

Highlights:

- *Daphnia laevis* and a species of *Ceriodaphnia* occur cyclically in a New Hampshire pond
- *Ceriodaphnia sp.* was observed to be dominant in the first half of the season, appearing in early summer and lasting until October
- *Daphnia laevis* is present in low numbers beginning in late summer, before exploding in population in October
- The two species seem to occupy the same niche and do not have large concurrent populations perhaps due to individual predation pressures or preferred food sources that are present at different points in the in the season
- This relationship should be observed over several more seasons to see whether this trend continues

Introduction:

Daphnia laevis (Birge, 1838) and *Ceriodaphnia spp.* are both filter feeding zooplankton in the family *Daphniidae*. This means that in water bodies where they coexist, they are often shown to be competitors (Lynch, 1978). Which species is present has been shown to depend on several factors including the presence of specific predators and food sources (Cooper and Smith, 1982, Iwabuchi and Urabe, 2010). Often times the population of daphnids is shown to vary seasonally, and the competition between species also varies due to biotic and abiotic factors in the pond. The variation can be sudden, with the dominant population changing within weeks (Lynch, 1978). Our goal was to look at the population dynamics of *Daphnia laevis* over time, particularly in regards to its relationship to a species of *Ceriodaphnia*, in a fishless pond.

Methods:

The sample site was a pond in Stratham, NH. Samples were collected with a 80 μm simple plankton net once a week from the middle of August through the middle of December, when the pond froze. The samples were then strained in a mesh that removed large invertebrates but allowed all zooplankton to pass through. These strained samples were then placed under a microscope and 4 photos were taken of different places within the sample. The *Daphnia* and *Ceriodaphnia* were then counted within each photo and the results were averaged. These numbers were then used to calculate each species' percentage of total abundance.



