

# Seasonal variation and drivers of parasite prevalence in migratory Serengeti wildebeest

Hempson, G. P., Morales, J. M., Hopcraft, J. G. C., Anderson, T. M., Devaney, E., Donaldson, J. E., Ezenwa, V. O., Holdo, R. M., Mohamed, R., McIntyre, J., Sabuni, P., Senso, B., Trentinus, A. & Morrison, T. A.















### Data overview:

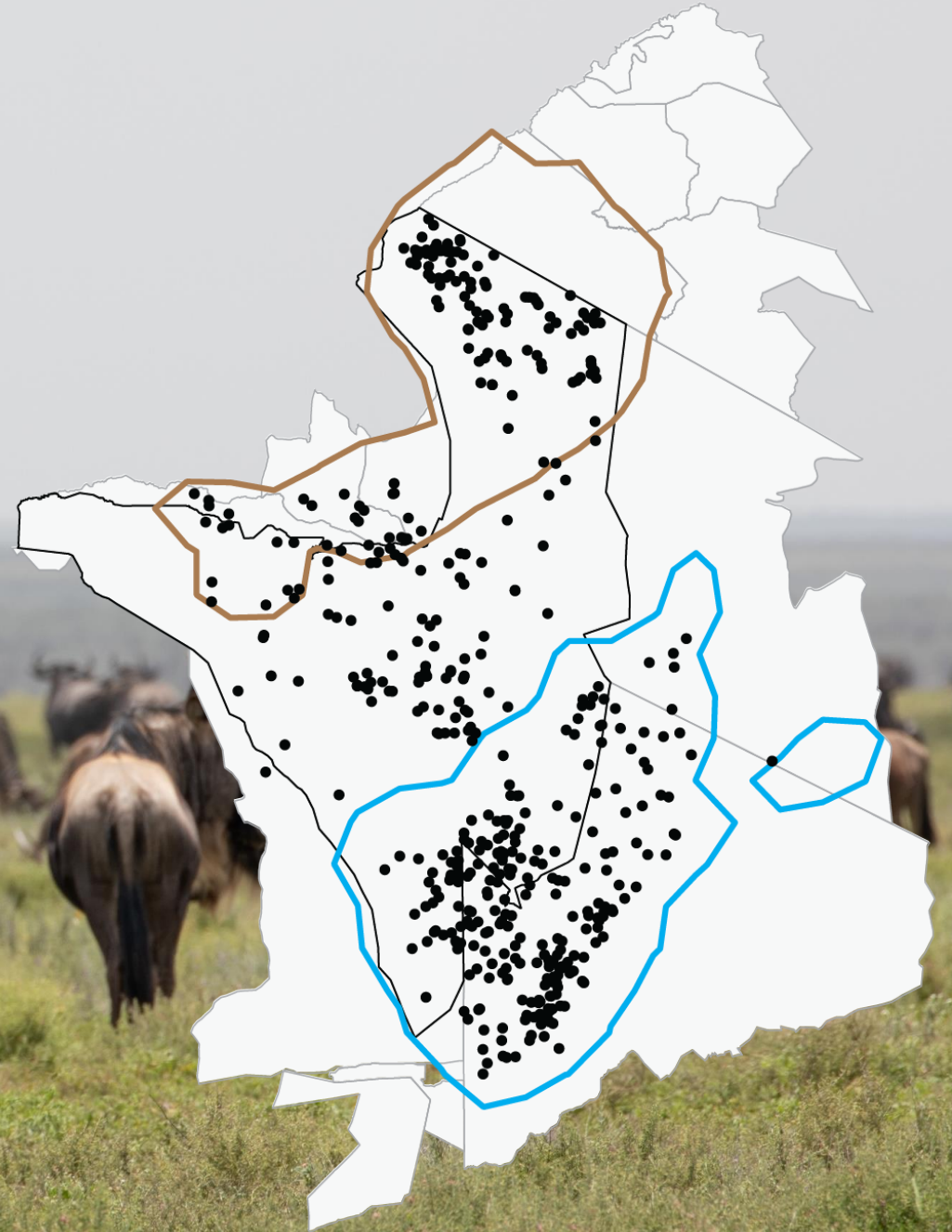
- October 2022 to December 2024
- 58 individuals GPS collars
- 476 faecal egg count (FEC) samples

### Field data:

- Calf
- Calf : Cow
- Group size

### Remote sensing data:

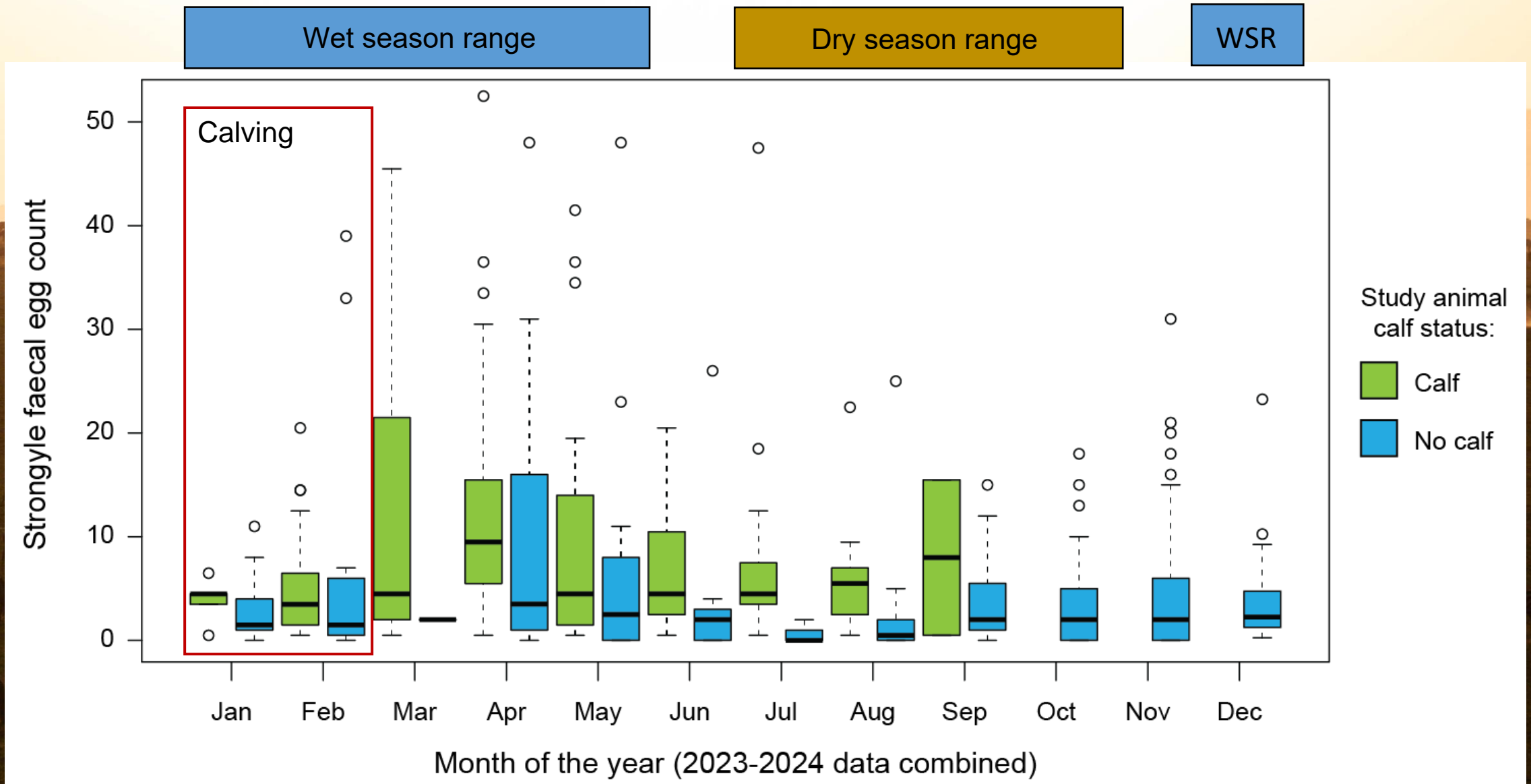
- Fire recentness
- NDVI anomaly (2001-2024 mean)
- Woody cover



When and where are strongyle nematode infections highest in migratory wildebeest?



