

A COMPARATIVE ANALYSIS OF THE DIVERSITY, DISTRIBUTION,  
AND BIOGEOGRAPHY OF ARACEAE IN SOUTHEASTERN PERU  
(CUSCO AND MADRE DE DIOS, PERU)

by:

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## CHAPTER ONE: GENERAL INTRODUCTION

Araceae, a family of herbaceous monocots with 106 genera and almost 3500 species, has a nearly world-wide distribution. Although a nearly equal number of genera occur in both the Old and New Worlds, the majority of species occur in the New World tropics. Araceae species inhabit a wide variety of life zones and habitats, extending from tropical dry to pluvial rainforest, and into subarctic marshes, tropical swamps, cloud forests, cold montane plains, and semi-arid to arid coastal plains.

Araceae is characterized by leaves that are highly diverse in shape, color, and texture. At first sight many of them are not monocot-like. Most of the species have leaves that are net-veined and relatively large. Many genera have closely parallel veins, but few species have grass-like or lily-like leaves.

About 60% of the Araceae species of the world occur in the Neotropics (Croat, 1999). In Peru the family is incompletely known. One of the earliest study on Araceae was made by Macbride (1936), wherein he described 18 genera and 164 species for the country. More recent research has resulted in dramatic increases in this number, with Croat (1993) recording 218 species, Ulloa Ulloa et al. (2004) adding 36 new reports, and Croat et al. (2005) further reporting 48 new species. Some taxonomic groups and geographic regions in Peru have been exhaustively studied: genus *Anthurium* (Croat et al., in press; Ligan & Croat, 2004), *Anthurium* Section *Pachyneurium* (Croat, 1991), genus *Dracontium* (Zhu & Croat, 2004), tribe *Spathicarpeae* (Gonçalves, 2005), and Araceae from Rio Cenepa, department of Amazonas (Croat et al., 2005). These studies have shown that Peru has the highest level of generic diversity in Araceae in the world

with 27 native genera, but it is clear that many species are poorly known or undescribed, and more research research is needed.

One of the major gaps in our knowledge of the diversity and distribution of Araceae is in the Andes-Amazon region of southeastern Peru, which includes the departments of Cusco, Madre de Dios, and Ucayali (Fig. 1). This area includes life zones and ecosystems where Araceae are common: transitional zone between Subtropical Moist Forest and Subtropical Rainforest, and Tropical Moist Forest transition to Subtropical Rainforest; which are denoted as bh T/S and bmh-S, respectively on the Ecological Map of Peru (ONERN, 1976). Southeastern Peru has not been well sampled and the available collections of Araceae species have not been thoroughly surveyed to determine the geographical ranges of the known species.



Figure 1. Map showing the locations of the departments of Cusco, Madre de Dios, and Ucayali in southeastern Peru.

The purposes of this study were to: (1) analyze existing collections from southeastern Peru, (2) integrate existing collections with new collections to better describe the diversity of Araceae in this region, and (3) use these collections to characterize the distribution of Araceae in southeastern Peru. This study is aimed at: (1) expanding the knowledge of the Araceae species diversity in the region, (2) identifying potential endemic taxa and their distribution in the region, and (3) characterizing the distribution of Araceae. The results of this study are useful in assessing conservation implications, such as the impacts of the interoceanic highway that is being constructed from the state of Acre, Brazil, through the departments of Cusco and Madre de Dios, Peru. This highway and the probable increase in population and resource use may greatly impact the diversity and distribution of the rich flora of the Andes-Amazon region of southeastern Peru. The Araceae serve as a model family for rich flora of the region.

The following three chapters describe the pre-existing and recent collections of Araceae species and their analysis. The second chapter, Study Areas, describes the available data and the sites of new collections. The third chapter, Diversity of Araceae in Southeastern Peru, expands our knowledge about the diversity of this family with analysis of the number of species per genera and other taxa (i.e. sections and subgenera) in southeastern Peru. The fourth chapter, Distribution and Biogeography of Araceae in Southeastern Peru, identifies how taxa are distributed in this region. Some geographic areas in the region where few to no collections have been made are proposed as major collection gaps and future work is proposed to fill in these gaps

## CHAPTER TWO: STUDY AREAS

This research is based on an extensive pre-existing dataset of Araceae collections supplemented by intensive new collections made by the author and other researchers from the Andes to Amazon Biodiversity Program team at BRIT. These collections are described below.

### Pre-existing Araceae Collections

From 1950 until 2000, 858 collections of Araceae were made in more than 40 sites located in southeastern Peru, which included the departments of Cusco, Madre de Dios, and Ucayali. The northernmost collection extreme collection is located at 3°50'S 73°30'W and the southernmost at 13°38'S 71°00'W. The easternmost collection is located at 12°30'S 68°38'W and the westernmost at 09°12'S 75°55'W. Sites of collection included native communities and reserves, roadsides, riversides, protected areas (i.e. Pampas del Heath, Manu, Tambopata, Alexander von Humboldt, etc), and at tourist lodges (i.e. Cusco Amazonico, Explorers Inn, etc).

### New Collections

In the last three years, 190 collections were made in four main areas of Madre de Dios and Cusco, Peru: Wayquechas Biological Station, Los Amigos Biological Station, Pantiacolla, and Quincemil (Fig. 2), as part of the botanical research component of the Andes to Amazon Biodiversity Program (AABP). The number of collections at these sites was six, 106, 36, and 42, respectively. The number of collections at the

Wayquechas Biological Station reflects the limited presence of Araceae presence at this site. These sites are described in the following paragraphs.

Wayquechas Biological Station (Fig. 3A) is located at the southeastern margin of the Manu National Park ( $13^{\circ}11'S$ ,  $71^{\circ}36'W$ ), in the department of Cusco, and its elevation ranges from 2200–3200 m.

The Los Amigos Biological Station (Fig. 3D) is located in the lowland Amazonian forest at the base of Peru's southern Andes ( $12^{\circ}34'S$   $70^{\circ}06'W$ ), in the department of Madre de Dios, at an elevation of 268 m. Wayquechas Biological Station and Los Amigos Biological Station are owned and operated by the Amazon Conservation Association (ACA), and the Asociacion para la Conservacion de la Cuenca Amazonica (ACCA).

Pantiacolla (Fig. 3C) is located in the upper Madre de Dios River basin ( $12^{\circ}39'S$   $71^{\circ}14'W$ ) in the department of Madre de Dios, and ranges from 400–1500 m. Its vegetation consists of elements from the lower Andes, upper Amazon, and the Amazonian lowlands.

Quincemil (Fig. 3B) is a jungle town in the southeastern portion of the department of Cusco, Peru ( $13^{\circ}24'S$   $70^{\circ}48'W$ ). It is situated in the district of Camanti and is the municipal headquarters for a number of communities in that district. Elevation around Quincemil ranges from 650–1200 m. Vegetation consists of montane forests of the lower Andes and moist to pluvial tropical forests, with a high annual precipitation of at least 8000 mm.

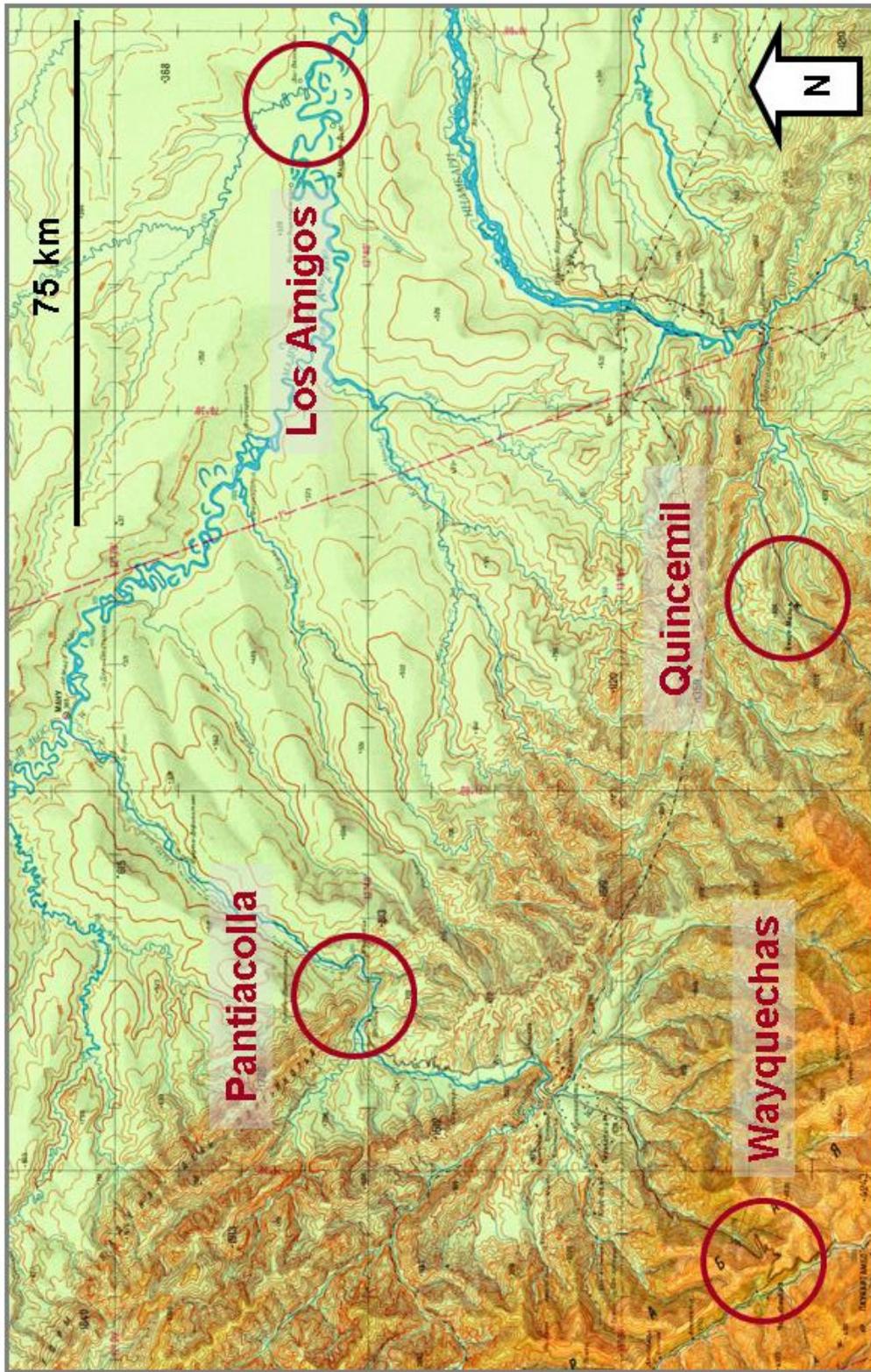


Figure 2. Map showing field sites where new collections were made.

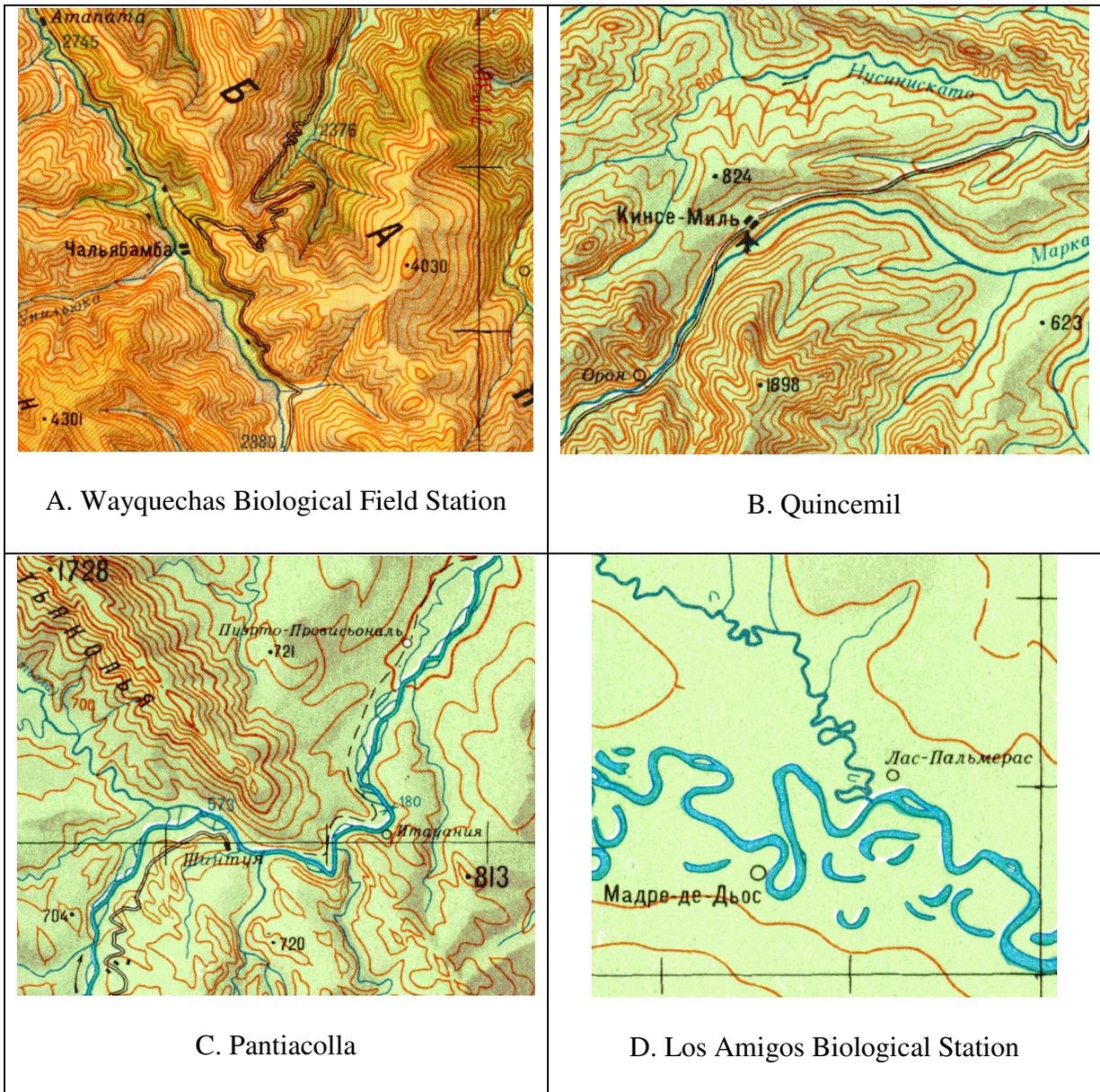


Figure 3. Details of the field sites where new collections were made in this study.

The lowland forests included in the study area at Los Amigos Biological Station appear to be the mature phase forest of the alluvial floodplain forest. This part of the forest is physiognomically spectacular, approaching the classic (but rarely encountered) “cathedral-like” rain forest. The understory is open, and the canopy is high at 25–30 m, but frequently broken by emergent trees that reach heights greater than 50 m. Many of

the large emergent trees are strangler figs that begin as epiphytes but grow down to form roots and up to form their own trunks. They eventually strangle and kill the initial host tree. Smaller stranglers are common as hemiepiphytes (i.e. plants that are mostly epiphytic, but may become rooted in the soil) in most forests of Amazonian Peru, but they only rarely reach the soil and develop into large trees. Palms are conspicuous element of the area and, like stranglers, impart a distinctive physiognomy to the forest.

The montane forests at Wayquechas Biological Station are characterized by a high incidence of low-level cloud cover. Trees in this region are shorter and more heavily stemmed than in lower altitude forests in the same region, and the moisture promotes the development of an abundance of vascular epiphytes and results in abundant mosses and ferns covering the ground and vegetation. The presence of mountainous terrain provides many different habitats in a relatively small area due to elevational changes, and to local differences in climate and soils. The heterogeneity of the physical environment interacts with evolutionary processes and isolation over long time periods to produce local genetic differentiation and high speciation rates.

### Temperature and Precipitation

The weather is relatively constant in the lowland, with temperatures averaging between 25 and 27°C. Occasionally, there is a sudden drop in temperature known as "friaje", sometimes dipping to as low as 10°C. This phenomenon lasts between one to seven days and occurs between June and September. Annual precipitation varies from 2400 to 3400 mm, without a defined dry season. There are two climatic periods: December to March, when precipitation is usually high; and, July to October, when

precipitation is low. Because: 1) there is not a defined dry season and 2) the variation in precipitation is higher than temperature per year, these are called respectively winter and summer.

In upper montane forests temperatures average 11°C with little seasonal variation. Eastern slopes have a relatively marked seasonality of precipitation. There is a drier season during the months from May to September (<10 mm/month in June and July), and a wet season from September to May (>10 mm/month in January, February, and March). The presence of fog ameliorates these effects, however, by reducing solar radiation, reducing temperature fluctuations, and increasing relative humidity (Young & Leon, 1998).

