

GLOBE Estonia Learning Expedition 2025



Land Cover Study at Jõulumäe Using GLOBE Methods

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Table of Contents

| | |
|--|----|
| Abstract..... | 3 |
| 1. Introduction..... | 4 |
| 2. Research Methods..... | 6 |
| 3. Results and Discussion..... | 8 |
| 3.1 Route to the study area..... | 8 |
| 3.1.1 Roadside temperature measurements..... | 9 |
| 3.2 Research area..... | 10 |
| Conclusions..... | 12 |
| References..... | 14 |

Abstract

This study was conducted at Jõulumäe, Estonia using GLOBE methods to investigate land cover, forest structure, microclimate, and possible environmental changes compared to observations made back in 2018. The aim was to assess whether paludification processes (peatland formation) are still ongoing in the study area and whether the proportion of managed forest¹ has increased. In addition, the study provided practical experience in applying the scientific method and using field measurement instruments.

Fieldwork included observations along a predefined route, during which land cover types, vegetation, and human impact were documented. Tree height, trunk circumference, canopy cover, and forest density were measured using a measuring tape, clinometer, and densiometer in accordance with the GLOBE MUC protocol. Surface and air temperatures were measured at regular intervals to examine the influence of different surface types on microclimate. Observations of soil type, vegetation, and water presence were supported by map data and photographic documentation.

The results showed that pine (*Pinus sylvestris*) remains the dominant tree species and that the ground is still wet, indicating that paludification is ongoing, although peat thickness could not be confirmed due to the lack of soil sampling. No clear evidence was found for an increase in managed forest. Overall, the forest has not changed significantly since 2018 but is now officially protected as a habitat for the western capercaillie (*Tetrao urogallus*). The study highlights the importance of vegetation, soil, and surface type in shaping local microclimate conditions.

¹ Managed forest is understood here as a forest where silviculture is practiced, e.g. harvesting and timber production.

1. Introduction

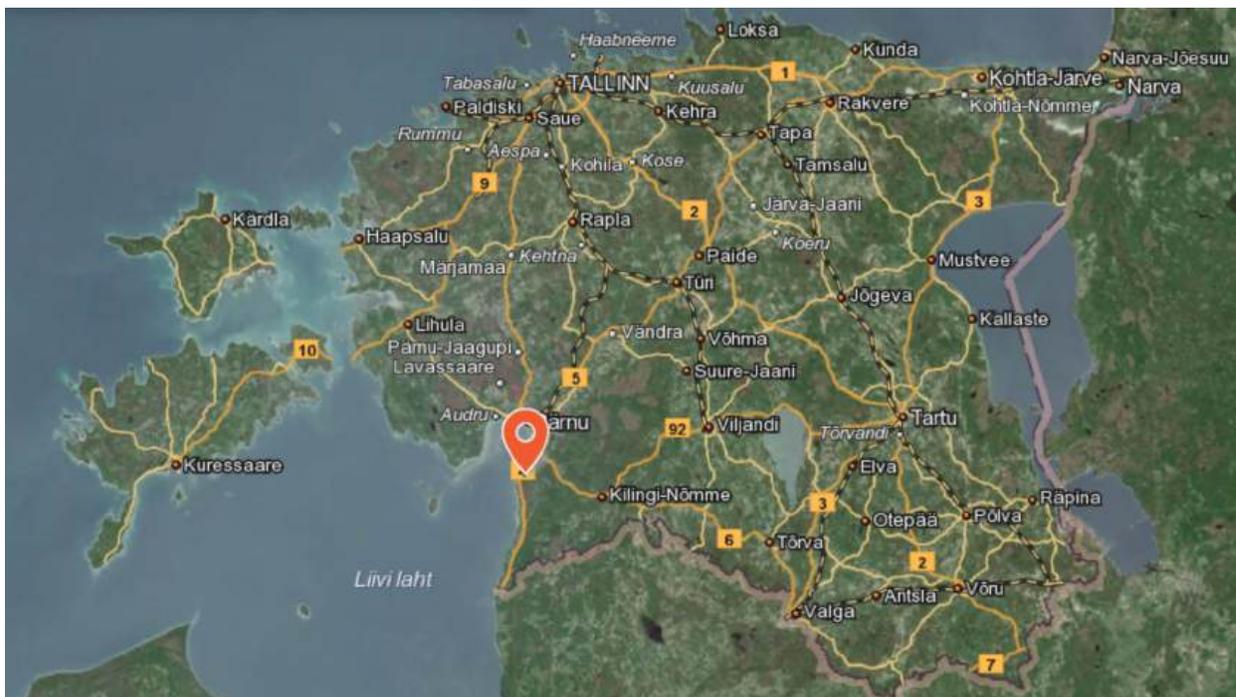


Figure 1. Location of Jõulumäe and the starting point of the observation trip (58°13'24" N, 24°30'54"E). Basemap: Estonian Land Board Geoportal.

