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Explorations for Araceae in Ecuador 2004: Part II

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In August 2004, I continued my Ecuadorian adventure, the first part reported in the last IAS Newsletter. During the second half I visited areas on the Pacific and Atlantic slope. I was accompanied by Genevieve Ferry and Elisa Levy. Genevieve arrived from Nancy Botanical Garden in France. I met Genevieve during a trip to Europe for Josef Bogner's honorary Ph.D. ceremony. Genevieve has great interest in Araceae, but had never been to a tropical rainforest. Her Director, Romeric Pereil, was convinced that Genevieve and the botanical garden would profit if she were to join an expedition to Ecuador. Elisa Levy, a botany student at the Universidad Catolica, is a native of El Chical in Carchi Province and proved very useful because she was very familiar with the area. I had been warned that it might not be safe because of Colombian guerilleras who frequented the area, and thought having a local resident along who the community was familiar with would provide us with a certain degree of cover. She also proved to be

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Figure 1. Paramo del Angel.

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a good field person and a competent plant presser.

On the journey to El Chical from Quito, most of the route consists of arid hills with the highway adhering to long winding slopes with lots of bus and truck traffic. We had lunch in Ibarra, the capitol of Imbabura Province, then continued on to Tulcán, the capitol of Carchi Province near the Colombian border. The area between Tulcán and Tufino is totally devoted to pasture due to its elevation of 3500 m. After being stopped by a military checkpoint just before reaching Tufiño, we entered an area of shrubby vegetation and began collecting; most of the species were new to me, but the area was too high for Araceae. Just to the east the road climbed higher and we entered the Paramo del Angel (**Fig. 1**), with vast stands of *Espeletia* and *Puya* extending for more than 20 km. The paramo was inhabited by llamas occasionally right along the road, and when the paramo was enveloped in fog, the llamas, barely visible among the *Espeletia,* gave an eerie sensation.

Beyond the paramo the road dropped steeply to the west and wandered through forested hills where Araceae soon became conspicuous and abundant with most of the species being new. Finally we reached Maldonado. We drove through town looking for a hotel, but saw nothing obvious and decided to continue on to El Chical, hoping there would be a hotel there. We arrived in El Chical just before dark and checked into the town's only hotel. It was the only concrete building in town and though somewhat primitive, it was very comfortable after I wired a couple of receptacles so we could run the computer and other essential appliances. We were the only guests in the hotel and even the owner left the following day on a trip to Quito, leaving us in the care of a friend who lived nearby.

El Chical lies on the Colombian border across from a small Colombian village on the other side of the Río San Juan with a foot bridge providing its electric current from the Ecuadorians. The village is not connected by road to any other part of Colombia, and El Chical has a garrison of Ecuadorian army on the hill above the town so the soldiers run through the streets in the early morning doing military exercises. The single road continuing from the town across the Río Chical goes on to Peñas Blancas, which is really nothing more than a house at the end of the road. The house is owned by Elisa's grandparents and it was here that Elisa's father Jim Levy, then a Peace Corp worker trekking into the lowlands to work with Awa Indian communities, met and fell in love with Elisa's mother. The Levys live in Quito part time and also in a house they built just east of El Chical.

We spent our first day collecting in the area of Peñas Blancas, which contains many Araceae. On the way, at the river bridge near El Chical, we found a large new species of *Anthurium* growing in a tree, a member of section *Cardiolonchium,* and one which was being pollinated by small wasp-like bees. I managed to get good photos and collected some bees in a plastic bag for later determination, but they all escaped by chewing their way out of the bag. In another area we found two additional new species, both also members of section *Cardiolonchium.* One had a dark purple spathe and a reddish spadix (**Fig. 2**) while the other had longer internodes and a flesh-colored spadix. Among the species previously seen in the Lita-San Lorenzo region were

Figure 2. New species of Anthurium *section* Cardiolonchium *with a dark purple spathe & reddish spadix.*

Figure 3. Philodendron esmeraldense *Croat.*

Anthurium anchicayense Croat, *A. andreanum* Linden, *A. angamarcanum* Sodiro, *A. dolichostachyum* Sodiro, *A. michelii* Guill., *A. peltigerum* Sodiro, *Dieffenbachia tonduzii* Croat & Grayum, *Philodendron curvipetiolatum* Croat, *P. esmeraldense* Croat (**Fig. 3**), *P. roseocataphyllum*

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Figure 4. Philodendron rugapetiolatum *Croat.*

Figure 5. New species of Philodendron *with a narrow blade.*

Figure 6. New species of Anthurium *section* Calomystrium.

Figure 7. New deeply three-lobed Anthurium *section* Belolonchium.

Figure 8. New species of Philodendron.

Figure 9. New species of Anthurium *section* Belolonchium.

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Croat & M. Mora, *P. rugapetiolatum* Croat (**Fig. 4**), *P. subhastatum* Engl. and *P. verrucosum* Mathieu ex Schott. Also present is a new species of *Philodendron* (**Fig. 5**) with a narrow blade similar to *P. tenue* K. Koch.

