PHRAGMIPEDIUM TAXONOMY AND THE SPECIES CONCEPT: WHO IS CORRECT, MOTHER NATURE OR US?

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WHAT IS A SPECIES? Because taxonomy applies to all living things, from the plant kingdom and as well as the animal kingdom, it is difficult to define a species in a way that applies to all organisms. No one definition satisfies all taxonomists. What might be good taxonomic practice for animals might be bad practice for plants. What might be good taxonomic practice for fungi turns out to be bad for orchids. What might be good taxonomic practice for one genus of orchids, such as *Paphiopedilum* or *Phalaenopsis*, turns out to be bad for *Phragmipedium*.

To understand the species concept in the genus *Phragmipedium*, we need to understand taxonomy. There are many questions to answer. How is a species defined? What is a taxonomic attribute or characteristic? What is a sample size? Are there rules or minimum requirements to name and specify a new species? Who can name a new species? Does anyone benefit from more species descriptions? Should we listen to what natural populations tell us, or do taxonomists have the final word on what makes a species or a natural hybrid?

We need to consider the ultimate question: what is a species in the genus *Phragmipedium*? What can the natural populations teach us to help us answer these questions? Defining the species concept as it applies to the genus *Phragmipedium* is critical to our ability to name new species, understand what has been published, and interpret it as our knowledge expands.

Simply put, a species is an irreducible group whose members all possess a combination of certain defining traits and characteristics. These characteristics must be stable, quantifiable, and specific to that species. At a minimum, a taxonomic description at the species level must contain appropriate taxonomic characteristics that specifically describe and define the species and differentiate it from other species. Any overlap in the specificity of a characteristic with closely related species should not be used as a taxonomic indicator since that attribute applies to more than one species. Variations in taxonomic characteristics should be understood and properly documented in formal descriptions for *Phragmipedium* species.

What is needed to describe a species formally? It is generally accepted that species descriptions have five elements:

1. The new species must be given a name based on the 26 letters in the Latin alphabet.
2. The name of the new species must be unique.
3. The description must be based on at least one name-bearing type specimen.
4. The description should include statements about appropriate taxonomic characteristics to describe (define) the new species (taxon) or to differentiate it from other species (taxa).
5. The first four requirements must be published in a work that is obtainable in numerous identical copies, as a permanent scientific record.

What is a taxonomic characteristic? A taxonomic characteristic is any attribute of a member of a taxon by which it differs or may differ from a member of a different taxon. These include morphological (structural features), ecological (its niche in nature), and geographical characteristics.

When a species is described, the description must contain a list of specific taxonomic characteristics that define the species. The description also explains how it differs from similar species. If a characteristic is variable, the taxonomist should state the range of variability of that characteristic within the proposed species concept.

In my opinion, a description cannot be written agnostic of ecology, pollinator specificity, natural clines in variation, and little or no habitat or ecological information. Specificity in the genus *Phragmipedium* is connected to specific ecology. A taxonomist must be aware of the ecological characteristics of the plant being considered for a specific status and must know the habitat where the species is found, and if it populates secondary habitats.

Where does taxonomic characteristic variability begin and end? If the shape of the staminode is variable, then the taxonomist cannot use the shape to define the new species. To correctly describe a species, the taxonomist must know the source material. Knowing that phragmipedium flowers continue to develop after anthesis, it would be incorrect to use the ratio of one floral part to another as a distinguishing characteristic. This variability makes describing a new species in *Phragmipedium* challenging.

There is a problem because not all cultivated plant histories used in some recent *Phragmipedium* species descriptions can be verified. Second- and third-hand information about long ago, lost jungle collections, including plant location and who imported it has, on several occasions, been demonstrated to be wrong. A sufficient sample size will cure reliance on second-hand information.

Understanding the source material is where the sample size comes into consideration and is especially important when understanding the species concept within the genus *Phragmipedium*. The natural populations teach us that the only constant within the species concept is variability.

What is a sample size? The sample size is the number of observations taken from a population through which inferences for the whole are made. The sample size must have sufficient statistical power.

