To Run or Not to Run: Harvester Ant Response to Invasive Argentine Ants

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Introduction

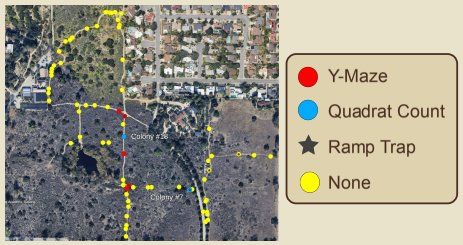
Harvester ants (*P. californicus*) are a keystone species in grassland ecosystems [1]. However, invasion by the Argentine ant (*L. humile*) has displaced harvester ant communities across California [2]. Prior research suggests that Argentine ants do not displace native harvester ants through competition for food resources, but instead through colony raids targeted at harvester ant brood [3]. To understand how harvester ants are responding to invasive pressures, we designed and tested experimental methods that capture potential changes to harvester ant foraging behavior at both the individual and colony level.

Research Question

How do native harvester ants adjust their foraging behavior in the presence of invasive Argentine ants?

Surveying the Field Station

Our research took place in the Robert J. Bernard Field Station (San Bernardino Co., 34°06' N, 117°42' W).



We identified 71 harvester ant colonies in the southern part of the field station. To identify other ant species present near the colonies, we 3D printed ramp traps inspired by previous work [4] and deployed them for 48 hours at colonies indicated by stars on the map above.

Colony ID	*L. humile* presence	Other species
7C	high	unknown
17A	low	*D. insanus*, *F. purinosus*, *S. molesta*
44B	medium	*D. insanus*, *M. wheeleri*
56B	low	*D. insanus*, *T. nitens*
65A	medium	unknown

In total, we identified 5 other species of ants. Argentine ant presence could be divided into roughly 3 categories: low (<5), medium (5<50), and high (50+).

Scented Y-maze Method

To see if individual harvester ants change their behavior in response to Argentine ant presence, we exposed foraging harvester ants to Argentine ant trailing pheromones.

Collection

- Redirected natural trail of Argentine ants with sugar water bait
- Collected pheromones on filter paper placed under new trail
- Waited for strong trail (>25 ants/min) lasting at least 15 minutes
- Transferred filter paper to y-maze apparatus

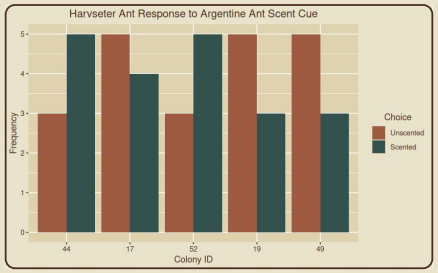
Testing

- Trained harvester ants to enter y-maze using bait stations filled with pecan sandy cookies
- Replaced bait stations with y-mazes containing one scented and one unscented arm
- Allowed single harvester ant to enter and observed direction turned at fork

Scented Y-maze Results

We ran the experiment on 41 ants across 5 colonies.

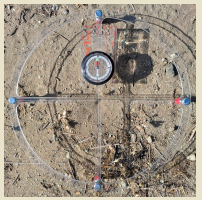
- No preference indicates lack of response to Argentine ant trails while foraging
- Results consistent across colonies



Quadrat Activity Count Method

To measure potential changes in colony behavior after exposure to Argentine ants, we developed a quadrat counting method:

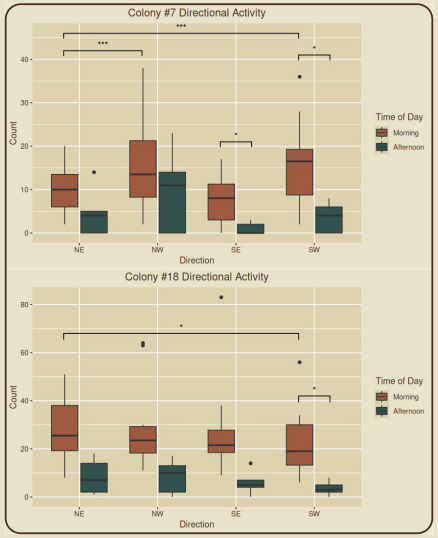
- Placed circular acrylic frame with radius of 15 cm with center at colony entrance
- Waited 5 minutes
- Counted harvester ants that entered and exited each ordinal direction of quadrat for 5 minutes



Quadrat Activity Count Results

We conducted quadrat activity counts 17 times at Colony #7 and 15 times at Colony #18.

- Morning activity higher than afternoon activity (p=0.019)
- Unique direction preferences, e.g. Colony #7 prefers SW while Colony #18 avoids it (p=0.011)



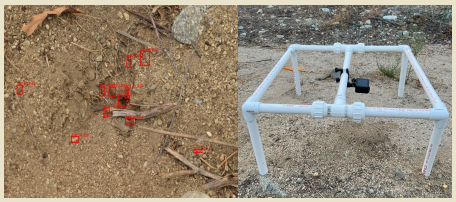
Automatically Quantifying Ant Activity

The goal of this project is to quantity ant activity and its direction

- Manually counting quadrat activity is very labor-intensive
- To measure activity across the whole day, we filmed ant colonies on an automated schedule
- For this summer, we decided to work on the detection step of ant tracking

Filming

- We placed a GoPro camera directly over a nest which filmed 5 minutes every hour from 8AM to 6PM
- These videos were then used to create 250 annotated frames from two different nests
- The frames were then used to train Pytorch's Faster RCNN model



Annotated Frame of Foothill Colony at a 80% threshold

GoPro Camera Setup

Outcome

- For the two colonies we achieved a 75% accuracy of correctly identifying ants in a frame
- In the future we hope to add more nests and lighting variations into the dataset to make the model more applicable to other nests

Conclusion

Together the Y-maze and quadrat activity count methods allow us to understand native harvester ant behavior on both the individual and colony scale:

- Y-maze results suggest that individual harvester ants are not avoiding Argentine ant trails despite numerous raid events
- Quadrat activity count results indicate colony-level directional preferences which may correlate with Argentine ant presence

While these methods did not reveal a response to invasion, native harvester may be resisting displacement in other ways. Future work may focus on:

- Individual harvester ant response to other olfactory or visual Argentine ant cues
- Colony remodeling behaviors after Argentine ant raids

Acknowledgements

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References

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