POTENTIAL DRIVERS OF AMERICAN RED SQUIRREL OCCUPANCY IN ALBERTA'S OIL SANDS REGION

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Scientific Report

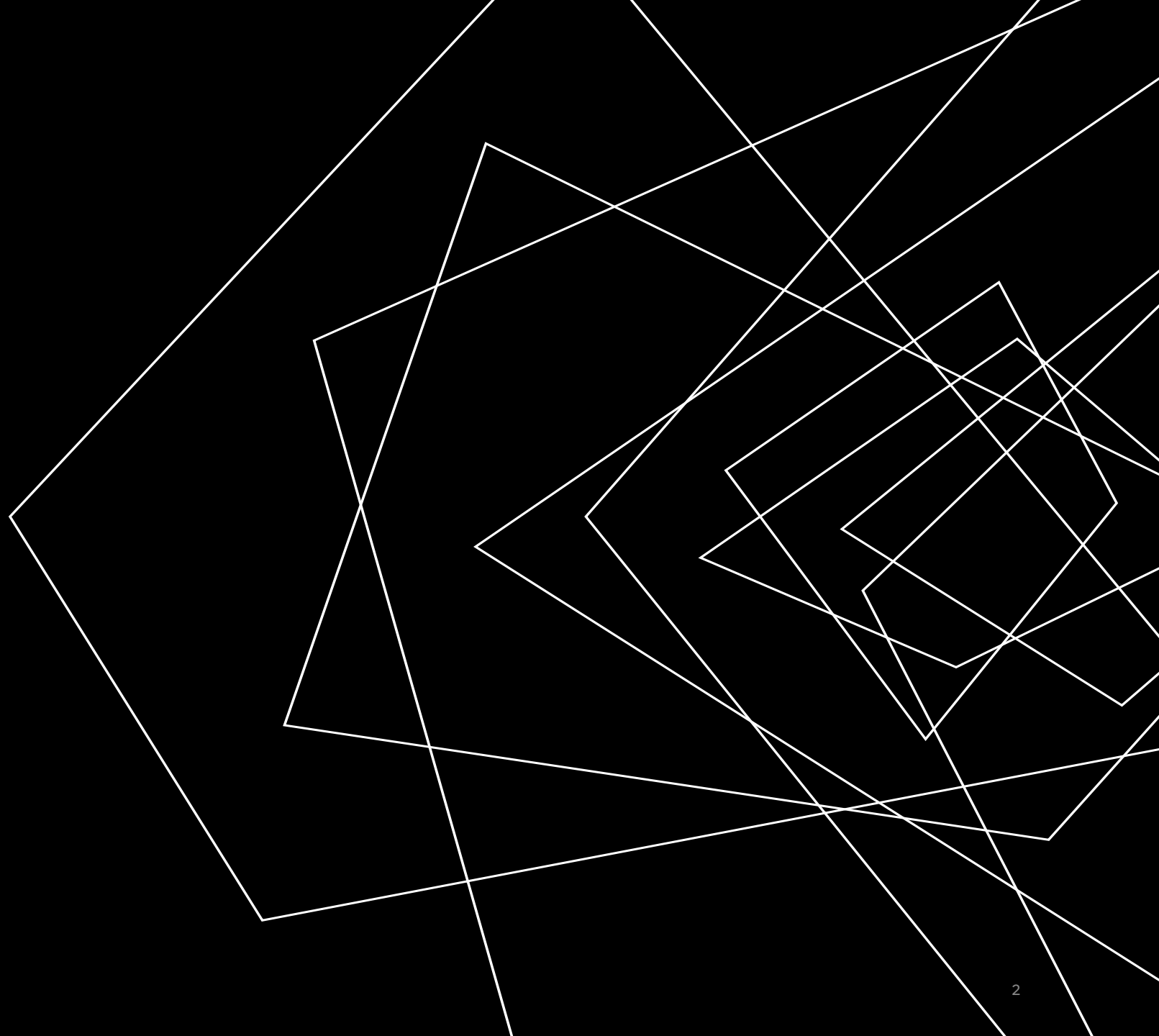
AGENDA

Introduction

Method

Result

Acknowledgment



INTRODUCTION

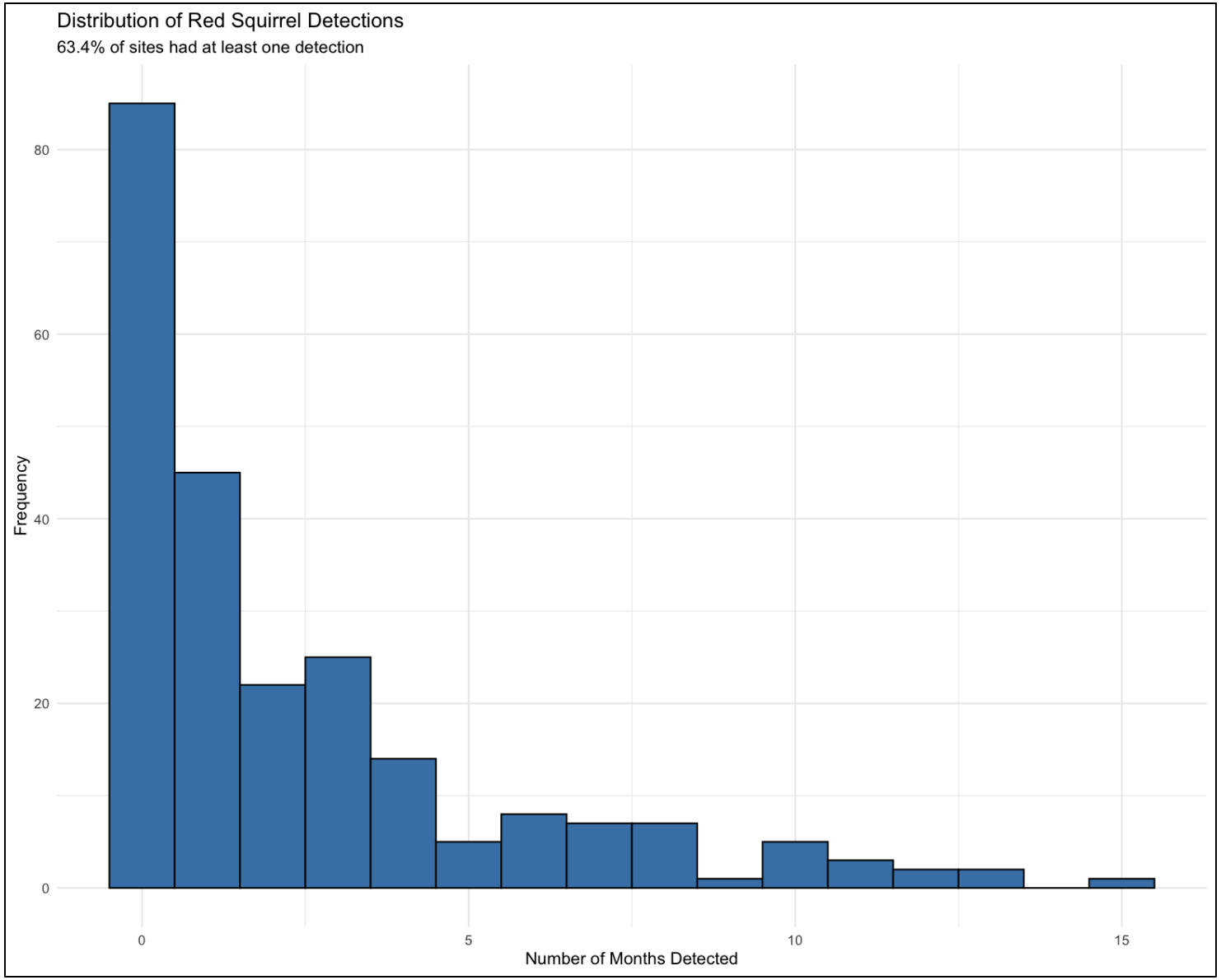
Previous Studies

- The American red squirrel (Tamiasciurus hudsonicus) is a forest-dependent species that relies heavily on **coniferous forests** for food caching and nesting (Fisher et al., 2005).
- Some studies report that small **seismic lines** or pipelines have minimal impact on generalist rodent abundance (i.e. the community remains largely unchanged in those contexts) (Shonfield & Bayne, 2019).