Known species found in the El Chical region that were not found in the Lita-San Lorenzo region include *A. ovatifolium* Engl., *A. pulverulentum* Sodiro var. *adsimile* (Sodiro) Croat & Rodríguez, *P. fibrosum* Sodiro ex Croat, *P. oligospermum* Engl. and *Stenospermation densiovulatum* Engl. Many more species that occur in the El Chical region are still unnamed and new to science. One is a long-bladed member of *Anthurium* section *Polyneurium* similar to *Anthurium cuspidatum* Masters, as well as a member of *Anthurium* sect. *Calomystrium* with thick ovate blades and free basal veins, sometimes even a peltate blade (**Fig. 6**). Another was a deeply three-lobed member of *Anthurium* sect. *Belolonchium* similar to *Anthurium herthae* K. Krause from the Oriente of Ecuador (**Fig. 7**). Several new species of *Philodendron* were found including one with a thick, ovate blade and deciduous cataphylls (**Fig. 8**).

On the return to Tulcán, we made numerous stops at elevations that contained Araceae, collecting many interesting and new species. The majority were in flower and large sets were collected for type specimens. Between El Chical and the Paramo del Angel, ranging from 1200 to 2000 m, many species of *Anthurium* section *Belolonchium* were found, most new to science. One species near Maldonado has long internodes and stood more than two meters tall (**Fig. 9**). Higher up we found a large *Anthurium* section *Belolonchium* with

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Figures 10 and 11. New species of Anthurium *section* Belolonchium *with blades over 1 m long.*

Figure 12. Anthurium cupulispatha *Croat & J. Rodríguez.*

blades over a meter long and stubby purplish red spadices with a broad hooding spathe (**Figs. 10 & 11**).

We made it back to Quito the same day and began pressing the collections. Chris Davidson had arrived the previous day and we hurried to get back to the field. Our first field trip with Chris was along the Quito-to-Santo Domingo road, departing at Chilligallo and ending in Chiriboga. Two species in this region were a large *Anthurium* with long internodes and cordate blades with conspicuously sunken tertiary veins, and a very small *Anthurium* with a stipitate spadix. We arrived at Tinalandia, where we spent the night pressing plants on the front porch of the lodges overlooking the Río Pilaton not far below the mouth of the Río Toachi. I finished pressing plants the following day while Chris collected in the forest around Tinalandia.

We left the next day for Ventanas and stayed in Babahoya, where we met Xavier Cornejo in the morning. It was a miserable hotel with roosters crowing outside the window. The next morning we headed to Hacienda Clementina, headquarters of the large banana industry around Babahoya. We got permission to collect at Cerro Samana, the ultimate goal of the trip.

Cerro Samana is an isolated hill about 750 m elevation – one of the few remaining areas at this elevation on the western slope of the Andes. It will be another study site for an aroid florula, so collecting there was intense. Species found were *Anthurium angamarcanum* Sodiro, *A. argyrostachyum* Sodiro, *A. asplundii* Croat, *A. brachypodum Sodiro, A. cupulispatha* Croat & J. Rodríguez (**Fig. 12**), *A. dolichostachyum, A. guayaquilense* Engl., *A. ochreatum*

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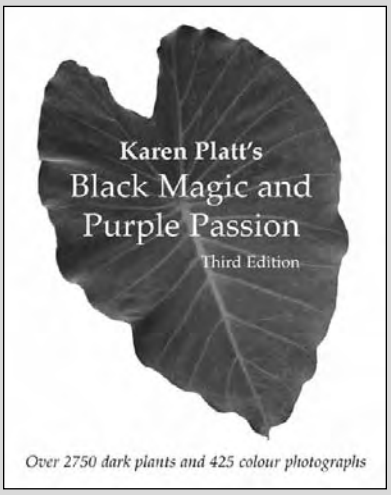
Book Review...

Black Magic and Purple Passion: Black Aroids

By Karen Platt



Aroids are superb in any colour, but it is amazing how many of them approach black. It is understood that when we talk about "black" plants we are encompassing the darkest colors found in horticulture – from bronze, to purple to near black.

I have been researching dark plants for over ten years. Aroids being my favourite group of plants, I've amassed a lot of information on them, chiefly Arisaemas and Arums. I am fascinated by the spathes and spadices of these plants, let alone their magnificent foliage. I could

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hardly contain myself when I also learned of purple and red foliaged forms of some species from China. I love the elegance of *Arisaema sikokianum* aptly described by one visitor to my booth at the Chelsea flower show in 2004 as "like one of Cecil Beaton's hats in *My Fair Lady.*" It is probably the most beautiful of all *Arisaemas,* a true aristocrat. However, I am also taken by the deeply coloured spathes of *A. speciosum* and many others.

I keep both of these slightly moist in their pots out in the garden over winter (Z7). This year, for the first time in many, we had a lot of snow. I thought I might have lost them, as they were unprotected. Thankfully, they came through unharmed. *Arisaema sikokianum* finished flowering in May just as *A. speciosum* was breaking dormancy. They both grow in light shade. *Arisaema griffithii* is another favourite, the patterning on this species is incredible. My favoured Arum is *palaestinum,* for I believe it is the darkest, but this is hard to come by. As with many aroids, the smell is notorious but I have learned that it often depends on provenance. I first discovered this while talking to a journalist in Oregon whose family had grown *Dracunculus vulgaris,* once classified as Arum, for almost 100 years and he claimed it had no off-putting smell at all. Yet it is the plant

Figure 13. Chlorospatha dodsonii *Madison.*

Figure 14. Anthurium samanaense *Croat.*

Figure 15. New species of Philodendron.

