GLOBE Estonia Learning Expedition

SOIL IMPACT ON VEGETATION

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Abstract

Varemurru is located on the coastal area of Gulf of Livonia and soils have been affected by the closeness of the sea and the vegetation (plants). The aim of our study was to investigate soils around Varemurru, Pärnumaa and compare thes to the soil map of Estonian Land Board.. We asked three research questions:

- Is it possible to predict from places with different vegetation that soils will be different?
- How does flora affect the amount of soil?
- How does the soil affect vegetation?

We made 3 excavations and collected samples from them. We analyzed the samples, identified the MUC core for eacg site. Based on the results we made a conclusion that soil does affect vegetation. Soils differ a little from the soil map data.

Location and weather conditions

The location of the research area is Pärnu county, Lääneranna parish, Matsi village. Three excavations were made for the research. The excavations were made about 60-100m south-west from Varemurru recreation center's yard. Landscape around the research area is flat, average altitude is 1.5 meters.

Research was conducted on August 10, 2021. The air temperature at the time of the excavations was 22 degrees, air humidity 63% and air pressure 1018 hPa. The day before was rainy.

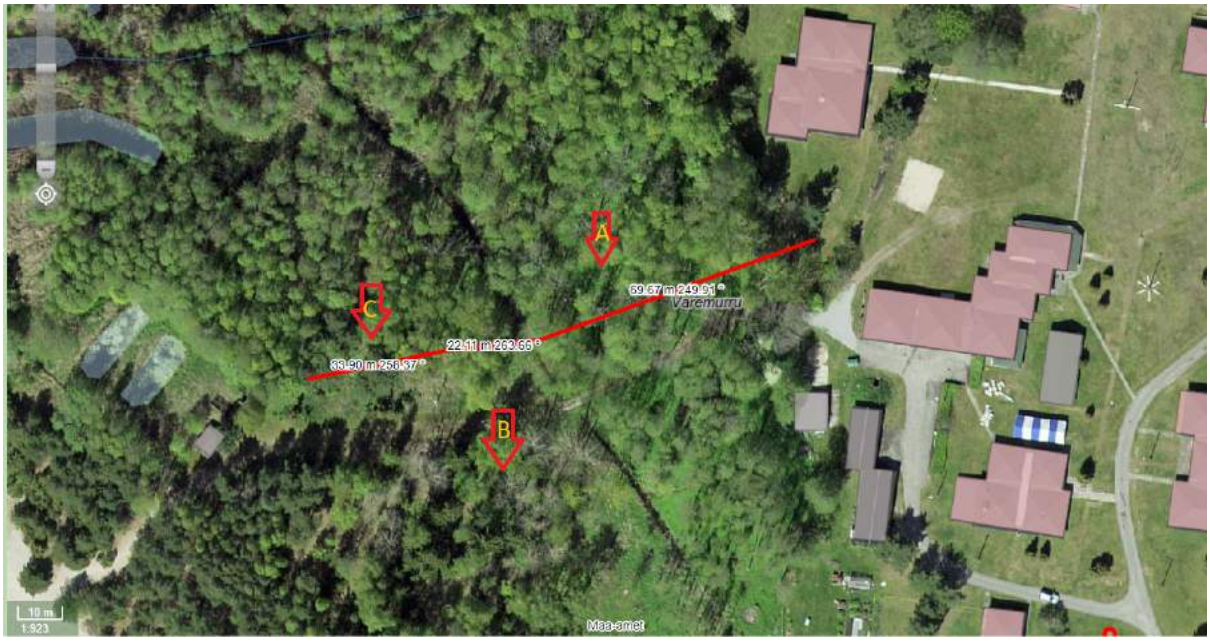


Figure 1. Research area description (excavations A, B and C).

We made 3 excavations (figure 1) and collected samples from each of them. We analyzed the samples and made the conclusion that soil does affect vegetation. Over a long time vegetation affects soil.

Research questions and hypothesis

Before asking research questions and hypotheses, we discussed the role of soil. Soil is an important natural resource. We agreed that soil is an important natural resource and one of the biggest problems is simply its loss. After the discussion, we raised the following questions and hypotheses:

Research questions

- Is it possible to predict from places with different vegetation that soils will be different?
- How does flora affect the amount of soil?
- How does the soil affect vegetation?

