Growth and dispersal patterns of *Tribolium castaneum* in different size habitats

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Abstract

Competition for space, resources, and mates plays an important role in the survivorship of many organisms (Sbilordo et al. 2011). Understanding how competition affects a population is a crucial component in ensuring the survival of threatened and endangered species (Halliday et al. 2015). But what affect does an organism's habitat size have on its ability to grow in population? Habitat size and competition have an inverse relationship. As the habitat decreases in size, there is an increase in intraspecific competition. In this experiment, we tested this relationship. We found that *Tribolium castaneum* produced less offspring in smaller containers compared to larger ones. They also had larger distances between individuals in larger containers. This research helps support the hypothesis that habitat destruction can negatively affect the growth of a population (Van Allen et al. 2016).

Purpose

The purpose of this research is to understand how altering habitat size can influence intraspecific competition.

Questions, Hypotheses, and Predictions

Question: How does habitat size affect the dispersal pattern and growth of a population?

Hypothesis: Smaller habitat size causes an increase in intraspecific competition, and ultimately decreases the growth of a population.

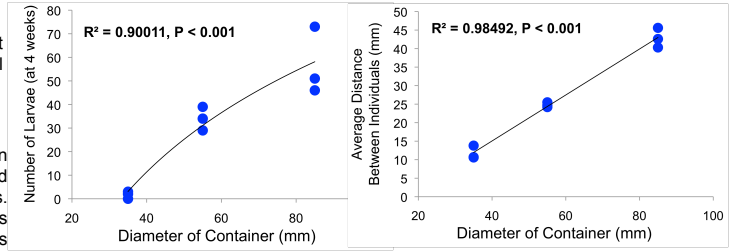
Prediction: As the habitat size increases, individuals will spread out more from each other and less competition will take place. This will allow the population to grow.

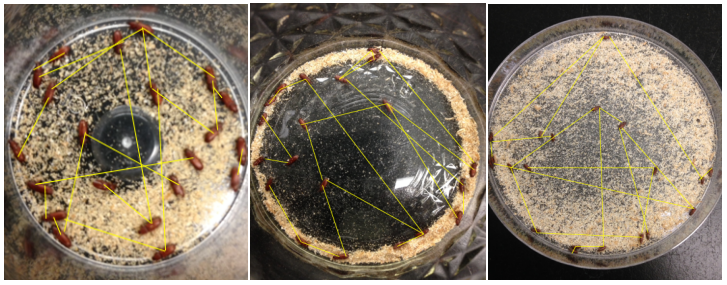
Study System

The red flour beetle (*Tribolium castaneum*) is a species of beetle in the family Tenebrionidae. It is known worldwide as a pest to stored food grains and other foods including flour, cereals, and legumes. The red flour beetle lives primarily in warm, indoor environments around the world. Female red flour beetles mate with multiple males before laying (polyandrous behavior) to increase egg fertility. Red flour beetle adults can grow up to 4.5 millimeters in length and can live up to three years.

Methods and Experimental Design

For my experiment, I selected three different container sizes (35mm, 55mm, 85mm diameters) to test my hypothesis. I tested three containers for each size to ensure that my data were accurate and unaffected by other variables. I used brown flour with added yeast as their food source, and equally distributed a even layer of feed across all nine containers. Next, I selected twenty beetles from a 2:1 female-to-male population ratio to be put in each container. Over the next month, I visited the lab on a weekly basis to observe differences in beetle distribution. After four weeks, I used a set of testing sieves to sift out the flour, larvae, and adults. I hand counted the number of larvae present and recorded the changes in population. Finally, I used the pictures I took during the experiment to calculate the average distance between individuals in each container. I used Microsoft PowerPoint to draw in lines between individual beetles, measured the lines using a ruler, and converted those measurements using a ratio.





Results

There was no adult mortality during the experiment. However, there was a significant increase in the number of larvae that correlated with increased container size ($P<0.001$; averages are small = 2, medium = 34, large = 57; see figure). Also, there was a significant increase in the average distance between individuals as container size increased ($P<0.001$; averages are small = 11.7mm, medium = 24.8mm, large = 42.8mm; see figure).

Conclusions

At the end of this experiment, I understood that habitat size has a major effect on the ability of a population to grow. Increasing the density of a population drastically increases intraspecific competition within a species. Specifically, this research shows that increasing the area available for a species to utilize dramatically decreases competition and enables females to better maximize their fitness. This research is important in determining the factors that cause major declines in threated and endangered species.

Future Directions

If I continued my research, I think the next step for me would be to test this experiment with other limited resources. Instead of evenly dispersing food on the container floor, I could measure an exact amount of food and place it in each container. Another variable that I could change, is the ratio of males to females in each container. Both of these changes to the experiment would show the affect of other limited resources on the growth of a population. Using the data from all of these experiments would help show what limited resources affect intraspecific competition the most. Such studies could also help determine what resources are affecting declines in threatened and endangered species.

References

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