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Market Potential of Torch Ginger and Beehive Ginger, Part 2

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Harvest, post harvest and standards for commercialization of *Etlingera* spp. and *Zingiber spectabile*

The procedures for harvest and post harvest of species of genera *Etlingera* and for *Z. spectabile* are very similar. The harvest should be done in the time of the day with mild temperatures, and inflorescences taken quickly to the place for handling to be prepared for commercialization. The stems should be immersed in water from harvest in the field.

Even though the inflorescences of *Etlingera* are more beautiful with bracts completely opened, they are more difficult to pack and present less post-harvest durability than if harvested with semi-opened bracts (Criley, 1996b). However, depending on the market or client, the inflorescences could be harvested from the initial formation to the total open flower (Figure 2). The possibilities of selling the flower in different stages increase the options for commerce.

The floral stems of beehive ginger can be harvested when the inflorescence diameter is longer than the length or when the length is longer than the diameter (Figure 3). There are situations when the market asks for inflorescences with a size longer than 18 cm. As with torch ginger, the possibility of selling it in different stages of development increases the chances of commerce for beehive ginger.

In the post-harvest procedures (Table 4), the stems are first immersed in water for cooling. Afterwards, the stems and inflorescences are cleaned with neutral soup and remaining insects are removed, with immersion of floral stems for 5 minutes in a solution with insecticide. The stems are examined individually and sunk in clean water for 30 minutes to 2 hours to hydrate. After this process, the excess of water from

Hydration of floral stems of *Z. spectabile*

inside the bracts should be removed, and the base of stems should be placed in water (as above), keeping the inflorescences in the vertical position, to dry naturally, and then be packed (Loges et al., 2005).

The classification of torch ginger based on the quality is: type A – bracts semi-open or inflorescence with big bud, absence of marks or dry bracts, pseudo-stem with diameter over 1cm; type B – bracts totally expanded, light marks of mechanical damage (such as handling), pseudo-stem with diameter under 1 cm.

In beehive ginger, the true flowers inside the bracts should be removed. Inflorescences up to 18cm have higher durability.

Over that size, the swollenness and curve may be lost, compromising the aesthetic value. With respect to quality, the inflorescence is considered type A when the terminal bracts are closed, and the pseudostem is longer than 40 cm with a minimum diameter of 1 cm (Loges et al., 2005).

In the Farm Mumbecas, the inflorescences are sold commercially in boxes of 1.15 x 0.4 x 0.2 m, with average capacity of 18 kg. Boxes are packed with 60 floral stems of torch ginger of 0.9 m length or 48 stems of beehive ginger 0.4 to 0.6 m long, protected by leaves from the same production, nets or perforated plastic bags (Figure 4).

General considerations

The torch ginger, together with other tropical flowers, such as heliconias, gingers, bromeliads, and others, are reported in the period of January to June of 2007 as fresh flower items exported from Brasil (Junqueira & Peetz, 2007), demonstrating the potential of these cultures.

The cost for cultivating *Etlingera* spp. and *Zingiber spectable* is low, compared to other flowers that require protected environments and temperature, moisture, photoperiod and light control. The initial investment is mainly for purchasing propagative material and an irrigation system. One way to reduce these costs is the acquisition and planting of a few rhizomes that will be used as mother stock for developing commercial production, although this will delay production. There are no studies about the total operational costs for cultivation and production of these cultures in Brasil, as example of the study done by Kiyuna (2004) for production of anthurium in Sao Paulo. Considering the similarities of these cultures with the production of *Heliconia*, this could be used as reference.

Z. spectabile and species from genus *Etlingera*, present unique beauty, forms and colors, but present aspects that should be improved to aid the commercialization. Hoult and Marcsik (2000) described a series of criteria that should be observed for selection and breeding of these genera for introduction in commercial production (Table 5). Those criteria should be used as a reference in the evaluation of suitability of genotypes of *Etlingera* and *Zingiber* cultivated in Brasil and the potential to introduce them for commerce.

The production of torch ginger is limited for growers of tropical flowers because of their short post-harvest life, thus limiting the commerce to the internal market and use for short time decorations. Hoult and Marcsik (2000) observed that, in four cultivars of *E. elatior,* the post-harvest durability varied from 3 to 10 days.

The organic production of torch ginger flowers in Brasil has begun to show high potential. The price of one stem of torch ginger Porcelain, for example, costs R$7 (US$ 4) in a store in Brasil, while in the USA it costs from US$12 to 15, and in Europe, on average, 22 Euros. Also, based on information from growers, the clumps are more productive and of superior quality.

Conclusion

Because of the shortage of information and research related to the genera *Etlingera* and *Zingiber* in Brasil, the techniques for production were developed first by exchange of experiences from several areas and the adaptation of techniques adopted in other center of production in the world.

The Purpose of HIS
The purpose of HSI is to increase the enjoyment and understanding of *Heliconia* (Heliconiaceae) and related plants (members of the Cannaceae, Costaceae, Lowiaceae, Marantaceae, Musaceae, Strelitziaceae, and Zingiberaceae) of the order Zingerberales through education, research and communication. Interest in Zingiberales and information on the cultivation and botany of these plants is rapidly increasing. HSI will centralize this information and distribute it to members.

The **HELICONIA SOCIETY INTERNATIONAL**, a nonprofit corporation, was formed in 1985 because of rapidly developing interest around the world in these exotic plants and their close relatives. We are composed of dues-paying members. Our officers and all participants are volunteers. Everyone is welcome to join and participate. HSI conducts a Biennial Meeting and International Conference.

