Araceae in a High Andean Forest of the Colombian Occidental Cordillera (Natural National Park Tatamá)

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ABSTRACT

Colombia represents the highest register of Araceae species by area. However, across the country there is a high sampling bias, with records especially lacking in the Andes and the biogeographic region of Chocó. Therefore, a study of the aroids was developed in the oriental slope of the Colombian Western Cordillera in the Natural National Park Tatamá using plots every 200m in an altitudinal range between 2400 – 3000m asl. Two genera (Anthurium and Chlorospatha) and 14 species were recorded. Of these 71.42% had a terrestrial habit, 21.43% were hemiepiphyte and 7.14% epiphyte. The genus with the largest number of species (12) and the widest distribution was Anthurium. One species,
Anthurium longogeniculatum, was present through all the altitudinal gradient studied. The highest species diversity was found in the plots located between 2400 – 2600 m. The known distribution of nine species of Anthurium and two species of Chlorospatha is enlarged in the Natural National Park Tatamá. These results highlight the fact that it’s necessary to increase the sampling and the floristic researches on Araceae, due its complexity, high diversity and endemism in the Neotropics, especially in the Andes.

KEY WORDS
Araceae, inventory, distribution, mountain ecosystem, Andes.

INTRODUCTION
The Araceae family is characterized by its high diversity and endemism in the Neotropics (Croat, 1983, 1988, 1992), and Colombia has the highest species diversity (Croat, 1992). This is related to the Andean orography, which has produced speciation, mainly in mid-high elevations in the Andes (Croat, 1992; Mora et al., 2006; Álvarez et al., 2007). Currently, there are few inventory and distribution studies of the family in the Colombian Western Cordillera despite the botanical richness of the region (Croat, 1992). Moreover, Araceae from high altitudes have been poorly documented.

In the 80’s, the project “Ecoandes” focused its efforts in the study of the structure, function and evolution of the tropical Andean ecosystem. To achieve its goals, they recently studied the Tatamá Natural Park (in the Colombian Western Cordillera) through vegetation surveys...
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(Rangel–Ch., 2005). The project presented a catalogue of the vascular plants of Tatamá Massif, which reported Araceae records below 2300 m above sea level (asl) of elevation (Rangel–Ch., 2005). However, most of the records are from localities in the south of the Tatamá Massif, and because of that the oriental slopes of the Western Cordillera and especially the high altitude zones are poorly explored.

Here, we present an inventory and an analysis of the distribution of Araceae in the boundary of the Andes and the biogeographic region of Chocó. We focused our research on the high altitude Andean forest of the Natural National Park Tatamá (2400–3000 m asl).

MATERIAL AND METHODS

National Natural Park Tatamá is located in the municipalities of San José del Palmar (Chocó department), Pueblo Rico, Apía, Santuario and La Celia (Risaralda department), and El Águila (Valle del Cauca...
Located on the Western Cordillera, the Tatamá park belongs to two biogeographic regions: the Andes and Chocó (Figure 1) (Rangel-Ch., 2005). The Tatamá park covers a total area of 51,900 hectares and presents a temperature and altitudinal gradient which varies between 15°C at 2,000 m asl to 3°C at 4,000 m asl. The topography is variable, with strong pending, mainly between 50 and 70% with Andean and Paramo ecosystems highly conserved (Florez, 2005). The oriental slope records an annual average precipitation of 1963 mm in the Sub Andean ecosystem (range: 1100–2350 mm) and 2181 mm in the Andean ecosystem (range: 2350–3500 mm).

The studied site is located on the oriental slope of the Occidental Cordillera, with an altitudinal range from 2400 to 3000 m asl; every 200 m of altitude, two plots of 50 x 2 m (eight in total) were designed (Figure 2). In each plot, all the species of Araceae were registered, the plant habit recorded and photographed, following the collecting procedures recommend in Croat, 1985.

For taxonomic determination the specialized literature was reviewed (Croat, 1983a; 1986a; 1986b; 1992; Croat et al., 2006; Álvarez et al., 2007), and comparisons were done with herbarium specimens from: Caldas University (FAUC) and Antioquia University (HUA). For a correct taxonomic and nomenclatural denomination, the Missouri Botanical Garden data base (W3TROPICO, 2011); the IPNI data base (2011) and the Nomenclatural Type data base (BORES, 2011) were reviewed.

