

# Movement ecology hackathon: A dingo case-study



Photo by Alexander Babych

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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

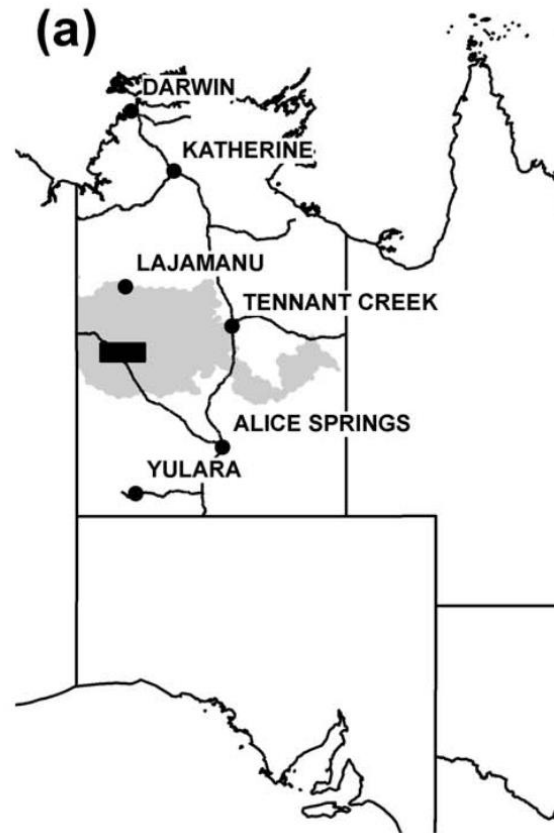
# Purpose of the workshop

- 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



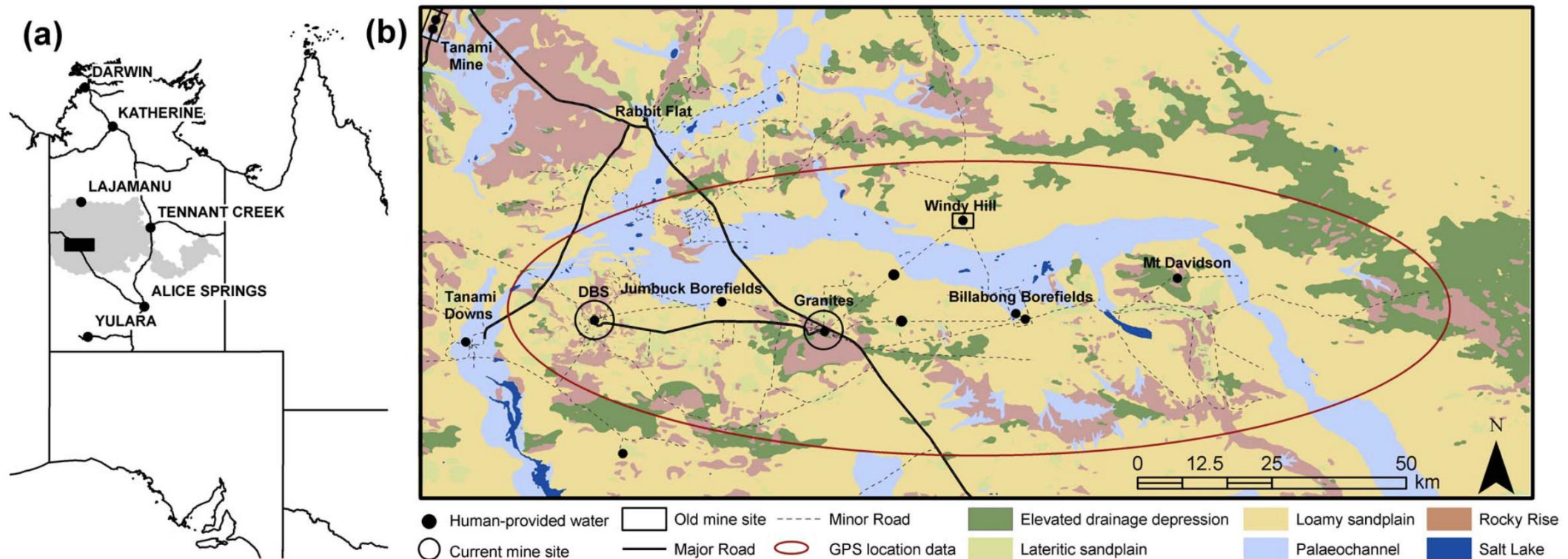
# Dingo (*Canis lupus dingo*)

- 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

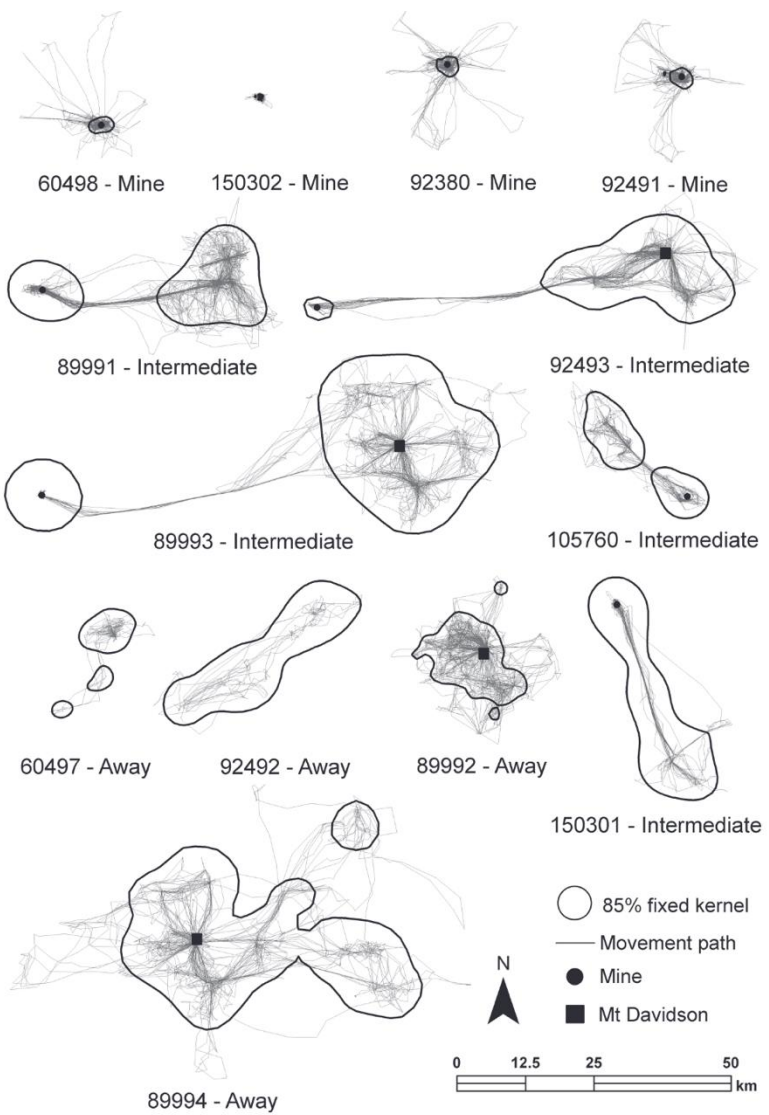


Figure 4. Fixed kernel home range estimates (85%) and movement paths of thirteen adult dingoes fitted with GPS collars in the Tanami Desert.

