Herbivorous protists affect phytoplankton abundance and community size structure in the North Pacific during EXPORTS

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Motivation

- Grazing by herbivorous protists (microzooplankton) directly affects primary and export production.
- Protists can alter size distribution and abundance of phytoplankton.
- Yet predictive understanding of this key carbon export variable remains limited.

Goals

- Quantify protist grazing rates and phytoplankton growth rates.
- Assess impact of grazing on phytoplankton composition and size structure.
- Build predictive understanding by parameterizing grazing rates in relation to environmental variables.

Approach

- Grazing experiments were performed during the North Pacific EXPORTS cruise.
- Incubations to measure phytoplankton growth and herbivory along vertical and light gradients.
  - Flow cytometry for group specific dynamics
- Novel method to measure protistan herbivory below the euphotic zone.

Protist grazing consumed all new phytoplankton growth and decreased standing stock resulting in a net decrease of phytoplankton abundance

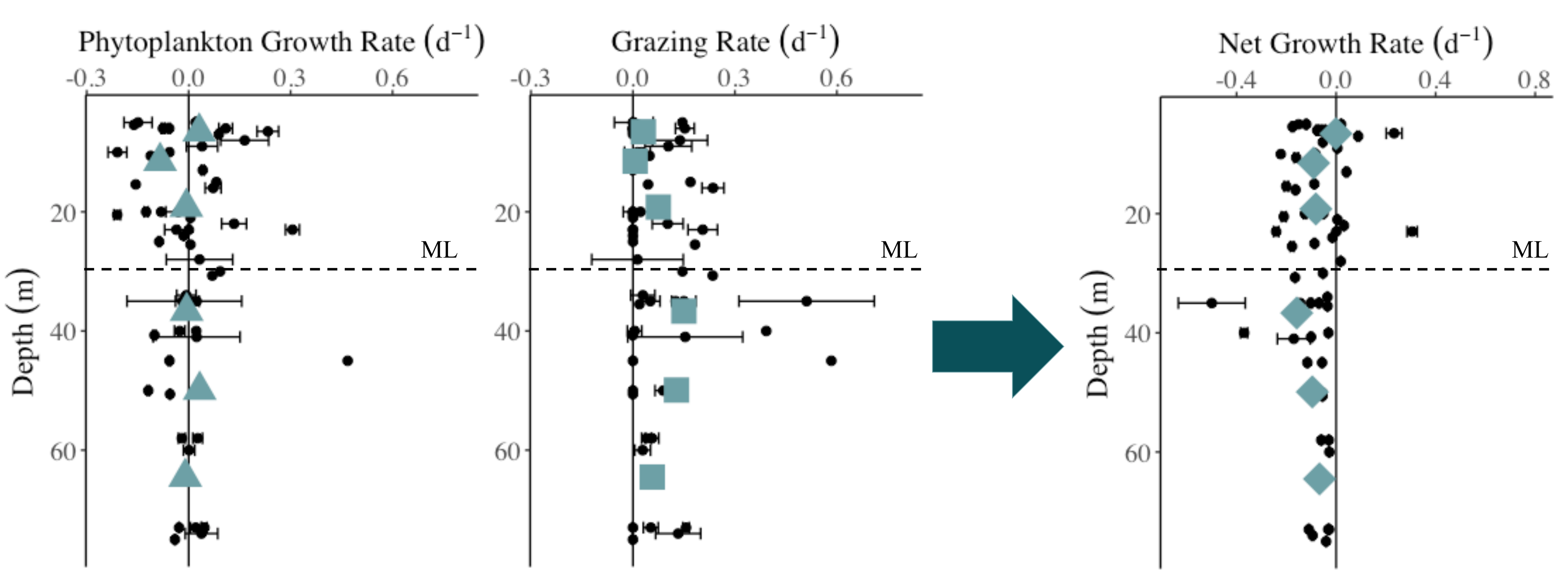

Figure 1: Growth, grazing and net growth rates based on changes in phytoplankton abundance (Flow cytometry) in 24 h, deck-board incubation experiments. **Black** dots show the results from individual experiments (+/- SE), Blue points show the mean rate binned by incubation light level (i.e. % PAR). Dashed line denotes average bottom of the mixed layer based on potential temperature (calculated by Andy Thompson, Cal Tech from Δ **θ** > 0.2 °C).

