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TITLE: A Key Marine Diazotroph in a Changing Ocean: The Interacting Effects of Temperature, CO₂ and Light on the Growth of *Trichodesmium erythraeum* IMS101

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ABSTRACT:

Trichodesmium is a globally important marine diazotroph that accounts for approximately 60 - 80% of marine biological N₂ fixation and as such plays a key role in marine N and C cycles. We undertook a comprehensive assessment of how the growth rate of *Trichodesmium erythraeum* IMS101 was directly affected by the combined interactions of temperature, pCO₂ and light intensity. Our key findings were: low pCO₂ affected the lower temperature tolerance limit (T_{min}) but had no effect on the optimum temperature (T_{opt}) at which growth was maximal or the maximum temperature tolerance limit (T_{max}); low pCO₂ had a greater effect on the thermal niche width than low-light; the effect of pCO₂ on growth rate was more pronounced at suboptimal temperatures than at supraoptimal temperatures; temperature and light had a stronger effect on the photosynthetic efficiency (F_v/F_m) than did CO₂; and at T_{opt}, the maximum growth rate increased with increasing CO₂, but the initial slope of the growth-irradiance curve was not affected by CO₂. In the context of environmental change, our results suggest that the (i) nutrient replete growth rate of *Trichodesmium* IMS101 would have been severely limited by low pCO₂ at the last glacial maximum (LGM), (ii) future increases in pCO₂ will increase growth rates in areas where temperature ranges between T_{min} to T_{opt}, but will have negligible effect at temperatures between T_{opt} and T_{max}, (iii) areal increase of warm surface waters (> 18°C) has allowed the geographic range to increase significantly from the LGM to present and that the range will continue to expand to higher latitudes with continued warming, but (iv) continued global warming may exclude *Trichodesmium* spp. from some tropical regions by 2100 where temperature exceeds T_{opt}.

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