Vaucheria sp. – a xanthophycean alga from Svalbard intertidal zone. Year 2

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Introduction

The Arctic coastal zone represents extreme environment characterized by frequent disturbances in the system of temporal lagoons and channels. The microbial mats play important role in substrate colonization and stabilization of the sediment. *Vaucheria* sp. (Xanthophyceae) is the main component of the microbial carpet, and seems to be adapted well to such variable environment. In 2016, we performed initial study on *Vaucheria* sp. photosynthetic activity in a microcosm which revealed that the photosynthetically active irradiance (PAR) is the most important factor controlling the diel periodicity of the photosynthetic activity and suggested low-light adaptation in *Vaucheria* sp. (Kvíderová et Elster 2017).

During the summer season 2017, we focused on

- detailed characterization of the habitat
- collection of samples for molecular taxonomy analyses
- photosynthetic activity measurements *in situ* using variable chlorophyll measurements approach
- photosynthesis measurements *ex situ* using gasometrical approach

Material and Methods

The locality and experimental site is situated in the Adventdalen tidal flat, near the Czech Arctic Research Infrastructure in Longyearbyen (*see* Kvíderová et Elster 2017). The continuous climatic (PAR, air temperature) and microclimatic data in the tidal flat were recorded using Minikin dataloggers (EMS Brno, Czech Republic). Before photosynthesis measurements, temperature in the sample, irradiance and UV radiation were recorded.

The samples for habitat characterization were collected during summer 2017 (from August to September). A total of 3 transects encompassing a total of 11 sites were assayed and are represented on the map using QGIS (Map - Fig. 1). At each place water physico-chemical properties (pH, temperature, salinity) were registered extensively using a Low Range pH/Conductivity/TDS Tester in combination with a refractometer for salinity measurements.

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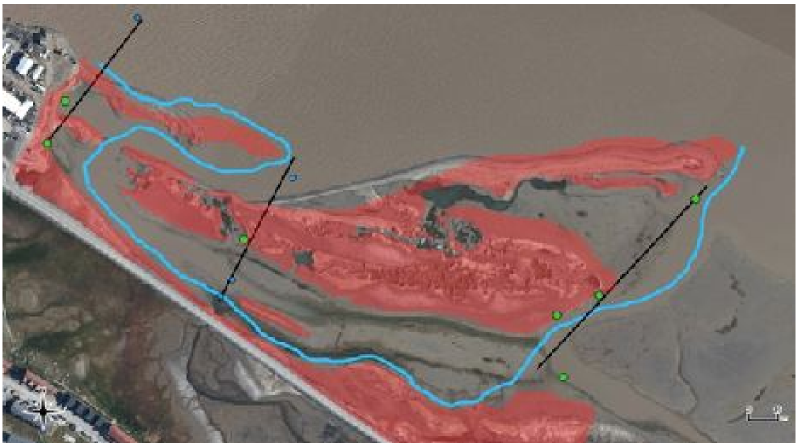

Fig. 1. Map. Sampling area with Transects I, II and III from left to right. Sampling sites along the transect are numbered from 1 to 3/4 from down to up. The red zone delimits the high tide front. In blue the low tide channel is represented. Sampling site in green refers to the presence of *Vaucheria* communities in the close surroundings.

The photosynthetic measurements were performed in the conditions of late Arctic summer from August 12 to August 31, 2017. The variable chlorophyll fluorescence was measured using hand-held FluorPen fluorometer (Photon Systems Instruments, Czech Republic) and the CO_2 assimilation using Gas Fluorescence System GFS-3000 (Walz, Germany).

Results and Discussion

At present, majority of samples is being processed and data are being evaluated. Therefore, only preliminary data are presented here. The air temperature and irradiance (Fig. 2) corresponded to late Artic summer in Svalbard (Kvíderová et Elster 2017, Láska et al. 2012). Contrary to previous season (Kvíderová et Elster 2017), the air temperature dropped below 0 °C.