- As species with **different habitat dependencies** respond variably to disturbance type, it is essential to consider those differences when assessing ecological impacts (Roberts et al., 2021).

HYPOTHESES

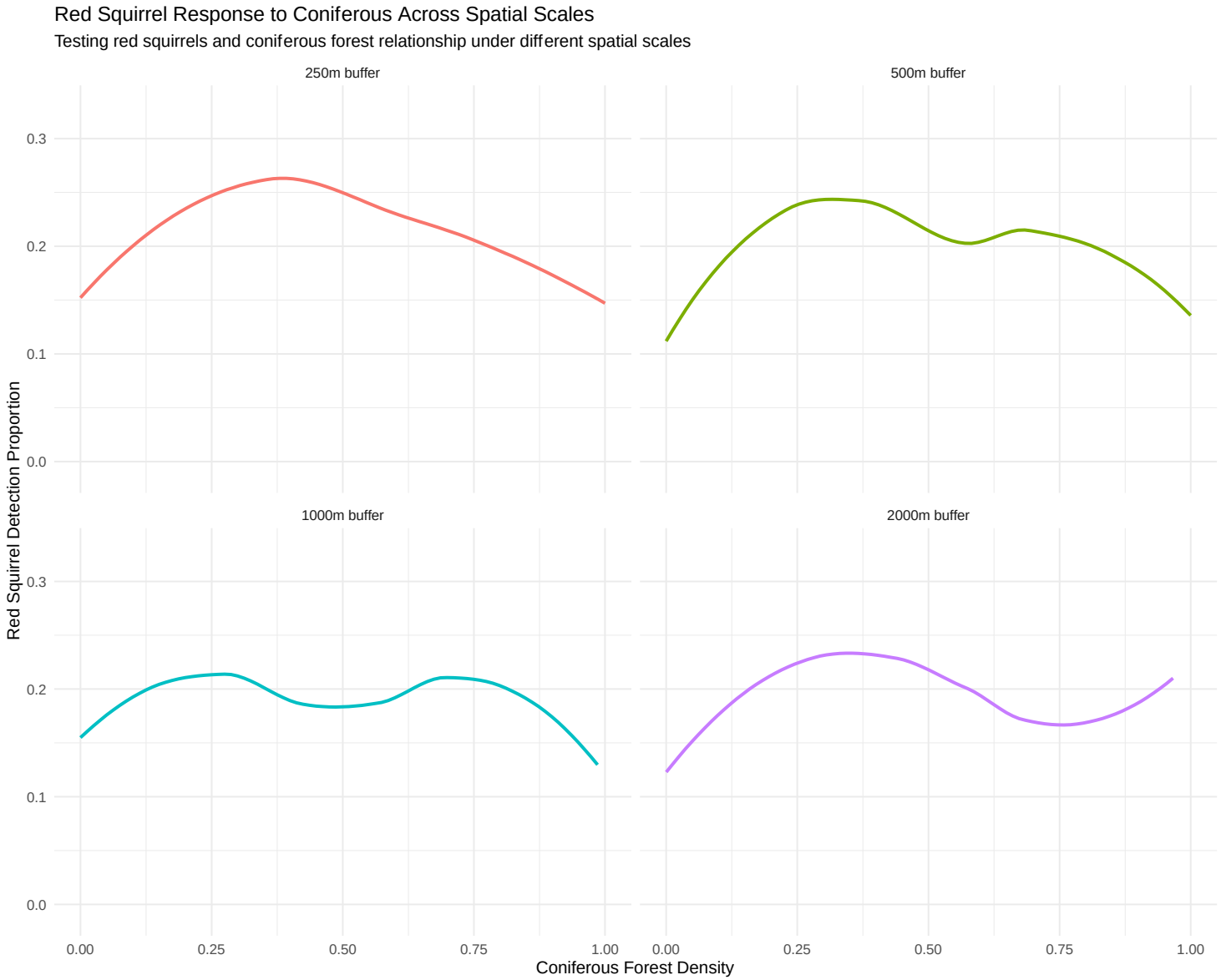
Red squirrels show stronger negative responses to **polygonal** disturbances (harvest areas, well pads, etc.) than to **linear** features (roads, seismic lines, etc.), as the former represents greater habitat loss.

METHOD



- red squirrels show a right-skewed detection pattern with approximately 37% of sampling sites having zero detections

