

Assessing invasion risk: *Cotoneaster bullatus* compared to invasive *Rhododendron ponticum* based on leaf trait similarity



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BACKGROUND AND CONTEXT

Terminology (study specific):

- Native, alien, naturalised, invasive.
- *Rhododendron ponticum* (invasive) and *Cotoneaster bullatus* (alien)

Context:

- Biodiversity crisis (Vilá and Hulma, 2017; Pyšek *et al.*, 2020).
- Limiting similarity hypothesis (LSH; MacArthur and Levins, 1967).
- Phenotypic divergence (Catford *et al.*, 2010).
- Leaf traits (LTs; Lavorel and Garnier, 2002; Wright *et al.*, 2004; Poorter and Bongers, 2006).

Rationale:

- Scarce temperate climate and LT information (Ordonez *et al.*, 2010; Dawson *et al.*, 2017).
- Invasive vs. naturalised (Divíšek *et al.*, 2018).
- *R. ponticum*:
 - 58% of grid cells in the UK (Preston *et al.*, 2002)
 - 1.2% of native woodlands and 65% of all non-native species in Scotland (Paterson *et al.*, 2013)



Image credit: Milne, 2022

AIMS AND RESEARCH QUESTIONS

Aim: to understand the LT drivers behind the success of *R. ponticum* as an invasive species in Scotland, and use them to infer the invasion potential of *C. bullatus*.

Research questions:

1. Does *R. ponticum* differ significantly from native species in its LT values in Scotland?

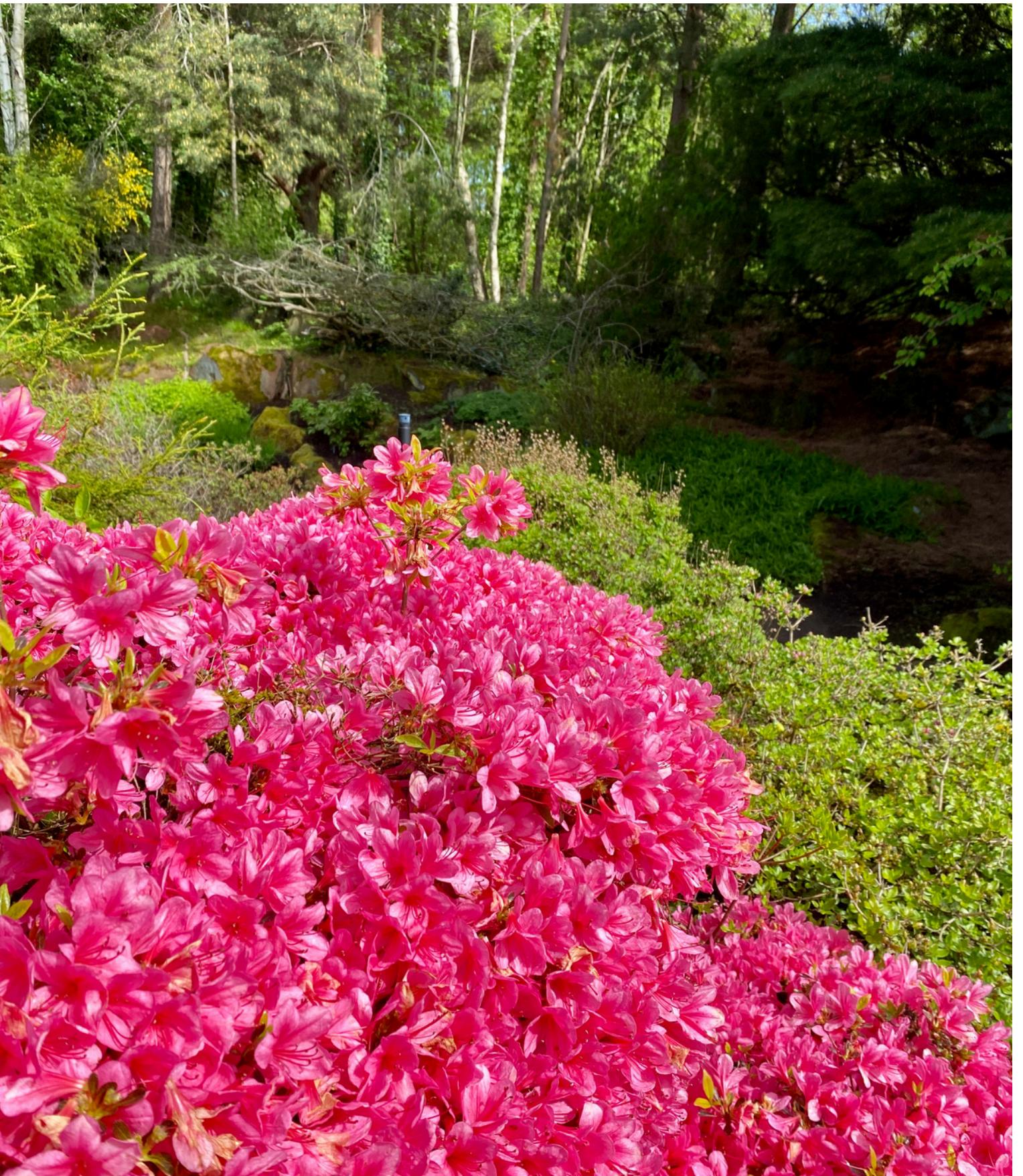
a. **Rationale:** Invasive species differ in their traits from natives, as per the LSH and phenotypic divergence (MacArthur and Levins, 1967; Catford *et al.*, 2010), and in general, show higher trait values (Pyšek and Richardson, 2007).

