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FRONT COVER: *Puya coerulea* in bloom at the Huntington Botanical Garden. Story Starts on page 159.

BACK COVER: An impressive clump of *Tillandsia funckiana* at the 2013 SW Guild Show. Story starts on page 149.

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# A Note on the Numbering and Pagination of Volume 63 of the Journal of the Bromeliad Society

Volume 63 of the Journal of the Bromeliad Society does not follow the customary pattern established for this publication. A series of mistakes in numbering issues starting with the final issue (6) of Volume 62 is to blame.

As a preliminary, please note that for many years, a volume of the Journal has remained constant at 288 pages per year. This 288 pages has usually been divided into six (6) 48 page issues each year.

The final issue of Volume 62 was a 96 page double issue. This issue was labeled 62(6) when, by page count, only the first 48 pages of the issue should have been so labeled. The final 48 pages of this issue should have been labeled 63(1). Unfortunately, the only indication that such a division was necessary was the cryptic listing of both Nov/Dec 2012 (the nominal time slot for 62(6)) and Jan/Feb 2013 (the nominal time slot for 63(1))on the front cover and the inside front cover.

The following issue was labeled 63(1) and was again a double issue wth 96 pages. Following page count, this should have been labeled 63(2-3). A final issue printed during 2013 was labeled 63(2), but should have been labeled 63(4). Pagination was also incorrect in these issues because the extra 48 pages printed in 62(6) were not included.

The current issue completes Volume 63. Since there were 192 pages attributable to Volume 63 printed in 2013, this issue contains 96 pages to bring the total to the normal 288 pages for the volume. This current issue is labeled 63(3-6) solely to emphasize that it finishes the volume. In reality, it should be labeled 63(5-6).

I deeply apologize for the confusion created by this sloppiness in labeling, and fully appreciate the difficulties created by having parts from two separate volumes in the same issue.

Starting with Volume 64 in 2014, the number of issues per volume fell from 6 to 4, although the number of pages printed per volume remained at 288.

The following table summarizes the correspondence between the printed labels and the 'correct' labels for issues in Journal of the Bromeliad Society Volume 63.

| Labeled as | Should be |
|---|---|
| 62(6) pages 289-336 | 63(1) pages 1-48 |
| 63(1) pages 1-96 | 63(2-3) pages 49-144. |
| 63(2) pages 97-144 | 63(4) pages 145-192 |
| 63(3-6) pages 145-240 | 63(5-6) pages 193-288 |

# 2013 Southwest Bromeliad Guild Show

Alan Herndon

In September 2013, members of the local bromeliad societies from Louisiana and Texas (along with a few adventurous Californians and Floridians) congregated in Addison, on the outskirts of Dallas, for a show and sale - the 35th annual Soutwest Bromeliad Guild show. This year, the SW Guild Show was somewhat enlarged by the addition of the International Cryptanthus Society show and sale held in the same room.

In the competitive show, 23 exhibitors entered 114 plants in the horticultural divisions and 41 exhibits in the artistic divisions. The head table was larger than usual because several of the exhibitors with far too many *Cryptanthus* on their hands put entries in the SW Guild Show and in the Cryptanthus Society Show, making themselves eligible for both BSI awards and Cryptanthus Society awards. The Cryptanthus Society Show has been covered in the Cryptanthus Society Journal 28(3); here I will just note that their show added another 43 horticultural entries and 10 artistic entries. Figure 1 gives some idea of how the Show Room appeared.

The sales room featured several commercial growers from the local area and attracted vendors from as far away as Florida and California.

Although the large number of *Cryptanthus* entered, thanks to the influence of the Cryptanthus Society show, guaranteed that the largest number of major awards in the Guild Show went to entries featuring *Cryptanthus*, entries featuring *Dyckia* or *Tillandsia* were not far behind.

Figure 1. Partial overview of the setup in the Show Room. Entries on benches in front are from the SW Guild Show. The tables along the back wall held many of the Cryptanthus Society Show entries to the left and the Head Table for the SW Guild Show to the right. Not visible in this photo are the line of Artistic Arrangment entries along the wall to the right. Photo by Gene Powers.

Figure 2. Winner of the Mulford B. Foster Award for the best entry in the Horticulture divisions was this clump of *Tillandsia funckiana* grown and exhibited by Rick Richtmyer of Houston. Photo by Chris Krumrey.

Figure 3. Winner of the Morris Henry Hobbs Award for the best entry in the Artistic Divisions. This Artistic Arrangement is titled 'Eternal Flame' and was designed and exhibited by Allyn Pearlman of Houston. The bromeliad featured in this entry is *Cryptanthus* 'Corrine'. Photo by Chris Krumrey.

The Mulford B. Foster plaque for the best bromeliad in the Horticultural Divisions was awarded to a large clump of *Tillandsia funckiana* (Fig. 2) exhibited by Rick Richtmyer of Houston. This clump is notable for the number of living leaves on each growing segment, a sure sign of vigorous growth under excellent growing conditions. Among entries in the Artistic Divisions, the Morris Henry Hobbs plaque went to Allyn Pearlman of Houston for an Artistic Arrangement titled 'Eternal Flame' that featured *Cryptanthus* 'Corrine' (Fig. 3). Another special award, the John M. Anderson Best *Aechmea* Award went to Elizabeth Patterson of Dallas for a blooming specimen of *Aechmea lueddemanniana* x *weilbachii* (Fig. 4). The same entry was also judged the best plant in Division I (Single blooming plant). This photo illustrates the very strong

Figure 4. *Aechmea lueddemanniana* x *weilbachii*, winner of the John M. Anderson Award for Best Aechmea. Grown and exhibited by Elizabeth Patterson. Photo by Chris Krumrey.

influence of *Aechmea weilbachii* on the leaves of the hybrid.

Other Division winners among the Horticulture entries were Rick Richtmyer whose x*Neophytum* (*Orthophytum*

Figure 5. *Orthophytum navioides* x *Neoregelia* 'Purple Star'. Division winner for Rick Richtmyer. Photo by Chris Krumrey.

Figure 6. *Dyckia* 'Dakota'. Another Division winner for Rick Richtmyer. Photo by Chris Krumrey.

Figure 7. *Tillandsia xerographica*. Division winner grown and exhibited by Steve Reynolds. Photo by Chris Krumrey.

*navioides* x *Neoregelia* 'Purple Star' see Fig. 5) topped Division II (Single non-blooming plant) and *Dyckia fosteriana* 'Dakota' (Fig. 6) topped Division III (Non-blooming multiple plants). It should come as no surprise that Rick also won the Sweepstakes award in the hobbyist category.

Steve Reynolds won Division IV with a *Tillandsia xerographica* having nicely curled leaves and a large inflorescence (Fig. 7). Steve also won top Section honors for his flowering *Hohenbergia leopoldo-horstii* and his clump of exceptionally large *Neoregelia lilliputiana*.

David Whipkey, with a very large *Deuterocohnia brevifolia* (Fig. 8), stood atop Division V (Horticultural display). There was actually another very impressive plant of *Deuterocohnia* in the show. Bryan Windham entered an equally large *Deuterocohnia brevifolia chlorantha* in Division III where he won Section B.

Figure 8. *Deuterocohnia brevifolia*, Division winner for David Whipkey. Photo by Chris Krumrey.

Two additional *Tillandsia* species won their respective Sections in the Horticultural Divisions. *Tillandsia vernicosa* in full bloom on an interesting piece of wood (Fig. 9), was a winner for Charlie Birdsong. A large clone of *Tillandsia diaguiten-*

Figure 9. *Tillandsia vernicosa* grown and exhibited by Charlie Birdsong. Photo by Chris Krumrey.

Figure 10. Large form of *Tillandsia diaguitensis* grown and exhibited by Gene Powers. Photo by Chris Krumrey.

*sis* (Fig. 10) won for Gene Powers. Just to complete the tally, an old-time hybrid, x*Neophytum* 'Firecracker' gave Elizabeth Patterson another spot on the head table.

Participants in the SW Guild Show take their artistic entries seriously. An entire wall of the show room was devoted to the Artistic Arrangement entries alone. Fig. 11 shows only a part of this line devoted to Artistic Arrangemnts. In the Artistic Divisions, Allyn Pearlman topped Division VI with an Artisitic Arrangement titled 'Going Green' that featured *Dyckia* 'Yellow Glow'

Figure 11. Only a portion of the wall filled with Artistic Arrangment entries. Photo by Gene Powers.

(Fig.12). Ray Johnson won Division VII with *Dyckia* 'Snowball' in a decorative container (Fig. 13) and Phil Speer took top honors in Division IX with a stained glass design featuring a stylized *Vriesea* (Fig. 12). A final major award for artistic merit went to Calandra Thurrott who won Best Judge's Entry for her hand-crafted bag flaunting the view from above of a bright green *Guzmania* with an even brighter orange inflorescence (Fig. 15).

Figure 12 (left).Best Artistic Arrangement "Going Green". Designed and exhibited by Allyn Pearlman. Photo by Chris Krumrey.

Figure 13 (above). Best Decorative Container. Created with *Dyckia* 'Snowball' and exhibited by Ray Johnson. Photo by Chris Krumrey.

Figure 14 (left). *Vriesea* immortalized in stained glass by Phil Speer. Photo by Chris Krumrey.

More evidence of the seriousness artistic entries inspire in Guild territory can be seen in this photo of a small part of the Decorative Container entries (Fig. 16). The bird-nest container in the lower right corner by Shawn Crawford is intriguing. The farmyard (or should that be junkyard) bird by Jim Gerken in the center of the figure is just amazing.

Special mention must also be made of Aaron Davila from Dallas, who won the Best Novice Entry award with *Dyckia choristaminea* (Fig. 17).

Figure 15. Hand-crafted bag by Calandra Thurrott. Best Judge's Entry. Photo by Chris Krumrey.

Figure 16. A portion of the Decorative Container entries. Photo by Gene Powers.

One unique feature of the SW Guild show is the Malo Grande Award. To win this prestigious award, you need to find a plant that has fallen from its normal perch, lain unnoticed and neglected for months in some unhealthy corner of your growing area until it is more dead than alive. If you are willing to face public humiliation and the scorn of your peers by acknowledging your ownership and entering such a hideous specimen into the show, you certainly deserve an award. This years 'lucky' winner was Margo Racca.

Figure 17. *Dyckia choristaminea*, the Best Novice entry, by Aaron Davila. Photo by Chris Krumrey.

It would be unthinkable to end without highlighting at least a few of the plants entered in the Cryptanthus Society Show. Figure 18 shows Best in Show winner *Cryptanthus* 'William Richtmyer', judged the best entry in the horticultural divisions. Winner of the Warren Loose Best Cryptanthus Hybrid award was *Cryptanthus* 'Pele' (Fig. 19) exhibited by Carole Richtmyer. Larry Giroux took top honors in the Decorative Containers Division with his *Cryptanthus* 'Very Cold Tooth'

Figure 18. Best of Show winner for the 13th biennial Cryptanthus Society show - *Cryptanthus* 'William Richtmyer'. Raised and exhibited by Carole Richtmyer. Photo by Gene Powers.