This study was carried out to explore nature and to better understand forest ecosystems in our home country. Through this research, we also practiced using the scientific method and writing a research report.

Based on online map data, the forest site studied is classified as a *Vaccinium myrtillus* – peat forest site type, where pine (*Pinus sylvestris*) is the main tree species. Birch (*Betula* spp.) trees are also common along the observation route. The forest area is protected to preserve the habitat of the western capercaillie (*Tetrao urogallus*).

In the future, nesting areas of nearby coastal bird species may be threatened by climate change. Rising temperatures and changes in precipitation can make

reproduction more difficult, and rising sea levels in the Baltic Sea may also affect these habitats (Kont, Jaagus, & Aunap, 2003).

According to data from the Estonian Land Board map application, two soil types occur in the study area: deep transitional peat soil and deep fen peat soil (Figure 2). Both soil types depend on precipitation and may therefore be affected by climate change.



Figure 2. Soils within the study area: M¹ – deep fen peat soil and S¹ – deep transitional peat soil. The study area used for determining the MUC code is marked with a red alder symbol. Basemap: Estonian Land Board Geoportal.

Based on the collected information, we formulated a research question: **What changes have occurred in the studied forest compared to the observations made in 2018?**

In addition, two hypotheses (H1 and H2) were proposed.

H1: The process of paludification (peat formation) is still ongoing in the study area.

H2: Observations along the study route indicate that the proportion of managed forest has increased.

2. Research Methods

To collect data, we used a measuring tape, a clinometer, the GLOBE MUC Field Guide, a calculator on a mobile phone, a compass, a map, and a camera. We also used a densiometer, pencil and paper, the “GLOBE 25” learning collection (Altin et al., 2021), flags, a laser thermometer, and insect repellent (Figure 3).

These tools were used to measure tree height, trunk circumference, canopy cover, and the density of the upper forest layer. Insect repellent was used to ensure the comfort and well-being of the observers during fieldwork.



Figure 3. Equipment required for land cover investigation. Photo by Berit Reinaru.

2.1 Route of movement

Our route (Figure 4) began at the Jõulumäe Recreational Sports Center, from where we walked to the study area that had been investigated during the 2018 expedition.



Figure 4. Our movement route. Orthophoto: Estonian Land Board Geoportal.

3. Results and Discussion

3.1 Route to the study area

While walking toward the study site, we aimed to observe changes in the surrounding environment. Therefore, we made stops every 500 meters to measure temperature (Section 3.1.1) and to take photographs documenting changes in the landscape.

- **First stop (500 m).** The surroundings were mainly artificial. Buildings, asphalt roads, and agricultural fields were present (Appendix 2, Photo 1).
- **Second stop (1000 m).** The surroundings remained largely artificial, with no noticeable changes compared to the first stop (Appendix 2, Photo 2).

- **Third stop (1500 m).** The environment was still predominantly artificial. However, we had left the asphalt road and were walking on a gravel road. A small ditch with aquatic plants was present alongside the road (Appendix 2, Photo 3).
- **Fourth stop (2000 m).** The surroundings were similar to the previous stop. Aquatic vegetation was taller, and common cattail (*Typha* spp.) was observed (Appendix 2, Photo 4).
- **Fifth stop (2500 m).** The surroundings indicated that we had entered a forested area. The road surface had changed, and artificial roads were no longer present. Movement continued along a grassy path (Appendix 2, Photo 5).
- **Sixth stop (3000 m).** The environment changed noticeably. A birch forest was present on the right side of the path, while a pine forest was located on the left (Appendix 2, Photo 6).
- **Seventh stop (3500 m).** The surroundings showed little change compared to the previous stop. However, trees had been cut along the road to prevent them from growing into overhead power lines (Appendix 2, Photo 7).
- **Eighth stop (4000 m).** No significant changes in the surroundings were observed compared to the previous stop (Appendix 2, Photo 8).
- **Ninth stop (4500 m).** A major change in the surroundings was observed compared to the previous stop. Tree density was lower, a field was visible in the distance, and a gravel road had been constructed through the forest (Appendix 2, Photo 9).

