Surviving a Decade of Drought?

Some *Cypripedium* species of Lijiang, Yunnan

BY PETER BERNHARDT

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IF YOU WANT to see the greatest variety of temperate zone orchids in bloom the general opinion is that you must go to China from midspring to early summer. Chinese and Western botanists record up to 1,449 orchid species within China's borders but 90 percent of them are distributed in less than 3 percent of the country. The secret of locating orchid diversity in China is to visit the mountainous borders where the provinces of Yunnan, Sichuan and Tibet all come together (Zhang et al. 2014). This places you on one of the many doorsteps of the Himalayas where the tallest mountain peaks should always wear snowcaps. These days, though, the working word in that last sentence is "should."

Thanks to a generous fellowship for visiting scientists from the Chinese Academy of Sciences in 2015, I was able to work in the laboratory of Dr. Zong-Xin Ren at the Kunming Institute of Botany, Chinese Academy of Sciences (Kunming, Yunnan) from May 15–August 15. We had a most interesting project. As the majority of the orchids of Western Europe and North America have so many relatives native to China it allowed us to ask the question, "Does the pollination of so many unstudied Chinese species resemble their far better researched relatives in the western regions of the Northern Hemisphere?" Darwin (1877), after all, was restricted to the orchid species growing near his home in what today is only a rural patch of southern London. He obtained potted, exotic specimens from private collectors and the Royal Botanic Gardens at Kew (see Edens-Meier and Bernhardt 2014). His investigations of "Asian" species were restricted to greenhouse flowers of *Calanthe*.

Dr. Ren and I were especially interested in the *Cypripedium* species as the mountains of southwestern China are centers of diversity for these lady's slippers. Darwin's own work on *Cypripedium* was restricted to two North American species (*Cypripedium parviflorum* and *Cypripedium acaule*). His interpretations of how these flowers manipulated insects required correspondence with his friend Asa Gray, of Harvard University (Edens-Meier and Bernhardt 2014). As wild plants, the Chinese cypripediums are not happy or long-lived in pots. That meant finding them in their natural habitats in the mountains of Yunnan.

Some of the best sites for finding populations of *Cypripedium* species in bloom in Yunnan were, historically, in the mountains of the counties of Lijiang and Shangri-la. What we found, instead, was continued evidence that these spectacular plants remain in decline due to a decade-long drought based specifically on a lack of snowmelt each spring. From late May through early July one should find extensive populations of *Cypripedium* species in Yunnan on mountain slopes bathed by runoff as creeks and streams should be full of snowmelt from the highest peaks. The humus insulating forest floors should be moist and spongy. Orchids should bloom extensively with dozens, if not hundreds, of flowering stalks up and down the slopes at elevations of 8,800 to 11,500 feet (2,700–3,500 m). That's not what we found in the mountains we visited. Our observations within the better sites showed that, while all spring-flowering species remain, they occurred in numbers far too small to manipulate for most experimental studies.

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[1] *Cypripedium flavum* at Yulong Snow Mountain, Lijiang. This was the most common lady's slipper found over several days. Photo by Peter Bernhardt. (Insert) Molecular phylogeny confirms that the "sister species" of this widespread, Chinese species is the North American, showy lady's slipper (*Cypripedium reginae*). Note that both species produce leafy, canelike stems. Photo by Professor Retha Edens-Meier.

[2] Walkway on Yulong Snow Mountain, Lijiang (about 10,800 feet [3,300 m]), late May, 2015. Note the scarcity of snow on the mountain tops. By placing a walkway through the dense pine and oak forest more light hits the forest floor and the trail is lined with anemones, gentians, native mints and other wildflowers this time of year.

