The hitchhiker's guide to invading an ecosystem: effects of recreation on non-native plant dispersal

BIOL 406 Plant Ecology
April 3, 2025

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Statement of positionality

“Musqueam traditional territory is the area that we’ve lived off of, we’ve fished, we’ve hunted, we gathered, and it’s something that we’ve never given away. It’s something that we still hold and we still believe is our right. We still hold title over the lands, which encompass what is now called Greater Vancouver.”

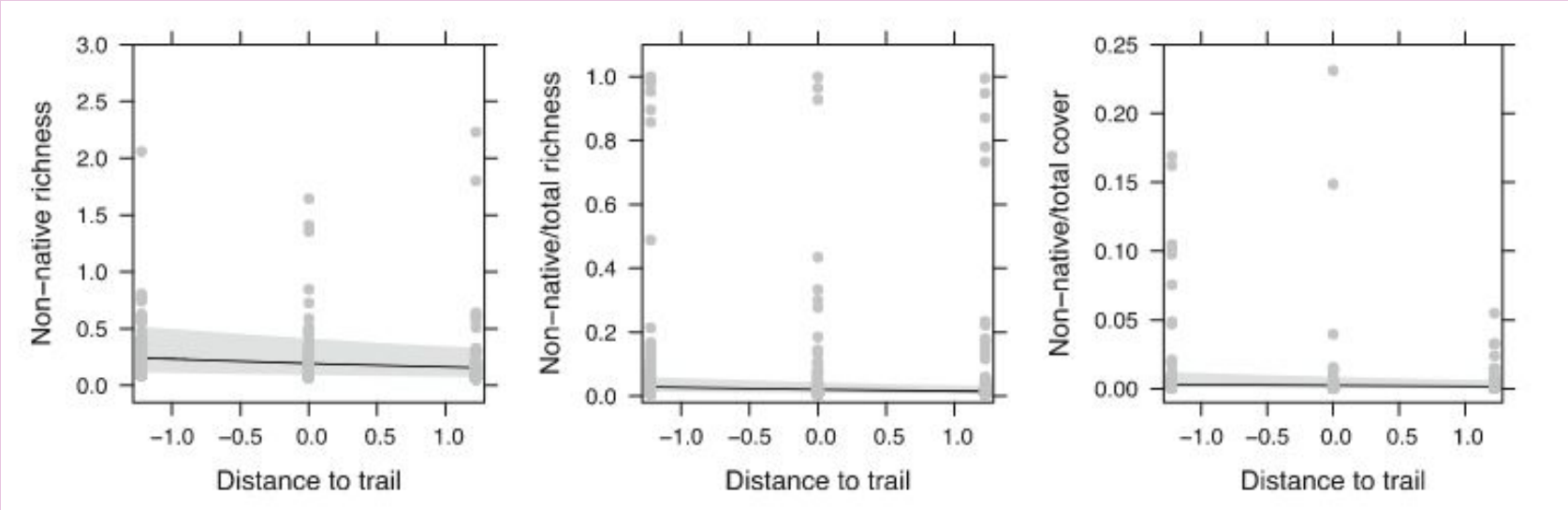
ċaləχʷələnəxʷ—Wade Grant, 2014

Non-native species

“Species that are not naturally present in a native assemblage, but have been moved beyond the limits of their normal geographic ranges by human actions”

(Blackburn et. al, 2011)

Anthropogenic Dispersal



(Liedtke et al., 2020)

B.B.Q.

How does the anthropogenic use of trails **facilitate** the dispersal of non-native species?

Hypotheses

- **H1:** Trail use **facilitates** the **zoochorous** dispersal of non-native species because trails serve as **dispersal corridors**.