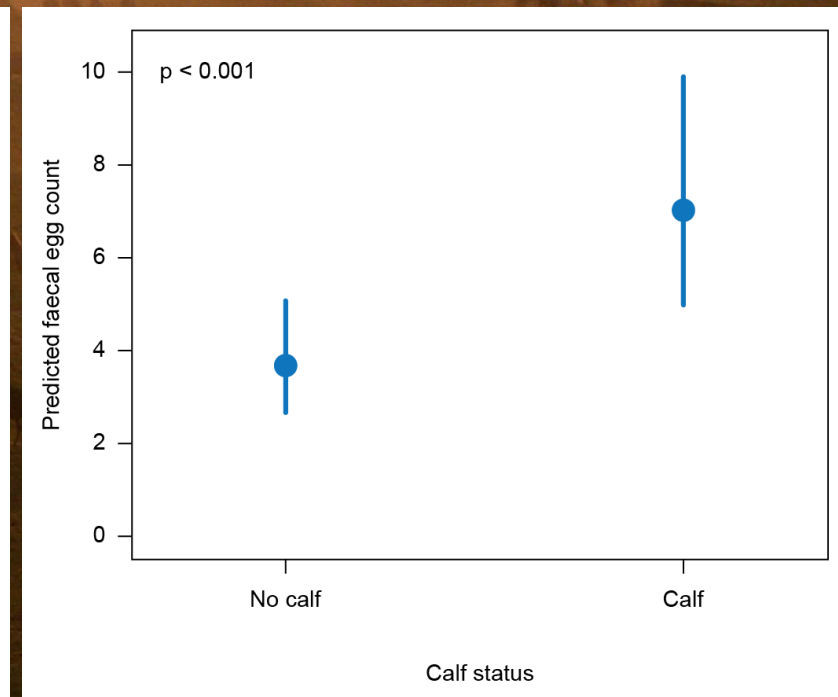
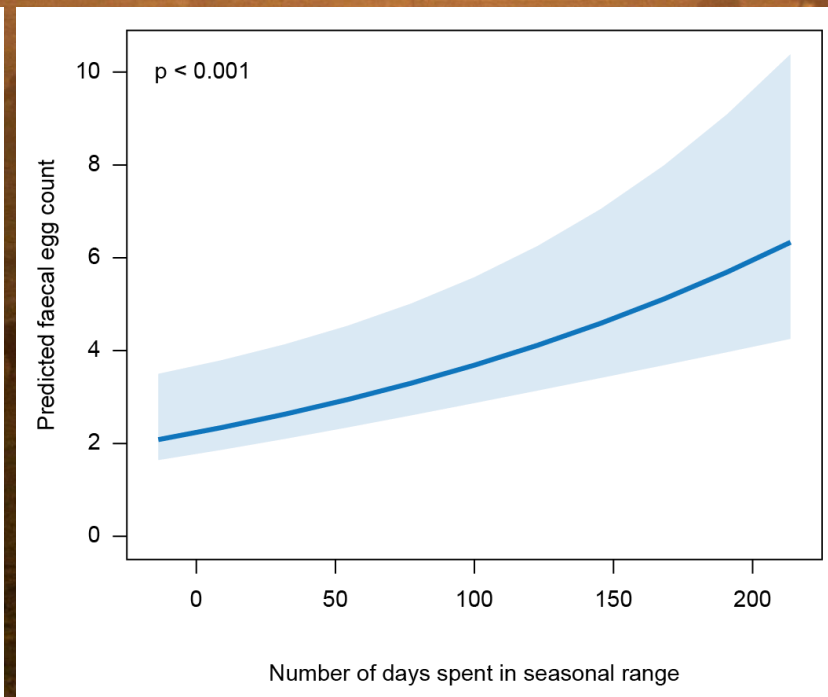
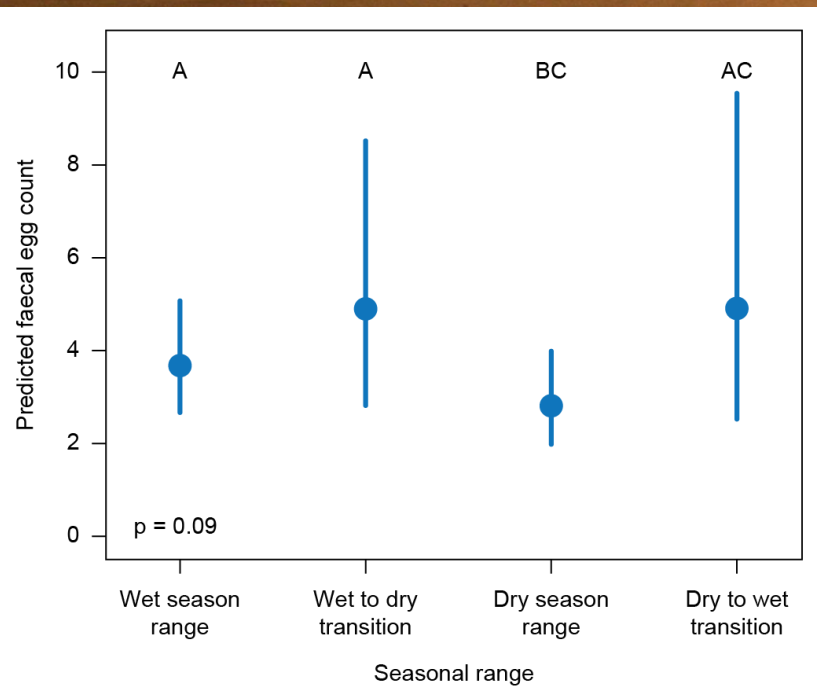
When and where are strongyle nematode infections highest in migratory wildebeest?



# When and where are strongyle nematode infections highest in migratory wildebeest?

Mixed effect model: negative binomial

$$\text{FEC} \sim \text{Seasonal range} + \text{Days in Range} + \text{Calf} + (1|\text{Individual})$$



When and where are strongyle nematode infections highest in migratory wildebeest?

- 1) Wildebeest have higher parasite infection levels during the wet season
- 2) Parasite infection levels increase while animals are more sedentary during the wet and dry season
- 3) Wildebeest with calves have higher parasite infection levels



Positive feedback

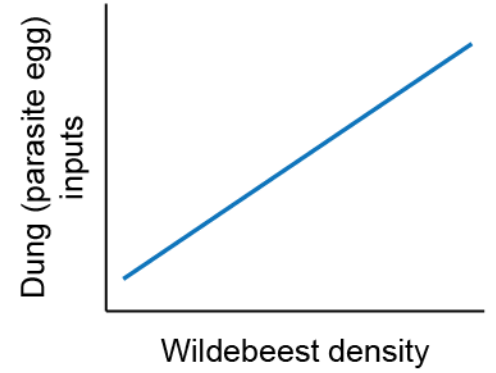




1. Calving females aggregate

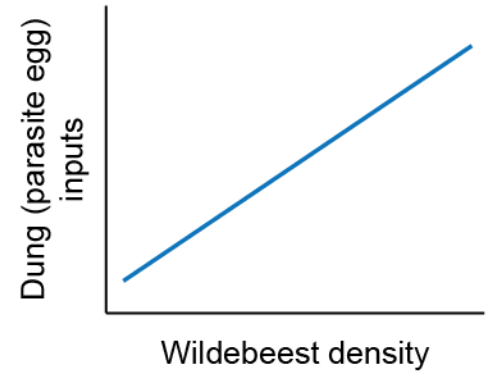


Positive feedback

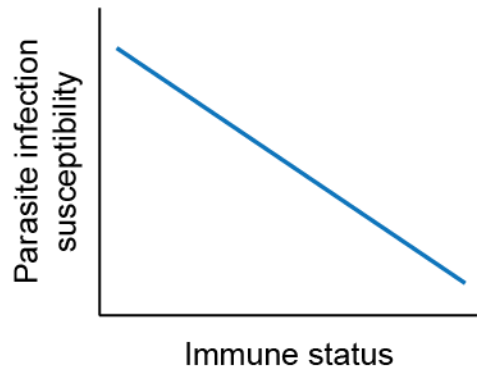




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2. Calving causes immunosuppression