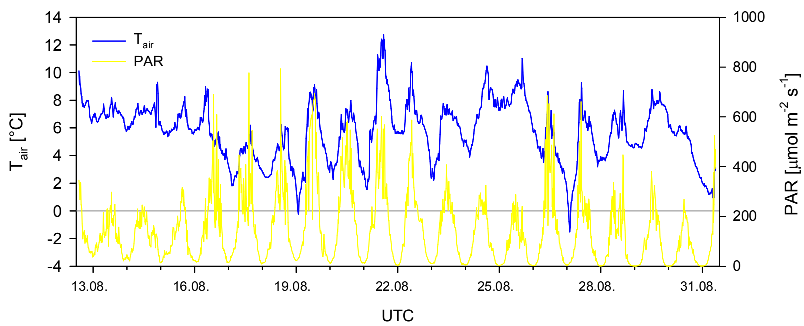

Fig. 2. The course of air temperature (T_{air}) and photosynthetically active radiation (PAR) during ecophysiological measurements in Svalbard.

The water physicochemical properties (pH, temperature, salinity) were registered extensively using a Low Range pH/Conductivity/TDS Tester in combination with a refractometer for salinity measurements is drawn in Table 1.

We performed a variety of experiments as to determine the nutrient supplies of these distinct habitats within this ecosystem both in the water and the sediment. A stress was laid on a specific set of nutrients which are assumed to have a strong influence on the microphytobenthos, namely: Nitrogen, Phosphorus, Silicate and Carbon.

	Mean Temperature (℃)	*Mean salinity (psu)*	*Mean pH at Low tide*	*Mean pH at High tide*	*depth of the permafrost active layer (cm)*
TI.1	6.15	26.00	7.29	7.18	+120
TI.2	5.9	28.00	7.26	7.06	56
TI.3	5.375	27.50	7.70	7.11	+120
TII.1	4.85	16.75	6.80	6.83	50,0
TII.2	5.7	23.50	6.82	6.83	60,0
TII.3	5.825	25.25	7.33	7.10	+120
TII.4	5.7	21.25	6.69	7.41	+120
TIII.1	5.875	18.25	7.59	7.29	+120
TIII.2	5.95	17.50	7.52	7.44	+120
TIII.3	5.7	17.50	7.52	7.39	+120
TIII.4	5.575	17.25	7.34	7.20	+120

Table 1. Physicochemical properties of water.

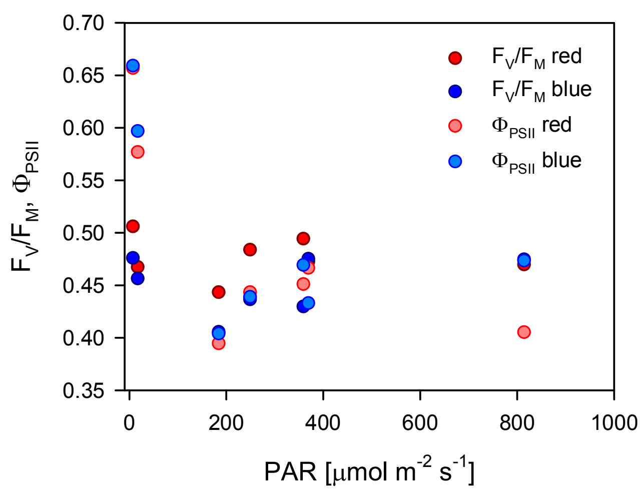

Fig. 3. The dependence of maximum quantum yield (F_V/F_M) and actual quantum yield (Φ_{PSII}) of *Vaucheria* sp. measured *in situ* on PAR measured by FluorPens with red or blue excitation light.

The changes in nutrient content could indicate *algal* adaptation to *nutrient* sources in the *sediment* rather than from the *nutrient*-limited *water especialy in this poor ecosystem.* We assume that nitrogen and phosphorus stocks greatly influenced algal growth.

In situ photosynthesis measurements using variable chlorophyll fluorescence approach indicated slightly increased quantum yields at the lowest irradiances (Fig. 3). The CO_2 assimilation measurements did not show any photoinhibition at PAR values around 500 µmol m^{-2} s^{-1}.

References

KVÍDEROVÁ, J., ELSTER, J. (2017): Photosynthetic activity of Arctic *Vaucheria* (Xanthophyceae) measured in microcosmos. *Czech Polar Reports*, 7(1): 52-61.

LÁSKA, K., WITOSZOVÁ, D. and PROŠEK, P. (2012): Weather pattern of the coastal zone of Petuniabukta, central Spitzbergen in the period 2008 – 2010. *Polish Polar Research*, 33(4): 297-318.