Incubation results closely reflect *in situ* dynamics (r = 0.52)

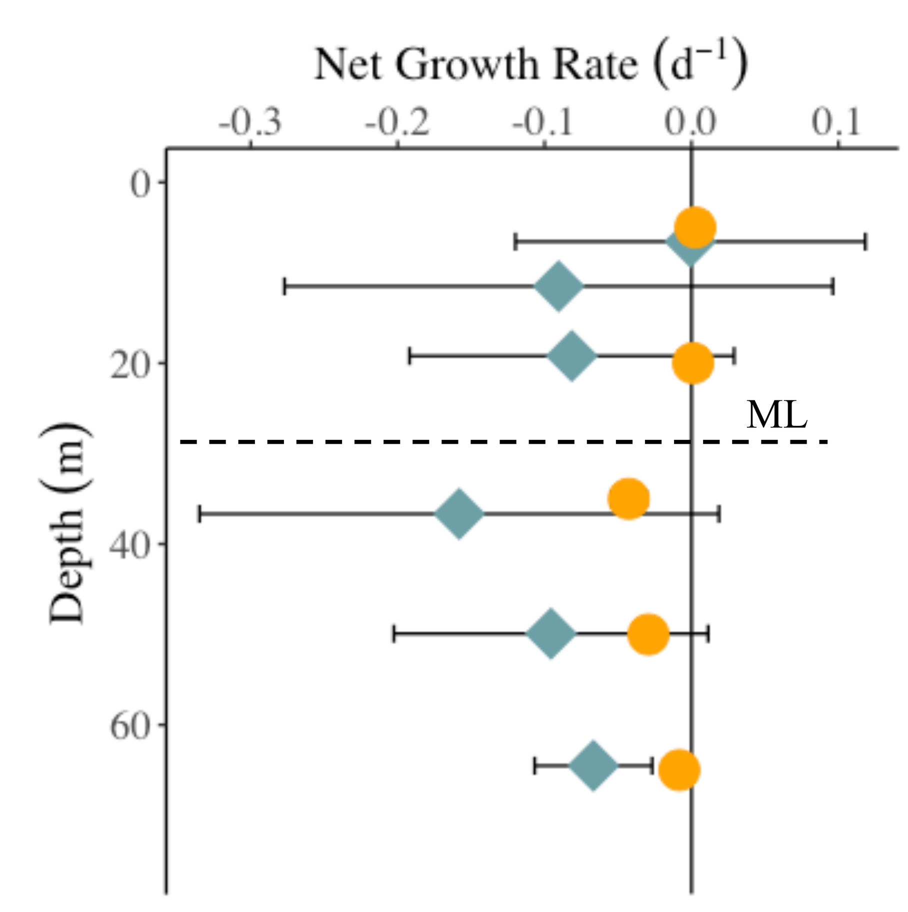

Figure 2: Net Growth in incubation experiments with bars denoting biologic variability compared to Net Growth from twice-daily flow cytometry profiles. Flow cytometry rates are the linear regression of the natural log of phytoplankton abundance over time.