Hypotheses

- Places with different vegetation have different soil.
- Flora affects the amount of humus in the soil.
- The thickness of the humus layer affects the amount of plants.

Research methods

For the research we dug three excavations, measured and described different horizons, measured the soil temperature at a depth of 5 cm and 10 cm, measured the air temperature, humidity and air pressure.

In addition, we used the following values:

- soil humidity, structure
- soil warp (figure 2)
- the amount of roots
- free carbonates
- MUC code
- photos of surroundings
- color
- consistency
- soil horizons pH
- the amount of stones soil warp (figure 3)

Figure 2. Soil warp.

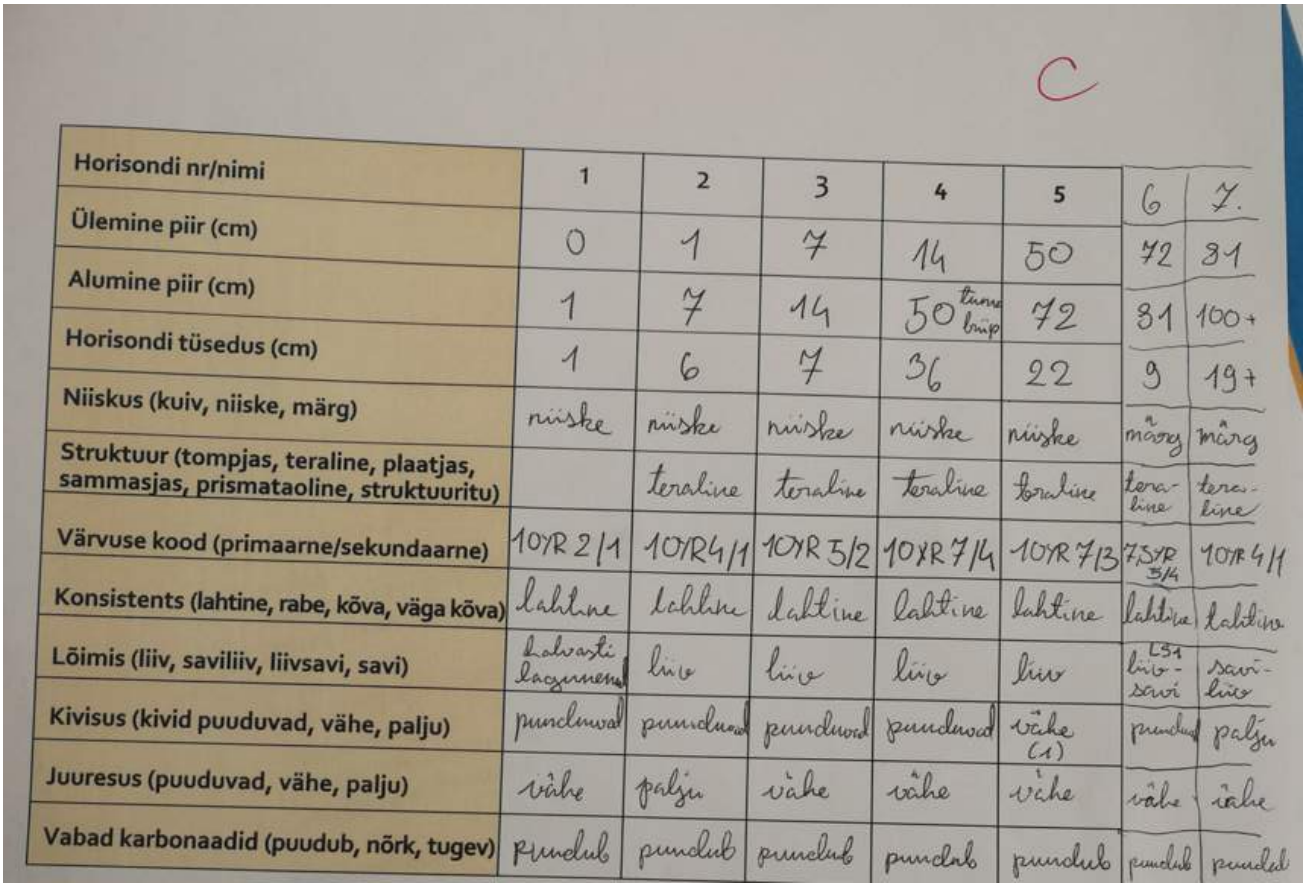
Figure 3. Soil sieve.

