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The story behind the species – *Costus rubineus*

By Dave Skinner, selvadero@gmail.com

After six long years of collaboration our team published 18 new species in the family Costaceae in the peer reviewed journal *PhytoKeys*, published March 22, 2023 by Pensoft Publishers. The full manuscript is available at <https://phytokeys.pensoft.net/article/87779> as an open access publication. I was also asked by Pensoft to write a guest blog as background material to the *PhytoKeys* article about our work on a future revision to the entire taxonomy of New World Costaceae. The guest blog can be found on line at <https://blog.pensoft.net/2023/03/30/tax-man-turned-taxonomist-a-citizen-scientists-journey-into-botany>. In forthcoming issues of the Heliconia Society Bulletin, I will be writing about the story behind each new species, beginning with the new species we published as *Costus rubineus* D.Skinner & Maas.



Ramiro Galoc photographing what is now published as *Costus rubineus* D. Skinner & Maas

In a way, the Heliconia Society was indirectly responsible for my discovery of this species. In July 2008 I attended my first Heliconia Society conference held in Iquitos, Peru. I had already planned after the conference to go to the Tarapoto area to look for *Monocostus uniflorus*, and when I mentioned that to one of the attendees at the conference, Cristine Bohn, she suggested that I visit the Alto Mayo reserve in the north of Department San Martín. She put me in contact with one of the guards in the reserve, Ramiro Galoc Pinedo, and I arranged to meet him in the town of Rioja.



The Alto Mayo reserve from 2000 meters looking down into the valley.

The Alto Mayo Protected Forest reserve contains 450,000 acres (182 thousand hectares) of mostly cloud forest in the mountains above Rioja. Ramiro and I stayed at the ranger encampment there and explored the area at elevations between 1500 and 2000 meters for several days. Just as I was beginning to think there were no *Costus* there we spotted this plant at left, being photographed by Ramiro.

I knew at once that this was something different, but whether it was a new species or just a variation of the very common species *Costus scaber* I could not tell. Later we

found several more of the same form in the reserve, and I took detailed photos and documented the plants with a detailed description of the vegetative and floral characteristics. . I still did not know whether it was a new species, but I chose the cultivar name 'Twister' and eventually published it in the *Heliconia Society Bulletin's* cultivar registry.

The next time I saw this species was in 2016. I traveled to the central Peruvian department of Huanuco to look for the three species in Costaceae that had been collected and described over 230 years ago by the Spanish explorer, Hipólito Ruiz. I wrote an article about that trip for the *Heliconia Society Bulletin* entitled "Following Ruiz" (vol. 22, n. 4, pg 7-14, 2016. <https://www.heliconia.org/back-issues>). My main purpose was to look for plants in the type locality of *Costus laevis* Ruiz & Pavon, but in order to do so I had studied his journal and determined all the present-day localities where Ruiz had been. One of those localities is a place called Chinchao at an elevation of nearly 2000 meters. Here he had described the species that is now known as *Dimerocostus argenteus* and he also mentioned in his journal a species he called "Costus ruber", but that name was never again mentioned or described by him. His shipment back to Spain of this species was lost in a shipwreck of the coast of Portugal.

When I arrived at Chinchao I found, as expected, the *Dimerocostus argenteus*, but growing right next to it was a completely different species similar to what we know as *Costus scaber*, but with a very different flower form, longer calyx, and lacking the characteristic line of hairs on the upper midrib of the leaves. I did not know what to make of it, but I photographed it in detail and wrote down the measurements and description of all the details. This observation can be found on Inaturalist at <https://www.inaturalist.org/observations/4622557>. Later, at lower elevations, I found plants growing that were consistent



Costus rubineus at Chinchao, Huanuco, Peru.

in all details with the species Ruiz had described as *Costus scaber* Ruiz & Pavon.

After finding this at two high-elevation locations nearly 500 km apart, with similar distinguishing characteristics, I still was not totally convinced that I had a new species. It was not until the following year when I went to the Peruvian department of Pasco, and saw this in the mountains above the town of Villa Rica, that I was sure it was a separate species from the lowland species *Costus scaber*. . Here, in Oaxapampa province, I found many more populations of this species at elevations between 1500 and 2100

The Purpose of HSI

The purpose of HSI is to increase the enjoyment and understanding of *Heliconia* (Heliconiaceae) and related plants (in the families Cannaceae, Costaceae, Lowiaceae, Marantaceae, Musaceae, Strelitziaceae, and Zingiberaceae) of the order Zingiberales 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 non-profit corporation, was formed in 1985 because of rapidly developing interest around the world in these 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.