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Sodiro, *A. obscurinervia* Croat, *A. palenquense* Croat, *A. pallidiflorum* Engl., *A. versicolor, Chlorospatha dodsonii* Madison (**Fig. 13**), *Dieffenbachia sp., Monstera* cf. *adansonii* Schott, *Philodendron acuminatissimum* Engl., *P. platypetiolatum* Madison, *P. purpurascens* Engl., *P. tenue* K. Koch, *P. tenuipes* Engl., *P. umbricolum* Engl., *Rhodospatha dodsonii* Croat, *Syngonium macrcarpum* Engl. and *Xanthosoma sp.* One species of *Anthurium* is considered new, *A. samanaense* Croat (**Fig. 14**), as well as two new species of *Philodendron.* One being (**Fig. 15**), reasonably common on the Pacific slope also near Piñas and Guasaganda. Clearly more time will have to be spent at Cerro Samana before any florula can be prepared.

On the way back to Quito we collected at the Universidad Polytechnica Salesiana's Estacíon Sacha Wiwa. This is another logical site for an aroid florula and collections began there with this in mind. Among the species here not yet seen on the Pacific slope in southern Ecuador were *Anthurium laciniosum* Sodiro, *A. propinquum* Sodiro, *A. pulverulentum* Sodiro, *A. urbanii* Sodiro, *Philodendron inequilaterum* Liebm. and *P. rugapetiolum.*

Next we headed east and into the Ecuadorian Oriente. After continuously having trouble starting the Mazda pickup for over a month it seem to be getting worse. After driving around by taxi to several neighborhoods we finally found some kid claiming to be a mechanic. He arrived with virtually no tools and ended up pouring a bucket of water over the battery to get better ground. I had taken the battery cable

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Figure 16. Philodendron asplundii *Croat & M.L. Soares.*

Figure 17. Philodendron schmidtiae *Croat.*

Figure 18. Stenospermation killipii *Croat.*

apart so many times that it eventually broke, so on the way down to Baeza we stopped at a automobile parts place and bought a new terminal. When I removed the terminal end I discovered that the problem had not been terminal itself, but the connection. Putting on the new end solved the problems permanently.

We stayed at a new place in Baeza and found it well protected with about half the rooms filled with soldiers. It was a nifty place where you could drive inside and park right next to the room. The last time I was in Baeza I stayed at a place made entirely our of wood and nearly caught it on fire with my plant dryer. Since it is no longer there, I suspect someone may have succeeded in burning it down.

The following day we drove to Lago Agrio, collecting along the way. The route is much more denuded since the last time I was on the road, but there are still patches of forest with aroids. One of these areas is the road that goes from the main highway to the small village of Gonzales Díaz de Pineda at the gateway to the Parque Nacional Sumaco Napo Galeras. The town lies east of the Río Quijos and the area between the highway and the river was quite rich in aroids. Among the collections made was of a new species of *Anthurium* section *Cardiolonchium, Anthurium amoenum* Kunth, *Philodendron asplundii* Croat & M. L. Soares **(Fig. 16)**, *P. palacioanum* Croat & Grayum, *P. ruizii* Schott, *P. schmidtiae* Croat **(Fig. 17)**, *Rhodospatha latifolia* Poepp., *Stenospermation killipii* Croat **(Fig. 18)**, *Xanthosoma purpureomaculatum* Croat, and an unknown *Anthurium* in section

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that I receive the most phone calls about. The conversation usually goes something like this: 'I have this plant that smells like something is wrong with the drains...' I find this frustrating; after all, animal lovers get used to the smell of horses, cows and pigs. The beauty of these plants far outshines any offence to the nose.

I just missed the flowering of *Amorphophallus titanum* at Kew by two days. I'll regret this for the rest of my days. No other plant is so outrageous or flamboyant.

Having just started up my nursery again, (I have the accolade of being the very first person to run a nursery specializing in black plants), I hope to be introducing many species into the U.K. As more of these plants are introduced to the West, one realises the wealth and magnitude of dark aroids and just how easy most of them are to grow.

Karen Platt is author of Black Magic and Purple Passion, *the only comprehensive guide to 2750 dark plants with 425 stunning photos, available through Ball Publishing at www.ballpublishing.com. She frequently speaks in the U.S.*

You can read more about her books (all 14 of them) at her website, www.karenplatt.co.uk, and become a member of the International Black Plant Society, which Karen founded in 2002 to further the knowledge of dark plants, at www.blackplants.co.uk.

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Figure 19. Unknown Anthurium *section* Cardiolonchium.

Cardiolonchium (**Fig. 19**). Another side road to the Río Quijos and San Raphael Falls was blocked by a huge landslide. Later in the day we reached Lumbaquí and went north on the good asphalt road that heads to the Colombian border. After less than 6 km we found a remnant of good forest and collected seventeen species of Araceae, most relatively common to the lowland Amazonian basin.

On August 20th, we returned to the Lumbaquí road intending to make it all the way to La Bonita. At about 4:00 p.m. we were stopped by a huge landslide. Since they were already there with large front-end loader moving the deep pile of rocks and mud from the road we decided to press plants while we were waiting. Suddenly we heard a large noise and looked up to see the side of the steep mountainside falling with the trees still standing mostly erect. This mass of rocks soil and trees hit the road with such force that I had to assume that the man operating the front-end loader had to have been buried alive or carried down into the steep valley below. We ran up to the site only about 50 m ahead of us to find that the operator had been warned by one of his coworkers who had been eyeing the forest above the cut and signaled to him to back up as soon as the soil began to loosen. We realized we were not going any further that day. By that time it was dark and we had to drive all the way back to Lumbaquí, where we spent the night.

