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The Influence of Temperature on the Rate of Oxygen Consumption of Harvester Ants from Two Different Species and Climates

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*Linepithema humile* running speed at the BFS

Introduction

*Linepithema humile*, commonly known as the Argentine Ant, is one of the most successful invasive species worldwide. Experiments that assess *L. humile*’s relationship to temperature may offer perspective on the ant’s ability to succeed in a variety of environments around the globe. The Argentine ant’s relative aptitude for a range of habitats and temperatures may offer insight into the potential geographic distribution of *L. humile* in the wake of the shifting temperatures caused by global climate change.

Previous studies have examined *L. humile*’s ability to adjust to a range of temperatures, and the effect of temperature on its development (Jumbam et. al, 2008; and Abril et. al, 2010). Jumbam et. al (2008) observed optimum performance of the Argentine ant at around 25 °C. Abril et. al (2010) similarly found that *L. humile* larvae were less likely to survive at higher temperatures between 37 and 44 °C, and the adult ants had a similarly lower survival rate at temperatures above 30 °C. Another study observed the effect of temperature on Argentine ant running speeds, and found a correlation between a higher temperature and a faster speed (Shapley, 1924). Shapely (1924) found that Argentine ants performed best near 30 °C.

Our study seeks to assess the effect of temperature on the running speed of *L. humile* within two distinct environments at the Claremont College’s Bernard Field Station at a range of temperatures. In examining the Argentine ant’s competence, we predicted that *L. humile* would exhibit similar running speeds in both microhabitats. We further expected that these running speeds would increase as temperature increased until
the ground temperature reached a level that would deter the ants, likely near 40 °C, at which point we expected the ants would stop foraging.

Methods

To assess ant running speed in relation to thermal conditions we observed two different colonies of *Linepithema humile* at the Claremont College’s Bernard Field Station (BFS). The first colony was located in the riparian forest habitat near the pHake Lake (Colony A), and the second was located in the non-native grassland near the Amherst Avenue entrance to the BFS (Colony B). Colony A was located at North 34° 6.5279' and West 117° 42.7728’. Colony B was located at North 34° 6.4862’ and West 117° 42.5667’. We observed each colony on six different occasions over the course of a few days between April 4th and April 12th 2018. We recorded data at different times of day, morning, afternoon, and evening to collect data at a range of temperature between a low of 19.4 °C and a high of 56.1 °C.

We began by identifying an active foraging trail of *L. humile* in the chosen regions of the BFS. We recorded the time of day of observation, and noted the temperature as reported by a thermometer at ground level. We placed a ruler, 15 centimeters in length, alongside the pheromone trail of the ants. We used a stopwatch to record the amount of time a single ant took to cover that distance, and noted the times of no less than five ants per colony under observation. We used the distance travelled and the time taken by a single ant to travel that distance to calculate an individual’s speed.

Once this data was collected, we ran a linear correlation and regression analysis for each of the observed colonies of *L. humile*. Using this we can determine the impact of
temperature on the running speed of *L. humile* in the two distinct habitats examined within this study.

Results

Colony A of *Linepithema humile*, located in the riparian woodland habitat at the Bernard Field Station, showed a positive correlation between temperature and running speed ($r^2 = 0.47$). For every 10 °C increase, we observed a 0.67 cm/s increase in the ant’s speed at this location (Figure 1). This correlation was deemed statistically significant ($p < 0.01$). We observed no Argentine ants from Colony A foraging when the ground temperature was 56.1 °C.

Colony B, located in the non-native grassland at the BFS, showed a negative correlation between temperature and ant running speed ($r^2 = 0.22$). For every 10 °C increase, we found a –0.29 cm/s decrease in *L. humile*’s running speed (Figure 1). This correlation was also found to be statistically significant ($p < 0.01$). We observed no Argentine ants from this colony foraging when the ground temperature was 50 °C.
Figure 1. The effect of temperature on the running speed of *L. humile* in two different habitats, the riparian woodland (•) and the non-native grassland (•).

Discussion

The results recorded for Colony A of *Linepithema humile*, located in the riparian woodland microhabitat, supported our hypothesis with a positive linear correlation between temperature and ant running speed. However, Colony B, located in the non-native grassland, showed a negative correlation that fails to support our hypothesis. Consequently, it seems probable that our experiment design contained flaws, as we feel opposite data trends for the same species in such close proximity and similar temperatures seems unlikely.

One concern may be the temperatures recorded by our thermometer, as we recorded the highest running speeds from Colony A at 46.5 °C. This temperature exceeds the 44 °C at which other researchers found that both *L. humile* larvae and adults all died, which begs either the question of our thermometer’s veracity or this ant colony’s unexpected resilience (Abril et. al, 2010). In addition, it was a challenge to find active
foraging trails of *L. humile*, and consequently it’s possible that some of the ant speeds recorded do not reflect the trends we expected.

Furthermore, as our experiment took place at a temperate time of year over a short period of time it was difficult to record ant activity at a wide range of temperatures. In light of this, and without observations at each temperature between our highest recorded speed at 46.5 °C, and the temperatures at which we did not find ants foraging, 56.1 °C and 50 °C respectively, it’s difficult to ascertain a clear understanding of an optimum temperature for *L. humile* at the BFS.

Future studies would benefit from collecting data on ant running speeds over a greater length of time so as to improve the odds of recording data for a larger range of temperatures. In addition, researchers might consider providing a food source to encourage a given colony of *L. humile* to establish a clear foraging trail. This would help minimize concerns that recorded ant speeds were not necessarily accurate reflections of their potential peak speeds at a given temperature.

Works Cited


