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Cover photographs. Front: *Puya fosteriana*, growing at about 4,630 m (15,345 ft) on the road from La Paz to Caranavi in Bolivia. Text begins on page 158. Photograph by Thorsten Krömer. **Back**: *Puya ferruginea*, a nocturnal species found on the same road at a lower elevation. Text begins on page 158. Photograph by Thorsten Krömer.

CONTENTS

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Effects of Predation on Tillandsias: A Case from Chiapas

Robert Guess and Virginia Guess
Photographs by Robert Guess

David Benzing (1980) expressed little optimism when he speculated on the long-term future for naturally occurring species of Bromeliaceae. His apocalyptic predictions of diminishing habitats throughout the Western Hemisphere have proven alarmingly true. Even more accurate was his caveat that wildlife preserves established in the midst of developed areas were fraught with hazards, and thus not always a viable solution. Some startling changes observed in a large population of *Tillandsia guatemalensis* L.B. Smith growing within the confines of Reserva Huitepec confirm his warning, as well as illustrate the effects of increased predatory pressure on this species.

The one hundred and thirty-five-hectare ecological preserve on the outskirts of San Crist6bal de Las Casas, Chiapas, Mexico, was founded in 1986. Now managed by PRONATURA CHIAPAS, A.C., this swath of mostly primary and secondary growth oak forest ranges in altitude from 2100 to 2550 meters. The habitat supports 300 to 400 species of plants, some 100 species of resident and migratory birds, and several small animal species including squirrels, skunks, and raccoons (Rabasa Tovilla 1999). The relatively small census of epiphytic bromeliads is composed mostly of *T. guatemalensis* and *Tillandsia vicentina*, with some specimens of *Tillandsia eizii, Tillandsia ponderosa*, and *Tillandsia leiboldiana.*

Within the last several years, dwelling sites and small cultivated plots based on subsistence farming have replaced the high-altitude woodlands surrounding the Reserve. As a result, the corridors of natural habitat that once served as conduits for wildlife have slowly disappeared. Concomitant with this increasing isolation is an interruption in the fragile balance between the animals and plants that coexist within the protected zone.

During this period of changing land-use at the perimeters of the Reserve, we began to notice occasional damage to the inflorescences of *T. guatemalensis*. Some scapes were severed either midway along the rachis or close to the plant body. At the peak flowering season in 1999, however, we observed mutilation in nearly three-quarters of the inflorescences of *T. guatemalensis*, as well as in those of *T. vicentina* and *T. leiboldiana*. Also in some plants of *T. eizii*, the terminal spikes, which are exposed and easily reached early in inflorescence development, had been partially destroyed. In contrast, we noted no injury to the thick, robust inflorescences of *T. ponderosa*.

Figure 1. Tree laden with *Tillandsia guatemalensis*, one of the more prevalent bromeliads in Highland Chiapas.

Figure 2. Two specimens of *Tillandsia guatemalensis* in Reserva Huitepec: one fully developed and the other damaged by arboreal squirrels.

Figure 3. Growth continues around a severed inflorescence of *Tillandsia guatemalensis*.

Figure 4. Flowers of *Tillandsia guatemalensis* emerge below a mutilated scape.

The culprit is the common gray squirrel, *Sciurus aureogaster*, a small arboreal mammal that makes its nest of leaves and twigs high in the canopy of the trees. The vegetarian diet of this agile climber consists of nuts, fruits, berries, insects, as well as the tender buds and shoots of plants (Alvarez del Toro 1991). Since the squirrels encounter none of their usual predators within the Reserve, namely large birds of prey, man, and other mammals, they have found a safe environment in which to live and reproduce. Now that the Reserve is cut off from other highland forests, the concentrated squirrel population has multiplied thus impacting their food source. One effect of this additional need for food is manifesting itself in an increased number of damaged or destroyed inflorescences of epiphytic bromeliads.

Plants of *T. guatemalensis*, which reproduce primarily by seeds and occasional offsets, appear to compensate for this stress by continuing to produce flowers and seeds, but in fewer numbers. Often a cluster of spikes emerges below the severed end of the rachis developing into a short, stunted inflorescence, far different from the usual erect, graceful scape. Although *T. guatemalensis* remains one of the more abundant species of Bromeliaceae within the Reserve, it is unpredictable how long the species can sustain itself given the continuation of this predatory pressure. On the other hand, the predation seems to have a lesser effect on *T. vicentina*, as this species reproduces by seeds as well as multiple offsets that form large aggregates of plants. The greater impact may be on *T. eizii*, since this species, known to reproduce only by seeds and incidental adventitious offsets, is already in decline within the Reserve.

Although Benzing suggested that the future for bromeliads rests in the specialized greenhouses and gardens of skilled hybridizers and horticulturists, nevertheless, wildlife sanctuaries still offer the potential for the development and preservation of natural species. Certain predators, however, may become an important factor in the ultimate survival of those plants dependent on protected habitats. Our observations, limited to only a few species, verify that interdependence of plants and animals can be adversely affected by changes in land use surrounding ecological reserves. To this end, Reserva Huitepec may offer a natural laboratory to study the long-term effects on species when biological highways are closed.

Santa Barbara, California

Figure 5. Remnants of an inflorescence of *Tillandsia guatemalensis* at Reserva Huitepec.

Figure 6. Tree squirrels in Reserva Huitepec often target the terminal spike of *Tillandsia eizii* in their search for food.

Cold Sensitivity in Bromeliads

Andrew Steens

Bromeliads are surprisingly hardy. Most people think of them as being tropical plants which are unable to be grown outdoors in most areas of New Zealand and other parts of the temperate world. In fact, many bromeliads can survive frosts of minus 7°C (19° F), which we have recorded in the early 1990's here in New Zealand in gardens with plants such as *Aechmea apocalyptica, Billbergia nutans, Canistropsis billbergioide*s and others. On the other hand, *Guzmania zahnii variegata* will start showing cold spots when the night temperatures drop below 10°C (50° F).

Cold sensitivity is variable though. It is affected by the overall condition of the plant (for example its nutrient status), the light levels received, and temperatures preceding the cold period. The placement of plants in the garden also has a marked effect, with overhanging foliage or proximity to a building being quite beneficial. Also, both the duration and intensity of the cold period and the moisture level of the air have an impact.

An early cold snap, particularly one that had been preceded by warm temperatures, is more damaging than one that occurs late in the winter.

Even in a greenhouse some of these factors are important. Increasing the cold resistance of your plants will allow you to decrease the heating level, thereby reducing your costs. Factors such as correct nutrition, light levels, air movement and placement are all important in greenhouse situations. Leading into winter, it is good practice to prepare your plants by cutting back on nitrogen fertilizers. Consider applying foliar feeds which are high in potassium and low in nitrogen.

Improve air movement and light levels by reducing the amount of overhead shade (without exposing the plants to frost) and prune away dense foliage surrounding your bromeliads. Consider which plants are most susceptible to cold, wet conditions and consider moving these to a bank, near a building or even indoors for the winter.

Frosts occur most often around the full moon when the weather is settled, especially at times with little wind and clear skies. Keep an eye on the weather forecasts. If frost is predicted, set your alarm for at least an hour before daybreak and start watering! Don't stop until at least 1/2 hour after daybreak, when the sun starts to warm the plants (or later in shaded areas). Spraying water over plants is a long established method of preventing frost settling and is surprisingly effective.

The Journal of the Bromeliad Society, in an article by Dale Jenkins (reprinted from the Sarasota Bromeliad Society Newsletter), provides a comprehensive list of cold sensitivity by individual species and cultivars. Use this to determine the requirements of your collection. The list can also be found on the web site of the Florida Council of Bromeliad Societies at http://fcbs.org.

The following table summarizes some of the factors that impact the cold sensitivity of bromeliads:

Factor	Impact	Reason
High nitrogen levels	Negative	Lush growth with low resistance.
Low nutrient levels (other than nitrogen)	Negative	Poor resistance to cold.
Low light levels	Negative	Produces weak, thin leaves
Overly wet Soil	Negative	Produces poor root growth
Poor air movement	Negative	Cold wet air is trapped around plants
Lengthy cold period	Negative	Plant resistance deteriorates with time
Planting in hollows & valleys	Negative	Cold air settles in low areas
Overhanging foliage	Positive Negative	Prevents frost May restrict air movement
Nearness to buildings/structures	Positive	Buildings retain heat longer
Planting on upper slopes & banks	Positive	Cold air flows downward
Planting among rocks	Positive	Rocks retain heat longer

Reprinted in part from the bulletin of the Bromeliad Society of New Zealand, Inc. (40)5:12-13

A Mere Dab Of Pollen

Doug Upton

From its inception, the Queensland Bromeliad Society's Study Group has set upon a course designed to incite fellow members to more participation and furtherance of their knowledge about bromeliads. The Study Group was formed six years ago. Meetings are held on the fourth Saturday of each month. Members arrive at 7.00 a.m., with each attendee contributing food to the breakfast table, including fruit and fruit juices, and different breads and pastries. Hot food is prepared and voila!...a table magically appears to suit every taste.

