A CHECKLIST OF PHRAGMIPEDIUM SPECIES

FRANK CERVERA

Phragmipedium besseae

Phragmipedium besseae Dodson & J. Kuhn, *Amer. Orchid Soc. Bull.* 50: 1308 (1981).

Phragmipedium besseae was discovered on wet rocks on the side of the road from Tarapoto to Yurimaguas, San Martin, Peru, in 1979. It is named after Elizabeth Besse, who first encountered the plant. It was amazing that this *Phragmipedium*, with extraordinary red flowers, would first be found in an area of Peru that had previously been well-explored. That it was undiscovered until 1979 was as much a surprise as the brilliant red flowers, and the subsequent sensation initiated by the discovery of this species. It is not surprising that it was found on the side of the road, given what we have learned about this species in the decades since its description.

While the initial encounter with *Phrag*. *besseae* still confounds some authors, long-term study of *Phrag*. *besseae* primary and secondary habitats gives us the clues we need to understand how and why the natural world pulled back the veil of secrecy and presented *Phrag*. *besseae* to the world in 1979. Two things from that encounter stand out to me. One, the plants were encountered in a secondary habitat on a roadside, and two, they were found growing on wet rocks. Seed had come into that area from an undiscovered primary location in either southern Ecuador or Northern Peru. The question is not how did these plants remain on that roadside undiscovered for so long, as some authors contemplate; the question is, how long were the plants there on that roadside before they were first seen? My guess is not long.

The single herbarium specimen and a pickled flower were misidentified as *Phrag*. *schlimii* when it was brought to the Marie Selby Botanical Garden in Florida. At this point, you could export and import orchids without CITIES permits or legal issues. When Dodson examined the flower photograph, the decision was made that it was a new species and, in 1981, *Phrag*. *besseae* was formally described.

While the first specimen of *Phragmipedium besseae* was misidentified as *Phrag*. *schlimii*, they are easy to tell apart. *Phragmipedium schlimii* is the most closely aligned cousin of *besseae*, but its brilliant orange to scarlet red flowers have no equal. *Phragmipedium besseae* can only be found in natural populations south of the Equator, while *Phrag*. *schlimii* can only be found in natural populations north of the Equator, with distinct ecological differences between the two species.

Thought to also exist in Ecuador, it turns out that in the early 1960s, Father Angel Andreetta, an Italian priest who came to Ecuador in the 1950s and began to research and collect orchids, encountered *Phrag*. *besseae*, but he mistakenly believed the brilliant red flowers were a begonia common to the area (per personal communication). I once made the same error, mistaking the brilliant red begonia flowers for *Phrag*. *besseae* until I came closer.

What would later be described as *Phrag*. *dalessandroi* was discovered in Zamora-Chinchipe, Ecuador, by Marco Jimenez. He brought the plants to the attention of Dennis D'Alessandro, who subsequently took credit for the first encounter of *Phrag*. *besseae* in Ecuador (per personal communication).

Phrag. *besseae* growing in a primary habitat in southern Ecuador. Note the differences in the labellum shapes.

All the observed populations of *Phrag*. *besseae* in both primary and secondary habitats exhibit natural variation in the overall form and flower color. A simple preponderance of one set of variations on a roadside does not equate to a new species, variety, or form. Different varieties and forms are intermixed throughout all primary and secondary habitats. Several forms based on geography and floral variations are found in the horticultural trade. There are several contrived varieties and forms, but the natural populations support none. These include an Ecuadorian form *Phrag*. *besseae* var. *paute*, a Peruvian form, and more recently, *Phrag*. *besseae* var. *amazonas* and *Phrag*. *besseae* var. *guarumales*. Knowing the specifics of the provenance of your *Phrag*. *besseae* or of the *Phrag*. *besseae* parentage of your hybrid is desirable, and accurate records should be maintained for future generations.

There is a yellow form, *Phrag*. *besseae* var. *flavum*, that was described in 1990. Sometime in the 1980s, a large exportation of *Phrag*. *besseae* left Ecuador for the nursery of Popow Orchids in Germany. Not long after selling most of the plants, Popow received a customer complaint about a yellow flower instead of the expected red flower. Popow took the plant back and exchanged the yellow-flowered *Phrag*. *besseae* for a red-flowered plant. The plant with the yellow flower was soon divided, and one division went to Frank Smith in the United States, and another division went to Asia. The Frank Smith division was self-pollinated, and soon after that, seedlings of this variety were available in the trade. Assertions that any of the divisions sent to the United States and Asia were somehow unique from the original plant are incorrect. All yellow *Phrag*. *besseae* are derived from a single jungle parent. Several spectacular hybrids have been made using *Phrag*. *besseae* var. *flavum* as a parent, with more breeding lines being pursued each year.

Although the primary flowering season is March, *Phrag*. *besseae* flowers year-round on an inflorescence that can reach 50cm (20 inches). Rhizomes can range in length from about 1 to 10 cm. This variation in the rhizome length has been observed in plants in both primary and secondary habitats and is not exclusive to any one population. Plants in natural populations that grow horizontally on shelves that protrude from the cliff surface show more compact growing habits and shorter rhizomes than plants growing vertically nearby. This characteristic is variable with plants with elongated rhizomes growing only a few meters from plants with much shorter rhizomes in the same populations. I believe that the amount of runoff and accumulated mosses immediately near each plant in natural habitats impacts the length of the rhizome. Still, more study is needed to confirm this. Several plants with elongated rhizomes in situ have demonstrated much shorter rhizomes when moved from natural populations to cultivation.

Between one and six flowers open successively. The exception to this being var. *dalessandroi*, which can have as many as six flowers open on multiple spikes and branches simultaneously. The depth of the flowers' color, that can range from orange to almost scarlet red, is variable within all populations observed. In cultivation night temperatures, moisture levels during the flowering season, and fertilizer levels impact color intensity and form.

A group of *Phrag*. *besseae* demonstrating a mixture of different forms in one habitat in central Ecuador.

One secondary population in Ecuador, a site known for the profuse amount of runoff falling from above, has flowers that consistently produce tiny hairs that appear to prevent water from clinging to and rotting the flowers. The prominence of these hairs does not indicate a new species, but rather an adaptation to immediate plant ecology. How villous (hairy) the inflorescence appears to be a function of how wet the environment. Hairs on the inflorescence appear to protect flower spikes from rot.

Phragmipedium besseae has been observed growing and flowering in both bright and low light levels, and the levels are quite uniform year-round. The amount of light is not a trigger to produce flowers. The length, width, and substance of the leaves vary depending on cultural conditions, especially light levels. Plants of *Phrag*. *besseae* in secondary roadside habitats exposed to brighter light consistently demonstrate shorter leaves than plants growing in primary habitats along cliff surfaces hidden by dense foliage.

Phragmipedium besseae inhabit vertical cliff surfaces in both primary and secondary habitats, although some plants have been observed on horizontal shelves protruding from these cliff surfaces. All primary and secondary habitats experience constant runoff from the surrounding jungle, runoff that has, in some wet years, been observed to be substantial. When primary and secondary habitats receive reduced runoff, and the cliff surfaces experience temporary dry periods, flowers tend to be smaller, less intensely colored, and the flower changes its overall shape. The staminode shape varies, as does the attitude of the petals demonstrating different angles and degrees of reflex based on the cultural differences.

Phrag. besseae in situ in Peru.

Intense collection pressure after the description in 1981 destroyed the first known populations in Peru. However, in recent years *Phrag. besseae* has been rediscovered at several locations in the San Martin region in northern Peru. *Phragmipedium besseae* also thrives in abundant numbers in Ecuador in both primary and secondary habitats. The species appears to be centered on the Paute River in Ecuador, with numerous secondary habitat locations radiating from this central point through southern and central Ecuador and northern Peru. The Paute River, and its immediate tributaries, have populations of *Phrag. besseae* that are inaccessible to collectors. Demonstrative of the endless tug of war between humans and nature, the author estimates that tens of thousands of *Phrag. besseae* perished when the Paute River dam was built.

The author has regularly visited five secondary locations in southern Ecuador and has visited one such site from its inception when the rock was first blasted away for a road and seedlings of *Phrag. besseae* started to populate the cliff surface, to the present day. *Phragmipedium besseae* is a weedy species and readily populates secondary habitat locations where the ecological conditions are correct. Two new secondary populations have been encountered, both on roadsides in southern Ecuador, bringing the total to seven that the author is aware of in that area outside of the cliff surfaces of the Paute river and its tributaries.

Its ecology is vital to *Phragmipedium besseae*. Exposed vertical granite surfaces with constant runoff are an absolute requirement. No epiphytic or terrestrial plants have been observed. The height of the vertical surfaces can vary from a few meters to several hundred meters. Every few years, dry periods have been observed in secondary habitats, but this is a function of climate fluctuations. Temporary dry periods last no more than a month or two and are extremely rare. Almost nothing but mosses are found on these cliff surfaces. *Phragmipedium besseae* does not comingle with grasses, shrubs, or trees, although nearby vegetation can provide shade over the cliff surfaces. The species anchors to the underlying rock with roots in intimate contact that guarantees constant exposure to moving water and may also act as a form of temperature control.

Phragmipedium besseae is a cool-growing species. It is found at altitudes between 1,100 and 2,000 meters (3,609 to 6,562 feet), with most populations near 1,800 meters (5,906 feet). Populations at the lower end of that range persist in microclimates that are cooler than the surrounding environment. Reports of *Phrag. besseae* growing in warm populations or below 1,000 meters are questionable.

No population of *Phrag. besseae*, either primary or secondary, has been encountered in the area between Zamora-Chinchipe Ecuador and Moyobamba, Peru. However, there is a vast national reserve, mostly unexplored, north of Moyobamba, and east of Zamora-Chinchipe. Ecuador and Peru occupy the same latitudes east of Zamora-Chinchipe and north of Moyobamba. Additional primary habitats are probably located throughout this area. One of these sites might have been the source of the seed that populated the roadside near Tarapoto, where *Phrag. besseae* was first encountered. What happened in 1979 is now easy to understand: humans created the correct environment along the side of a road and *Phrag. besseae* started populating the wet rock surfaces in high numbers where this species was first discovered.

Phragmipedium besseae* var. *dalessandroi

Phragmipedium besseae var. *dalessandroi* (Dodson & O.Gruss) A. Moon & P. J. Cribb, *Orchid Rev.* 105: 229 (1997).

Synonym:
Phragmipedium dalessandroi Dodson & O. Gruss, *Orchidee* (Hamburg) 47: 217 (1996).

The description of *Phragmipedium dalessandroi* was based on a specimen alleged to have been collected by Dennis D'Alessandro in Zamora-Chinchipe, Ecuador, at

Phrag. *besseae* var. *dalessandroi* from the type location.

an altitude between 900 and 1,300 meters (2,953 to 4,265 feet). I have been to this location several times, and it is found up to 1,500 meters (4,921 feet). Marco Jimenez, an avid orchidist and author from Zamora-Chinchipe, reported that he brought this population to the attention of Mr. D'Alessandro, who was looking for populations of *Phrag*. *besseae* in Ecuador after the initial description in 1981 (Per personal communication). *Phragmipedium dalessandroi* was differentiated from *Phrag*. *besseae* based on its more compact habit, drooping petals, rhombic staminode, more orange-colored flowers, and a more villose, or hairy, inflorescence. It is also alleged to have a different number of chromosomes (2N=28 vs. 2N=24 for *Phrag*. *besseae*).

Interest in the genome number of different species of *Phragmipedium* has increased in the past twenty years; however, a statistically significant and comprehensive genetic study of the genus using natural populations has, to date, not been attempted. Into this void has come many claims by the commercial orchid industry of genome counts to prop up dubious names.

Knowledge of the genome in the genus *Phragmipedium* could help us understand the unique ecology for the species concept, and the biology of the species. Differing chromosome numbers within a single species of flowering plants are not uncommon. As to whether the genome count is stable within the species concept, at least one recent study found that out of one hundred and sixteen species of flowering plants sampled, twenty-eight presented more than one value of chromosome numbers (Castro, Mariana, et al., 2012). The alleged chromosome difference between *Phrag. besseae* and *Phrag*. var. *dalessandroi* cannot be validated as stable and indicative of specific status without more comprehensive testing, nor can the plants used for the genetic analysis, several of which were nursery raised plants from a single seed pod and not plants from natural populations, putting provenance in doubt.

In his 2013 article on *Phrag*. *dalessandroi*, Cribb notes genetic testing on an Ecuadorian plant, not from the Zamora-Chinchipe population, that demonstrates a chromosome count of 2N=26 and correctly questions why this plant does not constitute yet another new species based on this difference. Cribb further notes that four colchicine-treated, seed-raised plants "revealed four different [chromosome] counts: 2N=24, 25, 26, 36, the last being a triploid." Cribb continues, "Variation in chromosome number has already been reported in a number of slipper orchids such as *Phragmipedium* [*Paphiopedilum*?] *venustum*, *Paph bullenianum*, *Paph. javanicum* and *Paph. dayanum* (Karasawa, 1979) and chromosome number alone is insufficient to recognize the cytological races as distinct at specific level," and I agree. Only a statistically significant genetic analysis of plants from a cross-section of primary and secondary *Phrag*. *besseae* habitats can indicate what, if any, natural

variations in chromosome count exist throughout and between populations.

Cribb's statement is true for a finding of differing or increased chromosome or genome counts in any *Phragmipedium*. Unless, and until, a proper genetic study is done, utilizing a statistically significant sample size from a cross-section of verifiable natural sources, statements regarding genetic differences or specific status for any species in the genus *Phragmipedium* are dubious. Findings based on an insignificant sample size or a group of nursery-raised plants from a single parent(s) are debatable and insufficient for drawing genetic conclusions for the hundreds of thousands, or perhaps millions, of plants from many different primary and secondary habitats that were not included in the testing.

The stated floral and vegetative differences between *Phrag*. *besseae* and *Phrag*. *dalessandroi* all fit well within the natural cline in variation throughout all known primary and secondary habitats of *Phrag*. *besseae* and are insufficient to maintain *Phrag*. *dalessandroi* at the species rank. Other than demonstrating a propensity for a shorter, branching inflorescence with multiple flowers opening simultaneously, *Phrag*. *dalessandroi* cannot be said to be consistently different from *Phrag*. *besseae* based on any other observable taxonomic characteristic, specifically staminode shape, petal attitude, color, a more hirsute inflorescence, and vegetative characteristics that are either inherently variable across the species concept or are just wrong. Mature plants of *Phrag*. *besseae* have also, although rarely, been seen to produce branching inflorescence in cultivation.

