Mapping *Rhododendron ponticum*'s distribution and pathways of invasive spread in temperate rainforest zone

William Brown 3124759

UNIVERSITY of STIRLING

The problem with *R. ponticum*

- *Rhododendron ponticum* L. is an evergreen shrub non-native and invasive in Scotland and the west coast of the UK[1].
- It threatens temperate rainforest—a globally scarce ecosystem[2]—by preventing tree regeneration[3] and outcompeting the diverse plant[4], lichen and moss community[5].
- However, current management strategies—expensive and time intensive[6] —do not account for human factors in its spread[7,8], potentially creating a risk of reinvasion in the long-term at a landscape-scale[9].

Aims

1 Assess the importance of human factors as drivers of *R. ponticum* dispersal in relation to environmental variables.

2 Assess whether the movement of vehicles and people along roads and footpaths impacts the abundance of *R. ponticum*.

3 Identify areas at risk of *R. ponticum* invasion in Loch Lomond and Trossachs National Park (LLTNP) temperate rainforest zone.

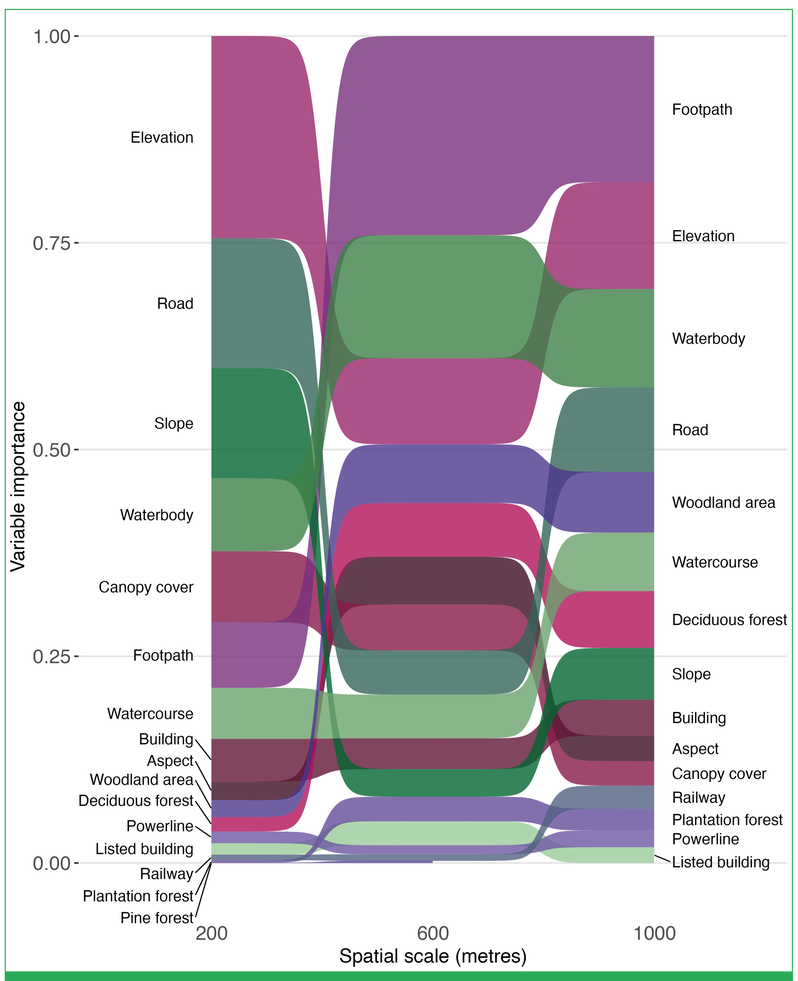
4 Propose recommendations to protect temperate rainforest from *R. ponticum* invasion.

Methods

- Located in the Loch Lomond Rainforest project area within the national park.
- *R. ponticum* abundance data was collected via 33x 1km box transects, supplemented by data supplied by the national park and GBIF.
- Environmental and human-disturbance variables sourced from open government spatial databases.
- Variable importance was quantified via comparing standardised coefficients of generalised linear models (GLMs)[10].
- GLMs and linear models were used to assess the role of human movement (traffic and footfall) in predicting R. ponticum abundance.
- GLM used to interpolate results for the risk map, i.e. probability of *R. ponticum* presence based on environmental/human variables.