## CHAPTER THREE: DIVERSITY OF ARACEAE IN SOUTHEASTERN PERU

### INTRODUCTION

The monocot family Araceae is one of the most inadequately described families in the Flora of Peru (Macbride, 1936), which lists 18 genera and 164 species for the country. Two examples of this inadequacy treatment are the most speciose genera in Araceae, *Anthurium* and *Philodendron*, with 56 and 46 names reported by Macbride (1936), but which now have approximately 123 and 71 species respectively, an increase of about 100%. Even though Macbride (1936) provided a valuable baseline of research, it does not reflect the real diversity of this group in Peru. The number of species reported by Macbride (1936) was reduced because many of them were incorporated as synonyms of other species.

Recent research has expanded the known flora of Araceae in Peru. Croat (1993) elaborated a more accurate checklist of Araceae in Peru, including all previously described species and all available herbarium specimens. He recorded 218 species of Araceae, but did not include species that had been collected but not yet named.

Ulloa Ulloa et al. (2004) added 36 new reports of Araceae for Peru. Croat et al. (2005) reported 48 new species of Peruvian Araceae that were included in the genera *Anthurium*, *Dieffenbachia*, *Monstera*, *Philodendron*, *Rhodospatha*, *Spathiphyllum*, *Stenospermation*, and *Xanthosoma*. Croat (1999) predicted future studies of Peruvian Araceae will increase the number of species to 300 or more.

Except for the genus *Anthurium* (Croat et al., in press; Ligan & Croat, 2004), *Anthurium* Section *Pachyneurium* (Croat, 1991), genus *Dracontium* (Zhu & Croat, 2004), tribe *Spathicarpeae* (Gonçalves, 2005), and Araceae from Rio Cenepa in the department of Amazonas (Croat et al., 2005), few genera and geographic areas have been studied intensively and many others remain in a state of taxonomic confusion due to the lack of systematic studies.

In nearly 80 years since Macbride (1936), new studies have added nine new genera, including *Croatiella*, *Filarum*, *Incarum*, *Gorgonidium*, *Schismatiglottis*, *Spathanthium*, *Synandropadix*, *Urospatha* and *Stenospermatum* (the last one had been included under *Rhodospatha* in the revision by Macbride). These studies have also increased the total known species diversity of the Araceae of Peru by more than a 200%. As a result, Peru has the highest level of generic diversity in Araceae in the world with 27 native genera. Species diversity is also relatively high (Croat, 1999). Most Araceae species diversity in Peru occurs on the mesic eastern slopes of the Andes Mountains and in the Amazonian lowlands.

The Araceae family has adapted to a range of habitats, showing a broad variety of habits including free-floating aquatics like *Pistia*; rooted aquatics like *Montrichardia* and *Urospatha*; some terrestrial genera, such as *Caladium*, *Dieffenbachia*, *Dracontium*, *Homalomena*, *Spathiphyllum*, *Urospatha*, and *Xanthosoma*. Most of the larger genera are hemiepiphytic climbers or vines, including *Anthurium*, *Heteropsis*, *Monstera*, *Rhodospatha*, *Syngonium* and most *Philodendron*. *Stenospermatum*, most *Anthurium*, and many *Philodendron* are true epiphytes.

The main goal of this chapter is to expand the baseline database about Araceae diversity and ecology in southeastern Peru, consolidating the data available for aroid collections in Peru. This project has taxon-driven implications for conservation research and management in this region. The project's goals were to:

1. Build a consolidated checklist of the species collected in the area.
2. Document the diversity of Araceae in southwestern Peru.
3. Define the state of taxonomic knowledge of Araceae in this region.

Southeastern Peru is expected to exhibit a relatively high diversity in aroids especially in genera *Anthurium* and *Philodendron*, since it comprises one of the richest arrays of ecosystems and microhabitats on Earth. Despite the large number of collections, new species are expected to occur in this area due to few taxonomic studies that have been made for the region and the generally high number of species inhabiting the area.

## MATERIALS AND METHODS

This study is based on pre-existing collections (Chapter 2) and new collections acquired from several field excursions in Peru supported by the Botanical Research Institute of Texas, Missouri Botanical Garden, Universidad Nacional Mayor de San Marcos, and many other projects developed by scientific institutions. Except for some previous collections deposited in the San Marcos Herbarium (USM), all the previous collections used in this study are deposited in the Missouri Botanical Garden Herbarium (MO).

The new collections were made by randomly walking the forests. Cuttings of fertile<sup>1</sup> samples of the species found were taken (Fig. 4) and plant data that are lost in the drying process were recorded in a field log: habit, color of structures (stem, spathe, spadix, etc), and special features (hairs, variegation, etc). Digital images were taken and uploaded to the Atrium Biodiversity Information System (<http://atrium.andesamazon.org>).

Fresh specimens were pressed inside sheets of paper and labeled with collection codes. These codes consist of numbers and letters corresponding to data acquired in the field and registered in a field notebook at the time of collection. The specimens collected were then dried at temperatures about 70°C for three or four days depending on the thickness of the specimens and water content. Finally, the specimens were mounted and deposited in the herbaria mentioned above or in the Botanical Research Institute of Texas – Fort Worth (BRIT).

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<sup>1</sup> Samples with reproductive structures (flowers and/or fruits).



Figure 4. Specimens of Araceae collected in southeastern Peru (Quincemil, department of Cusco).

The identification of Araceae species was conducted principally by Dr Thomas Croat, Senior Curator of Botany and specialist in the Araceae family at the Missouri Botanical Garden (MO). Collections made by the AABP team were identified using the appropriate monographs, keys, and treatments, and many identifications were made or confirmed by Dr. Croat. The terminology and scheme used in the descriptions is taken from Croat & Bunting (1979) and the revisions of Croat (1997, 2004) and Zhu & Croat (2004).

Species of the two largest genera are mentioned in this study with their infrageneric classification: Sections for *Anthurium* (Croat & Sheffer, 1983) and

Subgenera for *Philodendron* (Grayum, 1996). *Anthurium* comprises 18 Sections: *Tetraspermium*, *Gymnopodium*, *Porphyrochitonium*, *Pachyneurium*, *Polyphyllium*, *Leptanthurium*, *Oxycarpium*, *Xialophyllum*, *Polyneurium*, *Urospadix*, *Digitinervium*, *Cardiolonchium*, *Chamaerepium*, *Calomystrium*, *Belolonchium*, *Semaeophyllum*, *Schizoplacium*, and *Dactylophyllum*. *Philodendron* includes three Subgenera: *Pteromischum*, *Meconostigma*, and *Philodendron*.

## RESULTS

A total of 1048 field collections, 190 of which were new collections obtained in this study, have so far yielded 161 Araceae species in 22 genera identified to be present in southeastern Peru (Appendix 1). These 161 species (Table 1) included 98 previously reported from southeastern Peru, 42 known species that had not previously been reported from the area, and 22 taxa that appear to be previously undescribed species. New additions to the Araceae flora of southeastern Peru were made for 16 of the 22 genera known to occur there. New and previously undescribed species were found for seven of the 22 genera. There were 14 genera where species previously reported for other regions in Peru were found for the first time in southeastern Peru.

*Philodendron* and *Anthurium* were the two most diverse genera in our study area, with 46 and 45 species respectively (Table 1) representing approximately 29% and 28% of the total species recorded. *Dieffenbachia*, *Monstera*, and *Xanthosoma* are the next most diverse with 12 (7.5%), 11 (6.8%), and eight (5%) species respectively. Twenty-two potential new species were collected and assigned to the genera *Philodendron*, *Anthurium*, *Dieffenbachia*, *Monstera*, *Xanthosoma*, *Stenospermation*, and *Rhodospatha*.

Sections of *Anthurium* are not equally distributed in southeastern Peru. The highest specific diversity is represented by Section *Pachyneurium* with 14 species. *Cardiolonchium* and *Dactylophyllium* have seven and eight species respectively, while other Sections are represented by a maximum of three species (Table 2).

Table 1. Diversity of Araceae species by genus in Southeastern Peru. Genera are listed in declining order of the number of species.

<b>Genus</b>	<b>Spp reported in SE Peru *</b>	<b>Spp found in SE Peru</b>	<b>New reports to SE Peru</b>	<b>Unpublished species**</b>
<i>Philodendron</i>	25	46	21	7
<i>Anthurium</i>	32****	45	13	4
<i>Dieffenbachia</i>	2	12	10	6
<i>Monstera</i>	6	11	5	2
<i>Xanthosoma</i>	7	8	1	1
<i>Stenospermation</i>	5	6	1	1
<i>Rhodospatha</i>	2	5	3	1
<i>Dracontium</i>	3	4	1	0
<i>Heteropsis</i>	3	4	1	0
<i>Syngonium</i>	3	4	1	0
<i>Spathiphyllum</i>	1	3	2	0
<i>Homalomena</i>	1	2	1	0
<i>Spathantheum</i>	1	2	1	0
<i>Alocasia</i>	0	1	1	0
<i>Caladium</i>	1	1	0	0
<i>Colocasia</i>	1	1	0	0
<i>Croatiella</i>	0	1	1	0
<i>Filarum</i>	0	1	1	0
<i>Gorgonidium</i>	1	1	0	0
<i>Incarum***</i>	1	1	0	0
<i>Pistia</i>	1	1	0	0
<i>Taccarum</i>	1	1	0	0
<b>TOTAL</b>	<b>97</b>	<b>161</b>	<b>64</b>	<b>22</b>

\* Croat 1993, 1999; Ulloa 2002

\*\* Still under study and further collections are required.

\*\*\* Reported as *Asterostigma* in Croat 1993, 1999

\*\*\*\* *A. idmense* is known from two collections: one without locality data and one from Cajamarca.

Table 2. Diversity of the sections of the genus *Anthurium* in Southeastern Peru.

<b>Section</b>	<b>Spp reported in SE Peru *</b>	<b>Spp found in SE Peru</b>	<b>New reports to SE Peru</b>	<b>Unpublished species**</b>
<i>Pachyneurium</i>	10	14	4	0
<i>Cardiolonchium</i>	4	7	3	2
<i>Dactylophyllium</i>	7	8	1	1
<i>Calomystrium</i>	2	3	1	0
<i>Decurrentia</i>	2	2	0	0
<i>Digitinervium</i>	1	2	1	0
<i>Tetraspermium</i>	2	2	0	0
<i>Belolonchium</i>	0	2	2	1
<i>Leptanthurium</i>	1	1	0	0
<i>Porphyrochitonium</i>	1	1	0	0
<i>Polyneurium</i>	0	1	1	0
<i>Xiallophyllium</i>	2****	2	0	0
<b>TOTAL</b>	<b>32</b>	<b>45</b>	<b>13</b>	<b>4</b>

\* Croat 1993, 1999; Ulloa 2002

\*\* Still under study and further collections are required.

\*\*\* *A. idmense* is known from two collections: one without locality data and, one from Cajamarca.

Approximately 15.5% of the collections could not be adequately identified and may represent taxa previously unknown in southeastern Peru.

## DISCUSSION

### ***Philodendron* in Southeastern Peru**

*Philodendron* is the second largest genus in the family and is as widespread as *Anthurium*, ranging from Central Mexico to the West Indies, the Guyanas, and Argentina. Similar to *Anthurium*, it is difficult to know exactly how many species there are in the genus, but a reliable estimate is that there are approximately 700 species. Until now, only 25 of the 82 *Philodendron* species that had been reported for Peru (Croat 1993, 1999; Ulloa 2002) were reported for southeastern Peru. As a result of this study, 21 more previously known *Philodendron* species are known from southeastern Peru, and seven more species are probably new to science.

*Philodendron* is much more abundant and diverse at lower elevations than is *Anthurium* (Croat, 1999). It becomes more dominant in areas with large lowland forest cover (particularly in seasonally dry forests), such as the Amazon basin or in Southeastern Peru. Infrageneric groupings of *Philodendron* are less well understood than those of *Anthurium* (Grayum, 1996; Croat, 1997), but its three subgenera are distinct and their spatial distribution is relatively well known. In our study area, subgenus *Philodendron* is the most diverse, with 35 species, with four probably new to science (Table 1). Subgenus *Pteromischum* is represented with ten species and three are probably new to science. Subgenus *Meconostigma* is represented by only one species: *Philodendron solimoesense*.

## ***Anthurium* in Southeastern Peru**

*Anthurium* is the largest genus in the family. While the number of species in Central America (221 species), and some parts of South America: Venezuela (68 species), the Guyanas, and Paraguay are well known, other areas, especially eastern Brazil and the Andean region in western South America the number of species is doubtful. A number of species occur in the Peruvian foothills on the eastern slopes of the Andes, but the species diversity there does not come close to matching that in Ecuador. The species occurring there, including *Anthurium breviscapum*, tend to be more widespread, but there are also significant centers of species richness and endemism, such as the areas around Tingo Maria (department of Huanuco), Tarapoto (department of San Martin), and Oxapampa (department of Pasco).

Peru is one of the two centers of diversity for section *Pachyneurium*, with 29 species; the other is in Ecuador with 36. This section is well distributed especially in seasonally dry forests. In our study area, 14 species are reported (Table 2). *Cardiolonchium* is also heavily concentrated in the Andean region at low to middle elevations, especially on the western slopes of the Andes. Many species in this section are new to science. Seven species are reported for this area and probably two of them are new to science. *Dactylophyllum* is a small but widespread section, with palmately compound blades. Eight species are reported for southeastern Peru, with one of them probably new to science and very similar to *Anthurium croatii*, which also occurs in this section.

### ***Dieffenbachia* in Southeastern Peru**

This genus has approximately 135 species ranging from Mexico to the Guyanas, Brazil, Paraguay, and northeast Argentina, and is, after *Stenospermation*, certainly the most poorly understood genus in the Araceae. The principal problem with the taxonomy of *Dieffenbachia* is delimitating species; for example, sometimes leaf variegation is shown in some individuals of the same species in the same population. Species are highly variable and difficult to collect and prepare properly, so those collections are difficult to study. *Dieffenbachia* contains a large percentage of species new to science (Croat, pers. com., 2008).

Distribution of *Dieffenbachia* species is heterogeneous, with major centers of diversity in Colombia (with 37 species), Ecuador (34), Brazil (27), Panama (20), and Costa Rica (13), principally at lower to middle elevations (Croat, 2004). Macbride (1936) described 11 species for Peru, but Croat (2005) increased that number to more than 30. This study found 10 previously unreported species, but five of them had already been found but not yet published by Croat (pers. com.). A new, sixth unpublished species was found in this study (Appendix 1).

### ***Monstera* in Southeastern Peru**

Madison (1977) described 22 species of *Monstera* in Central and South America, but perhaps a more realistic estimate, as it is known today, is closer to 60 (Croat, 1988). This genus is particularly rich in Central America, however, South America is expected to have a proportionately larger increase owing to the fact that it is a larger area, and because it remains poorly collected.

The taxonomy of *Monstera* is highly dubious. Despite the 22 species described by Madison (1977), it is clear that many of them include several difficult species complexes. Some of these complexes are *M. adansonii*, *M. dilacerata*, *M. pinnatipartita*, and *M. spruceana*. Croat (1988) has estimated 60 species. After this study, we found that 11 species are occurring in southeastern Peru and two of them require more collections to identify them (Table 1).

### **Other genera of Araceae in Southeastern Peru**

*Xanthosoma* ranges from Mexico to Trinidad, the Guyanas and Argentina. There are 12 species in Central America, 20 species in Venezuela, nine species in the Guyanas, ten in Brazil, ten in Peru, and two in Paraguay and Argentina (Croat, 1994). We report here seven species of *Xanthosoma*, one of them probably new to science (Fig. 5).



Figure 5. *Xanthosoma* sp (center of image), probably a new species to science collected in Quincemil, department of Cusco.

*Stenospermation* and *Rhodospatha* range from Mexico and Guatemala in Central America to Brazil and Peru in South America. Peru and Panama harbor the greatest number of species for both genera. *Stenospermation* and *Rhodospatha* are represented in Peru with 15 and 10 species, respectively. We report six species of *Stenospermation* (one probably new to science), and five species of *Rhodospatha* (one new to science: *R. rubropunctata*, now in process of publication by Croat).

We report four species of *Dracontium*, *Heteropsis*, and *Syngonium*; three for *Spathiphyllum*; and two for *Spathantheum* and *Homalomena*. Only one species of *Alocasia*, *Caladium*, *Colocasia*, *Croatiella*, *Filarum*, *Gorgonidium*, *Incarum*, *Pistia*, and *Taccarum* was found in southeastern Peru.

## CONCLUSION

Peru is the richest country in the number of genera of Araceae due to the proximity with the equator, its immense expanse of Andean slopes extending three degrees of latitude to the south, and its eastern tropical forests. These forests and slopes form a unique ecosystem where tropical and temperate aroid floras coexist. In this area, most of the genera involved have relatively few species for Araceae. These genera: *Croatiella*, *Gorgonidium*, *Incarum*, *Spathantheum*, and *Taccarum* are all members of the tribe *Spathicarpeae*.