The following day we headed back north again. By the time we got to the landslide area it had been cleaned

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Figure 20. Anthurium *section* Belolonchium.

Figure 21. Anthurium *section* Belolonchium.

Figure 22. Unknown Philodendron.

Recent Aroid Activities *at the* Missouri Botanical Garden

Thomas B. Croat, Missouri Botanical Garden

Summers are times of great activity owing to the extra help I sometimes get from student interns and this year is not an exception. This summer we have two interns, Jocelyn Tsai and Ryan Kirkman. Jocelyn applied for a Howard Hugh's Fellowship through Washington University, where she is an undergraduate student, to work with *Anthurium* section *Porphyrochitonium.* Although competition was steep, and the award went to another student, she remained undaunted and decided to volunteer to contribute to studies in Araceae. She is a bright and enthusiastic student who has already mastered character recognition in this complicated group replete with new species. Her goal is to sort out as many new species as possible that have adequate material to be described. These new species will be published in an upcoming paper treating new species of section *Porphyrochitonium* with her as co-author.

Ryan Kirkman, a high school student from neighboring Illinois, responded to an article in the Riverfront Times featuring Garden staff. In the article, I talked about the need for more Araceae research and indicated that I didn't have enough help. My appeal led Ryan to ask if there was some way he could help this summer. We have managed to sort through the backlog of boxes of plants to be confirmed to species by matching them with specimens in the herbarium. With his help it has been a very efficient way to get this massive job done. He has become skilled at entering specimen data into Tropicos3, the Garden's electronic database of herbarium specimens, and with our 2005 plant sale in full swing, Ryan has been very helpful in organizing plant lists, helping to get plants prepared for packing, and helping to fill plant orders. Ryan's upcoming project for the summer will involve working on a database of all *Anthurium* species names and their geographic distribution. This will eventually be placed on the IAS webpage and will make a useful tool to better understand the phytogeography of *Anthurium.*

Emily Yates, research assistant in Araceae at the Garden, has been writing and editing numerous manuscripts, turning out nearly 30 in the last year. As editor of the IAS Newsletter she has organized, edited and written articles, and is involved with editorial work for Aroideana, making the final edit of not only our own papers, but those of many others before sending them on to Aroideana Editor Derek Burch. One major project Emily has worked on includes the Araceae treatment for the Flora of the Río Cenepa Region in Amazonas Department, Peru. Rodolfo Vasquez, author of the flora, is currently editing this manuscript. A total of 47 new species from that flora are also in press for a special issue of the Brazilian journal *Rodriguezia,* dealing exclusively with papers on Araceae. When this issue becomes available IAS members will be made aware of how it can be obtained.

We have only recently received my 2004 collections from Ecuador, totaling 3600 numbers, and Emily has finished inserting labels, choosing specimens to be mounted for MO, and aggregating new species we are working on describing. The approximately 1000 collections from my 2005 trip to Ecuador have not yet been shipped.

Another series of Araceae articles was published in the *Annals of the Missouri Botanical Garden* 93(3). These papers were first presented at the VIII International Aroid Conference in 1999. Other papers from this conference are being published in the upcoming volume of *Aroideana. Annals of the Missouri Botanical Garden* volume 93(4) contained

treatments of two aroid genera, a revision of *Dractonium* by Guanghua Zhu and Tom Croat, and a revision of *Dieffenbachia of Central America* by Tom Croat.

Recently, the revision of *Chlorospatha,* a long and detailed work on this interesting genus completed by Lynn Hannon, was submitted to the Annals. About five years ago I suggested to Lynn that she write a key to the existing species of *Chlorospatha* because I knew that she had a good collection of the genus. Later, I suggested that she go a bit further and prepare descriptions of the species, then one thing led to another until we did a full revision.

It was partly due to Lynn's efforts with *Chlorospatha* plus her outstanding ability to grow tropical plants that she received the Bette Waterbury Award for outstanding accomplishments in horticulture at the IX International Aroid Conference in Kuching, Sarawak last November. Lynn and I still continue to collaborate on a variety of papers dealing with new species of Araceae, especially those involving our work in Ecuador.

Emily Colletti, who returned two years ago to be my greenhouse manager after a 17 year "vacation" to raise her family, has been doing an outstanding job of organizing the greenhouse. She has been improving records, making new, more permanent tags for existing pots, repotting overgrown plants, and reshuffling collections to provide better organization and improve growth. I can always rely on her to find something for me. Our computerized record system has never been in better shape.

We have recently gotten the support of Amparo Acebey de Krömer to work on the Araceae treatment for the Flora of Veracruz. Carola, as she is commonly called, worked with me on the treatment of the Araceae for the Flora of Bolivian checklist, and is very knowledgeable about Araceae (among other epiphytic families). She and her husband, Thorsten, recently moved to Mexico, where Thorsten is working on epiphytes at the Los Tuxtlas Biological Station in Veracruz State of Mexico. Carola is currently trying to get a grant to work on Araceae of Veracruz as well as for the Araceae of Mesoamerica (that portion of Mexico which lies below the Isthmus of Tehuantepec).

My student Monica Carlsen, who was awarded the Monroe Birdsey Award two years ago, is currently in England working at Kew on a KLARF award for *Anthurium.* Monica is doing a molecular study of *Anthurium* at the sectional level for her Ph.D. thesis at the University of Missouri, St. Louis. She and I will be presenting a poster on the sectional classification of *Anthurium* at the International Botanical Congress in Vienna, Austria, in July.

