How Can a Worm Live Longer in a Population?

Elena Zobel
Faculty Advisor: Dr. Andrea Scharf

Department of Biological Sciences,
Missouri University of Science and Technology,
Rolla, MO, USA

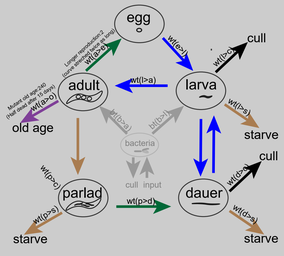
Abstract: Today there is a problem with the loss of biodiversity in the world. Therefore, it is important to understand population dynamics and how reproductive and aging traits impact their survival. Since it is very challenging to analyze wild populations, we use a laboratory and computational ecosystem based on *Caenorhabditis elegans*. To determine how reproduction and lifespan impact the stability of worm populations, we studied wild type verses mutants with longer lifespans and longer reproductive span. In our first observation we observed that the long-lived mutants show a slow population growth compared to the wild type. We observed the same trend in the simulation experiments. In addition, mutant populations with the later reproductive schedule exhibited higher average worm numbers. This data gives us an idea of how worms live longer in populations and influence population survival.

Goals

- Understand how mutations effecting the lifespans of *C. elegans* effects the population dynamic compared to wild type
- Understand how reproductive rates effects population dynamics

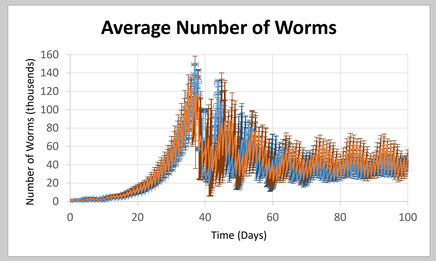
Methods

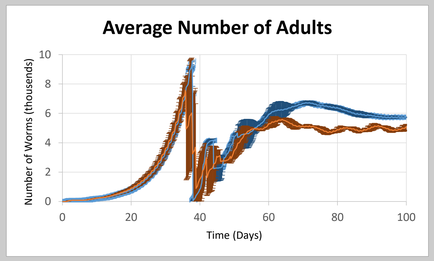
- A simulation was used to predict and make graphs of the worm populations.
- Culling was set to 0.8 for larve and dauers and 0 for everything else.
- Initial larvae amount was set to 1000
- 10mg of food was given per day
- For wild type adult lifespan was set to 160 and long lived mutant adult lifespan was set to 240.
- Normal reproductive rate was set to 1 and longer reproducive rate was set to 2

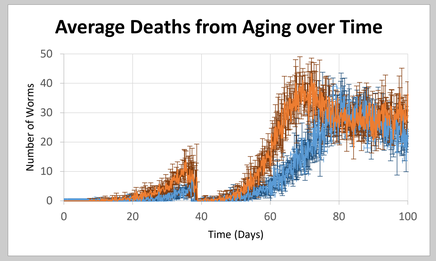


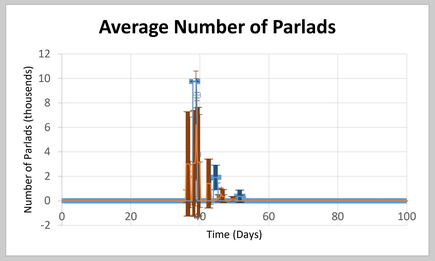
Wild Type Compared to Long Lived Mutants with Normal Reproductive Rates

