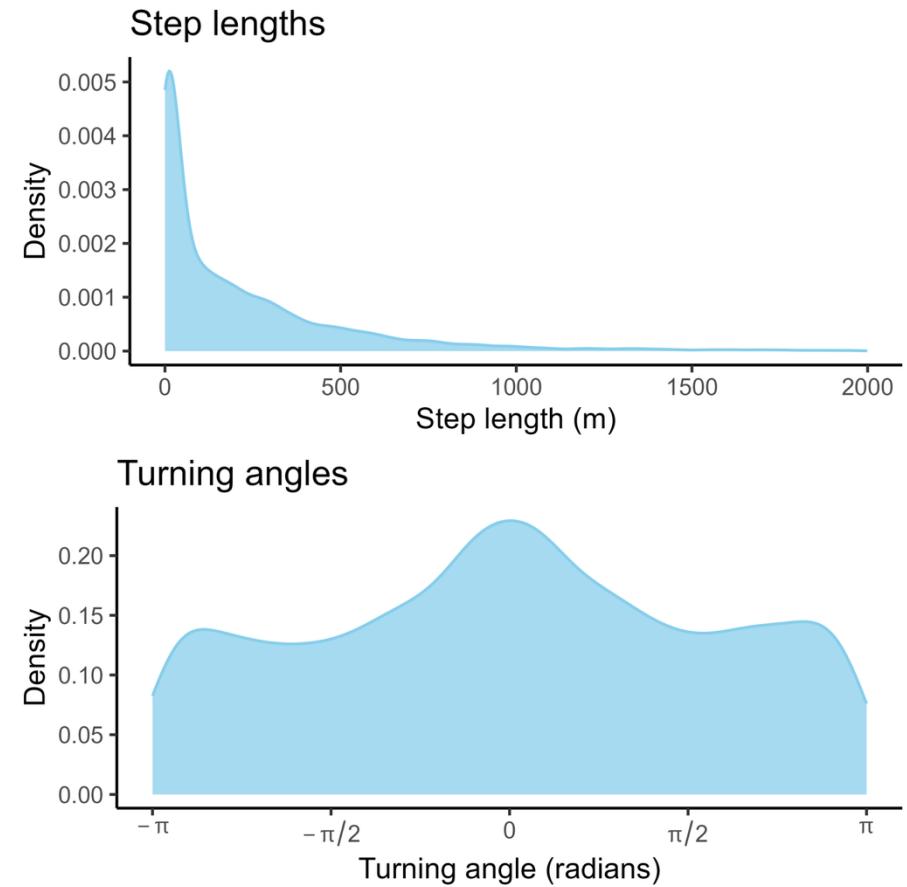
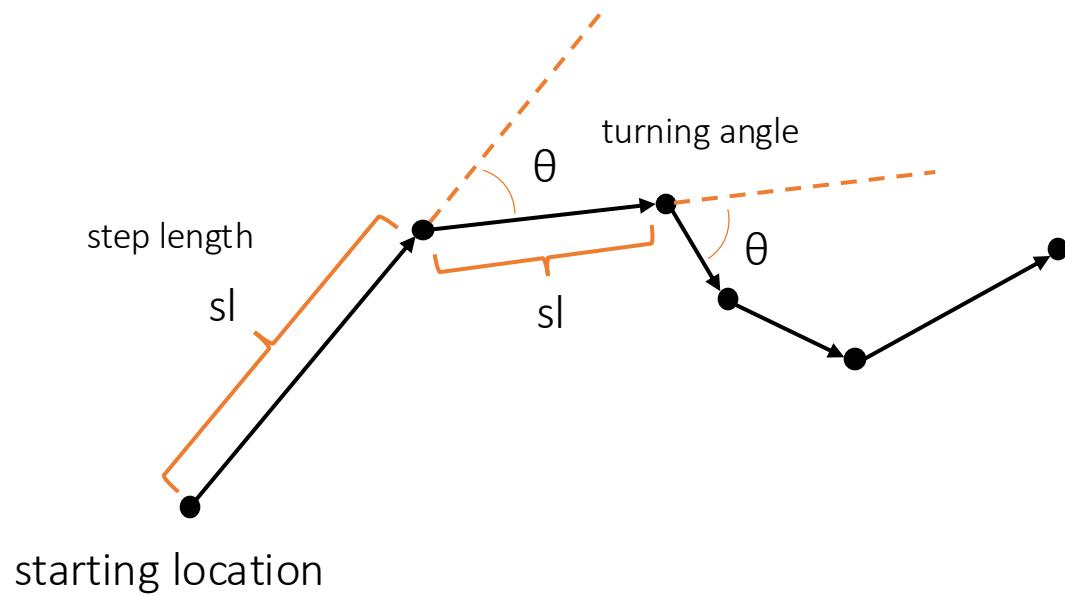
Movement ecology approaches

