Volume 17, Issue 1

The Bulb Garden

Volume 17, Issue 1

~Gardening with Bulbs ~

In this edition...

The Mexican Rain Lilies

Christian Omar Valdes Ibarra was a 2018 recipient of a Mary Sue Ittner PBS Grant. He is a biology student at Centro Universitario de Ciencias Biológicas y Agropecuarias, Universidad de Guadalajara. Camino Ing. Ramón Padilla Sánchez 2100, Las Agujas 45200, Zapopan, Jalisco, México. He may be reached at b.christianvi@gmail.com. Christian's focus was on the "Richness and geographic distribution of *Zephyranthes* (Amaryllidaceae) in Mexico". *All photos by the author.*

The Amaryllidaceae are a group of plants with tunicate bulbs, seldom rhizomatous. The leaves are basal, annual or persistent. The inflorescence is scapose and its shape is pseudoumbellate. In the distal part of the floral scape, two or more bracts enclose the flowers before anthesis. Each inflorescence produces one or numerous showy flowers. The flowers can have a cone, trumpet, funnel, tube or ventricose shape. They have six tepals; the inner tepals are shorter than the outer tepals. Sometimes, tepals are fused at the base forming a tube. They can be white, yellow, pink, purple, red or blue. Stamens are generally 6, although 5, 18, or more may occur. The style is filiform or tripartite. The stigma can be capitate or trifid. The ovary is inferior with three cavities. The fruit is a capsule, rarely baccate. Seeds are globose, subglobose or flattened, black or brown (Meerow & Snijman 1998).

The family Amaryllidaceae is distributed over most of the world, especially in tropical and subtropical regions. It consists of 70 genera and around 850 species. In Mexico, six genera have been recorded with approximately 81 species: *Chlidanthus*, *Crinum*, *Habranthus*, *Hymenocallis*, *Sprekelia* and *Zephyranthes* (Villaseñor 2016).

Zephyranthes macrosiphon

In this family we can find plants of ornamental importance, such as

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The Mexican Rain Lilies *cont'd*

Species	Flower color	Flower size (cm)	Distribution*
Habranthus arenicola	White, purplish tips, greenish at base	3	Mexico
Habranthus chichimeca	Pink or white	3	Mexico
Habranthus conzattii	rose-purple	5 a 7	Mexico
Habranthus howardii	Pale yellow/Primrose yellow	6	Mexico
Habranthus longifolius	Yellow	2 a 2.8	Mexico, USA
Habranthus medinae	Yellow, basal red	3.5 a 4.9	Mexico
Habranthus mexicanus	white, white veined pinkish or reddish	3 a 7	Mexico
Habranthus tepicensis	white or pinkish	3 a 6.5	Mexico
Habranthus vittatus	Light pinkish background, overlaid reddish lines	5.5 a 6.2	Mexico
Zephyranthes bella	Pink or white, red tips	2	Mexico
Zephyranthes brevipes	Pink	6 a 7.5	Mexico, GT, CR, Caribe
Zephyranthes carinata	Pink	6 a 7	Mexico, GT, CR, Caribe
Zephyranthes chlorosolen	White	8 a 13	Mexico, USA
Zephyranthes citrina	Bright yellow	2 a 4.5	Mexico, USA, PAN, HN, Caribe
Zephyranthes clintiae	Light pink to deep red	6 a 7	Mexico
Zephyranthes concolor	White, basally yellow-green	5.5 a 7.7	Mexico
Zephyranthes crociflora	White, tinged pink outside	4 a 6	Mexico
Zephyranthes dichromantha	Light yellow, streaked and tipped bright red	3	Mexico
Zephyranthes drummondii	White	6 a 9	Mexico, USA
Zephyranthes erubescens	White, flushed with pink-red at the tips	2.5	Mexico, USA
Zephyranthes fosteri	Bright red-rose	(3.5) 5 a 6 (7)	Mexico
Zephyranthes katheriniae	Yellow flushed with red, red, yellow	5.5 a 6	Mexico
Zephyranthes latissimifolia	white, pink flush	3	Mexico
Zephyranthes leucantha	White, green throat	5 a 6.8	Mexico
Zephyranthes lindleyana	Pink to deep rose	(1.5) 2.5 a 4.5 (4.8)	Mexico, BZ, CR El Salv. GT, HN
Zephyranthes longituba	White	14.8 a 18.7	Mexico
Zephyranthes macrosiphon	Deep rose, often streaked with white	6 a 7.5	Mexico
Zephyranthes miradorensis	Pink or white	3 a 5	Mexico
Zephyranthes moctezumae	Flesh pink	3 a 4	Mexico
Zephyranthes morrisclintii	Light rose pink	5 a 7	Mexico
Zephyranthes nelsonii	White	2.5 a 4.3	Mexico
Zephyranthes nymphaea	Light yellow	3.2 a 4	Mexico
Zephyranthes orellanae	Yellow	2.5 a 3.5	Mexico
Zephyranthes primulina	Light yellow, the exterior tinged reddish	3.4 a 4	Mexico
Zephyranthes pseudoconcolor	pale yellow	3.5 a 5.7 (6.2)	Mexico
Zephyranthes pulchella	Bright yellow	2 a 4(6)	Mexico, USA
Zephyranthes reginae	Light yellow, exterior streaked red in upper half	4.3 a 4.5	Mexico
Zephyranthes sessilis	White, pink tints	3 a 6	Mexico
Zephyranthes stellatorosea	Pink, white star in the throat	(4)4.5 a 5.9	Mexico
Zephyranthes subflava	Ivory yellow	5	Mexico
Zephyranthes verecunda	White, pink tints	3 a 5	Mexico, GT

