

Fieldwork report

**DEVELOPING A NEW RAPID BIODIVERSITY
ASSESSMENT SYSTEM: A TOOL FOR
INVENTORY AND CONSERVATION**



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Abstract

This research has been carried out using empirical data from the tropical rainforest using aerial images in order to produce baseline understanding about tree crown aerial identification. This approach will bridge the gap between traditional botanical identification and aerial technologies. The objective is to explore general aspects on the process of tree aerial identification. The methodological bases are human crown texture hierarchical classification, and textural computer analysis. The data used for this report were collected in Tiputini Biodiversity Station, Amazonia, Ecuador. An eight weeks fieldtrip was conducted during 2005. During this trip data about trees taxonomic identification were collected and a preliminary dataset was produced. Those data were analysed visually and some baseline computer analysis were done.

The human texture classification rules were summarised into two hierarchical categories: supra and infra crown. First, supra includes single- continuous, (rounded-shallow or deep) or flat classes. Secondly, the infra has multiple- layered or clumping (granular, smoky, dotted and grainy) classes. Based on this classification, spectral analysis and first order textural statistical measures –variance- were applied to the crown level at different spatial scales.

For the machine measures, the occurrence analysis for the Green, Red and Blue band shows inconsistency in spectral behaviour depending on the image spectral quality. The effect of scaling up crown properties suggested two categories of impact: smoother textures were minimised at lower altitude (50-150m), while roughness properties were maximised at higher altitudes (200-250 m). This could mean that coarse (clumping) crown properties are better captured in diffused images with a coarse resolution. In addition, even vivid images with a fine resolution do not have better sensitivity to rough textures but do have effective recognition of smoother (continuous) crown properties.

Aim

Little research has been published on the identification of trees from a distance, and consequently, our understanding of distance identification and of crown characteristic scaling behaviour is poor. Our aim is to develop manual taxonomic techniques suitable for the characteristics of tree genera and families for high-resolution aerial photographic sensors.

Methodological strategy

The community of trees recognizable from the imagery is the core of this analysis. The upper crowns of these trees has been described, classified and identified under visual parameters, according to the different features and properties of each taxa as an individual tree. The images used were taken using helium balloons and light aircraft. Botanical validations were made on the ground. The basic steps of the methodological strategy are: (find a summary in Figure 1)

- Collect low altitude high-resolution imagery

- Use those images to characterise the visual taxonomical diversity of tree crowns
- Develop a preliminary key for the qualitative identification of canopies
- Investigate the scaling properties of the leaf characteristics through laboratory studies using multi-distance photography
- Investigate the scaling properties of the crown characteristics used for identification through the analysis of how properties change in multi-altitude imagery collected from the same sites.
- Use the information from laboratory and field scaling experiments to develop a multiscale key implemented in HTML.

Main results

Traditional taxonomical methodologies were adapted to develop an aerial identification technique for crown classification using high-resolution aerial photographic data. The process began with characterising sub-crown structures such as clumps, which helps to prioritise the most useful characteristics for further identifications. Each sub-crown structure was defined by characters (i.e. crown with repetition of small leaves). The characters were interpretative and descriptive and were organised in identification keys according to hierarchies. The final crown characteristics such as clumpy, continuous etc. that may be considered key identification properties were quantified for some representative canopies using statistical textural analysis. Simulated leaf models were used along with real crown images for the assessment of scale (resolution) effects on these textural properties. The models were photographed from different distances and different configurations of leaf size, shape, and arrangement.

Crown properties

A total of 50 individual crowns, grouped within 20 botanical families, from different canopies were photographed at varying resolutions and validated on the ground at the family taxonomical level. From this data and also observation of imagery of the study site, the basic crown types have been identified as continuous, clumps, leaf clusters, and individual leaves (Figure 1).

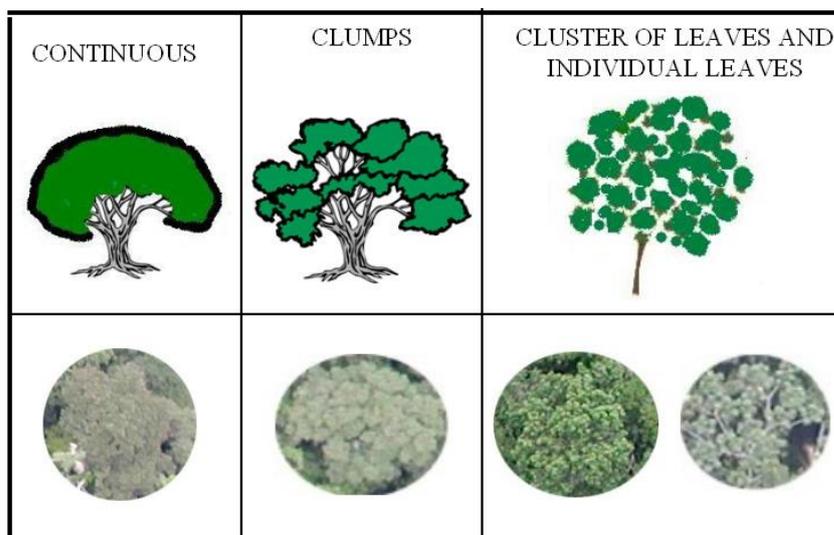


Figure 1. Basic crown type for Amazonian trees

Identification keys

Figure 2 and 3 show the two different types of keys proposed, namely, a visual interpretation key and an interactive online key. Interpretation keys generally show a route that illustrates how to identify an object; in this case, each step describes different classes of internal crown properties (Figure 2).