- Movement summaries
- Home range analyses (KDE, AKDE)
- Behavioural classification (HMM, BCPA)
- Resource and step selection functions (RSF, SSF)
- Revisitation analysis
- Social network analysis

Movement summaries

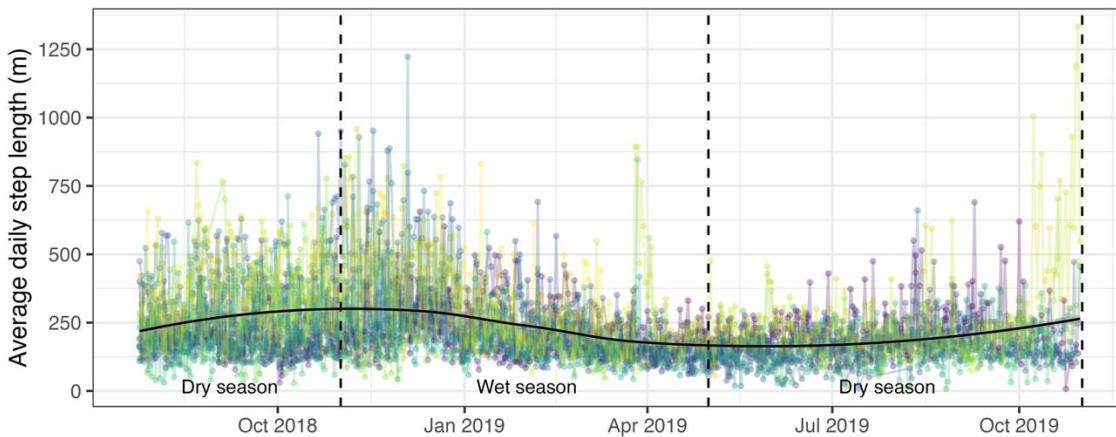
- Did the animal show different movement behaviour in different areas, times?
- May be exploratory or used for inference
- Can be used to guide model development

Movement data as 'steps'