Higher grazing rates on larger phytoplankton reinforces dominance of small phytoplankton

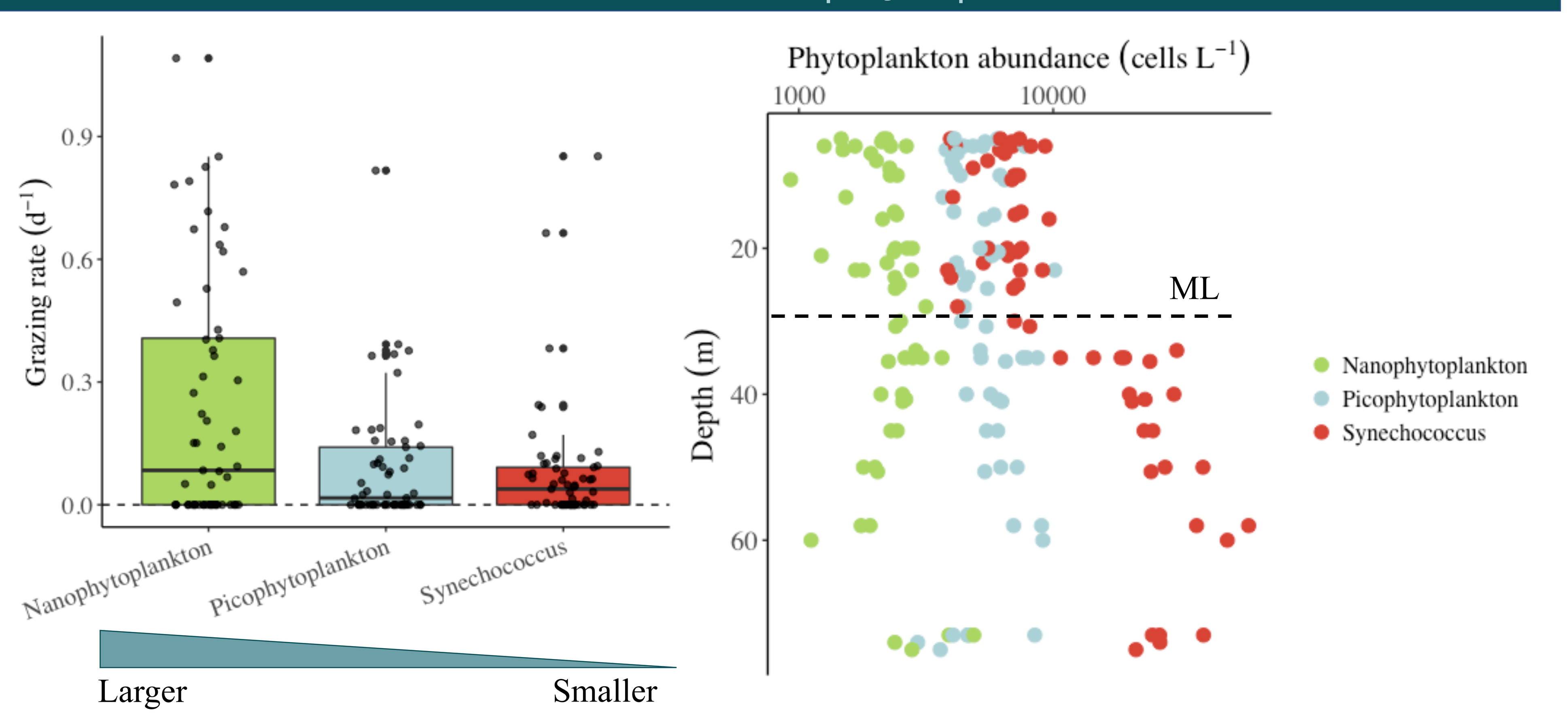

Figure 3: Left-Group specific grazing based on cell abundance (Flowcytometry) from incubation experiments, grazing rate declined with cell size. **Black** dots show the results from individual experiments, box plots show the median, 25 and 75 percentiles. Right-*In situ* cell abundance.

