Fecundity and Population as Measures of Fitness in *D. melanogaster*

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Introduction

Drosophila melanogaster (*D. melanogaster)* has been used for over a hundred years in the study of evolution due to its large number of conserved genes as well as its ability to be easily sustained and to reproduce rapidly[1]. In recent years, an increasing amount of evidence suggests that adaptation occurs at a pace similar to ecological changes[2]. Within *D. melanogaster*, there has recently been evidence of this adaptive tracking (adaptation in response to environmental/ecological change) in response to continuous environmental change, such as annual temperature fluctuations associated with seasonal change[3].

Photos courtesy of Mandy Wang and Paul Schmidt Laboratory

Numerous other species have been shown to follow the same pattern of rapid evolution that is found, and can be modeled in, *D. melanogaster*. This includes, but is not limited to, species of bacteria[4], plants[5], insects[6], and birds[7]. By gaining a better understanding of how rapid evolution functions through pigmentary changes in *D. melanogaster*, insight is gained into not only evolution of organisms as a whole but also how they are able to rapidly adapt to their ecological niche.

Objectives

- To utilize fecundity and population census measurements in order to determine the association between pigmentation phenotype and fitness
- To examine how traits correlated with pigmentation evolve within a natural (non-laboratory, quickly changing) environment by examining the fitness of *D. melanogaster* over time

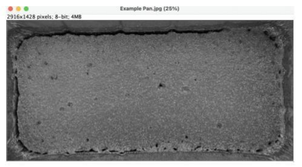
These objectives contribute to the overall assessment of the significance of pigmentation in how *D. melanogaster* adapts within rapidly-evolving populations in a dynamic environment.

Methods

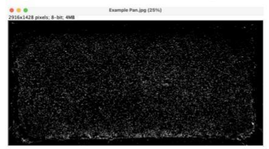
An equivalent number of flies were released into 27, eight cubic meter mesh cages, of which nine cages were artificially selected for darker pigmented flies, nine for lighter pigmented flies, and nine used as controls. Metal loaf pans containing a carbohydrate-based food mixture were placed in each cage to support the growing population and provide a place for egg laying. After the flies were given two days to lay eggs in the pan, the pans were photographed and sealed with an air-permeable covering and replaced into the cage to pupate for approximately one week before the flies were released into the cage. Additionally, photographs of the flies present at the top of each cage were taken intermittently throughout the data collection period.

The analysis process for a fecundity photo can be seen below:

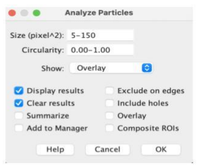
1) Photo of pan before it is placed back into the cage.



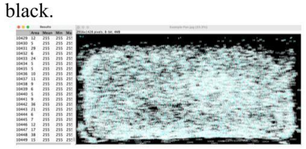
2) Photo is cropped and gray-scaled before analysis.



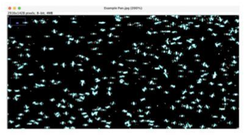
3) The image is altered so that the eggs are white and the background is black.



4) The thresholds are set so that only the eggs are counted in the analysis.



5) After analysis: the number of eggs is to the left in the bottom row.



6) A close-up of the individual eggs in the pan can be seen here.

A similar analytic process was used to evaluate the photos from the top of the cages to determine the fly populations. Each cage surface was divided into four different photos, or quadrants, to prevent the image from being too minimized.

The counts were recorded within a spreadsheet for further analysis and evaluation.

Observations and Future Steps

Lighting disparities on the fecundity pans during photographic documentation in 2022 occasionally resulted in inconsistent coloration of the surface of the food. As a result, the analytic software was unable to properly identify the eggs, since the background within the areas of extra light appeared to be the same color as the egg. In order to achieve an accurate count in these pans, the photograph must be divided into two parts, the affected area and the remainder of the pan, with the results added together after counting. In the future, uniform, low-level lighting will be required for the photography of each pan.

Use of the ImageJ software has proven to be both an accurate and useful tool which will likely expedite the collection process for data moving forward. ImageJ may be beneficial for similar projects in the future.

Final results are pending, as this is an ongoing project. After data collection is completed, statistical analysis will be performed using R.

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References Used:

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