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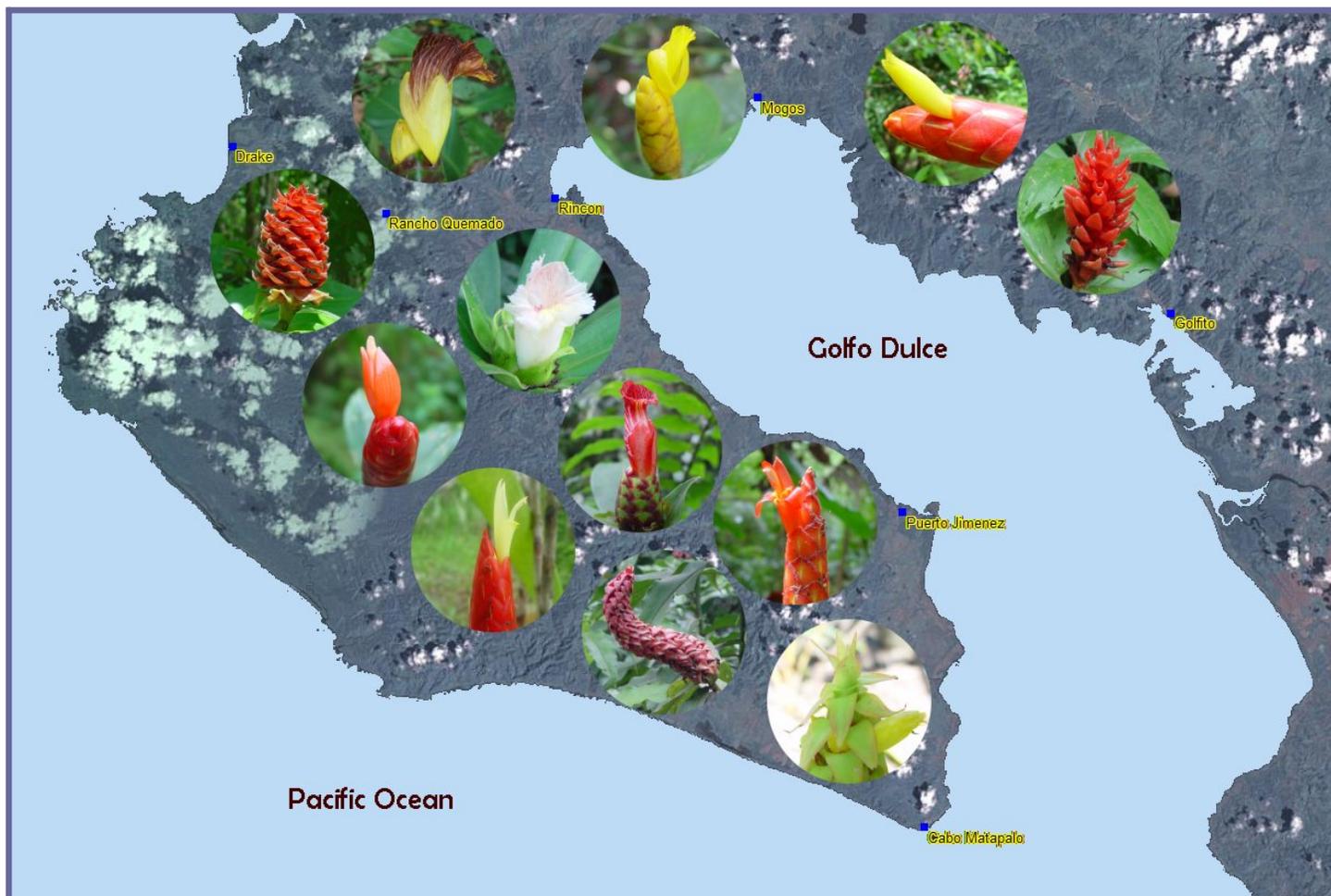
## Costus of the Golfo Dulce Region

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About ten years ago I became fascinated with the plants known in horticulture as gingers, including the true gingers from the family Zingiberaceae and the spiral gingers of the family Costaceae. I started gathering every

scrap of information I could find on these plants and posting it to a website, which now can be found at [www.gingersrus.com](http://www.gingersrus.com). As my research progressed, I became more and more focused on the genus *Costus*; I started building my collection of *Costus* species and trying to learn the nuances distinguishing the species in this genus. It was only natural that I should want to see and study these plants in their native habitats.

In southern Costa Rica is an area known by botanists as the "Galapagos of Mesoamerica" due to the wide



diversity of plant and animal species – many of which are endemic to the area. It is comprised of the Osa Peninsula and the area bordering the northern and northeastern shores of the Golfo Dulce (“Sweet Gulf”). There is an exceptionally large percentage of primary forest and old growth secondary forest in this region - including two of the country’s largest national parks (Parque Nacional Corcovada on the peninsula and Piedras Blancas on the mainland) as well as other conservation areas such as the Reserva Forestal Golfo Dulce connecting these two national parks. There are eleven species of *Costus* documented in the area, so three years ago, I chose this area for my first venture into the wild looking for *Costus* species.

My trip started in late June, well into the rainy season. I began with a brief visit with Barry Hammel at In-BioParque, near San Jose, and spent a day at Wilson Botanical Gardens near San Vito. Then I began my quest for *Costus* in earnest at Tropenstation La Gamba, ([www.lagamba.at/researchdb/pageen/index.php](http://www.lagamba.at/researchdb/pageen/index.php)) which is a biological research station associated with the University of Vienna, and located at the edge of the Parque Nacional Piedras Blancas north of Golfito. The Tropenstation maintains a small botanical garden with collections of plants from the area. It’s director, Mag. Werner Huber, is one of the authors of “An Introductory Field Guide to the Flowering Plants of the Golfo Dulce Rainforest, Costa Rica”, published in 2001.

After three days of hiking trails in the rainforest of the Piedras Blancas, I crossed the Golfo Dulce by ferry and met up with noted field botanist Reinaldo Aguilar to continue my search of *Costus* species on the Osa Peninsula. Reinaldo and his wife Catherine Bainbridge were working with the Andes to Amazon project and with the organization “Friends of the

Osa” ([www.osaconservation.org](http://www.osaconservation.org)), compiling information on the flora of the peninsula. We were joined by Eva Schembera, a legume specialist with the University of Vienna, whom I had met at the Tropenstation.