Ideally, a taxonomist should understand, with certitude and based on consideration of a statistically significant sample size, the natural cline in the variation of specific characteristics to justify a new species. Examining one plant, or flower, or a small group of plants or flowers ex situ does not provide a sufficient sample size. The impact that cultural conditions have on the variability of taxonomic characteristics must also be considered since changing cultural conditions, both in situ and ex situ, change the flower and plant morphology, if the specimen is obtained *ex hortus*. Considering a statistically significant sample size will allow the taxonomist to thoroughly understand and document the many morphological and anatomical variations by considering a widely distributed population of plants rather than one or two specimens.

A sufficient sample size helps the taxonomist understand the natural progressive development of flowers within the genus after anthesis. This now accepted fact has led to multiple specific delineations of the same species. While the authors of 19th-century publications had minimal exposure to natural populations and natural plants, today, natural populations are easier to access and understand.

Taxonomy is charged with identifying differences between a proposed new taxon and closely related species, but taxonomy also looks for similarities with closely related species. In some cases, documenting the similarities may warrant further investigation and a larger sample size. Unfortunately, in the genus *Phragmipedium*, the rules only require one flower to be measured. Similarities, often significant, between proposed new species and closely related species are overlooked, ignored, or described as natural hybrids to justify maintenance of a dubious species at the specific rank. In some instances, authors have cherry-picked which species are used to contrast with the proposed new taxon while ignoring other more closely related species. When considered, the similarities might cause an objective observer to see at most a variety, or in some instances, a form of an existing species. Not only are differences significant, in the genus *Phragmipedium,* failure by taxonomists to consider and document the similarities and natural variations has led to confusion and perpetual debate as to what we are looking at and the proper name. This needs to change.

Another issue, in the author's opinion, is that many phragmipedium taxonomists are also paphiopedilum taxonomists who carry over assumptions and personal prejudices from their work on the genus *Paphiopedilum* into their work on the genus *Phragmipedium*. The two genera are not similar, only separated by an ocean. The ecology, biology, and taxonomy of the different genera must be considered as distinct, and assumptions about *Phragmipedium* should be based solely on the underlying facts of that genus and not assumptions brought in from practice in the genus *Paphiopedilum*. In the 1996 description of *Phrag. fischeri*, a statement was made that the primary taxonomic differentiation in slipper orchids is through the morphology of the staminodal shield. While this may be accurate in the genus *Paphiopedilum*, it is incorrect for the genus *Phragmipedium.* This brings us back full circle to the sample size and the need for phragmipedium taxonomists to adequately understand the source material before publishing new species concepts.

Phragmipedium species are closely connected to their respective ecology and geography, and the connection between a species and its environment cannot be severed. It should be part of any species discussion. Unlike *Paphiopedilum* species, which can be found inhabiting similar, and in some cases, the same, limestone hills and outcrops, *Phragmipedium* species inhabit diverse and specific ecosystems. The gaps in ecology further help us define the species concept.

My reference to geography is not intended to differ-

The Equator is a boundary line for the closely related species *Phrag. pearcei* and *Phrag. hirtzii*.

Phrag. besseae and *Phrag schlimii* are not synonymous but closely related.

entiate one population from the next or one roadside habitat from a primary location. *Phragmipedium* species are inherently variable and mobile within the broader species range but do have some geographic limitations. For many species, the Equator is a natural boundary to the expansion of both primary and secondary habitats. *Phragmipedium besseae* is a weedy and opportunistic species, readily and rapidly populating secondary habitats, but not a single plant has been observed in a natural population north of the Equator. The Equator is a boundary line for the closely related species *Phrag. pearcei* and *Phrag. hirtzii*. *Phragmipedium boisserianum* is an interesting case for future study. Millions of plants in both primary and secondary habitats from central Ecuador south through Peru rapidly populate recently degraded areas. The species self-pollinates, resulting in enormous amounts of seed in the air, yet not a single natural population has been encountered north of the Equator. With each species intimate connection to its ecology and geography, the natural populations help us further define the species concept.

The genus *Phragmipedium* presents us with a distinct problem when it comes to defining the species concept. How a *Phragmipedium* species is defined in the genus is not the same as in the genus *Paphiopedilum* or *Phalaenopsis*. There is no evidence of widespread natural hybridization despite propositions to the contrary. The clines in variation across multiple taxonomic characteristics within each species concept make the genus utterly indefinable based on a formal, static taxonomic methodology. So, what do we do?

