GLOBE Estonia Learning Expedition

Relationship between mire peat and its plants

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Estonia
2021

Table of contents

Abstract

We were really interested in what species can grow in the mire, and if and how different soil indicators affect the plants and *vice versa*. We studied 6 research locations across different sites in the mire of Sammuli on the shore of Lake Viljandi. According to the research that we conducted, the bog peat pH did not depend on the plant species present there. Considering the plant species themselves, we found that if the environmental conditions in the mire are unfavourable, more specialist plants grow that are more capable of surviving in the demanding environment. Where the environmental conditions are favourable there are many generalist plants because they have the necessary nutrients.

1. Introduction

Mires (natural peatlands) are ecologically very important because they absorb a great amount of precipitation and store enormous amounts of carbon in the peat. They are home to many species of plants and wildlife, some of which are exclusive to these environments. These species can be classified into generalists and specialists. Generalists are organisms with a wide ecological amplitude and who use a variety of resources. Specialists are organisms specialised on specific environmental conditions and resources (Masing, 1992).

Peatlands make up about 22% of the total area of Estonia. There are three types of mires. Firstly, the fen where the surface is lower than the surrounding areas, . Secondly, the transitional mire is the middle stage of bog development, and is almost at the same level as the surrounding areas. And lastly the raised bog where the surface is higher than the surrounding areas.

We were really interested in what species can grow in the mire, and if and how different soil indicators affect the plants and *vice versa*. Based on these interests we set our research questions.

Our research questions for our expedition were:

1. Does the mire pH depend on the plants growing there?
2. How does the soil affect plants in the mire?

Our hypotheses were:

1. Bog peat pH depends on the plant species present in the mire.
2. In unfavourable environmental conditions, specialist plant species grow, whereas in favourable conditions, generalist plant species grow.

2. Research locations

We studied 6 research locations across different sites in the mire of Sammuli on the shore of Lake Viljandi (Figures 1 and 2). The first, third and fourth research locations were mires that were located ~20 meters away from the lake. The first research location was relatively dry and there were some trees that were about 2 meters high, and the most common plant species at the first location were different sedges. The second location was on the shore of the lake, it was very wet and quaking. There were no trees and the most common plant species were various aquatic plants. The third location was similar to the first one but it was closer to the woods and the most common plant species were sedges. The fourth research location was closer to the shore than the last two but was still relatively dry. There were a lot of bushes. The fifth location was a ridge between former peat extraction pits, canopy coverage was high and the most common plant species was picea abies. The sixth location was a former peat extraction pit, it was very wet, almost like a small pond and the most common plant species was *Calliergonella cuspidata*.