Species of rain lilies present in Mexico, color and size of the flower and distribution in other countries. *Distribution data were extracted from Topicos (2019). Abbreviation: BZ, Belize; CR, Costa Rica; El Salv., El Salvador; HN, Honduras; GT, Guatemala; PAN, Panama; USA, United States.

Amaryllis, *Clivia*, *Cyrtanthus*, *Eucharis*, *Galanthus*, *Hippeastrum*, *Narcissus*, and a few others. There are also many plants with potential for use in the pharmaceutical industry, due to their alkaloids content. Phytochemical research has shown potential antitumoral, antimicrobial, and other possible uses. For example, galanthamine is a medicine isolated from *Galanthus* and it is prescribed to patients with Alzheimer's disease (Bastida et al. 2011).

The *Habranthus* and *Zephyranthes* genera are commonly known as rain lilies and they only grow in the American continent. The distinction between these genera is confusing. *Habranthus* (from the Greek *habros*, delicate, and *anthos*, flower) has zygomorphic (bilaterally symmetric), funnel-shaped flowers, with a short tube. In some cases, *Habranthus* flowers may present scales or fimbriae in the throat. The stamens are declinate-ascendent, in four lengths. The seeds

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The Mexican Rain Lilies *cont'd*

are obliquely winged. *Habranthus* is made up of 30-40 species, which are distributed in Mexico and South America. *Habranthus longifolius*, *H. robustus* and *H. tubispathus* grow in the United States (Flagg 2014). Only *H. longifolius* is native, while *H. robustus* and *H. tubispathus* are naturalized in the southeast of the country.

On the other hand, in *Zephyranthes* (from the Greek *zephyros*, west wind, and *anthos*, flower) the flowers are actinomorphic (possessing radial symmetry). The tube can be short or long. The stamens are in two lengths. The seeds are flattened and D-shaped. The genus includes around 50 species, which are distributed from the southern United States to South America, including the Antilles (Meerow and Snijman 1998).

Biological collections (herbaria) are repositories of biological material. In particular, an herbarium is a collection of preserved plants stored, cataloged and systematically organized (Royal Botanic Gardens Kew 2019). Each specimen is associated with a label that has information about its identity, scientific name, common names, collection locality, description of its habitat, date of collection and characteristics of the plant that cannot be collected or that can be lost in the preservation process. They are an important source of information for various researches related to botany, ecology, biogeography, conservation biology, among others.

For this work, a database was made with the information derived from reviewing specimens of 18 herbaria, literature, virtual herbaria and electronic databases. A total of 939 records were obtained, of which 834 belong to *Zephyranthes* and 105 to *Habranthus*. With the information of the collection locality, a geographic coordinate was assigned to each record. In turn, each record was projected onto the map of Mexico. The Mary Sue Ittner grant helped me to visit four herbaria and to make expeditions to the states of Zacatecas and San Luis Potosi.

The knowledge of these plants in Mexico begins with the description of *Zephyranthes carinata* and *Zephyranthes verecunda*, by William Herbert in 1825. In contrast, *Zephyranthes pseudoconcolor* is the most recently published species (Flagg, Smith & García-Mendoza 2018). In the same context, it highlights the importance of the expeditions of Thaddeus M. Howard, who described 13 species of Mexican rain lilies.