Equipment

We used various measuring instruments and tools to describe the excavations.

- shovel, soil drill, scoops
- cups
- distilled water
- measuring pole, measuring tape
- horizon markers
- marker
- GLOBE pedosphere datasheets (figure 5)
- pH-paper, pH-meter
- Soil Color Book
- MUC-code book
- Vernier and Globisens lab-disc (figure 4)
- soil thermometer
- 30% vinegar

Figure 4. Globisens lab-disc.



Horisondi nr/nimi	1	2	3	4	5	6	7.
Ülemine piir (cm)	0	1	7	14	50	72	81
Alumine piir (cm)	1	7	14	50 tume pruun	72	81	100+
Horisondi tüsedus (cm)	1	6	7	36	22	9	19+
Niiskus (kuiv, niiske, märg)	niiske	niiske	niiske	niiske	niiske	märg	märg
Struktuur (tompjas, teraline, plaatjas, sammasjas, prismataoline, struktuuritu)		teraline	teraline	teraline	teraline	teraline	teraline
Värvuse kood (primaarne/sekundaarne)	10YR 2/1	10YR 4/1	10YR 5/2	10YR 7/4	10YR 7/3	7,5YR 3/4	10YR 4/1
Konsistents (lahtine, rabe, kõva, väga kõva)	lahtine	lahtine	lahtine	lahtine	lahtine	lahtine	lahtine
Lõimis (liiv, saviliiv, liivsavi, savi)	kalvarti laoginem	liiv	liiv	liiv	liiv	LS1 liiv-savi	savi-liiv
Kivisus (kivid puuduvad, vähe, palju)	puuduvad	puuduvad	puuduvad	puuduvad	vähe (1)	puudub	palju
Juuresus (puuduvad, vähe, palju)	vähe	palju	vähe	vähe	vähe	vähe	vähe
Vabad karbonaadid (puudub, nõrk, tugev)	puudub	puudub	puudub	puudub	puudub	puudub	puudub

Figure 5. GLOBE pedosphere worksheet.

The GLOBE pedosphere worksheet contains the following values: upper and lower horizon limits, thickness, humidity, structure, color code, consistency, warp, amount of stones, amount of roots, and free carbonates (figure 5).

Results

Excavation A

MUC Code for the site A was 1233 – a woodland mainly deciduous, cold-deciduous without evergreen trees, mixed. Both broad-leaved and needle leaved, deciduous species provide more than 25% of the canopy (figure 6, figure 7, figure 8, figure 9, figure 10, figure 11).

Three differentiable horizons (crude humus (AT), sand, clay). The humus and sand layers were humid and the clay layer was wet. The two lower horizons of the soil profile were rich in rocks and free carbonates (table 1).Lush vegetation grows on a thick layer of humus (Betula, Populus tremula, Fraxinus excelsior, Acer platanoides, Alder, Urtica, Filipendula ulmaria, Aegopodium podagraria).
Due to the stoniness, it was not possible to dig deeper than 75 cm with a shovel and a soil drill was used to analyze the deeper profile (continued clay horizon) (figure 12, figure 12).

Soil type of the site is leached glial soil.

Figure 6. From north.

Figure 7. From east.

Figure 8. From south

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Figure 9. From west.

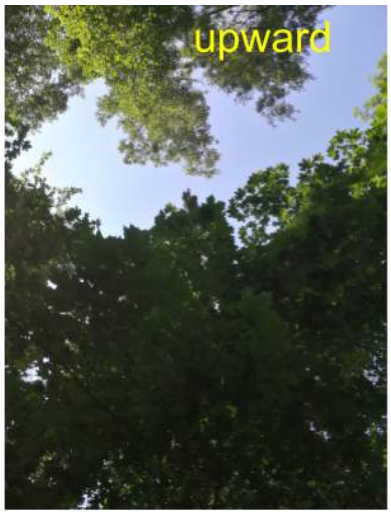

Figure 10. Upward.

Figure 11. Downward.

Table 1. Data of excavation A.

