DOI: https:/doi.org/10.56981/P0000123
"Intl. J. P. Sci., vol. 01 no. 2, pp. 13-17" Ineternational Journal of Pure Sciences ISSN:2961-3159

"ENVIRONMENTAL MICROBIOLOGY"

Development of "Ice Algal Blooms" on the surface of "Greenland Ice Sheet" (Article review)

Kawther Mohammed Radah[1], Sara Saad Abdulameer[2]
[1,2] Directorate of Education in Holy Karbala, Iraq
E-mail: Haidermohamed561@gmail.com

(Received 10 June 2022, Revised 7 July 2022, Accepted 11 August 2022)

ABSTRACT

The supraglacial areas within continental areas, including areas of "Antarctica, Siberia, Alaska, The Himalayan range, and Greenland Ice Sheet", have the presence of microalgal blooms with enough capacity to affect both the physical and chemical surface of the environment. The researchers have chosen suitable methodologies to determine the nature of the microalgal blooms. The main aim of this study is to review an article on chosen topic Environmental Microbiology concerning the progress of "ice algal blooms" on surface area of the "Greenland Ice Sheet". "The Greenland Ice Sheet" is considered as the most extensive supraglacial areas in the world. The Southwestern area has the presence of algal blooms, and the research article has been reviewed by determining the methods that have been executed in order to understand the nature and growth of the "ice algal blooms" on the surface ice. The paper has reviewed results after conducting the research by incorporating scientific methodologies.

Citation:
Kawther Mohammed Radah, Sara Saad Abdulameer Environmental microbiology development of "ice algal blooms" on the surface of "greenland ice sheet". Intl. J. P. Sci. 2022;01(2):13-17. https:/doi.org/10.56981/P0000123

INTRODUCTION

The paper will deal with an article that has discussed the development of "ice algal blooms" on the surface ice of "***the Greenland Ice Sheet***". Methodologies that have been adopted by the researchers in order to determine the outcome of the ice algal blooms will be reviewed in this study. The review of the paper, along with the intended method and results that have been achieved, will finally be the main aim of the discussion. The paper will discuss references from other authors who have executed research on relevant topics. The source of the species of the ice algal blooms and the pigmentation caused by the "algal blooms" on the surface ice, which causes the darkening of the ice, will be discussed in the paper.

DISCUSSION

As per Williamson *et al*. (2018), it is very significant to determine the development of "***Zygnematophycean***", a microalgal bloom within the areas of supraglacial environments of Greenland Ice Sheet. It has been found that the microalgal blooms have enough potential to affect both physical and chemical surfaces in that environment. The researchers have chosen a suitable methodology to identify the main research problem. They have used the method of reporting by using a "space-for-time valuation" of a Greenland Ice Sheet "ice algal bloom". The method used in the project