A

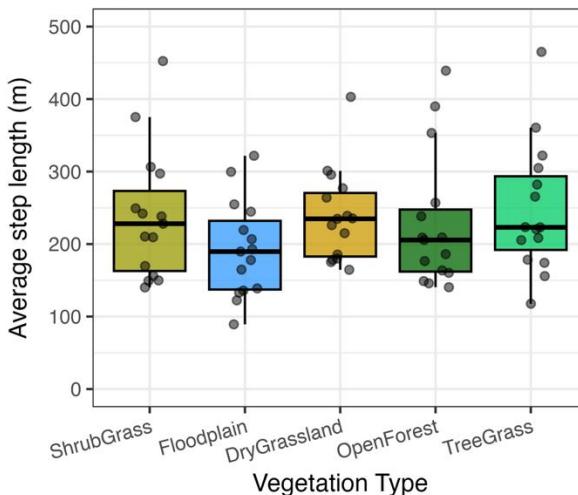
Average Daily Step Lengths



B

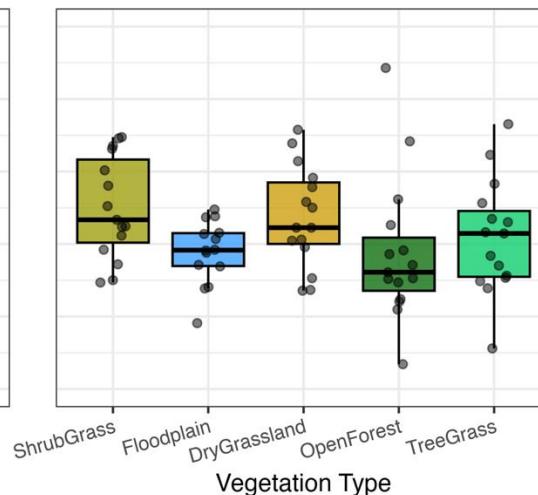
Step length by vegetation type and ID

Dry season



C

Wet season

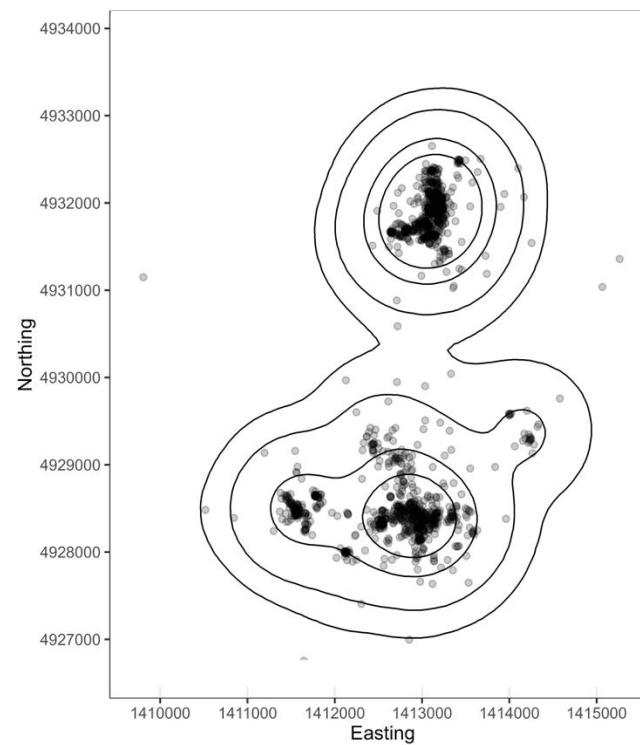
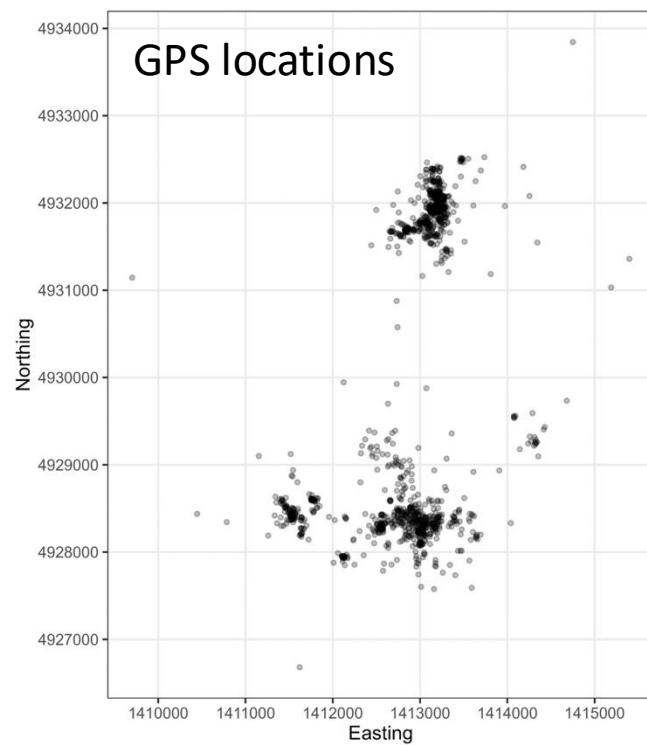


