Would Mosquitofish Choose You? Mosquitofish Prey Preference in a Daphnia-Based System

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Background/ Introduction

- The healthy herds hypothesis is the idea that predators can effectively reduce the disease in prey/host populations (Richards et al. 2023), through a variety of mechanisms (Duffy et al. 2019; see below).
- If the healthy herds hypothesis is correct, then increased predation could be used to control the spread of disease in predator-prey-host systems.

How do predators reduce disease ?

Mechanism 1: Predator driven reduction in host density. In systems with density dependent disease transmission, the reduction of host density due to predation can slow the spread of disease through the host populations (Duffy et al. 2019).

Mechanism 2: Selective predation. Predators may selectively prey on infected hosts and reduce the amount of infected prey in the host/prey populations. This can be caused if infected host are easier to detect and/or catch (Duffy et al. 2019).

Mechanism 3: Predator-driven shifts in host demography. Predators may preferentially prey on hosts of a certain stage or age (e.g., juvenile vs adult). This mechanism can influence disease if prey of different ages vary in their susceptibility to infection (Duffy et al. 2019)

About the Study System

Host: ***Daphnia dentifera***

Nearly transparent planktonic crustaceans, very common in many lakes. Natural lakes that have a high intensity of fish predation often have smaller epidemics (Strauss et al. 2016).

Parasite: ***Metschnikowia bicuspidata***

Changes the appearance of Daphnia: Pearly white against dark backgrounds and a dark opaque appearance against light backgrounds

Predator: ***Gambusia affinis*** **(mosquitofish)**

Visual predators. Optimal diet theory is the idea that predators choose prey that provides more energy from consumption than the amount of energy needed to catch them (Ray 2010). It suggests that there are biological advantages for predators to choose larger prey (Bence and Murdock, 1986).

Purpose/Hypotheses

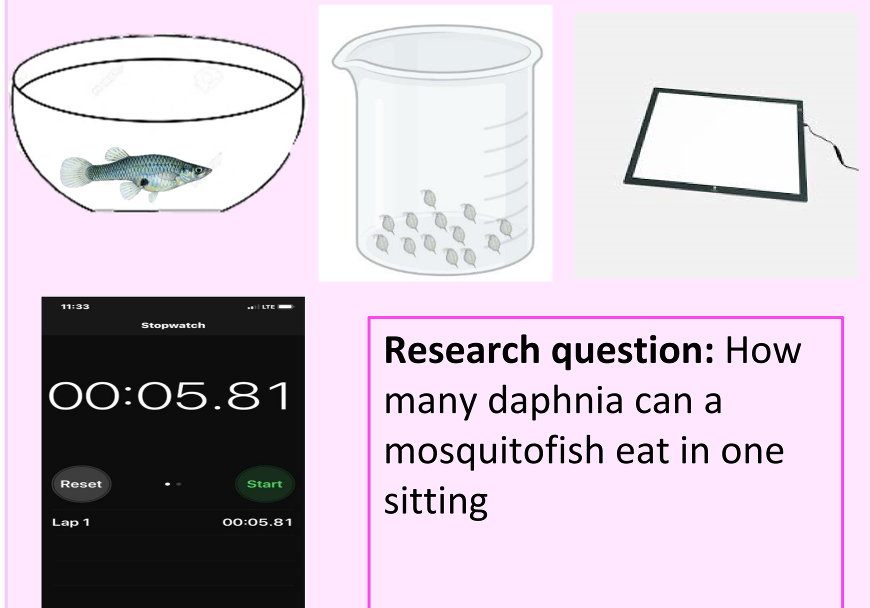
Mechanism 1 Hypothesis: Mosquitofish should eat a substantial amount of *Daphnia* in one sitting. This can help us predict if there will be enough predation in the natural system to lower overall host densities and influence the spread of disease.

Mechanism 2 Hypothesis: When presented with the choice based on infection, the mosquitofish should primarily prey on the infected *Daphnia*. This can help predict how predation will affect the density of infected host in a natural system

Mechanism 3 Hypothesis: When presented with the choice based on size, mosquitofish should primarily prey on the larger *Daphnia*. This can help predict which stage will be preyed on primarily in a natural system. Adults are more susceptible to the parasite.

