

THE DIVERSITY AND DISTRIBUTION OF HELICONIA (HELICONIACEAE) IN BRAZIL

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RESUMO — É apresentada uma revisão filogenética das Zingiberales e os padrões de distribuição geográfica e a diversidade das *Heliconia* são apresentados. Para o gênero são referidos 65 nomes de espécies dos quais provavelmente 28 sejam sinónimas. Das 37 espécies restantes, existe controvérsia pelo menos para oito delas. Duas áreas de distribuição de espécies de *Heliconia* são apresentadas para o Brasil: a bacia amazônica (21 espécies) e a floresta costeira Atlântica (20 espécies).

Palavras-chaves: Zingiberales, *Heliconia*, diversidade, distribuição.

ABSTRACT — A review of the phylogenetic relationships of the Zingiberales is presented and the distribution patterns and diversity of *Heliconia* are discussed. Sixty-five species names have been applied to the heliconias that occur in Brazil. Of these 65 names, 28 are generally recognized synonyms. Of the remaining 37 species of Brazilian *Heliconia*, some controversy exists over the taxonomic status of at least eight. Two primary areas of distribution of species of *Heliconia* exist in Brazil: the Amazon basin (21 species) and the Atlantic coastal forest (20 species).

Key-words: Zingiberales, *Heliconia*, diversity, distribution.

Introduction

The taxonomy of *Heliconia* (Heliconiaceae: Zingiberales: Monocotyledonae) is currently being investigated by a number of South American (e.g., Abalo & Morales, 1982, 1983; Aristeguieta, 1961; Barreiros, 1976, 1980; Emygdio, 1975, 1976; Emygdio & Santos, 1987; Santos, 1978), European (Andersson,

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1981a, 1985a, b; Maas, 1985) and North American (Daniels & Stiles, 1979; Kress, 1984, 1989, 1990a; Smith, 1980) botanists and a consensus on species boundaries and relationships has not yet been reached. For this reason estimates on the number of species of *Heliconia* range from 120 to over 400. However, recent progress on enumerating and describing taxa indicates that 200 to 250 species is a good estimate for the genus.

Results and discussion

The Zingiberales

Heliconia is the only genus in the plant family Heliconiaceae, which is a member of the order Zingiberales (earlier called the Scitamineae). In addition to the several cellular features (short root hair cells, sieve tube plastids with starch, silica bodies, inaperturate and exineless pollen) that distinguish the Zingiberales from other monocots, there are several very conspicuous characters by which they can be recognized, including, 1) large leaves with long petioles and blades possessing transverse venation, 2) large, usually colorful, bracteate inflorescences, and 3) arillate seeds. This order is most closely related to the family Bromeliaceae and their relatives in the superorder Bromeliiflorae (Dahlgren, Clifford & Yeo, 1985; Kress, 1990b).

Most current taxonomists (see Kress, 1990b) recognize eight separate families in the Zingiberales: Musaceae, Strelitziaceae, Lowiaceae, Heliconiaceae, Zingiberaceae, Costaceae, Cannaceae, and Marantaceae. Most of the members of these eight families are native to the tropical regions of the earth and many are found in Brazil.

FAMILY MUSACEAE. Native species of the two genera of the banana family, *Musa* (35 species) and *Ensete* (7 species), are restricted to the paleotropics of Africa, eastern Asia, Australia, and the South Pacific. However, both genera have been extensively cultivated and hybridized for thousands of years and are now distributed around the world. In Brazil, many cultivars of edible bananas (triploids of *M. acuminata*) and plantains (hybrids of *M. acuminata* x *paradisica*) are grown.

FAMILY STRELITZIACEAE. The three genera and seven species of the family, *Strelitzia* (five species), *Ravenala* (one species), and *Phenakospermum* (one species), are restricted to southern Africa, Madagascar, and South American, respectively. The latter genus is native to Amazonian Brazil. The birds-of-paradise (*Strelitzia reginae* and *Strelitzia nicolai*) and traveller's palm (*Ravenala madagascariensis*) are commonly grown as landscape and greenhouse ornamentals throughout tropical America, including Brazil.