water buffalo
(Bubalus bubalis)



Home range analysis

- What is the animal's 'home range' or space use?



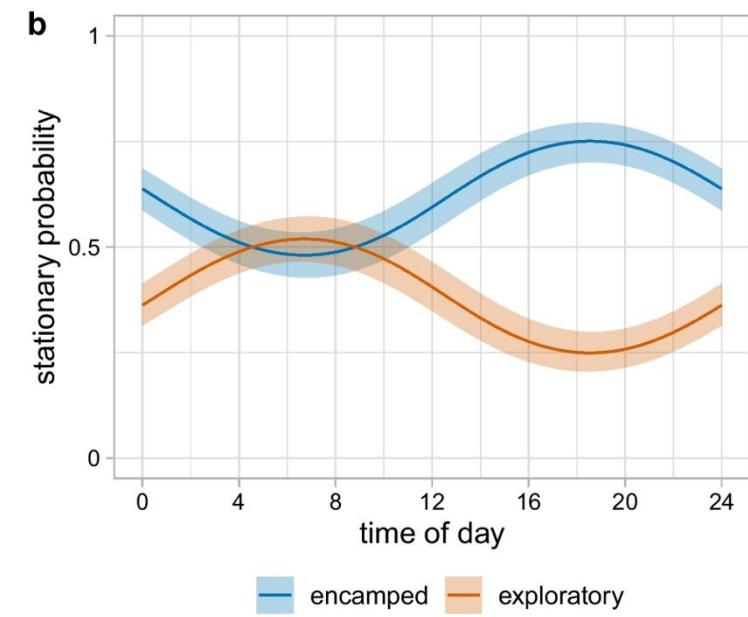
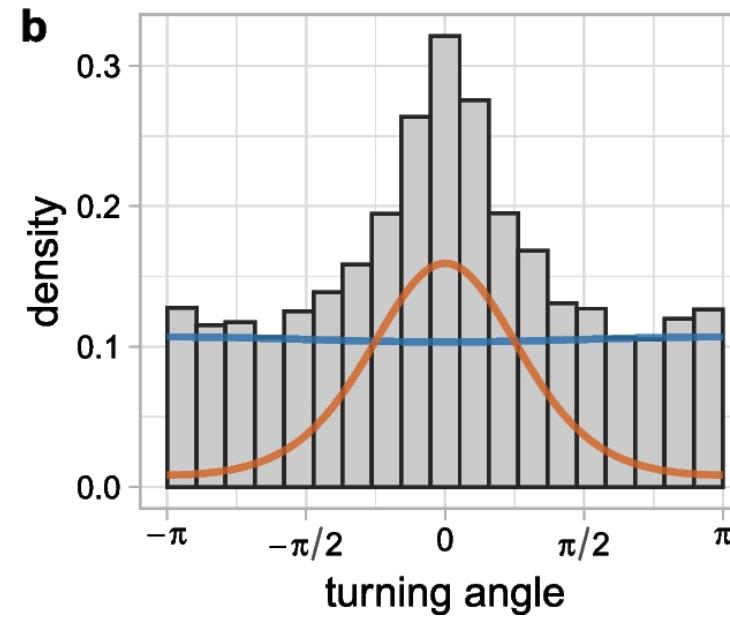
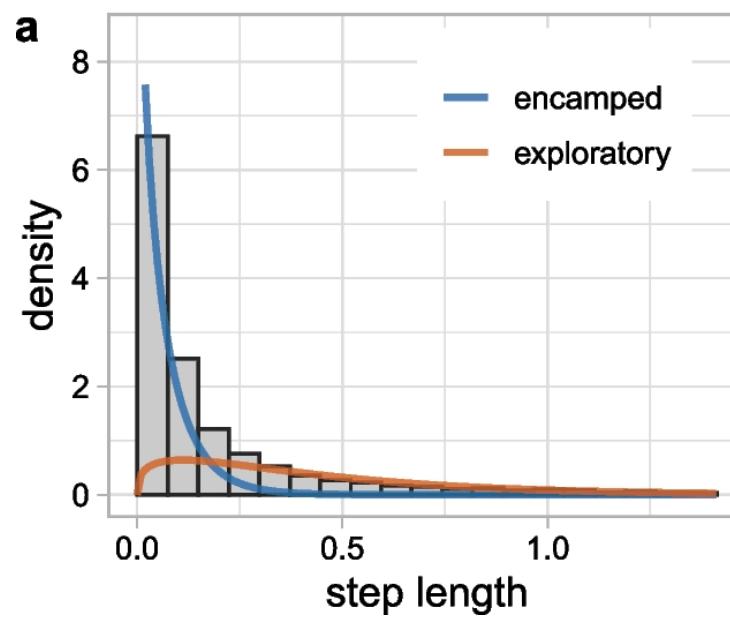
Kākā
(*Nestor meridionalis*)



