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ORCHIDS

THE BULLETIN OF THE AMERICAN ORCHID SOCIETY

VOL. 89 NO. 11 NOVEMBER 2020

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ORCHIDS

The Bulletin of the American Orchid Society

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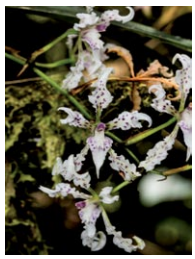
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FRONT COVER

Found at elevations from about 7,500 feet to as high as 13,000 feet (2,300–4,000 m), *Cyrtochilum halteratum*, is a spectacular, cold-growing epiphyte in Colombia, Venezuela and Peru. Photograph by Tatiana Arias.

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A 501(c)(3) Nonprofit Organization Founded in 1921

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The mission of the American Orchid Society is to promote and support the passion for orchids through education, conservation and research

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The American Orchid Society provides leadership in orchids

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Membership in the AOS includes a subscription to *Orchids* magazine that begins with the next available issue at the time of enrollment. For information on membership, please call 305-740-2010, email theaos@aos.org or join online at www.aos.org.
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PRONUNCIATION GUIDE

Pronunciation of orchid names can be daunting for the novice and experienced grower alike. Presented below is a simplified pronunciation guide specific to the names found in this issue of *Orchids* magazine. An attempt has been made to represent each syllable using easily recognized sounds or words separated by hyphens and not standard phonetic symbols. Check out the Orchidist's Glossary on our website at https://www.aos.org/orchids/orchidists-glossary.aspx.

ampullaceum (am-pull-LAY-see-um)
aquilonis (a-kwi-LOH-niss)
Arachnis (a-RAK-niss)
arunachalensis (a-roon-a-chal-EN-sis)
aurantiaca (aw-ran-tee-AY-ka)
aurea (AW-ree-a)
bicolor (BYE-kul-ur)
Biermannia (beer-MAN-ee-a)
bimaculata (bye-mak-yew-LAY-ta)
bowringiana (bow-ring-ee-AY-na)
Bulbophyllum (bulb-oh-FILL-lum)
calodictyon (kal-oh-DIK-tee-on)
canaligera (kan-a-LIJ-er-a)
Catasetum (kat-a-SEE-tum)
cathcartii (kath-KART-ee-eye)
christensoniana (krist-en-son-ee-AY-na)
Corybas (KOR-ee-bus)
Cymbidium (sim-BID-ee-um)
Cyrtochilum (sir-toe-KYE-lum)
deckeri (DEK-er-eye)
Dracula (DRAK-yew-la)
elegans (EL-eh-ganz)
ensifolium (en-see-FOL-ee-um)
Epistephium (eh-pih-STEF-ee-um)
Esmeralda (ez-mer-AL-da)
filamentosa (fil-la-men-TOS-a)
fimbriatum (fim-bree-AY-tum)
forceps-cancri (FOR-seps-KAN-kri)
Galearis (gal-ee-AIR-is)
gibbosa (gib-BOS-sa)
Guarianthe (gwar-ee-AN-thee)
guatemalensis (gwa-teh-mal-EN-sis)
Habenaria (hab-ee-NARE-ee-a)
halterum (hal-TER-rum)
hennisiana (hen-nis-ee-AY-na)
hortensis (hore-TEN-sis)
Isochilus (eye-soh-KYE-luss)
jainiana (jane-ee-AY-na)
kanran (KAN-ran)
khasiana (ka-she-AY-na)
laelioides (lay-lee-OY-deez)
Lepanthes (leh-PAN-theez)
longifolium (lon-jih-FOL-ee-um)
lowii (LOWE-ee-eye)
lucifer (LOO-sih-fer)
macranthum (mak-RAN-thum)
maculata (mak-yew-LAY-ta)
malipoensis (mal-ee-poe-EN-sis)
Masdevallia (mas-de-VAHL-ee-a)
mirandum (meer-AN-drum)
misericors (mih-SEER-ih-kors)
Odontoglossum (oh-don-toe-GLOS-sum)
Oncidium (on-SID-ee-um)
oreophilum (ore-ee-OFF-ih-lum)
pachecoi (pa-CHAY-ko-ee or pa-CHAY-ko-eye)
Paphiopedilum (paff-ee-oh-PED-ih-lum)
parishii (pa-RISH-ee-eye)
parviflora (par-vee-FLOR-a)
parviflorum (par-vee-FLOR-um)
passerinum (pas-ser-EE-num)
patinii (pa-TIN-ee-eye)
Phalaenopsis (fail-en-OP-sis)
phasmida (fas-MEE-da
Phragmipedium (frag-mih-PEED-ee-um)
Pinalia (pin-AL-ee-a)
Platanthera (plat-AN-ther-a)
Platystele (plat-ee-STEE-lee)
Pleurothallis (plur-oh-THAL-liss)
Porroglossum (pore-roe-GLOS-sum)
pulcher (PULL-ker)
quinquecallosa (kin-kay-kal-LOH-sa)
ramosissimum (rae-moe-SIS-sih-mum)
Restrepia (reh-STREP-ee-a)
rhodovanoides (roe-doe-van-OY-deez)
Rhyncholaeliocattleya (rink-oh-lay-lee-oh-KAT-lee-a)
rhynchostyloides (rink-oh-sty-LOY-deez)
romanzoffiana (roe-man-zof-fee-AY-na)
rotundifolia (roe-tun-dee-FOL-ee-a)
sceptrum (SEP-trum)
Schoenorchis (shown-ORE-kis)
Selenipedium (sel-len-ih-PEED-ee-um)
skinneri (SKIN-ner-eye)
Spiranthes (spy-RAN-theez)
Teagueia (TEEG-ee-a)
Telipogon (tel-ee-POE-gon)
telipogoniflora (tel-ee-poe-gon-ee-FLOR-a)
violacea (vye-oh-LAY-see-a)
williamsii (wil-lee-AM-zee-eye)
wilsonii (wil-SON-ee-eye)
xiphiifolium (zye-fee-ee-FOL-ee-um

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THE HOLIDAYS ARE right around the corner and the hustle and bustle of upcoming weeks will consume much of our time. Very soon it will be Thanksgiving Day, and that is the official kick-off of the holidays. It is my hope that this year, folks will consider the true meaning of Thanksgiving Day. Considering that the major event that defined this year, the coronavirus, has left an indelible mark on the entire world, let alone the US, we could all use a holiday.

So, on that day, as we sit down to share a Thanksgiving meal with family and friends, we should show how grateful we are, first and foremost, for being there with our dear ones. As I think about it, the list of things to be thankful for is endless: from family and friends to health, employment, pets, laughter, sunshine and, of course, orchids.

I have to mention orchids. I cannot help it. Orchids are a large part of my life. And if you are reading this, I am sure they are a large part of yours as well. I look forward to the holidays. For many people, the holidays are a wonderful diversion from everyday life, especially this year. It is a wonderful opportunity to introduce orchids into more areas of our lives, not just our gardens or shows.

Orchids may be given as gifts or as part of any holiday home decoration. Giving an orchid as a gift shows that person they are held in high regard. It is by far a most extraordinary gift that so many people will appreciate tremendously.

In the home, orchids may be used in a tabletop centerpiece, along mantels or even on front porches, weather permitting. Any home décor will instantly be elevated several notches simply by adding a sprig of orchids. The possibilities are endless.

Slowly but surely, we are beginning to see the light at the end of the coronavirus tunnel. Following the guidelines has resulted in fewer contractions and deaths. With a vaccine a certain probability now, quarantines and restrictions will be relaxed. Life will get back to normal again.

This is definitely something to be thankful for!

Getting back to normal in the orchid world means a return to shows and judging. Last September, I was fortunate to attend my first judging event in many months at the Carolinas Judging Center. Once there, you could feel the excitement and enthusiasm of everyone showing their beautiful plants and by the AOS judges evaluating them.

MICHAEL CORONADO

MICHAEL CORONADO

There were five plant tables full of beautiful orchids to be judged and for everyone to enjoy. As with any judging event, the teams assembled and you could hear the murmurs of the judges as they evaluated each of the plants with possible scores while measuring all the parts of the plants and recording everything on the award forms, then moving on to the next plant.

[1] Arielle Jones (left) and Will Bottoms (right), student judges in the Carolinas Center, attending to the work of getting plants entered, recorded and ready for judging.

[2] Left to right: Jeff Wuilliez, Director of Horticulture at the Daniel Stowe Botanical Gardens, Linda Wilhelm and Robert Fuchs.

At the end of the day, the AOS granted 17 awards, which took all afternoon to process. Even so, due to the excitement, the time flew by! I am looking forward to visiting more centers across the country in the next couple of years as they open for shows and judging.

Even as things begin returning to normal, the uncertainty of the virus still looms. As a result, the date of the AOS Centennial Celebration has been changed to Saturday, October 30, 2021. It will still be held at the Biltmore Hotel in Coral Gables, Florida. There will be more details from the Centennial Committee as they become available.

We felt it was prudent to make the change to the fall as all indications point to the virus being behind us and life will be returning to normal. By then, more people will feel comfortable traveling to Florida for this incredible event. Without question, this will be the most amazing American Orchid Society event in the history of the AOS.

Even with the change of date, the Centennial will be here before we know it. We are quite fortunate though, to have an amazing committee working hard to ensure the success of the celebration. They are a tireless group of people completely focused on the celebration, and they will be rewarded by seeing each and every one of you celebrating along with them.

Even with the upcoming celebration in mind, we cannot forget that our mission and accomplishments are not just about the AOS, they are also about orchid conservation. The AOS has been around for 100 years, but orchid study is centuries old. The proceeds from the Centennial Celebration are earmarked for orchid conservation, something very dear to me and to many others. We cannot allow orchid habitats to disappear along with the orchids found there.

Focusing on orchid conservation will ensure that the orchids that we have been fortunate to have for the last 100 years are there for the next 100 years. Obviously, this will not happen by itself. It is going to take a concerted effort by many people and organizations working together. The great thing is, together, we *can* help make it happen.

Happy growing!

— Bob Fuchs, American Orchid Society President (email: bob@rforchids.com).

MICHAEL CORONADO

[3] Linda Wilhelm examining one of the spectacular Phalaenopsis considered that day.

IX International Conference on Orchid Conservation "Soroa 2021"

THE SOROA BOTANICAL and Orchid Garden and the University of Artemisa announce the IX International Conference on Orchid Conservation "Soroa -2021," which will take place November 22–27, 2021 at our facilities.

The Symposium will feature scientific panels addressing such topics such as:

- In situ and ex situ Conservation
- Ecology and Population Dynamics
- Systematic
- Invasive Species
- Biotechnology
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For more information on the Conference, contact Dr. Lawrence W. Zettler (lwzettle@ic.edu) or Dr. Ernesto Mujica Benítez Scientific Secretary (emujica@upr.edu.cu).

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November: The Month of Gathering

By Thomas Mirenda

TRADITIONALLY, WE RELY on November as our time of harvest, family feasts and grateful thanksgiving for the prosperity and blessings bestowed on us over the past year. Even if the year of 2020 has been a particularly vexing one and has not provided us with much in the way of joy and fortune, there is still plenty to be grateful for. Despite a year of shutdowns and sequestration, many of us, with fewer workplace commitments, have focused on our homes, gardens and enhancing glorious plant collections. Commercial growers, unable to supply blooming plants for canceled orchid shows, have reinvented their businesses and become mail-order powerhouses, thriving and prospering as never before. It is tribute to our collective resilience, and indeed the very *necessity* of orchids in our lives that reveals some strangely remarkable things about us and them.

Thomas Mirenda

Our orchids are almost like partners and playmates, but in suspended animation. The slow dance of interaction with them and the eventual reward of astounding beauty provide us with the same adrenaline rush of an extremophile sportsman, only prolonged and sharable with our friends around the world in this modern age of online distribution and circulation.

Personally, I find the daily development and anticipation of a flower as delightful, or even more so, as one that has fully opened. The daily progress of an inflorescence, the fattening of buds, their gradual infusion of color, all these aspects of orchidology are gathered in our hearts, souls and minds providing the rich experience and exquisite torture all readers of this column can relate to. I am sure that is magnified even further in the eyes of intrepid orchid breeders when they see their speculative hybrids develop and bloom splendidly. Slowly but surely, the aggregations of such experiences linger in our hearts and minds, calming us and assuring us that life really can be wonderful.

REINVENTION This month we witness the development of inflorescences in phalaenopsis, cymbidiums, many dendrobiums, cattleyas and several other genera. The shortening of day length (photoperiod) and gradual cooling of temperatures in the Northern Hemisphere has halted the growth we saw in the spring and summer and signaled to our plants that all that energy they stored is now to be used for reproduction, and flowers. As they elongate and develop, make sure these inflorescences are supported and allowed to grow unobstructed so that their natural grace is evident. The hybridizers have been so busy producing new, exciting, easily grown, vigorous plants for us to enjoy. If you look at the awards pages at the back of this magazine, you will see unprecedented wonders, never imagined 50-plus years ago. Whether you are into species or hybrids, it is undeniable that remarkable achievements have taken place in recent years.

EXTREMOPHILES Generally considered to be athletes "living on the edge," the orchid world is seeing fantastic examples of extreme beauty, novelty and outstanding culture that rival anything ever seen before. When we see such plants awarded, they represent the best of the best. Like Olympic athletes, they have often hit the genetic lottery. When coupled with excellent culture and training, extraordinary horticultural feats are possible. Chances are you were feeding and nurturing your orchids religiously this past year. Well now, in most cases, it is best to stop all that training and feeding and watch from the sidelines as the plants perform. Many growers stop feeding and hold back watering this time of year as the change discourages further production of foliage and pseudobulbous storage organs, redirecting those resources toward the production of flowers. Some, such as catasetums, habenarias and seasonally dry-forest types of dendrobiums can require extreme dryness, as they get in the wild, to perform well in your collection. But make no mistake, if your plants are in spike or bud at this time, you should still give them some moderate watering and humidity or risk the blasting of buds before they actually open.

EXQUISITE TORTURE If horticulture is primarily about patience, then the development of flower spikes is truly our big test in this regard. It can be tempting to fuss, water and feed unnecessarily as we anticipate flowers. This rarely turns out well. If you choose to stake and groom your plants, often crucial to excellent floral

Matthias Seelis, Shogun Orchids, with his magnificent plant of *Cattleya* Bow Bells 'White Wings' AM/AOS

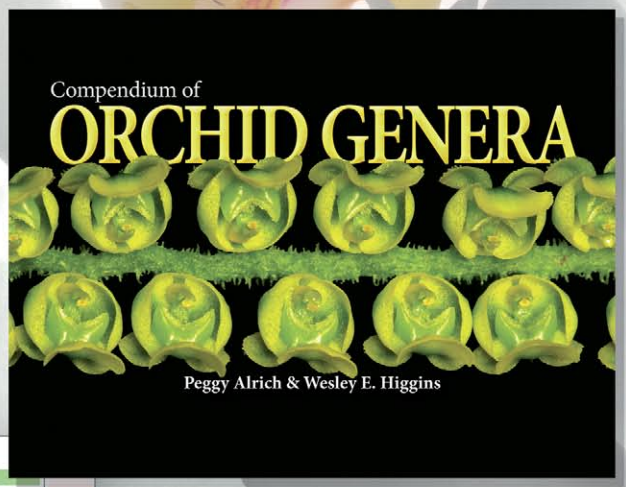
presentation, you must do it with extreme care and caution. There is nothing more heartbreaking and frustrating than accidently detaching or damaging spikes you have labored so diligently to produce. Make sure you have a clean, uncluttered work area for such tasks, and do not rush, especially while staking and positioning spikes. A full year of impeccable growing can be instantly marred by a bit of carelessness at this point in the process.

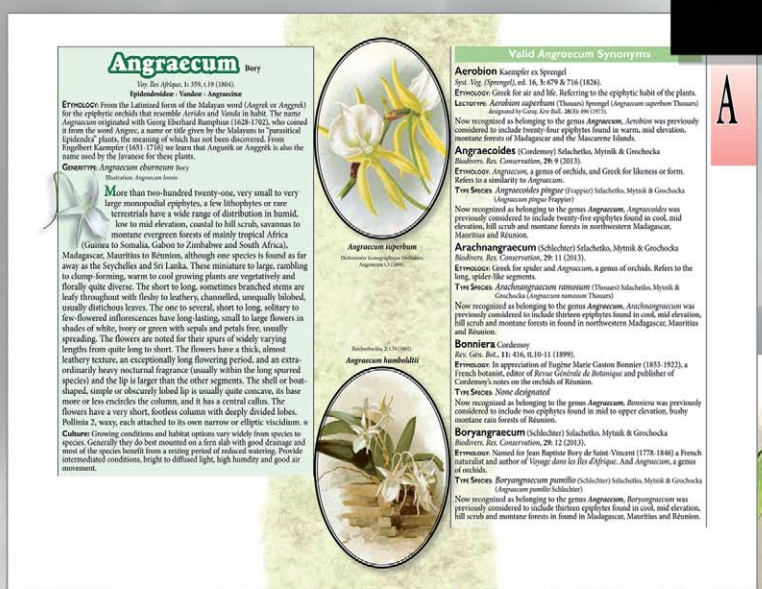
NECESSITIES Imagine how bereft we would be at this time without the exuberance and life-affirming joy of our plants. Of course, we know that humans need plants for oxygen, fibers and food. But plants, particularly those in cultivation, need the animal world in return to supply carbon dioxide, nitrogen and water. We cannot thrive without each other. While it does not fully explain away the mysteries of our orchid obsessions, perhaps it does partially elucidate the reasons why we gather so many of these exceptional plants into our lives. They just make everything better.

— Thomas Mirenda has been working professionally with orchids for over three decades and is the past chair of the AOS Conservation Committee. He is an AOS accredited judge in the Hawaii Center (email: biophiliak@ gmail.com).

Presenting

The Compendium of Orchid Genera by Peggy Alrich and Wesley Higgins




Angraecum Bory

Valid *Angraecum* Synonyms

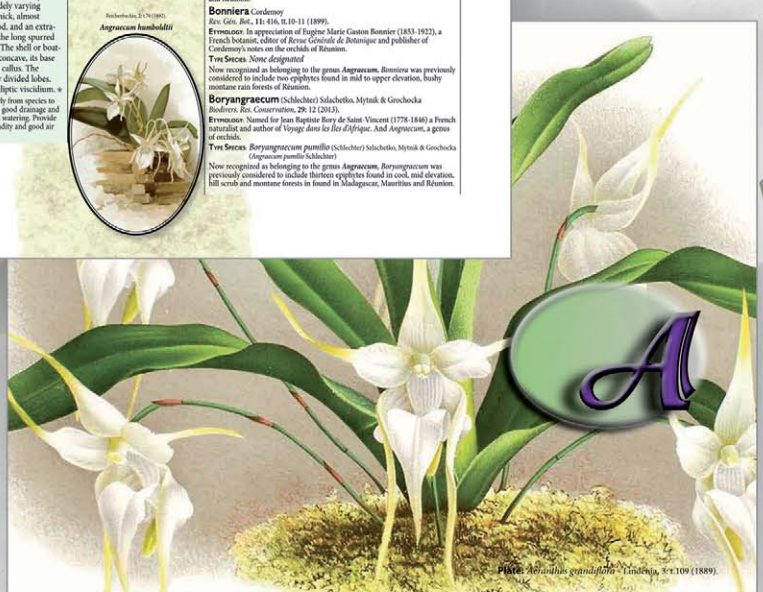
Aerobion Kaempfer ex Sprengel

Angraecoides (Cordemoy) Szlachetko, Mytnik & Grochocka

Arachnangraecum (Schlechter) Szlachetko, Mytnik & Grochocka

Bonniera Cordemoy

Boryangraecum (Schlechter) Szlachetko, Mytnik & Grochocka



More than 200 orchid genera are presented with the original orchid discoverer and date as well as the etymology and an easy to read description of growth habit. The book is illustrated with antique color plates, many from an original publication, all compete with citations. This book will be a welcome and beautiful addition to any orchid grower's library, a stunning work and artistic treasure.

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Judging Tiny Flowers

by Carrie Buchman

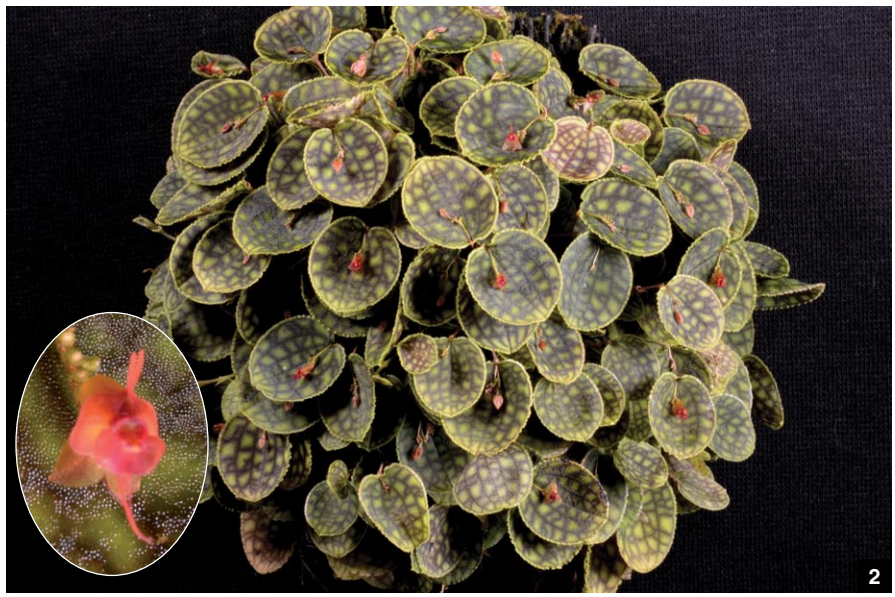
THERE ARE NO standard definitions for flower sizes. I am defining tiny flowers as those whose natural spread, both horizontal and vertical, is less than 0.6 inches (1.5 cm). Tiny flowers can be on small plants — for example, *Lepanthes* and *Platystele* — or on larger plants, such as *Schoenorchis* and *Isochilus*.

What preconceived preferences may be present in judging tiny flowers? They are certainly more difficult to see and to photograph. Do we want to see multitudes of flowers when considering a flower quality award for tiny flowers?

The American Orchid Society *Judging Handbook* promotes ways to set a positive approach to judging and to mitigate individual bias. The *Judging Handbook* suggests starting judging with "What can we do for this plant?" to set the tone for a positive discussion. Asking "If the flower were white, would we award it?" is a mitigation for color preferences as it prompts judges to look past color and assess form, presentation, floriferousness, and other scoring elements. The judging score sheet is another mitigation. Of course, the most obvious avoidance of bias is that a judge never participates in judging their own plant.

AWARD HISTORY TRENDS Data can dispel preconceptions but can also be presented in such a way as to confirm an assertion or preconception. Remember Mark Twain's famous quote: "There are three kinds of lies: lies, damned lies and statistics." An analysis of *OrchidPro* data from January 1, 2000, to May 15, 2020, suggests some interesting trends. The results could indicate a lack of appreciation for tiny flowers: Zero percent of the FCC awards in this timeframe were to tiny flowers; for AMs, it is 0.47 percent; for HCCs, 0.74 percent; and, for CHMs, 20.2 percent. These numbers are interesting and may indicate something, or they may indicate nothing, because there is no way to know how many plants with tiny flowers have been presented for judging. Judging centers can only judge what is brought to them, and each exhibitor has different interests and capabilities. So, one center may have several people who grow genera that have tiny flowers in their region and others may have none.

A case study of *Lepanthes*, a genus with many tiny-flower species, is a bit more telling. There are 145 awards to tiny-flowered *Lepanthes* in the same 20.5-year time period. Nine percent are flower quality awards (two AMs and 11 HCCs); cultural awards account for 9.7 percent (two CCEs and 12 CCMs); botanical awards are 80 percent (29 CHMs and 87 CBRs); and 1.4 percent for other awards.



CHAUNIE LANGLAND

2

MICHAEL PEARSON

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Two popular *Lepanthes* species and one hybrid are included in the case study. *Lepanthes calodictyon* 'Vistamont' was awarded a CCE. Its flower's natural size was almost twice that of the awarded CHM. So, was a flower quality award considered at the time? None was awarded. Is there a bias at times against simultaneous awards to the same plant? There is nothing in the award description to indicate if a quality award was considered, and I am not suggesting that there should be.

A second example is *Lepanthes telipogoniflora*. *Lepanthes telipogoniflora* 'Magic Bubble' was awarded a CCM in 2016. It had relatively large flowers compared to previous awards. Was it considered for a flower quality award as well? Three years later, *Lepanthes telipogoniflora* 'Duck Creek' with a flower 40 percent smaller than 'Magic Bubble' and without the form and color of 'Solar Place' was awarded an HCC. The AM awarded to *Lepanthes telipogoniflora* 'Solar Place' in 2007 was well deserved based on its full, round form, and intense color.

My last *Lepanthes* example is a hybrid, Sherry Bridygham (*calodictyon* × *telipogoniflora*). *Lepanthes* Sherry Bridygham 'Elven Jewel' was awarded an HCC in March 2015. Two years later, *Lths*. Sherry Bridygham 'Star Eyes' was

[1] *Lepanthes* Sherry Bridygham 'Star Eyes' CCM/AOS (*calodictyon* × *telipogoniflora*) Photograph by Ed Cott.
[2] *Lepanthes calodictyon* 'Vistamont' CCE/AOS
[3] *Lepanthes telipogoniflora* 'Solar Place' AM/AOS

awarded a CCM. Again, the question must be asked, was a flower quality award considered? Its color, form, size and floriferousness appear to all be improved over the previous quality award to 'Elven Jewel'.

Looking at a couple of other examples gives some additional insight into quality awards for tiny flowers. *Vanda christensoniana* received an HCC in 2006, then a CHM in 2011, an AM in 2016, and an FCC in 2020. It is an example of improved breeding and culture moving a tiny plant out of the tiny category and into an FCC.