home range estimates

home range overlap

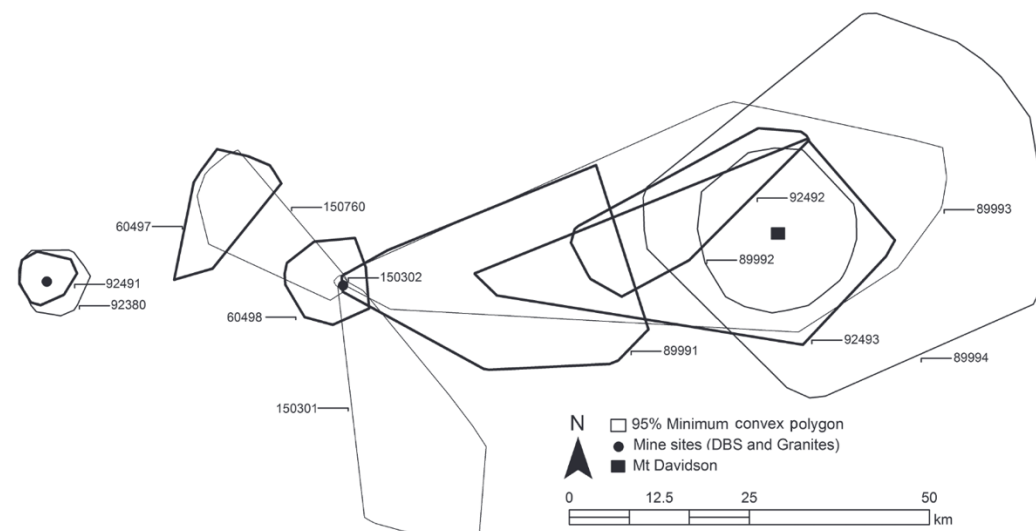
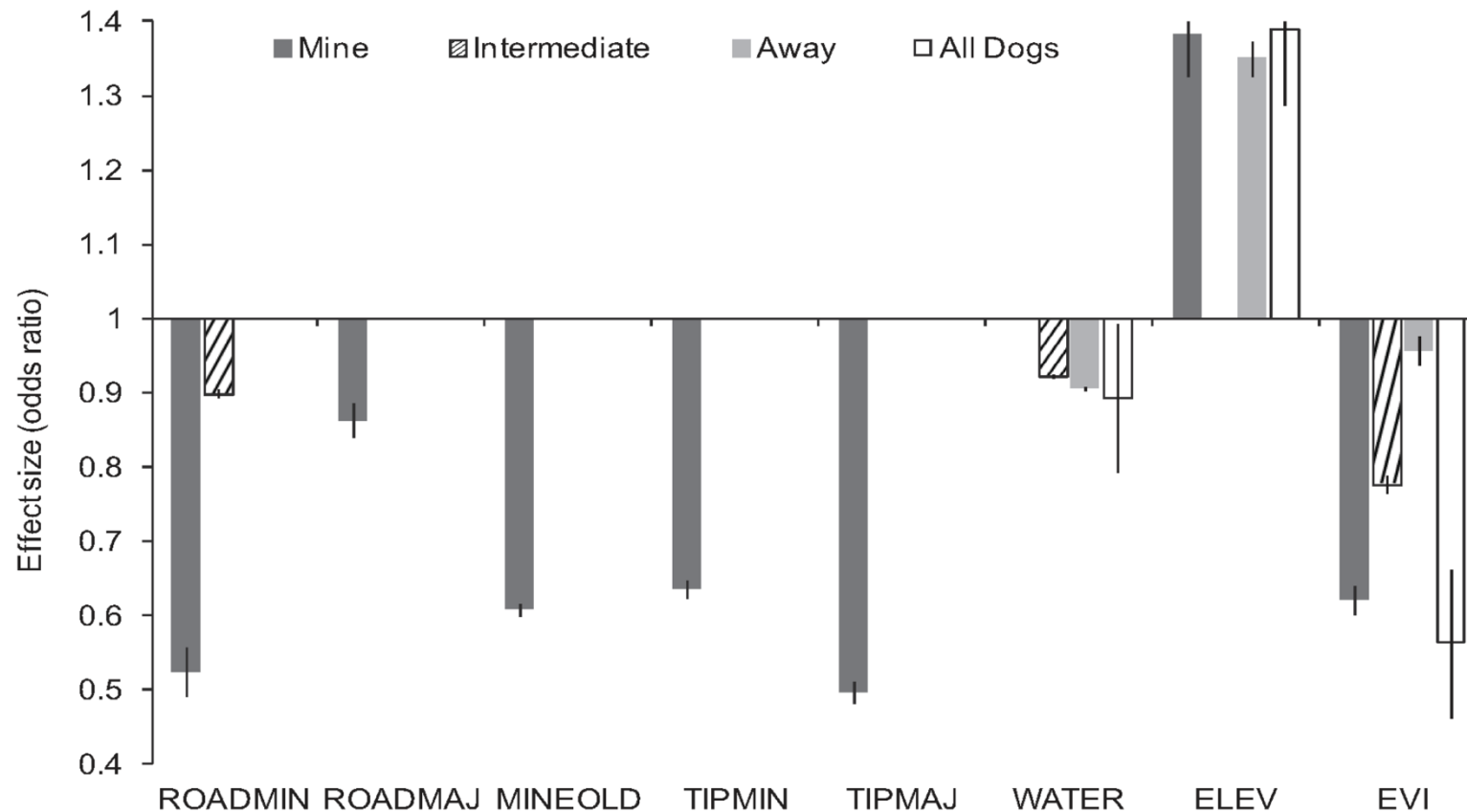