Altogether after about a week of searching, and with Reinaldo’s and Eva’s help, I succeeded in finding 10 of the 11 documented species, plus one that had not previously been documented on the peninsula.

#### *Costus laevis* Ruiz & Pav.



By far the most common *Costus* in the area is *Costus laevis*. I found this species growing in several habitats from riverbanks to deep forests, and from lowlands up to 1100 meters around Wilson Botanic Gardens. As noted by Dr. Paul Maas in Flora Neotropica, this species is quite variable in form, but the form I found in southern Costa Rica is the one with the purplish colored bracts

and the mostly red flowers, including red corolla lobes. My own specimen of this species came



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from Panama and looks quite different with solid green bracts, yellow corolla lobes and not quite so much red in the labellum.

In this region it is fairly easy to recognize even when sterile, thanks to the characteristic silvery midrib on the young foliage and the long, usually purplish petioles.

*Costus pulverulentus* C. Presl



Another very common *Costus* in this area is *Costus pulverulentus*. I usually found it at the lower altitudes, in clearings along streams and disturbed areas along roads. This species has a large range from Mexico to Ecuador and is found in many different forms. The common form grows as tall as 2.5 meters (about 8 feet), but there are some compact forms with different colored bracts and flowers. The species also is quite variable in its indument – some forms being glabrous throughout and some quite hairy.

If you find it in flower, it is very easy to identify with the distinctive stamen that far exceeds the labellum and the corolla lobes that usually curl outwards. Even without the

flowers it can be recognized by the narrow, fusiform shape of the inflorescence with the pointed apex and bracts with fibrous margins, white on the newer bracts and turning dark on mature bracts.

Sterile plants are not so easy to identify as there is nothing much distinctive about the vegetative parts, and they are so variable in form. Fortunately this is such a regular bloomer that usually you will at least find a spent inflorescence to aid in identification.

*Costus stenophyllus* Standl. & L.O. Williams

This species is endemic to the Golfo Dulce region according to the “Manual de Plantas de Costa Rica” (2003). I found it growing in the forests mostly at higher altitudes



(200-400 meters) in well drained soil and widespread in both the Piedras Blancas (a/k/a the Esquinas Rainforest or “Rainforest of the Austrians”) and on the Osa Peninsula proper. In horticulture it is sometimes called the “bamboo *Costus*” due to its narrow leaves and straight bamboo-like stems. It is easily recognized whether in flower or not. The inflorescences are borne from a separate basal stem from the rhizome with bright red non-appendaged bracts and yellow tubular flowers. It seems to be a somewhat shy bloomer in nature just as it is in my own greenhouse. I only saw it blooming on mature plants over 2 meters tall.

*Costus lasius* Loes.

This species is more common to the south of Costa Rica, from Panama



to Peru. We only found it in a couple of places on the Osa Peninsula during our search and might have missed it entirely if I had not checked in advance to find out where it has been collected in the past. The plant I found there is exactly like the specimen I have at home. It is unmistakable in flower with its yellow bracts (not appendaged) and its yellow tubular flowers. The plant is rather small in size compared to many other *Costus* species, with thin stems and stiff brownish hairs on all vegetative parts and on the lower bracts.

*Costus scaber*  
Ruiz & Pav.

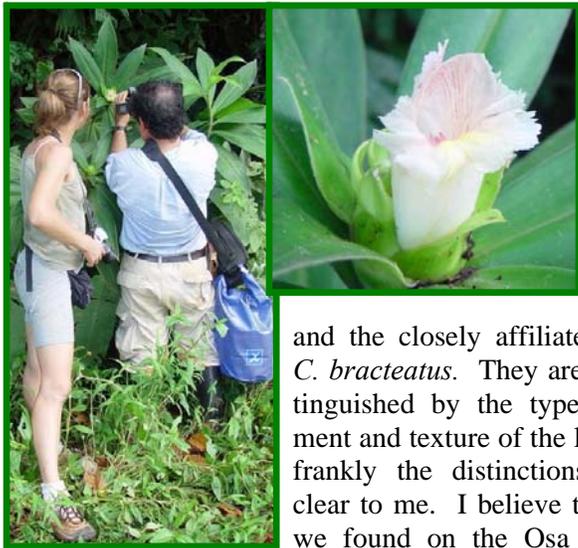
This species, like *C. pulverulentus*, has a very wide range from Mexico to parts of South America, and it is variable in form.



It is often confused with other similar looking species *C. spicatus* and *C. spiralis*, and I am still never certain of the identity. The distinction according to Dr. Maas deals with fine points in the length of the calyx and so forth. One plant we found at higher elevations that MIGHT be *Costus scaber* is pictured at the right. It has thin, tightly spiraling stems, long ligules and petioles, long acuminate leaves and red non-appendaged bracts. We never saw a fully developed flower on this plant. There are more photos at [www.gingersrus.com/botanical/aff-scaber](http://www.gingersrus.com/botanical/aff-scaber) if anyone would like to render an opinion.

*Costus guanaiensis* Rusby

Another very widespread species is *Costus guanaiensis*, which has been described by Maas with three named varieties and the closely affiliated species *C. bracteatus*. They are each distinguished by the type of indument and texture of the leaves, but frankly the distinctions are not clear to me. I believe the variety we found on the Osa Peninsula



was var. *guanaiensis*.

It is a *Costus* with large leaves and green bracts that have green leafy appendages and produce beautiful large white spreading flowers with reddish lines on the labellum. The amount of color in the flowers varied with different plants we found. We found this species on the Osa Peninsula from the northern area near Rincon and all the way to the southern tip at Cabo Matapalo, mostly at lower altitudes and at the edge of clearings and along roads.

*Costus lima* K. Schum.