Our first orchid hunt was June 2, 2015, and we started from Baishuihe, the Yulong Snow Mountain tourist site in Lijiang at 9,990 feet (3,050 m). This area offers a cluster of buildings, local people (Naxi minority group) doing traditional dances to attract tourists and a ski lift to better observe the mountain. As we were doing scientific research we were allowed to walk through a mixed conifer and oak forest area prohibited to casual visitors. Walking up the slope was a treat as a path of stone and concrete slabs was built through the forest. Where there is a chasm leading to a deep, snowmelt-based riverbed the slabs were replaced by a wooden boardwalk. The concrete path was charming, like a white version of the Yellow Brick Road, with wildflowers in bloom on either side of the shady woodland including various species of salvias, gentians, yellow *Stellera* and

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[3] *Cypripedium lichiangense.* The population we found that day was severely reduced to less than 10 flowering plants and no new ones turned up during subsequent searches but, in previous years, Dr. Ren has found more than 60 of these orchids in bloom at the same site.

anemones. Native primroses and creeping cotoneasters colonized more open, rockier places.

Cypripedium plectrochilum had finished flowering for the year. It blooms almost a month earlier than the other four species and withered flowers with fruiting ovaries suggested it had enjoyed a respectable season while the soil was still moist. Instead, Dr. Ren took me to a "hidden" population of *Cypripedium lichiangense* he's been watching and guarding for several years. Only three flowers were open for inspection. A few were in bud but it was obvious this clump would produce fewer than 10 flowers this year. They were magnificent, as a single flower had a circumference the size of a tea saucer. Attempts to suck pollinators out of the labellum trap, using an aspirator, were unsuccessful. There was no obvious floral scent either but touching the floral organs for the first time was an uncanny experience. Petals and sepals felt like they were made out of latex and boiled animal cartilage.

Cypripedium flavum bloomed within a few meters of the *Cyp. lichiangense.* This was the only slipper orchid that was relatively common while we worked at Snow Mountain. The patch we found on the first day, on level ground, proved atypical. In fact, the majority of these yellow slippers preferred rather narrow and scary rocky slopes. Over 30 flowering stems were located but this, once again, was a fraction of the number found in previous, wetter years. These orchids should be of interest to most North American lovers of their native species as genetic studies finally confirmed that they are "sisters" to our own *Cypripedium reginae* (Li et al. 2011). Aside from obvious differences in color patterns, *Cyp. flavum* has a far stronger and more complex scent (rose oil and lily-of-the-valley) compared to its almost odorless North American cousin.

We explored additional areas the following day crossing a bridge over a rocky, dry riverbed that should have contained moving water that time of year. This is the only place in which we found *Cypripedium tibeticum*. While there were a number of emergent and mature leaves only one stem was in flower and I had to gently push up the dorsal sepal with a twig to take its portrait. The majority of *Cyp. flavum* bloomed in this area but Dr. Ren also located a few flowering specimens of *Cypripedium margaritaceum.* Their flowers do resemble a miniature version of *Cyp. lichiangense* but, once again, attempts to suck out pollinators from the labellum trap, using aspirators, failed.

The overall impression of the area above the riverbed was that the ground was unseasonably dry. By June, *Pleione bulbocodioides* should be easy to find in this mountain range. Its purple-pink flowers poke up through moss-covered rocks or under shrubs. The moss was dry, as well, and I found only two plants in bloom under a spindly bush along the path above the bridge.

Indeed, the biggest surprise occurred on the previous day when we ran into Holger Perner and his family leading a tour of Japanese and German orchid photographers along the same path. To find orchids they enthusiastically walked off the path far greater distances and with far greater enthusiasm than I had, but they had to admit that the flowering orchids they found were also few and far between. Holger was pessimistic about the last decade of drought and felt that the prospects of monitoring extensive populations of *Cypripedium* species in the area where the three Chinese

states meet the Himalayas are over. He also warned that the drought affected local agriculture and this also impacted surviving populations of orchids. The sons of poor farmers were now encouraged to dig the orchids up and sell them to dealers passing through. It's illegal, but provincial protection over such a broad area is minimal, at best.

It was time to leave Lijiang to try our luck in the neighboring county of Shangri-la. We hoped our luck would change at even higher, hopefully wetter elevations.