Given this, I agree with Cribb that I am not sure that even if a statistically significant sample size can establish a consistent difference in chromosome count, it would make much of a difference for the specific level of *Phrag*. *besseae* var. *dalessandroi* or any other species in the genus. The floral propensity carries over into cultivation with plants in Ecuadorian nurseries that can be validated as having come from the type location continuing to demonstrate a propensity for a shorter, branching inflorescence with multiple flowers open simultaneously. The propensity to produce multiple spikes with multiple flowers open simultaneously is the only consistent differentiating characteristic supported by empirical evidence. For horticultural reasons it is best to treat plants from the type location of *Phrag*. *besseae* var. *dalessandroi* as a variety of *Phrag*. *besseae* based on a narrow difference in floral propensities.

Phragmipedium besseae var. *dalessandroi* is currently known from a single location in Zamora-Chinchipe, Ecuador. The author has examined plants from several nearby secondary roadside habitats. Only one plant in twenty-five years of observation has exhibited the same floral propensities as plants from the type location. *Phragmipedium besseae* var. *dalessandroi* grows on moss-covered vertical cliff surfaces with constant runoff from the surrounding jungle cascading down on the plants. The plants grow in bright, diffused light. The humidity is high, and airflow is constant and perceptible. The plants are, on average, larger than most *Phrag*. *besseae*, however, plants of equal size have been encountered in secondary habitats of *Phrag*. *besseae* further north and west. *Phragmipedium besseae* var. *dalessandroi* is anything but more compact. As more areas, specifically east of Zamora-Chinchipe in northern Peru, are explored, perhaps more populations demonstrating the same floral propensities may be discovered. In that case, maintenance of *Phrag*. *besseae* var. *dalessandroi* will need to be reevaluated, as this unique population will then melt into the broader range of *Phrag*. *besseae*.

Phrag. *besseae* var. *dalessandroi* with one flower spike showing branching and flowers that were open simultaneously.

True plants of *Phrag*. *besseae* var. *dalessandroi* are rare and exceptional breeding parents. When a verifiable plant can be obtained, it should be cherished and properly noted. The horticultural trade is replete with sales misrepresenting plants as *Phrag*. *besseae* var. *dalessandroi*. Theories about seed-raised and natural plants being hybrids of the Peruvian forms and Ecuadorian forms cannot withstand scrutiny, are not supported by empirical evidence, and are false. It is alleged that natural hybrids between *Phrag*. *besseae* var. *dalessandroi* and *Phrag*. *besseae*, and other varieties of *Phrag*. *besseae* are present in natural populations, but that is not true. We can take some solace that except for *Phrag*. *besseae* var. *dalessandroi,* other purported varieties, and forms of *Phrag*. *besseae* have not, to date, been formally reduced to a new species or natural hybrid.

Phrag. boissierianum with spotting on the claw face and twisted petals.

Phrag. boissierianum with spotting on the claw face and without a staminode.

Phragmipedium boissierianum

Phragmipedium boissierianum (Rchb.f. & Warsz.) Rolfe, *Orchid Rev.* 4: 332 (1896).

Synonym:

Phragmipedium czerwiakowianum (Rchb. f. & Warsz.) Rolfe, *Orchid Rev.* 4:332 (1896).

Phragmipedium reticulatum (Rchb. f.) Schltr., Repert. Spec. Nov. *Regni Veg. Beih.* 8: 111 (1921).

Phragmipedium cajamarcae Schltr., Repert. Spec. Nov. *Regni Veg. Beih.* 9: 41 (1921).

https://wcsp.science.kew.org/namedetail.do?name_id=454824" *Phragmipedium boissierianum* var. *reticulatum* (Rchb. f.) Pfitzer in H. G. A. Engler (ed.), *Pflanzenr.*, IV, 50(12): 50 (1903).

Phragmipedium boissierianum var. *czerwiakowianum* (Rchb. f. & Warsz.) O. Gruss, *Orchidee* (Hamburg) 46: 219 (1995).

Phragmipedium boissierianum was the first of four descriptions. Two of them, *Phrag. czerwiakowianum* and *Phrag. reticulatum*, have been reduced to synonyms of *Phrag. boissierianum* by most taxonomists, and are indistinguishable from *Phrag. boissierianum* based on the characteristics documented in the descriptions. *Phragmipedium cajamarcae* was described in 1921 and has not been considered a distinct species since that time.

Reichenbach described *Phrag. czerwiakowianum* and differentiated it from *Phrag. boissierianum* based on the ratio of the labellum to the synsepal length. The ratio of the length of the labellum to the sepal was thought to be a stable, repeatable taxonomic characteristic. The type flower for *Phrag. czerwiakowianum* appears to have a shorter labellum than synsepal; however, it is believed this is due to how the flower was pressed. Separating species and forms within the species concept of *Phrag. boissierianum* based on any ratio or size of any part of the flower is risky as the flowers enlarge and develop as the flower matures, and some taxonomic characteristics change. Garay later opined that differences in the shape of the staminode could differentiate *Phrag. czerwiakowianum* from *Phrag. boissierianum*. The shape of the staminode is highly variable, and the use of the shape of the staminode for species differentiation cannot be supported.

Reichenbach later described *Phrag. reticulatum*, which until Garay resurrected the name in 1979, was long considered to be a synonym of *Phrag. boisserianum*. Garay differentiated *Phrag. reticulatum* based on the shape of the staminode, and a central groove on the labellum. Neither has been found to be stable within primary or secondary populations.

A flower of *Phrag. boissierianum* with petal margins with slight undulations before starting to twist.

With few exceptions, these four species are now regarded as one widely distributed and variable species. The initial confusion and misinterpretation of the natural materials used to describe these four species are understandable given the minute sample size; the four descriptions refer to a total of only five plants. The developmental variations inherent in individual flowers, and the cline in variation evident throughout natural populations were not documented or understood. Simply put, the sample size has always been too small to be of evidentiary value for the description of new species within the concept of *Phrag*. *boissierianum*.

Contrary to Garay's statements in 1979, flowers continue to develop over the life of the flower, and floral characteristics change. Colors change from yellow to green to brown, petals that open untwisted begin to twist and continue to do so until the flower's death. What appears as a smooth petal margin develops undulations, and the slippers and sepals grow longer. No species or form can be separated from the concept of *Phrag*. *boissierianum* based on staminode shape without giving each plant in every population a unique name.

Phragmipedium boissierianum forms clumps due to a short rhizome length, and the rhizome is challenging to distinguish. When not in flower, these short rhizomes help to distinguish *Phrag*. *boissierianum* from *Phrag*. *longifolium*. The crown of the plant typically has some degree of a purple color, whereas *Phrag*. *longifolium* has a red color at the base of its leaves.

In natural populations, the leaves can reach up to one meter (39 inches) in length. The examination of hundreds of plants in flower over the years demonstrates that the flower's size, color, and specific attributes continue to develop as the flower matures. The flowers are green and brown to green-yellow with varying degrees of color intensity throughout all floral parts. The claw face is generally yellow to green and spotted.

The petals can be held out at the sides at a 180-degree angle or can reflex back almost so they cannot be seen from the front of the flower. Petal twisting is variable and continues to change during the life of the flower, as do the undulations seen on the petal margins. The shape of the staminode is also highly variable. *Phragmipedium boissierianum* has been observed throughout multiple populations to be in flower all year and does not appear to have a specific flowering season. Flowers open sequentially on spikes that can reach two meters tall but typically do not exceed one meter. Flowers are obligatorily autogamous, that is, they self-pollinate as do plants in cultivation. All plants observed in natural populations bore pods on every floral bract.

Phragmipedium boissierianum has a wide range, from southern Ecuador south through Peru as far as Cuzco. No known populations extend as far east as Brazil; however, I would not be surprised to learn of a population encountered further east given its weedy nature. But for now, *Phrag*. *boissierianum* appears limited to the Andes. It should be noted that despite both *Phrag*. *boissierianum* and *Phrag*. *longifolium* having an extended range, the habitats do not overlap. *Phragmipedium boisserianum* has been encountered from 200 to 1,800 meters (656 to 5,906 feet) in primary and secondary habits and from full sun to deep shade. Groups of plants starting under dense canopy and ending in full sun have been seen.

Phragmipedium cabrejosii

Phragmipedium cabrejosii Damian, M. Díaz & Pupulin, *Phytotaxa* 423: 260 (2019).

Phragmipedium cabrejosii is a recently described species said to come from east-central Peru, in the department of Junín, in the middle of the southern part of the range of *Phrag*. *pearcei* in San Martin and the northern part of the range of *Phrag*. *caricinum* in Bolivia. At the time I write this, *Phrag*. *cabrejosii* is known only from two plants, the type plant and one other plant. However, the author has seen several photos taken during the last blooming season, showing flowers that are consistent with the two plants used for the description. This species is, like *Phrag*. *besseae* and *Phrag*. *kovachii*, something entirely new. However, this could change as more plants become available from the habitat, and the cline in natural variation is better understood. I would generally discount any new species publication based on a plant in a greenhouse; however, the type plant, which flowered in the collection of Alfredo Manrique in Lima, can be verified to have come from a natural population of known provenance and appears consistent with the

Phrag. *cabrejosii* flowering in cultivation with a bald staminode.

Phrag. *cabrejosii* flowering in cultivation.

rest of the population. The authors correctly compare *Phrag*. *cabrejosii* to *Phrag*. *caricinum*. Plants were not in flower when collected and were thought to be *Phrag*. *pearcei*. The two species are vegetatively and ecologically indistinguishable. The authors differentiate *Phrag*. *cabrejosii* from *Phrag*. *caricinum* based on the smaller size of the plants, the elliptical dorsal sepal, simple inflorescence, color, morphology of the labellum, and the shape of the staminode.

Although variations in the overall shape of the staminode are evident in the photos I have seen, *Phrag*. *cabrejosii* has a broadly defined staminode shape unlike that seen in either *Phrag*. *caricinum* or *Phrag*. *pearcei*. The images of the plants used in the description show what appears to be a bald staminode, and plants with small, black hairs across the top of the staminode, demonstrative of overall staminode variations across the genus, have started circulating privately. As more photos have become available, it is apparent the type plant is typical, and the morphological characteristics of the labellum appear consistent and readily distinguish *Phrag*. *cabrejosii* from closely related species. We should, however, proceed with caution until more information is known. If consistent, the morphological differences in the labellum alone are significant enough to warrant maintaining of *Phrag*. *cabrejosii* at the species level.

Phragmipedium caricinum

Phragmipedium caricinum (Lindl. & Paxton) Rolfe, *Orchid Review*, 4: 332 (1896)

Phragmipedium caricinum, another species of *Phragmipedium* found clinging tenaciously to rocks in rivers below the high-water mark, is aptly named after the long, narrow, sedge-like leaves that are sometimes folded down the middle, almost to the point of ninety degrees. Plants can be found atop boulders at the margins of rivers large and small throughout its range. The plants grow in dense mats with little more than mosses, and, occasionally, grasses. Rhizomes are up to 5 cm long, and the plants can reach 60 cm (2 feet) in height. Inflorescences can be up to two feet tall and bear up to six flowers successively lasting for several months. Branching inflorescences have been seen on larger plants and can bear up to ten flowers over several months. The flowers are yellow-green with different amounts of orange and brown and are morphologically close to *Phrag*. *pearcei*. The dorsal sepal is elliptic, the synsepal is ovate and can range from equal to or shorter than the labellum in overall length. The labellum is oval and has an orange to brown coloration. As with the closely related *Phrag*. *pearcei*, *Phrag*. *hirtzii*, and *Phrag*. *cabrejosii*, the labellum lacks protuberances or side lobes. The shape of the staminode is roughly rhombic with dark purple hairs. The claw face is beige with the characteristic red and brown spots that vary from small to large. Petals are about six

Phrag. *caricinum* in situ in Bolivia with pattern variations of the spots on the claw face.

cm (two inches) long and can be held between a twenty-five and forty-five-degree angle from the labellum. I have seen one plant in cultivation with the petals hanging almost straight down. The petals can twist one to two times after the flower opens. This species is currently known only from Bolivia.

In *Die Orchidee* 26(2): 56-62 (1975), Werner Rauh, a botany professor in Heidelberg, Germany, and one of his students, Karlheinz Senghas, published an article that attempted to document the differences between *Phrag. caricinum* and *Phrag. pearcei*. According to the article, they traveled to Peru and claimed to have found *Phrag. caricinum* in the vicinity of Moyobamba, Peru. The Rauh–Senghas analysis is flawed because the authors were not working with a population of *Phrag. caricinum*, but a Peruvian population of *Phrag. pearcei*. All Peruvian plants alleged to be *Phrag. caricinum* have turned out to be *Phrag. pearcei*. *Phragmipedium caricinum* is close to *Phrag. pearcei* but differs mostly in the color of the flowers, the size of the plant, the shorter, thicker rhizomes, and the type of inflorescence. *Phragmipedium caricinum* has a very hairy inflorescence compared to *Phrag. pearcei*. *Phragmipedium pearcei* has long rhizomes compared to the shorter rhizomes of *Phrag. caricinum*. A distinguishing characteristic might be the overall height and length of the leaves; however, the leaves of larger *Phrag. pearcei* plant can be the same size as a smaller *Phrag. caricinum* plant. Ecologically, the two species are the same. The distinctive characteristics of each species, however small, warrant the maintenance of two species. Most authors accept two distinct species, and I see no reason to disagree.

Phragmipedium caudatum

Phragmipedium caudatum (Lindl.) Rolfe, *Orchid Rev*. 4: 332 (1896).

The long-petaled species *Phrag. caudatum* once included plants found in Peru and Bolivia, as well as Central America. *Phragmipedium caudatum* remained the valid name for plants from both these locations until 1922 when Rudolf Schlechter proposed removing the Central American population and gave that long-petaled *Phragmipedium* the name *Phrag. warszewiczianum*. This touched off an almost one hundred year "discussion" among slipper orchid taxonomists as to the correct name for the Central American plants. I agree that there was a need to separate the Central American populations from the Peruvian and Bolivian populations into two distinct species. The "discussion" amongst some of the most prominent slipper orchid taxonomists, some of whom declared each other's work illegitimate, centered around the correct name for the Central American plants. I will dive deeper into this "discussion" under *Phrag. humboldtii,* as well as in a future article in the *Orchid Digest* focusing on the long-petaled species. We will discuss the Peruvian and Bolivian populations, for which there is almost universal taxonomic agreement and whose specific status is not questioned nor in doubt.