This study reports 22 genera and 161 species of Araceae in southeastern Peru, making that region probably the richest area in the southern range distribution of Araceae. *Philodendron* and *Anthurium* are the richest genera, with 46 and 45 species respectively. *Philodendron* subg *Philodendron* is the infrageneric group most diverse for genus *Philodendron* with 35 species. *Anthurium* sect *Pachyneurium* is the most diverse for genus *Anthurium* with 14 species. After this study, we report 64 new records of Araceae to southeastern Peru and 22 species probably new to science (Table 1). Six of these new species are already in their process of publication (Croat, pers. com.).

Although this study has increased the known diversity of Araceae in southeastern Peru by 60%, this increase is not enough increase to alter the general pattern of declining Araceae diversity with increasing south latitude (Croat, 1991; 1994; 1999; Croat & Mount, 1988). This trend of declining diversity with increasing latitude is still valid after including the results of this study.

## **CHAPTER FOUR: DISTRIBUTION AND BIOGEOGRAPHY OF ARACEAE IN SOUTHEASTERN PERU**

### **INTRODUCTION**

The Araceae, with 105 genera and around 3200 species, has a worldwide distribution. The Paleotropics has more genera than the Neotropics (60 versus 36), but the Neotropics holds almost two thirds of the species (Croat, 1999). There are two major centers of species diversity: tropical Asia and tropical America. The level of knowledge in Neotropical Araceae systematics varies greatly from area to area, since revisionary work has been focused in particular areas. According to Croat (1992), Central America is better known than South America because there are more aroid taxonomists working in that region and also because some parts of Central America are less diverse, especially compared to northwestern South America.

The Neotropical Araceae is one of the most conspicuous groups of plants growing in the tropical forests. Aroids are generally tropical and occur in terrestrial, aquatic, and epiphytic habitats. They range from sea level to more than 3000 m in Peru, with the highest concentration of species at middle elevations, especially in the 500 to 1800 range.

One of the most interesting characteristics of aroids is their broad diversity of adaptative habits. This plasticity in shapes allows the family to occur in a wide variety of life zones and habitats throughout its range, extending from Tropical moist forest to Premontane wet forest principally. Tropical moist forest occurs along both sides of the Amazon River to the Brazilian border, in a band along both sides of the Ucayali River, and in isolated patches on the eastern slopes of the Andes, often surrounded by or

bordered by areas of Premontane wet forest. Premontane wet forest occurs in distinct and separate patches. The largest area of Premontane forest extends south from the border of southwestern Ecuador, then spreads in a relatively broad band across northern Peru to the Amazon River and bifurcating to include the basin of the Napo river. This band extends all the way to the Brazilian border centering on the Trapecio Amazonico. Another fairly large area is located in the east band of Ucayali River, extending somewhat north of Contamana southeast to the Bolivian border (Croat, 1988).

Peru has a vast arc of lowland tropical rainforest in the upper Amazon basin. Although rather rich in species, it does not constitute an area with many species being endemic to Peru. The species occurring in this region very often are widespread species that range into Brazil, Ecuador, and Colombia or throughout the Amazon basin. In contrast to those species occurring in the Amazon basin of Peru (Ucayali and Madre de Dios), those species, which occur on the eastern slopes of the Andes (Cusco) and intermountain valleys between the branches of the Andes, are often highly endemic to Peru. The eastern slopes of the Andes, where Quincemil is located (Chapter 2), are especially interesting since they are likely to turn up the most new and endemic species. Lingan (2006) recognizes 52 Peruvian endemic taxa placed in nine genera. One genus, *Filarum*, is endemic to Peru. Endemic aroids are found in Pluvial and Humid Montane Forests, and in the Humid Amazonian Forest, between 100 and 3000 m elevation. Thirteen Peruvian endemic species have been found within Peru's protected areas network.

These endemic species are now threatened because Peru and Brazil have agreed on promoting a transnational project to expand a network of roads and highways through the Peruvian Amazon, to connect Acre (Brazil) with Puerto Maldonado and Cusco (Peru), and the Pacific coast of Peru. The overall objectives of the highway project are beneficial in the sense that they will bring better communication, economic improvement for the cities involved, and improved transportation and distribution routes. However, this network of improved roads and highways will run through pristine forests and, as a consequence, many areas will be deforested. Owing to the vulnerable nature of lowland forest especially in this area, species already known and many unknown are endangered. Developing research projects in these areas are important and urgently required.

The main goal of this chapter is to identify how Araceae are distributed in southeastern Peru. This study will identify areas where little or no fieldwork has been done. The project's goals were:

1. Characterize the distribution of Araceae in southeastern Peru.
2. Identify endemic species of Araceae in this area.
3. Define gaps of knowledge of Araceae in this region.

A high number of species of Araceae is expected to occur in this region. Forests placed at middle elevation and areas where botanical expeditions were conducted are probable to have the highest number of species.

## MATERIALS AND METHODS

This study is based on pre-existing collections (Chapter 2) and new collections acquired from several field excursions in Peru, supported by the Botanical Research Institute of Texas, Missouri Botanical Garden, Universidad Nacional Mayor de San Marcos, and many other projects developed by scientific institutions. Except for some previous collections deposited in the San Marcos Herbarium (USM), all the preexisting collections used in this study are deposited in the Missouri Botanical Garden Herbarium (MO).

The new sample collections were made by randomly walking the forests. Cuttings of fertile<sup>2</sup> samples of the species found were taken, and plant data that are lost in the drying process: habit, color of structures (stem, spathe, spadix, etc), and special features (hairs, variegation, etc) were recorded in field notes. Also, digital images were taken and uploaded to Atrium (<http://atrium.andesamazon.org>). Fresh specimens were collected, dried, and mounted as described in Chapter 3. Mounted specimens were deposited in the herbaria mentioned above or in the Botanical Research Institute of Texas – Fort Worth (BRIT).

The identification of Araceae species was conducted principally by Dr Thomas Croat, Senior Curator of Botany and specialist in the Araceae family at the Missouri Botanical Garden (MO). Collections made by the AABP team were identified using the appropriate monographs, keys, and treatments. The terminology and scheme used in the descriptions is taken from Croat & Bunting (1979) and the revisions from Croat (1997, 2004) and Zhu & Croat (2004). As in Chapter 3, the two biggest genera will be described

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<sup>2</sup> Samples with reproductive structures (flowers and/or fruits).

using their infrageneric classification, this involves Sections for *Anthurium* (Croat & Sheffer, 1983), and Subgenera for *Philodendron* (Grayum, 1996).

## RESULTS

A database with a total of 885 collections of Araceae from southeastern Peru was built. The number of collections from the department of Madre de Dios was 574, including those from Los Amigos Biological Station (106), and Pantiacolla (36); collections from Cusco were 231, including those from Quincemil (42), and Wayquechas Biological Station (6); and collections from Ucayali were 80.

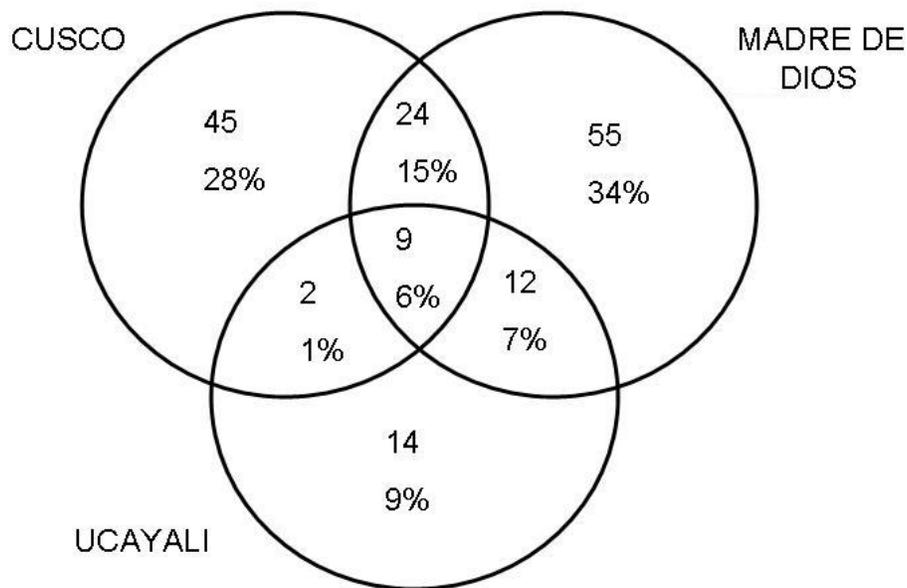


Figure 6. Distribution of species of Araceae by departments in Southeastern Peru

One hundred and sixty one species from 22 genera were found (Fig. 6). Potentially new species to science are included in this group. Approximately 28% (45) of the species collected in southeastern Peru occurred only in the department of Cusco, 34% (55) only in the department of Madre de Dios, and 9% (13) only in the department of Ucayali. Interestingly, 15% (24) of the species were collected from both Cusco and Madre de Dios, and only 7% (12) from both Madre de Dios and Ucayali. Only 6% (9) of

the species of Araceae found in southeastern Peru occurred in all three departments (Fig. 6). One of these species, *Philodendron megalophyllum*, is illustrated in Figure 7.



Figure 7. *Philodendron megalophyllum* growing in a fallen trunk in Quincemil, department of Cusco.

### Department of Cusco

A total of 80 of Araceae in 18 genera were found in the department of Cusco (Table 3). *Anthurium* is the most diverse genus with 27 species; and *Philodendron*, the second most diverse is represented by 17 species. Seven endemic species were found in this department: *Dieffenbachia acevedoi* (ined.), *D. schunkei* (ined.), *Dracontium plowmanii*, *Filarum manserichense*, *Gorgonidium vargasii*, *Spathantheum intermedium*, and *Spathiphyllum lechlerianum* (Appendix 2). Fifty one collections grouped into five

genera: *Anthurium* (37), *Philodendron* (9), *Xanthosoma* (3), *Monstera* (1), and *Rhodospatha* (1) remain undetermined.

Sampling at Wayquechas Biological Station found 11 species of aroids in six genera that were present in the existing collections, and two species of *Anthurium* that had not previously been collected from Cusco. No endemics to Peru were found here.

Sampling at Quincemil found 15 species in six genera that were previously known from Cusco; and, 32 species and 10 genera that were not previously known including *Gorgonidium vargasii*, which is endemic to Peru.

Of the 50 species found at Wayquechas Biological Station and Quincemil, four were found at both locations.

### **Department of Madre de Dios**

Araceae family is represented by 100 species in this department, grouped in 16 genera (Table 3). *Philodendron* is the most diverse genus with 30 species, followed by *Anthurium* with 20 species. Five endemic species occur in Madre de Dios: *Anthurium manuanum*, *Dieffenbachia manuensis* (ined.), *D. schunkei* (ined.), *D. tambopatensis* (ined.), and *Dracontium plowmanii* (Appendix 2). Ninety five collections representing 10 genera: *Philodendron* (31), *Anthurium* (24), *Dieffenbachia* (17), *Monstera* (9), *Xanthosoma* (6), *Stenospermation* (3), *Rhodospatha* (2), *Homalomena* (1), *Spathiphyllum* (1), and *Syngonium* (1) continue to be undetermined.

Sampling at Pantiacolla found 15 species in five genera that were previously known from Madre de Dios, and 12 species and 5 genera that were not previously known. No endemic species to Peru were found in this site.

Sampling at Los Amigos Biological Station found six species in five genera that were present in the existing collections; and, 24 species and five genera that had not previously been collected from Madre de Dios. One endemic species was found in this biological station: *Spathiphyllum gracilis*.

In a total of 43 species found at Los Amigos Biological Station and Pantiacolla, 10 were found at both locations.

Table 3. Distribution of Araceae species in Southeastern Peru (by departments and field sites). Departments: CU = Cusco, MD = Madre de Dios, and UC = Ucayali; field sites: Way = Wayquechas, Qui = Quincemil, Pan = Pantiacolla, and Lam = Los Amigos.

GENUS	CU	MD	UC	Way	Qui	Pan	Lam
<i>Alocasia</i>	---	1	---	---	1	---	---
<i>Anthurium</i>	27	20	15	7	19	9	9
<i>Caladium</i>	1	1	---	1	1	---	---
<i>Colocasia</i>	1	---	---	---	---	---	---
<i>Croatiella</i>	1	---	---	---	---	---	---
<i>Dieffenbachia</i>	3	10	4	---	1	1	1
<i>Dracontium</i>	2	4	---	---	1	---	1
<i>Filarum</i>	1	---	---	---	---	---	---
<i>Gorgonidium</i>	1	---	---	---	1	---	---
<i>Heteropsis</i>	---	4	1	---	1	1	2
<i>Homalomena</i>	1	1	---	---	1	---	---
<i>Incarum</i>	1	---	---	---	---	---	---
<i>Monstera</i>	6	11	6	---	5	1	6
<i>Philodendron</i>	17	30	7	2	8	9	6
<i>Pistia</i>	---	1	---	---	---	---	---
<i>Rhodospatha</i>	2	5	2	1	1	1	1

<i>Spathantheum</i>	2	---	---	---	1	---	---
<i>Spathiphyllum</i>	2	1	---	---	1	1	2
<i>Stenospermation</i>	3	1	1	1	1	1	1
<i>Syngonium</i>	3	3	1	---	1	1	1
<i>Taccarum</i>	---	1	---	---	---	---	---
<i>Xanthosoma</i>	6	6	2	1	3	2	---
<b>TOTAL</b>	<b>80</b>	<b>100</b>	<b>37</b>	<b>13</b>	<b>47</b>	<b>27</b>	<b>30</b>

### Department of Ucayali

Thirty seven species in nine genera were collected in the department of Ucayali (Table 3). *Anthurium* is the most diverse genus with 15 species, *Philodendron* follows with seven species. Three endemic species occur in Ucayali: *Anthurium peltatum*, *Dieffenbachia engleri*, and *Dieffenbachia wurdackii* (Appendix 2). A total of 15 species remain undetermined: *Anthurium* (6), *Philodendron* (5), *Monstera* (3), and *Xanthosoma* (1).

### Endemic species in southeastern Peru

Seven endemic species occur in Cusco, making it the department with the highest number of endemic species in southeastern Peru (Fig. 8). *Dieffenbachia* is the genus with the highest number of endemic species, and it occurs in the three departments: Cusco, Madre de Dios, and Ucayali.

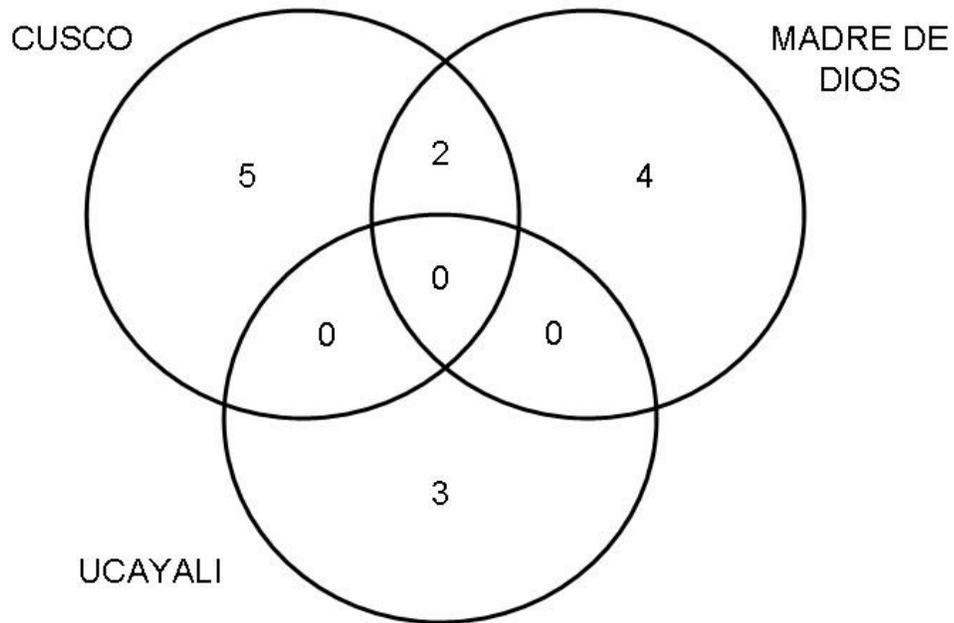


Figure 8. Distribution of endemic species of Araceae by departments in Southeastern Peru.

Cusco was expected to have the highest number of endemic species in southeastern Peru due to its broad variety of life zones and topography. It is clear that the department of Ucayali requires more fieldwork since it is not sharing endemic species with Madre de Dios and the number of endemic species is really low. It is probable that endemic species shared by the department of Cusco and Ucayali will be very few or absent.

## DISCUSSION

It was expected that by increasing the number of collections in southeastern Peru the number of species occurring only in Cusco and Madre de Dios would decline, while the number of species shared between these two departments would increase. This increase is expected because of the life zones that are shared or are similar between the two departments. The number of species occurring only in Madre de Dios and only in Ucayali are awaited to be similar, while the number of species ranging only in Cusco is expected to increase due to the accidented topography which is very likely to lead speciation processes in Araceae.