Figure 19. *Cryptanthus* 'Pele', winner of the Warren Loose Best *Cryptanthus* Hybrid award. Exhibited by Carole Richtmyer. Photo by Rick Richtmyer.

Following the banquet on Saturday, an auction of rare plants to support the activities of the SW Guild was held. Charlie Birdsong acted as our auctioneer for the evening. An auction in support of the Cryptanthus Society was interwoven with the Guild auction.

With the serious business completed, Sunday was a day to revisit the show at a less hurried pace, and to scavenge through the sales room for special plants that were somehow overlooked previously. The Southwest Guild is to be congratulated on this fine show.

Figure 20. *Cryptanthus* 'Very Cold Tooth'. Winner of the Decorative Containers Division in the *Cryptanthus* show. Exhibited by Larry Giroux. Photo by Rick Richtmyer.

# Some rarely seen *Puya* at the Huntington Botanical Gardens

*Mike Wisnev*

The Huntington Botanical Gardens (HBG) is known for many things – its world class desert gardens, the Blue Boy painting, an outstanding collection of rare books, a Japanese garden and a new Chinese garden – the list goes on. Less well known is the fact the desert gardens contain a wealth of *Puya*, *Hechtia*, *Deuterocohnia* and *Dyckia*, most of which bloom in the spring and early summer.

[Editor's note: The Huntington Botanical Library, Art Collections and Botanical Gardens is located in San Marino, California - near Los Angeles. For more information on the various gardens and other collections held this institution, please visit the official web site www.huntington.org]

Long time readers with great memories may already know this. William Hertrich, then Curator Emeritus of the HBG, wrote an article about these bromeliads in the garden for this Journal in 1953 (Hertrich 1953). His successor, Myron Kimnach, followed up with another piece 19 years later (Kimnach 1972). It has been over forty years since the more recent article, and many of the plants mentioned at that time have grown into fantastic specimens. Early collections were made as far back as the mid-1930's - on various expeditions to the Andes by T. Harper Goodspeed of the University of California and one of his traveling companions, James West. Some of these early collections still remain unidentified.

In later years, many *Puya* and *Dyckia* at HBG were found on explorations by Myron Kimnach in Bolivia and Peru, and numerous *Hechtia* were collected on expeditions in Mexico, often with Gary Lyons who is still a curator at HBG. Myron started his career at the U. of California Botanical Garden, and many of HBG *Puya* came from there. Bill Baker is renowned in the Bromeliad world for his stunning *Dyckia* hybrids; less well known is that he did considerable field work, and many bromeliads at HBG were collected on those travels. Recently, some new species have been contributed by Professor Rachel Jabaily, who spent time studying *Puya* at the HBG a few years back as a graduate student and identified many of the unknown specimens. In fact, some of the HBG specimens shown in this article were included in her DNA studies.

This article will focus on *Puya* and their spectacular inflorescences. The best months to see the *Puya* blooms were April and May, at least in 2014, though some bloomed as early as January. Almost all had finished by July, except for *P. mirabilis* which seems to be a late bloomer, and a couple of others. Interestingly, most of the *Hechtia* tended to bloom later, and some were still blooming in September.

*Puya* are generally too large for hobbyists to grow, and as a result are not all that well known. In fact, of the many thousands of man-made bromeliad hybrids, only a couple of man-made *Puya* hybrids have been registered, although there are some natural

Figure 1. *Puya venusta* inflorescence showing tightly spiraled petals on the lower, spent flowers – this is an unusual specimen of *P. venusta* with light colored petals as opposed to the typical dark violet ones. Prof. Jabaily reports that there is considerable color variation in these flowers in habitat. Photo by Mike Wisnev.

hybrids. Included within *Puya* is the largest bromeliad, the massive *P. raimondii*, while a few are quite small – one shown later in this article has leaves only 6-8 inches long in habitat and resemble those of a *Tillandsia*. Most look like large dyckias or hechtias, while some would seem more at home in a jungle garden. For that matter, a few, like *P. mirabilis*, look more grass-like (although rather large), and might not even be recognized as bromeliads. But there is one common denominator – they all have lovely inflorescences, though they can be quite varied!

*Puya* has a large range throughout the Andes in Bolivia, Peru, Ecuador, Colombia, and Venezuela, as well as in Chile and Argentina. Though studies suggest they originated in Chile, only about ten taxa are there now. The heaviest concentrations are in Bolivia and Peru. Two even grow in Central America. They grow from sea level to about 4500 m altitude. Most pup profusely, but a few don't pup much – mainly those at higher elevations. Given their extensive range, they grow in different climates. Those nearer the equator tend to live in wetter climates, and those at higher elevations

Figure 2. A beautifully colored ***Puya alpestris*** inflorescence showing the sterile inflorescence branch apices characteristic of the traditional *Puya* subgenus *Puya*. **Inset:** It is generally thought that these sterile branch apices are an adaptation for perching birds – in cultivation, they also come in handy for other creatures! Photo by Mike Wisnev.

tend to live in cooler conditions and have denser inflorescences. Perhaps because they grow in mountainous regions, approximately one-third of the species are only known (so far!) from one location.

Traditionally, *Puya* have been part of the subfamily Pitcairnioideae, along with *Dyckia* and *Hechtia*. One key taxonomic difference between *Puya* and other members of this subfamily is that the flower petals tightly spiral after anthesis (Fig. 1). *Pitcairnia* apparently also do this but not so tightly. The petals are also fairly broad at the end, but narrow at the base.

There have been a lot of changes in the *Puya* world in the last few decades. The number of *Puya* species has grown from about 168 in 1974 to about 225 today. Most importantly, recent DNA studies have split the traditional Pitcairnioideae subfamily into six different subfamilies (Givnish et. al. 2007; Givnish et. al. 2011). *Puya* are in their own subfamily, which is sister to the Bromelioideae subfamily. This Puyoideae-Bromelioideae clade is sister to the stripped down Pitcairnioideae sub-family consisting primarily of *Dyckia*, *Deuterocohnia*, *Pitcairnia*, *Encholirium* and *Fosterella*. Like *Puya*, *Hechtia* is now also in its own subfamily.

The traditional breakdown of *Puya* into two subgenera, *Puya* and *Puyopsis*, has also been shown to be incorrect. There were only a few species in subgenus *Puya*, which was distinguished primarily on the basis that their inflorescences have branches that are sterile at the tip. This means there are no flowers in the terminal part of inflorescences (or branches) of species in the subgenus *Puya* (Fig. 2), in contrast to members of *Puyopsis* that have flowers all the way up the branches (see Fig. 5 and Fig. 19). HBG has many of these species.

Figure 3. *Puya wrightii* (Wright and Hutchison 3560) - same clone as the type specimen. It was collected near a waterfall in Cajamarca, Peru. Photo by Mike Wisnev.

There have been a number of recent phylogenetic studies of *Puya*, many of them co-authored by Professor Jabaily (Jabaily and Sytsma 2013; Jabaily and Sytsma, 2010). These DNA studies have shown that sterile branch tips have evolved numerous times – thus, subgenus *Puya* is not monophyletic and should be discarded. Instead, the studies show there is a large core *Puya* group located in the Andes (usually well above 1500 m altitude). The core *Puya* group appears to break into two primary clades – a northern-central Andes group and a southern-central Andes group. Separate from the large core *Puya* group is a separate small group of blue flowered *Puya* at sea level in Chile, which includes the two *Puya* shown above, *P. venusta* (Fig. 1) and *P. alpestris* (Fig. 2), as well as *P. coerulea* (see Fig. 24). These studies indicate that *P. alpestris* may be the result of ancient hybridization. In any case, some of the traditional subgenus *Puya* members (those with sterile inflorescences) are in Chile, and others fall in the core *Puya* group.

Thus, like many other plant genera, *Puya* taxonomy has changed significantly as a result of these recent DNA studies and analyses. Many of these results may seem surprising from a morphological standpoint, and they reveal that convergent evolution is probably much more common than has been realized. Viewed in another way,

Figure 4. Flower of *Puya wrightii*, Wright and Hutchison 3786. Unlike other clones of this species at HBG, the petals are striped. Photo by Mike Wisnev.

Figure5. *Puya ultima* has gangly leaves but a spectacular inflorescence. Photo by Mike Wisnev.

however, some of these results probably shouldn't be so surprising: more closely related species tend to grow near each other. Conversely, plants growing in distant geographical locations are less likely to be closely related. Thus, traditional groupings based on common morphological traits appear more suspect in genera that include species in disparate geographical areas.

A small group of yellow flowered Chilean *Puya*, which includes the well-known *P. chilensis* (see Fig. 25), is especially interesting. When chloroplast DNA is used for testing, the yellow flowered Chilean group belongs with the blue flowered Chilean group, while if nuclear DNA is used, the yellow flowered group belongs to the core *Puya* group. This is a complicated story of hybridization and

Figure 6. *Puya ultima*. A close-up shot of the flowers highlighting the unusual pectinate floral bracts. Photo by Michael Wisnev.

backcrossing briefly summarized below.

Professors Jabaily and Sytsma (Jabaily and Sytsma 2010) hypothesize that the yellow flowered Chilean *Puya* are the product of (1) an ancient cross of their ancestor (as pollen donor) with an ancestor of the blue flowered Chilean group, (2) followed by repeated backcrossing with the yellow flowered ancestors (again as pollen donors), and (3) subsequent diversification leading to the current yellow flowered species. Since chloroplast DNA is generally maternally inherited, the resulting plants ended up with yellow flowered nuclear DNA, and blue flowered chloroplast DNA. For those who

Figure 7. A massive clump of *Puya stenothyrsa*. Photo Photo by Mike Wisnev.

really like scientific terms, they refer to this as "chloroplast capture following hybridization and unidirectional introgression."

It also appears that there are a number of Chilean *Puya* hybrids in habitat. One of the studies (Schulte et al., 2010) found that some of the *Puya* initially identified as one of the Chilean species were in fact hybrids.

Public gardens that have puyas tend to have the Chilean species, despite the limited number of taxa from that region. HBG does as well, with huge specimens of *P. alpestris* ssp. *alpestris*, *P. alpestris* ssp. *zoellneri*, *P. chilensis*, *P. venusta* and *P. coerulea*. This may be because they are among the most spectacular, and the fact they have a relatively large range, often grow along the coast which provided easier access. Professor Jabaily has also suggested that the main reason may be the similarity of the climate in California with that of Chile – the summers are dry and the winters are wet. Pictures of many of these species are readily available on the web if you are interested, so this article will focus on other *Puya* that are rarely seen, if at all, on the web or in literature.

*Puya wrightii* is one such plant. HBG is lucky enough to have multiple collections of this species, including the type specimen (Fig. 3) collected near a waterfall in Cajamarca, Peru (Wright and Hutchison 3560). If you have ever been to HBG you have probably seen it, since it is located right next to the Desert Conservancy. You also probably ignored it unless it was blooming. HBG has a couple more clones of

Figure 8. Close-up of the flower spike on *Puya stenothyrsa*. Photo by Mike Wisnev.

Figure 9. This is a typical bed at HBG with a wealth of plants. *Puya densiflora* is in the middle with a tall, narrow bloom spike, *P. stenothyrsa* to the left, and a huge *P. chilensis* is above and behind. On the far right and at the top are a variety of yuccas and palms. Photo by Mike Wisnev.

