ICE DIATOMS - THREE CASE STUDIES ON EFFECTS OF ELEVATED CO_2 AND TEMPERATURE

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Sea ice algae, dominated by pennate diatoms, are a vital part of the primary production in ice-covered Polar Regions and provide a substantial carbon source for higher trophic levels. Simultaneously, as atmospheric CO_2 increases, sea surface temperature rises due to global warming. This has resulted in decreased summer ice cover and loss of multi-year ice. Thus, there is an urgent need to study the sea-ice communities and their role in the ecosystem and carbon cycling. In three different experiments, we studied the effects of elevated pCO_2 and temperature on pennate diatoms isolated from Arctic and Antarctic sea ice. In the first experiment (Expt A), we investigated the response of *Navicula directa* (isolated from the Svalbard area) to elevated pCO_2 (960 ppm) in combination with temperature increase of 4°C. In the second experiment (Expt B), we used a similar set-up but we studied the response of *Nitzschia* sp. (isolated from Amundsen Sea area). The third experiment (Expt C) was performed to test physiological responses to a temperature range (5 levels from -2 to +12°C) on *Nitzschia* sp. For *N. directa* (Expt A), no interaction effects of temperature and pCO_2 were found. Temperature alone had significant effects on growth rate and photosynthetic activity (F_v/F_m). Interestingly, at elevated *p*CO2 the growth rate was 5% lower ($p<0.05$) compared to ambient concentrations. For *Nitzschia* sp. (Expt B), a significant interaction effect for growth rate was observed. Growth rates were only promoted by increased pCO_2 when temperature was increased from -1.8 to 2.5°C. In general, temperature had a stronger effect where e.g. primary productivity and photosynthetic activity increased when exposed for 2.5°C compared to -1.8°C. Of the 5 levels tested (Expt C), the optimal growth temperature was 5°C, and highest F_v/F_m was reported at 8°C. No oxidative stress (lipid peroxidation) was observed until 12°C. These experiments have a mechanistic approach and we can only speculate on what could happen in a future polar ocean / ice habitat. However, elevated temperature stimulated photosynthesis and growth within the temperature window for the studied species, but responses to elevated pCO_2 may be more taxa-specific.