The Species Concept in The Genus *Phragmipedium*

Our understanding of the species concept within the genus must start with the knowledge that all species of *Phragmipedium* are inherently variable across multiple taxonomic characteristics. All species within the genus *Phragmipedium* are ochlospecies, as defined by Cronk (1998). An ochlospecies is "A very variable (polymorphic) species, whose variation, though partly correlated with ecology and geography, is of such a complex pattern that it cannot be satisfactorily accommodated within a formal classification." Ochlospecies show variation that is independently polymorphic as opposed to having easily distinguishable sub-species. A subspecies would need to demonstrate any number of static taxonomic characteristics as opposed to independent variation, and we do not see that in the genus *Phragmipedium*. Ochlospecies have a diverse taxonomic character distribution with weak connections to specific locations, with all allegedly stable taxonomic characteristics present across the species range. This is what we see in the genus *Phragmipedium*. Attempts to tie combinations of variable characteristics or specific attributes to a location have proven to be ineffective. Ochlospecies are not localized hybrid populations.

Ochlospecies do have some recognizable local variations or forms, as we sometimes call them in the phragmipedium community. When aggregated across the entirety of the species range, these local variations intergrade, and defining species based on specific habitats and connecting variations to those localities becomes impossible. Different "species" can occur in the same habitats with taxonomic variables from more than one species seen within localized populations.

Importantly, ochlospecies are defined by their long history of synonyms. The natural variation within populations and across the broader range of each species has resulted in a long list of names that have proven to be untenable as knowledge has expanded. The use of statistically insufficient sample sizes and gaps in our understanding of natural populations has resulted in

Habitats are created and destroyed, but the species quickly populate the areas.

poorly defined species. The ever-growing numbers of natural hybrids are proposed to account for natural variation rather than openly studied variations.

In situ and ex situ, cultural conditions can impact taxonomic variables, and flowers continue to develop after anthesis. What defines the species concept in the genus *Phragmipedium* is a range of variation, and the gaps in that range across the genus mark the species boundaries.

In simple terms, polymorphism refers to the natural variation that results in several different forms or types of individuals among the members of a single species. There are highly characterized traits that can be defined to yield a homogenous set of taxonomic characteristics that can separate one species from another. It is evident that *Phrag*. *besseae* is not synonymous with *Phrag*. *schlimii*, although very closely related.

Phragmipedium species are inherently polymorphic, and taxonomic characteristics are not specific to individual populations nor connected to particular habitats within the broader species range. *Phragmipedium* species are intimately connected to their specific ecology. Natural hybridization is extremely rare, and not the source of observed variations within natural primary and secondary populations. Many years ago, a commercial nurseryman opined in an online forum that he knew of a location where *Phrag*. *besseae* grew with *Phrag*. *dalessandroi*, and he saw many plants of the hybrid *Phrag*. Jersey growing in the same habitat. I am familiar with this location, and his observation is not correct. It is observations such as this that accomplish little more than demonstrating the natural polymorphism inherent in the species concept.

The natural polymorphism, or variation that we see in the genus, is possibly explained by the nature and biology of *Phragmipedium* species. Over the millennia, habitats are created and destroyed by landslides, droughts, volcanic activity, earthquakes, flooding, and recently, humans. *Phragmipedium* species quickly populate many recently degraded areas, creating new populations as others are destroyed. Within the broader range of a species, *Phragmipedium* species are always on the move. The prolific and rapid manner in which many species populate new habitats, especially roadsides in Ecuador, would not be possible without the intricate variation patterns that give ochlospecies an

Labellum shapes vary as seen here between *Phrag. caricinum* and *Phrag. schlimii.*

advantage over species that would otherwise need to undergo an evolutionary mutation. For example, two separate populations of *Phrag. boisserianum* form a new population in an impacted area, increasing what were once subtle variations into complex variations in staminode, color, floral morphology, and vegetative characteristics. This is part of the natural biology of the genus.

Within species, variation may also play a role in mediating the speciation process. In species with broad variation, there will always be some individuals that can easily adapt and move to a newly created ecosystem. In contrast, fewer individuals will thrive in the newly created ecosystem in species with a narrow variation. The author has seen, over the past twenty-five years, known primary and secondary populations appear and disappear in several locations impacting several species. The propensity of adaptable *Phragmipedium* species to quickly colonize new areas, both primary and secondary, makes proposed physical isolation of species at the population or location level a fool's errand.

