

Invasive hybrid vigor?

Niche and trait variance between three knotweed taxa

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Introduction

- There are 3 widespread invasive knotweed taxa
- (Fig. 1)
- Sympatric but rarely co-occur in Pennsylvania
- The taxa can hybridize and back-cross.
- There is evidence that the hybrid, Bohemian knotweed, exhibits hybrid vigor.

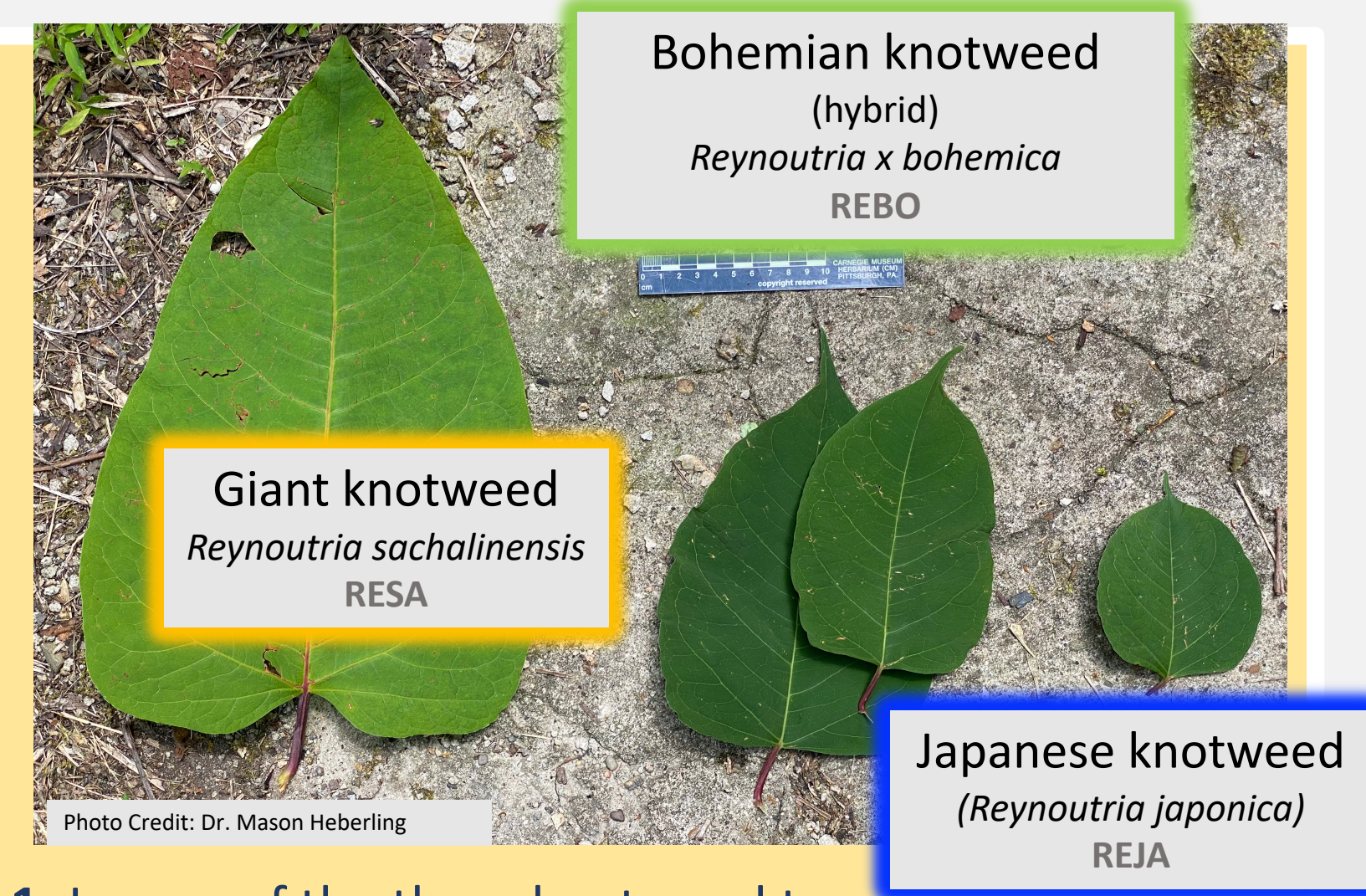
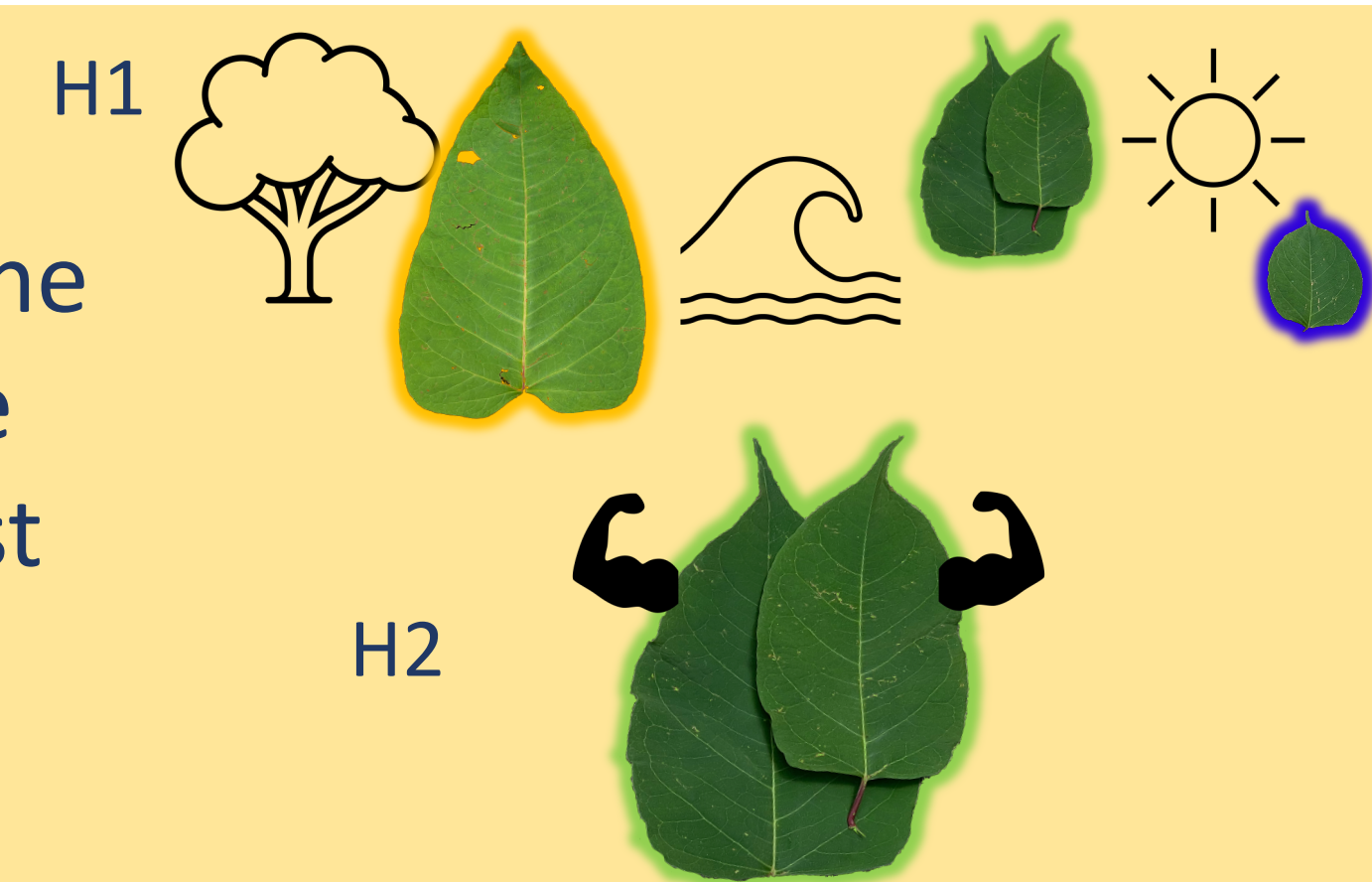