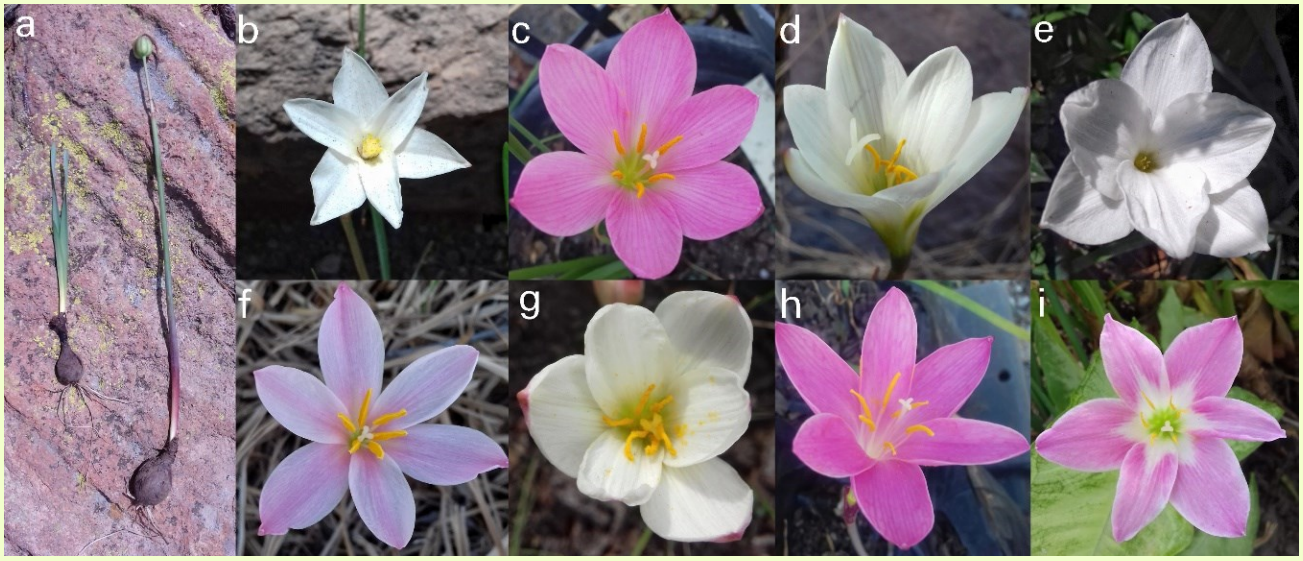

Figure 1. Mexican rain lilies. a) Leaves, bulbs and fruit of *Zephyranthes concolor*, b) *Z. chlorosolen*, c) *Z. clintiae*, d) *Z. concolor*, e) *Z. drummondii*, f) *Z. fosteri*, g) *Z. latissimifolia*, h) *Z. macrosiphon*, i) *Z. stellatorosea*.

The rain lilies are all very similar morphologically. The floral characters help identify them (Figure 1, above). Tepals can be white, pink, reddish or yellow. These can simply be one color or have tints of other colors as well. The size of the flower varies from 2 to 18.7 centimeters (.8 to 7.4 inches) in length. The style can be long and exceed the stamens, be at the same level, be below the stamens or can even be inside the perianth tube. The position of the ovary is also important; it can be sessile or pedicellate.

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The Mexican Rain Lilies *cont'd*

Rain lilies are known under various common names in Mexico. The most frequent is "mayito" or "flor de mayo", "mañanitas" in Veracruz State, "quiebra platos" in the center of the country, "brujitas" in the Yucatan Peninsula, and "tempranillas" in some western regions. These names are related to the flowering period of the species, which occur after the first showers, usually in May; however, the flowering can start in March and extend until October.

Forty-one species of rain lilies grow in Mexico. (See Table page 2.). Nine species of *Habranthus* are registered, of which eight are exclusive to the country while one is shared with the southeast of the United States (*H. longifolius*). In *Zephyranthes*, 32 species are registered, 23 are