Tag ID: 45505

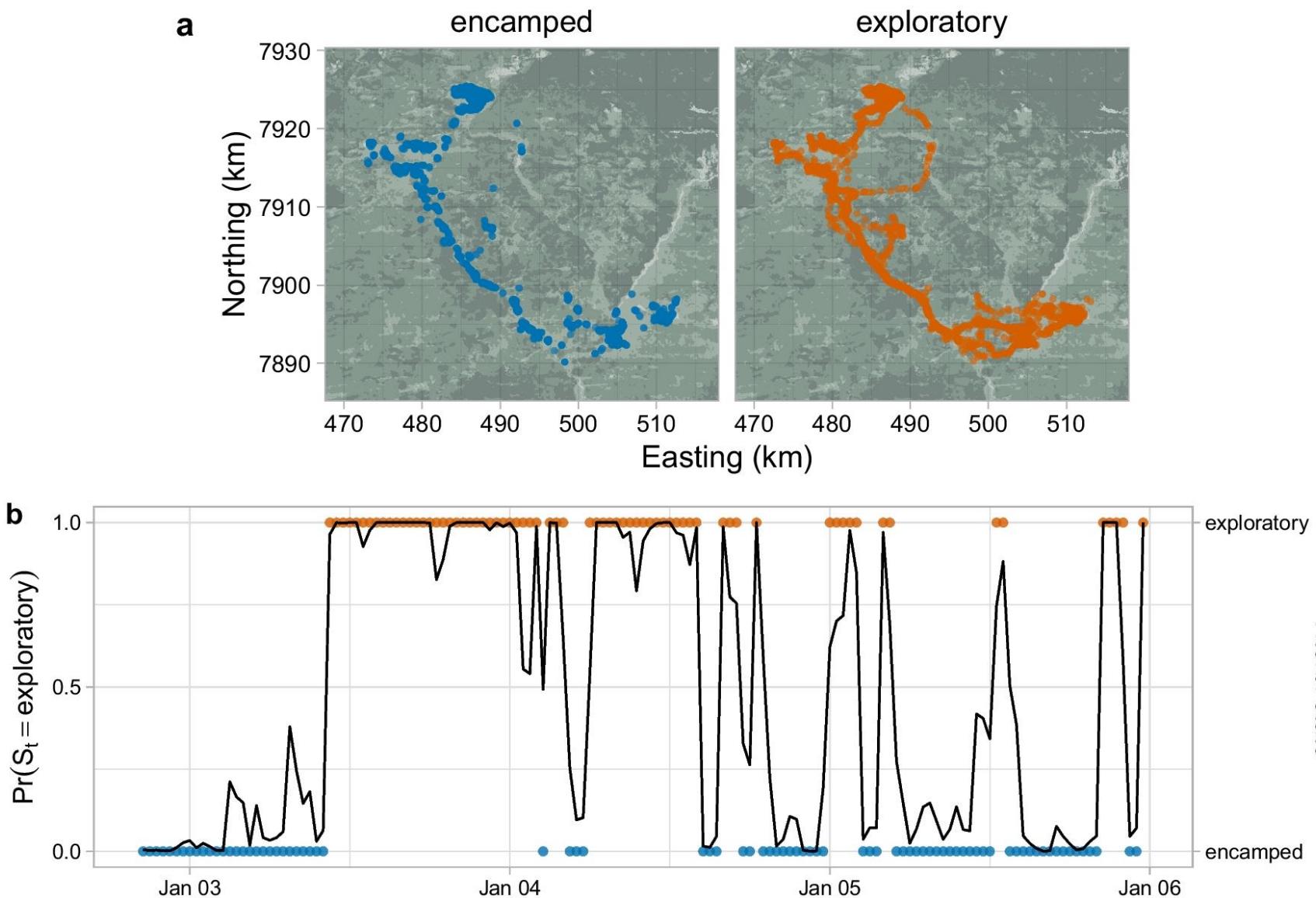
Behavioural classification

- What behaviours was the animal displaying?
- Does this relate to any covariates (time of day, spatial layers)?



Figures from Klappstein et. al (2023)

behavioural
state of each
GPS location



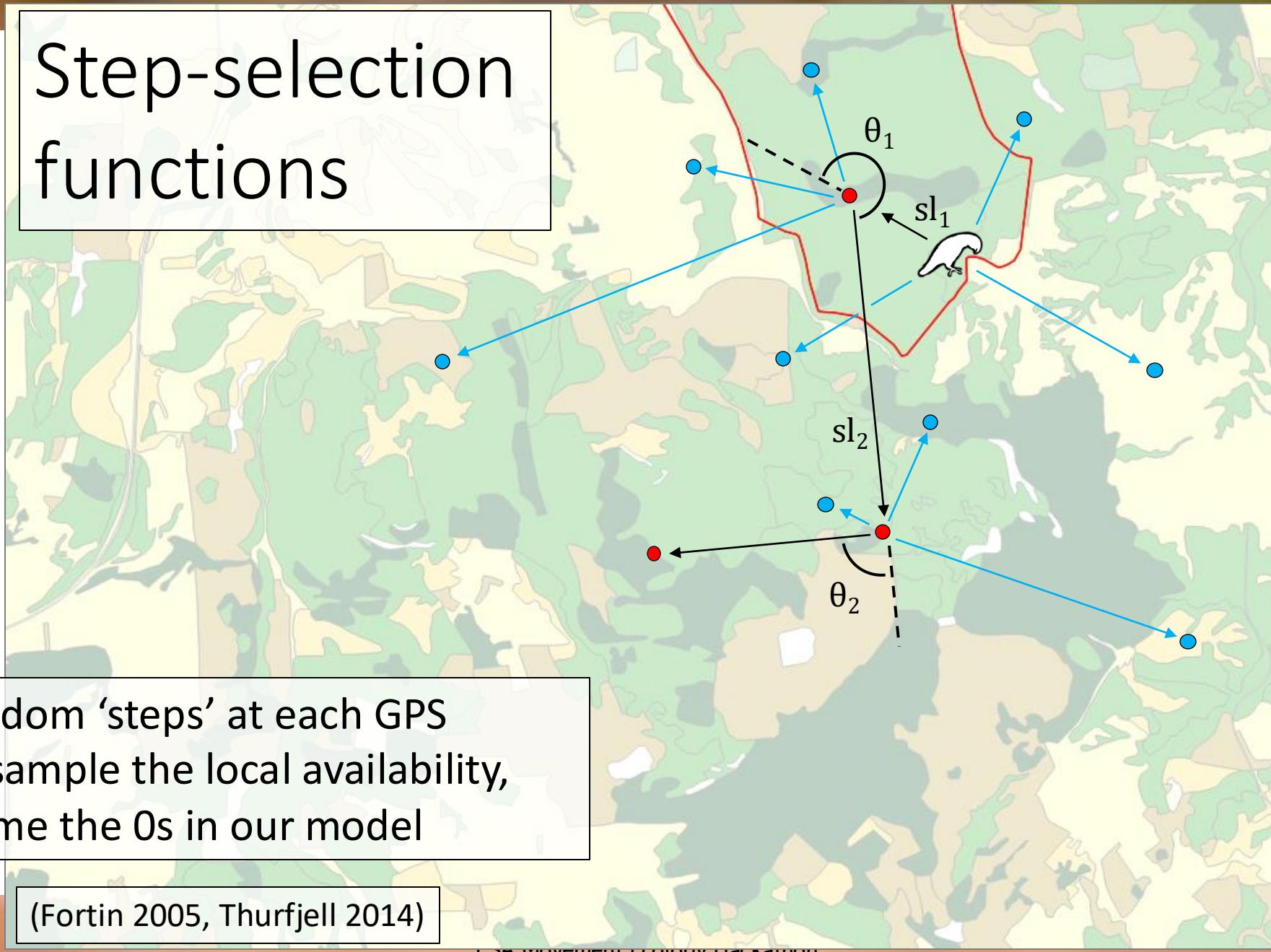
Plains zebra
(*Equus quagga*)



