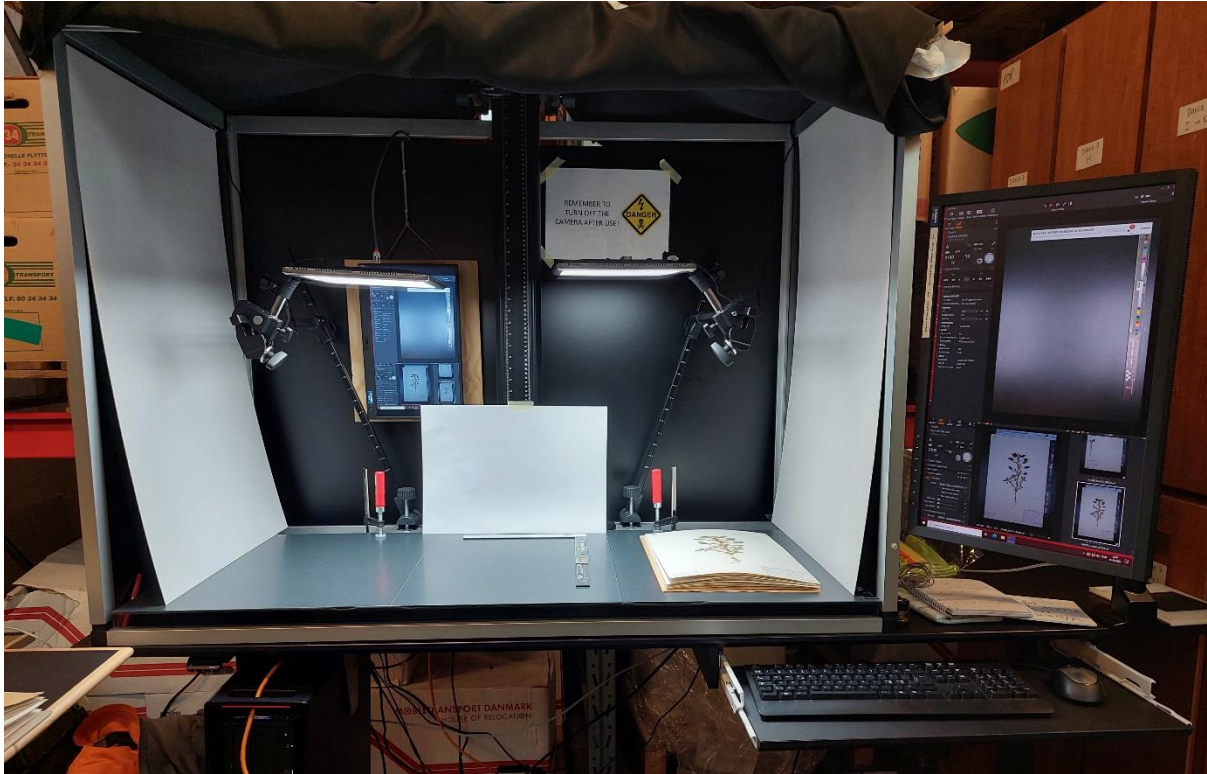


# Second Herbarium Lightbox testing

## Current Setup



The current Herbarium sheet imaging setup consists of a 140 x 97.5 x 97.5 cm scaffolding from Porsa, draped in black cloth. It provides space for three piles of 27x41 cm herbarium sheets next to each other. A Fuji GFX100S DSLR camera with a 80mm lens (Fujinon GF 80mm f/1.7 R WR) is mounted at 94.5 cm on a copy stand. Illumination is provided by two LED light panels (Godox LEDP260C) mounted on either side of the camera. Additionally, there are white sheets on the inside of the enclosure to reflect the light. The main screen is attached to the right of the enclosure, and another smaller screen on the inside.

## Objective for new setup

### **Create and test a smaller, more mobile herbarium sheet imaging setup**

- Attempt to decrease size of imaging setup, particularly height.
- Create a more mobile and universal setup for Herbarium sheets, also for other collections
- Attempt to separate lightbox from table, for increased mobility.
- Improve ergonomics if possible, particularly in regards to PC (on top of lightbox?), light glare
- Lower camera/ keep it outside lightbox to make it more accessible.
- Improve uniform lighting of sheets (ringlight? matt white interior)
- Easier to clean, protect camera from plant dust
- Testing 2 different lenses: Fujinon GF 80mm f/1.7 R WR vs. Fujinon GF 63mm f/2.8 R WR

# Initial Thoughts

## First Prototype

Simple Box, 114 (w) x 60 (h) x 55cm (d) (Fig. 1)