Figure 10. A close-up view of a small portion from the long, narrow inflorescence of *Puya densiflora* (See Fig. 9). While it may be hard to tell since the side branches are so short, this is a compound rather than a simple inflorescence. Photo by Mike Wisnev.

Figure 11. Clump of an as-yet unidentified 'mystery' *Puya*. Photo by Mike Wisnev.

Figure 12. Inflorescence of the mystery *Puya* seen in Fig. 11. **Above:** Rosettes of the plant develop a reddish color as in some *Dyckia* species, **Below:** Close-up of the inflorescence showing open flowers. Photo by Mike Wisnev.

this species as well. Another clone collected by Wright and Hutchison (Wright and Hutchinson 3786) has a rather unique flower – it is tricolored, with one side cream colored, one light purple, bisected with a green line. With the green and yellow lepidote sepals, it is a beautiful flower (Fig. 4).

*Puya ultima* is another rarely seen, and somewhat gangly, plant (Figs. 5, 6). This plant was collected 30 years ago in La Paz, Bolivia on an HBG expedition which included Myron Kimnach, Bill Baker, and Seymour Linden - the latter a well-known succulent

Figure 13. A large silver-leaved *Puya coerulea* in the Jungle Garden. Photo by Mike Wisnev.

explorer. Unlike many *Puya* species, this plant has a long arching inflorescence, and red-orange sepals. Based on the key in Smith and Downs (1974), it is one of very few *Puya* species with "pectinate-serrate" floral bracts (Fig. 6). They are indeed quite unique.

Various studies have shown that unlike cacti and other succulent plant families, some bromeliads use CAM photosynthesis [Crassulacean Acid Metablolism; see Editor's note at the end of the article.] and others don't (Crayn et al., 2004; Givnish et al., 2007). Since CAM is an adaptation to a xeric environment, and some bromeliads live in more mesic regions, this may not be all that surprising. It appears that the various bromeliads using CAM are not related – instead, it appears CAM has developed about four times among bromeliads, presumably in response to their environment. But *Puya* are somewhat unique – they appear to be the only genus in the traditional Pitcairnioideae subfamily in which some species use CAM and others don't (Crayn et al., 2004). Approximately one-quarter of the *Puya* studied use CAM. It would hardly be surprising if *Puya wrightii and P. ultima* (Figs. 3-6) don't use CAM, given their long floppy leaves.

Other *Puya* at HBG are much more xeric looking, and can resemble a large *Dyckia*. One of the largest in the garden is an enormous thicket about the size of a bus, although the individual heads are only slightly more than two feet in diameter (Figs. 7 & 8). Unfortunately, this monster plant has long overgrown its label, if there was one, and its origins may remain unknown without a bulldozer. However, it has been identified as *P. stenothrysa*, which grows in La Paz and Cochabamba, Bolivia.

Another *Puya* growing next to *P. stenothrysa* looks a lot like a *Bromelia* given its leaves. It turned out to be *P. densiflora*, a species that grows in Apurimac, Peru, and is aptly named as you can see (Figs. 9 & 10). Like many *Puya*, its sepals are covered with a thick furry indument.

Figure 14. Flowering *Puya humilis*, collected in Cochabamba, Bolivia at an altitude of 11,200 feet (3400 m). Photo by Mike Wisnev.

Traditionally, flower color has often not been used as a diagnostic tool. It isn't clear whether this is due to the fact that dried herbarium specimens don't show the colors, or whether color is too variable or difficult to describe. Another reason may be that the flowers change color. Many *Puya* have flowers that appear greenish at first, and then turn more violet, and can be more reddish purple when they dry.

Figure 15. Inflorescence of a *Puya* species - likely *P. prosanae.* This plant was collected in the same expedition as the *P. humilis* seen in Fig. 14, but is considerably smaller. Photo by Mike Wisnev.

The identity of one of the prettiest *Puya* (when out of flower, at least) at the HBG remains elusive – it appears to have affinities with *P. venusta* (Figs. 11 & 12), but could well be a hybrid

Figure 16. *Puya humilis* or *P. tunarensis*. Originally identified as *P. werdermannii*, a synonym *P. humilis*, but the plant is twice as large as the *P. humilis* seen in Fig. 14 and the inflorescence differs in some details. Photo by Mike Wisnev.

Figure 17. An unidentified *Puya* species - perhaps *P. huancavelicae* or *P. olivacea*. Photo by Sean Lahmeyer.

of unknown origin. Until the real world catches up with television criminal investigation shows that have databases with every living plant, we may never know what it is. But it is one of the few that blushes red at HBG - like *Dyckia* species often do.

Actually, to my eye, the prettiest *Puya* at HBG was a complete surprise. HBG has a large jungle garden that I hadn't visited for a few years. Meandering through it one day with Ana, my wife, we discovered it had tons of Bromeliads – lots of *Neoregelia*, *Billbergia*, *Quesnelia* and *Aechmea* and perhaps even a *Greigia*. Not surprisingly, this is a lush and green area that is heavily shaded for the most part. There are also some large ponds stocked with water lilies and fish, turtles and birds. One was bordered by an unbelievable white *Puya* – most likely *P. coerulea*, but I haven't seen it flower yet (Fig. 13).

A number of the bromeliads still haven't been identified, and others have grown so much that their labels disappeared long ago. With millions of visitors and a century of storms, signs can get misplaced – hardly surprising for a living garden a century old the size of HBG. When I started trying to identify some of the *Puya*, I hadn't realized that Professor Rachel Jabaily had been there, and I was happy to find that all of

Figure 18. Flowers of the unidentified *Puya* species shown in Fig. 17 have pink petals. Photo by Sean Lahmeyer.

Figure 19. *Puya ferruginea* with greenish white petals - the most commonly encountered flower color. Photo by Mike Wisnev.

Figure 20. This *Puya ferruginea* clone has dark-violet petals. Photo by Mike Wisnev.

my tentative ID's weren't wrong.

Even with most of the relevant reference materials at hand, it is often difficult for a novice to identify many bromeliads. If they are out of flower, it is impossible in most cases – many *Puya* species have virtually indistinguishable leaves. Even when an inflorescence is available for study, it usually seems that a feature or two don't match up with the description of the species considered most likely to match the plant, or some features match one species while others match another. This is especially true with closely related species, such as the *P. humilis* complex. This rather challenging complex includes *P. prosanae* (Ibisch & Gross 1993) and *P. tunarensis* (Vasquez & Ibisch 2002), both of which were described in this Journal.

HBG may have specimens of all three species. Figure 14 shows flowering plants of *Puya humilis*, collected in Cochabamba, Bolivia at an altitude of 3500 m (11,200

Fig.ure 21. *Puya ferruginea* (HGB accession 7132) has purplish flowers. Photo by Mike Wisnev.

Figure 22. A very small clone of *Puya ferruginea*. Photo by Mike Wisnev.

Figure 23. *Puya thomasiana* or *P.* aff *adscendens* or something else? Photo by Mike Wisnev.

Figure 24. Inflorescence of *Puya coerulea.* Photo by Mike Wisnev.

feet). Some of you may have specimens of this plant, since it was offered as part of the International Succulent Introductions (ISI 94-40). Figure 15 shows an even smaller *Puya* that has been offered twice (ISI 1680 and ISI 94-41). Collected on the Oruro-Cochabamba road, near the turnoff to Independencia, Bolivia, I am pretty sure it is in fact *P. prosanae*. Both this plant and the *P. humilis* were collected on the same 1984 HBG expedition that collected *P. ultima*. Figure 16 was identified as *P. werdermannii* from Cochabamba, Bolivia, now synonymized with *P. humilis*, but it is about twice as large as the *P. humilis*

Figure 25. Inflorescence of *Puya chilensis.* Photo by Mike Wisnev.

Figure 26. *Puya alpestris* ssp. *zoellneri* (known until recently as *P. berteroniana*). with *P. chilensis* on right. Photo by Mike Wisnev.

seen in Fig. 14, and seems to match *P. tunarensis* in some respects.

Another mystery plant has wonderfully wide strapping leaves and large spines (Fig. 17). I haven't seen it flower, but Sean Lahmeyer of HBG took pictures of it a few years ago – it has pink petals (Fig. 18), unusual for the *Puya* species grown at HBG. Sean and I have wondered if it might be *P. huancavelicae* or *P. olivacea*. Part of the problem is that often there are no pictures available of a species, or only a couple, so it can be extremely difficult to match up.

*Puya ferruginea* is one of the most widespread *Puya* species around, growing in Ecuador, Bolivia and Peru. It is characterized by its thick rust colored indument on the sepals (thus the name) and apparently almost everything with this feature has been lumped into *P. ferruginea*. It is also one of the few *Puya* species with zygomorphic flowers, and might be pollinated by bats. Most seem to be reasonably large plants with leaves up to 3 feet long, and with greenish white flowers – HBG has one like that (see Fig. 19), but also some others.

Lyman Smith and Myron Kimnach identified HBG 7132 as *P. ferruginea* in 1977, noting it had 10 cm dark violet flowers. Having never seen this species, I was more than puzzled when the large white *Puya* behind this sign bloomed and had some of the smallest petals of any *Puya* at the HBG. I later learned that Professor Jabaily had tentatively identified this plant as a possible hybrid with strong affinities to *P. coerulea*. A few months later, a very similar looking but smaller plant growing right behind this possible hybrid began to bloom. I had suspected it might be an offset of the larger one, but it turned out to match *P. ferruginea* 7132. See Figs. 20 and 21. Interestingly, this plant is about half the size of the white flowered *P. ferruginea*. There is yet another *P. ferruginea* (see Fig 22) from Peru, also identified as such by Lyman Smith, that is even smaller – its largest rosette is perhaps 18 inches in diameter. I saw it after it flowered and it was indeed ferruginous, but I couldn't tell what color its flowers had been. Maybe next year!

Another mystery has been identified as *Puya thomasiana* or *P.* aff *adscendens* by different folks (Fig. 23). Adding to the confusion is that the sign next to the plant relates to a *Puya* collected in La Paz, Bolivia and neither *P. thomasiana* nor *P. adscendens* has been found anywhere near La Paz.

It is only fitting to finish up by returning to the Chilean *Puya*, since they are spectacular. It is hard to beat the many *P. coerulea* (Fig. 24), with their pink furry sepals and violet tubular petals. *P. coerulea* var. *violacea* is much more austere with a less dense inflorescence – one study suggested that it and the other subspecies of *P. coerulea* might constitute a different species (Shulte et al. 2010). While there are *P. raimondii* planted at HBG, none are near full size. Currently, the largest *Puya* at HBG is *P. chilensis*, with an inflorescence of stunning yellow flowers that must be 15 feet high (Fig. 25). A few beds away there is a dwarf *P. chilensis* less than half the size of the larger one with an almost identical inflorescence. The large *P. chilensis* dwarfs the *P. alpestris* ssp. *zoellneri* (Fig. 26) next to it. *P. alpestris* ssp. *zoellneri* has a surprisingly green flower as opposed to the blue green flower of *P. alpestris* ssp. *alpestris* (Fig. 2). All of them are simply stunning!

