GLOBE Estonia Learning Expedition 2024

Land cover variation in the forests surrounding Taevaskoja according to the MUC system and the Estonian vegetation classification

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ABSTRACT

The landscape around Taevaskoja is diverse, with areas of different elevations and water regimes. Given the variation in landscape, the land cover is likely also diverse, as the composition and abundance of trees and understory plants depend on the availability of water in the soil. The objective of the expedition was to determine whether and how different land cover types are present in the Ahja River valley (lower area) and on the sandstone cliff bordering the river (higher area). We selected one research area in the valley and another on the higher bank and conducted land cover studies based on the GLOBE protocol. Additionally, we identified all the shrub and herbaceous plant species and the more abundant moss species growing in the research areas. The land cover of the lower area had a Modified UNESCO Classification (MUC) code of 0192, and the forest type in the Estonian vegetation classification was bog forest, while the higher area had an MUC code of 0193 and was classified as broadleaf forest. Thus, the land cover around the Ahja River is variable, and differences between the research areas are evident both in the MUC system and in the Estonian vegetation classification. We did not collect data on soil and water regimes in our research areas, so in the future, it would be necessary to investigate how soil and water regimes differ in the selected research areas and whether the differences in land cover are due to soil variations or other factors.

Keywords: land cover, vegetation, GLOBE

1. Introduction and background

Research Question:
Does the land cover differ in the forests around Taevaskoja, along the banks of the Ahja River, and how?

Why is the posed question scientifically important?
Land cover measurement is important because the data obtained through the GLOBE protocol supports the accuracy and reliability of information obtained from satellites. It is especially crucial to collect land cover data in areas like Taevaskoja, where, from a distance (by registering reflected radiation from satellites), one might assume the land cover is uniform (e.g., coniferous forest), but according to the GLOBE protocol, no such data has been collected in this region over the last five years. Before the expedition, we practiced land cover measurement using the GLOBE protocol in a training area near the camp, and we already noticed that the terrain was not flat (the training area was on a gentle slope) and the understory plants within the training area were quite diverse. Therefore, we hypothesized that the variability in the understory vegetation around Taevaskoja could be even greater. The tree layer in the training area showed little variability, with coniferous trees being dominant.

Hypotheses:

1. There are no large broadleaf trees at the measurement site.
2. The forest at the measurement site contains *Centaurea cyanus* (cornflower).
3. There are many plant species at the measurement site.
4. Orchids grow in the forest at the measurement site.
5. Blueberries (*Vaccinium myrtillus*) and lingonberries (*Vaccinium vitis-idaea*) can be found at the measurement site.
6. The vegetation at the measurement site is richer.
7. The forest at the measurement site contains *Cephalanthera rubra* (red helleborine).

2. Materials and methods

GLOBE Protocol Selection

To test the hypotheses on land cover variability and to answer the research question, we chose to measure land cover using the GLOBE protocols (GLOBE Handbook, Protocol 1 - Land Cover Mapping, Protocol 2 - Biometry). Based on the Land Cover Mapping protocol, we identified our research areas in the field and assigned the Modified UNESCO Classification (MUC) code according to the guide. Using the Biometry protocol, we collected data on the tree layer and understory plants to verify the accuracy of the MUC code. The same biometry data, along with the creation of a detailed species list, allows us to determine the forest type group in the Estonian vegetation classification. Describing land cover using these two classifications helps validate our results and adds reliability to the conclusions.

Description of the Research Areas

The research areas are located in Estonia, in Põlva County, within the Ahja River Gorge Landscape Protection Area, which is situated along the middle course of the Ahja River (Figure 1, Figure 2). Geographically, the research area lies within the Southeastern Estonian Upland. The substrate in the Southeastern Estonian Upland is Devonian sandstone with a thin layer of moraine on top, which has led to the development of various soil types with differing moisture content and fertility. In the Ahja River Gorge Landscape Protection Area, coniferous and mixed forests (heath forests, bog forests, and broadleaf forests) dominate, with broadleaf trees not being the primary species. The region falls within the climate zone of Central Estonia.