RESULTS
Two genera were registered (Anthurium and Chlorospatha) representing 14 species, with the most frequent habit of growth being terrestrial (Table 1). The genus Anthurium is represented by twelve species while Chlorospatha was represented by only two species (Figures 3–8). Nine species of Anthurium and the genus Chlorospatha (with
Figure 3. − 3, − 4, − 5. Anthurium sp1 (JAS 74 FAUC). − 6, −7. Anthurium sp 2 (JAS 108, 109 FAUC).
<table>
<thead>
<tr>
<th>Altitude</th>
<th>Growth habit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Terrestrial</td>
<td>Hemiepiphyte</td>
</tr>
<tr>
<td>2400</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>2600</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>2800</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3000</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>3</td>
</tr>
</tbody>
</table>

**Table 1.** Habits of growth represented in each plot evaluated

<table>
<thead>
<tr>
<th>No .</th>
<th>Species</th>
<th>Altitude (meters)</th>
<th>Habit of growth</th>
<th>Total altitudinal levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Anthurium sp1.</td>
<td>0 2 0 0</td>
<td>HT</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Anthurium sp2.ting</td>
<td>0 0 1 0</td>
<td>HT</td>
<td>1</td>
</tr>
<tr>
<td>3.</td>
<td>Anthurium caramantae Engel.</td>
<td>2 2 0 0</td>
<td>HT</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>Anthurium bogotense Schott.*</td>
<td>1 0 0 0</td>
<td>HT</td>
<td>1</td>
</tr>
<tr>
<td>5.</td>
<td>Anthurium caucanum Engel.</td>
<td>0 2 2 2</td>
<td>HEM</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>Anthurium longigeniculatum Engel.</td>
<td>1 4 3 2</td>
<td>HEM</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>Anthurium nanegalense Sodiro.*</td>
<td>2 3 0 0</td>
<td>HEM</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>Anthurium pulchellum Engl.</td>
<td>0 0 1 0</td>
<td>HE</td>
<td>1</td>
</tr>
<tr>
<td>9.</td>
<td>Anthurium scabrinerve Sodiro.*</td>
<td>0 1 0 0</td>
<td>HT</td>
<td>1</td>
</tr>
<tr>
<td>10.</td>
<td>Anthurium sect. Calomystrium Schott *</td>
<td>1 0 0 0</td>
<td>HT</td>
<td>1</td>
</tr>
<tr>
<td>11.</td>
<td>Anthurium sect. Cardiolonchium Schott*</td>
<td>2 1 0 0</td>
<td>HT</td>
<td>2</td>
</tr>
<tr>
<td>12.</td>
<td>Anthurium versicolor Sodiro.*</td>
<td>0 1 1 3</td>
<td>HT</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>Chlorospatha luteynii Croat &amp; L.P. Hannon*</td>
<td>1 0 0 0</td>
<td>HT</td>
<td>1</td>
</tr>
<tr>
<td>14.</td>
<td>Chlorospatha cf. amalfiensis Croat &amp; L. P. Hannon *</td>
<td>2 2 0 0</td>
<td>HT</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>12 18 7 10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2.** Total number of species with abundance per plot and the total altitudinal levels where they were recorded. The species with "*" represent the chorological novelties for Natural National Park Tatamá.
two species) are documented here as new chorological records for the Natural National Park Tatamá (Table 2).

**DISCUSSION**

**Altitudinal distribution**

Within the altitude gradient studied (2400–3000 m asl), it appears that the terrestrial habit dominates at lower altitudes (2400–2600 m asl), whereas the unique epiphyte species was found at the higher altitude (3000 m asl). The hemiepiphytic habit appears to be evenly present along the studied altitudinal gradient.

Only 6 species out of the 14 observed were present at more than one altitude level. Thus most of the species were growing in one altitude, mainly 2400 and 2600 m asl, except for *Anthurium* sp2. (2800 m asl) and *Anthurium pulchellum* (3000 m asl).

The species from the two highest altitudes could be considered as high altitude “only found in one (or two) altitudinal levels” whereas the species only located on the lower altitudes (below 2600 m asl) could in fact be on the upper limit of the distribution range. It may be the same for the three species present at two altitudes (*Anthurium caramantae, Anthurium nanegalense, Anthurium* sect. *Cardiolonchium*) since they were only growing at 2400 and 2600 m asl. Interestingly the two species (*Anthurium caucanum, Anthurium versicolor*) present at the three higher altitudes were not found at 2400 m asl. These species may be of higher altitudes or species with large distribution area and not found at 2400 m asl due to their low density/frequency and the relatively small surface explored. When looking at the total altitudinal levels of the species, only one species, *A. longgeniculatum* appeared along the entire altitudinal gradient studied (Table 2). When looking at the altitudinal distribution of the three plant habits, it appears that terrestrial habit (n=10) is more restricted (mean+/−sd: 1.4+/−0.7 altitude levels) compare to hemiepiphyte habit (n=3; 3+/−1 altitude levels). Epiphyte represented by only one species present in one level cannot be interpreted.

