A Report on the Comparison of Species present in Sackenbach marteloscope

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Introduction

The objective of this study is to distinguish the diameter growth and height growth of various species within and among the four quadrants of "Sackenbach" marteloscope, during a span of seven years ranging from 2015-2021.

A marteloscope is a large, rectangular forest area in which all trees are systematically numbered, mapped and recorded. The site is one-hectare rectangular plot that is subdivided into four subplots of fifty metres each. The tree's location, height, diameter at breast height, tree number (ID), crown base height are some of the parameters that can be measured in a marteloscope. Stem volume and Basal Area are the derived parameters which are computed from the measured parameter of marteloscope.

Marteloscope areas are capable of serving as an effective tool for silviculture training, providing educational resources for a range of target groups, including forest practitioners, decision makers, scientist, students and other communities. These areas can be particularly useful for supporting policy dialogue between different interest groups. Furthermore, they offer opportunities for field trips and forestry educational programs, while also contributing in improved decision making with respect to integrating biodiversity aspects into forest management.

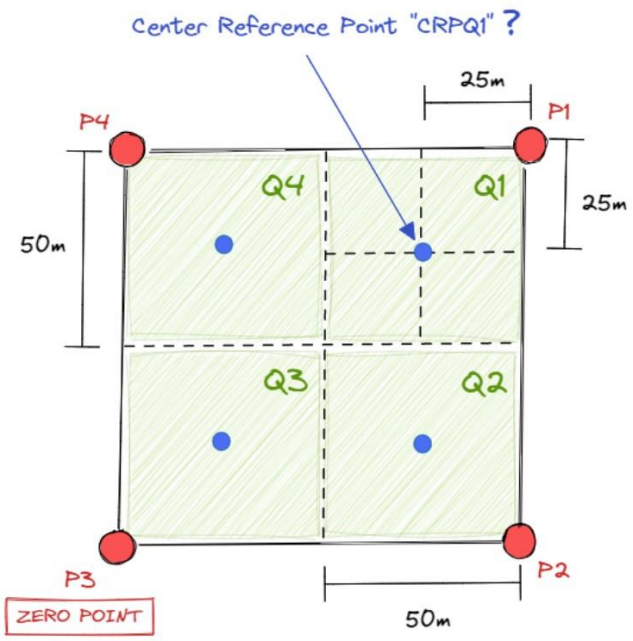


Fig.: Sketch of the Marteloscope (Green = Quadrants, Red = Corner Points & Zero Point, Blue = Center Reference Points)

Trees of different species for instance, Birke, Larch, Oak, Pine, Spruce, Beech and Fir are present in Sackenbach marteloscope. Species composition is distinct for each quadrant(plot) of Sackenbach. For instance, Plot2 consist of trees of Oak, Pine, Spruce, beech species whereas, Plot 3 consist of Spruce, Beech, Oak, Fir, Larch and Pine.

It has been observed that a particular plot of Sackenbach marteloscope reinforce the growth of height and diameter of a specific type of species over others. Similarly, the entire marteloscope supports the growth of diameter and height of a specific type of species over others. Therefore, this study aims to report the contrast in growth of diameter and height of different tree species using the visualization tools of bargraphs and scatterplot.

