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Uncovering How Partner Interchangeably Affects Mutualistic Outcomes In A Species Complex Of Seed-dispersing Ants

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Uncovering how partner interchangeably affects mutualistic outcomes in a species complex of seed-dispersing ants

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Introduction

Background

Myrmecochory is seed dispersal performed by ants, a unique mutualism involving 11,000 species of plants worldwide that produce seeds with lipid-rich appendages (elaiosomes) that attract seed-dispersing ant partners [1-6]. Ants take the seeds to their nests, feed on the elaiosomes, and then place seeds outside nests in locations conducive to germination [7-8]. Partners involve guilds of seed-dispersing ants including ***Aphaenogaster picea*** and ***A. rudis***, which are responsible for 74% of dispersal of myrmecochore seeds in North American forests[9]. *Aphaenogaster sp.* exist in a polyphyletic group, and seed-dispersal related traits and functional traits might vary among or within putative species.

This project aims to uncover variation in seed dispersal among ant partners and determine impacts of variation on forest understory community structure.

Figure 1. Seeds of two of myrmecochore species used for foraging trials. Circled in red are the elaiosomes. Ants disperse 30-40% of understory plants in eastern NA forests.

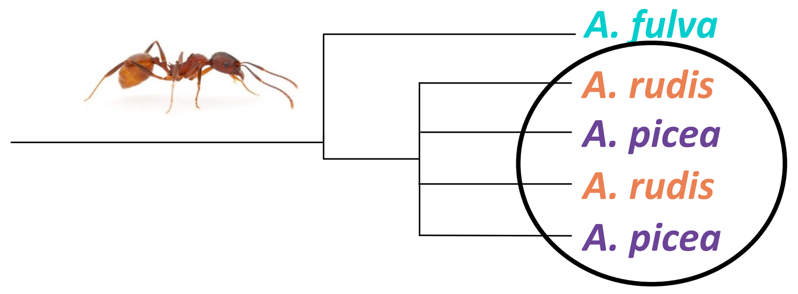
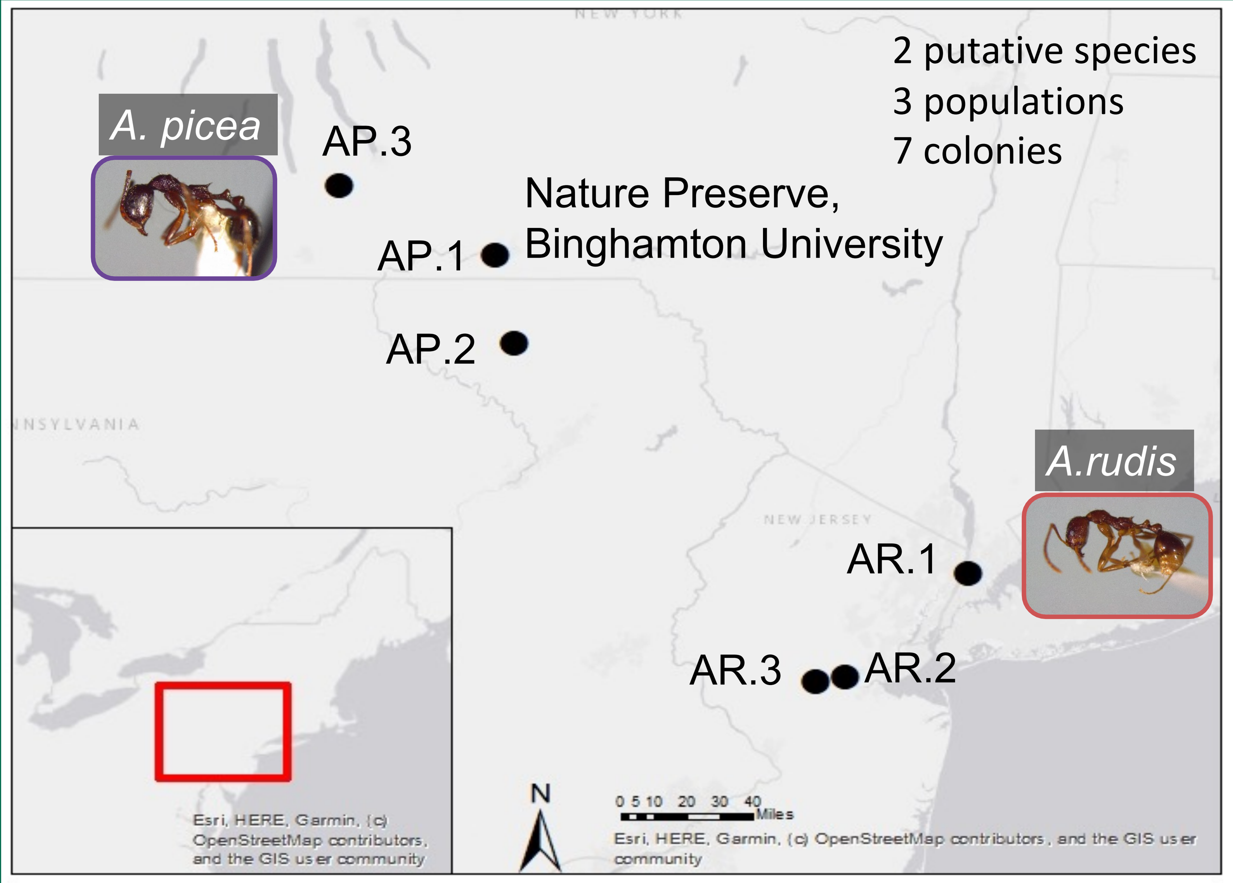