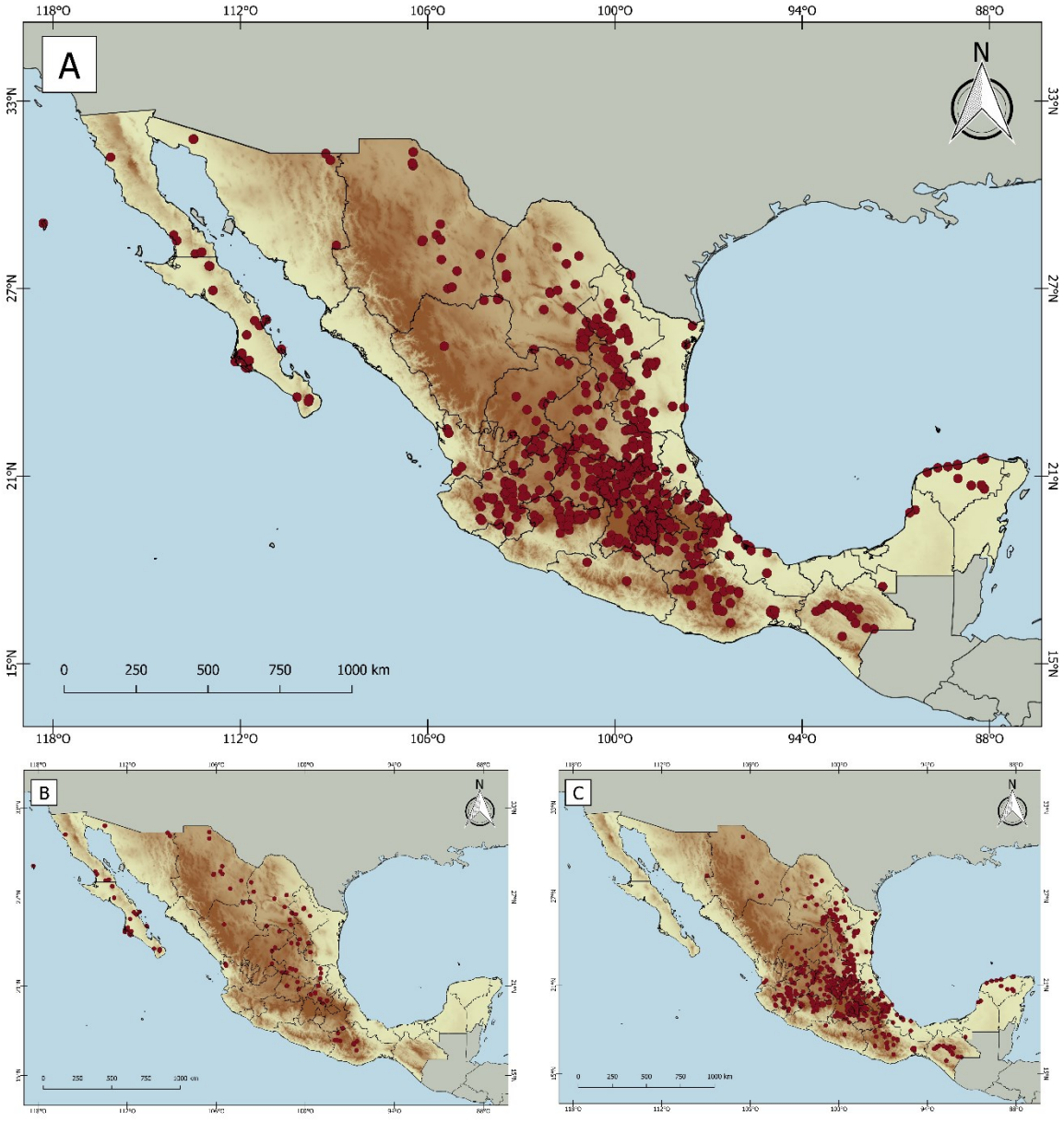

Figure 2. Distribution of Mexican rain lilies. A) Distribution of *Habranthus* and *Zephyranthes*. B) Distribution of *Habranthus*. C) Distribution of *Zephyranthes*.