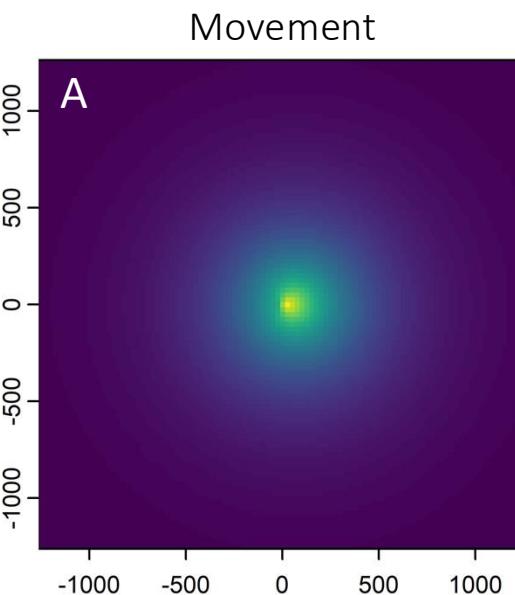
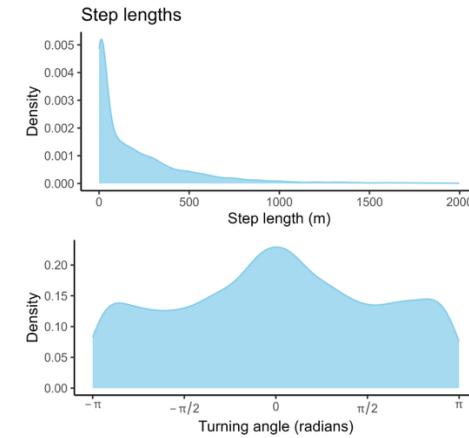
Resource and step selection functions

- What habitat was the animal using?
- How was the habitat affecting its movement behaviour?

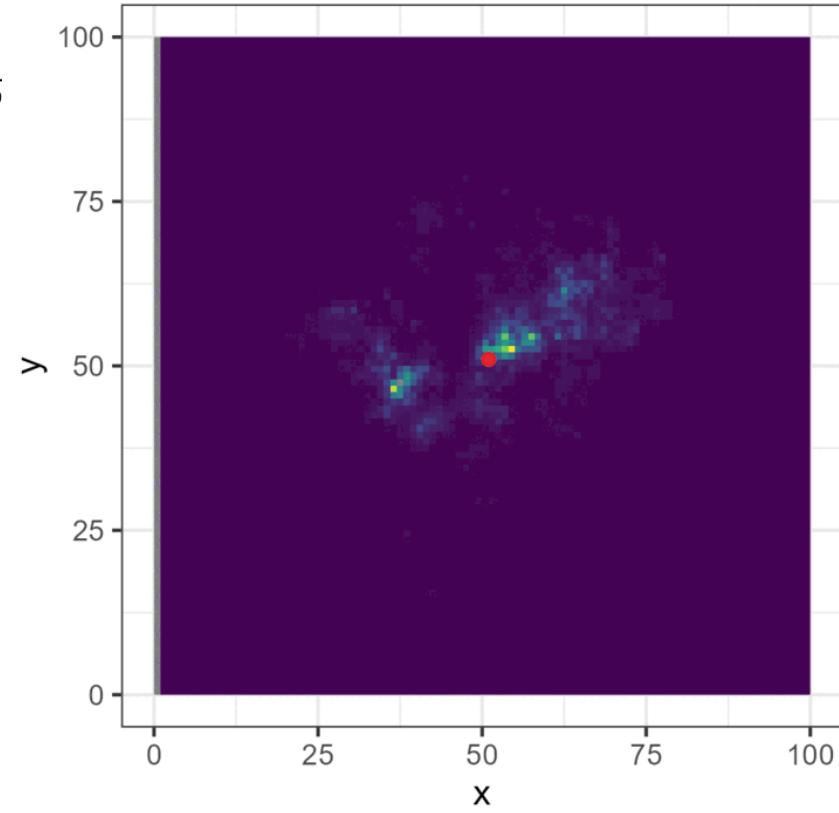
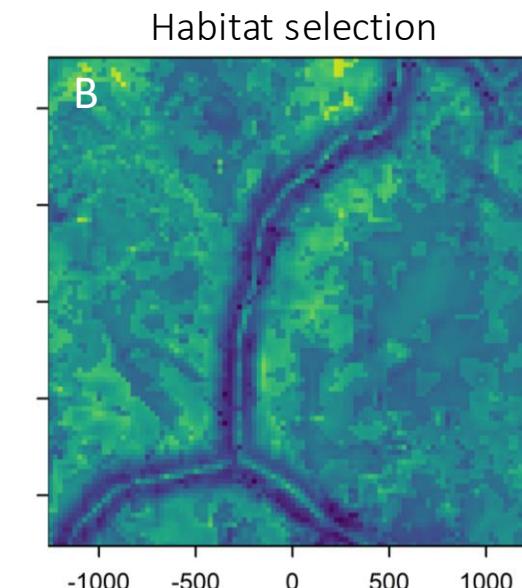
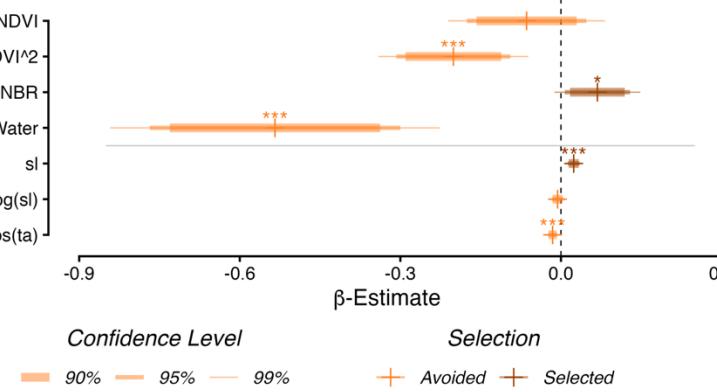
Step-selection functions



