GLOBE Estonia Learning Expedition

Correspondence between two soil types on the soil map and in the nature in Käsmu

Liisa Loreena Värton, Julia Nechipor, Xenia Voronovich, Alina Baranova, Sofia Zimina, Ljubov Melnik, Ranet Viru, Mikk Mattias Mahla

Supervisors:

Elli Altin,

Aiki Jõgeva,

Rauno Einmann

Estonia

2023

Table of Contents

Abstract

Käsmu is located in Northern Estonia on the coast of the Gulf of Finland. The sea has affected the vegetation and soil. The purpose of our research was to investigate different soils around Käsmu village and control soil maps.

We posed 3 research questions:

- How do Käsmu's two soil types correspond to the map provided by the Estonian Land Board.
- How do these two soil types correspond to landforms?
- How do these two soil types correspond to vegetation?

In addition, we established 3 hypotheses based on the previous ones:

- Soil types in nature correspond to the soil map.
- Soil types correspond to landforms.
- Soil types correspond to vegetation.

We did the fieldwork in one day on August 3, 2022.

The course of work was checking the study area from the soil map. To do this, we identified two soil types on the map, searched for them according to surface pattern and vegetation cover, collected the necessary data, dug two holes, described the soil horizons and collected samples, analyzed the results and drew conclusions.

Based on the results, we concluded that the hypotheses are true.

Location description

Käsmu is a village located on the Käsmu Peninsula in Haljala municipality, Lääne-Virumaa, Northern Estonia (Figure 1). The soil and vegetation there have been affected by the sea.

In total, we dug two diggings, the locations of which we chose based on the soil map of the Maa-amet and the vegetation cover.

The first excavation site was located one kilometer southwest of Lainela resort (Figure 2, letter A). The excavation site was a local depression, slope 1-2 degrees.

The second excavation site was 1.2 kilometers away southwest from Lainela resort and the ground there was flat (Figure 2, letter B).

We conducted the survey on August 3, 2022.

