

Syllabus for research Project

„ Does water(ice) bloom in the Arctic?/ The influence of chosen factors on water bloom in the Arctic”

1. A short description of the project:

- 1) Research problem: Does water(ice) bloom in the Arctic?/ The influence of chosen factors on water bloom in the Arctic.
- 2) Hypothesis: Water bloom in the Arctic. Chosen factors do influence on water bloom in the Arctic.
- 3) The main aim of the project.
- 4) Detailed aims of the project.
- 5) Research methods.
- 6) Necessary equipment.
- 7) The presentation of the findings.

Phenomenon of the water bloom is common. It is caused by excessive amount of nutrients, positive light conditions and appropriate temperature. In these conditions algae - chiefly planktonic green algae, diatoms and cyanobacteria. In general this is not a positive phenomenon, because algae consume oxygen which leads to the dieback of aerobic organisms. While algae mass diebacking they fall on the tank's bottom and undergo decay (caused by oxygen shortages), tank taints by hydrogen sulfide.

The appearance of water blooms was observed in the Arctic too. Daylight permeates ice and lets algae grow properly on the bottom side of the ice cap. During polar day, which on the North Pole lasts from May, daylight reaches even several meters deep into the ice cap. Pace and density of water bloom probably depend on amount of the daylight reaching the tank. Every restriction of the daylight permeating caused by snow layer leads to retardation or even to cramp of the growing algae. Although organisms responsible for water blooms are usually single-celled algae, they are able to create huge clusters under the ice cap, which looks like "Algae sea".

Psychrophiles is a general term for organisms which are able to survive and grow in extremely low temperatures. Water(ice) bloom is possible in polar regions and such phenomenon is called "Watermelon snow". The main aim of my project is to observe and search this phenomenon.

The Arctic lies on the northern hemisphere, includes the North Pole, the Arctic Ocean along with islands and north parts of continents - North America, Europe and Asia. The Arctic area encompasses: Canada, the United States, Denmark (Greenland), Finland, Norway, Sweden, Russia, and Iceland. However the Arctic is an exclusive property of no state.

The Arctic climate is unfavourable for the life and the development of organisms. In the Arctic occurs a phenomenon of the polar day and the polar night. A major part of the Arctic soil is covered with the permafrost. The flora mainly consists of mosses and lichens. On the surface, deep inside and under the ice algae can live. In the Arctic prevail negative temperatures. Their value within the limits of the Arctic Circle can fall to even -60 °C, however the highest temperatures reach 5-10 °C. In the Arctic areas are located seasonal and all-year-round research stations of various countries. Polish research stations are concentrated on the Norwegian territory of Svalbard.

Svalbard lies on the Arctic Ocean, eastward from the Greenland coast, on western edge of the North European continental shelf. Svalbard encompasses a dozen islands, including the Spitsbergen archipelago, where Polish Arctic research stations are situated. To the purpose of the accomplishment of my project I would like to establish contact with Polish Polar Station of Stanisław Siedlecki in Hornsund.

1. Research problem: Does water(ice) bloom in the Arctic? The influence of chosen factors on water bloom in the Arctic.
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The organisms connected with the floating ice can be found in different parts of the ice. On the surface there are three types of habitats and groups of organisms connected with them:

- a) Infiltration zone- between snow and ice. Mostly is formed by diatoms.

Characteristic for the Antarctica.

- b) Ice sheet deformation zone- water can infiltrate and mass in this zone.
- c) Melting ponds- sometimes located under the snow layer. They appear in the Arctic, often covering parts of the ice cup. Besides the water from the melting ice they can feature the oceanic water.

Inside the ice cup many varied spaces can be found. They form as a result of the temperature and ice tension changes. Footwall ice layer is created by two zones, each connected with defined groups of organisms:

1. The interstitial water zone (doesn't exceed more than a few centimeters) is among crystals. The dominant organisms of the zone are diatoms, but there are other organisms like: flagellate, and among them- heliozoa, dinoflagellate, ciliate, nematoda, copepod, turbellaria, rotifer and larvas of polychaeta.
2. The plate-like ice zone, spaces in this zone are so sizable that apart from phytoplankton, there are even fish¹.