Phragmipedium caudatum can be found from northern Peru near San Martin south to Cusco and then east into Bolivia. *Phragmipedium caudatum* is terrestrial favoring a sandy loam consisting of accumulated organic materials, old leaves, and soil. Most taxonomists classify *Phrag. caudatum* as lithophytic or epiphytic. Based on my observation of natural populations in Peru, this species is terrestrial. The plants I have seen growing on vertical surfaces, or in small depressions on rocky outcrops, grow in an accumulated ball, or pocket, of loam.

According to Lindley (1850), great efforts were made by commercial nurseries in Europe to collect this beautiful, large, and unusual slipper orchid after its discovery and publication in 1840.

Rhizomes are up to 3 cm (1 inch) and are noticeable on larger plants. The leaves have been described as up to 60 cm (2 feet), but I have seen plants with longer leaves. The leaves are thick and stiff and can support themselves and stand upright. *Phragmipedium caudatum* can produce up to five flowers simultaneously on an inflorescence that can range from 30 to 60 cm (1 to 2 feet)

Phrag. caudatum showing the morphology of the labellum and hairs on the rim of the lip.

Phrag. caudatum with the color of labellum changed from the more commonly seen green to dark brown after several years in cultivation.

tall. Mature plants in bloom with multiple growths present one of the most spectacular displays in the genus or the orchid world.

The primary difference between *Phrag. caudatum*, *Phrag. warszewiczianum* and the Central American *Phrag. humboldtii* is in the labellum of the flower. *Phragmipedium caudatum* has a labellum veined with green or dark brown, and the fold along the distal edge (directly across from the staminode) of the labellum is subquadrate-angular (almost square and angular) in cross-section.

The sepals of *Phrag. caudatum* are oblong-lanceolate, tapering to a point. The dorsal sepal folds in on itself like a tube at the tip and is quite noticeable. The shape of the dorsal and synsepal present as a mirror image and curve around the front of the flower, creating a "C" shape that frames the labellum. The petals are quite spectacular; they are long, pendent, slightly twisted, and up to 80 cm (31 inches) long and 1.2 to 1.9 cm wide. They tend to be thinner toward the tip of the petals. The petals are cream with green veins becoming red-brown to mahogany distally. Petals continue to lengthen after the flower opens and can continue to lengthen until the flower dies. The staminode is widely triangular, bilobed, and variable with dark red tips on each side and hairs that are long, obvious, and sparse. Overall, the labellum shape, color, and spotting can vary considerably.

The overall color of the flower ranges in differing degrees from green and white through to yellow and brown. Flowers with brown lips are known, and this brown labellum cannot be used to distinguish *Phrag. caudatum* from the Central American *Phrag. humboldtii*.

Color is a strange thing in this species. Over the past few decades, I have seen many plants in situ, especially those near Cusco, with dark brown flowers that become green, yellow, and white after several years in cultivation. There is a horticultural color variant, *Phrag. caudatum* var. *sanderae* that has been applied to lighter, greener colored flowers. However, this designation has never been formally published. Given the color changes that can occur in cultivation, I do not see the need to publish the designation.

Phragmipedium caudatum is found from 1,000 to 2,100 meters (3,281 to 6,890 feet). In the higher end of that range are the populations near Cusco, Peru, and at the lower range are the populations near San Martin in Peru. *Phragmipedium caudatum* is a warm grower and can be found in both primary and secondary habitats. Secondary populations tend to have a few dozen plants, but they do not survive for long.

Phragmipedium guianense

Phragmipedium guianense Sambin & Braem, *Richardiana* 15: 4 (2014).

Phragmipedium guianense is based on a plant that was collected near Saül in French Guiana and flowered in cultivation. According to the description, plants later described as *Phrag. guianense* had been misidentified as *Phrag. caudatum* dating back to as early as 1994. *Phragmipedium guianense* is differentiated by its smaller flowers, shorter dorsal, and synsepals, and what was described as shorter petals in the range of 10 to 70 cm (4 to 28 inches). That is a considerable range for petal length. The other long-petaled species from the Andes typically have petals in this range. The plants are described to be about 24 cm (9 inches) high and are epiphytic on tree branches high in evergreen forests. The plant size and ecology of *Phrag. guianense* are the same as *Phrag. humboldtii*. The inflorescence, slightly taller than the plant, bears one to two flowers that open sequentially. The ovary is green and spotted with red. The staminode is rhombic with red tips on both sides and a small protrusion at the bottom. The labellum is morphologically like *Phrag. warszewiczianum* with a low, narrow keel, with the lower third projecting forward. *Phragmipedium guianense* has a claw face heavily covered with large brown and purple spots that are unique, in my opinion, if it is stable, that sets *Phrag. guianense* apart from the closely related *Phrag. caudatum* and *Phrag. klotzschianum* that have a white claw face.

Oddly, since the publication of the description, no further photos of this species have been seen. The description should have spurred an interest in this species. Cribb (2017) states that more investigation is need-

ed regarding this species' affinities to the closely related *Phrag. klotzschianum*. I both agree and disagree. *Phragmipedium guianense* is quite distinct, preferring tree branches as opposed to life along the banks of rivers below the high-water line. Vegetatively, the species are utterly inconsistent. *Phragmipedium guianense* has leaves much closer to the Central American *Phrag. humboldtii* than the small, thin leaves of *Phrag. klotzschianum* that, in turn, are closer to *Phrag. pearcei*. There does not seem to be any doubt that *Phrag. guianense* is distinct from *Phrag. klotzschianum*. However, this species is currently only known from a small sample size and has a very restricted range in the area around Saül in French Guiana. Ecologically and morphologically, this species has many commonalities with *Phrag. humboldtii*. The three Andean species in the *Caudatum* group are very closely related, and the differences do not need to be substantial to separate them into distinct species. However, given how little we know about this species it is best to accept *Phrag. guianense* with caution until further information can be obtained.

Phrag. hirtzii

Phragmipedium hirtzii

Phragmipedium hirtzii Dodson, *Orchis* 58: 129 (1988).

Synonym:
Phragmipedium anchicayense Braem, Tesón & J. P. Faust, Austral. *Orchid Rev.* 81(5): 10 (2016).

Phragmipedium hirtzii was first encountered on large boulders in a river that cuts under the main road leading from Lita, Ecuador, west to the Pacific coast. Contrary to some reports, this species was never found growing on the side of the road or in a railroad cut. I am intimately familiar with the river as well as the railroad cut referenced in reports, and *Phrag. hirtzii* is encountered only on the banks of the river. *Phragmipedium hirtzii* is found in large mats mostly on the top and sides of boulders. I have not seen a natural hybrid between *Phrag. longifolium* and *Phrag. hirtzii* during my careful observation of the area.

This species is best aligned with *Phrag. pearcei*, *Phrag. caricinum*, *Phrag. cabrejosii,* and *Phrag. klotzschianum*. *Phragmipedium hirtzii* shares substantial ecological and vegetative characteristics as well as floral morphology with these species.

Plants of *Phrag. hirtzii* can range from 20 cm to 40 cm (9 to 16 inches) tall. The rhizomes are long and have been seen up to 5 cm (2 inches) in length. Plants subsist below the high-water mark. The roots attach firmly and tenaciously to the boulders and rocks both mid-stream and along the edges of rivers with occasional mosses accumulating around the roots. Leaves are long and thin and can reach 25 cm (10 inches), but most plants are smaller than this. The inflorescence is tall for the size of the plant and has been seen to reach 60 cm (2 feet) in natural populations and cultivation. Plants can have up to seven flowers produced successively across several months. I have seen one group of cultivated plants growing terrestrially at a well-known Ecuadorian nursery, and their plants produce longer flower spikes and flower year-round as the growths mature. I have visited populations several times in three geographically distinct populations that flower in April.

The petals are pendent and all populations twist at a progressive rate. Petals emerge at one angle to the labellum and elongate and progress to different angles as the flower matures. As opposed to heavily twisted petals, slight twisting is a function of the flower's age; it is not static, and not consistent within natural populations. It is useless as a defining taxonomic characteristic.

The labellum can have varying degrees of color from pale to deep red-brown. The degree of prominence of the side lobes varies. There is one distinguishing characteristic of the staminode that sets *Phrag. hirtzii* apart from all closely related species; the staminode is bald. This is an obvious taxonomic indicator that leaves little room for misinterpretation.

Braem et al. described *Phrag. anchicayense* in 2016 based on a plant from Anchicaya, Colombia. The habitat is identical to *Phrag. hirtzii* habitat in every way. The location northwest of Cali extends into the known range of *Phrag. hirtzii*.

Braem states in support of *Phrag. anchicayense*: "[W]e came across some plants collected in the Anchicaya region of Colombia. On first sight, the plants looked very much like *Phragmipedium hirtzii*: reddish colouration of the pouch, more or less glabrous staminode, reddish pollinia. Upon closer scrutiny, however, various clear and unambiguous differences were observed." The "clear and unambiguous differences" were listed as 1) Petals only slightly twisted and ruffled; 2) Pouch without the sidelobes characteristic of *Phragmipedium hirt-*

Phrag. hirtzii 'Godzilla' from the type location with a bald staminode and lack of a V-shaped notch in the front of the labellum.

zii and the other members of subgenus *Longifolium*; 3) Pouch without "V" mark at the front of the pouch (not always, but often present in *Phragmipedium hirtzii*).

Braem fails to compare the side lobes of this proposed new species with either *Phrag. pearcei* or *Phrag. caricinum*, both species lack side lobes, or spurs on the top side of the labellum, with which *Phrag. hirtzii* is more closely related than *Phrag. longifolium*. The photo and line drawing of the type plant for *Phrag. anchicayanse* show a slipper that does have side lobes more prominent than those from the type location of *Phrag. hirtzii* near Lita, Ecuador. As the authors concede in the description, pouches without a "V" mark at the front of the pouch is a variable trait and is also seen in *Phrag. hirtzii*. Petal twisting is progressive and not static. What Braem et al. refer to as "clear and unambiguous differences" are little more than variable and progressive morphological characteristics present in natural populations of *Phrag. hirtzii*.

Additionally, Braem et al. fail to identify the significant consistencies of this proposed species with *Phrag. hirtzii*. First, the staminode is bald; this is a defining taxonomic characteristic of *Phrag. hirtzii,* and the proposed *Phrag. anchicayense* has a bald staminode. Plants are ecologically consistent. *Phrag. anchicayense* is vegetatively indistinguishable from *Phrag. hirtzii*.

Cribb (2017) reduces *Phrag. anchicayense* to a variety of *Phrag. hirtzii.* Considering the variable nature of what the authors refer to as "clear and unambiguous differences," as well as the many similarities to *Phrag. hirtzii* that the authors failed to note, it is best to treat *Phrag. anchicayense* as a synonym of *Phrag. hirtzii*. The differences are insufficient to warrant even treatment at the variety level.

Phragmipedium humboldtii

Phragmipedium humboldtii (Warsz.) J. T. Atwood & Dressler, *Selbyana* 19: 246 (1998 publ. 1999).

Synonym*:*

Phragmipedium popowii Braem, Ohlund & Quéné, *Richardiana* 4: 185 (2004).

Phragmipedium exstaminodium Castaño, Hágsater & E. Aguirre, *Orquidea* (Mexico City), n. s., 9: 193 (1984).

Phragmipedium monstruosum Archila, *Revista Guatemalensis* 2(3): 5 (1999).

Phragmipedium triandrum Archila, *Revista Guatemalensis* 2(3): 6 (1999).

Phragmipedium warszewiczianum (Rchb. f.) Schltr., Repert. Spec. Nov. *Regni Veg. Beih*. 17: 9 (1922).

The specific status of *Phragmipedium humboldtii* does not appear to be in doubt, and it is easily recognized. There is almost universal agreement in both the taxonomic and horticultural communities that the Central American populations are, in fact, a distinct species. However, much discussion has centered on the correct name for *Phragmipedium humboldtii.* It is the correct name that is causing all the confusion. Except for Braem, there appears to be a consensus, with which I agree, that the correct name is *Phrag. humboldtii*. After considering the same history of published names and the International Code of Botanical Nomenclature (ICBN), Cribb, Atwood, Dressler, Gruss, and Pupulin are all in agreement; the correct name for this species is

Phrag. humboldtii. Braem is the sole outlier.

Phragmipedium humboldtii can be found from southern Mexico south into Panama. The species is terrestrial and epiphytic. However, the soil in which *Phrag. humboldtii* grows is a mix of rocks and clay, as opposed to the sandy loam preferred by its Peruvian and Ecuadorian cousins, *Phrag. caudatum* and *Phrag. warszewiczianum*. Plants can be found growing on both dead and living trees. Terrestrially growing plants send their roots very deep into the rocky clay. Plants growing on dead trees send their roots deep into the deadwood. Unlike some other *Phragmipedium* species, this species does not subsist with its roots exposed continuously to the light and air around the plant.

Rhizomes are up to 3 cm (1 inch) and are evident on larger plants. Plants can form large clumps in nature, and plants with fifteen to twenty growths and multiple flower spikes are not uncommon. Plants can produce one to four flowers on a spike, however, three is typical in natural populations. It has been stated leaves can be up to 60 cm (2 feet) long, but I have not seen plants this big in natural populations or in cultivation. On average, plants of *Phrag. humboldtii* are smaller than *Phrag. caudatum*. The inflorescence is 30 to 60 cm (1 to 2 feet) in height. The leaves are thick and stiff, and in natural populations can support themselves and stand upright. Mature plants with multiple inflorescences in bloom present one of the most spectacular displays in the genus or in the orchid world.

Dressler & Pupulin differentiate *Phrag. caudatum* and *Phrag. humboldtii* from each other based on the characteristics of the labellum; I agree. *Phragmipedium humboldtii* has a distinctly round labellum throughout and not markedly thickened, while *Phrag caudatum* has a labellum with a prominent hairy band on each side; however, the word "prominent" is subjective. Brown lips are present in both species in varying degrees and cannot be used on its own as a differentiating taxonomic characteristic. The staminodes vary. Some plants present a central tooth at the apex with a red tip. Some have a protruding button in the middle; others have staminodes that curve like your hand.

The sepals are spectacular and can be four times longer than the size of the plant. The sepals are oblong-lanceolate, tapering to a point. The petals are quite spectacular! The petals are long, pendent, slightly twisted, up to 80 cm (32 inches) long and 1.2 to 1.9 cm wide, tending to be thinner toward the tip of the petals. They are cream with green veins becoming red-brown to mahogany distally. The petals continue to lengthen after the flower opens until the flower dies. The dorsal and synsepals present as mirror images of each in shape and curve around the front of the flower creating a "C" shape that frames the labellum in the center.

