



AIPC

SPECIAL ISSUE

3

Special Edition

The Mexican *Pinguicula*

by Gabriele Basso



President
Graziella Antonello
presidente.aipc@gmail.com

Vicepresident
Elena Severgnini
vicepresidente.aipc@gmail.com

Secretary
Andrea Scaccabarozzi
segretario.aipc@gmail.com

Treasurer
Luigi Tartaglia
tesoriere.aipc@gmail.com

Editor
Editorial Group AIPC
editore.aipc@gmail.com

Editor in Chief
Cristina De Rossi

◆
Get in touch with AIPC

AIPC
via Mar Tirreno 9/3
30034 Mira (VE)
Italy

www.aipcnet.it

info@aipcnet.it

◆
Graphic and Composition

Chiara di Biase

◆
The opinions expressed by the
authors are not necessarily those of
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by Gabriele Basso

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Editorial



Dear Readers,
AIPC is pleased to present this Special Issue n° 3, which belongs to the series, available on CD, specifically addressed to the English-speaking friends of the Association: the English version of AIPCMagazine 14 (June 2009), a special double issue, an incredibly beautiful monograph by Gabriele Basso, completely devoted to Mexican Pinguicula. The issue is also available for downloading as a .pdf file at the AIPC website (www.aipcnet.it).

We would like to thank all those who collaborated, back in 2009, in the preparation of the monograph and also all those who today have prepared the translation of the text and the adaptation of this issue (the whole Translators Group, Chiara di Biase, Andy Smith, Noah Elhardt and Sara Pennak).

Maurizio Saroldi

Introduction

Pinguicula are herbaceous plants belonging to the family of *Lentibulariaceae*; all genera belonging to this family (*Utricularia*, *Genlisea* and *Pinguicula*) have evolved a carnivorous behavior, although the capturing mechanism of the three genera differs greatly. *Pinguicula* form rosettes of greasy-looking leaves, whose upper surfaces are densely covered with small, glandular hairs. These glandular hairs produce a mucilaginous liquid that attracts and traps small insects, which are then digested and absorbed by the plant.

The earliest known mention of *Pinguicula* dates back to the fifteenth century. In 1555 the famous botanist Conrad Gesner coined the term '*Pinguicula*' (meaning 'small and fat') which was then used by Linnaeus to describe this genera in the middle of the 1700's. At the time of Linnaeus only four species of *Pinguicula* were known to science. With an increase in overseas travel and the great scientific explorations of the early 1800's, the list of species greatly increased, and by the second half of the century it contained over thirty names.

Towards the end of the 1800's the genus *Pinguicula* attracted the attention of the great naturalist Charles Darwin, who examined their carnivorous behavior. The study of these plants continued throughout the twentieth century and new species continued to be discovered. In 1966 Jost Casper wrote an important document on

the genus *Pinguicula* and his monograph includes approximately forty species. Since the publication of Casper's monograph, the number of described taxa has doubled, with most of the new discoveries occurring in Mexico. Geographically, *Pinguicula* are present on all continents except Oceania; in Africa, though, the genus is only represented by a couple of species typical of Europe whose ranges extend into northern Morocco.

The main center of diversity of *Pinguicula* is Central America. The majority of species are found here: roughly 50 in Mexico and Central America and a further 10 from the Caribbean islands. Another center of diversity is Europe, where about fifteen species occur, mostly in mountainous areas. In Asia, seven species inhabit cool, temperate regions at high latitudes; one of these is endemic to the mountains of Japan and *P. alpina*, which grows also in southerly regions as far as the Himalayas. Six species are found in the subtropical zone of the Gulf of the U.S.A., while three temperate species are found in mountains and at high altitudes in North America. South of the equator, at last, *Pinguicula* can be found just in South America where six species grow at high altitudes in the Andes mountains.

It is clear that Mesoamerica can be considered the probable center of origin for the genus *Pinguicula*, from where it likely spread to other continents.

Part I The Mexican *Pinguicula*

The discovery of the first *Pinguicula* in Mexico is intertwined with the stories of those famous explorers and botanists whose names have entered the annals of history. In the late eighteenth century, scientific expeditions were fundamentally sponsored by governments (attracted by both the scientific knowledge and the economic implications resulting from the exploitation of the resources on the other side of the oceans) or by institutions or botanical organizations that were then creating enormous collections of exotic specimens (e.g. the Royal Horticultural Society). Soon, this passion for the exotic became a real mania, and, from the middle of the nineteenth century onwards, also many private people were interested in the trade in exotic plants, funding the research and the collection of plants from the wild.

Whatever fuelled this age of exploration, the fact is that a band of explorers, botanists, zoologists, geologists, geographers and painters, crossed the vast oceans to collect samples and specimens and then see them transported back home alive or in a dry state, or to reproduce them in beautiful and delicate watercolor paintings. More often than not, just a single person would combine all these skills themselves.

A classic example of this explorer/naturalist as a whole is Humboldt: between 1799 and 1804, together with Bonpland, he discovered *P. moranensis* and *P. macrophylla* while conducting his famous expedition

in Latin America, in which, in addition to Mexico, also Cuba, the Amazon and Peru were visited. The two naturalists collected over 6000 species, many of them unknown to science at the time. The two new *Pinguicula* species were published some years later in 1817, in "*Nova Genera and Species Plantarum*", one of the first books dealing exclusively with the flora of South America. Between 1824 and 1828, two German naturalists, Schiede and Deppe, collected another new butterwort. They sent it to Germany and it was described in 1830 by Schlechtendal and Chamisso as *P. lilacina*.

Also during this era, on an expedition that lasted from 1836 to 1843, Hartweg, a procurer of plants for the Royal Horticultural

P. moranensis 'orchidioides', botanical illustration by W. J. Hooker, 1846



Society (then famous for its collection of exotic orchids which he helped to create), discovered *P. acuminata* and *P. heterophylla*. In 1839 Benthham published these two new species in the collection "*Plantae Hartwegianae*".

In 1844, the book "*Prodromus Systematis Naturalis Regni Vegetabilis*", initiated by the famous botanist Augustin De Candolle and continued by his son Alphonse, was published. This is a fundamental work for all the taxonomy that will follow, and contains as many as 32 species of *Pinguicula* from all over the world, ten of which are Mexican. Here appears the first infrageneric classification into three sections based on the morphology of the corolla and also the description of three new Mexican butterworts: *P. crenatiloba*, *P. orchidioides* and *P. oblongiloba*. In truth, these species had been discovered much earlier, during the Spanish expedition of Sessé-Mociño of 1787-1803, during which thousands of botanical and zoological specimens were both collected and reproduced in paintings. Upon returning to Spain, however, Sessé died, and in addition the political situation had changed dramatically, so the publication of a Mexican flora, which includes the new discoveries made on the expedition, is cancelled. Mocino then moved to France where he showed the numerous and beautiful drawings of the Mexican plants to Augustine De Candolle, who recognized the importance of the material and quickly began to make copies of the watercolors. These were later used for the descriptions made in his *Prodromus*.

Many years later, in 1910, the discovery of a new Mexican butterwort with long leaves generated much interest: it was discovered by the explorer and collector Purpus and was named *P. gypsicola*. Purpus, who was in correspondence with various institutions to

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basi calcarata; labio superiore trilobo; inferiore bilobo, brevior. STIGMA bilamellatum. CAPSULA unilocularis, semibivalvis, polysperma; placenta centrali, libera.
Herbæ acules. Folia radicalia pinguia. Scapi uniflori.
1. PINGUICULA CALYPTRATA. †
P. foliis ovatis, obtusis, convexis, glabris, sessilibus; scapis glabris; calcare conico, obtuso. corolla brevior.
Crescit locis temperatis et frigidis juxta Loxam et in Paramo de Saraguro, alt. 600—1500 hex. (Regno Novo-Granati.) et Floret Augusto.
Herba scapulis Pinguicula vulgaris, sed minor. Rami perennis, ramosi, fibrosi. Folia radicalia sessilia, ovata, apice retundato-obtusis, integerrima, convexa, glaberrima, supra nitida, pollicaris. PENECELLA radicales uniflori, erecti, tri- aut quadriflori, teretes, glabri, nudi. CALYX bilabiatus; labio superiore erecto, tridentato; inferiore reflexo, bidentato. COROLLA violacea, ringens, basi calcarata; laciniis emarginatis; fauce villosa; calcare conico, corolla brevior. STIGMA campulatum, bilabiatum, reflexum, extensori intar antheras obtegens. CAPSULA ignota.
2. PINGUICULA MACROPHYLLA. †
P. foliis subrotundo-ovatis, obtusis, planis, glabris, petiolatis; scapis tenuissimiglandulosis pilosis.
Crescit in Novæ Hispaniæ collibus inter urbem Guanajuato et pagum Santa Rosa. et Floret Augusto, Septembri.
Folia radicalia petiolata, subrotundo-ovata, obtusa, plana, integerrima, glabra, triplicaria. PENECELLA semipollicares. PENECELLA radicales uniflori, erecti, semipedales, teretes, nudi, pilis glanduliferis tenuissime conspersi. FLORES non vidi.
3. PINGUICULA MORANENSIS. †
P. foliis spatulatis, obtusis, convexis, glabris, apice ciliatis, sessilibus; scapis glabris; calcare filiformi, recto, corolla longior.
Crescit locis temperatis prope Moran Mexicanorum, alt. 1340 hex. et Floret Augusto.
Rami fibrosi. Folia radicalia crebra, copiosa, sessilia, spatulata, obtusa, integerrima, margine revoluta, supra piloscula, subtus glabra, apice ciliato-fimbriata, semipollicaria. PENECELLA radicales uniflori, erecti, quadriflori, teretes, glabri. CALYX bilabiatus; labio superiore tripartito, erecto; inferiore bipartito, reflexo. COROLLA violacea, ringens, basi calcarata, novem lineas longa; labio inferiore (superiore Bopli) bilido; superiore (inferiore Bopli) tridentato, inferne alba-maculato, laciniis intermedia majore. Calcare rectum, cylindricum, corolla longius. STIGMA et PLACENTA brevissima, acuta, alba. OVARIUM ovatum, violaceum. STIGMA sessile, infundibuliforme, subbilabiatum, denticulatum.