Figure 1. Leaves of the three knotweed taxa

Hypotheses

H1 Niche partitioning: There will be niche variation between the three taxa with Bohemian knotweed having the broadest niche

H2 Hybrid vigor: Bohemian (hybrid) knotweed will have highest fitness of the three taxa indicated by functional traits and photosynthetic rate



Methods

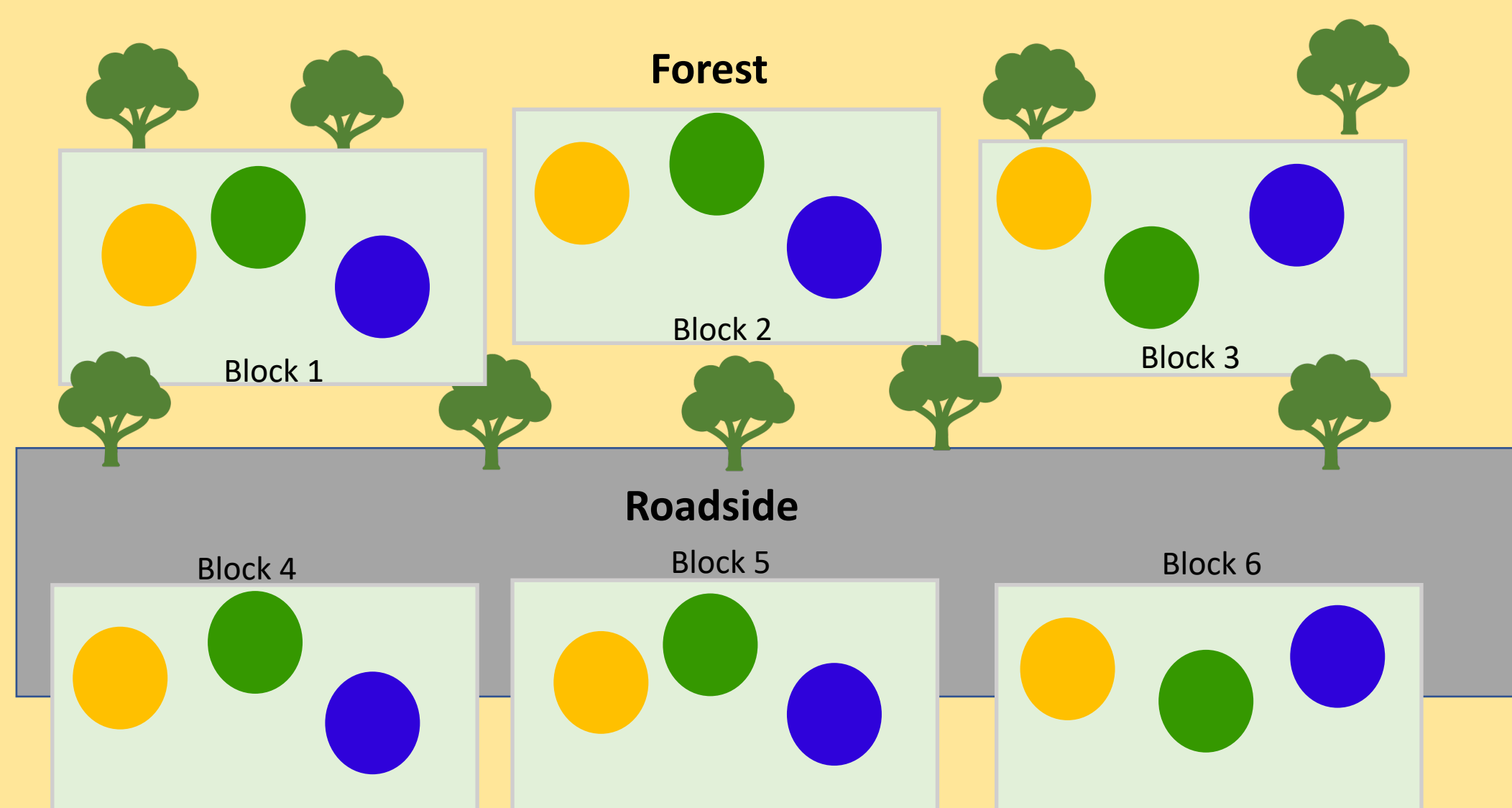


Figure 2. Barking Slopes sampling design, includes 6 knotweed blocks containing all three taxa, three roadside and three forested.

