



Effects of Ni on N₂ fixation by *Trichodesmium* under Natural High-light Conditions



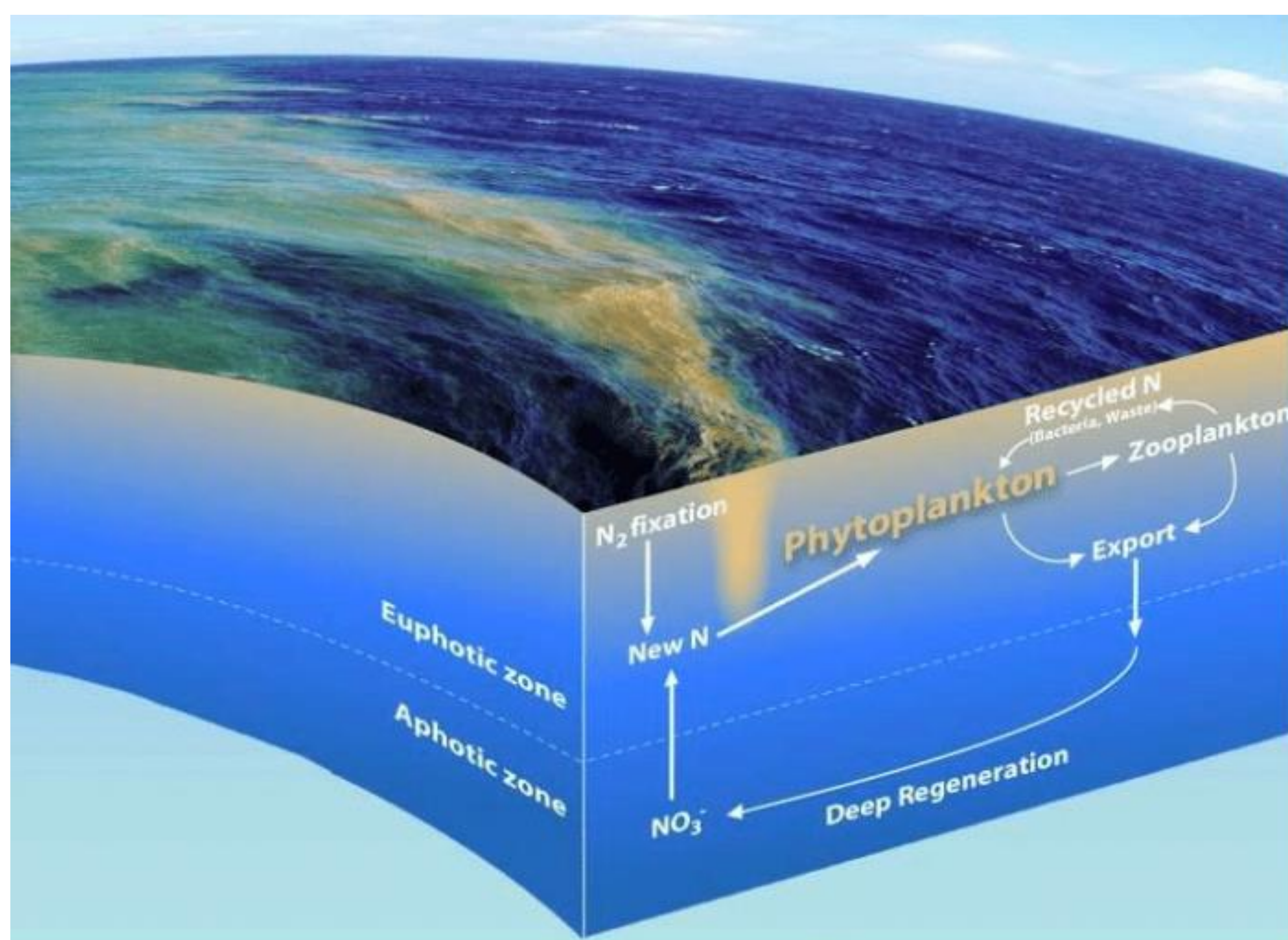
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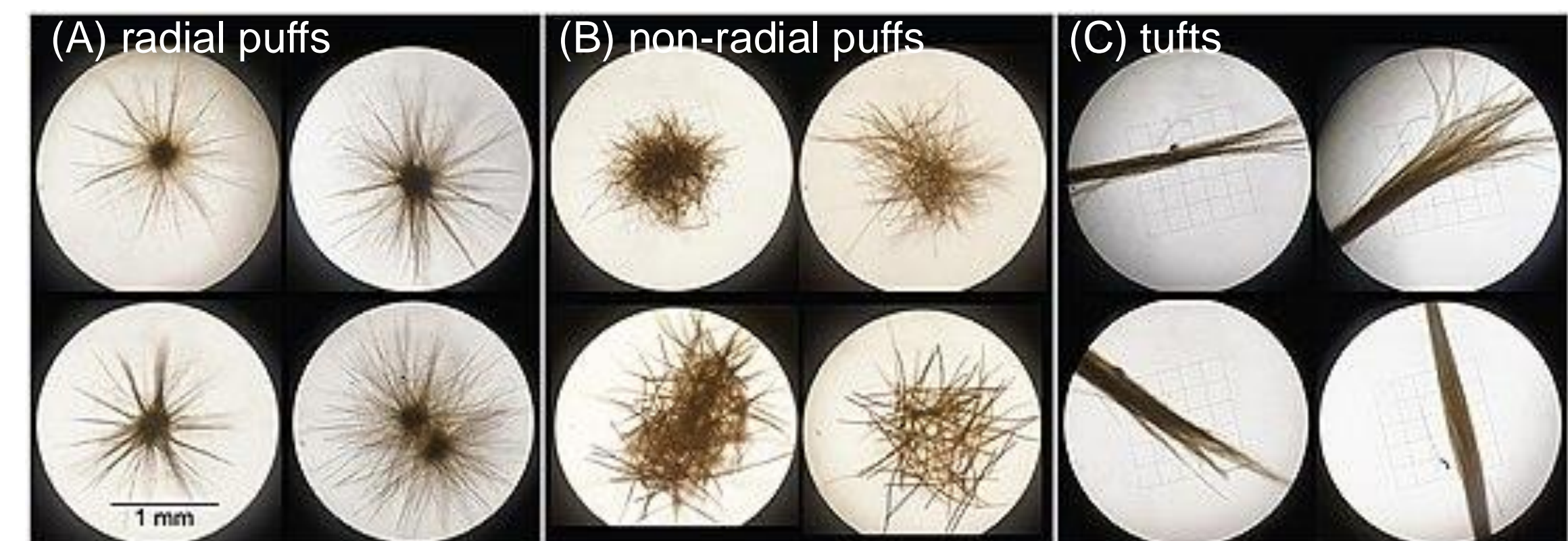
The importance of N₂ fixation