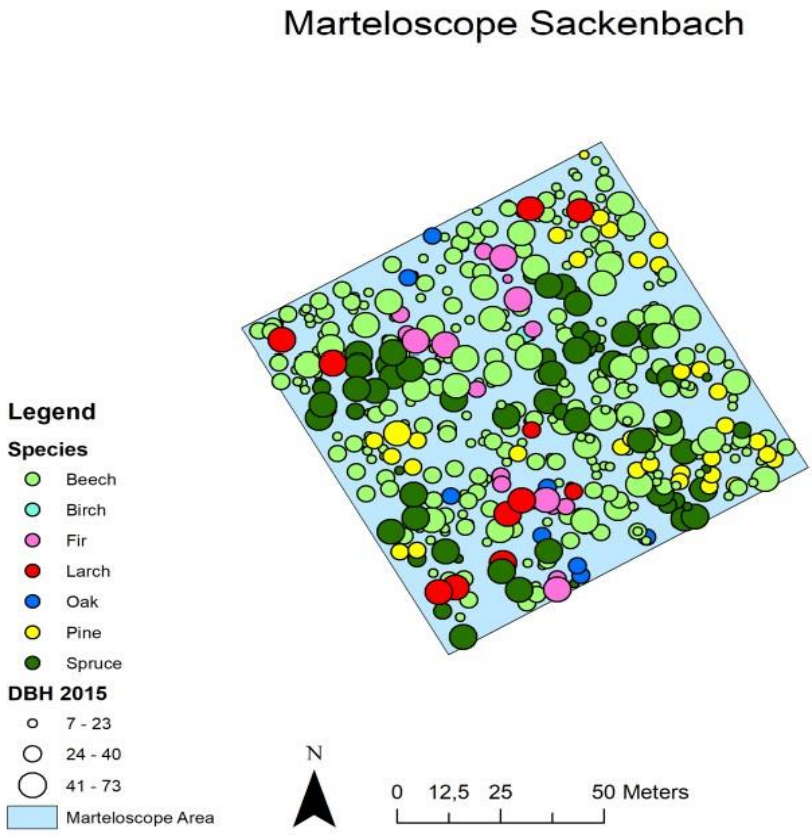
Materials

Study Region

The Sackenbach marteloscope is located at latitude 50.00788 and longitude 9.59348, situated in the Main Spessart district of Bavaria, Germany. Its establishment occurred in the year of 2016, and is currently owned by the Bavarian State Forest Enterprise.

The study region encompasses an expanse of one hectare, situated at an elevation of 350 metres above the mean sea level (m.a.s.l). The Sackenbach marteloscope comprises a diverse range of tree species, including Birke, Oak, Pine, Larch, Beech, Fir and Spruce.

The forest site contains 490 trees per hectare. The site experiences an average annual precipitation of 700 mm and has a mean annual temperature of 8.4 degrees Celsius.



Data Acquisition

Data is gathered from the owner of Sackenbach marteloscope. Robert Staufer, the concerned person working in Bavarian Technical School assist in data collection process. A total of four CSV files were procured for each of the four plots. Furthermore, an additional four CSV files that included the center refrence points for all plots were also obtained.

CSV file of plots contain attributes (columns) for instance, identity number of species, species name, value of diameter breast height and tree height in two different years, diameter and height growth from year 2015 to 2021, crown base height and deadwood volume. The field values for diameter growth and height growth in the data lack measurement units.

Method

Data attributes, namely Species, diameter growth and height growth are utilized for data visualization. In order to perform a comparative analysis of diameter growth and height growth between different species, mean values of these growth metrics are utilized. The terms diameter growth and height growth describe the augmentation in diameter and height of trees within a span of seven years. To facilitate proper analysis and visualization, the measurement units of centimeters and metres were respectively allocated by user to diameter growth and height growth respectively.

The construction of bar graphs and scatterplots involve the utilization of three python libraries, namely, Pandas, Numpy and Matplotlib. Therefore, these three libraries are installed and imported.

Subsequently, data frames are created for each of the four quadrants using pandas library. Unique elements of species attribute are extracted from all quadrants. Then, a data frame is created that sorts the species based on their average diameter growth values across all four quadrants. Similarly, a data frame is also created that sorts the species based on their average height growth values across all four quadrants.

The obtained data frames and species array are utilized to create a bar graph using the matplotlib library and saved in the directory.

The fields “diameter growth” and “height growth” of all four quadrants are assigned separate variables and used them to create a scatter plot using matplotlib library and saved in the directory.

Result & Discussion

Based on the bar chart of first quadrant presented in Figure1, it can be inferred that Pine trees exhibit the smallest growth in diameter among all the tree species considered, while Spruce trees demonstrate the largest growth in diameter. According to the data, the height growth of Oak trees has the smallest value while Pine exhibits the largest height growth value.

Based on the bar chart of second quadrant presented in Figure2, Oak trees exhibit the highest values for both diameter growth and height growth among the tree species analyzed, whereas Pine trees display the lowest values for both diameter growth and height growth.