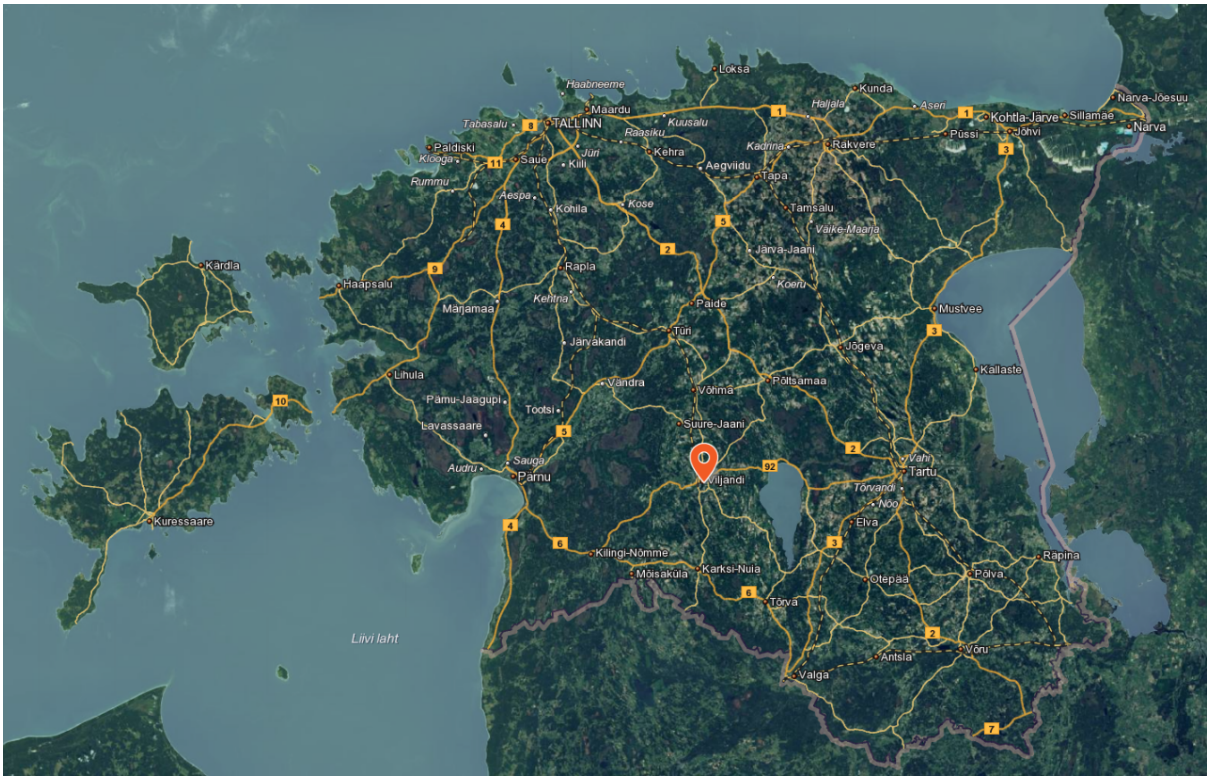

Figure 1. Lake Viljandi marked on the map of Estonia. Source: Estonian Land Board