Flowers bloom in natural populations in May and July. The Panamanian populations bloom in May, and the populations in Guatemala and southern Mexico bloom in July. Out-of-season flowers are rare. The habitats are found at elevations of 1,200 to 1,800 me-

Phrag. humboldtii

Phrag. exstaminodium without a staminode

ters (3,937 to 5,906 feet) with most occurring near 1,500 meters (4,921 feet). *Phragmipedium humboldtii* has been reported in secondary roadside habitats where it can be found growing side by side with *Phrag. longifolium*. Dressler (2005) reported a natural hybrid between *Phrag. longifolium* and *Phrag. humboldtii* from one of these secondary locations, but that has not been verified.

Phragmipedium exstaminodium presents an interesting situation for us in the *Phragmipedium* community. When this species was described, it was the only species we knew of that occurred in a natural population with no staminode. It is rare. Cribb (2017) reported only five plants when he went to the habitat in 1990, and McCook reported about ten (per personal communication). Instead of a staminode, the plants only have the center ridge or part of the center ridge. The center ridge looks like a tiny tail. For many years I also subscribed to the concept of *Phrag. exstaminodium*. After all, here was a species that, despite being a *Phrag. humboldtii* in every way, lacked a staminode. This should have been the first clue that something was not correct about this concept.

Phragmipedium exstaminodium was always, in my mind, a valid species because of this morphological difference from *Phrag. humboldtii*. Then one day, I stopped in a small town in southern Ecuador while on my way south through Zamora-Chinchipe on my way to San Martin in northern Peru. The road was blocked due to a landslide, and I could not continue until the road was cleared. I had an unplanned day to spend in southern Ecuador. I got a hotel room, ate lunch, and headed out to explore. I found an unpaved road leading up into the mountains and started out. I stopped in an area that looked clear of dense jungle and started climbing. About 10 meters (33 feet) from the road, I encountered a large population of *Phrag. boisserianum*. This was not unusual since this species can be found in the millions in primary and secondary habits throughout southern Ecuador, especially in the Zamora-Chinchipe area. I approached a large clump with perhaps thirty growths. When I got close enough, much to my great surprise, the flowers had no staminodes with only the center ridge protruding like a tiny tail. This is precisely what we see in *Phrag. exstaminodium*. *Phragmipedium boisserianum* without staminodes! My eyes opened wide, and I looked around and found about ten plants at this location with flowers that did not have a staminode. I have never encountered anywhere else plants of *Phrag. boisserianum* without a staminode.

But this is not the only instance of phragmipediums without staminodes. Popow Orchids in Germany posted a picture on social media of a seed-raised plant called *Phrag. fischeri*, without, you guessed it, a staminode. Instead of a staminode, the flower had only a tiny protrusion like a small tail. While at the World Orchid Conference in Guayaquil, Ecuador, in 2017, I was shown a photo of a group of flowers taken along the Colombian border in a phragmipedium habitat. The picture showed three flowers of *Phrag. schlimii* alongside two flowers of *Phrag. longifolium*. Two of the flowers of *Phrag. schlimii* had no staminode. In southern Ecuador, a small colony of *Phrag. boisserianum* were found without staminodes. We see the same thing with *Phrag. schlimii*. This forced me to rethink the concept of *Phrag. exstaminodium*.

If *Phrag. exstaminodium* is a species, then we have two additional species to describe. We must describe every group or subpopulation without a staminode as a new species if we are going to give that designation to one, *Phrag. exstaminodium*. Taken in the context of the significant variations in the staminode seen across the genus, does the description of a new species seem unwarranted now that we know of at least two other species that demonstrate the same trait? We cannot stake our claim for species status against the self-pollinating propensities of *Phrag. exstaminodium* since both *Phrag. boisserianum* and *Phrag. schlimii* also self-pollinate. So, what do we do? Nature is again teaching us how little we know when we claim to know so much.

The shape of the staminode in the genus *Phragmipedium* is highly variable; the only consistency throughout is the center ridge. This ridge presents in different ways, but it is present in all flowers of the genus. Without a stable staminode, it should not be presumed that the staminode attracts pollinators. In several species, it has been demonstrated that the petals and claw face attract pollinators. There is no research demonstrative of the staminode as a lure for pollinators in this genus. That allows the staminode to vary like every other floral part, and it does. Until another way can be shown that *Phrag. exstaminodium* differs from *Phrag. humboldtii*, it is best to treat *Phrag. exstaminodium* for what it is, a *Phrag. humboldtii* without a staminode showing only the center ridge. This is also the case with at least two other species, *Phrag. boisserianum* and *Phrag. schlimii*. The plants without a staminode, however uncommon, are part of the broader species concept and are not distinct species.

Phragmipedium klotzschianum

Phragmipedium klotzschianum (Rchb.f.) Rolfe, *Orchid Rev.* 4: 332 (1896).

Phragmipedium klotzschianum is a small species similar to *Phrag. pearcei* vegetatively as well as ecologically. When out of bloom, it is not easy to differentiate the two. P*hragmipedium klotzschianum* has small, grass-like leaves that are minutely trifid at the tip, and long, stoloniferous rhizomes can be up to 10 cm (4 inches) in length. The flower spikes can range from 20 to 40 cm (8 to 16 inches), but most plants in natural populations and cultivation have flower spikes closer to the shorter end of the range. Spikes can carry up to four flowers blooming sequentially of the labellum that forms the channel between the bottom of the labellum and the

Phrag. klotzschianum

escape holes near the pollen at the back. The claw has two halves that come together in the front below the staminode. The claw face is white with brown spots on the rim of the labellum. The unique labellum is obovate, generally egg-shaped, with the broadest part just below the mid-labellum and does not overlap with other species. Another differentiating characteristic is the dense, hairy ovary noticeable on the majority of the plants. When in flower, the species is easy to recognize, and its specific status is not in doubt.

The lateral petals are linear and can be up to 10 cm (4 inches) long, and as the labellum widens, the petals angle outward at almost the same angle as the sides of the labellum, creating two nearly parallel lines. Petals are untwisted when the flower opens, and progress to one to three twists as the petals lengthen, and the flower matures. The staminode is very like the staminode that we see in the Caudatum Group in general shape. There are two side lobes with darker red-brown tips and, in some flowers, a third lobe at the bottom without coloration.

Plants in cultivation, as well as in natural populations, have been seen in flower primarily in March. However, the occasional flower can be seen from September through February. This corresponds roughly to the dry season when it would be unwise for the species to bloom during the rainy season as it grows below the high-water line.

Phragmipedium klotzschianum is limited to a small range. There are several large populations along the edges of rivers throughout the Gran Sabana in Venezuela, Guyana, and northern Brazil. The range overlaps that of *Phrag. lindleyanum*. However, the two species have not been observed nor reported to cohabitate, nor are there any natural hybrids.

I have seen plants growing in small amounts of accumulated mosses, but this is a function of the dry season. Enormous dense mats, similar to *Phrag. pearcei*, along with the mosses, keep this species continuously moist throughout the dry season. Here, we see another species that seems to exist in two different worlds. Densely packed roots with mosses under the vegetative parts of the plants remain moist and are sustained by the passing water. However, the vegetative parts subsist in an arid environment going for long periods without rain. Growing on rocks and in accumulated river sand during an extended dry season would not be ideal. Still, *Phragmipedium klotzschianum* has adapted to survive and thrive in its unique ecological niche.

You may have seen this species listed for sale as *Phrag. klotzcheanum*. This was a 19th-century error in spelling. The rules of the ICBN warrant a spelling of *Phrag. klotzschianum*.

Phragmipedium kovachii

Phragmipedium kovachii J. T. Atwood, Dalström & Ric. Fernández, *Selbyana* 23(Suppl.): 1 (2002).

Synonym:
Phragmipedium peruvianum Christenson, *Orchids* (West Palm Beach) 71: 620 (2002).

Perhaps no orchid has reshaped, re-invigorated, nor frightened the *Phragmipedium* community or the greater orchid world, like the discovery, description, subsequent scandals, and criminal investigation surrounding *Phrag. kovachii*. Perhaps as important as the

Phrag. kovachii

Phrag. kovachii

discovery and criminal investigations that followed is how one of the greatest orchids ever discovered could have remained unknown to the orchid world for so long. The well-documented scandal engulfed the Marie Selby Botanical Garden for authoring the description, and Michael Kovach for bringing the type plant into the United States. I highly recommend *The Scent of Scandal: Greed, Betrayal, and the World's Most Beautiful Orchid* by Craig Pittman. However, lost in all this attention is the early story of how the plant first came to Mr. Kovach's attention and had avoided discovery for so long

Like the discovery of *Phrag. besseae*, *Phrag. kovachii* was first encountered on the side of a Peruvian road near Moyobamba in 2001. This roadside is also populated with *Phrag. boisserianum*, and, when not in flower, the two species are similar. When the first plants bloomed on the roadside, and there were only two of them, they were collected by a nurseryman named Fausto and taken to his roadside orchid stand. It is here that Kovach encountered *Phrag. kovachii*; the rest is well-documented history or infamy.

There are several roadside orchid stands in the area, and it is not uncommon for the owners to be unfamiliar with the plants they find and offer for sale. On a recent visit to Fausto and his orchid stand, several species of spectacular *Epidendrum* were found, none of which he could identify. Plants can be purchased for a few USD, and you take the plants with you.

After Kovach's discovery, an exhaustive search was undertaken by residents and orchid collectors, some at the fevered requests of a well-known orchid nursery located in Lima, to find the source population for the two plants. It was briefly feared that the described plant in the United States used for the description was the only one that might ever be located. Luckily, or unluckily depending on your point of view, the primary habitat was located several kilometers into the jungle from the roadside location where the plants first were found. It is possible to visit *Phrag. kovachii* today. There are three known primary habitats, two on public land and the third on private, guarded property. Large plants still populate at least one location, with plants of thirty growths still producing seed. One site has already been stripped of plants, and this is probably the first habitat found. Two other habitats in the jungle are difficult to reach and require several days on horseback.

Fortunately, licenses have been granted to two Peruvian nurseries to propagate *Phrag. kovachii* from seed, and the pressure on natural populations appears to be diminishing. You can buy nursery-raised plants of *Phrag. kovachii* today, with excellent parentage, from most slipper orchid dealers and at most orchid shows. The cost is a few hundred dollars, much less than the $1,000 to $10,000 price tag in the few years after the description.

The surrounding jungle in this area is one of the most orchid-rich and spectacularly beautiful habitats anywhere in the world. Except for a few local orchid hunters, the area is largely undisturbed. The area is mostly pristine primary forest cut by small rivers that run through beautiful valleys. Orchids, in copious numbers, can be seen on almost every tree and moss-covered rock. However, that all may be changing. Progress is starting to reach this area of Peru. In recent years, roads in the nearby area have been paved, and electricity more available. The constant tug of war between nature and the needs of humans for agriculture, roads, trade, schools, and medical care is starting to encroach on *Phrag. kovachii* habitat. *Phragmipedium kovachii* remained hidden for so long simply because the world had not yet reached its primary habitats. What it took to shake *Phrag. kovachii* lose from behind the veil of the jungle was the building of a nearby road.

Over the years, there have been several attempts to locate *Phrag. kovachii* in Ecuador, and all have failed because, in my opinion, they have been looking in the wrong places. I have found in Zamora-Chinchipe, Ecuador, some of the same species of fauna, other species of nearby orchids, and begonias found in Peru near the primary habitats of *Phrag. kovachii*. Also, there are

Phrag. *besseae* and *Phrag*. *boisserianum* in the same area. Missing in Zamora-Chinchipe are the primary habitats of *Phrag*. *kovachii*. I have every confidence that there are populations of *Phrag*. *kovachii* hidden here, and they will eventually be found. This area where I suspect *Phrag*. *kovachii* to be, has many foreign-owned mineral mines with guards with loaded rifles. Searching for orchids in this area has never been on my bucket list, nor should it be on yours.

A few days after the publication of *Phrag*. *kovachii*, Eric Christianson described the taxon as *Phrag*. *peruvianum*, however, the rules of taxonomic priority require that *Phrag*. *peruvianum* be reduced to a synonym of *Phrag*. *kovachii*. Notwithstanding repeated outcry, perhaps justifiable, from some of the Peruvian orchid community, *Phrag*. *kovachii* is the only name recognized. The taxonomy of *Phrag*. *kovachii* is not in doubt, and this species is one of the most recognizable orchids in the world.

Flowers can reach 25 cm (10 inches) in diameter. The buds are unique because they are covered in coarse brown hairs that make them readily recognizable and distinguish this species from the closely related *Phrag*. *besseae* and *Phrag*. *schlimii*. Petals are pink to purple, and the labellum can range from fuchsia to red with a yellow band at the base. Staminode shapes are variable, as is the overall shape of the labellum.

There is a widespread misunderstanding that the petals of *Phrag*. *kovachii* reflex after a few days, but this is not true. Many clones maintain a flat flower over the life of the flower.

There have been several plants over the years that have presented with a green flower spike and bud. More than one grower has been fooled into thinking they had an albino *Phrag*. *kovachii*. However, all these flowers opened to the beautiful pink and fuchsia flowers we are accustomed to seeing. On one trip to visit *Phrag*. *kovachii*, the owner of a local nursery allowed me to open some of the flower buds, and I noticed a curious thing. Every flower part was green within the buds until just before the flower started to open. It appears that the color develops late in the development of the flower. I assume that any albino flower would be green and not white based on this observation.

Like all species of *Phragmipedium*, *Phrag*. *kovachii* demonstrates some variability.

Phragmipedium lindenii

Phragmipedium lindenii (Lindl.) Dressler & N. H. Williams, *Taxon* 24: 691 (1975).

Phragmipedium lindenii was first described as a separate genus, *Uropedium*, in 1846. Since that time, various authors have either resurrected the name *Uropedium* or placed this species in the genus *Phragmipedium*. I follow the 1975 placement in the genus *Phragmipedium*. Whether or not this species is deserving of its own genus, a one-species genus, *Phrag*. *lindenii* is unique

Phrag. *lindenii* in situ in Ecuador.

among slipper orchids and unique in the genus. It is the only species of slipper orchid with a labellum that is formed into a third petal.