Membership dues are (in \$US): Individual \$40, Family \$45, PDF \$25, Student \$10, Contributing \$50, Corporate \$100, Sustaining \$500, Lifetime Member \$1000. Membership fees con-

stitute annual dues from 1 July through 30 June. All members receive the BULLETIN (usually published quarterly) and special announcements. Join or renew your membership at www.heliconia.org.

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meters, and I documented 4 of them on Inaturalist. I drafted a written description of the new species and decided to name it *Costus rubineus* in honor of Hipólito Ruíz who had first discovered it 230 years before. I would have named it *Costus ruber*, but that name was already conserved for another species, now known as a synonym of the species *Costus pulverulentus*.



Costus rubineus in Oaxapampa, Pasco, Peru

When I suggested this to Paul Maas, he examined several collections from Oxapampa and other areas and agreed that it is a new species. He selected as the holotype a specimen at the herbarium in Leiden in the Netherlands that was collected near the same site as one of my Inaturalist observations.

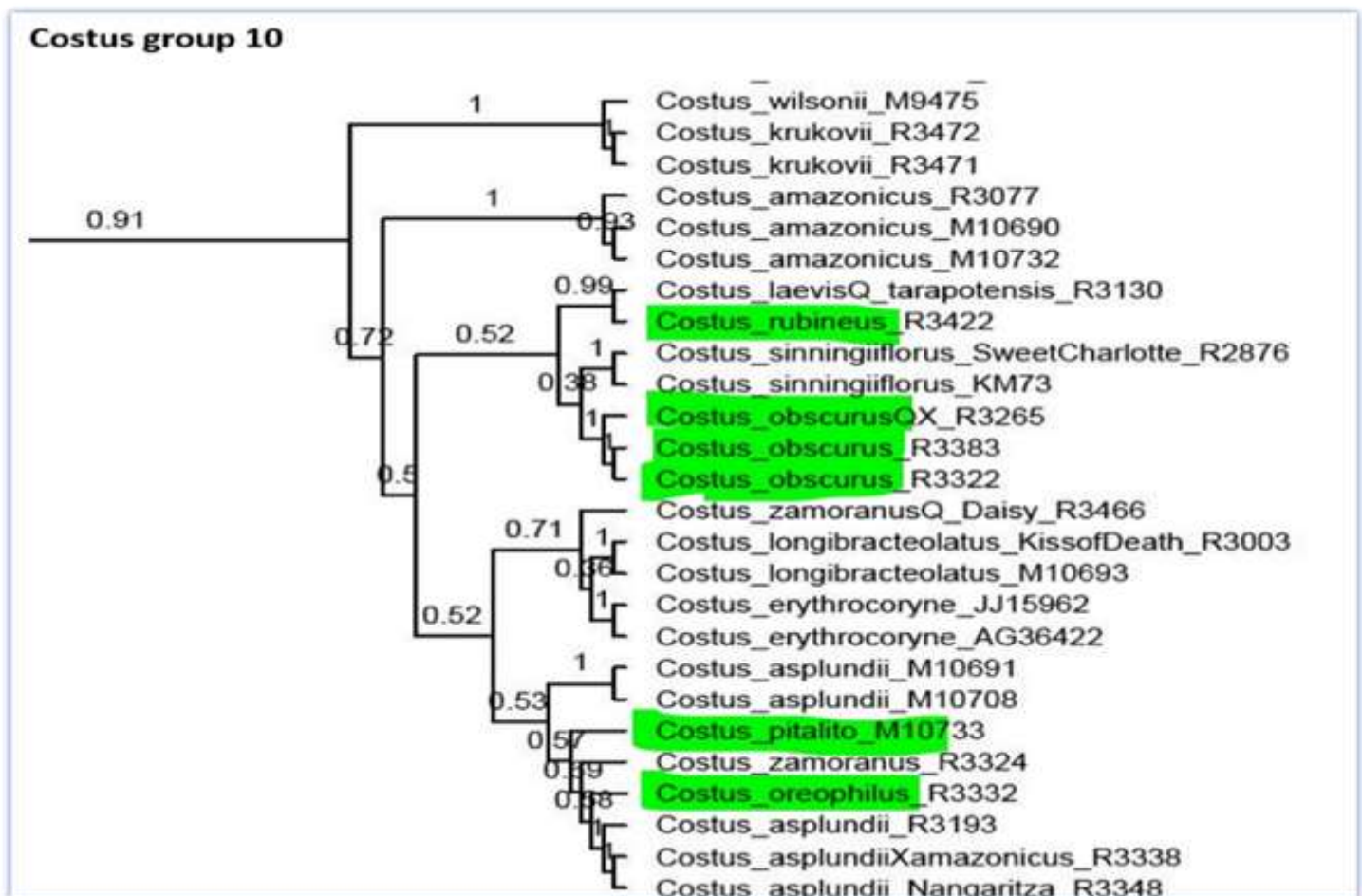
We finalized the description in our draft manuscript for the Revision to New World Costaceae, and sent tissue to Cornell to be included in the molecular phylogeny that is still being expanded there to make the most complete phylogeny of Costaceae ever published.