I had never seen this beautiful species in cultivation before this trip, but since then have found it many times in Costa Rica and in Ecuador. It seems to be quite common in the Golfo Dulce region. We found it mostly at the lower elevations and in wet places along streams or roadsides from Rincon all the way south to

the Rio Piro near Cabo Matapalo, in similar habitats to the foregoing *C. guanaiensis*. It is recognized by its red bracts with long reddish foliaceous appendages



and tubular red flowers, differing from *C. ricus* (below) by the fact that the appendages point downward. The inflorescences sometimes get quite long and are very showy. The ligules are short and obliquely truncate and the plants we saw on the Osa all had purplish margins to the ligules. The leaves have short stiff hairs making them feel scabrid to the touch.

*Costus ricus* Maas & H. Maas



*Costus ricus* is a recently described species endemic to Costa Rica. Unfortunately it flowers during the dry season, so I did not find any plants with fresh flowers during this trip – only the mature inflorescences. During subsequent trips to Costa Rica in December and in May, I found it in flower, and have posted many photos at [www.gingersrus.com/DataSheet.php?PID=4867](http://www.gingersrus.com/DataSheet.php?PID=4867).

We found it at higher elevations in open shaded areas growing in well drained soil. Like *C. lima* it has red appendaged bracts, but the shape of the appendages is distinctive, spreading horizontally, and with 2 concave areas near the apex. To remove any doubt, simply examine the bracteole and you will see a two-keeled (bicarinate) bracteole which is found only in *C. ricus* and *C. osae* among the larger *Costus* species in the neotropics.



*Costus ricus* bicarinate (2-keeled) bracteole



*Costus lima* unicarinate (boat shaped) bracteole

Sterile plants can usually be recognized by their spiraling form with most of the leaves gathered toward the top of the plant. The ligules are long and lobed and the leaf tips are long acuminate.

*Costus osae* Maas & H. Maas

Another species endemic to this area is *Costus osae*. I did not see it on the Osa Peninsula (although it certainly can be found there), but did see it growing along streams at about 200 meters on the mainland in the Parque Nacional Piedras Blancas. It seems to prefer a moist location right on the edge of the riverbanks. It is a medium sized *Costus* with showy red appendaged bracts that point upwards and small red tubular flowers that are not particularly noticeable behind the bract appendages. The labellum of the plant I found here had much more white color under the red corolla lobes than the one that is in



cultivation in the US. The bracteoles are bicarinate, like those of *C. ricus*. The vegetative parts are hairy and the plant is easily recognized even when sterile by the broad, light green felty leaves.

*Costus glaucus* Maas

The tallest *Costus* I had ever seen was a specimen of *Costus glaucus* that was growing in the garden at Tropenstation La Gamba. It was well over 6 meters (20 ft.) in height and had a huge inflorescence – over 25 cm in length. The plants we found in



the wild on the Osa Peninsula were not nearly that tall but impressive plants nonetheless. We saw two specimens in the northern part of the peninsula near Rancho Quemado, both in well drained soil at about 200 to 250 meters in altitude. As you

might guess from the name, the young stems and foliage of this plant are glaucous, which helps in identification, but then I have seen other *Costus* species with that characteristic. The ligules are long and lobed, and the vegetative parts are all glabrous. The bracts are green, not appendaged, and the flowers are large, spreading, yellow at the base and red striped on the labellum.

*Costus plicatus* Maas

The one *Costus* species documented in the area that I did NOT see in the wild during that trip was *Costus plicatus*.

Fortunately,



however, there was a beautiful specimen growing in the garden at the Tropenstation. It is easily

recognized by its broad, strongly plicate (pleated), and long acuminate leaves. The bracts are red, not appendaged, and have a conspicuous yellow nectar callus. The flowers are yellow and tubular.

*Costus* species from Cabo Matapalo

One mystery *Costus* was found at the southern tip of the Osa Peninsula at Cabo Matapalo. At the base of a steep slope, right at the edge of the beach we discovered a *Costus* with green appendaged bracts and yellow tubular flowers that appears to match the description in the “Manual de Plantas de Costa Rica” of a plant from the Isla del Caño that is intermediate between *C. comosus* and *C. villosissimus*. Details of this plant are posted on a web page at <http://www.gingersrus.com/botanical/Matapalo>.

In an area as rich as this is in its plant diversity, I suspect that there are many more discoveries waiting to be made. I congratulate the people who are working hard to preserve this wonderful place through such



territories. Given the behavioral and morphological differences between the two heliconias and their adaptation with the PTC hummingbirds we investigated the nectar profiles of *H. bihai* and *H. caribaea* to answer the following questions: a) What is the temporal pattern of nectar production in *H. bihai* and *H. caribaea*?; and, b) Are *H. bihai* and *H. caribaea* similar in percentage sugar, total volume and overall energy content of nectar?

### Method:

**Study sites** - Dominica is centrally located at 15° 25' N, 61° 20' W within the arc of the Eastern Caribbean islands or West Indies. *H. bihai* (above 700m) and *H. caribaea* (20m to 800m) are generally allopatric in Dominica with a small overlapping zone at an elevation of 650-700 m (Temeles and Kress, 2003). Investigations of pollinator visitation, and nectar characteristics were simultaneously carried out at six different sites on Dominica from March 2005 to March 2006.

**Nectar volume and percent sugar** - To determine the nectar characteristics of each species we carried out controlled experiments from March to April 2007 on Dominica. Inflorescences were covered with plastic mesh bags 24 hours before anthesis and both nectar volume and percent-sucrose were measured every two hours from 0700 hrs to 1700hrs. Flowers were destructively sampled ( $N_{H.bihai} = 22$  individuals,  $N_{H.caribaea} = 19$  individuals, one flower/individual/every two hours) for nectar values because the curvature of the flower prevented non-destructive harvest of all nectar using a micropipette. Calibrated capillary tubes (70 $\mu$ l and 150  $\mu$ l) were used to measure the total volume of nectar produced for each time period and a temperature-compensated light refractometer was used in the field to measure percentage sugar present in the nectar. Separate statistical comparisons of total volume of nectar

produced and the percent sugar in the nectar were carried out across the six time periods and between species using repeated measures ANOVA.

