How macrophyte beds in a shallow freshwater system influence diel vertical and horizontal migration of mesozooplankton taxa

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Introduction

Zooplankton are indicators of water quality, informing researchers of the link between algal abundance and fish predation. While previous studies have investigated the influence of macrophyte beds on mesozooplankton diel migration[3,5,6], few studies have been conducted in small waterbodies, despite their importance in our ecosystems. Being the most abundant freshwater environment, small waterbodies play an important role in maintaining biodiversity, water quality, and carbon cycling[2]. The goal of this project is to determine the primary diel migration pattern of different mesozooplankton taxa in Arrowhead Pond, a 0.5-to-2-meter freshwater pond located at the University of Kansas Field Station (KUFS). Mesozooplankton samples were collected in periods of ample light (noon) and no light (midnight)[1] to examine whether macrophyte beds, present in the littoral zone of Arrowhead Pond, are utilized as shade and refuge for mesozooplankton taxa from visual predation.

Hypotheses and Objectives

Hypotheses:

1. Predicted abundance of Cladocera and copepods dependent on time of day and sampling location[6].
2. A high to medium abundance of taxa is expected in the littoral, macrophyte dense zones during times of the day with ample light (noon).
3. Conversely, a high abundance of all zooplankton specific is expected in the limnetic zone during times of day with low light (midnight).

Abundance of Cladocera		LOCATION			
		Littoral, macrophytes	Littoral, no macrophytes	Limnetic, top	Limnetic, bottom
TIME OF DAY	Noon	High	Low	Low	Medium
	Midnight	Medium	Medium	High	Low
Abundance of Copepods		**LOCATION**			
		Littoral, macrophytes	Littoral, no macrophytes	Limnetic, top	Limnetic, bottom
TIME OF DAY	Noon	Medium	Low	Low	High
	Midnight	Low	Low	High	Low

Figure 1: Hypothesized abundance of Cladocera and Copepods in varying habitat conditions and times of day.

Objectives:

1. Determine the dominate diel migration pattern (vertical or horizontal) of mesozooplantkon taxa in a shallow freshwater environment.
2. Determine whether different macrophyte bed types affect the migration patterns of mesozooplantkon taxa.
3. Investigate if and how migration patterns change depending on time of day, seasonal conditions, and location within a shallow pond environment.

Figures

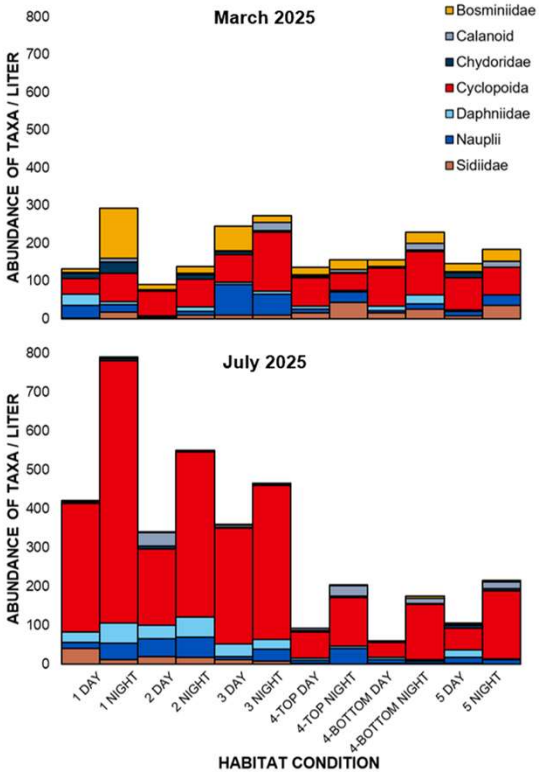

Figure 2: Abundance of Cladocera (Bosminiidae, Chydoridae, Daphniidae, Sidiidae) and copepods (Calanoid, Cyclopoida, Nauplii) across five habitat conditions in March and July 2025.

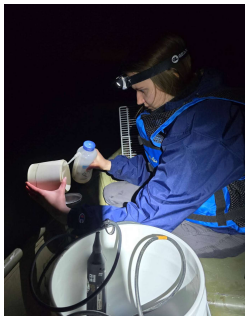

Figure 3: Rinsing and preserving March 2025 night sample.

Figure 4: Five sampling sites indicated on Arrowhead Pond. Each color suggests a different macrophyte bed type.

Figure 6: October Night sampling on Arrowhead Pond. Red headlamps were used to avoid disturbing zooplankton.

Results

My findings indicate that the abundance of taxa for noon versus night samples is statistically different for both March ($p=0.02$) and July ($p=0.003$). However, differences in the abundance of copepods and Cladocera for day versus night samples were not statistically significant in March ($p>0.05$) and only copepod abundance was statistically significant between day and night for July ($p=0.001$). March versus July seasonal differences in the abundance of taxa for day and night totals were not found ($p>0.05$).

Methods

Bi-monthly sampling began in March and ended in October 2025. Mesozooplankton samples were collected using a 12-Liter **Schindler-Patalas plankton trap** across 8 sample sites of varying depths and macrophyte bed densities. A metal grill attached to the bottom of the trap was utilized to divert macrophyte beds away from the trap. Samples were funneled through the 64µm mesh cod end of the trap and preserved in 95% ethanol in 120mL glass vials. A **5 to 10 mL subsample** was used to determine the abundance of taxa at each sampling site. Water temperature, turbidity, conductivity, oxidation-reduction potential (ORP), dissolved oxygen (DO) concentration, and pH were measured using a **YSI Multiprobe Water Quality Meter** at each sampling site[4]. Water transparency was found during daylight sampling using a **Secchi disk** measurement.