Nova genera et species plantarum by Humboldt, Bonpland & Kunth (thanks to Missouri Botanical Garden). Right: a cover of the IPSG newsletter

which he was providing scientific materials, introduced *P. gypsicola* into cultivation, at the Botanical Garden of Darmstadt, where his brother was working.

During this period, probably very few Mexican butterworts were cultivated. Even during the Victorian period of the mania for the exotic, when several species of carnivorous plants could be found in the most famous nursery catalogues, most *Pinguicula* in cultivation were grown almost exclusively at the major botanical gardens (e.g. *P. moranensis* 'orchidioides' is definitely already present at Kew by 1846, where it is cultivated and described by Hooker).

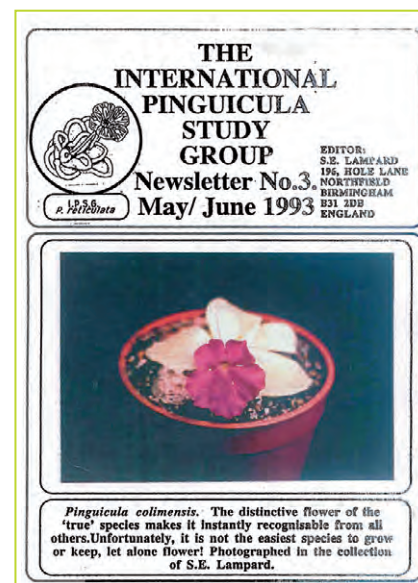
During the years between the 1930's and the 1970's many new species were discovered, including *P. agnata*, *P. clivorum*, *P. colimensis*, *P. cyclosecta*, *P. imitatrix*, *P. kondoi* and *P. sharpii*. Numerous revisions and studies were conducted (in particular involving the "moranensis complex"), but they were complicated, dealing with the variability of

characteristics in the different species, and further hampered by the quality of the samples in the hands of botanists as most of the studies were done in the Herbarium and the delicate tissues of *Pinguicula* do not preserve well in dry conditions. Among these studies, the best known is certainly the one made by Jost Casper who, in the 1960's, wrote a monograph of the genus *Pinguicula*, and which is still a reference for botanists today. It includes 46 species of *Pinguicula*, 13 of them Mexican, divided into three subgenera. The systematics of his *Monographie* are based primarily on the morphology of the flower, but also analyzed are the habitus of the plant, geographical distribution, and the cytological and embryological data.

During the 1970's there is a revival in the cultivation of carnivorous plants, culminating in 1972 with the founding of the ICPS in the USA. Availability and circulation of new species coupled with the publication of various texts for amateur growers promotes the knowledge of these plants among the general public. The countries with the biggest audiences are England, Germany, the United States and Japan. However *Pinguicula* are still rare in cultivation (although in the mid 1980's Adrian Slack foresees a future where the hybridization of the genera in cultivation may rival that of the African Violet) and the species available on the market are few and often wrongly labelled. Several new discoveries occur in Mexico, often by enthusiasts and growers, as well as researchers of succulents that ship these new species to botanical gardens and bring them into cultivation before any formal description can take place. A dozen new species are described during the 1980's.

In the 1990's the passion for *Pinguicula* finally explodes. The *International Pinguicula Study Group* is created, involving researchers and enthusiasts from all over the world. Just

before the impact of the Internet, photos and detailed information of virtually unknown species begin to circulate (note that until this time the same botanists rarely had the opportunity to see these plants for real and, often, the Herbarium specimens reported uncertain info about the habitat and place of origin of the samples). Soon, with the advent of the Net and reproduction en masse in vitro, the spread of these plants will surge exponentially. At the time of writing, almost all the Mexican species are commercially available and more and more growers are proud to include them in their collections. In recent years, Mexico has continued to be a source of surprises: in fact, since 1990, approximately 20 new species have been described, mainly by the botanist Sergio Zamudio.



What is now desirable for the foreseeable future is a comprehensive review of the genus *Pinguicula*, taking into account the latest discoveries and all those genetic studies currently in progress, using an approach that takes in a greater account of the ecology of the plants.

Distribution and habitat

The territory of Mexico is predominantly mountainous: from North to South the Sierra Madre Oriental and Sierra Madre Occidental run parallel to both the Pacific coast and to the Atlantic one, with an average altitude of 2200 meters and peaks up to 3000 meters. Between these two spines lies a vast plateau with average altitudes of 1000 meters at the northern part and 2000 m in the southernmost part. In the South, Mexico is cut across by the Cordillera Neovolcánica, that runs from the Pacific Ocean to the Gulf of Mexico and includes the highest peaks in the country (three of them exceeding 5000 m). Further south, we find another moun-

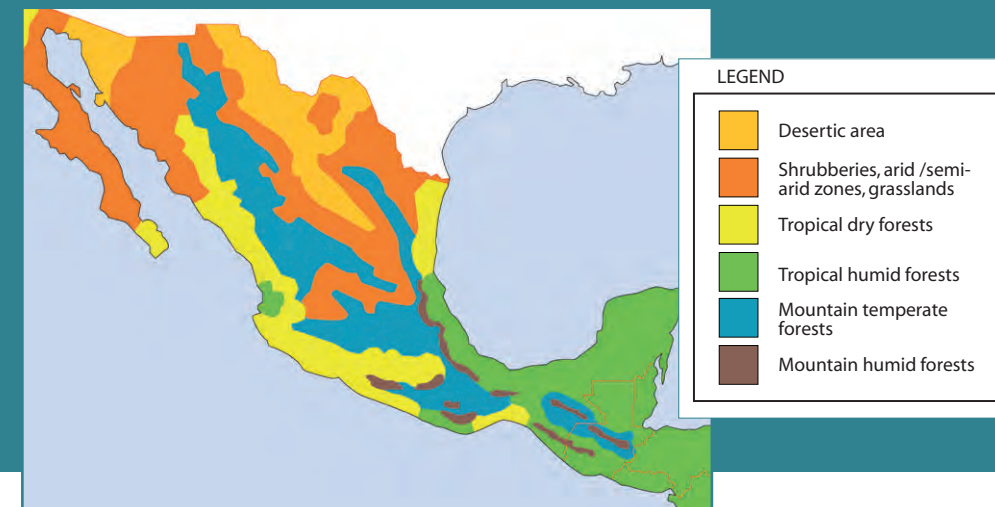
tain chain parallel to the Pacific called the Sierra Madre del Sur, with average heights of 2000 m. These mountains end in the plain of the Isthmus of Tehuantepec. The mountains continue with the Sierra Madre de Chiapas, averaging 1500 meters high and straddling the border with Guatemala.

Obviously the climate varies greatly according to latitude and distance from the sea (thus determining a warm climate along the coast, hot and humid conditions in the southern plains and continental weather inland), but the main variations are due to the altitude, and we can identify four different climatic areas:

Distribution of *Pinguicula* species in Mexico and neighboring countries of Central America



Mexico vegetation types map



Tierras calientes: 0 to 700 meters above sea level, average annual temperature of about 25 °C.
Tierras templadas: 700 to 1700 m asl, with warmer summers and not so cold winters, average temperatures of about 17 °C.

Tierras frias: 1700 to 3000 m asl, with cool summers and cold winters (rare frost is possible), average temperature of about 10 °C and distinct difference between day and night temperatures.
Tierras heladas: above 3000 meters, with an alpine climate.

acacia trees and cacti. Going South, in the central plateau, the climate is more mild and humid with average temperatures of 18 °C; in this area are grasslands, steppes and semi-arid shrubberies with yucca and cacti. In the mountains, and depending on the altitude, it is possible to find subtropical forests, mesophyllous wood, submontane wood with oak and pine trees and the mountain conifers of higher altitudes. Further South, towards the states of Chiapas and Oaxaca, the tropical humid forests.

Where do butterworts grow?

Rainfall varies according to geography (abundant in the South-East, decreasing towards the North and the Central Plateau) and the season; the whole of the area is subject to a wet season from May-June until mid-October, with July being the wettest month, and a dry season during the rest of the year.

Almost all Mexican *Pinguicula* species grow in the mountain and submountain zones above 1400 meters, usually on vertical, North-facing walls. However, even if the mountains of Mexico represent a geographical continuum, there are a variety of habitats determined by different geology and environmental conditions. This has resulted in ecological niches in which speciation was favored. There are very few *Pinguicula* that have a wide distribution and many species grow in very restricted areas, and some are real endemisms.

Habitat



The few species coming from *tierras calientes* usually grow on limestone walls in the tropical deciduous forest (b) or, in the case of annual species, on moist soil near streams.

A large group of butterworts come instead from the so-called *matorral submontano*, along Sierra Madre Oriental. It is a xerophytic environment, between 800 and 1700 meters, dominated by shrubs and scattered trees of medium size, agaves, spikemosses

(a). These butterworts are lithophyte, they grow on gypsum or limestone and have compact shapes. They often show a marked pubescence during the dry season, to absorb moisture. In this semiarid environment, plants grow on North-facing walls or in crevices in the rock, to protect against excessive insolation; some are found only in canyons or deep gorges where the microclimate is more humid and temperate.

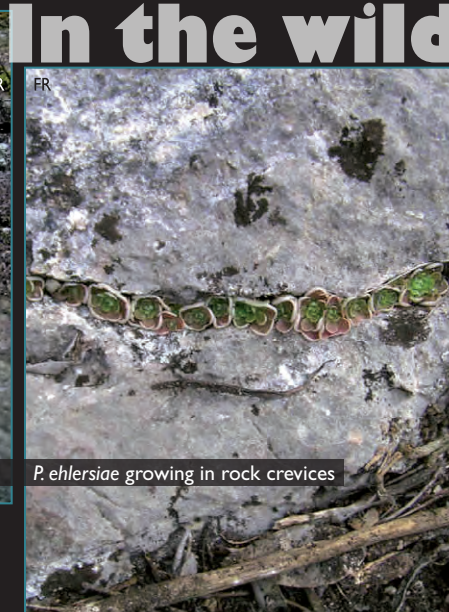
Another large group of *Pinguicula* originate from the areas of mountainous forest in the *tierras frias*, situated along the western mountains, from the southernmost part of the Sierra Madre Oriental to the Cordillera Neovolcanica. These major biotic communities consist of pine and oak forests (c) or, at higher altitudes, the mountain forest of conifers. The butterworts of these areas have larger and thinner leaves and prefer rocky walls (of mainly volcanic origin) and moss,

while those that form an underground hibernaculum prefer sandy-clayey slopes.

