

NATURAL ENERGY AROUND US

A study of movement of energy in natural ecosystems surrounding Sammuli Holiday Village

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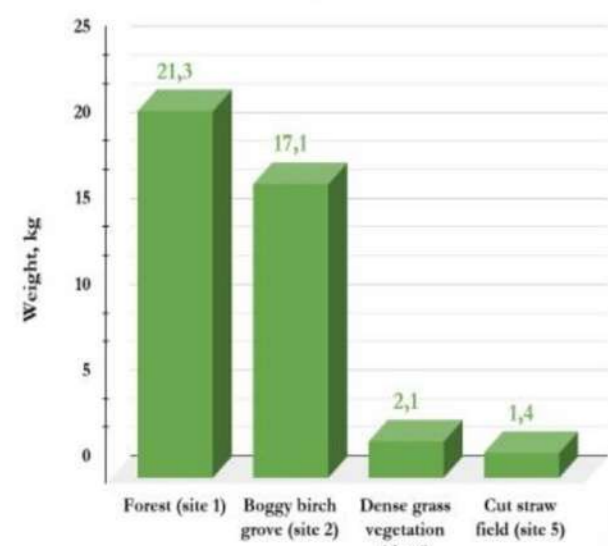
● Energy stored in biomass:

We had to mark the measurement area of 30m x 30m and area of 15m x 15m, then measure and record the circumference of a tree stem, estimate species of the tree, and estimate biomass of the tree from a graph. Finally, we summarised biomasses of all measured trees, and calculated carbon storage, biomass and energy storage per square meter.

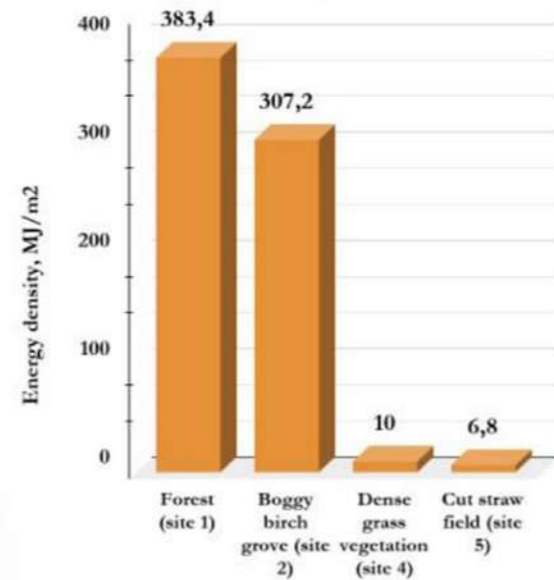
	Forest (site 1)	Boggy birch grove (site 2)	Dense grass vegetation (site 4)	Cut straw field (site 5)
Biomass, kg/m ²	21.3	17.1	2.1	1.4
Biomass energy MJ/m ²	383	307	10	6.8

Also we collected fresh green grass and dry cut grass to measure biomass and measured the soil temperature.

The Weight of the tree, grass, and straws biomass, kg

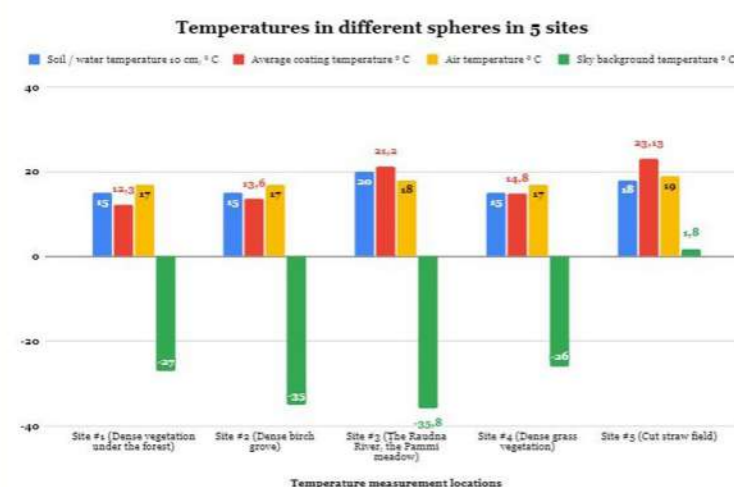


The Energy density of the tree, grass, and straws biomass, MJ/m²



● Temperatures in different spheres:

There were the difference and similarities of the temperatures in different spheres. We assume that this is mostly due to variation of the humidity and illumination of the area where the temperature measurements were taken. It is remarkable that the temperature of water in the river was higher than that of soil. This is likely to have been caused by the higher heat capacity of water which can store more sunlight energy than soil does. In the open field, the air, soil, and surface temperatures were higher than in other land sites. Also, the surface temperature was higher than the soil temperature.