A			
horizon no	1	2	3
upper limit (cm)	0	32	65
lower limit (cm)	32	65	75+
horizon thickness (cm)	32	33	10+
humidity (dry, humid, wet)	humid	humid	wet
structure		grainy	plastic clay
colour code	7.5YR 2.5/2	10YR 6/3	5B 4/1
consistence	loose	loose	friable
soil warp	t3	sand	sand clay
stoniness	little	a lot	a lot
roots	a lot	little	missing
free carbonates	missing	low	low

Figure 12. Excavation A profile.

Figure 13. Soil drill of the bottom 70-100cm from excavation A

Excavation B

MUC Code for the site B was 1222 - woodland, mainly deciduous, cold-deciduous with evergreens, with evergreen needle-leaved trees with evergreen needle-leaved trees such as hemlock (tsuga) and pine (pinus) (figure 14, figure 15, figure 16, figure 17, figure 18, figure 19).

Five differentiable horizons (decay, humus, 3 different layers of sand, in the last peat stripes). All layers except the second layer, which was dry, had wet horizons. In the metric well there was one sandstone in the third layer, which contained carbonates (there were no carbonates in the layers). There was no shrub front and there were fewer plants than in well A (Picea abies, Betula, Sorbus, Acer platanoides, Populus tremula, Convallaria majalis, Poaceae). Soil type of Excavation B is Kog - geysed leached soil (table 2, figure 20).

Figure 14. View from north.

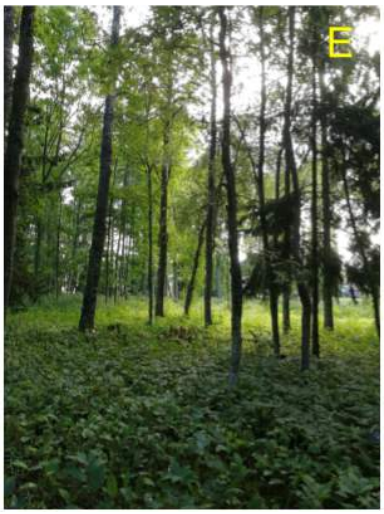

Figure 15. From east.

Figure 16. From south.

Figure 17. From west.

Figure 18. Upward.

Figure 19. Downward

Table 2. Table of excavation B.

B					
horizon no	1	2	3	4	5
upper limit (cm)	0	2	10	40	90
lower limit (cm)	2	10	40	90	100+
horizon thickness (cm)	2	8	30	50	10+
humidity (dry, humid, wet)	humid	dry	humid	humid	humid
structure		grainy	grainy	grainy	
colour code	25Y 3/2	10YR 5/3	10YR 6/4	10YR 6/4	N 2.5/
consistence	loose	loose	loose	loose	loose
soil warp	poorly decomposed	sand	sand	sand	t3
stones	missing	missing	a little (1)	missing	missing
roots	a lot	a lot	a few	missing	missing
free carbonates	missing	missing	missing	missing	missing

Figure 20. Excavation B profile.

Excavation C

MUC Code for the site C wasMUC 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) (figure 21, figure 22, figure 23, figure 24, figure 25, figure 26).

Seven distinguishable horizons (decay, humus, 4 distinct layers of sand, moraine) were seen (table 3). The top layers were moist and the last two wet (fogure 27). In the fourth layer, at 40 cm, there was a thin darker stripe. The last layer was rocky (moraine).

The vegetation was dominated by conifers (Pinus, Juniperus communis), the underlying vegetation is similar to well B (Convallaria majalis, Fragaria vesca, Poaceae).

Soil type of sxcavation C is geysed leached soil

Figure 21. From north.

Figure 22. From east.

Figure 23. From south.

Figure 24. From west.

Figure 25. Upward.

Figure 26. Downward.

Table 3. Data of excavation C.

C								
horizon no	1	2	3	4	4.1	5	6	7
upper limit (cm)	0	1	7	14	16	50	72	81
lower limit (cm)	1	7	14	50	48	72	81	100+
horizon thickness (cm)	1	6	7	36	2	22	9	19+
humidity (dry, humid, wet)	humid	humid	humid	humid	humid	humid	wet	wet
structure		grainy	grainy	grainy	grainy	grainy	grainy	grainy
colour code	10YR 2/1	10YR 4/1	10YR 5/2	10YR 7/4	10YR 5/4	10YR 7/3	7.5 YR 5/4	10YR 4/1
consistence	loose	loose	loose	loose	loose	loose	loose	loose
soil warp	poorly decomposed	sand	sand	sand	sand	sand	sand clay	sand clay
stones	missing	missing	missing	missing	missing	a little(1)	missing	a lot
roots	a little	a lot	a little	a little	a little	a little	a little	a little
free carbonates	missing	missing	missing	missing	missing	missing	missing	missing

Figure 27. Excavation C profile.