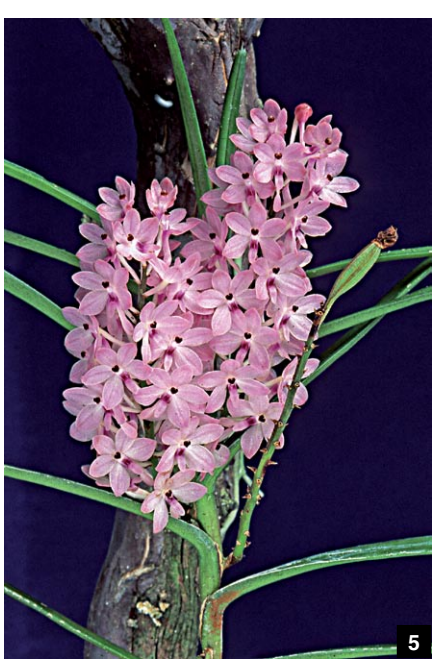
Lastly, looking at *Pinalia rhynchostyloides*, the AM in 2010 was to an unusual pink-orange color with fewer flowers per inflorescence and marginally bigger flowers. The previously awarded clones are a more typical lavender-pink color. Again, color likely played a significant role in this award.

TINY FLOWERS AND THE JUDGING SCORE SHEET For the most part, tiny flowers are not typical for any of the genera for which separate scales are provided, so the general scale should be used. For example, the Pleurothallid scale is for flowers with caudae, largely *Dracula*, *Masdevallia* and their hybrids, and *Porroglossum*. What about something like *Lepanthes lucifer*, which has vestigial caudae? As long as a judging team agrees, either scale could be used. There is no right or wrong answer as long as a judging team discusses and decides what scale to use prior to scoring a plant.

Many judges complete a score sheet with just a final score. Would scores differ if judges were obligated to score each element of the score sheet? Do the scales provide too small a differentiation between the elements, such that it is difficult to recognize a flower's most outstanding feature? Are the individual possible scores in the scales for parts, etc. so small that it is difficult to differentiate between a 75 percent and an 80 percent score?

TECHNOLOGY Judging tiny flowers can be difficult. How can you judge what you can barely see? Being prepared with the proper tools is essential. Technology can be our friend. In addition to magnifying glasses and loupes for magnification, a smartphone is an excellent judging tool: a judge can take a picture and expand it to see details of color, form and texture to facilitate counting flowers and writing descriptions. Adding an inexpensive macro lens to your smartphone gives even greater resolution on expanded

4 WES NEWTON



5 CHARLES MARDEN FITCH

6 JAMES OSEN

photos. Newer smartphones have even more capabilities.

An inexpensive digital microscope sold as a children's toy to look at insects and the like is an excellent tool for minute flowers. It can connect to a smartphone, tablet or PC where the image can be projected for discussion. Such a microscope has taken decent photos for me of *Platystele filamentosa*, whose natural spread is 0.04 inch (0.1 cm). It could be used for dissection with quadrille paper underneath, capturing still photos or video to be submitted to the Species Identification Task Force (SITF).

In addition to seeing the candidate plant, we need to have clear, detailed photos in *OrchidPro* to better enable judges to compare previously awarded flowers with candidate plants. Stack photography is a specialized technique that combines multiple photographs taken at different depth of focus resulting in a crisp photograph with astonishing detail. Stacking used to be time consuming, making it impractical for judging, and some photographers assumed its use was forbidden; it is not. Today, camera capability is increasingly automated with built-in stacking, microscope mode, macro lens, and ring-flashes. At the very least, as per the *Judging Handbook*, center photographers must have macro capability to take flower close-ups for *OrchidPro*, and other flower, leaf and stem views for the SITF. The SITF and the *OrchidPro* community benefit greatly from comprehensive photographic records.

Small plants, often with tiny flowers, are gaining in popularity. So, we are likely to see more and more of them at judging. Listen to everyone and be open to changing your first impressions. Looking at an enlarged image of a tiny flower can make the wow factor apparent.

Acknowledgement

The author gratefully acknowledges the guidance, feedback and input of Jean Stefanik, Albert Messina, Cordelia Head, Christian Carrillo, Maurice Garvey, Susan and Charles Wilson, and Lynn O'Shaughnessy.

—Carrie Buchman is an Associate Judge in the Northeast Judging Center; a past President, current Trustee, and Show Chair of the North Jersey Orchid Society; and Orchids Co-Chair at the Philadelphia Flower Show. She has been growing orchids since the 1980s, and has been a member of the American Orchid Society since 1984. She grows largely cool to intermediate South American miniatures.


CHARLES ROWDEN


JAMES MCCULLOCH


BRYON RINKE


LYNN O'SHAUGHNESSY

[4] *Vanda christensoniana* 'MV Pink Clouds' CCE-FCC/AOS. Inserts: close-up of 'MC Pink Clouds' (right); 'Wacousta' AM/AOS photographed by Katie Payeur (left).

[5] *Vanda christensoniana* 'Orchidgrove' CHM/AOS

[6] *Vanda christensoniana* 'Leesburg' HCC/AOS

[7] *Pinalia rhynchostyloides* 'Spicy' AM/AOS

[8] *Porrovalia* Phil Jesup 'Trader's Point' AM/AOS (*Porroglossum muscosum* × *Masdevallia hirtzii*) — a perfect example of applicability of the Pleurothallid scale.

[9] *Dracula woolwardiae* 'M&B' AM/AOS is another example of never-ending tails.

[10] *Lepanthes lucifer* 'Fannie-May's Free Spirit' HCC/AOS. Did the vestigial caudae help reach a flower quality award; perhaps the color — or all of the above?

FOR THE NOVICE

Silicon Supplements

Text by Sue Bottom/Photographs by Terry Bottom

1

SILICON SUPPLEMENTS, WHAT? Huh? You do not see silicon listed on fertilizer labels. It is not generally considered an essential plant nutrient because plants can grow in its absence. Silicon is known to have a beneficial effect on plants by strengthening cell walls and making them thicker, stronger and more resistant to abiotic stresses such as drought and cool temperatures, as well as biotic stressors such as pests and disease. Silicon is the second most common element in the earth's crust. It is minimally soluble in water, so it is found only in small quantities in natural water supplies. Dissolved silica is associated with soil particles in garden soil, available as roots absorb water from soil. Even small quantities are adequate for garden plants, where it is taken up through the roots as uncharged silicic acid, $Si(OH)_4$, and ultimately irreversibly precipitated within the plant as amorphous silica. Dissolved silica is available to orchids when roots absorb water directly or from water absorbed by the potting medium.

There are studies demonstrating the role of silicon in enhancing the growth of flowering ornamentals, including orchids. Anecdotal reports from Mark Rose of the former Breckinridge Orchids, who used potassium silicates in his fertilization program, attribute thicker leaves and stronger flower stems to silicate additions. Courtney Hackney often talks about Mark's well-grown plants with harder-than-cardboard leaves, and strong stems that did not require staking; a definite plus. The benefit of harder cell walls in preventing pathogen invasion is "icing on the cake."

Deciding how much silicon would be beneficial for orchid growth required some research. A study with commercial phalaenopsis was conducted at application rates from 25 to 100 ppm Si, with best results reported in the 25–50 ppm Si range (Vendrame 2010). For comparative purposes, there are typically 3–20 ppm in the soil-water matrix (per Epstein 1994, Marschner 2012). In our area of Florida (upper east coast), water in the surficial aquifer averages 15 ppm Si (range of 3–32 ppm), and the Florida aquifer averages 10 ppm Si (range of 7–15 ppm). You have to wonder how much silicon epiphytic orchids receive from rainwater in their natural habitat growing on trees. The only source of silicon would be the dust settling on tree leaves and trunks, decaying bark, and the silicon exuded from tree leaves that originated in the soils below. Orchids are efficient nutrient scavengers and accumulators of nutrients. Too much silicon

2

[1] Silica deposited in the cell tissues provides mechanical strength, so flower stems require less staking.

[2] Potassium silicates will form a goopy gel when mixed with concentrated fertilizer solutions.

and orchid leaves can actually become brittle. Many orchid growers consider the natural concentration of Si found in Florida waters to be adequate. However, anyone using rainwater or Reverse Osmosis (RO) water should consider adding silicates to their fertilization program. An application rate of 8–15 ppm Si as a starting point seems reasonable; perhaps half that much if applying as a foliar spray. After a year or two, you can evaluate your plants and see if a higher or lower rate is suitable for your growing conditions.

There are a variety of potassium silicate products on the market. These products can be difficult to compare because the active ingredient may be reported as silica (SiO_2), sometimes silicon (Si) and less often potassium silicate (K_2SiO_3). If a hypothetical product contains 10 percent potassium silicate, it contains only 3.9 percent silica and 1.8 percent as silicon, so you have to make sure you are comparing apples to apples when evaluating different products. Another problem is the application rates are given in volume of product per volume of water, but they do not specify the resultant Si concentration. If you are not comfortable with the calculations, contact the manufacturer for the silicon (as Si) concentration of their recommended dosage.

Many orchid growers are familiar with Dyna-Gro® Pro-TeKt® silicon additive that has been available for many years. This product contains 7.8 percent silica (as SiO_2) which is equivalent to 3.7 percent silicon (as Si). Dyna-Gro® suggests a Pro-TeKt® maintenance application rate from ¼–½ tsp/gal (0.3–0.65 ml/L), which translates to 16–32 ppm silicon. To be conservative, start with half the lower end application rate, 1/8 tsp/gal (0.16 ml/L), for about 8 ppm Si.

Hydroponic outlets carry a multitude of silicon supplements. The Bloom Silica produced by Bloom Yellow Bottle is a very concentrated formulation with 45 percent silica (21 percent Si). In fact, it is so concentrated it is labeled as a poison. At the recommended dosage of 0.33 ml/L, the irrigation water would contain 83 ppm Si, far in excess of the target amount. You would reduce the dosage to perhaps one tenth of the recommended rate, or 0.03 ml/L, to have 8 ppm Si in the irrigation water. This makes it a very cost effective solution if you are comfortable with metering out such small volumes. At the opposite end of the spectrum are the very dilute formulations containing 2 percent silica or less (less than 1 percent silicon). These products are mostly water with hefty price tags. Caveat emptor!

There are also products formulated for use on turf and golf courses containing potassium silicate, some with humic acids to improve uptake through the roots and leaves. These products, such as Chemical Dynamics Dyna-Flo K-Sil and Brandt Manni-Plex Traffic, generally have application rates given in volume per surface area, difficult to translate to orchid growers. You would have to calculate the application rate based

on your desired silicon concentration or contact the manufacturer for guidance.

Silicon supplements are a little tricky to use due to their chemical nature. They are made by dissolving silica (SiO_2, or sand) in lye to form potassium silicate. This solution is very alkaline with a pH in the 11–12 range; so alkaline that some people use it as a so-called "pH Up." Adding silicate fertilizers to rainwater or RO water can dramatically alter the pH, even to toxic levels. Whatever concentration used, the pH of the water being applied to plants should be checked with a pH meter to make sure it is still in the desirable range.

Concentrated solutions of potassium silicates and fertilizers should not be mixed because the silicates will polymerize to form a gel, or a colloidal silicate solution. As a general rule do not mix silicate solutions with any other chemical. If you use a Dosatron or Siphonex for applying fertilizer, alternate fertilizer and potassium silicate applications and run adequate clean water through between them to avoid precipitation in the mechanism. Do not mix more than you are going to use that day. The potassium silicate product is denser than water and it will tend to settle to the bottom, so keep the solution agitated, such as with an aquarium aerator in the concentrate bucket. If you apply fertilizers with a watering can or sprayer, you can add the potassium silicate directly to your final nutrient solution.

Water with a low soluble salts content is essential for the best orchid culture. With rainwater or other sources of pure water, you have to supply everything your orchids need to grow. This likely includes a fertilizer that contains calcium and magnesium along with the other macro and micronutrients. You should also consider routine silicon supplements, at low levels to provide a steady source of silicon for developing tissue. You may find your plants are more resistant to diseases and pests as well as environmental stresses if you add silicon supplements to your nutrition program when using a pure water for irrigation.

Acknowledgement

Many thanks to Dr. Courtney Hackney for his observations and insights. His breadth of knowledge never ceases to amaze.

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Further Reading

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— Sue Bottom started growing orchids in Houston in the mid-1990s after her husband Terry built her first greenhouse. They settled into St. Augustine, Florida, Sue with her orchids and Terry with his camera and are active in the St. Augustine Orchid Society, maintaining the Society's website and publishing its monthly newsletter. Sue is also a member of the AOS Editorial Board (email: sbottom15@gmail.com).

Sylvia Strigari

Cymbidium ensifolium f. *misericors*

Text by Franco Pupulin/Watercolor by Sylvia Strigari

Tribe Cymbidieae
Sutribe Cymbidiinae
Genus Cymbidium *Swartz*

Cymbidium ensifolium (L.) Sw. subsp. ***ensifolium*** f. ***misericors*** (Hayata) Pupulin, *stat. nov. Cymbidium misericors* Hayata, *Icon. Pl. Formosan*. 4:79, f. 386. 1914. *Cymbidium ensifolium* (L.) Sw. var. *misericors* (Hayata) T. P.Lin, *Native Orchids Taiwan* 2:105–108. 1977. *Cymbidium kanran* var. *misericors* (Hayata) S.S.Ying, *Col. Illust. Indig. Orch. Taiwan* 1:440. 1977. *Cymbidium ensifolium* var. *misericors* (Hayata) T.S.Liu and H.J.Su, *Fl. Taiwan* 5:942. 1978. (*nom. inval. homon.*). TYPE: China: Taiwan. Mt. Kwannonzan, prope Tamsui; cult. in seminario Taihoku, Mar 1914, *B. Hayata s.n.* (holotype, TI). *Cymbidium xiphiifolium* Lindl., *Bot. Reg.* 7:t.529. 1821. *Cymbidium ensifolium* var. *xiphiifolium* (Lindl.) S. S.Ying, *Mem. Coll. Agric. Natl. Taiwan Univ*. 30(1):38. 1990. TYPE: China?. Our plant flowered [...] in the hothouse at Wormeleybury, having been newly introduced by S, Abraham Hume, as believed, from China, *A. Hume s.n.* (holotpe, K). *Cymbidium misericors* var. *oreophilum* Hayata, *Icon. Pl. Formosan* 4:81. 1914, *nom. nudum*.

A terrestrial, sometimes lithophytic, caespitose *herb*, ca. 30 cm tall. *Roots* coarse, long, flexuous, ca. 5 mm thick. *Pseudobulbs* ovoid, 1.5–2.5 × 1.0–1.5 cm, completely enclosed in basal, fibrous-papyraceous. brownish, triangular, acuminate sheaths 4.5–8.0 × 0.5–0.8 cm, and the conduplicate, rectangular leaf-sheaths. *Leaves* few, 2 to 4(–6), lorate, 16–35(50) × 0.8–1.1(–1.5) cm, articulate 2–4 cm from the base, acute to subacuminate. *Inflorescence* arising from base of pseudobulb, erect, 20–35 cm, usually shorter than the leaves; rachis 3–7(–9)-flowered. *Floral bracts* much shorter than the ovary, narrowly triangular-lanceolate, acuminate, 5–7 mm long. Pedicellate *ovary* terete, glabrous, pedicel and ovary 25(–30) mm long. *Flowers* fragrant, the sepals pale green, the petals creamish white, flushed pale green toward the apex, the lip and the column white. *Dorsal sepal* narrowly oblong-elliptic, acute, 23–25 × 5–6 mm. *Lateral sepals* oblique, asymmetrically narrowly lanceolate, acute, conduplicate toward the apex, 23–26 × 5–6 mm. *Petals* subporrect to horizontally spreading, narrowly elliptic or narrowly ovate-elliptic, acute, 15–24 × 5–8 mm. *Lip* obscurely trilobed, narrowly ovate, 15–23 mm; lateral lobes semi-elliptic, rounded, erect, loosely clasping the column; midlobe triangular-ovate, recurved, 8–12 × 7–10 mm, the apical margins abruptly recurved; disk minutely papillate, with two fleshy keels extending to the base of midlobe, converging in their apical halves to form a short tube. *Column* slightly arcuate, with narrow, elliptic, thickened parastigmatic wings, 10–14 mm long; the stigma ventral, slitlike; the anther incumbent, the shallow clinandriun triangular. *Anther cap* operculate, cucullate, tranversely elliptic, truncate-retuse, bilocular. *Pollinia* four, in two dorsiventrally superposed pairs, broadly ovoid, complanate. *Fruit* a narrowly ellipsoid capsule, ca 5 × 2 cm.

The Japanese botanist Bunzō Hayata (1874–1934), who is particularly known for his taxonomic work in Japan and Formosa (today's Taiwan), described *Cymbidium misericors* in 1914 on the basis of a plant originally collected on Mount Kwannonzan (Mt.Kwannon, Mt. Kwanyinshan), near Tamsui (or Danshui), in the northwestern part of the island. The plant that served as the type was cultivated at the Imperial University Taihoku, the name that, during the Japanese occupation, was assigned to what is known today as Taiwan National University. At the herbarium of the University of Tokyo, the inflorescence of the type specimen is mounted with another Taiwanese collection made in 1919, from a locality called "Byoho," which I was unable to locate on modern maps of the island.

Hayata devoted most of his notable scientific work to the botany of Taiwan, on which he wrote 10 illustrated volumes published over 10 years of contributions (Hayata, 1910–1921). With roughly 1,600 new species and new infraspecifics of Taiwanese plants (Oashi, 2009), he described alone almost 15 percent of the entire flora of Taiwan, which encompasses a little more than 4,000 species of plants (Huang, 2000).

In the protologue of *Cymbidium misericors* (Hayata 1914), the author gave no reasons for the choice of the specific epithet. *Misericors* ia a Latin adjective with several meanings: compassionate, merciful, tender, and pitiful. I guess Hayata chose this name to refer to the somewhat delicate nature of the new species or to its immaculate flowers. Hayata compared his *Cym. misericors* with *Cymbidium kanran* (also known from Taiwan), distinguishing the new species for "the greenish white flowers with non-dotted lip" (Hayata 1914). The latter species, however, has much longer and narrower sepals and petals.

Contemporary botanists favor the treatment of *Cym. misericors* under a broad concept of the variable *Cymbidium ensifolium*, a species originally described by Linnaeus and lectotypified by a specimen bought in Canton, China, by one of his apostels, Pehr Osbeck (1723–1805). It is interesting to note that in his correspondence with Linné, Osbeck noted that plants of *Cym. ensifolium* were cultivated in houses in China for the scent of their flowers, a tradition that has been maintained in Japan and in China for over 200 years and is still alive in the present day (DuPuy and Cribb 1988) .

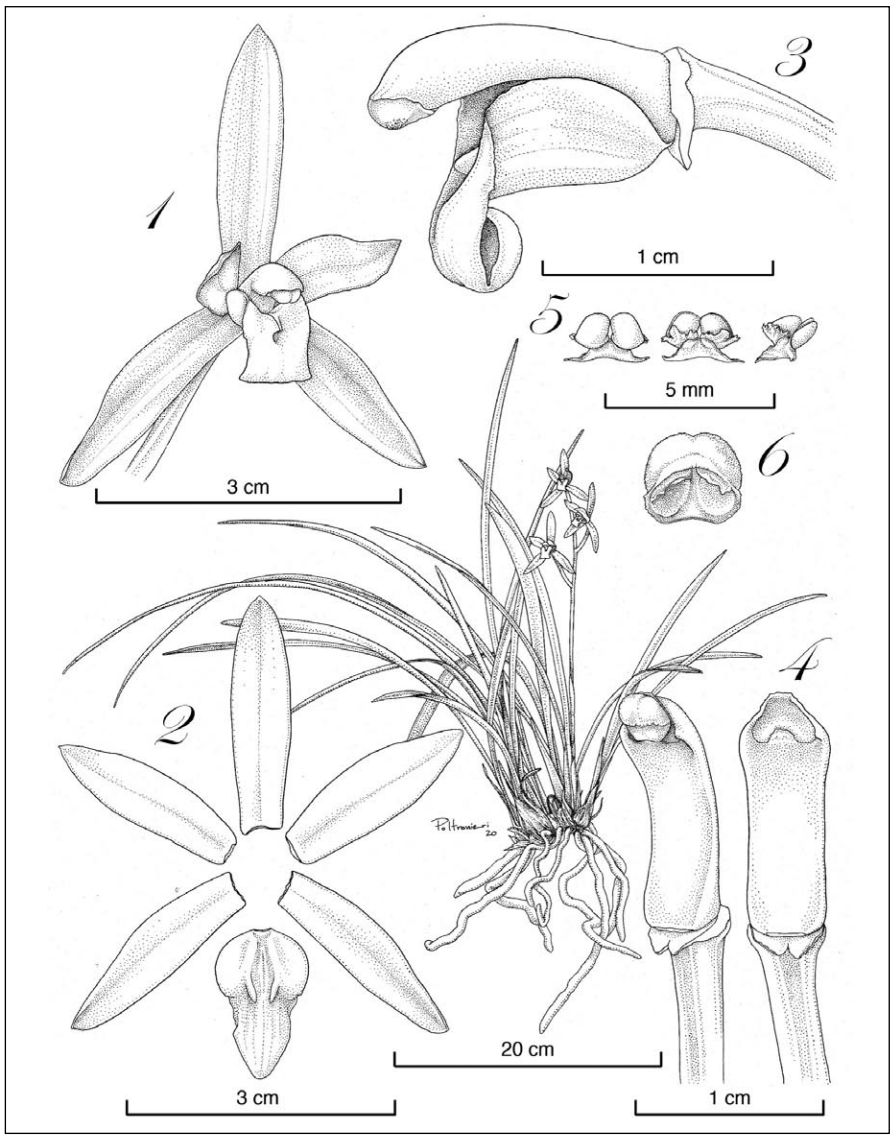
The species is of broad distribution in Southeast Asia, ranging from Sri Lanka and southern India to China, Hong Kong, Taiwan, southern Japan (Ryukyu islands), Cambodia, Laos, Vietnam, Thailand and western Malaysia, Indonesia (Sumatra, Java, Borneo), New Guinea, and the Philippines (Luzon island). Several color forms and morphological variants of *Cym. ensifolium* have received specific and infraspecific formal names (DuPuy and Cribb 1988). I have not quoted the entire synonymy of *Cym. ensifolium* at the beginning of this article, because it would probably have occupied half the space available for this chapter of the *New Refugium Botanicum*. Within the species, DuPuy and Cribb (1988) proposed to recognize only two subspecies, subsp. *ensifolium* and subsp. *haematodes*, being mainly distinguished by the leaves almost erect and distinctly longer (over 50 cm), and the midlobe of the lip undulate along the margin and finely spotted with red of the latter taxon. According to these characteristics, the Taiwanese, immaculate form of *Cym. ensifolium* belongs to subsp. *ensifolium*.

Together with seven other species of *Cymbidium*, *Cym. ensifolium* has been assigned to subgenus *Jensoa*, which is characterized by the presence of four pollinia (vs. two in subgen. *Cymbidium*) and a vey distinctive structure of the lip callus, consisting of two ridges that converge toward the apex to form a short tube. It is likely that this pseudotube plays a role in the

pollination of the species of subgen. *Jensoa*. Jin and colleagues (2007) have documented the visit to flowers of *Cymbidium lancifolium* (in subgen. *Jensoa*) by *Apis cerana cerana* (Apidae), which directly landed on the midlobe, adjusted its direction and entered into the flower in search of food. The position of the tube at the base of the lip helps in correctly orienting the bee, which receives the pollinaria together with the anther cap on the thorax during the retreating process.

Individuals of *Cym*. *ensifolium* with unblotched, greenish flowers and a white lip are not restricted to Taiwan. John Lindley first proposed a name for a similar variation with his *Cymbidium xiphiifolium* (the type is from Canton, China), a form with rather stiff leaves that he figured in color in the original description (Lindley 1821). Others names that likely refer to plants of *Cym*. *ensifolium* which lack red pigments and therefore have greenish and white, unblotched flowers, include *Cymbidium gyocuchin* Mak., *Cymbidium gyocuchin* var. *soshin* Mak. (both without type locality), and var. *susin* Yen, the only one originally published as a variety of *Cym*. *ensifolium*, based on a plant from China (Fukien: Anshee Hsien). Variants without anthocyanins occur rarely in the wild, but they are not exclusive to *Cym*. *ensifolium*, also occurring sporadically in other species of the genus. According to DuPuy and Cribb (1988: 159), individuals with this kind of mutation do not form distinct populations, but they have been selectively maintained in cultivation for their rarity. As such, they cannot warrant a subspecific rank, but are best treated as *formae*, as I formally propose at the opening of this chapter. I have chosen to use the epithet proposed by Hayata (1914) for this characteristic form of *Cym*. *ensifolium* with green and white flowers, as I am presenting here the f. *misericors* through a plant native to Taiwan. The plant illustrated by our artist, cultivated in the collection of Lankester Botanical Garden, was imported from a wild population in Taiwan, without more specific locality data. Together with *Cym*. *ensifolium*, 16 other species of *Cymbidium* have been recorded so far in Taiwan, according to the recent checklist of Taiwanese orchids compiled by Lin et al. (2016), that do not warrant inclusion in the taxonomic recognition of f. *misericors*. According to the importer of our plant, it was growing lithophytically at the base of a large, almost vertical rock outcrop, with very long roots growing among the crevices to reach the richest soil at the bottom of the rocks.

A species with broad ecological adaptation, *Cym*. *ensifolium* grows naturally in open forests, evergreen broadleaved forests, as well as in damp soils along steep watercourses, grassy places and on mossy limestone rocks as a lithophyte at elevations of 600 to 1,800 meters. At Lankester Botanical Garden, plants of *Cym*. *ensifolium* f. *misericors* are cultivated in a well-drained mix of small-grade pumice and coconut husk fiber, charcoal, and chopped sphagnum. Supplemental watering is provided on a daily basis during the dry season, and reduced during the wettest part of the year, without leaving the plants to completely dry between waterings. As the roots grow substantially long, the use of taller pots is preferred. The pots are maintained in a bright environment, where they receive direct sunlight during the morning.



Cymbidium ensifolium f. *misericors*. The plant.
1. Flower.
2. Dissected perianth.
3. Column and lip, lateral view.
4. Column, three-quarters view and ventral view (the anther and pollinarium. removed)
5. Pollinarium, three views.
6. Anther cap.
Drawn from *JBL-33283* by Sara Poltronieri.

