Activity report about the research in La Gamba

Thesis title: The development of *Dicranopteris* in Costa Rican secondary rainforests and its impact on tree development

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The research was conducted between late April and early June. Eight fern sites had already been investigated by Wyns (2015) in the vicinity of La Gamba. Six were further investigated in this study the remaining two were only visited. No sampling could take place on these two sites as one did not have any visible fern covering and the other one was too close to the airport in Golfito. For the latter there was no approval to unlock the air space even after several requests, preventing the drone's take off in the area. The other 17 sites were either chosen through scouting the area on a bicycle or through looking at Google Earth imagery of 2015, where a distinction between the characteristic light green colouring of the fern from other land use could rather easily be made.

Data acquisition consisted of two main tasks, flying a drone and measuring trees. Drone imagery was taken with the DJI MINI 2, which produces good images but does not come with extensive safety features. Thus, requiring an even landing strip and clear overhead conditions, meaning no vegetation above the starting and landing point. Especially on sites that were chosen with Google Earth these conditions were rarely met as the fern sites were always located on slopes and sometimes very far away from any sort of trail. A backpack was always used as a starting and landing platform to protect the rotors from any damage due to irregularities in land covering (see Figure 1).

Figure 1: Drone set up with a reference stick, backpack as a starting and landing point with drone on top. Left: Good landing conditions with even ground and no vegetation above. Right: Improvised landing strip after clearing the area of fern.

A wooden stick that was left over from the working area in the research facility was placed on the ground in order to reference the area to a known length. The stick was marked with red tape on one of its ends that was aimed northbound where possible. The drone was operated at 100 meters above the starting point and flown in a U- or inverted U-shape (see Fig. 2). This method of flight ensures overlap between pictures, which is important for the final merging into one big picture. Additionally, pictures were not only taken above the areas with ferns but also beyond, as the processed picture tends to be less smooth on the edges.

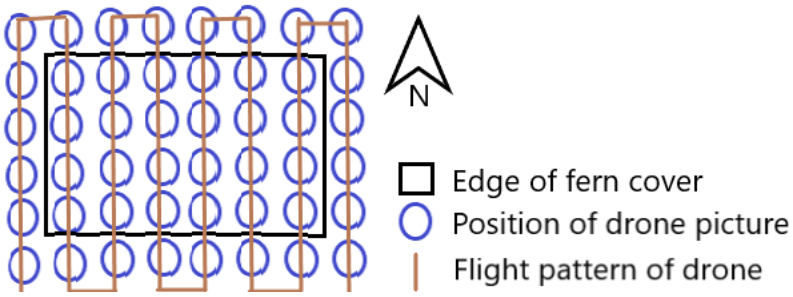

Figure 2: Sketch of drone usage

At first, the idea of taking the pictures around the same time in the morning came up so the sun would not reach over the hills yet and lighting conditions are somewhat similar. Though the lighting was mostly identical in the morning, the idea was soon discarded as

Figure 3: Two drone images shot at almost the same angle. Left: Highly faded by clouds. Right: Favourable outcome with low cloud interference.

low flowing clouds, which were common around that time, often interfered with achieving a favourable outcome (see Fig. 3). Clouds were not the only problem when trying to fly the drone: overheating, humidity, heavy rain and strong winds deterred its functionality. Hence, several sites had to be flown over more than once. Another site could not be flown over because even after several attempts, the drone could not ascend over 60 meters from the starting point due to legal reasons. As the only possible starting point with said site was at the bottom of the hill the drone was on a collision course with at least one tree crown (see Fig. 4).

Figure 4: Stephan Gräber attempting to fly over a fern site. Photo: Erika Coelho Veiga

Measuring trees was done with a standard measuring tape for trees with a length of 244 cm or 100 inches. The tree species were determined and measured at 1.3 m above ground from the higher elevated side. This information will be referenced to the respective crown projection area so a correlation can be drawn. In order to get to the trees, it was required to clear a path through the thickets of ferns with a machete, consuming a lot of energy. Navigating in the thickets was no simple task. It was virtually impossible to project the topography underneath the vegetation as its height is homogenous, though the slope of the hill was not. This, combined with the sharp edges the cut ferns left behind and other cutting plants, lead to a high injury potential. Given the strenuous, time-consuming

nature of the work as well as not having every landowner's approval to do so, trees were not measured on every site.

After gathering the drone images, they were processed using Agisoft Metashape 1.8.3. Through various steps, that sometimes took upwards of 24 hours, one big, georeferenced picture could be created that can be imported in Geographic Information Systems (GIS). The high demand of time and storage to process the imagery came as a surprise. Two additional flash drives, with a capacity of 128 GB each, had to be bought as the computer that was being used stopped working due to reaching its storage capacity. Furthermore, not all processing could be done in the research facility. Figure 5 shows part of a finished image, that has already been imported in the open-source GIS QGIS and laid over a satellite image of 2015. The fern dominated areas can easily be spotted and the improvement between a satellite on the right and drone image on the left is apparent.

Figure 5: Part of a processed image embedded in QGIS. The left side of the image shows the drone imagery while the right side shows the underlying satellite image. The fern dominated area is reflected in a light green from the left side to the centre. Source of Satellite image: Google Earth. (05.03.2015). La Gamba, Costa Rica. © 2022 CNES / Airbus.

Source:

Wyns, A. (2015). Arrested succession in Costa Rican lowland secondary rainforest through a Dicranopteris pectinata understory. Vrije Universiteit Brussel.