Measurable protistan grazing at transition from euphotic to mesopelagic removes 0.5% of phytoplankton daily

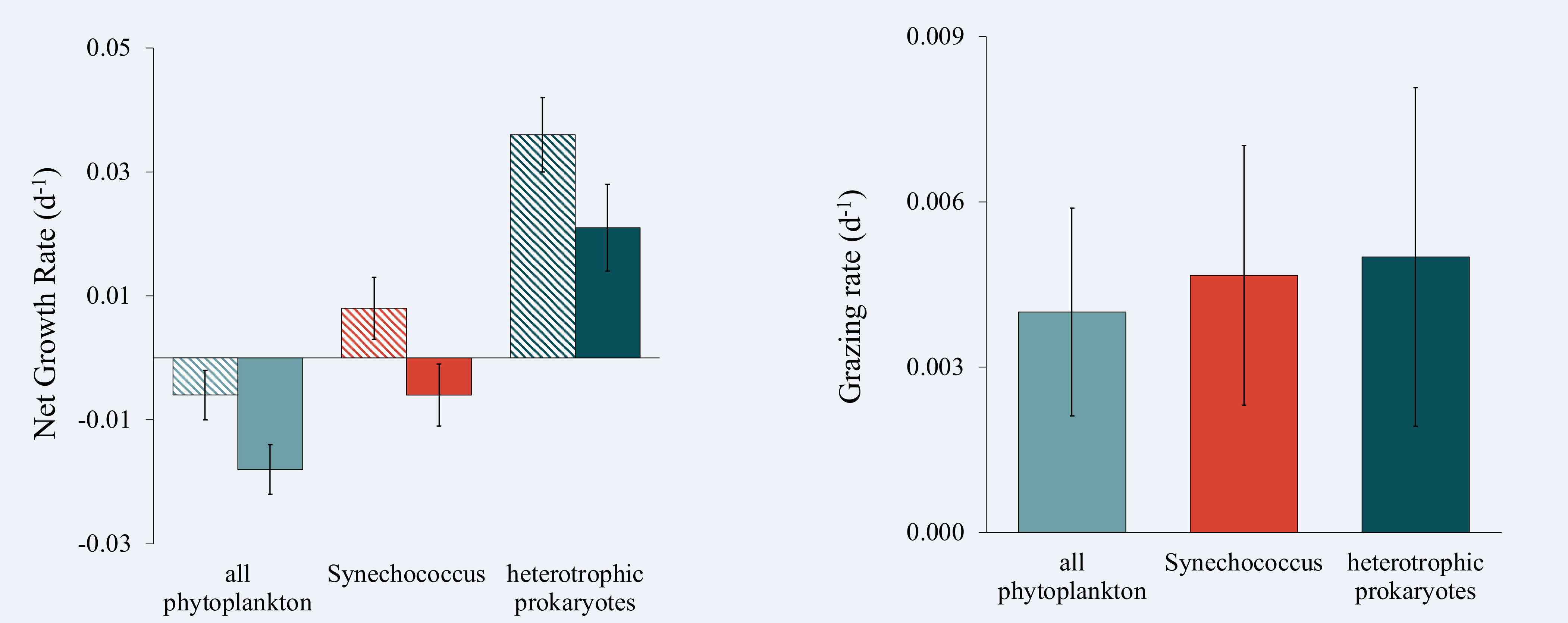

Figure 4: Left-Group specific net growth rate during a 7 day, dark, incubation with water collected from 95 m (~0.5% PAR). Net growth in control (**striped bars**) and predator concentrate (**solid bars**). Right- *In situ* grazing rate estimate shows low and significant removal of all prey types (McNair and Menden-Deuer in review).

Thank you!

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Discussion

- Bottle incubations exclude losses from mesozooplankton, sinking, advection etc. thus the match between in situ and incubation data suggest that protist grazing was a major loss factor of phytoplankton during EXPORTS.
- Phytoplankton growth was likely resource limited thus even low grazing pressure contributed to a steady decline in cell abundance.
- Grazing was detectable below the euphotic zone.
- Next steps: collaborating with interdisciplinary EXPORTS team members to synthesize results.