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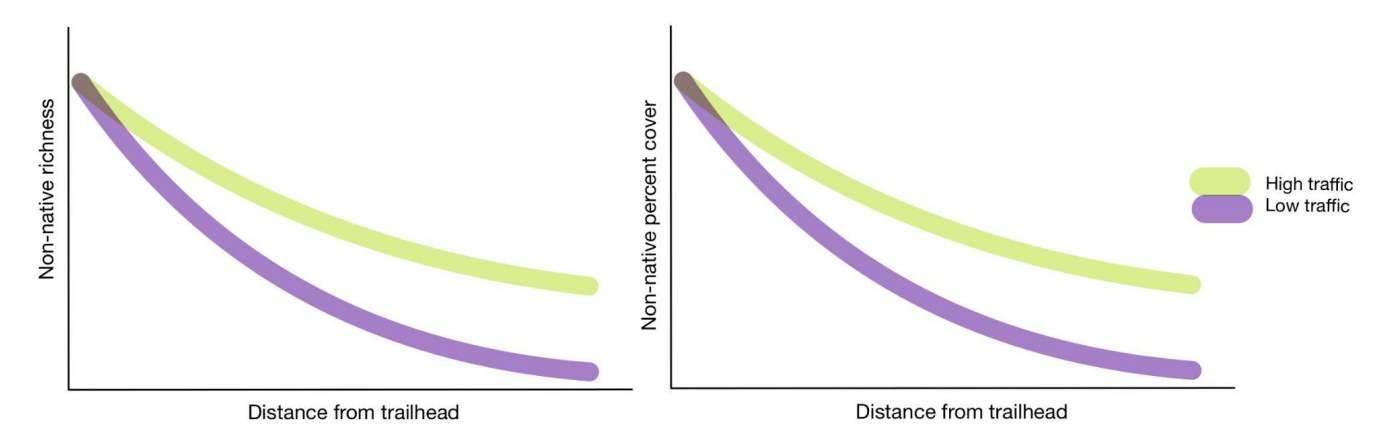
- **H1:** Trail use **facilitates** the **zoochorous** dispersal of non-native species because trails serve as **dispersal corridors**.
- **H0:** Trail use **does not facilitate** the zoochorous dispersal of non-native species.

Predictions

H1: Trail use **facilitates** the zoochorous dispersal of non-native species because trails serve as dispersal corridors.

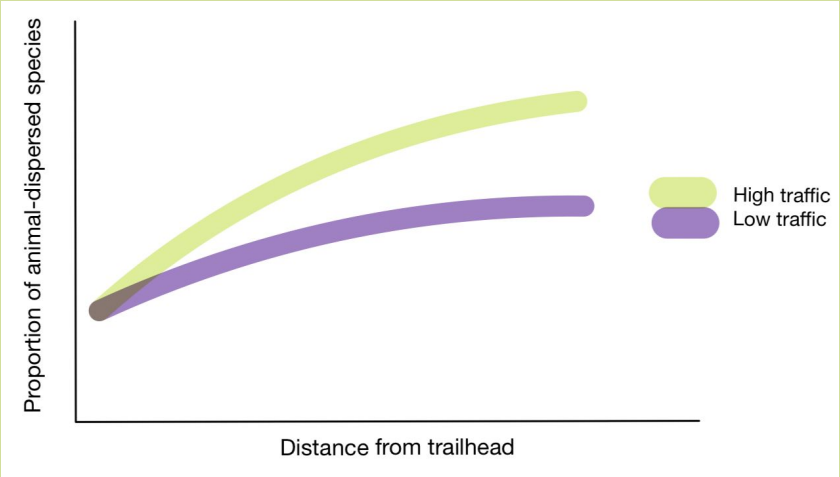
- High use trails will show greater **richness** and **abundance** of non-native species further from trailhead compared to low use trails.



Predictions

H1: Trail use **facilitates** the zoochorous dispersal of non-native species because trails serve as dispersal corridors.

- High use trails will show greater **proportions** of **zoochorous-dispersed** non-native species compared to low use trails.



Methods

- **Ten 5 x 5 m quadrats per trail**
  - March 10, 2025: Percent cover of 12 non-native plant species, richness of non-native species, dominant canopy species, canopy cover, and proportion of bare ground cover.
- **25 m intervals** from trailhead, along Top and Sasamat trails, in Pacific Spirit Park, BC.
- Quadrats were at a constant perpendicular distance from trail.

Data analysis

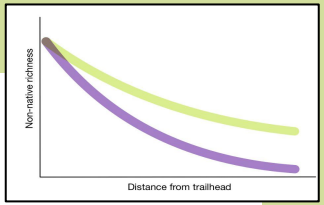
- **Analysis in R version 4.3.3**
  - Packages: dplyr (v1.1.4), ggplot2 (v3.5.0), lme4(v1.1-37), and vegan (v2.6.8).
  - GLM using Poisson and Gaussian distributions, no impact of order of variables on model.
  - NMDS ordination for species composition.

