Effects of changing photoperiod on the circadian rhythmicity of photophysiology in the polar diatom *Fragilariopsis cylindrus*

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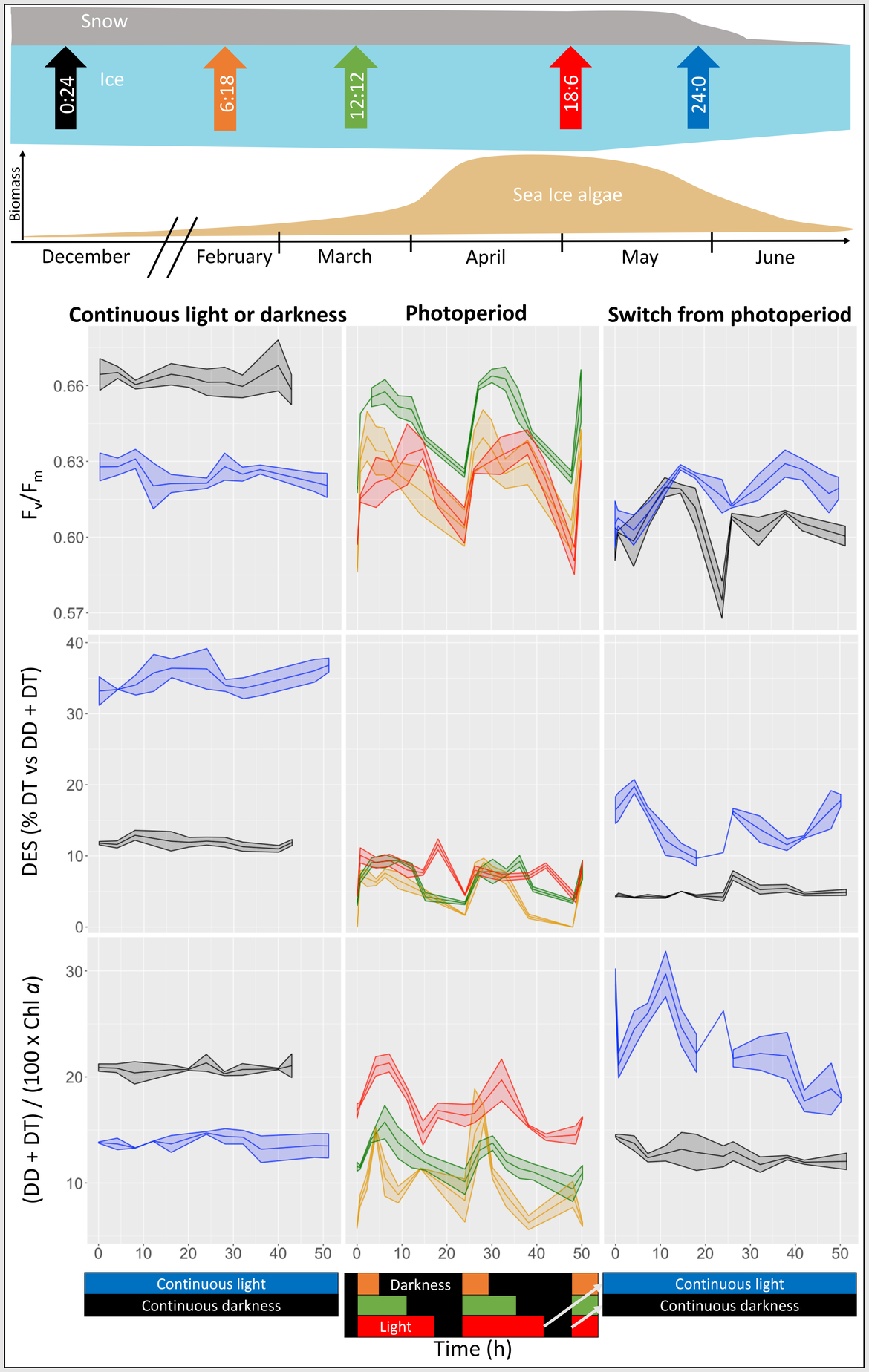
Context

The impact of photoperiod on the regulation of photophysiological processes of unicellular eukaryotic algae is largely unknown. Arctic diatoms experience large seasonal changes in photoperiod which make them relevant model to study the circadian rhythmicity of photophysiological processes.

The aim of this study is to characterize the rhythmic response of the cold-adapted species *Fragilariopsis cylindrus* (CCMP 3323) to representative seasonal photoperiods observed at 67° N.

Materials and Methods

- Experiments were conducted in bioreactors at 0° C and irradiance of 30 µmol photons m^{-2} s^{-1}.
- Cells were acclimated for three weeks with light:dark photoperiods of 0:24 (middle/end of December), 6:18 (early February), 12:12 (end of March), 18:6 (early May) and 24:0 (end of May).
- Diatoms were switched from light:dark photoperiod (18:6) to either complete darkness (0:24) or continuous light (24:0).
- After acclimation, the photophysiological response was monitored for 56 h:
  -Quantum yield of photochemistry (F_v/F_m, PAM-Fluorimeter).
  -Xanthophyll pigments (Diadinoxanthin, DD and Diatoxanthin, DT) use to estimate photoprotection (DES , de-epoxidation state (%) of DD into DT) and photoprotective capacities (DD + DT).



Results

- No clear rhythmicity observed without alternation of light and dark phases.
- Regular oscillation and synchronization between photoprotection and F_v/F_m rhythmicity were shown under different photoperiods.
- Following the switch from light:dark photoperiod (18:6) to continuous light, photophysiological parameters sustained their oscillation.
- After the switch from light:dark photoperiod (18:6) to continuous darkness only F_v/F_m oscillation was kept during the first 24 hours.

Conclusions

- Our results suggest that some photophysiological properties of *F.cylindrus*, have a strong circadian rhythmicity.
- The observed photophysiological rhythmicity could to depend on an endogenous regulation.
- *F. cylindrus* shows extraordinary photoacclimation abilities allowing it to grow under the extreme Arctic seasonal light conditions.

What's next?

To better understand the photophysiological rhythmicity, we need to additionally integrate:

- the effect of the light spectrum;
- the effect of the light intensity.