METHOD

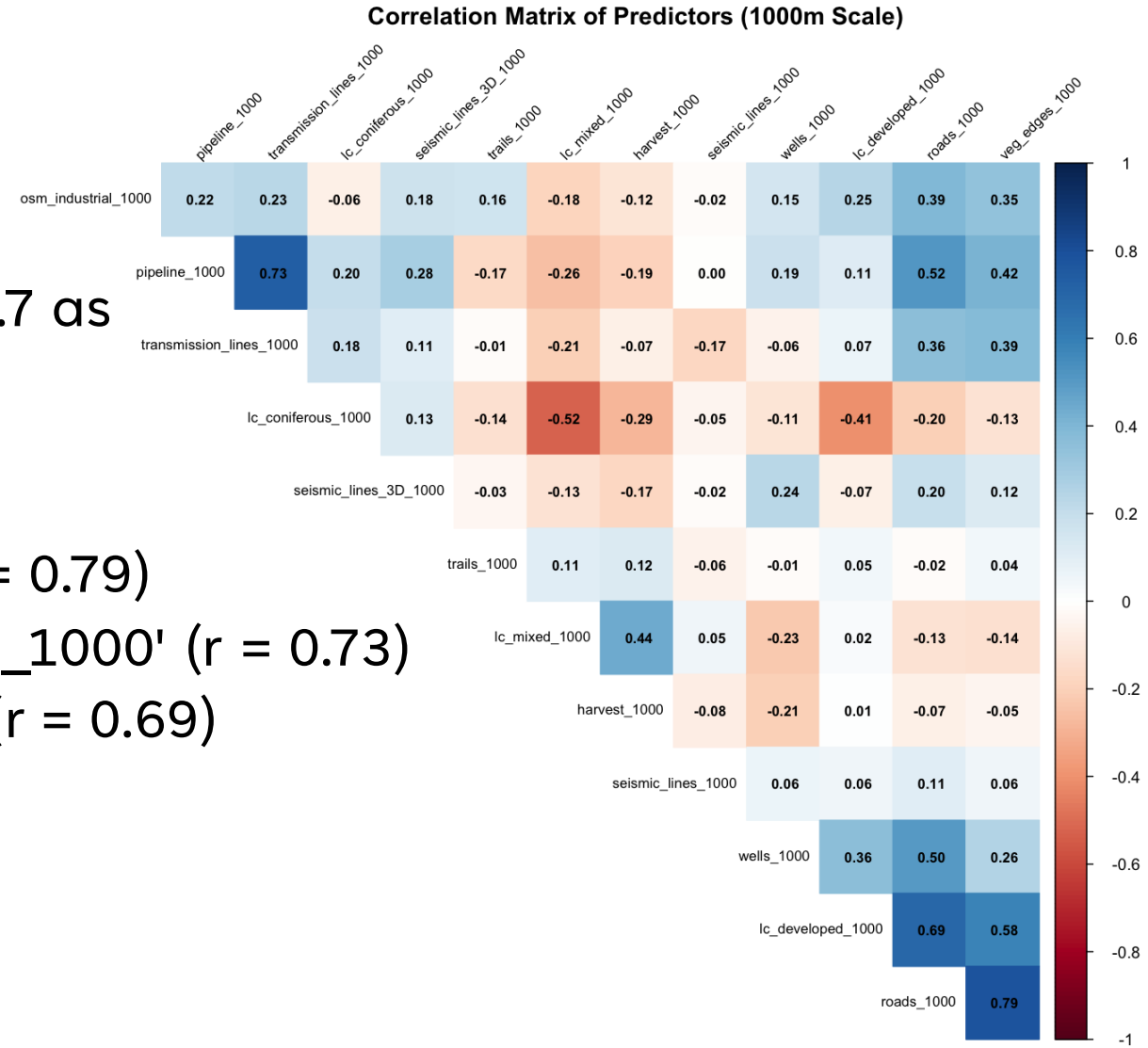


- **250m** and **1000m** as the main spatial scales for modeling to balance **local vs. landscape effects**

METHOD

- **Threshold:** variable pairs with |r| > 0.7 as problematic.

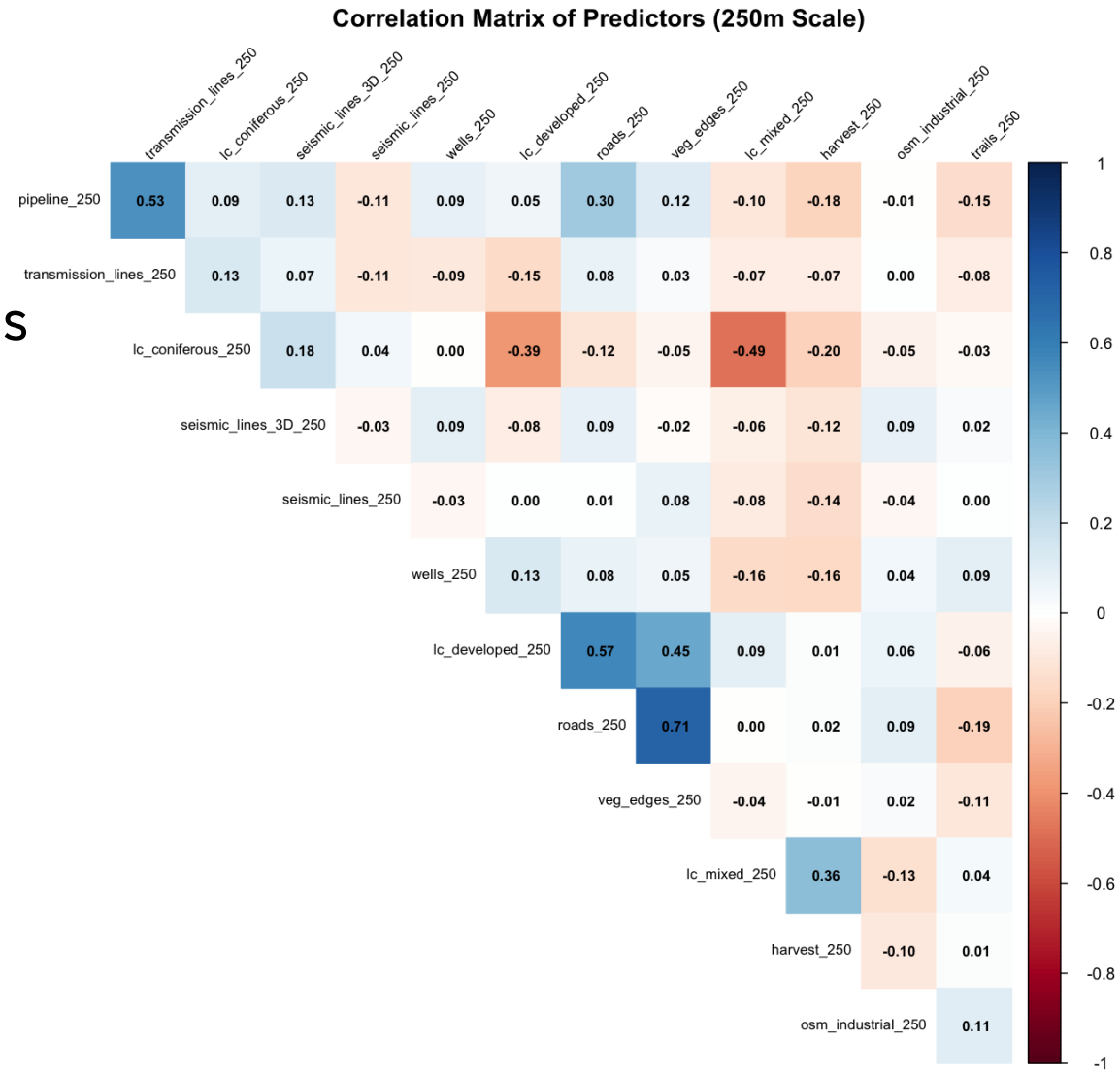
'roads_1000' & 'veg_edges_1000' (r = 0.79)
'pipeline_1000' & 'transmission_lines_1000' (r = 0.73)
'lc_developed_1000' & 'roads_1000' (r = 0.69)