FAMILY LOWIACEAE. The single genus of the family, *Orchidantha*, with five to eight species, is found in Southeast Asia and some Pacific Islands. *Orchidantha* has always been considered an unusual member of the Zingi-

berales and is among the most poorly known taxa in the order in terms of botany and horticulture.

FAMILY HELICONIACEAE. *Heliconia* has been variously associated with the Musaceae or the Strelitziaceae, but is now placed in its own family Heliconiaceae. The inverted flowers, the presence of a single staminode, and the drupaceous fruits are special features of *Heliconia*. Many species and varieties native to Brazil are now being grown as pot plants and as cut-flowers.

FAMILY ZINGIBERACEAE. The Zingiberaceae, the largest family in the Zingiberales, consist of approximately 50 genera and 1000 species. Gingers are found in all tropical regions of the world, but are concentrated in the Old World, especially in Southeast Asia. Only one genus, *Renealmia*, is found in the neotropics (one-third of the genus occurs in Africa) with about eight species found in Brazil (Maas, 1977).

FAMILY COSTACEAE. The Costaceae, consisting of four genera and about 150 species, are distributed throughout the Asian, African, and American tropics. The largest genus *Costus* (100 species) is most diverse in the American tropics, but is also found in Africa, Asia, and northern Australia. *Monocostus* (one species) and *Dimerocostus* (two species) are restricted to the New World tropics. *Tapeinochilos* (20 species) extends through New Guinea, Indonesia and tropical Australia. Only the genus *Costus* is found in Brazil with a center of diversity in Pará (Maas, 1972). The Costaceae in the past have been classified as a subdivision of the Zingiberaceae, but are now accepted by the majority of taxonomists as a separate family.

FAMILY CANNACEAE. *Canna*, the solitary genus in the family, is primarily found in the New World tropics and subtropics. Estimates on the number of species in *Canna* range from 10 to 60 (Maas & Maas, 1988). Probably three species occur in Brazil.

FAMILY MARANTACEAE. The Marantaceae are the second largest family in the order with 30 genera and 450 to 500 species. Although members of this family are found throughout the tropics, three-quarters of the species, many in the large genus *Calathea*, are found in the neotropics. Of the 14 genera occurring in South America, 11 are represented in Brazil. Among the Brazilian genera, two are endemic to Brazil (*Saranthe*, *Koernickanthe*), five have their major centers of diversity in Brazil (*Monotagma*, *Hylaeanthe*, *Maranta*, *Ctenanthe*, *Myrosma*), and three have at least one secondary center of diversity in Brazil (*Calathea*, *Ischnosiphon*, *Stromanthe*) (Andersson, 1977, 1981b; H. Kennedy, pers. comm.). Many members of the Marantaceae (e.g., *Maranta*, *Calathea*, *Stromanthe*, and *Ctenanthe*) endemic to Brazil (especially the Atlantic coastal forests) are cultivated as ornamentals.

Habitat and distribution of *Heliconia*

Heliconias are native primarily in the American tropics from the Tropic of Cancer in Central Mexico to the Tropic of Capricorn in South America, including the Caribbean. A curious disjunct group of six species of *Heliconia* separated by thousands of miles from most other species is found in the Old World tropics (Kress, 1985, 1990a). The center of diversity of the genus is found along the northern Andes (Colombia and Ecuador) extending into southern Central America (Panama and Costa Rica; Andersson, 1989). Most species inhabit moist or wet regions, but some are found in seasonally dry areas. Although *heliconias* attain their most luxuriant vegetative growth in the humid lowland tropics at elevations below 500 meters, the greatest numbers of species (many locally endemic) are found in middle-elevation (800-1,500 meters) rain and cloud forest habitats. Few species occur above 2000 meters.

The most conspicuous members of the genus inhabit open sites in secondary growth along roadsides, on river banks, and in forest light gaps. With increased destruction by man of the tropical rain forest, these species readily invade and colonize the newly opened areas. Other species never attain such extensive vegetative growth and are restricted to the more shaded habitats of the primary forest. These latter species are often locally endemic and are fast becoming extinct as destruction of the tropical forest accelerates.