Resource and step selection functions

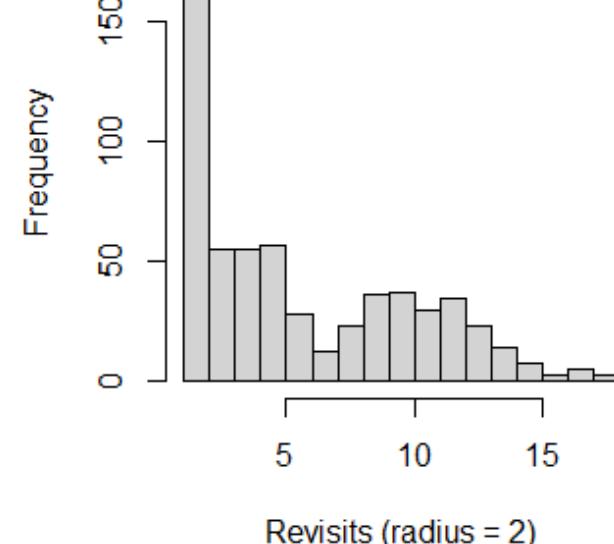
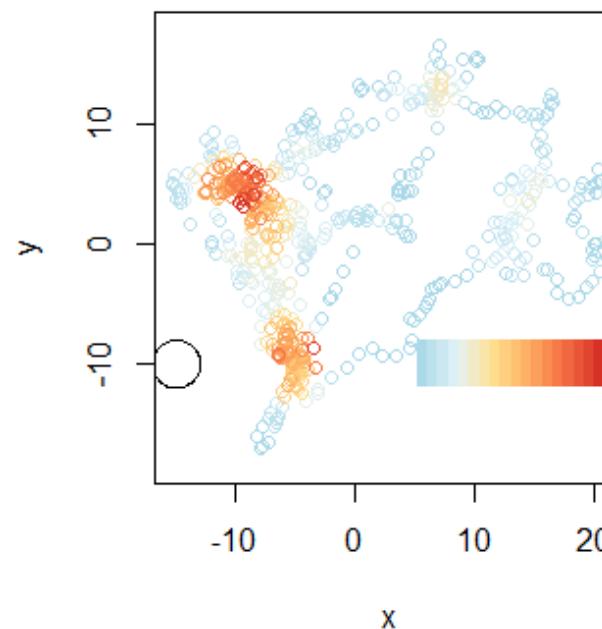