The species have much to offer in breeding programs. When aspects of the biology, ecology, and natural variation are considered, *Phragmipedium* species are easy to recognize. They do not require a microscope, dissection of your flowers, or genetic analysis to understand. A hobbyist should be able to look at his plant, read the description, and use it to identify what he is looking at year after year, no matter the change in cultural conditions, age of the flower, and inherent variations. Unverified hand-me-down sources of information passed off as factual statements in formal descriptions only make evaluating new species descriptions more challenging. The first hint of a dubious description is the ensuing confusion. "What do I have?" followed by "What is this?"

Without a sufficient sample size and consideration of their biology and ecology, *Phragmipedium* species are a nightmare. Species are described, and then some years later, an attempt is made to redefine what those names mean. There was no confusion between *Phrag. kovachii* and *Phrag. besseae*; however, for decades, growers have been asking "what is *Phrag. dalessandroi*?" It is possible to see one or more of the taxonomic characteristics defined for *Phrag. dalessandroi* in any plant of *Phrag. besseae*.

Vague species concepts that evolve and are reclassified based on changing characteristics, not part of the formal species descriptions, is problematic. *Phragmipedium roezlii* and *Phrag. hartwegii*, both synonyms of *Phrag. longifolium,* are good examples. The original publications of those names and the type material do not differentiate between them and *Phrag. longifolium*, as some would have us believe. The same is true for *Phrag. besseae*. Although it was rumored for many years that plants from Ecuador were *Phrag. dalessandroi,* while *Phrag. besseae* was exclusive to Peru, it is not supported by a shred of observable evidence.

There are no barriers to entering the field of taxonomy. No license is required, and no advanced degree, or job at a botanical garden or institute is necessary. You, me, or anyone with a collection of phragmipediums can write a species description.

How should the species concept be applied to the genus *Phragmipedium*? The natural populations teach us that the only constant in the genus is variability. As you read through the sections on each species in the "Checklist of Phragmipedium Species" in this issue of the *Orchid Digest*, you will read about different variations. Many of the flower variations are almost imperceptible without dissection. Floral characteristics such as subtle variations in the staminode, fenestrations, and petal angle, degree of reflex, twisting, and color vary

Phrag. boisserianum, *Phrag. lindenii,* and *Phrag. schlimii* self-pollinate.

substantially within each species and are poor taxonomic indicators.

Vegetative characteristics and overall flower size and color are inherently variable and are as dependent on cultural conditions as they are on genetic influence. Plants of *Phrag. besseae* demonstrate darker red and larger flowers if grown in cooler temperatures during the blooming period and kept moist daily. Plants of *Phrag. lindleyanum* with deep red flowers in situ begin producing greener and whiter flowers in cultivation. Plants of *Phrag. longifolium* have seen dramatic decreases in the overall length and width of their leaves when removed from nature. Some species demonstrate year-after-year variations in staminode shape, ratios, petal angel, and flower count on the same plant and, occasionally, on the same flower spike.

There is significant consistency in the species concept of *Paphiopedilum*, not so in the genus *Phragmipedium*. Mother Nature does not control and limit species to specific locations within a broader range. *Phragmipedium* species do not respect lines on a map, nor should the taxonomist when evaluating species. Geographic isolation within the broader species range looks nice on a map but is poor in helping with the species concept.

Natural populations do not create phragmipediums like Chevrolets off an assembly line. There are no cookie cutters that mass-produce exact copies within populations, locations, or year after year. As phragmipedium enthusiasts, we should embrace the variability within the species concept and cherish our clones for their individuality.

The list of current synonyms (33) exceeds the number of species (18) in the genus, with *Phrag. longifolium* and *Phrag. schlimii* being particularly problematic. Much of the confusion over how many species there are in the genus *Phragmipedium* has been due to a small number of variable taxonomic characteristics being taken from small numbers of plants. Regrettably, many species have been described from a single plant, more egregiously from single flowers, and perhaps most egregious of all, from aberrant flowers. The inherent variability within populations has been unrecognized, and the continued development of flowers as they mature has not been sufficiently studied or has been ignored.

Staminodes vary in shape and color.

Phragmipediums are new world tropical species. Except for *Phrag*. *lindenii*, all *Phragmipedium* species are easily distinguished by their labellum and all have a trilobed ovary. The labellum is critical to pollination but not mandatory. Three species of *Phragmipedium* self-pollinate, *Phrag*. *boisserianum*, *Phrag*. *lindenii*, and *Phrag*. *schlimii*. There is no reward for the pollinator for those species that have a labellum and rely on pollinators.