**Energy rewards in nectar** - Caloric value of the nectar was calibrated by converting the percent sucrose values as follows: 1 molar sucrose solution = 1,349.6cal/mL = 56.41 joules/mL where 1 mg sucrose solution contains 16.48 joules (Hainsworth and Wolf 1972). Total caloric value for *H. bihai* and *H. caribaea* was calculated for each time period as: caloric value per  $\mu$ l X total nectar volume ( $\mu$ l).

### Results:

**Nectar volume and percent sugar** - Total nectar volume differed significantly between *H. bihai* and *H. caribaea* (Fig. 3a, Table 1). However, differences in nectar volume across time periods were not observed for either species (Table 1 and 2). *H. caribaea* had much larger volumes of nectar than *H. bihai* with the highest nectar volume observed as early as 9:00 hours in the morning. Highest nectar volume in *H. bihai* was recorded for 13:00 hours. Two-way ANOVA showed significant differences in percent sugar in nectar across time periods (only for *H. caribaea*) and between the two species of heliconias (Fig. 3b, Table 1 and 2). Overall, *H. caribaea* had low sucrose percent in the nectar from 9:00 to 11:00 hours but by 13:00 hours sugar content in *H. caribaea* nectar was almost comparable to that in *H. bihai*. Correlation between nectar volume and sugar content were also tested in *H. bihai* and *H. caribaea* to investigate possible covariance between these two variables. No correlation was observed in either *H. bihai* or *H. caribaea* (Table 3). Finally, the total energy content of both *H. bihai* and *H. caribaea* also showed significant differences between species, but not across time periods (Fig. 3c).

### Discussion:

In Costa Rican heliconias, nectar profiles have been observed to differ between non-territorial and territorial hummingbirds where species visited by non-territorial hummingbirds produced less nectar than species visited and defended by territorial hummingbirds (Stiles 1975). A similar pattern was observed in the two Eastern Caribbean heliconias where *H. bihai* visited by trap-lining female PTC hummingbirds produced significantly less nectar and was energetically lower (in Joules/ $\mu$ l) than *H. caribaea* which was predominantly pollinated by territorial male PTC hummingbirds (Fig. 3 a to c; also see Temeles and Kress 2003). Temporal patterns of nectar production in Caribbean heliconias also were similar to those observed for mainland helico-



Figure 2: The primary pollinator of the two heliconias from Dominica: the Purple-throated Carib hummingbird (*Eulampis jugularis*). Male has shorter, straight bill (a) while female has a longer and curved bill (b).

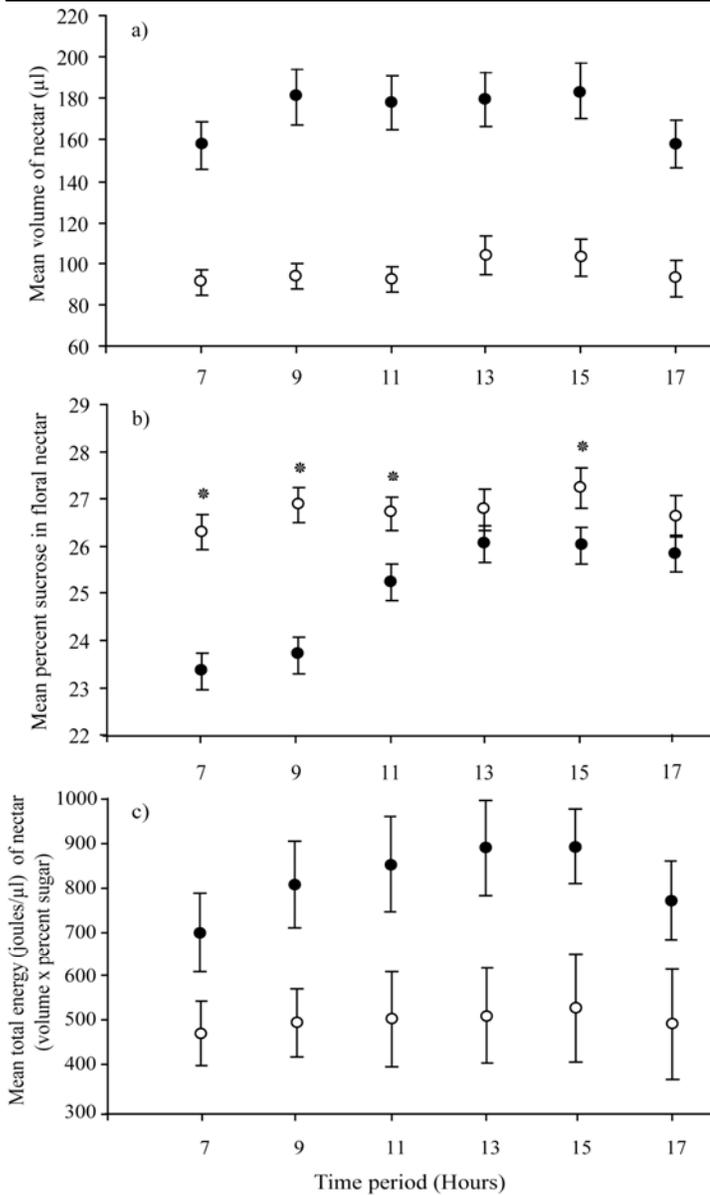


Figure 3: Nectar production (volume and percent sucrose) observed across a day at two-hourly time intervals in *H. bihai* (open circle, N=22) and *H. caribaea* (closed circle, N=19) on Dominica. Bars represent 95% confidence interval around the mean. a) Mean nectar volume ( $\mu\text{l}$ ) measured per flower every two hours, b) mean percent sucrose content in flower, and c) mean nectar energy present in flower in joules. Asterix represents significant effect of species and time-period on nectar production ( $P < 0.05$ ; one-way analysis of variance (ANOVA) with Tukey multiple comparisons).

nias from Costa Rica with a peak nectar production observed till mid-day followed by a reduced nectar production for the rest of the day (Stiles 1975). Though percent sugar and total volume of the nectars varied between the two species the overall temporal nectar production pattern was comparable between *H. bihai* and *H. caribaea* (Fig. 3 a). Temporal nectar production corresponds with the

Nectar volume	Df	F	P
Heliconia species	1	94.79	<b>&lt;0.0001</b>
Time period (hours)	5	1.45	0.2096
Heliconia species X Time	5	0.35	0.8794
Nectar sugar			
Heliconia species	1	17.24	<b>0.0002</b>
Time	5	11.46	<b>&lt;0.0001</b>
Heliconia species X Time	5	7.47	<b>&lt;0.0001</b>

Table 1: Two-way ANOVA showing interaction of time periods and species on the nectar availability (volume and sugar) in *H. bihai* and *H. caribaea*. All measurements of nectar were done across six two-hour time periods on flowers from the same inflorescence in April 2007.  $N_{H.bihai} = 22$ ,  $N_{H.caribaea} = 19$ . Significant interactions are shown in bold font.