Figure 2. Conceptual phylogenetic tree (left) showing the disperser complex of *Aphaenogaster.*

Methods



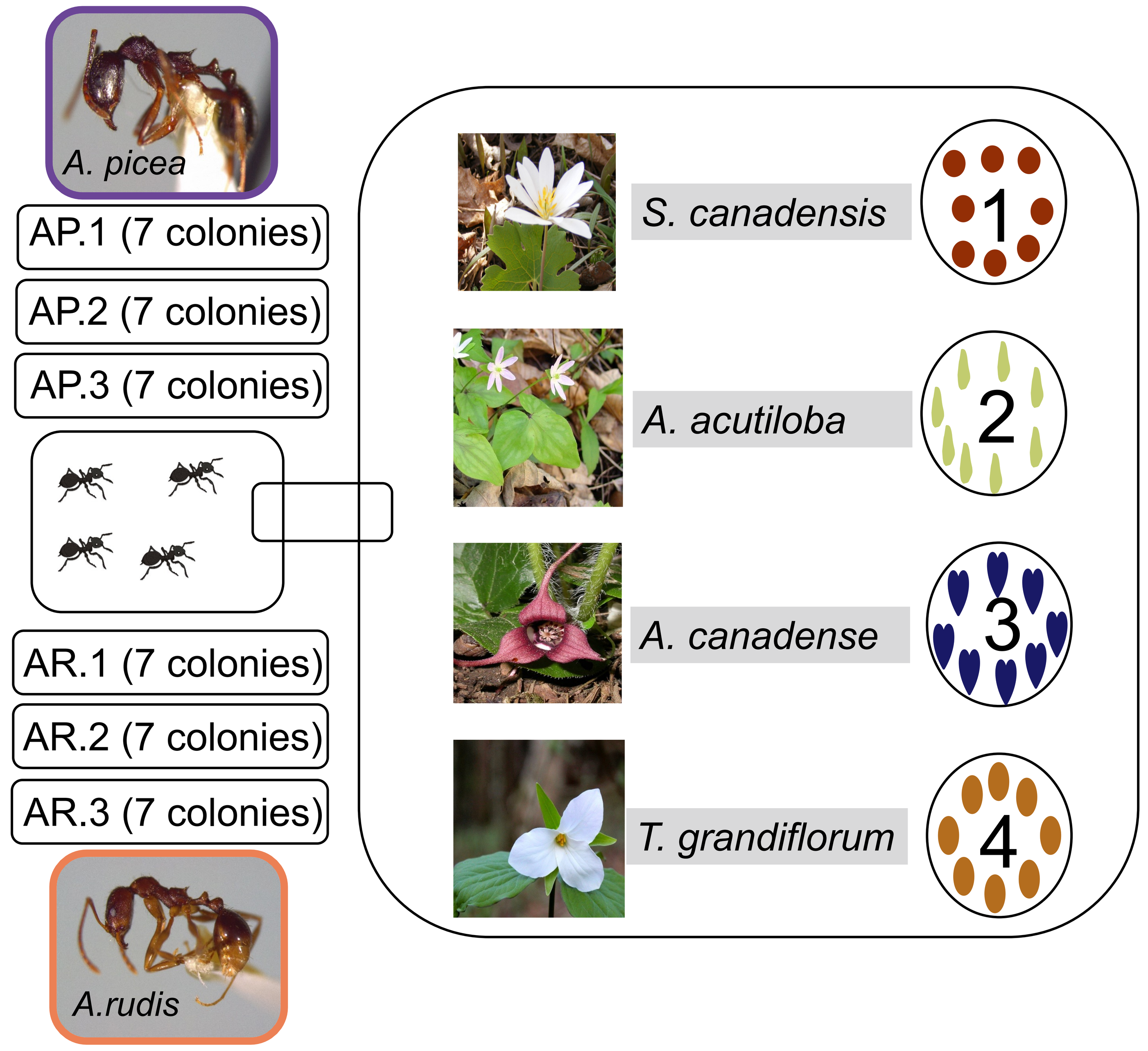


Figure 3 (top). The above map shows sampling locations in NY, NJ, and PA. Each dot represents a population, with seven colonies collected from each population. AP.1–AP.3 represent *A. picea* populations, and AR.1–AR.3 represent *A. rudis* population collection sites.

Figure 4 (right). A representation of the experimental setup with nests in small colony boxes connected to the large foraging arena which contained randomized seeds of four species of local myrmecochores. Colonies were kept in separate containers which removed intraspecific competition.

Experimental Setup

Seeds of ***Asarum canadense* (ASCA)**, ***Sanguinaria canadensis* (SACA)**, ***Trillium grandiflorum* (TRGR),** and ***Anemone acutiloba* (ANAC)** were collected in local forest patches during the Summer of 2019 or 2020. Ant colonies of *A. rudis* and *A. picea* were collected in the Summer of 2020. To perform foraging trials, foraging arenas were lined with fluon (Insect-a-slip) to prevent escape. Each day, eight seeds of each species were randomly placed in a location in a depot (drawn circle) and colonies were connected. Ants were continuously observed for six hours and then for a final count after 24 hours. Between trials, 70% ethanol was used to clean arenas. This was repeated for all 42 colonies for a total of 7 rounds. **Observations included number of ants present in the foraging arena, number of ants interacting with seeds, number and type of seeds in depot, and number and type of seeds removed from depot (either outside of the drawn circle or moved into the nest)**. Results were analyzed using principal component analysis, and linear and generalized linear models.