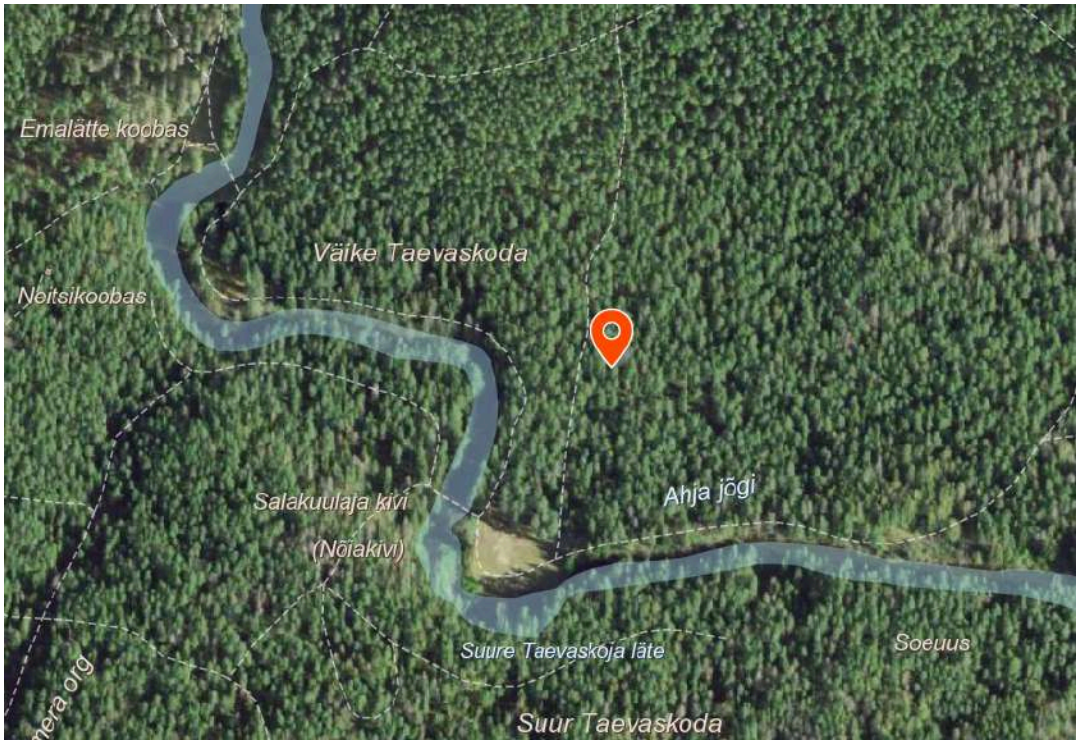

Figure 1. Research Area No. 1 in the Ahja River Valley, on the left bank (N 58° 06' 33" E 27° 03' 6")