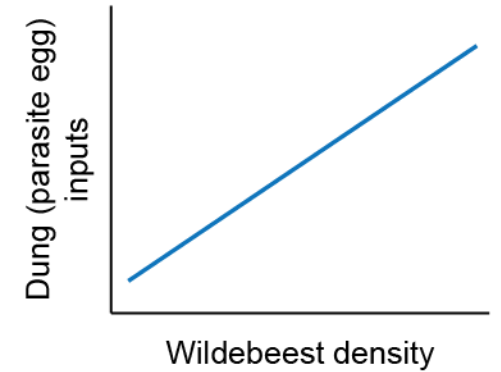


Positive feedback



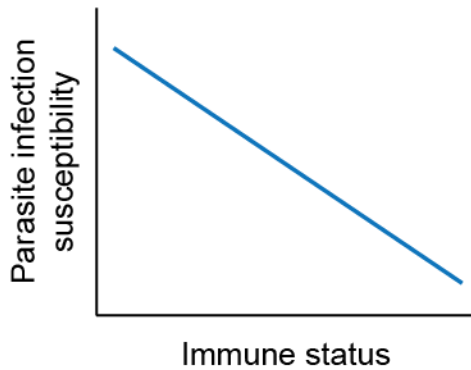


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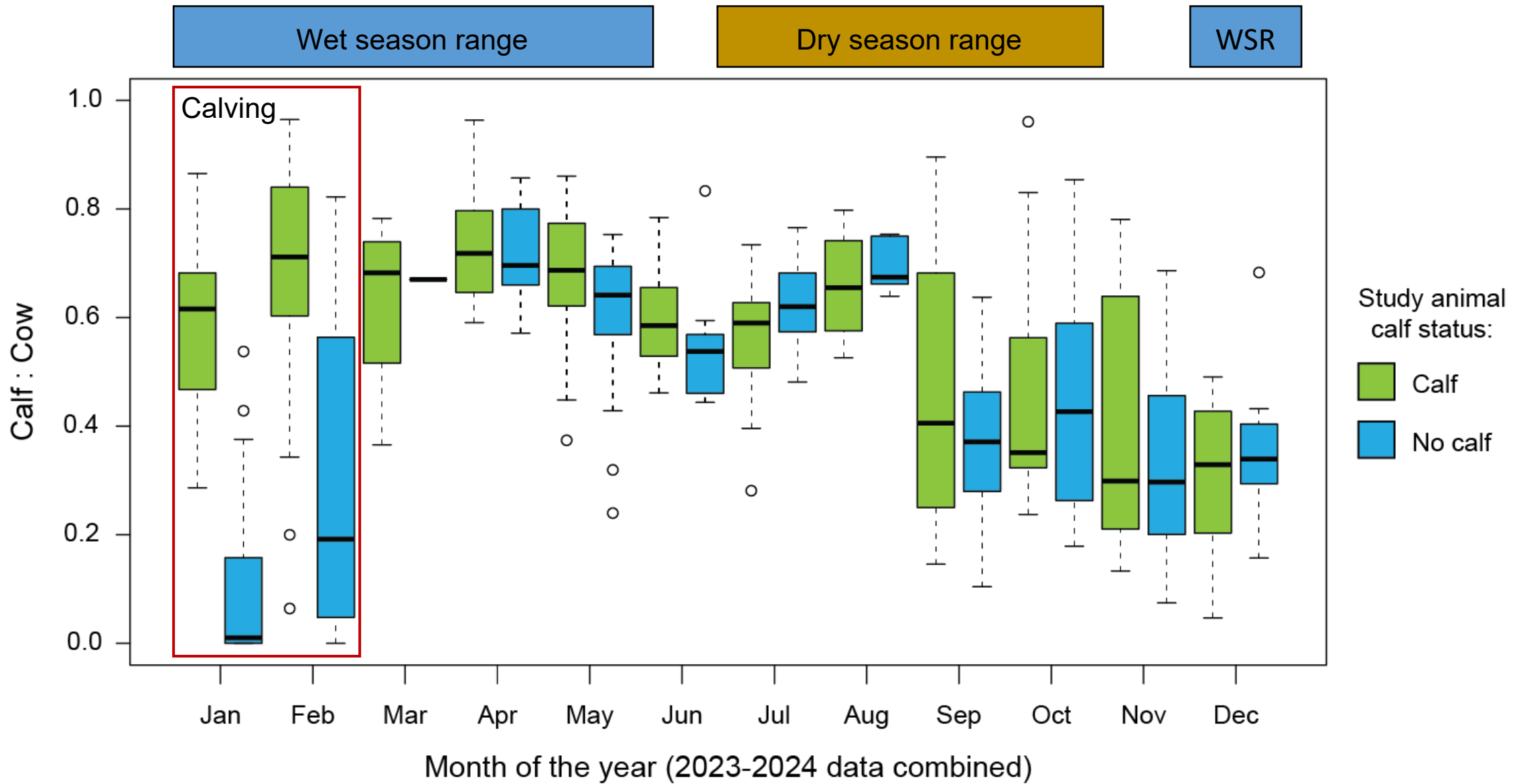
3. Both calf presence & parasite burden reduce animal mobility

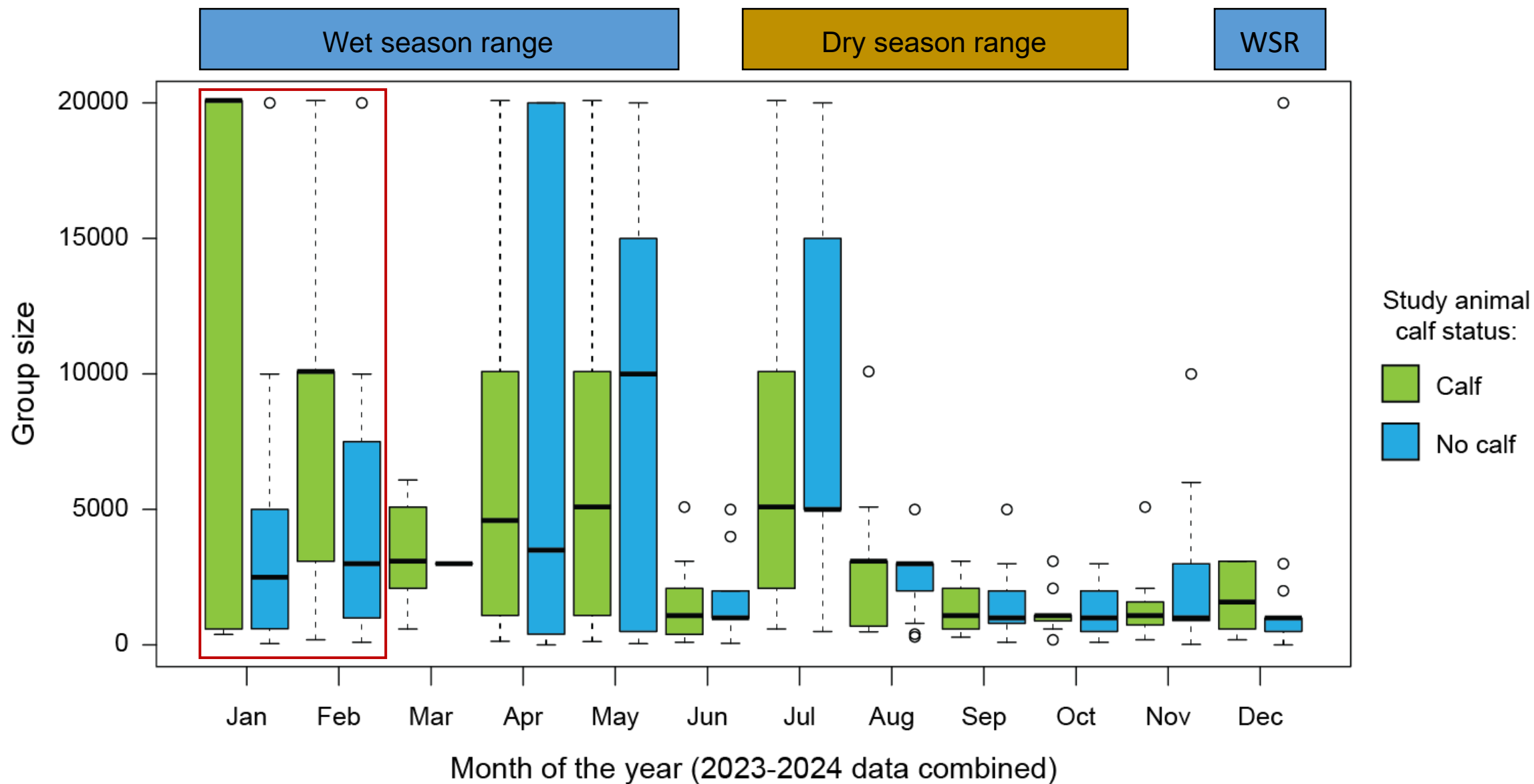
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Positive feedback







Evidence so far:

Wet season FEC > dry season FEC?

- Dense calving aggregations – support for “calving feedback”
- Immunosuppression likely – well-established in livestock

Movement effects – exacerbate feedback?

Habitat properties – effects on larval survival?

- Wet/humid conditions favour survival
- Fires in dry season range kill larvae directly and modify microclimate (hot and dry)