¹ Rita Horner, Stephen F. Ackley, Gerhard S. Dieckmann, Bjorn Gulliksen, Takao Hoshiai, Louis Legendre, Igor A. Melnikov, William S. Reeburgh, Michael Spindler, Cornelius W. Sullivan. *Ecology of sea ice biota*. „Polar Biology”. 12 (3–4), s. 417-427, wrzesień 1992. Springer.

3. The main aim of the project.

The arrangement if in the unfavourable environment water(ice) blooms. Does the water(ice) bloom occurring depend on the influence of the appointed biological and physical-chemical factors in the Arctic conditions? *The description of the influence of the appointed factors on the water bloom in the climatic conditions of the temperate zone.*

- ✓ The air and water temperature.

Is the factor which indirectly influences the intentionality and the bloom range. The species of the organisms which are responsible for formation of the water blooms are different from each other optimum temperature. Its value for particular species is measured by using the maximum effectivity of biosynthesis. General temperature range favourable for water blooms hovers from 15°C to 35°C².

- ✓ Insolation,

Has the prime influence on the water blooms. The dependence between the amount of the insolation and intensity of the water blooms was demonstrated³.

The higher amount of the insolation the faster and more effective water blooms. The reason of this phenomenon is that water blooms are mainly caused by phototroph organisms. That means in positive light conditions (high amount of the insolation) they are intensively photosynthesising.

- ✓ Wind speed,
- ✓ Content of the biogenic element,
- ✓ Water reaction,
- ✓ Content of the CO₂ and O₂ in the water tank,
- ✓ Humidity of the air,

The high humidity of the air supports the process of the eutrophication of the water (ice). What humidity level does support the ice blooms? What are the extreme values of the humidity of the air, by which organisms responsible for ice blooms in the Arctic conditions are able to grow? Experimental research is necessary in this field.

My task is to establish, whether in the Arctic such factors as the air and water temperature, insolation and the humidity of the air affect on the water(ice) blooms.

4. Detailed aims of the project.

² http://www.formatiocircumiectus.actapol.net/pub/7_1_25.pdf, s.12-13.

³ http://olbiol.ug.edu.pl/prace/2014/M_Lichy.pdf, s.4.

1) Determining when - in what months, water(ice) blooms appear.

2) Determining, what physical-chemical and biological factors can influence on water(ice) blooms.

Factors chosen by the author of this research are:

- the air and water temperature,
- insolation,
- the humidity of the air.

3) Determining, what organisms cause water(ice) blooms,

In water tanks of the moderate zone water blooms are mainly caused by protists and bacteria. Water blooms are particularly caused by algae (diatoms) and cyanobacteria.

4) Observing, whether ice blooms take place cyclically. Observing, what this cyclical nature is connected with.

5. Research methods.

All measurements will be done in surroundings and the place, in which the water(ice) bloom will be found.

1. Measurement of the humidity of the air,

Made twice a day, four times a week, for at least four weeks, in five different locations.

2. Measurement of the water temperature,

In case of the occurrence of the ice bloom drilling into the ice cup will be necessary. Made three times a day, five days a week, for the month, in five different locations.

3. Measurement of the air temperature,

Made five days a week, twice a day - in the morning and in the evening, during one month, in five different locations.

4. Measurement of the insolation,

Made for four weeks, every day, once within twenty-four hours, in the place, where the water bloom is found.

5. Field observation - searching for water (ice) blooms,

Made during the warmest month within the range of 20 km from the research station.

6. Taking samples and microscope analysis,

After making the preparatory analysis consultation with experts who examine found taxonomic groups will be necessary, in order to determine the species of the found organism materials.

6. Necessary equipment.

- light microscope,
- electron microscope,
- thermometer,
- hygrometer,
- heliograph,
- computer.

7. The presentation of the findings.

After examining chosen factors, making observation and measurements collected data will be put in the presentation. Measured data will be collected in the form of tables, and I will describe established relations and other findings on graphs. Appearance of the water blooms will be substantiated photographically.



Water(ice) blooms at the Malta Lake in Poznań

Aleksandra Sobańska