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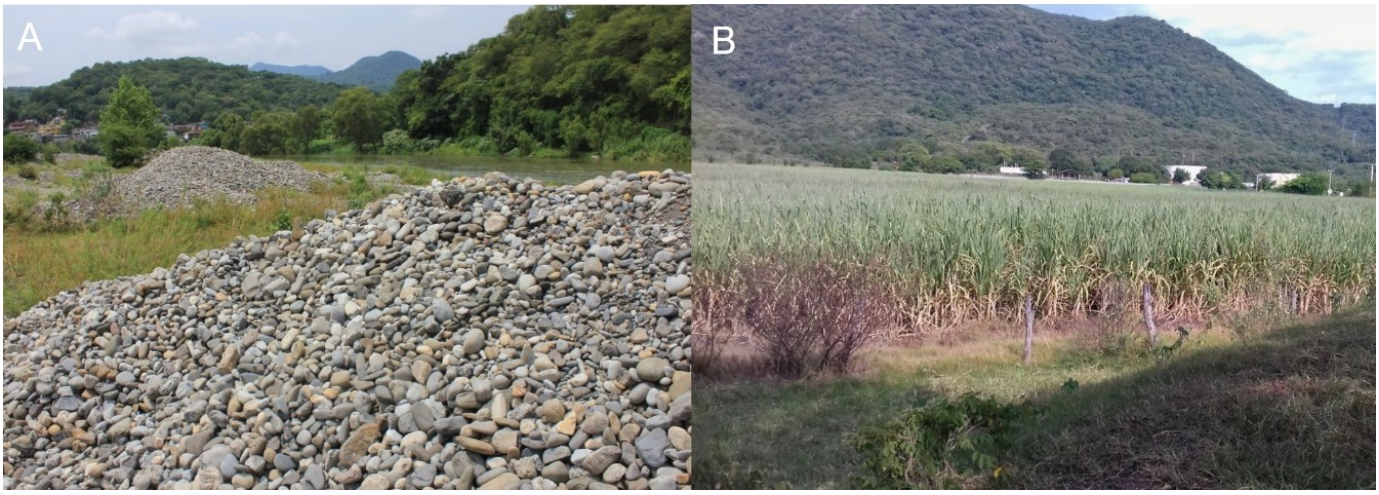
The Mexican Rain Lilies *cont'd*

endemic, four are shared with the United States (*Z. chlorosolen*, *Z. drummondii*, *Z. erubescens* and *Z. pulchella*), four with countries of Central America and the Antilles (*Z. brevipes*, *Z. carinata*, *Z. lindleyana* and *Z. verecunda*) and one with United States, Central America and the Antilles (*Z. citrina*, probably naturalized).

The rain lilies grow in a range of elevation from sea level to 3,500 meters (11,500 feet) above sea level. *Habranthus* grows from sea level to 2,700 meters (8,900 feet). In *Zephyranthes* the range is higher, from sea level to 3,500 meters (11,500 feet). Rain lilies grow in different types of vegetation, mainly xerophytic scrub, conifer and oak forest, tropical deciduous forest and grassland. The two genera are distributed in almost all the Mexican states, with the exception of the states of Quintana Roo and Sinaloa. *Habranthus* is in 17 states, while in contrast, *Zephyranthes* is in 26. Records indicate that these genera are mostly in the mountain ranges of eastern Mexico (Sierra Madre Oriental, the Chihuahuan desert and the coastal plains of the Gulf of Mexico), whereas with other bulbous plants, such as tiger flowers (Tigridiae tribe: Iridaceae) and mariposa lilies (Calochortus: Liliaceae) grow mainly in the Transmexican Volcanic Belt of central and southern Mexico (Munguía-Lino et al. 2015, García-Martínez et al. 2017). See Figure 2, page 4.

Rain lilies may be at risk of dying out. Eleven species are known to be in a single locality and some are subject to threats. *Zephyranthes crociflora* is known only near Saltillo city, in Coahuila State. *Zephyranthes dicromantha*, *Z. nymphaea*, *Z. primulina*, *Z. reginae* and *Z. subflava* grow in El Naranjo Valley, in the state of San Luis Potosi. In this region, sugarcane plantations are common and cane fields are displacing the native vegetation. *Zephyranthes moctezumae* was collected in the same state, on the banks of the Moctezuma River, municipality of Tamazunchale. The removal and extraction of rocks from the riverbank has been observed, probably due to activities related to the construction industry. *Zephyranthes bella* and *Z. leucantha* are other species that have not been collected again. Both of these species grow on the side of the road. The first one grows within the state boundaries of San Luis Potosi and Zacatecas, while the second grows in Hidalgo. *Habranthus medinae* has been collected in a single locality. Although it is located within a Natural Protected Area, in Tehuacán-Cuicatlán Biosphere Reserve, this location does not ensure its conservation.

There is still much to know about rain lilies, in regards to morphology, anatomy, ecological interactions, ornamental and pharmaceutical potential, among many other aspects. The growth of cities, the change of land use and agricultural production are all constant threats to the conservation of the species. In addition, the short flowering period makes it difficult to represent these species in biological collections. Knowing the distribution of the species can be useful to identify potential collec-



Threats to conservation of some rain lilies. A) Removal of rocks from the banks of Moctezuma river, locality of *Zephyranthes moctezumae*. B) Cane fields in El Naranjo Valley, locality of *Z. dicromantha*, *Z. nymphaea*, *Z. primulina*, *Z. reginae* and *Z. subflava.*

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The Mexican Rain Lilies *cont'd*

tion sites, to support the recognition of species and to propose plan management and conservation strategies.