Results

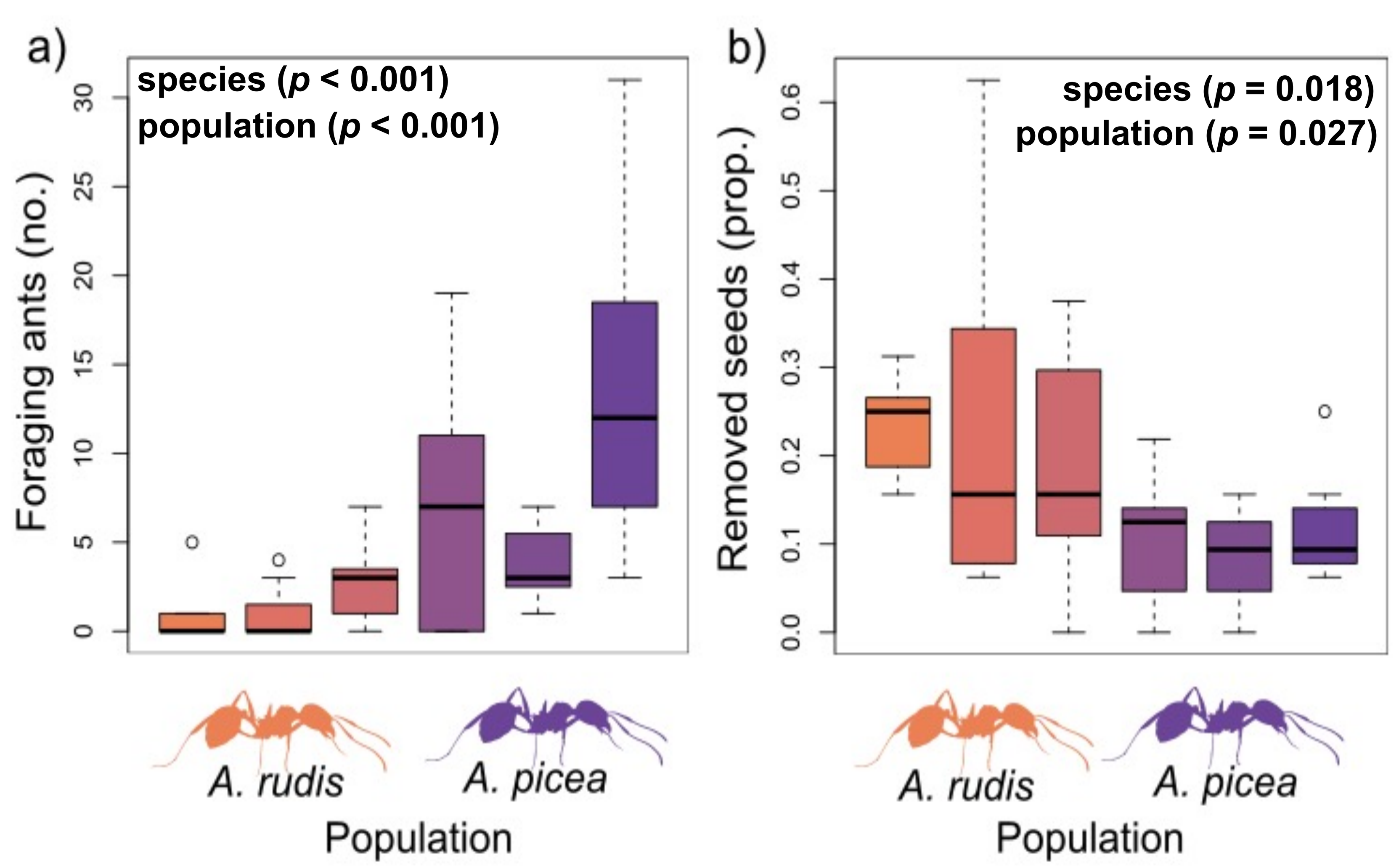


Figure 5. 5a) Represents boxplots of the number of ants in the foraging arena between species (orange vs. purple) and populations (color gradients). *A. picea* was significantly more active than *A. rudis.* 5b) Represents boxplots of the proportion of seeds removed from depots over the 24-hour period among populations and species. *A. rudis* was a significantly better disperser than *A. picea.* Boxplots depict the median +5th, 10th, 25th percentiles.