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Selected Botanical Terms

abaxial – lower or reverse surface
acuminate – tapering to a long point
acute – pointed
adaxial – upper or front surface
apiculate – ending abrupty in a small point
attenuate – gradually tapered into a petiole-like base
basal – at the very base of a segment
bilocular –two-chambered
caniculate – grooved longitudinally
caudicle – slender stalk of the pollen masses
clavate – club-shaped
cleistogrammous – type of self-fertilization that occurs in a completely unopened flower
complanate – held in a single plane
concave – curved inward like the inside of a sphere
concolor – of one color
conduplicate – folded lengthwise
connate – united to form a single part
convex – curved like the exterior of a sphere
coriaceous – leathery
cucullate – hooded
elliptic – oval
epiphyte - growing on another plant for support and not as a parasite
erose – irregularly notched
fibrose – fibrous
globose – spherical; ball-shaped
granulose – surface covered in granules
hysteranthous – having leaves emerge after flowers are open
incumbent – resting on another segment
incurved – curve inward
internode – space between two joints
laciniate – divided into deep, narrow, irregular segments
lanceolate – narrow oval tapering to a point at each end
lorate – strap- or tongue-shaped
mentum – chinlike protuberance
nonresupinate – having lip uppermost
oblanceolate - narrow at attachment, rounded apically
oblique – slanting
obovate – egg-shaped with the wide end up
obtuse – blunt or rounded
operculate – with a lid
ovate – egg-shaped, narrow end up
ovoid – egg-shaped, narrow end up
papillose – bearing minute, pimplelike protuberances
pedicel – a stem carrying a single flower
peduncle – main stalk of the inflorescence
petiole – stalk connecting leaf to stem
pilose – covered in soft hair
pollinium – coherent mass of pollen grains
raceme – cluster of pedicillate flowers
rachis – portion of the inflorescence carrying flowers
recurved – bent or curved backward
resupinate – lip lowermost
rugose – wrinkled
saccate – pouch-shaped
scandent – climbing, rambling
scarious – dry and membranous
septum – membrane separating two chambers
sessile – joined without a stalk
spathaceous – resembling a spathe
spatulate – spoon-shaped
stelidia – horns on the column
sub – somewhat less than; i.e., subsperical would refer to almost but not quite a sphere
terete - cylindrical or pencil-shaped
unifoliate – having one leaf
viscidium – sticky pad to which orchid pollinia are attached.

Amazon Spheres

Spherical splendors in Seattle

Text and photographs by Thomas Mirenda

AS THE WORLD grows further and further reliant on technology and our psyches focused on small but deeply compelling little movie screens on our computers and phones, it has become increasingly difficult to connect with the natural world. This is perhaps even more true for people working in large corporations in major cities. Although employers want their professionals focused on the tasks that earn them their salaries, and keep the wheels of industry turning, the tunnel vision that often occurs when we are buried in digital files and cyberspace often have some detrimental effects. It has been proven that respite from these kinds of sterile work environments increases happiness, inspiration and even productivity. It is the reason why college campuses are often beautifully landscaped. A wonderful environment stimulates us with new, marvelous ideas, insights and creativity.

Thomas Mirenda

It was with the intention of creating such a positive and progressive work environment for its staff that the Amazon Spheres were conceived and created. In construction since 2015 and opened in early 2018, this extraordinary space was eagerly and intensely anticipated. Having had the serendipitous opportunity to visit Seattle last February, I was anxious to see it for myself. Many of the institutional orchid cultivators of the world know (or at least know of) each other's work, as well as their gardens and collections. Although we never actually met in person, I came to admire the fellow who was to become one of their horticultural managers, Michael Gregory Fong, due to common interest in rare and unusual orchids such as corybas, epistephiums and selenipediums. Mike had unprecedented success with such refractory genera and many of us wanted to know his secrets. It is really wonderful that Mike and his horticultural prowess have found a perfect home at this spectacular venue. I felt no shame whatsoever in inviting myself to the extensive Amazon "back of house" facilities as well as the astounding tridomed conservatory on Lenore Street in downtown Seattle.

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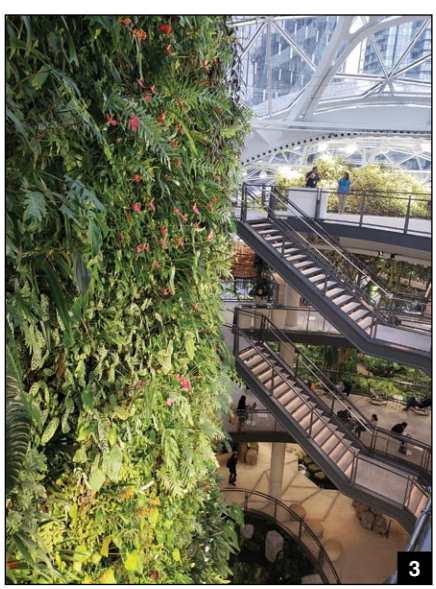

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With over 40,000 plants, many rare and endangered, on display within this delightful, lush, grand and yet almost whimsical workspace, naturally I expected a large representation of orchids, as they constitute about 10 percent of the world's flowering plant species. It is an understatement to say I was NOT disappointed. Mike has always been an orchid enthusiast. He and his staff have amassed an exceptional collection of rarities that rotate in and out of the display areas downtown and back to the growing range once blooms have faded. The plants get expert care in both venues. Both conservatories and growing range are kept at a people-comfortable 72 F (22.2 C) during the day, and a chilly, highly humid 55 F (12.8 C) while the space is unoccupied at night. Therefore, the climate closely replicates the conditions of a cloud forest, and hence, many of the exciting cooler-growing orchids such

as draculas, New Guinea oxyglossum–dendrobiums and odontoglossum-type oncidiums are reasonably easy to grow in this situation. It is as fine an orchid display as I have seen in any botanical garden conservatory, and I have seen quite a few. Plants are displayed correctly; i.e., naturalistically with epiphytes on trees, terrestrials on the ground and lithophytes on rocks. It is a joy for any lover of orchids to walk through the displays and find all the fantastic little wonders interspersed within.

Perhaps the greatest and most dramatic feature of the Spheres is the six-story curved green wall at its center, which is a marvel of engineering, as well as botanical abundance and glory. Horticulturists suspend on giant ladders in early morning, prior to opening, and basically rappel a tropical cliff-face while grooming the wonderfully exotic mélange of ferns, anthuriums, gesneriads, epiphyllums and, yes, orchids too! I spotted several *Phragmipedium longifolium* specimens in bloom 30 or 40 feet (9.2–12.2 m) up!

The "back of house" collection is a repository of many rare plants in many plant families, all getting expert care from a very talented team of horticulture professionals, including some old friends I was not expecting to see there. This is where the magic happens. Orchids are established on branches, carnivorous plants are coaxed into producing pitchers and traps, and the rarest-of-the-rare are cultivated, bloomed and propagated for future displays. Although many of their activities are top secret, the staff is generous in sharing its expertise and successes with the rest of us. I learned a lot about many plants I have struggled with in the past by walking through with my friend Mike. He has found a place where his knowledge and skills are appreciated and as a result, Amazon has a collection that, when more widely known, will be world renowned. I am delighted for them both.

With a world in turmoil and environmental crisis it is so encouraging to see places like the Amazon Spheres come into existence. It is bold and progressive leadership that encourages this kind of workplace innovation. At the same time, a repository of rare plants, and the distilling of knowledge and understanding of their successful cultivation will be crucially important in the age of climate change and deforestation. It is a hopeful and positive sign that companies such as Amazon revel in this insight and promote the beauty and value of the natural world enough to replicate it in downtown Seattle for benefit and inspiration of their employees and the world. It is said that CEO Jeff Bezos is a great lover of plants and has his own incredible collection. Notably he has set aside millions of dollars for the amelioration of climate issues. Plants are, of course, the ultimate source of all our air and our food. Is it any wonder why we feel safe, nurtured and inspired when blessed with their presence? Thank you for creating this fabulous urban oasis. The world looks forward with even more eager anticipation to see what you do next.

— Thomas Mirenda has been working professionally with orchids for over three decades and is the past chair of the AOS Conservation Committee. He is an AOS accredited judge in the Hawaii Center (email: biophiliak@ gmail.com).


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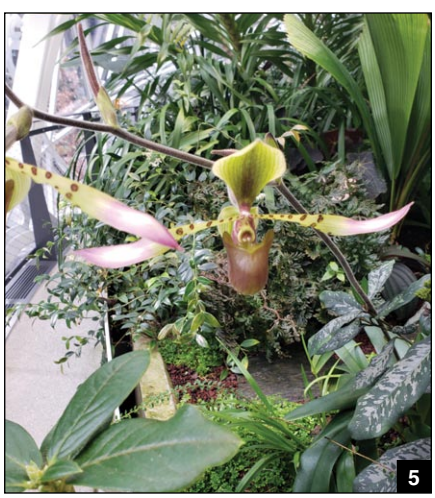
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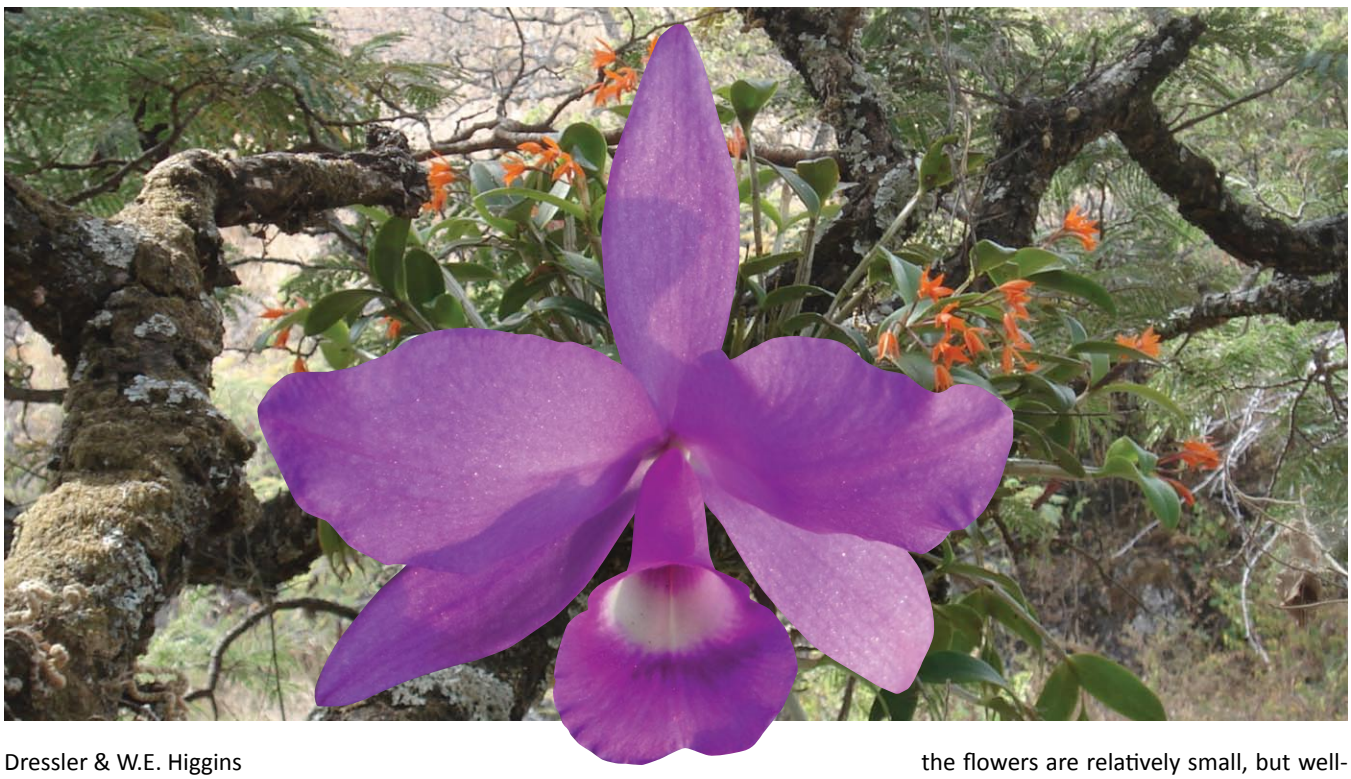
[1] Amazon Spheres, downtown Seattle.
[2] Michael Gregory Fong with one of the dracula trees.
[3] The six-story green wall. Imagine not only working in an environment such as this but also maintenance and horticulturists rapelling from giant ladders on a daily basis.
[4] Everything from the fairly common place to the sublime, grown in the "back of the house" rotates through the displays. Here are displayed beautiful specimens of *Dendrobium cuthbertsonii.*
[5] *Paphiopedilum lowii*
[6] Speaking of the sublime, *Corybas* species are rarely seen in even private collections.

EPIDENDRUM AURANTIACUM.

Guarianthe

by Peggy Alrich and Wesley Higgins



Dressler & W.E. Higgins
Lankesteriana, 7(1):37 (2003).

ETYMOLOGY *Guarianthe* derives from the Nahuatl language for tree (guaria) and Greek for flower (anthos), and refers to the local name applied to this flower that is usually found growing on trees.

Four sympodial species and one natural hybrid can be found growing epiphytically in seasonally moist, low- to mid-elevation, hill scrub, montane forests or along cliff embankments from western central Mexico (Jalisco) to northern Colombia, northern Venezuela and Trinidad. These plants have thickened, slightly compressed, often densely clustered, club-shaped stems, subtended by tubular sheaths, each with two to four oblong, leathery leaves borne at the tip.

The short, usually erect inflorescence, borne from mature stems, has flowers that have narrow, wide-spreading sepals and slightly wider petals with wavy margins. The throat is formed by the simple or obscurely trilobed lip that rolls around the small, slender to club-shaped column. Pollinia four, ovate, laterally compressed, with flattened caudicles.

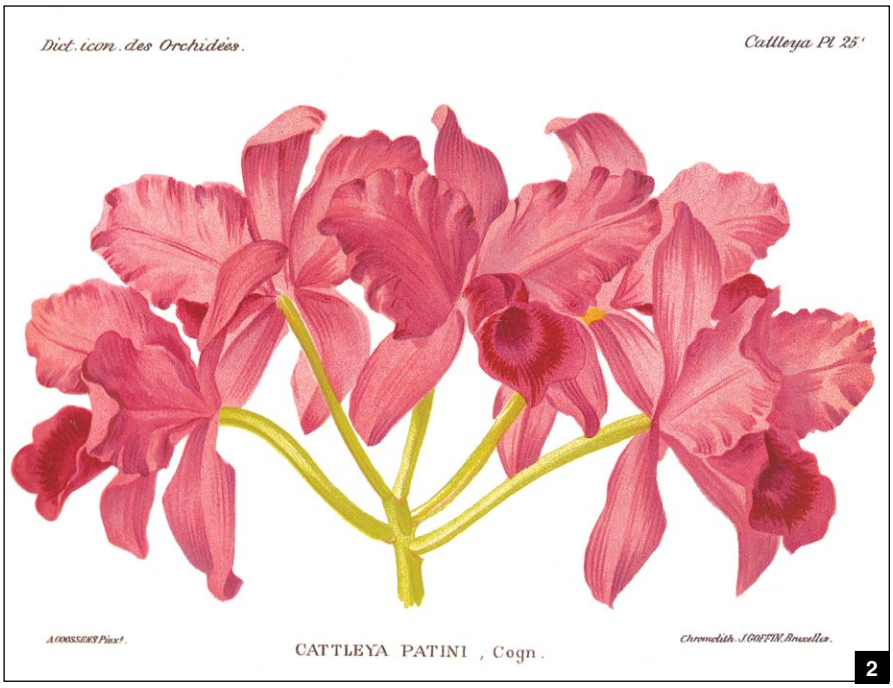
Guarianthe aurantiaca (Bateman ex Lindl.) Dressler & W.E. Higgins. The almost waxy flowers of this species are bright orange with darker dotted markings of red in the throat and on the lip. Its blooms, the smallest of the genus, are usually 1.5 to 2.5 inches (3.75–6.25 cm) across and occur in clusters of 2–10 flowers on short spikes. This species is highly variable; plants may be tall or short, and flowers can range from the common orange to reds, yellows and, rarely, whites.

Guarianthe bowringiana (O'Brien) Dressler & W.E. Higgins. The flowering season begins in the autumn when the plant produces an arching spike of 10–25 slightly fragrant flowers, each less than 3 inches across. Sepals and petals are mauve in color and the trumpetlike lip is a deeper purple with yellow in the center of the throat. Although the flowers superficially resemble *Guarianthe skinneri*, they are smaller and often more numerous. Flowering in the fall and alternate clasping flower sheaths are the identifying features of the species.

Guarianthe hennisiana (Rolfe) Van den Berg. Flower color is rather uniform; a medium lavender with darker lavender flare to the lip and dark purple throat. The lip rolls around the column with the apex flared and with a shallow notch in front. At 3.5 to 4 inches (8.9–10.2 cm), the flowers are relatively small, but well-grown plants are especially attractive when sporting several compact clusters of a dozen flowers each in October and November.

Guarianthe skinneri (Bateman) Dressler & W.E. Higgins. After several months of cool dry rest, an erect inflorescence emerges from a sheath that developed during the previous growing season. *Guarianthe skinneri* produces 4–12 faintly fragrant rose-purple blossoms up to 3.5 inches (8.9 cm) across. The lip, often darker than the sepals and petals, is rolled into a funnel-shaped tube that conceals the column. A large spot of white or creamy yellow is in the throat. The semialba form is all white except for a spot of purple at the base of the lip, and a few clones of the pure white alba form have been discovered.

Guarianthe × laelioides (Lem.) Van den Berg. Where their geographic ranges overlap, *Gur. aurantiaca* and *Gur. skinneri* interbreed readily to produce a lovely natural hybrid, *Guarianthe* × *laelioides*. Its flowers include a rainbow of pastel tones ranging from white through yellow and orange, to salmon, pink rose, purple, and even to red. This hybrid swarm occurs naturally over an area from Chiapas, Mexico, through El Salvador, Guatemala



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and Honduras to Nicaragua.

NOMENCLATURE A major goal of plant systematics is to produce a predictive and stable classification that reflects the evolutionary history of the organisms. Previous classifications that were based on overall physical similarity included convergent traits are misleading and have little predictive value in terms of ancestral relationships. Phylogenic DNA studies by van den Berg et al. (2000) had shown that the Central American "cattleyas" were not in the same clade with the South American cattleyas. The newspaper headline in La Nación S.A. on May 23, 2003, issue was "Guaria Cambio de Nombre" as Costa Ricans learned that their national flower had a new name. Taxonomist Robert Dressler had announced that *Gur. skinneri* was the new scientific name for Guaria Morada. When the genus *Guarianthe* was published, some confusion existed about the correct nomenclature for the hybrid swarm of *Gur. aurantiaca* × *Gur. skinneri*. Numerous names have been published for supposed members of this swarm: *Cattleya guatemalensis*, *Cattleya skinneri* var. *parviflora*, *Cattleya deckeri*, *Cattleya pachecoi* and *Cattleya laelioides*. The relationships between these taxa were clarified by Higgins and van den Berg (2013) at the 20th World Orchid Conference, held in Singapore in 2011. Accordingly, the accepted names have changed as presented above.

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van den Berg, C., W.E. Higgins, R.L. Dressler, W.M. Whitten, M.A. Soto Arenas, A. Culham and M.W. Chase. 2000. A Phylogenetic Analysis of Laeliinæ (Orchidaceæ) Based on Sequence Data from Internal Transcribed Spacers (ITS) of Nuclear Ribosomal DNA. *Lindleyana*, 15:96–114.

ANTIQUE PLATES

[1] *Guarianthe aurantiaca* as *Epidendrum aurantiaca*, *Orchidaceae of Mexico and Guatemala*, t.12 (1837).

[2] *Guarianthe hennisiana* as *Cattleya patinii*, *Dictionnaire Iconographique des Orchidées*, 2:t.25 (1837).

[3] *Guarianthe* × *laelioides* as *Cattleya skinneri* var. *parviflora*, *Botanical Magazine*, 82:t.4916 (1856).

[4] *Guarianthe skinneri* as *Cattleya skinneri*, *Orchidaceae of Mexico and Guatemala*, t.13 (1837).

[5] *Guarianthe bowringiana* as *Cattleya bowringiana*, *Orchid Album*, 7:t.323 3 (1888).

PL. 323.

J. Nugent Fitch del. et lith.

CATTLEYA BOWRINGIANA

B.S. Williams Publ.r

La Reserva Orquídeas

Protecting the Cloud Forest of the Northern Colombian Andes

TEXT AND PHOTOGRAPHS BY LUIS EDUARDO MEJÍA DUQUE AND TATIANA ARIAS
SOCIEDAD COLOMBIANA DE ORQUIDEOLOGÍA, CONSERVATION COMMITTEE

WHAT WAS ENVISIONED to be a catastrophe that our grandchildren would have to live through, is rapidly becoming a nightmare that we all will have to live with. Climate change due to human activities and deforestation, the loss of complete ecosystems and consequently, decline of many species, leading to their likely extinction is tragedy that we are currently witnessing.

The Colombian Orchid Society (Sociedad Colombiana de Orquideología [SCO]), with headquarters in Medellín, Colombia, has been concerned with the conservation of orchids since its creation in 1967. The Society has initiated two enduring conservation projects in Antioquia: the creation of the Medellín Botanical Garden, Joaquin Antonio Uribe, and in 1973, the concept–of the Parque Nacionales Natural de las Orquideas located in the vicinity of Urrao and Frontino, Antioquia, Colombia (http://www.parquesnacionales.gov.co/portal/es/parques-nacionales/parque-nacional-natural-las-orquideas/). As a society, we have learned a great deal and traveled a long way to finally understand that in order to preserve orchids, it is necessary to protect their ecosystems, particularly the extremely vulnerable cloud forest. In 2016 the SCO decided to create its first nature reserve, buying 492 acres (199 ha) of land in the cloud forest of Jardin, Antioquia — La Reserva Orquideas (the Orchid Reserve).

In Colombia, all ecosystems are threatened. The proliferation of livestock, extensive agriculture, deforestation for fuel and expansion of the agricultural frontier and, of course, the accompanying pollution are destroying natural areas such as forests, paramos, and plains that for millennia were the habitats for what is perhaps the world's greatest biodiversity. Andean ecosystems are now among the most vulnerable on earth. Located between two climatic extremes, the dry forest and the cloud forest, this ecosystem represented by La Reserva Orquideas is being rampantly destroyed. Today only a few acres (hectares) remain. In addition, little is left of the Colombian dry forest. This ecosystem is located at low altitudes between the inter-Andean valleys and mostly on the slopes of two great rivers, El Cauca and El Magdalena. Only 1,779,120 acres (728,078 ha) remain of the more than 23,000,000 (9,300,000 ha) — less than 8 percent of what the country once had. Even more alarmingly, the cloud forest in Andean mountainous areas, where most of the water wealth

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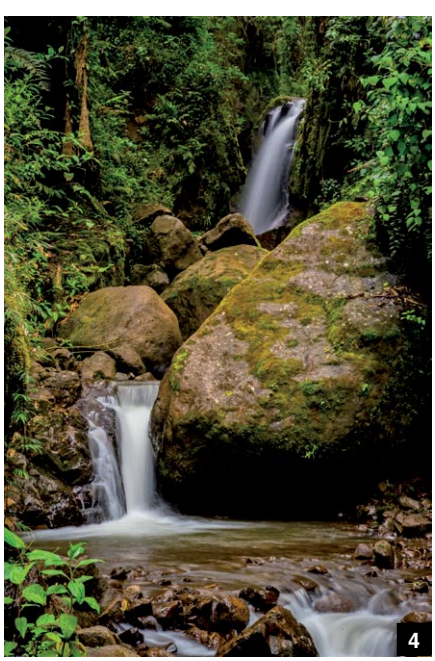
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[1] *Cyrtochilum* (*Odontoglossum*) *ramosissimum* is for the lovers of cold-growing orchids. The species is found high in the Andes 7,200 to 12,100 feet (2,200–3,700 m).
[2] Reserva Orquideas welcome sign.
[3] Cloud forests channel massive quantities of water from the clouds that shroud them to the terrestrial ecosystem.
[4] From a distance, the lush cloud forest belies the beauty of the terrain below the forest canopy.

of Colombia originates, is also a critically endangered ecosystem. Cloud forests such as these contain unparalleled epiphyte diversity, among which occurs a great wealth of orchids. This epiphyte-diversity is dynamic; an estimated 30 percent of the plants in this area are replaced by juveniles as larger, mature plants fall from the trees .

In 2016, a bird tourist guide and conservationist, Jose Castaño, told us about a very well-preserved property, located in the Municipality of Jardín, Antioquia, Colombia. Although the property was not exceptionally large, only 492 acres (199 ha), it had a very well-preserved cloud forest. This land also had an advantage toward its preservation: it forms a continuum with a governmental protection zone, the Integrated Management District (DMI from the Spanish Distrito de Manejo Integrado) of "La Cuchilla Jardin-Tamesis," a mountain range in the area. This DMI has a total of 34,592 acres (14,000 ha) of protected land and constitutes a biological corridor of great importance in the northwestern part of Colombia. The first time we visited the area, we realized that this was exactly what we were looking to preserve, a place rich in orchids and other epiphytes. Although its size was not very large for conservation purposes, its value was within the budget that the SCO could invest. This Andean cloud forest is in an area that borders the coffee plantations. Although little is cultivated in this particular forest due to its altitude, it has nonetheless been cut down as a way to colonize the territory.

Once the land was purchased, we created La Reserva Orquideas and proceeded to obtain legal certification from the National System of Protected Areas. According to Colombian law, land only has state protection for conservation when it is duly certified by the Ministry of Environment. Anyone who does not have this certification is subject to losing the land due to mining concessions or other exploitation authorized by the state. The first step then was to obtain certification to guarantee that the Orchid Reserve will exist as a protected area in perpetuity.

The reserve area has its administration cabin at coordinates 5°34'11.41"N, 75°45'31.10"W. The land ranges from 7,755 to 10,890 feet (2,368–3,325 m) above sea level. Located only 7.5 miles (12 km) from Jardin's urban center, making it easy to access, it has a private road of 2.5 miles (4 km) that can be easily reached by car. Its protected area is made up of


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[5] One of the greenhouses on the Reserve's property.
[6] Our ever-vigilant forest ranger examining one of the tiny epiphytic orchids that survive in the moss-covered ecosystem.
[7] The sign recognizing the donors that have made the reserve possible.
[8] *Epidendrum fimbriatum*
[9] *Epidendrum rhodovandoides*. This cold-growing miniature was only described 12 years ago.
[10] *Masdevallia hortensis.*

healthy cloud forest typical of the Western Mountain Range of the Colombian Andes, which is becoming increasingly scarce. While this mountain range is home to a smaller area of unique cloud forest in Colombia, its proximity to the Pacific Ocean and the tropical wet forest of El Chocó imbue it with an exceptionally rich biodiversity. We believe it is critical to protect and conserve what is left of the cloud forest in the Colombia Andes. Current surveys indicate that healthy cloud forest habitats have suffered a huge deterioration and currently less than 30 percent remains in the country.