After breakfast members settle down to discuss fundamental growing techniques, potting mixtures, fertilizers, and everything that will bring about solutions to guide and assist their growing practices. Then it's hands-on activities in a growing environment (the shade house) where practical activity, as opposed to theoretical discussion, allows each of us to visually observe and identify the differing characteristics of the genera.

All meetings are held at the home of Len and Olive Trevor. Their collection would amount to the tens of thousands - indeed a wonderful area affording the Study Group an unlimited supply of plant material for observation. Also, with hundreds of flowering bromeliads bearing pollen at any given time, the opportunity to cross-pollinate is another course to study and pursue.

Excited by the prospects of producing a superior multi-bracted, multi-colored magnificent hybrid with a mere well directed stroke of a pollen laden implement, I blindly followed the experienced Study Group and ventured into hybridizing.

In the past when hybridizing was discussed, I sat quietly and nodded my head. This purposeful nodding implied my immediate understanding and intuitive recognition of what was said, and, as long as I kept my mouth shut, I believed my ignorance would never be discovered.

Terms such as intergeneric breeding, F1 and F2 progeny, genetic barriers, knobby areas on condensing chromosomes, and similar botanical and genetic terminology were bandied about nonchalantly. Heaven help me! What had I gotten myself into? Anyway, I now realized that there was actually more to it than a mere dab of pollen delicately placed on the female plant parts, so, for factual information and directives, I sought out some books on the subject.

My aptitude for grasping complex meanings along with my faculty of understanding was certainly tested. However, I am delighted to report that well chosen books have given me a profound knowledge of the sexual reproduction structure of the sometimes insignificant, modest, bromeliad flower. The complete package (if one can refer to it as such) is a bloom composed of

mutually dependent parts, constituted to produce and yield seeds. I ask some tolerance from horticulturists who understand the complexities of fertilization. The following inferences and deductions are my own interpretations of this mystical process.

It was interesting to learn that the dab of pollen I mentioned previously is not synonymous with fertilization; however, that dab can ultimately form a membrane (pollen tube) which grows down from the stigma to reach the ovary with its ovules. Once there, this membrane containing pollen nucleus, enters the ovule allowing the pollen nucleus to become united with the egg nucleus, and off we go. We have a pregnant plant on our hands!

Evolving from the fertilized egg cell is a method of cell division resolving into chromosome material, and after many progressive changes, the egg cell becomes two, then four, and so on with further additions. To understand the relationships of these cells, one needs to be a botanist or scientist. I realized my own limitations while glancing through the books' chapters on different types of cells and the division process.

At certain stages of cell division the materials of the nucleus change in character - interesting stuff, but frightfully technical. Nevertheless, endowed with an inquiring mind, I managed to decode one chapter that affirmed the brilliance of nature. Hopefully I can translate it into a word picture.

Visualize a bromeliad seed on top of a growing medium: it has taken up moisture, expanded and split its seed coat. Within the embryo, cells that became the radicle (the lower part of the growing axis) and the plumule (the bud of the ascending axis) are now about to function. The radicle - the primary root - extends to find stability and nutrition. The plumule - the bud of the ascending axis - is tissue that will form the first leaf, and with the radiance of light will produce chlorophyll. This entity, precisely described as a seedling, will continue to grow and mature.

Full of presumptuous boldness, I convinced myself that it was time to knock 'em dead at the next Study Group meeting. No more of this head nodding sham. I could now dazzle them with my newly found knowledge and respond fluently to all comments and questions.

Disaster, total disaster! I knew nothing of self-fertile and self-sterile plants. True, I knew about the dab of pollen to the stigma lobes, but for the hybridist intent on producing a plant that is separate and distinct, it is not quite that simple.

To create a hybrid using a self-fertile species as the seed parent (female) there are methods used that ensure that the hybridist's chosen pollen plant (male) is first to make contact with the seed parent's stigma lobes. One option is to emasculate (Ouch!) the stamens from the seed parent before selfing can occur. It is not easy, and of course there are difficulties with species where the stamens

enclose the stigma; and then there are those where both stigma and stamens are located deep within the inflorescence.

Any boldness on my part was now utterly impracticable. Quite simply, I didn't know as much as I thought I did. Today, some years later, I do manage to join in discussions and have tried my hand at cross-pollinating, but I have yet to experience the excitement of producing that multi-bracted, multi-colored, magnificent hybrid of my dreams. Others in the group have had better success.

To mention a couple of them, *Neoregelia* 'Mars' ? N. 'Gold Fever', done by Mr. Bob Cross in 1996, and *Vriesea* 'Hazel' × V. 'Eva', a cross made by Mrs. Olive Trevor in 1997, are real keepers. They have not yet been registered. An evaluation of their potential will be assessed after their next generation.

Study Group meetings are not all about hybridizing. Our members are all serious bromeliad collectors seeking knowledge on all aspects of bromeliad culture. They are favorably disposed towards good fellowship; and they consult and compare opinions. When asked what are the most important aspects of hybridizing, there may be disagreement in some areas, but all agree on keeping accurate records and using correct labeling. Hybridizers will tell you to select the best cultivars from the grex and cull the rest.

As to my own opinion…well while I certainly agree with my fellow group members in all of those areas, I hasten to add, as a healthy male, even with full knowledge of what can be conceived by a mere dab of pollen, I still find using the word "emasculate" rather uncomfortable and can't help but sympathize with any gelded guzmanias.

Reprinted with minor alterations from the bulletin of the Bromeliad Society of Queensland, Bromeliaceae *33(3). (May/June 2000).*

Distribution of Terrestrial Bromeliads along the La Paz to Caranavi Road in Bolivia

Thorsten Krömer **Illustrations by the Author**

A drive along the road from La Paz to Caranavi is certainly one of the most exciting trips in the world. Along a 150 km (90 miles) stretch of road, one can observe nearly all tropical Andean vegetation zones in a period of just 6 hours while descending more than 4000 meters (13,100 feet) along the Cordillera Real. A striking element of the vegetation in the area is the high number of terrestrial bromeliads of the genera *Fosterella, Greigia, Pitcairnia*, and *Puya*. During several trips along this way between 1997 and 1999, I had the opportunity to observe 21 species of bromeliads and took notes on their distribution and flowering characteristics.

Beginning the trip in the city of La Paz, one can observe the beautiful blue-flowered *Puya meziana*. Some ragged plants of *P. ferruginea* can also be seen along the streets of the urban area itself. Eroded slopes in the same vicinity are home to *Tillandsia sphaerocephala*, an "atmospheric" species with pink bracts and purple flowers. Upon leaving the world's highest capital city at about 3800 m (12,540 ft), the road passes through *puna* grasslands until reaching "La Cumbre." At 4650 m (15,345 ft), this is the highest point along the road. From here you have a spectacular view of the nearly 5400 m (17,820 ft), surrounding, snow-covered mountain tops. Along this pass, the landscape seems to be composed mostly of barren rock, but *Puya fosteriana*, with its 1.5 m (5 ft) tall, thick-cylindrical inflorescences, and another, unidentified species of *Puya*, with its smaller, club-shaped inflorescence, appear as dwarves in the distance. Both of these species are characterized by their spinose-serrate leaves that form a dense rosette. Their flowers are surrounded by dense woolly scales, which probably help protect them against the frigid night temperatures.