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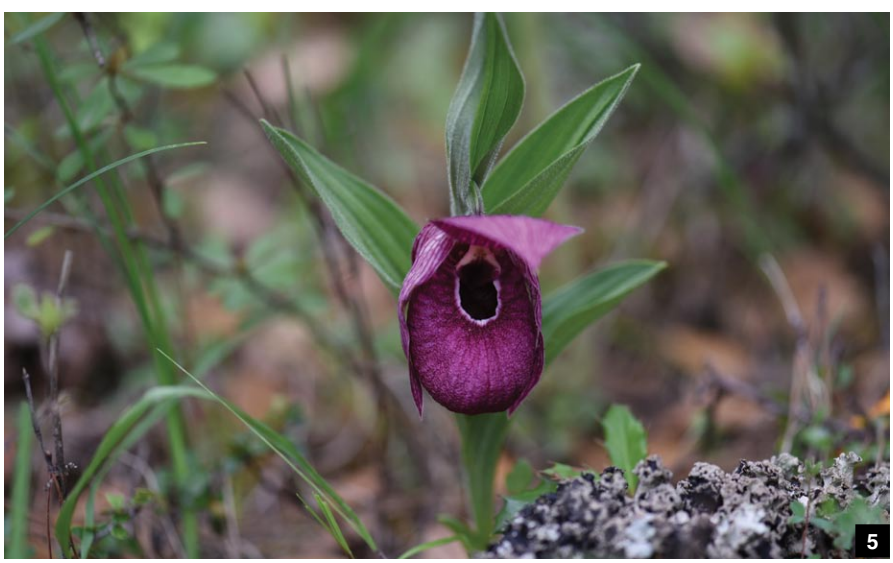
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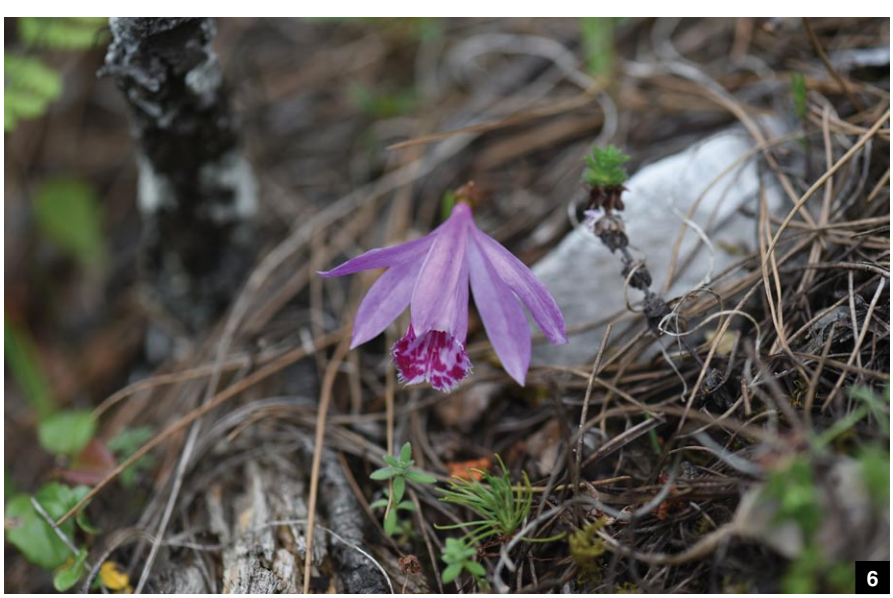
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[4] *Cypripedium margaritaceum*. Usually found in pairs or very small clusters. Less than 10 were located in a few rocky sites with some moss and debris. Dr. Ren remembers 50 flowering plants at Snow Mountain in years past.

[5] *Cypripedium tibeticum*. We found only one in bloom, near the dry river bed, after days of searching.

[6] *Pleione bulbocodioides*. A cluster of a few plants in bloom were found by a trail near the dry river bed and a cliff face. At that time of year the plants should bloom in a thick bed of fresh, green moss.