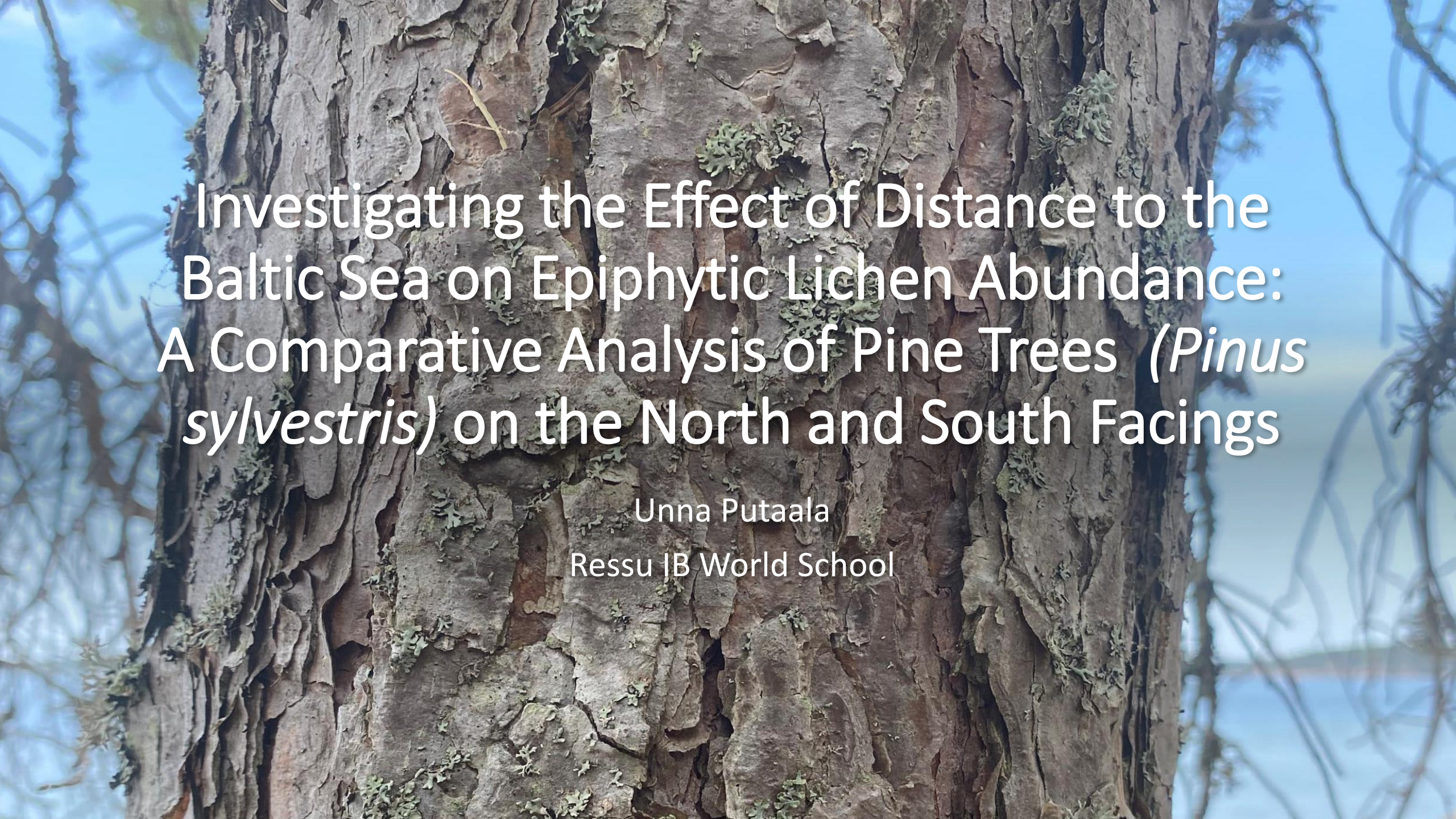

Investigating the Effect of Distance to the Baltic Sea on Epiphytic Lichen Abundance: A Comparative Analysis of Pine Trees *(Pinus sylvestris)* on the North and South Facings

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Background

- Lichens are symbiotic associations, consisting of fungi and an alga or *Cyanobacterium*.
  - The components have a symbiotic mutualistic relationship → they live in physiological association in which both benefit from each other.
- Lichens are found in various habitats, and they have an important role in the ecosystems in contributing to water cycle, nutrient cycle, soil formation, food-webs and providing habitats and food for invertebrates.
- Epiphytic lichens, which were investigated in this study, grow on tree barks, tree trunks and branches.
- Lichens are good indicators of air quality, since most of them are sensitive to air pollutants and to other changes in environmental conditions.
- Majority of previous lichen studies concentrate on the effects of pollution and air quality on lichen.