After the pass, one begins to drop again in elevation as the road descends into a series of seemingly endless switch-backs. Here the slopes become dominated more and more by grasses (*Stipa spp., Festuca andicola*) and small shrubs (*Baccharis ssp., Brachyotum microdon*) that are typical elements of the unique Andean vegetation called *páramo yungeñio*. Passing Pongo, a small village at 3800 m (12,540 ft), always a good place to get some fresh trout, there are big stands of *Puya riparia*. This species is quite variable in size, having arching inflorescences from 40 cm to 1.5 m long. Its large, more or less secund (1-sided) flowers are bluish-green and have orange colored anthers that stick out beyond the petals. The flowers are open during the day and provide large amounts of nectar for pollinating hummingbirds. The next "must stop" point is Unduavi, the coca control station at 3300 m (coca is the plant from which cocaine is made). In this area, the vegetation has changed again, this time to a

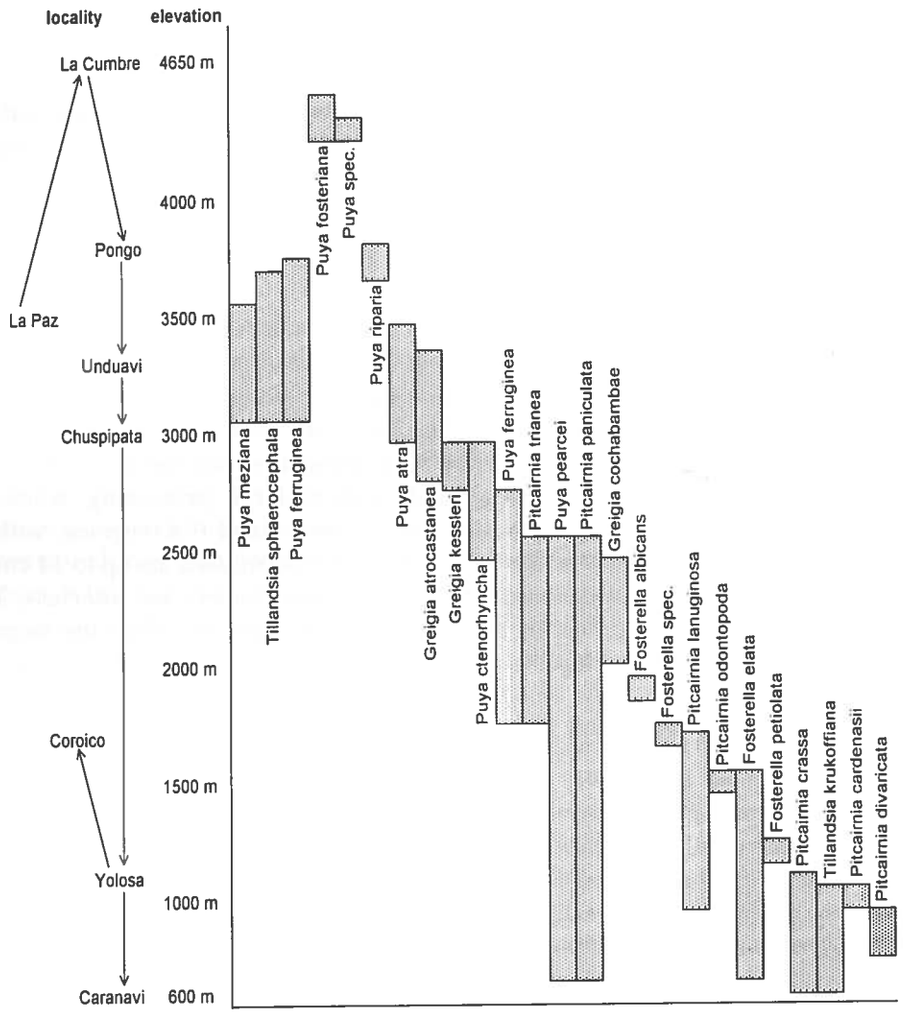
cloud forest characterized by small trees between 10 and 15 m tall (*Weinmannia ssp., Podocarpus ssp., Juglans boliviana, Alnus acuminata*) that are festooned with mosses and ferns. Here, in the understory, I found two recently described species of *Greigia: G. atrocastanea* and *G. kessleri*. Both of these species have stems to 1.5 m long that are covered by the old leaf sheaths, and have lateral inflorescences with pink to purple flowers. No pollinator observations could be made with the *Greigia* species: the flowers are open during the day but are hidden deeply in the axils of the big rosettes, so that hummingbird pollination seems unlikely. Another bromeliad at this altitude, growing along the rocky roadside, is *Puya atra*. This species is about 2 m tall in flower and has a dense white-woolly inflorescence and yellow-green flowers.

Near the few houses of Chuspipata, the paved road turns into a small, bumpy dirt road. There are no crash barriers so the precipice right along the edge of the road is always visible and threatening. Because of many accidents in the past, the government has converted the section up to Yolosa into a one way road. So, during the first half of the day, all traffic goes down, and in the afternoon and at night, the other way.

Continuing downwards, the vegetation becomes more luxuriant with every 100 m of vertical elevation loss. Below 3000 m, the first tree ferns (*Cyathea spp., Alsophila sp.*), as well as some epiphytic bromeliads (*Tillandsia ionochroma, Racinaea seemannii*) appear. On wet slopes at this elevation, *Greigia atrocastanea* and *G. kessleri* are accompanied by two species of *Puya, Puya ctenoryncha*, which forms big stands with its large, protruding, white-woolly inflorescences and showy yellow-green flowers, and *P. ferruginea*, with branched inflorescences to 4 m tall. The flowers of *P. ferruginea* are up to 14 cm long (5 1/2") and cream-colored. Although these flowers are odorless, I observed bats visiting the widely opened flowers at night to collect the large amounts of nectar that the flowers produce. After dawn, the petals hang down and close together.

At about 2500 m, the upper extent of the montane forest can be observed. Here, you can see a variety of trees between 15 and 20 m tall forming a dense canopy, and small palms (*Geonoma spp.*) growing in the understory. In disturbed areas in this region, the tropical montane forest is replaced by smaller trees of the family Melastomataceae and the ubiquitous *Cecropia* or "trumpet tree". Also here, the yellow flowered *Pitcairnia trianae* is abundant, forming a beautiful display of 2 m tall inflorescences during October and November. Less conspicuous is *Greigia cochabambae*, which replaces the two other *Greigia* species in this zone. The big rosettes of this plant are concealed among the dense roadside vegetation and are nearly always covered with mud.

Below 2000 m, the temperatures begin to approach a "tropical level" and the road becomes more and more dusty. Coroico, a small tourist town, appears at the horizon. Little natural vegetation remains here. For centuries, people have



burned the forests to clear the land for the cultivation of bananas, citrus, and coca. Erosion has long since washed much of the soils away so that today the hills remain covered with poor grasslands. These changed conditions have led to the disappearance of the common *Puya ferruginea* and *Pitcairnia trianae* at about 1800 m, allowing other, more widespread bromeliad species to take their place, especially *Pitcairnia paniculata* with its shining red flowers, and the purple-cream flowered *Pitcairnia lanuginosa*. Both of these latter species are pollinated by hummingbirds.

Three species of *Fosterella, F. albicans, F. petiolata* and one unidentified species were each found only once in small populations and seem to be rare. All three of these species have entire, rosulate leaves and tiny white to green flowers that are probably pollinated by insects or are possibly wind-pollinated. Only one of the species of *Fosterella*, tentatively identified as *F. cf elata* was observed more than once, in the 1500 down to 700 m submontane zone. This species, however, is easily seen due to its flat rosette of succulent leaves, whereas the other species have less-conspicuous rosettes.

Leaving Yolosa at 1200 m, the driver must be instructed to stop looking for bromeliads, since from here on, all traffic going downhill must drive in the outside lane, as vehicles going up the mountain have the right-of-way to hug the mountainside on the inside lane. Consequently one had better not watch too closely for bromeliads! However, this is not as unfortunate as it might seem because the clearing of roadside vegetation associated with road construction has not left many bromeliads anyhow.

From about 1000 m elevation, nearly as far as Caranavi, the road runs parallel to the canyon formed by the Coroico River. Here, the roadsides are covered by *Puya pearcei*, a species with 1 m tall inflorescences and blue-green flowers, and *Pitcairnia crassa*. The latter is an impressive plant with a dense, simple inflorescence to 1.5 m tall, and large cream-colored flowers. The flower color, and the fact that the plants offer nectar only after dusk, provide a good indication of pollination by bats. On steep rocky slopes of the canyon in this area, *Tillandsia krukoffiana* is seen. This is a large tank bromeliad with wide leaves that grow to 1 m long. This species has an ample inflorescence at least 2 m tall and large purple flowers.

In summary, while traveling along the road from La Paz to Caranavi the author observed 21 species of terrestrial bromeliads. Three more *Pitcairnia* species, which I did not see, were collected by Kessler (*P. cardenasii*), Beck (*P. divaricata*), and Pearce (*P. odontopoda*) and must also be added to the total, resulting in 24 species in five genera: *Fosterella* (4), *Greigia* (3), *Pitcairnia* (7), *Puya* (8), and *Tillandsia* (2).

The diagram on page 160 shows the distribution of all of the species observed. The upper zone of the region traversed (3 100\ 4500 m) is dominated by 6 species of *Puya*. Two species of *Puya* and two of *Greigia* have been found to

Figure 7. Road from La Paz to Caranavi in Bolivia. View from Chuspipata.

Figure 8. Flowers of *Puya riparia.*

Figure 9. *Puya atra* in habitat.