Fig 1. Photo of sample site

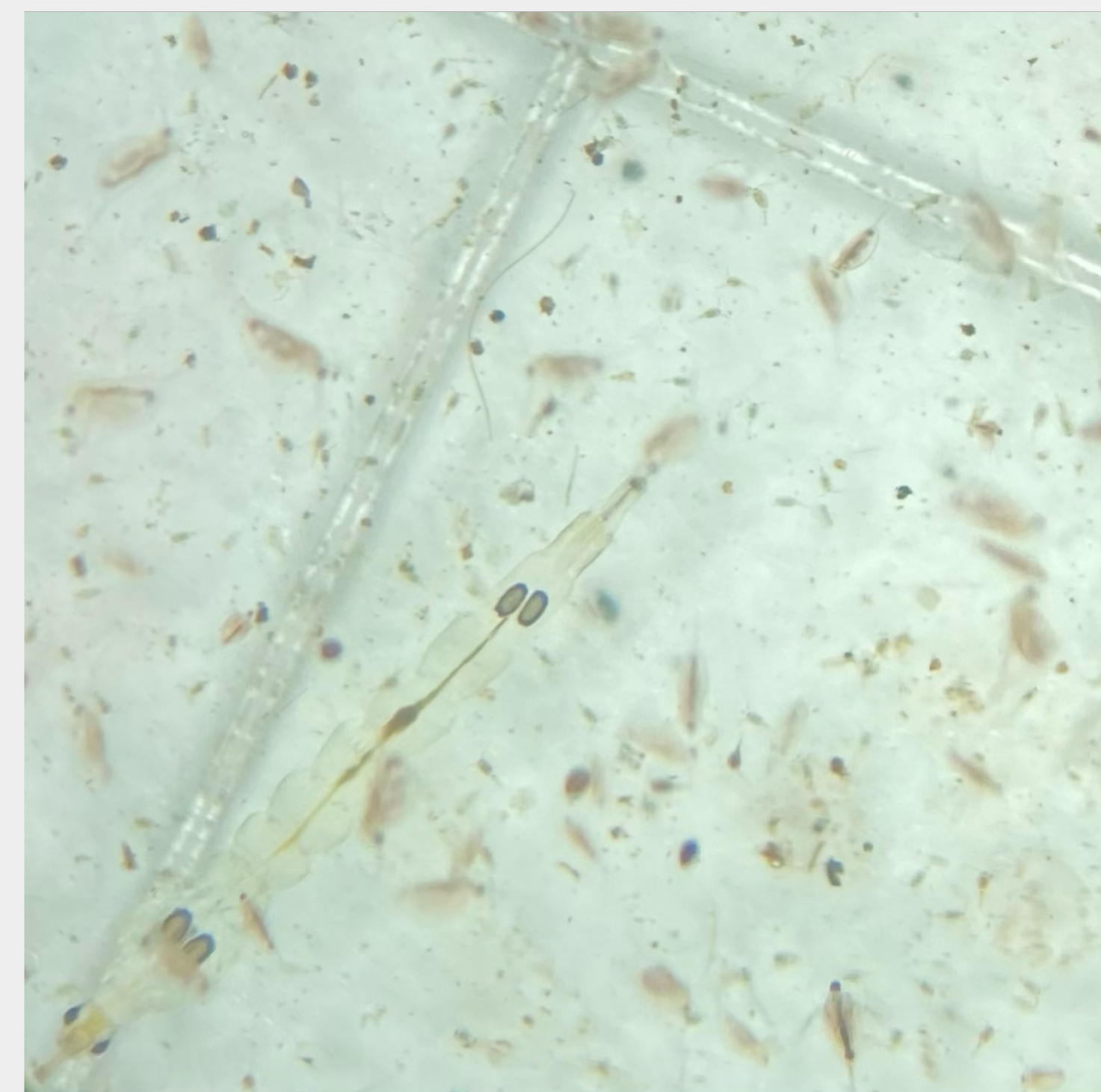


Fig 2. Image of sample before straining, including one macroinvertebrate (*Chaoborus americanus*)

Results:

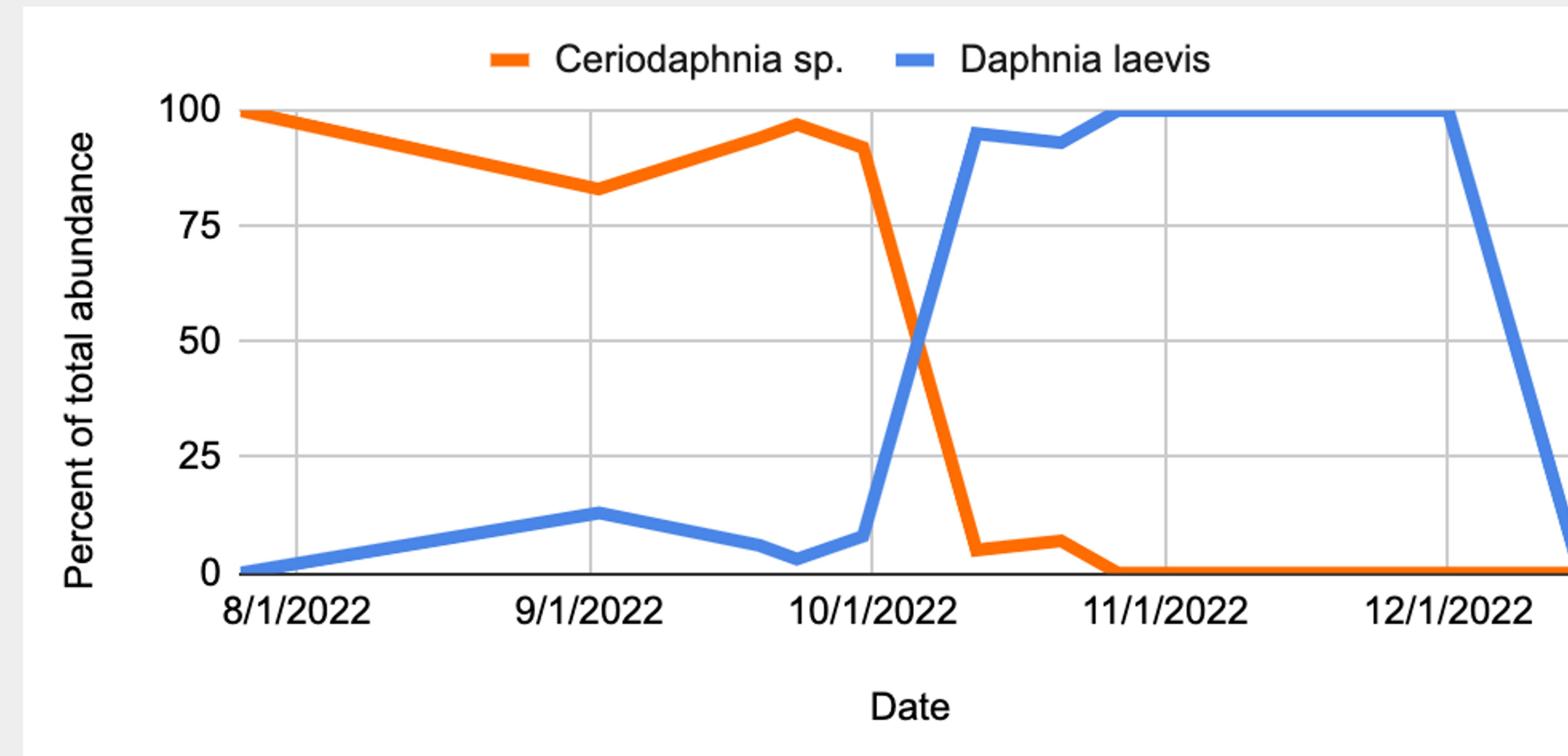


Fig 2. Graph showing the percent presence of *Ceriodaphnia sp.* vs *Daphnia laevis*. *Ceriodaphnia sp.* percent is shown in orange, *Daphnia laevis* percent is shown in blue.

- Temporal variations were observed in both the density and relative abundance of *Daphnia laevis* and *Ceriodaphnia sp.*
- Daphnids were uncommon in the beginning of the summer, with their population density increasing in July. At this point, almost all daphnids in the pond were *Ceriodaphnia sp.*
- The number of daphnids increased steadily into the fall. On September 30th, the samples contained more than 100 individuals of *Ceriodaphnia*, and one individual of *D. laevis*. By the next sample on October 12th, the number of *Ceriodaphnia sp.* plummeted to near zero, and the number of *D. laevis* skyrocketed to over 100 individuals per sample. No *Ceriodaphnia* appeared in the samples after October 21st.
- The number of individuals of *D. laevis* remained high until the pond froze in early December and the number of daphniids dropped to zero



Fig. 3: Photo of a sample showing *Ceriodaphnia sp.*



Fig. 4: Photo of a sample from September containing many *Ceriodaphnia sp.* and one *Daphnia laevis*

Conclusions and Future Directions

The results highlight a significant shift in the pond's population from nearly 100% *Ceriodaphnia* to almost 100% *Daphnia laevis* in just two weeks. This is similar to what has been seen in other studies, where it was caused by factors such as predator presence and food availability. In one study, a species of backswimmer was shown to prefer another species of daphnid over *Daphnia laevis* (Cooper and Smith, 1982). This led to seasonal variation that was dependent upon the population of backswimmers in the pond. Another study showed that a species of *Ceriodaphnia* was dominant over a species of *Daphnia* when the bacteria populations in the pond were higher, due to bacteria being a food source for *Ceriodaphnia* but not *Daphnia* (Iwabuchi and Urabe, 2010).

Going forward, the most important step is to continue this study over at least one more season in order to determine if the pattern observed this year is consistent. At the same time, it would be important to note predator presence and possibly take measurements of abiotic factors in the pond in order to determine if anything else changed significantly at the time the swap took place. One of the most common macroinvertebrates seen in the samples was a species of backswimmer, so it would be interesting to note their density as well and see if it follows a similar pattern to what was observed by Cooper and Smith. Following that, it would be interesting to take stomach contents from both *Ceriodaphnia sp.* and *Daphnia laevis* to determine if their diets differ, perhaps along with algae levels in the pond. Several individuals of *Ceriodaphnia sp.* were collected in a sample in April 2023, which is consistent with the population in early spring of 2022.



Fig 5. Photo of a sample showing *Daphnia laevis*