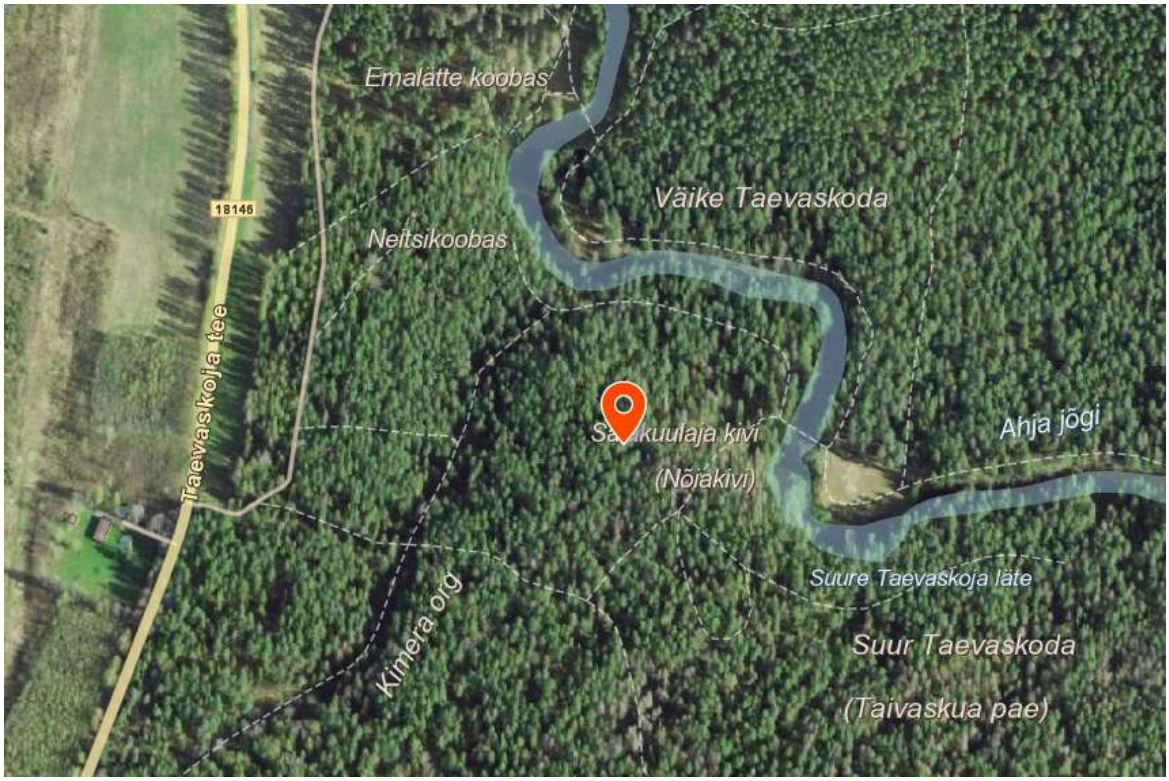

Figure 2. Research Area No. 2 on the right bank of the Ahja River (N 58° 06' 26.5" E 27° 02' 51.0")

Research Process
In both research areas, we conducted land cover measurements according to the GLOBE protocols (Land Cover Mapping, Biometry). We fixed the central point of a 30x30m plot and recorded its coordinates. Next, we marked the diagonals (corners) of the plot so that the sides of the square would align with the north-south and east-west directions. Through careful observation, we determined the MUC codes for the study areas based on the MUC guide.

We then assessed the coverage of the understory in both research areas according to the GLOBE Biometry protocol. We carefully examined the entire 30x30m area and identified all shrub, bush, and herb species, as well as the species of moss growing on the ground in the research areas. In collaboration with the Savimäe group (another student research group in the expedition), who measured the canopy coverage, tree height, and circumference, we verified the MUC codes of both areas using the MUC guide. To determine the forest type group corresponding to the Estonian vegetation classification, we used the Forest, Marsh, and Meadow Handbook (Marvet 2014).

To indirectly assess soil properties and water regimes, we identified the typical habitats of all understory plant species found in the research areas using the Estonian Plant Identification Guide (Kukk 2018) to gain a deeper understanding of our study sites. Based on the results (species composition and abundance), we determined the MUC codes and the habitat type group for both research areas in the Estonian vegetation classification. Based on the MUC code and habitat type group, we could decide whether the land cover of the studied areas is similar, slightly different, or significantly different.

a. Many hypotheses were made regarding the plant species growing at the research sites. We found that the land cover protocol was the most effective method for this research.
c. We used the GLOBE land cover protocol.
d. We used a 50-meter measuring tape and the same length of string to mark the diagonals. Flags were placed at the ends of the diagonals, as well as in the center, where we recorded the coordinates. Tree canopy coverage was measured with a densiometer, and tree heights were measured with a clinometer.

3. Results

In the first area, there was no species diversity as the understory consisted only of shrubs.
In the second area, there were many more different plant species compared to the first.

Most of the plant species were shrubs.