The enormous biological diversity of the cloud forest has made it difficult to carry out complete inventories, particularly on epiphytes. One of the first tasks once we had acquired the reserve was to do a survey of orchids and to install trail cameras to inventory the existing fauna. La Reserva Orquideas was created four years ago but we have only been exploring the forest for the past three years. So far, we have recorded around 120 orchid species including many pleurothallids. We believe this inventory is really just beginning; many species are rare and have been observed only once. We also have been registering endangered fauna such as the Andean bear *Tremarctos ornatus*, the pacarana *Dinomys branickii* and the crested eagle *Spizaetus isidorii*, all listed on the International Union for Conservation of Nature Red List of threatened species.

Inventories of birds, mammals and orchids are being done, but these activities are time- and money-consuming tasks that must be carried out with external aid. Now the SCO's effort is concentrated on paying fees for rangers that can protect the reserve from intruders, looters and deleterious agricultural practices such as slash-and-burn. Communities that inhabit this region have in their cultural background hunting as a food source for festivities, and the gathering of ornamental plants — especially orchids — which they buy from looters. Because there is a lack of knowledge about orchid cultivation, many are planted in pots of soil, where they quickly die. An environmentally harmful Catholic custom is to accompany Easter processions with wax palm (*Ceroxylon quinqiuense*) leaves that are used for weaving. The wax palms have been disappearing and, with them, the habitat of many bird species that are now in danger of extinction. This custom has been addressed and reformed by the Catholic Church and there are now very


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few palm leaves shown at annual Catholic festivals.

The programs at La Reserva Orquideas have been divided into three main areas. First is building logistical infrastructure, assembling all the necessary components to minimally function and maintain our facilities. Second, we work on developing high-quality scientific research. This is not only necessary to understand the diversity within the reserve, but also to reveal the biological processes that will allow us to restore habitats. And third, our community outreach is focusing on implementing horticultural strategies that allow the local communities to make life sustainable and create livelihoods while protecting the cloud forest biodiversity. We are deeply committed to promoting such community outreach and education in conservation among the stakeholders and neighbors of the reserve.

The SCO has overseen sustaining the first point by investing in ranger salaries and the reserve's basic operation. We have also carried out an important campaign to raise funds, especially from private companies and investors who have sponsored some of our activities. For example, through Odinsa Construction Group in Medellín, we obtained a donation of 741 acres (300 ha) of land adjacent to our initially acquired 492 acres (200 ha). By more than doubling the area of the Orchid Reserve, we are now preserving and restoring 1,233 acres (500 ha) of valuable habitat. Among this new acquisition there are 341 acres (138 ha) to be restored to cloud forest because they were cut down as a paddock for livestock. We have engaged in innovative fundraising such as the program to "adopt a hectare" (https://reserva.sco.org.co/adoptar-hectarea/), tree donations and two international grants that have been important in the development of our research and outreach goals. One, a grant from the Shuttleworth Foundation through the Arribada Initiative (London) (https://blog.arribada.org) is helping us to develop camera traps to record tiny floral morphologies and pollinating insect visitors. We were also quite pleased to obtain support in 2019 from the American Orchid Society which allowed us to make great progress toward our conservation goals. We are also pleased to report that we have received a grant from the Van Thien Conservation Fund from the Van Tienhoven Foundation to continue our work this year.

AOS GRANT Thanks to the American Orchid Society it has been possible to carry


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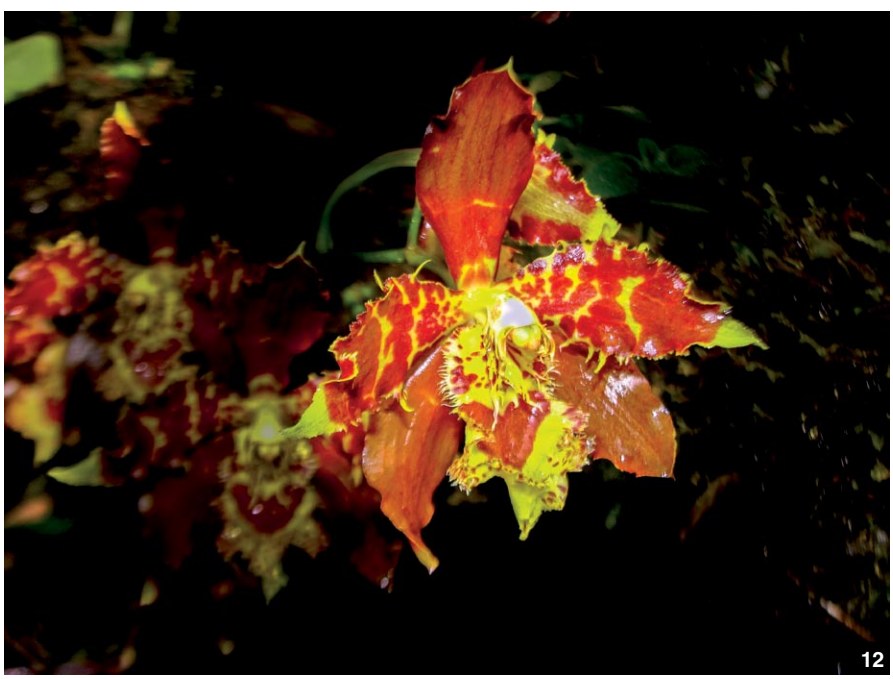
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[11] *Oncidium mirandum*.
[12] *Oncidium* (*Odontoglossum*) *sceptrum*
[13] *Pleurothallis forceps-cancri*
[14] *Pleurothallis canaligera*
[15] *Restrepia elegans*
[16] *Teagueia phasmida*. For perspective, the flowers are 1.2 inches (3 cm) long and only about 0.2 inch (3 mm) wide.
[17] *Telipogon pulcher*

out further orchid and bird inventories. For each, we have created field guides using commonly encountered species in protected forests. This catalog has been constructed in a way that we can easily expand it as new species appear. Over the years we have had visits from experts that have helped identify most of the orchids in the area. We also walk the trails on a regular basis and at different times of the year, in order to identify additional species in the area, with many of the plants photographed in situ. For example, today we know that we have five *Pleurothallis* and one *Lepanthes* species new to science and currently being described.

We are implementing "circa situm" conservation (farmer-based conservation) strategies for epiphytes and timber species. Orchids and bromeliads often fall to the ground from broken branches. On a regular basis these plants are being collected and transported to our nursery. There we propagate them, record their phenology and when ready, repopulate nearby trails for tourist enrichment and edification. Lastly, we take one division of each of these epiphytes to the original site where they were collected. Because these forests have been looted for years, it is part of our strategy to repopulate the degraded areas of our reserve. To this end, we have also made a historical inventory of what used to grow there and are creating a population stock of genetically diverse plants that can be reintroduced in the coming years, once local community members are more aware of the importance of not collecting horticulturally attractive species.

Thanks to the grant from the AOS, we were able to finish adapting the native plant nursery for orchids as well as for many types of trees that will be used to restore the forest, many of which are extremely important as phorophytes (hosts) for epiphyte species. An automatic irrigation system has now been installed in our orchid nursery. Eventually, a programmable system will be installed, in order to increase efficiency and productivity for forest rangers, using their time for other activities.

Relationships have been established with nearby communities for the purpose of involving them and creating awareness of the orchid diversity and importance of its preservation. This past year, we offered two courses to the community, one on the botany of the cloud forest and the second one on the botany of orchids. These practical courses were so well received that people that were unable to


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attend are asking for additional sessions and new courses. These assistants have become important "multipliers" and are already asking us to repeat the courses, which bodes well for the biodiversity consciousness raising we are trying to promote among community members.

In addition, two photography workshops were held for a limited number of participants, focusing on the reserve rangers. More professional development and specific training in climbing, botanizing, composting, gardening and other relevant topics has been done with rangers. We have found that this kind of transfer of knowledge goes both ways in that we have also learned quite a bit in this exchange process from the local communities. We are getting a handle on what works and what does not work in this specific conservation context. Three exciting new courses have been programmed for the community this year: orchid cultivation, the role of birds in the forest and botanical illustration. However, due to the quarantine generated by COVID-19, they have had to be postponed. With the orchid cultivation course, we aimed to involve several communities from the area, including women from the Indian Emberá Chamí community of Jardín, young students from the agricultural college and elders from a village nearby Jardin. Our intention is to train members of these three communities in orchid cultivation, help them to build small greenhouses to reproduce orchids and find them a way to benefit from sustainable production and cultivation of plants.

Seeds from La Reserva Orquideas orchids are also being germinated in vitro with the goal of repopulating trails in the forest and eventually, donating these seedlings to local nurseries. The intention is to remove pressure from the forest by avoiding looters and poachers with a viable supply of sustainably produced seedlings to meet demand.

Last, but not least, a video for children is being produced with the intention to promote awareness among the local youth about the precious resource that is biodiversity and the various ways they can help preserve the diversity while coexisting in this same environment. The video cleverly uses animation of an Andean bear who talks about why the forest should be protected and cared for, and how orchids serve as indicators of its state — the so-called canary in the coal mine. There are plans to continue creating similar environmental stewardship videos, eventually becoming a series for children.

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The generous funds provided by the American Orchid Society have been of vital importance to advance the dissemination work, protection activities and community outreach as well as supporting basic science. Anyone can join our project! We encourage you to visit us as well, and to support our work with any appropriate resources. We would like to invite all *Orchids* readers, and other nature fans who enjoy breathing clean air while admiring a spectacular Andean landscape, to visit us at La Reserva Orquídeas, savor a cup of really good Colombian coffee and learn about our conservation goals to protect the Andean forest. Your participation and contributions are greatly appreciated! Indeed, it is both welcome and essential to our success.

Further Reading

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[18] *Telipogon williamsii* with a seed capsule forming.

[19] Juan Felipe Posada manning the Reserve's booth.

[20–21] The Reserve aims to educate the surrounding population through its outreach workshops.

— Dr. Tatiana Arias is the scientific director at La Reserva Orquideas and associate researcher at La Sociedad Colombiana de Orquideologia (SCO). The main goal of her research is to contribute to the understanding of plant biodiversity, and support conservation and sustainable use of natural resources in Colombia. For the past four years, with students from different Colombian universities, we have been working in orchid evolution, horticulture and biotechnology. At La Reserva Orquideas we have been conducting experiments including monitoring of orchids, sphagnum moss, and cloud forest restoration (email: tatiana.tatianaaria@gmail.com).

— Dr. Luis Eduardo Mejia is the general director at La Reserva Orquideas and an active member of SCO for the past 10 years. Mejia has dedicated his life to promoting the conservation of Colombian natural resources through film making, photography and other initiatives to reach a broad audience. For the past four years he has been working to strengthen the conservation goals of SCO by focusing on La Reserva Orquideas as a way to promote orchid conservation in Colombia (email: sco@sco.org.co).

Orchids in Watercolor

Cattleya Tropical Pointer 'Cheetah' HCC/AOS

By Marcia Whitmore

CATTLEYA TROPICAL POINTER 'Cheetah' HCC/AOS is a lovely *Cattleya* hybrid I have grown for three years. The parents are *Cattleya* Tropic Glow and *Cattleya intermedia* The species in the background of this plant are *C. intermedia*, *Cattleya milleri*, *Cattleya labiata* and *Cattleya bicolor*. I grow my plant in a bright spot in the greenhouse with moving air and the Michican State University fertilizer formulated for rainwater…1/4 tsp per gallon (0.32 ml/L) of rainwater every three weeks and a clean flush on the fourth week. I have read that the color does not remain stable, varying with the amount of light given the plant and that it will grow happily under lights but the color and spotting may vary. However, my plant has produced consistent flowers in the greenhouse with every blooming. The flowers are large for the size of the plant (3.25 inches [8.2 cm] across); present themselves beautifully, and usually bloom on two or more growths.

I recently finished this watercolor from my blooming plant. It cooperated by remaining in flower until I completed the painting…silly plant…the flowers drooped and fell the afternoon of the completion…do these plants know a thing or two? It was done on Arches 400 lb.coldpressed paper.

Marcia Whitmore began growing orchids in a basement room under fluorescent lights in 1972 and moved into a 14-ft × 18-ft (4.3 m × 5.5 m) greenhouse in 1984. Marcia is a retired teacher and fine arts coordinator and taught in public schools for 35 years. She has earned many AOS awards and is a member of the Illowa Orchid Society, Eastern Iowa Orchid Society, American Society of Botanical Artists and the Great River Chapter of Botanical Artists (whitbrits@gmail.com, https://asba-art. rog/member-gallery/marcia -whitmore, www.marciawhitmore.com).

Phalaenopsis malipoensis

and its Hybrids

A Jewel of the Genus *Phalaenopsis*

OLAF GRUSS

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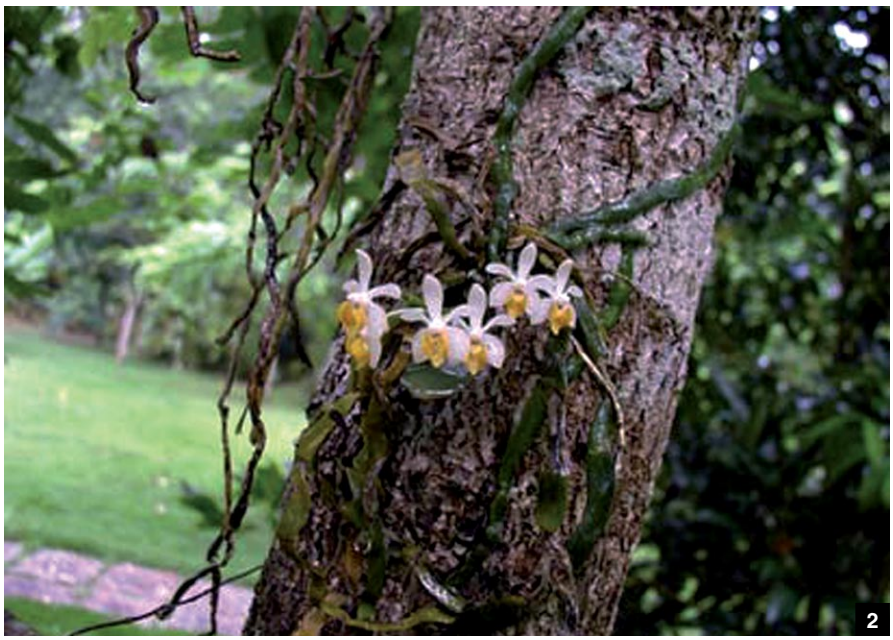
THE GENUS *PHALAENOPSIS* was first formally described by the German-Dutch botanist Carl Ludwig Blume in 1825 and published in *Bijdragen tot de flora van Nederlandsch Indië*, 1825. The name *Phalaenopsis* is derived from the ancient Greek word *phalaina* meaning "a kind of moth" and *opsis* meaning "having the appearance of," and thus is often referred to as the moth orchid.

The species *Phalaenopsis malipoensis* was initially discovered on May 14, 2004, by Zhong-Jian Liu of the Wuongshan Nurseries of Shenshen City, Malipo Province, China. The plants grow on trees at an altitude of 3,937 feet (1,200 m) near Xia Jin Chang Xiang. Later it was also found in the Ha Giang Province in northern Vietnam, which borders on China.

In the official description of the species in *Acta Botanica Yunnanica* 2005, authors Z.J. Liu, S.C. Chen, Z.Z. Ru wrote this: "An observation indicates that it is quite a distinct species from those known from China and its adjacent regions. It shows a faint resemblance to *Phalaenopsis gibbosa* Sweet, a species found in Laos and Vietnam characterized by having a strongly zigzag rachis and, a very small forked callus at the base of the midlobe. The Malipo plants have a straight rachis and a much larger callus at the base of the midlobe, which is deeply forked, with each arm dividing into two filiform-linear antennae up to 1/8 inch (3 mm) long. It is without doubt a remarkable new species. This species has more recently been found during field explorations in the Garampani Wildlife Sanctuary, Karbi Anglong, Assam, India, in 2011 and reported by Khyanjeet Gogoi et al. in 2012. This species appears to be rare and grows in the moist tropical climate of hot summers and dry cold winters. It receives an annual rainfall of approximately 110 inches (2.8 m) and annual temperature varies from 45 to 93 F (7–34 C). The vegetation of the sanctuary is predominantly tropical semievergreen.

Orchids in this genus are monopodial epiphytes or lithophytes, with long, coarse roots and short, leafy stems. The leaves are usually arranged in two rows, relatively large and leathery, oblong to elliptic and sometimes succulent. Depending on the species there may be few or many small-to-large, long-lasting, flat, often-fragrant flowers arranged on erect-to-hanging, unbranched inflorescences. The sepals and petals are free from, and spread widely apart from, each other. The labellum is joined stiffly to the column and has three lobes. The side lobes are erect and more or less parallel

S.S. CHEN



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[1] *Phalaenopsis malipoensis*, front view and side view (inset). Photographs by Olaf Gruss.

[2] *Phalaenopsis malipoensis* in the habitat in China. First classified as a form of *Phal. lobbii* in *Acta Phytotaxonomica Sinica*, 2007.

[3] *Phalaenopsis malipoensis*. Photographs courtesy of the National Orchid Conservation Center of China

[4] *Phalaenopsis malipoensis* photographed in situ in Northern Vietnam.

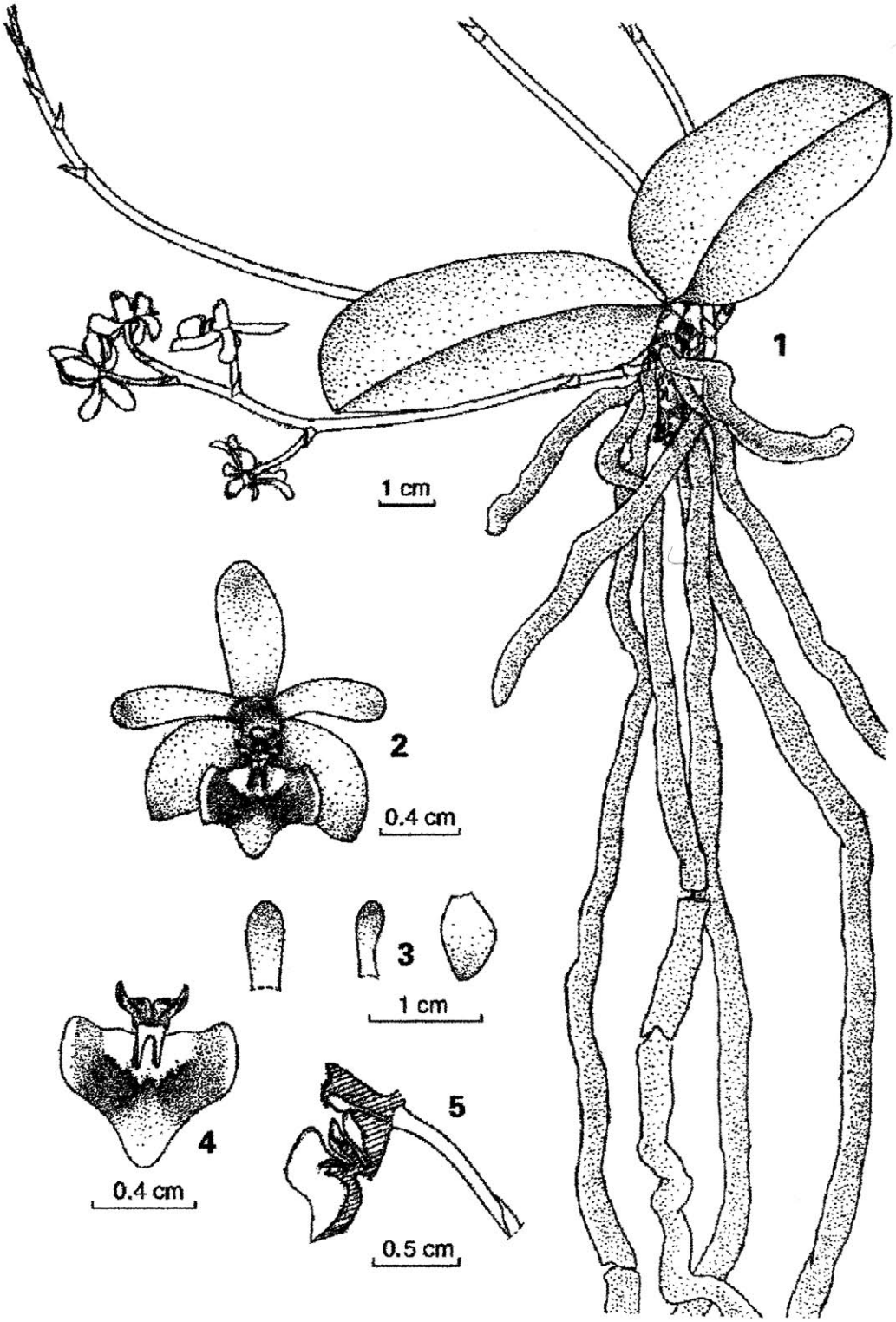

图 1　麻栗坡蝴蝶兰　1. 带花植株；2. 花；3. 中萼片（左）、花瓣（中）、侧萼片（右）；4. 唇瓣；5. 唇瓣与蕊柱（纵切面）

Fig. 1　*Phalaenopsis malipoensis* Z. J. Liu et S. C. Chen　1. Flowering plant; 2. Flower; 3. Dorsal sepal (left), petal (middle) and lateral sepal (right); 4. Lip; 5. Lip and column (longitudinal section)

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to each other and the midlobe may have a pair of appendages. Orchids in this genus are native to India, China, Southeast Asia, New Guinea and Australia with the majority in Indonesia and the Philippines (Liu et al. 2005).

In nature, *Phalaenopsis* species are typically fond of warm temperatures, thriving in temperatures around 59 to 90 F (15–34 C). In the greenhouse or lanai, the species is maintained like most other species of the genus in the temperate range at 64 to 77 F (18–25 C). They may be cultivated in a pot or may also be mounted on cork or bark, but then need more frequent sprays of water. They require regular watering once or twice a week depending on the temperature surrounding them. They also should be fertilized regularly. The species prefers high humidity (60 to 70 percent) and a bright location, where it is not directly exposed to the sun. They require a lot of fresh air and adequate air circulation. *Phalaenopsis* are typically hardier than other orchids, and this makes them particularly popular among first-time orchid growers. In their native habitat, they flower from April to May; however, in culture they may bloom until September.

Plants should be grown in well-drained medium, such as medium-to-large fir bark or shredded tree fern fiber. Add chunky Perlite to help hold the medium open and also retain some moisture and charcoal to help keep the medium open and prevent souring. Plants should be repotted immediately when the medium starts to break down or once every few years when the plant outgrows the pot. Repotting is probably best done just as new roots start to grow.

NOTES This species varies only slightly in pigmentation of the flower and the flower posture. The white flower color changes at the end of flowering to a light yellow.

A pale-to-golden yellow color form was discovered in 2012 (Gruss 2012) and described as a distinct color form: *Phalaenopsis malipoensis* f. *aurea* Gruss.

HYBRIDS Because the species has not been in cultivation for long, only a few hybrids have been submitted for registration. The first cross with *Phal. malipoensis*, namely *Phalaenopsis* Sacha (*parishii* × *malipoensis*), was bloomed in 2015 by Karine Hervé. The small white-background flowers with brown lip coloring are quite attractive for friends of small-flowering phalaenopsis. The following year, a strain of *Phalaenopsis* Alba Men Dream (*gibbosa* × *malipoensis* f. *aurea*) was flowered by Alba Men. In the same year, *Phalaenopsis* Heike (*malipoensis* × *maculata*) was submitted for registration, even though the cross had not yet flowered. You may read on the Internet in the Lonis Orchid Forum in which the breeder Ilona Ziems described her approach. It is surprising that the Royal Horticultural Society Orchid Registrar accepted this registration without a picture. It was not until 2019 that the first flower of this new cross was shown on the webpage. The small flowers should also develop a subtle fragrance, reminiscent of the fragrance of *Phalaenopsis violacea* and *Phalaenopsis* Maria. In 2019, *Phalaenopsis* Belle d'Éclipse (*lowii* × *malipoensis*) from the breeding of Alain Brochart flowered. A cross with *Phalaenopsis wilsonii* has


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OLAF GRUSS 7


OLAF GRUSS 8

[5] Line drawing of *Phalaenopsis malipoensis* from *Acta Botanica Yunnanica* 27(1):38; 2005

[6] Another typical form of *Phalaenopsis malipoensis*

[7–8] *Phalaenopsis malipoensis* forma *aurea*

OLAF GRUSS

already bloomed and recently named *Phalaenopsis* Grassau. This finely scented hybrid is quite variable in its color on the petals and lip.

Acknowledgments

My thanks go to Zhong-Jian Liu from the National Orchid Conservation Center of China in Shenzhen and Leonid Averyanov for the pictures provided. My thanks also to Judith Rapacz-Hasler for the German-to-English translation.