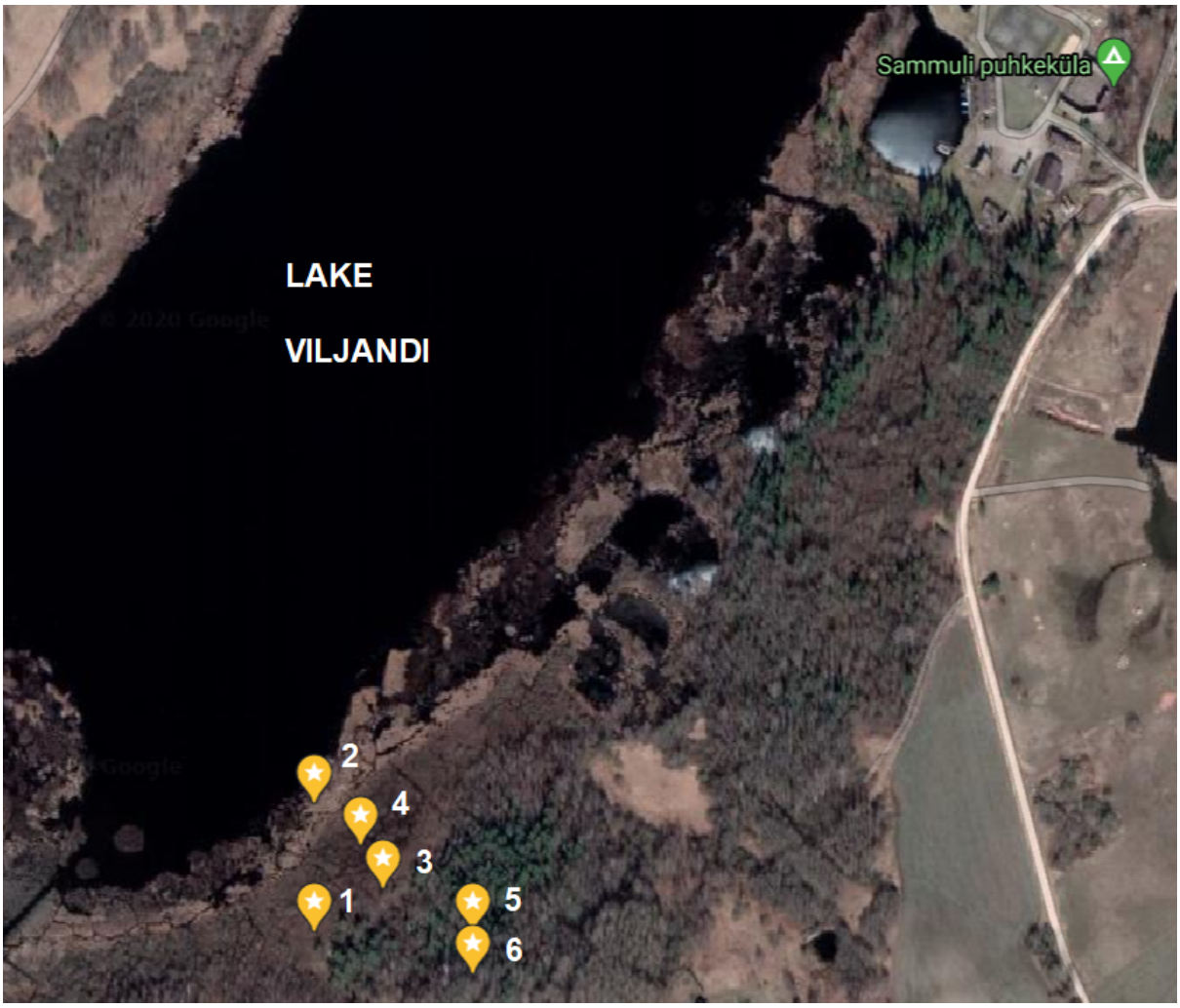

Figure 2. Map of research locations. Source of background aerial image: Google Maps

3. Methods

We did fieldwork at the research site on 12 August 2020 from 9:45 AM until 1:10 PM. At the research locations we collected different plant species and investigated the peat using a Russian-type corer. We identified all plant species in all locations using a field guide by Kukk (2020), Google Image Search and Google Lens. Across the peat cores we measured different soil characteristics using the Vernier LabQuest 2 and a tape measure - soil pH level, oxygen level, electric conductivity and water level.

Figure 3. Identifying plants from the research location 1. Photo by: Ekaterina Likhacheva.

Figure 4. Measuring the pH level of the peat water. Photo by: Ekaterina Likhacheva.

We divided the identified plant species into generalists (wide habitat) and specialists (narrow habitat) by using a field guide by Kukk (2020). We associated plant species with soil characteristics.

4. 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 the soils indicators collected from each location. The indicators in research locations 1-5 were similar and pretty generic. The fifth research location had a bit higher oxygen level. The sixth research location was the most different from others, it had much lower pH and the water level was very high. Soil pH was the highest at location 2 (7,2) and the lowest at location 6 (5). The oxygen level was highest at location 6 (5,6 mg/l) and the lowest in research location 1 (0,9 mg/l). Electric conductivity was the highest at location 3 (296 microS/cm) and the lowest at location 6 (267 microS/cm). The water level was the highest in research location 6 (100 cm) and the lowest in location 5 (-96 cm).

Table 1. Measured soil indicators from the research locations.

research location	**1**	**2**	**3**	**4**	**5**	**6**
pH	6,45	7,2	6,4	6,25	6,87	5
oxygen, mg/l	0,9	1,9	1	1,2	4,7	5,6
electric conductivity, microS/cm	272	285	296	288	291	267
water level, cm	-2,5	3	-2,5	-3	-96	100

Table 2 shows in which research locations given plant species were found and how big was the cover percentage in layer. Table also shows whether the plant is a generalist or a specialist. Generalists are plants that are able to thrive in a wide variety of environmental conditions and specialists are plants that can thrive only in a narrow range of environmental conditions. The research location with the most variety in plant species was research location 2. Research location 2 was also where the total plant coverage was the highest.

Table 2. Identified plants from research locations and the cover percentage.