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The University and institutes of research have developed projects for improvement of the Floriculture in Brasil, but face economic limitations and have few researchers available to dedicate themselves exclusively to these cultures. Institutes from several countries, such as USA, Netherlands, Costa Rica and Australia, assist companies and growers through conduction of research on demand, collaborating for the advance of the production of flowers.

It is observed that more research related to the production of Etlingera and Zingiber is necessary in the many areas of Brasil and that the sharing of experiences and information between researchers and growers is favorable to the process of improving the quality of the system of production.

Literature citations appear on the HSI website: www.heliconia.org

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Figure 2. Growth stages of floral stems of *E. elatior:* a – emergence of floral stem; b – Formation of inflorescence; c – inflorescence opening; d – lower bracts semi -opened, central part closed (stage of harvest); e – lower bracts opened, central part semi-open (stage of harvest); f – totally open inflorescence.

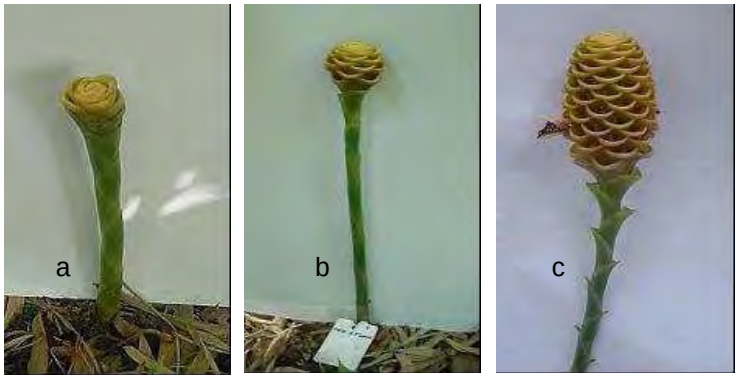

Figure 3. Growth stages of floral stems of *Z. spectabile:* a – Formation of inflorescence; b – inflorescence with diameter bigger than the length; c – inflorescence with length larger than the diameter (desirable stage of harvest).

Figure 4. Floral stems of *Z. spectabile* and *Etlingera* conditioned in cardboard boxes protected with leaves of the own plants (A), nets (B), or perforated plastic bags (C). Fazenda Mumbecas, Paulista, PE

Table 4. Sequence of the main postharvest procedures for tropical flowers.

Fazenda Mumbecas, Paulista, PE

Time length in each stage*	Sequence of procedures
0	Harvest
30 minutes	Transport to processing shed
15 minutes to 1 hour	Cooling
30 minutes	Cleaning in water
5 minutes	Immersion for pest control
30 minutes a 2 hour	Hydration
1 hour	Draining and in buckets
30 minutes	Packing

* This estimate may vary according to the season

Source: Loges et al., 2005.

Table 5. Criteria for selection and breeding of *Etlingera* and *Zingiber* genotypes.

Criterion	Characteristic	*Etlingera*	*Zingiber*
	Vibrant, innovative	Important*	Essential
Form	Uniform, symmetrical, uniqueness	Important	Important
Fl Stem length	Longer than 0,50 m		Essential
Durability	Greater than 14 days	Essential	Essential
Aroma	Pleasant or absent	Complementary	Complementary
Liquid in the bracts	Minimum or absent		Important
Floral opening	Minimum or absent	Complementary	Important
Growth conditions	Direct sun	Essential	Essential
Transport	Easy to pack	Important	Complementary
Main diseases	Tolerance	Important	Important
Nematodes	Tolerance	Important	Important
Productivity	Floral stems per clump	Essential >200	Essential >100
Harvest	Access to floral stems	Complementary	Complementary
Season of harvest	Long or continuous	Essential	Essential

Source: Hoult and Marcsik (2000)

* Scale of importance of the criteria: essential; important complementary.

Three New Distichous-bracted Species of *Calathea* (Marantaceae) from Panama

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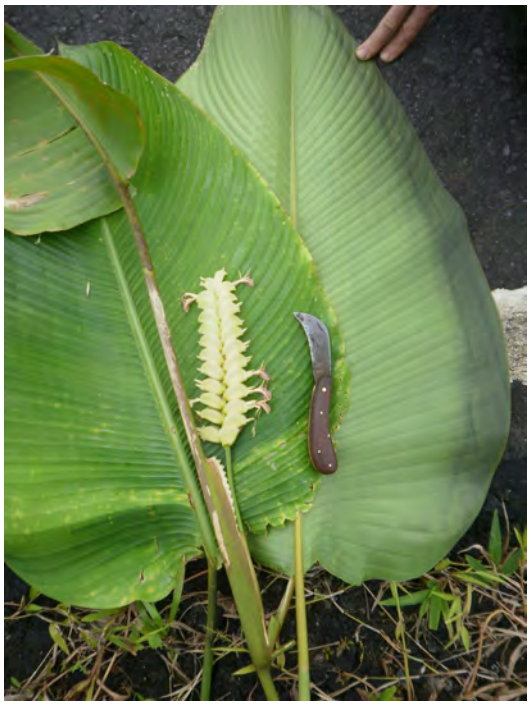
Photographs by Bruce Dunstan
and Helen Kennedy

Since the original treatment in 1945 of Marantaceae for *Flora of Panama*, the number of species known for Panama has more than doubled. In that publication, 23 species were listed for the family with 14 in the genus *Calathea*. In a 1976 paper, Helen Kennedy reported 49 species from Panama of which 23 were in the genus *Calathea*. Many of the new species were from areas made accessible by the new El Llano-Cartí road in Panama province. Another rich area for Marantaceae is in the forests along the Río Guanche near Portobelo (Colón province). The building of the Fortuna Dam in Chiriquí province led to greater access to the surrounding montane wet and cloud forest habitats. The three new species occur in these habitats at middle to higher elevations. All three species are assigned to section *Calathea* in the genus *Calathea*.



