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The Role of Apparent Competition in Facilitating Ecological Release of a Range-expanding Insect

Serena Feldman
Binghamton University--SUNY

Rachel Chen
Binghamton University--SUNY

Aly Milks
Binghamton University--SUNY

Dylan Jones
Binghamton University--SUNY

Leslie Huang
Binghamton University--SUNY

See next page for additional authors

Authors

Serena Feldman, Rachel Chen, Aly Milks, Dylan Jones, Leslie Huang, Jenna Ross, Lilly Griffen, and Will Smisko

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Serena Feldman, Rachel Chen, Aly Milks, Dylan Jones, Leslie Huang, Jenna Ross, Lilly Griffen, Will Smisko, Kirsten Prior
Binghamton University, Department of Biological Sciences

Introduction

- Species respond to climate change by expanding their ranges poleward
- Diversity decreases towards the poles and range-expanding species likely interact with fewer competitors and enemies there
- **"Release from apparent competition"** occurs when range-expanding species are attacked by fewer or less effective shared enemies (with competitors) in their expanded range (Fig. 1) [1]
- *Neuroterus saltatorius* is an oak gall wasp (Hymenoptera: Cynipidae) that expanded it's range and is outbreaking (Fig. 2,3). *Andricus opertus* co-occurs on oak *Quercus garryana* and is native to the full range [2]

Is the range-expanding species experiencing release from apparent competition from its co-occurring native competitor?

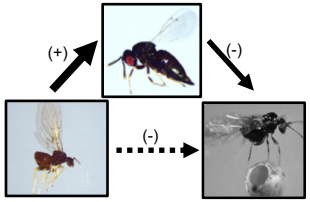

Fig 1. If *A. opertus* shares fewer parasitoid enemies with *N. saltatorius* in the expanded range, it provides weak apparent competition (dashed line) that could contribute to outbreaks of *N. saltatorius* (dashed = indirect interaction) (solid = direct interaction)

Methods

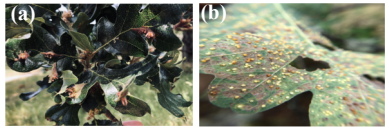

Fig 2. Wasps form structures (galls) on leaves. (a) *A. opertus* galls and (b) *N. saltatorius* galls outbreaking in expanded range.

- Galls were collected from *Q. garryana* trees from 30 trees (over three time periods at 18 sites (6 regions) in the native and expanded range (Fig. 3)
- Over a year they were kept in controlled environmental chambers and emergent (gall wasps and parasitoid wasps) were collected and stored in ethanol.
- Cynipid and parasitoid species were sorted into morphospecies using taxonomic keys [3].

Results

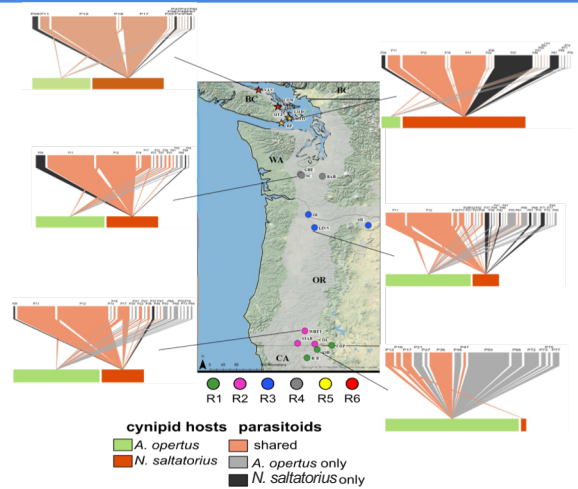

Fig 3. We made quantitative cynipid host-parasitoid interaction networks for each region in R using bipartite in R [4]. Grey shading is the range of *Q. garryana* and *A. opertus*. R1-4 is in the native range and R5-6 the expanded range of *N. saltatorius*. Bottom bars in networks represent relative abundance of host species, links and top bars represent relative emergence (attack rates) by parasitoids.

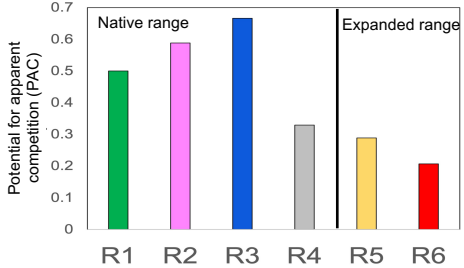

Fig 4. We calculated the potential for apparent competition (PAC) that quantifies the interaction between two host species by all shared parasitoids. Values close to 1 represent strong apparent competition from *A. opertus* to *N. saltatorius*

Parasitoid community

Shared parasitoids between *A. opertus* and *N. saltatorius*)

Aprostocetus vericarn (Eulophidae) **P12**	Tetrastichinae sp. 2 (Eulophidae) **P16**	*Brasema* sp. 1 (Eupelmidae) **P17**	*Sycophila wiltzae* (Eurytomidae) **P22**	*Ormyrus* sp. (Ormyridae) **P36**	Pteromalidae sp. 1 (Pteromalidae) **P41**	*Bootanomyia dorsalis* (Torymidae) **P47**	Platygastridae sp 1 (Platygastridae) **P61**
Aprostocetus sp. (Eulophidae) **P09**	*A. pattersonae* (Eulophidae) **P11**	*Amphidocius shickae* (Pteromalidae) **P37**	*Mesopolobus* sp. (Pteromalidae) **P38**	Pteromalidae sp. 2 (Pteromalidea) **P42**	Pteromalidae sp. **P67**	Braconidae sp. **P69**	Pteromalida sp. **P69**

Parasitoids only in *N. salatorius*)

Table 1. 16 parasitoid species were reared out of *N. saltatorius* and 29 out of *A. opertus*. Eight of these are shared between the two species (top row) and 8 are only found in *N. saltatorius*.

Conclusions

- *A. opertus* shares fewer parasitoids with *N. saltatorius* in the expanded range
  A. opertus is not a strong apparent competitor in R5 or R6
- This could be due to parasitoids being locally adapted to *A. opertus* in the expanded range and not effectively switching the the novel host
- *N. saltatorius* appears to be experiencing ecological release that could partially be a result of release from apparent competition by *A. opertus*
- Future work includes identifying parasitoids from the broader cynipid community (~24 species) co-occurring with *N. saltatorius* on *Q. garryana.*

Acknowledgements/References

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[1] Schönrogge & Crawley. 2000. J. Anim. Ecol. 69: 841-868. [2] Prior & Hellmann. 2013. Ecology 94: 1015-1021 [3] Gibson 1997. Annotated Keys to the Genera of Nearctic Chalcidoidea (Hymenoptera) NRC Press. [4] Dorman et al. 2021. Bipartite