Res. Jr. of Agril. Sci. **11**(6): 1295-1299, Nov-Dec 2020

ISSN: 0976-1675

www.rjas.org

Research Journal of Agricultural Sciences

Research Paper

DI: 6265-1707-254

A Study on the Polar Ecosystem and Photoautotrophs

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Received: 17 July 2020; Revised accepted: 21 August 2020

ABSTRACT

Polar Regions show a condition of extreme freeze with mean summer temperature below zero. Arctic and Antarctic areas are Polar habitats. Tundra's are the most common in the Low Arctic, while in the High Arctic, polar barrens dominate. The distinct phototrophic populations at the glaciers indicate the possibility of darkening on the ice surface for spatially varying processes. The term photoautotroph is an autotrophic combination, the term for an organism producing its own food, and the photo prefix, which means "light" in English. The study is done on the purpose of finding out the polar ecosystem and the materials and methods part of this study is basically related with the samples gathered from the polar regions, both the samples of soil and ecosystem is gathered. The results indicate that mineral loading differed among the glaciers on the Polar Regions. The distinct phototrophic populations at the glaciers indicate the possibility of darkening on the ice surface for spatially varying processes. The evolving structures can monitor the delivery of en- or sub glacial debris to the surface of the Ice, as well as modulate the hydrology.

Key words: Polar region, Areas, Arctic, Plants, Ice, Land, Regions, Energy, Carbon, Food

Polar ecology is the connection of plants to animals in a polar climate. The Arctic and Antarctic areas are Polar habitats. Arctic regions are in the Northern Hemisphere, and it contains the surrounding land and the islands. Antarctica is in the Southern Hemisphere and covers the land area, nearby islands and the ocean as well. Polar areas also include the sub-Antarctic and subarctic zones dividing the polar from the temperate zones. In the polar circles lie the Antarctica and the Arctic. The polar circles on Earth are not visible but the areas receiving less sunlight due to less radiation are seen on maps as being. Here areas either receive sunlight or shade (polar night) 24 hours a day because of the earth's tilt. Plants and animals in the polar regions are able to withstand living in harsh weather conditions but are facing environmental threats that limit their survival.

Polar barrens and tundra are located on land surfaces which are not covered by permanent ice and snow at high latitudes. These are in the Arctic and the subarctic, as no land is ever free of snow and ice in the Antarctic. Tundra's are the most common in the Low Arctic, while in the High Arctic (Fig 3), polar barrens dominate. The Russian expression "tundra" comes from the Finnish word tunturi which means treeless heights. The tundra biome is fairly new, having its origin in the Pleistocene (2, 6 million to 11,700 years ago) Tundra flora developed from plants in the coniferous forests and alpine areas as continents during the Miocene (23 million to 5,3 million years ago) migrated into higher and cooler latitudes.

Fig 1 Polar Night

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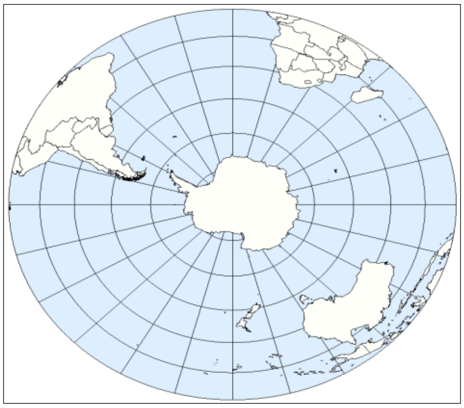

Fig 2 Southern Hemisphere

The term photoautotroph is an autotrophic combination, the term for an organism producing its own food, and the photo prefix, which means "light." The Polar Regions show a condition of extreme freeze with mean summer temperature below zero. Historically, however, they have been much cooler and this is reflected in plant paleo-biogeography. Throughout both plar areas, substantial rainforests existed at least from the cretaceous till the Miocene, when major global cooling existed. Afterwards, post-galacial recolonization occurred from multiple refuges that were abundant in the Arctic at least. A striking feature of contemporary polar landscapes is that vascular plants of high stature are largely absent from the Antarctic, and completely absent from it.