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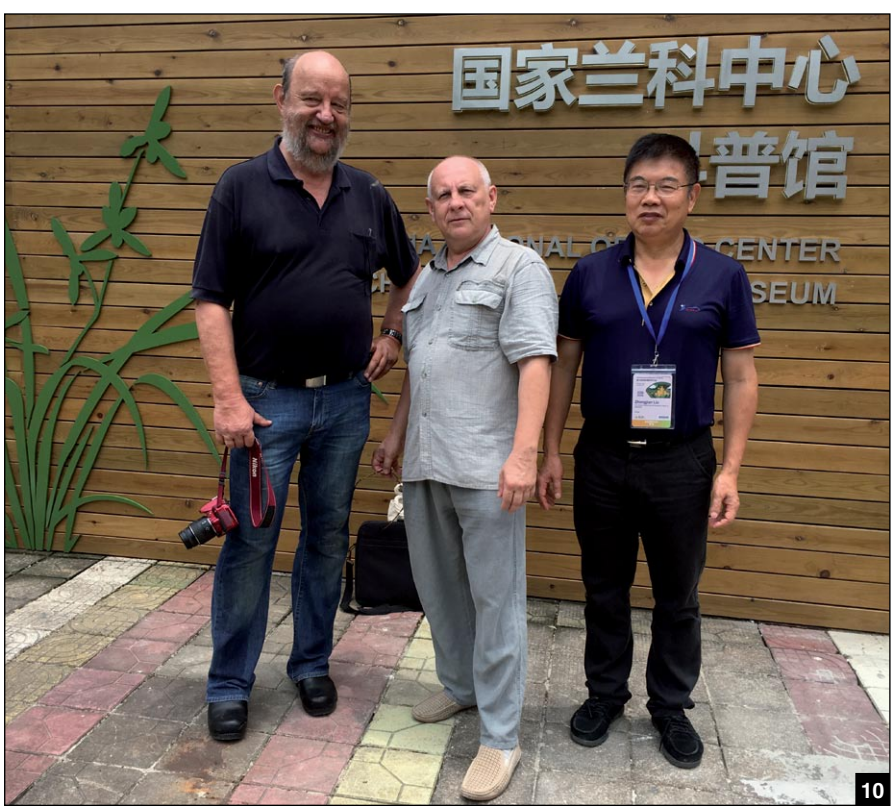

— Olaf Gruss is internationally recognized for his work with paphiopedilums, phragmipediums and phalaenopsis. He has written books about the genus Phalaenopsis *and the albino forms of the genus* Paphiopedilum*, as well as a booklet about the genus* Phragmipedium. *He has been a member of the editorial board of the journal of the German Orchid Society,* Die Orchidee. *Gruss resides in Germany and lectures throughout Europe, Japan, Taiwan, China, Canada and the United States. In der Au 48, D-83224 Grassau, Germany (email: a-o.gruss@t-online.de).*

[9] Comparison of *Phalaenopsis malipoensis* f. *aurea* together with the typical form.

[10] Left to right: Olaf Gruss, Leonid Averyanov and Professor Liu Zhong-Jian at the National Orchid Conservation Center, Shenzhen, 2017

Hybrids of *Phalaenopsis malipoensis*


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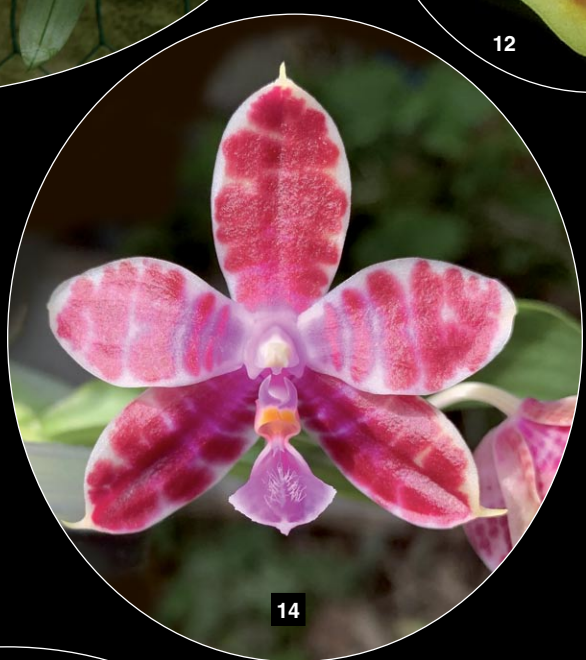
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***parishii*). Photograph by Karin Hervé.**

[12] *Phalaenopsis* Alba Men Dream (*gibbosa* × *malipoensis*) made using the f. *aurea* form of the latter species. Photograph by Michael Kopp.

[13] *Phalaenopsis* Belle d'Éclipse (*lowii* × *malipoensis*). Photograph by Alain Brochart.

[14] *Phalaenopsis* Heike (*malipoensis* × *maculata*). Photograph by Gregor Kleefeld.

[15] *Phalaenopsis* Grassau (*wilsonii* × *malipoensis*). Photograph by Kasia Kaktus.

A Not *Too* Hidden Oasis for Orchids in Alaska

TEXT BY BENJAMIN J. CRAIN/PHOTOGRAPHS BY THE AUTHOR UNLESS OTHERWISE CREDITED

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IT IS SAID that less than one percent of all visitors to Alaska head north of the city of Fairbanks, where the more adventurous traveler will eventually find themselves entering the James W. Dalton Highway (Alaska Route 11). Otherwise known as the North Slope Haul Road, the highway is a 416 mile (666 km) stretch of gravel and "paved" road that runs all the way north to its terminus in the town of Deadhorse, Alaska, on the Arctic Ocean's Prudhoe Bay. I personally found myself navigating this highway for the first time several years ago when I was invited to be a part of a research team studying the effects of climatic changes on tundra vegetation at a remote field station on Toolik Lake, just north of the Brooks Mountain Range. Although the route to the station abounds with beautiful scenery, a highway like this is not exactly the kind of place that normally brings orchids to mind. Still, the solitude of the rather empty road, and the tranquility of the scenery in juxtaposition to the occasional oil truck or mud-covered cross-country (or cross-continent) motorcyclist weaving expertly around garbage can size potholes somehow elicits memories of routes to many of the more "conventional" orchid sites I have visited in the past.

Perhaps there is a good reason for this, as there actually are a number of orchids to be found on this remote highway. Despite the tendency to associate orchidaceous habitats with a certain gestalt (i.e., next to that misty waterfall in a lush tropical island rain forest), it is always worth keeping in mind that orchid species can occur almost anywhere if the conditions are right, including along a rugged gravel road next to a massive oil pipeline in northern Alaska. And therein lies one of the many intriguing aspects of the orchid family — its members somehow find a way to exist in some of the most surprising places. I suspect that many readers might be amazed to learn that Alaska has around 32 species of native orchids (North American Orchid Conservation Center [NAOCC] 2019), several of which occur in the most northern parts of the state, including along the Dalton Highway. The Dalton Highway was originally built as a supply road to support the Trans-Alaska Pipeline System in 1974 but was only opened to public travel in 1994 (Bureau of Land Management [BLM] 2018). It parallels the pipeline for nearly the entire distance from the oil fields near Prudhoe Bay to just north of Fairbanks some 12 hours south, passing through the Arctic Wildlife Refuge, Gates of the Arctic National Park, the small town of Coldfoot and the Arctic Circle along the way. Travelers are likely to encounter some charismatic fauna along the road such as moose (*Alces alces* L.), caribou (*Rangifer tarandus* L.), musk ox (*Ovibos moschatus* Zimmermann) and foxes (*Vulpes vulpes* L.), while witnessing the transition from the boreal forests to the treeless tundra.

For the orchid enthusiast, there is one particular spot that is certainly worth a stop: the Yukon River Camp and Crossing Contact Station. Orchids aside, if you are heading north on the highway it will be the last chance for services for at least three hours, so most travelers will likely want to stop there regardless of their botanical affinities. The Yukon River Camp and Crossing Contact Station sits about 60 miles (96 km) south of the Arctic Circle where the highway spans the impressive Yukon River, the longest in Alaska. The camp is self-described as rustic by urban standards and as having the atmosphere of a truck stop, but clean (http://www.yukonrivercamp.com/), a description that I found to be pleasantly accurate given the extremely muddy conditions outside. Inside, the restaurant is homey and has

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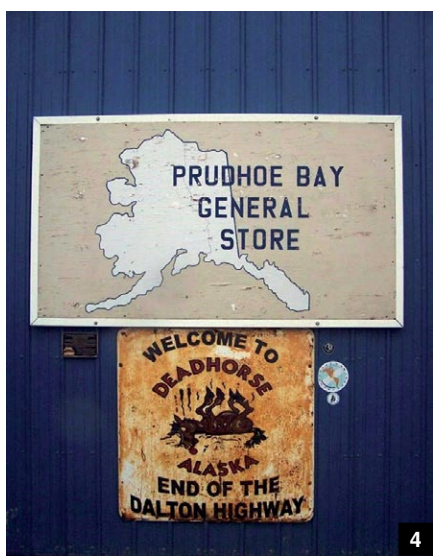

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[1] The round leaf orchid is a somewhat small but rather showy orchid whose range is declining in parts of North America, but it can still be found at the Yukon River Crossing Contact Station. Photograph courtesy of Jim Fowler.

[2] The welcome sign and map at the beginning of the Dalton Highway is a popular spot among travelers to northern Alaska for a unique photo opportunity before embarking on the 11-hour drive north to Prudhoe Bay.

[3] The sign marker at the Arctic Circle crossing is another great photo opportunity for the Dalton Highway traveler.

[4] The Prudhoe Bay General Store is one of the few places to stop in the town of Deadhorse, Alaska, where the Dalton Highway reaches it terminus.

surprisingly good food. In keeping with an old family rule of dining: "if you can see the water, order the fish," I recommend the noodle soup with fresh Alaska salmon, which is perfectly hearty for the setting. Unfortunately, the coffee is less exciting, and I can only conclude that Juan Valdez has yet to visit the area. Adjacent to the dining area is a small gift shop with plenty of Haul Road memorabilia for the more nostalgic traveler. I found a small Dalton Highway patch for my backpack there that now feels like some kind of adult merit badge to me. In the back, there is a simple but comfortable looking dorm, which I have yet to stay in since my final destination lies several hours north of the crossing. Outside, a line often forms at the gasoline pump, which is one of only two places to fill up on the entire route, so be prepared for some serious sticker shock as you watch the dials spin like a slot machine.

The Yukon River Camp also conveniently sits across the road from a small visitors' center at the Yukon Crossing Contact Station, which is run by the U.S. Bureau of Land Management (BLM). On my visit, I made my way over to the station with the simple intention of stretching my legs with a five-minute walk across the highway, unaware of the pleasant surprise I was about to happen upon. The center itself provides information on road conditions and has a map of notable stopping points. It also has interpretive signs about the pipeline, the bridge, the river, and some of the important wildlife of the region. Souvenirs, natural history guides, and other books are available for purchase, but you can also add amusing passport stamps for the Dalton Highway and the Arctic Circle to your collection free of charge. Outside of the visitors' center, there is a small picnic area that is the starting point of a short trail (< 0.6 mile [1 km]) leading to a viewing deck with a great photo opportunity of the E.L. Patton Bridge traversing the Yukon.

Tread slowly and lightly in the picnic area and on the trail, however, as much to my astonishment, I soon discovered that they offer a number of pleasant surprises for the orchid aficionado in northern Alaska. Much of the trail and picnic area is seasonally flooded with a steady shallow flow of runoff water from the melting snow that usually covers the ground in the area. This provides ideal moisture and temperature conditions for several species of orchids. In the picnic area itself, there is an abundance of *Platanthera aquilonis* Sheviak, the northern green (or bog) orchid. This species is rather widespread in North America, ranging from Alaska to New Mexico and Newfoundland (NAOCC 2019). The plants are comparatively unassuming as far as orchids go, with relatively small yellow-green flowers with a narrow-tapered labellum, and they can be easily overlooked. Although I found the species growing in the brush along the trail edge, it was remarkably abundant throughout the maintained picnic area where I was told regular mowing had occurred, unknowingly of the plants' presence. A number of orchids respond positively to mowing treatments, however (Bowles 1983; Sletvold et al. 2010; Paušič et al. 2017), and this made me wonder if the mowing regimen had actually bolstered this population unintentionally. Regardless of the cause, seeing such large numbers of this orchid (hundreds of individuals) just outside the station was an unexpected and impressive sight.

A second species, *Spiranthes romanzoffiana* Cham., hooded ladies' tresses, can also be found sporadically along the trail from the picnic area to the river overlook. This species is widespread in North America from Alaska to New England, but curiously, its range also extends into Europe in Ireland and England (NAOCC 2019). Like the northern green orchid, hooded ladies' tresses are

CRAIG MCCAA, BLM ALASKA

[5] The Yukon Crossing Contact Station is a wonderful stop for orchid enthusiasts in Alaska as at least four species occur along the short trail to the river overlook.

[6] Moose are regularly spotted grazing on willows and other plants along the roadside on the Dalton Highway.

[7] Caribou are another commonly observed grazer along the Dalton Highway as they migrate between winter and summer habitats.

[8] Musk oxen, which were reintroduced to northern Alaska after populations were decimated in the late 19th and early 20th century, are a remarkable site (and smell) along Dalton Highway where they forage on mosses, lichens, grasses and shrubby vegetation to build up reserves for the long Arctic winter.

commonly associated with wet habitats like those found at the Yukon Crossing Contact Station including moist meadows, fens, bogs and marshes, as well as with certain disturbed sites. The numerous flowers of *S. romanzoffiana* are small and white and they are distinctively arranged spirally around the rachis. The labellum is narrower in its center, which is a distinguishing feature when compared to the somewhat similar species, *Spiranthes cernua* (L.) L.C. Rich. Despite the extreme abundance of mosquitos in the area, the sweetly scented yet diminutive white flowers are actually pollinated by various bee species (e.g., *Apis* spp., *Bombus* spp.) in exchange for a nectar reward (Larson and Larson 1990; Duffy and Stout 2008). Interestingly, inflorescence height, as opposed to number of flowers or distances between plants appears to influence pollinator visitation rates (Larson and Larson 1990). Given the respectable height of many individuals in the population, I suspected these plants had little trouble attracting insect visitors.

A third orchid species found at the Yukon Crossing, *Galearis rotundifolia* (Banks ex Pursh) R.M. Bateman (the round leaf orchid) is less abundant but far showier. Curiously, these plants only produce a single leaf during the growing season. While somewhat small in size, the round leaf orchid has beautiful white and pink flowers with a lobed lip that is dotted with mauve spots, making it stand out rather strikingly from the *Pyrola grandiflora* radius flowers and *Betula nana* L. shrubs that are also scattered among the mossy beds. The round leaf orchid is attractive to pollinators such as bees and flies, who may ultimately be less delighted to find these plants than orchid enthusiasts are, as the showy flowers are deceptive and they offer no nectar reward (NAOCC 2019). From a conservation perspective, the range of *G. rotundifolia* is rather large in northern North America, although it has been shrinking in recent years (NAOCC 2019; Maine Natural Areas Project [MNAP] 2013). In the eastern US, Maine is the only state with an extant population, and even there it is considered imperiled-threatened (MNAP 2013). Such circumstances make it a particularly exciting find for lucky visitors like me at the Yukon Station in Alaska.

Although many of the orchids found at the Yukon Crossing may seem rather small or drab to those more interested in the truly charismatic species, rest assured this particular site has something for everyone, although fulfillment of


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GARY VAN VELSIR, NAOCC


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JIM FOWLER

[9] Foxes are a common sight along the Dalton Highway, were they hunt siksiks (*Urocitellus parryii* Richardson) and snowshoe hares (*Lepus americanus* Erxleben) and occasionally play among the willows (*Salix* spp.) and fireweed (*Chamaenerion angustifolium* (L.) Scop.).

[10] The northern green (or bog) orchid is a rather widespread orchid in North America that can be found in significant abundance at the Yukon Crossing Contact Station.

[11] Close-up of the northern green orchid with its tapered labellum.

[12] *Spiranthes romanzoffiana*, or hooded ladies' tresses is another wide-ranging orchid in North America and parts of Europe that occurs at the Yukon River Crossing Contact Station.

such interests may be a bit more difficult to achieve. Admirers of showy orchids from more temperate regions are likely to be familiar with many of the stunning species within the genus *Cypripedium*, and the Yukon Crossing area boasts two such members. The first is the beautiful yet delicate *Cypripedium passerinum* Richardson, or the sparrow's-egg lady's slipper. Its name is attributable to its distinctive egg-shaped lip; *passerinum* is derived from the Latin *passĕrīnus* meaning "of or fit for a sparrow." While most of the flower is egg-white in color, the dorsal sepal is a light green and the labellum can have purple spotting at its base, its opening and on its interior (NAOCC 2019). The staminode can have a general yellow coloration along with purple spots similar to those found on the lip. Despite the remarkable attractiveness of these flowers, this orchid is rather unique among lady slippers in that it usually self-fertilizes while still in bud (NAOCC 2019; Catling and Bennett 2007). Although individuals have been observed with varied column morphology that limits self-fertilization in the Yukon (Catling and Bennett 2007), no potential pollinators of this species (if any) have been identified. Even though the sparrow's egg lady's slipper is globally secure in terms of its conservation status, it is rather sparse in number where it does occur, and it has a very limited range in the US. Although visitors to the Yukon Crossing may have to work a bit harder to find this species, I have been fortunate to locate a few individuals on occasion along the trail from the station to the river overlook, so it is worth keeping a look out when visiting.

A final orchid species that is believed to occur near the Yukon Crossing Contact Station is another remarkably showy, but more elusive *Cypripedium* species in the area, *Cypripedium parviflorum* Salisb., or the yellow lady's slipper. Although this species is widespread across North America, including in Alaska (Lipkin and Parker 1995; NAOCC 2019), it is apparently very sparsely distributed along the Dalton Highway. Although at least two fellow botanists have reported seeing it on separate occasions close to the Yukon River crossing (as well as a great deal further north), I have yet to encounter it personally in my four visits to the area. That said, I remain vigilant and optimistic, as I suspect that it will eventually be found at (or at least very near) the station, given the abundance of the other species of orchids found there. The yellow lady's slipper should not be hard to miss with its large flowers and deep yellow saccate lip along with its captivating spirally twisted spreading petals, although it is reported that the flowers can be much smaller in boreal and arctic sites, and the sepals can be more flattened (Romero-González et al. 2003). Nevertheless, large or small, I will certainly have my eyes out for this gorgeous orchid when I return to Alaska in the future.

To conclude, I must express how I am happily reminded of the curious habits of orchids worldwide each time I stop at the Yukon crossing for a cup of coffee and a short stroll to the river while breaking up the long drive north to my final destination. Given the abundance of natural wonders that scatter the landscape there, I find it bewildering that less than one percent of visitors to Alaska head north of Fairbanks. At the same time, I cannot help but wonder how many (if any) of these "one percenters" might be looking for (or missing out on) northern Alaska's astonishing orchids. I admit that orchids were not the first thing that came to my mind when I initially visited the area, but they are now something I greatly look forward to seeing on each visit to Alaska. Thus, I wholeheartedly recommend becoming a part of that adventurous one percent, and I encourage orchid enthusiasts to explore some of the less traditional sites where orchids abound, as only then will we gain a greater appreciation of the true diversity that exists among orchids' various and seemingly unlikely habitats.

JIM FOWLER

JIM FOWLER

[13] The sparrow's-egg lady's slipper (*Cyp. passerinum*) is more challenging to find at the Yukon River Crossing Contact Station, but its remarkably showy flowers make it worth the extra effort.

[14] *Cypripedium parviflorum*, a species yet to be encountered by the author.

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Orchids of Bhutan

Biermannia

TANDIN WANGCHUK, KEZANG RINZIN AND STIG DALSTRÖM

THE ORCHID GENUS *Biermannia* King and Pantl. was established by George King and Robert Pantling (1897) in memory of Adolph Biermann, who at one time was the curator of the Botanic Garden in Calcutta, India. This poor gentleman was also the victim of a tiger attack in 1879, when a tiger escaped from the menagerie of the former King of Oudh (Awadh). The tiger swam across the nearby river and hid under some shrubbery in the botanical garden. Biermann, who happened to be standing nearby watching some noisy monkeys high up in a Kigelia tree (that were probably warning Biermann about the tiger), was attacked shortly afterwards by the most likely frightened feline and lost part of his scalp, but escaped alive. Unfortunately, Biermann died a year later of cholera (King 1895). The genus named in Biermann's memory was distinguished from *Doritis* Lindl. (today treated as *Phalaenopsis* Blume) by the absence of forked appendages on the "disc" (lip), with two species, one coming from the Khasia Hills and the other from the Sikkim Himalaya (King and Pantling 1897).

King and Pantling described *Biermannia quinquecallosa* King & Pantl. in the same publication as the genus and compared it with the only other known but unpublished *Biermannia* at the time: *Biermannia bimaculata* King & Pantl. They distinguished the new species by being a smaller plant and by the lip having side lobes. The type plant for *Bie. quinquecallosa* (*R. Pantling 631*) was growing as an epiphyte on *Pinus khasiana* at Jowai in Jaintia Hills, at an elevation of about 4,000 feet (1,330 m). Today, *Biermannia* consists of 13 accepted species (WCSP 2020), distributed from India, Myanmar, Thailand, Peninsular Malaysia, Sumatra, Java, Bali and Borneo (Pearce and Cribb 2002).

Returning to the birth of this genus in 1897, the picture gets blurry because when King and Pantling officially described *Biermannia bimaculata* the following year in their *Orchids of the Sikkim Himalaya* (King and Pantling 1898), the name *Biermannia khasiana* is cited as the only other species in the genus. The previously published epithet of *Bie. quinquecallosa*, which was described as coming from Khasia, is not mentioned at all. In addition, the name *Biermannia khasiana* seems to have disappeared completely since then. Perhaps King and Pantling changed their minds about what to call this particular species from the Khasia Hills (west of Jaintia Hills) and preferred to use a new name for the earlier described *Bie. qinquecallosa*. But since the nomenclatural rules state that the first validly published name has priority, it has to be *Biermannia qinquecallosa*. This does not explain why *Bie. khasiana* is not listed as a synonym, or possibly as a *nomen confusum* of the earlier published species though. Any enlightenment on this matter would be appreciated by the authors.

STIG DALSTRÖM 1

STIG DALSTRÖM 2

[1] Forest Rangers Tandin Wangchuk (left) and Kezan Rinzin in their favorite habitat of the lush Bhutanese jungle.

[2] The Rufous hornbill (*Buceros hydrocorax* L.) is one of four majestic hornbill species in Bhutan.

Author Tandin Wangchuk is a Forest Officer stationed at the Forest Range Office in Nganglam, under the Divisional Forest Office of the Pemagatshel District in southern Bhutan. With a Bachelors of Science degree in forestry, he has been connected with nature since childhood and has studied freshwater fish and amphibians as well as birds and orchids. He is also the station chief in Nganglam and, together with his 14 subordinates, performs the duties of protecting the wildlife from poaching and the forests from illegal cutting of trees. The Forest Rangers patrol day and night and sometimes risk their lives when enforcing the law against foreign armed poachers of various kinds. But whenever he has quiet and free time, Tandin Wangchuk enjoys taking his colleagues or his family out on photography trips documenting the fauna and flora of his jurisdiction. During one of these excursions he was trying to photograph the stately Rufous hornbill (*Buceros hydrocorax* L.) but was out of luck when the observant bird spotted him and flew away. Disappointed, Tandin Wangchuk turned around and started to walk back to his company when he

suddenly saw a small orchid growing on a rotten stump. The orchid was out of flower but had some new inflorescences developing and some seed capsules on an old inflorescence. He was intrigued by the plant and took a photo of it to show his colleague Kezang Rinzin to see if he knew what it was. As it happened, Kezang Rinzin was busy collecting baseline orchid data for the Divisional Forest Office of Pemagatshel. He immediately recognized the plant because he had also seen it in a nearby area, but again without flowers. The two rangers decided therefore to return to one of the sites later to monitor the development of new buds forming on the emerging inflorescences. At that time, the orchid team of Choki Gyeltshen, Pem Zam, Dupchu Wangdi and author Dalström arrived from the National Biodiversity Centre (NBC) in Serbithang, Thimphu. The NBC team was in the area surveying potential sites for *Paphiopedilum* Pfitzer species and expressed an interest in visiting the rich forest that surround the town of Nganglam together with somebody from the Forest Office. Without hesitation, Tandin Wangchuk and Kezang Rinzin opted to revisit one of the places where their unknown orchid had been found together with an assortment of other interesting species.

Unfortunately, the anonymous plant was still out of flower when visited by the expanded orchid team, but the emerging inflorescences looked promising. It was therefore decided that Tandin Wangchuk and Kezang Rinzin would keep the plant under observation and hopefully take some photographs of the flowers for a proper identification whenever they would open. A few weeks later the first photographs of the somewhat disappointing flowers were emailed to Dalström. It turns out they never fully open, but that characteristic in itself gave away the species' identity. *Biermannia jainiana* S.N.Hegde & A.N.Rao (1985) was previously only known from the Arunachal Pradesh State of India and never reported from Bhutan. This discovery happens to be the second *Biermannia* ever reported from that country, although the first one is only represented by low-resolution photos and no preserved specimen seems to have been made. Based on the photographs, however, it appears to be *Biermannia arunachalensis* A.N.Rao (2006). A renewed effort is needed to properly document this latter species for the orchid flora of Bhutan.

The cultivation of *Biermannia* species should probably be best under

STIG DALSTRÖM

TANDIN WANGCHUK

TANDIN WANGCHUK

[3] The excited orchid team from Nganglam and NBC examines the first plants of *Biermannia jainiana* ever documented from Bhutan. Close-up (inset) of the plant growing on a rotten stump along the river near Nganglam, Bhutan.

[4] Orchid data, such as measuring the seed capsule, is collected by Kezang Rinzin and logged for the Divisional Forest Office of Pemagatshel. Inset: the first flowers of *Biermannia jainiana* ever photographed in Bhutan.

[5] While excitedly waiting for the flowers to fully open, they disappointingly turned old, changed color and began to wither.

phalaenopsis conditions. A semi-shady, rather warm and humid environment with plenty of water and some plant food during the growing season (May to October), and reduced watering and cooler conditions during the resting season (November to end of April).

Acknowledgment

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STIG DALSTRÖM 6

STIG DALSTRÖM 7

TANDIN WANGCHUK 8

TANDIN WANGCHUK 9

[6] In the Paradise-like habitat of the undisturbed tropical forests of Bhutan there are many new species yet to be discovered.

[7] *Vanda bicolor* Griff. was for a long time considered to be endemic to Bhutan, but recently plants have been observed in the bordering Assam state of India.

[8] *Vanda ampullacea* (Roxb.) L.M.Gardiner is a warm-loving species that prefers bright and exposed conditions in the narrow strip of lowlands in Bhutan.

[9] Perhaps the most impressive species growing along the river near Nganglam is *Arachnis* (*Esmeralda*) *cathcartii* (Lindl.) J.J.Sm.