According to the data of third quadrant presented in Figure 3, both Oak and Pine trees exhibit the lowest values for diameter growth, while Fir trees demonstrate the highest value for diameter growth. Additionally, Pine trees display the smallest value, while Fir trees exhibit the largest value for height increase.

Based on the data in quadrant 4, present in Figure 4, it can be observed that Oak trees have the smallest values for both diameter growth and height growth among the tree species considered. Conversely, Spruce trees exhibit the highest value for diameter growth, while Larch trees demonstrate the greatest value for height growth.

Regarding the scatterplot presented in Figure 5, it can be observed that, out of the four plots depicted,Plot3 features the highest value for mean diameter growth in case of Fir species, whereas Plot 4 displays the lowest mean diameter growth for Oak.

The scatterplot presented in Figure 6 makes it evident that, among the four plots depicted, Larch demonstrates the greatest mean height growth value with Plot 4 accentuating this observation significantly. Conversely, Oak exhibits the lowest mean height growth value with Plot 1 displaying this trend most notably.

The variation in growth of different plant species in terms of height and diameter can be attributed to the influence of three critical abiotic factors- climate, soil and topography. The differential growth rate of various plant species in different plots can be largely attributed to variations in soil composition. The difference in growth of species within a plot is significantly influenced by both the temperature and topography of the region. The cool temperature and moderate precipitation in the study area render the region unsuitable for uniform growth of all plant species. Furthermore, the topography of the region, characterized by its undulating hills and valleys, is not equally supportive of all plant species.

Conclusion

After analyzing the data of Sackenbach marteloscope, it has been determined that Fir species exhibit the greatest growth in terms of diameter, while Larch species exhibit the highest growth rate in terms of height. Conversely, Oak trees exhibit the lowest growth rate in both diameter and height.

Refrences

The analysis is facilitated through the acquisition of data provided by the owner of marteloscope.

Figures for Data Visualization

	Species	Diameter_Growth
0	Beech	1.139241
1	Birke	NaN
2	Fir	1.666667
3	Larch	1.500000
4	Oak	1.000000
5	Pine	0.571429
6	Spruce	1.888889

	Species	Height_Increase
0	Beech	1.436709
1	Birke	NaN
2	Fir	1.033333
3	Larch	1.250000
4	Oak	0.700000
5	Pine	2.514286
6	Spruce	1.344444