-Barking Slopes Natural Area (Allegheny Co., PA) is inhabited by all three taxa (Fig. 2)

-For each taxa in each block, the following data was collected:

- Habitat: Soil pH, texture*, H₂O holding capacity*, moisture, temperature and canopy cover
- Functional traits: Specific Leaf Area (SLA), chlorophyll index, leaf thickness, as well as net assimilation rate (photosynthetic rate)

Results

H1 Niche partitioning (Fig. 3):

- Little niche variation
- Giant knotweed has broadest niche

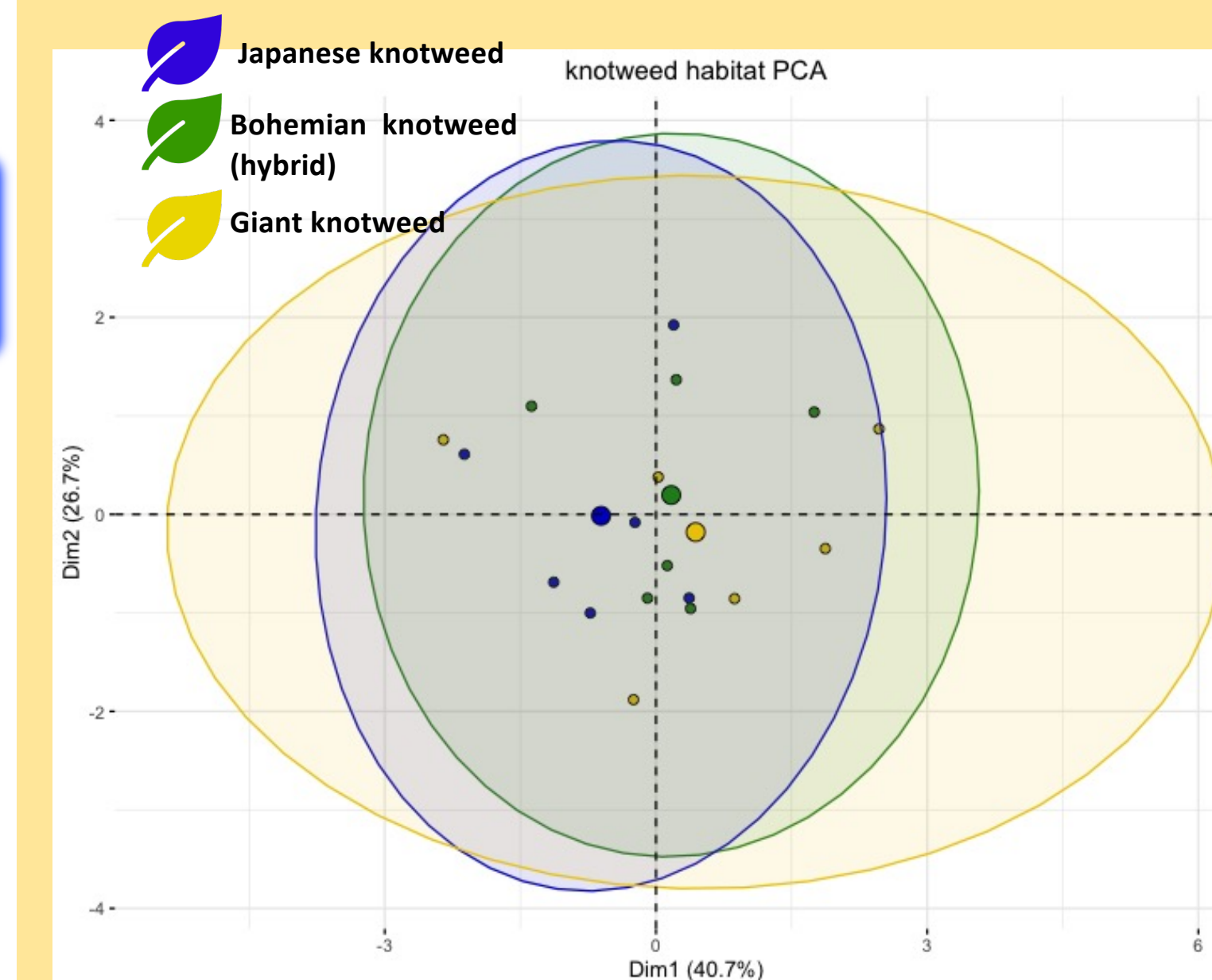


Figure 3. PCA of habitat data (soil pH, soil moisture, soil temperature, and canopy cover)



H2 Hybrid vigor:

- Taxon with highest fitness trait measures varies by trait
- SLA: ns (Fig. 4)
- leaf thickness & chlorophyll index: parent taxa significantly differ, Japanese knotweed has measures indicating highest fitness (Fig. 5)