Classification of *Heliconia*

Over the past 100 years several infrageneric classifications of *Heliconia* have been proposed; each one has been more complex than its predecessors (Kress, 1984). Until recently the classification recognized by most workers is the one proposed by Griggs in 1915. His classification consists of two subgenera and six subordinate taxa of unspecified rank. Plant habit and height, inflorescence orientation, cincinnal bract orientation, and the distance between adjacent bracts are characters he used to define subgeneric groups.

Andersson (1985a, b) has proposed a new, slightly different classification of the genus in which the ranks and arrangement of Griggs' taxa are changed (Table 1). Andersson's subgenera and sections are more carefully defined and circumscribed than those of Griggs. Although he has not discussed the phylogenetic relationships of his taxa nor provided evidence that his subgenera and sections are monophyletic, Andersson's system is a great improvement on the system of Griggs. A detailed analysis of the classification of subgen. *Griggsia*, one of the largest taxa that is made up of species possessing pendent inflorescences, is in progress (Kress, unpubl.).

Table 1. Classification of the Heliconias of Brazil (after Andersson, 1985a, b).

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- Subg. *Taeniostrobos* Kuntze (Griggs)
H. episcopalis Vell.
- Subg. *Heliconia*
 Sect. *Heliconia*
H. adeliana Emygdio & Santos
H. bihai (L.) L.
H. stricta Huber
- Sect. *Tortex* Andersson
H. pabstii Emygdio & Santos
H. spathocircinata Aristeg.
- Sect. Novo I
H. lourteigiae Emygdio & Santos
- Sect. Novo II
H. farinosa Raddi
H. kautzkiana Emygdio & Santos
H. rivularis Emygdio & Santos
H. sampaioana Emygdio
H. velloziana Emygdio
- Subg. *Griggsia* Andersson
H. chartacea Lane ex Barreiros
H. juruana Loes.
H. marie-augustae Emygdio & Santos
H. pendula Wawra
- Subg. *Stenochlamys* Baker
 Sect. *Stenochlamys* (Baker) Schumann
H. acuminata L. C. Rich.
H. angusta Vell.
H. auriculata Barreiros
H. aurorea Emygdio & Santos
H. citrina Emygdio & Santos
H. fluminensis Emygdio & Santos
H. lacletteana Emygdio & Santos
H. laneana Barreiros
H. psittacorum L.f.
H. richardiana Miq.
H. timothei L. Anderss.
- Sect. *Lanea* Andersson
H. aemygdiana Burle Marx
H. pseudoaemygdiana Emygdio & Santos
- Sect. *Proxichlamys* Andersson
H. densiflora Verlot
- Sect. *Lasia* Andersson
H. lasiorachis L. Anderss.
H. velutina L. Anderss.
- Sect. *Cannastrum* Andersson
H. mettalica Pl. & Lind. ex Hook
H. subulata R. & P.

Sect. *Zingiberastrum* Andersson

H. apparicioi Barreiros

H. hirsuta L.f.

H. schumanniana Loes.

Diversity and distribution of *Heliconia* in Brazil

Heliconia bihai, a widespread neotropical species, was published by Linnaeus in 1771 and is therefore the earliest name for a species occurring in Brazil. However, the earliest name for an endemic Brazilian heliconia, *H. angusta*, was published by Vellozo in 1825 in *Flora Fluminensis* (Eymygdio, 1975). Since that time many new taxa have been described and many new names have been published for Brazilian heliconias. The Brazilian botanists Dr. Luiz Eymygdio de Mello Filho, Dr. Emilia Santos, and Dr. Humberto de Souza Barreiros have been instrumental in furthering our understanding of the native taxa.

Sixty-five species names have been applied to the heliconias that occur in Brazil. Of these 65 names, 28 are generally recognized synonyms. Of the remaining 37 species of Brazilian *Heliconia*, some controversy exists over the taxonomic status of at least eight. For example, Andersson (1985a) has synonymized with *H. angusta* five species described from the Atlantic coastal forests. Estimates of the number of *Heliconia* species in Brazil therefore ranges between 29 and 37.

