Field training 02 - Leaf traits measurements

Documentation

Denis Streitmatter

2023-06-06

Table of Contents

1 Task 1: Leaf sampling

1.1 Procedure

Date: 16.05.2023

Group-ID: 4

Participants: Denis, Fabian, Louis, Lukas, Marie-Louise, Maxwell

Coordinates: 51.332222, 12.384167

Material used:

- Smartphone (GPS + plant species determination)
- Book (Flora Vegetativa)
- Survey sheet

1.2 Leaf images

1.3 Recorded species tables

2 Task 4: Leaf area measurement

In the next step, we determined the mass per leaf area. We took the sheets out of the paper bag and placed them one by one into the sheet scanner. We had to make sure that the sheets were fully spread out, did not overlap, and were within the measurement range area. For some sheets, the scanner was not large enough to measure all 10 sheets at once. So we did multiple scans and added up and documented the measured leaf area for each species.

To check the correctness of the scanner we performed a second type of leaf surface measurement. For this, we placed the leaves on a DinA4 sheet and took a photo. We wrote a small script to convert the scans of sheets and paper into black and white images and calculate the cumulative sheet area from the proportion of black pixels of the total paper area. Then we compared the measured area with the result of the sheet scanner. They were very similar everywhere with slight variations (see documentation).
There were two different approaches for measuring the leaf area: Using a specific tool or calculating it on the base of photos of the leafs on standardised A4 paper sheets

2.1 Photo-based approach

For the photo-based approach we preprocessed the photos with the image-software `gimp` and then calculated the leaf size with a python script.

Preprocessing of the Photos

The goal of this step is to reduce the image to the necessary parts, mainly cutting out the A4 paper sheet. For this a few steps were used:

1. Load the image in gimp
2. Use the `lasso-select tool` for selecting the corners of the A4 paper
3. Press `CTRL + i` for inverting the selection
4. Press `CTRL + x` for cutting out everything thats not on the paper
5. Use `Image > Crop to content` to reduce the image size
    - this step is optional since alpha channel (= transparency) is ignored in the script, but this reduces file size and therefor makes it a bit faster
6. Save images in proper format for script:

- Name of the file `{leaf-number}_someuniquename_{double}.jpg` (only use `double` if two A4 papers were used)
- save all files of one species in one directory

Calculating the leaf size

The code and the description how to use it can be found in this git repository. Here we will only describe the main ideas of the process. In general we know the area of the A4 paper, so we only need to know the number of `leaf-pixels` in relation to `leaf-pixels + paper-pixels` and therefor we can calculate the area of the leaf. Unfortunately shadows of not fully flat leaves can add a lot of noise to the trivial approach (converting it to greyscale and cutting at a certain threshold). To fix this we transposed the image in the `HSV` color space, where all grey/white colors have a very low saturation value (compared to the green leaves), so we determine a saturation threshold here (a comparison feature between Bitmask, HSV and original image was implemented to find a fitting value) and generate the bitmask in this way. The transparent parts are not considered during the area calculation, only the white (paper), grey (shadows, counted as paper) and green (leaf) pixels.

2.2 LMA

To calculate the biomass of the sheets, we now had to determine the dry weight of the sheets. To do this, we put the leaves back in the paper bag, and put them in the drying oven at 50 - 55 °C. The samples were dried for 72h. Then we measured the dry weight and noted the values. Finally we calculated the ratio of dry weight to leaf area in mg/cm^2, which is the Leaf mass per Aria (LMA).