Estonian name	**cover percentage in layer, fraction of 1**						**generalist (g) or specialist (s)**	**scientific plant name**
research location	**1**	**2**	**3**	**4**	**5**	**6**		
harilik kalmus		0,01					s	Acorus calamus

koeraputk	0,05		0,05	0,05			g	Aethusa cynapium
vaevakask	0,1						s	Betula nana
arukask					0,35		g	Betula pendula
sookask	0,05						s	Betula pubescens
soovõhk		0,4					s	Calla palustris
harilik teravtipp		1				1	s	Calliergonella cuspidata
hirsstarn	0,05		0,2	0,5			s	Carex panicea
kraavtarn		0,4					s	Carex pseudocyperus
nokktarn		0,2					s	Carex rhynchophysa
laiuv sõnajalg					0,05		g	Dryopteris expansa
soo-pajulill		0,3					s	Epilobium palustre
metsosi					0,1		g	Equisetum syvaticum
harilik angervaks	0,05						s	Filipendula ulmaria
paakspuu	0,02	0,01			0,05		g	Frangula alnus
harilik kadakas					0,01		s	Juniperus
äiatar	0,01	0,05		0,01			s	Knautia arvensis
harilik parkhein		0,03					g	Lycopus europaeus
ussilill				0,01			s	Lysimachia thyrsiflora
ubaleht	0,3		0,05	0,2			s	Menyanthes trifoliata
käpaline 1		0,01					s	Orchidea 1
käpaline 2		0,01					s	Orchidea 2
harilik kuusk					0,6		g	Picea abies
harilik palusammal	0,95				0,6		g	Pleurozium schreberi
soopihl	0,05						s	Potentilla palustris
harilik tamm					0,01		g	Quercus robur

roomav tulikas	0,01			0,01	0,01		s	Ranunculus repens
tuhkurpaju					0,05		g	Salix cinerea
kahevärviline paju	0,35						g	Salix phylicifolia
hundipaju	0,2		0,05	0,15			s	Salix rosmarinifolia
skorpionsammal				1			s	Scorpidium scorpioides
pihlakas					0,05		g	Sorbus
väikeseviljaline jõgitakjas		0,01					s	Sparganium erectum subsp. Microcarpum
põlu-jõgitakjas		0,01					s	Sparganium erectum subsp. Neglectum
ahtalehine hundinui		0,1					s	Typha angustifolia

We identified location 1 as a transitional mire. The most common plant species were *Pleurozium schreberi* and *Salix phylicifolia*. Location 2 was a quagmire and the most common plant species were *Salix phylicifolia* and *Carex pseudocyperus*. Location 3 was a transitional mire and the most common plant species was *Carex panicea*. Location 4 was a transitional mire and the most common plant species were *Carex panicea* and *Scorpidium scorpioides*. Location 5 was a drained peatland forest with *Pleurozium schreberi* and *Picea abies* as the most common plant species. Location 6 was a eutrophic pond with *Calliergonella cuspidata* as the most common plant species.

5. Discussion

Hypothesis 1 (Bog peat pH depends on the plant species present in the mire.) was not supported. In all research locations the peat pH was between 5.0 and 7.2 while the peat was made of similar plants - mosses and sedges. The bog pH does not depend on the plants present in the bog.

The bog pH can depend on the groundwater, which was the same in all research locations. This statement is also supported by the slightly acid (5.0) pH in the fifth research location, since there the groundwater was at the greatest depth (–96cm) and thus furthest away from the measured soil.

Hypothesis 2 (In unfavourable environmental conditions, specialist plant species grow, whereas in favourable conditions, generalist plant species grow.) was supported. In research location 5, the indicators were generic - pH close to neutral, the water level was -96 cm and the oxygen level in the water was high. The plants that grew there were generalists dominated by *Picea abies* and *Pleurozium schreberi*. Generalist plant species grow in favourable and generic conditions.

In unfavourable bog environments the oxygen levels were low (0.9-1.2 mg/L) and the water levels were close to the ground. The plants that grew there were specialists dominated by *Calliergonella cuspidata* and *Scorpidium scorpioides* mosses, *Calla palustris*, *Carex* sedges and *Salix rosmarinifolia* dwarf bushes.

6. Conclusion

According to the research that we conducted, the bog peat pH did not depend on the plant species present there. Considering the plant species themselves, we found that if the environmental conditions in the mire are unfavourable, more specialist plants grow that are more capable of surviving in the demanding environment. Where the environmental conditions are favourable there are many generalist plants because they have the necessary nutrients.

7. References

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