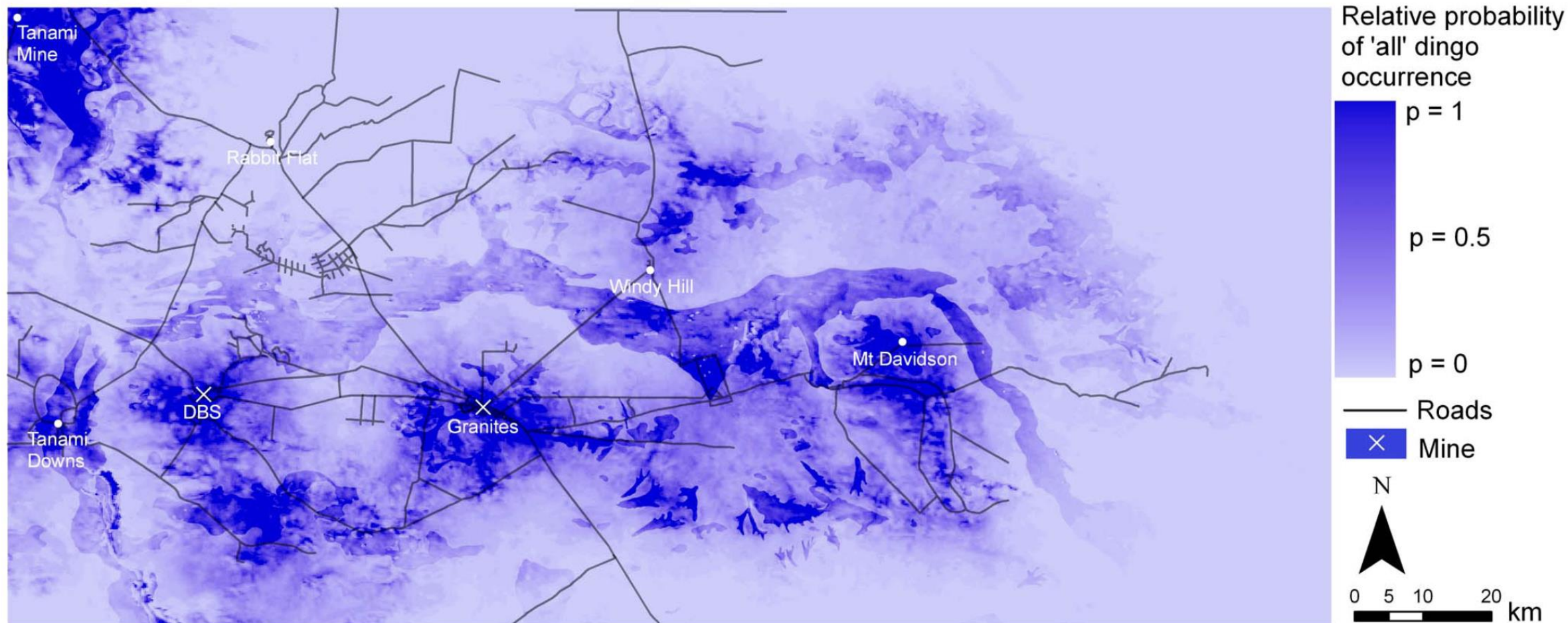
Figure 5. Overlapping minimum convex polygon (95%) home ranges for 13 adult dingoes fitted with GPS collars in the Tanami Desert.

# 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

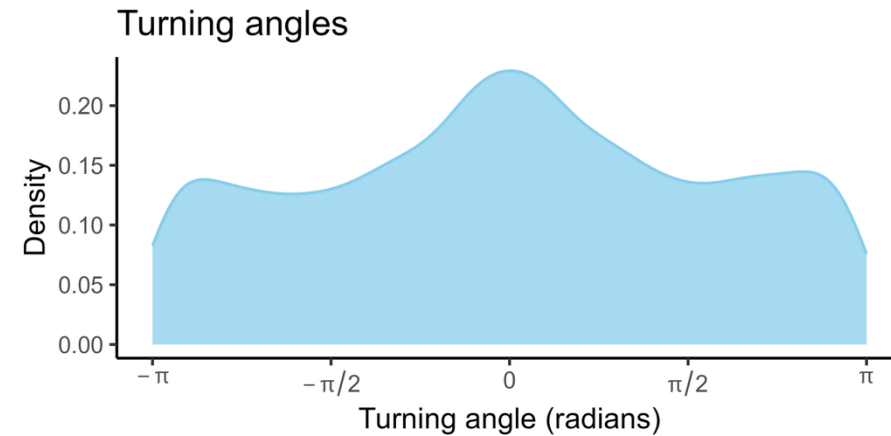
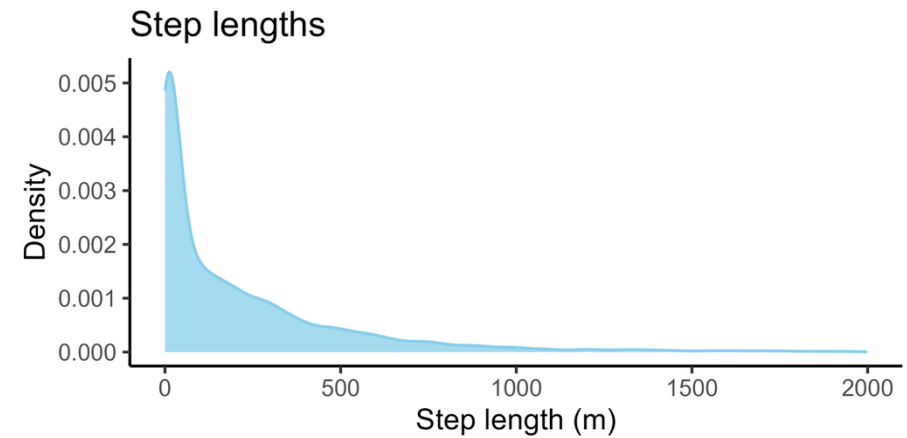
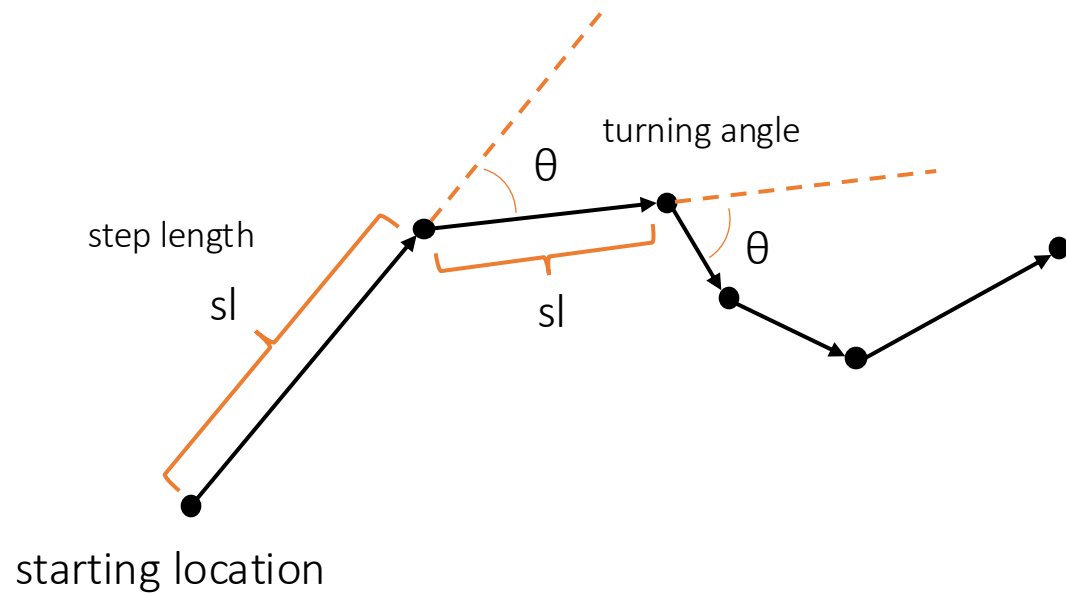
- Movement summaries
- Home range analyses (KDE, AKDE)
- Behavioural classification (HMM, BCPA)
- Resource and step selection functions (RSF, SSF)
- Revisitation analysis
- Social network analysis

