Grazing by mixotrophic nano– and dinoflagellates in the Northern Gulf of Alaska in response to gradients in light, inorganic nutrients, and prey availability

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Background

At the base of marine food webs are many single-celled planktonic organisms that are capable of both feeding and photosynthesizing (i.e. "mixotrophs). In laboratory studies, mixotrophs have shown increased growth rates and enhanced photosynthetic ability compared to pure autotrophs. Global ocean models that account for mixotrophy show increases in carbon flux and trophic transfer efficiency[2]. Mixotrophic species have been observed across the Northern Gulf of Alaska (NGA) and may contribute to the highly productive nature of the region and help buffer the ecosystem to seasonal and annual variability.

Feeding by mixotrophic flagellates in summer is a nutrient acquisition mechanism

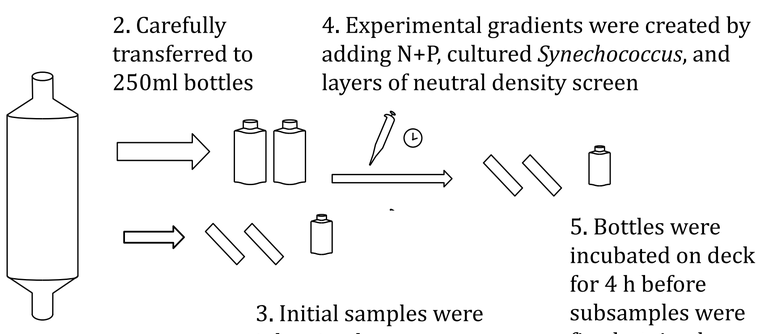
Feeding by mixotrophic flagellates was highest at high light and low ammonium levels, indicating that this trophic strategy is likely driven by a need for key nutrients to support growth.

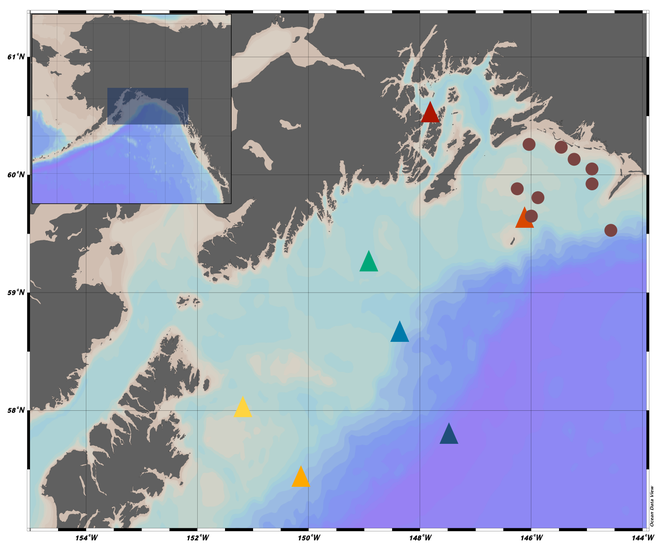
Does feeding by phytoflagellates respond to changes in light, inorganic nutrients or prey concentration?

Is natural ingestion by NGA phytoflagellates linked to environmental conditions?

Manipulation Experiments

Experiments were conducted at 7 sites across the NGA. At each site, three parallel experiments examined feeding responses to gradients in ambient light, inorganic nutrients and prey (*Synechococcus*) concentration.

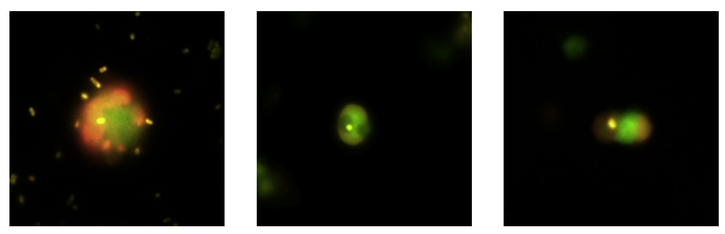




Circles and triangles indicate stations sampled for natural ingestion and environmental properties. Triangles represent stations where manipulation experiments were conducted.

