1

C. LAUDEREAU

Photo 1
New Caledonia. The endemic *Megastylis gigas*, one of the most common orchid species found on the island

Vanilla and Other Wonders of Nature

Orchids are masterpieces of evolutionary success and aesthetic splendor.

DOI: 10.24425/academiaPAS.2023.147639

Prof. Dariusz L. Szlachetko

Dean of the Faculty of Biology at the University of Gdańsk, specializes in the study of orchids. He has carried out dozens of expeditions and examined specimens in herbariums around the world. His field research has taken him to French Guiana, Peru, Ecuador, Colombia, Cameroon, Madagascar, Vietnam, and New Caledonia. He is the author or co-author of 3888 new taxa of various ranks and new nomenclatural combinations in the Orchidaceae family.

dariusz.szlachetko@ug.edu.pl

Photo 2
New Caledonia, 2019.
A misty mountain forest

Dariusz L. Szlachetko

Faculty of Biology, University of Gdańsk

Plants in the family Orchidaceae have undoubtedly achieved the greatest evolutionary success among all types of plants pollinated by animals. Representatives of this cosmopolitan family can be found on all the continents except Antarctica, and in all types of habitats except deserts (they avoid extremely dry areas). Adaptation to various groups of animals as pollinators and to different environmental conditions has led orchids to become a highly diverse group of plants in almost every aspect. Unlike other flowering plants, orchids do not undergo double fertilization, a characteristic process for angiosperms. Some 90% of all orchid species are epiphytes, meaning that they grow with their roots attached to another plant. Orchids have many features adaptive to this lifestyle. For example, the roots of epiphytic orchids are surrounded by a layer of dead cells, called velamen, which can quickly absorb water, either from rainfall or in the form of water vapor.

Orchids are a group of plants that displays a range of extremes – ranging from very small plants to true giants. Orchids are perennial plants, but there are certain species whose lower stem may become woody, such as *Clematepistephium smilacifolium* from New Caledonia. Orchid plants vary greatly in terms of size, from just a few millimeters to even 100 meters in length. The largest orchid is vanilla, a climbing plant with fleshy stems and leaves. The longest measured vanilla specimen was about 100 meters long, although

T. KUSIBAB (2)

Photo 3
Ecuador, 2008. Cordillera del Cóndor. In the tropics, botanizing sometimes requires unconventional skills

Photo 4
Ecuador, 2008. Cordillera del Cóndor. It's hard to believe this is almost on the equator. The weather in the páramo zone can be brutally cold, but there are plenty of orchids

Photo 5
Peru, 2008. Orchids can be found growing even among the ruins of Machu Picchu – *Brasolia dichotoma*

the plants can undoubtedly grow even larger. Vanilla is a monopodial plant, theoretically capable of unlimited growth. Among the sympodial orchids, the tallest is *Brasolia (Sobralia) altissima* from the Peruvian Andes, which resembles bamboo and reaches almost 15 meters in height. The largest epiphytic orchid is *Grammatophyllum speciosum* from Borneo, which can form pseudobulbs up to 7 meters long. Certain orchids have inflorescences so tiny they can fit on the head of a pin, such as *Platystele imperialis* from Guatemala.

Unique and intriguing flowers

Orchid flowers are also highly varied. Based on the kinds of orchids that are familiar to us from flower shops, greenhouses, or botanical gardens, we might think that they always have beautiful, very attractive flowers. However, most species found in nature have flowers that are quite inconspicuous at first glance. Only when observing them through a magnifying glass can one notice their unique and intriguing structure. Given the extent of the variation, it is worth asking what common feature this group of plants shares, what distinguishes them from others.