Another student, Marcela Mora, last year's awardee of the Monroe Birdsey Award, will also be presenting a poster at the same conference. Marcela was also awarded a KLARF award by Kew and will be working on *Philodendron* both at Kew and at the Missouri Botanical Garden for the next year.

Finally, our current efforts are concentrating on completing the Araceae treatment for the *Flora of Mesoamerica.* Emily Yates has already managed to compile all of the species of Central America that were previously described, into a single document ready to be edited for the *Flora Mesoamericana* project. Descriptions for those species not yet described must be prepared, and keys written for genera such as *Monstera* (now vastly expanded from those treated by Mike Madison in 1977), as well as *Spathiphyllum* and *Xanthosoma,* the three most complex genera, which remain unrevised in Central America.

I hope this discourse about our activities here at MO gives you some appreciation of what goes into the development of aroid systematics and how this allows your plants to get names.

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and traffic had passed. On the lower side of the road, the drop off is vertical and you would need a rope ladder to get down. On the upper side of the road it is equally as steep, generally almost straight up.

At one place there was a narrow goat path snaking up the side of the steep slope. At the top of the cliff it flattened out and the Solanaceous shrub "naranilla" was in cultivation. Aroids remained, including a large and beautiful member of *Anthurium* section *Belolonchium* (**Fig. 20, 21**), and a *Philodendron* (**Fig. 22**), that appeared to be neither *P. verrucosum* nor *P. findens,* yet resembled both.

We arrived in La Bonita at dark. We left for Santa Barbara the next day and found the area to be much easier collecting. This road from La Bonita to Santa Barbara was built many years ago and the slopes were not so steep so that it was easier to get into the adjacent forests. The area between La Bonita and Santa Barbara was at a high elevation and there were few species of Araceae in the region, but lots of interesting vegetation. Although there were few species of Araceae between La Bonita and Santa Barbarba, we did find *Anthurium umbraculum,* what appeared to be *A. corrugatum* Sodiro, a somewhat three-lobed *Anthurium* sect. *Belolonchium* (**Fig. 23**), and a member of section *Digitinervium.*

We arrived at Santa Barbara late in the day, assuming that we would spend the night there, but it proved to be a cold and barren place with no obvious sign of a hotel. Fearing that it might not be a safe place to stay in any event, we decided to head for the main highway south of Tulcán. We arrived in Julio Andrade after dark and it was a nasty-looking, crowded, noisy town, so we decided to move on. We drove south to San Gabriel, searching the main plaza for a hotel, inspected a miserable example and moved on. By now we were desperate, assuming that we would have to drive all the way to Ibarra to find a place to press plants. Fortunately, not too far south of San Gabriel we came across a small area

Figure 23. Somewhat three-lobed Anthurium *section* Belolonchium.

of Hosterias in a special vacation area that served Ibarra and Tulcán as a weekend resort. We pulled into a place called the Hotel Oasis, which proved to be very nice and we were able to park right next to the lodging.

The following day we collected along the road to Pirampiro in dry, disturbed habitat finding a lot of interesting species that I had never seen before. Just outside of Ibarra we ran into trouble with the road being blocked immediately in front of the toll station and traffic was turning around and going back to Ibarra. I knew from past experience that it would have been dangerous to try to drive through this crowd of ruffians. Apparently the protesters were indigenous people demanding more money for something. While we were sitting there studying the map for options, one of the local people said that it was possible to drive down the railroad tracks that paralleled the highway. This led out to the main highway and not only had we gotten past the protest, but we had avoided paying the toll. We felt pretty good about that.

With Chris Davidson and Genevieve Ferry gone, I set about drying plants and began the long process of sorting out 3600 collections. During the course of processing the plants, I took a little free time to do two more days of fieldwork. I drove to Reserva Maquipucuna near Nanegal. The Reserva Maquipucuna has a flora written and the Araceae is to some extent known. I was not able to spend enough time there to fully evaluate the aroid flora, but a few hours allowed me to see the aroids on the lower slopes, leading me to believe that there are species of Araceae not yet reported for the flora. For example, *Philodendron fibrosum* Sodiro ex Croat was common, even near the main station of the reserve, and this was not included in the flora. Additional trips are planned for Maquipucuna to produce a better aroid florula.

After leaving Maquipucuna, I went to the Reserva Bellavista, another area that I plan to study for its aroid flora. Bellavista is located along the old road from Nanegalito to Mindo via Tandayapa. I remember this road from trips made in the 1980's from Quito to Nono and on to Tandayapa. In those days Tandayapa was the main branch in the road with the road to the left going up onto the back of Volcán Pichincha and the road to the right going to Nanegal and Pacto. There was no connection with these roads to any area of the

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coast. They were areas of exploration for Padre Luis Sodiro, who made most of his earliest trips into the region on the back side of Volcán Pichincha. Sodiro collected frequently in the area between Nono and Nanegal and between Tandayapa and Mindo as well as between Nanegal and Pacto.

The best of the ecological reserves in the Mindo area is the Bellavista Cloud Forest Reserve – it is astonishingly beautiful. The road is narrow, rough and lacking any illumination, but suddenly I saw what appeared to be a broad, brightly illuminated gate extending over the road. It was quite startling. I found the manager and tried to negotiate a room that I could afford, threatening to drive on to Quito if I couldn't find one cheap enough. Bellavista has some regular buildings near the road, but most are made to look like gigantic beehives protruding into the canopy. The cheapest places are located on the top floor. The first two floors have stairways, but the third floor is reached only by climbing up a ladder. Fortunately, one of the hotel personnel helped me stuff my plants and equipment up through the tiny opening that accessed the third floor.