Calathea carlae (Knife is 17.5 cm = 7 in.) (B. Dunstan photo)

Calathea carlae was found near the Fortuna Dam at 1133 m elevation and is also found in several neighboring provinces as well as in Costa Rica. It is described as a caulescent herb about 1.7 to 3.5 m high. The shoot on which the inflorescences are borne bears one leaf about 1.2 to 2.2 m above ground and a terminal inflorescence, with up to 4 more borne axially. The bracts, borne distichously (alternating in one plane) are cream-colored, tinged olive-greenish at the rachis, minutely hairy, and subtend 6 or more pairs of flowers with yellow petals and yellow or pink-purple staminodes. The inflorescence length ranges from 14 to 36.5 cm. Flowering is noted as occurring primarily during the rainy season, April to August. The species was named in honor of Carla Black of Volcán, Chiriquí for her great enthusiasm for heliconia and related plants, and because she provided Helen with field support and accommodations during the field studies.

Calathea carlae (H. Kennedy photo)

Calathea chiriquensis was also found in limited distribution near the Fortuna dam region in Chiriquí and Bocas del Toro provinces at 800 – 1400 m elevations. Likewise a caulescent herb bearing one cauline leaf about 0.7 m above ground, it ranges from 1.2 to 2 m high. The 1 to 4 inflorescences, one terminal and the others axial, have their light green to yellow-green bracts arranged distichously subtending 5 to 7 unpaired flowers. The flowers have yellow petals and staminodes, but the lower, hooded staminode often has coral-colored touches in the central portion as well. Flowering occurs from February to September. It was named for the Chiriquí province where it was found.

Close-up of pink *Calathea carlae* flowers (H. Kennedy photo)

Close-up of *C. carlae* flowers
(B. Dunstan photo)

Calathea fredgandersii occurs at mid-elevations (800 – 1500 m) in premontane wet to cloud forest habitat in relatively dense shade, often near streams. While also found near the Fortuna dam region, it was more abundant in the Veraguas province where the other two species have not been recorded. Another of the large calatheas, it is a caulescent herb 0.75 – 2 m high with a cauline leaf borne about 54 to 86 cm above ground. The inflorescence (1 or, rarely, 2) usually is borne above the leaves. The outer surface of the bracts is white to cream, sometimes with a faint pinkish tinge in the youngest bracts with the base of the bracts a dark olive-green. Each bract subtends 5 or more pairs of white or pinkish flowers. The staminodes can be white, pink, or purplish pink. Flowers are borne mainly from December-February to July. The species was named in honor of Fred R. Ganders, former Director of the University of British Columbia Herbarium who funded Dr. Kennedy's field work and visits to various herbaria during this study.

C. chiriquensis (Knife is 17.5 cm = 7 in.)

Close-up of *C. chiriquensis* flower

Calathea fredgandersii
(Knife is 17.5 cm = 7 in.)

Close-up of *Calathea fredgandersii* flowers

This summary was adapted from the original publication, cited as follows: Kennedy, H. 2011. Three new distichous-bracted species of *Calathea* (Marantaceae) from Panama. Novon 21:201-211.

*Facilities for the herbarium studies for this project were provided by Univeresity of California at Riverside herbarium.

Island Explorations and Evolutionary Investigations

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For over a century the Caribbean region, held between North and South America, has been an active area of research for people with interests in island biogeography, character evolution, speciation, as well as geology. Most research have invoked both dispersal and vicariance processes to explain the distribution of the local flora and fauna, while ecological interactions such as niche partitioning and ecological adaptations have been used to explain the diversity within the Caribbean region. One of the biggest challenges in understanding island colonization in the Caribbean, however, has been its complex, dynamic and variable geological history, which varies both along a North-South and an East-West axis.

The Caribbean region is divided into the Greater Antilles (northern islands) and the Lesser Antilles (southern islands). The Lesser Antilles archipelago, the focus of my research interests, is 850 kilometers long with a radius of curvature of 450 kilometers, and consists of 19 islands. The Lesser Antilles stretches from South American continental margin (eastern Venezuela) to the Anegada Passage, which marks its boundary with the Greater Antilles (Puerto Rico-Virgin Islands platform).

Geologically, the Caribbean region is estimated to have formed in the Cenozoic era (65 million years ago), following the separation of North and South America during the Mesozoic era. The volcanic islands, today's Lesser Antilles, are proposed to have emerged from the tectonically active Aves Arc after a series of subsiding volcanic islands migrated eastward after the Aves Ridge was formed to the West. Although the Lesser Antilles is commonly referred to as a volcanically active chain of islands, not all of the Lesser Antilles is volcanic. Based on geological origin and elevation all the islands of the Lesser Antilles can be divided into two groups: a) Limestone Caribbees (outer arc: calcareous islands with a low relief, dating to middle Eocene to Pleistocene), and b) Volcanic Caribbees (inner arc: young volcanic islands with strong relief, dating back to late Miocene).