3.1.1 Roadside temperature measurements

While traveling to the study site, we measured the temperatures of different surface types to understand how artificial surfaces, such as asphalt, can absorb and store heat and thereby warm the surrounding environment. The results showed that natural surfaces, including grass and soil, absorb less heat and therefore have a smaller influence on surrounding air temperature. These observations are illustrated in the diagram (Figure 5).

The minimum grass surface temperature was recorded at the 2500 m stop, where we reached the forest edge. This was likely due to shading from trees covering the grass at this location (Appendix 2, Photo 5).

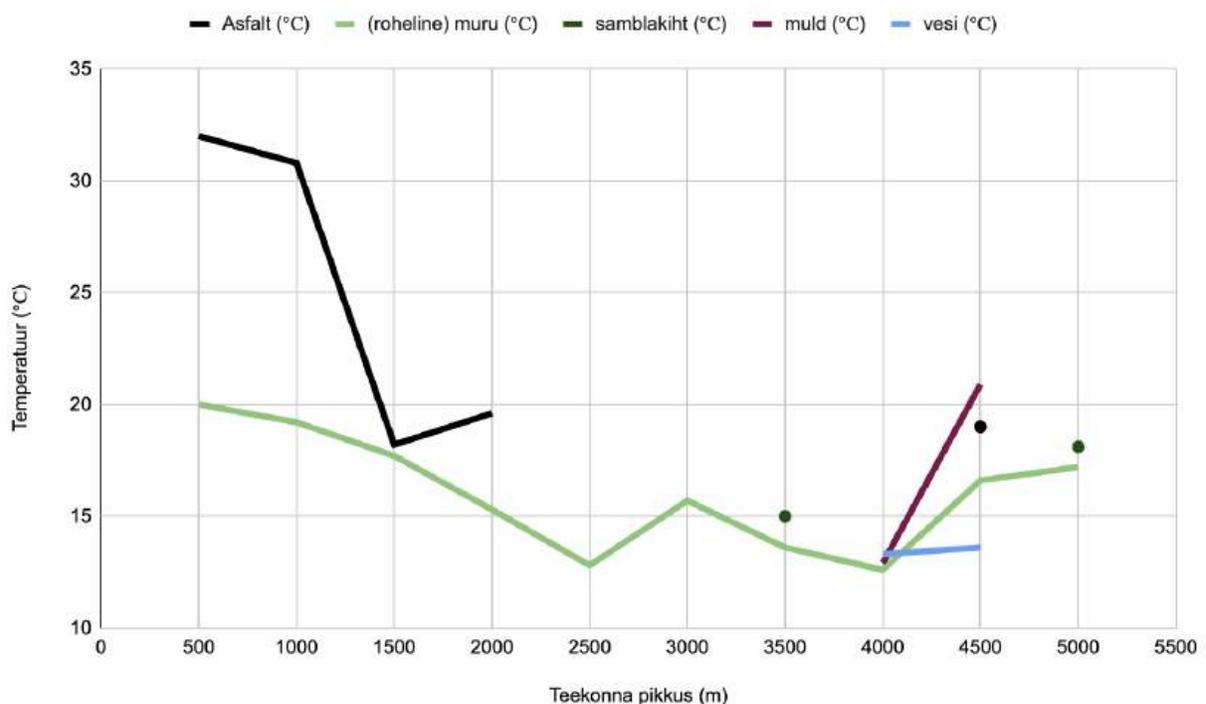


Figure 5. Differences in surface temperature along the observation route. Black - asphalt; green - grass; dark green - moss; red/brown - soil; blue - water.

3.2 Research area

MUC code: 1121

The dominant tree species in the study area is pine (*Pinus sylvestris*). We measured the height and trunk circumference of three pine trees, with three measurements taken for each tree (Table 1). Tree heights ranged from 19.17 m to 29.23 m, and trunk circumferences ranged from 53 cm to 126 cm (Table 1).

Based on these observations, we determined that the appropriate MUC code is **1121** rather than **0192**, because the tree crowns did not touch each other. Therefore, the criteria for MUC code 0192 were not met.

Table 1. Tree heights and circumferences.

| tree | height (m) | circumference |
|-------------|------------|---------------|
| | 21,35 | |
| Pine tree 1 | 19,17 | 53 cm |
| | 20,98 | |
| | 28,19 | |
| Pine tree 2 | 29,23 | 126 cm |
| | 27,18 | |
| | 23,04 | |
| Pine tree 3 | 19,48 | 81 cm |
| | 21,12 | |



Figure 6. View from the ground illustrating canopy closure and cover. Photo by Uku Alo Kaljurand.