It was still a huge relief to me when a preliminary phylogeny was completed (published in *Frontiers in Plant Science* 13: <https://doi.org/10.3389/fpls.2022.874322>) in which our new species was found in a completely separate lineage from any of the many *Costus scaber* samples from either South America or Central America.

Costus rubineus showed up in a clade with another species from near Tarapoto, Peru that will ultimately be included with our reinterpretation of *Costus laevis* R & P.

Three of our other new species, *Costus obscurus*, *Costus pitalito*, and *Costus oreophilus* were also well supported as separate species in this same lineage grouping.

I will write the stories of those other new species in future issues of the Heliconia Society Bulletin, or you can read more about them on my website at www.gingersrus.com .



Zingiberales and rolled-leaf beetles in a Costa Rican rainforest

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Zingiberales are important components of the understory and open areas flora of Costa Rican forests. Also, they are popular plants in the gardens of local people around the country because of their beautiful leaves and flowers, and their food potential. These plants include native and exotic members of the families Musaceae (bananas), Heliconiaceae (heliconia) (Fig. 1), Costaceae (spiral ginger or ‘caña agria’), Strelitzaceae (bird of paradise and travelers palm), Cannaceae (cannas), Marantaceae (prayer plants) and Zingiberaceae (gingers). Besides their ornamental and food uses, Zingiberales have diverse ecological interactions with pollinators, seed dispersers and herbivores. In the Neotropics, Zingiberales are eaten by larvae of various Lepidoptera, leaf-cutting ants and curculionids. However, rolled-leaf beetles are considered their main herbivores (Seifert 1982, García-Robledo *et al.* 2007, Santos & Benítez-Malvido 2012, Aristazábal *et al.* 2013).



Figure 1. *H. pogonantha* var. *pogonantha* at the gardens of La Selva Biological Station (LSBS), Costa Rica. Photo by Jeremy Squire.

The Neotropical rolled-leaf or hispine beetles are small, flattened beetles, in the highly diverse leaf beetle family, the Chrysomelidae (Fig. 2). The beetles complete their life cycle in the young rolled leaves of the Zingiberales, where they feed and mate (Strong 1977) (Fig. 2). Some beetle larvae feed on petioles and inflorescences of their host plants (Staines & García-Robledo 2014). The beetles rely on the rolled leaf as a resource. The rolled leaves provide a habitat that protects the beetles from desiccation, predators and parasitoids, while also serving as a food source (Strong 1984).



Figure 2. Rolled-leaf beetles with phoretic mites that use the beetles as taxis to colonize new rolled leaves. At LSBS, Costa Rica. Photos by Pablo A. Piedra.

For my PhD dissertation at the University of Missouri-St. Louis (UMSL), advised by Dr. Robert J. Marquis, I studied the Zingiberales and rolled-leaf beetles at La Selva Biological Station - LSBS (Fig. 3). At La Selva there are 33 native and 5 exotic species of Zingiberales, and 20 species of rolled-leaf beetles. Thanks to previous research of my collaborator Dr. Carlos García-Robledo, we know the specific diets of each of beetle species (García-Robledo *et al.* 2007). In other words, we know which host plants each beetle species feeds on, and what is the relative contribution of each host plant to the diet of each beetle species. For example, the beetle *Cephaloleia belti* feeds on 17 different host plants, whereas the beetle species *Cephaloleia bella* feeds on only one host plant. Overall, 75% (15 out of 20) of the beetle species are specialists at the family level, that is, they feed on only one plant family of Zingiberales. The factors determining the diets of the rolled-leaf beetle assemblage at La Selva are unknown, and they are the motivation of my research. By rolled-leaf beetle assemblage I refer to all the rolled-leaf beetle species that occur at La Selva which are structured by many factors such as their host plants. Some beetle species are common, others are rare, some feed on several plant species and others feed on a single plant species. Therefore, the assemblage includes all the species but also

takes into account their distribution across the host plant species that occur at La Selva.



Figure 3. Collection of rolled leaves of Zingiberales at LSBS, Costa Rica. Photo by Pablo A. Piedra.

For my dissertation, I look in an evolutionary context at **1)** the role of non-traditional plant traits (*i.e.* leaf size) structuring the rolled-leaf beetle assemblage, **2)** the role of physical, nutritional and chemical traits structuring the rolled-leaf beetle assemblage, and **3)** the role of physical, nutritional and chemical traits determining novel host expansion to exotic Zingiberales.