Figure 10. Inflorescence of *Puya ctenorhyncha.*

2600 m. The montane forest zone (1500\ 2500 m) contains the highest number of species (10) and four genera with *Pitcairnia* and *Fosterella* taking the place of higher altitude *Puya*. Below 1500 m and up to Caranavi there are nine species and also four genera: *Pitcairnia* is still the dominant genus and *Greigia* is replaced by *Tillandsia*. The high number of terrestrial species along just this short 150 km stretch of road indicates the importance of this group for the bromeliad diversity of Bolivia: counting a total of 28 1 species, about 33 % belong to the genera *Fosterella, Pitcairnia* and *Puya* (Krömer et al. 1999). These three genera also comprise more than 50 % of the country's endemic bromeliads. Only the large genus *Tillandsia* can compete with this.

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La Paz, Bolivia

Errata: Two recent errors

The back cover of volume 50(3) (the May-June 2000 issue) contains a photo of Wally Berg and Werner Rauh. Their names in the caption are transposed. Wally Berg is on the left and Werner Rauh is on the right.

In volume 50(2):68-72 (the March-April 2000 issue), the article "Portraits of Bromeliaceae from the Mexican Yucatan Peninsula-III: a new subspecies of *Tillandsia pseudobaileyi*" appeared.

Ivón M. Ramírez was listed as the author. It should also have listed Germán Carnevali F.C. and I. Olmstead as co-authors of the article.

Costa Rican Shangri-La

Moyna Prince

San Jose, the capital of Costa Rica, lies on a plain between two high mountain ranges. Flying over them you get a good view of these mountains while keeping fingers crossed that the landing isn't really as perilous as it looks. At the end of the dry season you can see a lot of brown down below, caused partly by the clearing of the forested slopes as well as the lack of rain.

Costa Rica is one of the most advanced of the Latin American countries, but unfortunately the environmental laws are not necessarily enforced and the result is oppressive pollution from vehicles, destruction of rainforests and heavy logging of valuable timber. San Jose has some lovely old colonial buildings, parks and plazas, but the pot-holed roads and crumbling sidewalks, crowds and pollution, detract from the city's charms. A sudden invitation to spend a few days with Chester Skotak outside the city was like a lifeline, and we grabbed at the chance.

Chester's nursery, Duraflor, is located in Palmares, about an hour's drive north of San Jose. At 3000 ft. the air is cool and fresh; the days are warm but the nights are cool enough for a couple of blankets. His house is built on eleven acres of steep mountainside. When Chester acquired the property seven years ago, it was a coffee farm. He cleared the land and replanted with hundreds of native trees that are now tall enough to provide the canopy that birds and butterflies need. We saw dozens of birds, including the mot-mot, a very beautiful bird with iridescent green and blue feathers, and a long, divided tail. There is a spring at the top of the property that Chester has routed down the slope into a pond behind the house before it continues down into the valley. The birds and butterflies obviously appreciate this source of water. A brick pathway winds up the slope behind the house, perfect for early morning bird-watching. Chester and Lorena's house is large and airy, and accommodates their five children and visitors easily. The walls are almost all windows. The guest room, on the second floor, is surrounded by windows on three sides. There at dawn we saw the mot-mot up close, three or four feet away.

Chester Skotak is of course famous for his bromeliad hybrids, and we spent a lot of time in his nurseries oohing and aahing over his crosses. Most bromeliad hobbyists are familiar with his neoregelia hybrids, such as cultivars of *Neo. carolinae* × *'Fireball'* ('Annik,' 'Nonis,' 'Little Debbie' etc.), cultivars of *Neo. (carolinae x concentrica)* × *concentrica* ('Chirripo,' 'Sybil Jane,' 'Johnathan'), cultivars of *Neo. (carolinae* × *'Painted Lady') ('Imperfecta,' 'Morado')*, cultivars of *Neo. carolinae* × *carcharodon* ('Jaws,' 'Gummy,' 'Grey Nurse,' 'Yin' and 'Yang'), and other well-known names like 'Milagro,' 'Permiento,' 'Dorothy,' 'Mosquito,' 'Lorena,' 'Orange Crush,' 'Sheba,' 'Ultima' and 'Zacate.' These are

Figure 11. *Guzmania conifera* just coming into bloom at DuraFlor.

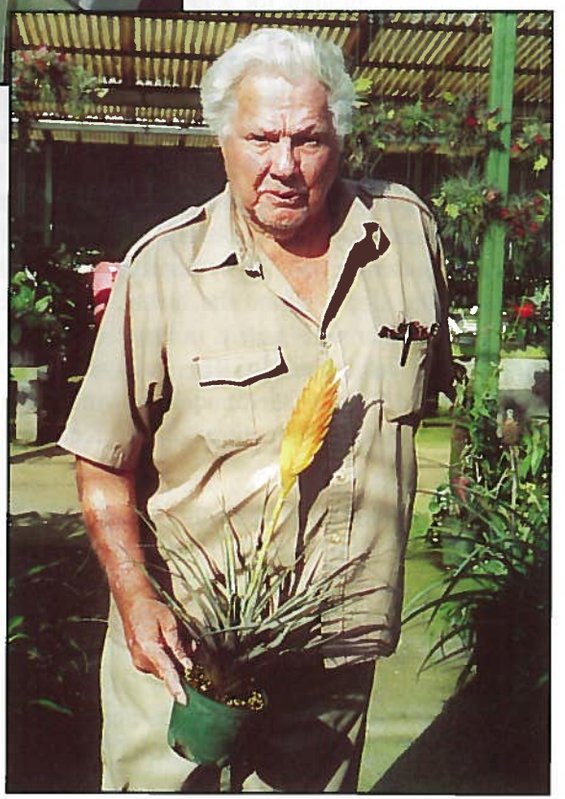

Figure 12. John E. Hall III holding what may be a new species of *Tillandsia* at Chester Skotak's nursery.

Figure 13. Chester Skotak holding one of his *Guzmania* hybrids.

Figure 14. Beautiful *Vriesea* hybrids at Chester Skotak's nursery in Costa Rica.

the glamour plants sold by Tropiflora and Paul DeRoose that flourish in Florida's landscapes. But the real business of Duraflor is producing *Guzmania* and *Aechmea* hybrids. We were stunned by the beautiful crosses and species on display in the greenhouses covering three acres. There were tall ones, short ones, vibrant reds and oranges, and delectable pinks of every hue. There were different clones of many species used in the crosses; for example, every shade of *Guz. wittmackii, squarrosa, musaica* and *lingulata*. Spineless *Aechmea fasciata* hybrids had enormous inflorescences in shocking pinks and vivid reds.

Creating these hybrids takes ten years of painstaking work. Seedlings with potential are set aside, others discarded. When the seedlings flower, the selection process takes effect again. Superior plants are shipped to Europe for further growth and evaluation. Those with suitable traits may be used for further hybridizing. The very best will be patented and then released. All of these *Guzmania* and *Aechmea* hybrids are for the European market. In the US, the *Neoregelia* hybrids, available from Tropiflora or Paul DeRoose, reign supreme.

The history of the variegated neoregelias is different. Chester acquired a group of variegated 'Meyendorffii' neos from Dennis Cathcart almost two decades ago. After making many crosses, Chester found a plant that passed its variegation on to its progeny. Dennis collected several thousand of the variegated neos and took them back to Tropiflora to sell, which explains why so many of us have Skotak hybrids which look quite different even though they have the same parentage. For his part, Chester continued with his hybrid work, selecting desirable clones from both Dennis's and his own collections to work with. Of course, species continue to play an integral role in the creation process and recent hybrids have been made with *Neo. olens*, *N.* 'Fireball', *N. pendula* and *N. eleutheropetala.*

For my part, I hope Chester continues with his hybridizing. Although I swear I have no more room, the colors, stripes, spots, dots, variegation, striation etc. continue to be irresistible. No South Florida garden is complete without a sprinkling of Skotak hybrids.

I hope it won't be long before Chester's current crop of neoregelia hybrids, of which we had a tantalizing preview, find their way from his mountain Shangri-La to South Florida's gardens.

Miami, Florida. U.S.A.

Vriesea lutheri, a New Species from Ecuador

José M. Manzanares[1] & Walter Till[2]

In April, 1997, Betty Girko, Vice-President of the Dallas Bromeliad Society, Jerry Raack, President of the Bromeliad Society International, Ed Doherty, President of the Dallas Bromeliad Society, Mónica de Navarro, President of the Quito Orchid Association, and the first author left Quito on an expedition to study the Bromeliads of southern Ecuador.