The department of Madre de Dios has the greatest diversity of Araceae in southeastern Peru. Considerable collecting efforts have been carried out in this department especially along the Madre de Dios, Tambopata, and Los Amigos watersheds. Studies conducted by BRIT (Los Amigos Biological Station and Pantiacolla), and the Missouri Botanical Garden (Cusco Amazonico) revealed a high number of Araceae species. *Philodendron* and *Anthurium* species are well distributed in this department because lowland and relatively middle elevation forests predominate in this area. The wetter forests in Madre de Dios and Ucayali are particularly rich in *Dieffenbachia*. This genus includes approximately 135 species with most of them in South America. Distribution of its species is unequal, with Peru as one of the major centers of diversity with more than 30 species principally at lower to middle elevations in the Andes (Croat, 2004). The genus is exceptionally abundant in the western Amazon basin in the foothills of the eastern Andes. Interestingly other genera like *Dracontium*, *Heteropsis*, *Monstera*, *Rhodospatha*, and *Xanthosoma* are also diverse in this area.

Araceae are also well represented in the department of Cusco and there are some interesting examples of disjunct distributions. For example, both *Croatiella integrifolia* and *Filarum manserichense* occur in Cusco and are distributed more to the north. *Croatiella integrifolia*, recently described by Gonçalves (2005), was only known from Morona-Santiago (Ecuador) near the border with Peru, but also occurs in Cusco. Before this study it was thought to be a monospecific genus endemic to Ecuador. This study also extended the range of *F. manserichense*, which has previously known only from the department of Loreto, near the border with Ecuador. This is also a monospecific genus that is endemic to Peru (Lingan, 2006). Another case of disjunct distribution is *Gorgonidium vargasi*. This species occurs in southwestern Peru (Cusco), Apurimac and Pasco in central Peru, at 2800 – 3000 m, was collected near Quincemil. It was also recently collected by Croat at lower elevation in Lima, said to have been collected near the coast, west of the Andes in 1994.

Distribution of *Filarum manserichense* and *Croatiella integrifolia* are showing an interesting case of allopatric pattern of distribution. Their populations are indicating that southeastern Peru is probably linked to northern Peru and southern Ecuador. *Croatiella integrifolia* was, after this study, found to be an endemic species to Ecuador. Peruvian endemic species occurring in Madre de Dios and Ucayali are likely to occur also in Brazil and Bolivia; further studies are required to define these questions.

Ucayali currently has the lowest number of reported Araceae species in southeastern Peru, and considerable more field work must be done to assess the real state of Araceae diversity in this department. However, the results of this study suggest that Ucayali has approximately the same diversity as Madre de Dios. Species occurring in

Madre de Dios, like *Anthurium breviscapum*, *A. gracile*, *Caladium bicolor*, *Dracontium spruceanum*, and *Homalomena crinipes* are likely to occur in this department, but further collections should be developed.

Species like *Anthurium breviscapum*, *A. clavigerum*, *A. dombeyanum*, *A. gracile*, *A. scandens*, *Dracontium spruceanum*, *Monstera adansonii*, *M. obliqua*, and *Syngonium podophyllum* have a widespread distribution for the family. The monospecific floating aquatic genus *Pistia*, represented by *Pistia stratiotes* occurs at lower elevation in Madre de Dios. *Dracontium* typically ranges from near sea level to about 500 m. A few species, like *D. spruceanum* may range from quite low elevations to high elevations. *Stenospermation* occurs primarily at middle elevations in areas of very wet forest (department of Cusco). Relatively few species occur at lower elevations except in the wettest life zones (Quincemil, department of Cusco). *Xanthosoma* ranges through a wide variety of life zones, from sea level to at least 2200 m. It may occur in the forest understory (Quincemil, department of Cusco; Los Amigos, department of Madre de Dios), along the edges of roads and streams or in open swampy areas (Los Amigos, department of Madre de Dios). *Rhodospatha* is well represented in Madre de Dios with five species. Its species diversity is highest in Venezuela and the Andes of South America as well as in Central America (Croat, 1999). *Rhodospatha latifolia* is widespread in the upper Amazon basin; however, some species recently discovered (for example, *R. mukuntakia* and *R. rubropunctata*, occurring in Madre de Dios) range in restricted areas.

There is still a large amount of research to be conducted on the Araceae family, especially in Peru. Until now, *Filarum* is considered a monotypic genus endemic to Peru,

with *Filarum manserichense* as the only species occurring in the departments of Amazonas, Loreto (Nicolson, 1966), and after this study, in Cusco. Croat et al. (2005) reported 48 new species of Araceae from the area of Rio Cenepa and Rio Santiago in northwestern Peru, near the border with Ecuador. They are preparing the treatment of the Araceae for “Flora del Cenepa y Areas Adyacentes, Amazonas, Peru” (Croat et al, in press), where they are reporting 135 species of Araceae (Croat, pers. com.). Exhaustive research and collection of Araceae in central Peru, in the Yanachaga–Chemillen National Park of Pasco, Peru, conducted by Lingan (2003-2004), increased the number of species from 46 to 130. This substantial and rather surprising increase in number consists of both new species and new reports for that area and for Peru in general.

## CONCLUSION

Species richness of Araceae is greatest between sea level and middle elevations up to about 1500 m (Quincemil, Pantiacolla, and Los Amigos Biological Station), but scientists have made very few collections from this range of altitudes on the eastern slopes of the Peruvian Andes. This makes it difficult to appraise the diversity of species present in that region. Nonetheless, these collecting efforts which have occurred have shown that southeastern Peru has a highly diverse Araceae flora with a number of endemic species (especially in Cusco). Because of the known and potential biodiversity, some preservation of remaining pristine vegetation in the region should be considered.

Quincemil, recently studied by BRIT, is the field site with the highest aroid diversity due to its location in the ecotone between lowland and premontane forests. This area and its surroundings (such as Quince Mil to Puerto Maldonado, and Marcapata to Quince Mil), are worthy of being intensively collected. Other areas where sampling may resolve questions about the distribution of Araceae, include the provinces of Padre Abad, Atalaya, and Purus in the western and southern department of Ucayali.

**APPENDIX 1: TAXA OF ARACEAE IDENTIFIED IN  
SOUTHEASTERN PERU**

***Alocasia***

*Alocasia macrorrhizos* (L.) G. Don

***Anthurium***

Section *Belolonchium* (02 species)

*Anthurium* sect *Belolonchium* sp nov (?)

*Anthurium oxybelium* Schott

Section *Calomystrium* (03 species)

*Anthurium grande* N.E. Br. ex Engl.

*Anthurium monzonense* Engl.

*Anthurium peltatum* Poepp.

Section *Cardiolonchium* (07 species)

*Anthurium* sect *Cardiolonchium* sp nov1 (?)

*Anthurium* sect *Cardiolonchium* sp nov2 (?)

*Anthurium breviscapum* Kunth

*Anthurium coripatense* N.E. Br. Ex Engl.

*Anthurium incurvatum* Engl.

*Anthurium sagittatum* (Sims) G. Don

*Anthurium versicolor* Sodiro

Section *Dactylophyllum* (08 species)

*Anthurium* sect *Dactylophyllum* sp nov (?)

*Anthurium brevipedunculatum* Madison

*Anthurium clavigerum* Poepp.

*Anthurium croatii* Madison

*Anthurium eminens* Schott

*Anthurium kunthii* Poepp.

*Anthurium pentaphyllum* (Aubl.) G. Don.

*Anthurium triphyllum* Brongn. ex Schott

Section *Decurrentia* (02 species)

*Anthurium decurrens* Poepp.

*Anthurium interruptum* Sodiro

Section *Digitinervium* (02 species)

*Anthurium lechlerianum* Schott

*Anthurium weberbaueri* Engl.

Section *Leptanthurium* (01 species)

*Anthurium gracile* (Rudge) Schott

Section *Pachyneurium* (14 species)

*Anthurium atropurpureum* var *arenicola* Croat

*Anthurium atropurpureum* var *atropurpureum* R.E. Schult. & Maguire

*Anthurium dombeyanum* Brongn. ex Schott

*Anthurium ernestii* var *ernestii* Engl.

*Anthurium galactospadix* Croat

*Anthurium gracillimum* Engl.

*Anthurium manuanum* Croat

*Anthurium ottonis* K. Krause

*Anthurium oxycarpum* Poepp.

*Anthurium paraguayense* var *coroicoanum* Croat

*Anthurium plowmanii* Croat

*Anthurium soukupii* Croat

*Anthurium uleanum* Engl.

*Anthurium vittariifolium* Engl.

Section *Polyneurium* (01 species)

*Anthurium lancea* Sodiro

Section *Porphyrochitonium* (01 species)

*Anthurium apaporanum* R.E. Schult.

Section *Tetraspermium* (02 species)

*Anthurium obtusum* (Engl.) Grayum

*Anthurium scandens* (Aubl.) Engl.

Section *Xialophyllum* (02 species)

*Anthurium amoenum* Kunth & Bouché

*Anthurium microspadix* Schott

### ***Caladium***

*Caladium bicolor* (Aiton) Vent.

### ***Colocasia***

*Colocasia esculenta* (L.) Schott

### ***Croatiella***

*Croatiella integrifolia* (Madison) E. G. Gonç.

### ***Dieffenbachia***

*Dieffenbachia acevedoi* Croat, ined

*Dieffenbachia alexiadesii* Croat, ined

*Dieffenbachia costata* H. Karst. Ex Schott

*Dieffenbachia engleri* Croat

*Dieffenbachia humilis* Poepp.

*Dieffenbachia* aff *humilis* Poepp.

*Dieffenbachia manuensis* Croat, ined

*Dieffenbachia parvifolia* Engl.

*Dieffenbachia schunkei* Croat, ined

*Dieffenbachia tambopatensis* Croat, ined

*Dieffenbachia williamsii* Croat

*Dieffenbachia wurdackii* Croat

### ***Dracontium***

*Dracontium longipes* Engl.

*Dracontium plowmanii* G. Zhu & Croat

*Dracontium polyphyllum* L.

*Dracontium spruceanum* (Schott) G. Zhu

### ***Filarum***

*Filarum manserichense* Nicolson

### ***Gorgonidium***

*Gorgonidium vargasii* Bogner & Nicolson

### ***Heteropsis***

*Heteropsis flexuosa* (Kunth) G.S. Bunting

*Heteropsis oblongifolia* Kunth

*Heteropsis peruviana* K. Krause

*Heteropsis spruceana* var *robusta* G.S. Bunting

### ***Homalomena***

*Homalomena crinipes* Engler

*Homalomena picturata* (Linden & André) Regel

### ***Incarum***

*Incarum pavonii* (Schott) E.G. Gonç.

### ***Monstera***

*Monstera* sect *Marcgraviopsis*

*Monstera adansonii* Schott

*Monstera adansonii* var *klotzschiana* (Schott) Madison

*Monstera aureopinnata* Croat

*Monstera dilacerata* (K. Koch & Sello) K. Koch

*Monstera dubia* (Kunth) Engl. & K. Krause

*Monstera lechleriana* Schott

*Monstera obliqua* Miq.

*Monstera pinnatipartita* Schott

*Monstera spruceana* (Schott) Engl.

*Monstera* aff *spruceana* (Schott) Engl.

*Monstera subpinnata* (Schott) Engl.

***Philodendron***

*Philodendron* subgen *Pteromischum*

*Philodendron acreanum* K. Krause

*Philodendron acutifolium* K. Krause

*Philodendron* aff *alatum* Poepp.

*Philodendron asplundii* Croat & M.L.C. Soares

*Philodendron barrosoanum* G.S. Bunting

*Philodendron brevispathum* Schott

*Philodendron brevispathum* ssp *holmquistii* (G.S. Bunting) G.S. Bunting

*Philodendron camposportoanum* G.M. Barroso

*Philodendron* aff *campii* Croat

*Philodendron caudatum* K. Krause

*Philodendron chanchamayense* Engl.

*Philodendron* aff *decurrens* K. Krause

*Philodendron deflexum* Poepp. ex Schott

*Philodendron distantilobum* K. Krause

*Philodendron divaricatum* K. Krause

*Philodendron ernestii* Engl.

*Philodendron exile* G.S. Bunting

*Philodendron fragrantissimum* (Hook.) G. Don

*Philodendron* aff *fragrantissimum* (Hook.) G. Don

*Philodendron glanduliferum* ssp *camiloanum* Croat

*Philodendron guttiferum* Kunth

*Philodendron aff guttiferum* Kunth  
*Philodendron herthae* K. Krause  
*Philodendron heterophyllum* Poepp.  
*Philodendron hylaeae* G.S. Bunting  
*Philodendron krukovii* Gleason  
*Philodendron lechlerianum* Schott  
*Philodendron leucanthum* K. Krause  
*Philodendron linnaei* Kunth  
*Philodendron maximum* K. Krause  
*Philodendron megalophyllum* Schott  
*Philodendron muricatum* Willd. ex Schott  
*Philodendron ornatum* Schott  
*Philodendron aff ornatum* Schott  
*Philodendron panduriforme* (Kunth) Kunth  
*Philodendron quinquelobum* K. Krause  
*Philodendron ruizii* Schott  
*Philodendron scandens* K. Koch & Sello  
*Philodendron schmidtiae* Croat  
*Philodendron schunkeanum* Croat  
*Philodendron solimoesense* A.C. Sm.  
*Philodendron toshibai* M.L.C. Soares & Mayo  
*Philodendron uleanum* Engl.  
*Philodendron verrucosum* L. Mathieu ex Schott

*Philodendron wittianum* Engl.

***Pistia***

*Pistia striotes* L.

***Rhodospatha***

*Rhodospatha brachypoda* G.S. Bunting

*Rhodospatha latifolia* Poepp.

*Rhodospatha moritziana* Schott

*Rhodospatha mukuntakia* Croat

*Rhodospatha rubropunctata* Croat, ined.

***Spathantheum***

*Spathantheum intermedium* Bogner

*Spathantheum orbignyanum* Schott

***Spathiphyllum***

*Spathiphyllum gracilis* G.S. Bunting

*Spathiphyllum juninense* K. Krause

*Spathiphyllum lechlerianum* Schott

***Stenospermation***

*Stenospermation* sp nov (?)

*Stenospermation amomifolium* (Poepp. & Endl.) Schott

*Stenospermation rusbyi* N.E. Br.

*Stenospermation ulei* K. Krause

*Stenospermation wallisii* Mast.

*Stenospermation weberbaueri* Engl.

### ***Syngonium***

*Syngonium hastifolium* Engl.

*Syngonium podophyllum* Schott

*Syngonium podophyllum* var *vellozianum* (Schott) Croat

*Syngonium yurimaguense* Engl.

### ***Taccarum***

*Taccarum weddellianum* Brongn. ex Schott

### ***Xanthosoma***

*Xanthosoma* sp nov (?)

*Xanthosoma caulotuberculatum* G.S. Bunting

*Xanthosoma helleborifolium* (Jacq.) Schott

*Xanthosoma pubescens* Poepp.

*Xanthosoma hylaeae* K. Krause

*Xanthosoma trichophyllum* K. Krause

*Xanthosoma undipes* (K. Koch & C.D. Bouche) K. Koch

*Xanthosoma viviparum* Madison

## APPENDIX 2: ENDEMIC ARACEAE IN SOUTHEASTERN PERU

*Anthurium manuanum* Croat

*Anthurium peltatum* Poepp.

