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# Do Biogeographical Patterns in Morphological Traits of Insect Host and Parasitoid Wasp Communities Contribute to Ecological Release of a Range-Expanding Host via Trait Mismatching?

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# Do biogeographical patterns in morphological traits of host-parasitoid communities contribute to ecological release of range-expanding species via trait mismatching?

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## Introduction

- As species expand their ranges **in response to climate change** they move into less diverse communities at the poles and leave interacting species behind.
- Range-expanders may experience open **niche opportunities** (i.e., reduced competition) and **ecological release**, causing damage in recipient ecosystems.
- Niche opportunities are determined by **traits of interacting species** [1,2] and non-overlapping traits in recipient communities provide open niche space [3].
- Range-expanding phytophagous insects can become major pests in expanded regions, where they often interact with fewer competitors and enemies (parasitoids).

## Objectives

**Do morphological traits of oak insect communities vary across the range of the dominant oak, *Quercus garryana,* in western savanna ecosystems?**

**Does variation in traits provide open niche opportunities for the range-expanding insect *Neuroterus saltatorius* (NSA)?**

## Methods

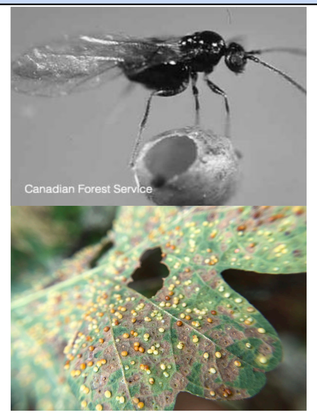



**Fig. 1**: *N. saltatorius* is an oak gall wasp (Hymenoptera: Cynipidae) that occurs on *Q. garryana.* It expanded its range from the mainland to Vancouver Island, BC where it is outbreaking. **It is a detachable leaf gall.**

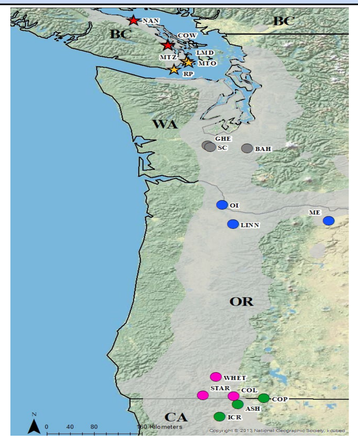
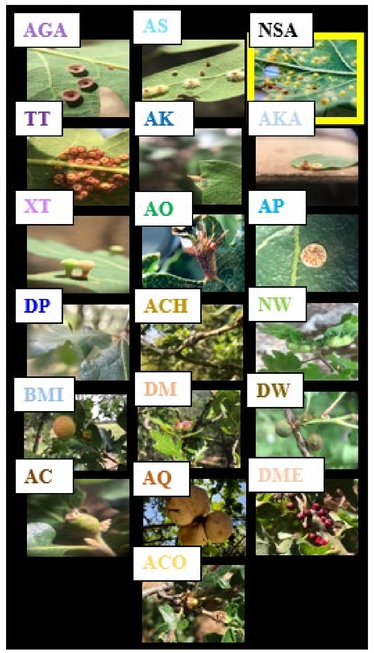



**Fig. 2**: We collected cynipids that occur with NSA on *Q. garryana* at 18 sites in the native range (circles) and the expanded range (stars). We reared parasitoid wasps out of collected cynipids and identified them using taxonomic keys.