- Nitrogen fixation affects the biological uptake of carbon dioxide in the ocean, as bioavailable nitrogen is a key limiting factor for the growth of marine phytoplankton. [1]
- The graph below^[2] shows how *Trichodesmium* and nitrogen fixation (NF) influence the growth of other phytoplankton and material cycling in the ocean.



Trichodesmium (*Tricho*)

- Tricho* is the most dominant diazotroph in the tropical and subtropical ocean in the world, providing a significant amount of bioavailable nitrogen in oligotrophic oceans. There are 3 types of *Tricho* colonies [3]:



- Tricho* can survive or even bloom in nutrient-poor surface waters. [4]
- Nitrogenase, the crucial enzyme for nitrogen fixation, is sensitive to increased levels of O₂ and reactive oxygen species (ROS) produced during photosynthesis. [5]
- The expression of nickel superoxide dismutase (NiSOD) is crucial for protecting nitrogen fixation from oxidative stress generated during photosynthesis in *Tricho* grown under high-light (HL) conditions. [6]
- All of these findings have been based on lab studies. No one has ever demonstrated the importance of Ni on NF in the field yet. My study aims to conduct a field experiment on Green island, Taiwan.

Method

- We have collected seawater from the Kuroshio, then pick up *Tricho* and transferred them to filtered seawater in the lab of Lyudao.
- Treatments: one group with 10 nM Ni added (HNi) group; the other group w/o added extra Ni (LNi).
- We added 10 mL of concentrated *Tricho* in a 20 mL glass vials, sealed the vial, and replaced 2mL of air with C₂H₂.
- We then cultured the cells for 0, 3, 6, 9, 12, and 15hr under natural HL conditions. We collected the air samples in the vials once the culture time was up.
- We then measured C₂H₄ production by Gas Chromatograph and calculated nitrogen fixation rate of the *Tricho* grown under the conditions.