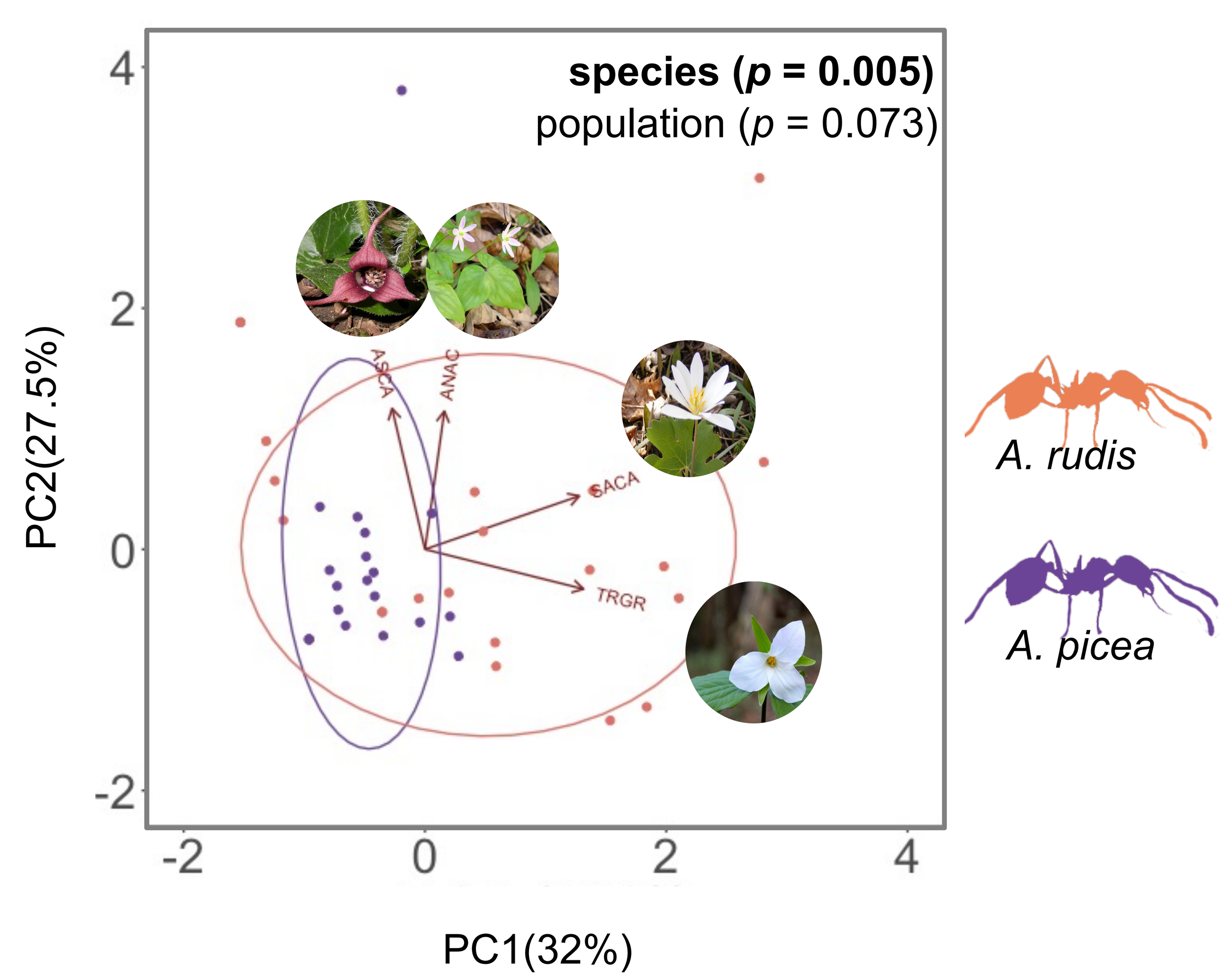


Figure 6. Biplot of PC1 and PC2 showing seeds of different plant species preferred by *A.rudis* and *A. picea* colonies. *A. rudis* preferred *T. grandiflorum* and *S. canadensis* seeds and *A. picea* preferred *A. acutiloba* seeds.

Conclusions

Behavior	*A. rudis*	*A. picea*	Populations
Foraging activity	↓	↑	+
Seed dispersal	↑	↓	+
Seed preferences	*T. grandiflorum S. canadensis*	*A. acutiloba*	−

- **Variation between species** – *A. picea* is more active than *A. rudis,* but *A. rudis* is a better disperser
- **Variation among populations**– Seed dispersal behaviors also vary along a continuum between polyphyletic putative species.
- **Climate change could lead to plant community changes** – Putative species have different thermal tolerances [10] and climate change could cause warm adapted *A. rudis to* overlap or displace cold adapted *A. picea* populations. This may result in forest understory communities changing in composition due to differences in foraging, seed dispersal, and preference.

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