Figure 1: Location of the research area in Estonia. Source: Google Maps. Käsmu

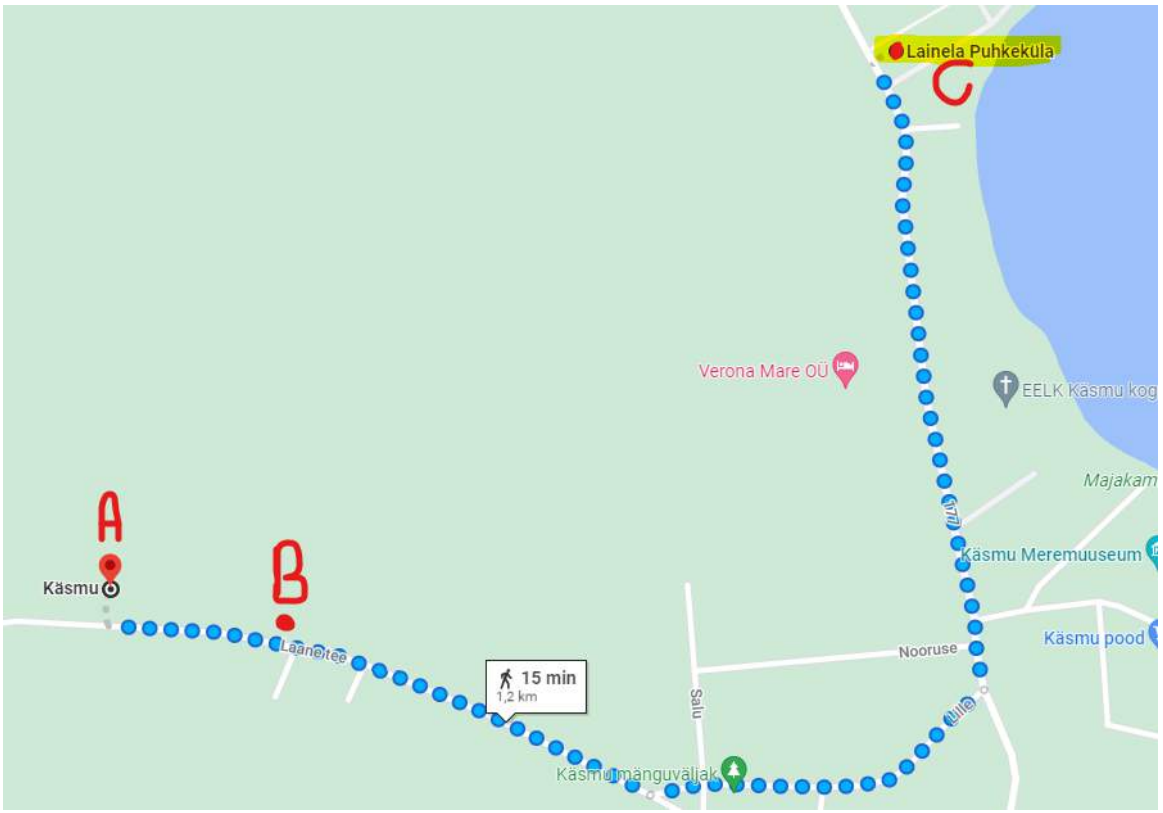

Figure 2: Excavations and Lainela resort (A-first digging, B: second digging, C- Lainela resort). Source: Google Maps. 59° 36' 14.3561" N 25° 54' 31.2538" E

Introduction and Review of Literature

The purpose of our study was to find out whether the Estonian Land Board soil map matches with nature. To do this, we had to identify two soil types on the map of the Estonian Land Board, find the selected soils in nature according to landforms and vegetation, and describe them. The Käsmu is located on the coastal plain of the Gulf of Finland, and the formation of the landscapes has been significantly influenced by the sea. The soils are dominated by podzolized soils and forest cover (Arold, 2005).

Since we found out where there should be some kind of soil on the map of the Estonian Land Board, we were able to find out where we should dig. However, in order to find suitable places for making excavations, it was necessary to identify the vegetation suitable for the soil based on the vegetation. Finding the right place, we were able to describe the location, vegetation and soil and draw conclusions.

Last year (in 2021), the Estonian GLOBE expedition took place in Pärnu county, Lääneranna municipality, Matsi village, Varemurru Puhkeküla, and a similar study was conducted there as well. Although their general topic was different from ours, they also compared the Estonian Land Board's map and nature. They got small differences in the results, which already showed that the ground is changing.

Now we were able to do a real survey on the other side of Estonia and check with the assumption of the Estonian Land Board`s soil map with the location of two soil types.

It is important to study the chosen topic, because that way we can find out how the ground and soil change over time. Since soil and vegetation are important components of the ecosystem, changes in them lead to changes in the entire ecosystem, including changes in biodiversity, water cycle and, through carbon sequestration, also in the climate. The change in soil and vegetation affects our daily lives, and for this purpose it is important that we know if the data is true.

Research Questions and Hypothesis

In order to collect the necessary data, we had to know what we wanted to know. Our team's goal was to find out whether two soil types correspond to the Map of the Estonian Land Board. Thanks to this, we were also able to set the goal of finding out how soil types correspond to landforms and vegetation. From there we got our three research questions:

1. How do two soil types in Käsmu correspond to the map provided by Maa-amet?
2. How do these two soil types correspond to surface forms?
3. How do these two soil types correspond to vegetation?

Once we had research questions, we also formulated hypotheses derived based on discussion:

1. The soil types in nature correspond to the soil map.
2. The soil types correspond to surface forms.
3. The soil types correspond to vegetation.

Our hypotheses were all connected, because if the soil types correspond to the soil map, it would be logical that the soil types also correspond to the landforms, and if they correspond to the landforms, they also logically correspond to the vegetation.