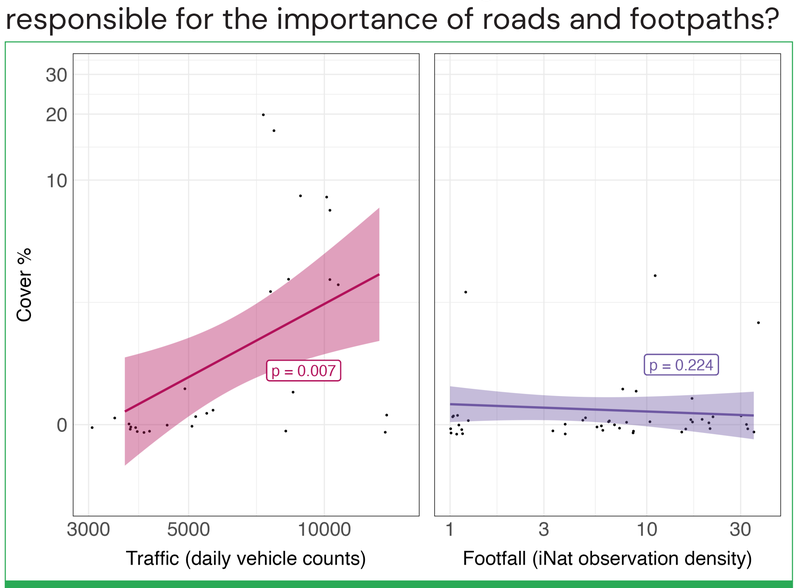
Results

Which variables are most important in predicting *R. ponticum* at varying spatial scales?



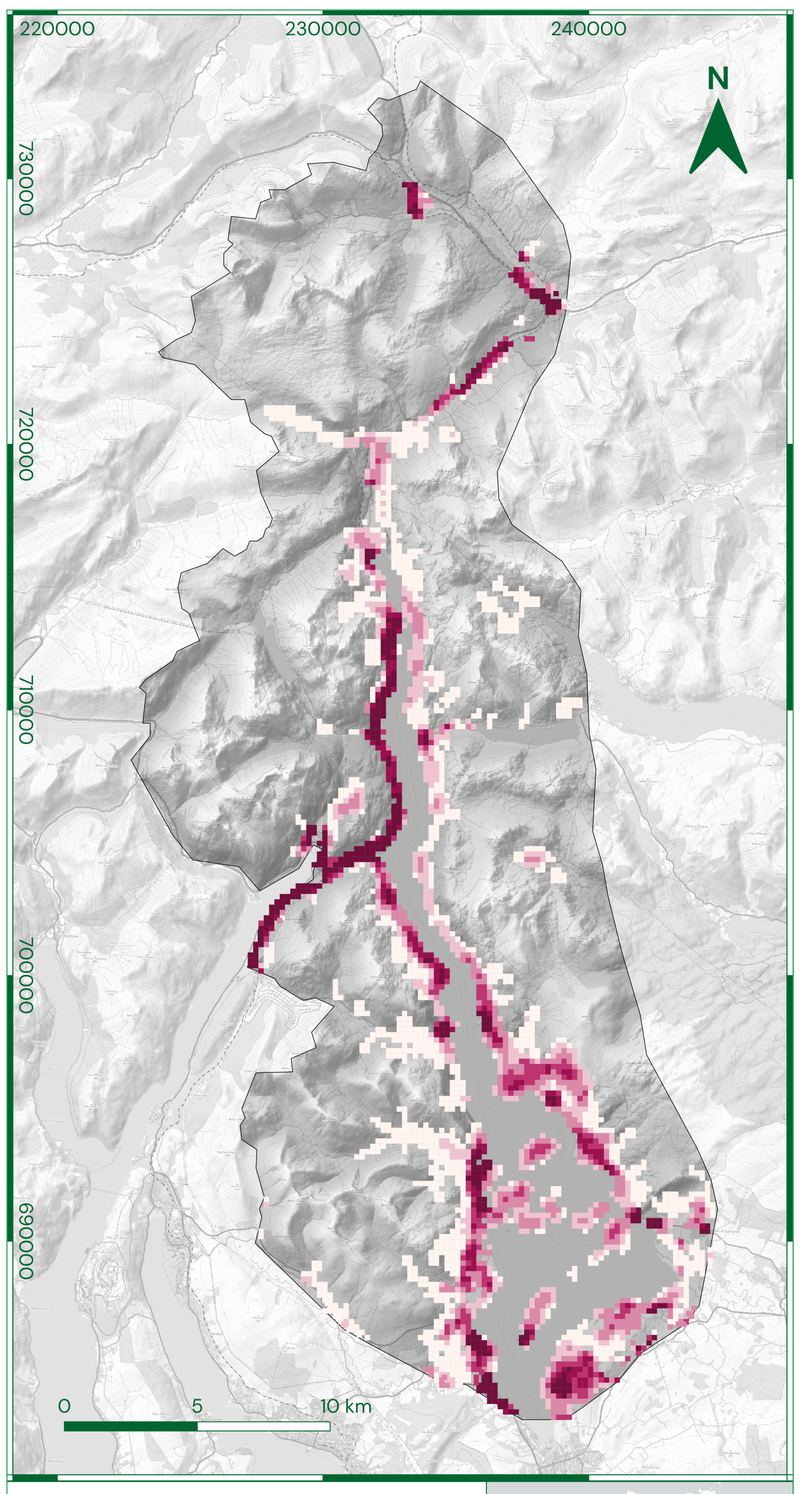
Elevation, roads and footpaths are the most important variables predicting *R. ponticum* abundance.

