Doctoral Thesis (set): Forest units characterization based on spectral, spatial and relief data at different scales. Application to the Andean forests of the Cuenca (Ecuador).

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Abstract: The tropical Andes is a priority area for biodiversity conservation due to their exceptional levels of endemism (Tejedor-Garavito et al., 2012). Highlands of Ecuadorian southern Andes is dominated by montane forests (~ 40%) and paramo (~ 32%) (Ministerio de Ambiente del Ecuador, 2012). Unfortunately, in this region natural habitats, even those within protected areas, are under strong pressure from human activities (Astudillo, Tinoco, & Siddons, 2015). Hence, Andean ecosystems suffer from constant loss of habitat, as a consequence of urbanization processes, expansion of the agricultural frontier, mining and illegal extraction of natural resources (Ministerio de Ambiente del Ecuador, 2012). Unofficial reports indicate that the country has the largest deforestation in the region with annual forest loss rates of 1.89% between 2005 and 2010 (Tejedor-Garavito et al., 2012). Additionally, climate change is also promoting changes in the structure and composition of habitats (Herzog, Martinez, Jorgensen, & Tienssen, 2012). Therefore, the identification and characterization of forest units within tropical Andes is an issue for conservation.

The specific study area for this work is located in Cuenca (Ecuador), where the mountain forests present a peculiar combination of humidity, temperature, geomorphology and evolutionary history that determine a very high diversity at different scales (Gobierno Provincial del Azuay, 2015). The objective of this study is to identify and characterize different highland forest parameters, their spatial distribution and classification in different forests units. Multi-scale geographic information, satellite images, aerial photographs (from National photogrammetry project and generated by UAV), multispectral images, Digital Terrain Models (DTM) as well as additional data derived from the textures analysis from high resolution images will be used.

This study is based on previous works that show that the combination of multispectral data with high resolution images allows to better stratify forest species (L. Á. Ruiz, Recio, Crespo-Peremarch, & Sapena, 2016). Besides that, spectral data provide information about the objects in function of the type of cover, state of vegetation, and soil composition. (L. A. Ruiz, Recio, Fernández-Sarría, & Hermosilla, 2011). Most of the literature, performed this type of studies with LIDAR information. However, in Ecuador there is scarce LIDAR information, thus the use of point clouds from UAVs will be evaluated as an alternative to the use of LIDAR information.

Variables to identify and characterize forest units will be defined for the study. Later, they will be parameterized and the procedures for classifying forest units will be proposed. In addition, contextual classification methods based on field data will be evaluated to increase the reliability of classifications.

Materials: Drone DJI Phantom 3 Pro, Drone DJI Inspire 2, multiespectral camera Double 4K RGB + 5-band Multispectral sensor w/Gimbal, spectral Parrot Sequoia, GPS Differential Trimble R8s

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