For over more than a decade John Kress, Ethan Temeles (Amherst College) and their team of researchers have been investigating mutualistic interactions between heliconias (*Heliconia*: Heliconiaceae) and their sexually dimorphic hummingbird pollinators the Purple-throated Caribs (Trochilidae: *Eulampis jugularis*) throughout the Eastern Caribbean Islands. Based on their studies they proposed the Caribbean *Heliconia*-hummingbird system as a case for adaptive evolution between the beak morphology of the Purple-throated Caribs and the floral morphology of the two native heliconias (Temeles et al. 2000 *Science*; Temeles and Kress 2003 *Science*).

Map showing the locations of St. Kitts & Nevis, Dominica, and St. Vincent within the Lesser Antillean chain of islands. Field work and study sites were set up at all three islands to study heliconias and their interactions with the native hummingbirds.

My involvement in this project started in September 2002, or more appropriately from July 2002 when I first met Kress at the Association of Tropical Biology and Conservation (ATBC) meeting in Bangalore, India. At the time, I was investigating a *Mussaenda frondosa*-insect interaction in the Western Ghats, India, and I was ready for new and bigger research challenges. On joining the graduate program at The George Washington University in Washington, D.C., in the Fall of 2002, I decided to investigate adaptation in plant-pollinator interactions using a 'multi-island' comparative approach using the Caribbean *Heliconia* hummingbird interactions as the study system. Since I was interested in understanding factors that could influence plant-pollinator mutualistic interactions between the geographically distinct islands, I chose three strategic islands of the Lesser Antilles: St. Kitts in the north, Dominica in the center, and St. Vincent to the south of the Lesser Antilles, respectively.

On all three islands only two native species of *Heliconia* occur in varying abundance: *Heliconia bihai* (L.) L. and *H. caribaea* Lam. However, floral polymorphism and abundance of these two species are completely reversed on these islands. On St. Kitts, *H. caribaea* is common and *H. bihai* is rare; on Dominica, both the species are common, but are mostly allopatrically distributed (commonly *H. bihai* can be found above 800 meters and *H. caribaea* below 800 meters with a small overlapping zone around 800 meters); and a reversed distribution is observed on St. Vincent where *H. bihai* is common and *H. caribaea* is rare. Both species have distinct color polymorphisms that vary among islands and serve as the primary nectar source for the Purple-throated Caribs.

The Purple-throated Caribs are sexually dimorphic birds that vary in their body size and bill morphology: males are 25 percent heavier than females, while females have bills that are 30 percent longer and 100 percent more curved than males (Temeles et al. 2000 *Science*). Males also display territorial behavior while females trap-line. The male Purplethroated Caribs allow only conspecific females to occasionally feed on their territories in exchange for mating. Since the breeding system of the two heliconias was not known at the time one of the main focus of my dissertation research was to investigate pollination, breeding system, and phenology of the two heliconias on each island. To further understand the role of hummingbirds in promoting outcrossing within the two species on each of the islands I also measured the inbreeding rates in both *H. bihai* and *H. caribaea* on each island using microsatellite markers that were developed specifically for both the species, and also measured pollinator effectiveness using manipulative field experiments.

Female Purple-throated Carib (*Eulampis jugularis*) tagged with a unique band for individual identification. Male and female Purple-throated Caribs were monitored over multiple years to understand their dependence and interaction patterns with native heliconias.
(Photo by Vinita Gowda)

The following are some interesting results of my research on the three islands:
a) male Purple-throated Caribs were indeed found to be important and effective pollinators of *H. caribaea*, however their territorial displays showed significant difference among the three islands, varying from a specialized interaction on Dominica to a more generalized interaction on St. Kitts, and almost no interaction on St. Vincent; **b)** female Purple-

throated Caribs were the sole pollinators of *H. bihai* on all three islands; **c)** inbreeding rates were significantly lower in *H. bihai*, which was pollinated by traplining females, when compared to inbreeding rates in *H. caribaea*, which was pollinated by territorial males, supporting the ecological hypothesis that traplining pollinators promote outcrossing, while territorial pollinators assist in reproductive success at the cost of higher inbreeding; and d) marked territorial male Purple-throated Caribs were observed to defend the same patch of heliconias for at least 5 to 6 years on the island of Dominica and St. Kitts, which was not known for this species or for any other territorial species of hummingbird.

Collecting *Heliconia* rhizomes in Dominica for the *Heliconia* experimental garden with Mike Bordelon in 2005. (Photo by John Kress)

Although there is much to say about each of these three islands, the northern island of St. Kitts (or St. Christopher and Nevis) warrants special discussion because, despite its small size and easy access, it is biologically under-explored and offers much in terms of biodiversity and evolutionary questions. The Federation of Saint Kitts and Nevis is comprised of two volcanic islands that are separated by a 3 kilometer wide channel called The Narrows. Comparatively, the size of St. Kitts is 1.5 times that of Washington, D.C.