Soils according to the soil map of Maa-amet

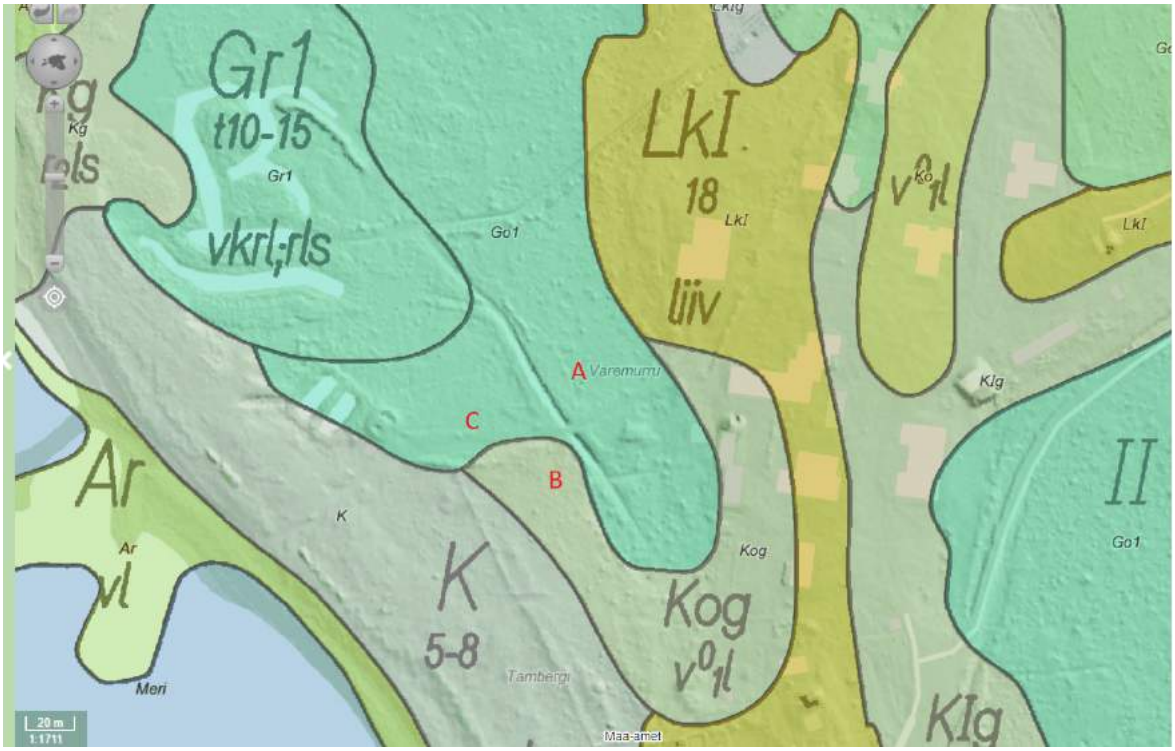

Figure 28. Soil map of Maa-Amet, (excavations A,B,C).

Excavations A and B corresponded to the soil types indicated on the soil map of the Maa-amet (figure 28). However, excavation C was more similar to the profile of excavation B, the bottom of the excavation was close to excavation A.

Comparison of excavations

Figure 29. Excavation A.

Figure 30. Excavation B.

Figure 31. Excavation C.

All excavations and sites were slightly different.

Discussion

Is it possible to predict from places with different vegetation that soils will be different?
Places with different vegetation have different soil. In our 3 excavations the plants growing on soil showed how the soils were different and how they were affected by the flora growing on ground.

Does flora affect the soil?
Flora affects the amount of humus in the soil. The decay contained leaves and other parts from trees and plants. The organic layer was thicker in deciduous forest.

Does the soil affect vegetation?
The thickness of the humus layer affects the amount of plants. The type of soil defines what kind of vegetation has the ability to grow.

Conclusion

Excavation A had a raw humus layer on top, excavations B and C had a thin layer of duff on top and a humus horizon below it (figure 32).