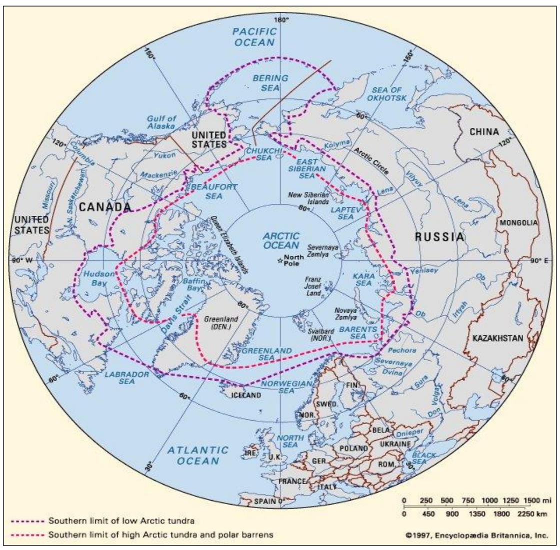

Fig 3 Arctic tundra 's Southern limit and rough line of demarcation between low and high arctic

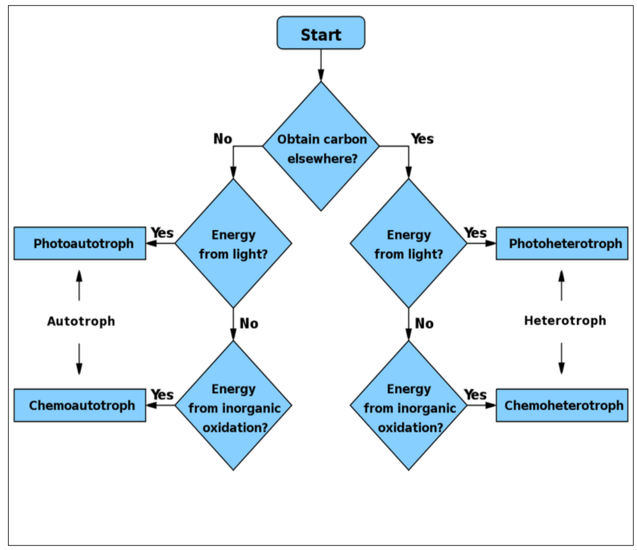

Fig 4 Flow chart to determine the type of species

Many of the well-recognized prototroph, also known as photoautotroph, are autotrophic and can address carbon. They can be exemplified with chemotrophs that get their energy through the oxidation of bundlers of electrons in their environment. Photoautotroph can synthesize their own food from inorganic compounds, using light as a source of energy. The photoautotrophs are green plants and photosynthetic bacteria. Photoautotrophic species are often alluded to as holophytic. These species derive their energy from light for food synthesis, and are able to use carbon dioxide as their primary source of carbon.

MATERIALS AND METHODS

Samples of this study were collected in July 2018 and February 2019 from Arctic Svalbard, Norway and Livingston Island, Antarctic Peninsula (polar region), respectively (Borchhardt *et al*. (2017a), Williams *et al*. (2017). According to the Köppen-Geiger classification method, both islands are in the polar tundra zone (Pereira *et al*. 2006, Vogel Eckerstorfer and Christiansen 2012). Details are given in (Table 1), while images of the analyzed BSCs and the corresponding sampling sites are shown in (Fig 1). The Lifeguard Soil Conservation Solution has maintained the nucleic acid content of the samples (MO BIO Laboratories, Carlsbad, CA, USA) as instructed by the manufacturer, and stored at −80°C.

Table 1 Location of the sampling data

Sample	Sampling location	Coordinates
BG	Breinosa Gruve 7, close to Longyearbyen, Svalbard, Norway	78.1485 N 16.04815 E
ED	Endalen, close to Longyearbyen, Svalbard, Norway	78.18634 N 15.761033 E
JC	Spanish Juan Carlos I Antarctic Base, Antarctic Peninsula	6206653889 S 60.39522 W
NA	Ny-Alesund, Svalbard, Norway	78.9233167 N 11.9245833 E
TD	Todalen, close to Longyearbyen, Svalbard, Norway	78.9233167 N 11.9245833 E