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Editor's Note: For sources of rain lilies, watch for the PBX notices. Try also Plant Delights Nursery (plantdelights.com), or Terra Ceia Farm, North Carolina (See website.)

♦♦♦

Zephyranthes latissimifolia

From the Treasurer - A Reminder...

When paying for a BX/SX order by check or by PayPal, please write or input the BX/SX number !

Encountering the Chilean Nasturtiums

Annika Smith received a Mary Sue Ittner Grant for Bulb Studies in 2018 to travel in central Chile this past fall to collect species of Tropaeolum *for her research. She is a Ph.D. student at the University of Florida and the Florida Museum of Natural History working with Drs. Pamela and Douglas Soltis, studying the evolution of the flowers of the nasturtiums (Tropaeolum). All photos by Annika Smith unless otherwise noted.*

Although many enjoy the edible flowers and leaves of the garden nasturtium, *Tropaeolum majus*, few know of the vast diversity of the genus *Tropaeolum*, which has up to an estimated 110 species, distributed from southern Mexico into Patagonia. Many other species have medicinal or culinary uses as well; some are spectacularly beautiful. Some species have adapted to the harsher environments of the mountains in various ways, including some with tubers.

The Chilean nasturtiums (Tropaeolum sect. Chilensia) are a section of the genus with the center of diversity in Chile. Some species are narrow endemics to part of Chile, and it is likely that the Andes mountains provide the diverse ecosystems that have driven the speciation of this group of plants. I am drawn to study this group of plants partly due to the variability in pollination syndromes within closely related plants, such as the long red spurs of *Tropaeolum tricolor*, versus the short-spurred, purplish-blue flowers of *Tropaeolum azureum*.

With the assistance of the Mary Sue Ittner Grant for Bulb Studies, I was able to do field work and collaborate with local experts in Central Chile in November 2018. In three weeks, I collected specimens of five species of *Tropaeolum*, collaborated with local experts and traveled with a Chilean student, and visited the herbarium at the Universidad de Concepción to collect more samples and annotate their specimens.

In October, a week before I arrived in Chile, I received an email from collaborators in Chile that made me wonder if my trip would be for naught. They explained that it was an exceptionally hot and dry spring that year in central Chile, and that places where they would normally see several species of *Tropaeolum* in bloom were now only dry ground. My previous hopes were to be able to collect specimens such as the lovely *pajarito azul* or "little blue bird", *Tropaeolum azureum*, but I had arrived slightly too late in too hot of a spring for that to happen. Although not what I expected entirely, my time in Chile was still incredibly productive and informative. I was able to collect other species of *Tropaeolum* I hadn't expected to see on this trip, such as *Tropaeolum sessilifolium*, *T. incisum*, and *T. ciliatum*. These plants represent a huge degree of diversity in shape and environment.

The first time I saw *Tropaeolum tricolor* in person was exhilarating, and my excitement for this plant did not diminish despite seeing it many times in many different localities across Chile-- this is the most common and vigorous member of the Chilean nasturtiums. Its red-spurred flowers, held away from the rest of the plant on long red pedicels, look like small dancing fish swimming in line after one another. These plants generally grew in full sun, clambering over scrubby, thorny vegetation.

***Tropaeolum tricolor*, collected on the road to Lagunillas ski basin. November 2018.**

As a consequence of arriving at a later, hotter

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Encountering the Chilean Nasturiums *cont'd*

time than was ideal, I was able to view some characteristics of *Tropaeolum* that I had not expected. I was surprised by the appearance of the

***Tropaeolum tricolor*, collected on the road to Lagunillas ski basin. November 2018.**

The dried flowers and fruits of *Tropaeolum tricolor*, collected on the road to Lagunillas ski basin. November 2018.

dried *Tropaeolum tricolor* on the vine (See photo above). Instead of the flowers shriveling, drying, and falling off like the *Tropaeolum majus* I have grown in my own garden, the dried flowers remain persistent and intact on the vine.

I had the opportunity to visit places across Chile. One day I went with a local student to Quebrada de la Plata, a preserve near Santiago. At the end of the day, after seeing withered vine after withered vine, we climbed to the very top of the hill and found a *Tropaeolum brachyceras* still with some green left in its leaves and yellow in its flowers.