As a summary, I found that **1)** Zingiberales species with larger leaves host more beetle species and more beetles in total (Chaves-Fallas et al. in prep.), **2)** rolled-leaf beetles feed on host plants that are more similar in their chemistry and that are more closely evolutionary related (Chaves-Fallas et al. in prep.), and **3)** rolled-leaf beetles feed on exotic host that are more similar in their plant traits and more closely related to their native hosts (Chaves-Fallas et al. in prep.).

The Zingiberales and rolled-leaf beetles represent a unique system to understand the ecology and evolution of plant-herbivore interaction in the tropics, and understanding their interactions is fundamental to promote management and conservation effort to protect them in this changing world.

Understanding plant-herbivore interactions in diverse multispecies systems is a challenge for ecologists. To understand these interactions in an evolutionary context, I constructed a phylogenetic tree, which is a tree of life, of the Zingiberales species occurring at La Selva. This phylogenetic tree was done thanks to the funding provided by the Heliconia Society International (HSI) through HSI

Awards for Botanical and Horticultural Research Projects on the Zingiberales and will be published in a future number of the Bulletin.

Acknowledgements

All this work has been conducted thanks to my collaborators Robert J. Marquis, Giselle Tamayo-Castillo, Carlos García-Robledo, Luis Quirós-Guerrero, Mónica M. Carlsson, Mónica Rojas-Gómez, Andrés Sánchez-Kopper, Jean-Luc Wolfender and Orlando Vargas, and the institutions to which they are affiliated. This research was funded by the Whitney R. Harris World Ecology Center at the University of Missouri-St. Louis (Christensen Fund in Plant Conservation, Van Trease, Peter Raven and Harris Center Research Scholarships), the Organization for Tropical Studies (OTS) (Glaxo Centro America-2017 and 2019, and William L. Brown-2019 Research Fellowships), the University of Missouri-St. Louis Dissertation Fellowship and the Heliconia Society International (HSI).

Literature Cited will be listed on the HSI web site.

The International Palm Society's 33rd Biennial in NEW CALEDONIA

(Southwestern Pacific Ocean)

Sunday September 22- Monday September 30, 2024

After over two years of intense planning and having procured of land visitation rights from several tribal and provincial leaders, the International Palm Society is thrilled to announce the upcoming biennial.

Endemism on this small island is unrivaled and we expect to see many botanical wonders in habitat.

We hope that you will join us. More information is available at palms.org



2024 IPS New Caledonia Eight Days in Review: Concentration on the Southern Provinces habitat



• **Day 1:** Sept. 22, 2024 **General Arrival**, Le Méridien Nouméa Hotel
Check-in, Welcome Reception

• **Day 2:** Sept. 23rd : Rivière Bleue Botanical Reserve. 64 Miles

• **Day 3:** Sept. 24th : La Madeleine Forêt du Pic du Pin AND Prony,
South, Goro, Yaté

• **Day 4:** Sept. 25th: Col d'Amieu, Plateau de Poro & Côte Est, Kua
Valley. (East Coast)

• **Day 5:** Sept. 26th: Nodela Botanical Reserve (West Coast) and
Rivière du Cap

• **Day 6:** Sept. 27th: Col d'Amos (Very North and a long 12 hour
day, 3.5 hour each way w/ stop at). Only North Province viewing

• **Day 7:** Sept. 28th: Forêt de palmiers Royaumes de Moindou (tallest R.
oleracia). Mont Koghi and Lavoix Property

• **Day 8:** Sept. 29th: Tontouta nickel mine, Pierson propriety, and
Farewell Banquet.

• **Departure** September 30th or start of the Post-Tour.

Checklist of 27 Possible Species planned for viewing

BASSELINIA:

Basselinia deplanchei (Pending)
Basselinia eriostachys
Basselinia favieri
Basselinia glabrata
Basselinia gracilis
Basselinia iterata
Basselinia moorei
Basselinia pancheri

BURRETIOKENTIA:

Burretiokentia dumasii
Burretiokentia grandiflora
Burretiokentia hapala
Burretiokentia koghiensis
Burretiokentia vieillardii

CHAMBEYRONIA:

Chambeyronia divaricata
Chambeyronia houailouensis
Chambeyronia macrocarpa
Chambeyronia magnifica
Chambeyronia oliviformis
Chambeyronia pyriformis

CLINOSPERMA:

Clinosperma bracteale
Clinosperma vaginata

CYPHOKENTIA:

Cyphokentia cerifera
Cyphokentia macrostachya

CYPHOPHOENIX:

Cyphophoenix alba
Cyphophoenix elegans
Cyphophoenix fulcita

SARIBUS:

Saribus jeanneneyi (Pending)

Non-endemic: Cocos nucifera

Heliconia species names and what they mean, Part III

See Bulletin 27(2) for Part I and 28(2) for Part II.