During our trip from Loja to Zamora, we crossed the mountains named Nudo de Sabanillas, which are part of the Podocarpus National Park. The dense and humid Andean forest is still intact thanks to the protection of the government. It is still possible to see the beauty of old trees covered with a great number of bromeliads, ferns and mosses. One small gray bromeliad attracted our attention with its light orange pendulous inflorescence.

After studying this plant, we determined it to be a new specie of *Vriesea.*

Vriesea lutheri J. Manzanares & W. Till, sp. nov. (Figures 15-17).

A *Vriesea castaneo-bulbosa* (Mez & Werckle) J. R. Grant bracteis scapi non ferrugineo-lepidotis, inflorescentia breviori, spicis brevioribus minus floribus compositis sine bracteis sterilibus, bracteis florigeris subcucullatis aurantiacis apice cano-lepidotis et sepalis brevioribus ecarinatis pallide aurantiacis latioribus differt. *A Vriesea incurva* (Griseb.) R. W. Read inflorescentia densiora, spicis sine bracteis sterilibus, bracteis florigeris 3—4 sterilibus apice spicarum, bracteis florigeris obovatis carinatis, acutis, subcucullatis et marginibus hyalinibus recedit.

Type. Ecuador: Prov. de Zamora-Chinchipe, Podocarpus National Park, epiphytic on tree in the Andean Forest, km 41.5 in the road Loja-Zamora, 03° 55′ S, 79°11′ W, 2690 m, *José M. Manzanares, B. Girko, J. Raack, E. Doherty & M. Navarro 6340*, 10 April 1997 (holotype QCNE).

Plant epiphytic, stemless, flowering to 35 cm high with pendant inflorescence. **Leaves** in a subglobose rosette, spreading. **Leaf sheaths** conspicuous, orbicular, 9 x 8.5 cm, dark brown lepidote on both sides, pale and glabrous at the base. **Leaf blades** triangular, apex long-attenuate and subulate, 14 x 2.5 cm, densely appressed cinereous lepidote on both sides. **Scape** curved, shorter than the leaves, hidden by the leaf sheaths, 10 x 0,4 cm, densely brown lepidote. **Scape bracts** erect, densely imbricate; sheath orbicular, 3.5 x 3 cm, inflated, yellow orange; blade filiform, 2—3.5 cm long; erect, cinereous.

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[2] Curator of the HerbariumWU, Institute of Botany, University of Vienna, Austria.

Photograph by José Manzanares

Figure 15. Type-specimen of the *Vriesea lutheri* Manzanares & W. Till at the moment of discovery.

Photograph by José Manzanares

Figure 16. Close up of the type-specimen of *Vriesea lutheri* Manzanares & W. Till in bloom.

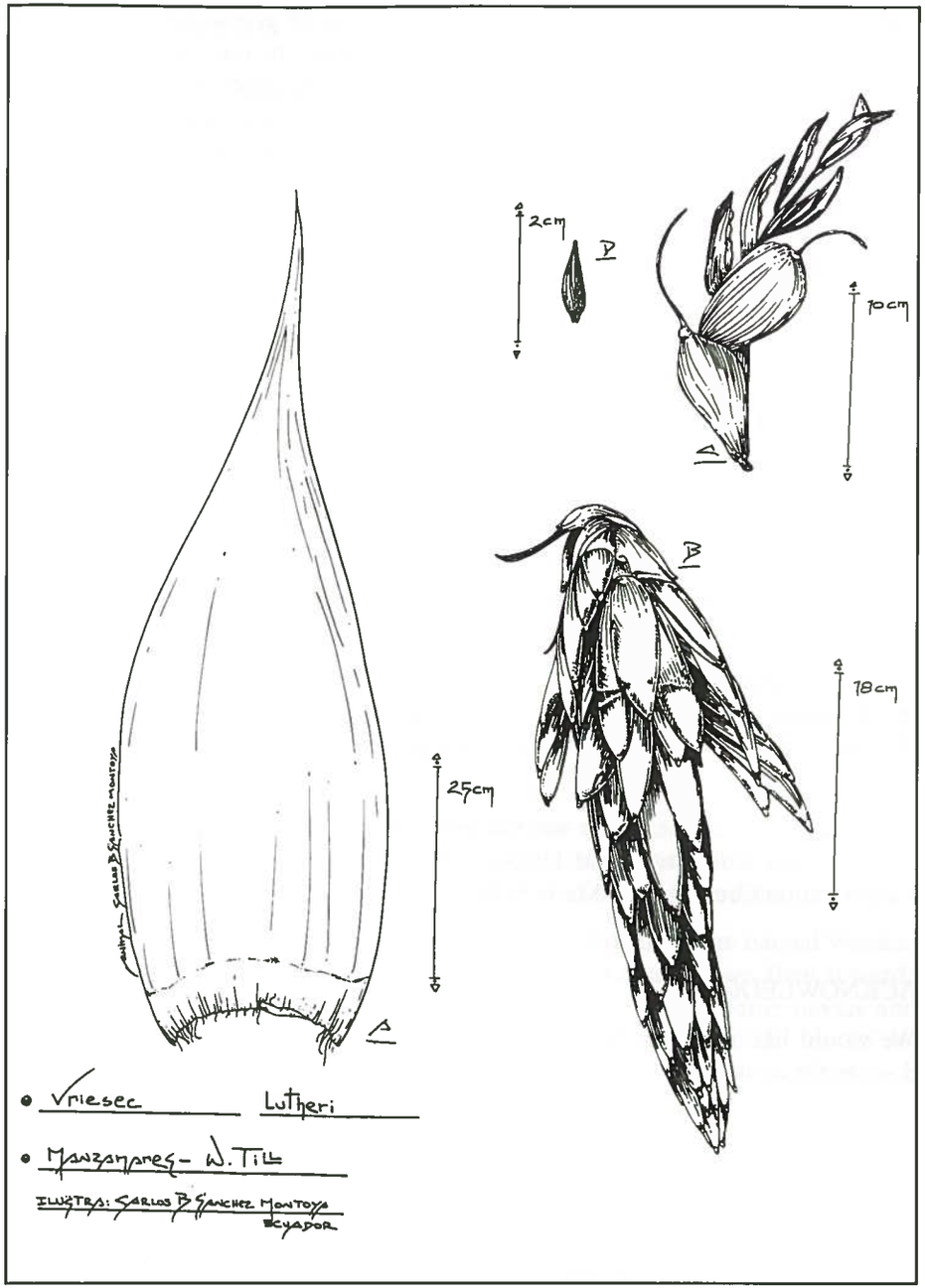

Illustration by Carlos B. Sanchez Montoya

Figure 17. *Vriesea lutheri* Manzanares & W. Till: a) leaf; b) inflorescence; c) primary bract and spike; d) sepal.

Inflorescence pendant, bipinnate, 16 x 5 cm, with ca. 12 polystichously arranged spikes, sparsely white-lepidote, orange red. **Primary bracts** ovate, the upper ones rounded and apiculate, the lower ones long attenuate, 4—4.5 x 2.8 cm, shorter than the branches, nerved, orange red, sparsely gray lepidote abaxially, glabrous abaxially, densely brown lepidote at the base. **Spikes** 8 cm long with a sterile base 7 mm long, no sterile bracts at base, 2.3 cm wide, elliptic, distichous, 5—6 flowered, apex with 3—4 sterile bracts, rachis alate densely brown lepidote. **Floral bracts** obovate, 2.8 x 1.3 cm, strongly nerved, sparsely gray lepidote abaxially, glabrous adaxially, orange-red, rounded and apiculate, tip densely gray lepidote, somewhat cucullate, carinate, with a hyaline margin. **Flowers** subsessile, erect. **Sepals** elliptic, 1.7 x 0.7 cm, apiculate, free, with a hyaline margin, ecarinate, strongly nerved, pale orange, glabrous on both sides, exceeded by the floral bracts. **Petals** linear, 4.2 cm long, 6 mm wide, green, with 2 ligules at the base of 8 mm long. **Style** slightly exserted. **Stamens** exserted, 4.8 cm long, filament green, anther yellow. **Fruit and seeds** unknown.

This new species differs from the related *Vriesea castaneo-bulbosa* (Mez & Wercklé) J. R. Grant3 by its 8 cm spikes and non 10—3 cm, the sterile base with no sterile bracts, the floral bracts somewhat cucullate apex with a densely gray lepidote and the 1.7 cm long sepal non 2—2.3 cm.

It differs from *Vriesea incurva* (Griseb.) R. W. Read by its dense inflorescence, no sterile bracts at the base, the 3—4 sterile bracts at the apex of the spike; the floral bracts obovate, carinate, subcucullate and with a hyaline margin.[4]

Etymology. The epithet name was chosen to honor Harry Luther, Curator of the Living Plant Collection and Director of the Mulford B. Foster Bromeliad Identification Center at The Marie Selby Botanical Gardens in Sarasota Florida.

