ICE DIATOMS - THREE CASE STUDIES ON EFFECTS OF ELEVATED CO₂ 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 CO₂ 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 pCO₂ 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 pCO₂ (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 pCO₂ were found. Temperature alone had significant effects on growth rate and photosynthetic activity (Fv/Fm). Interestingly, at elevated pCO2 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 pCO₂ 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 compared to -1.8°C. Of the 5 levels tested (Expt C), the optimal growth temperature was 5°C compared to -1.8°C. Of the 5 levels tested (Expt C), the optimal growth temperature was 5°C compared to -1.8°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 pCO₂ may be more taxa-specific.