Let's start with the reproductive organs. In the case of orchids, the stamen fuses with the pistil neck, forming a kind of rod, called the *gynostemium* or *column*. This is a unique structure found in this form only in orchids. The pollen mass in most orchids is compact and forms a pollinium. The stigma of the flower also undergoes various modifications. The central part of the stigma transforms into a rostellum, which is infertile and loses its primary functions. This structure forms various appendages for attaching the pollinium to a pollinator. Another feature of orchids is the transformation of the central inner petal into a labellum, which is larger and differently colored and shaped, often with protrusions. It serves as a kind of landing platform for insects. Some orchids have a spur at the base of the labellum, where nectar is stored. There are certain orchids whose labella mimic the females of particular insect species. *Paphiopedilum sanderianum* from Borneo, with inner petals of the perianth up to a meter long, is one of the most spectacular. Interestingly, this species was described in the late nineteenth century. For almost 100 years it was known only from a single herbarium specimen. It was even thought to be a chimera, not found in nature. It was not until the 1970s that the plant was rediscovered in Borneo.

Orchid seeds typically consist of a few dozen undifferentiated cells surrounded by a seed coat much

B. SZMIT

larger than the embryo itself, creating an air chamber. As a result, the seeds are very light, dust-like, and can weigh mere millionths of a gram. There can be up to several thousand seeds in a single fruit, which are very easily carried by the wind due to their small size. However, these lightweight seeds are not equipped with reserve nutrients and so require specific fungi, mainly of the genus *Rhizoctonia*, to be able to germinate. Of the vast number of seeds produced by orchids, only a few percent have the ability to germinate after interacting with the right symbiotic fungi. Moreover, the development of the young plant itself is very slow. For the first few years, the plant functions as a group of undifferentiated cells, called a *protocorm*. The entire developmental cycle from seed germination to flowering can take years, even a decade or two. Vanilla is an exception, with fleshy, berry-type fruits that contain substances harnessed in the food industry.

Victims of their own success

Nearly 30,000 species of orchids have been described worldwide. The country with the greatest number is Colombia, home to about 5,000 species. This is even more striking when compared to Poland, where the total count of *all* vascular plant species is about 3,000. South America, especially the Andean countries, is generally a hotspot for orchid diversity. Most of the species groups there are young, still evolving quite rapidly. Nearly every mountain valley and peak has a unique array of species not found elsewhere. Also very rich and diverse are Australasia, Africa, and islands like Madagascar, New Guinea, and New Caledonia, where we can find a great wealth of endemic species. The temperate zone, however, is not particularly preferred by orchids. Poland has about 50 species, mainly in the south. In the Tatra Mountains, for example, we may encounter several species growing along hiking trails, but there are far fewer in the central part of the country.

Orchids are, in a sense, victims of their evolutionary success. They are largely dependent on insects and on mycorrhizal fungi. If the right organisms are not present, seed production and subsequent germination are not possible, causing populations lacking pollinators or symbiotic fungi to die out. Climate change is taking its toll on quite a few organisms, and orchids are certainly no exception. High temperatures, droughts, fires, and floods are major threats. Another danger faced by orchids is the extermination of their pollinators. If the insects are unable to overwinter in rotting stumps, for example, they will die, reducing the availability of potential pollinators.

Locally, orchids can be very common. However, all orchid species are protected and on the CITES list, so they cannot be plucked or transported across the borders of countries where they occur naturally. One can even go to jail for illegally transporting orchids, and many places have banned the trade of orchids without special permits. Unfortunately, despite this, illegal trading in orchids obtained from the wild is still practiced today. Individual plants can sometimes fetch dizzying prices (up to several thousand euros) simply because they were collected from the wild. This is astonishing, given that most species can be purchased for much lower prices from specialized nurseries where they are reproduced *in vitro*. This is especially true for valuable and rare species, whose wild populations only consist of a few dozen specimens. For instance, orchids of the rare genus *Paphiopedilum*, which are available at specialized nurseries and can easily be purchased. Species such as *Paphiopedilum kolopakingii* are particularly sought after, as they form inflorescences up to two meters tall, boasting up to 14 impressive flowers. Preserving them in the wild and protecting their natural sites must be a priority. Orchids are, after all, true wonders of nature. ■

J.C. URIBE

Photo 6
Colombia, 2010. The road to Buenaventura. The author with a *Selenipedium aequinoctiale* specimen, one of the rarest species of the genus