GLOBE Regional Learning Expedition 2022

Connection between peat and plants

Team Rats

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1. Abstract

Peat is the surface organic layer of a soil that consists of partially decomposed organic matter, derived mostly from plant material, which has accumulated under conditions of waterlogging, oxygen deficiency, high acidity and nutrient deficiency. (International Peatland Society)

Our team was interested in the effects of low oxygen and nutrient levels to the plants in the peatland locations near Käsmu. We also wanted to see how different heights and water logging affect the vegetation on divergent locations.

We had 3 different hypotheses which were:

1. More pines grow in wetter peatlands.
2. Plants that tolerate water-logging, grow on deeper peat.
3. Plants that tolerate a low level of nutrients grow on deeper peat.

To analyze peatland, plants and other mentioned things, for our research, we used a variety of tools and data sheets. The parameters we analyzed were; the height of each horizon and its color and moisture. We also tested pH, oxygen levels, free carbonates, nutrients (Ca, Mg and P), plant species, cloud cover and canopy cover.

The results showed that first and third hypotheses were not supported. That being said, the first hypothesis was not supported because pines grow equally in all four sites and the last hypothesis was not supported because the sites have similarly low amounts of nutrients and a similar share of plants that tolerate a low level of nutrients. While the second hypothesis was supported because in the sites number 2 and 3, where we recorded deeper peat, we also saw more plants that tolerate water-logged conditions.

For future research and projects we would like to take a closer look at the nutrients that help or hinder plants to grow in different areas and locations.

2. Introduction

2.1. What is peat?

Peat is the surface organic layer of a soil that consists of partially decomposed organic matter, derived mostly from plant material, which has accumulated under conditions of waterlogging, oxygen deficiency, high acidity and nutrient deficiency (International Peatland Society, 2017). It is important to our planet for a lot of reasons such as carbon storage (peat holds more carbon than the forests of Britain, France and Germany combined), great habitat for wildlife (many scarce species inhabit peatlands), water management as well as archaeology. (National Trust) Nowadays and for the past centuries peatlands are at huge risk because of human action. They are either drained to make way for fertile pasture and cropland, or they are destroyed by the extraction of peat, which is used as a source of energy. The problem is that when peatlands are drained, their peat is exposed to air and releases its carbon in the form of CO_2 20 times faster than it was sequestered. (World Economic Forum, 2020)

2.2. The purpose of our research

We wanted to see the connection between peat and plants that grow in the conditions that peat provides, such as low levels of oxygen and nutrients, waterlogging, etc. But most importantly now when we analyze plants that manage to tolerate these conditions and the percentage of them in different locations, in the future we can see how human actions really affect the vegetation and properties of peatlands throughout the years. Also we wanted to spread awareness of the risk of peatlands and teach people how to protect them.

2.3. Research questions and hypotheses

Since there is always bio-diversity between locations and different sites we wondered if the height and moisture of the peat has anything to do with growing pines. We also questioned ourselves on the properties which plants, who tolerate water-logging, need; that is we wondered if they need deeper peat or not and how does that affect them, as well as how do plants that tolerate low-level of nutrients live and what do they need.
Based on those questions and interest we set three hypotheses which were:

1. More pines grow in wetter peatlands.
2. Plants that tolerate water-logging grow on deeper peat.
3. Plants that tolerate a low level of nutrients grow on deeper peat.

3. Research locations

We studied four locations near Käsmu village (Figure 1. and Figure 2)(Google Maps, 2022).
First site (Figure 3) was located almost in the entrance of the woods, while sites 2 (Figure 4) and 3 (Figure 5) were located in the deep woods. The fourth site was located away from other sites which gave us much more diversity in our locations.