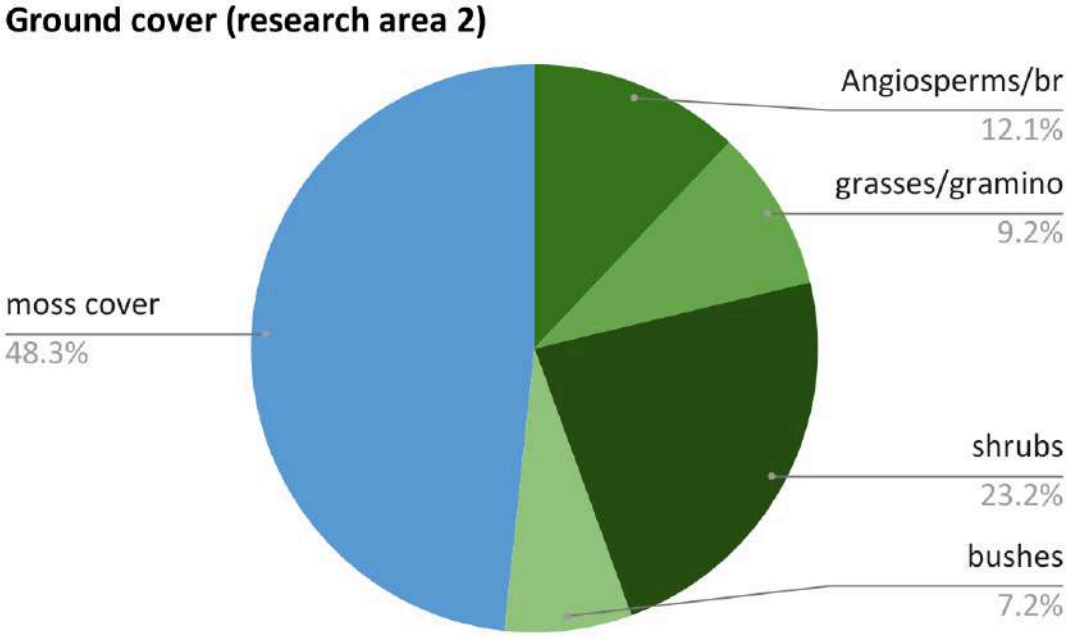

Figure 3. Ground cover in research area 2

3.1 Research area 1

Figure 4. Research area 1

The MUC code for the first research area is 0192 (Figure 4). Explanation of the MUC code: dense closed forest, evergreen coniferous forest, round crowns. The forest type is a bog forest. The forest had a lot of light, meaning the trees grew sparsely. There were few broadleaf trees, and the forest was mainly dominated by pines.
There was no shrub layer, and the herb layer contained one species.
The moss layer was dense, with four species present (Figure 5, Figure 6, Figure 7).

Tree Layer: Scots pine, birch, Norway spruce.
Shrub Layer: Absent.
Bush Layer: Blueberry and lingonberry.
Herb Layer: One species: hairy woodrush.

Figure 5. Hylocomium splendens

Figure 6. Pleurozium schreberi

Figure 7. Dicranum scoparium

Figure 8. Research area 1

3.2 Research area 2

The MUC code for the second research area is 0193. Explanation of the MUC code: dense closed forest, evergreen coniferous forest, conical crowns.
The forest had less light, and the trees grew more densely. The tree layer was dominated by spruces.
In the shrub layer, there were spindle trees, rowans, and common honeysuckle. In the bush layer, blueberries and lingonberries were present. In the herb layer, there were wood sorrel, wild ginger, lily of the valley, hairy woodrush, dog's mercury, marsh marigold, and tortoise plant.
In the moss layer, four species grew: twinleaf, bluebell, sphagnum moss, and hair moss.
The forest type is a broadleaf forest.

Tree Layer: Norway spruce, Scots pine, birch, maple.
Shrub Layer: Spindle tree, rowan, common honeysuckle.
Bush Layer: Blueberry, lingonberry.
Herb Layer: 8 different species, with the most common being lily of the valley, hare's-foot fern, and wood sorrel.

Figure 9. Polytrichum commune

4. Discussion and Conclusions

The plants observed in the first site included species such as *kilpjalg* (tortoise plant), *palusammal* (sphagnum moss), *pohl* (lingonberry), and *piibeleht* (lily of the valley), which are typically found in dry habitats. In contrast, the remaining herbaceous plants were typical of moderately moist environments. There were no species present that prefer very wet conditions or are found in boggy areas.

Conclusion: At the first research area, the herbaceous vegetation was sparse, indicating that the soil is likely poor and dry. In contrast, the second research had a more average density of herbaceous plants, suggesting that the soil there is more fertile and moist. Additionally, a greater variety of species was found in the second location.

In conclusion, next year, we could conduct a more detailed soil study in our research areas to better understand the soil composition and its impact on plant growth.

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Appendix 1. Plant Species in the Research Areas and Their Typical Habitats (Kukk 2018).

Liiginimetus		Tüüpiline kasvukoht
SAMBLAD		
kaksikhammas (perek.) *Dicranum sp.*		
harilik laanik *Hylocomium splendens*		
harilik lehviksammal *Ptilidium crista-castrensis*		
harilik palusammal *Pleurozium schreberi*		
harilik karusammal *Polytrichum commune*		
ROHTTAIMED		
kattekold *Lycopodium annotinum*		
kipljalg *Pteridium aquilinum*		
harilik maikelluke e. piibeleht *Convallaria majalis*		
karvane piiphein *Luzula multiflora*		
jänesekapsas *Oxalis acetosella*		
leseleht *Maianthemum bifolium*		
harilik laanelill *Trientalis europaea*		
metskastik		

Calamagrostis arundinacea	
PUHMAD	
harilik mustikas *Vaccinium myrtillus*	
harilik pohl *Vaccinium vitis-idaea*	
PÕÕSAD	
harilik paakspuu *Frangula alnus*	
harilik pihlakas *Sorbus aucuparia*	
harilik kuslapuu *Lonicera xylosteum*	
PUUD	
harilik mänd *Pinus sylvestris*	
harilik kuusk *Picea abies*	
arukask *Betula pendula*	