**Acknowledgements**

I'd like to thank Professor Rachel Jabaily for her help, as well as John Trager, Gary Lyons and Sean Lahmeyer of the Huntington Botanical Garden, Derek Butcher for his voluminous reference materials, and my wife Ana for her help and patience accompanying me many times to the HBG.

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[Editor's Note: Photosynthesis in a broad sense is the creation of food (starch) by a plant using energy from sunlight to attach carbon atoms taken from atmospheric $CO_2$ (carbon dioxide molecules) to a growing starch molecule. In the most common form of photosynthesis - the C3 pathway, stomata on the plant leaves are open when the sun is shining. Energy from captured solar photons power a set of chemical reactions within the leaf that lead to the splitting of a $CO_2$ molecule into a C (carbon) atom and an $O_2$ (oxygen) molecule. The free C enters the Calvin Cycle where it is ultimately used to form simple sugars that link together to form starch or other equally important cellular building blocks. As $CO_2$ within the leaf is depleted by this process, it is replaced by $CO_2$ from the outside air passing through the open stomata.

In plants using the CAM pathway, the stomata are open at night, but tightly closed during the day so access to atmospheric $CO_2$ is restricted during the time of active photosynthesis. $CO_2$ is captured at night and fixed to malic acid for storage. As the amount of captured $CO_2$ increases, the acidity of the fluid within the cell vacuole increases. During daylight hours, the $CO_2$ stored in malic acid overnight is slowly released throughout the day and is available for use in the C3 pathway.

CAM is found in many plant groups other than bromeliads. It is associated with succulence in plants, and habitats with limited or irregular supplies of water. In most cases, epiphytes face a highly irregular supply of water. During rains, there is far too much water for the plants to use. As soon as the rain stops, excess water drains away quickly since there is very little soil to hold it. Then the epiphytes have to rely upon the water they have stored within their own tissue or self-produced storage tanks to survive until the next rain.]

# A Bromeliad 'Hotspot' in French Guiana

*Joep Moonen*[1]

Figure 1. Aerial photo of Savane Roche la Virgenie . Photo by Joep Moonen.

## Introduction to French Guiana

French Guiana is situated on the north-east side of South America, 4 degrees north of the equator. The climate is tropical and humid, we call it Amazonian. It is 90,000 km$^2$, bordered in the south and south-east by Brazil, the west by Suriname, and the north by the Atlantic Ocean.

Due to the small human population of approximately 250,000 (most in the coastal area) and the absence of economic activities, 90% of the surface is still covered with tropical rainforest. There are only roads on the coastal area. The interior is accessible only by boat, bush plane or helicopter. If you have enough time, it is also accessible by foot - the way Brazilian gold diggers have explored the region.

The far north eastern part of French Guiana belongs ecologically to the Amazonian ecosystem. This is presented by different Amazonian animal and plant species. The Amazonian ecosystem has a higher biodiversity than the Guyana[n] ecosystem. Also, the north east of French Guiana has a high annual rain fall - to 6000 mm (240 inches) per year.

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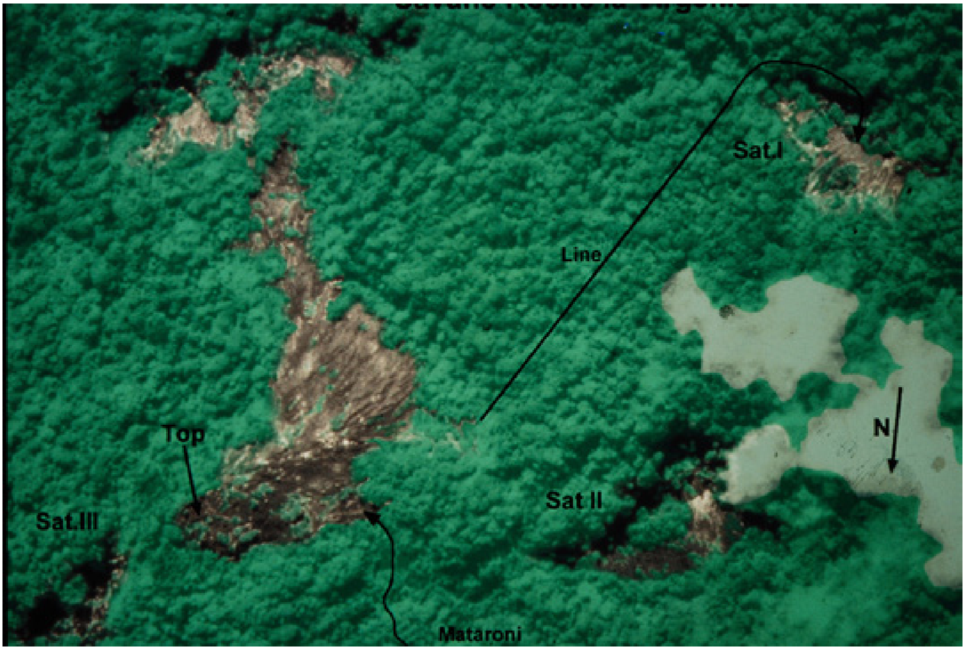


Figure 2. Satellite image of Savane Roche la Virgenie. Montage prepared by Eric Gouda.

## A special inselberg

Interesting bromeliad habitats in the rainforest areas of the Guianas are rocky outcrops, popularly known as inselbergs. Inselbergs are found in many parts of the world. They are generally defined as isolated, steep-sided hills rising above a relatively flat surrounding landscape.

In French Guiana, inselbergs are mostly hidden in the interior, with no road or river connection to the human world. Just by chance, one interesting inselberg could be reached by us in the 1990`s. It took a full day driving and boating to get near, and 2 hours of hiking on the second day to reach the areas of bare rock. This place is known as Savane Roche la Virgenie. It is decribed in the Journal of the Bromeliad Society in 2002 . (Volume 52, Issue 1 (Jan-Feb), starting page 25.)

Apart of the main inselberg, there are the two additional areas of sparsely vegetated rock with large patches of rock plates, known as satellite 1 and satellite 2.

Satellite 2 is home to three natural *Aechmea* hybrids (*Aechmea* SAT #04, *A*. SAT #05 and *A*. SAT #06 ) that are only found on this plateau !

In 2003 a road was opened to Brazil that passed near the base of this inselberg, making the site accessable with just one hour of hiking. Since then, an increasing number of visitors has visited the barren areas near the summit.

Figure 3. Savane Roche la Virgenie, the main rock. Photo by Joep Moonen.

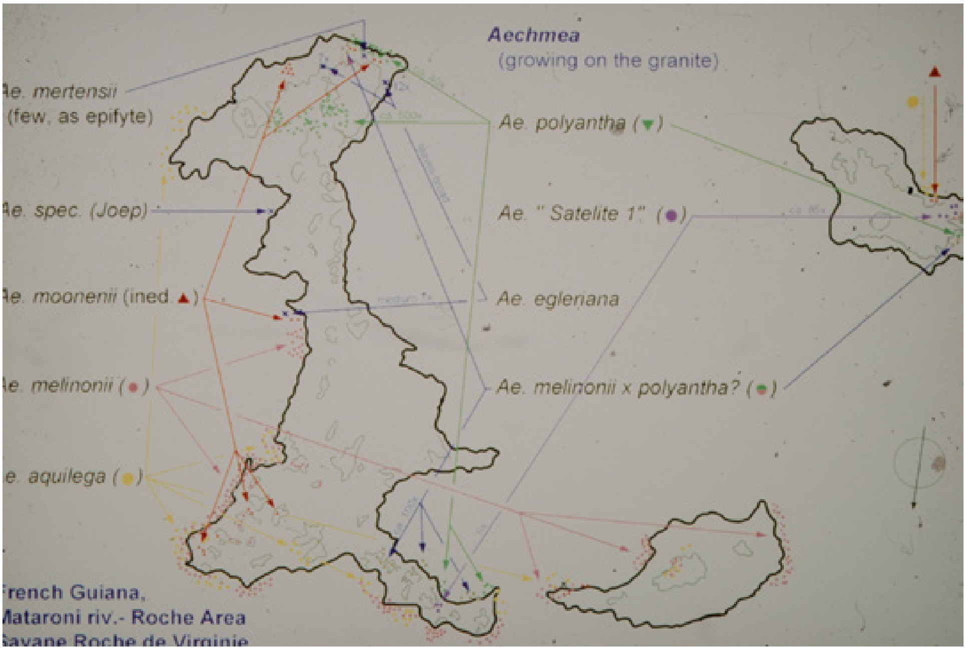


Figure 4. First inventory of Savane Roche la Virgenie. On the right side the two satelites. Map prepared by Joep Moonen.

Figure 5. The path to the inselberg leads through beautiful primary forest. Photo by Joep Moonen.

The inselberg summit is 134 meters (400 ft) above sea level. The higher section of bare granite slopes down, finally leveling out to form a platform. Seen from the air, the largest area of bare rock has roughly the form of a boot. The bare granite can be very hot, to 55 C, in the dry season. It is amazing that several plant species, and even one frog (!) have adapted to this harsh environment.

**Some vegetation types associated with Savana Roche la Virgenie and the bromeliads growing there**

Surrounding the inselberg is a high forest with a multi-layer canopy formed by trees reaching 30-40 m (100-135 ft) in height. A path to the summit of the inselberg, goes through this forest, and along this path we find *Disteganthus basilateralis* (Fig. 6 ) and *Disteganthus* sp. (Fig. 7) growing in the deep shade and wet soil of the forest floor.

Additional shade loving bromeliads are found as epiphytes in the lower layers of the forest. *Guzmania melinonii* (Fig. 8) and *G. lingulata* (Fig. 9) are found in this level of the forest. Perhaps less expected is *Tillandsia monadelpha* (Fig. 10) that can be found on tree trunks in the lower canopy.

Figure 6. *Disteganthus basilateralis* inflorescence. These plants grow on the forest floor. Photo by Joep Moonen.

Figure 7. An additional *Disteganthus* species, this one still undetermined, grows on the floor of the primary high forest. Photo by Joep Moonen.