Thirty-seven is a relatively low number of species of *Heliconia* for a country the size of Brazil with so many diverse habitats, especially when compared to the number of taxa found in some of the smaller Andean and Central American countries (e.g., 39 species in Costa Rica; 45 species in Ecuador). This low number is most likely the result of historical factors of distribution of *Heliconia* (i.e., the Andean-Central American center of diversity) and not environmental variables.

Two primary areas of distribution of species of *Heliconia* exist in Brazil (Table 2): the Amazon basin (21 species) and the Atlantic coastal forests (20 species). The species occurring in each of these general regions can be classified as endemic to one of these regions, disjunct between one of these regions and some other region (e.g., the Guianas, the Planalto), or widespread (found in more than one region of South America) (see Table 2).

With respect to the species found in the Amazon basin, eight (38%) are endemic to the Amazonian region in the broad sense. Only two of these species (*H. adelianna* and *H. auriculata*) are endemic to Brazil (and both are taxonomically controversial). Eight species (38%) are widespread throughout South America; four (19%) are found in the Amazon region and the Guianas; and one is distributed in the southern Amazon region and parts of the Planalto.

Table 2. Geographic Distribution of *Heliconia* which occur in Brazil.

Amazonian Region	Atlantic Coastal Region
**H. acuminata	+ H. aemygdiana
*H. adeliana	*H. angusta
+ H. aemygdiana	*H. aureora
*H. apparicioi	*H. citrina
*H. auriculata	+ H. episcopalis
+ H. bihai	*H. farinosa
**H. chartacea	*H. fluminensis
**H. densiflora	*H. kautzkiana
+ H. episcopalis	*H. lacletteana
+ H. hirsuta	*H. laneana
*H. juruana	*H. marie-augustae
*H. lasiorachis	*H. pabstii
**H. lourteigiae	**H. pendula
+ H. metallica	*H. pseudoaemygdiana
+ H. psittacorum	+ H. psittacorum
*H. schumanniana	**H. richardiana
+ H. spathocircinata	*H. rivularis
+ H. stricta	*H. sampaioana
+ + H. subulata	+ H. spathocircinata
*H. timothei	*H. velloziana
*H. velutina	
21 species	20 species
Total: 37 species	

* = endemic species

** = and Guianas

+ = widespread

+ + = and Planalto

Of the 20 species found in the Atlantic coastal rain forests of Brazil, 14 (70%) are endemic to the region. Even if one accepts Andersson's many synonyms for *Heliconia angusta*, the region is exceptionally high in endemics. This high degree of endemism for heliconias in the coastal forests is similar to the patterns of distribution of forest trees reported by Mori, Boom and Prance (1981). Of the remaining species of *Heliconia* in this region, four (20%) are widespread and two (10%) are also found in the Guianas.

There is at least one species of Brazilian *Heliconia* in each taxonomic category in Andersson's classification of the genus (Table 1). This distribution of species suggests that all of the major lines of evolution within the genus have radiated into Brazil. The broad taxonomic representation is also true if just the Amazonian species are considered. However, in the Atlantic coastal forests, only one-half of the taxonomic categories are represented. The high incidence of

endemics in this region is mostly the result of diversification in Subgen. *Stenochlamys* Sect. *Stenochlamys* (the *H. angusta* complex) and Subgen. *Heliconia* Sect. Novo II (the *H. farinosa* complex).

In conclusion, Brazil is not exceptionally species rich for the genus *Heliconia*. Species that are endemic occur primarily in the Atlantic coastal rain forests and represent principally two taxonomic groups in the genus. It is doubtful that many new species are still to be found in Brazil relative to the great number of new taxa being discovered in the Andean regions of Ecuador, Colombia, and Peru.

However, for the Brazilian heliconias, further systematic and evolutionary studies are certainly warranted. For example, investigations of reproductive biology and plant-pollinator relationships have not yet been thoroughly studied in Brazilian species. Moreover, studies on genetic diversity using isozyme electrophoresis and nucleic acid variation, especially in the Atlantic coastal species (e.g., the *H. farinosa* complex and *H. angusta* complex) should prove to be particularly interesting and informative for an understanding of species boundaries and the processes of speciation in these plants.

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