The taxonomy of *Phrag. lindenii* is not in doubt, and this species is easily recognizable by the lack of a slipper-shaped labellum. It might seem odd that it does not have a labellum since that usually plays a critical role in pollination. However, *Phrag. lindenii* does not need the labellum since it self-pollinates. Self-pollination is accomplished by a functional stamen that continues to grow until it touches the stigma and pollinates the flower. All flowers observed in habitats, private collections, or nurseries self-pollinate. Neither the long petals, typically between 20 to 40 cm (8 to 16 inches) in length, nor the elongated labellum (the third petal) of the same length, appear to play a role in pollination or attracting pollinators. The combination of unique characteristics, obligatory self-pollination, an elongated labellum like a third petal, and the volcanic ecology, separate *Phrag. lindenii* from the rest of the genus and make it an easy species to identify both in and out of flower.

The inflorescence typically carries between two and four flowers. Rhizomes are short, to 1 cm (0.4 inches), and the plants quickly form large clumps in primary habitats. The plants are short in stature, not seen to exceed 40 cm (16 inches); however, many are smaller. Flowers vary from maroon to green to yellow and tend to become more yellow as the flower matures. The petals do not twist, but instead, continue to elongate and continue to do so even after contact with the ground and surrounding grasses. *Phragmipedium lindenii* continues to develop after the flower is fully open as its self-pollination mechanism demonstrates. Without continuing to develop, the flowers could not self-pollinate. The flowering season is February to March. Out-of-season flowers are extremely rare.

Phragmipedium lindleyanum

Phragmipedium lindleyanum (R. H. Schomb. ex Lindl.) Rolfe, *Orchid Rev.* 4: 332 (1896).

Synonym:

Phragmipedium kaieteurum (N. E. Br.) Garay, *Orchid Digest* 43: 136 (1979).

Phragmipedium sargentianum (Rolfe) Rolfe, *Orchid Rev.* 4: 332 (1896).

Phragmipedium lindleyanum has a wide range of habitats, with most populations scattered throughout Venezuela, Guyana, Suriname, and French Guiana. There is a single area in Pernambuco State, Brazil, south of the equator, where several populations are found.

Like all species of *Phragmipedium*, *Phrag. lindleyanum* is variable across multiple vegetative and floral characteristics. This species is a large plant with branching flower spikes that can reach two meters (7 feet). Spikes bearing up to thirty flowers sequentially on a branched inflorescence are a sight to behold. I am six-foot-one, and it is not unusual for me to stand next to a plant growing terrestrially and have a flower at eye level. The inflorescence is about 1 cm thick, hairy, and tapers near the tip. The characteristics of the inflorescence are highly variable in *Phrag. lindleyanum.* The length and size of the floral bracts can vary from 2 cm (0.8 inch) on smaller, first-bloom plants, up to 5 cm (2 inches).

All flowers of *Phrag. lindleyanum* are hairy in varying degrees. The number of hairs ranges from subtle to obvious, and they are found on the ovary through to the staminode, sepals, and petals. This characteristic has been observed across habitats and in cultivation. The flowers are white, green, yellow, and red. The colors, particularly the depth of the red, vary considerably on the same plant from year to year, particularly those plants taken into cultivation from natural habitats. The petals have edges that often undulate, and they twist once. They angle out from 45 to 90 degrees from the labellum. The labellum is elliptic, with varying degrees of yellow, green, and red throughout. The claw face is entirely green to yellow with small reddish spots. There is a central chevron-shaped spot at the point where the two halves of the claw come together.

The staminode is three-lobed and ranges in shape from rhombic to triangular. It is white to yellow with reddish hairs at the top and bottom that appear scattered rather than linear, as seen in other species such as *Phrag. longifolium*. The dorsal sepal is variable, being oblong, ovate to elliptic, 2.7 to 4.0 cm long by 1.2 to 2 cm wide. Flowers appear in October, and plants can stay in flower for an extended period depending on the plant's size. The rhizomes are thick, up to 2.5 cm (1 inch) in diameter and length.

The leaves can reach a maximum of one meter (three feet) in length, but most have leaves that range from 30 to 60 cm (1 to 2 feet). The leaf color ranges from bright to a darker green, with some plants showing signs of sunburn with yellow streaks on the leaves. There is a yellow margin that varies from subtle to obvious. The leaves can be brittle, shiny, and stiff that indicates the partially xerophytic nature of the species. The base of the leaves is red.

In 1979, Garay wrote in the *Orchid Digest* that *Phrag. kaieteurum* could be differentiated from *Phrag. lindleyanum* based on the "the shape and color of the leaves, the color of the flowers, and the shape of the staminode." The shape of the staminode in his description is consistent with the variations seen throughout the range of *Phrag. lindleyanum*. The color of the flower and the leaves in *Phrag. lindleyanum* are highly variable and easily impacted by cultural conditions. Garay pointed out other differences. *Phragmipedium kaieteurum* has more glabrous (less hairy) sheaths and floral bracts, different colored flowers, and leaves that lack a yellow margin. The leaves of the type material have the same cells on the leaf margins as plants throughout the range, the difference being that they are difficult to see on the small plants used for Garay's description. As for the asser-

Phrag. lindleyanum: note the differences between the plant in situ and a wild-collected plant from the same location flowering in cultivation.

tion that these plants are less hairy, it is correct that the plants used for the description have fewer hairs than those used in the comparison. Plants from the area demonstrate varying degrees of pubescence with those with shorter hairs more prevalent. However, the amount and length of the hairs on the flowers are variable and cannot be used as a taxonomic characteristic.

Phragmipedium sargentianum was differentiated from *Phrag. lindleyanum* based on a description in the *Orchid Review*, "the presence of a pair of small white tubercles [a small rounded projection] on the inner margin of the side lobes of the lip." In the literature, it is not clear if Rolfe examined the herbarium specimens of two previously described species, *Phrag. lindleyanum* and *Phrag. kaieteurum*. The descriptions of both of those species have the small, white tubercles.

Since that time, the species concept of *Phrag. sargentianum* has evolved, with different authors attempting to document static and consistent differentiating taxonomic characteristics. Cribb (2017) supports *Phrag. sargentianum* at the species level based on the contention that *Phrag. sargentianum* has green leaves lacking the yellow margin seen on plants from the northern part of the continent. This is not accurate. The yellow margin is clearly visible on some of the photos of plants from Pernambuco, Brazil. Cribb (2017) further supports maintaining *Phrag. sargentianum* as a species based on the shape of the staminode describing it as triangular rather than square. The shape of the staminode varies considerably throughout all populations and plants seen in cultivation, as it does throughout the entire ge-

Phrag. lindleyanum with yellow leaf margins.

nus. Cribb also cites the considerable distance between the populations in Pernambuco, Brazil, and those in Venezuela, Guyana, Suriname, and French Guiana. Specific status based solely on geographic separation is not compelling, lacking any static and stable taxonomic characteristics other than distance, nor can it be definitively stated that no natural populations exist in the northeastern part of Brazil, a considerable and largely unexplored area. Braem (2018) appears to support *Phrag. sargentianum* based on a 1900 article by Kränzlin in *Orchidacearum Genera et Species* that cites the green leaves that lack a yellow margin. Kränzlin differentiates *Phrag. sargentianum* based on a dull, yellow flower versus a greener flower, the synsepal being less developed, larger floral bracts, and a taller inflorescence. These characteristics are inherently variable across the range and within populations seen in Pernambuco and are not static. Flower color is highly variable and can change with cultural conditions. The height of the inflorescence varies depending on the size and age of the plant. I have a friend who lives near one of the habitats in Pernambuco; on several occasions, the two of us have visited some of these populations. Wild plants with two-meter flower spikes in situ were taken and put into pot culture or placed directly into her flower garden. I have watched the flower spikes shorten, and the flower color change. The staminode shapes vary, and the floral bracts vary in size depending on the size of the plant and inflorescence.

The taxonomic characteristics used to differentiate both *Phrag. kaieteurum* and *Phrag. sargentianum* from *Phrag. lindleyanum* are not static or consistent within observed populations across the range and vary based on cultural conditions. The commonalities, often overlooked by authors who have focused solely on minute differences in small sample sizes, are considerable, as are the ecological consistencies. No author has managed to present a static and consistent taxonomic characteristic to break *Phrag. lindleyanum* into more than one species that can withstand scrutiny.

Phragmipedium longifolium

Phragmipedium longifolium (Warsz. & Rchb. f.) Rolfe, *Orchid Rev.* 4: 332 (1896).

Synonym:

Phragmipedium christiansenianum O. Gruss & Roeth, *Orchidee* (Hamburg) 52: 76 (2001).

Phragmipedium hartwegii (Rchb. f.) Pfitzer in H. G. A. Engler (ed.), *Pflanzenr*., IV, 50(12): 48 (1903).

Phragmipedium longifolium var. *hartwegii* (Pfitzer) Hallier f., *Ann. Jard. Bot. Buitenzorg* 14: 45 (1897).

Phragmipedium dariense (Rchb. f.) Garay, *Orchid Digest* 43: 141 (1979).

Phragmipedium roezlii (Rchb. f.) Garay, *Orchid Digest* 43: 145 (1979).

Phragmipedium hincksianum (Rchb. f.) Garay, *Orchid Digest* 43: 144 (1979).

Phragmipedium × *roethianum* O. Gruss & Kalina, *Orchidee* (Hamburg) 49: 245 (1998).

Phragmipedium chapadense Campacci & R. Takase, *J. Hokkaido Orchid Soc.* 28(Suppl.): 1 (2000).

Phragmipedium hartwegii f. *baderi* (Roeth & O. Gruss) O. Gruss, *Caesiana* 16: 40 (2001).

Phragmipedium longifolium var. *coloratum* (Rchb. f.) Pfitzer in H. G. A. Engler (ed.), *Pflanzenr*. IV, 50(12): 49 (1903).

Phragmipedium longifolium var. *gracile* (A. H. Kent) Pfitzer in H. G. A. Engler (ed.), *Pflanzenr.* IV, 50(12): 49 (1903).

Phragmipedium longifolium f. *minutum* O. Gruss, *Caesiana* 16: 40 (2001).

Phragmipedium longifolium var. *splendidum* (Pucci) Pfitzer in H. G. A. Engler (ed.), *Pflanzenr*. IV, 50(12): 50 (1903).

Phragmipedium longifolium f. *album* O. Gruss & Koop., *Orchidee* (Hamburg) 2(5)E: 3 (2016).

Phragmipedium longifolium was the first of fourteen names describing what is the same widely distributed and highly variable species. Over the years, some of these names have been redefined and repackaged into varieties and forms with changing, overly broad, and non-specific taxonomic characteristics with significant overlap in the descriptions. Minute sample sizes, lack of knowledge, erroneous presumptions, and dubious plant histories have all played a role. As you read through some of the descriptions below, I have included quotations wherever I could. It should become apparent how variable this species is and how the taxonomic community has struggled to define it.

Because *longifolium*, a reference to the long leaves, was the first name published, it takes precedence. *Phragmipedium hincksianum*, *Phrag. hartwegii*, *Phrag. longifolium* var. *hartwegii*, *Phrag. dariense*, *Phrag. roezlii*, *Phrag.* × *roethianum*, *Phrag. longifolium* var. *gracile*, *Phrag. chapadense*, *Phrag. hartwegii* var. *baderi*, *Phrag. longifolium* var. *coloratum*, *Phrag. longifolium* fma. *minutum*, *Phrag. longifolium* var. *splendidum*, and *Phrag. christiansenianum* are all synonymous with *Phrag. longifolium*.

Phragmipedium longifolium is an example of what can happen when we formally describe every variation that we see within a species concept as something unique and specific within a genus whose only consistent attribute is variation. A close review of many plants of *Phrag. longifolium* demonstrate the inherent variability of this species both within and between populations. All parts of the flowers show variability. None of the characteristics attributed to these fourteen names are constant or consistent within populations. All populations, both primary and secondary, that I have seen across several countries over the past twenty-five years, demonstrate a mixture of variations across multiple taxonomic characteristics.

Phragmipedium longifolium can be found from as far north as Panama and Costa Rica south through Co-

Phrag. *longifolium* habitat in Ecuador.

lombia and into northern Ecuador and east into Brazil. An impressive geographical range such as this is not uncommon for the genus. *Phragmipedium longifolium* is a weedy plant, quickly colonizing secondary habitats within its range.

The species is a variable-sized plant, with flower spikes starting at 20cm (8 inches) and others exceeding one meter (three feet) tall. The author has personally observed several plants with flower spikes reaching 2 meters (7 feet) tall. I can look at a flower in the "eye" while standing next to the crown of the plant. These plants grow side by side with plants that have spikes only 20 cm (8 inches) tall. The inflorescence has been rarely observed in nature to branch.

Flowering plants as small as 25 cm (10 inches) across have been seen in several populations, and plants with an overall width of 1 meter (3 feet) are not uncommon. Flowering size plants have individual leaves that range from 20 cm (8 inches) to 80 cm (32 inches) on larger plants. Variability in the leaves' length and width is the norm and can change from year to year as cultural conditions change.

Plants reproduce vegetatively, or spread, via a rhizome that can reach 2 cm in diameter on larger plants. *Phragmipedium longifolium* sets roots in the organic material covering cliff surfaces and roadsides but does not anchor nor attach to the underlying granite. Although most of the plants of *Phrag*. *longifolium* are found growing on cliff faces, the author has encountered a few plants growing terrestrially in cow pastures and on the forest floor.

The flowers vary in color from green to yellow to maroon with varying degrees of purple. Petal length varies, and the petals continue to grow as the flower matures. The angle at which the petals present is variable and can vary from a few to 90 degrees from the labellum. This characteristic and petal attitude vary widely within natural populations in both primary and secondary habitats. The amount of twisting of the petals has been observed to vary from none when the flower opens to four to five twists on mature flowers. Plants can carry between two and 15 flowers opening sequentially. Flowers are long-lived and can remain open for a month on a healthy plant. *Phragmipedium longifolium* has been observed to be in flower at all times of the year and does not seem to have a specific flowering season.

The shape of the labellum is variable regarding length and width. The shape of the staminode can vary, including diamond-shaped with sharp corners, oval-shaped with curved edges, and half-moon-shaped. There are varying degrees of the ridge's prominence down the middle of the staminode. Although less obvious, the labellum, sepals, and staminode enlarge after opening. The length of the claw face is not consistent.