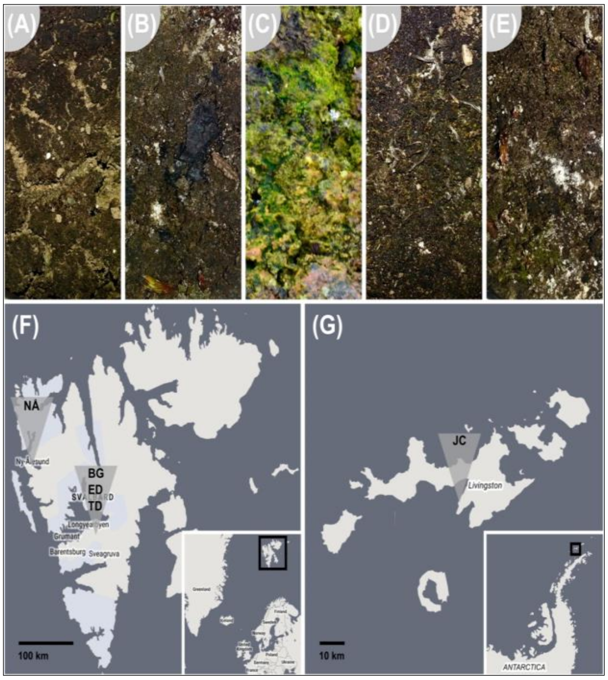

Fig 5 Samples and locations inside the polar region

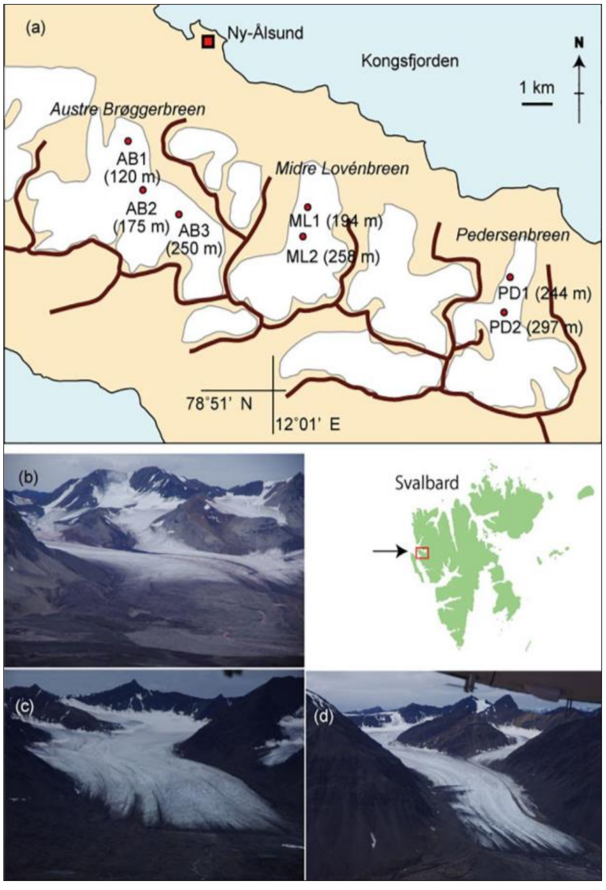

Fig 6 Map and images of glaciers (polar region)

In October 2018 the research was performed on three north-facing Arctic valley glaciers south of Kongsfjord, Svalbard: Austre Brøggerbreen, Midtre Lovénbreen, and Pedersenbreen, all accessed from Ny Alesund (78° 55N, 11° 56E, (Fig 1a–d). They are similar sized valley glaciers (almost 5 km^2), reaching from elevations of about 50–700 m a.s.l. Both glaciers display maximum degree of erosion from their Little Ice Age (LIA) around a century ago, with speeds of less than 10 m a−1. Geophysical research has shown that Austre Brøggerbreen is cold-based with ice thicknesses <100 m, while Midtre Lovénbreen and Pedersenbreen are polythermic, with temperate ice at its thickest Areas where the depth of ice reaches up to about 170 m. Both glaciers have areas of deposition of forms of rock in the Proterozoic basement, primarily mica schists, gneiss and migmatite. A ablation areas are surrounded by Proterozoic phyllite, and Carboniferous sandstones and shales and some conglomerates at the lowest ice elevations. When the field work was carried out, the snow line was situated above 400 m a.s.l. and the bare-ice region tended to be near to its height at the time of the test, as the air temperature at Ny Alesund normally is above 0°C from June to September.

