Daphnia Disease: Characterizing the Fitness Effects of a Previously Understudied Epibiont of *D. ambigua*

Almira Arnold, Class of 2023

This summer, Dr. Mary Rogalski and I have explored the relationship between *Daphnia ambigua* and an epibiont, that is, an organism that lives on the surface of *D. ambigua* individuals (Figure 1). *D. ambigua* are microscopic, freshwater crustaceans and are considered "keystone herbivores." They play a crucial role in their ecosystem, namely Sewall Pond, our study site in Arrowsic, Maine, by consuming algae and serving as prey for invertebrate and fish species. Dr. Rogalski had previously observed the epibiont on her *D. ambigua* samples multiple times in the past several years (2019-2023).

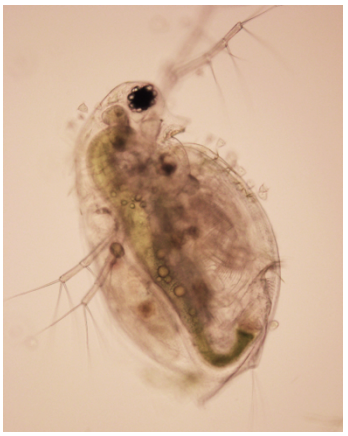

Fig 1. *D. ambigua* adult with epibiont on carapace.

Principal research questions:
How common (prevalent) is the epibiont in the field? How is the epibiont affecting the fitness of *D. ambigua*? If the epibiont is harming *D. ambigua* in the lab, is the epibiont harming *D. ambigua* in the field? What even is this epibiont?

We initially sampled Sewall Pond on June 7, 2023, and quantified disease prevalence back in lab. We did not find any *D. ambigua* infected with the epibiont, but we did find *D. ambigua* infected with at least three different parasites (0 epibiont; 5 *Spirobacillus*; 1 *Ordospor*a; 16 *Gurleya*; 476 uninfected). We still cultured these infected daphnia as well as 20 uninfected daphnia in individual beakers with filtered Sewall Pond water. Within five days, several of the *D. ambigua* that we had cultured appeared to be infected with the epibiont (13 epibiont). We remain curious about the possible differences between field and lab conditions. In lab, we found that the epibiont transmits easily: one infected *D. ambigua* adult could infect ten uninfected *D. ambigua* juveniles/babies within 24-48 hours. We suspect that in the field, the epibiont may not be able to infect *D. ambigua* as intensely if shed by molting (epibiont-covered molts were frequently observed in our cultures), or that our aggressive sampling methods may knock the epibiont off the *D. ambigua* (epibiont was observed detaching from *D. ambigua* in response to physical constraint). A second sampling of Sewall Pond on June 21, 2023, indicated an overall increase of disease prevalence in the field but still no epibiont (0 epibiont; 25 *Spirobacillus*; 2 *Ordospora;* 12 *Gurleya*; 30 uninfected).

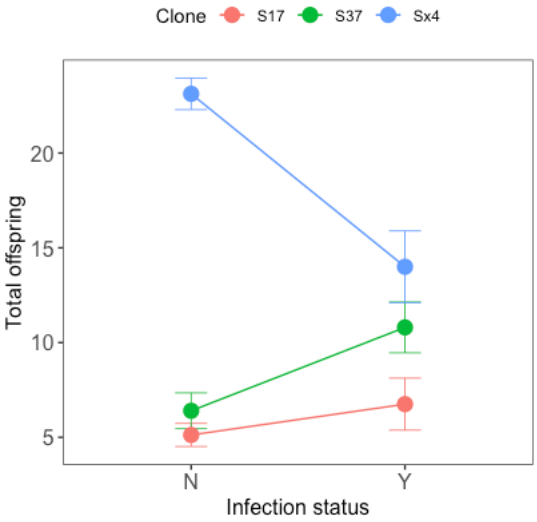

Fig 2. Pilot fecundity data

To assess the fitness effects of the epibiont on *D. ambigua*, we designed a pilot trial with three of our *D. ambigua* clonal lineages (S17, S37, and Sx4); all experimental replicates were 1-5 days old at initial exposure to the epibiont. We tracked fecundity over 21 days, and initial observations indicated that fitness was affected differently by clone (Figure 2). We set up another trial with four more *D. ambigua* clones (S66, S44, S46, Sx13) in which we more tightly controlled for the age of replicates: all were 1-day-old at initial exposure. We tracked the fecundity of these replicates over 14 days. Currently, our data suggests that the epibiont reduces the fitness of some clones of *D. ambigua*; that is, the epibiont may harm *D. ambigua*. Next steps include examining the interactions between clone, infection intensity, and innate clonal fecundity.

We have tentatively identified the epibiont to the family level, as Protozoa, Ciliate, Rhabdostyla, based on three primary characteristics: size, stalk rigidity, and prior literature documenting epibiosis between Rhabdostyla and other *Daphnia* species (Figure 3; Chatterjee 2013). We intend to have samples of the epibiont genotyped to confirm this identification.

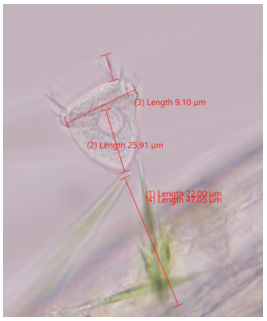

Fig3. Measurements of epibiont size.

Faculty Mentor: Mary Rogalski

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Chatterjee, T, Kotov, A, Fernández-Leborans, G. 2013. "A checklist of epibiotic ciliates (Peritrichia and Suctoria) on the cladoceran crustaceans." *Biologia*, 68(3), 439-447.