Figure 1. Location of Käsmu village in Estonia, source: Google Maps

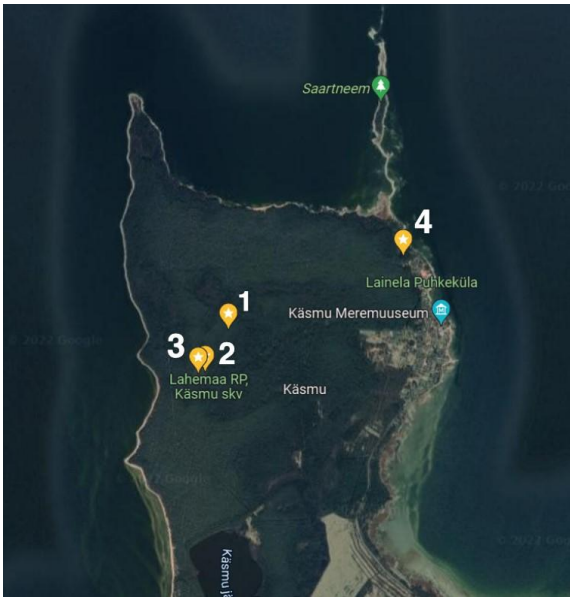

Figure 2. Map of research and sampling sites.

Figure 3. Picture of site 1

Figure 4. Picture of site 2

Figure 5. Picture of site 3

Figure 6. Picture of site 4

4. Materials and methods

The work on the sites took place during the expedition on August 3rd, 2022 from 2PM to 7PM (EEST, GMT+2).

Some measurements such as analyzing horizons, amount of dissolved oxygen (O_2) and free carbonates (mostly MgCO 3 and CaCO 3), cloud and canopy cover and moisture, we did at every site with the help of the following tools and data sheets: GLOBE soil data sheet, Russian-type peat corer, measuring tape for soil profile, a ProCheck hand held soil moisture device by Decagon, and a Fibox 4 hand held soil O_2 sensor.

As for vegetation identification we collected samples of every species we could find and later we identified them at the campsite with the help of Google Lens for species identification, *Taimenimed.ut.ee* database for scientific plant names and the “Taimede välimääraja” plant identifier book for tolerance of plant species.

The nutrient level of each soil sample that we collected doing fieldwork was analyzed using a portable x-ray fluorescence device. Specifically we used it for soil calcium (Ca), magnesium (Mg) and phosphorus (P) contents. After analyzing the data, we entered the collected data to the database at the globe.gov website. (Figure 7)

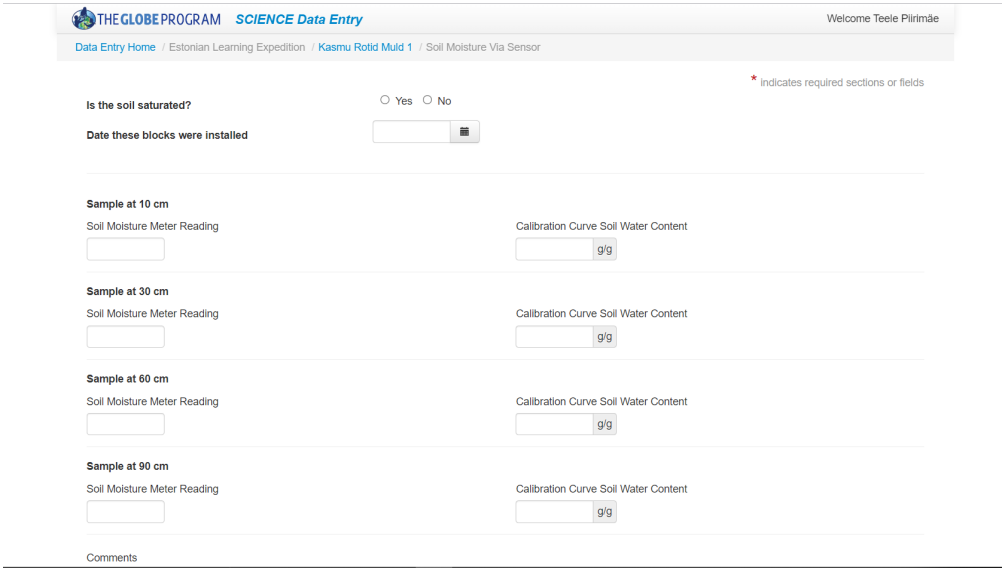

Figure 7. Screenshot of database at the website https://globe.gov/

5. Results

We gathered the collected data into tables for a better overview. In this section, the results of the fieldwork will be presented for each research location, followed by a comparison of the results. Table 1 shows measurements made at each sampling site.

Table 1. Results of analyzed samples from the sampling sites.