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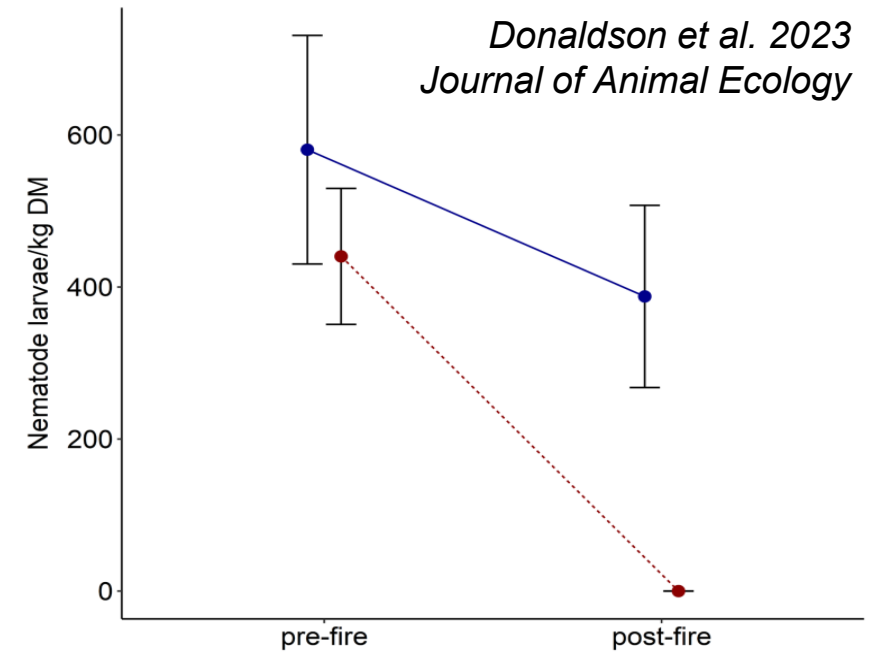
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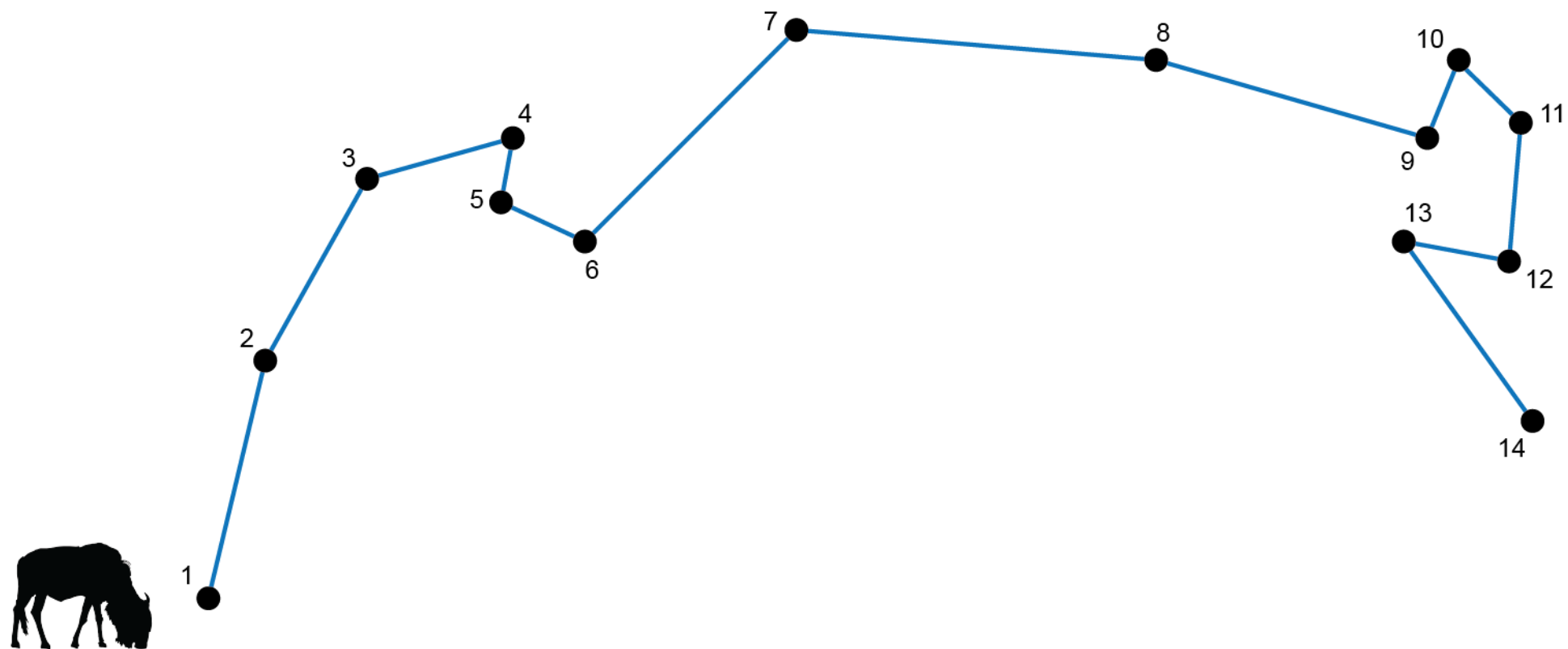
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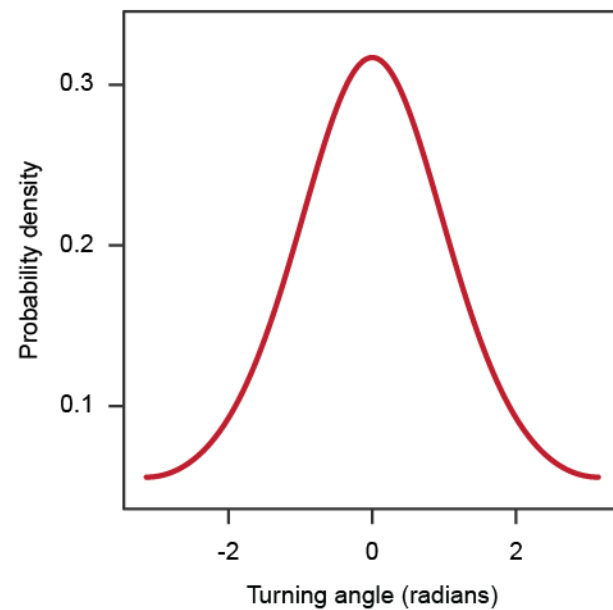
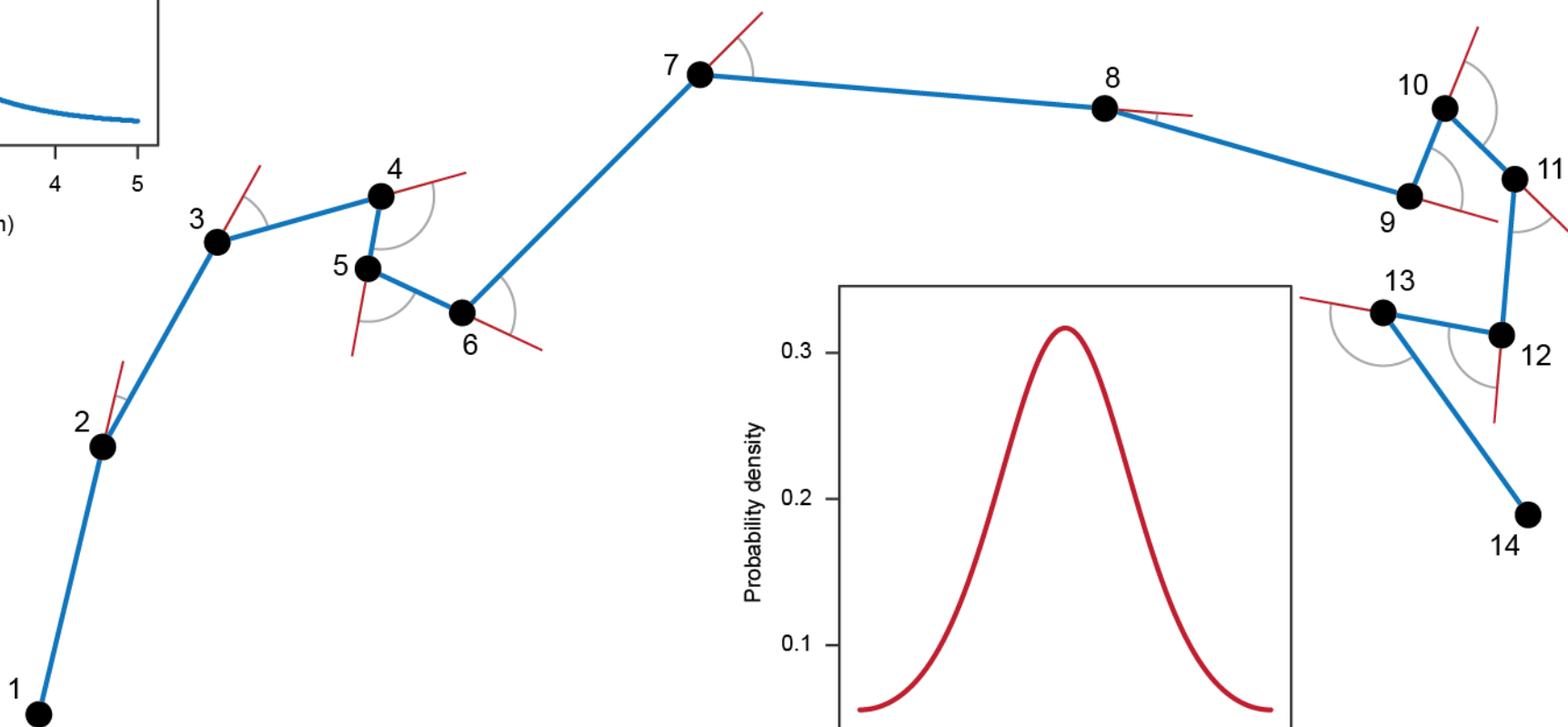
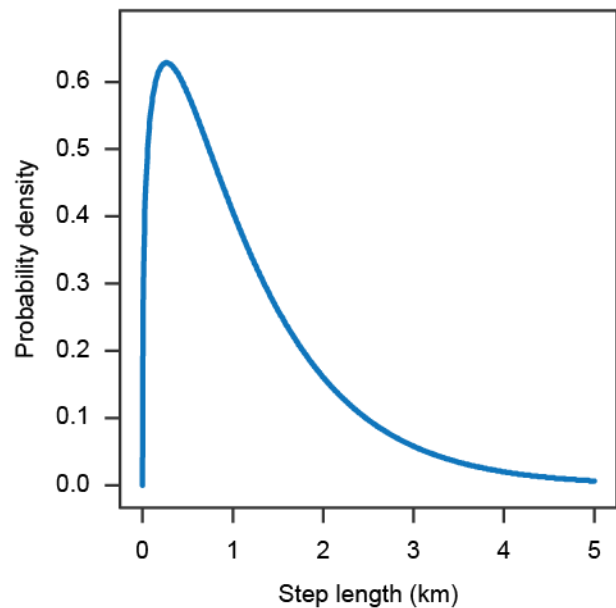
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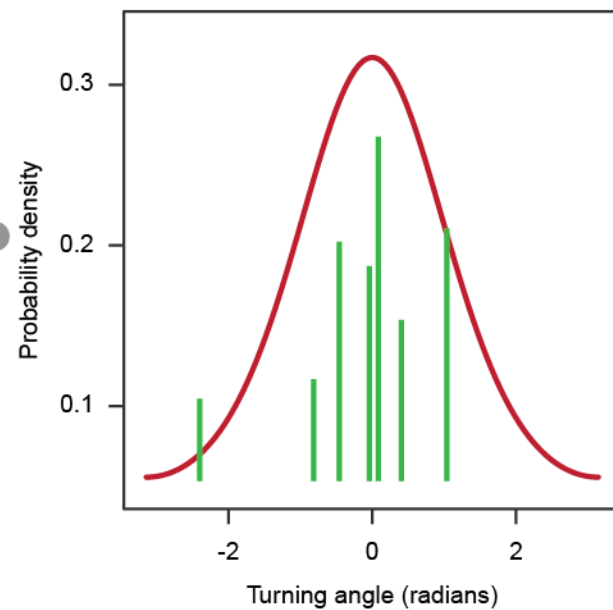
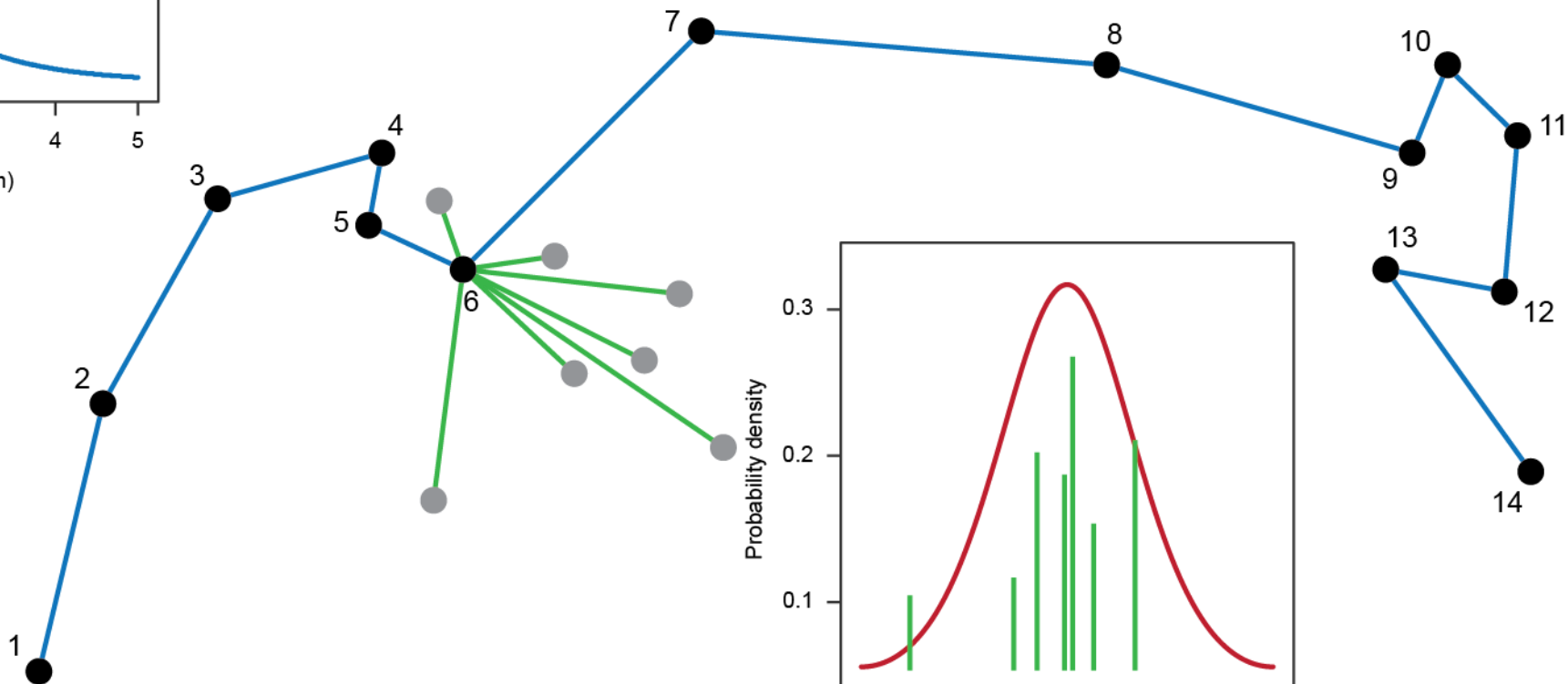
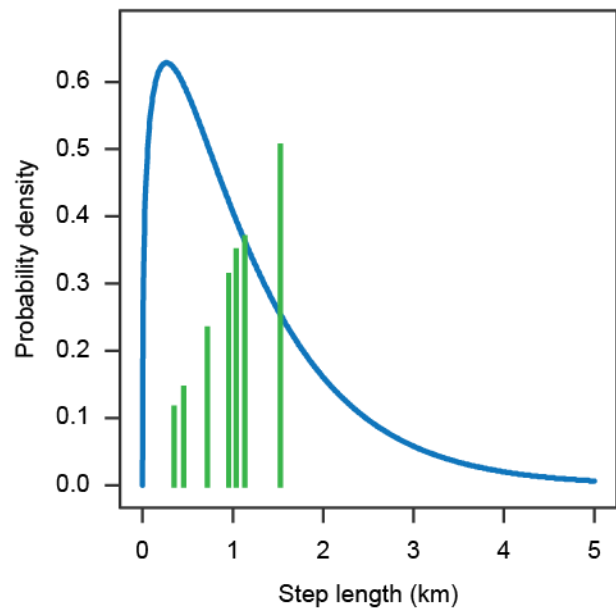
# Integrated Step Selection Analysis