In those mountainous areas closer to the coast, in places more sheltered from the wind, we find a more humid forest known as the mesophyllous mountain forest. Here, where ferns and orchids abound (d) grow different species of *Pinguicula*, some of which behave semi-epiphytically being found on the mossy trunks of trees.



P. laueana on volcanic rock in Sierra Mixe



P. ehlersiae growing in rock crevices



P. macrophylla in the underwood of Guanajuato



P. moranensis growing as epiphyte

In the wild

The Mexican *Pinguicula*



FR



FR



FR

In the wild



BB



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Above, *P. reticulata* in Matehuala.
Below, *P. agnata* (left photo: growing
with cacti and agaves)

Clockwise, from top left:
P. hemiepiphytica, *P. medusina*, *P. heterophylla*, *P. gypsicola*,
P. jaumavensis in their habitats

The Mexican Pinguicula



Phenology, morphology and classification

It is common practice among enthusiasts to group butterworts according to the geographical areas and climates of origin. Following this criteria, two different groups can be identified: those of temperate origin and those of a more tropical nature. These two groups can then be further divided into both homophyllous and heterophyllous species, depending on whether they produce leaves of the same type no matter what the season, or two distinct types of leaf at different times of the year.

In Mexico, both homophyllous and heterophyllous species can be found. The first group comprises a limited number of species which generally behave as annuals in nature and that can be identified by their uniform, very delicate and thin leaves (*P. crenatiloba*, *P. lilacina*). Most of the Mexican species are perennial and characterized by being clearly heterophyllous (*P. moranensis*, *P. gypsicola*), a clear adaptation to the local hot and cold climatic seasons. During the wet season, when the plant is in full growth, the rosettes produce large, thin, and carnivorous leaves, while during the dry season the plant lies dormant, and the rosette becomes more dense and consists of much smaller, embrate, succulent (and not carnivorous) leaves.

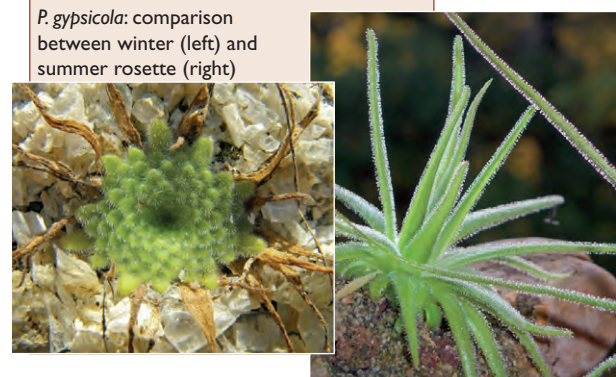
This behavior may be more or less pronounced, ranging from strongly heterophyllous species with winter rosettes that are very different to those in the summer, to other only slightly heterophyllous species with winter leaves just a little smaller and more succulent and not carnivorous, but relatively similar to the summer ones (*P. gigantea*), passing through every variation between these extremes, depending on the species but also depending on the environmental situation in which the plant occurs (high or

low humidity, solar radiation, temperature). In clearly heterophyllous species the winter rosette can be epigeal, hypogean or semi-hypogean and can have a small saucer, small cup, small bulb or pulvinate shape.

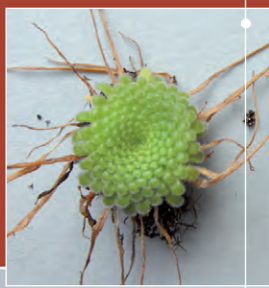
Also regarding the roots, variations between dry and wet periods can be noted. In those heterophyllous species the root system, during winter, is almost completely reduced and generally becomes completely dry in most cases. In annual species the whole plant dies at the end of the wet season, releasing its seeds that will ensure the development of a new generation when summer comes.

The summer rosette has leaves of various forms (linear, lanceolate, elliptic, spatulate, ovate, obovate, sub-orbicular), sometimes petiolate, of differing thickness, sometimes semi-succulent (some species, during summer, having a very dense, semi-succulent rosette that reminds one of certain *Sempervivum* sp., see for example the species of section *Crassifolia*), with margins from revolute to involute, and lengths from 1 to 25 cm. The leaf colour ranges from light green-yellowish to brown-reddish, depending on the species and from the degree of solar radiation.

P. gypsicola: comparison between winter (left) and summer rosette (right)



Small saucer:
P. gypsicola



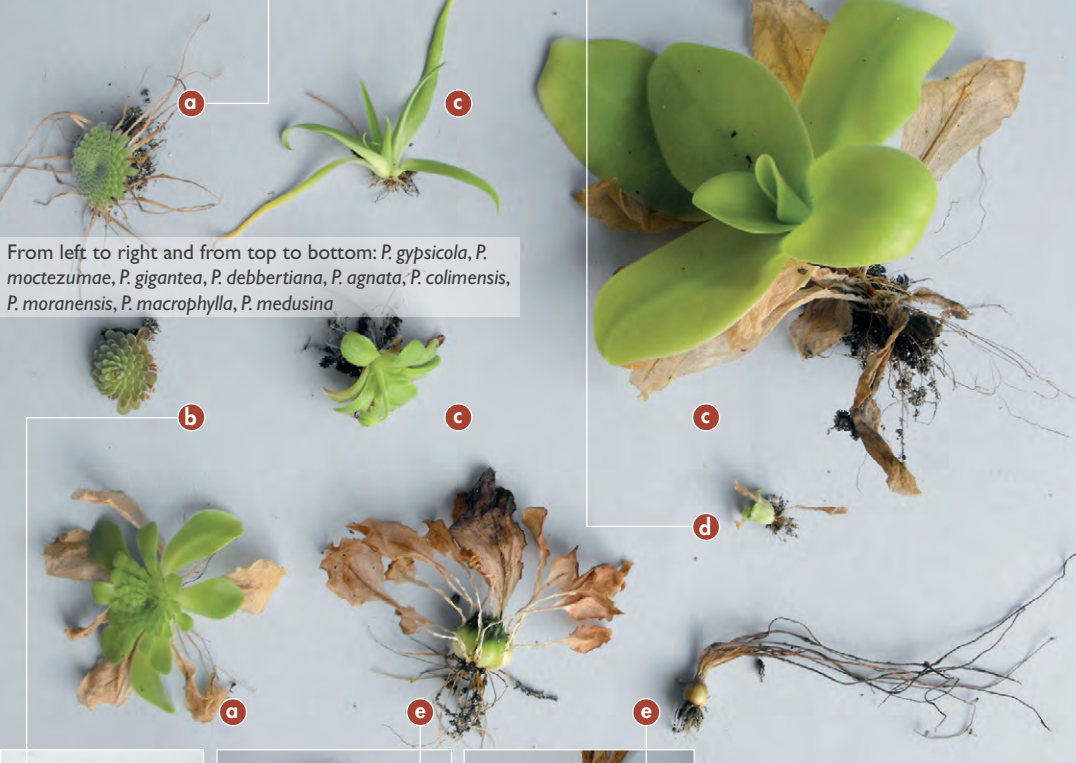
Small semi-hypogean cup:
P. colimensis



Winter rosettes

- a** small saucer:
P. gypsicola; *P. moranensis*
- b** pulvinate shape:
P. debbertiana

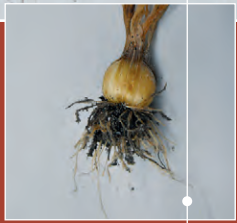
From left to right and from top to bottom: *P. gypsicola*, *P. moctezumae*, *P. gigantea*, *P. debbertiana*, *P. agnata*, *P. colimensis*, *P. moranensis*, *P. macrophylla*, *P. medusina*



Pulvinate shape:
P. debbertiana



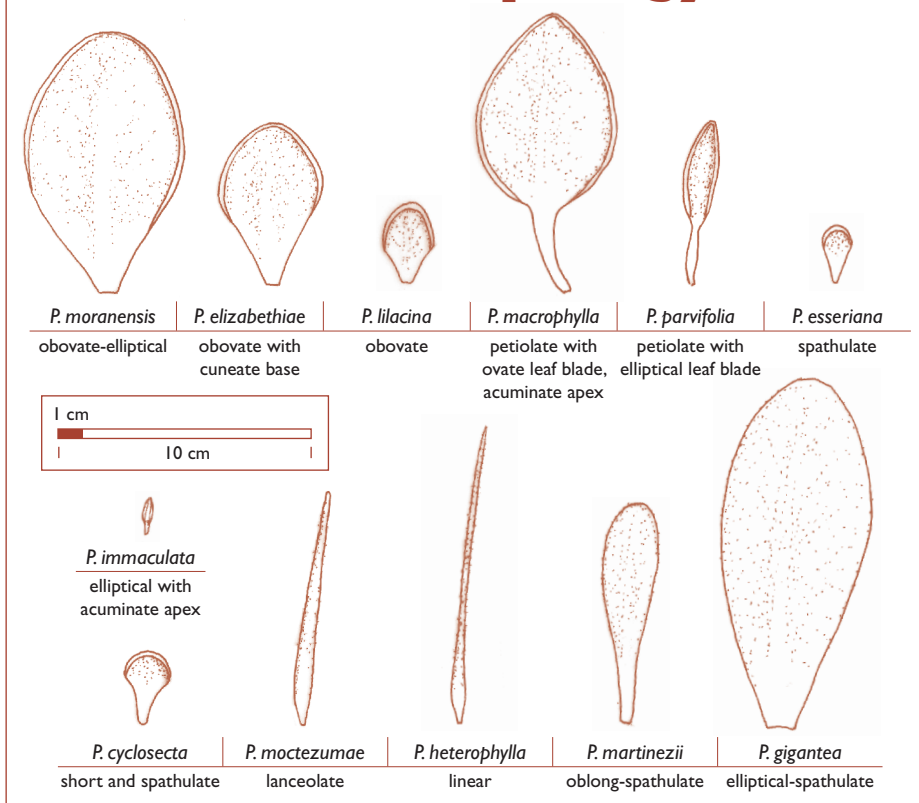
Small, not much compact bulb: *P. macrophylla*



Small, very compact bulb: *P. medusina*

- c** slightly heterophyllous:
P. agnata; *P. gigantea*;
P. moctezumae
- d** Small semi-hypogean cup:
P. colimensis
- e** Small bulb:
P. macrophylla; *P. medusina*

Summer leaf morphology



The flowers of Mexican butterworts are undoubtedly among the most beautiful and spectacular in the genus, both in size and colour. Moreover, many of these species are very generous in their blooms. This can happen once a year during the growing season or during the rest period, or twice, both in summer and winter. In some cases the blooms continue for months and months.