Our research questions and hypotheses are important because we know that data is changing and that species are constantly emerging or disappearing. If our two excavation sites, or diggings, had yielded a different result than what the soil map showed and we expected, we would have stated that the soil map is wrong and that the soil and vegetation have changed. From there, it would have been possible to start investigating the reasons for soil changes, and this is a large part of the GLOBE Program.

Research Methods and Materials

We followed methods set out by GLOBE soil protocol.

Soil pits (Data in Tables 1 and 2) dug on 3 August 2022.

1. Characterization of the soil horizons and collecting samples, measurements of slope
2. Measurements of soil temperature
3. Determining the MUC code and vegetation.
4. Analysing the samples (soil consistence, texture and structure, carbonates, pH

Equipment:

- clinometer
- compass
- smartphone GPS
- camera
- shovel
- scoop
- distilled water
- soil sample cups
- sticks for marking the horizons
- vinegar
- soil thermometer
- air thermometer
- pH meter
- tape measure
- 100 ml cup
- MUC code book

Results

Excavation A

Location A: Käsmu (59.6039851, 25.91087029) Date: 03.08.2022
Relief: local depression, slope 1-2°C, soil temperature: 16°C (5 cm), 13°C (10 cm)
Weather: sunny, 24 ^{0}C, Scattered - Cumulus, Cirrocumulus

MUC code for site 1 was 1123. Woodland, Mainly Evergreen, Needle-Leaved, Cylindrical Crowns Dominated by trees (more than 50% of the canopy) with crowns with very short branches and therefore a narrow cylindrical shape (e.g., Picea in the boreal regions)

Description: the ground is humid.
Vegetation: spruce, pine, rowan, willow, blueberry, ferns, peat moss, horsetail (Figures 3-8).

Figure 3. View from north.

Figure 4. View from east.

Figure 5. View from the south.

Figure 6. View from west.

Figure 7. View from upward.

Figure 8. View from downward.

Four different horizons: O – semi-decomposed, AT – crude humus, B – Illuviated, and C – bedrock. All horizons were wet, pH was over 5. The structure was blocky in the 1st, 2nd, 3rd horizons and structureless in the 4th horizon. The consistency was loose in the 1st, 2nd, 3rd horizons, and texture was sandy. Texture in the 4th horizon was gley. There were a few rocks only in the 3rd horizon. There were a few roots in the 1st and 2nd horizons, many in the 3rd horizon and none in the 4th horizon. No carbonates were present (Table 1).

Soil type of the site is Podzolized gley soil (Figure 9). Typical soils of boreal coniferous forests in cool humid climate but in wetter sites. Gleying occurs when stagnant water causes anaerobic conditions. It is the first stage of bog formation.

Table 1. Data of the 1. soil profile (A).

Horizon number and designation	1. O	2. AT	3. B	4. C
Top Depth (cm)	0	3	35	43
Bottom Depth (cm)	3	35	43	60
Thickness (cm)	3	32	8	17
Moisture	wet	wet	wet	wet
pH	-	5	5,3	5,1
Structure	blocky	blocky	blocky	structure-less
Consistency	loose	loose	loose	-
Texture	sand	sand	sand	gley
Rocks	none	none	few	none