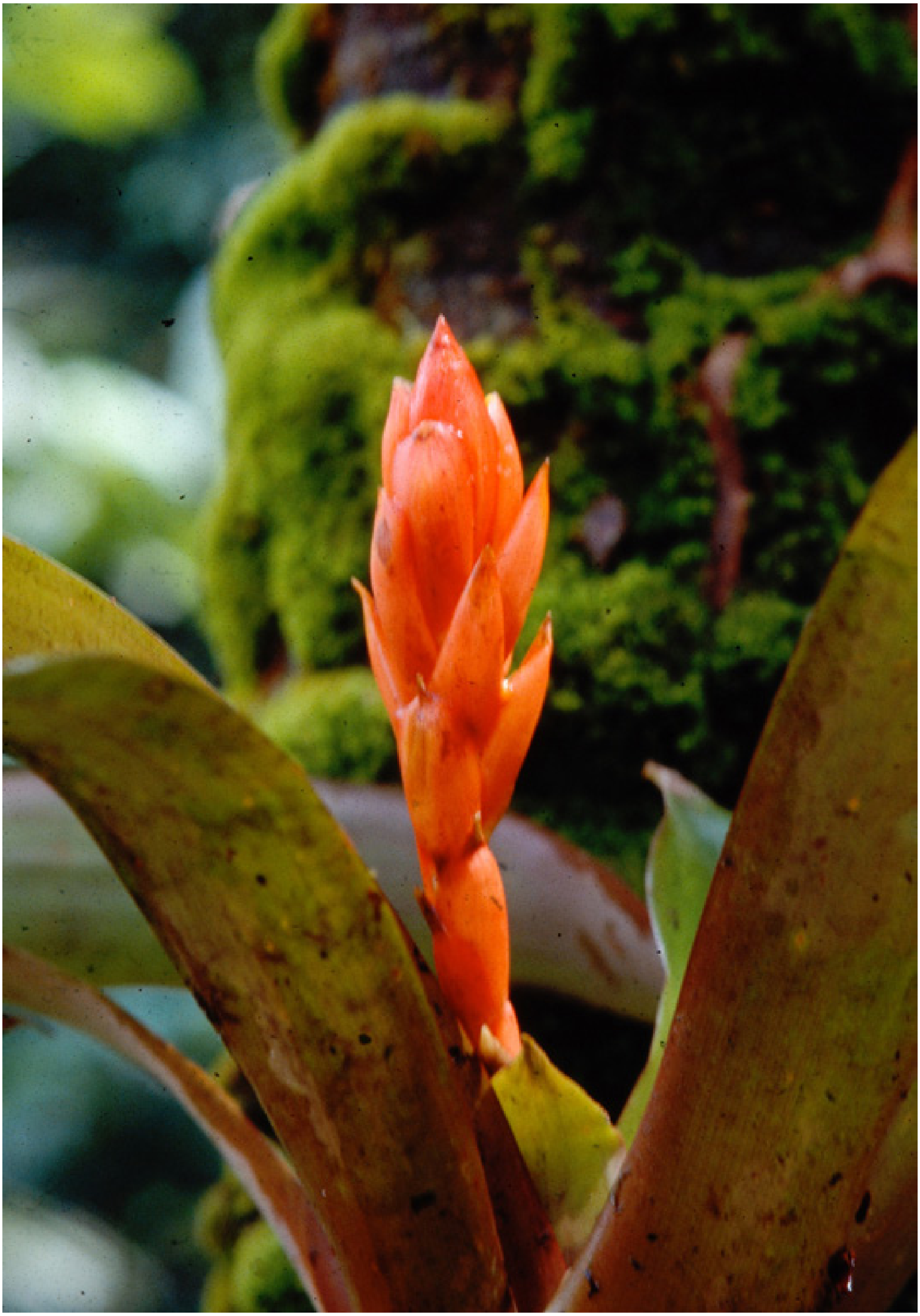

Figure 8. Inflorescence of *Guzmania melinonii* with the characteristic bright orange bracts. Photo by Joep Moonen.

Fgure 9. *Guzmania lingulata* growing in the low levels of the primary forest. Photo by Joep Moonen.

[Editor's Note: Inselbergs are widely distributed over the warmer regions of the globe. They are defined as isolated, steep-sided hills rising above the canopy of surrounding forests. These features are formed through erosion. As an intially flat area erodes, rock formations that are more resistant to erosion than surrounding rocks begin to rise above the eroding landscape. In essence, the inselberg rises relative to more easily eroded surroundings because it decreases in height more slowly. Over time, this leads to inselbergs up to a few hundred meters above the surroundings. In most cases, but not always, the rock forming an inselberg is granitic.

Many inselbergs feature areas of barren rock outcrop, but not always. In dry climates, the steep sides are typically sparsely vegetated or barren due to the lack of water. Barren patches on the top may be due to several factors. A hard, smooth rock surface can resist penetation by vascular plant root systems, especially if soil accumulations are inhibited by a factor such as high levels of rainfall that cleanse the surface on a regular basis.

Due to the low relative elevation of inselbergs, the vegetation in the surrounding landscape can grow anywhere on the inselberg where suitable habitat is found. Still, the plants that adapt themselves to the more extreme conditions of the inselberg, may look very different from their close relatives in the surrounding forest.]

Figure 10. *Tillandsia monadelpha* growing low in the forest - on the vertical trunk of a canopy tree. This *Tillandsia* species likes only a little sunshine. Photo by Joep Moonen.

Figure 11. *Aechmea longifolia* is found in the lower canopy levels of the primary forest. Photo by Joep Moonen.

Figure 12. *Aechmea moonenii* in the canopy. You can see the sky through the canopy, indicating that sunlight penetrates deeply into the canopy. Leaves on this plant can be 4' long . You can see the dark blooms above the rosettes, but it is not possible to see details from this distance. Photo by Joep Moonen.

Figure 13. *Aechmea vallerandii* (formerly known as *Streptocalyx poeppigii* or *Aechmea beeriana*) is another inhabitant in the upper reaches of the primary forest canopy surrounding Savane Roche la Virgenie. Photo by Joep Moonen.

Figure 14. *Aechmea setigera* inhabits canopy gaps in the high forest surrounding Savane Roche la Virgenie. Photo by Joep Moonen.

Additional epiphytic species of Bromeliaceae are found in the upper canopy of the high forest surrounding the inselberg. These are found in canopy gaps where sunlight penetrates further into the canopy.

*Aechmea moonenii* (Fig. 12) is a large plant with leaves that exceed 1 m (3 feet) in length. It typically forms large clumps on large trees. Although the plant is blooming, the relatively dark inflorescence does not stand out in the photograph (see also Fig. 36).

*Aechmea vallerandii* (formerly known as *Streptocalyx poeppigei* or *Aechmea beeriana*) is shown in close-up (Fig 13.) to highlight the bloom. It is reported from Colombia through Venezuela, the Guianas and adjacent regions of Brazil and the Amazonian regions of Peru and Bolivia.

*Aechmea setigera* (Figs. 14-15) is found in forests at low to mid altitudes from Panama, Colombia, Venezuela, the Guianas and adjacent parts of Brazil.

*Aechmea egleriana* var. *egleriana* (Fig. 16) is found in the high forest surrounding the inselberg, but *Aechmea egleriana* var. *major* was found growing on the ground in the rock barrens. This contrasts with the original descriptions of the forms. The type of *A. egleriana* var. *egleriana* was found growing as a terrestrial and the type of *A. egleriana* var. *major* was collected as an epiphyte The species is known from Venezuela and Brazil in addition to the Guianas.

Figure 15. The inflorescence of *Aechmea setigera*, shows one form of physical defense bromeliads have adopted against predators. Each floral bract carries a long, needle-like spine that sticks out beyond the developing fruit. With the fruit clustering tightly around the axis of the inflorescence, the spines form a formidable barrier to any any vertebrate with designs of making a meal from any part of the fruit. Photo by Joep Moonen.

*Mezobromelia pleiosticha* (originally described as *Tillandsia pleiosticha*, but best known as *Guzmania pleiosticha*) is found as an epiphyte in the forest (Fig. 17), but a single plant was also found growing as a terrestrial in the rocky zone. More generally, it is found in Colombia, Ecuador, Venezuela and the Guianas.

Also seen in the upper canopy of the primary forest are: *Aechmea melinonii* (known from the Guianas and Brazil) and *A. polyantha* (originally collected in Amazonian Brazil). These plants are also found in the barren rock zone near the top of the inselberg. Photos of these species from the rock zone appear later.

Figure 16. *Aechmea egleriana* var. *egleriana*, a tree dwelling species, has a bright inflorescence. Photo by Joep Moonen.

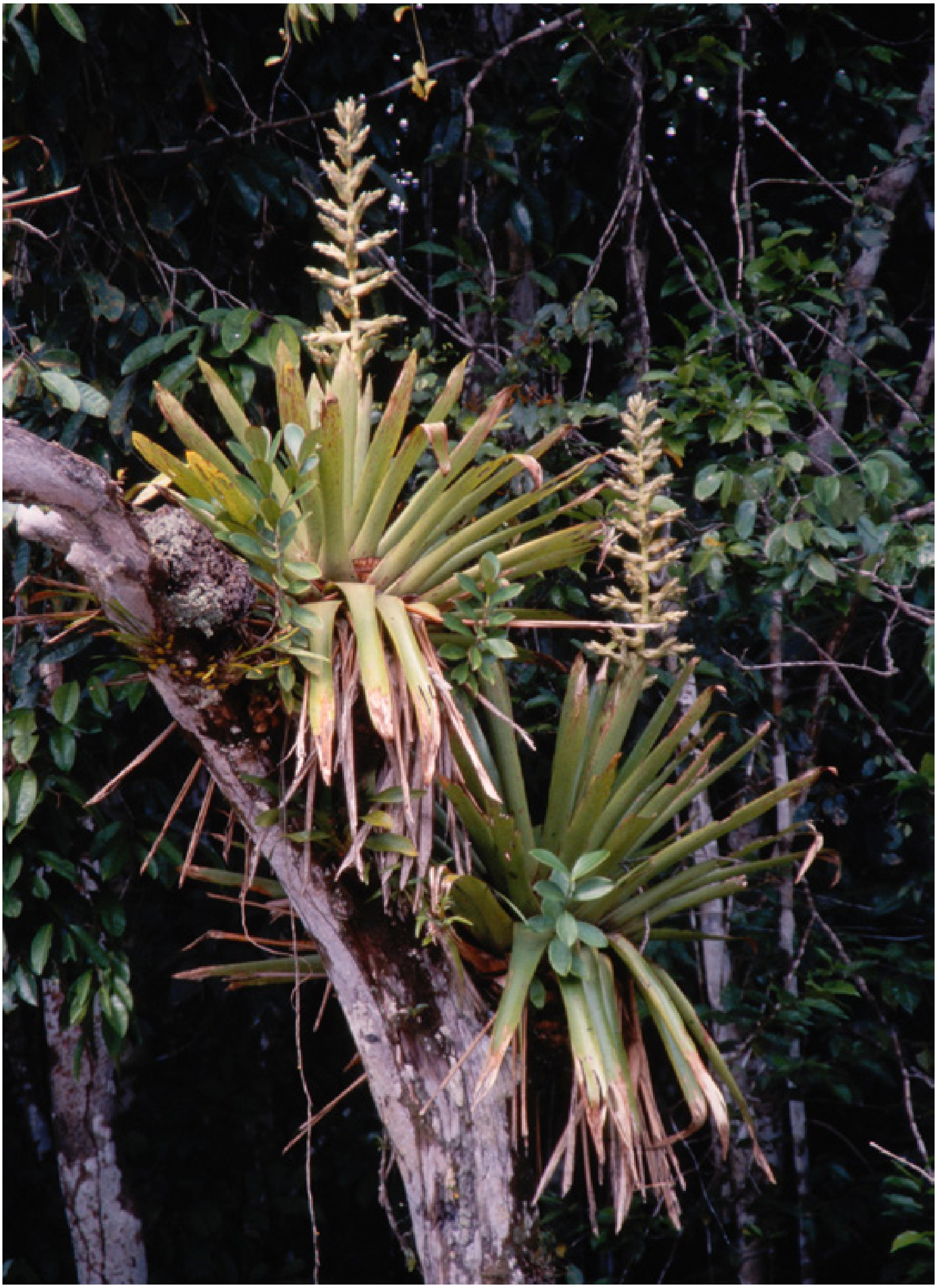

Figure 17. *Mezobromeiia pleiosticha* nornally grows as an epiphyte, often in full sun. Photo by Joep Moonen.