- Trail use data from Strava Global Heat Map.

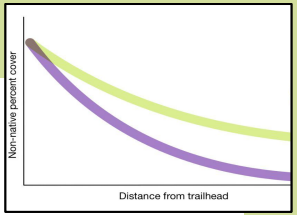
- Compiled literature to identify non-native species and reported dispersal vectors.

Results: Non-native richness and percent cover with distance from trailhead.

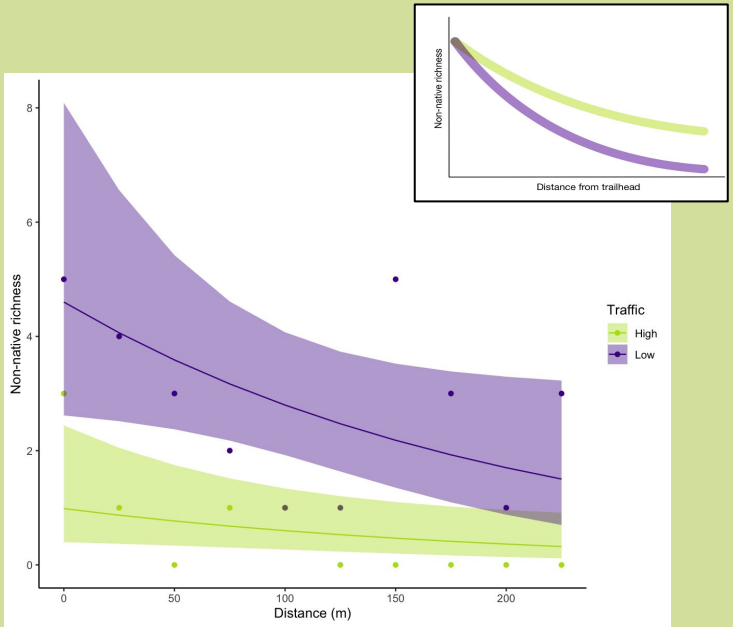
Prediction:



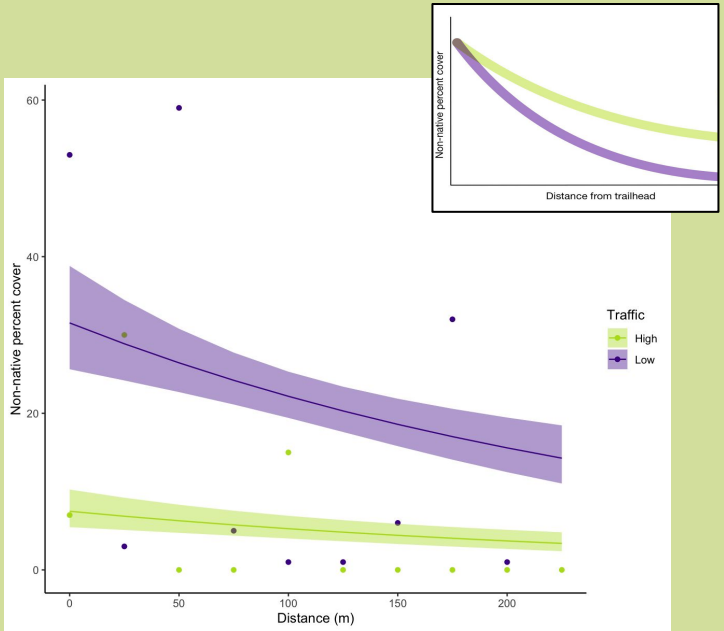
Prediction:



Non-native species richness and percent cover **decreased** with **distance from trailhead** and **traffic**.



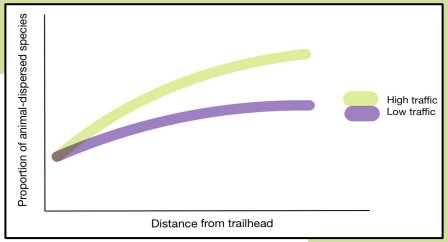
Intercept: -0.0143 ± 0.4624 (p = 0.9755)
Distance: -0.0050 ± 0.0025 (p = 0.04503) *
TrafficLow: 1.5404 ± 0.4499 (p = 0.0006) ***