Roots	many	many	few	none
Carbonates	none	none	none	none

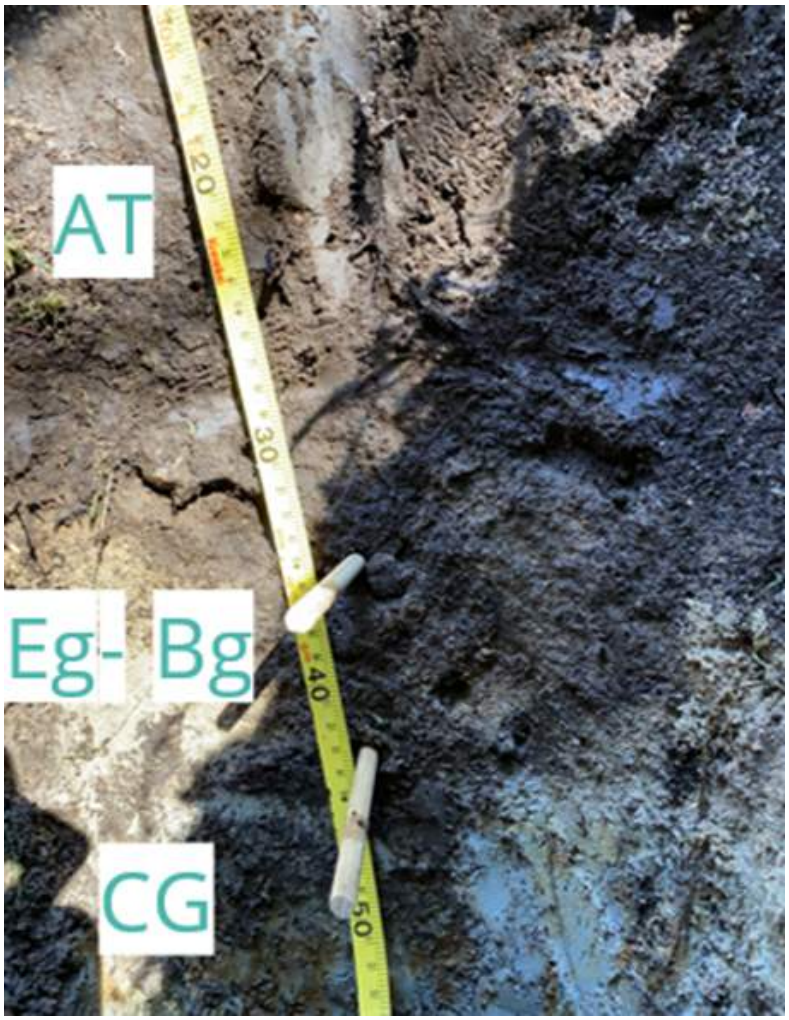

Figure 9. Excavation 1. soil profile (Location A).

Excavation B

Location B : Käsmu (59.6044196, 25.9079551).

Relief: flat, soil temperature: 17°C (5 cm), 15°C (10 cm), weather: sunny, temperature 24 ^{0} C, Scattered - Cumulus, Cirrocumulus.

The MUC code for this site was 1121. (Woodland, Mainly Evergreen, Needle-Leaved, Irregularly Rounded Crowns Dominated by trees (more than 50% of the canopy) with broad, irregularly rounded crowns (e.g., Pinus).

Description: the ground is dry and sandy.

Vegetation: pine, spruce, lingonberry, red-stemmed feather moss, glittering wood moss (Figures 10-15).

Figure 10. View from north.

Figure 11. View from east.

Figure 12. View from the south.

Figure 13.View from west.

Figure 14.View from upward.

Figure 15.View from downward

Five different horizons: O – mold, A – humus, E – eluviated, B – Illuviated and C – bedrock. All horizons were dry, pH was below 5. The structure was blocky, consistency was loose and texture sand. There were many rocks only in the 5th horizon. There were many roots in the 1st, 2nd, 3rd horizon, few roots in the 4th horizon and none in the 5th horizon. No carbonates were present (Table 2).

Soil type of the site is slightly podzolized soil (Figure 16). Typical soils of boreal coniferous forests in cool humid climate but drier sites. The minerals from the upper layers are leached and concentrated into the lower layer.

Table 2. Data of the soil profile (location B).