The island is comprised of a wet rainforest on the Atlantic side, while the Caribbean side tends to have a drier and more xeric habitat. Mount Liamuiga (formerly Mount Misery) stratovolcano is the highest point on the island standing at 3,793 feet (1,156 meters), and one of its summits is topped by a crater lake known as Dos d'Ane pond. The mountain sides above 800 meters and the top is covered in an elfin woodland that is laden with moss, epiphytes, orchids, bromeliads, and aroids. Some of the unique plants that can be seen on hiking to the top of the Dos d'Ane pond are: *Podocarpus coriceus* Rich. & A.Rich, *Hillia parasitica* Jacq., *Prestoea montana* (R. Graham) G. Nicholson, *Miconia mirabilis* (Aubl.) L.O. Williams, *Miconia laevigata* (L.) D. Don, *Anthurium cordatum* (L.) Schott, *Philodendron giganteum* Schott, *Begonia retusa* O.E. Schulz., and *Heliconia bihai*. The color form of *H. bihai* on St. Kitts and Nevis is unique to these islands, and a population was discovered on the edge of the Dos d'Ane pond in 2005 with the help of a local tour guide, Gregory Pereira. Interestingly, the *H. bihai* on this island are restricted to the mountaintops and have a very narrow distribution. Only three accessible areas were found where they were present, and even among these areas the number of individuals was restricted from four to about 27 individuals.

Despite the low population sizes of *H. bihai*, pollinator observations showed that the Purple-throated Carib females were visiting and pollinating these few widely scattered plants at least two to three times a day and against all odds of the strong cloud cover at the mountaintops for most of the day. Often the female Caribs managed to find the opportunity to visit the heliconias whenever the cloud cover broke; sometimes this meant a mere five to 10 minutes break between cloud covers. On the island of Nevis, the scattered and very restricted population of *H. bihai* was found on the trail leading to the top of the Nevis peak between 800 and 1,200 meters. Both the climb to the top of Dos d'Ane pond and Nevis peak is a treacherously steep trail that can get quite slippery due to the moist cloud cover that is persistent throughout the day.

The largest distribution of *H. caribaea* on the island of St. Kitts was found in two localities around the town of Molineaux: the rainforest trail on the south-east side of Mt. Laiamuiga or the Phillips level, and behind the Ottley's plantation trail. On Nevis, *H. caribaea* was most easily found around the trail leading to the Nevis peak, al-

Native *Heliconia bihai*, from Dominica
Photo by Vinita Gowda

the plants were also reported from other sides of the peak. *Heliconia caribaea* are abundant on both islands and both red and yellow morphs are found. Despite the small sizes of both islands, the high relief (especially St. Kitts) and significant difference in weather from the Caribbean to the Atlantic sides results in a world of difference in flora and fauna, and thus provides an ideal natural experimental garden where one can investigate adaptive differences in plants colonizing these islands.

Although my doctoral dissertation research focused on only three of the Lesser Antillean Islands, from 2004 to 2009, I along with Kress and other colleagues also had the opportunity to collect and study heliconias on a number of other islands such as St. Eustatius, Saba, Montserrat, Guadeloupe, Martinique, and St. Lucia. In general, strong efforts were invested in collecting vouchers, observational data, population samples, and morphological data on all heliconias from the other Caribbean Islands too. This has resulted in a very extensively collected, fine-scale meta data of variations in morphological characters in the two heliconias throughout the Caribbean Islands, and has great potential in future investigations of character evolution (especially floral) and adaptations between plants and their pollinators.

Native yellow, below left, and red, above, *H. cari*baea, from Dominica. Photos by V. Gowda

Ecological studies of this kind are not common among scientists in the Natural History Museum; however, the results from this study highlight the importance of exploring ecological studies along with population genetic and taxonomic studies to understand the diverse tropical interactions that define a tropical rain forest. One of the broader outcomes of this study has also been the research exchange between the local forestry divisions on the islands of St. Kitts, Dominica, and St. Vincent and the Smithsonian Institution where the local hosts have been significantly important partners in facilitating our research in the Caribbean Islands. The local forestry divisions and concerned citizens not only view the unique *Heliconia*-hummingbird interaction as a source of national pride unique to their island, but have also included it as part of their conservation programs in the wake of concerned developments within the islands.

Two websites proved to be useful in my research: (1) a catalogue of plants on each of the Caribbean Islands, <botany.si.edu/Antilles/WestIndies/catalog.htm>; (2) The Global Volcanism Program database for the Caribbean Islands, with thermal activity for 17 volcanoes, <www.volcano.si.edu/world/region. cfm?rnum=1600>.

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Will the REAL *Costus barbatus* PLEASE STAND UP!

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Most U.S. readers over the age of about 45 will remember the television show "What's My Line", where three contestants, claiming to be an individual with some unusual occupation, try to fool a set of panelists. At the conclusion of the panelists' questioning and guessing which one is the real person, the moderator exclaims, "Will the real Mr. Jones please stand up! Then it is revealed whether they were able to fool the panelists. In my search for *Costus barbatus* I sometimes felt like one of those panelists.

If you do a Google image search for *Costus barbatus* the plant you will get in every image you find will be like the one shown below. This plant was introduced to US horticulture many years ago by the USDA in Miami, Florida. Someone identified it as *Costus barbatus* and the name has stuck ever since. As I eventually learned, this plant is not really *Costus barbatus.* In Australia, it is usually tagged by its presumed correct name, *Costus comosus* var. *bakeri*

Presumed *Costus comosus* var. *bakeri*

When I first learned about all this I began to wonder, what does the REAL *Costus barbatus* look like, and where can I find it. I studied Dr. Paul Maas' monograph on Costus, published in 1972 (with an update in 1977) in the New York Botanical Gardens Flora Neotropical series. As I compared the plant in horticulture against the description by Dr. Maas, it became clear to me that there was an error in identification. The horticulture plant has very short ligules, the bract margins do not dilacerate into fibers, and the corolla lobes are not puberulous.