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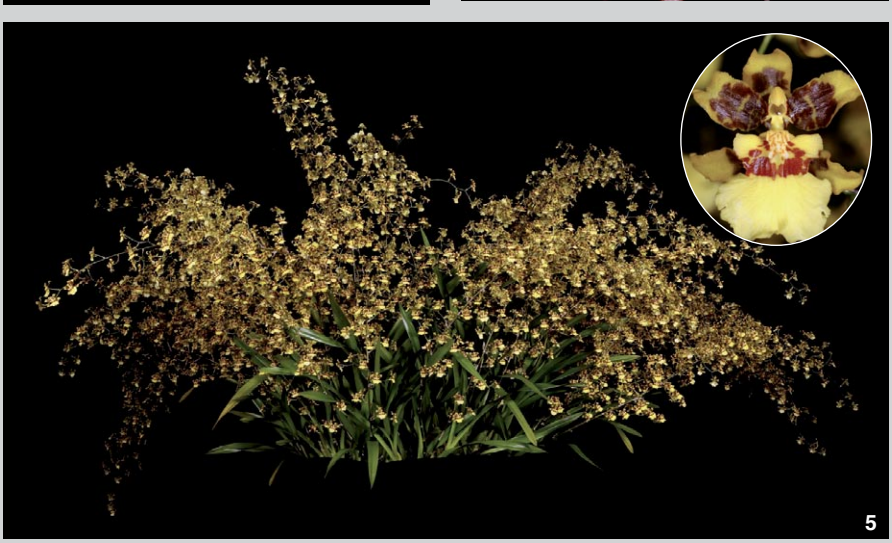
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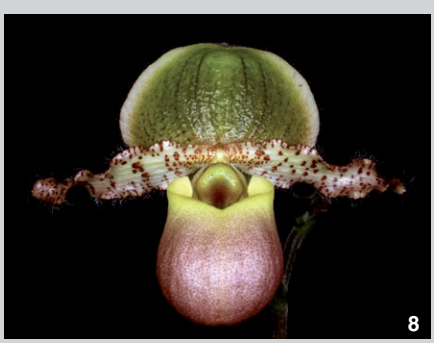
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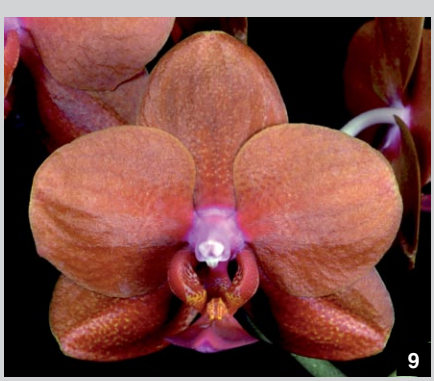
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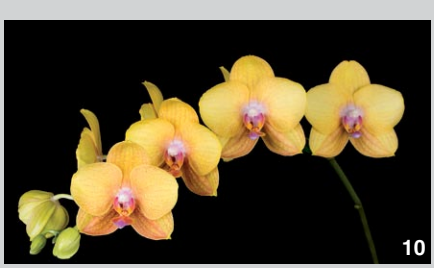
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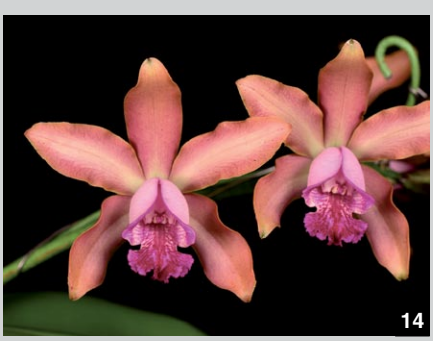
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[1] *Dendrobium cerinum* 'Mellow Yellow' CCM/AOS 87 pts. Exhibitor: Darrell Albert; photographer: Judith Higham. Western Canada Judging

[2] *Phragmipedium* Grande 'Wesley's Avatar' AM/AOS (*longifolium* x *humboldtii*) 87 pts. Exhibitor: Monica De Wit; photographer: Judith Higham. Western Canada Judging

[3] *Phragmipedium* Ruby Slippers 'Dorothy' AM/AOS (*caudatum* x *besseae*) 82 pts. Exhibitor: Bob Lucas; photographer: Judith Higham. Western Canada Judging

[4] *Paphiopedilum* Yang-Ji Diamond 'Springwater' AM/AOS (Prince Edward of York x *anitum*) 83 pts. Exhibitor: Springwater Orchids and Thanh Nguyen; photographer: Tom Kuligowski. West Palm Beach Judging

[5] *Oncidium sphacelatum* 'Kerns Passion' CCM/AOS 85 pts. Exhibitor: Marissa Gittelman; photographer: Tom Kuligowski. West Palm Beach Judging

[6] *Paphiopedilum* Krull's Lady 'Memoria Harold Smith' AM/AOS (Lady Isobel x Booth's Stone-Lady) 81 pts. Exhibitor: Krull-Smith; photographer: Tom Kuligowski. West Palm Beach Judging

[7] *Dendrobium tangerinum* 'Lien Nguyen' CCM/AOS 82 pts. Exhibitor: So Orchids; photographer: Tom Kuligowski. West Palm Beach Judging

[8] *Paphiopedilum* Pinocchio 'Chrysalis Orlando Morales' AM/AOS (*glaucophyllum* x *primulinum* var. *primulinum*) 85 pts. Exhibitor: Christine Morales and Alex Rodriguez; photographer: Tom Kuligowski. West Palm Beach Judging

[9] *Phalaenopsis* Jordon Winter 'Krull's Firecracker' AM/AOS (Citrus Candy x Krull's Red Bird) 84 pts. Exhibitor: Krull-Smith; photographer: Tom Kuligowski. West Palm Beach Judging

[10] *Phalaenopsis* Brother Sara Gold 'Mellow Yellow' AM/AOS (Sara Lee x Taipei Gold) 82 pts. Exhibitor: Paul Paludet; photographer: Judith Higham. Western Canada Judging

[11] *Phalaenopsis* Florida Rainbow 'Crystelle' AM/AOS (Tzu Chiang Chrisna x George Vasquez) 82 pts. Exhibitor: Krull-Smith; photographer: Tom Kuligowski. West Palm Beach Judging

[12] *Papilionanda* Corneels Cilliers 'Lavender Lady' AM/AOS (Mimi Palmer x *Vanda* Doctor Anek) 81 pts. Exhibitor: R.F. Orchids, Inc.; photographer: Tom Kuligowski. West Palm Beach Judging

[13] *Dendrobium bullenianum* 'Bob Bekoff' CCM/AOS 81 pts. Exhibitor: Lori Parrish; photographer: Carmen Johnston. West Palm Beach Judging

[14] *Myrmecocattleya* Geovanny Licona 'Melida Demorizi' AM/AOS (*Cattleya forbesii* x Emma Solossa) 81 pts. Exhibitor: Melida Demorizi; photographer: Carmen Johnston. West Palm Beach Judging

[15] *Brassia* Rex 'Memoria Gladys Corona-Rizo' CCM/AOS (*verrucosa* x *gireoudiana*) 84 pts. Exhibitor: David Foster; photographer: Carmen Johnston. West Palm Beach Judging

[16] *Paphiopedilum* Saint Low 'Kilkieran' AM/AOS (Saint Swithin x *lowii*) 83 pts. Exhibitor: Ernie Barham; photographer: Tom Kuligowski. West Palm Beach Judging


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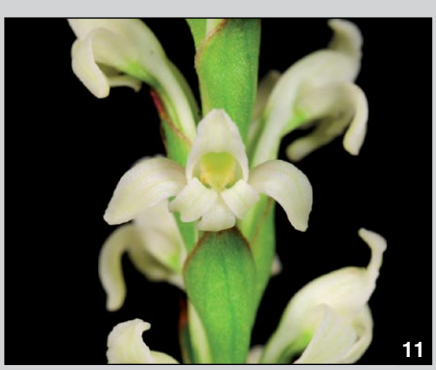
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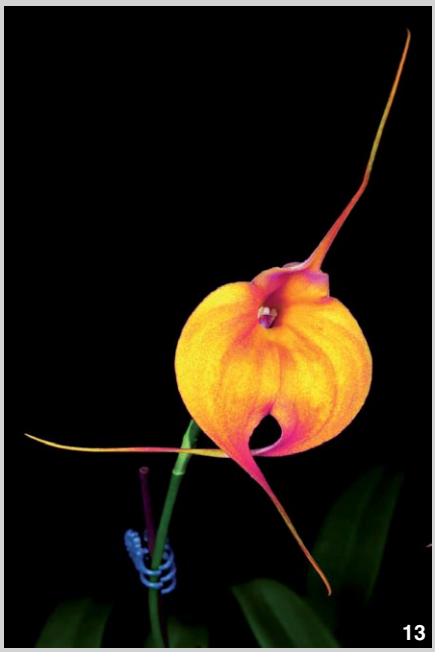
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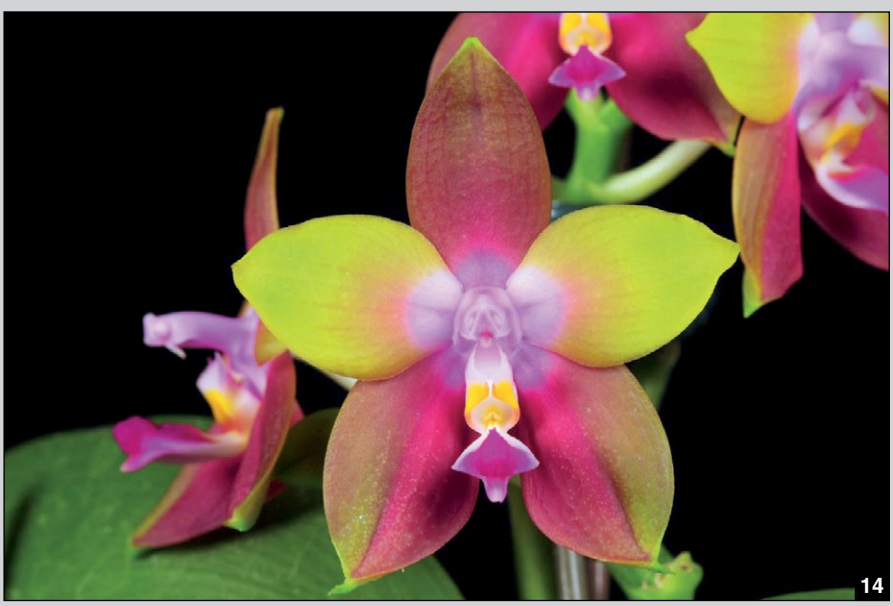
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[1] *Phalaenopsis* Smiley Tangerine 'Wilson' AM/AOS (Tying Shin Golden Rose x Kuntrarti Rarashati) 83 pts. Exhibitor: Olivier Turina; photographer: Tom Kuligowski. West Palm Beach Judging

[2] *Cattleya* Pole-Star 'Sunrise Surprise' HCC/AOS (*coccinea* x *briegeri*) 78 pts. Exhibitor: David R. Janvrin; photographer: Carson Barnes. Atlanta Judging

[3] *Sarcochilus* Kulnura Crystal 'Gracie' AM/AOS (Kulnura Glimmer x Heidi) 81 pts. Exhibitor: Amy and Ken Jacobsen; photographer: Ramon de los Santos. California Sierra Nevada Judging

[4] *Paphiopedilum* Paul Parks 'Windy Hill's Favorite' AM/AOS (*adductum* x *sanderianum*) 84 pts. Exhibitor: Marilyn LeDoux; photographer: Marcus Valentine. Atlanta Judging

[5] *Cattleya* Magairlin 'Elisa Marie' AM/AOS (*nobilior* x *aclandiae*) 83 pts. Exhibitor: Geoffrey Frost; photographer: Charlotte Randolph. Alamo Judging

[6] *Paphiopedilum moquetteanum* 'Foamy' AM/AOS 83 pts. Exhibitor: Carson Barnes; photographer: Carson Barnes. Atlanta Judging

[7] *Sarcochilus* Kulnura Crystal 'Bentley' HCC/AOS (Kulnura Glimmer x Heidi) 78 pts. Exhibitor: Amy and Ken Jacobsen; photographer: Ramon de los Santos. California Sierra Nevada Judging

[8] *Paphiopedilum* Lebaudyanum 'Kilkieran' AM-CCE/AOS (*haynaldianum* x *philippinense*) 88-90 pts. Exhibitor: Ernie Barham; photographer: Tom Kuligowski. West Palm Beach Judging

[9] *Cattleya walkeriana* f. *coerulea* 'Queen Jennifer Beattie' HCC/AOS 75 pts. Exhibitor: Juraj Kojs; photographer: Tom Kuligowski. West Palm Beach Judging

[10] *Dendrobium phillipsii* 'Forest Trumpet' AM/AOS 81 pts. Exhibitor: Randy Bayer; photographer: Marcus Valentine. Atlanta Judging

[11] *Satyrium stenopetalum* subsp. *brevicalcaratum* 'Whitespire' CBR/AOS. Exhibitor: Bart Jones; photographer: Marcus Valentine. Atlanta Judging

[12] *Phragmipedium* Giganteum 'Windy Hill's Burgundy Tails' AM/AOS (*caudatum* x Grande) 83 pts. Exhibitor: Marilyn LeDoux; photographer: Marcus Valentine. Atlanta Judging

[13] *Masdevallia* Sue Forrester 'David and Cheryl' CCM/AOS (Falcata x Chinese New Year) 81 pts. Exhibitor: Andrea Price; photographer: Marcus Valentine. Atlanta Judging

[14] *Phalaenopsis* Kung's Penang Girl 'Laura' AM/AOS (Penang Girl x Kung's Princess) 82 pts. Exhibitor: Stones River Orchids; photographer: Marcus Valentine. Atlanta Judging

[15] *Dendrobium* Island Mist 'Windy Hill' CCE-AM/AOS (Roy Tokunaga x *rhodostictum*) 94-80 pts. Exhibitor: Marilyn LeDoux; photographer: Marcus Valentine. Atlanta Judging


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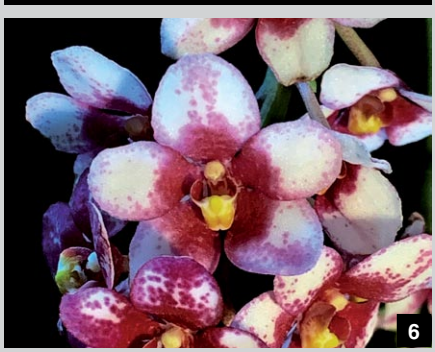
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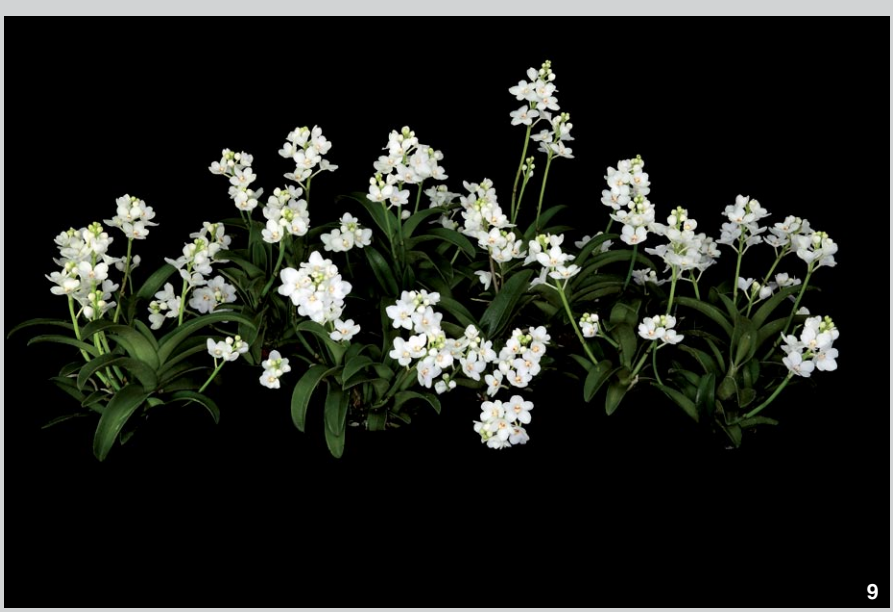
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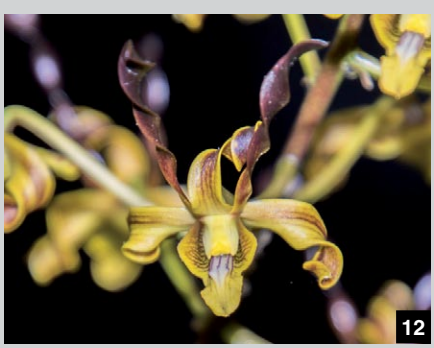

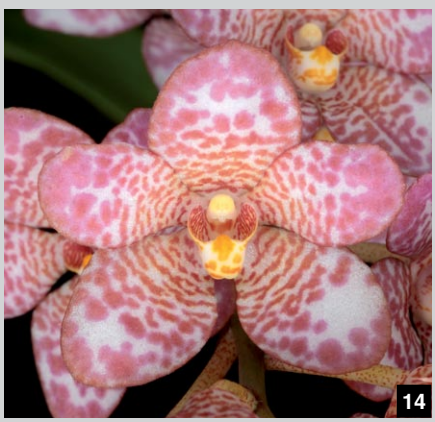

[1] *Brassidomesa* Golden Stars 'Sierra City' AM/AOS (*Gomesa echinata* x *Brassidium* Shooting Star) 82 pts. Exhibitor: Gold Country Orchids; photographer: Ramon de los Santos. California Sierra Nevada Judging

[2] *Cattleya maxima* (Coerulea) 'Wedding Sky' HCC/AOS 79 pts. Exhibitor: Virginia Grove; photographer: Ramon de los Santos. California Sierra Nevada Judging

[3] *Sarcochilus* Kulnura Class 'Bentley' HCC/AOS (Elegance x Kulnura Splash) 79 pts. Exhibitor: Amy and Ken Jacobsen; photographer: Ramon de los Santos. California Sierra Nevada Judging

[4] *Sarcochilus* Kulnura Dragonfly 'Emma Jane' AM/AOS (Sweetheart x Elegance) 85 pts. Exhibitor: Amy and Ken Jacobsen; photographer: Ramon de los Santos. California Sierra Nevada Judging

[5] *Dendrobium* Nagomi 'Punkin and Miss Kitty' AM/AOS (*cuthbertsonii* x *bracteosum*) 80 pts. Exhibitor: Sarah Patterson; photographer: James Curtis. Carolinas Judging

[6] *Sarcochilus* Kulnura Sugar 'Bentley' HCC/AOS (Kulnura Sanctuary x Heidi) 77 pts. Exhibitor: Amy and Ken Jacobsen; photographer: Ken Jacobsen. California Sierra Nevada Judging

[7] *Cymbidium* Pacific Sparkle 'New Horizon' HCC/AOS (*devonianum* x Red Beauty) 78 pts. Exhibitor: Ed Dumaguin; photographer: Ramon de los Santos. California Sierra Nevada Judging

[8] *Sarcochilus* Kulnura Dawn 'Gracie' AM/AOS (Kulnura Lady x Kulnura Kaleidescope) 80 pts. Exhibitor: Amy and Ken Jacobsen; photographer: Ramon de los Santos. California Sierra Nevada Judging

[9] *Sarcochilus* Kulnura Crystal AQ/AOS (Kulnura Glimmer 'Ashen' x Heidi 'New Multi'). Exhibitor: Amy and Ken Jacobsen; Hybridizer Barrita Orchids; photographer: Ramon de los Santos. California Sierra Nevada Judging

[10] *Sarcochilus* Kulnura Taser 'Bentley' HCC/AOS (Kulnura Need x Kulnura Kaleidescope) 77 pts. Exhibitor: Amy and Ken Jacobsen; photographer: Ramon de los Santos. California Sierra Nevada Judging

[11] *Cymbidium* Arthur Medellin Padilla 'Padilla' AM/AOS (Devon Parish x Devon Railway) 82 pts. Exhibitor: Bill Padilla; photographer: Ramon de los Santos. California Sierra Nevada Judging

[12] *Dendrobium* Sara Gallis 'Diablo 13' AM/AOS (*gouldii* x Brown Sugar) 80 pts. Exhibitor: Sara Gallis; photographer: James Curtis. Carolinas Judging

[13] *Sarcochilus* Kulnura Dawn 'Bentley' HCC/AOS (Kulnura Lady x Kulnura Kaleidescope) 78 pts. Exhibitor: Amy and Ken Jacobsen; photographer: Ramon de los Santos. California Sierra Nevada Judging

[14] *Sarcochilus* Kulnura Euphoria 'Gracie' AM/AOS (Kulnura Vibrance x Fitzhart) 80 pts. Exhibitor: Amy and Ken Jacobsen; photographer: Ramon de los Santos. California Sierra Nevada Judging

[15] *Cattleya* Lacey Michelle Matherne 'Memoria Harold Smith' AM/AOS (*aclandiae* x *tigrina*) 81 pts. Exhibitor: Krull-Smith; photographer: Brian Monk. Florida-Caribbean Judging

[16] *Pleurothallis nuda* 'Bryon' CCM/AOS 81 pts. Exhibitor: Chad Greene and Will Bottoms; photographer: James Curtis. Carolinas Judging


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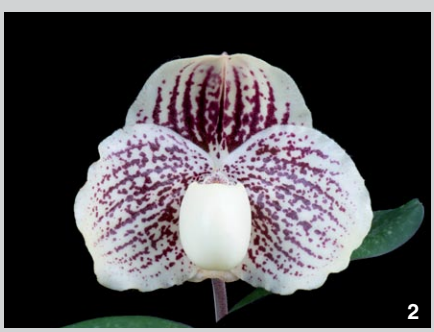
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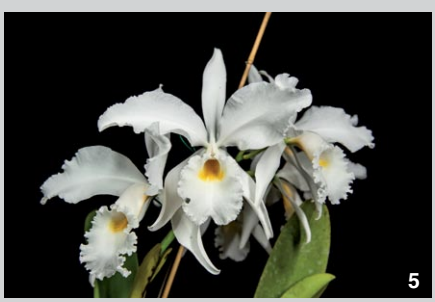
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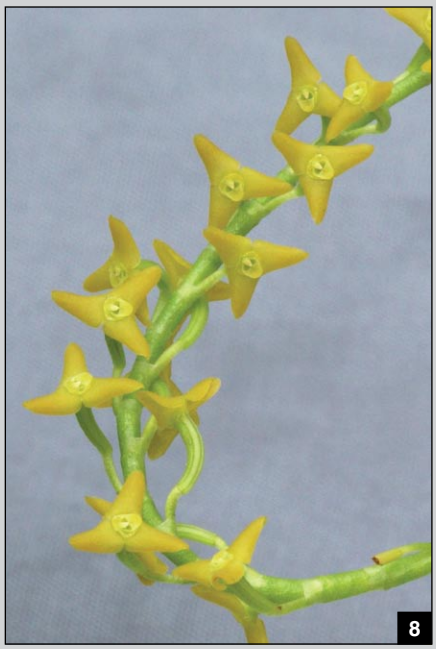
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[1] *Platystele examen-culicum* 'Orkiddoc' CCM/AOS 82 pts. Exhibitor: Larry Sexton; Photographer: Nile Dusdieker. Chicago Judging

[2] *Paphiopedilum leucochilum* 'Alex' AM/AOS 86 pts. Exhibitor: Orchid Inn, Ltd.; Photographer: Brian Monk. Florida-Caribbean Judging

[3] *Dendrobium* Hawaii Spectacular 'Buckboard' HCC/AOS (Big Alex x spectabile) 77 pts. Exhibitor: Karl Varian; Photographer: David Gould. Dallas Judging

[4] *Vanda* Eileen DeVries 'Orchid Haven' AM/AOS (*tessellata* x Robert's Delight) 82 pts. Exhibitor: Angela & Michael Birkett; Photographer: Brian Monk. Florida-Caribbean Judging

[5] *Cattleya warneri* var. *alba* 'Goliath's White Cloud' HCC/AOS 79 pts. Exhibitor: David Moore, David's Goliath Orchids; Photographer: Lorna Mazza. Florida North-Central Judging

[6] *Paravanda* Carlos Ochoa 'MV Red Diablos' HCC/AOS (*Paraphalaenopsis laycockii* x *Vanda* Laksi) 77 pts. Exhibitor: Stuart Henderson; Photographer: Brian Monk. Florida-Caribbean Judging

[7] *Encyclia* Sandra Elliott 'Starburst' CCE-HCC/AOS (*stellata* x *bractescens*) 90-76 pts. Exhibitor: Sandra Elliott; Photographer: Carmen Johnston. Florida-Caribbean Judging

[8] *Stelis tridactylon* (cf.) 'Cheryl's Joy' CBR/AOS. Exhibitor: Cheryl Erins; Photographer: Nile Dusdieker. Chicago Judging

[9] *Phalaenopsis* Pylo's Sensation 'Krull-Smith' AM/AOS (Yaphon Sensational x Dragon Tree Eagle) 82 pts. Exhibitor: Krull-Smith; Photographer: Brian Monk. Florida-Caribbean Judging

[10] *Eulophia* Memoria Alexis Pardo 'Nicola' AM/AOS (*guineensis* x *andamanensis*) 81 pts. Exhibitor: Richard Fulford; Photographer: Carmen Johnston. Florida-Caribbean Judging

[11] *Dendrobium chrysocrepis* 'Cheryl's Joy' CBR/AOS. Exhibitor: Cheryl Erins; Photographer: Nile Dusdieker. Chicago Judging

[12] *Brassavola nodosa* 'Quest' CCE/AOS 90 pts. Exhibitor: Quest Orchids, Inc; Photographer: Brian Monk. Florida-Caribbean Judging

[13] *Phalaenopsis parishii* 'Crystelle' CCM/AOS 81 pts. Exhibitor: Krull-Smith; Photographer: Brian Monk. Florida-Caribbean Judging

[14] *Encyclia* Paula Gross 'GG' CCM/AOS (*rufa* x *cordigera*) 83 pts. Exhibitor: David Foster; Photographer: Brian Monk. Florida-Caribbean Judging

[15] *Phalaenopsis* Pylo's Eagle Passion 'Marley' HCC/AOS (Brother Ambo Passion x Dragon Tree Eagle) 79 pts. Exhibitor: Mike Mims; Photographer: Brian Monk. Florida-Caribbean Judging

[16] *Bulbophyllum* Wade Hollenbach 'Whisper A-doribil Gift' HCC/AOS (Laura Newton x Manchind) 75 pts. Exhibitor: Laura and Wes Newton; Photographer: Kay Clark. Florida North-Central Judging