Phragmipedium hartwegii was described soon after the description of *Phrag*. *longifolium* based on a plant that was collected near Nanegal, Ecuador. It described larger floral bracts, an unfused claw face, and to quote "some discrepancies in the lip." Floral bracts within the species *longifolium* vary in size, as do many other taxo-

nomic characteristics, many of which continue to enlarge after the flower opens. In 1903, Pfitzer described the difference between *Phrag*. *hartwegii* and *Phrag*. *longifolium* based on a longer claw face, the shape of the labellum, and the more pendant petals, whereas *Phrag*. *longifolium*, it was surmised, had horizontal 180-degree petals. This assumption is simply incorrect. Garay, in 1979, differentiated *Phrag*. *hartwegii* based on the shape of the staminode. All of these taxonomic characteristics are inherently variable in *Phrag*. *longifolium*. None of these characteristics are consistent within any population of *Phrag*. *longifolium* and thus cannot be used to distinguish one species from another, nor one population from another.

Phragmipedium longifolium var. *hartwegii* has been redefined by numerous authors based on changing morphological characteristics. It was first described by Pfizer (1889) based on minute differences in the staminode and, previously by Kent (1889), based on the plants being "more robust with longer and broader leaves; scapes taller, green (not purple as in the type). Flowers somewhat larger, the dorsal sepal usually with a pale rose-colour stain on the apical half, the petals bordered with rose-pink." It is not clear how the concept of the name "*hartwegii*," be it a species or a variety, evolved from one taxonomic characteristic to the next. If we aggregate all the articles and descriptions of what *hartwegii* is alleged to be, it is a variable and widespread species called *Phrag*. *longifolium.* As with many other names in the genus, evolving species concepts result from poorly understood natural variations.

Phragmipedium dariense was described based on a plant that was alleged to have come from the coast of Darien in Colombia. *Phragmipedium dariense* was described on dried flowers that had been sent to Reichenbach. *Phragmipedium dariense* was different from *Phrag*. *hartwegii*, not from *Phrag*. *longifolium*, based on two angles at the base of the claw. Rolfe in 1890 and Atwood in 1984 agreed that the two angles at the base of the claw seen in the dried flowers were due to the pressing of the flowers and not observed in living materials. I agree and consider *Phrag*. *dariense* to be a synonym of *Phrag*. *longifolium*.

Phragmipedium hincksianum was described based on a plant that flowered in cultivation and was collected during an expedition to locate *Phrag*. *hartwegii*. In 1979, Garay described *Phrag*. *hincksianum* based on the shape of the labellum, an opening in the claw, and a notch in the anterior margin opening. Kent (1889) described *Phrag*. *hincksianum* with "[s]capes shorter and bearing fewer flowers than those of the variety *hartwegii* but conforming in every other respect to it." These attributes fit nicely in the cline in the variation of *Phrag longifolium* and are not consistent on a plant-by-plant basis within populations. They are problematic because floral parts, such as the labellum and claw, continue to develop as the flower matures. The name *hincksianum* appears to have been used to describe two different things.

Phragmipedium roezlii was proposed based on the type material appearing more robust and, as a result, a better breeding clone. In 1979, Garay differentiated *Phrag*. *roezlii* based on the anterior margin of the labellum being erose-denticulate to prominently rugose-tuberculate. The labellum and all parts of the flowers of *Phrag*. *longifolium* continue to enlarge as the flower matures. The labellum is inherently variable and subject to cultural conditions from year to year and flower to flower. That can impact any number of characteristics, sometimes on the same plant. There is nothing about the robust nature of the plants or minute fluctuations in which the labellum forms that would differentiate *Phrag*. *roezlii* as a separate species or variety.

Phragmipedium chapadense was described in 2000 by Roberto Campacci based on a plant in a private collection in Sao Paulo, Brazil, alleged to have come from the Chapada dos Veadeiros National Park in central Brazil. The alleged location is a few hundred meters from a population of *Phrag*. *vittatum*. No natural plant meeting the *chapadense* description was seen there.

Phragmipedium chapadense exists as a single plant in a greenhouse with a dubious history. Based on this information, *Phragmipedium chapadense* is best treated as a synonym of *Phrag*. *longifolium*. It should serve as a cautionary tale about describing species in a greenhouse based on unverified information that is second and third hand.

Kent (1887) differentiated *Phrag*. *longifolium* var. *gracile* as having "[l]eaves narrower, scapes more slender and paler in colour, and the bracts more compressed. Flowers somewhat smaller and coloured, as in the variety *hartwegii*."

Pucci (1891) defined *Phrag*. *longifolium* var. *splendidum* as having an "upper sepal narrow, lanceolate, greenish-white" and the petals as being "wavy, broad at base, glossy green at center, glittering pink on the sides and edged with white; the green extends about 1/3 in length, the rest is uniform purple" and the rest of the flower as having a "labellum of the same form as *longifolium*, light greenish, veined and washed with reddish brown; staminode small, light green uniform and hairy." This description generally applies to almost every flower of *Phrag*. *longifolium*.

In 1873, *Phrag*. *longifolium* var. *coloratum* was described based on a plant in a greenhouse being "a much finer variety of this well-known plant, with broader leaves and purplish petals, also having beautifully purplish-veined sepals. There is no claim to distinguish it as a species, though it well deserves the rank of a variety." It appears that this name is meant to distinguish var. *coloratum* as being a more beautiful plant than the typical *Phrag*. *longifolium*.

Phragmipedium longifolium forma *minutum* was differentiated by Gruss (2001) as having a shorter inflorescence but otherwise typical flowers.

Phragmipedium christiansenianum is yet another species described based on a plant in a greenhouse. The

Phrag. *longifolium* found in Colombia with twisted petals.

story goes that Hans Christiansen, a Danish orchid hobbyist, imported a group of *Phrag*. *longifolium* that he believed were from Colombia. Upon flowering, one of the plants was thought to be a hybrid. I have seen photos of the flower, and it is consistent with the clines in the variation of *Phrag*. *longifolium* seen throughout Colombia and northern Ecuador. When the plant was selfed, Christiansen reported that the seedlings resembled the mother plant, and thus had to be a species, because, if it were a hybrid, he presumed, the seedlings would all look different from the mother plant. This logic is flawed. Every aspect of the type plant fits in the range of variation for *Phrag*. *longifolium*, and the mother plant is indistinguishable from known natural populations of *Phrag*. *longifolium*.

There is an album form of the flower, *Phragmipedium longifolium* forma *album* that bloomed in the collection of Ecuagenera and came from a collection taken from the roadside heading west out of Lita in the province of Esmeraldas in northwest Ecuador (per personal communication). Ecuagenera gave the plant the clonal name 'Pepe'. On a visit to Ecuagenera, Tom Kalina of Fox Valley Orchids in the USA traded flasks for a division of this plant (per personal communication). When Kalina brought the division back to the United States, he changed the clonal name to 'Fox Valley Mint' and claimed in personal communications and online forums that he "discovered" the plant in Ecuador. All album forms of *Phrag*. *longifolium* originate with Ecuagenera's plant. Although Braem (2018) claims that *Phragmipedium longifolium* forma *album* was not "effectively" published by Gruss & Koopowitz, his opinion is based on his publications and interpretations. *Phragmipedium longifolium* forma *album* is the correct name for this form of the flower.

As demonstrated, it is difficult to classify this species in anything other than broad terms. I am not the first author to demonstrate and document the substantial variations in floral and vegetative characteristics within the species concept of *Phrag*. *longifolium*. Both Atwood (1984) and McCook (1989) documented substantial variation in both floral and plant morphology across numerous sampled natural populations. Cribb (2017) stated, "[b]ased on the evidence and examination of herbarium and plants in living populations, we recognize a broadly defined and rather variable species which includes all of these taxa." The evidence is clear that *Phrag*. *longifolium* is a highly variable species requiring a broad, not narrow, species concept. *Phragmipedium longifolium* is not unique in the genus as a variable and widely distributed species. Unfortunately, the lessons learned from the application of numerous names to every variation seen in a single species concept have been forgotten by several authors, who continue to describe new names that are inconsistent with what the natural populations tell us.

Phrag. pearcei group that is most likely one plant.

Phragmipedium pearcei

Phragmipedium pearcei (Veitch ex J. Dix) Rauh & Senghas, *Orchidee* (Hamburg) 26: 62 (1975).

Synonym:

Phragmipedium ecuadorense Garay, Fl. Ecuador 9(225: 1): 15 (1978).

Phragmipedium pearcei has been known in cultivation before 1865 when plants were considered *Phrag. caricinum*. In 1865, it differentiated *Phrag. pearcei* from the closely related *Phrag. caricinum* based on *Phrag. pearcei* having a long, stoloniferous rhizome, which can be up to 10 cm (4 inches) long, a hairy ovary, and a white claw face with smaller green spots at the lower end and larger brown spots at the top. Anyone who has a large plant of *Phrag. pearcei* knows how long the rhizomes can be. Together with the unique leaves and small size of the plant, *Phrag. pearcei* is easy to recognize in or out of flower. Another apparent difference between *Phrag. pearcei* and *Phrag. caricinum* is the flower color. The flower of *Phrag. pearcei* is green and white with hints of brown in the labellum and petals with the brown appearing in varying degrees depending on the individual clone. *Phragmipedium caricinum* has an orange-colored flower.

Phragmipedium pearcei flowers open with untwisted petals that continue to elongate and twist as the flower matures. The angle of the petals can range from straight down to 45 degrees from the labellum. Between two and ten flowers appear sequentially along an inflorescence that varies from 10 to 45 cm (4 to 18 inches) tall. The leaves are thin and sedge-like and can range from 20 to 40 cm (8 to 16 inches) tall; however, most of the plants that I have seen in situ and ex situ are closer to the low end of the range. Plants flower throughout the year.

Most of the plants of *Phrag. pearcei* can be found throughout its range in large numbers, forming immense colonies on boulders in midstream below the high-water mark and the stone embankments of rivers. *Phragmipedium pearcei* is found facing in all directions. Plants anchor themselves tenaciously to the rocks on the downward side away from the rushing water. Plants are subject to periodic submersion by floodwaters. The manner that plants draw a clean line at the high-water mark is conspicuous. There are reports of plants of *Phragmipedium pearcei* found in trees along the margins of the rivers and streams, although I have never seen one nor found it in the nearby jungle.

As stated in several places in this checklist, some phragmipedium behaviors warrant more study. Why *Phrag. pearcei* prefers life below the high-water mark in rivers that can, at times, produce powerful and fast-moving floodwaters is a curiosity. The water is so fast-moving that in floodwaters barely over our knees, I and some friends have been swept off our feet. Perhaps the floodwaters help in propagation by clearing the stone surfaces and keeping them free from grasses, mosses, and other plants. These floodwaters are clearly not critical for survival since we can cultivate these plants in our greenhouses. Perhaps we will never know the reason.

Phragmipedium pearcei is rare in secondary habitats, perhaps owing to its unique ecology. Two locations are currently known, one in northern Peru and the other in central Ecuador. These secondary habitats also contain large numbers of *Phrag. boisserianum* and *Phrag. richteri* with *Phrag. pearcei* found growing amongst them.

Phragmipedium ecuadorense was described in 1978 by Garay based on two plants from the northern part of the range of *Phrag. pearcei* on the Napo River in Pastaza, Ecuador. I have been to this location several times and have not found anything that supports *Phrag. ecuadorense* at the species level. Garay differentiated *Phrag. ecuadorense* from *Phrag. pearcei* based on the umbonate, cordate-shaped staminode (umbonate: having a protrusion like the stem of a mushroom cap and cordate: shaped like a heart) and the amount of hair on the petals. Garay stated that *Phrag. ecuadorense* has petals that

Phrag. pearcei

Phrag. richteri in cultivation in Peru.

are marginally pubescent, apically bilobed, and strongly twisted when compared to *Phrag. pearcei*. Apically bilobed refers to a tiny, barely noticeable split at the end of the petals, creating two lobes. None of these characteristics, especially the shape of the staminode, can be used to break *Phrag. pearcei* into two distinct species. The shape of the staminode is inherently variable. How many twists the petals have is a function of the maturity of the flower. The petals continue to develop after the flower opens from untwisted to heavily twisted. Along the Napo River and elsewhere, I have seen flowers with only one petal bilobed, with both petals bilobed, and with no petals bilobed. McCook (1989) reports the same observation. The Napo River is home to several large populations of *Phrag. pearcei*, and the flowers demonstrate all the different taxonomic characteristics.

Phragmipedium richteri

Phragmipedium × *richteri* Roeth & O. Gruss, *Orchidee* (Hamburg) 45(3): back cover (1994).

Synonym:

Phragmipedium × *merinoi* O. Gruss, *Orchidee* (Hamburg) 61: 176 (2010).

Phragmipedium richteri is a species that exists solely because of the influence humans have on the environment. *Phragmipedium richteri* is the result of cross-pollination between *Phrag. pearcei* and *Phrag. boisserianum* and is known from only two secondary habitats, one roadside embankment near Tarapoto in northern Peru and one near Mendez in southern Ecuador. *Phrag. richteri* grows on wet rocks along the roadside and the areas immediately near these roadside embankments. Reports of this species growing on rocks in and near fast-moving water are unverified. All three species are found growing in the habitats. Each of these roadside embankments exists due to the creation of these roads by man. Without the creation of these roadside habitats by humans, neither *Phrag. boisserianum* nor *Phrag. pearcei* would be present because their primary habitats are ecologically inconsistent with the site, and *Phrag. richteri* would not have been possible.

Both *Phrag. boisserianum* and *Phrag. pearcei* have similar large, brown spots on the claw face. This morphological similarity is the key to the cross-pollination. We know with that *Phrag. pearcei* is pollinated by syrphid flies attracted to the brown spots on the claw face that apparently mimic aphids (Pemberton 2011). Given the significant overlap in the range of *Phrag. boisserianum* and *Phrag. pearcei*, it is curious that *Phrag. richteri* is not found in the primary habitats of either species, and that may be another clue as to what is happening. At both locations, all three species grow within centimeters of each other. Natural hybrids can stabilize, and this is what has happened at both habitats. Speaking based on my observations of the Ecuadorian population, flowers of *Phrag. richteri* are consistent with little variation observed. Plants produce the same brown spots on the claw face as the parent species, and I contend that it would be unreasonable to believe that the same pollinators that bring about cross-pollination are not visiting the flowers of *Phrag. richteri*. I found no backcrosses or intermediate forms between *Phrag. boisserianum*, *Phrag. pearcei* and *Phrag. richteri*. *Phragmipedium richteri* is not obligatorily self-pollinating, as is *Phrag. boisserianum*. When not in flower, it is easy to differentiate the three species. Plants with flowers are also easy to recognize.

Phrag. richteri in situ in Ecuador.

