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What is the Winter Limiting Nutrient in Urban Reservoirs? A Case study.

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What is the Limiting Nutrient in Urban Reservoirs?: A case study.

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Introduction

- Lakes and reservoirs provide cultural, regulating and supporting services to the human population (1). These services have been declining in urban environments(2).
- Reservoirs are predicted to hold 7 times more natural river water than lakes and hold 1-3 billion deposits annually yet little research is dedicated to understanding them(3).
- Notable work has been done to assess lake limnology in winter (4). Similar work is needed to understand limiting nutrients in reservoirs during winter.
- This provides understanding on how urban reservoirs' ecosystems function in winter as an indicator of performance in other season. This provided information that enables governments and lake users to make conservation measures that are nutrient specific hence eradicating eutrophication.

Materials and Methods.

✓ The study was conducted on Holmes' lake(fig.1).

✓ Sampling was carried out in November (2019) and February 2020(fig.2) using a Van Dorn water sampler. Lake water filtered on spot using the 53 µm sieve to remove zoo plankton. Lake chemical properties were measured using YSI(table 2).

✓ Total Suspended Solids and Chlorophyll-a measurements using 1.5µm and 0.45µm filters respectively. In the lab, 125 ml glass bottles were chosen for least variability and highest light penetration.

✓ 8 treatments were conducted 1) Control 2) Phosphorous 3) Nitrogen 4) Trace elements 5) Nitrogen + Phosphorous 6) Nitrogen + Trace elements (NTE) 7) Phosphorous + Trace elements(PTE) 8) Nitrogen + Phosphorous + Trace element (NPTE).

✓ Dissolved oxygen was measured every 4 hours and this raw data was converted into gross primary production(GPP), net primary production(NPP), extracellular respiration(ER) . Analysis was done using ANOVA based on Tukey's Significant Difference (HSD).

Study site properties

Fig 1: Aerial Mapped Image of Holmes' lake. This shows surrounding land use(5)

Table 2: Physiochemical Lake Properties with each field measurement.

	November	*February*
Secchi disk measurement cm	50	45
Temperature ºC	3.6	2.4
PH	8.17	7.99
Dissolved oxygen mg/l	27.2	7.9
Dissolved Oxygen %	192.3	50.5
Specific conductivity	462.1	122.6