According to Dr. Maas, the true *Costus barbatus* was only found in the Central Valley area of San Jose, Costa Rica. The problem with that is that the entire area is now hopelessly urbanized with houses, roads and shopping malls, and nary a patch of native forest to be found. There were a few other collection location records at the National Biodiversity Institute of Costa Rica (INBio), so in many trips to Costa Rica I searched for a plant that might fit Maas' description of *Costus barbatus* and each time I came up with blanks. A search of the nearby Orosi Valley, Lankester Gardens, Parque Nacional Tapanti and other locales resulted in finding in habitat some beautiful *Costus montanus* and *Costus curvibracteatus* -close relatives to *C. barbatus*, but not the right plant. An INBio record for Cerro Nara, near Quepos, turned out to be a population of *Costus ricus*, interesting because it added 100km to its range, but still not what I was hoping to find.

I had begun to think that the species might be extinct since it had such a limited recorded range in a now urbanized area, and I had been unable to even find any photos, much less any living plants in cultivation. As far as I could tell, only a dried herbarium specimen of this species remained.

Now urbanized habitat of *Costus barbatus*

Then in a recent trip to Costa Rica I set aside one day to make a last ditch effort to find the plant. The holotype of this species was collected at Curridabat, an eastern suburb of San Jose. Another collection noted by Dr. Maas was at San Pedro, another eastern suburb, and yet another collection somewhere along the Rio Torres, which has its source to the east of San Jose from the western flanks of the Volcan Irazu. The Rio Torres flows right along the San Jose zoological park, but I had already checked there and only found *Costus pulverulentus.*

So I decided that my only hope of finding this species was to search the watershed to the east of San Jose for any remaining forest patch. I went to Google Earth and the Internet searching for any remaining forested areas at a reasonable altitude in the same watershed to the east of San Jose. Then I hired a 4 by 4 and driver, an American Expat named Steve who was willing to help me with my search at a reasonable price.

Steve and I systematically worked our way to every patch of forest we could find, but most of them were reclaimed coffee fields or simply pasture land with a few trees still standing. After several hours we had not seen a single *Costus* of **any** species. Then as we were heading up a rocky road at about 1800 meters, below Rancho Redondo, I saw a narrow driveway leading back to the edge of a patch of forest on the right and told Steve to turn there. At the end of the drive was a gate to some private property but there was a creek nearby, so I got out of the car and looked down into the creek bed and here is what I saw.

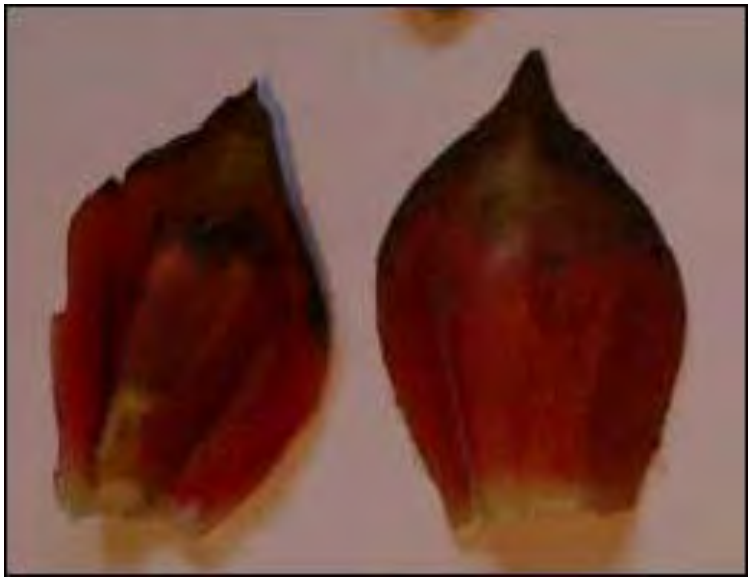
Costus barbatus, rediscovered

I could hardly contain myself as I slid under the barbed wire fence to get a closer look. Had I finally found it? Or was this another false alarm? I started sorting through the possibilities. It was definitely not *Costus-montanus*. It reminded me of *Costus curvibracteatus*, which I had seen many times in various different forms, but this was a new one if it was *C. curvibracteatus*. It had the longer ligule and the hairy vegetative and flower parts that barbatus was named for – the root word for "bearded". It had to either be *Costus barbatus* or a new species!

It was a large patch with many plants at various levels of maturity, and there should have been some seeds, but all were sterile. Could it be that the pollinator is extinct, or this is too high an altitude for the pollinator Unlikely that it was a sterile hybrid since there were no other *Costus* in the area to be found.

So when I returned home I began the process of the detailed analysis in Table 1, comparing it against the *C. barbatus* description and the horticulture plant. Based on this analysis, I have concluded that at long last I have indeed discovered the real *Costus barbatus.* It may well be one of the last patches remaining of this species, and the location will be shared with the Biodiversity Institute of Costa Rica.

So what of the plant in US horticulture, that has been masquerading all these years as *Costus barbatus?* I have never seen that plant in the wild and have no clue to its origin. I guess that will be my next mystery plant search.