ACKNOWLEDGMENT

We would like to thank Betty Girko, Vice-President of the Dallas Bromeliad Society for revisions to the manuscript.

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Museo Nacional de Ciencias Naturales
Herbarium QCNE
Quito, Ecuador

[3] For a color photograph see J. Bromeliad Soc. 42 (1): 14-19, 1992.

[4] For a color photograph of *V. incurva*, see J. Bromeliad Soc. 30(4):192

Expedition to Southern Venezuelan Highlands (The Lost World)

Francisco Oliva-Esteve[1]

In February, 2000, a group composed of Austrian Professor Walter Till[2], Peter Bak[3] and the author left for an expedition to the Venezuelan southern town of Santa Elena de Uairén, close to the Brazilian border, in Bolivar State.

On the first day we flew from Caracas to Puerto Ordaz, Canaima and Santa Elena with a domestic airline on the afternoon of Feb 14th. Right arter our arrival we made the necessary arrangements with a local helicopter pilot to fly next morning. The plan was to visit some *Tepuis*[4] trying to find the subfamily Pitcairnioideae genera *Navia, Lindmania, Connellia*, and *Brocchinia*.

Our nice little hotel in Santa Elena was located in the outskirts of town, and the helicopter came to pick us up in the early morning right at the door of the hotel next to a small hill. From there we flew directly to Chimantá-Massif, an extensive mountain composed of a many closely scattered *tepuis*. For an hour or so the pilot made several passes over the mountain until we finally landed on a huge flat area on top of Acopán-tepui at an elevation of 2520 m. We were continuously surrounded by changing cloud formations and weather conditionals. We immediately set out to look for bromeliads for the next 15 to 20 minutes. Peter was looking for navias, while Walter and I sought navias, lindmanias, and brocchinias and anything else we could find. Unfortunately, we only saw *Brocchinia reducta* in flower, some sterile lindmanias and *Ayensua uaipanensis* in a deep crack that was too difficult of access to collect.

Next we took off for the lowlands to a small Indian village named Wonken near the Grand Sabana to refuel the helicopter. Later on, we flew towards another remote location named Auyán-tepui hoping to find some navias and tillandsias. It took us about an hour and a half flight to arrive at the foot of the vertical walls of the huge mountain. The helicopter closely followed the rock cliff at mid level because weather conditions were poor, until we descended into the "*Cañon del Diablo*" (Devil's canyon) where Angel Falls, the highest waterfall in the world with a drop of 3,000 ft (950 m) is located. In a few minutes the pilot made several sharp turns around and near the lofty cascade base, amidst a fine mist, which, to a certain degree, prevented us from admiring the extraordinarily beautiful waterfall. After a short time, the pilot started gaining altitude to look for a place to land on top of the mountain at 2580 m. The weather was still not very good with strong winds and clouds surrounding us. We couldn't collect

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[2] Curator, Herbarium, Institut of Botany, University of Vienna, Austria
[3] Corn Bak B.V., Assendelft, The Netherlands

[4] Pemón Indian word for the table-land mountains or *mesetas*.

Figure 18. Chimanta-Massif

Figure 19. Summit of Apocan-Tepui in Chimanta-Massif

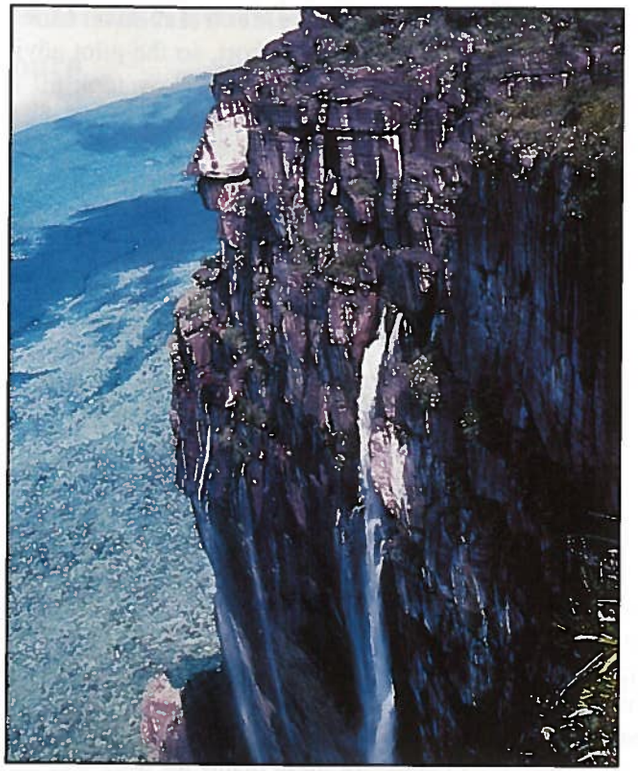


Figure 20. Angel Falls, the world's tallest waterfall.

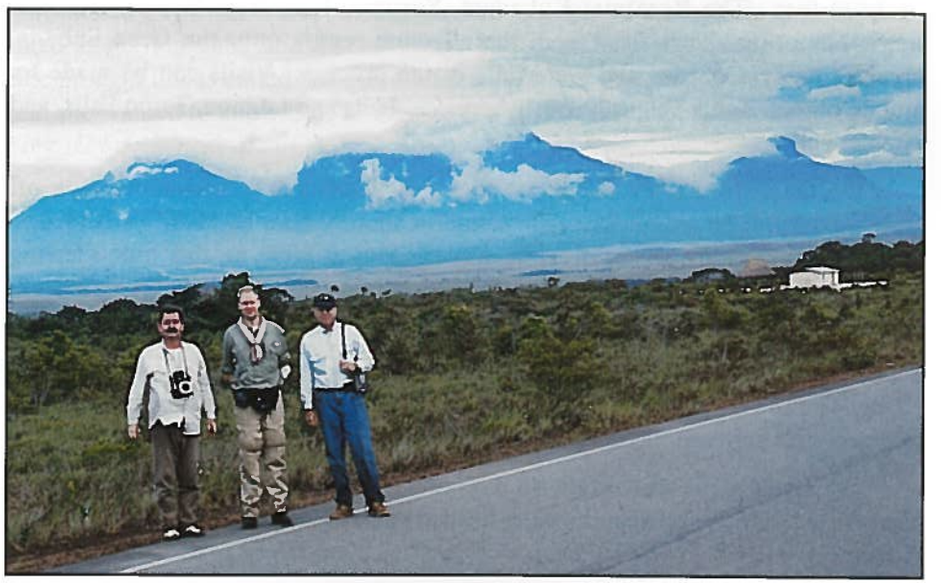
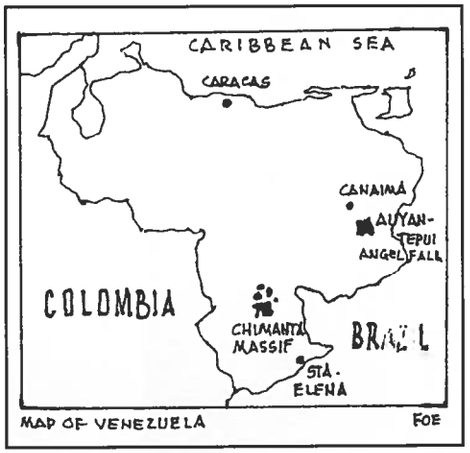


Figure 21. Left to right: Walter Till, Peter Bak, Francisco Oliva-Esteve



much because time was running short, so the pilot advised us to leave soon, so we took off again, to Santa Elena. We made the last few flight passes over Angel Falls and the Churún river which drains into the Carrao river to join the Canaima Resort area, 60 km away, where another beautiful waterfall makes an enormous black water deep lagoon. On our way back, we stopped near the Canaima resort for about an hour. Here we spotted the red bract petaled *Pitcairnia ctenophylla* and the common large *Aechmea bromelifolia*. Immediately afterwards we flew back to the hotel in Santa Elena de Uairén for a good nights sleep.

On the morning of the second day we contracted the services of a young woman who makes trips to the Gran Sabana with a 4-wheel drive station wagon for the whole day for $110, including meals. On the Gran Sabana we hoped to find *Brocchinia tatei, B. steyermarkii, Catopsis berteroniana, Racinaea spiculosa var. stenoglossa, Pitcairnia brittoniana, Puya floccosa, Guzmania sphaeroidea, G. squarrosa, G. steyermarkii, Navia arida* and *N. splendens*. As it turned out, we found less than half of these plants we were seeking.