METHOD

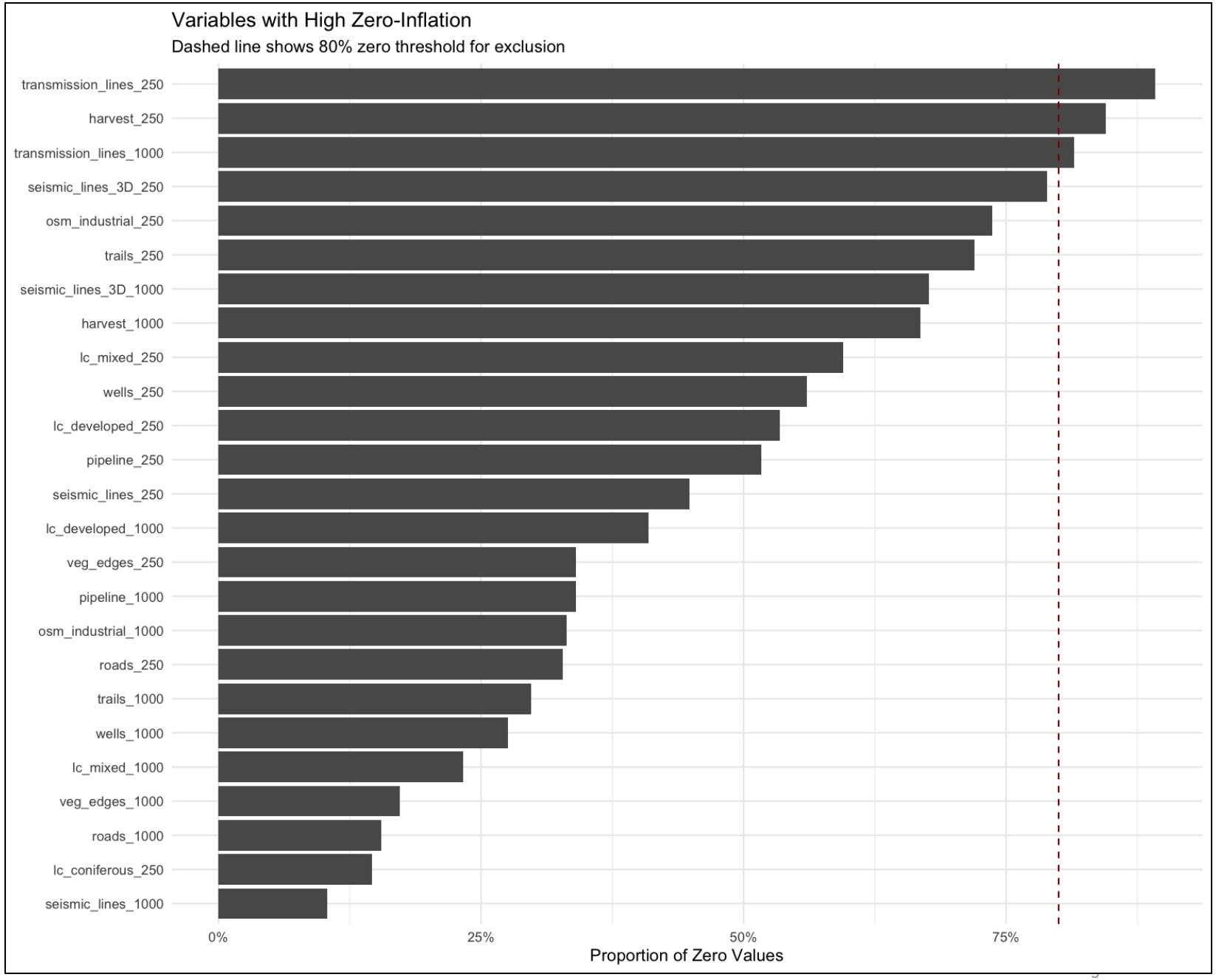
- **Threshold:** variable pairs with |r| > 0.7 as problematic.

'roads_250' & 'veg_edges_250 (r = 0.71)



METHOD

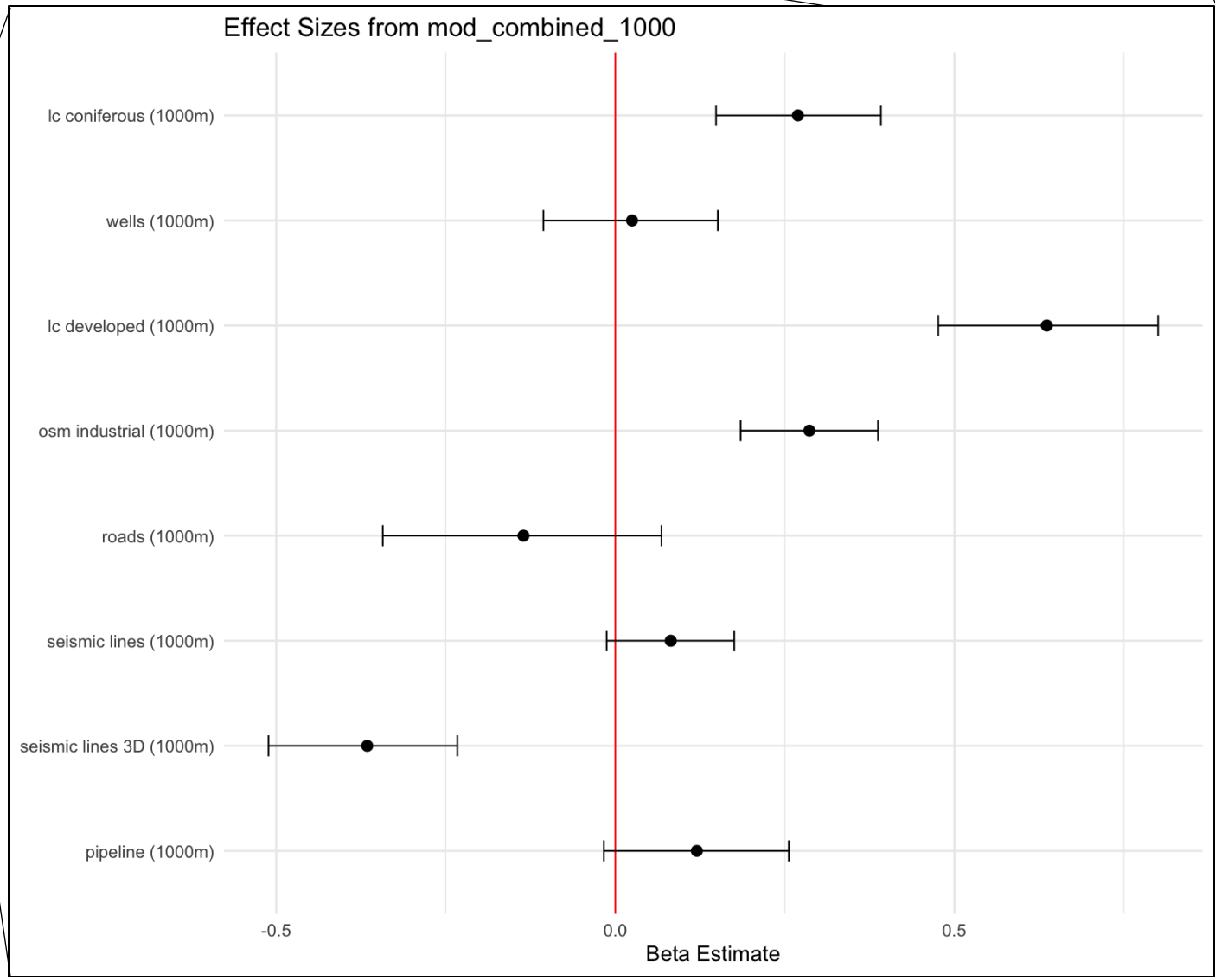
- transmission_lines_250: 89%
- harvest_250: 84%
- transmission_lines_1000: 81.5%