When I discussed the name *Phrag. richteri* with Eric Christenson, he opined that *Phrag. richteri* was a natural hybrid because the roadside embankment in Peru where the plants were found was full of both *Phrag. boisserianum* and *Phrag. pearcei*. Cribb treats *Phrag. richteri* as a natural hybrid, as does Braem. I differ for several reasons. First, *Phrag. richteri* has stabilized. The earliest documented encounter with *Phrag. richteri* was by J. Schunke in 1985. Had *Phrag. richteri* been an accidental hybrid or was unstable, we would not be seeing plants at all stages of development as we see today, thirty-five years after the initial documented encounter. Seedlings, single growth plants, and multiple growth mature plants with several flower spikes were observed in 2019. Seedpods were visible on some plants.

Phragmipedium richteri is now self-sustaining and can produce juveniles consistent with the mother plants and themselves in natural populations. The stabilization of *Phrag. richteri* carries over into cultivation and has been reported by Gruss from as far back as 1996. Had *Phrag. richteri* been a one-time event, or if plants were encountered once every decade due to an infrequent or arbitrary hybrid event, perhaps maintaining *Phrag. richteri*, as a natural hybrid, would be prudent. However, this is not the case. We can also verify both natural populations, the high probability of cross-pollination based both parents' morphological characteristics, and a specific pollinator. Species can, and do, arise through natural hybridization. Research indicates that thirty to seventy percent of all flowering plant species have hybridization events in their phylogenetic histories (Ehrlich and Wilson 1991; Rieseberg 1995; Soltis and Soltis 2009). Merely identifying a natural hybrid origin for a species is insufficient to relegate that name to perpetual hybrid status or, worse, reject the concept outright.

Phragmipedium richteri has long, thin, linear leaves that are quite distinct from both *Phrag. boisserianum* and *Phrag. pearcei*. Mature plants have been observed to have a purple-red coloration at the crown. Flowering size plants range in height from 30 cm to 60 cm (1 to 2 feet). The inflorescence is tall for the size of the plant and can exceed the overall height of the leaves two-fold, making *Phrag. richteri* an excellent breeding parent. Some plants produce a branching inflorescence. Flowers sequentially appear as growths mature. The staminode is elliptic, green with dark purple hairs along the top of the basal margin and presents as consistent with *Phrag. pearcei*. The labellum is green and faintly veined in brown and purple. The petals progressively elongate and twist as the flower matures with varying degrees of green, brown, and purple. The claw face is white at the center with brown spots near the margins.

In 2010 Gruss described *Phrag. × merinoi* as a natural hybrid between *Phrag. boisserianum* var. *reticulatum* and *Phrag. pearcei* based on a plant at Ecuagenera, a nursery in Ecuador, alleged to have been collected by Gilberto Merino in the province of Pastaza. The information that I have about the group that the type specimen came from is different. Nonetheless, the type plant was natural in origin. The type plant originated from the same roadside habitat as *Phrag. richteri*. The postulated parents are identical to those of *Phrag. richteri*; *Phrag. × merinoi* is indistinguishable from *Phrag. richteri*.

Phragmipedium schlimii

Phragmipedium schlimii (Linden ex Rchb. f.) Rolfe, *Orchid Rev.* 4: 332 (1896).

Synonym:

Phragmipedium andreettae P. J. Cribb & Pupulin, *Lankesteriana* 6: 1 (2006).

Phragmipedium anguloi Braem, Tesón & Manzur, *Richardiana* 14: 290 (2014).

Phragmipedium fischeri Braem & H. Mohr, Leafl. *Schlechter Inst.* 3: 30 (1996).

Phragmipedium manzurii W. E. Higgins & Viveros, *Lankesteriana* 8(3): 89 (2008).

Phragmipedium colombianum O. Gruss, *Orchidee* (Hamburg) 62: 30 (2011)

Phragmipedium × daguense Braem & Tesón, *Schlechteriana* 5: 1 (2017).

Phragmipedium × narinense Tesón & Braem, *Schlechteriana* 5: 4 (2017).

Reichenbach first described *Phragmipedium schlimii* in 1854 based on a specimen found near Ocaña, Colombia. Since that time, both primary and secondary roadside habitats have been found from the Ecuadorian border to Cúcuta, Colombia, on the border with Venezuela. It is only recently, in the past two decades, and particularly since the peace process between the Colombian government and FARC began in 2012, that many of these habitats have become accessible, substantially increasing our knowledge and exposure to this beautiful species. *Phragmipedium schlimii* inhabits both sides

of the eastern and western Cordillera of Colombia, the two main ranges of the Andes Mountains. The natural range for three species, *Phrag. schlimii*, *Phrag. longifolium* and *Phrag. hirtzii*, intersect in this general area, and it is one of the most spectacular orchid habitats I have ever visited.

Phragmipedium schlimii is weedy and widespread in its range and shares several habitats with *Phrag. longifolium*. The habitats present as consistently wet slopes and rocky crevasses overlooking streams and rivers, and road embankments that mimic these conditions. Like *Phrag. boisserianum* and *Phrag. longifolium*, *Phrag. schlimii* has an extensive range and variability. Fowlie (1970) described its habitat as "seepages" on granite above streams. Runoff, or "seepage" to quote Fowlie, from the surrounding jungle, is present in varying degrees. The broader geographic range currently includes overlap with *Phrag. longifolium* and *Phrag. hirtzii*, with all three species a few hours horseback ride from one another along the same river along the Ecuadorian border.

I have observed no natural hybrids between *Phrag. schlimii, Phrag. longifolium* or *Phrag. hirtzii* in any combination in any location. Like its cousins *Phrag. longifolium* and *Phrag. boisserianum*, *Phrag. schlimii* is a broadly defined and highly variable species.

Self-pollination is not a distinguishing taxonomic characteristic between one population of *Phrag. schlimii* and another and is part of the species' natural biology throughout its range. In 1854, when this species was discovered, orchid nurseries took note of the self-pollination. *Phragmipedium schlimii* has sticky pollen-masses surrounded in a thin envelop that dries as the flower matures. This allows the granular pollen within this envelope to contact the stigmatic surface and self-pollinate the plant (Anon, 1922).

The discovery of *Phrag. schlimii* caused a sensation because the unique colors were found nowhere else in the genus until the discovery of *Phrag. kovachii*. The colors vary and can be found through the entire range. The staminode can vary from pure white with hints of green and varying degrees of pink to purple touches. The labellum can vary from pink to a deep pink-purple. The color is variable within a range and changes from year to year, depending on cultural conditions. Rose-red flowers, and flowers with varying degrees of pink and white are found in all habitats. Even with one color variation in one habitat, color is not a stable taxonomic characteristic that separates one proposed species from the next. However, color can be used to differentiate *Phrag. schlimii* from the closely related *Phrag. besseae* because there is no overlap of color between the two species. Flowers have been observed throughout the year in natural populations and cultivation, with most flowering in March and April.

The lateral petals are rounded to oval-shaped and present with different degrees of reflexing. The lateral petals' overall shape is consistent throughout the section *Micropetalum* and can be seen in *Phrag. besseae* and *Phrag. kovachii*. Consistent with the genus overall, the shape of the staminode is highly variable within natural populations and across the species range. The shape of the staminode can vary from oval to typically egg-shaped (triangular), or quadratic, or long and tapered, or to varying degrees of being shaped like a violin.How the two side lobes of the staminode approach each other at the bottom, creating a cleft or notch, varies from plant to plant, from noticeable to non-existent. The staminode has a central ridge with varying degrees of prominence. This ridge is the only constant in the species concept and is present on every staminode and is readily visible on plants without a staminode. Flowers without a staminode presenting only the center ridge have been observed in situ and nursery-raised plants.

Phrag. schlimii

Vegetative characteristics vary. Blooming-sized plants in situ have been observed to range from 12 to 45 cm (5 to 18 inches) across. The base of the leaves of plants in natural populations present with different levels of red that appear to be related to how much light the plants receive. *Phragmipedium besseae* and *Phrag. kovachii* share this trait. On mature plants, leaves can be long and slender, up to 25 cm (10 inches), or shorter and broader. Stiff or erect leaves are a function of culture and vary throughout natural populations and in cultivation.

Labellum morphology varies from round and ovate (oval) to more elongated, bulbous, and narrow. Some slippers in section *Micropetalum* have small translucent windows on the labellum, called fenestrations, which present in varying degrees of length, width, and number. These variations are seen in *Phrag. besseae* but not in *Phrag. kovachii*. Fenestrations vary throughout natural populations as well as in cultivation. *Phragmipedium schlimii* shares morphological variations in the shape of the labellum with *Phrag. besseae*. The shape of the labellum and the presence of fenestrations are variable throughout the range of *Phrag. schlimii* and cannot be

used to differentiate *Phrag. schlimii* from *Phrag. besseae*, or to elevate variations to species status. Elongated rhizomes, like those seen in some natural populations of *Phrag. besseae,* were seen in one population of *Phrag. schlimii* in southern Colombia, demonstrating further morphological overlap with *Phrag. besseae*.

Ecologically, *Phrag. schlimii* differs from *Phrag. besseae* in several aspects. No natural population of *Phrag. schlimii* has been found south of the Equator, nor has any natural population of *Phrag. besseae* been encountered north of the Equator. *Phragmipedium schlimii* roots embed themselves in cracks and crevices to obtain, trap, and maintain moisture at the roots. *Phragmipedium besseae* prefers open, exposed conditions with roots rambling along the surface of the granite.

Primary habitats range from 1,100 to 2,000 meters (3,280 to 6,562 feet) with most at the lower end of that range. Despite the upper limit of the elevation, *Phrag. schlimii* is a warm-grower and cannot survive in cooler conditions. *Phragmipedium besseae* is a cool-grower and cannot survive in warm conditions.

Phragmipedium schlimii roots are covered in layers of decomposing organic material, leaf litter, and wet, sandy mud, while *Phrag. besseae* prefers small amounts of moss at the roots. Runoff from the surrounding jungle is essential to *Phrag. schlimii*, although plants do not survive in standing water. *Phrag. schlimii* roots seek out crevices where the combination of moisture and decomposing organic material maintain it during interruptions in the runoff. *Phragmipedium besseae* draws its moisture from the constant flow across the surface of the granite.

Phragmipedium schlimii can tolerate varying degrees of light. Like *Phrag. longifolium, Phrag. besseae*, and *Phrag. boisserianum* that have natural populations found in low-light conditions, *Phrag. schlimii* can be found under the dense canopy of nearby plants, as well as in more exposed positions. Plants in direct sunlight are rare.

Taxonomy is not meant to be an absolute science, nor is any species description above reproach and immune from peer review or testing against the realities of the natural world and natural populations. The genus *Phragmipedium* appears to be particularly problematic, given the excessive number of synonyms and discredited species. As I mention throughout this checklist, exploration and the expansion of our knowledge have been particularly harsh on species descriptions, particularly those authored in the past twenty to thirty years. Natural populations reveal errors. Our understanding of the species concept evolves to better align with what the natural world is telling us, resulting in the need to expose those errors and make corrections and adjustments no matter how correct those species descriptions seemed at the time. Perhaps no species in the genus better exemplifies the need to make corrections based on expanded knowledge than *Phrag. schlimii*. The recent rapid accumulation of scientific names in this species concept has not been due to the discovery of new taxa

Phrag. schlimii in situ in Colombia.

but the assignment of new names to combinations of variable taxonomic attributes within one species concept; in some cases, synonymous and taxonomically indefinable language is used. This is taxonomic inflation for any species concept in the genus *Phragmipedium* and, for reasons that follow, is not accepted here.

Phragmipedium schlimii was first described in 1854 and until the 1990s remained a single species despite its variability and one hundred and fifty years of collection and cultivation. *Phragmipedium schlimii* remained a single, variable species until 1996 when, based on an old (1924) reference in the literature to a phragmipedium with a rose-red flower from Colombia that was thought to be *Phrag. besseae* and a single malformed, abnormal flower on a single plant in a greenhouse in the United States. Braem used this information to describe *Phrag. fischeri*. Braem and others subsequently divided *Phrag. schlimii* into four species, *Phrag. schlimii, Phrag. fischeri*, *Phrag. andreettae*, and *Phrag. anguloi*, two natural hybrids, *Phrag.* ×*daguense* (*andreettae* × *schlimii*) and *Phrag.* ×*narinense* (*anguloi* × *fischeri*), and one variety (P*hrag. schlimii* var. *manzurii*).

Add to this the description of *Phrag. manzurii* by Higgins and Viveros in 2008, and *Phrag.* ×*colombianum* (*manzurii* × *schlimii*) by Gruss in 2011, and what we are expected to accept is that *Phrag. schlimii*, a widely distributed and variable species like all other species within the genus, is five different species and three natural hybrids. Braem (2016) notes that Rudolf Jenny has photos of *Phrag. schlimii* from 1986 and 1988 that match the description of *Phrag. andreettae* and uses this to support the concept of this species. On the contrary, this is evidence of the variability within the species' range, and further proof that almost any plant can, and will, demonstrate one or more taxonomic characteristics of other alleged species and natural hybrids within the species concept. This is proof that species' boundaries are vague and indefinable. The claims made in support of these names do not withstand scrutiny and all are synonyms

Phrag. schlimii without a staminode, only a center ridge.

of *Phrag. schlimii*. Various clones of *Phrag. schlimii* show variability as broad as that of *Phrag. longifolium*, *Phrag. vittatum*, and *Phrag. boisserianum*. The concept of *Phrag. schlimii* is not singularly unique in the genus as deserving of eight different names, possibly nine.

If there is a single exclusive, static, not variable taxonomic characteristic within individual populations or across the entire range that can be used to break *Phrag. schlimii* into more than one species or variety, these authors have not identified it.

It is always a risky proposition to attempt to define as constant the shape of any part of a flower that is inherently polymorphic, progressive, and continues to develop as the flower matures. The shape of the labellum is no exception to this. Braem goes to great lengths to choose an overly broad and synonymous language to describe variations in the shape of the labellum to separate several proposed species. Slipper-shaped labella differ from elongated labella that differ from "apparently, but not really (quasi) spherical" labella, that differ from 'spherical' labella, with "intermediate characteristics" between these adjectives noted in other natural populations that must be natural hybrids. All *Phragmipedium* species have a labellum that is, in one form or another, slipper-shaped (calceolate).

The vegetative characteristics of the plants vary throughout natural populations and are culturally dependent. Use of synonymous language, such as "compact" and "shorter" to differentiate species, without a word dedicated to how variable the overall length and width of the leaves are in plants found from Ecuador through to Venezuela, is curious, ambiguous, and unconvincing.