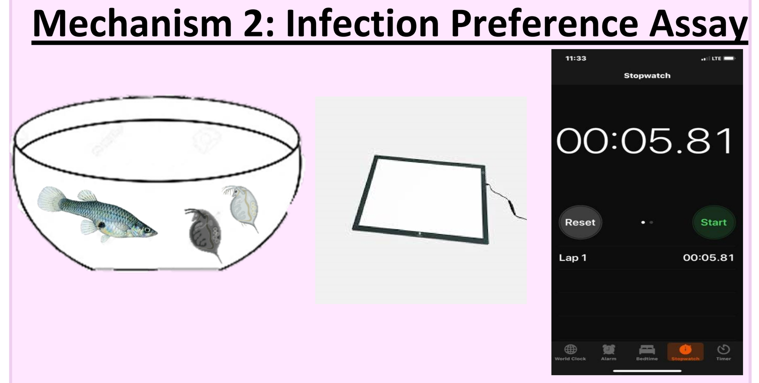
Methods

Mechanism 1: Consumption Assay



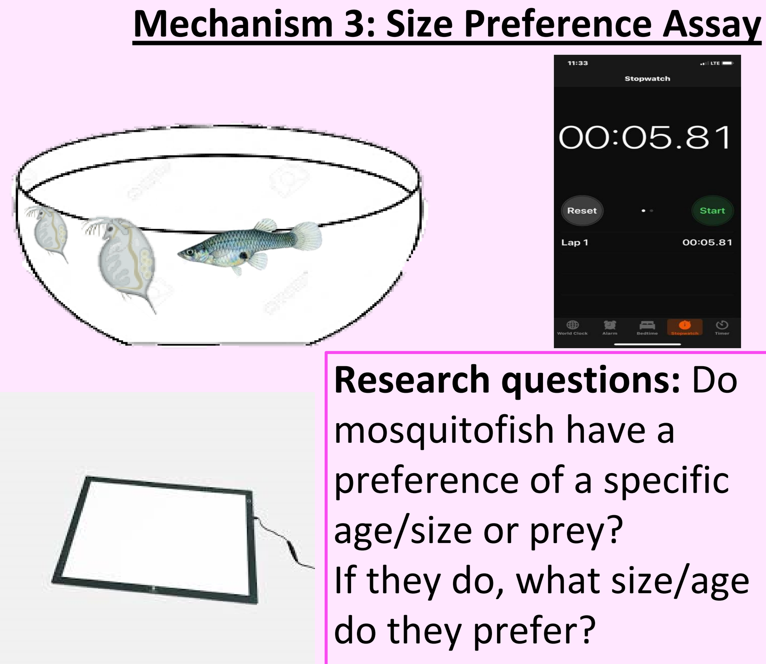
Research question: How many daphnia can a mosquitofish eat in one sitting

Mechanism 2: Infection Preference Assay



Research questions: Do mosquitofish have a preference if prey is infected? If they do, they prefer infected or healthy prey?

Mechanism 3: Size Preference Assay



Research questions: Do mosquitofish have a preference of a specific age/size or prey? If they do, what size/age do they prefer?

All fish were left to acclimate for approximately 20 hours. All results were analyzed using the R software

