Approximating abundance of *Daphnia dentifera* using environmental DNA (eDNA) samples

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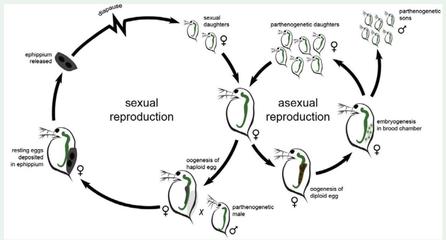
Introduction

Background:

- *Daphnia dentifera* is a zooplankton found in freshwater ecosystems[1]
  - Zooplankton are important in trophic food webs
- Organisms constantly shed DNA
  - Daphnia are molting animals[1]



- Strong correlations of eDNA and species biomass[2]

The mesocosm experiment:

- Looks at effects of:
  - Dilution
  - Temperature variation
  - Competition
  - Disease
  - eDNA
- Species:

Daphnia dentifera

Ceriodaphnia dubia

Metschnikowia bicuspidata

Questions:

i. Can the abundance of *Daphnia dentifera* be estimated using eDNA?
ii. Will temperature affect the amount of eDNA?

Hypotheses:

i. There will be a negative correlation between *Daphnia dentifera* abundances and the cycle threshold
ii. Temperature:
   i. At warmer temperatures: Faster lifecycle, more DNA shed in a period, DNA is less stable
   ii. At cooler temperatures: Slower lifecycle, less DNA shed in a period, DNA is more stable

Methods

Results

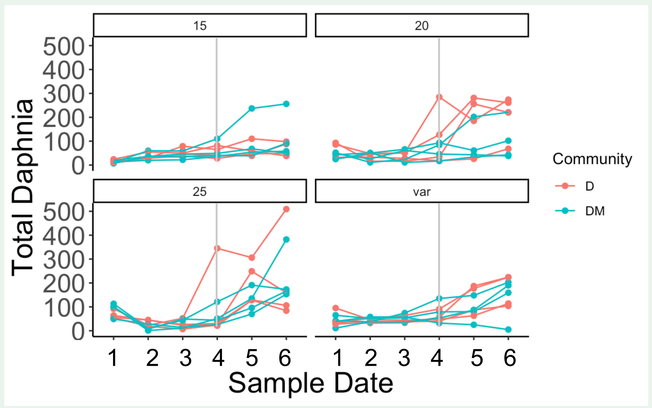


Figure 1. *Daphnia dentifera* abundances across sample dates in each bucket by temperature treatment. Colors indicate community composition where *Daphnia dentifera* communities (D) are red and *Daphnia dentifera* with *Metschnikowia bicuspidata* communities (DM) are blue. Metschnikowia was added to DM tanks on the fourth sampling date.

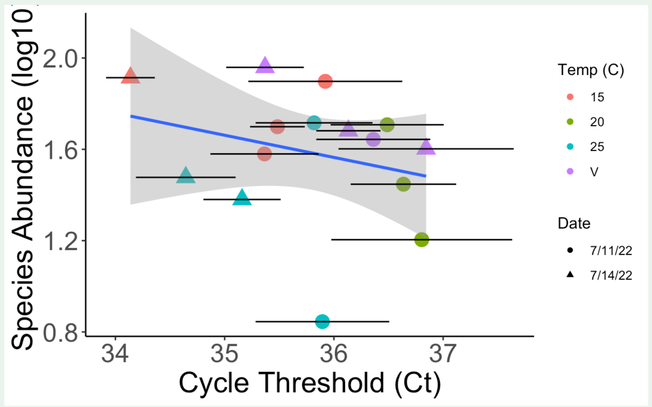


Figure 2. Scatterplot of cycle threshold on the x axis and species abundance (log 10) on the y axis. Points are representative of nine buckets across the temperature treatments (color) from two sampling dates (shape). Linear model indicates the relationship is not significant.

Conclusions

Fail to reject the null hypothesis:

- No significant relationships
  - No standard curve
- Complex system
  - Results offer a starting point to get more accurate estimates with further testing

Sources of error:

- Splashing water between pools/buckets
- Contamination in sampling methods
- Contamination of eDNA extraction materials

Significance

Implications for disease:

- Monitoring epidemics for the study system in the field
- Other disease surveillance
  - COVID-19 waste water surveillance

Implications for ecology:

- Easier sampling in the field
- Monitoring disease and its impacts

Looking ahead:

- Run more samples
- Look at other abiotic factors that might affect the persistence of eDNA in the environment
- Allometric scaling[3]

Literature Cited

[1]Ebert (2005). Ecology, Epidemiology, and Evolution of Parasitism in *Daphnia,* 2
[2]Takahara et al. (2012). PLosONE, 7(4)
[3]Yates et al. (2020). Molecular Ecology, 2021;30:3068-3082

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