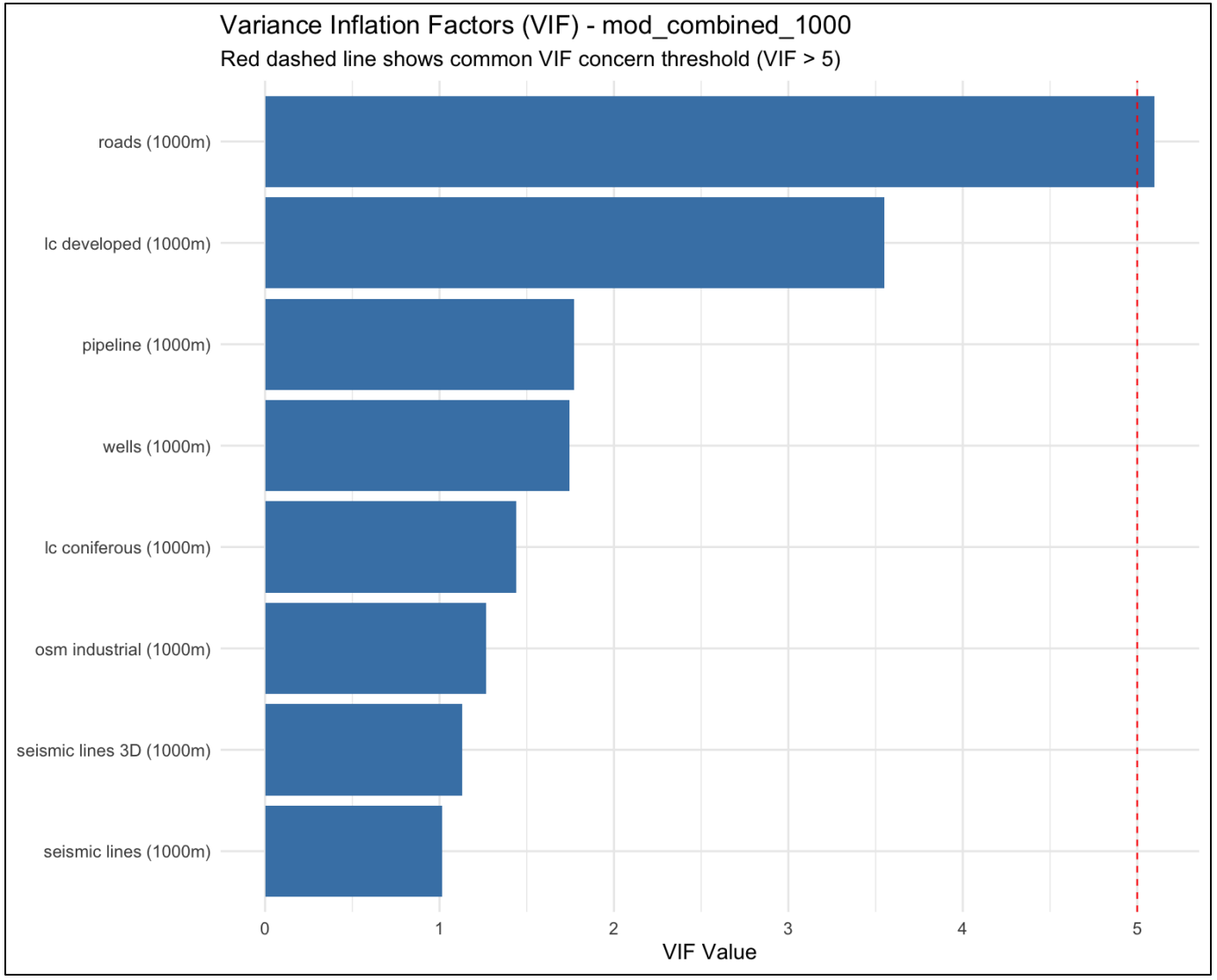
RESULTS

Model Comparison with LogLik and df

Model	df	logLik	AICc	delta	weight
combined_1000	7	-584.62	1183.74	0.00	0.61
full_model	17	-573.89	1184.63	0.89	0.39
poly_1000	5	-602.78	1215.83	32.09	0.00
linear_1000	7	-626.66	1267.82	84.08	0.00
combined_250	9	-645.00	1308.80	125.06	0.00
poly_250	5	-652.35	1314.96	131.22	0.00
linear_250	7	-676.46	1367.43	183.69	0.00
habitat_1000	3	-690.12	1386.34	202.60	0.00
habitat_250	3	-695.56	1397.22	213.48	0.00
null_model	1	-698.75	1399.52	215.78	0.00



RESULTS



However, ...

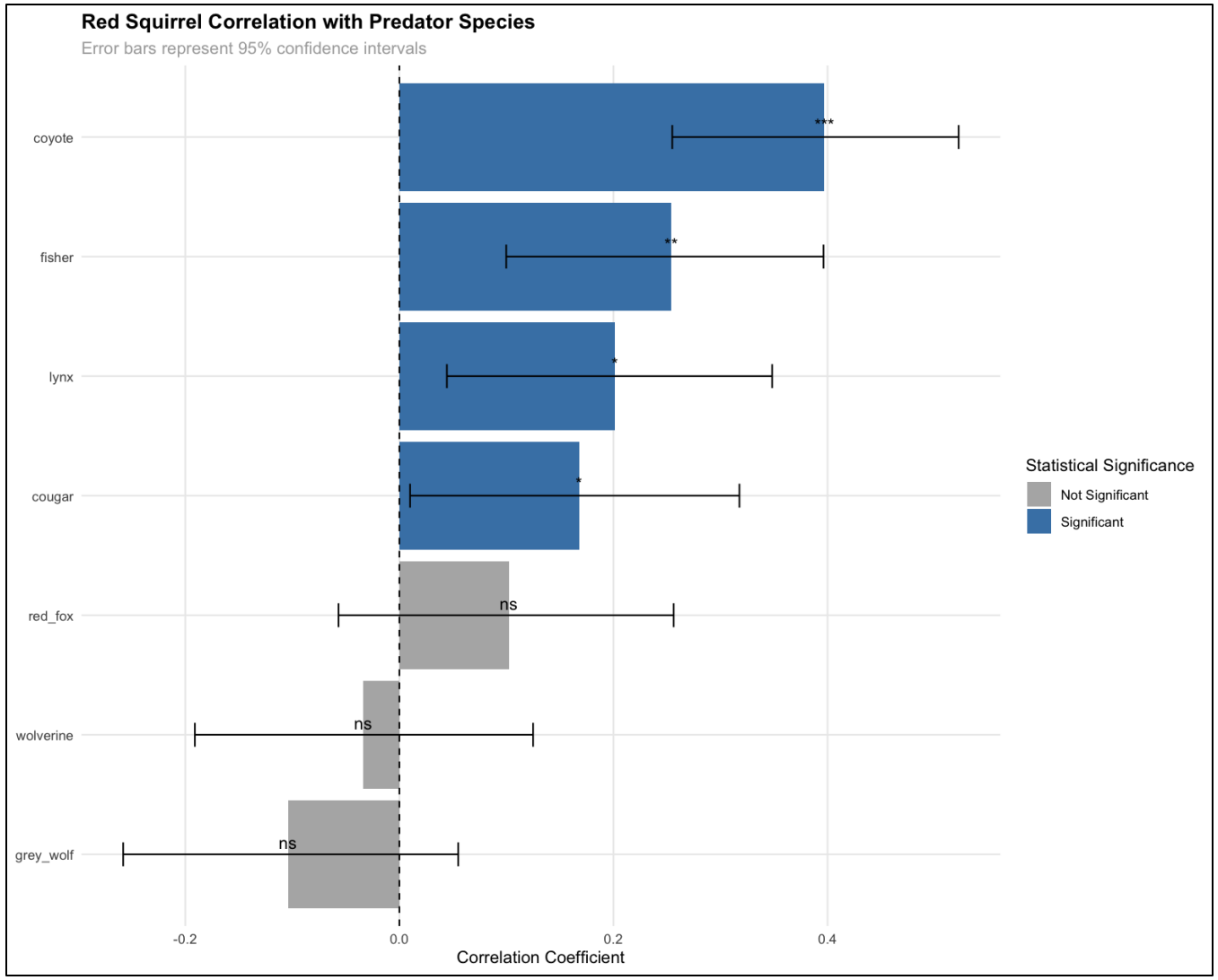
Overdispersion detected (2.269)