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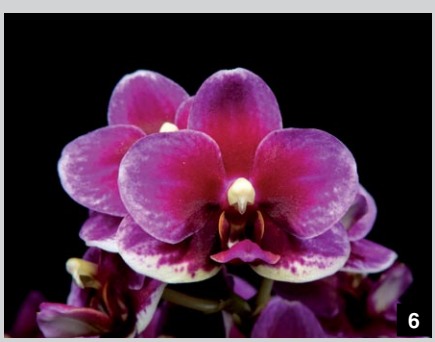
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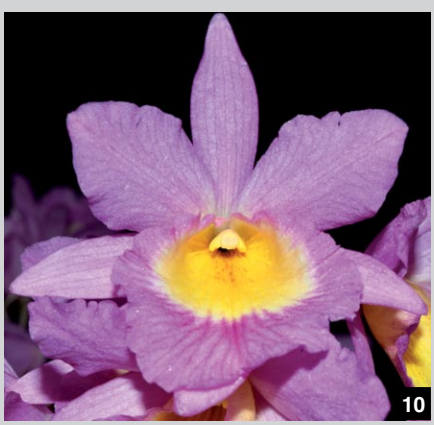
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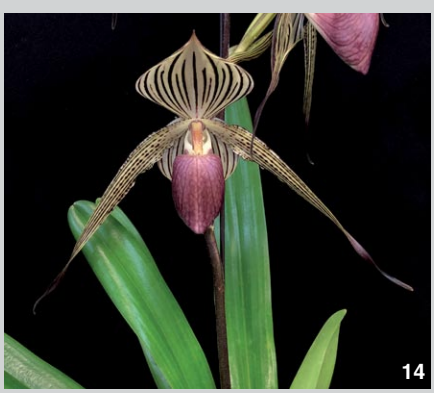

[1] *Cattleya* Petitfleur 'Russell Child' AM/AOS (*jongheana* x *praestans*) 80 pts. Exhibitor: Tony Millet; photographer: Carmen Johnston. Florida-Caribbean Judging

[2] *Dendrobium* Frosty Dawn 'Red Hawk' HCC/AOS (Dawn Maree x Lime Frost) 79 pts. Exhibitor: Sheri Liggett-Macchia and Red Hawk Nursery; photographer: Lorna Mazza. Florida North-Central Judging

[3] *Paphiopedilum hangianum* 'Fajen's Luna Moth' HCC/AOS 78 pts. Exhibitor: Fajen's Orchids; photographer: Lorna Mazza. Florida North-Central Judging

[4] *Paphiopedilum hangianum* 'Fajen's Orchids' HCC/AOS 76 pts. Exhibitor: Fajen's Orchids; photographer: Rachel Kelmer. Florida North-Central Judging

[5] *Vanda tessellat*a 'Garrett's Ol' Blue' AM/AOS 82 pts. Exhibitor: Sharon and David Garrett; photographer: Wes Newton. Florida North-Central Judging

[6] *Phalaenopsis* Taisuco Micky 'Bredren' AM/AOS (Golden Peoker x *pulcherrima*) 82 pts. Exhibitor: Bredren Orchids and Phillip Hamilton; photographer: Lorna Mazza. Florida North-Central Judging

[7] *Paphiopedilum* Memoria Gerhard Conrad 'Springwater' HCC/AOS (Hilo Ruby x Hsinying Rubyweb) 78 pts. Exhibitor: Springwater Orchids and Thanh Nguyen; photographer: Rachel Kelmer. Florida North-Central Judging

[8] *Phragmipedium* Fritz Schomburg 'Whisper OMG 3N' AM/AOS (*kovachii* x *besseae*) 86 pts. Exhibitor: Laura and Wes Newton; photographer: Wes Newton. Florida North-Central Judging

[9] *Paphiopedilum* Berenice 'Smiley's Charm' CCM/AOS (*lowii* x *philippinense*) 80 pts. Exhibitor: Smiley Orchids; photographer: Lorna Mazza. Florida North-Central Judging

[10] *Guaritonia* Caribbean Princess 'Ed's Princess' CCM/AOS (*Broughtonia lindenii* x Why Not) 84 pts. Exhibitor: Steve Balderson; photographer: Rachel Kelmer. Florida North-Central Judging

[11] *Broughtonia sanguinea* var. *aurea* 'Winter Haven's Butter Churn' AM/AOS 83 pts. Exhibitor: Keith and Dina Emig - Winter Haven Orchid Nursery; photographer: Wes Newton. Florida North-Central Judging

[12] *Paphiopedilum* Mystically Macabre 'Chris McAdams' HCC/AOS (Macabre Pops x Mystically Wood) 75 pts. Exhibitor: Eric Cavin; photographer: Rachel Kelmer. Florida North-Central Judging

[13] *Coelogyne pandurata* 'Shadow Memories' CCM-AM/AOS 82-86 pts. Exhibitor: Mike and Joni Sielaff; photographer: Rachel Kelmer. Florida North-Central Judging

[14] *Paphiopedilum* Krull's Ruby Lady 'Winter Haven' AM/AOS (Booth's Stone-Lady x *rothschildianum*) 82 pts. Exhibitor: Keith and Dina Emig - Winter Haven Orchid Nursery; photographer: Wes Newton. Florida North-Central Judging

[15] *Paphiopedilum* Memoria Renette L. Gatny 'Winter Haven' HCC/AOS (Oriental Jewel x Oriental Spring) 78 pts. Exhibitor: Keith and Dina Emig - Winter Haven Orchid Nursery; photographer: Wes Newton. Florida North-Central Judging

[16] *Paphiopedilum philippinense* 'Bredren' HCC/AOS 79 pts. Exhibitor: Bredren Orchids and Phillip Hamilton; photographer: Rachel Kelmer. Florida North-Central Judging


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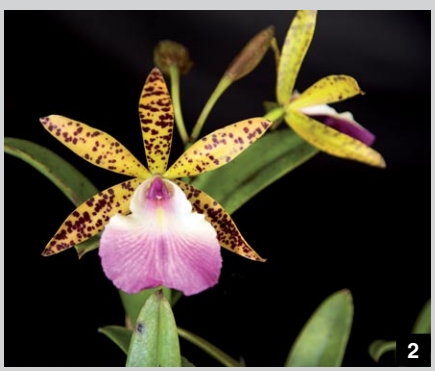
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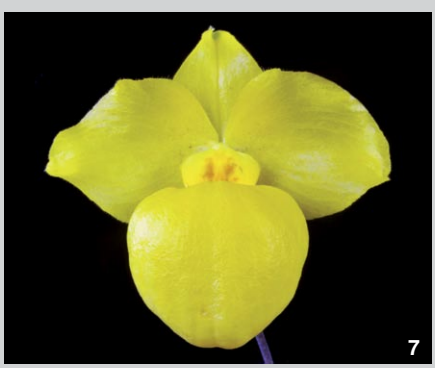
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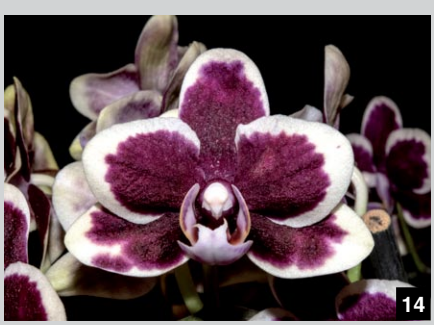
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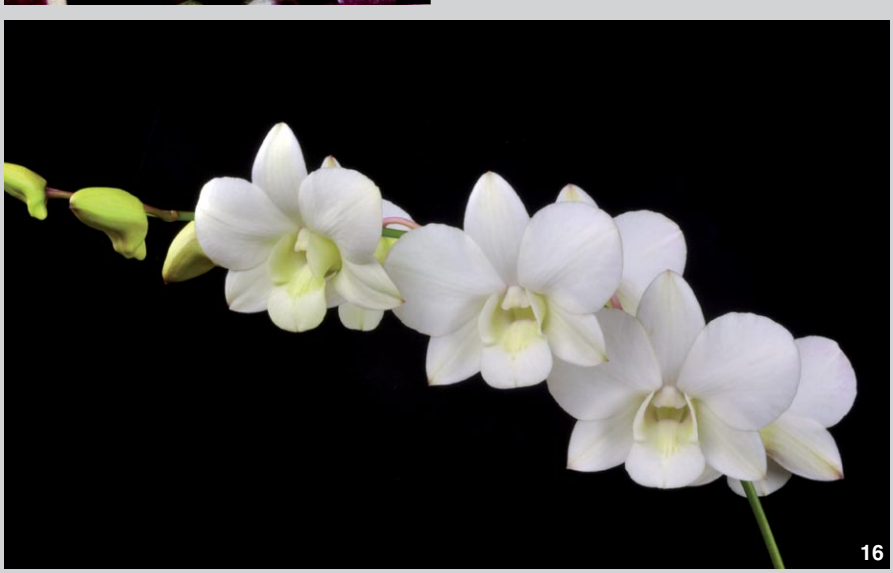
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[1] *Papilionanda* Ben Fragrance 'Garrett's Golden Boy' AM/AOS (*Vanda* Memoria Thianchai x Mimi Palmer) 84 pts. Exhibitor: Sharon and David Garrett; photographer: Wes Newton. Florida North-Central Judging

[2] *Brassocattleya* Theresa Ricci 'Wing-Dreams Wild One' HCC/AOS (Hippodamia x *Cattleya aclandiae*) 77 pts. Exhibitor: Julio and Eileen Hector; photographer: Kay Clark. Florida North-Central Judging

[3] *Phragmipedium* Acker's Dragon 'Duck Creek' AM/AOS (Twilight x *humboldtii*) 81 pts. Exhibitor: Dave Miller; photographer: Katie Payeur. Great Lakes Judging

[4] *Rodrumnia* Orchidom Orange Joy 'Duck Creek' HCC/AOS (Orchidom Orange Delight x *Tolumnia* Alameda Joy) 76 pts. Exhibitor: Dave Miller; photographer: Katie Payeur. Great Lakes Judging

[5] *Vandachostylis* Ben Mianmanus 'Garrett's Rosy Lip' AM/AOS (Evergreen Magic x *Vanda tessellata*) 82 pts. Exhibitor: Sharon and David Garrett; photographer: Wes Newton. Florida North-Central Judging

[6] *Paphiopedilum* Robinianum 'Chad's Green Glow' AM/AOS (*lowii* x *parishii*) 85 pts. Exhibitor: Chad Whetstone; photographer: Kay Clark. Florida North-Central Judging

[7] *Paphiopedilum armeniacum* 'Orchid Fix Golden Orb' HCC/AOS 76 pts. Exhibitor: The OrchidFix Nursery Jurahame Leyva; photographer: Glen Barfield. Hawaii Judging

[8] *Maxthompsonara* Bryon Rinke 'Bryon and Max' AM/AOS (*Galabstia* Green Tyger x *Batemannia colleyi*) 80 pts. Exhibitor: Max Thompson and Bryon Rinke; photographer: Bryon Rinke. Great Plains Judging

[9] *Paphiopedilum* Honey 'Sweet Edna' CCM/AOS (*philippinense* x *primulinum* var. *primulinum*) 83 pts. Exhibitor: Nancy Morrison; photographer: Kay Clark. Florida North-Central Judging

[10] *Paphiopedilum* Lady Isobel 'Larks Over Honoli'i' AM/AOS (*rothschildianum* x *stonei*) 83 pts. Exhibitor: Sandra Dixon; photographer: Katie Payeur. Great Lakes Judging

[11] *Pleurothallis gargantua* 'Timbucktoo' AM/AOS 86 pts. Exhibitor: Sarah Pratt; photographer: Bryon Rinke. Great Plains Judging

[12] *Paphiopedilum hookerae* 'Fajen's Orchids NJL' AM/AOS 85 pts. Exhibitor: Fajen's Orchids; photographer: Kay Clark. Florida North-Central Judging

[13] *Cattleya purpurata* (Werckhauseri) 'Wacousta' AM/AOS 84 pts. Exhibitor: Dorothy Potter Barnett; photographer: Katie Payeur. Great Lakes Judging

[14] *Phalaenopsis* Lioulin Sparrow 'Taida Little Panda' HCC/AOS (Tai-I Yellow Bird x Sogo Rosa) 77 pts. Exhibitor: Jay C. Simon; photographer: Bryon Rinke. Great Plains Judging

[15] *Paphiopedilum* Johanna Burkhardt 'Imperial Prelude' AM/AOS (*rothschildianum* x *adductum*) 83 pts. Exhibitor: The OrchidFix Nursery Jurahame Leyva; photographer: Glen Barfield. Hawaii Judging

[16] *Dendrobium* Nopporn White Diamond 'Lily's White Grace' HCC/AOS (Walter Oumae x Burana White) 76 pts. Exhibitor: The OrchidFix Nursery Jurahame Leyva; photographer: Glen Barfield. Hawaii Judging


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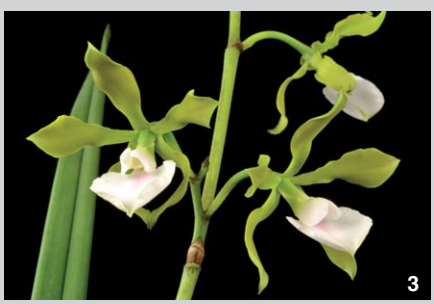
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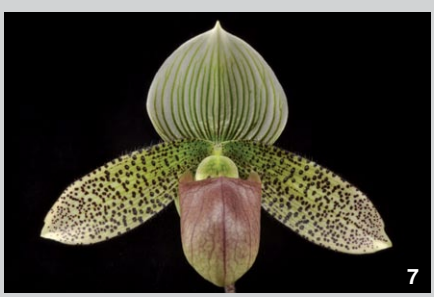
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[1] *Cattleya mossiae* var. *coerulea* 'Mother's Finest' HCC/AOS 75 pts. Exhibitor: Ben Oliveros and Orchid Eros; photographer: Glen Barfield. Hawaii Judging

[2] *Rhyncholaeliocattleya* Mirtha Luz Estrada 'Mother's Day' AM/AOS (Toshie Flare x *Cattleya* Waccamaw) 80 pts. Exhibitor: Ben Oliveros and Orchid Eros; photographer: Glen Barfield. Hawaii Judging

[3] *Encyclia randii* 'Gabriel Amaru' HCC/AOS 77 pts. Exhibitor: Ben Oliveros and Orchid Eros; photographer: Glen Barfield. Hawaii Judging

[4] *Paphiopedilum* Excitingly Fred 'Slipper Zone Goodbye Spots' AM/AOS (Excitingly Wood x Friedrich von Hayek) 80 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[5] *Cattleya x dolosa* (Alba) 'Mirtha Isabel' AM/AOS (*loddigesii* x *walkeriana*) 80 pts. Exhibitor: Ben Oliveros and Orchid Eros; photographer: Glen Barfield. Hawaii Judging

[6] *Oncostele* Tan Treasures 'Brown Sugar' AM/AOS (*Oncidium* Bunbury x Catatante) 82 pts. Exhibitor: Okika, Ltd.; photographer: Glen Barfield. Hawaii Judging

[7] *Paphiopedilum* Fluttering Fred 'Slipper Zone Form Delight' AM/AOS (Montera Moth x Fred's Aura) 80 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[8] *Paphiopedilum* Excitingly Fred 'Slipper Zones Spots Galore' AM/AOS (Excitingly Wood x Friedrich von Hayek) 80 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[9] *Encyclia* Rioclarense 'Honoli'i' HCC/AOS (*cordigera* x *randii*) 78 pts. Exhibitor: John Jusczak; photographer: Glen Barfield. Hawaii Judging

[10] *Paphiopedilum* Wilhelmina's Stone 'Slipper Zone Find' AM/AOS (*stonei* x *wilhelminae*) 81 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[11] *Paphiopedilum* Odette's Beauty 'Slipper Zone Shower Curtain' AM/AOS (Odette's Blush x Grand Fred) 82 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[12] *Paphiopedilum* Excitingly Fred 'Slipper Zone Dark Desire' AM/AOS (Excitingly Wood x Friedrich von Hayek) 82 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[13] *Paphiopedilum* Grand Philip 'Slipper Zone Charming Five' AM/AOS (Philip's Prayer x *glanduliferum*) 82 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[14] *Paphiopedilum* Jacob's Dream 'Slipper Zone Venus on High' HCC/AOS (Memoria Jacob Jake Piloto x *venustum*) 78 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[15] *Paphiopedilum* Hawaiian Charm 'Slipper Zone Lustrous Glow' AM/AOS (Hawaiian Illusion x Kiwi Charm) 80 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[16] *Paphiopedilum* Presidential Moon 'Slipper Zone Almost Spotless' HCC/AOS (Luna Magic x President Fred) 77 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging


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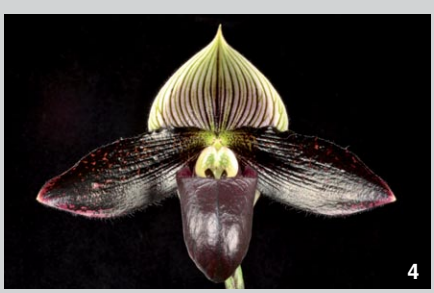
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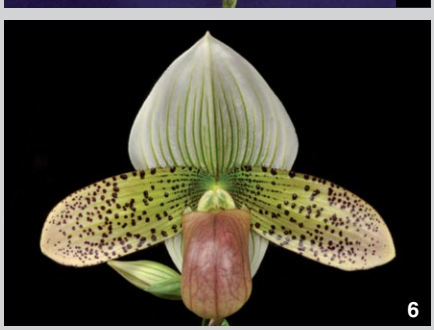
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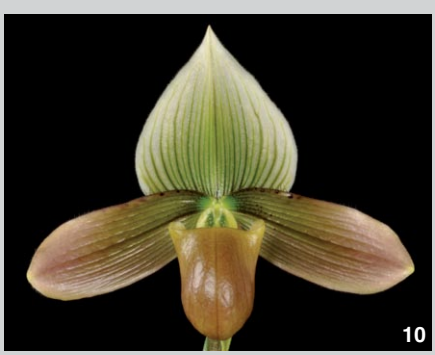
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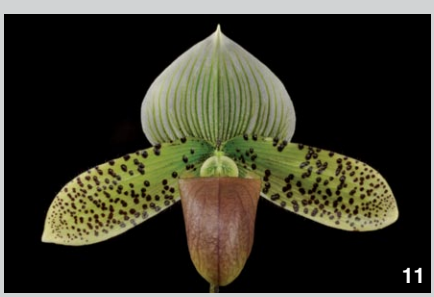
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[1] *Paphiopedilum* Petula's Love Song 'Slipper Zone Just a Delight' AM/AOS (Love Song x Petula's Flame) 80 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[2] *Paphiopedilum* Petula's Sensation 'Slipper Zone Petite Delight' HCC/AOS (Macabre Contrasts x Petula's Flame) 76 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[3] *Paphiopedilum* Petula's Sensation 'Slipper Zone Black Beckons' HCC/AOS (Macabre Contrasts x Petula's Flame) 77 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[4] *Paphiopedilum* Petula's Sensation 'Slipper Zone Pink Spreading' HCC/AOS (Macabre Contrasts x Petula's Flame) 77 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[5] *Paphiopedilum* Montera Vogue 'Slipper Zone Parading Spots' AM/AOS (Montera Moth x Vogue Wonder) 81 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[6] *Paphiopedilum* Macabre Flutter 'Slipper Zone Vertically Challenged' AM/AOS (Macabre Pops x Montera Moth) 82 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[7] *Paphiopedilum* Petula's Sensation 'Slipper Zone Striding Black' HCC/AOS (Macabre Contrasts x Petula's Flame) 79 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[8] *Paphiopedilum* Petula's Sensation (Macabre Contrasts 'Strident Rush' x Petula's Flame 'Almost Black') AQ/AOS. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[9] *Paphiopedilum hennisianum* f. *christiansenii* 'Slipper Zone Laid Back' HCC/AOS 78 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[10] *Paphiopedilum* Macabre Fantasy 'Slipper Zone Clarity' AM/AOS (Macabre Pops x Flighty Fred) 81 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[11] *Paphiopedilum* Macabre Fred 'Slipper Zone Flowing Form' HCC/AOS (Macabre Magic x Fred's Spots) 77 pts. Exhibitor: Lehua Orchids; photographer: Glen Barfield. Hawaii Judging

[12] *Paphiopedilum bellatulum* 'Oxblood' AM/AOS 82 pts. Exhibitor: Hilo Orchid Farm; photographer: Glen Barfield. Hawaii Judging

[13] *Cattleya* Callistoglossa (Coerulea) 'Dacota' AM/AOS (*warscewiczii* x *purpurata*) 84 pts. Exhibitor: Ben Oliveros and Orchid Eros; photographer: Glen Barfield. Hawaii Judging

[14] *Paphiopedilum* Johanna Burkhardt 'Imperial Splendor' AM/AOS (*rothschildianum* x *adductum*) 84 pts. Exhibitor: The OrchidFix Nursery Jurahame Leyva; photographer: Glen Barfield. Hawaii Judging

[15] *Masdevallia* Urundil 'J & L' AM/AOS (Bocking Hybrid x Copper Angel) 83 pts. Exhibitor: J & L Orchids; photographer: Robert Hesse. Northeast Judging

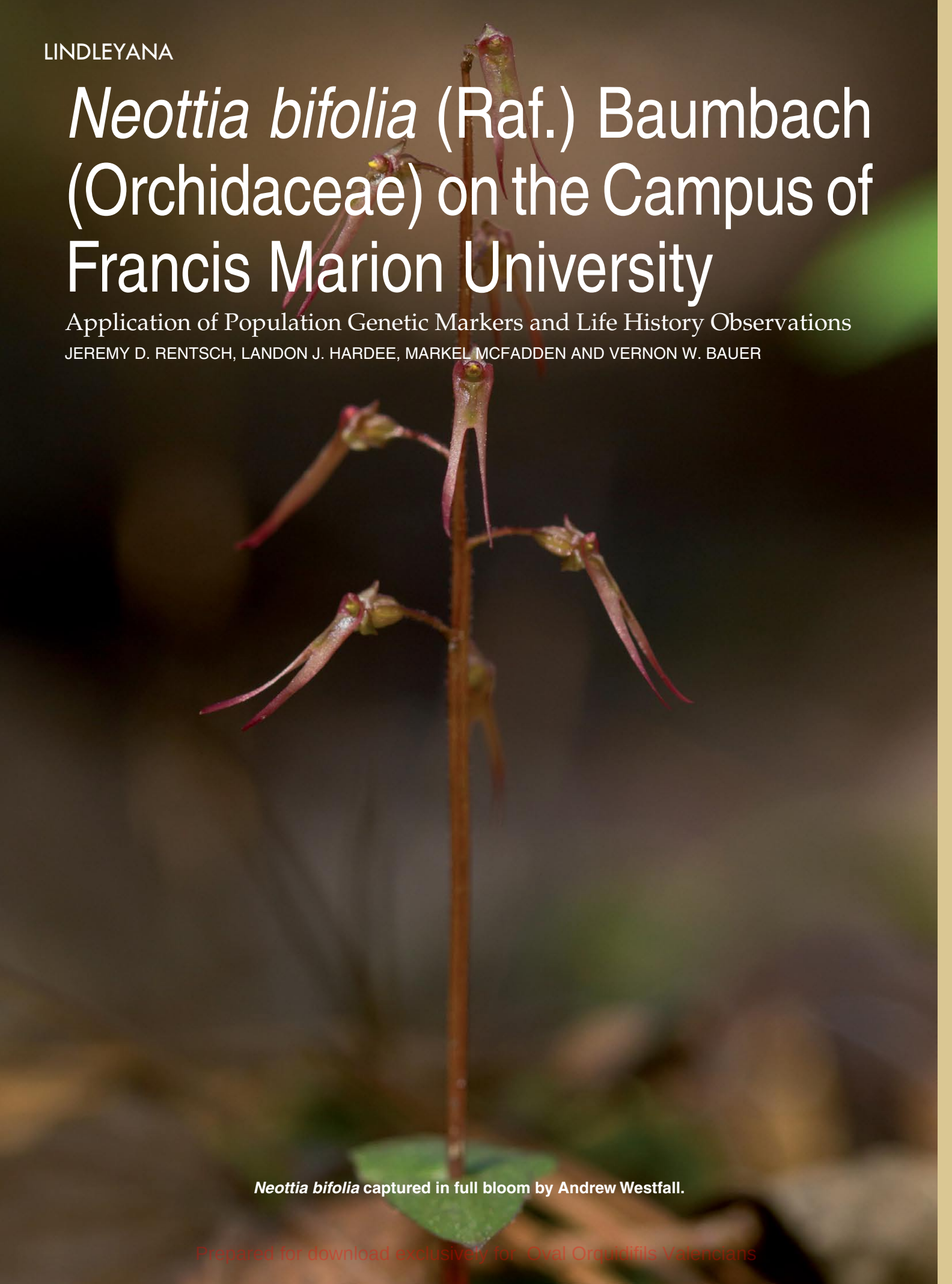
[16] *Rhyncholaeliocattleya* Hisako Song 'King of Shogun' AM/AOS (Hisako Akatsuka x *Cattleya* Mini Song) 86 pts. Exhibitor: Shogun Hawaii- Matthias Seelis; photographer: Glen Barfield. Hawaii Judging

LINDLEYANA

Neottia bifolia (Raf.) Baumbach (Orchidaceae) on the Campus of Francis Marion University

Application of Population Genetic Markers and Life History Observations

JEREMY D. RENTSCH, LANDON J. HARDEE, MARKEL MCFADDEN AND VERNON W. BAUER



Neottia bifolia **captured in full bloom by Andrew Westfall.**

ABSTRACT *Neottia bifolia*, the southern twayblade, is an orchid native to the southeastern United States as far west as Texas and distributed up the eastern coast of the United States into Ontario and Quebec. The orchid is most often found in moist forests, marshes and bogs. The campus of Francis Marion University in the sandhills region of South Carolina hosts a thriving population of *N. bifolia*, making it an ideal location to study some of the basic biology of the species that is yet to be documented. We sampled leaf material from 63 *N. bifolia* individuals and provide results on the usefulness of a chloroplast marker, *rps16-trnK*, and a nuclear marker, *ITS2* for population genetic utility. We found *rps16-trnK* to be a useful marker, yielding four haplotypes among our 63 individuals. *ITS2* was found to be monomorphic among our samples but does have significant utility in molecular phylogenetic inferences. We also provide one growing season's worth of phenological data and pollinator observations, during which time we found a species of *Mycomya*, a fungus gnat, pollinating the orchid.