*Dieffenbachia acevedoi* Croat, ined

*Dieffenbachia engleri* Croat

*Dieffenbachia manuensis* Croat, ined

*Dieffenbachia schunkei* Croat, ined

*Dieffenbachia tambopatensis* Croat, ined

*Dieffenbachia wurdackii* Croat

*Dracontium plowmanii* G. Zhu & Croat

*Filarum manserichense* Nicolson

*Gorgonidium vargasii* Bogner & Nicolson

*Spathantheum intermedium* Bogner

*Spathiphyllum gracilis* G.S. Bunting

*Spathiphyllum lechlerianum* Schott

**APPENDIX 3: TAXA OF ARACEAE PER DEPARTMENT IN  
SOUTHEASTERN PERU**

A. Araceae collected in the department of Cusco

TAXA	COLLECTIONS
<i>Anthurium</i> sp	37
<i>Anthurium</i> sect <i>Belolonchium</i> sp nov (?)	1
<i>Anthurium</i> sect <i>Cardiolonchium</i> sp nov1 (?)	1
<i>Anthurium</i> sect <i>Cardiolonchium</i> sp nov2 (?)	1
<i>Anthurium</i> sect <i>Dactylophyllum</i> sp nov (?)	1
<i>Anthurium amoenum</i> Kunth & Bouché	4
<i>Anthurium breviscapum</i> Kunth	10
<i>Anthurium clavigerum</i> Poepp.	2
<i>Anthurium coripatense</i> N.E. Br. Ex Engl.	3
<i>Anthurium croatii</i> Madison	3
<i>Anthurium dombeyanum</i> Brongn. ex Schott	29
<i>Anthurium eminens</i> Schott	1
<i>Anthurium gracile</i> (Rudge) Schott	7
<i>Anthurium grande</i> N.E. Br. ex Engl.	1
<i>Anthurium incurvatum</i> Engl.	1
<i>Anthurium lancea</i> Sodiro	1
<i>Anthurium lechlerianum</i> Schott	3
<i>Anthurium microspadix</i> Schott	1

<i>Anthurium monzonense</i> Engl.	2
<i>Anthurium obtusum</i> (Engl.) Grayum	2
<i>Anthurium ottonis</i> K. Krause	3
<i>Anthurium oxycarpum</i> Poepp.	2
<i>Anthurium oxybelium</i> Schott	1
<i>Anthurium paraguayense</i> var <i>coroicoanum</i> Croat	1
<i>Anthurium pentaphyllum</i> (Aubl.) G. Don.	1
<i>Anthurium scandens</i> (Aubl.) Engl.	2
<i>Anthurium soukupii</i> Croat	4
<i>Anthurium triphyllum</i> Brongn. ex Schott	3
<i>Anthurium versicolor</i> Sodiro	4
<i>Anthurium vittariifolium</i> Engl.	1
<i>Anthurium weberbaueri</i> Engl.	2
<i>Caladium bicolor</i> (Aiton) Vent.	1
<i>Colocasia esculenta</i> (L.) Schott	1
<i>Croatiella integrifolia</i> (Madison) E. G. Gonç.	1
<i>Dieffenbachia acevedoi</i> Croat, ined	2
<i>Dieffenbachia costata</i> H. Karst. Ex Schott	1
<i>Dieffenbachia schunkei</i> Croat, ined	1
<i>Dracontium plowmanii</i> G. Zhu & Croat	3
<i>Dracontium spruceanum</i> (Schott) G. Zhu	1
<i>Filarum manserichense</i> Nicolson	1
<i>Gorgonidium vargasii</i> Bogner & Nicolson	6

<i>Homalomena picturata</i> (Linden & André) Regel	2
<i>Incarum pavonii</i> (Schott) E.G. Gonç.	2
<i>Monstera</i> sp	1
<i>Monstera adansonii</i> Schott	3
<i>Monstera dubia</i> (Kunth) Engl. & K. Krause	1
<i>Monstera lechleriana</i> Schott	5
<i>Monstera obliqua</i> Miq.	5
<i>Monstera</i> aff <i>spruceana</i> (Schott) Engl.	1
<i>Philodendron</i> sp	9
<i>Philodendron</i> subgen <i>Pteromischum</i>	1
<i>Philodendron acutifolium</i> K. Krause	2
<i>Philodendron asplundii</i> Croat & M.L.C. Soares	1
<i>Philodendron barrosoanum</i> G.S. Bunting	1
<i>Philodendron</i> aff <i>campii</i> Croat	1
<i>Philodendron deflexum</i> Poepp. ex Schott	1
<i>Philodendron divaricatum</i> K. Krause	2
<i>Philodendron ernestii</i> Engl.	1
<i>Philodendron herthae</i> K. Krause	2
<i>Philodendron lechlerianum</i> Schott	3
<i>Philodendron leucanthum</i> K. Krause	1
<i>Philodendron megalophyllum</i> Schott	1
<i>Philodendron panduriforme</i> (Kunth) Kunth	1
<i>Philodendron ruizii</i> Schott	3

<i>Philodendron schmidtiae</i> Croat, ined	1
<i>Philodendron verrucosum</i> L. Mathieu ex Schott	1
<i>Philodendron wittianum</i> Engl.	1
<i>Rhodospatha</i> sp	1
<i>Rhodospatha latifolia</i> Poepp.	2
<i>Spathantheum intermedium</i> Bogner	1
<i>Spathantheum orbignyianum</i> Schott	1
<i>Spathiphyllum juninense</i> K. Krause	1
<i>Spathiphyllum lechlerianum</i> Schott	1
<i>Stenospermation ulei</i> K. Krause	2
<i>Stenospermation wallisii</i> Mast.	4
<i>Stenospermation weberbaueri</i> Engl.	1
<i>Syngonium podophyllum</i> Schott	1
<i>Syngonium podophyllum</i> var <i>vellozianum</i> (Schott) Croat	1
<i>Syngonium yurimaguense</i> Engl.	1
<i>Xanthosoma</i> sp	3
<i>Xanthosoma caulotuberculatum</i> G.S. Bunting	2
<i>Xanthosoma pubescens</i> Poepp.	2
<i>Xanthosoma hylaeae</i> K. Krause	1
<i>Xanthosoma trichophyllum</i> K. Krause	2
<i>Xanthosoma viviparum</i> Madison	1
<b>TOTAL</b>	<b>229</b>

B. Araceae collected in the department of Madre de Dios.

TAXA	COLLECTIONS
<i>Alocasia macrorrhizos</i> (L.) G. Don	2
<i>Anthurium</i> sp	23
<i>Anthurium apaporanum</i> R.E. Schult.	1
<i>Anthurium atropurpureum</i> var <i>arenicola</i> Croat	1
<i>Anthurium brevipedunculatum</i> Madison	2
<i>Anthurium breviscapum</i> Kunth	2
<i>Anthurium clavigerum</i> Poepp.	24
<i>Anthurium croatii</i> Madison	17
<i>Anthurium eminens</i> Schott	3
<i>Anthurium ernestii</i> var <i>ernestii</i> Engl.	30
<i>Anthurium galactospadix</i> Croat	1
<i>Anthurium gracile</i> (Rudge) Schott	8
<i>Anthurium gracillimum</i> Engl.	1
<i>Anthurium interruptum</i> Sodiro	5
<i>Anthurium kunthii</i> Poepp.	25
<i>Anthurium lechlerianum</i> Schott	1
<i>Anthurium manuanum</i> Croat	4
<i>Anthurium obtusum</i> (Engl.) Grayum	1
<i>Anthurium oxycarpum</i> Poepp.	24
<i>Anthurium plowmanii</i> Croat	3
<i>Anthurium triphyllum</i> Brongn. ex Schott	2

<i>Anthurium versicolor</i> Sodiro	1
<i>Caladium bicolor</i> (Aiton) Vent.	6
<i>Dieffenbachia</i> sp	17
<i>Dieffenbachia alexiadesii</i> Croat, ined	1
<i>Dieffenbachia costata</i> H. Karst. Ex Schott	4
<i>Dieffenbachia</i> aff <i>humilis</i> Poepp.	1
<i>Dieffenbachia humilis</i> Poepp.	1
<i>Dieffenbachia manuensis</i> Croat, ined	1
<i>Dieffenbachia parvifolia</i> Engl.	2
<i>Dieffenbachia schunkei</i> Croat, ined	2
<i>Dieffenbachia tambopatensis</i> Croat, ined	1
<i>Dracontium longipes</i> Engl.	1
<i>Dracontium plowmanii</i> G. Zhu & Croat	14
<i>Dracontium polyphyllum</i> L.	1
<i>Dracontium spruceanum spruceanum</i> (Schott) G. Zhu	1
<i>Heteropsis flexuosa</i> (Kunth) G.S. Bunting	12
<i>Heteropsis oblongifolia</i> Kunth	5
<i>Heteropsis peruviana</i> K. Krause	1
<i>Heteropsis spruceana</i> var <i>robusta</i> G.S. Bunting	1
<i>Homalomena</i> sp	1
<i>Homalomena crinipes</i> Engler	3
<i>Monstera</i> sp	9
<i>Monstera</i> sect <i>Marcgraviopsis</i>	2

<i>Monstera adansonii</i> var <i>klotzschiana</i> (Schott) Madison	1
<i>Monstera aureopinnata</i> Croat	1
<i>Monstera dilacerata</i> (K. Koch & Sello) K. Koch	1
<i>Monstera dubia</i> (Kunth) Engl. & K. Krause	5
<i>Monstera lechleriana</i> Schott	10
<i>Monstera obliqua</i> Miq.	27
<i>Monstera pinnatipartita</i> Schott	3
<i>Monstera spruceana</i> (Schott) Engl.	12
<i>Monstera subpinnata</i> (Schott) Engl.	6
<i>Philodendron</i> sp	31
<i>Philodendron acreanum</i> K. Krause	7
<i>Philodendron</i> aff <i>alatum</i> Poepp.	1
<i>Philodendron asplundii</i> Croat & M.L.C. Soares	1
<i>Philodendron brevispathum</i> Schott	4
<i>Philodendron brevispathum</i> ssp <i>holmquistii</i> (G.S. Bunting) G.S. Bunting	2
<i>Philodendron camposportoanum</i> G.M. Barroso	9
<i>Philodendron caudatum</i> K. Krause	2
<i>Philodendron chanchamayense</i> Engl.	12
<i>Philodendron</i> aff <i>decurrens</i> K. Krause	1
<i>Philodendron distantilobum</i> K. Krause	1
<i>Philodendron divaricatum</i> K. Krause	2
<i>Philodendron ernestii</i> Engl.	12

<i>Philodendron exile</i> G.S. Bunting	2
<i>Philodendron fragrantissimum</i> (Hook.) G. Don	8
<i>Philodendron aff fragrantissimum</i> (Hook.) G. Don	1
<i>Philodendron guttiferum</i> Kunth	1
<i>Philodendron aff guttiferum</i> Kunth	1
<i>Philodendron herthae</i> K. Krause	3
<i>Philodendron heterophyllum</i> Poepp.	5
<i>Philodendron hylaeae</i> G.S. Bunting	2
<i>Philodendron krukovii</i> Gleason	4
<i>Philodendron lechlerianum</i> Schott	4
<i>Philodendron megalophyllum</i> Schott	12
<i>Philodendron muricatum</i> Willd. ex Schott	1
<i>Philodendron ornatum</i> Schott	6
<i>Philodendron aff ornatum</i> Schott	1
<i>Philodendron panduriforme</i> (Kunth) Kunth	1
<i>Philodendron quinquelobum</i> K. Krause	2
<i>Philodendron scandens</i> K. Koch & Sello	5
<i>Philodendron schunkeanum</i> Croat	2
<i>Philodendron solimoesense</i> A.C. Sm.	1
<i>Philodendron toshibai</i> M.L.C. Soares & Mayo	6
<i>Philodendron uleanum</i> Engl.	1
<i>Pistia stratiotes</i> L.	1
<i>Rhodospatha</i> sp	2

<i>Rhodospatha brachypoda</i> G.S. Bunting	1
<i>Rhodospatha latifolia</i> Poepp.	8
<i>Rhodospatha moritziana</i> Schott	1
<i>Rhodospatha mukuntakia</i> Croat	1
<i>Rhodospatha rubropunctata</i> Croat, ined.	1
<i>Spathiphyllum</i> sp	1
<i>Spathiphyllum gracilis</i> G.S. Bunting	1
<i>Spathiphyllum juninense</i> K. Krause	3
<i>Stenospermation</i> sp	3
<i>Stenospermation rusbyi</i> N.E. Br.	5
<i>Syngonium</i> sp	1
<i>Syngonium hastifolium</i> Engl.	9
<i>Syngonium podophyllum</i> Schott	24
<i>Syngonium yurimaguense</i> Engl.	4
<i>Taccarum weddellianum</i> Brongn. ex Schott	1
<i>Xanthosoma</i> sp	6
<i>Xanthosoma helleborifolium</i> (Jacq.) Schott	4
<i>Xanthosoma pubescens</i> Poepp.	3
<i>Xanthosoma hylaeae</i> K. Krause	1
<i>Xanthosoma trichophyllum</i> K. Krause	1
<i>Xanthosoma undipes</i> (K. Koch & C.D. Bouche) K. Koch	1
<i>Xanthosoma viviparum</i> Madison	3
<b>TOTAL</b>	<b>569</b>

C. Araceae collected in the department of Ucayali.

TAXA	COLLECTIONS
<i>Anthurium</i> sp	6
<i>Anthurium atropurpureum</i> var <i>atropurpureum</i> R.E. Schult. & Maguire	1
<i>Anthurium clavigerum</i> Poepp.	2
<i>Anthurium croatii</i> Madison	2
<i>Anthurium decurrens</i> Poepp.	1
<i>Anthurium eminens</i> Schott	2
<i>Anthurium ernestii</i> var <i>ernestii</i> Engl.	8
<i>Anthurium galactospadix</i> Croat	2
<i>Anthurium gracile</i> (Rudge) Schott	2
<i>Anthurium interruptum</i> Sodiro	1
<i>Anthurium kunthii</i> Poepp.	1
<i>Anthurium oxycarpum</i> Poepp.	2
<i>Anthurium peltatum</i> Poepp.	2
<i>Anthurium pentaphyllum</i> (Aubl.) G. Don.	1
<i>Anthurium sagittatum</i> (Sims) G. Don	1
<i>Anthurium uleanum</i> Engl.	3
<i>Dieffenbachia engleri</i> Croat	1
<i>Dieffenbachia humilis</i> Poepp.	8
<i>Dieffenbachia williamsii</i> Croat	1

<i>Dieffenbachia wurdackii</i> Croat	1
<i>Heteropsis peruviana</i> K. Krause	1
<i>Monstera</i> sp	3
<i>Monstera adansonii</i> var <i>klotzschiana</i> (Schott) Madison	1
<i>Monstera obliqua</i> Miq.	3
<i>Monstera pinnatipartita</i> Schott	1
<i>Monstera spruceana</i> (Schott) Engl.	1
<i>Monstera subpinnata</i> (Schott) Engl.	1
<i>Philodendron</i> sp	5
<i>Philodendron ernestii</i> Engl.	1
<i>Philodendron fragrantissimum</i> (Hook.) G. Don	3
<i>Philodendron glanduliferum</i> ssp <i>camiloanum</i> Croat	1
<i>Philodendron linnaei</i> Kunth	1
<i>Philodendron maximum</i> K. Krause	1
<i>Philodendron megalophyllum</i> Schott	1
<i>Philodendron wittianum</i> Engl.	1
<i>Rhodospatha latifolia</i> Poepp.	2
<i>Rhodospatha mukuntakia</i> Croat	1
<i>Stenospermation amomifolium</i> (Poepp. & Endl.) Schott	1
<i>Syngonium podophyllum</i> Schott	3
<i>Xanthosoma</i> sp	1
<i>Xanthosoma helleborifolium</i> (Jacq.) Schott	1
<b>TOTAL</b>	<b>80</b>

## APPENDIX 4: TAXA OF ARACEAE COLLECTED FIELD SITE

### A. Araceae collected in Wayquechas Biological Station (department of Cusco)

TAXA	COLLECTIONS
<i>Anthurium</i> sp	3
<i>Anthurium amoenum</i> Kunth & Bouché	3
<i>Anthurium lechlerianum</i> Schott	2
<i>Anthurium obtusum</i> (Engl.) Grayum	1
<i>Anthurium oxybelium</i> Schott	1
<i>Anthurium paraguayense</i> var <i>coroicoanum</i> Croat	1
<i>Anthurium scandens</i> (Aubl.) Engl.	1
<i>Anthurium weberbaueri</i> Engl.	1
<i>Caladium bicolor</i> (Aiton) Vent.	1
<i>Philodendron ernestii</i> Engl.	1
<i>Philodendron verrucosum</i> L. Mathieu ex Schott	1
<i>Rhodospatha</i> sp	1
<i>Stenospermation ulei</i> K. Krause	1
<i>Xanthosoma trichophyllum</i> K. Krause	1
<b>TOTAL</b>	<b>19</b>

B. Araceae collected in Quincemil (department of Cusco)

<i>Alocasia</i> sp	1
<i>Anthurium</i> sp	8
<i>Anthurium</i> sect <i>Cardiolonchium</i>	1
<i>Anthurium</i> sect <i>Dactylophyllum</i>	1
<i>Anthurium</i> sect <i>Pachyneurium</i>	2
<i>Anthurium amoenum</i> Kunth & Bouché	1
<i>Anthurium breviscapum</i> Kunth	10
<i>Anthurium clavigerum</i> Poepp.	1
<i>Anthurium coripatense</i> N.E. Br. Ex Engl.	1
<i>Anthurium croatii</i> Madison	3
<i>Anthurium dombeyanum</i> Brongn. ex Schott	4
<i>Anthurium eminens</i> Schott	1
<i>Anthurium gracile</i> (Rudge) Schott	5
<i>Anthurium interruptum</i> Sodiro	2
<i>Anthurium kunthii</i> Poepp.	1
<i>Anthurium lancea</i> Sodiro	1
<i>Anthurium lechlerianum</i> Schott	1
<i>Anthurium monzonense</i> Engl.	2
<i>Anthurium oxycarpum</i> Poepp.	2
<i>Anthurium scandens</i> (Aubl.) Engl.	1
<i>Anthurium triphyllum</i> Brongn. ex Schott	3
<i>Anthurium versicolor</i> Sodiro	6