Once we aggregate the now documented cline in natural variation seen across populations of *Phrag. schlimii* throughout Colombia and into northern Ecuador, the gaps that we need to see to define species boundaries and maintain five species and three natural hybrids do not appear. As our knowledge increases, the trend in what we see is away from a plethora of different species and natural hybrids, toward one variable species with an extended habitat range and consistent with the genus overall. *Phragmipedium schlimii* has an extended range and is a polymorphic ochlospecies (a species that exhibits a complex variation pattern among its members but is not separable into distinct subspecific groups). A more in depth discussion of *Phrag. Schlimii* and the recent publications within this species concept is planned for future publication in the *Orchid Digest.*

If there is a single taxonomic characteristic that can be used to break *Phrag. schlimii* into more than one species, I will be happy to revisit the taxonomic treatment of this species. Until that time, cherish your *Phrag. schlimii* for their individuality. Buyers beware; you are asked to pay a steep price for some of these "new" species and the new "hybrids" associated with them.

Phragmipedium vittatum

Phragmipedium vittatum (Vell.) Rolfe, *Orchid Rev.* 4: 332 (1896).

Synonym:
Selenipedium paulistanum (Barb.Rodr.) Rolfe, *Orchid Rev.* 1: 239 (1893).

Phragmipedium vittatum was first described by a Brazilian friar, José Mariano de Conceição Vellozo, in the 1780s, making it the first *Phragmipedium* ever described. Vellozo's original specimens have never been found; however, his illustrations in *Flora Fluminensis*, published in 1831, have survived. In the 1840s, Lindley does not mention Vellozo's description in his work on slipper orchids, but Reichenbach did in 1852. The type location listed by Vellozo is the "Alps north of Rio de Janeiro." Since that time, *Phrag. vittatum* has been found on the Brazilian central plateau in peat bogs, exposed to bright light, in mixed grasses, and low-lying shrubs subject to occasional fires. The habitats on the central plateau are surrounded by seasonally dry "cerrado," a vast tropical savannah.

Although the habitats are exposed to extensive seasonal droughts and occasional fires, the immediate habitat of *Phrag. vittatum* is ideally structured to protect the plants and ensure re-growth that has been observed to be exceedingly rapid. Plants exposed to fire have rhizomes and crowns protected in the wet peat, and they quickly rebound. After the fire, the plants produce large, meter-long leaves and flower within the year. It is not clear what role, if any, the fires play in helping *Phrag. vittatum* seedlings establish. It could be that the orchids are more easily seen after the fires, and that plays a role in propagation.

Menezes reports that after the fire, the soil of the peat bogs has a pH that becomes more alkaline, in the range of a pH of 7.2 to 7.8 (per personal communication). However, fires are not an annual occurrence, and given the constant flow of spring water through the

Phrag. vittatum in situ on the Brazilian central plateau. Note the variability in color.

area, it is doubtful that any change in the pH after a burn would be long-lived. It is not clear whether these fires are a natural occurrence or are set by local farmers. The area is used extensively for agriculture, and it is common for farmers to use fire to clear land for planting and to help establish grasses for livestock. The entire region becomes "seasoned" fuel for fires during the dry season.

Phragmipedium vittatum is rare, if not the rarest species of *Phragmipedium*. Habitats contain a few hundred plants and are subject to the ever-present encroachment of agriculture. A keen eye can discern small holes in the central plateau peat bogs that feed spring water to the bogs and nearby streams. Unlike other species of *Phragmipedium*, *vittatum* is not fed by runoff from the surrounding jungle or by excess rainfall. It is the constant, year-round flow of spring water from below the habitat that keeps the roots of *Phrag. vittatum* constantly moist. The area outside the bogs is seasonally dry. The bog does create a microclimate around *Phrag. vittatum*. The uniqueness of the environment and ecology are part of what defines *Phrag. vittatum* as a species.

Perhaps because of its rarity, *Phrag. vittatum* has not been described as multiple species. *Phragmipedium vittatum* is as variable as are all other species in the genus, and flowers continue to develop as they mature. Most flowers I have observed in natural populations have the fused labellum and generally a rhombic staminode. The ratio of the length of the synsepal to the labellum's length varies as the flower matures.

Phragmipedium vittatum is very closely allied with *Phrag. longifolium.* The two species overlap in general floral morphology. In both species, the shape of the synsepal is elliptical and ovate, and the synsepal size is typically longer than the labellum in length and width. The general shape of the staminode and dorsal sepal is consistent with the variability seen in both species. Flower color varies and changes as the flower matures. The range of color varies from dark red-brown to green-purple in both *Phrag. vittatum* and *Phrag. longifolium*.

There are, however, unique characteristics of *Phrag. vittatum* that separate the two species. One is the white to yellow margin on the edge of the leaves. It is evident when you see it, and photos do not adequately portray the striking contrast. The margin is quite wide, measuring ~2 mm on mature plants and can be seen from a distance through the grasses. This margin is equally apparent on the 15 cm (6 inches) seedlings I have seen in

situ. If you need to look closely or look twice to discern the margin, your plant is probably not *Phrag. vittatum*.

Ecologically, the species are different. *Phragmipedium vittatum* occurs only south of the equator, while *Phrag. longifolium* occurs north of the equator. *Phragmipedium longifolium* inhabits cliff surfaces and roadsides with copious amounts of runoff from the surrounding jungle, whereas *Phrag. vittatum* inhabits peat bogs on the Brazilian Central Plateau fed by underground springs. However, there is one secondary population reported north of Rio on the side of an old railroad track where water flowed down from an agricultural smallholding (Dick Warren per personal communication).

The *Phrag. vittatum* petal attitude is always low, with most flowers having petals that run parallel to the sides of the labellum, a characteristic not seen in *Phrag. longifolium*. The lateral petals of *Phrag. vittatum* tend to be shorter and less twisted than those of *Phrag. longifolium*; however, petal length and the number of twists in the petals of *Phrag. longifolium* varies, and there can be some overlap in length and appearance.

Phragmipedium vivatum has a distinct growth and flowering season, whereas *Phrag. longifolium* can be found in flower all during the year. This biological difference should be noted, as it is significant.

Phragmipedium vittatum is a large plant with leaves on mature plants reaching one meter (3 feet) in length. Flowers are long-lived and come successively on one-meter spikes, bearing up to eight flowers over several months. The surrounding grasses and vegetation can, at times, start to crowd the plants, influencing the overall height of the *vittatum* inflorescence.

Phragmipedium vittatum has a distinct growth and flowering season. Plants sit idle, almost in a state of suspended animation, from June through August, and this is the period of heightened risk of rot when attempting to cultivate this species. New growth starts to appear in September, with all mature plants starting to produce spikes in October. The flowering season is distinct and consistent and has been observed to begin as early as November; however, the peak time is January through April.

Phragmipedium vittatum is rare in cultivation, and this has led to plants being misidentified. Two plants believed to have come from Brazil that Ron Ciesinski of Taylor Orchids sold to Orchids Limited were described as *Phrag.* × *Brasiliense* Quené & O. Gruss, *Orchid Digest* 67: 242 (2003) were once thought to be *Phrag. vittatum*. Some authors, including myself, do not recognize these plants as species, nor are they believed to be wild collected. A division of one of those plants was erroneously identified as *Phrag. vittatum* by the Marie Selby Botanical Gardens and awarded by the American Orchid Society as *Phrag. vittatum* 'Fox Valley'. Apparently, neither Tom Kalina, the owner of the plant, nor the Marie Selby Botanical Gardens, nor the AOS judges knew the description well enough to recognize that the plant was not *Phrag. vittatum*.

Phragmipedium warszewiczianum

Phragmipedium warszewiczianum (Rchb. f.) Schltr., Repert. Spec. Nov. *Regni Veg. Beih.* 17: 9 (1922).

Synonym:

Phragmipedium wallisii (Rchb. f.) Garay, *Fl. Ecuador* 9(225: 1): 24 (1978).

This species is the last member of the long-petaled species, and it also has a long-confused nomenclature history. Based on a color illustration of a plant from Ecuador by John Lindley from 1844, Reichenbach described this species as *Cypripedium warszewiczianum* in an 1852 article entitled "Neue Orchideen der Expedition des Herrn J. de Warszewicz." In 1844, it was believed that all the long-petaled *Phragmipedium* were *Cypripedium caudatum*, and the color illustration by Lindley was labeled as such, based on that belief. The color illustration leaves no doubt that the species described is the long-petaled species from Ecuador that we know today as *Phrag. warszewiczianum*, formerly known as *Phrag. wallisii*. However, that description had been ignored, lost, or overlooked for one hundred and fifty years. Rudolph Schlecter transferred the name *Cypripedium warszewiczianum* to the genus *Phragmipedium* in 1922 and created some confusion when he cited a Panamanian collection, suggesting that the name *Phrag. warszewiczianum* applied to the Central American plants we now know as *Phrag. humboldtii*. As a result, for many years, the species from Central America was referred to as *Phrag. warszewiczianum*. Plants of what we now

Phrag. warszewiczianum in situ in southern Ecuador.

as *Phrag*. *humboldtii* from Central America were once available in the trade as *Phrag*. *warszewiczianum* and American Orchid Society awards were given under that name.

If the names for the long-petaled *Phragmipedium* were not confusing enough, we have the name *Phrag*. *warszewiczianum* that is both a valid name for one species and a synonym of another. The previous name for this species, *Phrag*. *wallisii* became associated with this species because Reichenbach, in the second volume of *Xenia Orchidacea* (1874), described the same species that he had previously described as *Cypripedium warszewiczianum* as *Selenipedium wallisii*. The ICBN requires that priority be given to the first name that Reichenbach gave this species, *Cypripedium warszewiczianum*. Dressler & Pupulin (2011) considered *Phrag*. *warszewiczianum* to be a variety of *Phrag*. *lindenii* based on their opinion that *Phrag*. *lindenii* "is probably a self-pollinating mutant of *Phragmipedium* [*warszewiczianum*]. This opinion was based on observations of man-made hybrids (per personal communication). There is no support in natural populations for this assumption. *Phragmipedium lindenii* is drastically different morphologically, biologically, and ecologically from *Phrag*. *warszewiczianum* and each is more than deserving of its own species status.

Phragmipedium warszewiczianum is terrestrial and rarely epiphytic. Rhizomes are up to 3cm (1 inch) and noticeable on larger plants. Leaves are generally about 60 cm (2 feet) long; however, I have seen large plants in natural populations with leaves one meter (3 feet) long. The inflorescence usually carries three to four flowers simultaneously. The flower color is unique, white, suffused with yellow and pink. The dorsal sepal is ovate-lanceolate and can be as long as 20cm (8 inches). The labellum is calceolate or obovate, four to six cm in length. In *Phrag*. *warszewiczianum*, the labellum's rim has a low, narrow keel, with the lower third projecting forward. The *Phrag*. *warszewiczianum* labellum morphology is the primary differentiating characteristic from *Phrag*. *caudatum* and *Phrag*. *humboldtii*. The labellum is white suffused with yellow and pink. The claw face is white and edged in red-brown. The staminode is consistent with the *caudatum* group overall. It is generally triangular with two lobes, one on each side, with some plants showing a noticeable third lobe at the bottom. You might have to look carefully to see the third lobe, as it is not always tipped in red, and it can be bent back, making it difficult to see. The petals are linear cordate and can be 60 cm (2 feet) long. The petals continue to elongate for the life of the flower.

There is a discrepancy between the reported distribution range for *Phrag*. *warszewiczianum* and direct observations of natural populations. Cribb, who bases his distribution range on the data accompanying herbarium specimens (per personal communication), has the range extending from northwestern Venezuela to southern Ecuador. McCook (1989) reports the range from southwestern Colombia to southern Ecuador. The natural populations examined by McCook (1989) were all in southern Ecuador. I have seen this species in southern Ecuador extending into northern Peru. One population of *Phrag*. *warszewiczianum* grows intermixed with a population of *Phrag kovachii* near Moyobamba in northern Peru. I am aware of one reliable report of a plant growing on a tree along the Ecuador—Colombia border, although I have never seen a natural population that far north. None of my contacts in Colombia or Ecuador are aware of any natural populations in Colombia or further north; however, that does not mean that small, isolated populations do not now nor have ever existed further north. Presently the natural range of this species can only be verified from Columbian border south to Ecuador to San Martin, Peru.

Phragmipedium warszewiczianum can be found in secondary habitats on roadsides in southern Ecuador. The species is not a weedy and opportunistic species like its cousins *Phrag longifolium*, *Phrag*. *boisserianum*, and *Phrag besseae*. Secondary populations tend to have a few dozen plants, and when the species blooms, plants are quickly picked up from roadsides and primary habitats that are close to the road. One primary population in central Ecuador that once had thousands of plants has sadly been wiped out by over-collecting. In several locations, plants grow on the same section of the roadside as *Phrag*. *boisserianum* and *Phrag*. *besseae*. As discussed in the culture section, *Phrag*. *warszewiczianum* is a terrestrial favoring a sandy loam, consisting of accumulated organic materials, old leaves, and soil.

Conclusion

What I hope the reader takes away from this revision of the *Phragmipedium* genus is what natural populations tell us about the species concept. This revision should not be construed as a product of my mind, enhanced with information culled from herbarium specimens and the articles and books of others. A species concept that cannot be supported by what the natural populations are telling us, and statements made in support of a species that cannot be supported by the realities of the natural world, should be reconsidered.

> "It has been truly said: "Never argue with Nature, her first word is a blow." (Lucretius), and taxonomic treatment should be in agreement with nature." (Cronk, 1998).✾

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About the Author

Frank Cervera is a biologist who has been studying the ecology, biology, and taxonomy of the genus *Phragmipedium* throughout natural populations for the past twenty-five years. His journey with *Phragmipedium* started in the 1980s when one of his ecology professors introduced him to orchids that led him to buy a plant of *Phrag. longifolium*. After many years of trying to get a sense of which *Phragmipedium* species were which, and why he was killing so many plants, Frank decided to take the matter into his own hands. This revision is the result of Frank's twenty-five-year sojourn to the jungles of Mexico, Guatemala, Panama, Colombia, Ecuador, Peru, Venezuela, Guyana, and into Brazil studying the genus *Phragmipedium*, its taxonomy, ecology, and culture. Along the way, Frank has met some of the most well-known names and personalities in the phragmipedium community. He has been to some of the most famous, and infamous, orchid nurseries in South America at critical times in the history of the genus and asked them to retell their stories. Frank has had the unique opportunity of going straight to the source and examining plants and flowers. Frank currently works in the Financial Services industry and resides, along with his family and his orchids, in New York.