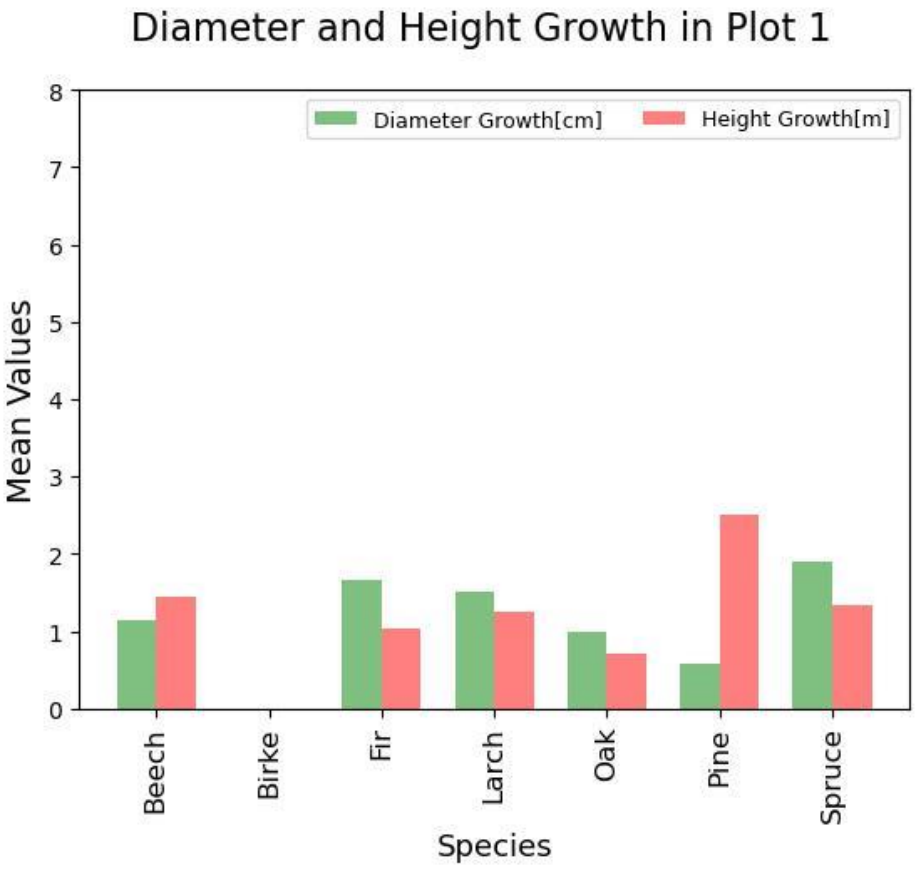


Figure 1

	Species	Diameter_Growth
0	Beech	1.548780
1	Oak	2.000000
2	Pine	0.533333
3	Spruce	1.384615

	Species	Height_Increase
0	Beech	2.245679
1	Oak	6.700000
2	Pine	1.266667
3	Spruce	2.253846

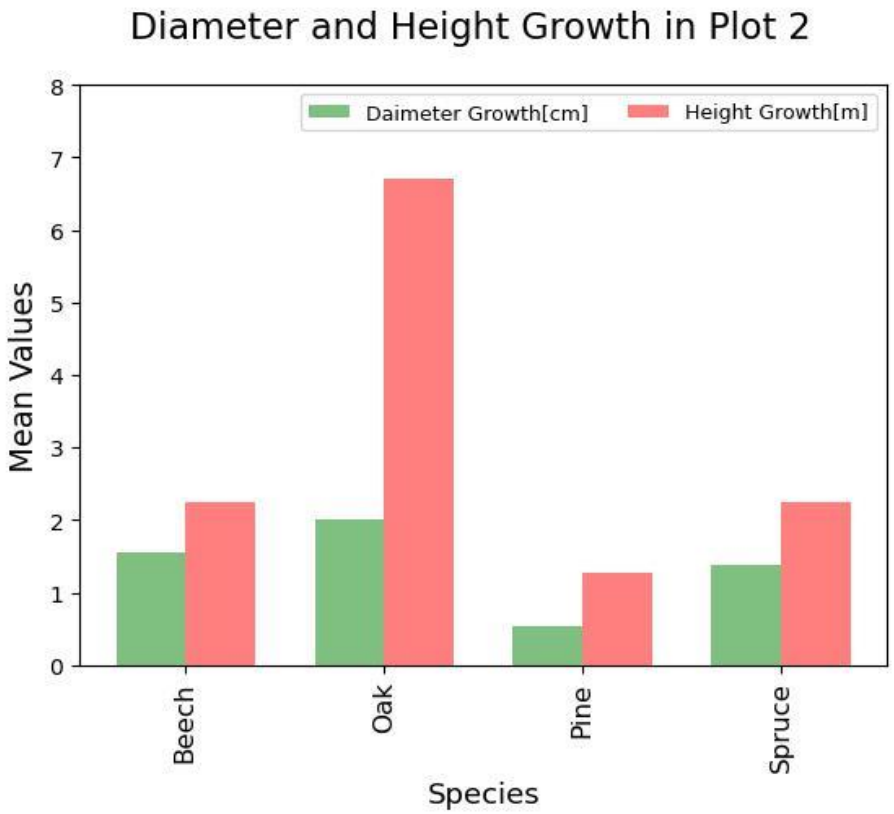


Figure 2

	Species	Height_Increase
0	Beech	1.851765
1	Fir	2.814286
2	Larch	2.671429
3	Oak	1.550000
4	Pine	1.525000
5	Spruce	1.776923

	Species	Diameter_Growth
0	Beech	1.625000
1	Fir	3.285714
2	Larch	1.571429
3	Oak	1.000000
4	Pine	1.000000
5	Spruce	2.636364