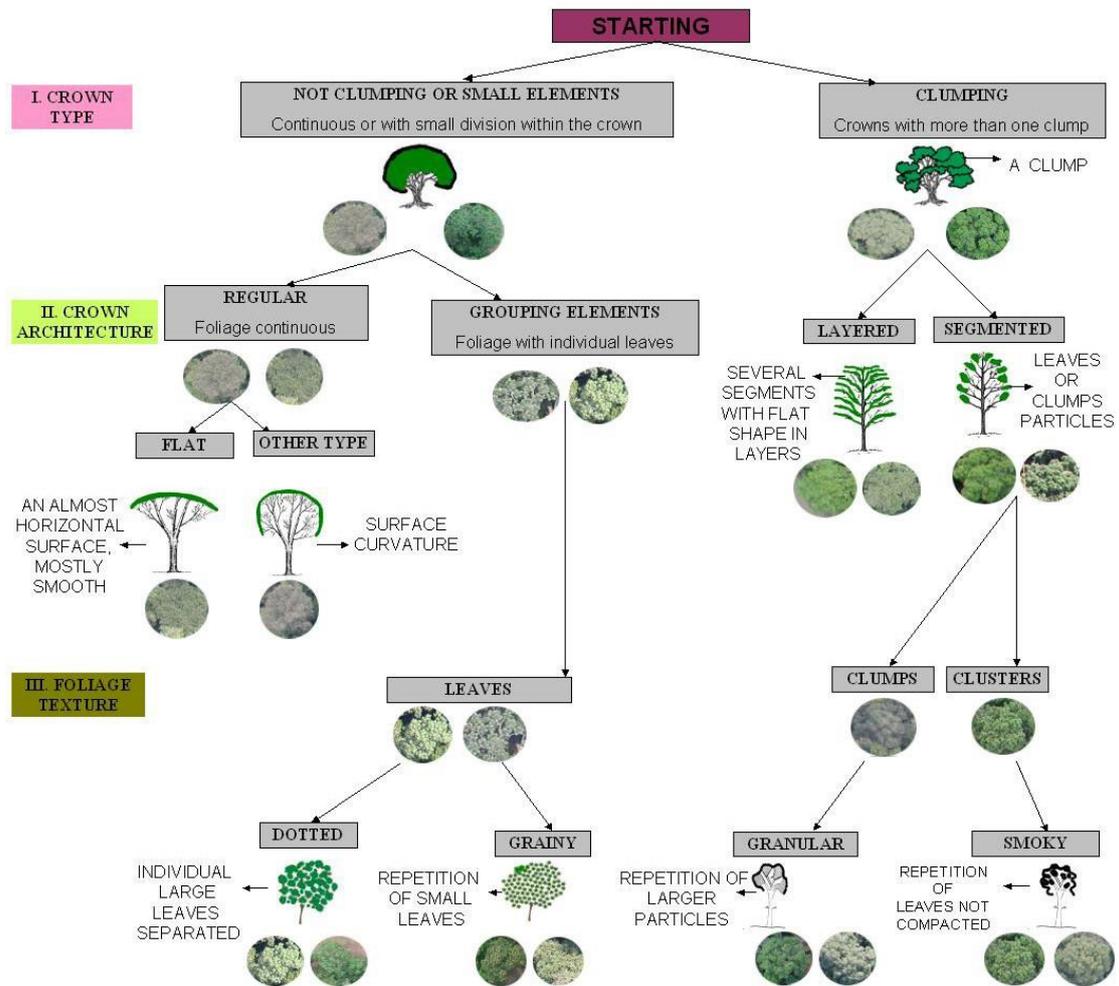


Figure 2. Visual interpretation key for Amazonian crowns.

A complementary multiscale online identification key was developed from the initial interpretative paper keys at the family level, using the fieldwork data in the form of an HTML database. This key is available online at: (<http://www.ambiotek.com/biodiversity/index.html>); Figure 3 illustrates the first pages of the preliminary online version.