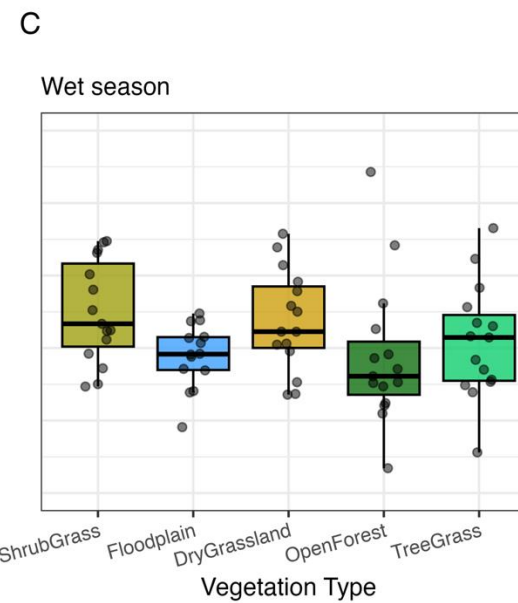
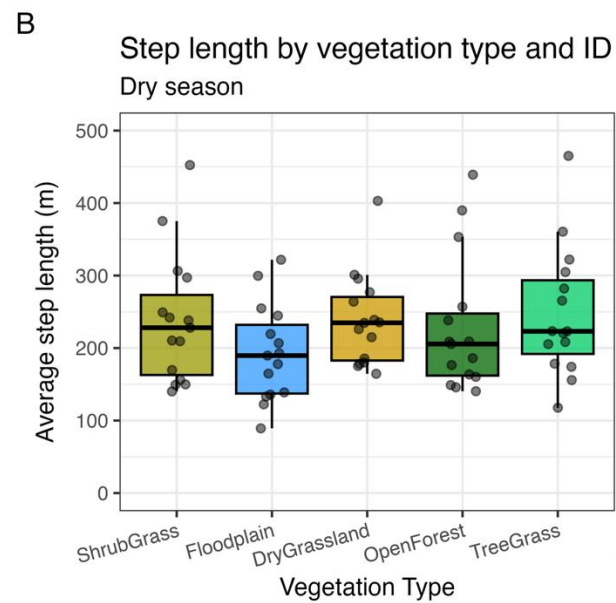
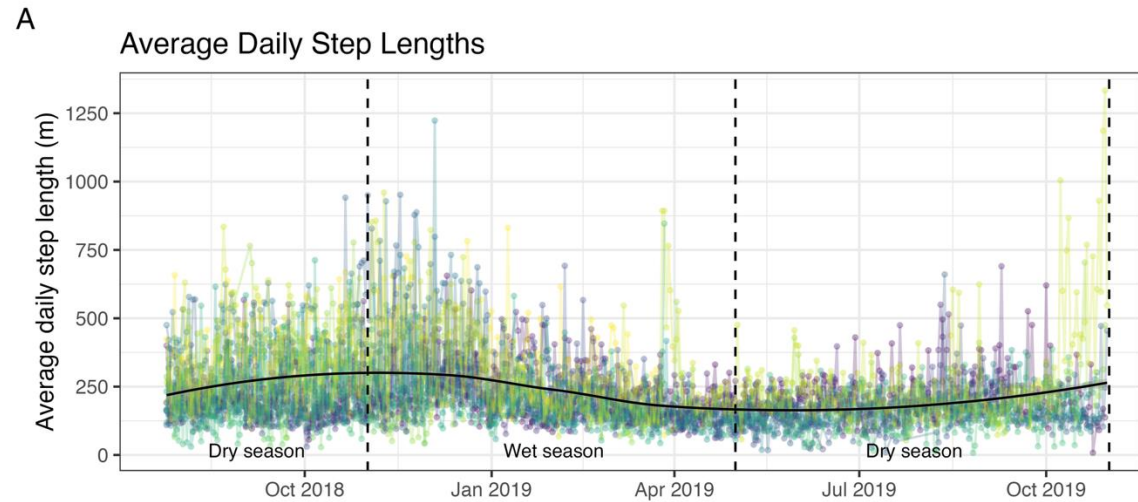


# Movement summaries

- 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'