  → I wanted to study something else.
- Clean air and nature are important to me, and I am worried about climate change.
- Climate change is closely linked to seas.
  - As average temperatures rise, the sea surface evaporation increases, and this elevates humidity levels.
  - Wind patterns can also change due to climate change and influence humidity levels.

  → I hypothesized that these factors could influence lichen communities in coastal areas.

Research question, hypothesis and variables

What is the effect of the distance from the Baltic Sea (0-100m) on the abundance (percentage coverage (%)) of epiphytic lichen on pine trees (Pinus sylvestris) measured from sea-facing (north) side and from away from the sea facing (south) side in Ölmos, Turku Archipelago, Finland?

- H0 Null hypothesis: There is no statistically significant relationship between the distance from the sea and lichen percentage coverage on pine tree trunks.
- H1 Alternative hypothesis: There is a statistically significant relationship between the distance from the sea and lichen percentage coverage on pine tree trunks.

- Independent variable:
  Distance from the sea (0-100m) ± 0.5m

- Dependent variable:
  Lichen coverage percentage (%)

Study site

- I investigated epiphytic lichens on pine trees in Ölmos, Turku Archipelago along the Baltic Sea coast (WGS84: 60.093, 22.382)

- Pre-tests were conducted in Uutela, Helsinki and Porkkalanniemi, Espoo. I observed that those environments were not suitable for the study, because the terrains were too rocky and steep with varying elevations. Additionally, in Porkkalanniemi, there were not enough pine trees, and the forest was too dense with other tree species.

- The selected study site in Ölmos exhibited stable environmental controlled variables across the gradient and provided enough of pine trees for measurements.

Figure 1. Map of the Baltic Sea. The white star marks the study site in Ölmos, Turku Archipelago, Finland. Photo: WorldAtlas.com

Experiment materials

- The experiment materials used in the investigation

Figure 3. Materials for the field experiment with uncertainties.

Methods

- **A systematic sampling method** by selecting pine trees within two 100-meter transect lines was conducted (figure 2)
- **The point grid sampling method** was used to measure lichen coverage percentages (figure 4)
- For lichen coverage percentages on trees from both transects **Pearson correlation** was conducted
- **Mann-Whitney U -test** was used to compare the lichen coverage percentage distribution in distances of 0-49 meters and 50-100 meters using SPSS-software.

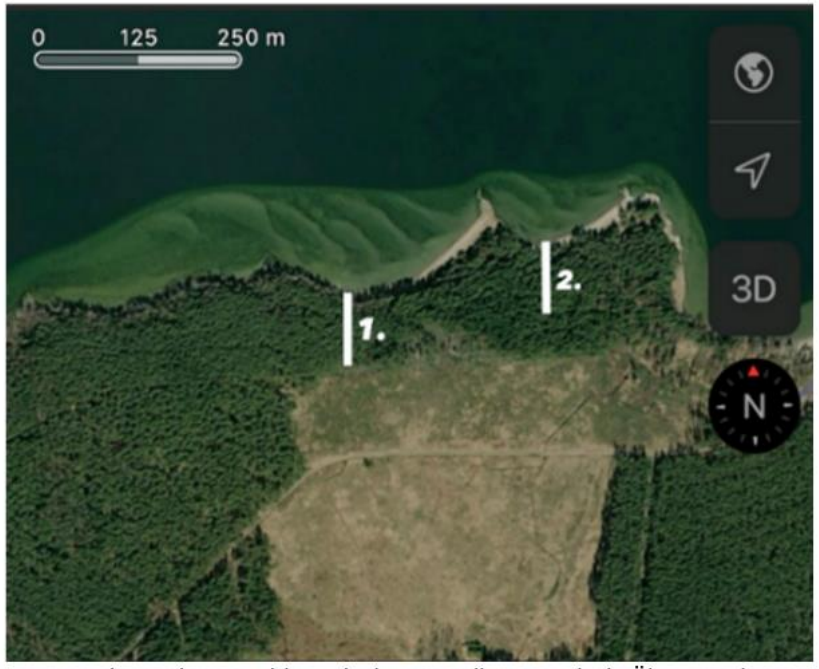

Figure 2. The study area with marked transect lines 1 and 2 in Ölmos, Turku Archipelago, Finland. Screenshot of the map taken from Iphone's Maps application.

Figure 4. An example on how point grid intersections on a transparent quadrant that were covered by lichen were marked by a dot using red marker

Results

- In total, my experiment included 111 pine trees along two transect lines.

- Both Pearson correlation and Mann-Whitney U -tests **(next slides)** showed a statistically significant relationship between the distance from the sea and lichen percentage coverage on the sea-facing (north) side of the pine tree trunks → there was found a decrease in the lichen coverage when going further from the sea.