<i>Caladium bicolor</i> (Aiton) Vent.	1
<i>Dieffenbachia</i> sp	1
<i>Dieffenbachia</i> aff <i>humilis</i> Poepp.	1
<i>Dracontium</i> sp	1
<i>Gorgonidium vargasii</i> Bogner & Nicolson	1
<i>Heteropsis</i> sp	1
<i>Heteropsis spruceana</i> var <i>robusta</i> G.S. Bunting	1
<i>Homalomena crinipes</i> Engler	1
<i>Monstera</i> sp	2
<i>Monstera adansonii</i> Schott	1
<i>Monstera dubia</i> (Kunth) Engl. & K. Krause	2
<i>Monstera lechleriana</i> Schott	3
<i>Monstera obliqua</i> Miq.	3
<i>Monstera subpinnata</i> (Schott) Engl.	1
<i>Philodendron</i> sp	4
<i>Philodendron</i> subgen <i>Philodendron</i>	4
<i>Philodendron</i> subgen <i>Pteromischum</i>	4
<i>Philodendron barrosoanum</i> G.S. Bunting	1
<i>Philodendron chanchamayense</i> Engl.	1
<i>Philodendron ernestii</i> Engl.	1
<i>Philodendron herthae</i> K. Krause	1
<i>Philodendron lechlerianum</i> Schott	2
<i>Philodendron megalophyllum</i> Schott	1

<i>Philodendron panduriforme</i> (Kunth) Kunth	1
<i>Philodendron schmidtiae</i> Croat, ined	1
<i>Rhodospatha latifolia</i> Poepp.	2
<i>Spathantheum orbignyana</i> Schott	2
<i>Spathiphyllum</i> sp	1
<i>Spathiphyllum juninense</i> K. Krause	2
<i>Stenospermation</i> sp nov (?)	1
<i>Syngonium podophyllum</i> Schott	1
<i>Xanthosoma</i> sp	2
<i>Xanthosoma</i> sp nov (?)	1
<i>Xanthosoma pubescens</i> Poepp.	2
<i>Xanthosoma trichophyllum</i> K. Krause	1
<i>Xanthosoma viviparum</i> Madison	1
<b>TOTAL</b>	<b>114</b>

C. Araceae collected in Pantiacolla (department of Madre de Dios)

TAXA	COLLECTIONS
<i>Anthurium</i> sp	4
<i>Anthurium apaporanum</i> R.E. Schult.	1
<i>Anthurium atropurpureum</i> var <i>arenicola</i> Croat	1
<i>Anthurium breviscapum</i> Kunth	2
<i>Anthurium clavigerum</i> Poepp.	1
<i>Anthurium croatii</i> Madison	2

<i>Anthurium eminens</i> Schott	1
<i>Anthurium ernestii</i> var <i>ernestii</i> Engl.	1
<i>Anthurium obtusum</i> (Engl.) Grayum	2
<i>Anthurium triphyllum</i> Brongn. ex Schott	1
<i>Dieffenbachia</i> sp	1
<i>Dieffenbachia humilis</i> Poepp.	2
<i>Heteropsis</i> sp	3
<i>Monstera</i> sp	1
<i>Monstera spruceana</i> (Schott) Engl.	1
<i>Philodendron</i> sp	4
<i>Philodendron asplundii</i> Croat & M.L.C. Soares	1
<i>Philodendron chanchamayense</i> Engl.	1
<i>Philodendron ernestii</i> Engl.	1
<i>Philodendron guttiferum</i> Kunth	1
<i>Philodendron heterophyllum</i> Poepp.	1
<i>Philodendron hylaeae</i> G.S. Bunting	1
<i>Philodendron megalophyllum</i> Schott	1
<i>Philodendron panduriforme</i> (Kunth) Kunth	1
<i>Philodendron quinquelobum</i> K. Krause	1
<i>Rhodospatha</i> sp	1
<i>Spathiphyllum</i> sp	1
<i>Spathiphyllum juninense</i> K. Krause	2
<i>Stenospermation</i> sp	1

<i>Syngonium</i> sp	1
<i>Xanthosoma trichophyllum</i> K. Krause	1
<i>Xanthosoma viviparum</i> Madison	1
<b>TOTAL</b>	<b>45</b>

D. Araceae collected in Los Amigos Biological Station (department of Madre de Dios)

TAXA	COLLECTIONS
<i>Anthurium</i> sp	5
<i>Anthurium atropurpureum</i> var <i>atropurpureum</i> R.E. Schult. & Maguire	2
<i>Anthurium clavigerum</i> Poepp.	2
<i>Anthurium croatii</i> Madison	2
<i>Anthurium ernestii</i> var <i>ernestii</i> Engl.	5
<i>Anthurium galactospadix</i> Croat	1
<i>Anthurium gracile</i> (Rudge) Schott	3
<i>Anthurium kunthii</i> Poepp.	12
<i>Anthurium oxycarpum</i> Poepp.	1
<i>Anthurium sagittatum</i> (Sims) G. Don	2
<i>Dieffenbachia</i> sp	3
<i>Dieffenbachia parvifolia</i> Engl.	2
<i>Dracontium</i> sp	1
<i>Dracontium spruceanum</i> (Schott) G. Zhu	1

<i>Heteropsis</i> sp	5
<i>Heteropsis flexuosa</i> (Kunth) G.S. Bunting	3
<i>Heteropsis spruceana</i> var <i>robusta</i> G.S. Bunting	5
<i>Monstera</i> sp	1
<i>Monstera adansonii</i> Schott	1
<i>Monstera aureopinnata</i> Croat	1
<i>Monstera obliqua</i> Miq.	5
<i>Monstera pinnatipartita</i> Schott	3
<i>Monstera spruceana</i> (Schott) Engl.	1
<i>Monstera subpinnata</i> (Schott) Engl.	2
<i>Philodendron</i> sp	10
<i>Philodendron</i> subg <i>Pteromischum</i>	2
<i>Philodendron chanchamayense</i> Engl.	4
<i>Philodendron ernestii</i> Engl.	1
<i>Philodendron fragrantissimum</i> (Hook.) G. Don	1
<i>Philodendron heterophyllum</i> Poepp.	1
<i>Philodendron hylaeae</i> G.S. Bunting	1
<i>Philodendron muricatum</i> Willd. ex Schott	4
<i>Rhodospatha latifolia</i> Poepp.	1
<i>Spathiphyllum</i> sp	1
<i>Spathiphyllum gracilis</i> G.S. Bunting	3
<i>Spathiphyllum juninense</i> K. Krause	2
<i>Stenospermation</i> sp	1

<i>Syngonium podophyllum</i> Schott	3
<b>TOTAL</b>	<b>104</b>

## APPENDIX 5: DESCRIPTION OF REPRESENTATIVE SPECIES OF ARACEAE IN SOUTHEASTERN PERU

Since this is not a taxonomical study of the Araceae occurring in Southeastern Peru, I am not including the complete description of all the species existing in this area. However, descriptions of some species considered as representative in our study are included here. Additional information like taxonomic comments, infrageneric placement, some diagnosis characters, distribution, and ecology is also included.

### *Anthurium*

Estimated number of species: 1000 spp (Croat, 1988)

Total number of species recorded: 710 spp (Govaerts & Frodin, 2002).

Species recorded in Peru: ~123 spp (Croat, 1999; Croat et al., 2005)

*Anthurium amoenum* var *humile* (Schott) Engler, Bot. Jahrb. für Syst., Pflanzengeschichte und Pflanzengeographie 25: 433. 1898.

**Plant** hemiepiphytic to nearly terrestrial. **Stem** grayish green; cataphylls 6.5 to 13.5 cm long, greenish, deciduous to persistent as short brownish fibers, membranaceous. **Leaves** erect to erect spreading; petioles terete to obtusely sulcate, sometimes with a medial rib; blades 22 to 37 cm long, wider to the middle or immediately above, oblong obovate, acuminate at apex, obtuse to base; primary lateral veins 13 to 15 per side; basal veins up to 3 per side, usually free to margin; collective vein arising from base, upper basal vein or

basal primary lateral veins. **Inflorescence** erect; peduncle 12.5 to 26.5 cm; spathe membranaceous, green, persisting in fruit, reflexed, oblong lanceolate; spadix cylindrical to slightly tapered, 3.5–5 cm long, green, pollen yellow to orangish. **Infructescence** erect; spadix dark green; berries obovate.

This species occurs in Venezuela, Colombia, Ecuador, Peru and Bolivia. In Peru its distribution ranges from the departments of Amazonas and Cajamarca, to Puno. It prefers to grow in the shadowy understory of the subtropical rainforest, from 800 to 2500 m.

*Anthurium amoenum* belongs to Section *Xialophyllum* and is distinguished by its caducous cataphylls, thin leaves and conspicuously nerved, inflorescence erect, green spadix and reflexed spathe.

*Anthurium apaporanum* R.E. Schultes, Bot. Mus. Leaf1.18: 115, 120 t. 19. 1958.

**Plant** epiphytic to terrestrial. **Stem** terete, green; cataphylls 3 to 5 cm long, lanceolate, persisting semi-intact or as reddish brown to brown fibers, subcoriaceous. **Leaves** erect; petioles 13 to 29 cm long, terete, green, chartaceous, 27 to 41 cm long, lower surface with dark punctuations; primary lateral veins 19 to 26 per side, straight to the collective vein; collective vein arising in the first or second lower pair of primary lateral veins. **Inflorescence** erect; peduncle 11 to 29 cm long, green to purplish, spathe subcoriaceous, green, persistent, spreading, 3 to 7 cm long, oblong lanceolate; spadix cylindrical, 5 to 8 cm long, green to white. **Infructescence** erect; spadix 7 to 11 cm long, berries slightly obovate.

This species occurs in Venezuela, Colombia, Ecuador, and Peru; ranging from 200 to 1700m. In Peru is found from the departments of Amazonas to Madre de Dios and is rarely frequent in the understory of the subtropical forest, around 200 to 500 m. Its presence in Madre de Dios, at Los Amigos Station is the southern most reported. Before this, Ucayali had the southern most registered presence.

This is a member of Section *Porphyrochitonium*, a section with many new species already described by Croat et al. (2005) in the Northern area of Peru and Ecuador. This species is recognized by its short internodes, oblong-elliptic blades and whitish spadix. Leaves dry yellowish green and present dark punctuations in the lower surface.

*Anthurium atropurpureum* R. Schultes & Maguire, Bot. Mus. Leafl.16: 60. 1953.

**Plant** terrestrial or rarely epiphytic. **Stem** to 30 cm long; **roots** mostly descending; cataphylls subcoriaceous, narrowly acute at apex, drying pale brown, persisting more or less intact. **Leaves** erect; petioles 2 to 25 cm long, slightly D-shaped to terete narrowly sulcate, rounded abaxially, concolorous when dried; blades subcoriaceous to coriaceous, mostly elliptic, often acuminate at apex, attenuate or acute at base, 11 to 75 cm long, 5 to 14 cm wide, broadest at or near the middle, margins flat to sometimes undulate; upper surface glossy, lower surface matte, sometimes paler than the upper surface, drying pale green; primary lateral veins 5 to 11 per side, mostly arcuate ascending, raised above; interprimary veins rarely present. **Inflorescence** erect, shorter than or sometimes equaling leaves; peduncle 15 to 47 cm long; spathe spreading to reflexed, withering at anthesis, subcoriaceous lanceolate to linear lanceolate, 2 to 15 cm long, up to 2 cm wide,

apex and base acute; spadix purple to brown, erect, pollen yellow orangish, creamy when dry. **Infructescence** with spathe withered; berries dark purple to deep red.

Its distribution ranges from Venezuela and Colombia to Bolivia, from 200 to 1100 m; its distribution reaches Madre de Dios in Peru at low elevations (100 to 160 m) on white sandy soils.

*Anthurium atropurpureum* belongs to Section *Pachyneurium*, Series *Pachyneurium*. This species is distinguished by its leaf blades with the tertiary veins conspicuously etched above (when fresh), by its adaxially sulcate petioles and its purple spathe withering at anthesis.

*Anthurium breviscapum* Kunth, Enum. Pl. 3: 78. 1841.

**Plant** hemiepiphytic. **Stem** terete green to purple, purple to grayish green, smooth; cataphylls lanceolate, green to purplish, caduceous to persistent as grayish or light brown fibers, papyraceous. **Leaves** erect to spreading; petioles 28 to 54 cm long, obtusely sulcate to flattened with marginal ribs; blades membranaceous, 53 to 67 cm long, 31 to 37 cm wide, cordate to cordate sagittate, acuminate to the apex, cordate to base; anterior lobe with margins convex to undulate, posterior lobes rounded to oblong, slightly divergent; primary lateral veins 10 to 16 per side, straight to ascendant; basal veins 6 to 9 per side, the first (or second) to fourth (or fifth) fused into a basal rib; collective vein arising from the first or ninth basal vein. **Inflorescence** erect to spreading; peduncle 12 to 23 cm long, green to purplish; spathe subcoriaceous, green to purplish, persisting in

fruit, 7 to 15 cm long, lanceolate, acute to apex; spadix attenuate 14 to 23 cm long, green to deep purple. **Infructescence** recurved to sometimes pendant; berries obovate, red.

This widely distributed species is found from Venezuela and Colombia to Brazil, Bolivia and Peru. In Peru, *A. breviscapum* grows in the departments of Amazonas, Cajamarca, Cusco, Huanuco, Junin, Loreto, Madre de Dios, Pasco, Puno, San Martin, and Ucayali. This species occurs in almost all the types of rainforests and cloudforests, ranging from 100 to 2500 m.

This species belongs to Section *Cardiolonchium* and is distinguished by its cordate leaves and numerous primary lateral veins, spathe green and reflexed, spathe deep purple. Sometimes the inflorescence is showing green or greenish spadix.

*Anthurium clavigerum* Poeppig, Nov. Gen. Sp. Pl. 3: 84. 1845.

**Plant** epiphytic to hemiepiphytic. **Stem** dark green, drying reddish brown; cataphylls coriaceous, reddish brown to dark brown, deciduous or persisting as fibers brownish. **Leaves** erect spreading; petioles 91 to 93 cm long, terete to weakly sulcate, green; blades reniform in outline, 102 to 116 cm long, 9–15-foliolate, leaflets 29 to 33 cm long, margins slightly to deeply lobate, acuminate to apex, acute to base; primary lateral veins 3 to 7 per side, drying reddish brown in the lower surface, straight to slightly curved to apex. **Inflorescence** arcuate pendent; peduncle 26 to 38 cm long, terete; spathe coriaceous, purplish, lanceolate, 25 cm approximately; spadix violet, 15 to 60 cm long. **Infructescence** pendent; spathe persisting or deciduous, dark brown; spadix grayish brown; berries obovate.

This species ranges from Honduras and Nicaragua in Central America to Brazil, Bolivia and Peru in South America, from below 100 to 1300 m. *Anthurium clavigerum* is very common in the Peruvian forests, occurring in the departments of Amazonas and Cajamarca, reaching the departments of Madre de Dios and Puno.

Belongs to Section *Dactylophyllum* and is distinct from other species because its leaves are palmatisect with the leaflets conspicuously lobate and its huge inflorescence (sometimes reaching 60 cm long).

*Anthurium croatii* Madison, Selbyana 2(2,3): 268, t. 4. 1978.

**Plant** terrestrial. Stems very short with internodes until 2.5 cm long, deep green; cataphylls 5 to 8 cm long, chartaceous to subcoriaceous, triangular, green, deciduous or persisting as few fibers. **Leaves** erect; petioles 66 to 81 cm long, terete, green to grayish green; blades 5 to 11 foliolate, membranaceous, leaflets lanceolate to oblanceolate or obovate, acuminate to apex, acute to long attenuate to base, 11 to 38 cm long; primary lateral veins numerous, straight to slightly ascendent to the margin; collective vein arising at the base or in the first pair of basal primary lateral veins. **Inflorescence** erect; peduncle 41 to 55 cm long; spathe green, narrowly lanceolate, 9 to 14 cm long, long acuminate, spreading to reflexed, persistent; spadix long attenuate, 5 to 14 cm long, purplish. **Infructescence** erect; spadix up to 19 cm long; berries deep purple, ovoid.

*Anthurium croatii* ranges from Colombia and Ecuador to Brazil and Bolivia. In Peru is distributed in the departments of Amazonas and Loreto to Cusco, Madre de Dios, and Puno, ranging from 110 m to 1600 m approximately.

This species belongs to Section *Dactylophyllium* and is recognized by its leaves palmatisected, habit strictly terrestrial and its short stem.

*Anthurium eminens* Schott, *Oesterr. Bot. Wochenbl.*5: 273. 1855.

