# Coupled carbon and nitrogen dynamics in Arctic stream ecosystems

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## Background and Conceptual Framework

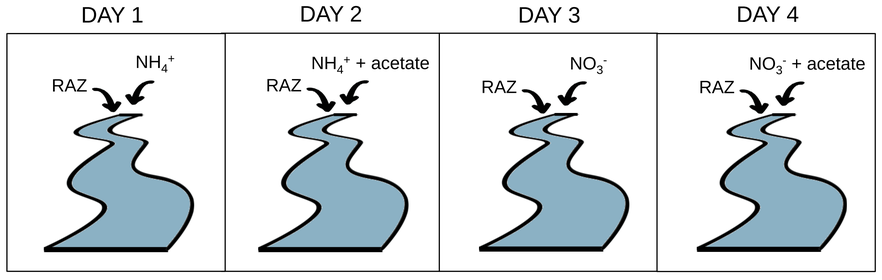
BACKGROUND:
Many studies have used experimental nutrient additions in streams to quantify rates of uptake and transformation. However, few have incorporated strategies to investigate the response of greenhouse gas (GHG) concentrations and fluxes to manipulated nutrient and energy availability.

OBJECTIVE:
To determine nutrient uptake metrics and the response of GHG production to manipulated C and N availability

HYPOTHESIS: Higher C relative to N may increase heterotrophic activity and complete denitrification (to $N_2$) resulting in lower $N_2O$ concentrations. Lower DOC:DIN could increase nitrification and incomplete denitrification, both of which can produce $N_2O$ as byproducts.

APPROACH

- Four short-term constant rate additions in two streams draining catchments with tundra and birch forest near Abisko, Sweden with contrasting light, thermal, and nutrient regimes
- Constant rate additions of resazurin (Raz) were performed to measure how heterotrophic respiration changed across treatments
- Other metrics measured to explain variability in nutrient uptake and GHG production: stream metabolism rates, dissolved organic matter (DOM) composition, channel morphology, incident light, temperature





*Tundra stream*


*Birch forest stream*

## Preliminary Results

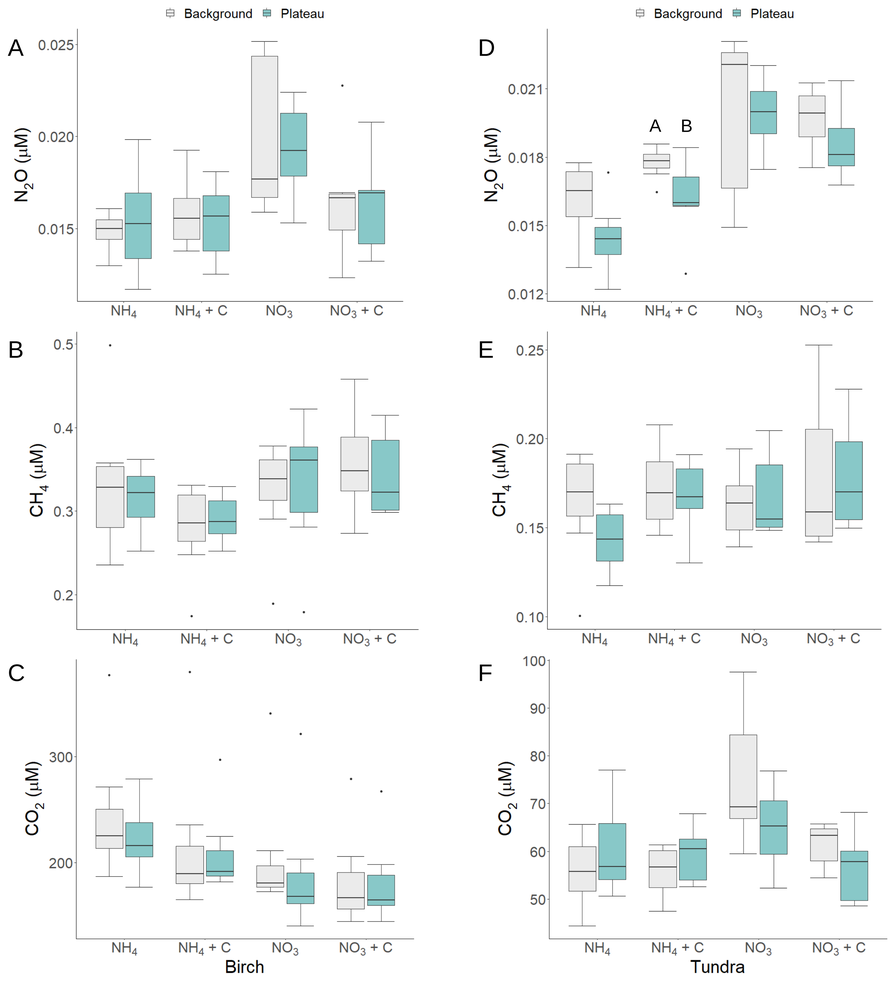



**Figure 2.** Boxplot panels show differences between background and plateau concentrations for $N_2O$ (A, D), $CH_4$ (B, E), and $CO_2$ (C, F) for each addition at the birch forest (A-C) and tundra (D-F) streams.

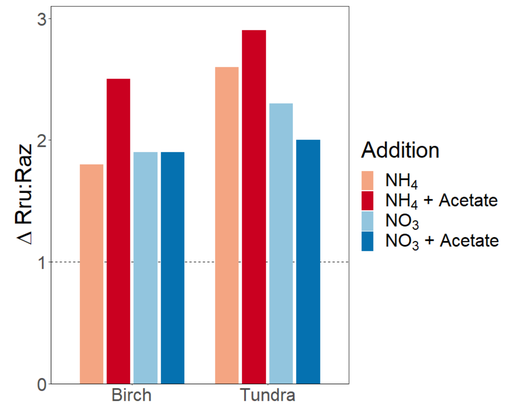



**Figure 3.** Relative change in Rru:Raz for each addition.

**Table 1.** Background metabolic rates of gross primary production and ecosystem respiration for each stream.

| | GPP ($g\ O_2\ /m^2/d$) | ER ($g\ O_2\ /m^2/d$) | P/R |
|---|---|---|---|
| **Tundra** | 0.62 ± 0.04 | -2.91 ± 0.12 | 0.21 ± 0.02 |
| **Birch** | 0.30 ± 0.06 | -2.86 ± 0.05 | 0.13 ± 0.02 |

**Table 2.** Background characteristics for each stream.

| | Q (L/s) | DOC (µg C/L) | DIN (µg N/L) | $NO_3$:$NH_4$ | PAR ($mol/m^2/d$) | Temp (ºC) |
|---|---|---|---|---|---|---|
| **Tundra** | 12 | 800 | 10 | 1 | 52 | 8.9 |
| **Birch** | 25 | 2400 | 15 | 2 | 15 | 6.6 |

## Conclusions

- Lack of a clear response in GHG concentrations suggests that short term enrichments may not result in detectable increases in gas production
- However, results from Raz additions show a metabolic response to manipulated C and N availability

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