## Methods



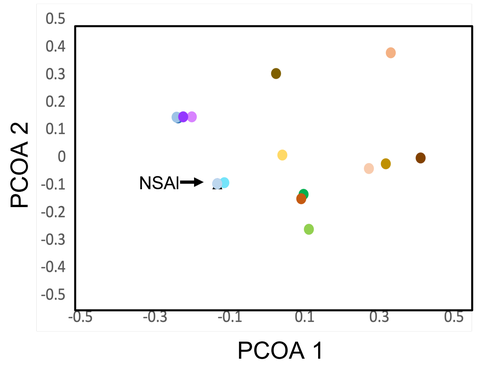




**Fig. 3**: **(a)** We measured **morphological traits** of cynipid species (acronyms/colors), including including **gall volume, toughness, fuzziness, plant tissue location, and # of individuals per gall. (b)** We projected cynipid species onto multidimensional trait space and measured the distance of each cynipid species to the focal species at each study site.

## Results

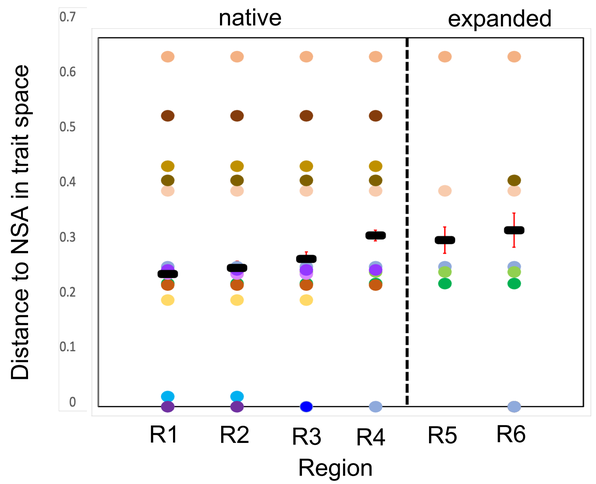



**Fig. 4**: Distance of each cynipid species to NSA in cynipid trait space (Fig. 3) in each region. Means (+/-SE) are calculated over all cynipid species at each of the three sites within each region.

## Future work

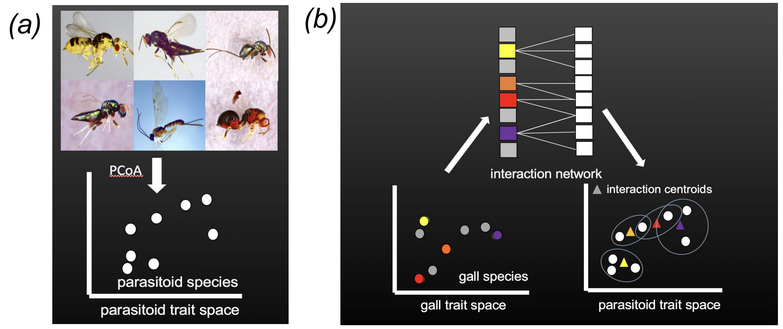



**Fig. 5: (a) I am currently measuring traits of parasitoid morphospecies that reared out of cynipid hosts, including wing length, height, area, and perimeter, body length, thorax width, back tibia length, and ovipositor length**. Next, I will plot parasitoid species in multidimensional trait space. **(b)** I will create an **interaction trait space** by plotting each cynipid morphotype in the center of parasitoids they interact with in parasitoid trait space (interaction centroids). This represents traits of the suite parasitoids that interact with each cynipid. I will calculate distances of centroids of each morphotype to NSA and calculate averages over species and sites (as in **Fig. 4**).

## Conclusions

- Cynipid community traits are less diverse at higher latitudes.
- Distance of cynipids in cynipid trait space to NSA is greater in the expanded than the native range, which is evidence of **open niche opportunities.**
- There are **fewer detachable leaf cynipids** in the expanded range that share traits (and likely compete) with NSA.
- We predict that there will also be greater trait divergence in interaction trait space (of interacting parasitoid species), meaning fewer parasitoid species possess adaptations to attack the novel host - NSA.

## References

[1] Bailey et al. (2009). PLoS Biol 7(8): e1000179. [2] Dehling et al. (2016). Proc. R. Soc. B. 203: 20152444. [3] Prior K, Hellmann JJ. (2013). Ecology 94:5, 1015-1024.

## Acknowledgments

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