Prepared by Dr. Richard Criley with contributions from Ana Cecilia R. Castro* and Carla Black**

Note: Not all of these species' names are currently accepted, but we include them because they appear in the literature. If you have additional information or insight to these names, please let us know.



H. clinophylla. Clinophila: bent



H. abaloii at Jardin Botánico Quindío. Abaloii: honors José Ábalo, heliconia collector



H. arrecta. Arrecta: erect; referring the upright position of its leaves*



H. atropurpurea, dark underleaf. Atropurpurea: dark purple.



At left, *H. aurantiaca*. Aurantiaca: orange. At right, *H. beckneri*. Beckneri: honors John Beckner of Florida, who introduced author R. R. Smith to the genus Heliconia* Below, *H. beckneri in situ* in Costa Rica.



H. apparicioi. Apparicioi: honors Apparicio P. Duarte for his valuable contributions *





H. bella in situ in Panama. Bella: beautiful



H. bourgaeana. Bourgaeana: honors Eugene Bourgeau, lectotype collector of the herbarium type specimen*



H. colgantea in situ in Costa Rica.



H. donstonea in situ in Colombia. Donstonea: honors Dr. Donald E. Stone of Duke University*



H. gigantea in situ in Colombia. Gigantea: very large; giant size of plants and especially inflorescences* With Carla Black.



H. dielsiana. Dielsiana: honors botanist and collector Dr. Friedrich Ludwig Emil Diels*



H. cucullata. Cucullate: hooded, referring to the unusual shape of the tip of the flower**



H. linnartiana has many color forms, Linnartiana: honors Dr. Lennart Andersson



H. marginata. Marginata: margined; refers to yellow margins of the red bracts**



H. montana. Montana: montane



H. librata. Librata: free



H. lutheri and Bruce Dunston in northwest Ecuador. Lutheri: honors type specimen collector Harry E. Luther*



H. lindsayana. Lindsayana: honors Dr. Lindsay Clarkson, wife of Dr. W. J. Kress**



H. mooreana. Mooreana: honors Harold E. Moore, holotype collector*



H. mutisiana. Mutisiana: honors José Celestino Mutis, 18th Century scientist in Colombia**

Floral architecture in sympatric species in the genus *Heliconia*

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Introduction

The close relationships between plants and animals can reveal the occurrence of co-evolutionary processes. The diversity of forms in the expression of angiosperms stands out mainly in the reproductive structures and in the different pollination mechanisms. Those are a reflection of the co-evolutionary adaptations between plants and their floral visitors (Stebbins, 1970; Smith and Smith, 2007). This has been visualized in various taxa, such as mutualistic interactions between plants and hummingbirds (Amaya *et al.*, 1999, Gutiérrez and Rojas, 2004). Therefore, the interest in learning about these interactions between heliconias and a group of birds that has been suggested to be their exclusive pollinators, hummingbirds, stands out (Stiles, 1975).

Heliconias, belonging to the tropical order Zingiberales, are part of the monocotyledonous class. They are large herbs with brightly colored inflorescences that exhibit evolutionary associations related mainly to their floral biology, in which some species of hummingbirds participate in particular (Stiles, 1979). Interesting interaction factors have been identified between hummingbirds of the Trochilidae family and a large number of heliconia species, such as *Heliconia latispatha* Benth., *H. griggsiana* L.B.Sm., *H. burleana* Abalo and G. Morales L., among others. The division of resources such as nectar and pollen suggest co-adaptive changes that involve morphological attributes such as the curvature and length of the hummingbird beak and its coupling with the perianth shapes of this plant group (Cardozo *et al.*, 2018). According to Gutiérrez y Rojas (2004), hummingbirds choose their floral resources more specifically based on the perianth-beak morphological compatibility, since this is a determining factor in the efficiency of nectar extrac-

In a co-evolutionary perspective, Smith and Smith (2007) suggests that these interaction processes take place when two or more organisms with close ecological relationships exert mutual and synchronous selective pressures, without

exchange of genetic material, which can lead to reciprocal specific adaptations generating exclusivity between species. This presents benefits and disadvantages for plants, since having exclusive pollinators would decrease self-fertilization, given that many heliconia species are self-compatible (Donjuan *et al.*, 2013), thus favoring cross-pollination. However, this situation is not usually frequent, since hummingbirds are floral visitors to various heliconia species, which could lead to a reduction in reproductive success due to loss of mixed pollen loads, or even in hybridization processes assisted by hummingbirds.