Covariate

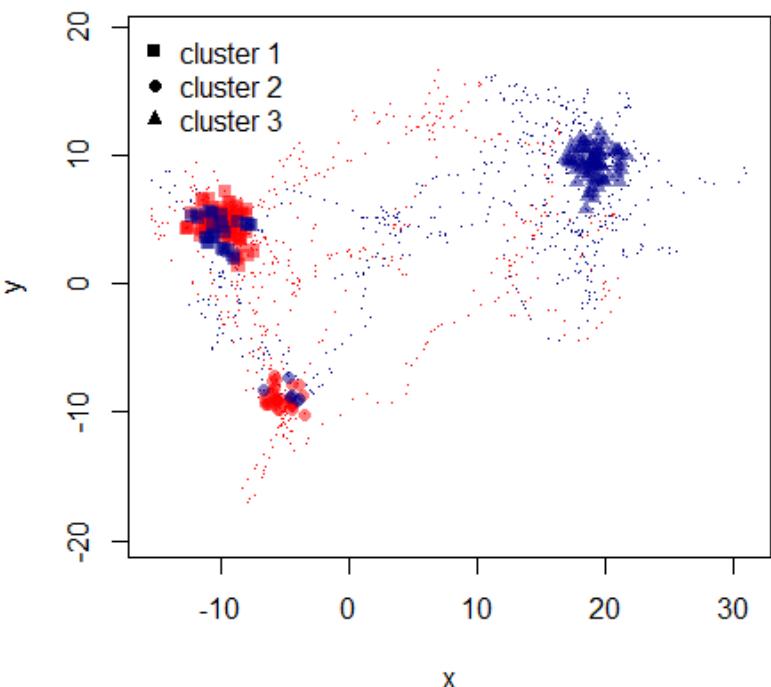


Revisitation analysis

- Where did the animal ‘revisit’?



clusters of locations to identify important areas

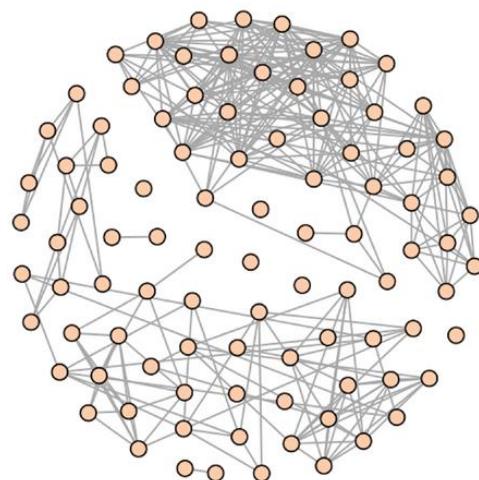


Figures from: <https://cran.r-project.org/web/packages/recurse/vignettes/recurse.html>

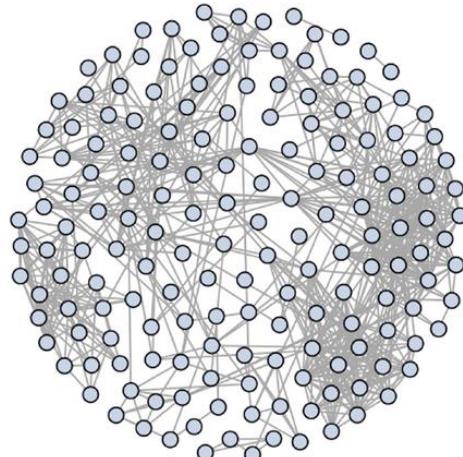
Social network analysis

- Assessing connections between individuals based on proximity (in space and time)

Caribou Network



Elk Network



Mule Deer Network

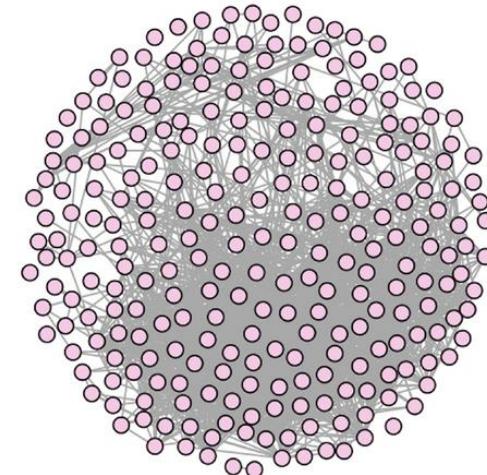


Figure from Kaur et al. (2024)

Suggested workflow and delegation of tasks

- Develop a research question
- Determine which methods could be used to answer it
- Use the resources on the website, and look for packages, papers, tutorials online
- Divide tasks
 - Looking for resources/tutorials
 - Getting data into appropriate format
 - Running analyses
 - Creating figures
 - Documenting methods
- Feel free to move between groups if you want
- Remember – not a competition – the aim is to learn!

Note on the use of generative AI – go for it but make sure you understand the code!

- good for general approaches
- does not always capture specifics of animal movement

Collaborative journal article

- Outlining the process of the workshop
- Showcasing outputs from each team
- Everyone can be a co-author
- Would require follow-up for tidying analyses, figures etc, and for putting the paper together

Possible research questions

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