is selection of an "~85 km transect" that spans the "South-Western" area of the "Greenland Ice Sheet", and it was executed in 2016 during the "ablation" season. The abundances of the cells ranged from the rate of "0 to 1.6 × 104 cells ml−1" along with "algal biomass" that is being verified to upsurge the surface's ice with period since the time of 'snow line retreat (R2 = 0.73, P < 0.05)'. Quantification of "light harvesting and photo-protective pigments" was done across transects [5]. The main aim of the study by the researchers is to determine the development of ice algal blossoms, and this research has been an important one in projecting the existence of bloom into the Greenland Ice Sheet area. Further, the researchers intended to understand and present their study on the emergence of the occurrence of bloom on the surface area of the "Greenland Ice Sheet" by making it an important study for future researchers. Microalgal residents found within the supraglacial environments include the areas of polar and higher altitude locations – ***Antarctica, Alaska, Siberia, The Himalayas, and the areas of Greenland Ice Sheet***. According to the article, the presence of "microalgal residents" was found in the 'Greenland Ice Sheet' during the second half of the 19th century. The blooms that have been found in this area are found within the higher scarce centimeters of surface ice when the liquid water, radiation that is active photosynthetically, and nutrient resources are accessible during the season of ablation [5]. As recollected from the article, it seems that the ice algal blooms influence the carbon and nutrient cycling with the locales in the supraglacial zones. The bacterial movement is closely related with "***cryoconite debris"*** [5]. The ice on the surface of the supraglacial areas dominated mostly by the ice algal blooms might fix much additional CO2 than "***cryoconite"*** because of its spatial extent. McCutcheon *et al*. (2021) have opined that the ice algae's blooms are responsible for lowering the ice-albedo and generating the melting of the ice surface, especially in the southwest sector of the 'Greenland Ice Sheet'. The ice algae are accountable for melting the surface region by 13%, so it has been difficult to observe the controls on bloom development. The authors have found a direct link between "mineral phosphorus" in the icy surface and glacier ice algae by making quantification of both "solid and liquid phase reservoirs of phosphorus" in the ablation zone of the Greenland Ice Sheet [2]. As per the research of Williamson *et al*. (2018), an occurrence of widespread algal blooms has been found in the surface ice of the southwestern region of the Greenland Ice Sheet. It has been found to be consistent along with heavy domination of the darker zone made by pigmented autotrophs. The article's main focus was to demonstrate the nature of the ice algal blooms by highlighting the potential for an increase in the "alga biomass", the darker pigmentation associated with it, and the potential for carbon fixation. The Greenland Ice Sheet that has been melting is well known to be the second largest body of glaciers in the world. It is also considered to be the "single largest cryospheric contributor to the eustatic sea level rise of the world". The surface of the Greenland Ice Sheet has been facing continuous loss, and the surface is melted by about 61%. The solid ice on the surface is discharged less and is controlled by the presence of albedo on the surface. When the declination of the surface albedo happens, the pigmented or the darker ice absorbs the increased amount of shortwave radiation responsible for much more surface melting. The surface of the ice becomes pigmented or darkened because of the deposition of mineral dust from "anthropogenic sources" and the "gathering of pigmented photoautotrophs". These are the materials that have light-absorbing impurities that help to darken the surface of the ice resulting in pigmented ice. As per Williamson *et al*. (2020), the reason behind the darkening and melting of the Greenland Ice Sheet is intertwined with the blooms within the surface ice that has been heavily pigmented. As per the data that the researchers have produced, it has been found that

the secondary phenolic pigmentation is letting the glacier algae allow the irradiance regime that has been found apparent within the area of the Greenland Ice Sheet. This helps provide sufficient shading to the "underlying chloroplasts" and adapted to low light (Williamson *et al*., 2020). The importance of studying the occurrence of ice algal blooms in the Greenland Ice Sheet is a highlighted approach. The Greenland Ice Sheet is considered one of the largest ice surface masses in the northern hemisphere. It has occupied an area of around 1.7 million km per square, and it is comprising of "11% of the cryosphere of the Earth", which is really great. Researchers have recently considered the Greenland Ice Sheet as one of the biomes present on the Earth. The area is dominated by numerous microbial communities which inhabit a range of surface "environments, and the areas include snow, solid ice, supraglacial water, and holes of cryoconite" which is focused on the ice algal taxa. The ice algal taxa have been derived from the class "***Zygnematophyceae***", and it has the ability to survive in environments covered with surface ice. The article mentions that the algae can form extensive blooms within the surface ice of the Greenland Ice Surface during the time period of ablation season in summer. As per Perini *et al*. (2019), the contribution of the fungal and bacterial communities has been left unconstrained.

Further, the researchers used suitable methodologies by applying a threshold to the daily band 2 (841–876 nm, R < 0.6). The methodology was applied during the first day of the ablation or melting season. During this period, each site where the sampling method was executed became free from snow and was identified by applying a 7-day rolling window. This method expected three days to be free from snow [5]. The locations that the researchers chose to execute the sampling procedure were across an area of ∼50 × 50 m upwind of the landing position for the helicopter. In this formal research, the sample was not given much importance, but it was executed to be representative of the individual surface site. Measurement of "spectral reflectance" was taken in advance of the disturbance of the surface by using a "Field Spec Pro 3 spectrometer" along with a "collimating lens". As per the data, it has been sound that the ice algal blooms in the Greenland Ice Sheet are dominated consistently by fewer specialist taxa, which are capable of survival and propagation in "cryo-environments". The algal lives are a specific species that is well known to bloom in environments that are packed with snow, like "***Chlamydomonas and Chloromonas spp"***. According to Hoham and Remias (2020), snow and glacial algae have been found in almost every continent, and the majority of the species live in the "***Chlamydomonadales"***. Other types of algae are found in different colored ice surfaces, and they have been considered to be an important part of the biosphere, carbon, and water cycles. The life cycle of the species living in the "***Chlamydomonas–Chloromonas"*** includes the movement of the "flagellates" in water and forms cysts that are resistant [1]. "***Cylindrocystis brebissonii"*** has been discovered in the study, an opportunistic species generally observed at the lower glacial locations. The study by Williamson *et al*. (2018) has also captured the dynamism within the algal loadings present in the surface ice of the Greenland Ice Sheet. The abundance of the alga cells helps to increase the extent of the cell volume, and it has also been captured that there has been a significant loss of algae cells from the surface of the environment within a short time. The mechanism included for removing the algae cells from the environmental surface includes mortality and subsequent loss. The paper has also demonstrated that fact rainfall or precipitation helps to reduce the abundance of algae in the ice on the surface. The Ice algal blooms are effective in increasing the melting of the surface of the Greenland Ice Sheet. As per Wang *et al.* (2018), it has been very difficult at the initial stage to track the development of the ice alga at the regional scale with frequent observations that are temporary. The