The efficient temperature of the sky background was in most cases negative, and remarkably lower than the temperatures near the ground. Therefore, as the heat moves up, the Earth's surface is cooled. Different temperatures in different spheres cause local movements of heat energy between spheres. According to the laws of thermodynamics thermal energy always moves from the warmer objects towards the cooler ones.

● Introduction:

Nature has huge reserves of energy. It is exposed to sunlight, winds, and river water. Energy is stored in wood, gas, oil, and coal deposits, and is released during the combustion of these substances. Our aim was to measure and study energy in different spheres, namely in water, in the air, in the atmosphere, in the soil, and on the surface, and to understand its effect on these spheres. The expediency in this study lies in the understanding that the use of these energy resources is not an innovation, and some of them are not relevant and problematic. This study was performed in August 2020 during Estonian GLOBE Learning Expedition. The expedition took place near the City of Viljandi at the Sammuli Holiday Village and lasted 4 days. Members of our team were GLOBE students of two Estonian schools.

● Methods & Materials:

Our investigation was related to various natural spheres. We measured:

- Temperatures of soil, water, surface, air and sky, in order to learn how thermal energy moves throughout spheres; (study material)
- Biomass of trees to estimate energy accumulated in trees per square meter;
- Biomass of grass to estimate energy, accumulated in graminoids per square meter;
- Flow rate of water in Raudna river and wind speed at the same site to estimate kinetic energy in water and air;
- illumination and cloud cover to understand the background of measurements.

Was used:

- Soil thermometer
- Liquid filled thermometer
- Infrared thermometer
- Psychrometer
- Vernier sensors: air, flow rate, wind speed, light
- Globe data entry app and cloud charts
- Mobile phones
- Compass
- Scale
- Measurement tapes (50 m and 1 m)
- Flags
- GLOBE protocols, route map, GPS, table with MUC codes, paper bags, scissors.

● Results:

According to the results of the study, it was revealed that:

- temperature of various spheres is influenced by many factors, including sunlight, clouds, illumination, humidity, ecosystem characteristics, and movement of thermal energy between spheres;
- the life cycle affects the energy stored in the biomass of herbs and trees;
- biomass and energy stored per square meter differ between forested and herbaceous areas.
- energy is permanently moving between spheres and parts of an ecosystem.

As an illustration a figure about thermal fluxes in expedition site 2 is presented (Fig 12). The results obtained can lead us to the conclusion that not all energy sources are chaste for human use for their own purposes. It is not profitable for energy producers such as heat from a power plant to use it as fuel.

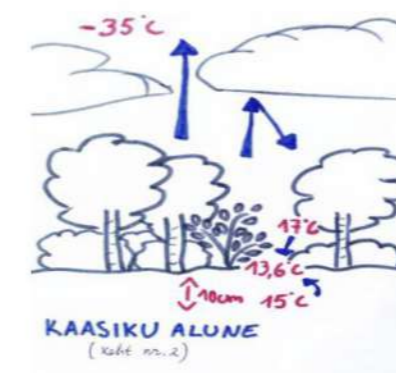
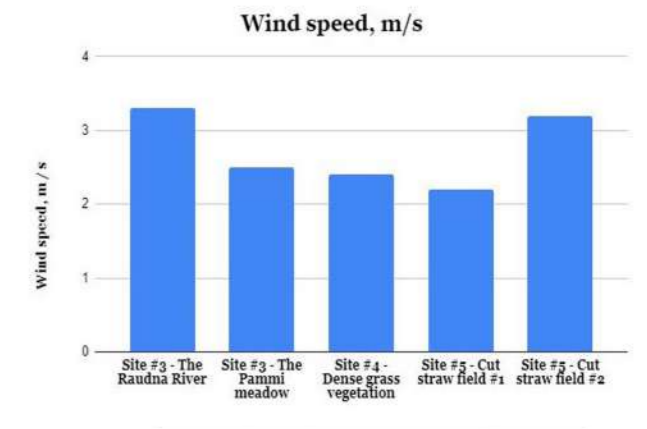