Figure 18. *Vriesea splendens* growing in the transitional forest approaching the rock barren. Photo by Joep Moonen.

Figure 19. The transitional forest has more light, leading to a rich flora. The thin long leaves in the center of this photo are those of *Bromelia granvillei.* Photo by Joep Moonen.

As we ascend the slope further and come near the rocky outcrops, the soil thins and trees grow shorter and have less dense canopies, allowing more light to reach the lower levels of the forest. This transitional forest contains many epiphytic bromeliads in the low trees.

*Vriesea splendens* is shown in Fig. 18 growing as a terrestrial. This species is found in the Guianas, Venezuela and the neighboring island of Trinidad. It is recorded as growing both terrestrially or epiphytically at various places within its range.

A true terrestrial found in the transitional forest is *Bromelia granvillei* (Figs. 19-20), whose bloom is nestled at the base of the leaves, and easy to overlook.

*Tillandsia monadelpha* (seen in the high forest surrounding the inselberg) is also found in the transitional forest (see Fig. 10). This species is found from Central America and nothern South America.

Figure 20. *Bromelia granvillei* flowering. The flowers grow at the base of the plant and are typically hidden by the long, thin, but spiny, leaves. This plant is a denizen of the transitional forest. Photo by Joep Moonen.

Figure 21. *Tillandsia adpressiflora* growing on the branch of a low *Clusia* sp. tree in one of the small islands of vegetation scattered within the area of barren rock outcrop. Photo by Joep Moonen.

Small tree islands dot the areas of barren granite outcrop. These are usually formed by small trees in the genus *Clusia* that manage to survive on a very thin layer of organic soil built up over the rock. Shade provided by these tree islands are an important habitat for many bromeliad species. Among the Tillandsioids we find *Tillandsia adpressiflora* (Fig. 21) growing on the branches of *Clusia* within these tree islands, It is joined by *T. bulbosa* (Fig. 22-23) and *T. flexuosa* (Fig. 24-25). The two latter species are both myrmecophytes, having a symbiotic relationship with ants (Fig. 25). *Tillandsia paraensis* (Fig. 26), a very rare species in French Guiana, along with *Racinaea jenmanii* (Fig. 27) and the widespread *Catopsis berteroniana* (Fig. 28) can also be found in these tree islands.

All but one of these species grow at low elevation (down to sea-level) and grow over a wide range. *Tillandsia bulbosa*, *T. flexuosa* and *Catopsis berteroniana* all range through the West Indies, parts of Central America and northern South America. *T. adpressiflora* and *T. paraense* are widespread in northern South America, even though *T. paraensis* is rare in French Guiana. *Racinaea jenmanii* is also found in the West Indies and northeastern South America, but it prefers higher elevations (600-1100 m, 2000-3500 feet) and, as a result is less commonly recorded.

Figure 22. *Tillandsia bulbosa* in the branches of a *Clusia* tree growing in a tree island within the zone of barren rock. The photo is not printed upside-down. Plants of this species are often found growing in hanging clumps. Photo by Joep Moonen.

Figure 23. *Tillandsia bulbosa* growing on the branch of a small tree above the granite. You can see that the clump is growing almost entirely on the lower surface of the branch. Photo by Joep Moonen.

[Editor's note: Myrmecophytes (also known as ant plants) are common in the tropics where arboreal ants are abundant because the ants are not required to survive freezing temperatures during winter. Some of these arboreal ants utilize bromeliads as shelters and nest sites. Several bromeliads, such as *Tillandsia bulbosa* seem to encourage this use by producing a pseudobulb with the greatly inflated leaf sheaths whose lowermost margins (on inner leaves) flare out enough to allow ants passage between neighboring sheaths. The spaces formed between the layers of sheaths provide a relatively stable shelter that tends to stay moist longer than any exposed area, but do not flood during rains.

The plants that provide such useful shelter to ants are thought to also benefit from the presence of the ants. An ant colony protecting its home could also chase off predators looking to feast on some succulent bromeliad tissue. In addition, the soil, food particles brought into the colony by ants, and waste produced by the ants provide some water-soluble nutrients that can be absorbed through the specialized trichomes on the bromeliad leaf surface.]

Figure 24. *Tillandsia flexuosa* growing on the branch of a small tree in a tree island on the rock barren of the inselberg. Photo by Joep Moonen.

Figure 25. *Tillandsia flexuosa* and also *T. bulbosa*, are ant plants. Many clumps and individual plants of these species will contain colonies of arboreal ants. Photo by Joep Moonen.

[Editor's note: Insectivory is rare in bromeliads, having been confirmed only in two species of *Brocchinia* (*B. hechtioides* and *B. reducta*) and *Catopsis berteroniana*. Unlike most other insectivorous plants, the insectivorous bromeliads look very similar to some of their non-insectivorous relatives. Many non-insectivorous bromeliads have the same water-holding tanks and the specialized absorptive trichomes that provide a pathway for the transfer of nutrients from the tank water into plant tissue as those found in the insectivorous species. Specialized adaptations such as very slippery leaf surfaces may be involved in the transition to an insectivorous diet, but these changes are not easy to see without detailed study.

All three insectivorous bromeliads live in nutrient-poor conditions, but *Catopsis berteroniana* shares this habitat with several non-insectivorous species of *Tillandsia* on Savane Roche la Virgenie - and elsewhere throughout its wide range.]

Figure 26. *Tillandsia paraensis*, a very rare species in the Guianas, can be found in the forest surrounding Savana Roche la Virgenie, and in the tree islands that dot the rock barren. Photo by Joep Moonen.

Figure 27 (right). *Racinaea* (formerly *Tillandsia*) *jenmanii.* Photo by Joep Moonen.

Figure 28. *Catopsis berteroniana*, a small carnivorous bromeliad also found in the tree islands. Photo by Joep Moonen.

The edges of tree islands in the rock barrens of Savane Roche la Virgenie form an ideal habitat for several large *Aechmea* species that grow on a very thin layer of organic soil exposed to large amounts of direct sunlight. Several of these species have been mentioned previously as epiphytes in the surrounding forest.

Plants of *Aechmea aquilega* are found with green leaves or darker 'red' leaves (Figs. 29-30). Like the other species noted here, *Aechmea aquilega* has a wide distribution range in northern South America. *Aechmea egleriana* var. *major* (Figs. 31-33) is found in the rock barren area while *Aechmea egleriana* var. *egleriana* (Fig. 13) is found growing as an epiphyte in the surrounding forest. *Aechmea melinonii* (Figs. 34-35) and *Aechmea moonenii* (Fig. 36) are also found growing on the ground here, but as epiphytes in the surrounding forest.

Figure 29. Several large *Aechmea* species, such as this purple-leaved variety of *Aechmea aquilega*, can be found growing around the edges of tree islands in the rock barren on Savana Roche la Virgenie. Photo by Joep Moonen.

. Small plants of *Aechmea polyantha* will grow on the open rock away from the tree islands, even forming mats (Figs. 37-38), but they topple over before reaching mature size because they cannot root into the rock. Mature, blooming plants are found at the edges of tree islands (Fig. 39). This species has the most restricted distribution among the plants mentioned here, being known primarily from nothern Brazil.

Another group of imperfectly known, large *Aechmea* species or, more likely, natural hybrids are also present along the edges of tree islands in the barren rock zones. The first three are found in the main rock barren of Savane Roche la Virgenie, and have been seen nowhere else in French Guiana. The rosette of *Aechmea* SRLV # 01 is shown in Fig. 40.

*Aechmea* SRLV # 02 (Figs. 41-42) has an inflorescence that looks like a condensed version of the *A. moonenii* inflorescence where the internodes between the branches have shrunk to almost nothing and the branches themselves have been lengthened.

Plants of *Aechmea* SRLV # 03 (Fig. 43) have been carefully watched for many years, but have never flowered.

The remaining 3 plants are known only from the small area of barren rock labelled Satellite 2:

Figure 30. Close-up of a young inflorescence of *Aechmea aquilega*. Unlike the plant seen in Fig. 29, this is the green-leaved variety. Photo by Joep Moonen.

Figure 31. *Aechmea egleriana* var. *major* - grows in the rock barren areas of Savane Roche la Virgenie. Photo by Joep Moonen.

Figure 32. *Aechmea egleriana* var, *major*, a close-up of the bright inflorescence. Photo by Joep Moonen.

Figure 33. *Aechmea egleriana* var. *major*, close-up of a mature inflorescence with seed-bearing fruits. This is considered to be taxonomically distinct from the *Aechmea egleriana* var. *egleriana* growing in the surrounding forest. Photo by Joep Moonen.

Figure 34. The summit of Savane Roche la Virgenie with *Aechmea melinonii* growing at the edge of a small tree island. Photo by Joep Moonen.

Figure 35. Inflorescence of *Aechmea melinonii*. Photo by Joep Moonen.

Figure 36. *Aechmea moonenii* inflorescence - this is the biggest *Aechmea* species in the Guianas, described by the Dutch botanist Eric Gouda in 2002 (Journal of the Bromeliad Society Volume 52, No. 1 (Jan-Feb), pages 21-24). Photo by Joep Moonen.

Figure 37. *Aechmea polyantha* at lower plateau. We counted 600 plants of this species in 1999. Photo by Joep Moonen.

Figure 38. Clusters of *Aechmea polyantha* on bare granite. Exposed to full sun and heat, the plants stay very compact. Photo by Joep Moonen.

Figure 39. Inflorescence of *Aechmea polyantha*. Although young plants of this species are found growing on the bare rock (Figs. 37-38), the adults are found near the edges of the tree islands. Photo by Joep Moonen.

Figure 40. A distinct *Aechmea* species (or natural hybrid) labeled SRLV # 01 hosts a colony of wasps. The wasp nest is well protected by the spiny leaves. Photo by Joep Moonen.

Figure 41. *Aechmea* species or natural hybrid SLRV # 02, known from only 7 plants in 1999, growing under the shade provided by small *Clusia* trees forming tree islands in the rock barrens on Savane Roche La Virgenie. Photo by Joep Moonen.

Figure 42. *Aechmea* SRLV # 02 inflorescence, with white flowers. Photo by Joep Moonen.

The remaining 3 plants are known only from the small area of barren rock labeled Satellite 2:

*Aechmea* SAT # 04 (Figs. 44-45) has an inflorescence similar to that seen in *A.* SLRV #02, but with even longer cylindrical branches.

*Aechmea* SAT # 05 (Figs. 46-47) has a much smaller inflorescence compared to the plant size. It is also more colorful, with red floral bracts visible.

*Aechmea* SAT # 06 (Figs. 48-49) returns to the long, cylindrical inflorescence branches seen in *A.* SRLV # 02 and *A.* SAT # 04, but is much more colorful with the red floral bracts contrasting nicely with the green ovaries and the mostly white sepals.