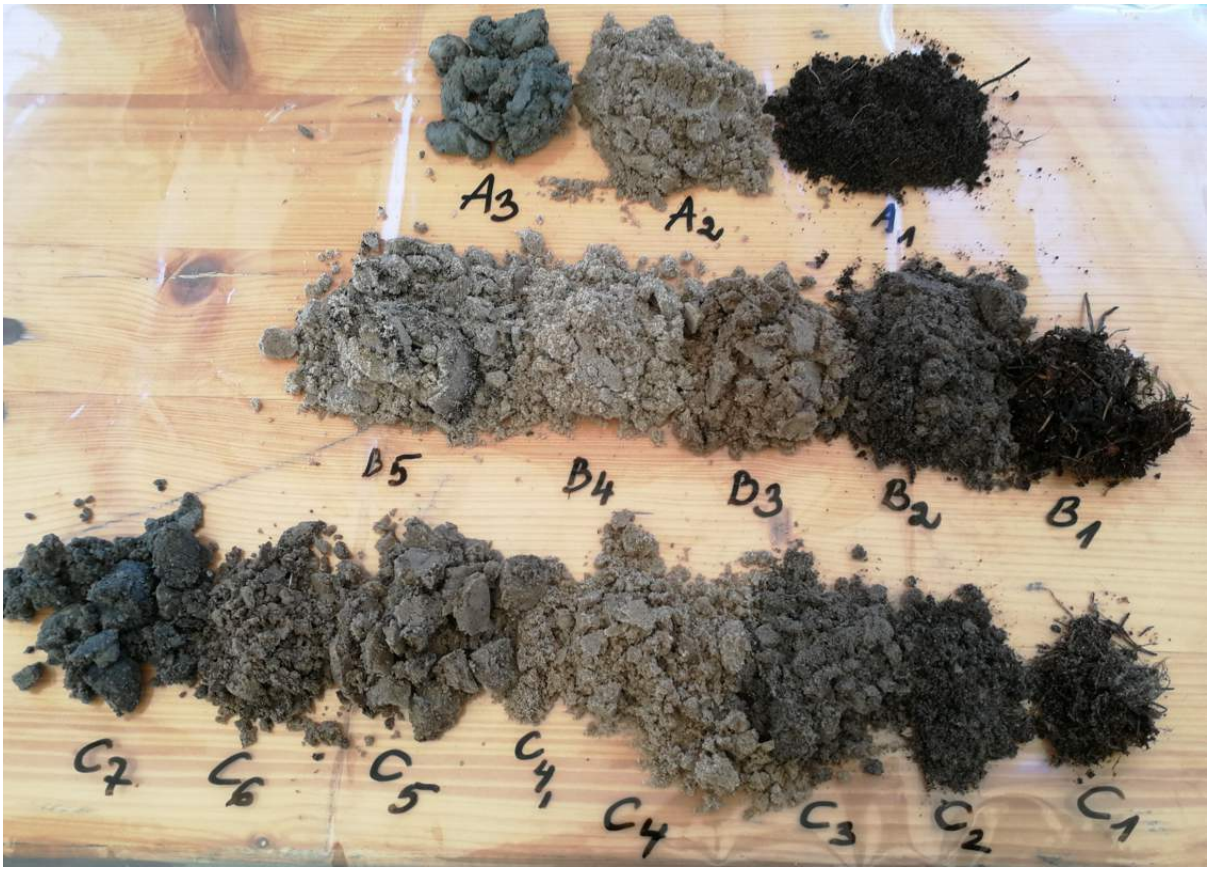

Figure 32. Soils from excavations A,B,C.

What could be better

- We could use new GLOBE soil colour books (old codes do not work with GLOBE data entry).
- Different pH levels with different equipment (universal indicator) could be compared.
- We could conduct temperature soil measurement at different times.
- Sieves. The wet material was difficult to sieve, most of the particles remained on the 2.0 mm sieve (figure 33).

Figure 33. Soil warp in action.

Bibliography

1. GLOBE Equipment – Pedosphere, https://www.globe.gov/do-globe/research-resources/globe-equipment/pedosphere

2. GLOBE Equipment – Pedosphere, Astover, Alar; Reintam, Endla; Leedu, Enn; Kõlli, Raimo (2013). Muldade väliuurimine. Tartu: Eesti Loodusfoto.

Figure 34. Team without the tutor.