The room was round with beds clustered around the periphery. The lighting was not the best, but I managed to get the plants described and investigate the area the next morning. Although this area is right in the center of Luis Sodiro's old stomping grounds, and I could assume most of the *Anthurium* species were already described by Sodiro, I was surprised to find how many species I did not know. The Bellavista area is laced with trails with access to most of the region and there are aroids literally everywhere. Obviously, more collecting needs to be done in the area. Among the species I saw in this area were:

Anthurium aristatum Sodiro
A. cordiforme Sodiro
A. corrugatum Sodiro
A. giganteum Sodiro,
A. longicuspidatum Engl
A. malacophyllum Sodiro
A. mindense Sodiro
A. ochreatum Sodiro
A. ovatifolium Engl
A. pulverulentum Sodiro
A. striatipes Sodiro
A. tremulum Sodiro
A. umbraculum Sodiro
A. versicolor Sodiro, and
Philodendron fibrosum Sodiro ex Croat.

I also collected along the road between Bellavista and Mindo. The first 10 km are quite rich and the roadsides are much more invested with plants now than ever in the past. For the first few kilometers there are many points of access into the Bellavista property. There is a branch in the road on the right that goes back down to the Mindo Tandayapa highway. It also provides access to a separate scientific field station operated by Bellavista. It is cheaper to stay there, but the facilities are better at the tourist camp. The place has solar hot water and lighting, so it is a good place to stay while studying.

That was the last collecting trip for my 2004 adventure to Ecuador. Like most of the other areas I visited, it was a very rewarding experience. I am certainly looking forward to working on the large number of aroids collected. With five separate aroid florulas tentatively planned for the western slopes and two additional aroid florulas planned for the eastern slopes of the Andes, there should be fairly good coverage of Araceae for the Flora of Ecuador project.

Pistia stratiotes L. (Araceae) – Ubiquitous Aroid Invader

By Emily D. Yates, Missouri Botanical Garden
and Kristen E. Kordecki, Chicago Botanic Garden

Figure 1. Pistia stratiotes *L. Croat 85014. Photo by Tom Croat.*

Common names: laitue d'eau, pistie (French); Lechuguilla de agua, lechuguita de agua, repollo de agua (Spanish); water lettuce, tropical duckweed, shellflower (English).

Pistia stratiotes, or water lettuce, is an interesting, unique aroid. Like any potential invasive species, it must be kept in check so it does not become destructive; however, it has valuable properties, as a medicinal, a food source, and environmental remediator.

The name *Pistia stratiotes* comes from the Greek "pister" meaning hollow trough, in the sense of a drinking trough (Mayo *et al.* 1997) or the Greek "pistos" meaning water; and "stratiotes" meaning soldier. It was classified in 1943 to its own *Pistiaceae* family, but as a result of later research it is now in the *Araceae,* subfamily *Aroideae,* tribe *Pistieae,* and is the only species in the genus *Pistia.*

Water lettuce is a perennial monocot of the *Araceae* family. It's fairly unmistakable; it looks like floating lettuce (Fig. 1). Many descriptions of the plant abound: see Mayo *et al.* 1997, Bown, 1988.

There is some confusion about the origin of water lettuce due to its worldwide distribution, however, there is strong evidence that it is native to South America (Rivers, 2002). *Pistia stratiotes* is now found throughout the tropics and subtropics (Glazier, 1996), and is one of the most widely distributed hydrophytes in the tropics (Holm *et al.* 1977). *Pistia stratiotes* requires a wet, temperate to tropical habitat (Rivers, 2002).

Pistia stratiotes may have been introduced to North America by natural means or by humans. It was spied as early as 1774 by William Bartram, in "vast quantities ... several miles in length, and in some places a quarter of a mile in breadth" in the St. Johns River in Florida (APIRS Online). It has been suggested that trade via St. Augustine, founded in 1565, may have provided an early avenue for introduction into the St. Johns watershed (APIRS Online).

Pistia stratiotes is a "state listed," "prohibited," "category I," "species of concern" or "noxious" plant in at least eight states including CA, AZ, TX, LA, SC, GA, FL, HI and Puerto Rico. While the abundance of water lettuce is recorded primarily in sub-tropical regions of the US, it has been discovered in northern states, including Ohio and New York (Dray Jr. and Center, 2002). Several states impose fines for individuals who posses or participate in the sale or distribution of water lettuce, including South Carolina and Texas. The Connecticut Dept. of Environmental Protection will add *Pistia stratiotes* to the list of prohibited species in October, 2005 and will fine individuals who possess it $100 per plant (CDEP, 2005). It occured in 68 public water bodies in Florida by 1982 and in 128 water bodies by 1989, but total abundance reduced by half over the same time period as a result of a statewide management program (APIRS Online).