Length: 114 cm

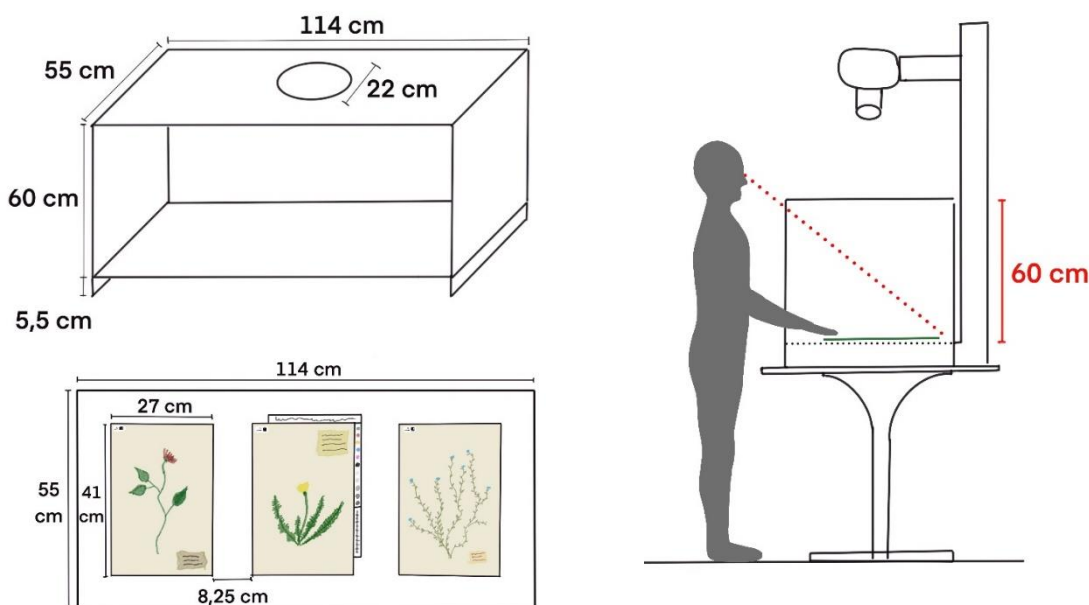
- We want to keep the “to be imaged” and “already imaged” sheet piles inside the box (for ergonomic reasons), so we need to fit 3 sheets in there side by side. (sheet: 41 x 27cm)
  - ➔ 81 cm wide, + extra space for clear FOV + extra space for moving etc.
  - ➔ At least 110 cm, we ended up with 114 right now, seems good.

Depth: 55 cm

- At least ~45 cm for sheet + angle (sheet 41 cm, angle 2.55cm)
- Main question: attachment of lighting. Do we include it in the back, then it needs to be deeper, otherwise it is fine. Can we cut holes in the back / have only a partial back wall?

Height: 60cm

- Main concern: ability to see the barcodes for imaging (how many, are they covered?)
  - ➔ At least 60cm high from sheet level (65.5 from table surface) seems a good height for this. But: smaller people? Also, you're rather subjected to light glare then.
- How high / low is best for the camera, how big would the hole in the top need to be, does it fit with the ringlight if we decide to use that?
- If it is rather low, can we then fit the monitor on top, or is it annoying to look up all the time? Also, since the camera is in the middle, the monitor would need to be either left or right of it.



**Fig 1:** top left: dimensions of lightbox; bottom left: dimensions of working surface / bottom of lightbox to accommodate three sheets; right: illustration of setup and minimum required height of lightbox.

## Lenses

### **Fujinon GF 80mm f/1.7 R WR**

- Longer focal lens (80mm) -> more details, better magnification, but smaller angle, smaller FOV.
  - ➔ How high would this need to be to fit in the entire sheet, how big would the hole in the ceiling need to be, does it fit in the ringlight?
- Smaller f-number -> wider aperture, faster shutter speed for same light exposure, higher light intensity at focal plane, but also shallower depth of field
  - ➔ Probably better lighting, but is the depth of field enough for thick specimens?

### **Fujinon GF 63mm f/2.8 R WR**

- Shorter focal lens (63mm) -> bit less magnification, but wider angle, wider field of view.
  - ➔ Maybe easier to fit into setup, doesn't have to be as high, smaller hole in the top, better for ringlight. But is the image quality the same?
- Bigger f-number -> smaller aperture, slower shutter speed for same light exposure, lower light intensity at focal plane, but bigger depth of field
  - ➔ Better depth of field, but maybe slightly darker images?

## Lighting

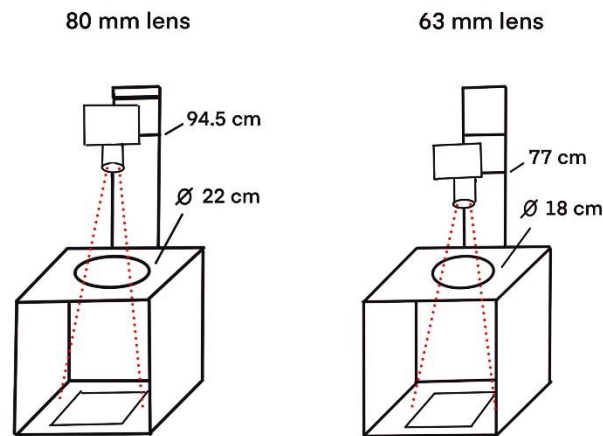
- Needs to be uniform -> how do we measure this?
- Panels, or ringlight or both?
- Ideally a square ringlight/ the whole ceiling as a light?
- White, matt interior for best indirect light / light reflection
- How do we attach the lighting, how do we get it into the box?