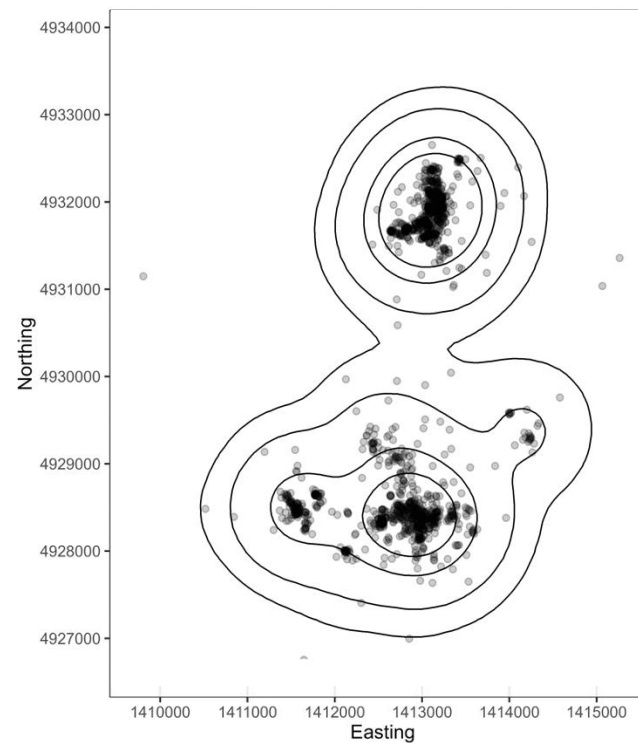
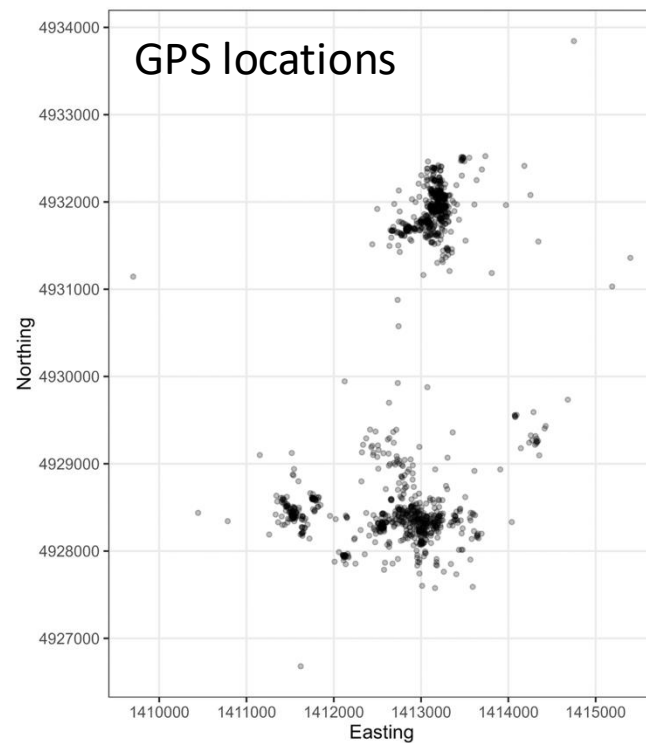
water buffalo  
(*Bubalus bubalis*)





# Home range analysis

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



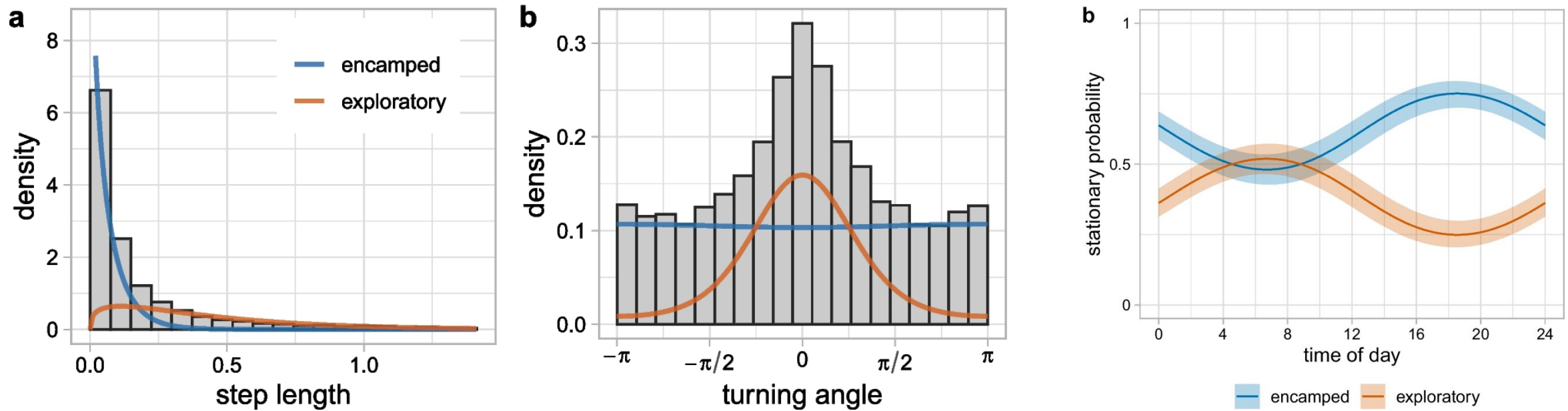
Kākā  
(*Nestor meridionalis*)