mass of the land and the surface ice has been melting, which has become the predominant procedure of the loss of the Ice Sheet. As recollected from recent studies, it has been found that there has been a significant reduction in the albedo of the surface, especially in the area of the South-West that is producing a dark zone every summer in the ablation period [4]. Across the samples, a suite of light harvesting and photoprotective pigments has been found, resembling green microalgae. The species include "***chlorophylls, xanthophylls, antheraxanthin, lutein, neoxanthin, violaxanthin, and zeaxanthin***". The article has also elaborated that the ice algal communities which drive net autotrophy on the environment of the surface ice. The paper has presented the potential importance of albedo in the surface and flux of carbon, and other authentic studies have presented the growth of algal blooms in supraglacial environments. The results of the paper include the nature of the ice algal bloom growth that has highlighted the growth of the increase in the biomass of algal ice. The result that has been achieved from the present study has an in-depth connection with the regulation of algal pigment, which is necessary to execute projections of the magnitude and impact made by ice algal blooms on the Greenland Ice Sheet.

CONCLUSION

After reviewing the whole article, it has been understood that the growth of the ice algal blooms in the surface ice has been positively determined in the research. The main aim of this study is to provide an article review on the development of ice algal blooms on the supraglacial surface of the Greenland Ice Sheet. The reporting method of space for time assessment has been carried out, which has been successful for the purpose of sampling the data in the surface ice. After the study, it has been found that the ice algal blooms have been spanning throughout the area of the GrIS. This study has reviewed the results that have been derived from the research and analyzed critically with authentic references. The source of the pigmentation of the ice surface in the period of ablation in summer, which is causing the melting of the ice, has been discussed in the paper.

REFERENCE

1. Hoham RW, Remias D. Snow and glacial algae: a review1. Journal of phycology. 2020 Apr;56(2):264-82. https://onlinelibrary.wiley.com/doi/pdfdirect/10.1111/jpy.12952
2. McCutcheon J, Lutz S, Williamson C, Cook JM, Tedstone AJ, Vanderstraeten A, Wilson SA, Stockdale A, Bonneville S, Anesio AM, Yallop ML. Mineral phosphorus drives glacier algal blooms on the Greenland Ice Sheet. Nature communications. 2021 Jan 25;12(1):1-1. https://www.nature.com/articles/s41467-020-20627-w
3. Perini L, Gostinčar C, Anesio AM, Williamson C, Tranter M, Gunde-Cimerman N. Darkening of the Greenland Ice Sheet: Fungal abundance and diversity are associated with an algal bloom. Frontiers in microbiology. 2019 Mar 21;10:557. https://www.frontiersin.org/articles/10.3389/fmicb.2019.00557/full
4. Wang S, Tedesco M, Xu M, Alexander PM. Mapping ice algal blooms in southwest Greenland from space. Geophysical Research Letters. 2018 Nov 16;45(21):11-779. https://agupubs.onlinelibrary.wiley.com/doi/pdfdirect/10.1029/2018GL080455
5. Williamson CJ, Anesio AM, Cook J, Tedstone A, Poniecka E, Holland A, Fagan D, Tranter M, Yallop ML. Ice algal bloom development on the surface of the Greenland Ice Sheet. FEMS microbiology ecology. 2018 Mar;94(3):fiy025. https://academic.oup.com/femsec/article/94/3/fiy025/4850643
6. Williamson CJ, Cook J, Tedstone A, Yallop M, McCutcheon J, Poniecka E, Campbell D, Irvine-Fynn T, McQuaid J, Tranter M, Perkins R. Algal photophysiology drives

darkening and melt of the Greenland Ice Sheet. Proceedings of the National Academy of Sciences. 2020 Mar 17;117(11):5694-705. https://www.pnas.org/doi/full/10.1073/pnas.1918412117