The flower of the butterwort is zygomorphic (irregular, being symmetrical only on the vertical plane of symmetry), gamopetalous (the petals are welded at the base to form a tube) and bilabiate (possessing a lower lip with three lobes ending in a spur and an

upper lip with two lobes). Depending on the species the corolla may be strongly bilabiate (having a strong asymmetry between the upper and lower lip) to sub-isolobate (nearly regular corolla, the lobes nearly equal). The lobes of the corolla have various forms (obovate, ovate, elliptic, sub-orbicular or cuneate), and may be entire, emarginated or crenated. The flower colour can be white, lilac, pink, carmine, purple, dark purple and rarely scarlet (*P. laueana*), sometimes with veins or darker edges of the petals. Often there is a patch of white, yellow or light green on the lower lip of the corolla.

The size of the flower varies greatly from species to species, ranging from just a few

millimeters to over 5 centimeters in diameter in the most bountiful species. Another particular feature of the flower of the butterworts is the spur that can be long and slender (*P. moranensis*) or short and saccate (*P. agnata*) and can measure from a few millimeters to 5 centimeters (the length of the spur in certain species suggests pollinators such as butterflies, macroglossum or hummingbirds). The flowers are carried singly on hairless to hairy-glandular stems, from a few centimeters long to over 20, ending in a bilabiate calyx, with three lobes on the upper lip and two on the lower. Following pollination, a seed capsule, globose to sub-globose in form is produced and, once mature, opens in two halves to release numerous small seeds from 0.25 to 1 mm in length. Oblong in shape, with an alveolated surface, they are transported by wind and water (in this case the alveolated surface is useful for the floating of the seed). In some species that grow on vertical walls (*P. emarginata*) a certain peculiarity has been noted: the stem, which during the flowering period stretches towards the void, away from the wall and where air-borne pollinators are to be found, then bends back and is brought close to the wall once pollination has taken

place, giving the seeds the chance to be as close as possible to the damp rock wall on which they can then germinate.

In addition to sexual reproduction, some species use asexual methods of increasing their numbers too. Most Mexican butterworts, once mature, produce lateral shoots from which new rosettes grow, and sometimes, after a few years, from a single plant a large, beautiful and compact colony is created; some species produce stolons (*P. orchidioides*) while others develop plantlets directly on the apex of the leaves (*P. medusina*).

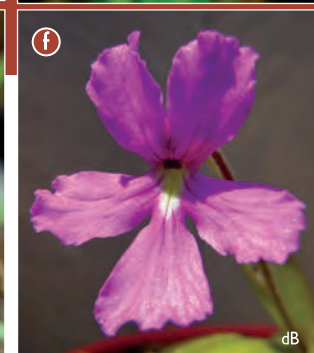
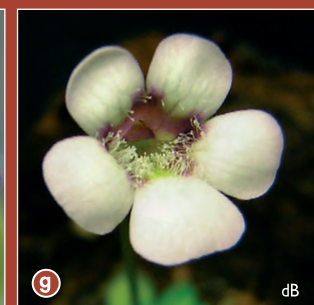
From a systematic perspective, the classification that has been used until now is mainly based on the morphology of the flower. Crucial in this regard is the work of Casper, which organizes the genus *Pinguicula* into 3 subgenera and 12 sections. Needless to say, this is a slippery subject for the beginner because these groupings are based on arguments that are under continuous discussion and these sometimes cause conflicting arguments between botanists; in addition to that, the most recent genetic studies have shown that some of these sections are polyphyletic, which could soon make them obsolete. I'll cut this story short and leave it to the taxonomists who have the task of creating categories, defining them and incorporating the various elements to sort it all out. I'll not enter into the debate about the validity of certain species that we'll cover later in the article.

In Table 1 (page 22) I provide a list of those Mexican species most commonly accepted, leaving out the infraspecific taxa (forms, varieties or anything similar that maybe tomorrow could be elevated to the rank of species) and presenting a list of 48 species, grouped into 10 sections, some resulting from the latest revisions and updates. Again, although this list and this classification may be considered by some to be incomplete, with some

Part I

Flowers

- a Bilabiate corolla with wide, tangent and slightly veined petals: *P. cyclosecta*
- b Bilabiate corolla with crenate-emarginate petals: *P. emarginata*
- c Sub-isolobate corolla: *P. gigantea*
- d Bilabiate corolla: *P. gracilis* (see the wide median lobe of the lower lip, typical of subgenus *Temnoceras*)

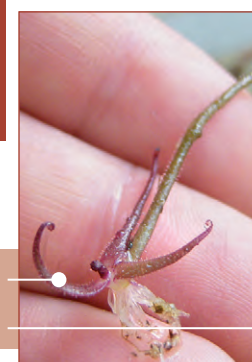


- e Bilabiate corolla: *P. moctezumae*
- f Bilabiate corolla with slightly undulated petals: *P. rectifolia*
- g Sub-isolobate corolla: *P. rotundiflora* (see the hairy throat)

redundant or obsolete species, I believe it is still a good starting point for those who wish to study the Mexican butterworts.

Close-up of a plantlet at the apex of a *P. medusina* leaf

Stolons of *P. orchidioides*



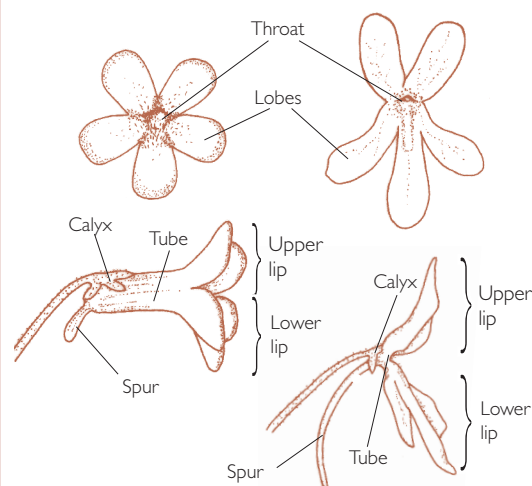
The Mexican Pinguicula

AIPC Special Issue n. 3-19

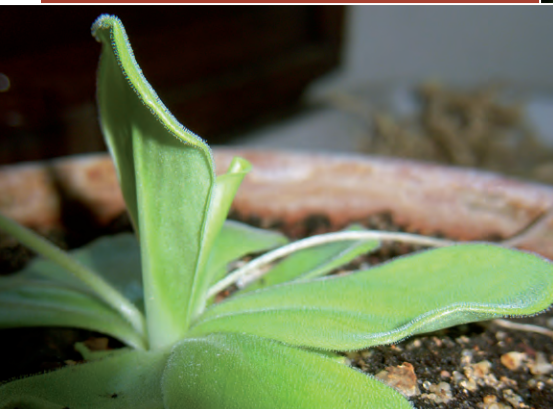
Flower morphology

Sub-isolobate corolla

Strongly bilabiate corolla



Summer Rosettes



P. colimensis (left) and *P. gigantea* (right), two species with oblong-spathulate leaves with revolute margins



Rightside: *P. parvifolia* with petiolate leaves

Below: *P. heterophylla* (left) and *P. gypsicola* (right), two species with linear-lanceolate leaves



Above: the small and compact rosette with semisucculent leaves of *P. esseriana* (left) and the variability in nature of colour and shape in the same population of *P. potosiensis* (right)

Below: the small rosette with semi-transparent leaves of *P. lilacina* (left) and the large ovate leaf with involute margin of *P. moranensis*



The Mexican Pinguicula

Table 1: classification of Mexican *Pinguicula*

SUBGENUS	SECTION	SPECIES
<i>Isoloba</i> (Barnhart) Casper	<i>Agnata</i> Casper	<i>P. agnata</i> Casper, 1963 <i>P. gigantea</i> Luhrs, 1995 <i>P. ibarrae</i> Zamudio, 2005 <i>P. martinezii</i> Zamudio, 2005 <i>P. pilosa</i> Luhrs, Studnicka & Gluch, 2004
	<i>Heterophyllum</i> Casper	<i>P. acuminata</i> Benthams, 1839 <i>P. conzattii</i> Zamudio & Van Marm, 2003 <i>P. heterophylla</i> Benthams, 1839 <i>P. imitatrix</i> Casper, 1963 <i>P. kondoi</i> Casper, 1974 <i>P. medusina</i> Zamudio & Studnicka, 2000 <i>P. mirandae</i> Zamudio & Salinas, 1996 <i>P. parvifolia</i> Robinson, 1894 <i>P. reticulata</i> Fuchs ex Schlauer, 1991 <i>P. rotundiflora</i> Studnicka, 1985
	<i>Isoloba</i> Casper	<i>P. lilacina</i> Schlechtendal & Chamisso, 1830 <i>P. sharpii</i> Casper & Kondo, 1977 <i>P. takakii</i> Zamudio & Rzedowski, 1986
<i>Pinguicula</i> Casper	<i>Crassifolia</i> Speta & Fuchs	<i>P. debbertiana</i> Speta & Fuchs, 1992 <i>P. ehlersiae</i> Speta & Fuchs, 1982 <i>P. esseriana</i> Kirchner, 1981 <i>P. jaumavensis</i> Debbert, 1991
	<i>Homophyllum</i> Casper	<i>P. greenwoodii</i> Cheek, 1994
	<i>Longitubus</i> Zamudio & Rzedowsky	<i>P. calderoniae</i> Zamudio, 2001 <i>P. crassifolia</i> Zamudio, 1988 <i>P. hemiepiphytica</i> Zamudio & Rzedowski, 1991 <i>P. laeana</i> Speta & Fuchs, 1989 <i>P. utricularioides</i> Zamudio & Rzedowski, 1991
	<i>Orcheosanthus</i> A. De Candolle	<i>P. colimensis</i> Mc Vaugh & Mickel, 1963 <i>P. cyclosecta</i> Casper, 1963 <i>P. elizabethiae</i> Zamudio, 1999 <i>P. gypsicola</i> Brandege, 1911 <i>P. macrophylla</i> Humboldt, Bompland & Kunt, 1817 <i>P. mesophytica</i> Zamudio, 1997 <i>P. moctezumae</i> Zamudio & Ortega, 1994 <i>P. moranensis</i> Humboldt, Bompland & Kunt, 1817 <i>P. oblongiloba</i> A. De Candolle, 1844 <i>P. orchidioides</i> A. De Candolle, 1844 <i>P. potosiensis</i> Speta & Fuchs, 1989 <i>P. rectifolia</i> Speta & Fuchs, 1989 <i>P. zechei</i> Speta & Fuchs, 1982
	<i>Orchidioides</i> Luhrs	<i>P. laxifolia</i> Luhrs, 1995
	<i>Temnoceras</i> (Barnhart) Casper	<i>P. clivorum</i> Standley & Steyermark, 1944 <i>P. crenatiloba</i> A. De Candolle, 1844 <i>P. emarginata</i> Zamudio & Rzedowski, 1986
<i>Temnoceras</i> (Barnhart) Casper	<i>Microphyllum</i> Luhrs	<i>P. gracilis</i> Zamudio, 1988 <i>P. immaculata</i> Zamudio & Lux, 1992 <i>P. nivalis</i> Lampard & Luhrs, 2006

Part II

Species by species

Identifying a butterwort on the basis of its distinctive features and according to the previously mentioned subdivisions may not be so easy for the beginner/unskilled grower.