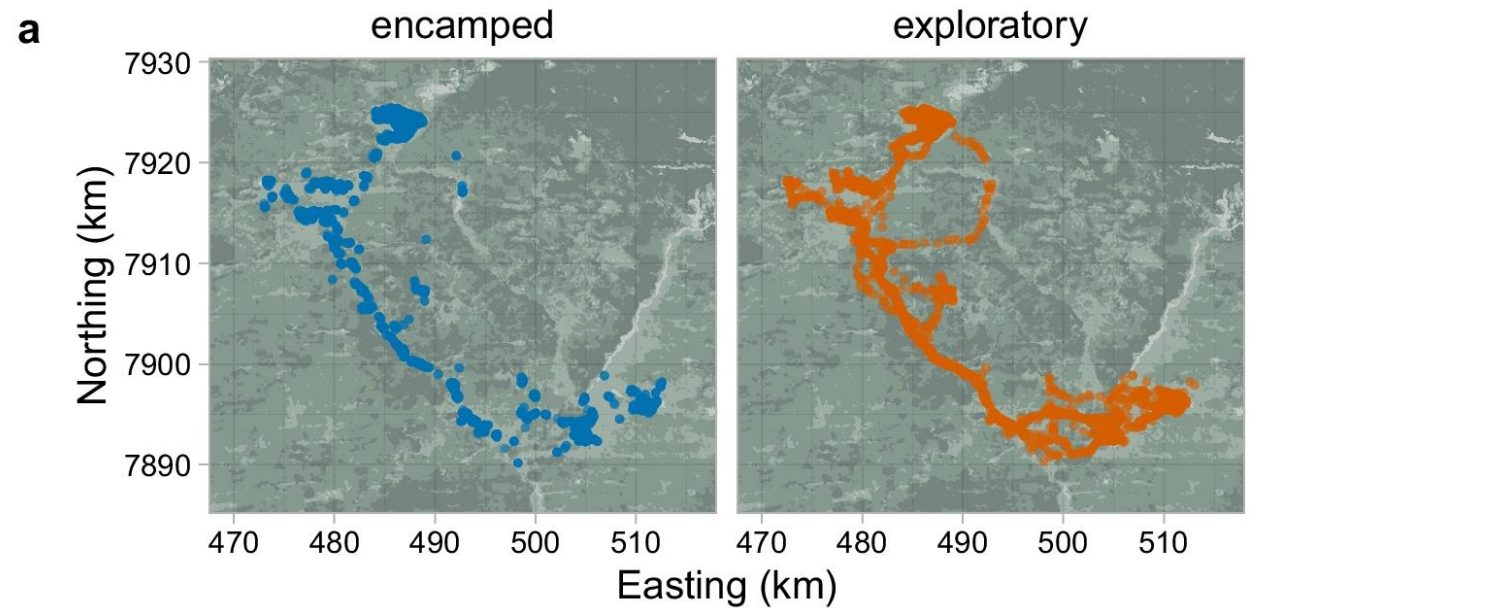


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# Behavioural classification

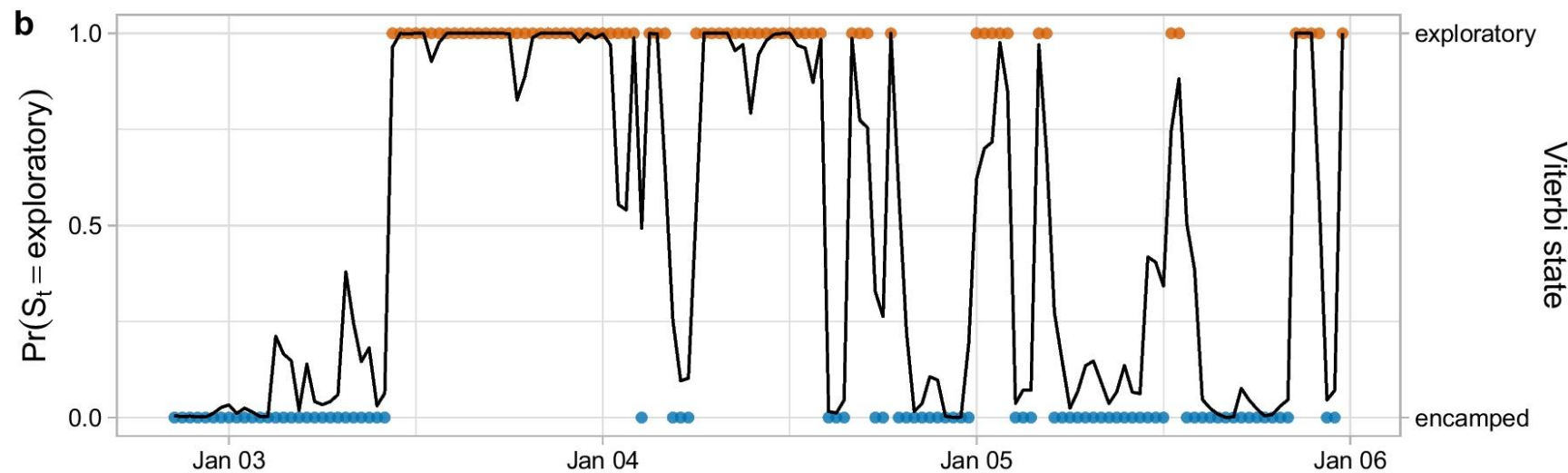
- What behaviours was the animal displaying?
- Does this relate to any covariates (time of day, spatial layers)?





Figures from Klappstein et. al (2023)

behavioural  
state of each  
GPS location



Plains zebra  
(*Equus quagga*)



# Resource and step selection functions

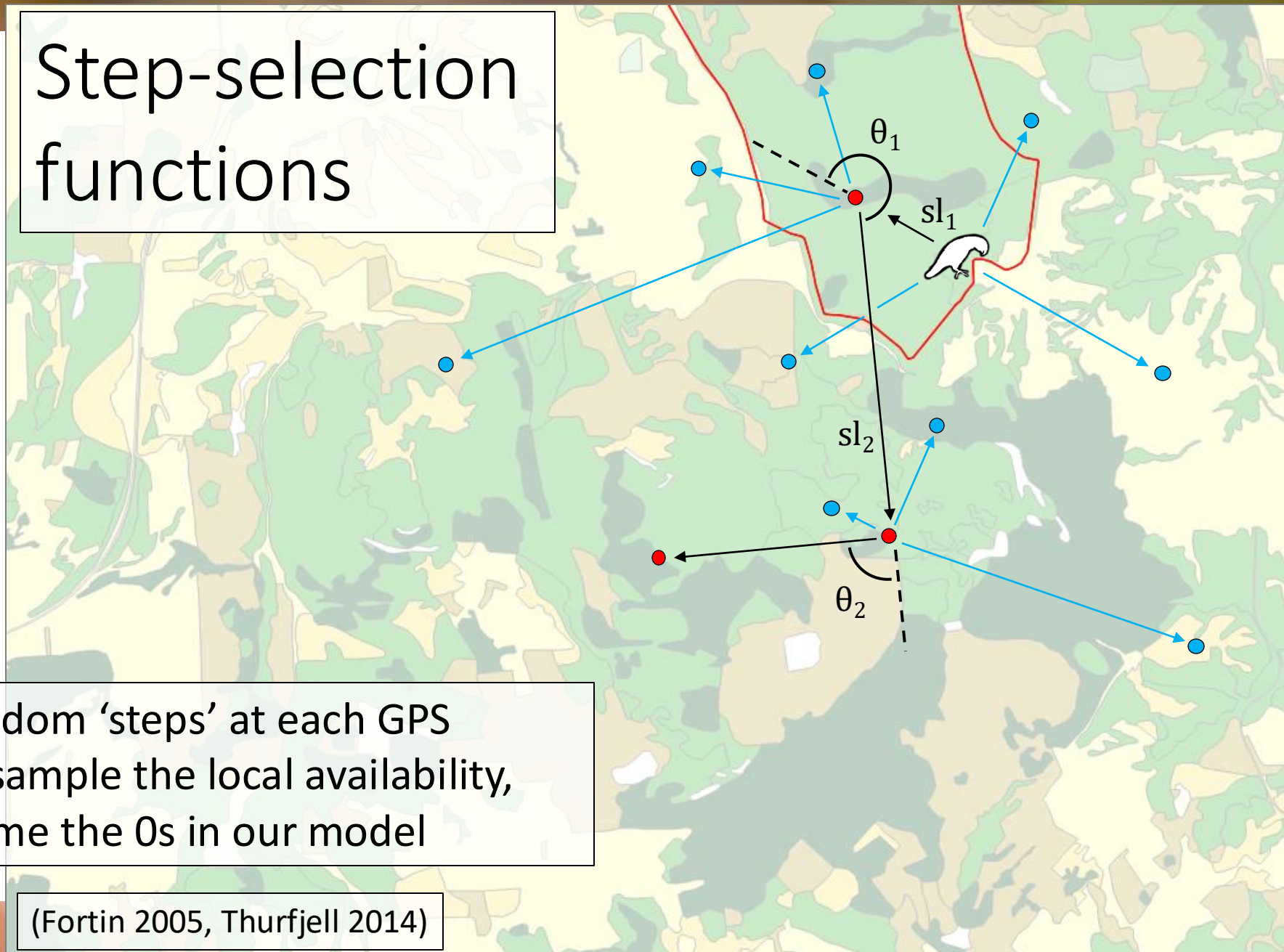
- What habitat was the animal using?
- How was the habitat affecting its movement behaviour?