Nectar Volume ( $\mu\text{l}$ )	Df	F	P
Across time ( <i>H. bihai</i> )	5	0.55	0.7389
Across time ( <i>H. caribaea</i> )	5	1.26	0.2852
Percent sugar (% sucrose)			
Across time ( <i>H. bihai</i> )	5	0.87	0.5002
Across time ( <i>H. caribaea</i> )	5	20.61	<b>&lt;0.0001</b>

Table 2: One-way ANOVA showing results of changes in nectar sugar and nectar volume across time periods in *H. bihai* and *H. caribaea* on Dominica. Nectar characteristics were compared across six two-hour periods on flowers from the same inflorescence in April 2007.  $N_{H.bihai} = 22$ ,  $N_{H.caribaea} = 19$ . Significant interactions are shown in bold font.

Correlated factors	N	R <sup>2</sup>	P
Nectar Volume X Sugar ( <i>H. bihai</i> )	102	0.1026	0.3046
Nectar Volume X Sugar ( <i>H. caribaea</i> )	114	0.0981	0.2990

Table 3: Correlation coefficients of total volume and percent sugar present in floral nectars of *H. bihai* and *H. caribaea* on Dominica. Data were polled across time periods.

peak activity of the pollinator (here, hummingbirds, Gowda and Kress - in prep.) suggesting that nectar properties are important in understanding plant-pollinator interaction in the heliconia-hummingbird interactions in the Caribbean. Flowers of *H. caribaea* have longer and narrower nectar chambers than in *H. bihai*, though overall *H. caribaea* flowers are shorter and straighter than *H. bihai* flowers (Fig. 1, inset). At

1100 hours bagged flowers of *H. caribaea* often showed nectar overflow, which was never observed in any *H. bihai* flowers. Though nectar production is not expected to dramatically increase past 1100 hours, it should be noted that the values presented here for *H. caribaea* nectar quantity after 1100 hours are restricted estimates of nectar volume and can potentially be higher than the values reported here (since after the overflow of nectar at approximately 1100 hours, any potential increase in volume cannot be successfully harvested). In addition, the observed increase in sugar concentrations in *H. caribaea* after 1100 hours could also be a result of continued increase in production of nectar in the flower or due to evaporation of water content and therefore concentration of the sugars in the nectar (Fig. 3b).

Both *H. bihai* and *H. caribaea* also significantly differ in their habits. Clumps of *H. bihai* are composed of fewer individual shoots (ramets) per rhizome while clumps of *H. caribaea* have three to four times more ramets per rhizome (Fig. 1). Therefore, the total number of ramets (where each ramet bears only one inflorescence) available in a clump of *H. caribaea* as opposed to *H. bihai* significantly increases the overall total number of flowers (and hence total nectar) available to a visiting bird. *H. caribaea* is therefore an energetically more efficient species for a male PTC hummingbird to defend territorially (Fig. 3c). Nectar properties have been also used to explain sex-specific interactions in butterfly-plant interactions (Rusterholz and Erhardt 2000) and though our investigations here do not extend to the chemical constituents of the individual nectar of the two heliconias the sex-specific interactions of the Purple-throated Carib hummingbird does seem to be a response to the overall nectar quality, quantity and availability of the two heliconias and the sex-specific differential energetic demands of the pollinators (Gowda and Kress, unpublished). Male Purple-throated Carib hummingbirds requiring high-energy resources probably prefer energetically richer *H. caribaea* for territorial displays probably relegating females to the energetically less rich *H. bihai* flowers eventually leading to their sex-specific specialization.

On the island of St. Lucia Temeles et al. (2005) showed that most male PTC hummingbirds defended smaller but densely flowered *H. caribaea* territories thus optimizing both their foraging cost and total energy costs per flower. To understand the role of nectar production as a key attractant to hummingbird visitors in the Caribbean heliconias future experiments should focus on understanding the effect of varying nectar crops to the visitation frequencies of the pollinators, i.e. do hummingbirds visit flowers fewer times if nectar volume or sugar amount are reduced in a flower? Finally, it will also be important to calculate the increased fitness due to higher nectar crops in the two Caribbean heliconias by estimating both within-species and between-species seed set rates in con-

trolled experiments and natural populations.

### Conclusion:

Here, we have shown that the temporal nectar production patterns are similar in *H. bihai* and *H. caribaea* across the day on the island of Dominica. While nectar of *H. bihai* has higher sugar content than *H. caribaea*, the total nectar volume produced is significantly lower than that observed in *H. caribaea*. However, overall the nectar of *H. caribaea* is higher in energy content and overall the species represents a richer nectar crop for both male and female PTC hummingbirds. Thus, the nectar traits of total volume and percent sucrose do differ between the two species of Caribbean heliconias on Dominica. Other factors such as plant morphology and habit may also play a critical role in the co-evolutionary dimorphic specialization of *H. bihai* and *H. caribaea* with their PTC hummingbird partners.

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Ms. Vinita Gowda holds a Bachelor of Science degree in Botany, Zoology and Chemistry (1997) and a Master of Science degree in Applied Botany (1999) both from Mangalore University, India. She plans to graduate in Spring 2009 with a doctorate from the Systematics, Evolution and Ecology Program in the Dept. of Biological Sciences at The George Washington University, Washington, DC. Her interests are in the ecology and evolution of mating systems in plants, mainly tropical, and in biogeography. Her advisers are Dr. W. John Kress (Smithsonian Institution) and Dr. Patrick Herendeen (Chicago Botanical Garden). She was a recent recipient of a research grant from the HSI student grant program to study pollination biology and inter-island geographical variation in *Heliconia*-hummingbird interaction on the islands of St. Kitts, Dominica, and St. Vincent in the Lesser Antilles .