To investigate phototroph network at each site of the polar region which is taken in this study, five examples of haphazardly chose surface ice were gathered with a disinfected tempered steel scoop (1–2 cm top to bottom). The gathered ice tests in this examination were taken from level removing exposed ice surfaces without discernible melt water stream and rivulets. Inspecting areas were picked to speak to the prevailing uncovered ice living space in the removal zone of the ice sheets, and abstained from testing of other microbial living spaces (e.g., cryoconite). Zones rich in cryoconite gaps, meltwater streams, and hills of cryoconite or trash were avoided from the testing procedure. The surface territory from which exposed ice tests were taken was estimated with an expected exactness of ±4 cm^2. The gathered ice tests were liquefied and protected as a 3% formalin v/v arrangement in clean 30 mL polyethylene bottles. The algal biomass of each site was spoken to by algal cell volume (biovolume) per unit zone (μL m^{-2}). Cell checks and estimations of cell volume were directed with an optical magnifying instrument (BH-51, Olympus, Japan). The examples were at first recolored with 0.5% erythrosine (0.1 mL was added to 3 mL of test) and ultrasonicated (20 and 100 kHz) for 5 min to release dregs particles. A volume of 50–1000 μL of the example water was gone through a hydrophilized PTFE layer channel (pore size 0.45 μm, Millipore FHLC01300), which got straightforward with water, and the quantity of cells on the channel was tallied. Filamentous cyan bacteria were checked each 50 μm of their fiber since their cells were too little to possibly be recognized with certainty. From the cell number and sifted test water volume, the cell (or unit fiber) focus (cells mL^{-1}) of the example was gotten. Mean cell volume got from standard mathematical properties was evaluated by estimating the size of 50–100 cells for each taxa utilizing minuscule photos with a picture preparing programming. The all-out phototroph biomass was assessed by adding values acquired by increasing cell focuses by the mean cell volume. This count was accomplished for every species at each site. Network structure was spoken to by the mean extent of every species in five examples to the all-out phototroph volume at each testing point. In light of the cell volume biomass, species assorted variety was determined utilizing Simpson's Diversity Index D:

$$D = \frac{1}{\sum_{i=1}^{s} P_i^2}$$

Where S is the total amount of species in the ecosystem, and where P*i* is the amount of the total algal biomass of the *i*th life forms.

RESULTS AND DISCUSSION

Analysis of the major soluble ions in ground sea water demonstrates that nutrients such as nitrogen and phosphorus were only trace levels at all platforms of the research. NO3− was detected only at site AB2 (0.01 µeq L−1) and NH4 + was identified only at site AB1 (0.4 µeq L−1) but both were close to the detection limit. The concentrations of Na^+ and Cl^- ions ranged from 0.3 to 21.9 µeq L−1 (mean: 8.4 µeq L−1), and from 0.5 to 30.4 µeq L−1 (mean: 11.8 µeq L−1), accordingly. (All things are elaborated in the figure below).

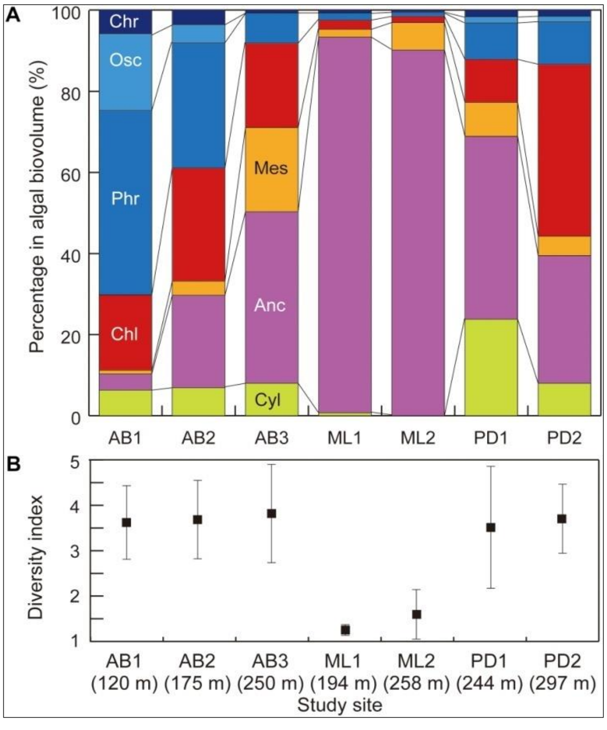

Fig 7 Variations of significant soluble ions in ice melt at Polar region research sites

Observation of phototrophs on the polar ecosystem

The seven photoautroph taxa were observed with a microscope on the surface of the glacier (Fig 8). They included green algae and cyan bacteria commonly found over the glaciers in the Arctic. Mesotaenium bregrenii and Ancylonema nordenskiöldii on glaciers across the Arctic regions are typical desmids algae. Cylindrocystis brébissonii has been found on Arctic ice and soil; Chlamydomonas nival is commonly found over the Arctic area as a clear reddish bloom on the snow sheet.