Horizon number and designation	1. O	2. A	3. E	4. B	5. C
Top Depth (cm)	0	3	11	20	45
Bottom Depth (cm)	3	11	20	45	60
Thickness (cm)	3	8	9	25	15
Moisture	dry	dry	dry	dry	dry
pH	-	4,7	4,5	4,2	-
Structure	blocky	blocky	blocky	blocky	blocky
Consistency	loose	loose	loose	loose	loose
Texture	sand	sand	sand	sand	sand
Rocks	none	none	none	none	many
Roots	many	many	many	few	none
Carbonates	none	none	none	none	none

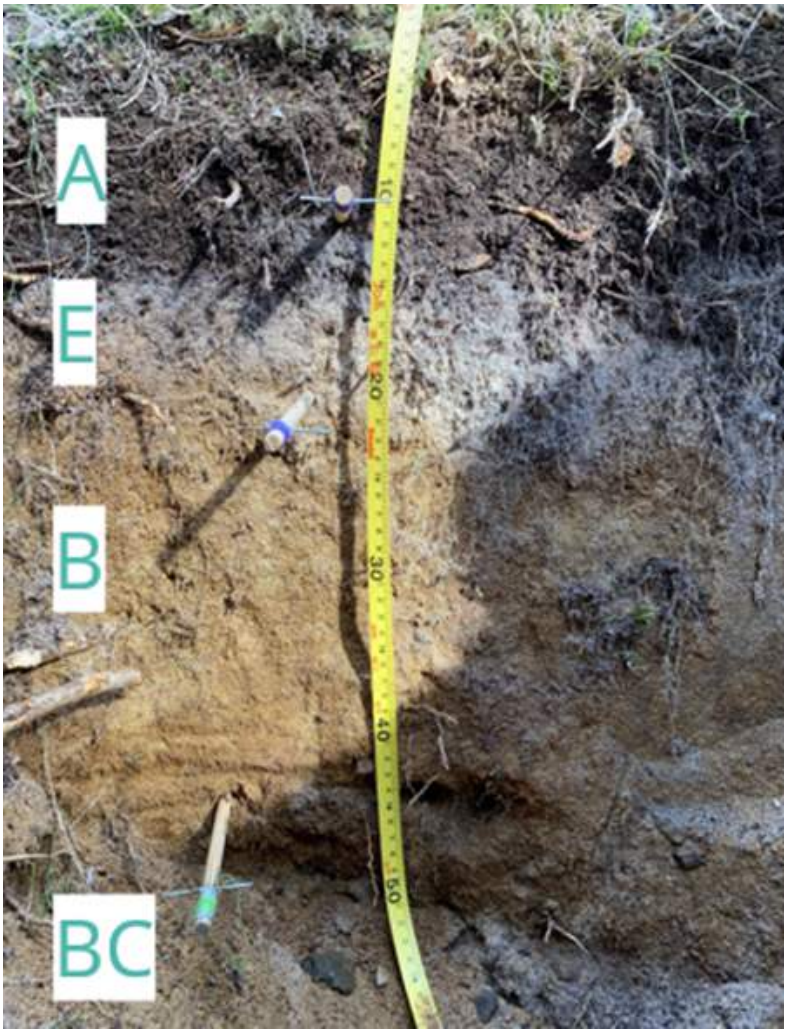

Figure 16. Excavation 2. soil profile (B).

Discussion

Both excavations were located close to each other in a flat area, the first digging was located in a shallow depression. The vegetation cover of both excavations was forest. Around the first dig were more spruces and growing herbaceous plants . The ground was wetter around the 1st dig. There were no free carbonates in both wells, the pH value of the soil of the second dig was lower than the pH of the soil of the first dig. In the first excavation, the soil was moist and a thick raw humus horizon had formed, and the source rock was clay, and glaciation occurred due to excess moisture. In the second dig, the soil was dry and sandy and there was lithification.

The soils of both our digs (excavations A and B) corresponded to the soil map of the Estonian Land Board (Figure 17).