Bracts

Calyx and Bracteole

Sheath and Ligule

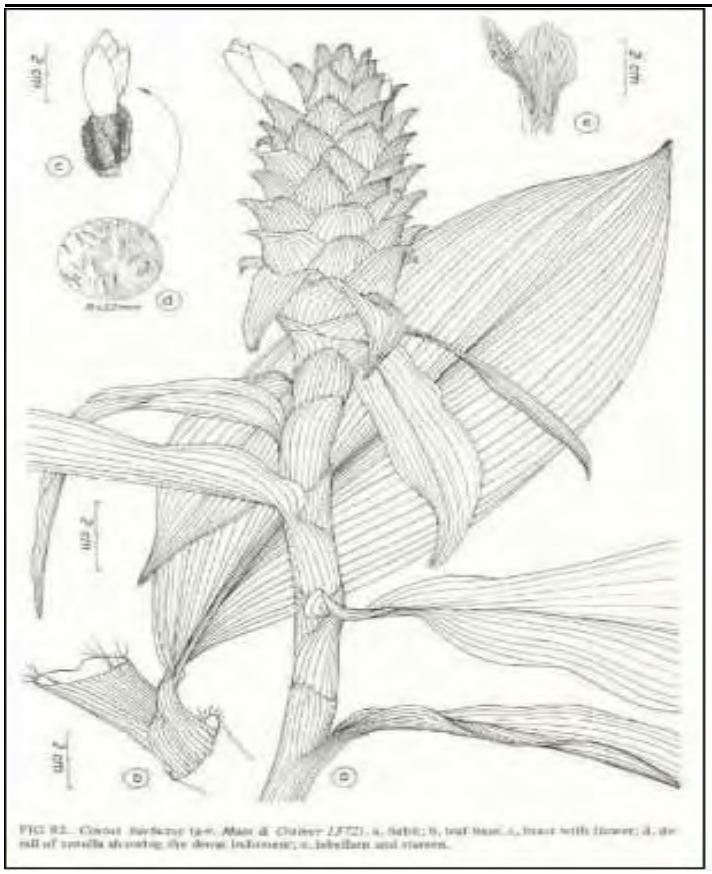
Leaf costa

Table 1. *Costus barbatus* Comparison of Characters

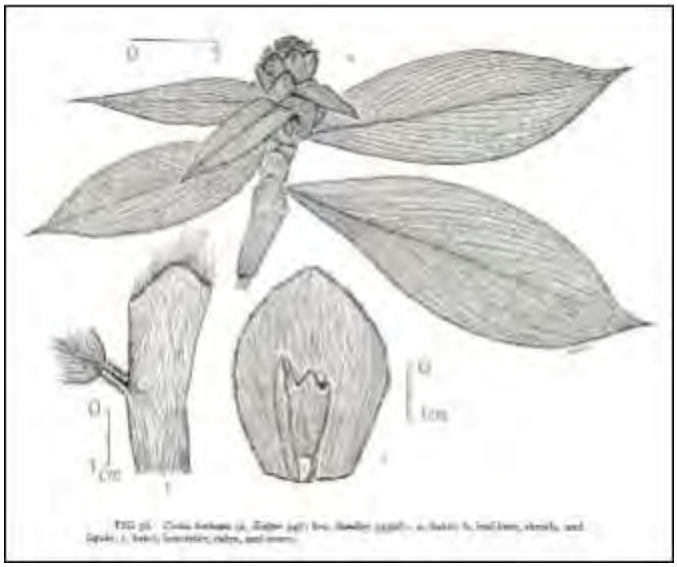
Maas (in 1972) distinguishes *C. barbatus* from *C. montanus* by its ligule, longer and not acute triangular.

Maas (in 1977) distinguishes *C. barbatus* from *C. curvibracteatus* by its bracts, longer ligule and puberulous corolla.

***Costus barbatus* characters per Maas,** (1972 & 1977 additions)	**New plant in question**	**Plant sold as *Costus barbatus* in US horticulture**	**Could it be *Costus curvibracteatus*?** (description comparison)
1.5-2.5 m tall	Yes, matches description	Yes	Similar range in height
Sheaths puberulous to villose, 10-17 mm	Yes, quite hairy	Glabrous to velutinous	Similarly described
Long Ligule 15-30mm, two lobed rounded, hairy	Yes, most ligules were 20-25 mm in length, distinctive purple margin	Short ligule, less than 5 mm, glabrous to velutinous	**Shorter Ligule 5-10mm**, truncate to slightly two lobed
Petiole 6-12mm, villose	Yes, about 8 mm	Glabrous to velutinous	Similarly described
Leaves 13-26cm long by 4.5-8.5 cm wide	Not measured but appear to match size	Larger leaves to 12 cm wide by 40 cm long.	**Larger leaves** 20-35mm long by 6-10mm wide
Leaves upper glabrescent	Yes, matches description	Yes	Similarly described
Leaves lower rather densely villose towards base and costa	Yes, matches description	Velutinous – very fine dense soft hairs.	Similarly described
Inflorescence ovoid to fusiform, 4-10 cm long by 2.5-4.5 cm wide	Yes, matches description	Yes	**Fatter inflorescence** -Ovoid to broadly ovoid, 6-18mm long by 3-9mm wide
Bracts 3-4 cm long by 2-4 cm wide, red, coriaceous, broadly ovate, apex acute or slightly rounded and sometimes reflexed	Yes, 3.5 cm long by 2.8 cm wide.	Yes	Similarly described
Bracts sparsely to rather densely puberulous, **margins fibrous,** apex acute to slightly rounded, sometimes reflexed	Yes, matches description	Glabrous to velutinous at base, margins entire	Similarly described, glabrous to densely strigose but no mention of margins
Bract callus absent or inconspicuous	Yes, matches description	Yes	Similarly described
Appendages reflexed (In 1977 only, 1972 description does not mention appendages.)	Yes, but appendage not distinct, small as in C. barbatus description	No distinct appendage	No appendages mentioned
Bracteole 22-25mm, puberulous, margin fibrous	Yes, 22mm, hairy and fibrous margin	25mm, minutely puberulous, margins entire	Similarly described
Calyx 13-15mm long, puberulous, margins fibrous	Yes, 15mm, hairy and fibrous margin	No, 18mm, minutely puberulus, margins entire	Similarly described
Calyx lobes shallow triangular	Yes, matches description	Calyx lobes deeply triangular	Similarly described
Corolla 40mm long, yellowish and orange at base, **densely puberulous**	Yes, matches description	No, totally glabrous, solid yellow	**Corolla glabrous** (otherwise the same)
Labellum tubular	Yes, matches description	Yes	Similarly described
Stamen yellow, slightly exceeding labellum	Yes, matches description	Yes	Not mentioned whether it exceeds labellum