However, the road was very good and the landscape spectacular. The *Gran Sabana* is a vast extensive area of rolling green hills at a relatively level elevation of 3800 feet. The Roraima, Kukenam, Yuruani, Karauren, Ilú, Tramen and numerous other rivers flow from the adjacent tepuis onto the Gran Sabana, creating many cascades and waterfalls in the process. Visits can be made to, among others, Kamá Fall (300 feet), Aponwao Falls and Lagoon, Torón Falls, and Arapán Falls.

On the third day we left Santa Elena for Canaima. At noon we took off from the airport on a domestic airline, and in about 1 hour and half we landed in Canaime, once again flying over the Auyán-tepui at 3000 m, this time viewing Angels Falls from a DC-3.

Canaima is a beautiful resort, where you might swim in the lagoon, rest, admire and be in contact with the Amazonian jungle, or take a day tour by boat (bongo) on the river to the very base of Angel Falls. It is an unforgettable trip to this beautiful and awe-inspiring wonder of nature.

We spent a pleasant night at the hotel, having a well-balanced, tropical Venezuelan dinner, and next morning headed back to Caracas.

Caracas, Venezuela

And how Often Should I Prune it?

Chet Blackburn

There is a popular local radio gardening show in Sacramento whose host regularly supports upcoming flower shows by having guests appear and talk about any plant groups to be displayed the weekend before a given show is scheduled. When the Sacramento Bromeliad Society has its annual show and sale, for example, someone from the Sacramento Bromeliad society will appear for an hour on his three-hour radio show as a guest to talk about bromeliads and field questions from his audience about them and about the upcoming show. That lot usually falls to either Keith Smith or I.

Unfortunately, most of the time, the callers have already jumped on the phone lines even before the show started and have no idea who the guests are or what this week's theme is about – and most of them have never even heard of a bromeliad! Therefore, after bantering on the virtues of bromeliads for 10 to 15 minutes, the host will go to his first caller and the question is inevitably something like, "I've got these little green bugs on my peaches…what should I do about it?" Indeed, that is the way most of the hour allotted to bromeliads goes…caller after caller talking about pruning, spraying, and propagating every conceivable kind of plant except bromeliads.

After one of those days I left after the bromeliad hour was up and was driving home listening to the rest of the show on the car radio. I was pleased when a caller said that she was sorry she couldn't get through earlier while the "bromeliad guy" was there, but that she had a couple of bromeliads and really liked them. Then she said that her friend had given her a plant called a *Vriesea*. She thought it was called "Marie" or something like that, and it was beautiful and she wanted to know how to take care of it after it finished flowering.

"At last", I thought, "someone who knows something about bromeliads." However, I almost drove off the road at the host's response.

"After the flowers have faded, let the foliage dry out completely, then stick it someplace where it won't get watered until the rains start again in the fall. About September or October, you can bury it about two inches below the ground level and it will come back in the spring and flower again."

While that advice might work very well for a *Freesia*, I'm not so sure her *Vriesea* survived that treatment.

Auburn, California

The Added Joy of Growing Epiphytically

Len Butt

Every opportunity I get to view bromeliads in private or commercial collections brings more to the fore my opinion that there is much to be said for growing these plants as they grow in nature. My initial addiction to this method was many years ago when the dreaded pin spot scale got into my own collection from purchases made elsewhere.

Despite advice from many sources I still battle with this bogey. Much of the joy of growing these plants can fly out the window, so to speak, because adding to a collection by swapping and trading is then forgone, and even the pleasure of helping to put displays together using your plants with others is not ethical.

Only the heavily trichomed species of genus *Tillandsia* seem to be immune to this insect and perhaps genetic study into this aspect will, in time, eradicate the pest.

The powerful insecticides used by reliable commercial bromeliad nurseries are very successful so they do not have the problem, but these have a toxicity of perhaps S7 and as a garden and environment lover, I prefer not to dabble.

Being a dedicated and hopefully responsible bromelian, I now have to adjust to this situation, and if I want to increase my collection of plants but cannot swap or sell, I can only buy more and more.

My answer is to copy nature where possible; using suitable trees, fallen logs, stumps with hollows, sandstone rocks and the withered leaf bases of certain palms.

Every private or commercial collector I know seems to have attempted epiphytic growing and many have achieved it to perfection. To see Dennis Cathcart's transparencies of South America is to realize that the landscaping aspect as done in nature enhances the plant, improves the visual garden and adds to the appeal of growing attractive plants when the commercial value is no more.

Such, in my humble opinion, is the truly dedicated bromelian, growing a much-loved genus, with the thought of the sheer beauty of the plants themselves. Open aeration, uncrowded growing of species on trees, dappled to full sunlight and removal of older flowered clones is the only treatment necessary to eventually find the epiphytic plants have a minimum of still active scale.

When growing in trees, choose a firm-barked host, not one that sheds layers of bark. If the plant is fixed into a crotch or hollow branch, you will find that when the plant produces stolons they will be encouraged to grow into the actual tree bark. When this occurs the growth pattern will accelerate, better color

results and natural pests are kept at bay merely by the plant's own strength to repel them.

Growing on rocks, hollow stumps and fallen logs is just as rewarding. In this case the subjects are easily managed by regular application of a soap based spray or a mild insecticide such as the wide spectrum MAVRIK, to which is added an agricultural wetting agent (2 drops to a bucket of mix, no stronger).

Queensland, Australia

Reprinted from Bromeletter 31(4), 1993).

Address Change Reminder

Please remember to notify Membership Secretary Carolyn Schoenau as early as possible when you change addresses. It is an expensive proposition for the BSI when Journals are returned as undeliverable. Not only is the original postage wasted, but within the United States it costs the BSI 99 cents when Journals are returned to us as undeliverable. Then it costs another 99 cents to remail a copy to the subscriber when they notice that their Journal did not arrive at their new address. Of course, items returned from addresses outside of the United States cost even more.

Whenever possible, we attempt to recover the costs involved when we have not received an address change, but it is an imperfect process. To begin with, we only recover the "hard" costs of the postage, and not the "soft" costs of the communication and handling involved, and sometimes the "missing journal" is not noticed until months later when it cannot always be attributed to a recent address change.

The number of Journals that have been returned because of address changes or "temporarily away" increases every summer. Your cooperation will go a long way to keeping our subscriber rates down in the future.

Affiliates in Action

Gene Schmidt

The Southeastern Michigan Bromeliad Society has voted to name Lou Wilson a Lifetime Member. Lou has lived in Florida many years now, but is known in Michigan both for his smile and his enormous contributions to the SEMBS. Photographs by Willem Vilders and Paul Wingert are on the SEMBS web site. The address is:

http://community.mlive.com/cc/broms. (*The Southeastern Michigan Bromeliad Society Newsletter, Jan.-Feb. 2000*)

Graham Bevan, vice-president of the Illawarra (Aus) Bromeliad Society, overheard one of their newest members, Sylvia Derig, say at their March meeting that she had just become an Australian! Sylvia and her other half, Trevor, did in fact just receive their Australian citizenship on Australia Day in January. They are both New Zealanders and moved from Auckland about two-and-a-half years ago. Sylvia said she had quite a large collection of bromeliads in New Zealand and she is trying to rebuild her collection now that she is in Australia, but due to limited space she is forced to collect only her favorites. We wish Sylvia and Trevor good luck being new Australian citizens as well as with her hunt for new bromeliads.

Following are some dates of interest for Australian shows for the remainder of the year: August 4-6 Central Coast NSW Bromeliad Society, Inc. Spring Show at Gosford Show Grounds. September 9-10 Illawarra Bromeliad Society Spring Show in Corrimal. October 9-10 Bromeliad Society of New South Wales Spring Show at Five Dock. November 4-5 Hunter District Bromeliad Society Exotic Flower Show in Adamstown. November 4-5 Bromeliad Society of Australia Spring Show in Burwood (*Illawarra Bromeliad Society, Inc. Newslink, April, 2000*)

The Caloosahatchee (FL) Bromeliad Society is enjoying a wonderful beginning to the year 2000. The 78 bromeliad fanciers at the February meeting is believed to be the largest attendance enjoyed at a monthly meeting. The response to the January and February meetings was so well appreciated that it left some feeling slightly tipsy with pride. A count taken from the new roster with adding the newest members brings the membership to 153. A great way to begin the new year! (*Caloosahatchee Meristem, March, 2000, Caloosahatchee Bromeliad Society*)

Rick Cohen, a member of the Bromeliad Society of South Florida and the Florida Native Plant Society, sent the latest issue of *The Palmetto*, quarterly magazine of the FNPS, to the BSSF regarding an article in Volume 19, No.4,

which documents in alarming detail the destruction brought on by *Metamasius callizona*, the "Evil Weevil." Up until now, most of the financial support for research into a biological control of this imported pest has come from the Florida Council of Bromeliad Societies. (As an example, over $1500 was generated for the Weevil Fund at an auction held at the March meeting of the Caloosahatchee (FL) Bromeliad Society.) Now that the Native Plant Society has alerted its members to the danger befalling the native tillandsias, perhaps there will be financial support from the Florida legislature. Dr. Howard Frank, University of Florida, writes in the above mentioned publication, "In federal and state parks and nature preserves, the plants are protected from developers, but not from the weevil. Florida law does not mandate that anything be done to control an invasive pest such as *Metamasius callizona* that kills endangered plants." He also points out that while the Florida legislature approved an increase to $30 million in funds to combat invasive plants that threaten Florida's native plants and natural areas, there is no funding for a program to combat invasive insects that threaten Florida's native plants. The real concern is that when the legislature finally realizes the danger, it will be to late. (*The Bromeliadvisory, Volume 43, # 4, April, 2000, Bromeliad Society of South Florida*)

The BSI Affiliated Societies Committee would like to thank all those who have responded so positively to our request for information regarding affiliation. Our task of documenting affiliation is almost complete, and we look forward to publishing a complete list of affiliates, addresses, and newsletters after completion of the 50th Anniversary BSI World Conference held in July. Please contact us if you have questions or comments about affiliating your local society.