Is human movement or habitat fragmentation responsible for the importance of roads and footpaths?



Increased traffic, but not footfall, correlated with higher *R. ponticum* presence and density.

Which areas in the Loch Lomond Rainforest project area have the highest probability of *R. ponticum* occurrence?



Risk map shows hotspots where footpaths, major roads and railway lines are in close proximity.

Conclusions

- Roads and footpaths were highly ranked predictors of *R. ponticum* occurrence.
- For roads, this can be attributed to vehicle movement.
- Spread is greatest along these corridors, especially where they intersect each other and optimal habitat.

Recommendations

1. Target removal of *R. ponticum* within areas of high conservation value where human-disturbance pathways intersect and along those corridors.
2. Prioritise *R. ponticum* management along invasion corridors where they lead into high conservation value areas to reduce reinvasion risk.
3. Develop policies for cleaning maintenance equipment.
4. Raise awareness of human-assisted seed dispersal and how to mitigate it.
5. Offer boot and car washing facilities to visitors.

For a full list of recommendations and to read the report scan this QR code.

References

1. Cross JR. Rhododendron ponticum L. The Journal of Ecology 1975 Mar 1,;63(1):345–64.

2. Alliance for Scotland's Rainforests. The state of Scotland's rainforests. The Woodland Trust; 2019.

3. Vacek Z, Vacek S, Eşen D, Yildiz O, Král J, Gallo J. Effect of invasive Rhododendron ponticum L. on natural regeneration and structure of Fagus orientalis lipsky forests in the black sea region. Forests 2020 May 1,;11(5):603.

4. Maclean JE, Mitchell RJ, Burslem DFRP, Genney D, Hall J, Pakeman RJ. Understorey plant community composition reflects invasion history decades after invasive rhododendron has been removed. Journal of Applied Ecology 2018 Mar 1,;55(2):874–84.

5. Maclean JE, Mitchell RJ, Burslem DFRP, Genney D, Hall J, Pakeman RJ. The epiphytic bryophyte community of Atlantic oak woodlands shows clear signs of recovery following the removal of invasive Rhododendron ponticum. Biological Conservation 2017 Aug;212:96–104.

6. Dehnen-Schmutz K, Perrings C, Williamson M. Controlling rhododendron ponticum in the British Isles: An economic analysis. Journal of Environmental Management 2004 Apr 1,;70(4):323–32.

7. Edwards C. Practice guide: Managing and controlling invasive Rhododendron. Edinburgh: Forestry Commission; 2006.

8. Vaz AS, Kueffer C, Kull CA, Richardson DM, Schindler S, Muñoz-Pajares AJ, Vicente JR, Martins J, Hui C, Kühn I, et al. The progress of interdisciplinarity in invasion science. Ambio 2017 Feb 1,;46(4):428–42.

9. Lookingbill TR, Minor ES, Bukach N, Ferrari JR, Wainger LA. Incorporating risk of reinvasion to prioritize sites for invasive species management. Natural Areas Journal 2014;34(3):268–81.

10. Guisan A, Zimmermann NE. Predictive habitat distribution models in ecology. Ecological Modelling 2000 Dec 5,;135(2):147–86.