Selective pressure that can be visualized at the beak-perianth junction is considered a co-adaptive event (Stiles, 1979; Cardozo *et al.*, 2018). However, the specificity is not total. There are hummingbirds whose visits are not effective and there is evidence of their behavior as nectar thieves (Fuchs and Quesada, 2005; Rojas-Nossa, 2013). As a consequence of this, the possible competition between the members of the genus *Heliconia* for pollinators becomes a determining factor. The "configuration" in terms of color, smell and habit of the inflorescence, becomes crucial when attracting pollinators. The variables of length of the perianth tube, width, curvature, opening angle of the free sepal, among others, are essential to understanding the pollination process and the possible competition that could exist between populations of heliconias that coexist in the same place (Stiles, 1975).

In this study, the following question was raised: How do the morphometric attributes of floral architecture vary in six sympatric *Heliconia* species present in a relict of secondary forest located inside the campus of the University of Quindío and called Sendero Cedro Rosado? To resolve this question, the objective was to examine the variation of the eight variables related to floral morphology in six species of the genus *Heliconia*, with pendent and erect inflorescences, to identify the variation in their floral morphology.

Materials and Methods

Study area

The study was carried out in a premontane humid forest, according to the zone classification system proposed by Holdridge *et al.* (1971). This has 130,577 m² and includes mostly natural vegetation interspersed with patches of secondary forest and the presence of *guaduales* (bamboo stands), on the Cedro Rosado trail, located on the campus of the University of Quindío in the city of Armenia, Colombia. It is located at 4° 38' 12.88" N and 74° 5' 1.73" W, approximately 1530 meters above sea level (Rodríguez, 1999).

Field phase

A pre-sampling (Fig. 1) of 50-meter free transects was carried out on the Cedro Rosado trail of the University of Quindío, identifying the *Heliconia* species that were in a fertile state. From this search, six species were selected: *Heliconia burleana* Abalo and G. Morales, *Heliconia griggsiana* L.B. Sm., *Heliconia latispatha* Benth., *H. montana* Abalo and G. Morales, *H. vaginalis* Benth. and *H. venusta* Abalo and G. Morales. Table 1 and Fig. 2 highlight the basic characteristics of the selected species.



Figure 1. Pre-sampling for the identification of *Heliconia* species on the Cedro Rosado trail of the University of Quindío.

perianth width (AP), stamen length (LE), pistil length (LPO), stamen exertion (EE), effective length (LEF) and angle of the free sepal (ASL), according to Morales A. et al. (2019). Finally, the curvature of the perianth (CC) following Temeles *et al.* (2009). With the ImageJ program, the measurements were taken digitally (Fig. 5). For data analysis, a principal component analysis (PCA) was used using Past version 4.11.

The results of the Principal Component Analysis (PCA) denote a clear separation of two groups: the first group is made up of species with small (4 to 4.5 cm) and parabolic flowers, and the second group by species with large (6.5

Table 1. Basic macroscopic morphology and coloration of the heliconias.

<u>Species</u>	<u>Inflorescence habit</u>	<u>Bract color</u>	<u>Flower color and shape</u>
<i>H. burleana</i>	Erect	Wine red	Green and parabolic
<i>H. griggsiana</i>	Pendent	Yellow border, grayish in the medial portion, base and rachis reddish	Orange or yellow, straight
<i>H. latispatha</i>	Erect	Orange border, yellow In the medial portion	Yellow, greenish at the apex and inside of the free sepal, semi-parabolic
<i>H. montana</i>	Erect	Red	Yellow and straight
<i>H. vaginalis</i>	Erect	Red	Yellow, greenish at the apex, parabolic
<i>H. venusta</i>	Erect	Red	Yellow and greenish at its apex, straight

Sampling and laboratory phase

In the field, a total of 72 flowers were collected. They were chosen at anthesis stage that did not show signs of mechanical deterioration or herbivory. For each of the species, 12 flowers from different individuals were collected. The flowers were collected manually with fine-tipped tweezers and placed against a blue background for contrast. Each flower was assigned a unique code to facilitate identification. The code was based on the initial of the genus and the specific epithet, the number assigned to the individual of the species at the time the flower was obtained, and the number of the flower collection (Fig. 3).

Finally, photographs of the complete flowers were taken with their respective code and with a ruler that will facilitate the morphometric measurements. A longitudinal cut was made to each of the flowers (Fig. 4) to evaluate variables such as effective length, stamen length, pistil length, among others.

Data analysis

Eight measurements were taken: perianth length (LP),

to 8 cm) and straight flowers. It was identified that the width, curvature of the perianth and the angle of the free sepal were the variables that contributed most in the correlation of the species, obtaining in the PCA analysis 84% of the total variance of the data (Fig. 6). Furthermore, the differences in the perianth length, pistil length, stamen length and effective length are the variables that stand out between the group of small-parabolic flowers and large-straight flowers. In the perianth curvature variable, *Heliconia burleana* is significantly different from the other species because it presents a parabolic curvature of 0.28 mm, while the rest of the species range between 0.14 and 0.17 mm.

