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Title: *Diurnal cycles in photochemical activity of polar algae and cyanobacteria*

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Despite continuous light during polar summer, the input of solar irradiance at midnight is approximately 1/4th of the mid-day value on summer solstice and the difference between the midday and midnight values increases toward equinox. Thus, diurnal cycles of photosynthetic activity should occur, and hence of carbon fixation, should influence estimation of productivity of polar ecosystems.

Diurnal rhythms of photosynthesis were studied in colonies of cyanobacterium *Nostoc commune* and seepage biofilms of green alga *Zygnema* sp. at Czech polar station in Petuniabukta, Svalbard, during polar summer. The diurnal cycles were investigated using variable chlorophyll fluorescence methods. Maximum quantum yield (F_V/F_M) was measured and parameters of rapid light curves (RLC), i.e. maximum electron transfer rate ($rETR_{max}$), photochemical efficiency (α) and saturation irradiance (E_k), were estimated every 4 hrs, together with environmental conditions (temperature, PAR and UVR). Two days with different light regimes - sunny and cloudy days - were evaluated.

In *N. commune*, the F_V/F_M, $rETR_{max}$ and α were lower in higher irradiances on both days and this decrease was deeper on sunny day. The E_k was slightly rose in higher irradiances, however its increase was delayed for 4 hrs on sunny day. The RLC indicated strong photoinhibition at irradiances above 200 - 300 µmol m^{-2} s^{-1}, so the colonies seem to be adapted to very low irradiances.

In *Zygnema* sp. biofilm, the F_V/F_M was also lower at higher irradiances. The $rETR_{max}$ was slightly increased on both days. α and E_k remained stable on cloudy day, however α slightly decreased and E_k slightly increased at higher irradiances on sunny day. The RLC showed photoinhibition at higher irradiances than *Nostoc*, so *Zygnema* biofilm seems to tolerate even increased irradiances and only minor irradiance stress was observed even on sunny day.

The different response of the photochemical processes in *Nostoc* and *Zygnema* could reflect different structure of photosynthetic apparatus in cyanobacteria and green algae. However, the response could be also connected with different survival strategies of both studied microorganisms. The *Nostoc* colonies overwinter in polar tundra and should be able to photosynthetize even at very low irradiances in early spring or late autumn, when water is more available. On the other hand, *Zygnema*

survives winter in form of hypnozygotes (unicellular dormant stages). During polar summer the alga must complete its life cycle and produce the hypnozygotes, so it must utilize maximum of available light energy for photosynthesis.