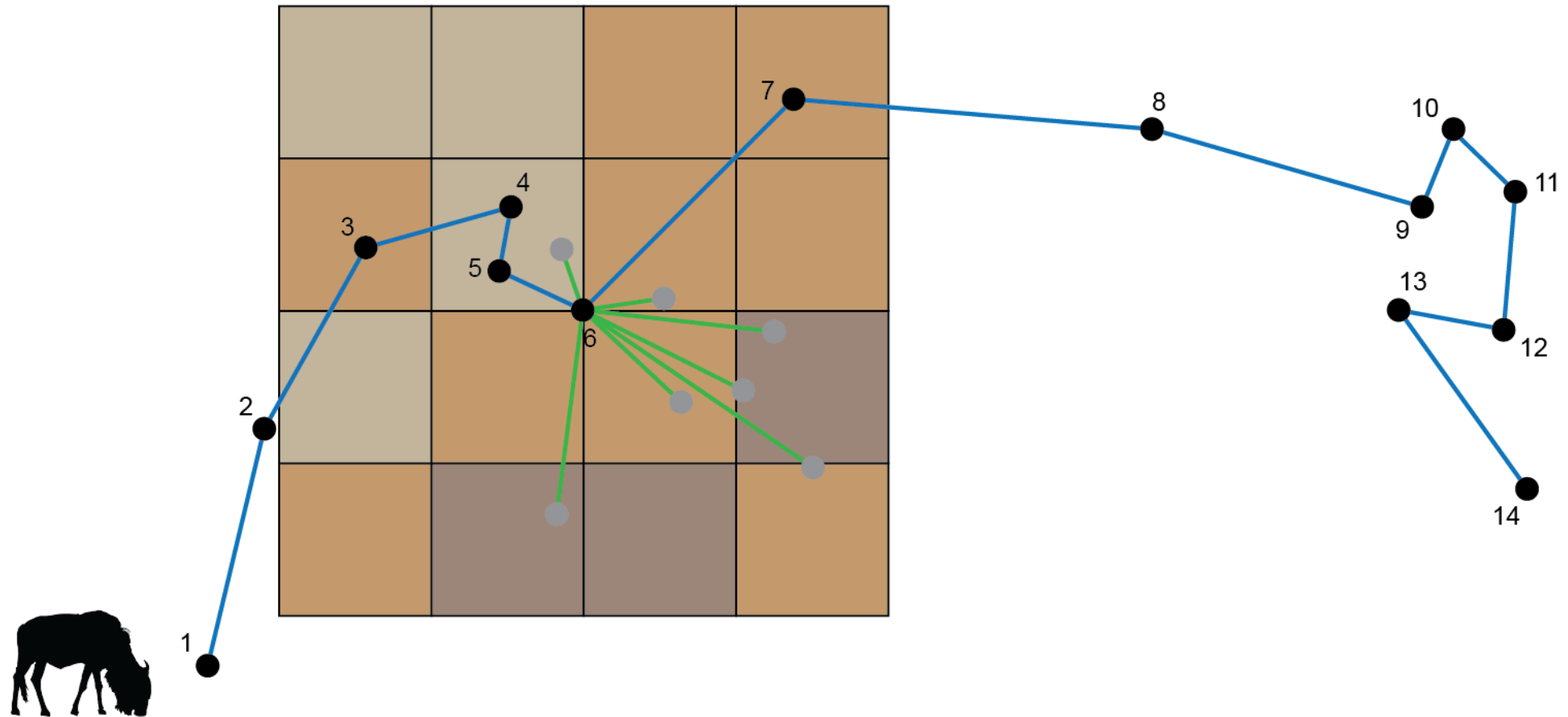
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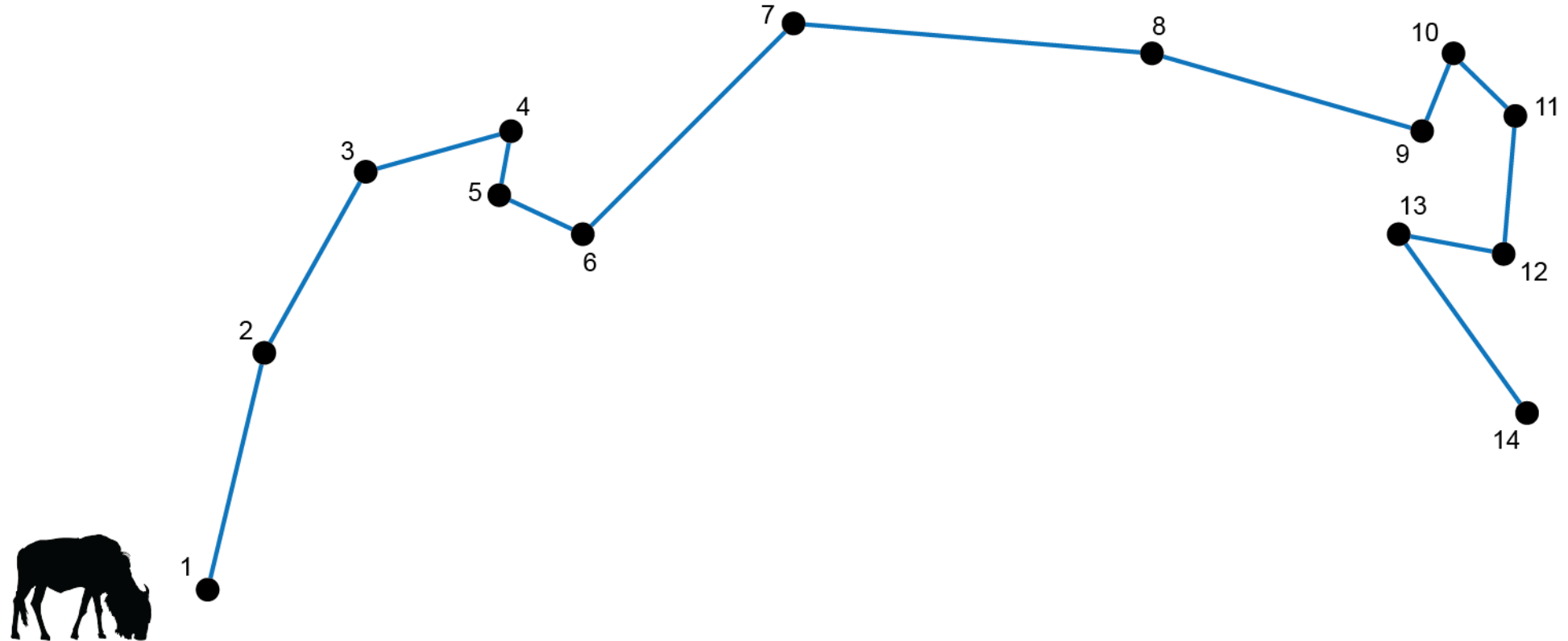