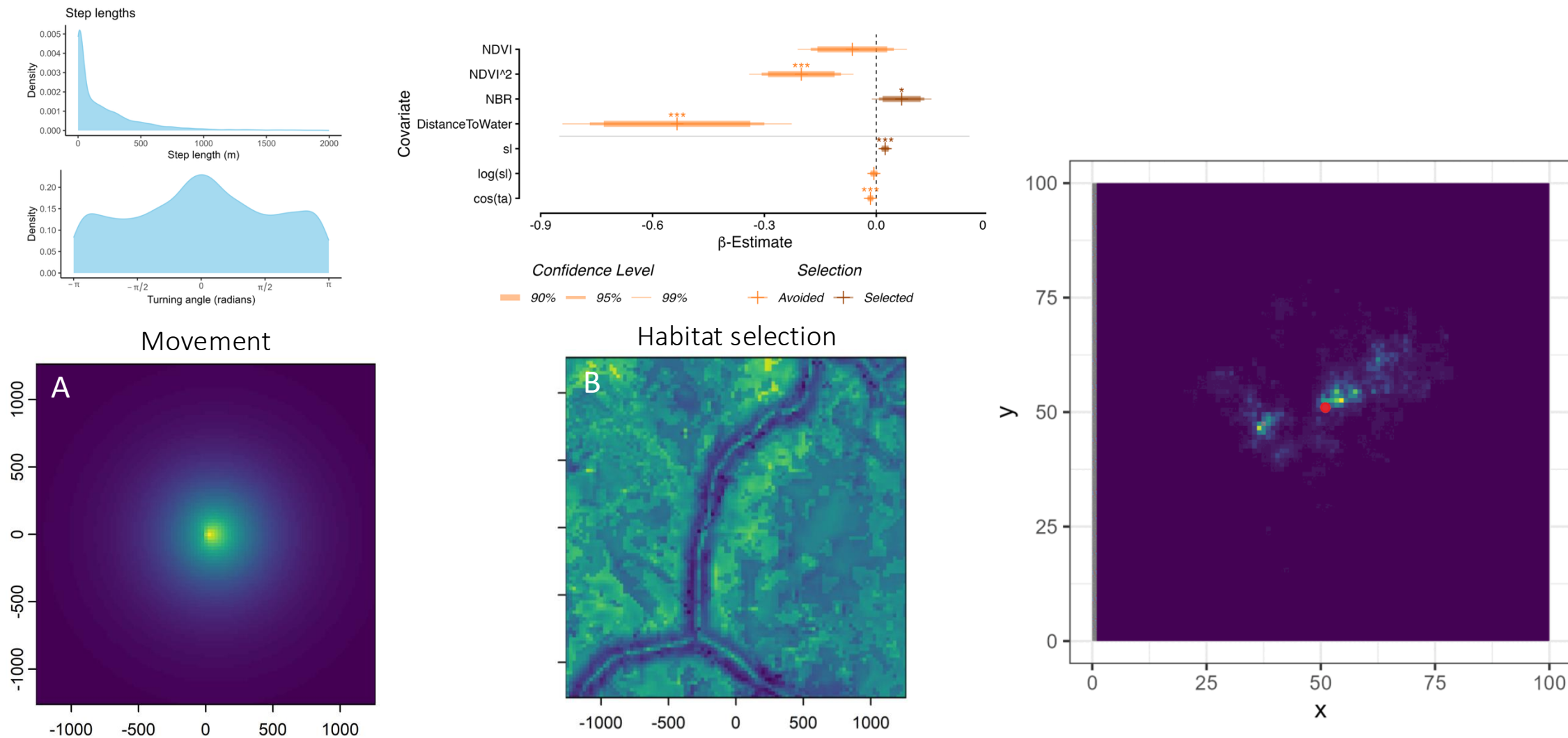
# Step-selection functions

We take random 'steps' at each GPS location to sample the local availability, which become the 0s in our model

(Fortin 2005, Thurfjell 2014)