Sampling location



Sampling process on Kuroshio

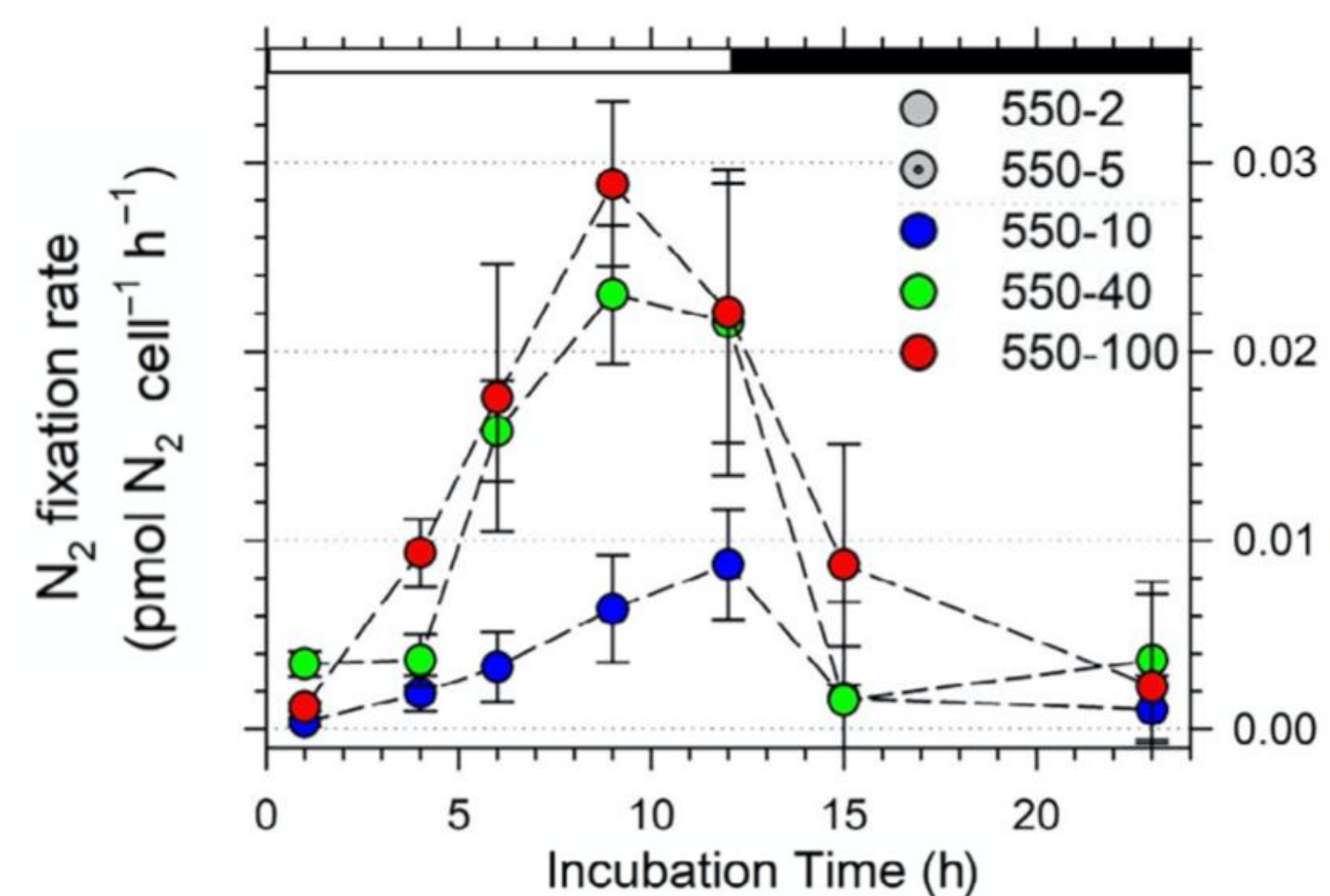


Tricho from Kuroshio



Experimental setup at the Lyudao St.

Result & Discussion



The plot shown above is typical NF rate trend for *Tricho* with time^[6]. It demonstrates that under high light conditions, Ni addition would result in higher nitrogen fixation rate for *Tricho*. For the field experiment we conducted on Green island, I am still working on the analysis of NF rate, SOD activities, and NiSOD concentrations.

I have noticed that temperature regulation is important in this experimental design as the temperature of tap water used for cooling may be too high. For future field experiment, it is critical to maintain cooling water temperature stable. Moreover, it is also important to ensure that cultures vials are exposed to similar light intensity.

Acknowledgements

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References

- Capone et al. 1997; Zehr and Kudela 2011. [2] Figure source: Annette Hynes, Illustration: Paul Oberlander, Photo: Daniel Ohnemus. [3] Gradoville et al. 2017. [4] Karl et al. 2002; Chen et al. 2014. [5] Gallon 1981; Fay 1992. [6] Chen 2022.