METHOD

- Build a Combined Random Intercept Model
- mod_HDP_1000:

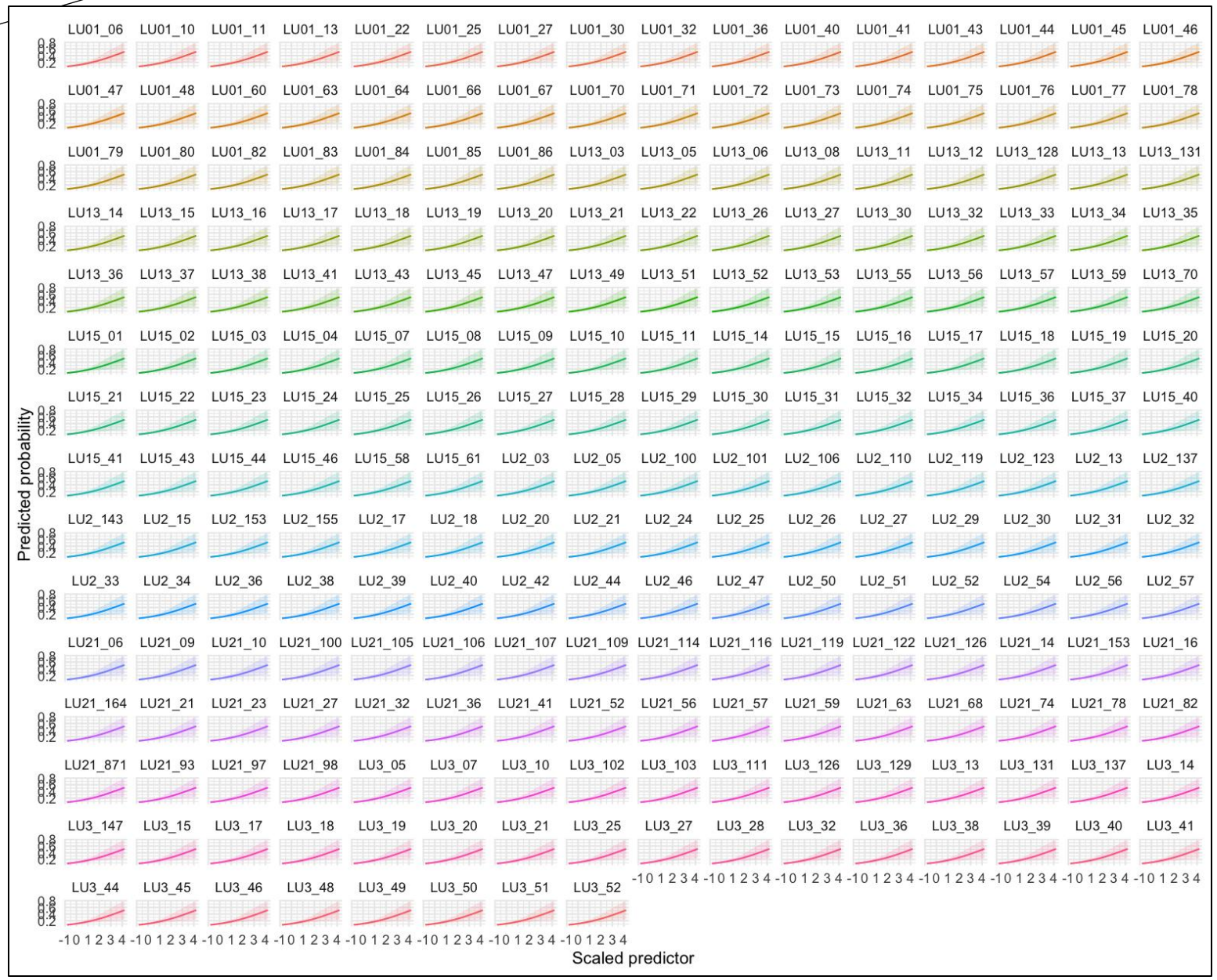
scaled_lc_coniferous_1000 — habitat
scaled_lc_developed_1000 — polygonal disturbance
scaled_seismic_lines_3D_1000 — linear disturbance (especially since it was strongly negative)
scaled_coyote_risk — predator
Site — as random intercept

METHOD



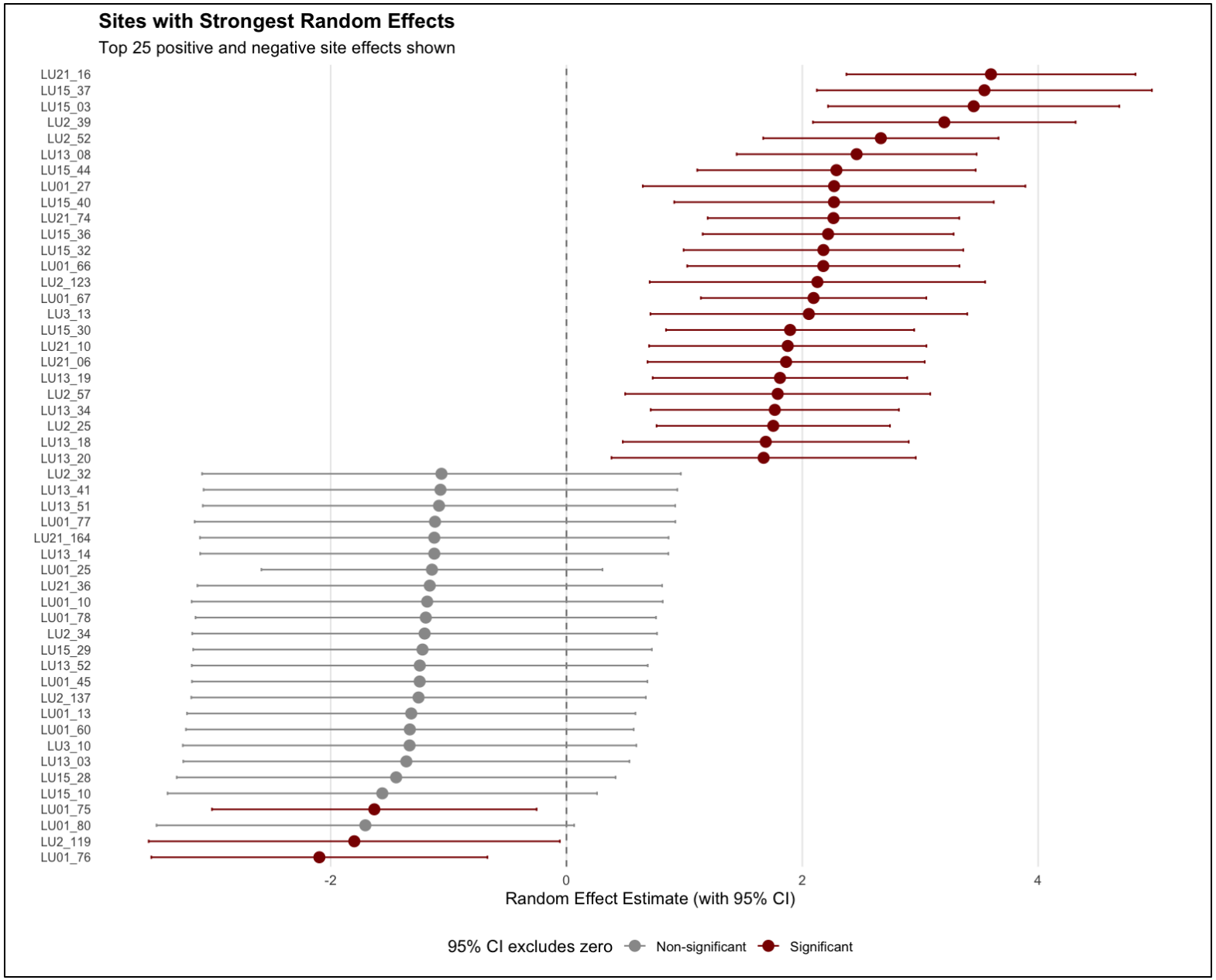
- coyotes showed the strongest positive correlation with red squirrels (r = 0.40)