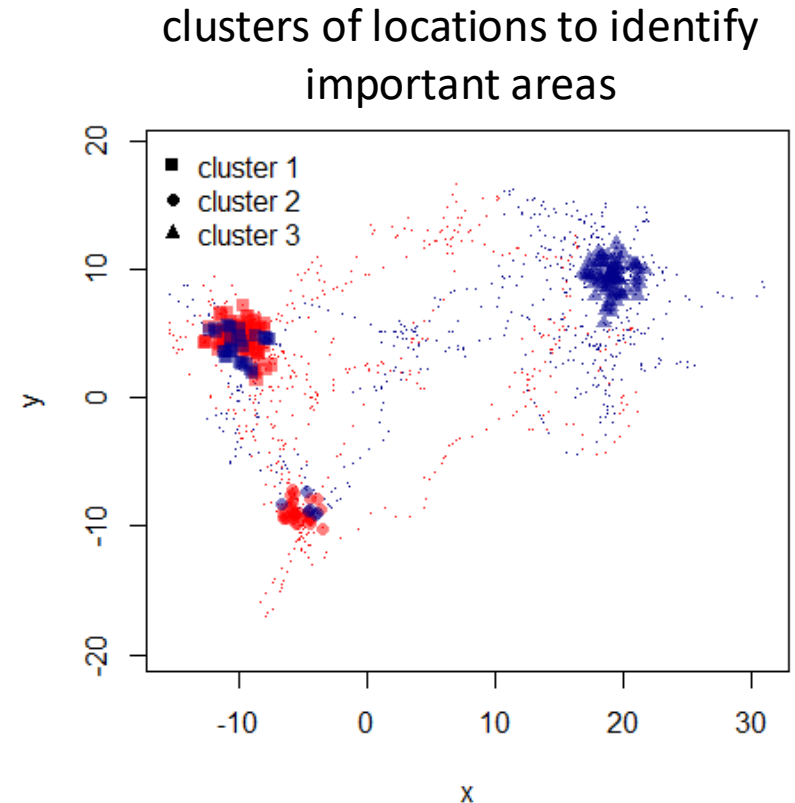
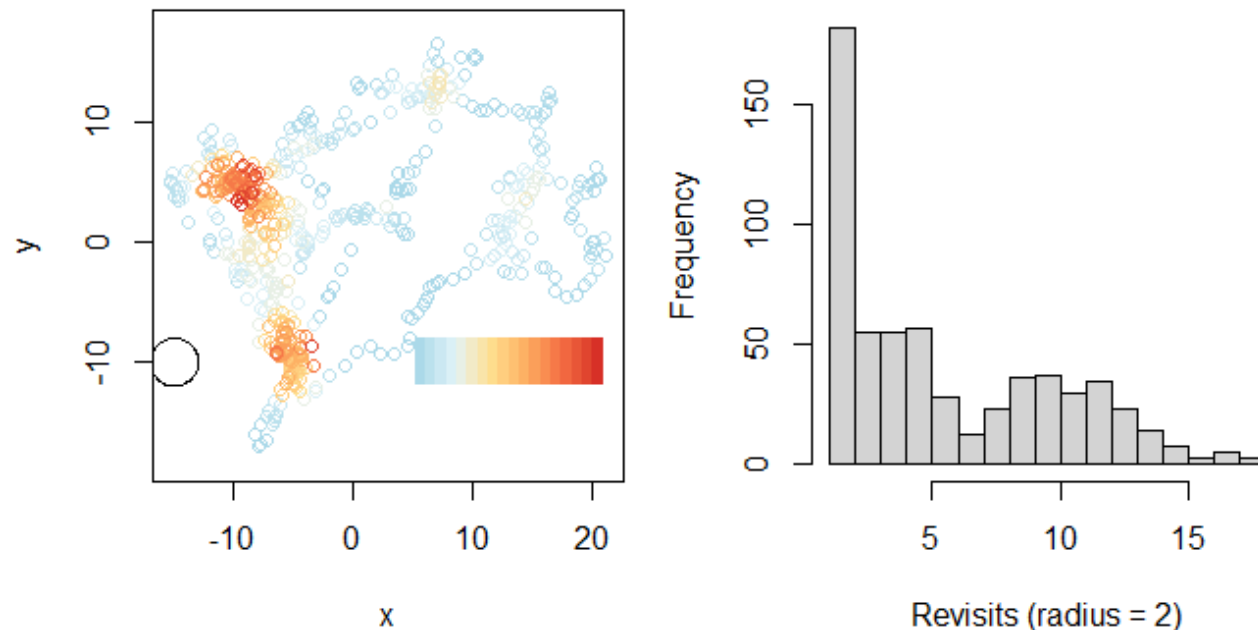


# Resource and step selection functions



# Revisitation analysis

- Where did the animal 'revisit'?



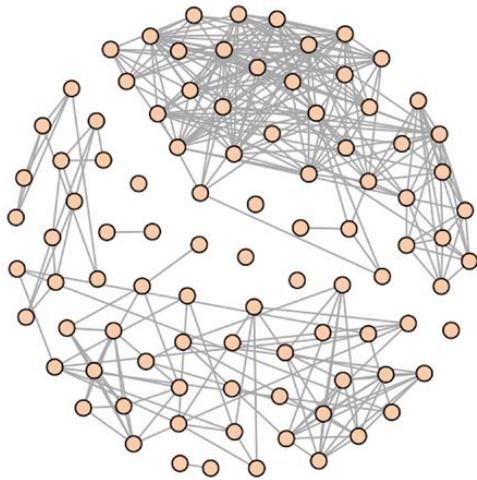
Figures from: <https://cran.r-project.org/web/packages/recurse/vignettes/recurse.html>



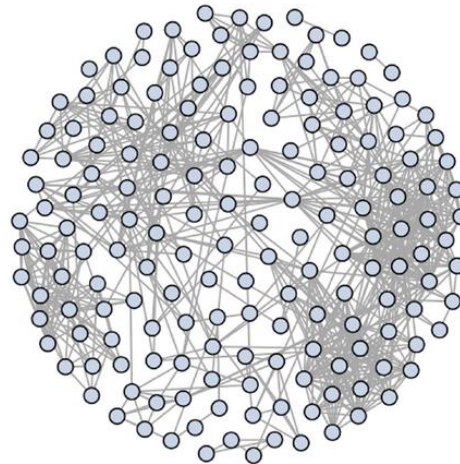
# Social network analysis

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

Caribou Network



Elk Network



Mule Deer Network

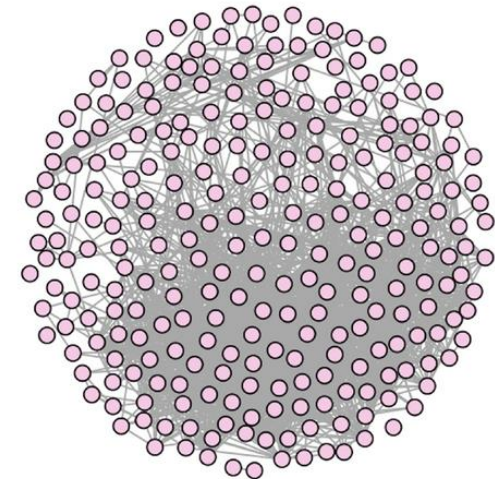


Figure from Kaur et al. (2024)



# 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

- 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?
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