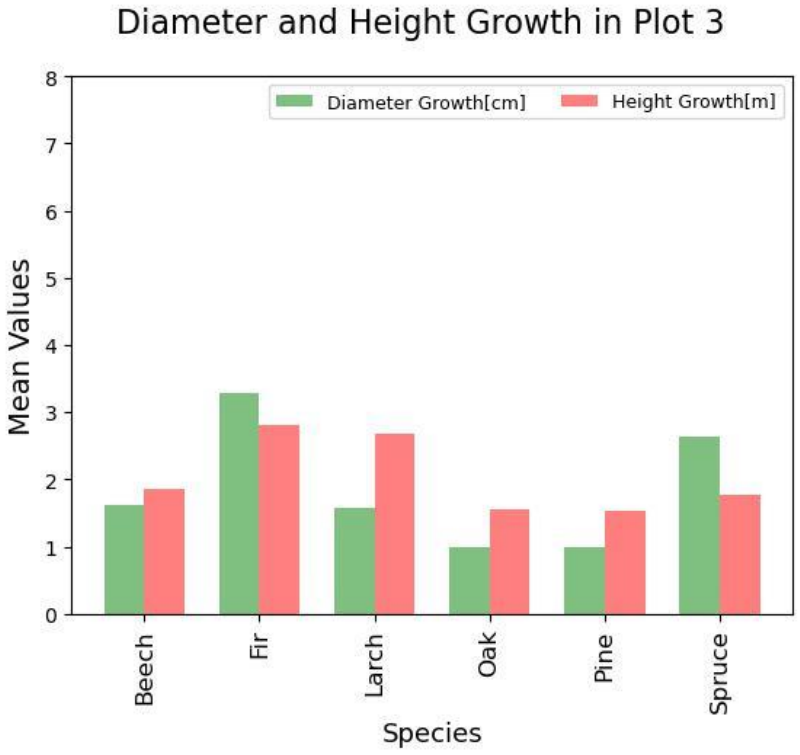


Figure 3

	Species	Height_Increase
0	Beech	1.590196
1	Fir	2.383333
2	Larch	2.950000
3	Oak	1.300000
4	Pine	1.750000
5	Spruce	2.020000

	Species	Diameter_Growth
0	Beech	1.098039
1	Fir	1.166667
2	Larch	1.500000
3	Oak	0.000000
4	Pine	1.250000
5	Spruce	1.533333