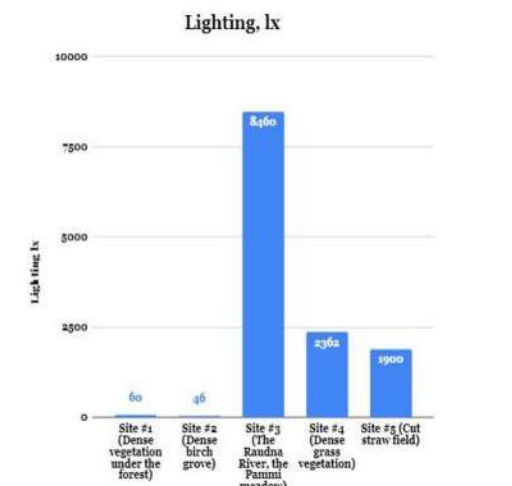
Figure 12. Heat flows in birchwoods in observation site 2 (author Markus Lambing).

● Other measurements in expedition route:

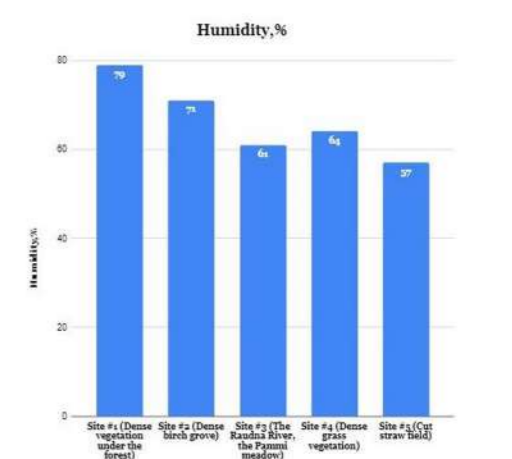
Wind speed was measured in five different sites. The highest speed was measured in the second cut straw field, namely 3.3 m/s. The lowest speed, 2.2 m/s, was measured in the first cut straw field. The average speed of water flow in the Raudna river resulted in 0.01 m/s. As the water flow and wind speeds were low, it can be concluded that there was little kinetic energy in the air and river.



The sunlight exposure was measured at five different sites. This helped us to find out how much sunlight affects the temperature in various areas. The Raudna River site had the greatest illumination, namely 8460 lux. The lowest illumination levels were measured under dense birch grove (46 lux) and under forest (60 lux).



Measurements of air humidity were made to assess the effect of humidity on temperatures in the selected areas. The highest humidity, 79%, was measured in the first site - dense vegetation under the forest. The lowest humidity, 57%, has the fifth site - cut straw field. The arithmetic average of all air humidity measurements resulted was 65.5%. Decreasing of humidity from site 1 towards site 5 was likely to have been caused by the changing time of the day and increasing flow of solar energy. However, the humidity was also influenced by the illumination of a certain place.



● Something:

To obtain heat, organic fuel, like coal, peat, natural gas, fuel oil, oil shale, is burned in boiler units of TPPs. The high consumption of raw materials such as straw, wood, and grass, which we studied in this study, can lead to catastrophic consequences, for example, some species of insects will become smaller and more of them will become extinct. They pollinate plants, are an important link in the process of soil formation, serve as food for birds, mammals, reptiles, and fish, and also perform many other useful functions and their disappearance can lead to so many losses, which in turn lead to more serious problems that already concern climate change. If problems occur in the life and energy cycles, it can lead to serious climate change. The most noticeable consequence of climate change will not be gradual warming, but "emergencies" such as severe droughts, floods, storms, hurricanes, extremely hot days that will occur more often. The level of the world's oceans will rise and ocean currents may change significantly. Mankind will face water supply problems and the degradation of agricultural land