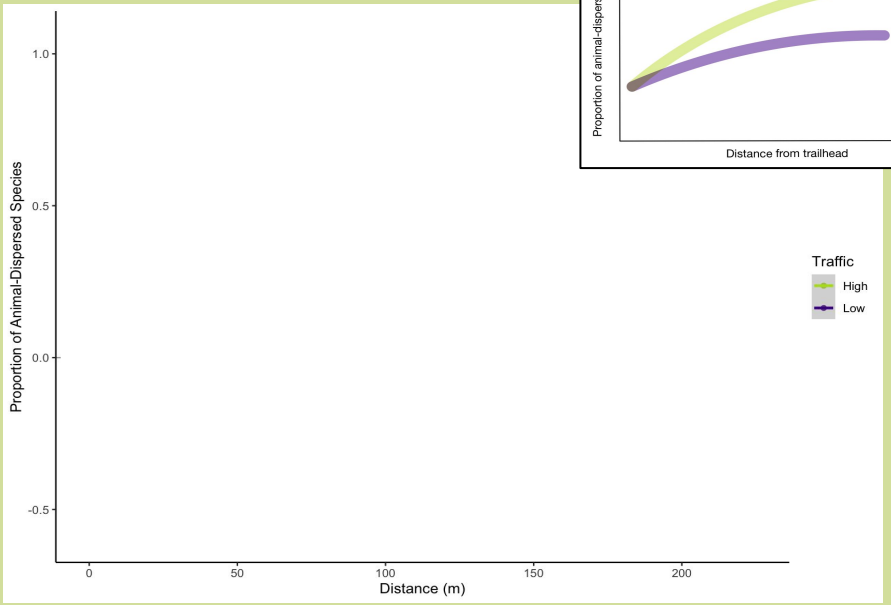


Intercept: 2.0134 ± 0.1609 (p < 2e-16) ***
Distance: -0.0035 ± 0.0009 (p = 4.37e-05) ***
TrafficLow: 1.4379 ± 0.1543 (p < 2e-16) ***

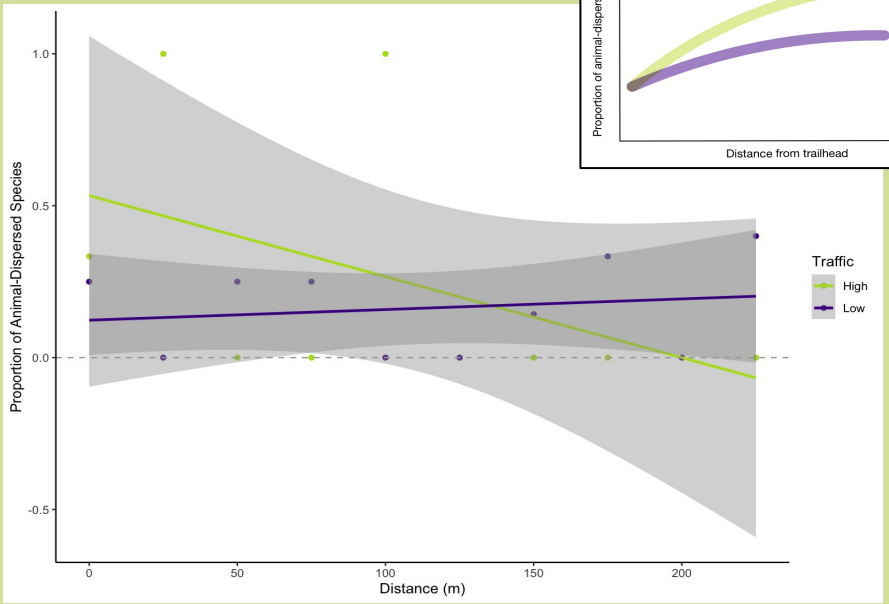
Results: Proportion of animal-dispersed non-native species in relation to trail use.