Recently, I found also *Mezobromelia pleiosticha* (Fig. 50) growing as a terrestrial on Satellite 1. Obviously this is an isolated plant: there are no lithophytic populations comparable to those seen in Aechmeas. Still, it is interesting to see a *Mezobromelia,* that is normally found in the forest canopy, grow on rocks.

At certain places we find also *Ananas ananassoides* (Fig. 51). This is evidence that the area of this granite mountain was many centuries ago inhabited by Amerindians.

[Editor's note: Pineapples (members of the genus *Ananas*) have been cultivated for many centuries by humans. Over that period, there have been innumerable crosses between wild and cultivated plants, as well as between different cultivars. The result is a confused conglomeration of forms that defy easy comprehension despite

Figure 43. Plants of *Aechmea* SRLV # 03 are very bulky bromeliads. They have never flowered during15 years of observation. Photo by Joep Moonen.

Figure 44. Bernie Moonen by a group of *Aechmea* SAT # 04 on Satellite 2, in 2009. Photo by Joep Moonen.

detailed study. This is particularly true within the Guianas - where the genus first arose and was first cultivated. Although BSI currently recognizes a few species of *Ananas*, including *A. ananassoides* (see the list of accepted names on the BSI website in the members only area), but there is still active debate over the correct application of these names. The author's identification of the species shown in Fig 51 and his interpretation of its meaning are based on prolonged field study, but may be disputed by others.]

Granite rock is bare or has locally some weeds of small plants, that can withstand the enormous heat during sunny days. The only bromeliads growing there are young plants of *Aechmea polyantha* (Figs. 37-38). I never observed adult plants on the bare rock. It is possible that once they get too large, they fall over since they cannot root in the granite.

**Other flora and fauna**

Apart from Bromeliads, this inselberg and surrounding forests, is rich in other plants that grow as epiphytes or lithophytes. We have seen aroids, ferns, orchids and species of Cyclanthaceae on our trips. The surrounding forest is also the habitat of several species of very rare palms.

From the fauna we just mention granite frogs (*Leptodactylus meyersii*). poison-arrow frogs (*Dendobates tinctorius*) and bromeliad frogs (*Dendrobates ventrimaculatus*). The latter live in the tanks of *Aechmea* species growing on the bare granite!

Figure 45. The impressive young inflorescence of *Aechmea* SAT # 04. When older, the bracts turn brown. It is highly unusual to see bromeliad flowers line up so perfectly in 5 or 6 straight rows. Photo by Joep Moonen.

Figure 46. Group of *Aechmea* SAT # 05. Photo by Joep Moonen.

Figure 47. Inflorescence of *Aechmea* SAT # 05. Photo by Joep Moonen.

Figure 48. The author with a group of *Aechmea* SAT # 06, in 2005. Photo courtesy of Joep Moonen.

Figure 49. The red bracts with white patches near the tips of typical of *Aechmea* sp. SAT 06. Photo by Joep Moonen.

Figure 50. *Mezobromelia pleiosticha* growing as a terrestrial at SRLV satellite 1. This is the only place we have ever seen *M. pleiosticha* growing on the ground. Photo by Joep Moonen.

Figure 51. *Ananas ananassoides* is a reminder Amerindians lived here many centuries before. These plants do not have any natural dispersal mechanism and rely on humans to move them over the landscape. Photo by Joep Moonen.

Figure 52. Broken quartz rocks strewn over the granite surface were left by gold diggers, probably in the early 20th century. The miners would dig into any accessible veins of quartz, searching for gold. Photo by Joep Moonen.

Figure 53. Helicopters bringing tourists to the barren rock outcrops can damage the inselberg vegetation. Photo by Joep Moonen.

Figure 54. Prop wash from a helicopter has lifted the edge of this *Aechmea polyantha* mat (compare to Fig 38), . Notice the difference in color of the granite. The dark color is caused by microorganisms, such as algae, living on the granite surface. Photo by Joep Moonen.

Figure 55. Tourism has become big business on the inselberg. By 2015, the number of visitors had risen to approximately 7000 each year. Photo by Joep Moonen.

## The missing genus *Pitcairnia*

Where extensive areas of bare granite are found in the Guianas, the primary bromeliads growing on the exposed rock are species belonging to the genus *Pitcairnia*.

For some reason *Pitcairnia* species are missing on Savane Roche la Virgenie and some other granite plateaus in the north east of French Guiana. Without the big carpets of *Pitcairnia* covering exposed rock surfaces, a habitat was open for other bromeliads to exploit. So species of *Aechmea* that are normally found growing in trees, became lithophytes. Or, were these *Aechmea* species, in fact, originally lithophytes - rock dwellers - that moved into the epiphytic habitat when the rain forest started to cover big surfaces of the Guiana Shield ?

[Editor's note: The Guiana Shield is an area of very ancient rock exposed at the earth's surface. It covers all of the Guianas (Guyana, Surinam, French Guiana) and large areas of southern Venezuela. Along with the Brazilian Shield, it was the first section of what would become the South American continent to emerge from the sea during earth's history. The Guiana and Brazilian shields were originally connected as a single craton, but the Amazon River split them apart.]

Figure 56. Not all tourists behave responsibly. This photo was staged to emphasize the increasing defacement of the rock surface by casual visitors. Photo by Joep Moonen.

Figure 57. Fires caused by campers, and granite exploration are the biggest threats of inselbergs. Here is a typical camp fire site. You can see how charcoal and ash will accumulate in these sites, creating conditions for invasive plant species to enter the habitat. Photo by Joep Moonen.

Figure 58. Some of the tree islands on the summit of Savane Roche La Virgenie caught on fire in Oct 2015 - presumably as a result of an uncontrolled camp fire set by a tourist. Photo from 18 Oct 2015 © Nils Koster, Berlin BG

## Human impacts and threats to Savane Roche la Virgenie

In the early 1990`s, when I first found this unique inselberg, human disturbances were very limited.

Amerindians who lived on and around the inselberg 100`s of years ago left behind only plants of *Ananas* (Fig. 51) that still survive in limited numbers. In fact they contribute to the bromeliad flora of the inselberg.

Gold diggers, probably from Brazil in the early 20th century, left crushed quartz (Fig. 52) at some places on satellite 2 where they carried out some preliminary digs in their search for the precious metal.

The Foreign Legion carried out some military exercises on the site 20 years ago. They unearthed some *Clusia* trees and left a layer of bullet shells and fake plastic hand grenades scattered over the rock surface and in the tree islands. This garbage was finally collected by my late friend Kris Wood and sent to the Foreign Legion`s commander in Kourou.

Damage is done by helicopters (Fig. 53) hovering low over the granite mountain: the downwards airflow from the propeller flips over the edges of *Clusia* and *Aechmea* mats (Fig. 54) that are rooted only in a thin layer of humus. Plants with their roots exposed in this fashion quickly die.

Tourists (Fig. 55) and hunters had almost no impact until 2003. Then the road to Brazil was opened, and the inselberg suddenly became easy to reach by car and one hour hiking.

Now, 12 years later, 7000 people per year visit Savane Roche la Virgenie. Fortunately they leave the satellites alone. But the impact on the main rock summit is shocking. The granite surface itself is damaged and sometimes cracked by so much foot traffic.

Figure 59. The sad result of a fire on the summit of Savane Roche la Virgenie. Two acres of this unique habitat were destroyed. Fire makes the granite surface crack. Then, other plants like grasses and mimosa quickly invade the altered habitat and the unique Inselberg flora is gone forever. Photo by Joep Moonen.

*Clusia* and other trees are cut to make campfires. Remains of campfires and candles are left on the granite. The forest is cut open to make bivouacs. Old tarpaulins, rope, cans and bottles are left on the granite and in the nearby forest. The top of the inselberg is now a mess.

My fear was always that a campfire would get out of hand and a bush fire would destroy the inselberg, and the unique flora. Finally, on 18 October 2015, fire spread through part of the vegetation on the top, and 2 acres of vegetation burned down to bare granite (Figs. 58-59). Photos of the resulting damage shocked many people.

**The protection of Savane Roche la Virgenie**

In February 2002 Savane Roche la Virgenie was proposed as a priority protection site at the international meeting of Conservation International and the Guiana Shield Initiative in Paramaribo. But nothing happened. Several later efforts to protect the inselberg also failed to advance.

Finally the National Forest Office (ONF) took on the project to protect the inselberg

Figure 60. Granite orchids *Cyrtopodium adansonii*. Hopefully this Botanical Paradise will soon be protected…….. Photo by Joep Moonen.

and the surrounding satellites and forest. The goal is to make it a Biological Reserve. This process is going on now. We can only hope that the Savane Roche la Virgenie and its unique flora (Fig. 60) will be protected and guarded before it is too late……...

**Acknowledgements**

I want to thank the many people who have helped me study this inselberg over the years, especially: Luc Ackermann, Pierre-Olivier Albano, Oliver Brunaux, Drs. Dick and Hanny Dekker, the Florschutz family, Drs. Eric Gouda, Dr. Nils Koster, Dr. Paul and Hiltje Maas, Dr. Vincent Mercks, Marijke and Bernie Moonen, Dr. Scott Mori, Narciso de Freitas Freire, Dr. Larry Noblick, Oliver Tostain, Col. Bastiaan van Tussenbroek, Rick West, Chris Wood and dozens of other biologists and naturalists that enabled me to visit and take notes and photos of Savane Roche la Virgenie from 1994 up to the present.

And to the Deutsche Bromelien Gesellschaft and the Bromeliad Society International for publishing my updated findings from the field.

# Bromeliad Society of South Florida Show 2014

*Alan Herndon*

Due to conflicts with other activities scheduled at Fairchild Tropical Botanical Garden during April, the Bromeliad Society of South Florida Show was held about six weeks earlier than normal in 2014 Judging was carried out on the last day of February and the show was open to the public through March 2. There was some consternation that the early date might severely limit the number of plants available for exhibit, but we had a mild winter - so mild that many of the *Neoregelia* species and hybrids normally blooming in winter and early spring were already past flower by the time of the show. In fact, only a single plant was entered in the Blooming Neoregelia section. Most years, Blooming Neoregelia is either the largest, or second largest section. As if to compensate for the dearth of flowering *Neoregelia*, many more *Vriesea* were exhibited than in the past several shows.

Despite the early date, 25 exhibitors entered some 230 plants or artisitic exhibits in the show.

As usual, our show was complemented by an art show that featured works by students from art programs in a few local public schools. Most of these works were paintings in a variety of media. Sharon Biddex-Maessen deserves credit for her tireless efforts to supply bromeliads to the classrooms for students to draw, followed by her

Figure 1. Best Blooming Bromeliad in the 2014 Bromeliad Society of South Florida (BSSF) was this clump of *Billbergia* 'Hallelujah' exhibited by Josefa Leon. Photo by Ana Thompson.

effort to collect the paintings and deliver them to the show rooms, staging the display of the paintings and bringing in judges to assess the student works.

Top honors in the Horticultural divisions went to *Billbergia* 'Hallelujah' for the Best Blooming Bromeliad (Figs. 1-2) and *Tillandsia duratii* (Fig. 3) for Best Non-blooming Bromeliad. A special award for cultural excellence sponsored by BSSF in honor of one of its founding members - RalphDavis - was also bestowed upon the *Tillandsia*.