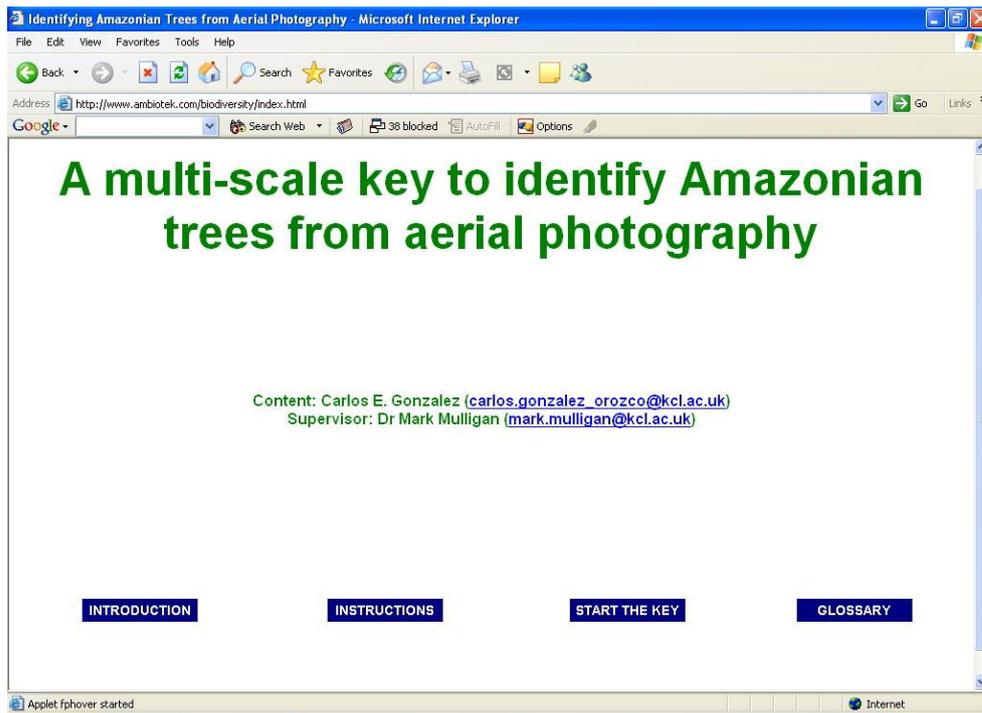


Figure 3. Example of main web pages of the multiscale aerial key for some Amazonian tropical botanical families

Resolution effects on crown properties

The result observed on analysis of crown properties might suggest that up scaling resolution (low to high) affects the identification of crown properties. Evidences from figure 4 demonstrate that when resolution decreases texture tends to decrease, at least for this specific range of data.

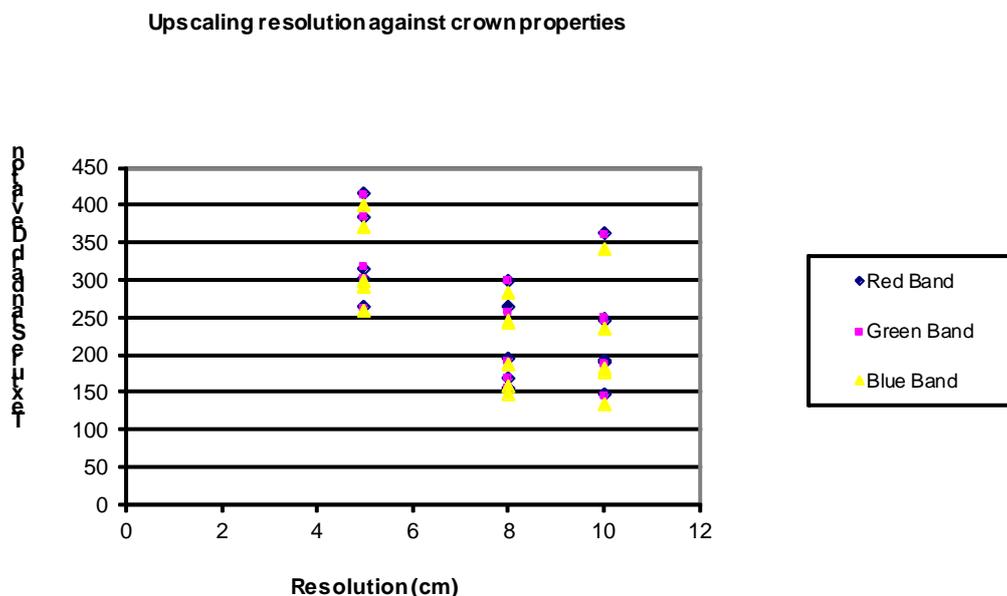


Figure 4. Impact of resolution (4 to 10 cm) on crown properties

Fieldwork activities and budget invest

Activity	Duration	Budget
- Flight from UK-Colombia-UK - Travel Colombia-Ecuador- Colombia	2 days	£900 £200
- Fieldwork at Tiputini Biodiversity Station in Ecuador, Amazonia	8 weeks	£1,000
- Fieldwork assistance	8 weeks	£ 600
- Publicity: Developing a preliminary online key	8 weeks	£500
-Others: Local travelling, food and accommodation within Quito and Cali, workshop in Ecuador and Ciat, Colombia	1 week	£1500
TOTAL		£4700