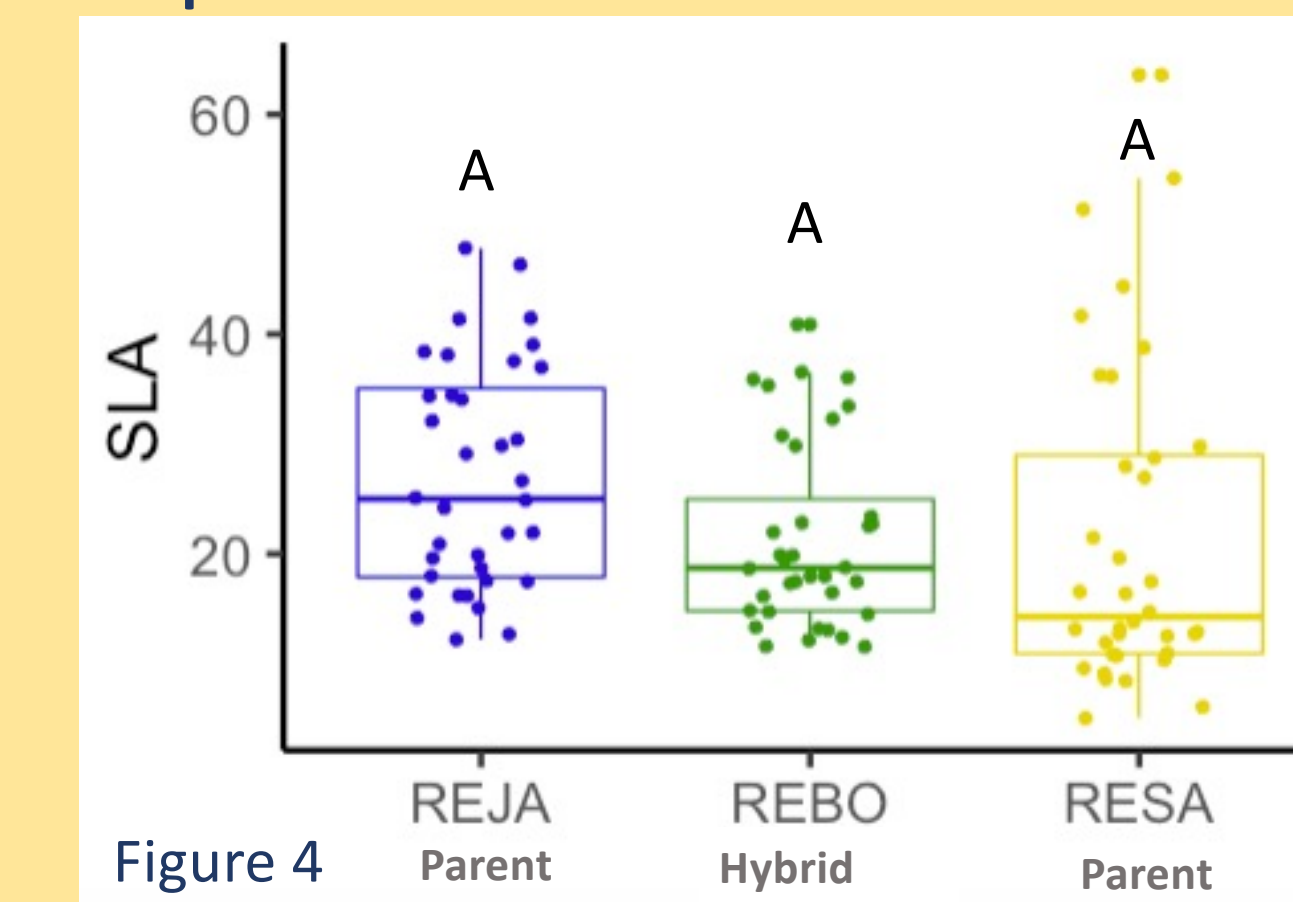


Figure 4

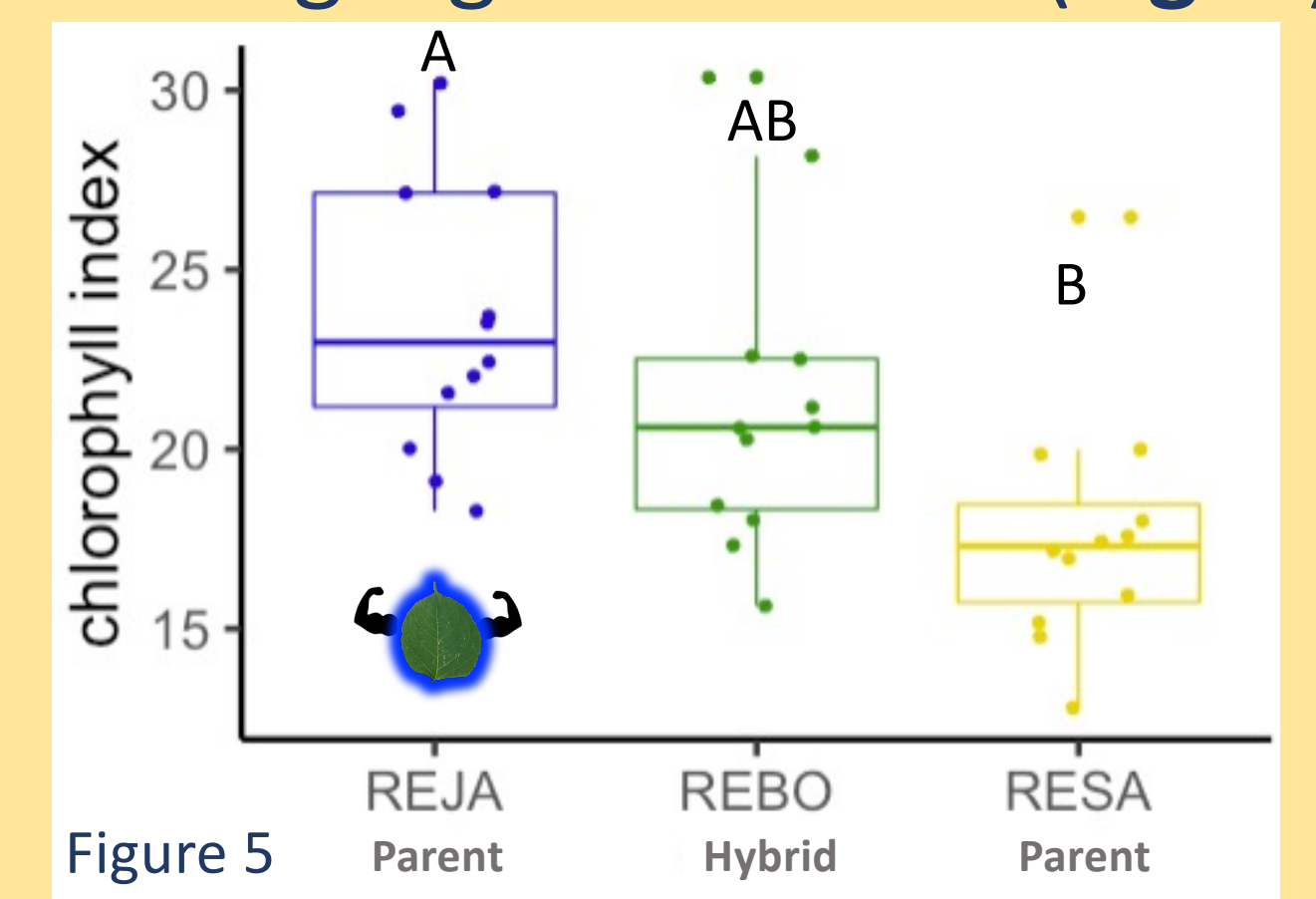


Figure 5

-Japanese and Bohemian knotweed have comparable photosynthetic rate (Fig. 6)