# Integrated Step Selection Analysis

Habitat: NDVI anomaly + Fire recentness + Woody cover

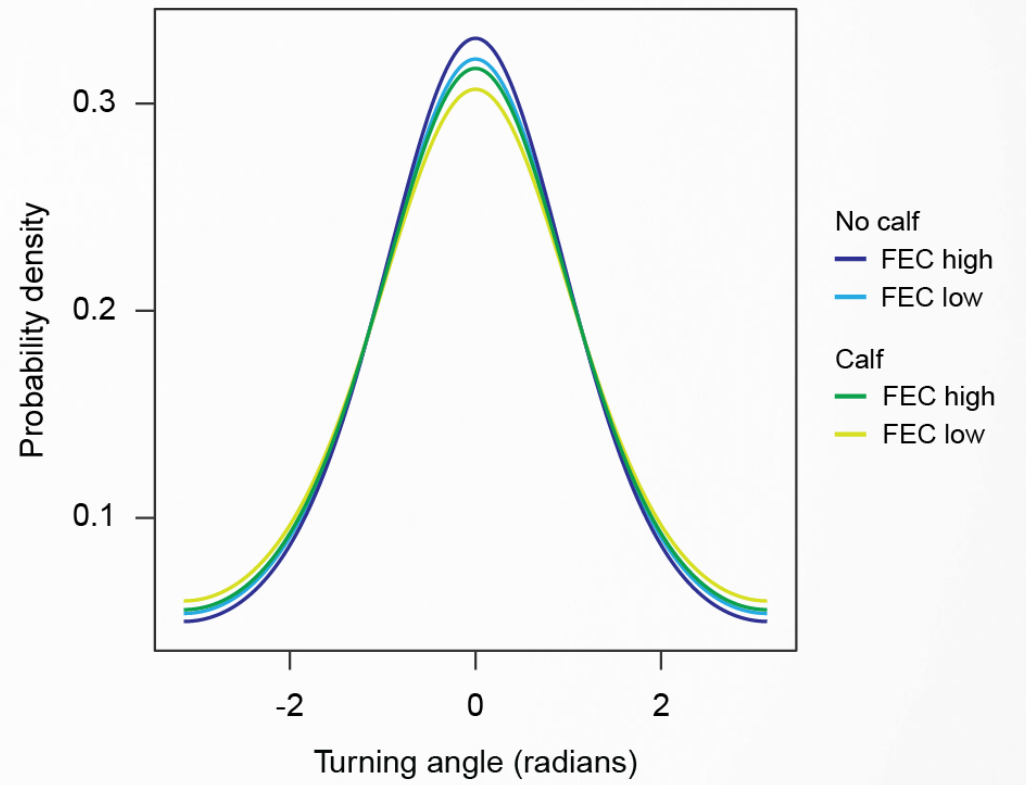
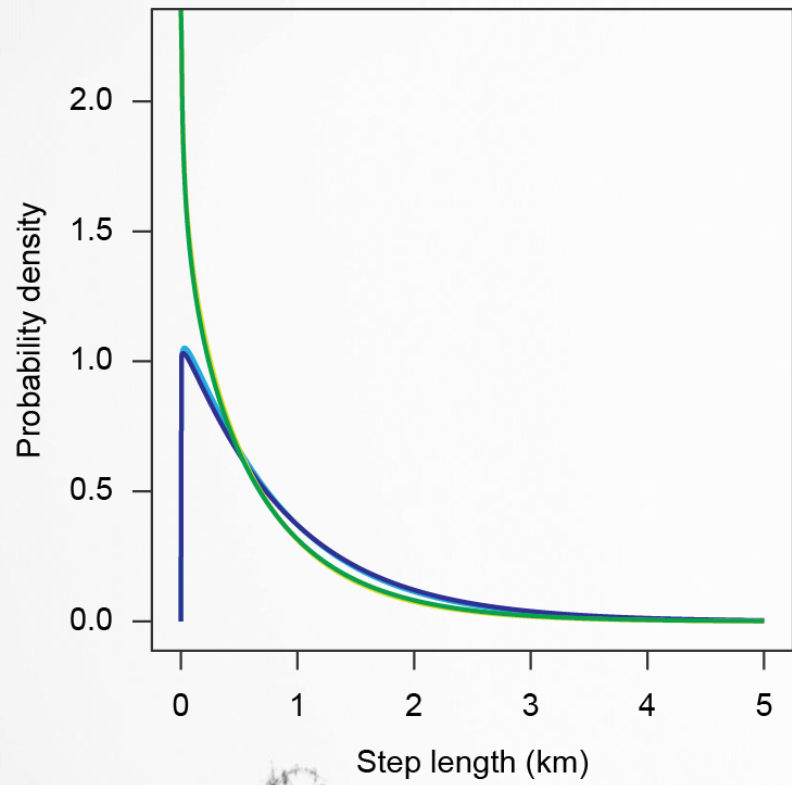
Movement: Step length +  $\log(\text{Step length})$  +  $\cos(\text{Turning angle})$