**Plant** epiphytic robust. Stems green to green grayish, with internodes short up to 4 cm long, green to grayish green; cataphylls 3 to 17 cm long, green. **Leaves** erect; petioles 28 to 105 cm long, terete to obtuse and widely sulcate; geniculum forming a “disc” where the leaflets arise; blades subcoriaceous to coriaceous, palmately 7 to 17 foliolate; leaflets subequal, narrowly oblong, oblong to slightly elliptic, rarely oblanceolate, acute to apex, acute at base, 19 to 49 cm long, margins entire; primary lateral veins numerous per side, subparallel, straight to slightly arcuate ascendant to reach the collective vein; collective vein arising from the base and running the margin straight, slightly undulate. **Inflorescence** spreading to pendent; peduncle spreading, green, 25 to 34 cm long; spathe pendent, green, lineal lanceolate, 21 to 47 cm long, apex long acuminate, often deciduous; spadix pendent, light purple to bluish, 14 to 35 cm long. **Infructescence** erect, to arcuate pendent, 14 to 40 cm long; spathe deciduous; spadix purple to deep purple; berries yellowish to reddish, obovate.

This species is found from Venezuela, Colombia, Suriname and French Guyana to Brazil and Bolivia. In Peru it ranges from Amazonas and Loreto to Cusco and Madre de Dios, from 100 to 2300 m.

*Anthurium eminens* is included in Section *Dactylophyllum* and is recognized by its palmatisected leaves with oblong leaflets arising from the pulvinus, and its purplish inflorescences with a long green spathe, pendant.

*Anthurium ernestii* var *ernestii* Engler, Pflanzenr. , IV IV 23B(Heft 21): 80. 1905.

**Plant** epiphyte; stem terete. **Internodes** 3 to 15 mm long; cataphylls 5 to 13 cm long, lanceolate, drying orangish brown, persistent, entire or as a net or fibers stramineous, subcoriaceous. **Leaves** subcoriaceous; petioles 1 to 20.5 cm long, D-shaped convex in the adaxial side with sharply margins and a midrib, drying light brown to reddish brown; blades membranaceous, 35 to 76 cm long, oblanceolate, acute at apex, attenuate to base with sometimes repand or sinuate margins; veins often drying orangish in the lower surface; primary lateral veins 8 to 12 per side, straight to arcuate ascendent to margin; collective vein arising near the apex. **Inflorescence** erect; peduncle 5 to 20 cm long; spathe subcoriaceous, green to sometimes purplish, persisting in fruit, reflexed to spreading, 3 to 10 cm long, oblong to oblong lanceolate, acute at apex to sometimes abruptly acuminate, acute to base; spadix cylindrical, 3 to 6 cm long, pink to light purple.

**Inflorescence** spreading to pendent; berries obovate, white to purplish, elliptic ovate.

*A. ernestii*, with its two varieties: *ernestii* and *oellgaardii*, occurs from Ecuador and Colombia to Peru and Bolivia, from 100 to 1300 m. *A. ernestii* var *ernestii* is found in Peru from Amazonas to Cusco and Madre de Dios. The reports of this species in Madre de Dios are expanding its distribution.

*Anthurium ernestii* is placed in Section *Pachyneurium*, Series *Pachyneurium* and is characterized by its cataphylls persisting as a net of thin fibers light brown, primary lateral veins showing an orangish color when dry and a short peduncle with a cylindroid spadix.

*Anthurium galactospadix* Croat, *Ann. Missouri Bot. Gard.* 78(3): 654. 1991.

**Plant** epiphytic. **Cataphylls** coriaceous lanceolate, 7 to 9 cm long acute to emarginated at apex, drying reddish brown, persisting semi-intact as a reticulum of fibers. **Leaves** erect spreading; petioles 11 to 28 cm long, D-shaped, with a prominent medial rib and sharply raised margins adaxially, rounded to 3 ribbed abaxially; blades coriaceous to subcoriaceous, broadly oblanceolate elliptic, acute to apex, often attenuate with concave margins to slightly obtuse at base, 51 to 92 cm long, 18 to 34 cm wide, broadest above the middle, margins moderately undulate; primary lateral veins 7 to 14 per side, ascending straight to arcuate to the margin, interprimary veins absent except toward the base, collective vein absent. **Inflorescence** erect; peduncle 4 to 11 cm long, terete, spathe erect spreading, rarely reflexed, coriaceous, dark green to greenish white, broadly lanceolate elliptic, 5.5 to 12 long, 1.5 to 3.5 wide, broadest near the middle, obtuse at apex or (apiculate) at apex, acute at base, sometimes decurrent; spadix pale green to creamy white, 7.5 to 11 cm long, flowers square. **Infructescence** erect; spathe persisting; berries not observed.

*A. galactospadix* is restricted to the western Amazon basin. It is only known from Colombia, Peru and Brazil, growing in Tropical wet and Tropical moist forests below

300 m. Before analyzing the collections included in this study, this species was only known from the departments Loreto and Ucayali. At the moment, *A. galactospadix* is reported to reach Madre de Dios.

This species is distinguished by its thick, relatively short, whitish spadix with the spathe usually longer than the spadix, its short peduncle, and its broadly elliptic oblanceolate leaves which are often attenuate with conspicuously concave margins towards the base. It is related to *Anthurium ernestii*, but this species has cataphylls persisting as fine reticulate fibers, a shorter spathe and much less stout spadix. This species belongs to Section *Pachyneurium*.

*Anthurium gracile* (Rudge) Lindl., Wiener Z. Kunst Theater und Mode 1829(3): 828. 1829.

**Plant** epiphyte. **Roots** white; stems very short. **Internodes** short; cataphylls membranaceous, drying reddish or brown, persisting intact, ultimately deciduous. **Leaves** erect; petioles 1-20 cm long, subterete flattened adaxially; blades moderately thin, oblanceolate, 11-32 cm long, 3-8.5 cm wide, acuminate at apex, gradually tapered at base; primary lateral veins numerous, nearly obscure; collective vein arising from base, 4-7 mm from margin. **Inflorescence** spreading; peduncles 13-40 cm long, longer than petioles; spathe membranaceous, red-violet, lanceolate to oblong-elliptic or ovate-elliptic, 1.3-2.5 cm long, 3-7 mm wide, abruptly acuminate at apex, rounded at base; spadix sessile, purplish-brown, 0.6-6 cm long, 2-4 mm wide; flowers 4-lobed, 5-5.6 mm long, 3.8-4.3 mm wide, the sides jaggedly sigmoid; 2-3 flowers visible in the principal spiral,

3-4 flowers visible in alternate spiral; pollen white. **Infructescence** pendent; peduncle to 60 cm long; spadix to 10 cm long; berries bright red, globose.

This species is found from Guatemala and Belize to the Guyanas, southern Brazil and Peru, ranging from 0 to 1600 m. It is known only from Tropical moist forest.

*Anthurium gracile* has a large root system that may sometimes become infested with ants. It is distinguished by its thin, oblanceolate, the relatively few-flowered spadix, the whitish roots, and the bright red, globose berries.

*Anthurium gracile* is one of only two described species of section *Leptanthurium* (the other being *A. barrierii* Croat, Scherberich & Ferry from the department of Loreto) and is either an extremely variable species or comprised of some additional undescribed sibling species in the Andes of South America.

*Anthurium kunthii* Poepp., Nov. Gen. Sp. Pl. 3: 84-85. 1845.

**Plant** epiphytic herb to scandent. **Stems** usually to 1 m or longer; **roots** numerous at each node, descending; cataphylls subcoriaceous, drying yellow to tan, persisting as linear fibers at each node. **Leaves** spreading; petioles 20-60 cm long, cylindrical, shallowly sulcate; blades ovate, 5-9- pedatisect, leaflets moderately thin, elliptic to ovate-elliptic, 7-27 cm long, 3-8 mm wide, long-acuminate at apex, acute to attenuate at base; petioles to 5 cm long, broadly and sharply sulcate; upper surface glossy, lower surface matte; midrib prominent above, raised below; primary lateral veins 5-18 per side, sunken above, raised below, departing midrib at 45°-50° angle, loop-connecting, weakly sunken above, raised below; collective vein arising from one of the lower primary lateral veins,

3-8 mm from margin. **Inflorescence** spreading to slightly pendant, longer or shorter than the leaves; peduncle 20-55 cm long, cylindrical; spathe green or sometimes slightly purple, oblong-lanceolate, acuminate at apex, acute to obtuse at base, inserted at 50°-70° angle on peduncle; stipe 5-9 mm long in front, 0.5-3.5 mm long in back; spadix pale green, 7-21 cm long, 5-10 mm diameter at base, 1-4 mm diameter at apex; flowers with sides straight to sigmoid; 5-9 flowers visible in the principal spiral, 5-7 flowers visible in the alternate spiral; tepals matte; pistils not emergent; anthers creamy white; pollen white. **Infructescence** pendent; berries purple to violet-purple.

*A. kunthii* ranges from Nicaragua to Panama in Central America, to Brazil, Bolivia and Peru in South America, from 50 to 1800 m. In Peru, this species occurs in Tropical moist and Premontane wet forest and is found at the Los Amigos Biological station.

This is a member of Section *Dactylophyllum* (i.e. group with palmate leaves). This species has long, slender peduncles, nearly equaling the petioles in length, and a slender, elongate, usually greenish spadix.

*Anthurium obtusum* (Engl.) Grayum, *Phytologia* 82(1): 35. 1997.

**Plant** epiphytic to sometimes hemiepiphytic. **Stem** terete, green to dark green to grayish green; cataphylls 3 to 5 cm long, ovate lanceolate, yellowish brown to reddish yellow, membranaceous. **Leaves** erect to erect spreading; petioles 3 to 14 cm long; blades coriaceous, 8 to 18 cm long, wider in the middle or below, oblong lanceolate to oblong, acute to acuminate at apex, acute to base; primary lateral veins 10 to 14 per side, almost indistinguishable from the interprimary, straight to the collective vein; collective vein

arising from the base. **Inflorescence** erect; peduncle 6 to 8 cm long, green to reddish green; spathe membranaceous to subcoriaceous, grayish white, erect, persistent in fruit, 1.7 to 1.9 cm long, oblong elliptic, abruptly acuminate at apex, obtuse at base; spadix cylindrical to tapered, 2 to 3 cm long. **Infructescence** with white berries.

*Anthurium obtusum* ranges from Mexico, Belize, and Guatemala to Panama in Central America and to Suriname, French Guyana, Brazil, Bolivia, and Peru in South America, ranging from the sea level to 1800 m. In Peru, it is occurring from Amazonas to Madre de Dios, and also there are some collections from the department of Tumbes, in the Pacific coast. *A. obtusum* is widely distributed, but very inconspicuous and rarely found in the subtropical forest.

This species belongs to Section *Tetraspermium* and is often confused with *Anthurium scandens* ssp *scandens* (other species widely distributed), but differs in having white spadix (vs. reddish to maroon) and white spathe always erect (vs. reddish and flexed).

*Anthurium oxycarpum* Poepp., *Nov. Gen. Sp. Pl.* 3: 83. 1845.

**Plant** terrestrial. **Stems** very short, hidden by the roots; cataphylls 3 to 7 cm long, lanceolate, persisting entire or as creamy white fibers, membranaceous. **Leaves** erect to spreading; petioles 5 to 12 cm long, superficially sulcate, light green; blades subcoriaceous to membranaceous, 20 to 33 cm long, wider in the middle, elliptic to elliptic obovate, shortly acuminate to apex, acute to base; whitish green in the lower surface; primary lateral veins 9 to 12 per side, straight to slightly arcuate to the collective vein; collective vein arising from the base. **Inflorescence** erect; peduncle 14 to 19 cm

long, green; spathe oblong to obovate, light green, persisting, spreading, 3 to 6 cm long, acuminate to apex, acute to base; spadix 2 to 5 cm long, green to bluish green; pollen yellow. **Infructescence** not observed.

*A. oxycarpum* ranges from Colombia, to Bolivia, Peru and Brazil, from 100 to 1000 m. This species is known in Peru from Amazonas and Loreto to Cusco and Madre de Dios. It grows in the understory of the subtropical rainforest.

*Anthurium oxycarpum* is placed in Section *Pachyneurium* Series *Pachyneurium* and is distinguishable by its elliptic to obovate leaves and its bluish green spadix.

*Anthurium sagittatum* (Sims) G. Don, Enum. Pl. 3: 79. 1841.

**Plant** terrestrial. **Stem** terete, yellowish green to grayish, striate longitudinally; **internodes** very short, 7 to 30 cm long; cataphylls 5 to 7 cm long, triangular lanceolate, brown to reddish brown, deciduous, subcoriaceous. **Leaves** erect; petioles 32 to 38 cm long, conspicuously ribbed, green to reddish green; blades papyraceous, 32 to 42 cm long, wider in the area of insertion with the petiole, ovate to lanceolate, acute to apex, deeply cordate at base, margins slightly undulate; posterior lobes oblong elliptic, sometimes convergent, 9 to 11 cm long; abaxial surface lighter than the adaxial, both faces velvety; midrib ribbed below; primary lateral veins 7 to 9 per side, recurved ascendant; basal veins 5 to 6 pairs, first to fourth fused into the basal rib; basal rib 3 to 5 cm long, slightly recurved; collective vein arising from the lower basal vein. **Inflorescence** erect; peduncle 14 to 18 cm long, conspicuously ribbed; spathe papyraceous, green, persisting in fruit, reflexed, 9 to 11 cm long, lanceolate, acute to apex

and base; spadix cylindric, 7 to 13 cm long, green. **Infructescence** erect to recurved; spadix dark purple; berries rounded to obovate, purplish to greenish.

*Anthurium sagittatum* is reported from Panama, French Guyana and Suriname, to Brazil and Peru, from 100 to 1700 m. In Peru, its range comprises the region from Amazonas and Loreto to Madre de Dios. This species prefers to grow in shadowy, wet places in subtropical forests.

It is placed in Section *Cardiolonchium* and is characterized by its terrestrial habit, conspicuously ribbed petioles and peduncles and velvety upper surface of the leaves. A group of species with very similar phenology and terrestrial habit are also referred as *Anthurium rubrinervium* further research is required to clarify the identity of these species.

### ***Dieffenbachia***

Estimated number of species: 50 spp (Croat, 1988)

Total number of species recorded: 13 spp (Govaerts & Frodin, 2002).

Species recorded in Peru: ~12 spp (Croat, 1999; Croat et al., 2005)

*Dieffenbachia humilis* Poeppig, *Nov. Gen. Sp. Pl.* 3: 90. 1845.

**Plant** terrestrial, 50 to 100 cm tall. **Stem** up to 2 cm diameter, internodes short to slightly longer than broad, semiglossy. **Leaves** with petioles up to 45 cm long, dark blackish green with faint yellow-green speckles; the free portion subterete; blades narrowly ovate to elliptic, up to 40 cm long, narrowly acuminate at apex acute to rounded at base;

primary lateral veins 14 to 25 per side. **Inflorescence** 2 per axil; peduncle about 15 cm long; spathe green, 9 to 11 cm long, narrowly acuminate at apex; spadix with portion pistillate 6 cm long, the young berries closely aggregated. **Infructescence** not observed.

*Dieffenbachia humilis* is known from Brazil, Ecuador, Guyana, French Guyana and Peru. In Peru, it occurs in the understory of the rainforests located in Pasco, Loreto and Madre de Dios from 100 to 600 m. This species is recognized by its oblong, yellowish green-drying blades, sometimes mottled with green spots.

Most of the material collected for this species comes from the Guyanas. However being reported in Peru and Ecuador, *Dieffenbachia humilis* identification in those countries is considered controversial.

*Dieffenbachia parvifolia* Engler, *Pflanzenr.* IV. 23Dc (Heft 64): 59. 1915.

**Plant** terrestrial, small. **Stem** short with short internodes. **Leaves** spirally arranged; leaves up to 50 cm long, petioles sheathed about the middle; blades lanceolate, conspicuously inequilateral, narrowly acuminate and falcate at apex, subacute at base primary lateral veins 7 per side approximately. **Inflorescence** with peduncle 6 cm long; spathe 8 cm long, 1.5 cm diameter, spadix not at all stipitate; pistillate portion 4 cm long; staminate portion 3.5 cm long, separated from the pistillate portion by a short sterile segment. **Infructescence** composed by berries 1 or 2 seeded, ca. 5 mm diameter.

*Dieffenbachia parvifolia* ranges from Colombia and Venezuela, to the Guyanas, Brazil, Peru and Bolivia, from near to sea level to most less than 300 m (exceptionally to 900 m). In Peru, this species ranges from Loreto, to Ucayali and Madre de Dios.

This species is one of the smallest in the genus and it is hard mistake it for other species of *Dieffenbachia*.

### ***Dracontium***

Estimated number of species: 18 spp (Croat, 1988)

Total number of species recorded: 24 spp (Govaerts & Frodin, 2002).

Species recorded in Peru: 7 spp (Croat, 1999; Zhu & Croat, 2005)

*Dracontium spruceanum* (Schott) G. Zhu, *Novon* 6(3): 308. 1996.