Duluth, Minnesota, U.S.A

Variegation in Bromeliads

Luiz Felipe Nevares de Carvalho[1]

Variegation is a rather common phenomenon in the plant kingdom, and is found in many plant families. It is especially pronounced in Bromeliaceae.

The word "variegata" comes from Latin – *variegatus, variegata, variegatum* - meaning variable coloration with patches of different colors. A bromeliad is known as "variegata" when it has two or more different colors. Over 60% of cultivated bromeliads have bands, dots, lines and streaks, and can therefore be considered variegated. However, the term is accepted in horticulture when applied to bromeliads that have leaves with lines, streaks and longitudinal bands of contrasting colors, especially those that show differences in pigmentation between the green chlorophyll-containing tissues and albino tissues.

On the other hand, if we look at the many bromeliads that grow in the wild, it appears that variegation is a rare phenomenon. As a general rule, patently variegated plants are less hardy and slower growing than normal, and those that arise spontaneously in nature normally survive the competition for space and light only when man intervenes, taking them from the wild for cultivation.

Variegation is rarely found in the subfamily Pitcairnioideae, and is not particularly common in Tillandsioideae. It does occur, however, in the genera *Guzmania, Vriesea, Alcantarea* and in a few species of *Tillandsia*. In the subfamily Bromelioideae, variegation is quite common, especially in the genera *Aechmea, Ananas, Billbergia, Cryptanthus, Neoregelia* and *Nidularium.*

CAUSES OF VARIEGATION

Although there has been much progress in scientific research on bromeliads, comparatively little is known about the causes of variegation. As a general rule, botanists agree that bromeliads have a rather mutable genetic structure, and therefore, several different theories are possible. The first of these links variegation to virus infection.

Viruses are common in plants and animals and may cause many harmful and debilitating illnesses. In nature, they provide a quality control system for living organisms. These viroids have the capacity to alter the genetic programming of plant cells by molecular inclusion or extraction of chromosomes. Bromeliads are known to host viruses, but the physiological mechanisms of virus infection in plants is poorly known.

Viruses may attack the plant meristem or main vascular system. Bromeliads are monocotyledons and as such, they mostly have parallel veins running lengthwise along the leaves. Beginning from a tissue with infected cells,

[1] President, Sociedade Brasiliera de Bromélias (SBBr)

as the plant grows the "problem" is transmitted down the entire leaf, producing clearly defined lines or bands. Variegation that appears in plants grown from seed can be explained by previous infection of the seed producing plant, even before ovule fertilization, or by infection of the pollen grains. The viruses are often no longer present when the symptoms — variegation —manifest themselves.

Variegation is also thought to be frequently associated with environmental factors, but there is no scientific proof to back up this assumption. Some investigators support the hypothesis that natural radiation may cause genetic mutation. Laboratory experiments show that B- and X-rays lower the number of meristem cells, which may cause variegation.

Chemical substances are also capable of producing variegation in plants. It is a well known fact that flower inducing substances produce lateral buds of the "variegata" type in adult plants.

Factors related to microclimate, temperature, humidity and light are also sometimes mentioned as influencing variegation. Biological stress, such as prolonged dehydration or poor nutrition, is said to bring on variegation, as are ecological disturbances such as fire, flooding, freezing, cyclones, etc.

In short, variegation may be caused by genetic mutation or by virus infection, but is seems probable that a number of different causes can potentially bring on this phenomenon.

TYPES OF VARIEGATION

Plants with two different types of tissues — albino and chlorophyll-pigmented (diploid and tetraploid)— are called chimeras. This definition can be applied to the "variegatas". Variegation may be fixed or mutable, temporary or permanent. Tissues with fewer chloroplasts are light green or yellowish in color. A total lack of chloroplasts leads to white or creme-colored tissues.

There are certain visible forms of variegation that are recognized botanically, although naming the forms is not always consistent nor precise, and some are treated as synonyms:

variegata	The white or yellow bands have no clear organization, and usually do not extend to the margin of the leaf. As was mentioned above, the term "variegata" refers generically to any form of variegation (i.e. *Vriesea platynema* var. *variegata*). The term striata is also used here (i.e. *Nidularium innocentii* var. *striatum*).
marginata	The leaf margins are white (albomarginata) or yellow (flavomarginata) and the central part of the leaf is green (i.e. *Aechmea nudicaulis* var. *flavomarginata*).

lineata Thin white or yellow lines run along the leaf (i.e.. *Nidularium innocentii* var. *lineatum*).

medio-picta meaning "painted center", this type is similar to "variegata" but with green stripes in the center of the leaf.

tricolor three-colored; usually green, creme and rose (ex. Neoregelia carolinae forma tricolor).

quadricolor four-colored; usually white, yellow, red and green (Aechmea magdalenae var. quadricolor).

The pigment group known as the anthocyanins is present in many bromeliads; it is found in the epidermal cells and may hide both chlorophyll-pigmented and albino tissues. In *Aechmea orlandiana* var. 'Ensign', anthocyanin produces a very beautiful red or rose color in the albino tissue.

Reddish brown stripes and bands are found' in several hybrids such as *Aechmea* 'Red Ribbon' and Neoregelia 'Amazing Grace'.

Variegation is also found sometimes in inflorescences, and in primary and floral bracts, such as happens in some *Guzmania* hybrids.

PROPAGATION OF VARIEGATES

Theoretically, vegetative reproduction will lead to the replication of the mother plant, but this method is not totally reliable when dealing with variegates. Even the best lines — the so-called fixed clones — may occasionally show some alteration. Some however, have survived for decades without mutations, generation after generation.

As a rule, variegated plants are harder to grow than all-green plants. Inflorescences are smaller than normal and the tendency to bud laterally is also reduced. Some have definitely slower growth rates than normal plants. This is especially true of vrieseas and guzmanias, which also are slower to take root.

It is advisable to leave lateral shoots on the mother plant for a longer time than with normal plants. Experience has shown that shoots about half the size of the mother plant can be detached with no problem. An important sign of shoot maturity is root emergence. To promote increased production of lateral shoots, the removal of the newly formed inflorescence is recommended, so that the plant can channel its energy into the lateral shoots.

Mutable variegate plants tend to produce either albino shoots or all-green shoots. True albinos are apt to die when separated from the mother plant, thus wasting precious reproductive energy. It is therefore recommended that they be removed as soon as they appear.

Rio de Janeiro, Brazil

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Photograph by Marcel Lecoufle

Figure 23. Fields of a variegated pineapple *Ananas comosus variegata* in Ivory Coast.

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

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Photograph by Thorsten Krömer

Puya ferruginea a night blooming species of bromeliad, is photographed as it opens.

Calendar

5-6 Aug — The South Bay Bromeliad Associates year 2000 show and sale will be held at Rainforest Flora's new location at 19121 Hawthorne Blvd, Torrance, CA. Show hours are none to 4:30 p.m. on Saturday and 10 a.m. to 4:30 p.m. on Sunday. Plant sale hours are 10 a.m. to 4:30 p.m. on both days. There is no entrance fee and parking is free. Contact: Bryan Chan, 8110 Murietta Ave., Panorama City, CA 91402; telephone (818) 787-4265; e-mail bcbrome@aol.com

26-27 Aug — The Sacramento Bromeliad Society will hold its annual show and sale at the Shephard Garden & Arts Center, 3300 McKinley Blvd. in Sacramento. The hours are 10 a.m. to 5 p.m. on both days. Contact: Evon Ray 530-885-2777.