Figure 2. Close-up of a *Billbergia* 'Hallelujah' inflorescence. from the clump seen in Fig. 1. This specimen was exhibited by Josefa Leon. Photo by Ana Thompson.

It is noteworthy that *Billbergia* 'Hallelujah', despite the age of this Don Beadle hybrid, it is still one of the most frequently shown cultivars, and it still wins major awards. The combination of vibrant colors with exceptional contrast between the light and dark areas of the leaf has apparently not been significantly surpassed in more recent hybrids. Even better, the growth of this cultivar is robust enough that even less-experienced growers can consistently produce very nice-looking clumps - not, perhaps, the same quality as the clump shown here, but still a pleasure to look at.

*Tillandsia duratii* is also commonly seen winning major awards in bromeliad shows. The shape of the plant is at once somewhat strange and somewhat elegant (Fig. 3). Curling leaf tips used to support the plant are known elsewhere among vascular plants, but they are quite rare. Also, the thick coating of light reflecting trichomes covering the succulent leaf surfaces makes this species stand out in the show setting.

These two plants receiving top awards were exhibited by two familiar names. Josefa Leon grew the *Billbergia* and Karl Green grew the *Tillandsia*. Both of these growers have a long history of entering superior plants in BSSF shows, and are usually in a tight race for the Sweepstakes Award. This year Karl Green came out on top to win the Sweepstakes, but you will find both names frequently among the Major Award winners.

For instance, the Best Blooming Tillandsia was a clump of a small, but bright clone

Figure 3. *Tillandsia duratii* Best Non-blooming Bromeliad and winner of the Ralph Davis Award for Cultural Excellence. Exhibited by Karl Green. Photo by Ana Thompson.

Figure 4. This clump of *Tillandsia bulbosa* was judged the Best Blooming Tillandsia. Exhibited by Karl Green. Photo by Ana Thompson.

of *Tillandsia bulbosa* from the collection of Karl Green (Fig. 4). Blooming on this clump was perfectly aligned with our show. Flowers were just starting to open as the show was set up, so they were as fresh as possible.

Another entry by Karl Green was the magnificent clump of *Vriesea philippo-coburgii* shown in Figure 5. It was only judged worthy of a Bronze Award among the Non-blooming Vriesea section, but it went on to win The Nat DeLeon Award for

Figure 5. *Vriesea philippo-coburgii* winner of the Nat DeLeon Award for Best Guzmania or Vriesea and Bronze Award for Non-blooming Vriesea. Exhibited by Karl Green. Photo by Ana Thompson.

Best Guzmania or Vriesea. Even when out of bloom, this *Vriesea* is particularly attractive with its brown 'fingertips' at the ends of the leaves (Fig. 7). Although the plant grows well for us, it does not bloom in southern Florida. It apparently blooms regularly in the northern half of the Florida peninsula.

Josefa Leon also had many entries on the head table. Featured are her *Billbergia* 'Afterglow' that won the award for Best

Figure 7. Detail of leaf tip from plant in Fig. 5. Photo by Ana Thompson.

Figure 6. Best Non-blooming Billbergia - *Billbergia* 'Afterglow' exhibited by Josefa Leon. left: the entire clump, right: a close-up showing some details of the leaf pattern. Photo by Ana Thompson.

Non-blooming Billbergia and her winning entry in the Artistic Arrangement Section. Transformation of a discarded racket into a pineapple is characteristic of Josefa's inventive work in the Artistic Division for many years.

Despite the large numbers of awards by our two most active exhibitors, additional members were able to find their plants on the head table after judging was completed. Probably the two most spectacular entries came from Bullis Bromeliad Nursery. *Neoregelia gigas* (Fig. 8) was the Best Non-blooming Neoregelia on its first entry in our show. A very nicely varigated *Vriesea ospinae gruberi* (Fig. 9) was also entered by Bullis Bromeliads.

Best Non-blooming Aechmea was awarded to a splendid *Aechmea egleriana* exhibited by Pepe Donayre (Fig 10).

A photo of special beauty is Fig. 11, a close-up of an open flower on *Billbergia nutans*.

Finally, the winner of the Best Novice award was Jacqueline Thomas with her *Quesnelia marmorata* in a Decorative Container.

Figure 7. Best Artistic Arrangement, created by Josefa Leon. Photo by Ana Thompson.

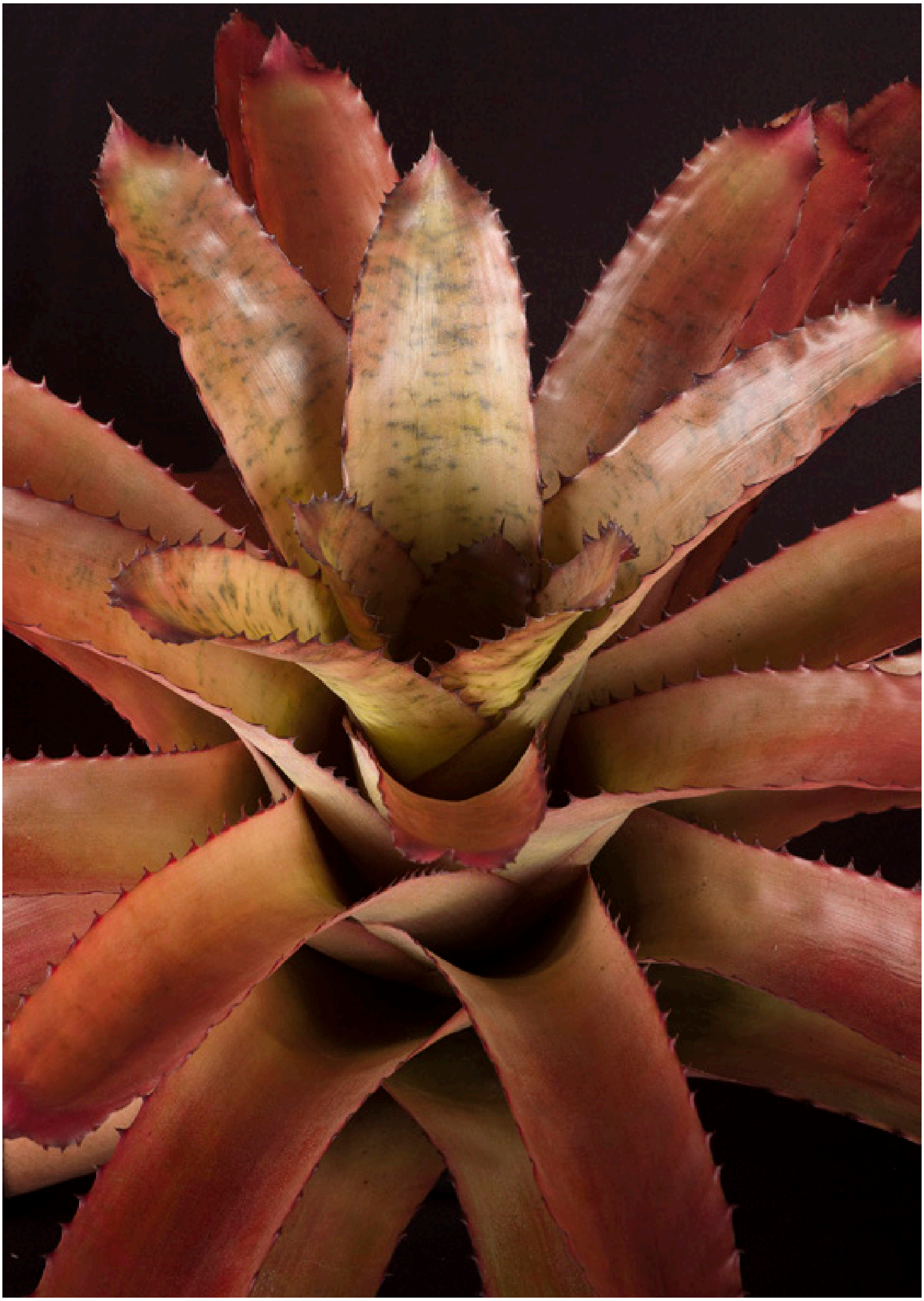

Figure 8. *Neoregelia gigas*. Best Non-blooming Neoregelia. Exhibited by Bullis Bromeliads. Photo by Ann Thompson.

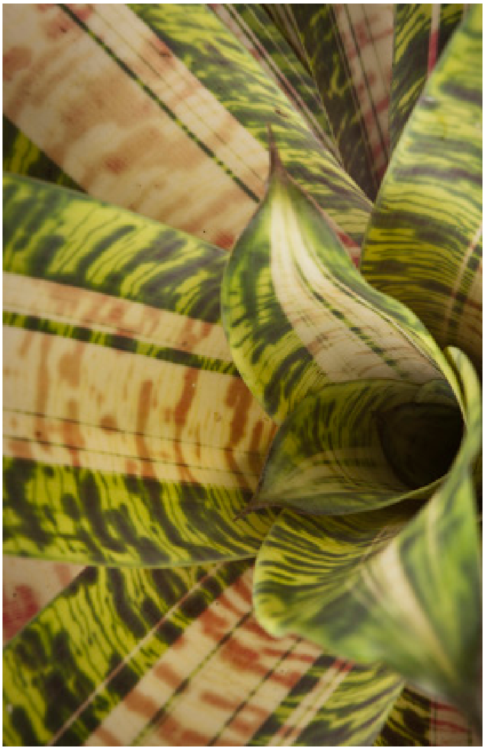

Figure 9. A very nicely variegated *Vriesea ospinae* var. *gruberi* exhibited by Bullis Bromeliad Nursery. Photo by Ana Thompson.

Figure 10. *Aechmea egleriana*, Best Non-blooming Aechmea in the 2014 BSSF Show. Exhibited by Pepe Donayre. Photo by Ana Thompson.

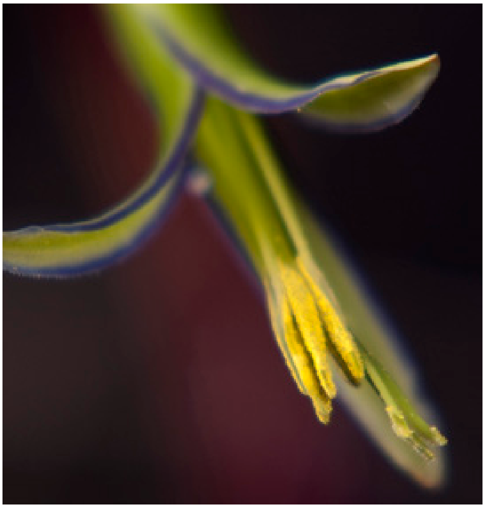

Figure 11. Flower of *Billbergia nutans minuta* exhibited by Jose Donayre. Photo by Ana Thompson.

Figure 12. *Quesnelia marmorata* in a Decorative Container, Best in Novice Class, exhibited by Jacqueline Thomas. Photo by Ana Thompson.

# The Bromeliad Society International

The purpose of this nonprofit corporation is to promote and maintain public and scientific interest in bromeliads through support of scientific and horticultural research, preservation, and display of bromeliads, both natural and hybrid, throughout the world. You are invited to join in this endeavor.

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