Analyzed parameter	**Unit**	Sampling Site 1	Semping Site 2	Sempling Site 3	Sempling Site 4
Peat depth	cm	50	71	71	18
Moisture	none	0.1444	0.4144	0.387	0.14
Oxygen	%	95.5	77	85	95
Ca(Calcium)	%	0.328	0.111	0.131	0.167
P(Phosphorus)	%	0.081	0.043	0.059	0.07
Mg(Magnesium)	%	1.792	1.916	1.535	1.213

We made a diagram with every species we could find on sampling sites and calculated the percentages of appearances at each site (Figure 8).

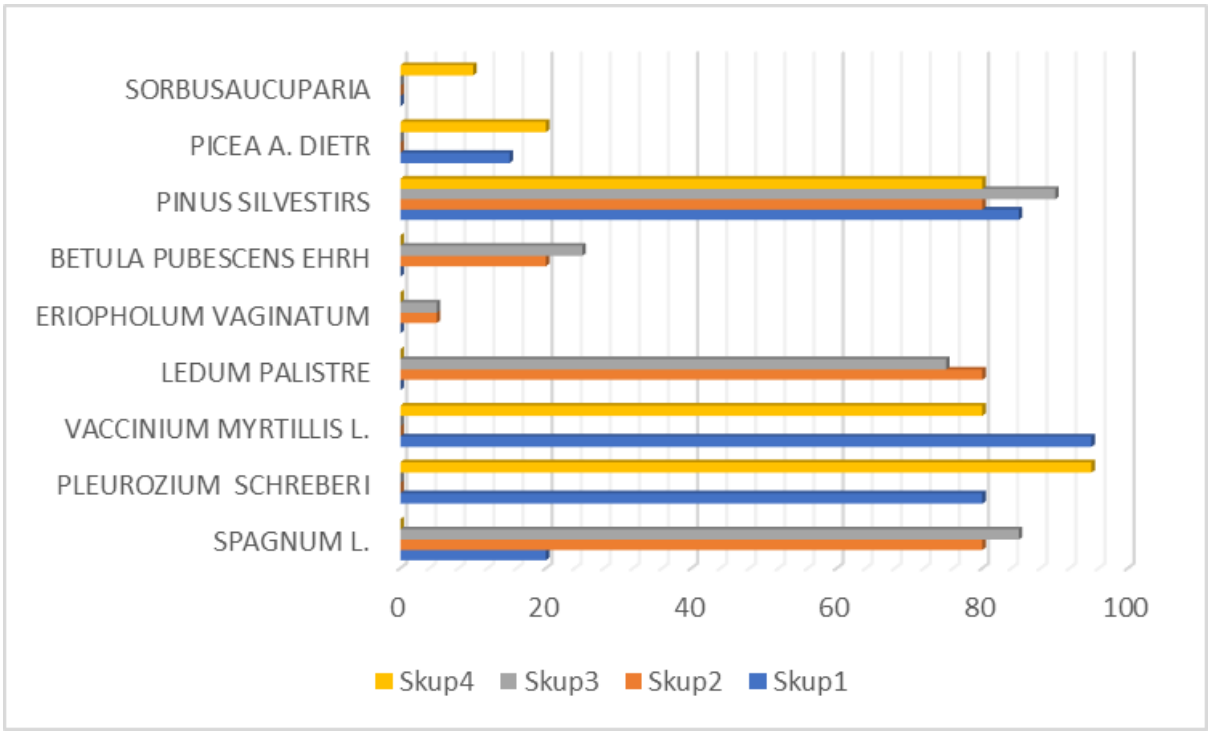

Figure 8. Percentages of appearances of plant species for each site. Color-coding: Blue - site 1, orange - site 2, grey - site 3, yellow - site 4.

Based on peat depth we analyzed the percentage of wetness tolerant plants and nutrient poverty tolerant plants (Figures 9 and 10). The percentage of wetness tolerant plants is higher in deeper peat, while the percentage of nutrient poverty tolerant plants is the same no matter the peat depth.