To facilitate this task, it may then be useful to group the species according to the shape of the rosette and to the shape of the summer leaves since these are the most noticeable elements when observing a plant. Even in such instances, there may be species not quite clearly and immediately identifiable. However, restricting the choice to a limited group of species will be a useful starting point for correct identification.

A) SMALL SPECIES WITH INVOLUTE MARGIN OF THE LAMINA

A1) SMALL AND COMPACT ROSETTE: the rosette is small, rounded, from subglobose to flat with several leaves, embricate and in most cases semi-succulent (*P. cyclosecta*, *P. debbertiana*, *P. ehlersiae*, *P. esseriana*, *P. gracilis*, *P. immaculata*, *P. jaumavensis*, *P. kondoi*, *P. nivalis*, *P. reticulata*, *P. rotundiflora*).

A2) SMALL, NOT COMPACT ROSETTES: the small rosette has few, thin leaves (*P. crenatiloba*, *P. lilacina*, *P. sharpii*, *P. takakii*).

A3) LARGE-ROSETTES SPECIES WITH OVATE TO OBOVATE LEAVES: the leaves are wide, rounded, ovate to obovate in shape, rarely spatulate. A further subdivision can be made comparing the petiole length:

A3.1) PETIOLATE LEAVES: the petiole, variably developed, is clearly distinct from the lamina (*P. acuminata*, *P. crassifolia*, *P. macrophylla*, *P. mesophytica*, *P. oblongiloba*, *P. orchidioides*, *P. parvifolia*, *P. utricularioides*).

A3.2) UNPETIOLATE LEAVES: the leaf has no evident petiole (*P. clivorum*, *P. conzattii*, *P. elizabethiae*, *P. emarginata*, *P. greenwoodii*, *P. hemiepiphytica*, *P. ibarrae*, *P. laeana*, *P. mirandae*, *P. moranensis*, *P. pilosa*, *P. potosiensis*, *P. rectifolia*, *P. zechei*).

B) SPECIES WITH REVOLUTE MARGINS OF THE LAMINA

B1) LARGE-ROSETTED SPECIE WITH SPATHULATE TO OBOVATE-OBLONG LEAVES (*P. agnata*, *P. colimensis*, *P. gigantea*, *P. laxifolia*, *P. martinezii*).

B2) ROSETTED SPECIES WITH LINEAR TO LANCEOLATE LEAVES (*P. calderoniae*, *P. gypsicola*, *P. heterophylla*, *P. imitatrix*, *P. medusina*, *P. moctezumae*).

Species

A1) SPECIES WITH SMALL AND COMPACT ROSETTE

PINGUICULA CYCLOSECTA

History: Collected in the late 1930s and identified at that time as *P. lilacina*, it was later published in March 1963 under the name of *P. cyclosecta* by Casper (just in time! A month later the same plant was described and published by Rogers Mc Vaugh and John T. Mickel under the name *P. lateciliata*).

Distribution and habitat: It comes from a rather narrow area between the states of Nuevo Leon and Tamaulipas where it grows on limestone walls exposed to the north at an altitude between 450 and 2050 meters above sea level. *P. cyclosecta* typically grows with agaves and spikemosses in the area of mixed oak and pine forests.

Description: The summer rosette is flattened to the ground and is composed of leaves up to 3.5 cm long, obovate-spathulate in shape, slightly involute at the apex, greenish-gray to bluish-green in colour with violet shades. The winter rosette is about half-sized compared to the summer rosette and is saucer-shaped. The flower is very gaudy, large (up to 3 cm in diameter), and characterized by suborbicular corolla lobes which are mutually tangent or overlapping; it has a beautiful deep purple colour on the front surface and a pale lilac with darker veining on the back. Flowering occurs around June at the beginning of the growing season.



P. cyclosecta: see the sharp veins on the back page of petals

PINGUICULA DEBBERTIANA

History: *P. debbertiana* was collected in 1989 during an expedition in Mexico by the German botanist Paul Debbert and was cultivated by Debbert himself at the Botanic Garden of Munich. It was then described in 1992 by Franz Speta and Franz Fuchs who named it after the discoverer.

Distribution and habitat: *P. debbertiana* grows on north-facing limestone or gypsum walls or clayish slopes at about 1800 m of altitude in the state of San Luis Potosí.

Description: The summer rosette is similar to that of *P. ehlersiae* and of *P. esseriana* but is usually a little



smaller, up to 4 cm in diameter. The winter rosette is smaller, pulvinate, and is composed of numerous little leaves (up to 100). The flower that sprouts from the winter rosette just before the vegetative resumption is rather peculiar and differs by several features from those of other species in section *Crassifolia*: the corolla is rather closed with an angle of about 90 degrees between the upper and lower lips; obovate to spatulate-cuneate lobes purple to violet in colour with touching or slightly overlapping edges (another form of this species exists with completely white flowers). Also peculiar to this species is the rather prominent palate on the median lower lobe which shows two small yellow and hairy crests; the throat is paler and veined. Another peculiarity: the flower closes at night.

PINGUICULA EHLERSIAE

History: *P. ehlersiae* was collected in 1979 by the bromeliads expert Renate Ehlers and was introduced to cultivation at the botanical garden in Linz where, three years later, it was published by Franz Speta and Franz Fuchs who named it after the discoverer.

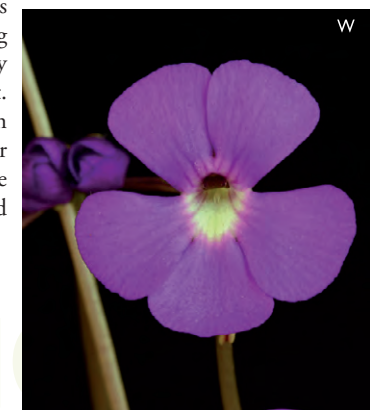
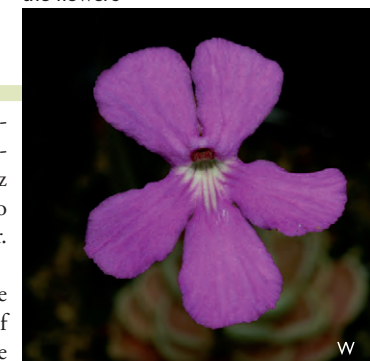
Distribution and habitat: The species comes from the states of San Luis Potosí and Hidalgo where it grows at an altitude between 1200 and 2000 m on north-facing limestone slopes in the area of oak forests.

Description: The summer rosette is composed of semi-succulent leaves compactly arranged one above the other, obovate-spathulate in shape, up to 2 cm long, and light green to red-brownish in colour. The margin, involute at the apex, is much paler than the upper surface of the leaf. The winter rosette is cushion-shaped.

The flower emerges from the winter rosette just before the vegetative resumption and is highly variable depending on different populations, but also within the same population: the corolla lobes are obovate, spatulate or cuneate in shape, more or less oblong and tangent, coloured from pink to purple, sometimes completely white, with a white or yellowish, not pubescent spot at the throat. *P. ehlersiae* is rather similar to *P. esseriana* and to *P. jaumavensis* from which it differentiates in characteristics that are all but obvious. For instance, the presence of small hairs on the spot in *P. esseriana* that are not present on *P. ehlersiae*; or, for example, the angle between upper and lower lip which is less wide in *P. esseriana* than in *P. ehlersiae*.



P. ehlersiae: see the variability of the flowers



Species by species

by species

Species

PINGUICULA ESSERIANA

History: In 1977, the cacti collector Gerhard Köhres picked up three specimens of an unknown butterwort and took them to the Botanical Garden of Bochum in Germany. Later, in 1981, the plants were described by Bernd Kirchner who gave them the name *P. esseriana* after the director of the Botanical Garden.

Distribution and habitat: This species comes from the states of Tamaulipas, San Luis Potosí and Querétaro where it grows on limestone slopes, mainly north-facing, at an altitude between 1500 and 2350 m in oak and pine forests or in submontane semi-arid shrubberies.

Description: The summer rosette is up to 5 cm broad and is composed of semi-succulent, obovate-spathulate leaves, densely overlapping and light green to reddish in colour. The leaf margin, involute at the apex, is peculiar in that it is also much paler than the upper surface of the leaf. The winter rosette is pulvinate. The flower is quite large, usually about 2 cm wide with cuneiform lobes coloured from pale pink to lilac. It is paler at the throat and shows a pubescent, yellowish spot on the lower median lobe. Flowering occurs in the period of vegetative resumption.

PINGUICULA GRACILIS

History: Collected in 1980 and called *P. aff. pumila*, it was then published in 1988 by Sergio Zamudio with the current name.

Distribution and habitat: *P. gracilis* comes from a very confined area in the state of Nuevo León where it grows among mosses on calcareous, north-facing walls, at an altitude between 1000 and 2150 m in the area of oak and cypress forest.