Keskmine osakaal võrastikus

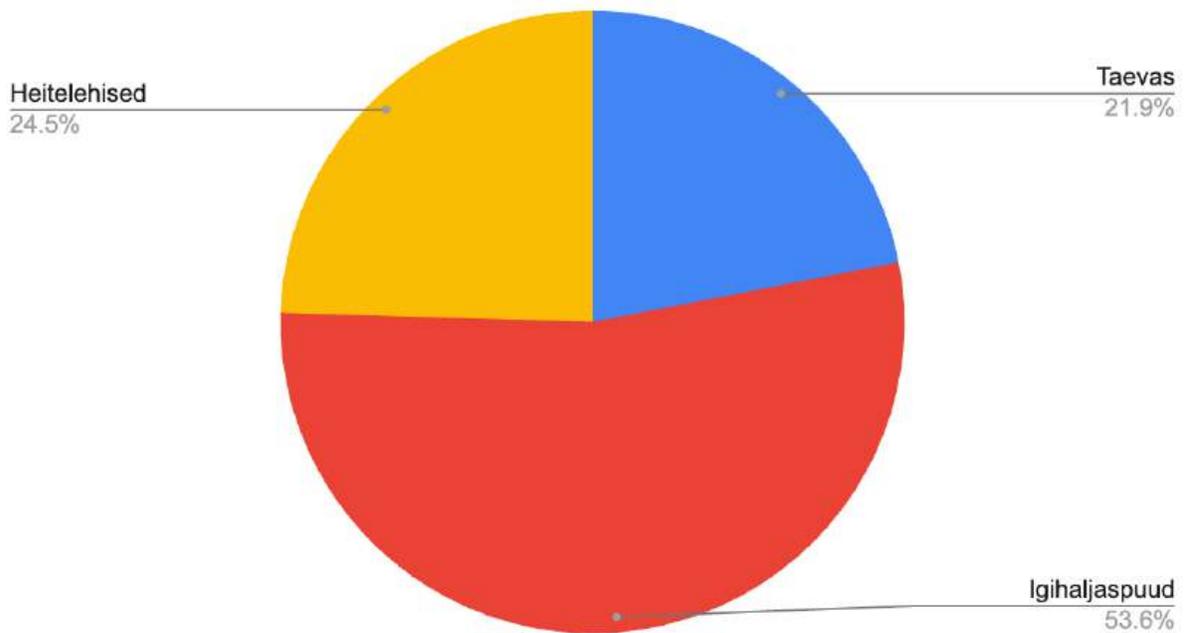


Figure 7. Average canopy cover ratio. Blue - sky; red - evergreen trees; yellow - deciduous trees.

Conclusions

Two hypotheses (H1 and H2) were proposed.

H1: The process of paludification is still ongoing in the study area.

H2: The proportion of managed forest has increased along the observation route.

The first hypothesis was **partially supported**. Based on soil maps and the vegetation observed on site (e.g. tussocks, stiff clubmoss *Lycopodium annotinum*, and pine trees), the area still shows characteristics of wetland conditions. However, because soil samples could not be collected, it was not possible to determine whether the peat layer

has increased. The bog ecosystem continues to play a role in the area, as a nearby ditch was observed to carry brown water originating from the bog.

The second hypothesis was **not supported**. Although signs of past heavy machinery use and a clear-cut area were observed at one location, it was evident that these activities had taken place several years earlier.

We also formulated a research question: **What changes have occurred in the studied forest compared to the observations made in 2018?**

Overall, the forest has not changed significantly. Pine remains the dominant tree species, tussocks are still present, and the ground continues to be quite wet. In 2018, the expedition group assessed the conservation value of the forest as moderate; however, the area is now officially under nature protection due to its importance as a habitat for the western capercaillie (*Tetrao urogallus*).

Through this study, we learned how to apply the scientific method and how to use field instruments such as clinometers and densiometers. We also learned to observe variations in microclimate and to understand the relationship between surface type and temperature.

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Appendix



Appendix 1. From left to right and from top to bottom, views from the center of the diagonals toward the north, south, east, and west. Photo by Uku Alo Kaljurand.

Appendix 2. Photographs from left to right in the order of the route (1–9). Author: Berit Reinaru.