Conclusion

We found more mesozooplankton per site in the summer (July 2025) and substantially more migration during the summer given proportionally more taxa were observed at night compared to the day. Future statistical analyses will indicate whether differences in abundance were observed between habitat conditions. Additionally, the samples I have collected in May and October will improve our understanding of how migration patterns shift spatially and with seasonal conditions. My findings contribute to expanding our understanding of zooplankton habitat preference and migration patterns in a shallow pond system, improving the accuracy of assessments linking habitat conditions, algal abundance, and fish vitality in small waterbodies.

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References

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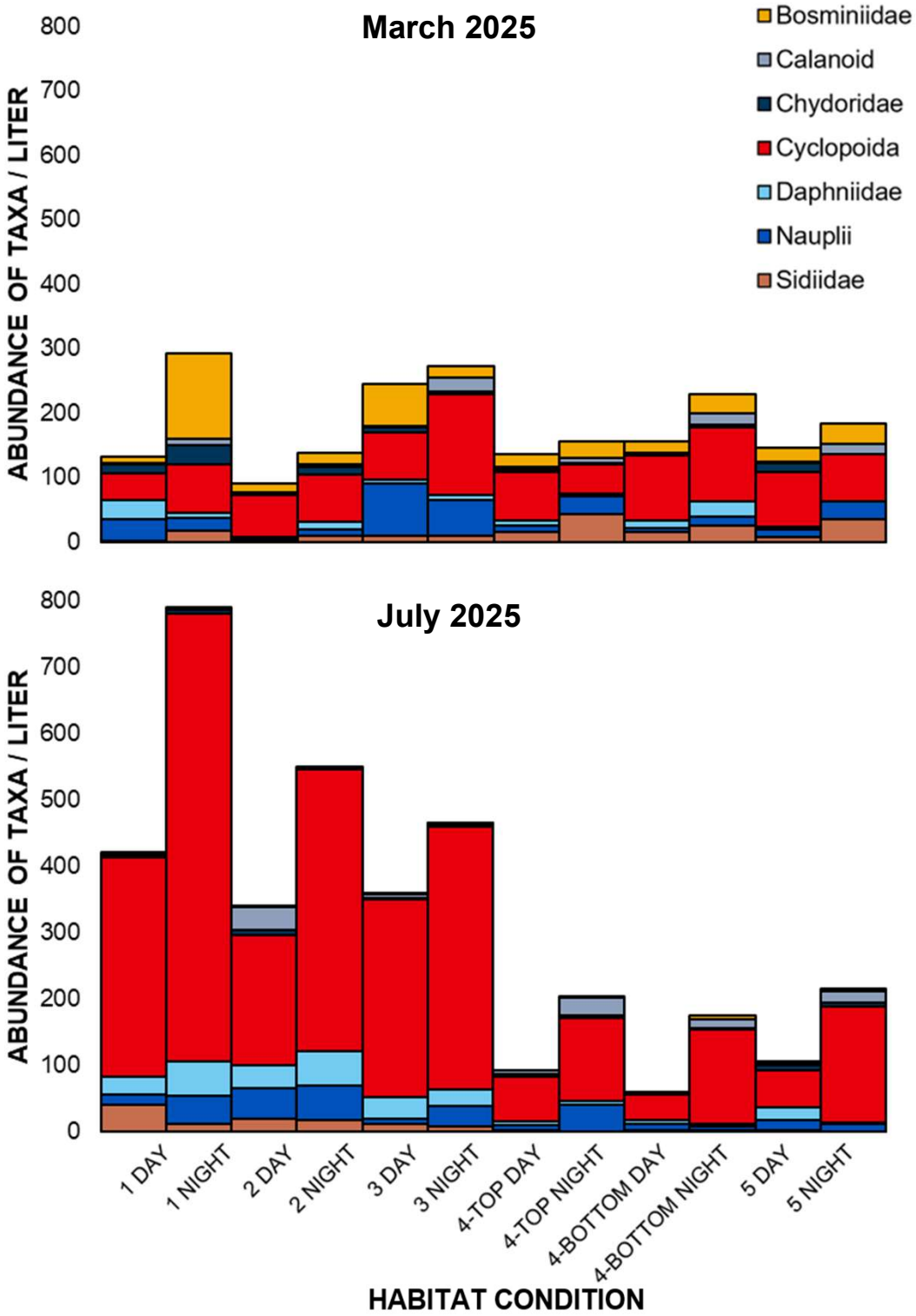
March 2025
Bosminiidae
Calanoid
Chydoridae
Cyclopoida
Daphniidae
Nauplii
Sidiidae
ABUNDANCE OF TAXA / LITER
800
700
600
500
400
300
200
100
0
July 2025
ABUNDANCE OF TAXA / LITER
1 DAY
1 NIGHT
2 DAY
2 NIGHT
3 DAY
3 NIGHT
4-TOP DAY
4-TOP NIGHT
4-BOTTOM DAY
4-BOTTOM NIGHT
5 DAY
5 NIGHT
HABITAT CONDITION