Pistia is common in dams, lagoons, lakes, and also grows in wetland rice. It can also be found on stagnant water and rooting on muddy banks. It's often grown in ponds and aquaria, and can become a serious invasive pest in the tropics. Its capable of forming vast mats that disrupt submersed plant and animal communities and interfere with water movement and navigation (Holm *et al.*1977); also serves as host for at least two genera of mosquitoes (Holm *et al.* 1977). It is considered a serious weed in Ceylon, Ghana, Indonesia, and Thailand and at least present as a weed in 40 other countries (Holm *et al.* 1977). It is listed by the Nature Conservancy's Invasive Species Initiative as a pest in Australia (http://tncweeds.ucdavis.edu/global/australia/aca.html), and has been a target

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of management research and control in Florida for at least two decades.

As a case study of invasion biology, *Pistia stratiotes* is intriguing. Rivers (2002) states that *P. stratiotes* reproduces vegetatively and by seed. Rapid vegetative reproduction allows water lettuce to cover an entire lake, from shore to shore, with a dense mat of connected rosettes in a short period of time. This type of rapid reproduction makes *Pistia* a particularly effective invader, where densities of rosettes can range from less than 100 to over 1,000 per m^2 in south Florida (APIRS Online). Seed production by *P. stratiotes,* once thought not to occur in North America, is now considered important to reproduction and dispersal (Dray and Center 1989). While *Pistia* is not cold tolerant (Holm *et al.* 1977), its leaves re-grow after moderate freezes, and it can survive for extended periods of time on moist muck, sandbars, and banks (Holm *et al.* 1977), contributing to its success as an invader.

Pistia stratiotes can spread from whole plants or pieces of plants moved on boats or fishing equipment from an infested to a clean body of water (Rivers, 2002). The most commonly accepted pathway of this species into the United States is in ballast water in ships from South America. Ships that travel through mats of water lettuce can carry fertile plant segments to new areas. Once established within a water body, *P. stratiotes* can be spread by water currents and floods.

According to Ramey (2001), *P. stratiotes* continues to be sold through aquarium supply dealers and through the internet. Rivers (2002) cites that dumping of aquarium or ornamental pond plants is often the means of spread for *P. stratiotes.* The popularity of water lettuce as a garden plant has also led to its spread, in a more controlled manner.

Although there are several other aroids considered invasive in various regions, *P. stratiotes* is by far the most insidious. According to Pimentel *et al.* (2005) *Pistia stratiotes,* among several invasive aquatic plant species, is altering fish and other aquatic animal species, choking waterways, altering nutrient cycles and reducing recreational use of rivers and lakes. In a study published in 2000, Pimentel *et al.* determined invasive aquatic plants species costs $10 million in losses and damages and $100 million in control costs in the US. In 1994, *Pistia stratiotes* control cost was estimated at $650,000 annually (Center, 1994) in Florida, where it is currently under "maintenance control." This excludes costs associated with interference with recreational opportunities, like swimming and fishing, and impacts associated with insects that breed in waterways choked by water lettuce. Dray Jr. and Center (2002) estimated expenditures increased to over $1 million dollars annually in Florida by 2002.

Like Water Hyacinth, *Pistia* also blocks irrigation canals and provides a breeding ground for mosquitoes and clogs fishery waters. *Pistia stratiotes* can inflict a severe impact on the environment and economy of infested areas (Rivers, 2002). The dense mats created by connected rosettes of the plant lead to the majority of problems encountered with water lettuce. These mats can have a negative economic effect by blocking waterways, thus increasing the difficulty of navigation, boat traffic, fishing, and hindering flood control efforts. It may become an important constituent of a sudd – a dense aggregation of a free-floating vegetation. *Pistia stratiotes* even played a role in the infamous Dr. Livingstone's explorations in Africa, where, while exploring the river Shire, a northern tributary of the Zambesi, they learned of a previous attempt by the Portuguese to ascend the river. The Portuguese had to abandon the trip on account of the impenetrable duckweed *(Pistia stratiotes)*, making Dr. Livingstone's expedition up the river Shire the first by Europeans (Livingstone, website).

Mats of *P. stratiotes* can also disrupt natural ecosystems. They can lead to a lower concentration of oxygen in covered waters and sediments by blocking air-water interface and root respiration. They can degrade water quality by blocking the air-water interface and greatly reducing oxygen levels in the water, eliminating underwater animals such as fish. Extremely thick mats of *P. stratiotes* can prevent sunlight from reaching underlying water, possibly eliminating native submerged plants. The cumulative effect of these negative characteristics of the plant is a loss of biodiversity in invaded habitats. Animal communities may be altered by blocking access to the water and/or eliminating plants the animals depend on for shelter and nesting. *P. stratiotes* mats can also serve as a breeding place for mosquitoes. It reproduces exponentially and reduces the oxygen levels in a body of water by reducing the water's surface area (Dunn, 1934).

Mechanical controls, like the flail chopper or harvester, have been used to control populations of water lettuce, but this method is costly. Biological control is under investigation. The South American weevil, *Neohydronomus affinis,* can reduce populations, but once introduced, the weevils themselves continue to spread (http://aquat1.ifas.ufl.edu/lettuce.html). The moth, *Samea multiplicalis,* which attacks *P. stratiotes* and *Salvinia* spp., has been established in Australia, but its impact has not been evaluated. In Thailand, classical biological control has not been attempted, but mass

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rearing and release of the native noctuid moth *Spodoptera pectinicornis* has replaced the use of herbicides. Research indicates this biological control is not as useful as originally hypothesized (Dray Jr. *et al.,* 2001). Chemical control can be effective, but can be accompanied with its own set of problems such as bioaccumulation in bivalves, fish and other fauna in the food chain (Colborn and Thayer, 2000).