Staminodes vary in shape, pubescence, and color. In *Phrag*. *kovachii*, *Phrag*. *schlimii* and *Phrag*. *besseae,* the shape of the staminode varies from oval or generally egg-shaped (triangular), to long and tapered, to varying degrees of being shaped like a fiddle (quadratic, hexagonal or octagonal). Edges can be curved or more angular. In other species, the staminode is laterally lobed. The curvature, or bending at the edges, varies from slight to noticeable depending on the species, floral individuality, and age of the flower.

The significant variation in the staminode exists within all populations, making staminode morphology challenging to quantify on a species by species basis. However, this has not stopped taxonomists from Reichenbach in 1869 through to Braem in 2016, from attempting to use the shape of the staminode to identify species of *Phragmipedium.* In support of her monograph of the genus, McCook (1989), after extensive observation in Mexico through Bolivia and into Brazil, stated, "From a practical aspect, primary reliance on staminode characteristics for species delimitation is almost impossible…" After twenty-five years of visiting *Phragmipedium* in situ in many countries, I agree. Reliance on staminode characteristics to differentiate and separate species within this genus is impossible in all but the broadest terms. Therefore, staminode shape has been omitted from consideration as a taxonomic indicator in my revision.

Characteristics of the inflorescence vary from plant to plant and in primary and secondary habitats. For example, the author has observed plants of *Phrag*. *besseae*, *Phrag*. *longifolium*, and *Phrag*. *vittatum* with long flower spikes necessary to get the flowers above the surrounding vegetation. These were growing next to plants with much shorter inflorescences surrounded by no vegetation. In cultivation, flower spikes may have sequential flowering after demonstrating branching flower spikes in situ, including *besseae, longifolium,* and *lindleyanum.* Vegetative characteristics, including the leaves, are so dependent upon the culture and environmental factors that they are useless as specific characteristics within each species concept.

The shape and specific characteristics of the lateral petals vary significantly and continue to develop as the flower matures. The most obvious examples of this are *Phrag*. *caudatum*, *Phrag*. *humboldtii*, and *Phrag*. *warscewiczianum*. These species have long petals that continue to grow as the flower matures. Other species have the same qualities, although less obvious. In some species, as the petals lengthen, the angle at which the petals appear changes. These variations make petal characteristics useless as specific taxonomic indicators within the species concept.

Other highly variable characteristics include the pattern, size, quantity, and placement of the claw face spots. The claw face is the area of the labellum that forms the tube between the opening of the pouch and the escape hatch at the back, close to the stigma and pollinia. Labellum shapes vary, as well as the length, width, and attitude of both the dorsal and synsepal petals.

Ratios and the complexity of floral parts are impossible to use. To illustrate this, there is a photo of *Phrag*. *vittatum* with two flowers. One flower is close to death, the other just after anthesis. You can see the severe, progressive, and variable nature of the flowers. The staminode in the older flower has curved over to accommodate the upper labellum opening. In comparison, the younger flower has a flat staminode, and the ratios of floral parts have changed. The shape of the slipper has changed, petal characteristics are inconsistent, and the color could not contrast more. Yet, these two flowers are on the same spike on the same plant. Even if less severe and only slightly perceptible, all flowers in all spe-

Phragmipedium vittatum is closely allied with *Phrag*. *longifolium.* They overlap in floral morphology.

cies in this genus have the same progressive and highly variable characters that define them as ochlospecies. This makes species differentiation based on supposed static characters such as the staminode, slipper, petal attributes, and ratios a fool's errand. It would be easy to define these two flowers as two different species if they were found separately.

Taxonomy of phragmipediums is by no means easy, and the natural populations keep throwing us curve-

Ratios and the complexity of floral parts are impossible to use as illustrated with *Phrag*. vittatum.

balls. Just when we think we have found a stable taxonomic characteristic, a new primary or secondary habitat is located that throws our preconceptions into confusion. The only constant, stable characteristic of species within the genus *Phragmipedium* is variability.