## Testing

We created lightbox prototype out of cardboard, with white paper on the inside for better lighting. The back wall was left out for now since we don't know where the lighting will go yet. Inside the lightbox we installed a Nanlite Halo 16 ringlight and 2 Nanlite light panels (Fig. 3). We then measured the minimum heights both lenses need to be at to capture the entire FOV (Table 1, Fig. 2).

**Table 1:** Measurements for different lenses

Measurement	Fujinon GF 80mm f/1.7 R WR	Fujinon GF 63mm f/2.8 R WR
Min. height of camera	94.5 cm (highest point)	77 cm
Hole Diameter in 60cm roof	22 cm	18 cm
Minimum ringlight height	46 cm	40 cm



**Fig. 2:** minimum height of camera to fit entire sheet into the FOV with both lenses, and minimum diameter of hole in lightbox roof needed for this, assuming the roof is at 60 cm.

## Lenses

With each lens, we took pictures with 3 different lighting setups: only panels, only ringlight, and both. In each setup, we pictured a thin specimen, a thick one, a distortion reference, a darker sheet, a coloured sheet and a white sheet. All with aperture ring on and off. Initially we did this at aperture f4.5, but then redid it with f10. Both lenses have already been compared with regards to image quality in previous tests, and we mainly wanted to see if the 80mm lens would also fit in a smaller setup, which it does.



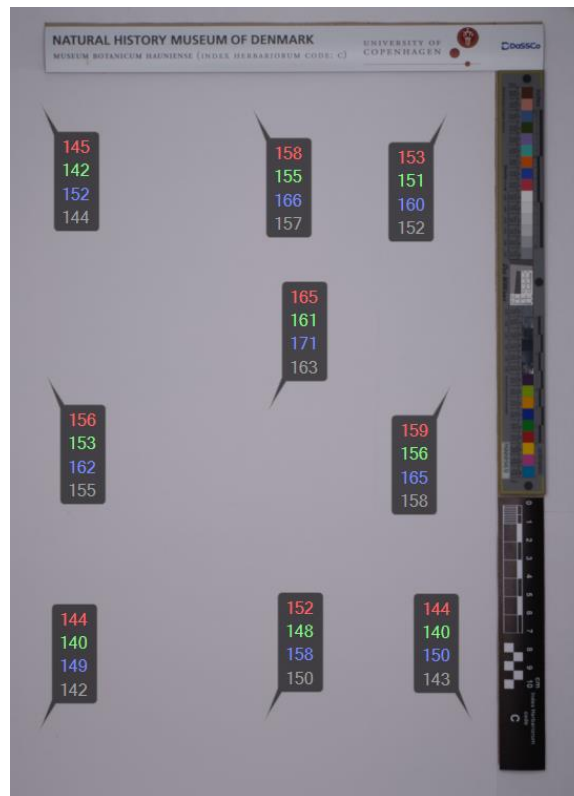
**Fig. 3:** Lightbox prototype with both ringlight and light panels.

### Lighting

We took images with light panels, the ringlight, and both. While using only the ringlight caused the least amount of shadows and using ringlight or ringlight + panels produced the brightest images (Fig. 4), none of our approaches provided even illumination across the entire sheet. We tested this by measuring pixel brightness across the sheet in CaptureOne. The range that was previously used, as suggested by the Rijksmuseum in their “Photography of 2D objects – Manual Part I”, was a maximum difference of 8 pixels. We achieved this with none of our attempts. The top and especially the bottom of the image were always slightly darker, and the very middle was the brightest part. We also used larger, brighter panels (Lupo Superpanel DUAL COLOR 60), in the hope that light panels that are larger than our sheet would solve the problem of the top and bottom being too dark. Unfortunately, this didn’t work. A reflective sheet in front of the box improved the dark bottom of the image, but it is not practical to use this during actual imaging. This could probably be solved by a smaller, more enclosed lightbox, but it would make the workflow slower and more tedious.



**Fig. 4:** Images of “thick specimen” lit using ringlight, ringlight+panels and panels respectively. Focus mode c. Aperture 4.5. GF 63mm f/2.8 R WR. “Aperture ring” off.



**Fig. 5:** Measuring the difference of lighting across the image. The highest value is 163, the lowest 142, resulting in a difference of 21, instead of the desired 8. This was the best result we achieved, and it was only possible with reflective panels in the front and back of the lightbox, which is not possible during actual imaging. Lit by the ringlight.

## Recommendations

### Lightbox

- Dimensions of our prototype work well, and it also fits with the 80mm lens
- We strongly prefer having all 3 piles inside the box for speed and ergonomic reasons
- Work on eye protection against light when the lights are finalized
- Figure out a way to fit the lights through the back once we decide on lighting.

### Lens

- Use the 80mm lens, it fits with the setup and previous tests showed that the pictures are better
- Neither lens caused any distortion.

### Lighting

- Still a problem, couldn't find a good solution.
  - ➔ Get advice from someone who has experience with this.

### Screen placement

- We still need a side screen for working, exporting etc.
- Maybe additionally a small screen on top of the lightbox, to either side of the camera