METHOD



- Clear color patterns by site series (reds→greens→blues→purples) reveal site-to-site variation.
- Quantify unmeasured local habitat factors that influence squirrel distribution

METHOD



- LU21_16, LU15_37, and LU15_03 at the top show particularly **strong positive effects**, potentially indicating especially favorable habitat conditions.
- Conversely, sites like LU01_76 and LU2_119 at the bottom show **substantial negative effects**, suggesting these areas may have characteristics that make them unsuitable for red squirrels.

RESULTS

Model Comparison with LogLik and df

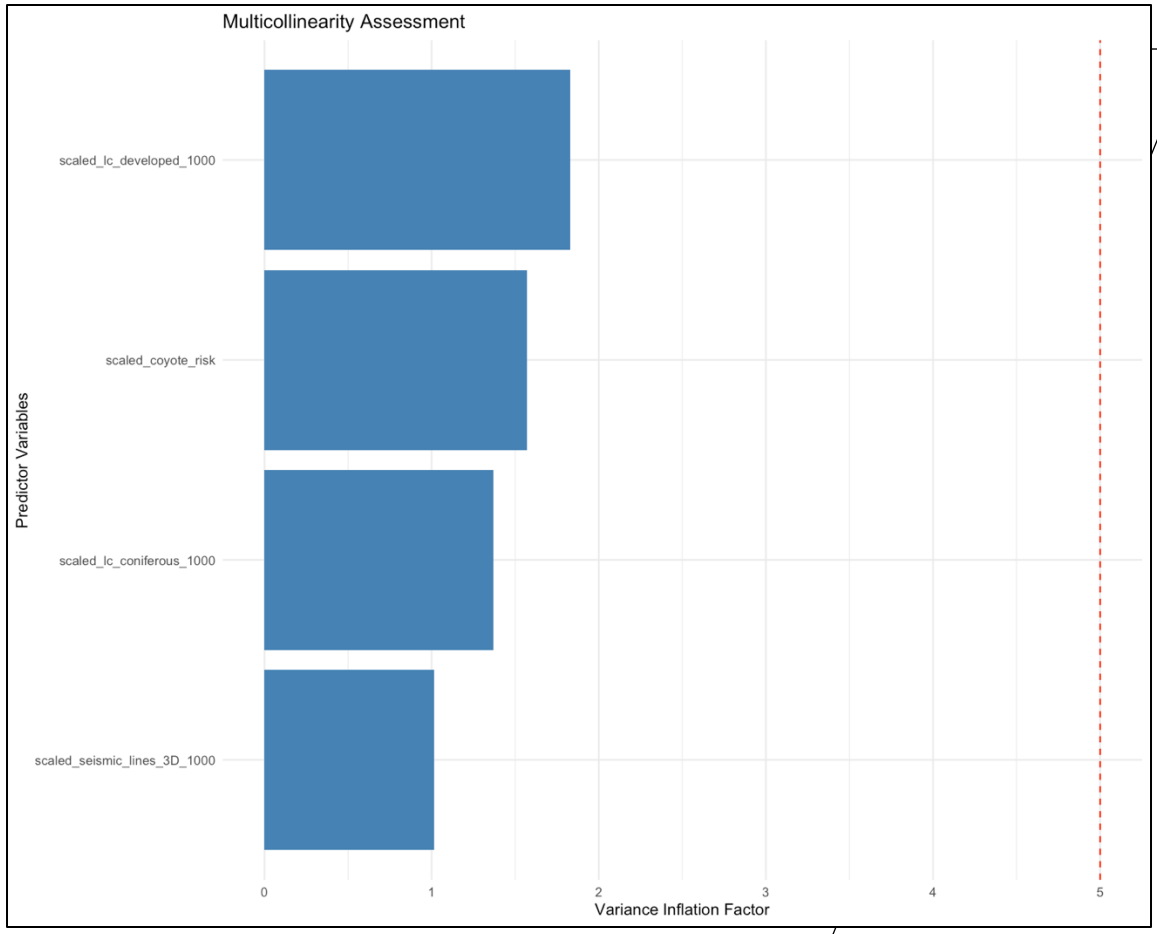
Model	df	logLik	AICc	delta	weight
random_model	6	-433.20	878.78	0.00	1
fixed_model	5	-578.79	1167.84	289.06	0
interaction_model	5	-598.74	1207.74	328.96	0