Description: The summer rosette is small, up to 3 cm in diameter, composed of semi-succulent leaves, spatulate-obovate in shape, with involute apex and brown-reddish margins. The winter rosette is pulvinate and is covered with white hairs. The flower, produced on red-brownish scapes, is up to 2 cm long (including spur); the corolla lobes are white with a faint purple veining, obovate-oblong in shape. The central lobe of the lower lip is much larger than the others (a feature peculiar to the butterworts in the section *Microphyllum*), emarginated with a hairy yellowish-green spot near the throat. The dark purple stigma stands out against the whiteness of the corolla. Flowering occurs in winter, around February.



PINGUICULA IMMACULATA

History: In 1990, Alexander Lux discovered this butterwort by chance and described it two years later with Zamudio under the name of *P. immaculata*.

Distribution and habitat: This species comes from the state of Nuevo León, where it grows between 1300 and 2200 m of altitude in the arid area of submontane shrubberies on gypsum walls with agaves and spikemosses.

Description: This is one of the smallest Mexican species with its summer rosettes seldom exceeding 2 cm in diameter. The summer leaves are slightly petiolate with an elliptic pointed lamina, clearly involute, pale green to reddish in colour, with reddish-brown margins. The winter rosette is pulvinate and is covered by a white down similar to a spiderweb. The flower, up to 2 cm long (including spur), is produced on very short reddish scapes (average 2.5 cm). The corolla is strongly bilabiate; the upper lip has obovate-oblong and very small lobes. In the lower lip, the lateral lobes are obovate, the central lobe is much larger (about double sized compared to the lateral ones), enlarged like a fan and emarginate, with a yellowish-green spot near the throat. Stigma is brownish-purple in colour. Flowering occurs around February.

PINGUICULA JAUMAVENSIS

History: *P. jaumavensis* was collected in 1991 near Jaumave by Paul Debbert. Although very similar to *P. esseriana*, Debbert deemed it a new species and described it during the same year, naming it after the toponymous of the collection.

Distribution and habitat: It grows on vertical limestone walls (in the original publication is said feldspar) at an altitude of about 1400 m. in oak forests in the state of Tamaulipas.

Description: The compact summer rosette, composed of overlapping semi-succulent leaves, can reach 5 cm in diameter and is very similar to those of *P. esseriana* and *P. ehlersiae*, as is the winter rosette. The corolla is lilac in colour with cuneate-obovate shaped lobes that are 0.8 to 1.2 cm long, with a yellow to brown spot on the median lower lobe. The throat is paler with a faint veining and pubescent. Flowering occurs at the end of winter dormancy.



Species



Probably *P. kondoii* e *P. reticulata* in cultivation are actually the same species

This is a problematic species: in 1974, Casper described as *P. kondoii* a butterwort from Kondo's herbarium, which had been collected in 1971 in the state of Tamaulipas. In 1995, the Dutch Hans Luhrs examined the dried specimens and stated that *P. kondoii* was a synonym of *P. reticulata*, described in 1991 by Jan Schlauer. Schlauer replied that the plants examined by Luhrs were not those used by Casper for the original description and that it is very difficult to identify and examine the latter. All plants in cultivation identified, sold and traded under the name *P. kondoii* would indeed be specimens of *P. reticulata*. However, Schlauer himself, when describing *P. reticulata*, had to admit that these two species are closely related; he deemed a distinction could only be made on the basis of the presence of little hairs on the scape and of veins on the flower (absent in *P. kondoii*), features that are actually variable and hard to notice in dry material.



PINGUICULA NIVALIS

History: This butterwort was discovered in 1994 by Hans Luhrs and Stan Lampard during an expedition to the state of Nuevo León. Some considered it a form of *P. immaculata* and it was cultivated for years by Lampard and other European growers under the name *P. sp.* 'Zaragoza'. Finally, in 2006, Luhrs and Lampard published it in the *Carnivorous Plant Newsletter* as *P. nivalis* and, on this occasion, Luhrs proposed to create the new section *Microphyllum* in which to insert it, together with *P. immaculata* and *P. gracilis*.

Distribution and habitat: It grows in the state of Nuevo León on north-facing gypsum walls together with spikemosses and agaves at an altitude between 1350 and 1450 m.

Description: *P. nivalis* has a summer rosette composed of fleshy leaves, with a rounded or slightly acuminate and heavily involute apex, up to 1.5 cm long, dark green in colour with brownish margins. The hairy and semi-hypogean winter rosette has a small cup shape. The flower scape is reddish-brown in colour up to 7 cm long. The corolla is white, strongly bilabiate with obovate lobes; the median lobe of the lower lip is much larger than the others, emarginate and undulate, and shows a yellow spot near the throat. The stigma, purplish-brown in colour, stands out against the white corolla. Flowering occurs in winter, around February.



The flower scape is reddish-brown in colour up to 7 cm long. The corolla is white, strongly bilabiate with obovate lobes; the median lobe of the lower lip is much larger than the others, emarginate and undulate, and shows a yellow spot near the throat. The stigma, purplish-brown in colour, stands out against the white corolla. Flowering occurs in winter, around February.

PINGUICULA RETICULATA

History: In 1977, the succulents grower Gerhard Koehres collected some butterworts near Tula and sent them to several botanical institutions in Europe. Once in cultivation, plants were identified by different botanists as *P. agnata*, *P. esseriana* or *P. kondoii*, while other botanists thought they were facing new species. Among the latter was Franz Fuchs, who informally began to call the butterwort *P. reticulata* (because of the veins of the flower). This name became commonly used, even before Jan Schlauer adopted it for the species formal description which appeared in 1991. The situation is still controversial since most butterwort experts think that *P. reticulata* is actually a synonym of *P. kondoii*.



Distribution and habitat: It comes from the states of San Luis Potosí, Nuevo León and Tamaulipas where it grows in crevices of vertical limestone walls between agaves and cacti between 1400 and 1900 m in the pine forests and in *matorral submontano* area.

Description: *P. reticulata* has a compact summer rosette formed by semi-succulent leaves, dark green to reddish in colour, spatulate with involute margin at the apex, 2 cm long on average. The winter rosette is slightly heterophyllous. The isolobate corolla has cuneate to suborbicular lobes, white in colour with a beautiful purple veining. The throat is yellowish-green with yellow hairs. Flowering occurs just before the vegetative resumption.



Colony of *P. reticulata* during winter dormancy in Aramberri



PINGUICULA ROTUNDIFLORA

History: This species was collected in the late 1970s and was then introduced to cultivation with the name *P. sp.* 'Nova n. 2'. It was finally described in 1985 by Miloslav Studnička who gave it the name *P. rotundiflora*.

Distribution and habitat: It grows in shady places on limestone and gypsum rocks in xerophytic environments at an altitude between 800 and 2100 m, in the states of Nuevo León and Tamaulipas in the mixed forest or *matorral submontano* area.

Description: The summer rosette, small and compact (up to 3 cm in diameter), has reddish-green semi-succulent leaves, densely overlapping, obovate to spatulate in shape with margin involute at the apex. The winter rosette is pulvinate. The corolla has obovate to cuneate lobes with touching or overlapping edges, white to violet in colour with a purple ring and whitish hairs at the throat. Flowering occurs in winter.



Species

A2) SPECIES WITH SMALL, NON-COMPACT ROSETTE

PINGUICULA CRENATILOBA

History: José Mariano Mocino was a Mexican naturalist who took part in the expedition of 1787-1803 that was promoted by the King of Spain Charles III and was directed by the physicist-botanist Martin de Sessé. During that trip, more than 10.000 specimens – both vegetable and animal – were collected and illustrated. Due to political reasons, Mocino left Mexico thereafter and went to France where he met A. P. De Candolle to whom he showed his collection. Some years later, in 1844, A. De Candolle, successor of the immense taxonomic work of his father, described *P. crenatiloba* only on the basis of the watercolours included in the Sessé-Mocino collection. Although its long history and the vastness of its distribution, *Pinguicula crenatiloba* is still almost unknown in cultivation.

Distribution and habitat: *P. crenatiloba* comes from a very large area that ranges from the state of Jalisco, in the western Mexico, to Panama. It grows between 800 and 2200 m of altitude usually on wet, sandy-clayish and mossy soils near streams.

Description: *P. crenatiloba* is an annual species in the wild. The rosette is very small (hardly reaches a diameter of 2 cm) and is formed by obovate, strongly involute leaves, light green in colour, thin, membranous and semi-transparent. The flower is also very small (3 to 7 mm in length) and carried on 3 to 4 cm long scapes. The corolla is whitish with a little yellow spot at the throat and, as the name suggests, has crenate lobes. Flowering occurs from August to February.

PINGUICULA LILACINA

History: Between 1824 and 1829, the two naturalists Christian Julius Wilhelm Schiede and Ferdinand Deppe collected this species in Mexico with several other botanical and zoological specimens that were then sent to and studied in Germany. Among those, there was a new butterwort, that was then described in 1830 and named *P. lilacina* by Diederich von Schlechtendal and Adelbert von Chamisso.

Distribution and habitat: Widespread in Mexico, this species has been seen in a vast area that covers the Mexican states of Chihuahua and Oaxaca but has also been found in the Honduras, Belize and Guatemala. It grows in rather moist environments in pine tree and oak forests between 700 and 2400 m, either on rock or on sandy-clayish slopes of both calcareous and igneous origin.

Description: *P. lilacina* is an homophyllous, annual species, although it can live many years when kept in stable conditions. The rosette has fine, ovate to obovate leaves, pale green in colour, up to 4.5 cm in length. The corolla is subisolate with obovate to suborbicular lobes, light to dark lilac in colour with yellowish, purple-veined tube. It flowers from August to February.

PINGUICULA SHARPII

History: This homophyllous, annual species is very similar to *P. lilacina*. It was collected by the American botanist A. J. Sharp in 1972 and described in 1977 by Casper and by the Japanese Katsuhiko Kondo.

Distribution and habitat: It comes from Chiapas, where it grows on very damp, shadowy slopes in humus-rich soils.