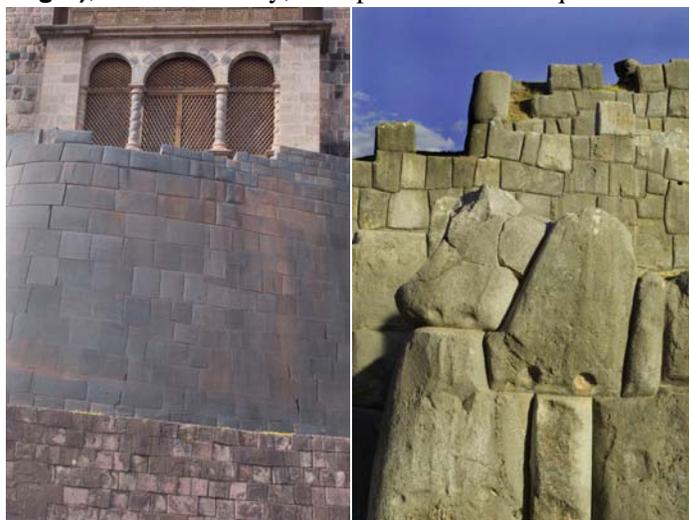
## Land of the Incas

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This is an excerpt from "Inkaterra: A suite in three movements", The HSPR Newsletter 13(3), September 2008. The author is current president of the Heliconia Society of Puerto Rico. (See Carla Black's account of the meeting in Iquitos in the last HSI Bulletin.)

Twelve Heliconia Society International members participated in the Pre-Conference Tour to Machu Picchu and other Inca ruins. On the first day of our guided tour (Thursday, June 19<sup>th</sup>) we boarded tourist buses in Cuzco and headed for the Temple of the Sun (the Convent of Santo Domingo sits atop the Qoricancha – the main astronomical observatory of the Incas) (**below left**), the impregnable fortress of Saqsaywamán, (**below right**), Tambomachay, Pukapukara and O'engo.



**Inca stone,  
Cuzco**

**12 corner stone,  
Cuzco**





**Tambomachay baths**



**Ollantaytambo**

The following day we visited the Sacred Valley of the Incas. There we had the opportunity to appreciate the Urubamba River (the earthbound counterpart of the celestial Milky Way), the ancient ruins of Pisac and its cultivated terraces overlooking the green valley (**below**);



as well as, the massive temple-stronghold of Ollantaytambo - with its dozens of rows of incredibly steep stone precipitous terraces carved on the hillside (**top of next column**). In the afternoon we boarded the train and headed to Aguas Calientes, where we stayed overnight in different

hotels located inside the Historical Sanctuary preserve (named a UNESCO natural and cultural World Heritage Site).

The next morning we woke up at 4 o'clock and headed for the jammed packed tourist line and boarded one of the 22 buses to the citadel of Machu Picchu – Cultural Patrimony of Humanity. The ruins of the “lost city of the Incas” sits majestically among the massive Andes and is one of the most spectacular sites on Earth! We got to the sacred temple before sunrise and experienced the magical winter solstice (June 21<sup>st</sup>), when dramatic rays of light creep over the mountaintops and illuminate the ruins. In the afternoon we happily returned to



**Temple of the Sun, Machu Picchu, at sunrise on winter solstice, 21 June 2008**



Cuzco (at a daunting altitude of 3,400 meters / 11,000 feet above sea level), the capital of South America's archeology.

**Condor head carved in stone**



Scenes from Machu Picchu



Sun dial



Stairway carved in stone

All photos by the author, except the group photo at right which was taken by our guide.



Left to right, standing: Christine Evans, Chris Marshall, Héctor Méndez Caratini, David Lorence; kneeling: Annette Lopez de Méndez, Annop Ongsakul, Supranee Kongpitchayanond, Joyce Baker, Daranee Derojanawong, Ray Baker, Ginette Lorence, Mark Friedrich.

## Two recently published species of *Musa*

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In an effort to make knowledge of these two new species of *Musa*, section *Rhodochlamys*, available to a wider audience, an account of the two follows (see references for full publication).

*M. siamensis* Häkkinen & R. Wallace was discovered in eastern Thailand in 2002 and soon after that introduced to western horticulture markets under the commercial name “Thai Gold” by the Thai nursery industry. However, this species has been known in Cambodia for many years and is known by the vernacular name “Chek Meas”. It has also been cultivated in Cambodia for a long time for ornamental purposes and its buds are used as a vegetable. This species is closely related to *Musa laterita*, *M. rosea* and *M. rubra* having similar growing habits with travelling rhizomes. However, it is a distinct species based on its morphology and in according to DNA (RAPD) analyses (Häkkinen *et al.* 2007).

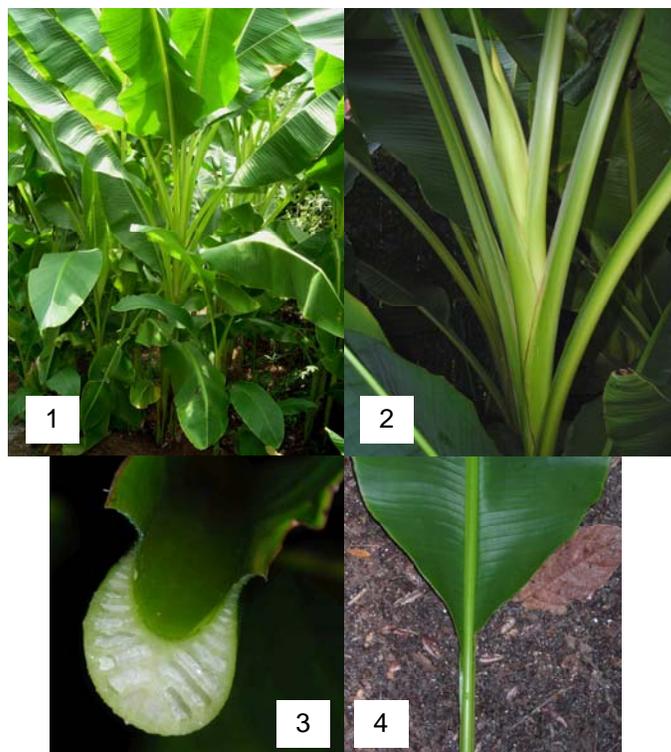
This species is described based on cultivated plants in Richmond Hill, Georgia, USA by completing the entire INIBAP *Musa* Descriptor List (IPGRI-INIBAP/CIRAD 1996). In its natural habitat *Musa siamensis* is rare occurring only in eastern Thailand and the bordering area to Cambodia. However, it is now disseminated all over the world as an ornamental plant for horticultural applications.