Prediction:



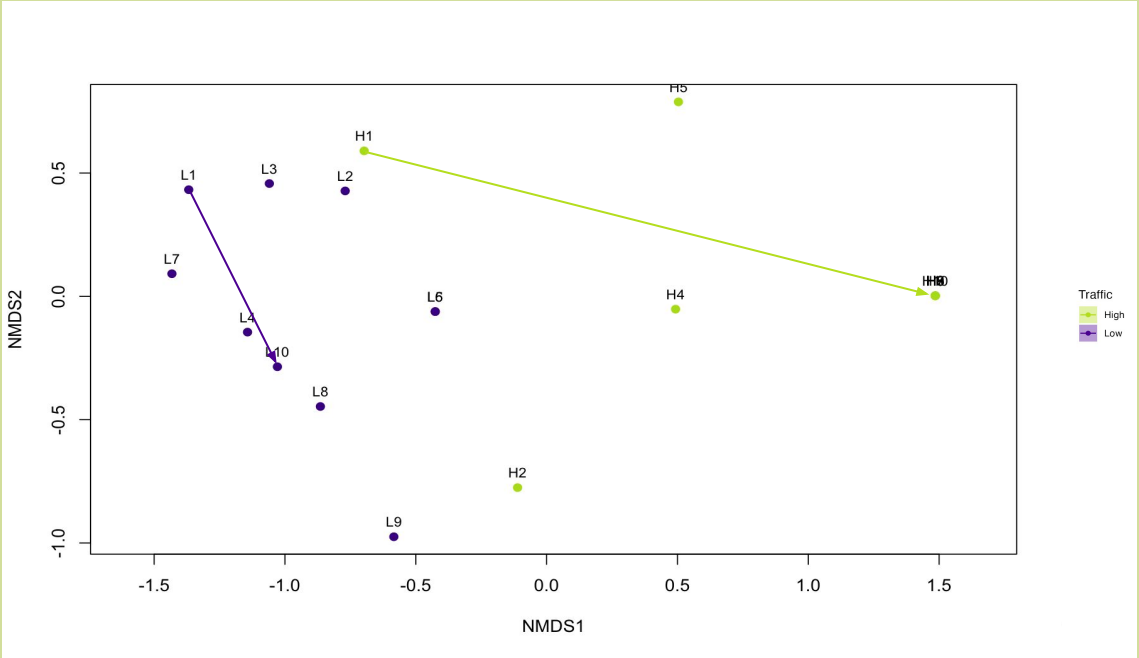


Proportion of animal-dispersed non-native species was **not different** between high and low traffic trails, and did not change with distance from trailhead.



Intercept: 0.3636 ± 0.1467 (p = 0.024) * **Distance**: −0.0012 ± 0.0010 (p = 0.248) **TrafficLow**: −0.0707 ± 0.1390 (p = 0.618)

Non-native species assemblage clustered differently in NMDS along **high** and **low** traffic trails, and **diverged** with distance from trailhead.



Summary of findings

Matching our predictions:

- Non-native species richness and percent cover **decreased** with distance from trailhead.
- Non-native species assemblage clustered **differently** in NMDS along high and low traffic trails, and **diverged** with distance into trail.

Summary of findings

Matching our predictions:

- Non-native species richness and percent cover **decreased** with distance from trailhead.
- Non-native species assemblage clustered **differently** in NMDS along high and low traffic trails, and **diverged** with distance into trail.

However:

- Non-native species richness and percent cover also **decreased** with traffic.
- Proportion of animal-dispersed non-native species was **not different** between high and low traffic trails, and did **not** change with distance into trail.

Discussion

- Non-native species richness and percent cover was greatest near trailhead, declined with distance into trail. → **Possible signal in support of impact of trail use near entry points.**

Image: Susan Olding (2018)

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Discussion

- Non-native species richness and percent cover was greatest near trailhead, declined with distance into trail. → **Possible signal in support of impact of trail use near entry points.**
- However, no evidence in support of **H1** – that trail use facilitated zoochorous dispersal of non-native species into trails.

- **Unclear impact of trail use on species dispersal between the trails studied, we are unable to reject H0.**

Discussion

Future research and limitations

- Expand sample size – **increase** the power of this study to test for the impact of trail use on non-native species dispersal.
- Larger gradient in regards to trail use and traffic.
- Control for confounding variables (ex. management practices).
- Account for temporal variation in species occurrence.

Image: Susan Olding (2018)

Conclusion

Takeaways

- Anthropogenic use of trails has the potential to **impact plant community structure** and **facilitate the introduction** of non-native species.
- Management of non-native species can however make the study of these processes *in situ* challenging.

- **There remains a gap in our understanding of the mechanisms through which anthropogenic trail use impacts plant community dynamics.** As recreation in stewarded areas increases, it is critical to identify the mechanisms driving these changes to inform conservation and management strategies.

References

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