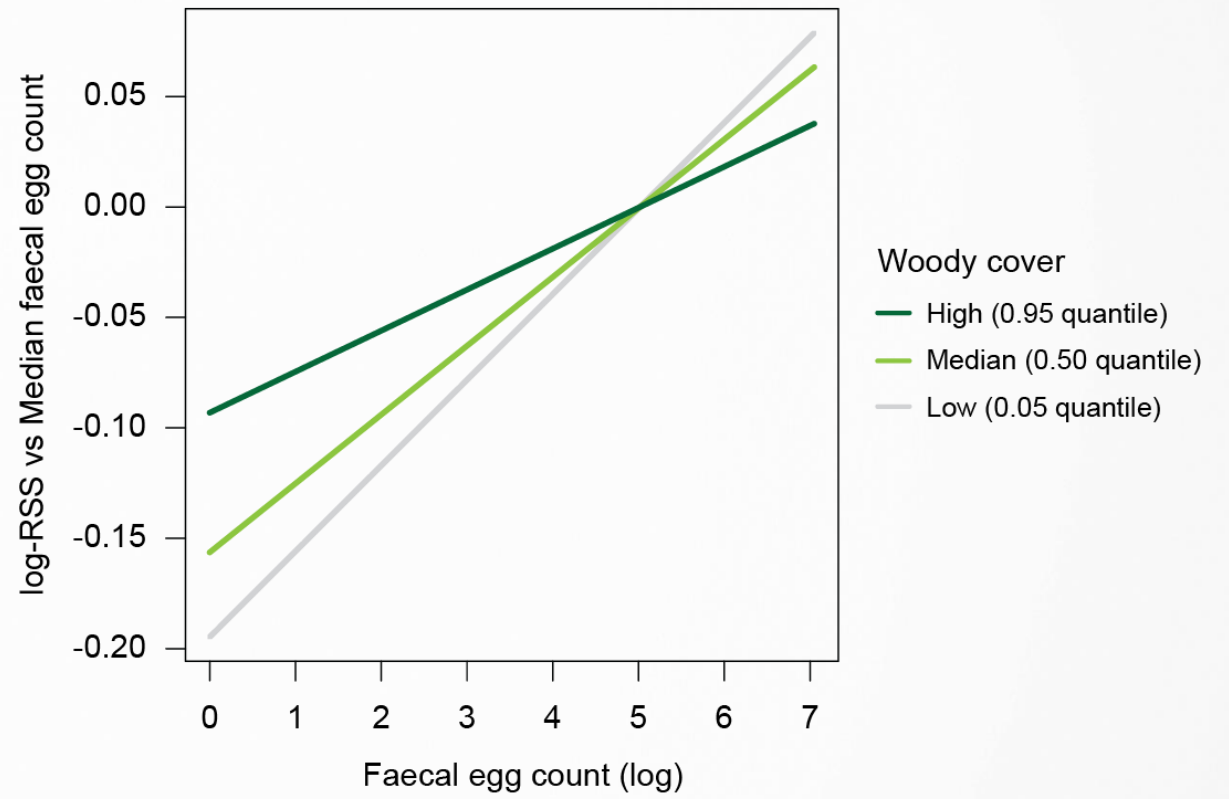
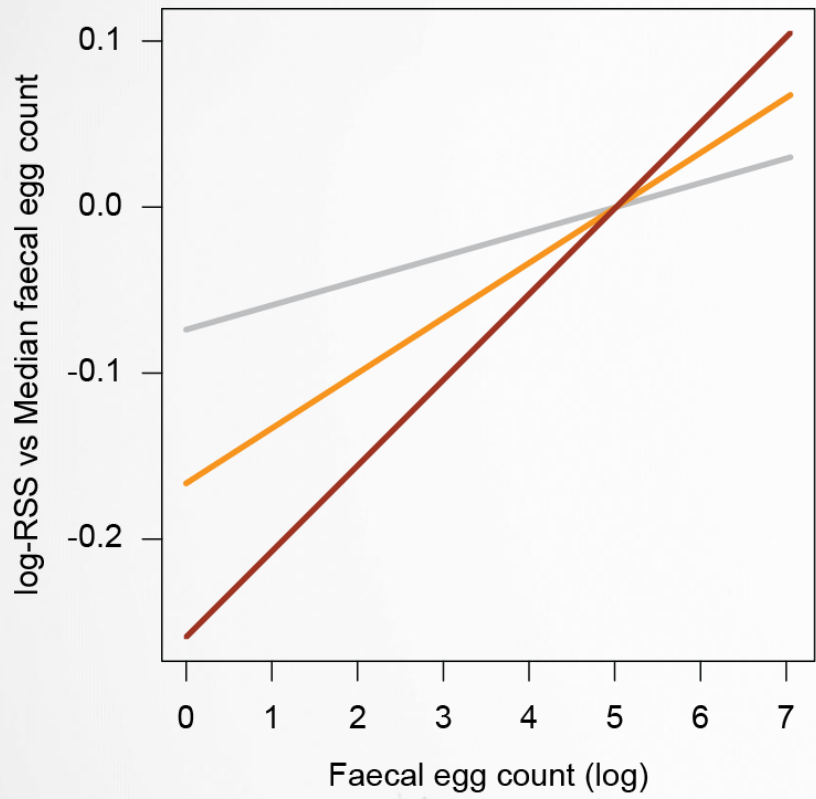
Use  $\sim$  Habitat + FEC:Habitat + Movement + FEC:Movement + Calf:Movement + (1|Individual)



	Mean	SD	10%	50%	90%
<i>Habitat selection</i>					
NDVI anomaly	-0.217	0.299	-0.596	-0.217	0.171
Fire recentness	-0.022	0.067	-0.107	-0.021	0.065
Woody cover	-0.539	0.045	-0.597	-0.537	-0.484
<i>Habitat selection × FEC</i>					
NDVI anomaly:FEC	0.016	0.062	-0.063	0.016	0.096
Fire recentness:FEC	0.041	0.016	0.021	0.041	0.061
Woody cover:FEC	-0.012	0.011	-0.025	-0.012	0.002
<i>Movement</i>					
Step length	-0.023	0.027	-0.058	-0.022	0.010
log(Step length)	0.119	0.026	0.086	0.119	0.153
cos(Turning angle)	0.019	0.025	-0.014	0.019	0.052
<i>Movement × FEC</i>					
Step length:FEC	0.011	0.007	0.002	0.011	0.019
log(Step length):FEC	-0.002	0.006	-0.009	-0.002	0.005
cos(Turning angle):FEC	0.007	0.006	0.000	0.007	0.015
<i>Movement × Calf</i>					
Step length:Calf	-0.130	0.031	-0.169	-0.130	-0.090
log(Step length):Calf	-0.155	0.025	-0.186	-0.155	-0.124
cos(Turning angle):Calf	-0.076	0.031	-0.115	-0.077	-0.038