The photo above at right, of a mature inflorescence of the plant rediscovered and believed to be *Costus barbatus,* closely matches the illustration in Maas' 1977 update to his Flora Neotropica Monograph No. 18 on new world Costaceae.



Compare this photo of a younger inflorescence of the plant in question to the illustration on the right found in Maas' 1972 monograph on new world Costaceae.

At left, an old inflorescence of the rediscovered *Costas barbatus.*

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Presentations are to be in English and should be 30 minutes long.

A PowerPoint projector and computer will be available during the conference.

Printed handouts will be the responsibility of the speaker.

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	Pre Booking Before March 31, 2012 Single Rate	Double Rate		**Booking** April 1, 2012 or later Single Rate	Double Rate
Pre-conference 23-27 July	US $ 810	US $ 690		US $ 895	US $ 735
Conference 27-31 July	US $ 755	US $ 670		US $ 899	US $ 810
Extra night in Panama City	US $ 99	US $ 185		US $ 99	US $ 185
Post-conference 31 July-7 Aug	US $ 2208	US $ 2008		US $ 2475	US $ 2275

All fees will be handled by either Credit Card or Bank Transfer. Please see the Conference Registration form for details, including cancellation penalties.

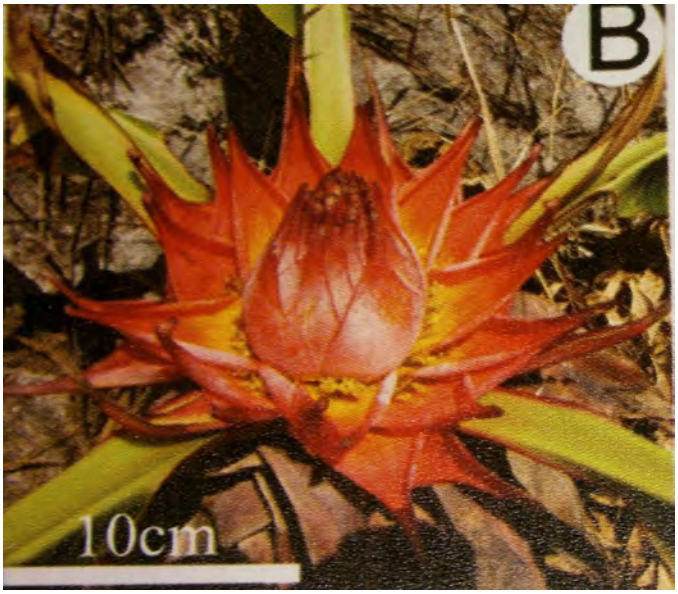
A New Variety of *Musella lasiocarpa*

In HSI Bulletin 17(3), the research that proposes a genus name change from *Musella* to *Ensete* was cited for the attractive yellow form of the species. New research in China probably missed that information although it appeared in 2010. Now, comes word that an orange-red variant has been found, so this paper describes both the yellow form (*Musella lasiocarpa* var. *lasiocarpa*) and the new one, *Musella lasiocarpa* var. *rubrabracteata*. The Chinese authors cite their own molecular data that suggest *Musella* should remain as a monotypic genus.

Musella lasiocarpa is found in southwestern China in central and northwestern Yunnan province and southern Sichuan province. Wild populations can be found on cliffs above the upper Yangtze River. Due to habitat destruction the wild populations are disappearing (eight wild populations have been identified), but it is semi-cultivated as a livestock feed because of the high starch content of the stems, and as an edible vegetable, for medicine, and in wine-making.

The red-orange variety is found as a single wild population in southern Sichuan Province near Panzhihua City growing on limestone cliffs of a dry hot valley, 1136-1254 m in elevation. The foliage tends to have green to purple coloration on the underside of the petioles and the mid-rib on the upper surface is light red to purple red, but the lamina is green. A detailed description is found in the original Novon article referenced below. Fewer than 130 individual plants were found. The conservation status of this variety is Critically Endangered according to the IUCN Red List criteria. Plants of var. *rubrabracteata* produce fewer fruits (about three per inflorescence) than var. *lasiocarpa* which produce 19 to 41 fruits (a berry) and produce only one to four tillers, making it difficult to propagate.

In this issue:



Permission to publish this account and photo was granted by Novon. Ma Hong, Pan Qingjie, Wang Lan, Li Zhenghong, Wan Youming, and Liu Xiuxian. 2011. *Musella lasiocarpa* var. *rubrabracteata* (Musaceae), a new variety from Sichuan, China. Novon 21:349-353.

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