Though *Pistia stratiotes* can be invasive, it is also an oxygenator for fish, and helps keep pond water clear. The species provides food for manatees (although Dunn, 1934, states that this natural predator cannot keep *Pistia* in check). Its roots can provide breeding and hiding space for small aquatic animals.

Pistia stratiotes is reported to absorb large amounts of heavy metals from water and are being used in remediation and wastewater treatment efforts because of their ability to increase water quality (Smirnova & Mironova, 2004). In a comparative study of 10 water plants, *Pistia stratiotes* showed one of the highest removal rates for zinc and lead. These heavy metals were found in or adsorbed into the roots (Awuah *et al.,* 2001).

Pistia stratiotes has also been used as a "famine food" – plants that are not normally considered as crops, but are consumed in times of famine (Famine Foods Database). In India it was used as a famine food in 1877-1878. In China, young leaves are eaten cooked.

In traditional medicine, dried water lettuce or tropical duckweed is burnt into an ash, then moistened with a drop of mustard oil, and applied in a thin layer on chronic, enlarged tonsils, twice a day to help get rid of tonsillitis. (www.bestincosmetics.com). In the Philippines, it is used to treat gonorrhea. *Pistia stratiotes* leaves are used in traditional medicine for the treatment of ringworm infection of the scalp, syphilitic eruptions, skin infections, boils, and wounds, because it possesses antifungal properties (Premkumar & Shyamsundar, 2005). The oil extract of *P. stratiotes* is used in the treatment of worm infestations, tuberculosis, asthma, and dysentery, and is applied externally to treat skin diseases, inflammation, piles, ulcers, syphilitic infections and burns (Kirtikar & Basu, 2000). *Pistia stratiotes* is listed on the checklist of medicinal plants in Southeast Asia as effective against boils and ezcema (www.arcbc.org).

Pistia stratiotes has a high potash content (Burkill, 1935). The extraction of caustic potash from wood ash for use as an emulsifier is probably one of the most ancient ethnobotanic traditions (e.g., Quiapo or *Pistia stratiotes,* one of the Araceae family; Water Hyacinth or *Eichhornia crassipes,* of the *Pontederiaceae* family; the Royal fern or *Osmunda regalis,* the fruit of the Prickly Chaff flower or *Achyranthes aspera* of the Ameranthaceae family. (www.dweckdata.com). However, like other Araceae, it is poisonous if ingested because of the calcium oxalate crystals.

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Englera 25: 1-263. [Available from Botanischer Garten und Botanisches Museum, Königin-Luise-Str. 6-8, 14191 Berlin, Germany ($40)]

This is a classic revision in the tradition of the German-speaking aroidologists Schott (1794-1865) and Engler (1844-1930), although dealing solely with the African (including Madagascar) taxa (35 species and 7 subspecies). However, the author has worked closely with Wilbert Hetterscheid and, between them, they are masters of this Old World splendid tropical genus. Members of the Aroid Society may remember Hetterscheid & Ittenbach's extremely useful (standard) work "Everything you always wanted to know about Amorphophallus, but were afraid to stick your nose into" (Aroideana 19: 7-131. 1997) with its key to all then known taxa of the genus, descriptions, photographs, etc.

The treatment's frontispiece is a classic photo (taken at the same time as the one in Aroideana 1: 68. 1978) of young Josef Bogner (now an Ehrendoktor!) standing among flowering *Amorphophallus angloensis* subsp. *maculatus.* The treatment is based on study of about 1000 specimens and living material of most taxa. The chapter on morphology (pp. 11-24) is well illustrated with drawings and photographs and the chapter on distribution and habitat (pp. 26-34) gives one a general overview. There is an important discussion of the genus, how its parts may have evolved leading to a classification delivered in the forms of synopses, keys, characters, and descriptions and followed by an evaluation of these characters. All this careful reflection (pp. 35-65) leads to a key to African species (pp. 66-68), followed by a discussion of the taxa. The taxa are arranged alphabetically, which means that you can move quickly from the key to the taxon. This has the disadvantage that the taxa closest to each other are not adjacent making it a bit harder to compare the treatments of similar taxa.

The best way to communicate the quality of this work is to report an example of a treatment of one species and assure you that each species has a comparable treatment, perhaps missing one or two items or adding something else, but to show that this is meaty stuff!

Example: *Amorphophallus gracilior* Hutchinson 1939, which begins on p. 160 and ends on p. 165, is a renaming of *A. gracilis* Chevalier (1920), a name which was an illegitimate later homonym of the same binomial published by Engler in 1881. The holotype, from Benin (in Paris), was tracked down and found to be useless because of having been consumed by herbarium beetles and therefore he here designates a neotype collected in Nigeria in 1946. A full page photo of the neotype appears on p. 162, followed by a full page distribution map on p. 163 (with two adjacent dots), followed by the full page drawing on p. 164 with many details. The text begins with the citation of the correct name, its place of publication, its synonyms, its typification(s), a long description, a long paragraph on observations, distribution, habitat, and ecology, and finally, citation of other (as opposed to type) material, including the herbarium where seen, with an exclamation mark if the author saw the specimen.

The work closes (after thanking various people and institutions) with (1) a classic bibliography and, for anyone who might have unannotated duplicates, (2) an alphabetic list of collectors and their specimen numbers identified by a taxon number, and (3) an index of scientific names.

Would that all aroids were as well studied as these African Amorphophalli!

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