b. **Hypothesis:** *R. ponticum* will show significantly higher LT values than native Scottish species.

2. Can we use these differences to infer the invasion potential of *C. bullatus* in Scotland?

a. **Rationale:** Based on Divíšek *et al.* (2018) who showed that plant functional traits differ significantly between native/non-native, but not between native/naturalised species.

b. **Hypothesis:** If *C. bullatus* exhibits LT similarity to *R. ponticum*, we can infer it has invasion potential in Scotland.



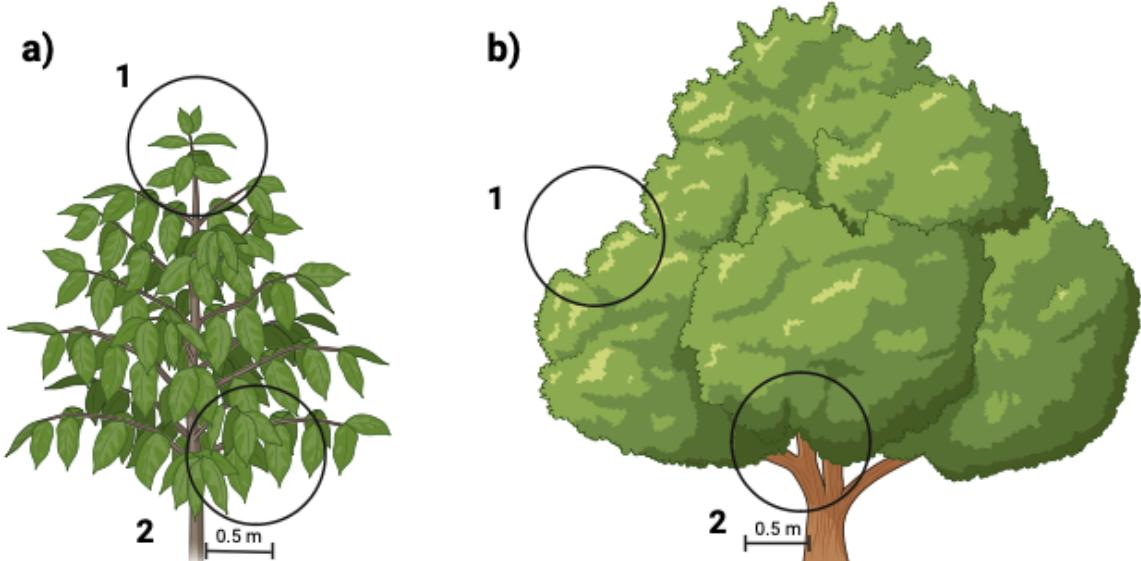
METHODS

Study site:

- RBGE, Edinburgh, UK
- Standardised environmental conditions

Species selection

- Criteria:
 - Wildlife and Countryside Act (1981)
 - New Atlas of British and Irish Flora (Preston *et al.*, 2002)
 - Wildlife Trust (2019)
 - NatureScot (2011, 2024)
- 34 woody angiosperm selected:
 - 20 native
 - 12 naturalised
 - 1 invasive (*R. ponticum*)
 - 1 alien (*C. bullatus*)



METHODS

Leaf traits (classified after Niinemets, 2020):

- Physiological: A, E, g, Rleaf
- Structural: LMA, LDNC
- Chemical: LCC, C/N ratio

Physiological LT measurements:

- GFS-3000 (on fresh leaves)

Structural LT measurements:

- Fresh leaves weighed, and dried in oven at 60C for 72 hours (until constant dry mass), and weighed again

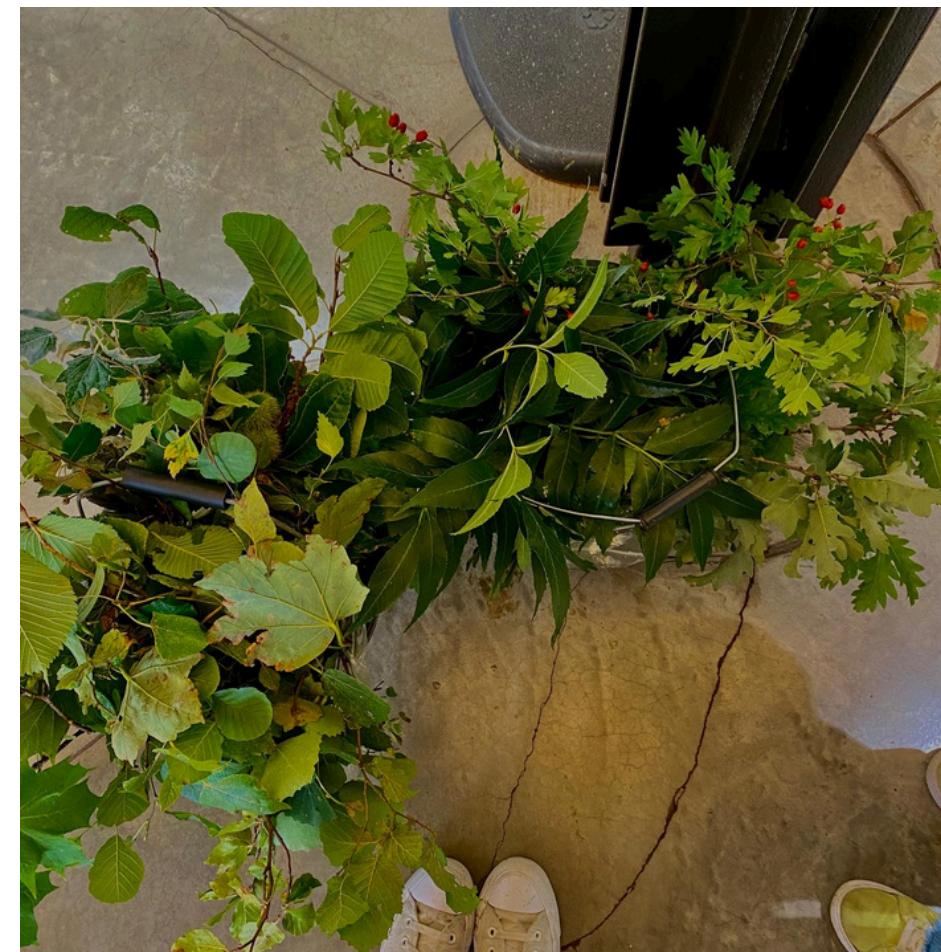
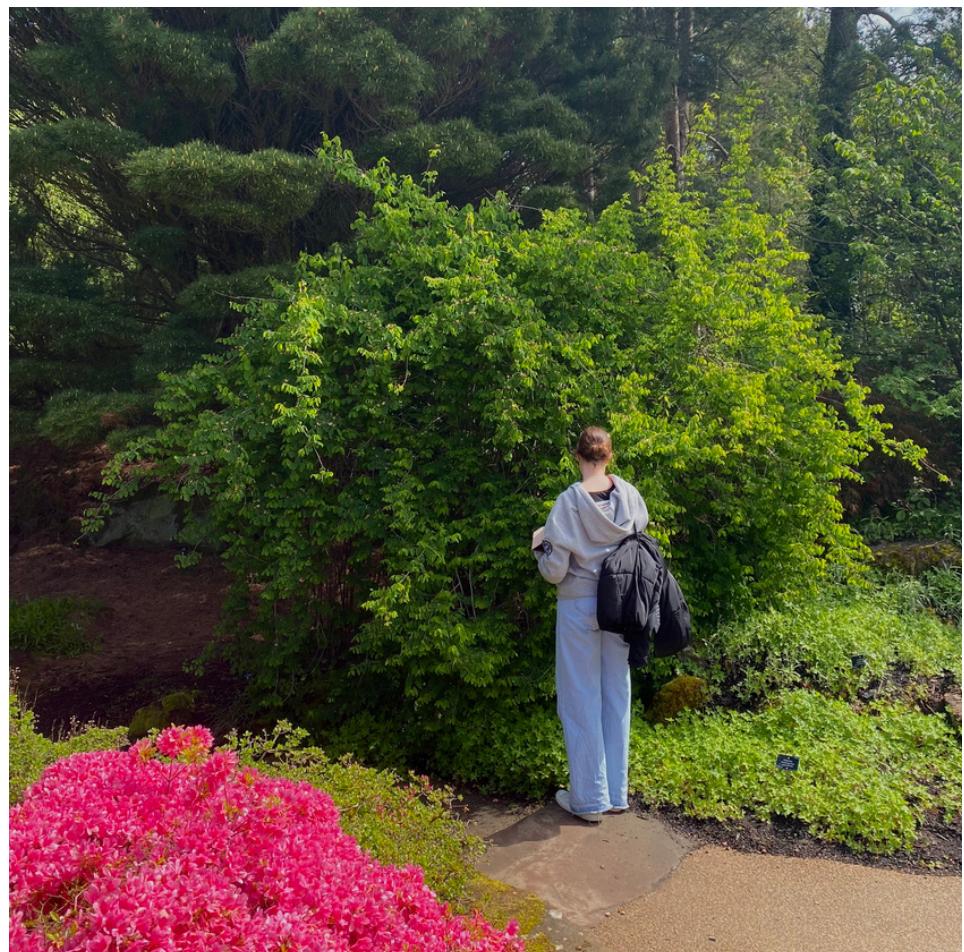
Chemical LT measurements:

- LCC: SPAD-502+ (on fresh leaves)
- C/N ratio: dried leaves were ground, dried again at 55C for 24 hours, and analysed using a CHNS/O analyser

n = 202 (n = 118, 72, 6, and 6, for native, naturalised, alien, and invasive, respectively). For C/N ratio, n = 99 (n = 54, 39, 3, and 3, respectively)

Statistical analysis:

- NMDS + ANOSIM
- Kruskal-Wallis + post-hoc Dunn test on significant effects
- Mean z-scale comparison (Wilcoxon's rank sum test)



SPATIAL ANALYSIS

Overall:

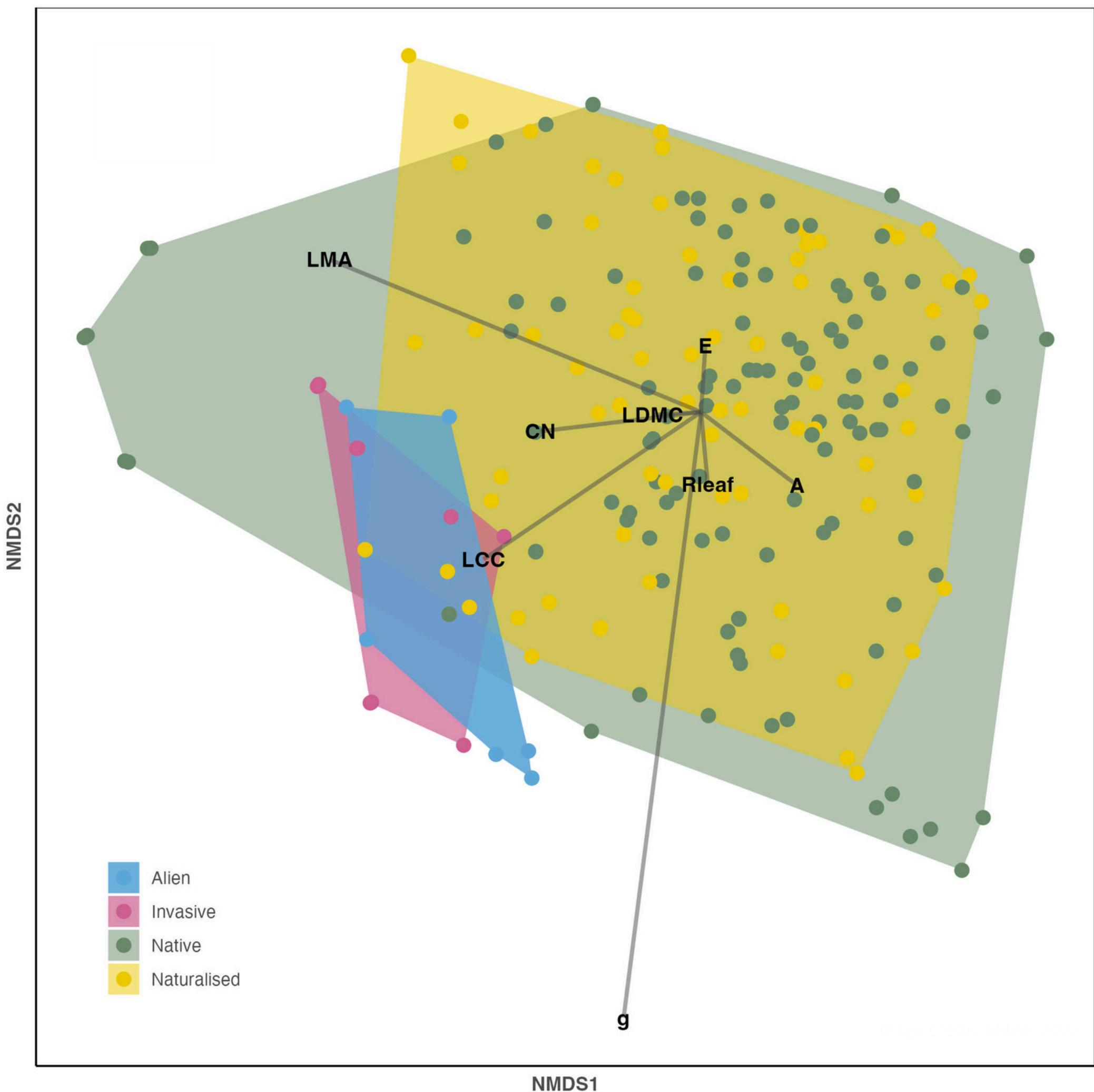
- Native and naturalised species are similar in LT profiles
- Invasive and alien species show some separation (and overlap with each other)

Traits driving the differences:

- LMA, g, LCC responsible for most of the variation, followed by A and C/N ratio
- E, Rleaf, and LDMC show no effect

Implications:

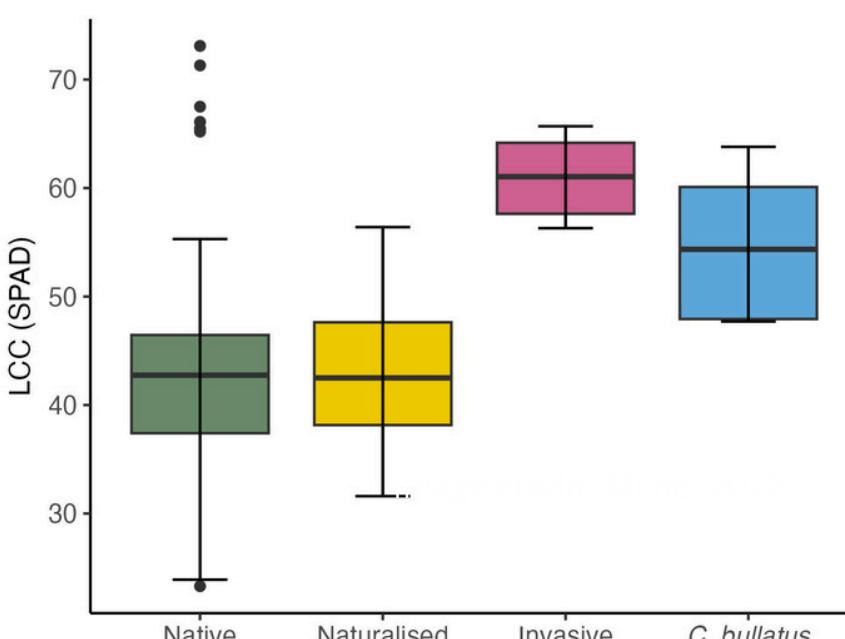
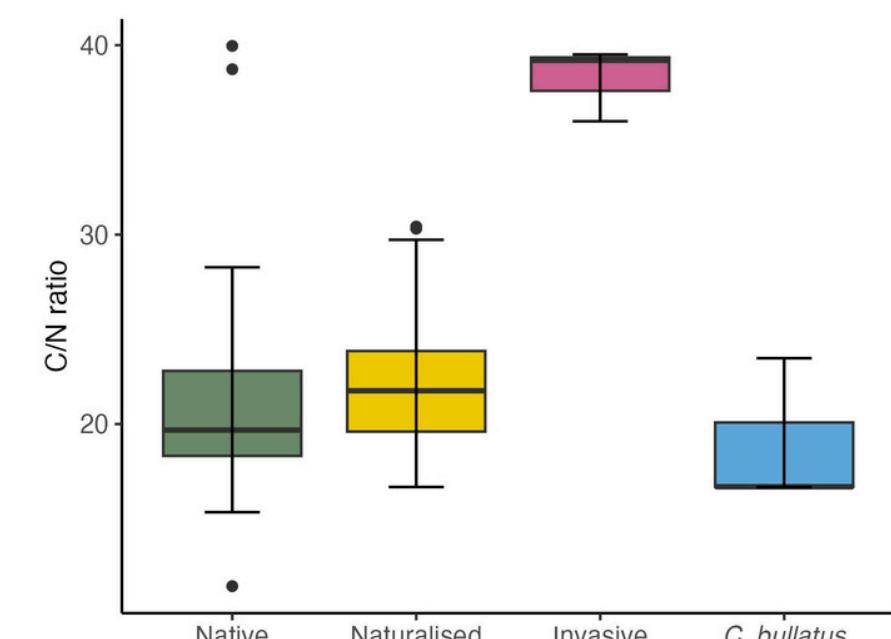
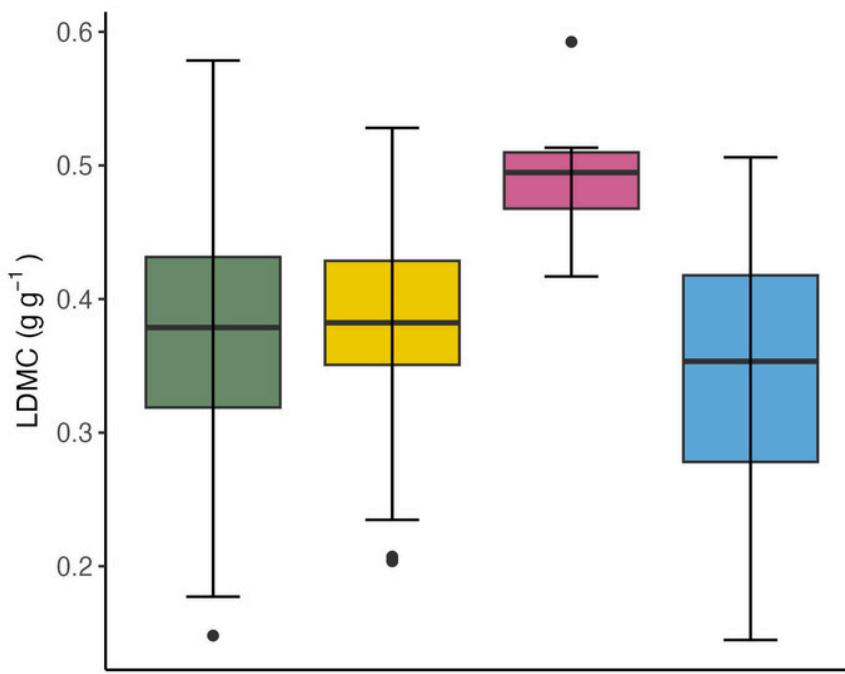
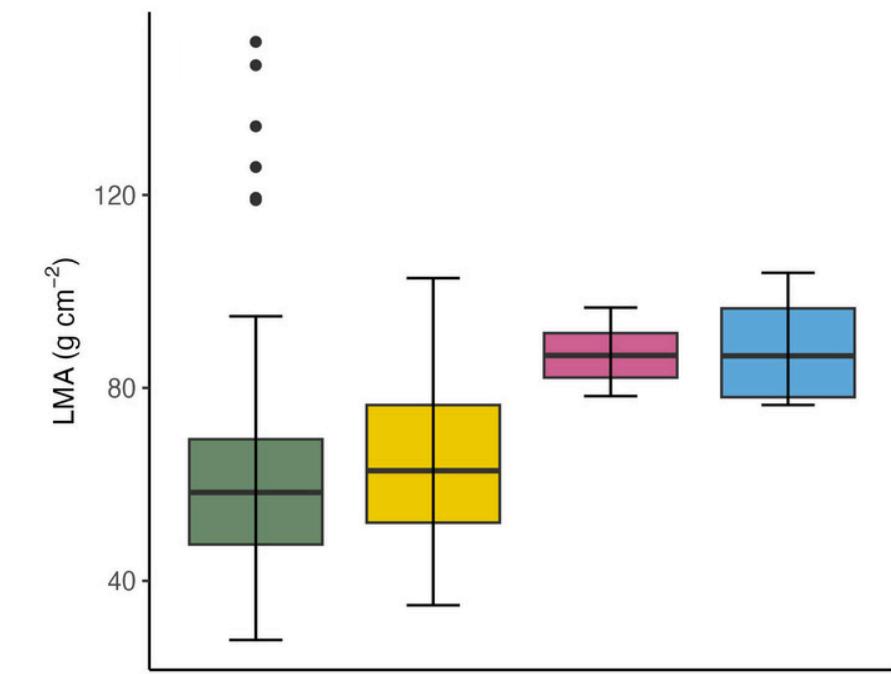
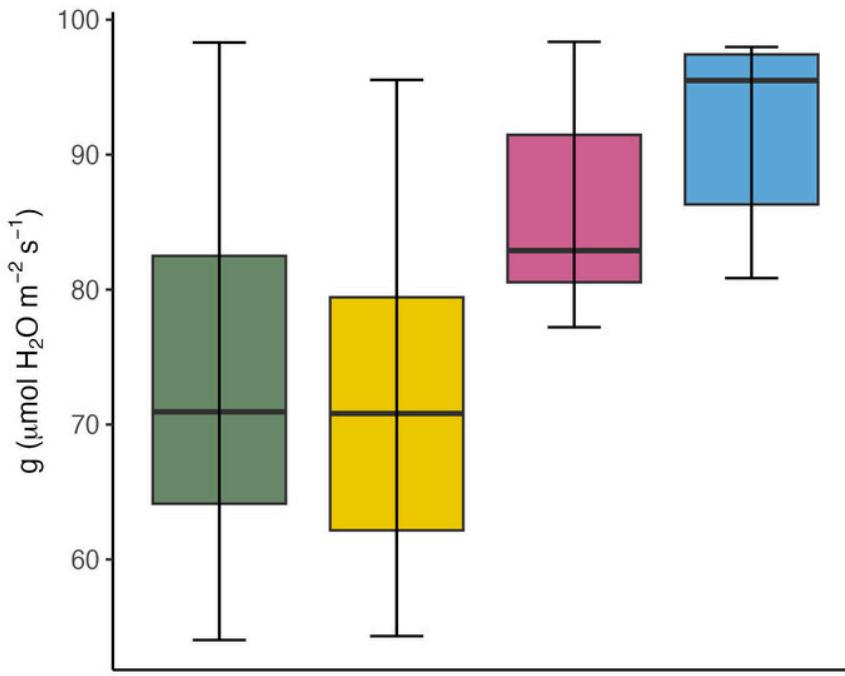
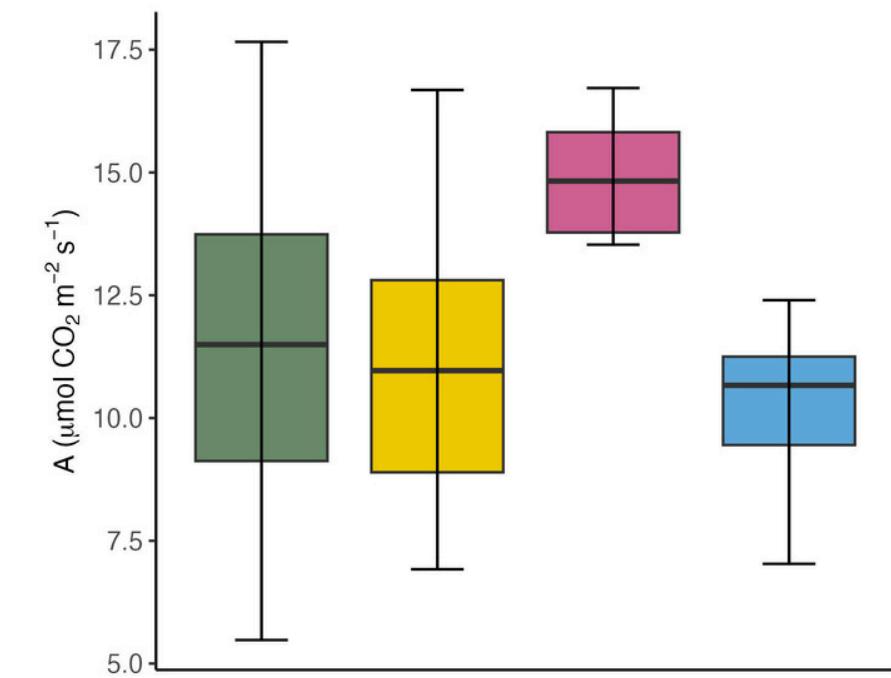
- Aligned with LSH and phenotypic divergence theories
- Trait combinations drive the differences
 - LMA, g, LCC, A, and C/N ratio are crucial determinants of plant performance
- *C. bulatus* appears similar to *R. ponticum* - suggesting invasion potential based on LT similarity



LT COMPARISONS

Overall LT differences:

- Significant overall differences shown
- Invasive species show the expected trend - significantly higher LT values than natives
- Naturalised species do not differ significantly from natives
- *C. bullatus* differ significantly from natives in LCC, LMA, and g



Implications:

- LTs show similar trends to other plant traits (Pyšek and Richardson, 2007; Divíšek *et al.*, 2018)
- *R. ponticum* competitive ability is dependant on resource acquisition strategies (photosynthesis) - not water-use efficiency
- *C. bullatus* has invasion potential based on LT similarity to *R. ponticum*

LIMITATIONS AND FURTHER DIRECTIONS

Limitations:

- Geographic and ecological scope
- Angiosperms only
- LTs only
- One individual per species at one time
- Uneven sample sizes

Future directions:

- Comprehensive plant trait framework
 - Whole plant traits, LTs, environmental conditions, and community composition to be included



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THANK YOU FOR LISTENING!

Any questions?