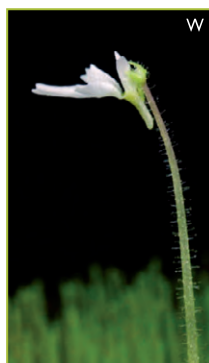
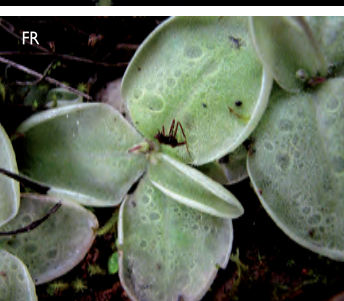
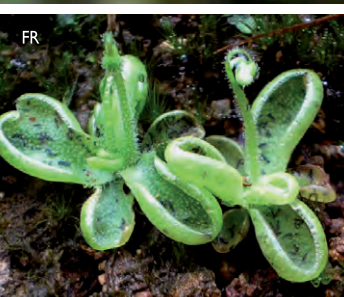
Description: It has a very small rosette, up to 3 cm in diameter and formed by thin, semi-transparent leaves, light green in colour, with wide obovate lamina, cuneate base and involute apex. The flower is very small (up to 0.9 cm including the spur) and is carried on green-yellowish scapes up to 5 cm long. Corolla subisolate with whitish lobes that are obovate-suborbicular in shape and tangent; throat yellow in colour and downy. Yellowish tube with reddish veins. Flowering occurs from late summer to the autumn.

PINGUICULA TAKAKII

History: Homophyllous, annual species discovered by the biologist Francisco Takaki, described by S. Zamudio and J. Rzedowski in 1986.

Distribution and habitat: It grows on gypsum soils together with spikemosses, agaves and *P. gypsicola* in the semidry shrubberies at an altitude of 1350-1400 m in the state of San Luis Potosí.

Description: The small rosette (up to 3 cm in diameter) is formed by obovate-spathulate leaves, strongly involute towards the apex, light green to yellowish in colour. The flower is carried on reddish scapes up to 5 cm long, is 1.4 cm long, including the spur, with obovate-suborbicular corolla lobes, light lilac in colour with spur and tube yellowish with purple veins. Morphologically speaking, this species is very similar to *P. lilacina* and *P. sharpii*, from which it can be distinguished through the smaller dimensions, narrower leaves and the reddish scape. It flowers from late summer to autumn.





A3.1) LARGE-ROSETTED SPECIES WITH PETIOLATE, OVATE TO OBOVATE LEAVES

PINGUICULA ACUMINATA

History: Karl Theodor Hartweg discovered *Pinguicula acuminata* and *P. heterophylla* during the 1836-1843 expedition. In 1839, both of these species were formally published in London by the famous botanist and taxonomist, George Bentham. Afterwards, the holotype of *P. acuminata* became lost and in the 1960s, Casper had to use Bentham's description without being able to see the plant. It was not until the late 1980s that the species was rediscovered in the wild by Hans Luhrs.

Distribution and habitat: *P. acuminata* grows in damp oak and fir-tree forests, between 2400 and 2800 m of altitude in the state of Hidalgo on volcanic rocks and clayey soils among mosses and ferns.

Description: The summer rosette has petiolate leaves with ovate to cordiform lamina, pointed apex and involute leaf margins, up to 17 cm long, light green to reddish in colour. During winter, the plant retracts, forming a small, slightly compact bulb which is semi-subterranean to wholly buried in the soil. It is in this period that flowering occurs. The corolla is subsilobate with obovate lobes with an apex that is rounded or truncated, white to lilac in colour. The greenish tube is peculiar, being throttled and strongly curved. Flowering occurs from the winter rosette, around February.

PINGUICULA CRASSIFOLIA

History: The holotype, collected in 1976 and initially identified as *P. macrophylla*, was described as *P. crassifolia* in 1988 by Zamudio.

Distribution and habitat: *P. crassifolia* comes from a very small area in the state of Hidalgo, where it grows amidst mosses on vertical cliffs of volcanic rocks between 2850 and 3000 m. At those altitudes (where fir trees, oaks, yews and junipers are to be found) light snowfalls may occur and even during summer the temperatures stay rather low.

Description: The summer rosette has slightly petiolate leaves with hairy petiole and elliptical-ovate leaf lamina, up to 11 cm long, slightly involute, bright green to brown-reddish in colour. The winter rosette, up to 3.5 cm in diameter, is a thick, compact cushion, subglobose in shape. The flowers, carried on a hairy scape, sprout from the winter rosette; they are rather large, up to 3 cm wide and up to 5 cm long (including spur). The corolla lobes are obovate-cuneate in shape with truncated or rounded apex and carmine to dark-red in colour.

PINGUICULA MACROPHYLLA

History: *P. macrophylla* is one of two Mexican species collected by Humboldt and Bonpland and described in 1817 by them and Kunth. Later, however, doubts arose and the species was renamed *P. caudata* (a name which indicated *P. moranensis* as well) and it remained as such until Casper's revision. Another oddity is that this species has never been found again in the places where the original holotype was collected while the rather similar *P. acuminata* is known to grow there... Did someone make a muddle of this species?

Distribution and habitat: *P. macrophylla* grows between 1300 and 2600 m of altitude in the pine and oak forests, preferably on damp and shady slopes on volcanic rocks and clayish-slimy soils (with a good share of organic material too). It is found in the states of Guanajuato, San Luis Potosí and Querétaro.



Description: The summer rosette is composed of beautiful petiolate leaves, up to 19.5 cm long, with ovate-cordiform to elliptical lamina and rounded to pointed apex, slightly involute, bright green to red-brownish in colour. In winter, the plant retracts in a small, slightly compact bulb. Flowers are up to 5.5 cm long including spur, with obovate, oblong corolla lobes that are also divaricate and of different shades of violet; throat dark violet in colour with a small, elongated white spot on the inferior lip. Flowering occurs from the summer rosette around June to July.

Above: pale flower of *P. macrophylla* in Guanajuato

Species

PINGUICULA MESOPHYTICA

History: Although this species comes from outside the political borders of Mexico, it can be included in this monography, since, botanically speaking, the floristic region of Central America includes both Mexico and the other nations of the isthmus. Moreover, *P. mesophytica* belongs to the section *Orcheosanthus* (that, as already seen, includes the most famous Mexican species) and, indeed, it has been considered a form of *P. moranensis* until Zamudio published it as a new species in 1997.

Distribution and habitat: It comes from El Salvador, Guatemala and Honduras where it grows as epiphyte or on mossy rocks in the mesophyllous mountain forests between 1300 and 2400 m of altitude.

Description: The summer rosette has bright green, shortly petiolate leaves up to 4.2 cm long with lamina that is more or less oblong, obovate to suborbicular in shape and with involute margins. The winter rosette is pulvinate. The flower is up to 4 cm long (including spur), dark carmine in colour with a white spot at the throat. The corolla is markedly bilabiate with the lobes of the inferior lip obovate-oblong in shape and those of the superior lip shorter and suborbicular in shape. Flowering occurs between April and July.



P. mesophytica in Montecristo National Park, El Salvador



PINGUICULA OBLONGILOBA

History: Described with other species in Alphonse de Candolle's *Prodromus* (1844), it is reported by Casper to live in quite a large area which, however, should probably be scaled down, especially in regards to its distribution in the southern states. This species is rare in cultivation, and in nearly every case, plants grown under this name in the past were in fact, some form of *P. moranensis*.

Distribution and habitat: It prefers shady locations between 1100 and 2800 m of altitude on clayish-sandy slopes of volcanic origin, often with a layer of leaf loam, in the pine and oak forests from Durango to Oaxaca.

Description: The summer rosette has shortly petiolate leaves, with ovate to suborbicular leaf blade and involute margins. In winter, the plant builds a small, underground bulb. The corolla has obovate to elliptic oblong lobes, carmine pink to violet in colour, with a white spot at the throat. The flowering starts at the vegetative resumption, around June.



PINGUICULA ORCHIDIODES

History: This species was described in 1844 by Alphonse De Candolle in *Prodromus* but was thereafter the subject of several debates, creating much confusion amongst botanists. To begin, Sir William Jackson Hooker published a picture in 1846 of a *P. orchidioides* growing in Kew but it was actually a variety of *P. moranensis*. Between the end of the XIX and the beginning of the XX century the entity described by De Candolle was alternately considered a correct species or a synonym of *P. moranensis* or of *P. macrophylla*. Later, Casper examined Hooker's description in his monography but did not explain the one made by De Candolle. According to Casper, the plants mentioned in De Candolle's work were to be considered specimens of *P. oblongiloba*. In 1995, Hans Luhrs described a new butterwort, *P. stolonifera*, in a way that perfectly matched the description of De Candolle, such that Zamudio (1998) considered it to be synonymous with *P. orchidioides*. Obviously, all of this confusion is mirrored in cultivation: plants that have been cultivated and traded for decades with the name *P. orchidioides* are actually *P. moranensis*, the true *P. orchidioides* has been introduced in cultivation only for a few years and it exists in very few collections.



Distribution and habitat: *P. orchidioides* grows on clayish-sandy soils, often on dead leaves substrate in moist pine and oak forests at 2000-3000 m of altitude in the Mexican states of Oaxaca and Guerrero and also in Guatemala.

Description: *P. orchidioides* distinguishes itself by its summer rosette of petiolate leaves up to 8 cm long with lanceolate to elliptic blade (whereas *P. oblongiloba* and *P. moranensis* have larger leaves, ovate to obovate in shape) and clearly involute margins, bright green to reddish in colour. In winter, it retires into a small, hypogeum bulb. The corolla is strongly bilabiate, up to 5 cm long including spur with elliptic to lanceolate, oblong lobes, carmine-violet in colour with a white spot at the throat. Another peculiarity of this species is that it forms stolons for the agamic reproduction. Flowering occurs from July to September.

Left: new plantlets of *P. orchidioides* at the base of the mother plant

PINGUICULA PARVIFOLIA

History: *P. parvifolia* was described by Benjamin Lincoln Robinson in 1894. The flower, which is very similar to that of *P. heterophylla*, made Casper introduce it in the section *Heterophyllum* (despite the fact that the two species look totally different, as one bears petiolate and elliptic leaves, while the other bears long and linear leaves).

Distribution and habitat: *P. parvifolia* comes from the states of Jalisco, Michoacán and Guerrero where it grows on clayish-sandy slopes, frequently in the shade of pine trees and oaks at an altitude between 1800 and 2750 m.

Description: The summer rosette has leaves up to 8 cm long, shortly petiolate, with an elliptic and very elongated lamina, rounded or pointed apex and very involute margins; the winter rosette is hypogean, small and bulb-shaped. The flower reaches the length of 2 cm including the spur; the corolla is sub-isolobate with obovate-spathulate, very elongate lobes, pale violet to white in colour, with darker edges and a yellow-greenish spot near the throat. It flowers from the vegetative resumption till August.