This trip was a remarkable opportunity to learn more about *Tropaeolum* from local experts. I worked with Dr. Nicolas Garcia from the Universidad de Chile; he helped to arrange local permits for collecting and offered boundless support and advice. Dr. Garcia and I traveled one day near Cajon de Maipo, up into the Lagunillas ski basin to find *Tropaeolum sessilifolium*. Dr. Garcia saw it first -- a tiny, greyish plant, its flowers still in bud, some forming the tiniest of spurs. I

The diminutive *Tropaeolum sessilifolium*, with flower buds. When the flowers open, they will dominate this small plant. November 2018.

preserved some of the flowers in a fixative to do

Continued on next page

Encountering the Chilean Nasturtiums *cont'd*

later microscopy work, to better understand the developmental processes of the flowers. I also dug deep into the dry, rocky soil of the ski slope, trying to trace the root of the plant, hoping to find a tuberous structure, but found nothing before the fragile root broke off.

On the way to Lagunillas, we had also hoped to find *Tropaeolum rhomboideum,* a narrow endemic known for growing especially in this area. Instead, there was distressing evidence of habitat disturbance in the area where this rare plant is supposed to grow. This was one of several experiences where I witnessed disturbed habitat on this trip. Later on in my journey, further south, I tried to find *Tropaeolum*

I searched for a tuber of *Tropaeolum sessilifolium,* but was unable to locate it before the long taproot broke off in the dry, compacted soil. November 2018.

speciosum and T. *ciliatum* at several localities where they had been collected many years before, only to find that the road I was traveling on dead-ended suddenly into a pine or eucalyptus plantation.

A highlight of this trip was the opportunity to meet Drs. John Watson and Ana Flores, whose main research interest of their careers have been the enigmatic, columnar Andean violas. However, they have also been studying and collecting *Tropaeolum* for the past 30 years, and recently identified *Tropaeolum austropurpureum* as its own species. For more information on the Chilean nasturtiums, I recommend their 2010 publication in Curtis' Botanical Magazine: Watson & Flores, 2010. On this trip, I was able to visit them at their home a couple of times and see their remarkable garden and hear their *Tropaeolum* stories. They kindly gave me many of

Treasurer's Report First Quarter 2019

	1st Quarter 2019
Balance Jan. 1 2019	$ 33,808.38
U.S. Members	$ 2,080.00
Overseas Members	$ 1,325.00
BX Receipts	$ 2,026.00
Investment results	$ 1,778.01
INCOME	$ 7,209.01
BX/SX Postage Domestic	$ (422.40)
BX/SX Postage International	$ (474.35)
BX/SX Supplies	
BX Helper	$ (187.93)
Board Conference call	$ (70.86)
Treasurer's Supplies	$ (349.00)
Publications	0
Publication postage	0
PayPal expense	$ (186.18)
Membership Directory editing	$ (120.00)
Bulb Garden editing	$ (700.00)
EXPENSES	$ (2,510.72)
Balance March. 31, 2019	$ 38,506.67

Learning from experts. From left: Annika Smith, Ana Flores, John Watson. November 2018.

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Encountering Chilean Nasturtiums *cont'd*

their duplicate *Tropaeolum* specimens from their home herbarium for future study-- a botanist's treasure. These specimens were brought back to the United States, and are now in the herbarium at the Florida Museum of Natural History, where I am able to study and illustrate them at my leisure.

Additionally, I also had the opportunity to work with an undergraduate student from the University of Chile, Victoria Perada. She accompanied me on my fieldwork across Chile, traveling from the Mediterranean climate of Santiago up into the Andes to the spectacular Laguna de la Maule, where snow still bordered the road in the summer. Victoria patiently accompanied me while I pulled over on the highway every so often to search for *Tropaeolum incisum*. Eventually I found it, stems and leaves snaking over loose rocks and gravel on a steep slope, too early in the season to find flowers. I carefully dug it out of the loose scree, eventually unearthing the tuber, over a foot long, the longest nasturtium tuber I have seen yet. Are these long, multi-parted tubers an adaptation to life in this unstable, harsh environment?

The steep slope where I finally found *Tropaeolum incisum* growing, on the road to Laguna de la Maule. November 2018.

From the heights of Laguna del Maule (at over 7000 feet (2135 meters) above sea level), Victoria and I drove in a few hours all the way to sea level, to the beautiful university city of Concepción. In Concepción, I was able to visit the herbarium at the Universidad de Concepción to collect more samples and annotate their specimens of *Tropaeolum*. They had an astounding, pristinely organized collection of over 1000 specimens of Chilean *Tropaeolum*, and getting to study them was extremely beneficial for my work. Additionally, the curator of the herbarium kindly allowed me to sample leaf tissue from many of the specimens for follow-up analyses, such as gene sequencing, and estimating the genome size of the specimens.