Results

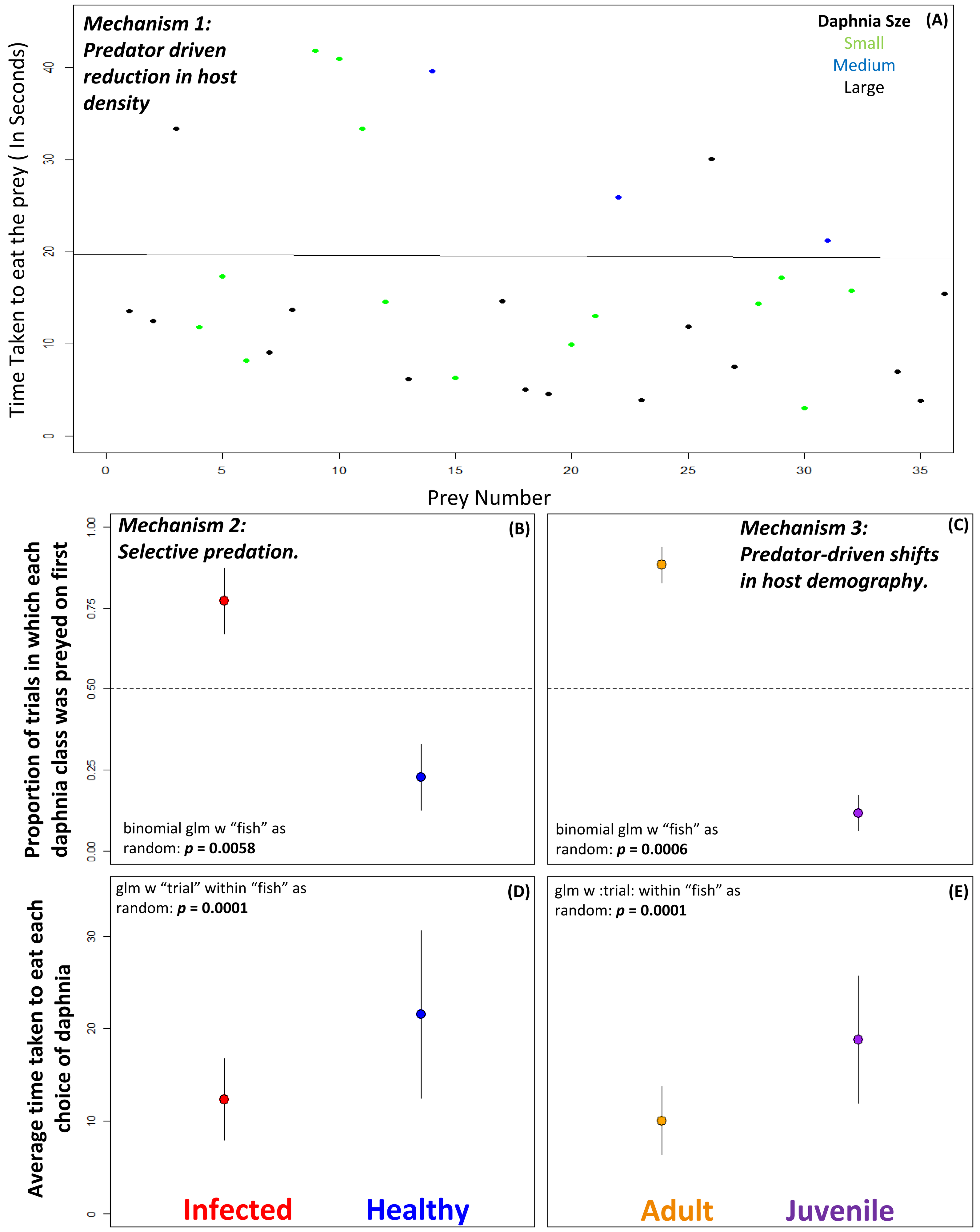


Figure A: Shows the amount of daphnia that a single mosquitofish can eat in one sitting, the size of the daphnia, and how long the mosquitofish took to eat each daphnia.

Figure B: Depicts the proportion of trails where either an infected daphnia(red) was eaten first, or a healthy daphnia (blue). The proportion of trials where infected daphnia was chosen first is twice as large as the proportion or trials where healthy daphnia was chosen first.

Figure C: Depicts the proportion of trials where either an adult daphnia (yellow) was eaten first, or a juvenile daphnia (purple). The proportion of trials where an adult daphnia was chosen first is substantially larger then the proportion of trials where juvenile daphnia was chosen first.

Figure D: Depicts the average amount of time to eat an infected daphnia and a healthy daphnia. It took nearly twice as long for the fish to eat the healthy daphnia than it did for the infected daphnia.

Figure E: Depicts the average amount of time to eat a adult daphnia and a juvenile daphnia. It took nearly twice as long for the fish to eat the juvenile daphnia than it did for the adult daphnia

Discussion and Future Directions

- All hypotheses were supported
- **Final assumptions:** Mosquitofish hold preference for adult or infected daphnia. A possible explanation for this is that larger and infected daphnia are easier for the mosquitofish to see compared to juvenile and healthy daphnia.
- **The next step:** After the collection of this preliminary data, the next step would be to add mosquitofish to larger systems that hold large populations of daphnia. It is important to include all ages and both infected and healthy prey. This step will show how the predation provided by mosquitofish may influence the spread of disease in daphnia populations, based off their observed preferences.

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