Temperature mitigates high-light stress

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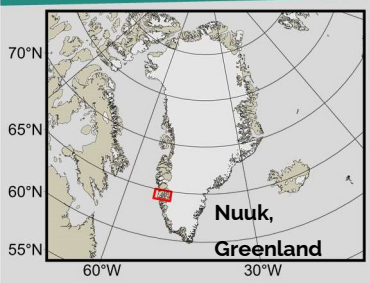
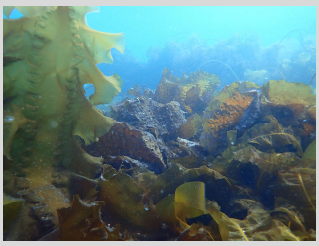


Due to ongoing climate change, Arctic fjords are subject to many environmental changes, e.g. intensification of marine heatwaves or a reduction of the photosynthetically available radiation by high concentrations of suspended particles. Kelps (brown macroalgae) act as foundation species along Arctic rocky shore coastlines, providing the livelihood for many associated species. To be able to understand kelp forest dynamics, we assessed the effect of marine heatwaves under different light regimes on two cold-temperate kelp species (*Agarum clathratum*, *Saccharina latissima)* at their cold distribution limit.

Research question: How are differences in light availability affecting the susceptibility of kelps to marine heatwaves in the Arctic?



Greenlandic kelp forest

High-light conditions

120 µmol photons m^{-2} s^{-1}

Conditions in clear Arctic fjords without a sediment plume

12 days heatwave

10°C
7°C
4°C (summer *in-situ*)

Low-light conditions

3 µmol photons m^{-2} s^{-1}

Conditions in sediment plume dominated fjord

High-light stress at 4°C, due to exposure of 24 h polar day

High-light stress is mitigated with rising temperature (10°C)

High-light stress, due to formation of reactive oxygen species
⇒ Decreasing of chlorophyll *a* concentrations to reduce oxidative stress
⇒ Reduced photosynthetic rates
⇒ Nevertheless, weight gain

No physiological stress experienced
⇒ No temperature effect due to light-limitation

Similar response pattern of both species

Low-light limited
⇒ Increasing chlorophyll *a* concentrations during the experiment:
⇒ Positive photosynthetic rates
⇒ Weight gain

BUT:

High temperatures promote the expansion of temperate kelps to higher latitudes.

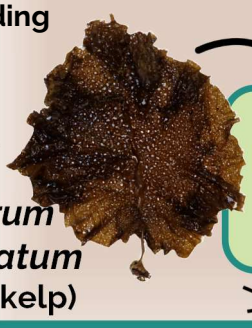
Reduced weight gain in darker fjords
⇒ Less production
⇒ Consequences for carbon cycling?

More weight gain & less high-light stress

More photosynthetic pigments & feeding deterrents

Saccharina latissima **(Sugar kelp)**

"Winner" in high-light environments with low grazing pressure



Agarum clathratum **(Sieve kelp)**

"Winner" in low-light environments with high grazing pressure

Changes in the ecosystems species composition might have cascading effects:

- **Changes in the kelp forest associated species community**
- **Changes in the of energy transfer to high trophic levels.**

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