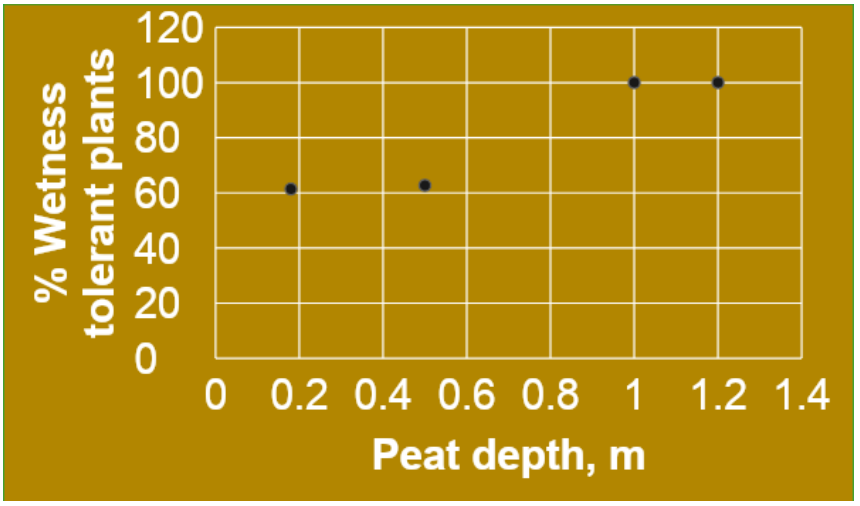

Figure 9. Percentage of wetness tolerant plants based of peat depth

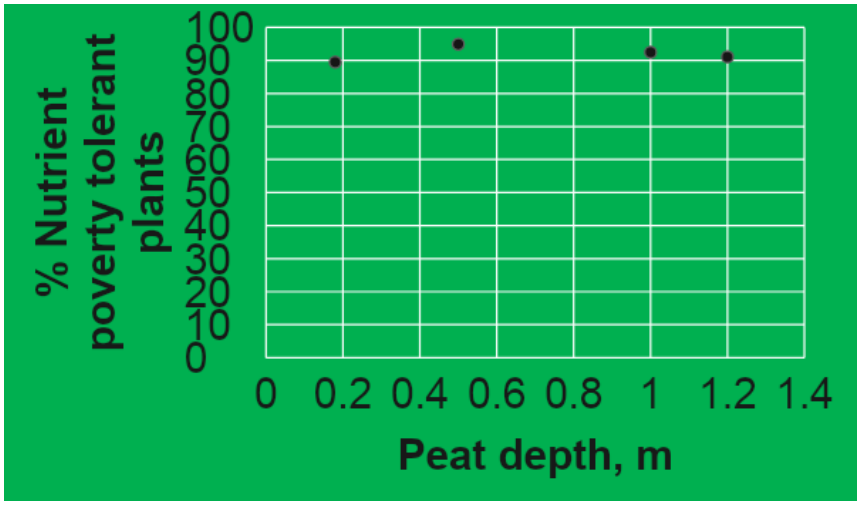

Figure 10. Percentage of nutrient poverty tolerant plants based on peat depth.

6. Discussion and conclusions

After the research, we could see that plants are quite different in the peatlands of Käsmu. Peat depth was higher in sites 2 and 3 (71cm) than in sites 1 and 3 (51cm and 18cm) which is possibly related to the higher moisture and lower oxygen content. But as for nutrients we can only see a slight difference between all 4 sites but nothing drastic. Only interesting part for the nutrients is that for magnesium we have the highest recording in site 2 which was not expected.

As for plants, we can see that pines grow the same in all four sites no matter the differences, and that wetness tolerant plants prefer deeper peat. As for nutrient-poverty tolerant plants we can say that “they do not care” about peat depth and they can survive on any peat depth.

Based on our discussion and analysis we came to some conclusions. Hypotheses 1 was not supported because pines grow almost equally in all 4 sites no matter the moisture in them. The second hypothesis was supported because in the sites with deeper peat (sites 2 and 3) we recorded a bigger percentage of plants that tolerate water-logging conditions. Even though the third hypothesis is not supported because the sites have similarly low amounts of nutrients and share of plants that tolerate a low level of nutrients, we would like to take a closer look at nutrients of the soil in the future.

Based on soil type we can see what type of soil succeeds in some area. Our research can help in developing local agriculture. Also, we saw that peat is a soil type which can contain a lot of water so it would be great to use peat in urban green areas.

7. Literature

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