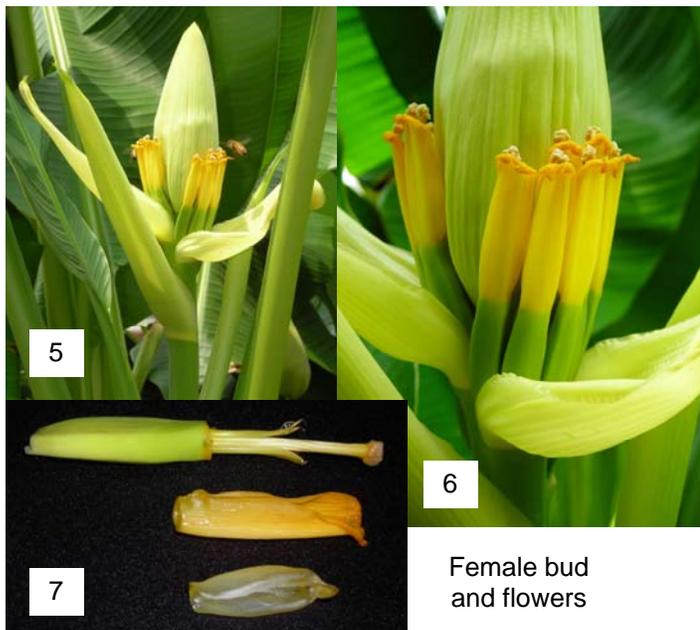
### Description

**Plant** suckering freely which can emerge up to 1 m from the mother plant, up to 25 suckers in the same mat, position vertical (Plate 1). Mature pseudostem slender up to 1.5 m high, sheaths light green, underlying colour pale green, some wax, sap watery. **Petiole** up to 60 cm long, petiole canal open with margins spreading and with narrow dark green and scarious margins, winged and clasping the pseudostem (Plates 2 & 3). **Leaf** habit intermediate, lamina up to 125 cm long, 40 cm wide on average, oblong-lanceolate, obtuse, colour of upper surface bright green, lower surface medium green, appearance shiny, leaf bases symmetric and both sides pointed, with very corrugated lamina, midrib dorsally and ventrally light green (Plate 4). **Inflorescence**, erect, peduncle, up to 40 cm long at exposing the first male flowers, 2.5 cm in diameter, minutely hairy and green in colour. **Female bud**, lanceolate, up to 20 cm long and 5.5 cm wide, bracts pale yellow in both sides tinted with green, imbricate, apex slightly pointed and greenish at the tip, no wax, lifting several bracts at a time, revolute before falling (Plate 5). **Female flowers** on

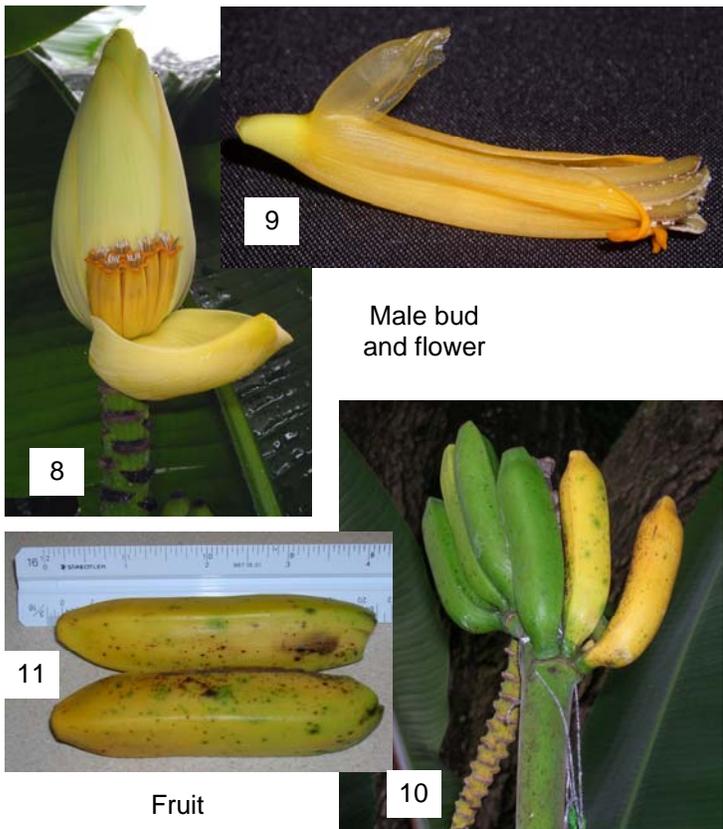
basal 1 - 6 nodes, each bearing 4 - 5 uniseriate flowers, ovary 4 - 4.5 cm long, light green, arrangement of ovules in two rows per loculus, compound tepal 4 - 5.5 cm long with two prominent thickened keels hyaline margins, orange to yellow in colour and the lobes orange, free tepal 1.9 - 2.3 cm long, boat shaped, yellowish with thickened keel and orange developed lobe, the yellowish style 4.5 cm long, orange-grey stigma 0.6 cm in diameter (Plates 6 & 7). **Male bud** lanceolate, up to 12 cm long, 5.2 cm wide, bracts pale yellow in both sides tinted with green, imbricate, apex slightly pointed and greenish at the tip, no wax, lifting several bracts at a time, revolute before falling (Plate 8). **Male flowers**, 5-8 per bract, in one row, falling with the bract, compound tepal 3.7 cm long, orange to yellow in colour and the lobes orange, ribbed at the dorsal angles, with 5 minute, mucronate teeth 1 - 2 mm long, free tepal 1.5 cm long, broadest near the base, nearly plane, tapered to a blunt mucronate point, tinted with yellow, fertile stamens 5, filaments 2.0 cm long, anthers 1.6 cm, same level, yellow, sterile pistil inserted, style cream in colour, stigma cream, ovary 6 mm long straight, without pigmentation (Plate 9). **Fruit** bunch small, rather lax, erect, consisting of 6 hands of 5 fruits each on average, fruits pointed upwards close to the stalk, 10 cm long, 2.3 cm in diameter, strait or slightly curved, slightly ridged, apex blunt-tipped, pedicel 1 cm long, glabrous, immature fruit peel colour green, at maturity yellow with small green and black blotches (Plates 10 & 11). **Seeds**, rounded, smooth, brownish, 4 mm in diameter. 70 - 80 per fruit (Plate 12).