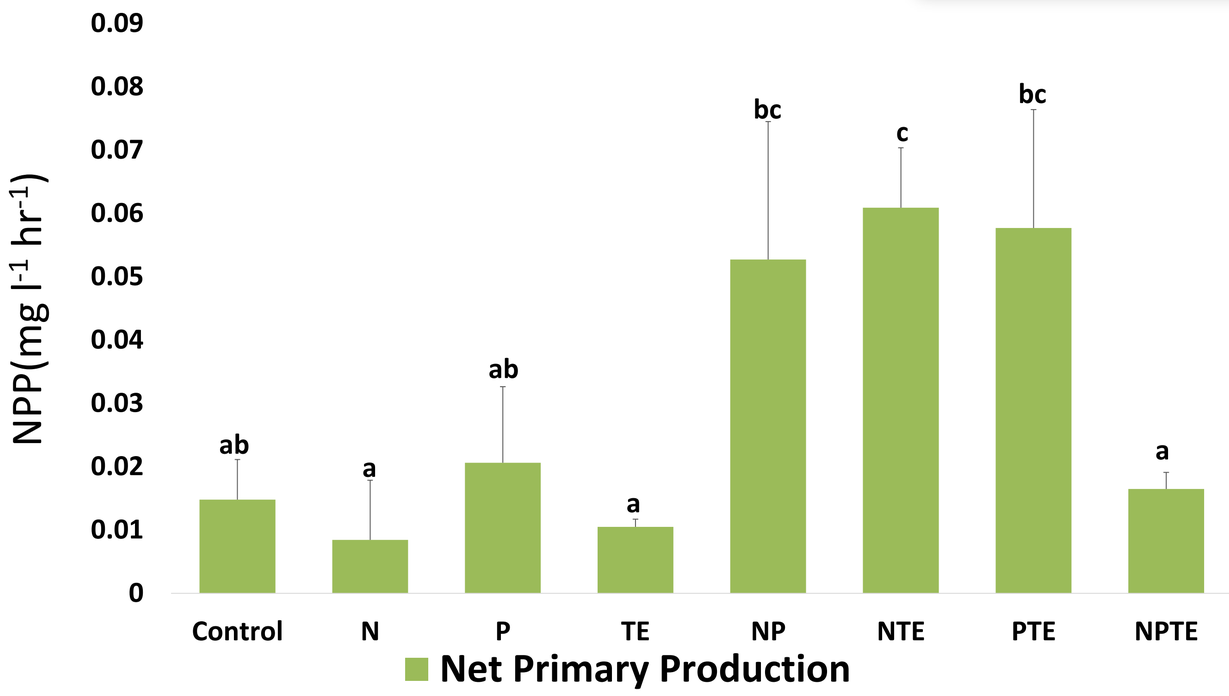

Fig 3: Net Primary Production in the November Treatment. This shows presence of colimitation in Holmes' lake.

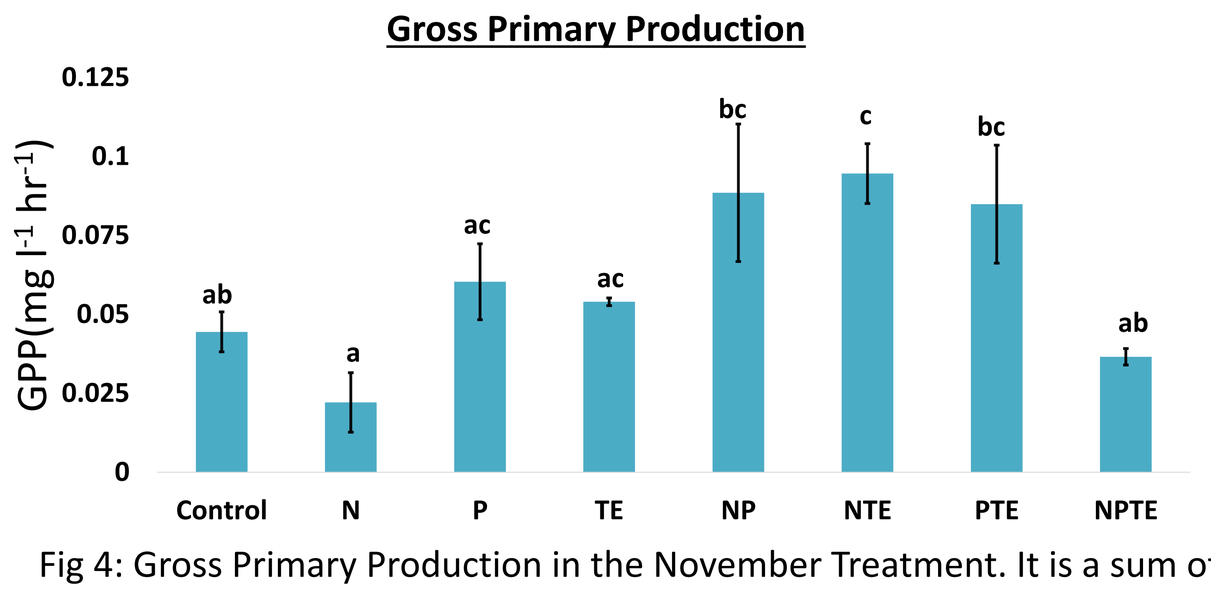

Fig 4: Gross Primary Production in the November Treatment. It is a sum of NPP and extracellular respiration. Respiration dampened respiration hence lower GPP than expected in Nitrogen treatments.

Discussion and Conclusions

- Holmes lake(fig.1) is a fairly productive lake as noted by the lake's low clarity. The secchi disk measurement ranged between 0.4-0.6 m which is typical for eutrophic and productive lakes(6).
- In single nutrient treatments, phosphorous performed fairly well. Though statistically insignificant, it aligned with the general consensus that phosphorous is a limiting nutrient in fresh aqua systems (7).
- Significant ecosystem response was observable in combined nutrient treatments namely:
- 1) Gross Primary Production and Net Primary production were highest in NTE treatment(fig 3 &4).
- 2)Extracellular respiration was not significantly different across treatments.

The above led us to believe that there is co-limitation in Holmes' lake.

- **Hence management of reservoirs needs to focus all nutrients for better water quality and usability of the lake.**

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