The observed characteristics may be due to the exclusive selection of pollinators (Stiles, 1975). Similarly, the curvature, length and exertion of the stamens are morphological variables that determine the placement of pollen on the pollinators because, depending on the pollen deposition site, an effective intra-species cross-pollination can be carried out or hybridization can occur.

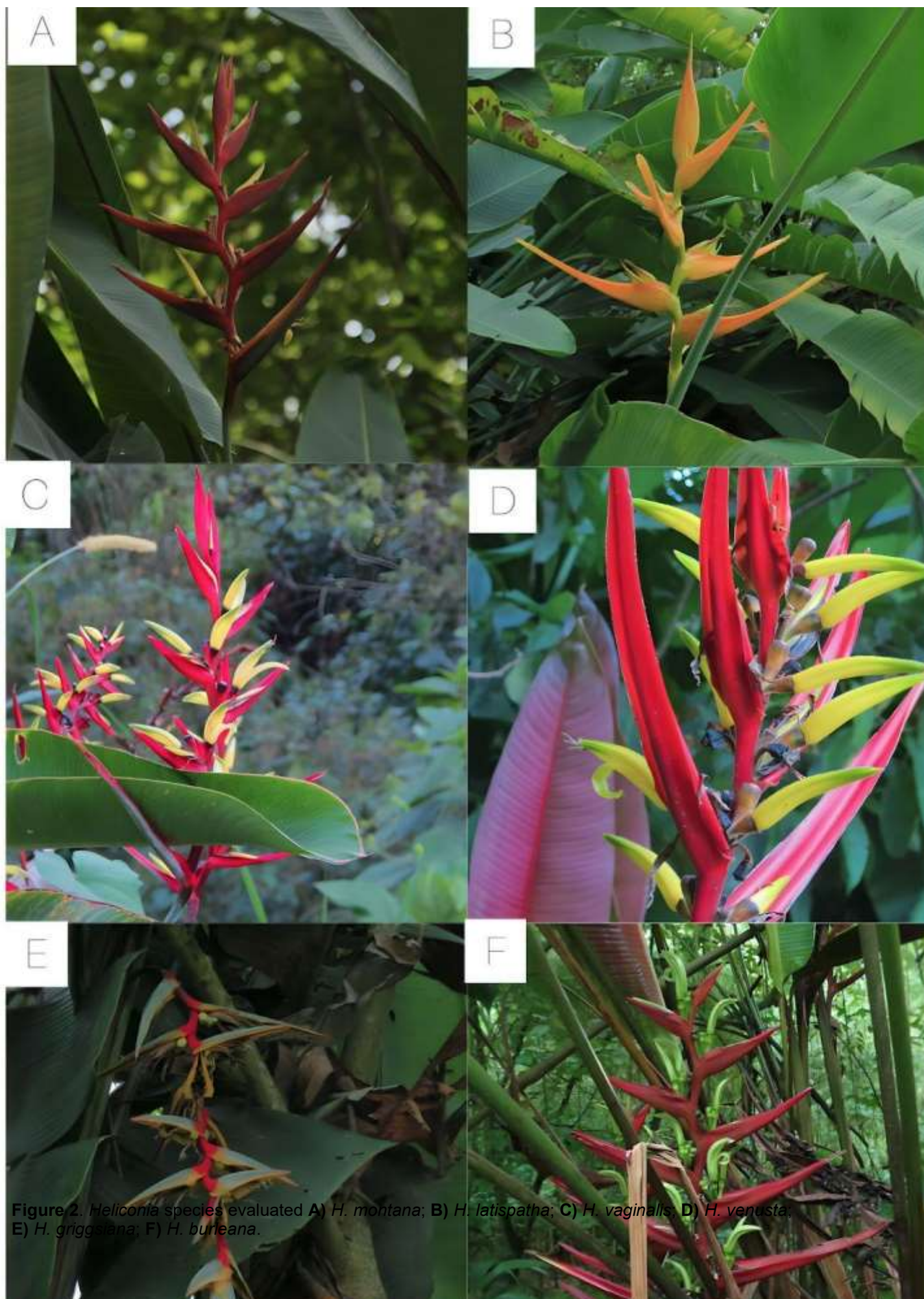


Figure 2. *Heliconia* species evaluated A) *H. montana*; B) *H. latispatha*; C) *H. vaginalis*; D) *H. venusta*; E) *H. griggsiana*; F) *H. bureana*.



Figure 3. Collection phase. **A** and **B**) Manual collection with tweezers. **C**) Utilization of pruning shears for species taller than 2 meters. **D**) Assignment of code and taking measurements of the flowers.