Figure 4. (top left) Specific leaf area for each taxa, no significant difference

Figure 5. (top right) Chlorophyll index for each taxa, Japanese knotweed and giant knotweed differ significantly

Figure 6. (bottom left) Max net assimilation rate (μmolm⁻²s⁻¹), a proxy for max photosynthetic rate for each taxa, giant knotweed is significantly lower

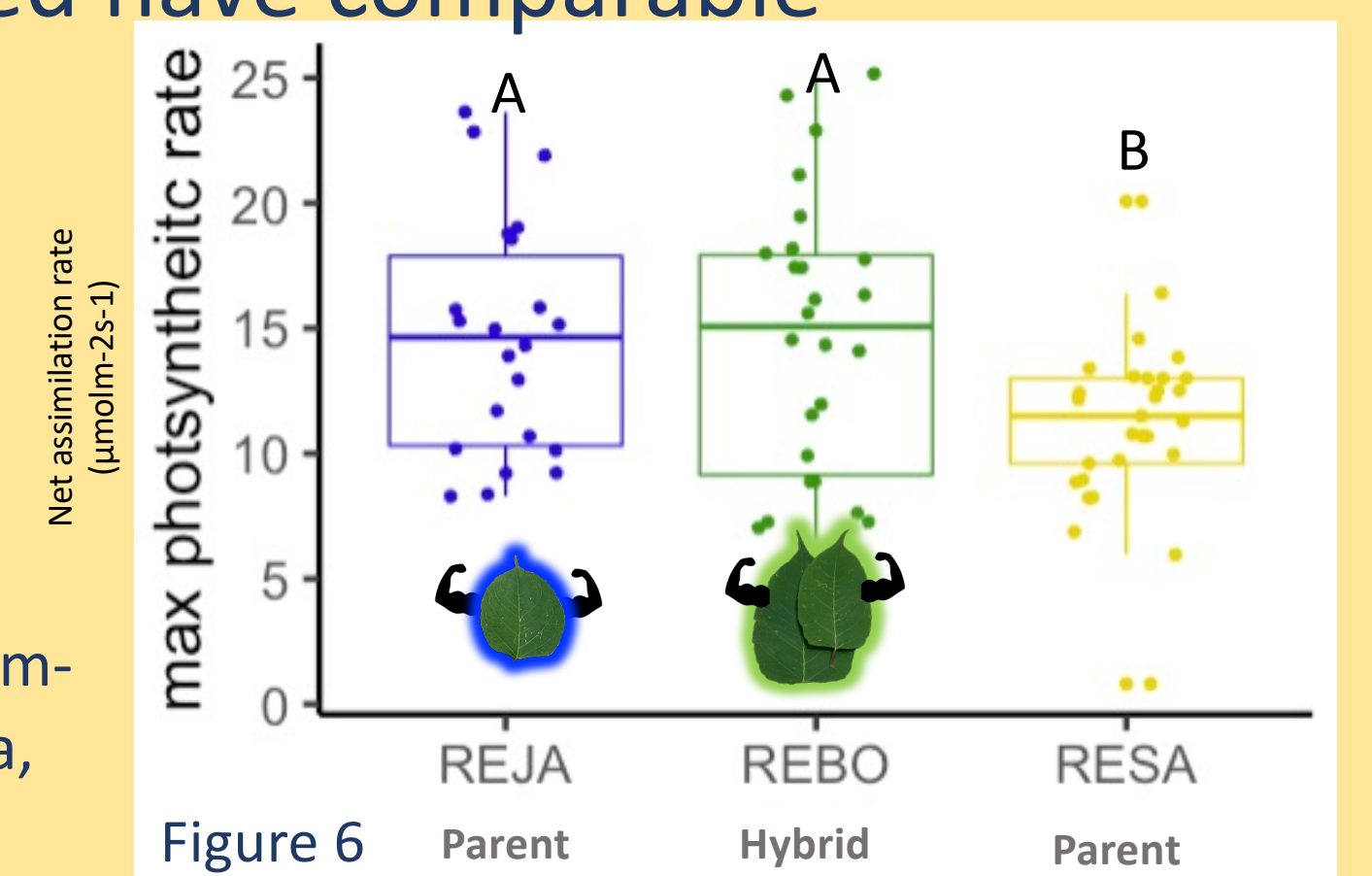


Figure 6

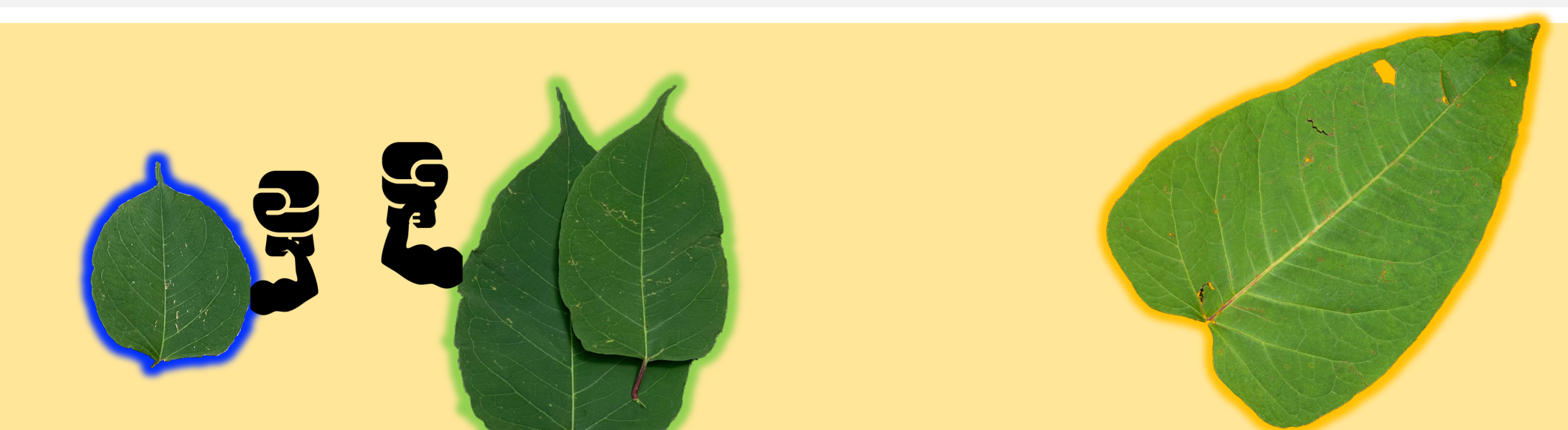
Conclusions

H1 Knotweed taxa likely not niche partitioning

-Co-occurring taxa are competing

H2 Each taxon has unique competitive advantages

-May see hybrid vigor- more data needed



Future hypothesis: Japanese knotweed and Bohemian knotweed (hybrid) are functionally similar and compete for a similar niche. Giant knotweed is less competitive and occupies a slightly broader niche where it is less likely to compete with the other two taxa

Acknowledgements

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Future directions:

- Additional functional trait measures
- Germination trials
- Greenhouse competition trials

References

- Lavoie, C. 2017. The impact of invasive knotweed species (*Reynoutria* spp.) on the environment: review and research perspectives. *Biol. Invasions* 19:2319–2337.
- Parepa, M., M. Fischer, C. Krebs, and O. Bossdorf. 2014. Hybridization increases invasive knotweed success. *Evol. Appl.* 7:413–420.
- Zika, P.F., and A.L. Jacobson. 2003. An overlooked hybrid Japanese knotweed (*Polygonum cupidentum* x *sachalinense*; Polygonaceae) in North America. 105. 143–152 pp.