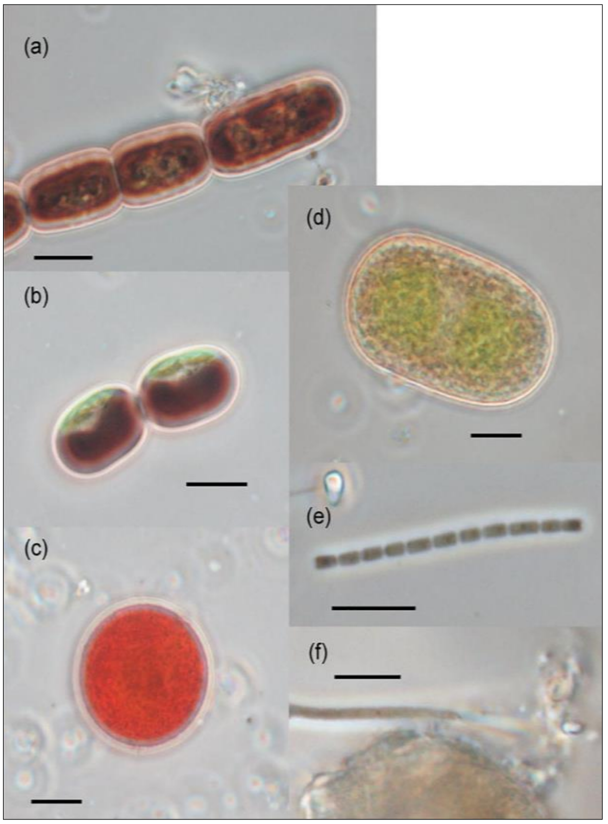

Fig 8 Photograph of phototroph

At least two cyan bacterial filamentous taxa were observed on the glaciers. It was a Cyan bacterium related to Oscillatoriaceae. This is possibly Phormidesmis priestleyi, the most common cyan bacterial in the cryoconite of Brøggerhalvøya and indeed throughout the Arctic region (e.g. Chrismas *et al*. 2016, Segawa *et al*. 2017). Oscillatoriaceae cyan bacterium was also another taxon, but has distinctive cell morphology (unclear sheath) from the P. priestleyi. Compared with P. priestleyi, the abundance of this taxon on the ice surface was generally smaller. They also found coccid cyan bacteria (Chroococcaceae).

Analysis shows that the phototrophic ecosystems among the polar regions studied were distinctive, given the similarity in their geographic environment. Although different surface habitats were present at each site, such as cryoconite holes, meltwater rills and streams, cryoconite or debris mounds, the sampling strategy aimed at generally flat, bare-ice mitigating potential contamination from these ecosystems. In addition, the phototrophs observed on the glaciers appeared to be the species that are widely distributed in the Arctic region, and thus the difference in their community is unlikely to be explained by the dispersal process for each species. Throughout this analysis, the number of sites per glacier was restricted, precluding the ability to describe heterogeneity in glacier-scale phototrophic communities.

Polar areas also include the sub-Antarctic and subarctic zones dividing the polar from the temperate zones. Tundra's are the most common in the Low Arctic, while in the High Arctic, polar barrens dominate. Areas either receive sunlight or shade 24 hours a day because of the earth's tilt. The term photoautotroph is an autotrophic combination, the term for an organism producing its own food, and the photo prefix, which means "light." The Polar Regions show a condition of extreme freeze with mean summer temperature below zero. The Russian expression "tundra" comes from the Finnish word tunturi which means treeless heights. The polar circles on Earth are not visible but the areas receiving less sunlight due to less radiation are seen on maps as being. The distinct phototrophic species on the polar ecosystems indicate the capacity for spatially varying processes of darkening on the ice sheet, so enhancing current understanding of the factors influencing the ablation surfaces in the phototrophic environment is important.

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