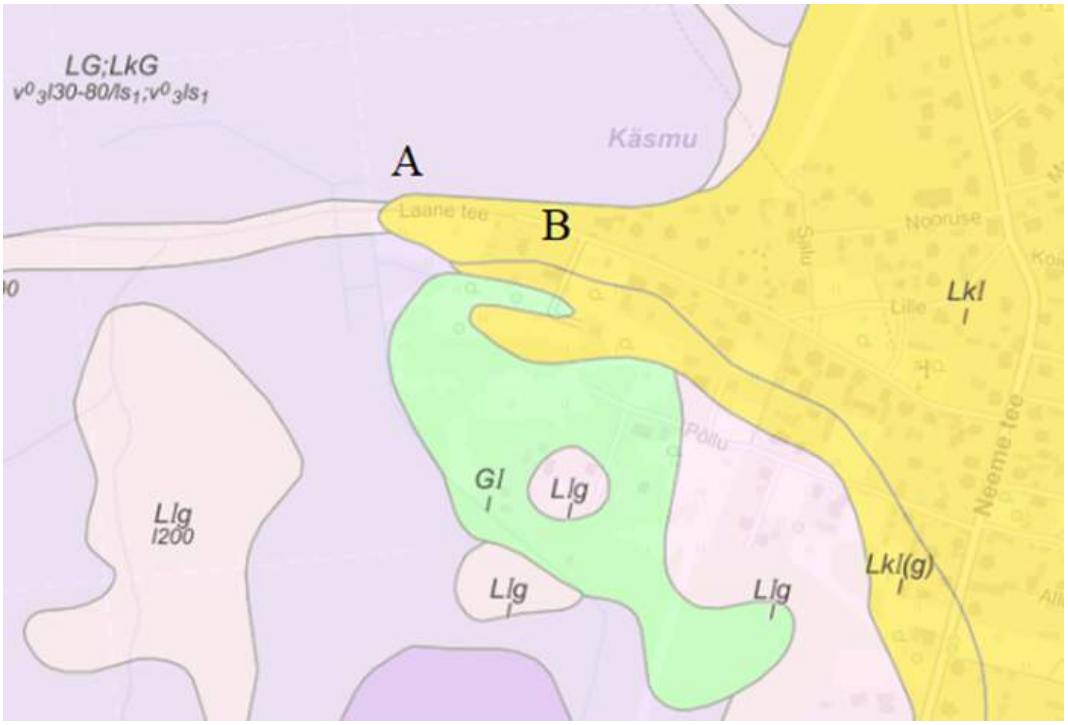

Figure 17. Soil map of Estonian Land Board (excavations A,B). Source: Estonian Land Board

Conclusions

Our first hypothesis was right ("The soil types in nature correspond to the soil map") because we found the soil types in nature as we predicted by the soil map.

Our second hypothesis was right ("The soil types correspond to surface forms") because we found the gleyed soil in a wet local depression and podzolized soil in a higher dry place.

Our third hypothesis was right ("The soil types correspond to vegetation") because we found the gleyed soil by looking for deciduous trees and peat moss and podzolized soil by looking for pine trees and forest mosses.

Next time we should do more excavations for the same soil type if possible. We should also use a soil drill to have more data. Also, not all GLOBE color assignment codes are compatible with GLOBE Data. Therefore, we had to exclude colors from our data analysis.

This kind of study is very important because with that we can verify the Estonian Land Board's maps and be sure that the maps have correct information. Also, with that we can identify soil changes and that will help us in the future.

REFERENCES

Altin, L., Kikas, Ü., Sepp, M., Kamenik, J., Jõgis, A., Laarmaa, R., Henno, I., Univer, M.J.,; Altin, E., Rootsmaa, V., Pärn, J., Raudsepp, J., (2021). Maa kui süsteem. GLOBE 25 õppekogumik. Tartu: Sulemees.

Estonian Land Board. https://xgis.maaamet.ee/xgis2/page/app/mullakaart (4.08.2021)

The GLOBE program, Pedosphere (soils).
https://www.globe.gov/do-globe/globe-teachers-guide/soil-pedosphere (3.08.2022)

Arold, I., 2005. Eesti maastikud. Tartu University Publishing House

Figure 18. Our team