Fig. 4. Photographs of the flower (left) and with a longitudinal section (right) for measurement of the structures of: **A)** *H. vaginalis*; **B)** *H. burleana*; **C)** *H. latispatha*; **D)** *H. griggsiana*; **E)** *H. venusta*; **F)** *H. montana*.

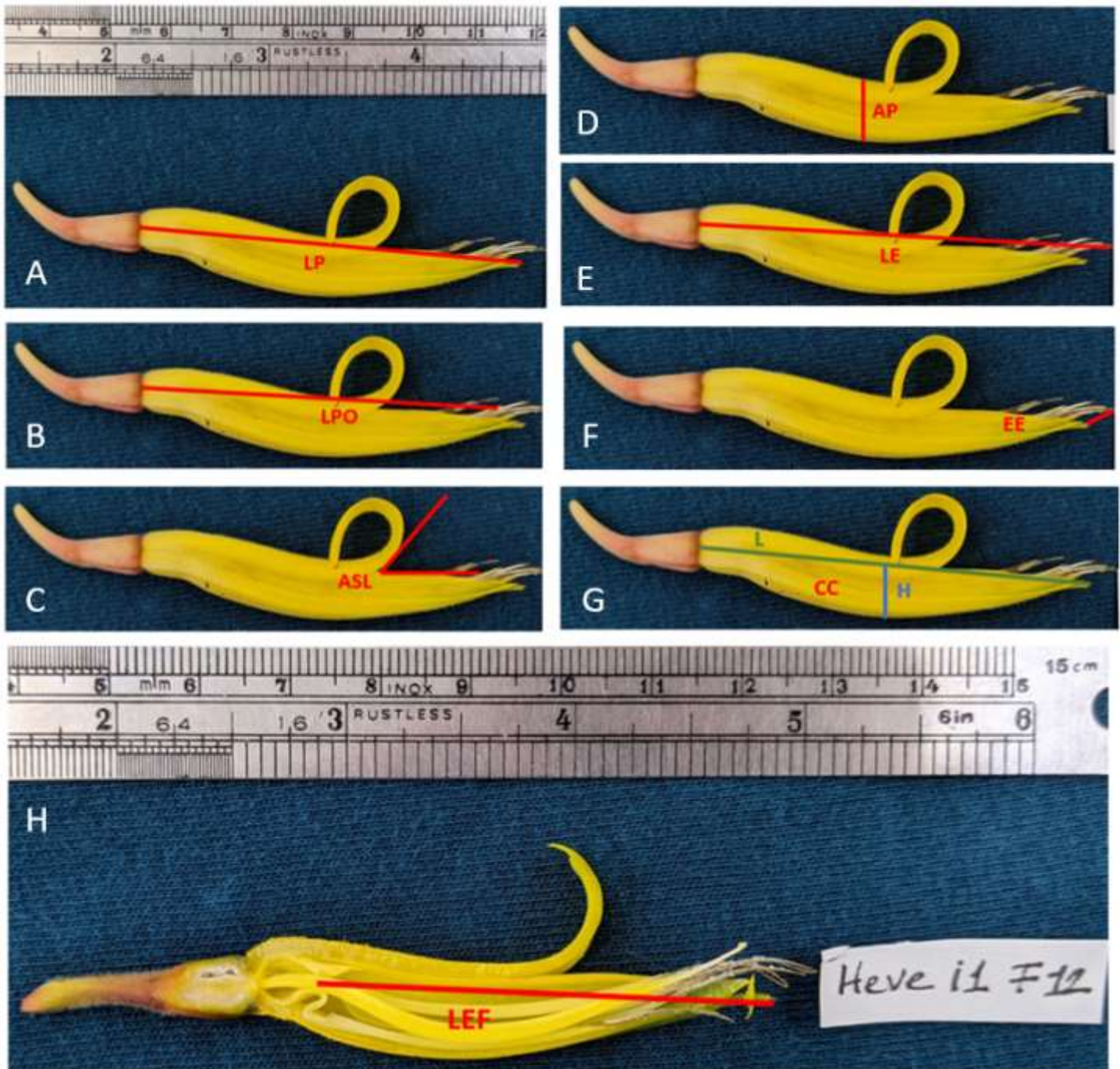


Fig. 5. Example of morphometry in *H. venusta* flowers parts. **A)** Perianth length (LP); **B)** Pistil length (LPO); **C)** Angle of the free sepal (ASL); **D)** Width of the perianth (AP); **E)** Stamen length (LE); **F)** Exertion of the stamens (EE); **G)** Curvature of the perianth (CC); **H)** Effective length (LEF).

The Results, Discussion, Conclusion and Acknowledgements, along with additional illustrations will continue in the next issue of the Bulletin.

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