Chromosome numbers are  $2n = 22$  (Cheesman & Larter, 1935).



**Musa siamensis**

Female bud and flowers



Male bud and flower

Fruit

Seeds



*Musa rubinea* Häkkinen & C.H.Teo was discovered in western Yunnan in 2003, and soon after that introduced to western horticulture markets under the commercial name “*Musa rubra*” by the TianZi Biodiversity Research & Development Centre. However, this species name was not formally published, and it was tentatively named *Musa rubinea* by the author in 2004. In this work, the morphologically very similar species *M. mannii* and one of its forms *M. cf. mannii* was also studied by using IRAP (Inter-Retrotransposon Amplified Polymorphism) markers in order to confirm its distinctiveness from *M. rubinea*. *M. mannii* is native to Assam, N.E. India where it has also become very rare, but the species has been preserved in different botanic gardens and collections all over the world. Extensive field observations were made by the first author in 2005, 2006 and 2007 in west Yunnan Province, China and during these expeditions the first author could not locate *M. rubinea* anymore in its natural habitats. *M. rubinea* is here described based on cultivated plants in the Xishuangbanna Tropical Botanical Garden, Yunnan, China, using the entire INIBAP *Musa* Descriptor List (IPGRI-INIBAP/CIRAD 1996).

**Description**

**Plant** suckering freely which can emerge 10-30 cm from the mother plant, up to 3 suckers in the same mat, position vertical (Plate 13 & 14). Mature pseudostem slender up to 1.05 m high, sheaths brown, underlying colour ruby-red with light green blotches, shiny, sap watery (Plate 15). **Petiole** up to 15 cm long, petiole canal open with open blackish and scarious margins, heavily wrinkled and not clasping the pseudostem (Plate 16). **Leaf** habit intermediate, lamina up to 123 cm long, 22 cm wide on average, oblong-lanceolate, obtuse, colour of upper surface green, lower surface medium green, appearance shiny, leaf bases asymmetric and both sides rounded, with very corrugated lamina, midrib dorsally red-purple and ventrally pink-purple. **Inflorescence** at first erect, then pendulous, peduncle up to 15 cm long at exposing the first female flowers, 3.5 cm in diameter, minutely hairy and ruby-red in colour (Plate 17) **Female bud**, lanceolate, up to 14 cm long and 4.5 cm wide, bracts ruby-red on both sides tinted with yellow in ventrally, apex pointed, no wax, lifting several bracts at a time, revolute before falling (Plate 18). **Basal** flowers female, hermaphrodite, 3 per bract in a single row, ovary 4 cm long, light green, arrangements of ovules in two rows per locule (Plate 19), compound tepal 4.2 cm long, orange-yellow in colour and the lobes orange, free tepal 4.2 cm, opaque white, oval, with a short orange acumen, pale yellow inserted style with yellow stigma, stamens 5, dark brown. **Male bud** lanceolate, up to 12 cm long, 4 cm wide, bracts

ruby-red on both sides tinted with yellow in ventrally, apex pointed, no wax, lifting several bracts at a time, revolute before falling. **Male flowers**, 2-3 per bract, in one row, falling with the bract, compound tepal 3.5 cm long, orange in colour, ribbed at the dorsal angles, with 5 minute, mucronate teeth 1 - 2 mm long, free tepal 3.6 cm long, opaque white, oval, with a short orange acumen, fertile stamens 5, filaments 1.8 cm long, anthers 3 cm, exserted, dark brown, sterile pistil inserted, style whitish, stigma cream, ovary 1.2 cm long straight, light green, without pigmentation (Plates 20 & 21). **Fruit** bunch small, rather lax, first pendulous, after aborting the male bud then horizontal, consisting of 5-7 hands of 2-3 fruits each on average, fruits pointed outwards from the stalk, 8 cm long, 1.8 cm in diameter, straight or slightly curved, pronounced ridged, apex blunt-tipped, glabrous, immature fruit peel light green, at maturity yellowish with black blotches (Plates 11 12 & b). **Seeds**, rounded, smooth, brownish, 4 mm in diameter. 30-40 per fruit. Chromosome numbers are  $2n = 22$  (Cheesman & Larter, 1935).

**Musa rubinea**



13



14

A corm with offshoots.  
Photo: TianZi.



15

The underlying pseudostem colour. Photo: TianZi.



16

The petiole basis.



17

Female bud emerging (above) and at right.  
Photo 18: TianZi.



18



19

Ovules in cut fruits.  
Photo: TianZi.



20

Male flowers (above); single male flower (right).



21



22



23

Fruits—unripe (left), ripe (above)

Photos 1-12 (*M. siamensis*) by Richard Wallace; most *M. rubinea* photos by Markku Häkkinen, unless otherwise noted.

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**Website News**

David Skinner, our most recent board member, has been hard at work improving our website, [www.heliconia.org](http://www.heliconia.org). He will have more detail in the next Bulletin issue when the improvements are in place. Look for:

Members-only sections.

Improved photo gallery.

A system that reliably works for on-line payment for membership fees and for ordering back issues of the bulletin.



**Could this be a heliconia petroglyph?**

Photo H. Méndez Caratini.



**Andean woman with alpaca.** Photo

H. Méndez Caratini.



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INTERNATIONAL

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