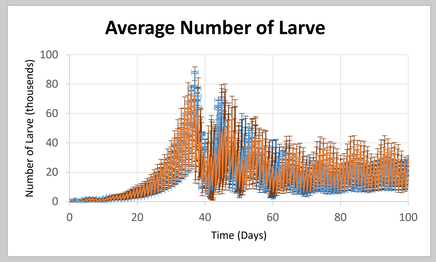
Wild Type Mutant

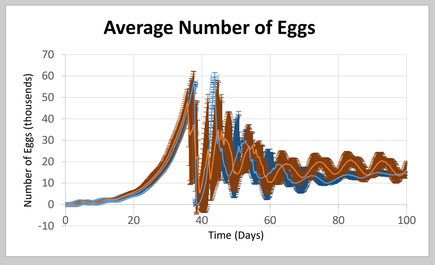






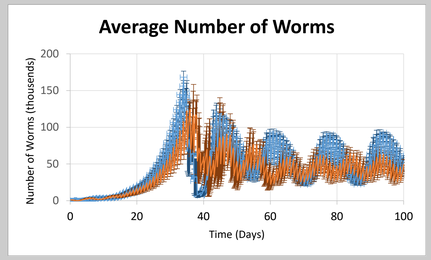


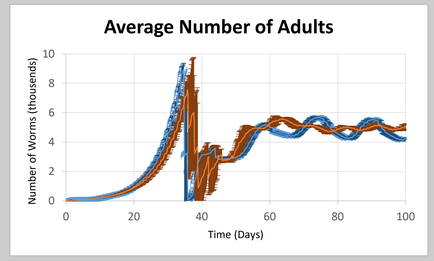


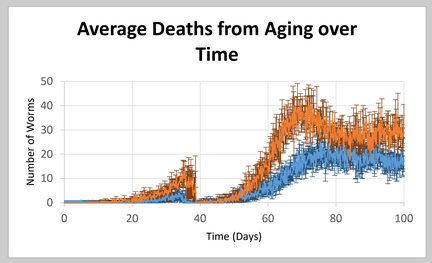


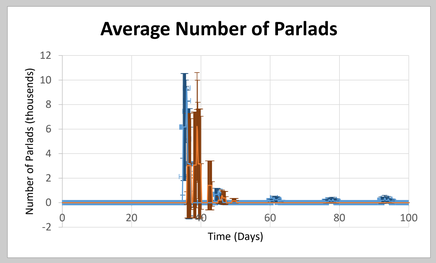
Wild Type Compared to Long Lived Mutants with Longer Reproductive Rates

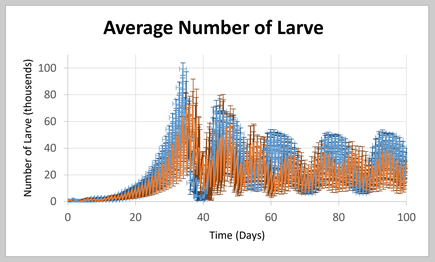
Wild Type Mutant

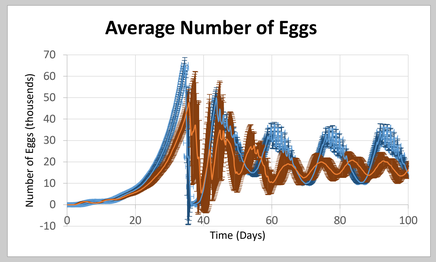












The graphs above show the differences and similarities in populations with wild type, long lived normal reproductive rate, and long lived extended reproductive rate *C. elegans.* All graphs except parlads show a deep drop in numbers around 40 days. This accounts for when the number of *C. elegans* becomes too high to survive on the store of food. Many worms die off from starvation and parlads increase to cope with the low food. Long lived mutants with normal reproduction tend to be the same or only slightly higher than the wild type which shows that changing the lifespan of a worm only leads to slightly higher peaks in most areas. Two exceptions to this are the vastly increased number of adults since they are not dying away as fast and the later increase in death from aging shown. The long-lived mutants with longer reproductive rates show a much larger difference in population from the wild type. The longer reproductive rates show a vastly higher population number in all areas except for adults and deaths from aging. The average death from aging for the longer reproductive rate worms were much lower than the wild type and the number of adult worms around the same numbers of the wild type.

Acknowlegment to Casandra Gorman, Phuong Tran, Erik Bergstrom, Clare Koerkenmeier, and Molly Ripper for their contrabutions.

Scharf et al. 2022. A laboratory and simulation platform to integrate individual life history traits and population dy individual life history traits and population dynamics. *Nat Comput Sci* 2, 90-101. https://doi.org/10.1038/s43588-022-00190-8.