All species of *Phragmipedium* are ochlospecies. There are no exceptions. However, different species can be distinguished based on their patterns of variation. These patterns are stable and present quite distinct species to us when that variability is understood. When the morphological variations are aggregated and quantified, we get a set of taxonomic variables for each characteristic. Think of them as bookends with different volumes in a series in the middle. The species concept for each attribute begins at the left bookend and ends at the right bookend. Then there is a gap, and the left bookend of the next species, or a closely related species, begins. Within the species concept of *Phragmipedium*, several characteristics demonstrate correlation, making species concepts easy when understood.

When we mistake independent variation of floral characteristics as species boundaries, we create a taxonomic mess. I follow the genotypic cluster species concept, meaning I will recognize species delineations based on gaps in morphological variation, and not based on that variation alone. Given the extent of natural clines in the variation of multiple taxonomic characteristics that were previously thought of as static, the morphological or typological species concept (Cracraft, 2000; Mayr, 1996), where every difference that you see defines a new species, agnostic of inherent clines in variation, ecology, and biology, cannot be imposed on the genus *Phragmipedium.* Groups of plants from primary and secondary habitats that are similar to one another are part of one distinct species. Yet, these groups are not at all similar to other species. This approach means that we need to begin our understanding of *Phragmipedium* species taxonomy with the study and knowledge of the common variations within the species concept and understand the discontinuous variation in morphology that forms the actual boundary lines between species in the genus *Phragmipedium*. Identification of the cline in natural variations and the gaps in that variation that create species boundaries is how the species concept in the genus must be applied.

I generally follow McCook (1989) and Cribb (2017) in recognizing four sections within the genus, *Micropetalum*, *Platypetalum*, *Lorifolia*, and *Phragmipedium*. I do, however, add subsection *Himantopetalum* under section *Phragmipedium*. I place those species that subsist below the high-water line on the banks of rivers into subsection *Himantopetalum*. This treatment is due to the severe ecological gap between the species in this subsection and the other species in section *Phragmipedium*. McCook (1989) does not recognize subsection *Himantopetalum* due to the lack of characteristics to support this subsection. However, when McCook wrote her monograph in 1989, we had not yet described *Phrag. hirtzii* and *Phrag. cabrejosii.* McCook considered only the physical attributes of the flowers, an analysis that lacked the additional species and ecological analysis available today. It is best to treat the species in subsection *Himantopetalum*as part of yet separate from the species in the *Phrag. caudatum* group. I will not do a deep dive into what separates each section and refer the reader to both McCook (1989) and Cribb (2017) for a detailed analysis of each of the four sections.

The four sections are broken out as follows:

Section Micropetalum:
- *Phrag. besseae*
- *Phrag. besseae* var. *dalessandroi*
- *Phrag. schlimii*
- *Phrag. kovachii*

Section Platypetalum:
- *Phrag. lindleyanum*

Section Lorifolia:
- *Phrag. boisserianum*
- *Phrag. longifolium*
- *Phrag. vittatum*

Section Phragmipedium:
- *Phrag. caudatum*
- *Phrag. humboldtii*
- *Phrag. guianense*
- *Phrag. lindenii*
- *Phrag. warszewiczianum*

Section Phragmipedium subsection Himantopetalum:
- *Phrag. klotzschianum*
- *Phrag. hirtzii*
- *Phrag. pearcei*
- *Phrag. caricinum*
- *Phrag. cabrejosii*
- *Phrag. richteri*

Conclusion

"Greenhouse taxonomy" is the practice of taxonomy not based on the realities of the natural world, but on observing of a minute sample size in a greenhouse, usually plants with colorful and dubious histories to support them. It has become a problem and led to the publication of quite a few questionable species and natural hybrids. This is a problem for the taxonomist when trying to navigate the genus. Every observable difference from plant to plant in a greenhouse or out of a box at an orchid show is not a new species, nor is every obvious commonality indicative of a new natural hybrid. Many times, the history of many of these plants are inaccurately stated. Why there has been a proliferation of questionable and problematic names in the past twenty-year period, as opposed to the previous two hundred years, is anyone's guess.

Whether they were "good" species names or not, before the 1990s, species descriptions were consistent with and based on valid natural populations. Today, new species and natural hybrids are commonly described based on single, or a few, greenhouse flowers, and, in one case, an aberrant greenhouse flower. Comparisons are made to man-made crosses instead of natural populations. Species or proposed natural hybrids should be consistent with natural populations and comparisons made only to those natural populations. As a community, we need to start paying more attention to what the natural populations of phragmipediums are telling us and less attention to our hubris and greenhouses.✾

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