  →The null hypothesis can be rejected for the north side, the alternative hypothesis can be accepted

- On the side facing away from the sea (south), the distance from the sea did not have an effect on lichen coverage on the trees.

Pearson correlation

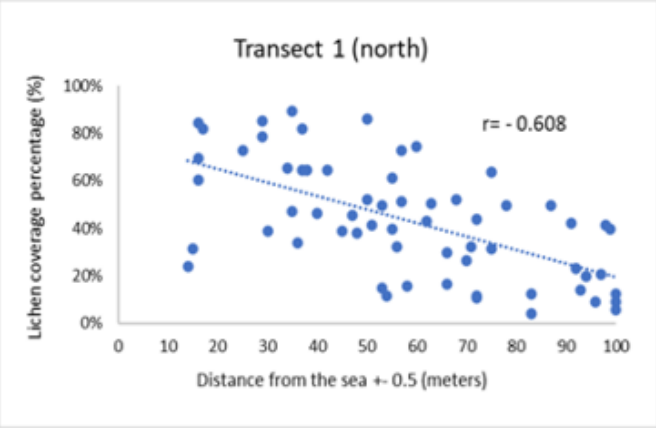

Figure 5a. Pearson correlation graph for the lichen coverage percentage (%) in transect 1 for sea-facing side (north) of pine tree with calculated r-values

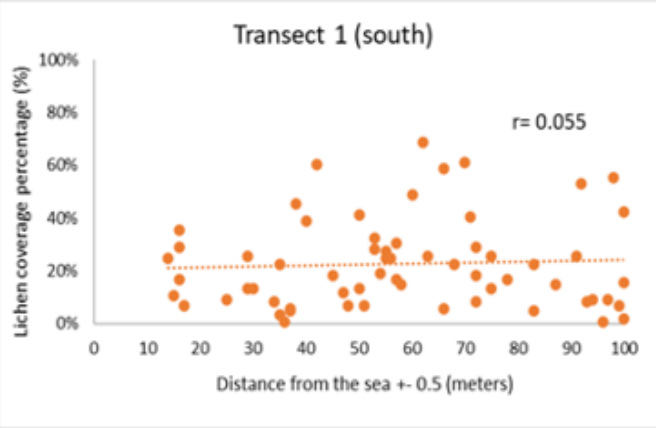

Figure 5b. Pearson correlation graph for the lichen coverage percentage (%) in transect 1 for the side of a pine tree facing away from the sea (south) with calculated r-values

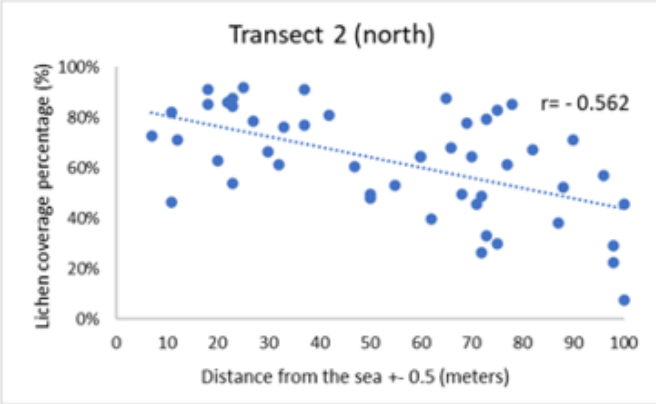

Figure 6a. Pearson correlation graph for the lichen coverage percentage (%) in transect 2 for sea-facing side (north) of pine tree with calculated r-values

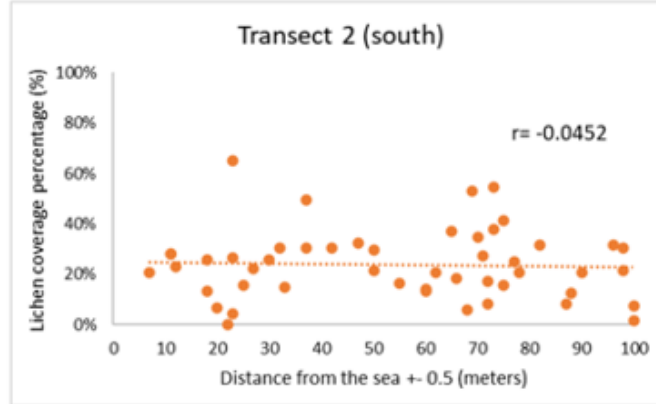

Figure 6b. Pearson correlation graph for the lichen coverage percentage (%) in transect 2 for the side of a pine tree facing away from the sea (south) with calculated r-values