After spending a few long days and late nights in the Concepción herbarium, Victoria and I were happy to get away for one last full day in the field, in a radically different environment than we had seen before. I obtained a permit to collect *Tropaeolum* in the Nature Sanctuary of the Hualpén Peninsula, a preserve bordering the coast just outside of Concepción. Hualpén was lush and green, with orchids poking out of grass, fuchsias bordering the trails, blooming epiphytes dripping from the trees. It was hard to believe that we were only a few hours away from the dry, cold, high-altitude heights of Laguna del Laule. In the forests of Hualpén, my hope was to

The tuber of *Tropaeolum incisum*, growing vertically through the slope. November 2018,

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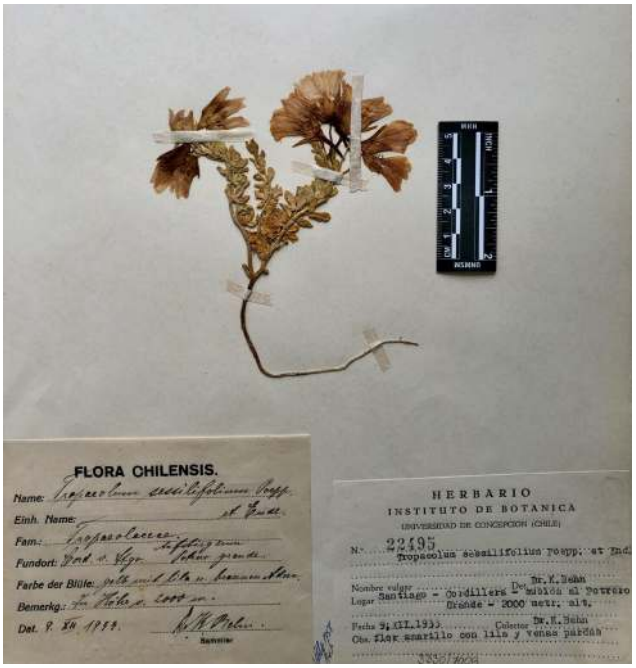
Encountering Chilean Nasturtiums *cont'd*



This specimen of *Tropaeolum sessilifolium* from the herbarium at the Universidad de Concepción was collected in full flower 1953 by Dr. K. Behn. We can see clearly here how the flowers come to dwarf the rest of the small plant. November 2018.

find *Tropaeolum ciliatum*, and I was not disappointed. I found them climbing in the dappled sunlight of a mature forest, their deeply lobed, palmate leaves like hands. Their small, orange flowers, held aloft on long pedicels with unusual ciliated structures dotted along them, were only days away from opening. Its habitat was noticeably different from the other species of *Tropaeolum* I had yet encountered (*Tropaeolum tricolor*, *T. brachyceras*, *T. sessilifolium*, and *T. incisum)* -- far wetter, with richer soil. I dug into the wet soil, and unearthed a long-surface-level root that was dotted with swollen portions of the root like a necklace-- almost like a precursor to a tuber. The experience of seeing the roots of *Tropaeolum ciliatum,* in stark contrast to the those of other species, brings up the question for me: how many times did tubers evolve in *Tropaeolum*, and how many different ways?

What's next? In February 2019, with the help of collaborators, I did my first DNA sequencing of the material I collected both in the field and in the herbarium in Concepción, and am waiting for the results. In late March, I will be traveling from Florida to Rutgers University in New Jersey to learn histology techniques with the flowers I collected on the trip. I hope to return to Chile for more fieldwork soon.

Overall, this trip exceeded my expectations, and opened up new avenues of research, energizing me with new ideas and possibilities. The experience provided me with incredible opportunities to see plants in person that I had only seen pictures of, and to place them in space and time.

If you want to learn more, see the Pacific Bulb Society's wiki on *Tropaeolum* for more pictures of the geophyte species of *Tropaeolum* -- PBS members have successfully grown many of the Chilean species! Additionally, if you have additional questions, or if you have successfully grown *Tropaeolum* and would like to contribute materials to my

The underground root structures of *Tropaeolum ciliatum*. November 2018.

research, please feel free to contact me at annikals@ufl.edu.

♦♦♦

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Gardening with Bulbs

By Dick Culbert from Gibsons, B.C., Canada - *Tropaeolum azureum* Uploaded by uleli, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=27938971

Inside This Edition:

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