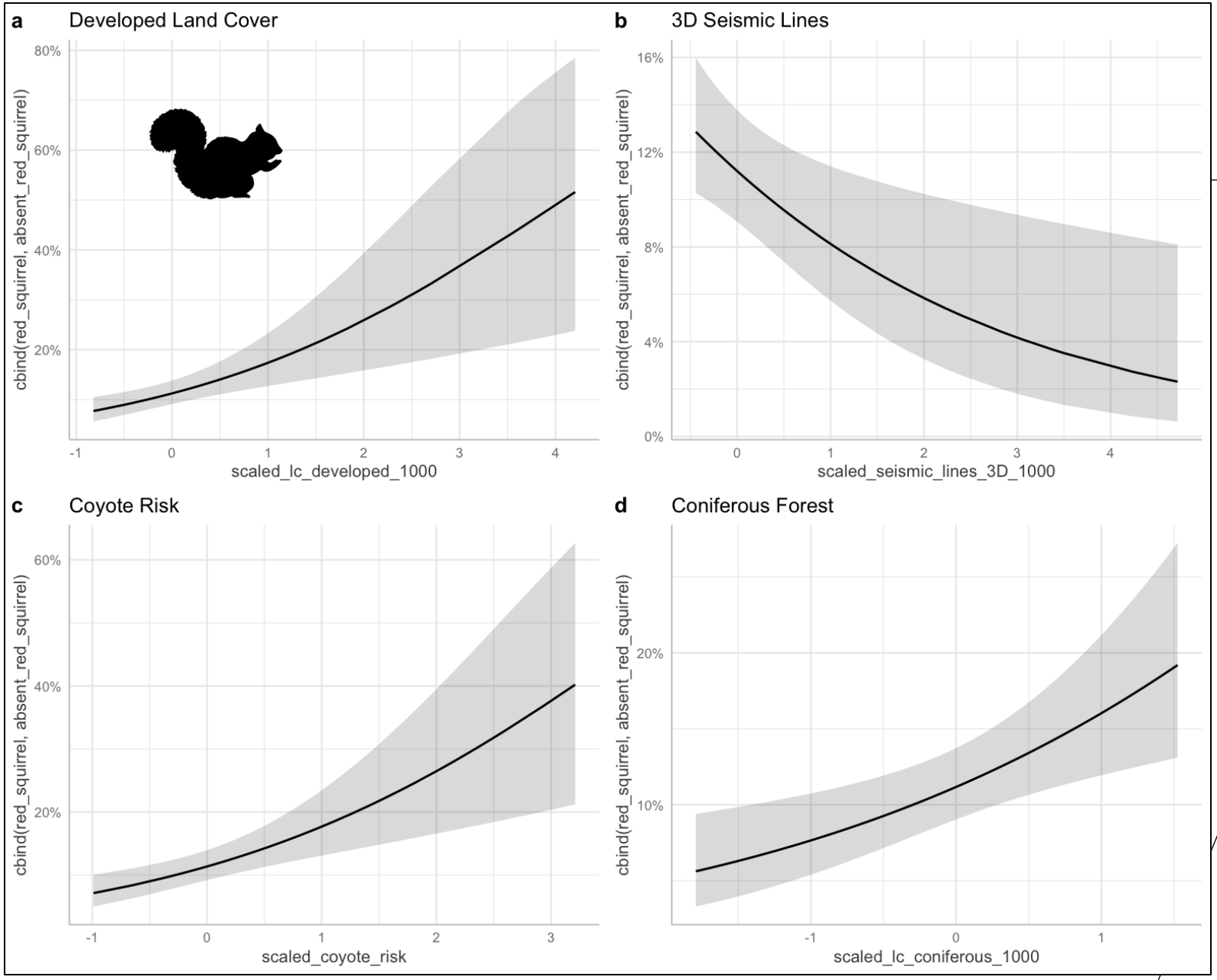
- Random effects:

Groups Name Variance Std.Dev.
site (Intercept) **2.129** 1.459

- Check overdispersion:

Dispersion ratio = **1.144**




a
Developed Land Cover
cbind(red_squirrel, absent_red_squirrel)
80%
60%
40%
20%
-1
0
1
2
3
4
scaled_lc_developed_1000
b
3D Seismic Lines
cbind(red_squirrel, absent_red_squirrel)
16%
12%
8%
4%
0%
0
1
2
3
4
scaled_seismic_lines_3D_1000
c
Coyote Risk
cbind(red_squirrel, absent_red_squirrel)
60%
40%
20%
-1
0
1
2
3
scaled_coyote_risk
d
Coniferous Forest
cbind(red_squirrel, absent_red_squirrel)
20%
10%
-1
0
1
scaled_lc_coniferous_1000

RESULT

Aspect	Finding	Certainty
Key driver of occupancy	**Positive response to developed land** at 1000m scale	High certainty
Linear disturbance effects	**Significant negative impact** from 3D seismic lines	High certainty
Scale of response	Landscape scale (1000m) patterns dominate	Medium certainty
Predator	**Positive association with coyote risk**	Medium certainty
Site-level effects	**Strong random intercepts** indicate important unmeasured local factors	High uncertainty

RESULT

Positive response to developed land:

- Edge effects along development boundaries may increase cone production in trees receiving more sunlight
- Supplemental food resources from human activities (bird feeders, waste) may subsidize squirrel populations

Negative response to 3D seismic lines:

- Linear features may provide corridors for predator movement

Positive association with coyote risk:

- Both species may select similar landscape features but utilize them at different times
- Coyotes may suppress populations of mesopredators (martens, weasels) that more efficiently hunt red squirrels

ACKNOWLEDGEMENT

Special Thanks

- Dr. Jason T Fisher and Dr. Marissa Dyck
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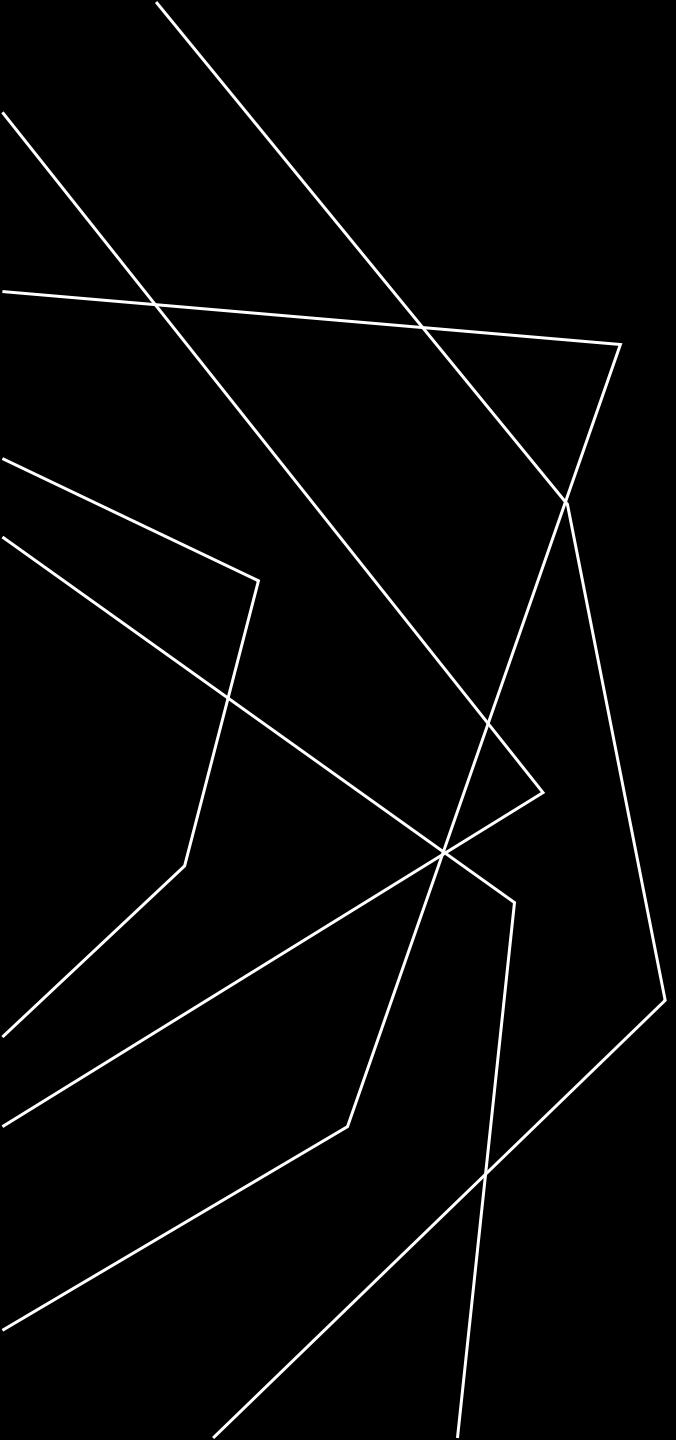

THANK YOU