**Plant** terrestrial, corm 4-18 cm diameter, with abundant tubercles. **Leaves** with petiole 1-2 m long, 1.2-4 cm diameter at midpoint; blades 0.9-1.5 m diameter; peduncle 0.5-1.1 m long, 2-3.5 cm diameter at midpoint. **Inflorescence** with spathe 17-35 × 3-6 cm, non-cymbiform (constricted medially), non-cucullate, the margins broadly overlapping at the base; inner surface with basal, translucent, whitish area 4-8 cm high (longer than spadix); spadix 3.4-6 × 0.7-1.1 cm (dried), hidden from view, stipitate. **Infructescence** not seen.

*Dracontium spruceanum* ranges from Costa Rica and Panama in Central America to Suriname, Brazil and Peru in South America, from 0 to 1500 m. This species prefers the Tropical moist forest, Premontane wet forest, and Tropical wet forest. In Peru, this species is found from Amazonas, to Madre de Dios.

*Dracontium spruceanum* is the most widespread species in the genus and the most morphologically plastic species in the genus. It is characterized by its usually erect or slightly arching (non cymbiform) spathe, which differentiates into a proximal tube and

distal lamina, with the translucent area of the inner spathe surface 1.5 to 3 times longer than the spadix, and by having the rachises of the leaf usually naked.

### ***Heteropsis***

Estimated number of species: 19 spp (Croat, 1988)

Total number of species recorded: 14 spp (Govaerts & Frodin, 2002).

Species recorded in Peru: 4 spp (Croat, 1999)

*Heteropsis flexuosa* var *flexuosa* (Kunth) G.S. Bunting, Revista de la Facultad de Agronomía 10: 201. 1979.

**Plant** hemiepiphytic. **Stem** terete, dark brown to blackish. **Leaves** distichous, axillary buds like spines; petioles short 5 to 7 mm, sulcate adaxially; blades coriaceous 10 to 20 cm long, oblanceolate to elliptic, acuminate to apex, acute to base, adaxially darker than the lower surface; primary lateral veins numerous, straight to slightly recurved; collective vein arising from base convex in both surfaces. **Inflorescence** not observed. **Infructescence** not observed.

This species ranges from Venezuela, the Guyanas and Suriname, to Bolivia and Peru, from 0 to 1000 m. *Heteropsis flexuosa* var *flexuosa* prefers to grow among the canopy in the tropical rainforest. In Peru, it is ranging from Amazonas and Loreto to Madre de Dios and Puno.

This genus is morphologically atypical in the Araceae family. Its appearance is very different to the other genera but the inflorescences and infructescences are the features most distinctive.

*Heteropsis spruceana* var *robusta* G.S. Bunting, Phytologia 60(5): 303-305. 1986.

**Plant** hemiepiphytic. **Roots** grayish yellow to grayish. **Stem** conspicuously 2 ribbed, drying yellowish brown to grayish. **Leaves** distichous, axillary buds like spines; petioles very short 3 to 4 mm, sulcate adaxially; blades subcoriaceous 10 to 17 cm long, elliptic to rarely ovate, acuminate to apex, acute to obtuse at base, adaxially darker than the lower surface; mid-vein drying light brown; primary lateral veins numerous, recurved ascendant; collective vein arising from base conspicuously convex in both surfaces. **Inflorescence** not observed. **Infructescence** not observed.

*Heteropsis spruceana* var *robusta* ranges from Venezuela, French Guyana and Suriname, to Bolivia, Peru and Brazil in the range between 50 to 1500 m. Its habitat is mainly the wet forest. In Peru occurs in Amazonas, Loreto, Pasco, Junin, and Madre de Dios.

This species is very similar to *H. flexuosa*, but when *H. spruceana* dries, it tends to show a darker color than *H. flexuosa*.

### ***Homalomena***

Estimated number of species: 147 spp in Africa and America (Croat, 1988); 17 spp in

Section *Curmeria*, occurring only in America

Total number of species recorded: 101 spp (Govaerts & Frodin, 2002).

Species recorded in Peru: 2 spp (Croat, 1999)

*Homalomena crinipes* Engler, Bot. Jahrb. Syst. 37: 124. 1905.

**Plant** terrestrial. **Stem** rhizomatous, terete, red to reddish purple; cataphylls 21 to 26 cm long, oblong-lanceolate, reddish to reddish brown, persisting entire, coriaceous. **Leaves** erect to spreading; petioles 41 to 132 cm long, terete, reddish to greenish, pubescent; blades papyraceous, 36 to 60 cm long, ovate, acute to apex, deeply cordate to base, margins entire to undulate; posterior lobes rounded to oblong, 12 to 17 cm long, adaxially darker than the lower surface, surfaces non glossy; primary lateral veins 5 to 7 per side, recurvate ascendant; basal veins 6 to 7, fused into a basal rib; basal rib 5 to 10 cm long; collective vein arising from the base or the second (or third) basal vein. **Inflorescence** erect, solitary; peduncle 7 to 16 cm long, red; spathe subcoriaceous, 22 to 26 cm long, moderately constricted above the tube; blade greenish to grayish red, apex conspicuously acuminate, frequently circinate; spadix 13 to 18 cm long; female portion greenish; male portion white. **Infructescence** not observed.

This species ranges from Costa Rica through Bolivia, from 0 to 1200 m in the tropical and premontane forests. In Peru, *Homalomena crinipes* occurs in Amazonas, Loreto, Junin, Pasco, Ucayali and Madre de Dios.

This species presents a collective vein in the margin of the leaves, and the pinnati-parallel venation system is very similar to *Philodendron*. The petioles present sometimes little spines and the peduncles are very short.

## ***Monstera***

Estimated number of species: 60 spp (Croat, 1988)

Total number of species recorded: 31 spp (Govaerts & Frodin, 2002).

Species recorded in Peru: 12 spp (Croat, 1999; Croat et al., 2005)

*Monstera adansonii* Schott, Wiener Z. Kunst. Theater und Mode 4: 1028. 1830.

**Plant** hemiepiphytic. Stem approximately 1 cm diameter; internodes 3 cm. **Leaves** 21 to 42 cm long, petioles canaliculated, apically geniculate, geniculum 1 to 2 cm long, sheath extended to geniculum; blades 31 to 51 cm long, green to discolored, ovate elliptic, fenestrate or not, acuminate to apex, attenuate to base, margin entire, coriaceous; midvein raised below sunken above, primary lateral veins 9 to 16 per side. **Inflorescence** 1 per axil; peduncle 10 to 20 cm long, green, erect; spathe 11 to 17 cm long, non constricted, elliptic, cuspidate at apex, deciduous after anthesis; spadix homogeneous, sessile, 7 to 12 cm long, cream. **Infructescence** 10 to 17 cm long; peduncle 16 to 20, green, erect; berries yellowish green, subprismatic.

*Monstera adansonii* ranges from Mexico in Central America, to the Guyanas, Suriname, Brazil, Bolivia, and Peru in South America. It ranges from 0 to 1300 m in the tropical, montane and premontane forests. In Peru this species is found in Loreto, Ucayali, Pasco, San Martin, and Madre de Dios.

*Monstera adansonii* has fenestrate adult blades, strongly canaliculated long petioles, and persistent sheath wings.

## ***Philodendron***

Estimated number of species: 700 spp (Croat, 1988)

Total number of species recorded: 398 spp (Govaerts & Frodin, 2002).

Species recorded in Peru: 71 spp (Croat, 1999; Croat et al., 2005)

*Philodendron fragrantissimum* (Hook.) G. Don, Hortus Britannicus 632. 1839.

**Plant** hemiepiphytic. **Stem** appressed climbing or rarely scandent with slender branches bearing small leaves; sap orangish to brownish, sticky, spicy-scented; internodes short, usually thicker than long, obscured by cataphyll fibers; cataphylls greenish white, sometimes drying reddish brown, persisting as fibers. **Leaves** erect spreading; petioles 20 to 70 cm long, D-shaped to sharply C-shaped; blades ovate to ovate triangular, subcoriaceous, moderately bicolorous, acuminate to apex, cordate at base, 21 to 59 cm long, about equal in length to petiole; posterior lobes 5 to 15 cm long, obtuse to rounded; midrib broadly sunken, paler than surface below; basal veins 3 to 5 per side; posterior rib sometimes naked; primary lateral veins 3 to 6 per side, sunken above, convex below. **Inflorescence** erect to semi erect, 2 per axil; peduncle 3 to 13 cm long; spathe 9 to 19 cm long, spathe blade white to greenish, rarely reddish outside, white to greenish inside, spathe tube reddish to dark maroon outside, red to maroon inside; spadix stipitate, cylindrical 9 to 16 cm long; pistillate portion 2 to 5 cm long; staminate portion 6 to 8 cm long; creamy. **Infructescence** with stipe or spadix maroon; berries bright red to purple red, sometimes orange.

This species ranges from Guatemala and Belize in Central America to Brazil and Peru in South America, from 0 to 1000 m. *Philodendron fragrantissimum* occurs in the Tropical moist forest, Premontane wet forest and Tropical wet forest.

This species belongs to Subgenus *Philodendron* and is distinguished by its short internodes, a tendency to produce slender branches from near the apex; persistent, reddish brown cataphylls, ovate triangular leaves; and colorful inflorescences with spathes bright red on the tube and white on the blade.

*Philodendron solimoesense* A. C. Smith, Journal of the Arnold Arboretum 20: 289. 1939.

**Plant** epiphytic to sometimes terrestrial. **Roots** tuberculate aculeate; foliage leaf scars transverse elliptic to suborbicular, 2.5 to 3.5 cm long, whitish gray. **Leaves** with petioles 50 to 100 cm long, often rugulose, adaxially flattened; leaf blade sagittate, margins repand, overall length 50 to 94 cm, overall width 27 to 48 cm, upper surface dark green, lower surface paler; anterior division 30 to 67 cm long, apex obliquely acute acuminate; primary lateral veins 3 to 6 per side; posterior veins retrorse 17 to 27 cm long; basal ribs denuded for 3 to 6 cm, tip usually acute, rarely subacute or obtuse. **Inflorescence** with peduncle 4 to 12 cm long, green; spathe 13 to 31 cm long, slightly cylindric, outer surface light green, becoming yellow with ripening of berries; spadix 10 to 28 cm long. **Infructescence** ripe spadix 12 cm long; berries white, orange or red, with fermenting odor.

*Philodendron solimoesense* ranges from Venezuela, Colombia, French Guyana, and Suriname to Brazil, Bolivia and Peru; it ranges from 50 to 700 m. This species is often

climbing in 'terra firme' or flooded blackwater forests or gallery forests. It is not commonly seen growing on sandy soils.

This species is placed in the Subgenus *Meconostigma* and appears to be the only member of this subgenus which occurs north of the Amazon basin.

### ***Pistia***

Estimated number of species: 1 spp (Croat, 1988)

Total number of species recorded: 1 spp (Govaerts & Frodin, 2002).

Species recorded in Peru: 1 spp (Croat, 1999)

*Pistia stratiotes* L., Species Plantarum 2: 963. 1753.

**Plant** floating herb; acaulescent. **Leaves** spirally disposed, rosulate; blades obovate, light green, truncated or emarginated to apex, 3 – 15 cm long, margins entire; venation subparallel, sponge-like, wide, densely covered by trichomes. **Inflorescences** not observed. **Infructescence** not observed.

*Pistia stratiotes* is widely distributed through Tropics and Subtropics and grows in water pounds like 'aguajales', lakes, oxbows, etc., generally below 500 m. These plants are occurring in US (Florida, Louisiana) to Mexico, Belice and Panama in Central America; and to Brazil, Bolivia, Uruguay and Argentina. It is also found in Africa (Burundi, Comoros, Gabon Kenya, Tanzania and Madagascar) and Asia (China and Sri Lanka)

This floating species belongs to a monospecific genus and is hardly ever confused with any other species.

## ***Rhodospatha***

Estimated number of species: 67 spp (Croat, 1988)

Total number of species recorded: 21 spp (Govaerts & Frodin, 2002).

Species recorded in Peru: 7 spp (Croat, 1999; Croat et al., 2005)

*Rhodospatha latifolia* Poeppig, Nov. Gen. Sp. Pl. 3: 91, pl. 300. 1845.

**Plant** hemiepiphytic. Stem with internodes 1 a 2 cm long. **Leaves** with petioles 34 to 47 cm long, light green, rounded below and slightly canaliculated above, apically geniculate; geniculum 2 to 3 cm long; sheathed all along; blade 31 to 45 cm long, green, slightly discolored, elliptic to oblong, acuminate to apex, rounded to base, margins entire, chartaceous; midvein rounded and strongly raised abaxially, sunken below, primary lateral veins more than 20 per side. **Inflorescences** 1 per axil; peduncle 14 to 16 cm long, light green, erect; spathe 17 cm long, non constricted, white inside and light green outside; elliptic, acute to apex, caduceus after anthesis; spadix homogeneous, pink to pinkish, stipitate 1 to 2 cm long approximately. **Infructescence** immature to 21 cm long, berries green when immature.

*Rhodospatha latifolia* occurs from Venezuela, Colombia, and French Guyana, to Brazil, Bolivia and Peru; and ranges from 50 to 2100 m. In Peru is distributed in Amazonas, Cajamarca, and Loreto, to Cusco, Puno and Madre de Dios.

This species shows a very characteristic venation parallel, spadix pink and very conspicuous stipe (up to 2cm long).

According Croat (pers. comm.) many new species under this taxon were misidentified and they are now in process of definition.

## ***Syngonium***

Estimated number of species: 36 spp (Croat, 1988)

Total number of species recorded: 36 spp (Govaerts & Frodin, 2002).

Species recorded in Peru: 4 spp (Croat, 1999)

*Syngonium podophyllum* Schott, Botanische Zeitung. Berlin 9(5): 85. 1851.

**Plant** hemiepiphytic. Juvenile plant with **stems** slightly glaucous; petioles sheathed 1/2-2/3 their length; blades simple, cordate, 7-14 cm long, sagittate or hastate, acuminate at the apex, the anterior lobe somewhat constricted at the base, posterior lobes usually more or less triangular, directed downward or prominently outward. Adult plants with stems sometimes glaucous, sap milky; petioles 15-60 cm long, sometimes glaucous, sheathed 2/3 their length; blades pedatisect, 3-11 foliolate, united or free; lowermost leaflet variously auriculate at the base, the auricles oblong to oblong-elliptic to broadly elliptic; median leaflet obovate to broadly elliptic, abruptly acuminate at the apex, broadly or narrowly decurrent at the base, 16-38 cm long; primary lateral veins 3-6 pairs on the median leaflet, prominently raised beneath; collective veins 2 or 3. **Inflorescences** 4-8 per axil; peduncle sometimes glaucous, erect, up to 9 cm long; spathe 5-9 cm long; spathe tube narrowly ovoid to ellipsoid, 3-4 cm long, green inside and out; spathe blade greenish white to creamy white or sometimes yellow, 5-6.5 cm long, long acuminate at the apex;

pistillate portion of the spadix 1-2 cm long, greenish cream; staminate portion of the spadix 4-7 cm long, cream. **Infructescence** reddish orange or yellow; peduncle pendent to 13 cm long in fruit; berries fused into a syncarp ovoid, brownish, 3-5 cm long, 1.5-3.5 cm wide; seeds many, ovoid, 7-11 mm long, brown to dark brown, enveloped in a soft, grayish, sweet, pulpy mesocarp.

This species is widely distributed in America. It occurs from Mexico, Guatemala, and Belize to Panama in Central America; and from Venezuela, Colombia, the Guyanas, and Suriname to Brazil, Bolivia, Paraguay and Peru. *Syngonium podophyllum* ranges in Peru from Amazonas and Loreto, to Cusco, Puno, Ucayali, and Madre de Dios. This hemiepiphyte prefers to grow under shady conditions.

*Syngonium podophyllum* includes three varieties. The variety founded in our study area is *podophyllum*. This species is well known in horticulture and it is easy to recognize by its pedatisected leaves, milky sap and fruits fused into a syncarp.

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## **ABSTRACT**

### **A COMPARATIVE ANALYSIS OF THE DIVERSITY, DISTRIBUTION, AND BIOGEOGRAPHY OF ARACEAE IN SOUTHEASTERN PERU (CUSCO AND MADRE DE DIOS, PERU)**

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Araceae family comprises 106 genera and almost 3500 species with a nearly world-wide distribution. About 60% of the Araceae species of the world occur in the Neotropics. Even though recent research in Peru has resulted in a dramatic increase of species, the family is still poorly known. One of the major gaps in our knowledge of the diversity and distribution of Araceae is in the Andes-Amazon region of southeastern Peru. The analysis of existing and new collections helped better characterize the diversity and distribution of Araceae in the region. A total of 1048 field collections, including the ones conducted in this study, have yielded 161 species in 22 genera. We report additions to the Araceae flora of southeastern Peru including 14 endemic species. The area of Cusco holds the highest number of endemic species. Other areas for further research in the distribution and diversity of Araceae are proposed in this study.