Mann-Whitney U -test

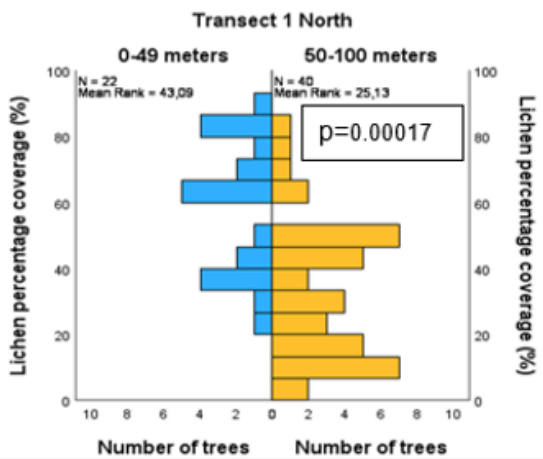

Figure 7a. Mann-Whitney U –test for transect 1 for sea-facing side of a pine tree (north) comparing lichen percentage coverage percentage (%) distribution on pine trees between distances 0-49 and 50-100 meters with calculated p-value

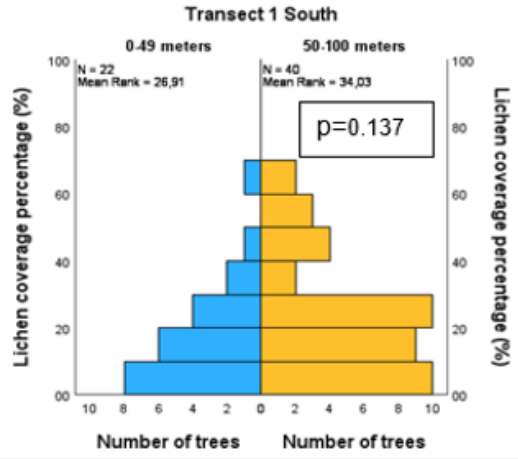

Figure 7b. Mann-Whitney U –test for transect 1 for the side of a pine tree facing away from the sea (south) comparing lichen percentage coverage (%) distribution on pine trees between distances 0-49 and 59-100 meters with the calculated p-value

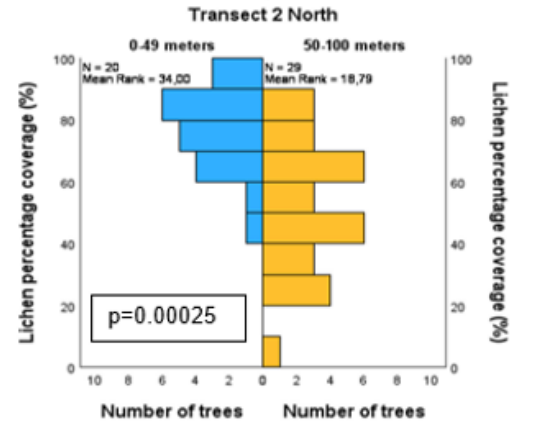

Figure 8a. Mann-Whitney U –test for transect 2 for sea-facing (north) side of a pine tree comparing lichen percentage coverage percentage (%) distribution on pine trees between distances 0-49 and 50-100 meters with calculated p-value

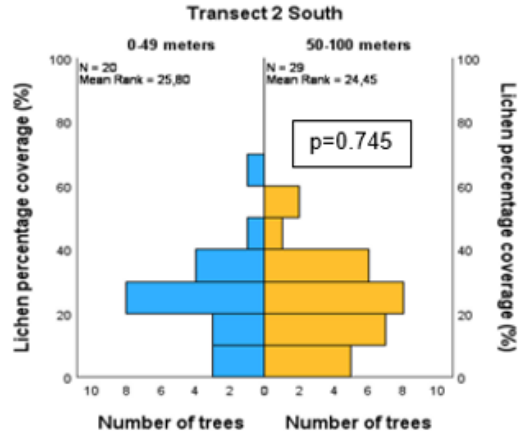

Figure 8b. Mann-Whitney U –test for transect 2 for the side of a pine tree facing away from the sea (south) comparing lichen percentage coverage (%) distribution on pine trees between distances 0-49 and 59-100 meters with the calculated p-value

Conclusions

- The distance from the sea had a significant effect on the lichen coverage percentage on the sea-facing (north) side. The shorter distance was demonstrated to promote the lichen growth. This effect was not observed on the side facing away from the sea (south).

- On the sea-facing north side, the most probable explanation for the larger lichen abundance in proximity to the Baltic Sea, was the increased humidity levels in the atmosphere, but also salinity, air quality, microclimate effects, differences in lichen species and edge effects can be considered as possible factors affecting lichen percentage coverage.