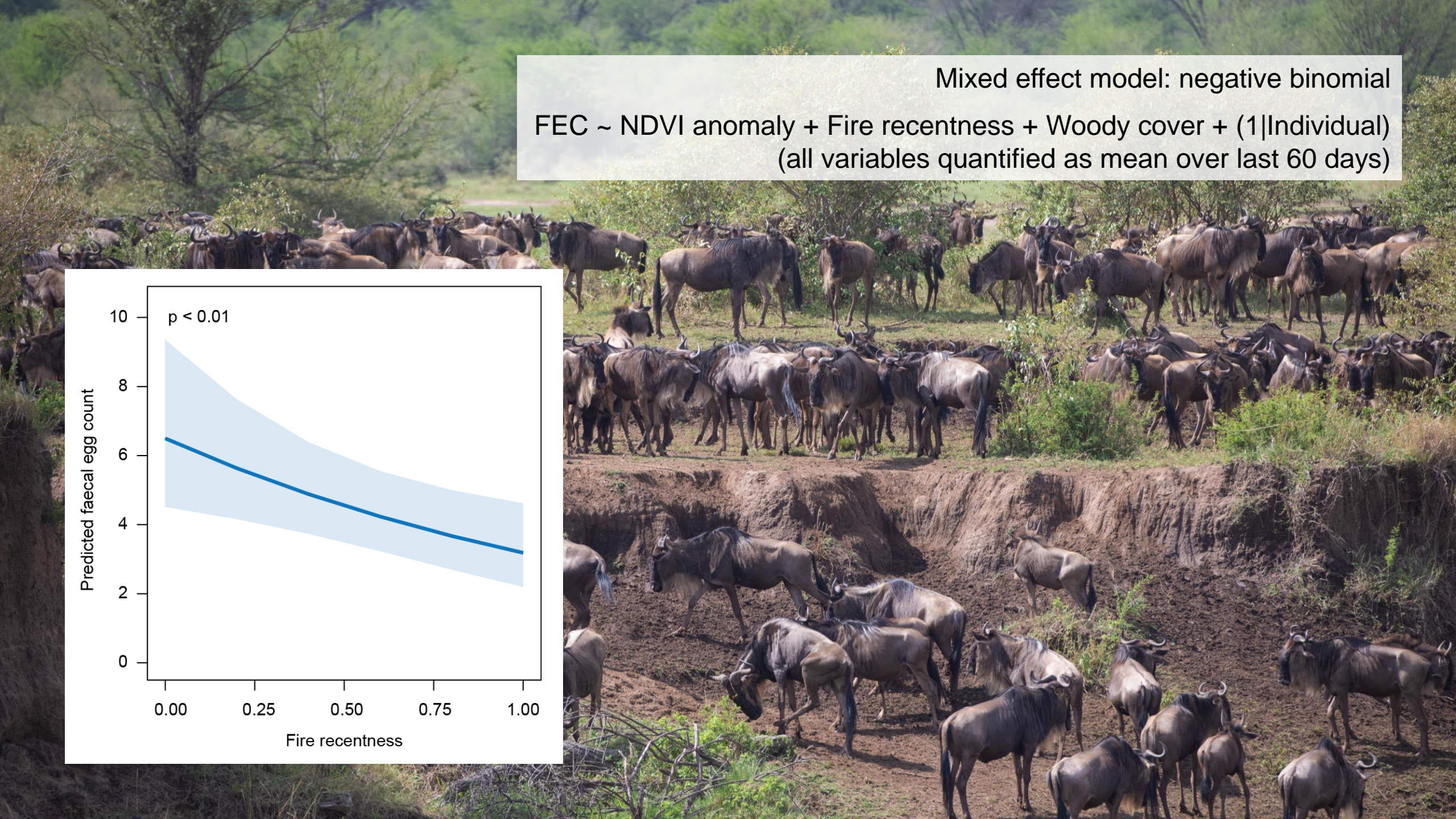
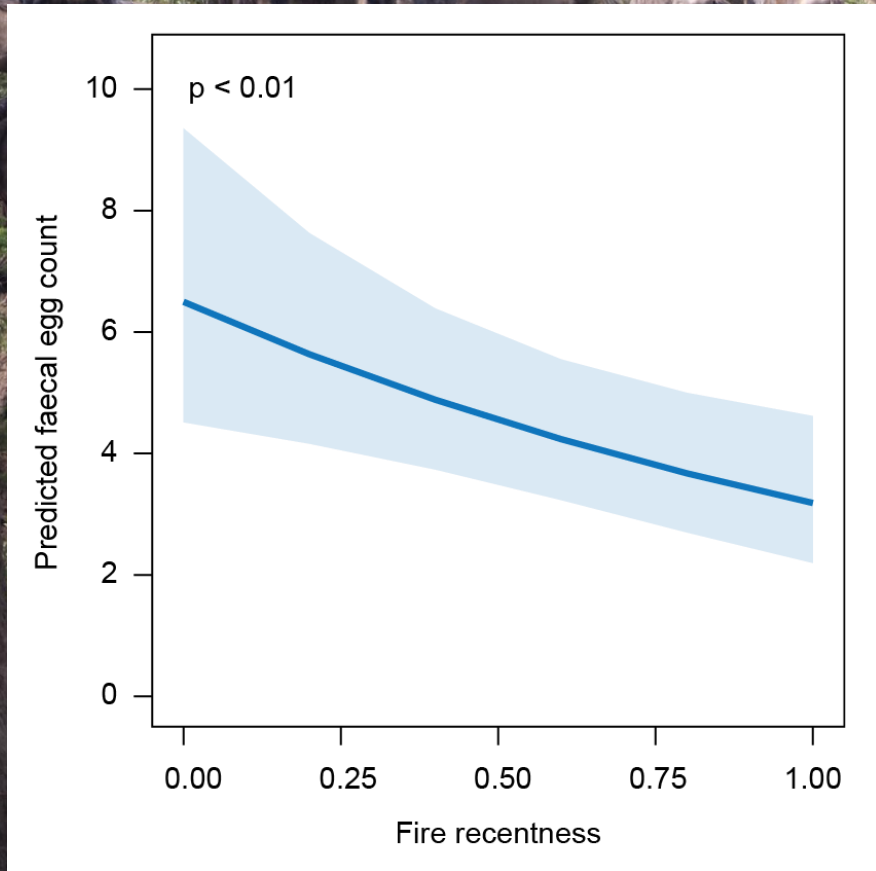






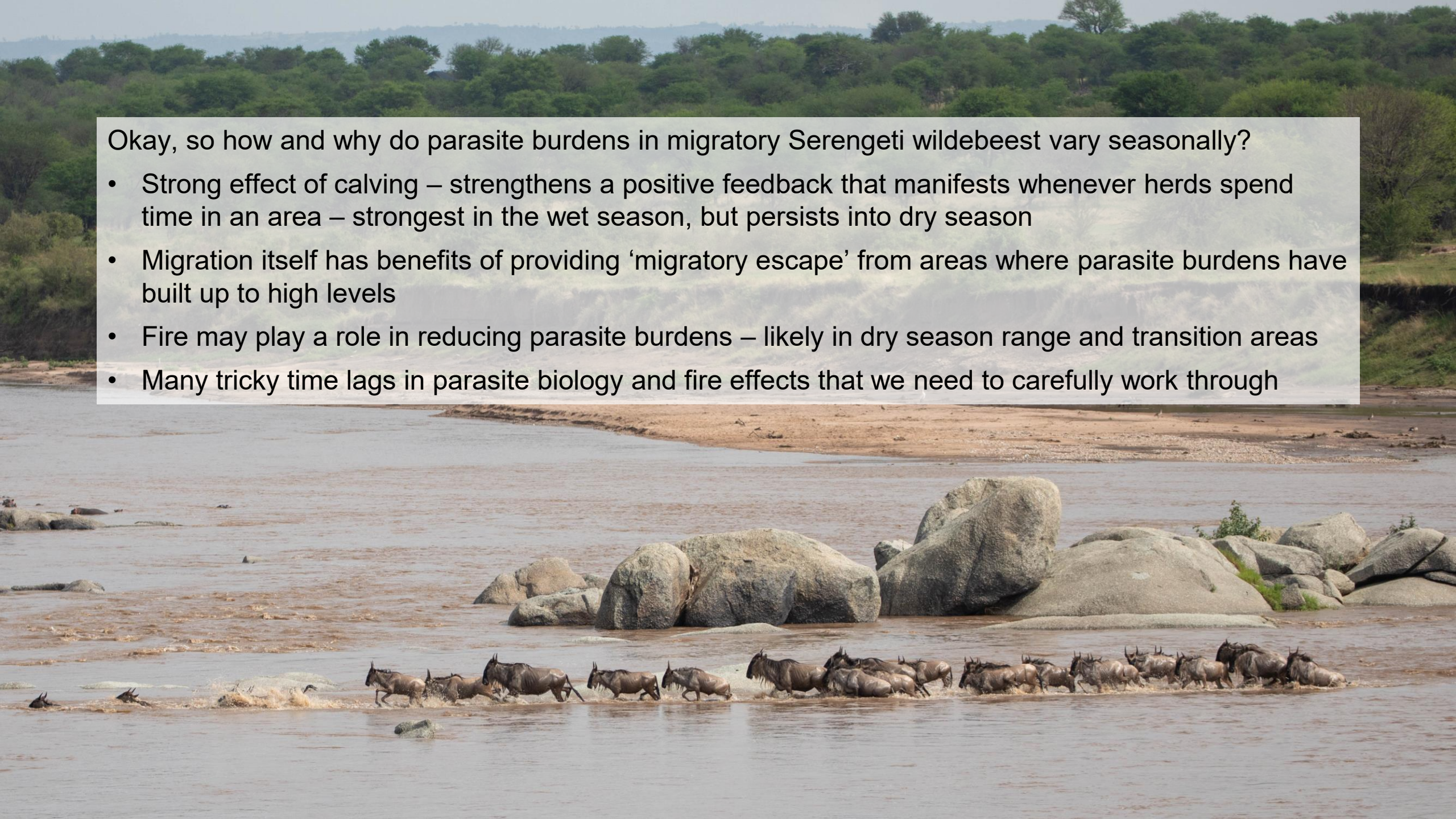
Mixed effect model: negative binomial

FEC  $\sim$  NDVI anomaly + Fire recentness + Woody cover + (1|Individual)  
(all variables quantified as mean over last 60 days)



Okay, so how and why do parasite burdens in migratory Serengeti wildebeest vary seasonally?

- Strong effect of calving – strengthens a positive feedback that manifests whenever herds spend time in an area – strongest in the wet season, but persists into dry season
- Migration itself has benefits of providing ‘migratory escape’ from areas where parasite burdens have built up to high levels
- Fire may play a role in reducing parasite burdens – likely in dry season range and transition areas
- Many tricky time lags in parasite biology and fire effects that we need to carefully work through



Thank you!