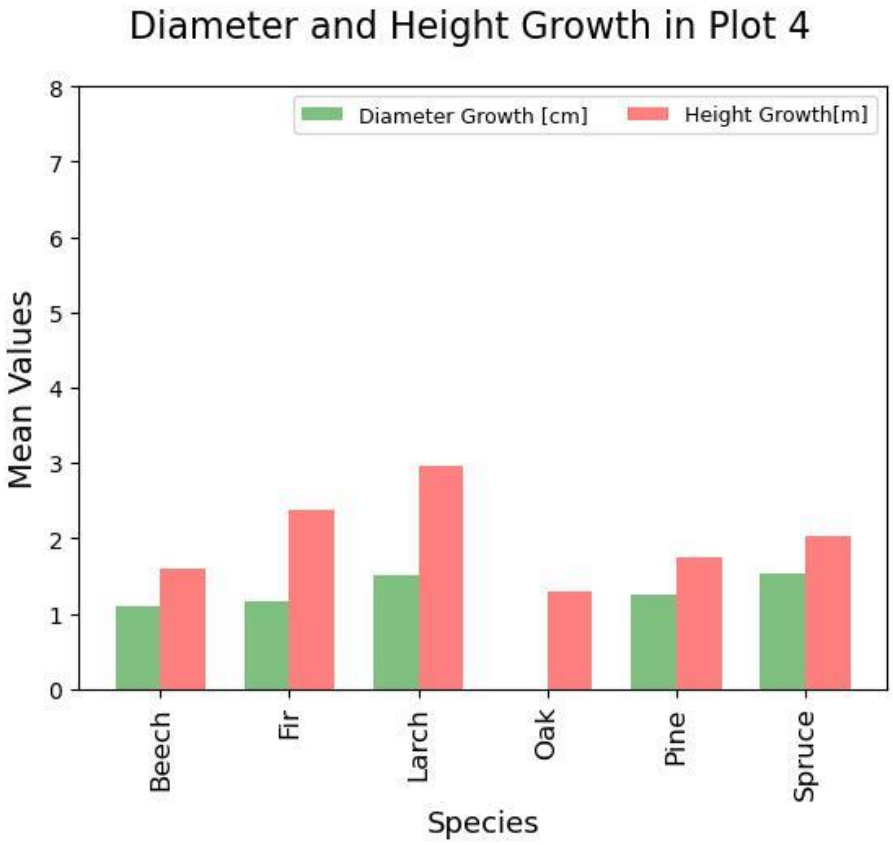


Figure 4

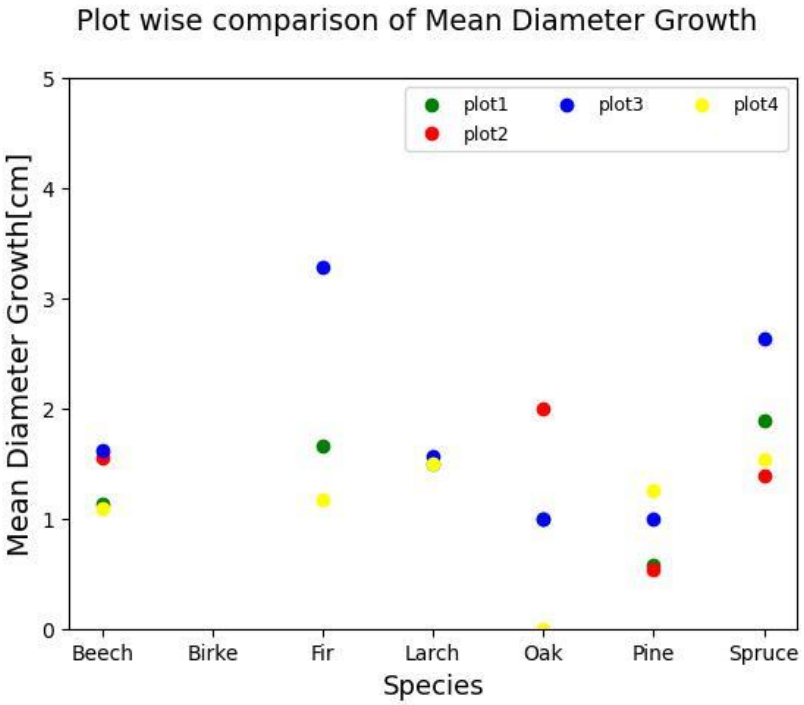


Figure 5

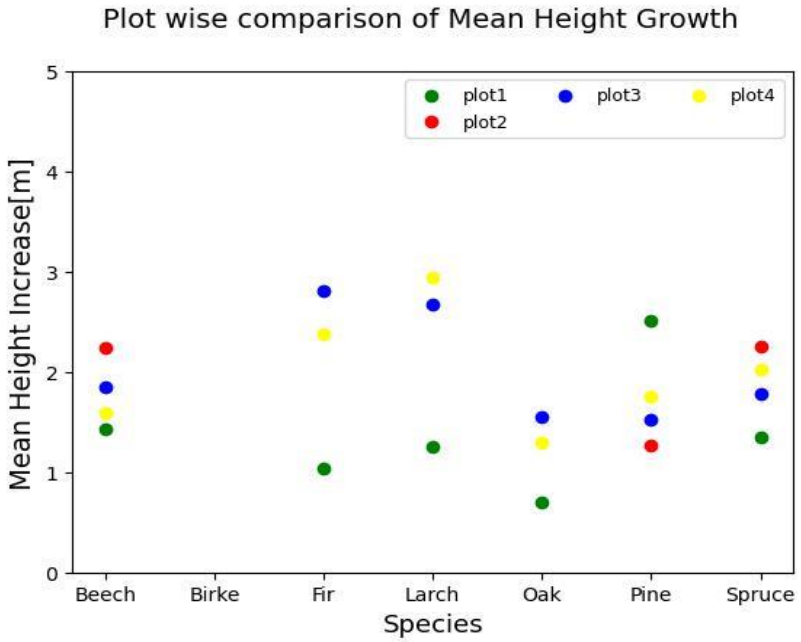


Figure 6