**Abundance distribution**

The majority of individuals (30) are in the plots located at lower altitudes (2400 to 2600 m asl), and only seven species were registered to 2800 m asl, this being the plot with lowest abundance of species in this study. The species most abundant throughout the altitudinal range were *A. caucanum, A. longgeniculatum* and *A. nanegalense* (Table 2).

The terrestrial plant habit was proposed as an ancestral character in Araceae (Grayum, 1990): this habit is frequent in the genus *Anthurium* (Mayo et al., 1997), the richest taxon in this study. This predominant distribution and richness is due to the altitude (2400–3000 m asl) and it has been found that in evergreen tropical low forest the Aroids can reach the same richness than
Orchids and can be even more abundant than ferns (Wolf & Flamenco, 2003).

According to Vargas et al. (2004), *Anthurium* is the most diverse and widely distributed taxon in the medium and high zones in the Andes. One example of that is represented by *A. longgeeniculatum*, which is registered in the Colombian Central Cordillera at 2600 m asl (Alvarez et al., 2007) and Colombian Occidental Cordillera between 2500–2740 m asl (Croat, 1992, Rangel-Ch. et al., 2005). In that sense, this study enlarges the altitudinal distribution of *A. longgeeniculatum* since it occurs in the Oriental slope of the Colombian Occidental Cordillera from 2400 to 3000 m asl. Moreover *A. longgeeniculatum* appears in this study to be the species with the largest altitudinal distribution and the most abundant species.

Anthurium sp1; A. sp2; A. sect. Calomystrium and A. sect. Cardiolonchium represent collections that were not determined to species level, so that in the future they will be reviewed to see if any are species new to science.

Our new registers, the chorological novelties, and the increase in the distribution width of some of the more boundary taxa in the Araceae of Natural National Park Tatamá, shows the necessity to increase the floristic exploration and study, mainly for the complexity and high diversity of this ecosystems.
### KEY TO ARACEAE OF THE ORIENTAL SLOPE IN THE COLOMBIAN WESTERN CORDILLERA, NNP TATAMÁ

1. Unisexual flowers, spathe compressing the spadix, stipe not visible . . . . . . . . . 2
2. Leaves hastate; herbs less than 50 cm . . . . . . . . . . . . . . . Chlorospatha cf amalfiensis
3. Base of the leaf cuneate, obtuse or cordate . . . . . . . . . . . . . . . . . . . . . . . 4
4. Blade and petioles less than 15 cm; stipes larger than 2 cm . . . Anthurium pulchellum
5. Apex of leaf aristate or setaceous; Side ribs curved and joined together before reaching the edge of the blade, no black spots on the blade . . . . . . . . Anthurium caucanum
6. Ovate leaf shape, margin sinuate, stem with smooth texture . . Anthurium longegeniculatum
7. Spathe with green or reddish color . Anthurium caucanum
8. Blade with apical lobe greater than 10 cm wide . Anthurium bogotense
9. Blades greater than 18 cm long . Anthurium sect. Calomystrium
10. Persistent cataphylls, spadix less than 1 cm wide . Anthurium sect. Calomystrium
11. Tertiary veins not prominent, and free . Anthurium sect. Calomystrium
12. Blade and petiole with superficial black spots . Anthurium sp2
14. Stems without canals or grooves . Anthurium versicolor
ACKNOWLEDGMENTS

The authors thank the Instituto de Investigaciones en Estratigrafía-IIES for the support, mainly to the professor Andrés Pardo Trujillo. The geologist Hugo Ballesteros (Director of the Natural National Park Tatamá) and Rosa Restrepo (Functionary at Natural National Park Tatamá), for their kindness and logistic help to develop this research. The professor Felipe Cardona Naranjo for giving us literature and for his help in providing access to collections of HUA Herbarium, the professor Luis Miguel Alvarez Mejia, for providing access to collections of FAUC Herbarium. Grateful to Marc Gibernau and to Tom Croat for the valuable observations, comments and corrections to the manuscript. The authors also thank Natalia Castaño for her taxonomy support, Yeison Gutiérrez for his photography, Camilo de los Ríos Restrepo, Julio Ávila and Gabriel Ardila for going with us in the field and to Mateo for showing us the unexplored trails of Tatamá.

LITERATURE


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