Natural Ingestion

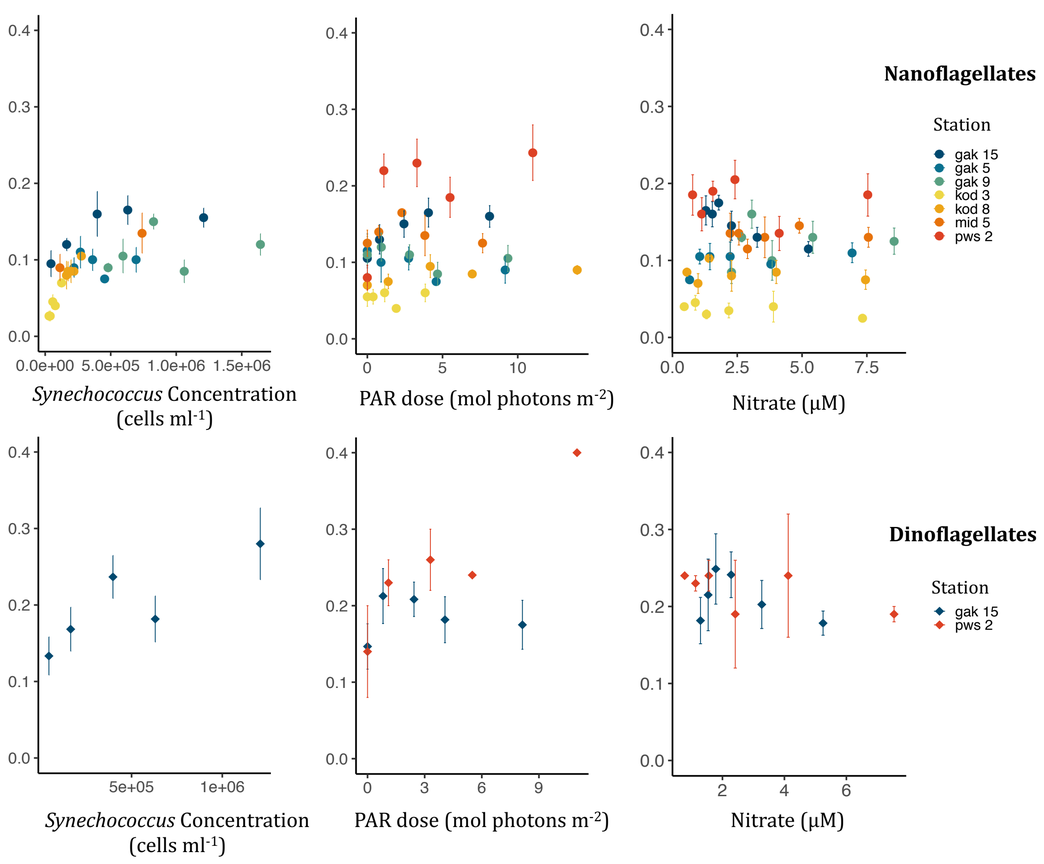
Samples were taken to observe phytoflagellate grazing in situ on naturally occurring *Synechococcus* at sites across the NGA and Prince William Sound. Levels of ingestion were compared to gradients in environmental conditions.



Images of nano- and dinoflagellates under 1000x epifluorescence illumination. Red autofluorescence of chloroplasts allowed for determination of inherent photosynthetic ability and yellow autofluorescence of *Synechococcus* was used to observe ingestion. Cell sizes ranged from 2-5um and 5-10um for nanoflagellates and dinoflagellates, respectively. Morphological characteristics were used to classify organisms.

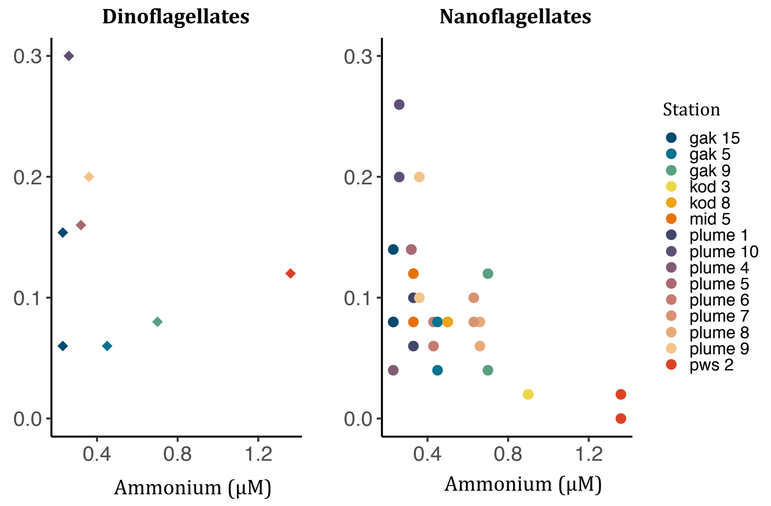
Results

- **Across stations ~10% of photosynthetic nanoflagellates and dinoflagellates contained ingested *Synechococcus***
- **In manipulation experiments ingestion increased with prey concentration and light availability**
- **Natural ingestion decreased with increasing ammonium concentration**



Negative correlation between ammonium and ingestion for nanoflagellates and dinoflagellates observed (Kendall's tau -0.375, $p<0.05$).

Fraction of the population feeding after 4 h deck board incubations. Nanoflagellates (top) and dinoflagellates (bottom) are shown across all experiments conducted.



Nitrate did not affect ingestion across manipulated experiments or natural ingestion. Relationships between fraction of population feeding and salinity, surface temperature, PAR, *Synechococcus* concentration, nitrate, phosphate, nitrite and silicate were examined with no significant correlations observed.

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Acknowledgements

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