INTRODUCTION The genus *Neottia* Guett. (Orchidaceae subfamily Epidendroideae) is composed of a mixture of species that are autotrophic as adults and species that are mycoheterotrophic as adults. The genus comprises 67–70 species after a well-supported (Zhou and Jin 2018) reclassification in which the genus *Listera* was subsumed into *Neottia* (Pridgeon et al., eds. 2005). Previously, photosynthetic species were classified into the genus *Listera*, while achlorophyllous, mycoheterotrophic species were classified into the genus *Neottia*. *Neottia bifolia* (Raf.) Baumbach (Syn *Listera australis* Lindl.), the southern twayblade, is a terrestrial orchid usually seen with two opposite, ovate leaves. The occasional three-leaved or many-leaved variety exists as well (Fowler and Brown 2005). The inflorescence develops into a raceme, producing around 25 red-purple to slightly green or occasionally fully green flowers. The labellum is bilobed and tapered into fine points (Flora of North America Editorial Committee 2002). The species is primarily found in cool wetland forests and is native to the southeastern United States as far west as Texas and distributed up the eastern cost of the United States into Ontario and Quebec (USDA 2020).

How species partition their genetic variation in space can have critical implications for species conservation (Frankham 1995) as well as for understanding their overall patterns of phylogeography (Soltis et al. 1997). Although little work has been done on *N. bifolia*, the widespread European orchid, *Neottia ovata* (L.) Bluff & Fingerh has been the subject of several population-level studies. Overall, *N. ovata* has been found to have lower genetic variation (Brzosko and Wróblewska 2012) than might be expected from a long-lived, perennial, monocotyledon (Loveless and Hamrick 1984; Hamrick and Godt 1996). The same study found that, despite a lower than expected level of genetic diversity, that the number of unique multilocus genotypes was high, suggesting a high level of sexual reproduction. Further, in two populations of *N. ovata*, it was found that seeds distributed a maximum of 10 meters from a parent plant with between 75.3 and 95.4 percent of seeds distributing only between 0 and 1 meter (Brzosko et al. 2017). Breeding system is known to be an important factor in a species' distribution of genetic variation (Tremblay et al. 2005). While the pollinators of *N. bifolia* are unknown, *N. ovata* was found to be pollinated by three insect groups including beetles, ichneumonids, and sawflies (Kotilínek et al. 2015). *Neottia listeroides* Lindl. is pollinated by ants (Wang et al. 2008). *Neottia cordata* (L.) Rich. was shown to be pollinated by fungus gnats in the families Mycetophilidae and Sciaridae and, to a lesser degree, insects in the families Braconidea, Ichneumonidae and Tipulidae (Ackerman and Mesler 1979; Kotilínek et al. 2018).

Barcoding genes, most often used for taxonomic classification and molecular phylogenetics, can also be used as cursory population genetic markers (Hajibabaei et al. 2007). Although one or two genetic markers are not enough for a robust population-level genetic analysis (Moritz and Cicero 2004), they can still provide valuable preliminary insights and provide justification for more robust, and more expensive data generation techniques. The intergenic space between the plastid genes *rps16* and *trnK* has been used as a barcoding marker in plant biology since being proposed in 2007 (Shaw et al.) and was used on occasion even earlier (e.g., see Takahashi et al. 2005). Since then, it has been demonstrated to be useful for both phylogeography as seen in *Helianthemum songaricum* Schrenk. (Cistaceae; Su et al. 2011) and the genus *Leymus* (Poaceae; Culumber et al. 2011) and phylogenetics, as seen in the *Sium* alliance of the Apiaceae (Spalik et al. 2009), the Barnadesioideae subfamily of the Asteraceae (Padin et al. 2015), and *Disakisperma* Steud (Poaceae; Snow et al. 2013). The *ITS2* marker is widely used in eukaryotes, especially animals, as a barcoding gene (e.g., see Ben-David et al. 2007; Prasad et al. 2009; Li et al. 2010). Although intraspecific variation of this marker can be low, the marker is able to identify monocotyledons to the genus level 97.9 percent of the time and correctly identify species 74.2 percent of the time (Yao et al. 2010).

Here, we report our results surveying for *Neottia bifolia* across 707 km^2 on the campus of Francis Marion University, South Carolina. In addition to reporting the distribution of chloroplast haplotypes and the usefulness of the *ITS2* nuclear marker, we report phenology of the species during the 2020 growing season as well as pollinator observations.

METHODS *Study area, plant collection and DNA extraction*. The study area is 707 km^2 on the campus of Francis Marion University, South Carolina, situated in the sandhills ecoregion. A single leaf was sampled from 65 *Neottia bifolia* individuals on the Francis Marion University campus (Florence County, South Carolina) during the spring of 2019 and spring of 2020. Sampling was done haphazardly with more individuals being sampled in larger putative subpopulations. Each sample was placed in silica gel until DNA extraction. DNA extraction was performed using Invitrogen's PureLink Genomic Plant DNA Purification Kit (Thermo Fisher Scientific, Waltham, Massachusetts). Eluted DNA was stored at −20 C. The GPS coordinates of each individual specimen were also taken.

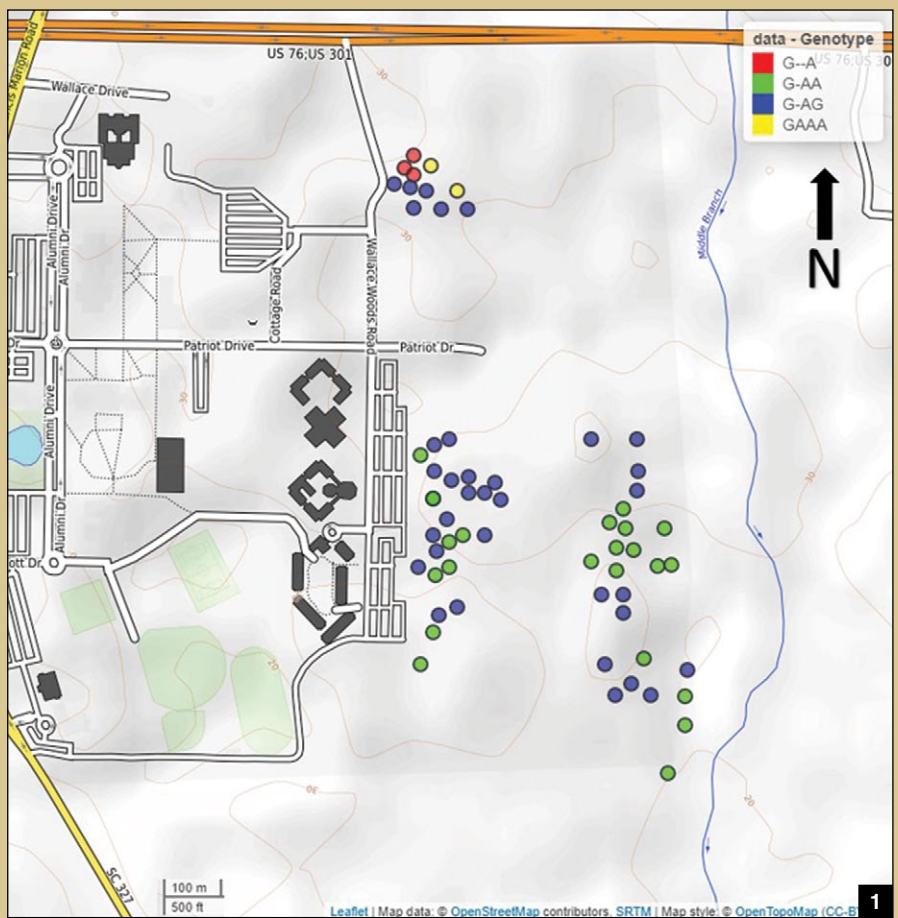
rps16-trnK and ITS2 amplification and sequencing. Thermocycling conditions for the *rps16-trnK* marker were performed as follows: initial denaturation for 30 seconds at 95 C, 35 cycles of 30 seconds denaturation at 95 C, a 60-second annealing step at 56 C and an extension step for 30 seconds at 72 C. A final extension time of 300 seconds was performed at 72 C. *ITS2* marker amplification followed the protocol proposed by Chen et al. (2010): initial denaturation for 300 seconds at 94 C, 40 cycles of 30 seconds denaturation at

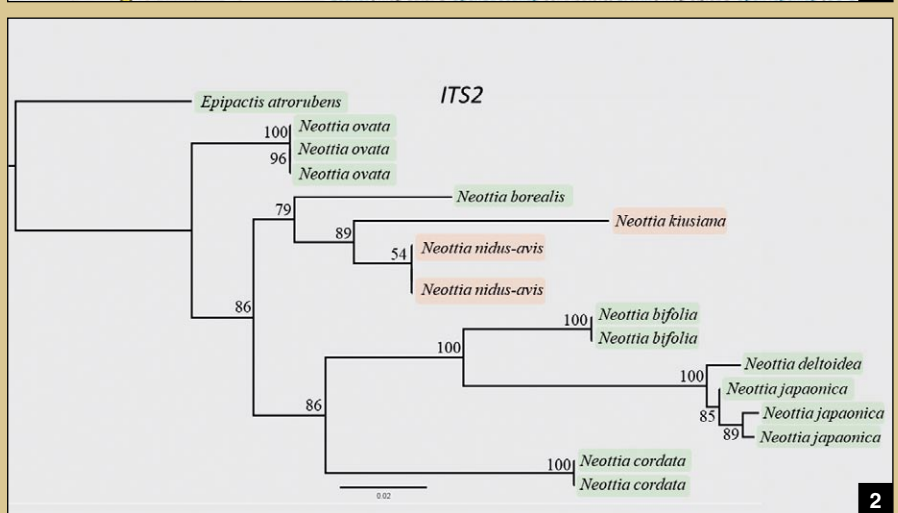
95 C, a 30-second annealing step at 56 C and an extension step for 45 seconds at 72 C. A final extension time of 600 seconds was performed at 72 C.

Amplicons were cleaned of excess nucleotides and primers using a Zymo Research DNA Clean & Concentrator kit (Zymo Research, Irvine, California). Sanger sequencing was performed on an Applied Biosystems 3730xl 96-capillary DNA Analyzer (Applied Biosystems, Foster City, California) at the North Carolina State Genomic Sciences Laboratory in Raleigh, North Carolina. Chromatograms were imported into Geneious 11.1.3 (https://www.geneious.com) ambiguous base pair calling and the trimming of low quality sequence ends. Multiple sequence alignment was performed within Geneious using the MUSCLE alignment algorithm (Edgar 2004). Chloroplast haplotypes were mapped in R (R Development Core Team 2017) and the map was produced using the package ggplot2 (Wickham 2009).

Assessing the utility of ITS2 as a standard marker in Neottia. After sequence data for the *ITS2* nuclear marker were generated, we performed a nucleotide BLAST search against the NCBI database (NCBI Resource Coordinators 2016) for other *Neottia* or *Listera* matches. Likewise, we selected an outgroup, which was the top hit that was not in the *Neottia* or *Listera* genera. We looked at percent identity differences between species and, where multiple hits for the same species were generated, we assessed percent identity differences within species. The queried sequences were aligned using ClustalW ver. 2.1 (Larkin et al. 2007) using the IUB cost matrix, 15 gap open cost, and 6.66 gap extend cost. The model of best fit was determined by use of the software jModelTest2.1.10 (Darriba et al. 2012) using the Akaike information criterion (AIC). Phylogenetic inference was carried out using maximum likelihood (ML) methods implemented in PhyML (Guindon and Gascuel 2003) using the model of nucleotide substitution suggested by jModelTest2.1.10. In each case, 1,000 bootstrap replications were also performed. Bootstrap consensus trees were then imported into FigTree v1.4.4 (Rambaut 2012) where branch lengths were made proportional to the number of substitutions seen in each lineage.

Phenology study and pollinator observation. From January 8, 2020 until April 20, 2020 three sites were surveyed once weekly for the number of plants: (1) in their vegetative state, (2) with developed floral buds, (2) in anthesis (open, pollen-receptive flowers), (4) while fruiting, (5) with dehisced fruits, and (6) undergoing above-ground senescence. These data were then aggregated and reported as the proportion of plants in any given stage at any time. As plants can fall within multiple categories simultaneously, each plant surveyed was placed in the latest stage displayed. For example, a plant with open proximal flowers and closed distal floral buds would be counted in the "anthesis" category. Rather than disturb leaf litter and risk damaging small plants, vegetative growth was not marked until the leaves were visible from above the leaf litter. General pollinator observations were conducted along with phenology tracking and tissue collection.





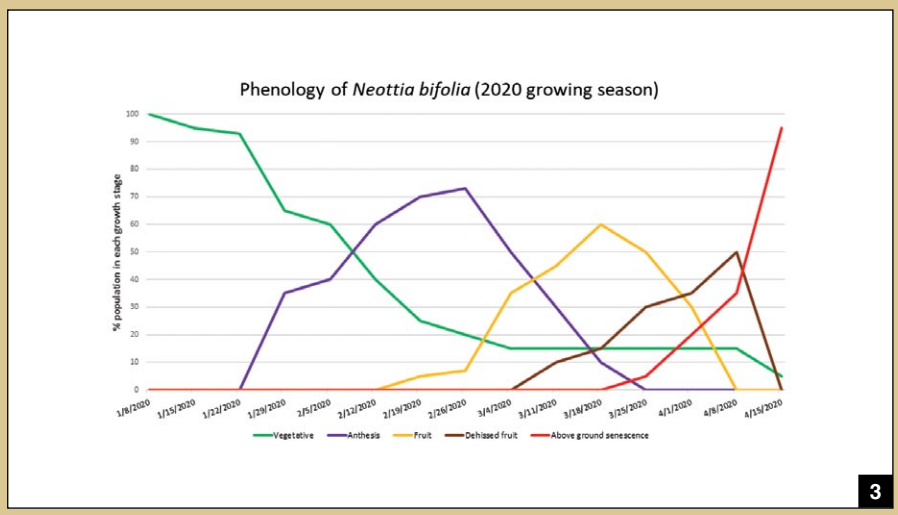
RESULTS *Neottia bifolia* individuals are clustered into three distinct field sites across the 707 km^2 surveyed: a northern cluster, a western cluster, and an eastern cluster. Of the 65 individuals sampled across 2019 and 2020, 63 of them yielded sufficient DNA for downstream PCR. The forward direction of the *rps16-trnK* marker was sequenced for each of

Table 1. *Neottia* species represented more than one time in the BLAST search results for the *ITS2* marker amplified in *Neottia bifolia*. Along with the number of times a species is represented, we report the average percent identity of all *ITS2* BLAST results of that species.

Species	BLAST hits found	Average percent identity
Neottia bifolia (Raf.) Baumbach	3	100
Neottia cordata (L.) Rich.	4	100
Neottia japonica (Blume) Szlach.	2	99.2
Neottia nidus-avis (L.) Rich.	3	91.02
Neottia ovata (L.) Bluff & Fingerh.	5	100

the 63 individuals and sequences were trimmed to an average length of 520 base pairs. The *rps16-trnK* marker amplifies approximately 91 base pairs of the *rps16* gene, with the remaining approximately 429 base pairs being intergenic space. The aligned sequences share a 99.8 percent average pairwise identity with only a few sites being variable. At this single locus, we detected four haplotypes across these 63 individuals. Positions 74, 75 and 76 show variation, with the most common genotype being "G-AG, at positions 73–76," seen in 34/63 (or 53.9 percent) of individuals. The "G-AA" genotype is seen in 23/63 (or 35.5 percent) of individuals, the "G–A" genotype is seen in 3/63 (or 4.7 percent) of individuals, and the "GAAA" genotype is seen in 2/63 (or 3.1 percent) of individuals. The northernmost site shows the greatest diversity of haplotypes (3/4 haplotypes), including the two least abundant haplotypes. The eastern and western sites show two haplotypes each, both being composed of the two most abundant haplotypes.

Post-trim, we were able to analyze 380 base pairs from the *ITS2* marker. The marker was found to be monomorphic in all 63 individuals sampled. Given our criteria, the *ITS2* BLAST search yielded



20 results, 19 from *Neottia* and *Listera* and one outgroup specimen *Epipactis atrorubens* (Hoffm.) Besser (Voucher NMW5069). The outgroup specimen had an 86.5 percent sequence similarity to the *N. bifolia* specimens sampled. BLAST results of the same species tended to have high sequence similarity to each other (Table 1) with three samples of *N. bifolia*, four samples of *N. cordata*, and five samples of *N. ovata* all having 100 percent sequence similarity within species. Two samples of *N. japonica* had a 99.2 percent sequence similarity, and three samples of *N. nidus-avis* had 91.02 percent sequence similarity, the most variation captured within species. The best nucleotide substitution model for the *ITS2* dataset was GTR + G. Bootstrap values were generally acceptable. The known mycoheterotrophic samples (*N. kiusiana* and *N. nidus-avis*) form a clade embedded within the chlorophyllous species. When multiple samples of the same species were present, they clustered together in every case.

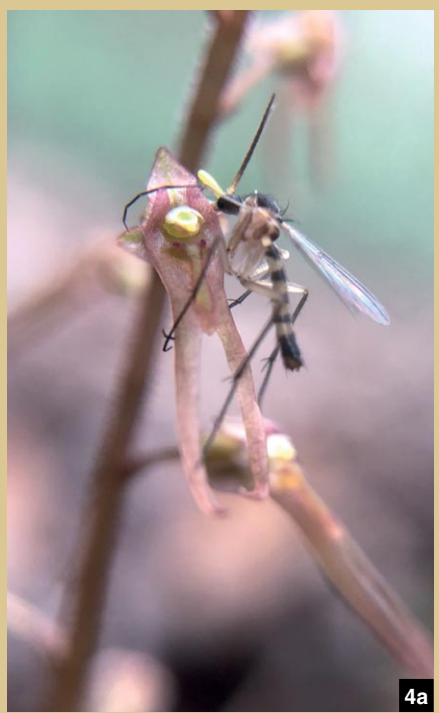
A total of 14 weeks passed from the first observed above-ground vegetative growth and we observed the final plants senescing above ground. We made our first observations *N. bifolia* in its vegetative state beginning the week of January 8, 2020. To avoid damaging the youngest plants, we did not disturb leaf litter during the course of our observations. Due to this, the actual date of above-ground emergence likely predates our observation by a week or more. Our first observation of open, pollen-receptive flowers was during the week of January 29, 2020, three weeks after above-ground vegetative growth was first documented and peaked during the week of February 26, 2020. Seven weeks passed between the appearance

[1] Distribution of *Neottia bifolia* individuals sampled across the 707 km² surveyed. Color of the plot indicates the chloroplast haplotype for that individual at the *rps16-trnK* locus. GPS coordinates have been manipulated so that individuals are not overlapping at the scale presented.

[2] Maximum likelihood phylogram for the *ITS2* marker for *Neottia bifolia* samples and BLAST search results in *Neottia* and *Listera*. Inference used the model of best fit, GTR + G, as determined by jModelTest2.1.10 along with 1,000 bootstrap replicates. Scale bar represents the number of substitutions per site. Tree rooted using *Epipactis atrorubens* (Hoffm.) Besser (Voucher NMW5069). Photosynthetic species are highlighted in green and species that are mycoheterotrophic as adults are highlighted in tan.

[3] Phenology of *Neottia bifolia* during the 2020 field season. Above-ground vegetative growth was not recorded until individuals were visible above any leaf litter. Values are reported as the proportion of the total plants surveyed in any stage at a time, with the exception of above-ground senescence, which was cumulative. When a single plant fell into more than one category, it was reported as being in the latest stage it displayed.

of the first flower and the final flower. Fruit development began the week of February 19, 2020, three weeks after the appearance of the first open flowers and lasted five weeks. Fruit dehiscence began the week of March 11, 2020, three weeks after the first fruits began to develop and continued to dehisce through the week of April 8, 2020. Above-ground senescence happened rapidly, within weeks after fruits dehiscence. A significant number



[4] *Mycomya* (Mycetophilidae) species collecting pollinia from *Neottia bifolia* flowers (4a and 4b) February 18, 2020 and successful fruit development (4c) from fungus gnat-visited flowers March 30, 2020. Photographs by Jeremy Rentsch.

of plants remained in a vegetative state through the entire growing season but senesced above ground, along with the rest of the plants, by the week of April 15, 2020.

During our observations, we found *Mycomya* (Mycetophilidae) species to be the sole pollinators interacting with *N. bifolia* generally, and collecting pollinia specifically. From our observations, their peak pollination activity was between February 17, 2020 and February 21, 2020 and we confirmed that plants visited by *Mycomya* species successfully set fruit.

DISCUSSION For the size of the area surveyed, the *rps16-trnK* marker proved to be highly informative, with four haplotypes being found among 63 individuals over a relatively small area of 707 km^2. On the other hand, the *ITS2* marker was found to be monomorphic among our 63 individuals and, what is more, the BLAST hits matching *N. bifolia* shared a 100 percent sequence similarity to our samples. While a more robust picture of the way genetic diversity is partitioned in space for these populations will involve more informative nuclear loci (Eidesen et al. 2007), we believe these data are a helpful first step for management and conservation decisions in relation to this orchid. Further, we believe that *rps16-trnK* is an informative marker that could likely be used in conjunction with an informative nuclear marker to study the broader phylogeography of the species. Our BLAST hits and resulting phylogram indicates that the *ITS2* nuclear marker is quite good for species-level discrimination, but likely has little value in population genetics or phylogeography where *N. bifolia* is concerned. Phylogenetic inferences based on *ITS2* were found to be consistent with the inferences presented by others (Zhou and Jin 2018; Zhu et al. 2019; Rentsch et al. 2020), with the mycoheterotrophic species of *Neottia* found nested in a clade within the larger *Neottia* genus.

Species of *Neottia* are known for vegetative reproduction with long, superficial roots that develop shoot apical meristems and leaf primordia after shedding their root cap (Rasmussen 1996; Kotilínek et al. 2018). Asexual reproduction may explain the clustering of genotypes seen in this research, with both rare chloroplast haplotypes being found in tight clusters. As with identifying the broader patterns of phylogeography of the species, an informative nuclear marker would help us identify the extent of clonal spread in the species. The average lifespan of *Neottia bifolia* is unknown, but all known *Neottia* species are perennial, living from a few years in *N. cordata* (Smith 1993) to well over 70 years in *N. ovata* (Tamm 1991). The perennial nature of the orchids explains the persistent number of individuals in a vegetative stage for the entirety of the growing season. These individuals may be young clones or seedlings.

During our pollinator observations, we found only a species of *Mycomya* (Mycetophilidae) visiting *Neottia bifolia* flowers and carrying pollinia. This direct observation of pollination in action is important, as many insects may associate with flowers without necessarily pollinating them, as observed in *Neottia ovata* (Nilsson 1981). Our observations do not preclude additional pollinators, of course. Despite the intricate nature of orchid flowers and a typical high degree of pollinator specificity (Tremblay 1992; Ibisch et al. 1996), it is not entirely uncommon for orchid species to have multiple pollinators. Both *Neottia cordata* and *Neottia ovata* have been shown to be pollinated by several groups of insects (Ackerman and Mesler 1979; Kotilínek et al. 2015; Kotilínek et al. 2018).

Overall, we believe the data provided here give us a more comprehensive understanding of *Neottia bifolia*. Although subject to change based on latitude and elevation (Tsiphtsēs and Antonopoulos 2017; Kotilínek et al. 2018) we provide a baseline reference for the phenology of the species across a growing season as well as evidence of a fungus gnat pollinator. We show the usefulness of the *rps16-trnK* chloroplast marker for potential population genetics applications and the usefulness of the *ITS2* marker in phylogenetic inference. Useful next steps

would include a broader study of the phylogeography of the species across the eastern United States and Canada, as well as more informative research into the potential clonal spread of the species.

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Fertilizer Baskets

These little baskets were first introduced to me by Desert Valley Orchid Society (Phoenix) member Karla Velasco who was using them with a timed-release fertlizer. Because I was using a liquid fertilizer at the time, I put it aside for future use. Then I read about a fertilizer called Purely Organic manufactured in South Carolina (purelyorganicfertilizer.com/about/how-to-order). Sue Bottom's article (2017) showed excellent results on struggling orchids. The instructions were to put it into a tea bag and place the tea bag on top of the medium. The fertilizer will slowly release its nutrients as you water. I used the tea bag approach, which worked but looked really ugly sitting in the orchid pot. So, I ordered these little fertilizer baskets (the small size is 0.8 inches [2 cm]) from Amazon, 100 for around $16.50. They were designed for pelletized fertilizers for plants such as bonsai and orchids. So far, they work beautifully. They blend in well with the plant and even fit into my small 2-inch (5.1-cm) pots. For my larger pots, I use two. You would think that the powdered fertilizer would fall through the small holes but if you press it down firmly, it does not leak out. — *Cindy Jepsen (email: cindyjepsen@cox.net).*

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Bulbophyllum macranthum

Text and photographs by Charles Wilson

How to Grow a Specimen-Size Plant!

1

GROWING ANY ORCHID to a specimen size can present all manner of challenges, and especially when its preferred growth habit is an upward creeping rhizome such as that of *Bulbophyllum macranthum,* which is perhaps best suited for mounting on a totem. Our mentor Joan Levy gave us a small plant in October 2000 that she had recently rafted onto a tree fern totem about 12 inches (30 cm) long. A few years later, when it had grown to the top end of the totem, we asked her "What do we do now?" Her response was simply "Put another totem on the top." And that is what we have done on average about every five years in addition to adding a swivel at the top so the plant can be regularly rotated when watering for even growth. Since the plant is now over 6 feet (2 m) tall, we have had to cut off the bottom 18 inches (45 cm) when adding the new tree fern totem extension to keep it within the confines of our greenhouse. In order for the extension to be added, a heavy metal wire is forced vertically through the tree fern totem (predrilling a pilot hole helps keep the wire straight) and attached to the protruding top wire on the main plant; the new totem is them forcefully slid downwards to close the gap. Within a year or two the upward-growing plant will cover the joint entirely. The plant blooms regularly and can be very floriferous, but the nonresupinate flowers are recondite (hidden beneath the foliage), presenting a challenge to photography. Grown under warm conditions with night minimums of 65 F (18 C), the plant this year produced over 215 flowers over two months.

[1] The author stands next to the specimen-size plant *Bulb. macranthum* that hangs on a swivel enabling regular rotation for even watering and growth around the totem.

[2] Closer inspection reveals hundreds of nonresupinate (lip uppermost) flowers nestled among the leaves. The individual flowers are about 2 inches (5 cm) in diameter and have a clovelike fragrance.

[3] The author and his wife recently relocated from the West Coast to suburban Atlanta by motorhome. How does one handle a specimen like this? Of course, hang it in the motorhome's shower!

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