PINGUICULA UTRICULARIOIDES

History: This taxon is an interesting as well as a mysterious one, so much so that some consider it to be a possible *trait d'union* with the genus *Utricularia*. It was described by Sergio Zamudio and Jerzy Rzedowski in 1991 on the sole basis of the analysis of dried specimens collected by T. MacDougall in 1956 and later it has never been found again. Among the detractors of the "Missing link theory" are those scholars who think that the strange, bladder-shaped leaves present in the samples are nothing but young summer leaves or deformed leaves, but in any case do not represent a stable peculiarity of the species.



Above: the peculiar utriculate-like leaves of *P. utricularioides*. Left: specimens of *P. utricularioides* kept at the Mexican National Herbarium

Distribution and habitat: The holotype was collected in the state of Oaxaca at an altitude of 1800-2000 m.

Description: The plants in the herbarium have small spathulate leaves (probably belonging to the winter rosette); these leaves are 2.5 cm long and only 2.5 mm wide. However, the peculiarity of the species lies in its strange other long-petiolated leaves, up to 3 cm long and whose lamina almost closes at the apex, thus resembling a sort of bladder with a diameter of 4 mm. A similarity to *Utricularia* species was also found in the two lower lobes of the calyx being fused. The corolla doesn't show strange features and is similar to that of the other species in the section *Longitubus*. According to MacDougall's description, it should be scarlet red in colour, like that of *P. laeana*. The holotype specimen shows the flowering from the winter rosette.

Species

A3.2) LARGE-ROSETTED SPECIES WITH OVATE TO OBOVATE, UNPETIOULATE LEAVES



A rare photo of *P. clivorum* in nature, El Porvenir

PINGUICULA CLIVORUM

History: This species was found in 1942 in Guatemala and was described in 1944 by the American botanists Paul Carpenter Standley and Julian Alfred Steyermark. The dried samples were later examined by Casper who first considered them to be *P. lilacina*; later, he re-accepted the name *P. clivorum* in his 1966 monography but put it among the ambiguous species and as such, botanists continued to consider it a synonym of *P. lilacina* for the subsequent twenty years. Meanwhile, in 1986, Zamudio described some butterworts from Chiapas with the name of *P. barbata*. In the 1990s he realized that the description given in 1944 perfectly matched his own description of the species *P. barbata*, which thus became a synonym of *P. clivorum* in 1997.



Distribution and habitat: *P. clivorum* comes from the Mexican state of Chiapas and from Guatemala where it grows on north-facing limestone rock walls amongst mosses in the wet pine forests area between 2400 and 2900 m.

Description: *P. clivorum* is probably an annual species although in the original description it is said to be perennial. The rosette can be up to 10 cm wide and is made of thin, membranous leaves with an obovate to semicircular lamina, clearly involute leaf margins and a short, tightly cuneate petiole. The corolla is deeply bilabiate, up to 1.6 cm long and with obovate to elliptic lobes; the median lobe of the lower lip is longer and larger than the others (a peculiarity of the butterworts belonging to the subgenus *Temnoceras*), and shows a greenish spot and pubescence at the throat. The flower scape, up to 10 cm long, gets near the wall when pollination is completed. The flowering occurs from November to April.

PINGUICULA CONZATTII

History: Alfred Lau discovered this butterwort in 1987 and sent its seeds to several growers around Europe. For many years it was called *P.* sp. 'Santiago Nuyoo' and was considered to be a form of *P. mirandae*. In 2003, it was finally described and given the name of *P. conzattii* by S. Zamudio and J. van Marm after the Italian botanist Cassiano Conzatti who specialized in the flora of Oaxaca.

Distribution and habitat: It comes from the state of Oaxaca where it grows on southwest-facing limestone walls, shaded by trees or shrubs in the mesophyllous mountain woods at 2400-2600 m of altitude.

Description: The summer rosette has up to 5 cm long leaves with a very short petiole and an ovate to sub-orbicular lamina which is of a bright green colour and slightly involute. The winter rosette is pulvinate (while *P. mirandae* presents a small saucer-shaped winter rosette). The corolla is sub-isolobate with obovate lobes and rounded or truncate apex, whitish in colour with violet-purple edges; the pale green spur is just slightly bent (whereas in *P. mirandae* spur and tube are strongly bent). Flowering occurs from the winter rosette.

PINGUICULA ELISABETHIAE

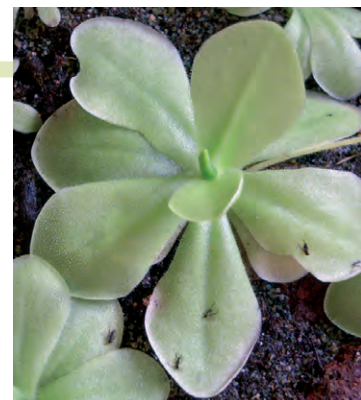
History: *P. elisabethae* was discovered at the same time as *P. moctezumae* in 1990 during the environmental impact surveys before the construction of an artificial lake in the Moctezuma canyon. It was described in 1999 by Zamudio.

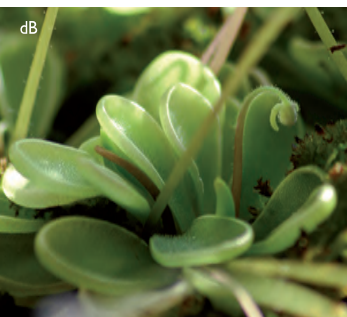
Distribution and habitat: Grows on sedimentary rock walls among mosses and spikemosses in the area of sub-mountain shrubberies, from 1000 to 1600 m of altitude, in the states of Hidalgo and Querétaro.

Description: The summer rosette has obovate to spathulate leaves,



up to 7 cm long, of a light green colour. The winter rosette is semi-hypogean, small cup-shaped, and presents a whitish, spider-web shaped down similar to that of *P. colimensis*. The flower is quite large and reminds one of *P. colimensis* and *P. cyclosecta*; the corolla is deeply bilabiate, with obovate to sub-orbicular, tangent or overlapping lobes, of a strong pink colour with a white spot on the throat. It blooms from July to October.





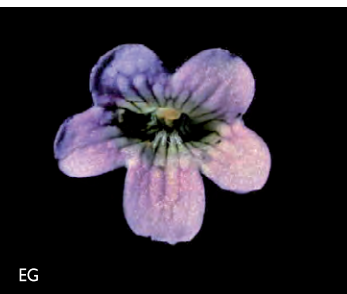
Variability in rosettes colour (above) and flowers shape and colour (right) of *P. emarginata*

History: *P. emarginata* was described by Sergio Zamudio and Jerzy Rzedowski in 1986.

Distribution and habitat: It grows on damp sandstone walls near waterfalls and along streams in a semi-shaded position in wet woods, together with bromeliads, orchids and tree ferns between 1400 and 1550 m of altitude in the states of Puebla and Veracruz.

Description: The summer rosette is up to 10 cm wide and is composed of spatulate to obovate leaves with a short petiole and a clearly involute leaf margin. The leaves may take on a reddish colour encouraged by a stronger insulation. In cultivation, even if the winter leaves often become smaller, the heterophyllous rosette will not develop in opposition to what occurs in the wild. The flower is rather small, about 1.5 cm long including the spur, but is beautiful and unique. Depending on the specimen, the lobes of the corolla are oblong and sub-rectangular in shape with emarginate to irregularly crenate margins, blue and purple veining against a white to violet background. There is a yellowish spot on the inferior lip near the throat. When the pollination has completed, the flower scape bends towards the base of the plant which is a feature peculiar to this and other lithophyte species in the subgenus *Temnoceras*.

The blooming, occurring both in spring and autumn, is copious and long-lasting.



PINGUICULA GREENWOODII

History: Discovered by the famous Mexican flora expert Edward Greenwood in 1987, it was dehydrated and sent to Kew where it was described in 1994 by Martin Cheek. In the herbarium specimens and in the pictures taken by Greenwood, a rather unique, violet-purple, veined flower can be seen which leads the author to record this species in the section *Homophyllum* with the Cuban *P. jackii*. However, this conclusion is speculative and requires further revision.

Distribution and habitat: The original Greenwood's publication reported that the plants were collected in the state of Oaxaca on a vertical dripping wall at 1550 m of altitude. However, the data has not been confirmed and after Greenwood, no one has been able to find these plants in the wild again.

Description: the rosette is homophyllous and can reach a diameter of 10 cm; it has obovate leaves with involute margins. The flower is up to 2.5 cm long including the spur. The corolla lobes are obovate-suborbicular in shape. It shows dark green veins on the tube.

PINGUICULA HEMIEPIPHYTICA

History: This species, considered to be a form of *P. moranensis* in the past, was described by Sergio Zamudio and Jerzy Rzedowski in 1991.

Distribution and habitat: It comes from the state of Oaxaca where it mainly grows as an epiphyte on mossy trunks but also on rocks, in a semi-shaded position, in the wet mountain forests between 1900 and 2300 m, together with bromeliads and orchids.

Description: The summer rosette has shortly petiolate leaves with elliptic to sub-orbicular and slightly involute lamina, up to 7 cm long, of a light green to reddish colour. The winter rosette has a small saucer-shape. The flower is very large, up to 8 cm in length including the spur; the corolla lobes are obovate to cuneate in shape and pink to violet-purple in colour, slightly veined, with white spots at the throat. The flower, on the whole similar to that of *P. moranensis*, differs from the latter in its quite elongated corolla tube which makes the species be included in the section *Longitubus*. It flowers from the summer until the beginning of its winter dormancy.

PINGUICULA IBARRAE

History: This butterwort, similar to *P. agnata*, was discovered in 2001 by the Mexican grower Adolfo Ibarra and was cultivated for many years by him and other enthusiasts with the transitional name of *P. sp.* 'Tlanchinol'. In 2005, Zamudio published an official description and named it after the discoverer.

Distribution and habitat: This species comes from the state of Hidalgo and grows between 900 and 1200 m of altitude in a rather humid region often covered with fog, halfway between a mesophyllous mountain wood and a tropical forest. It grows on sedimentary, mossy, north-facing rockwalls that retain a certain degree of moisture even during the dry season.



Description: The summer rosette has ground-flattened, prostrate, obovate-spathulate leaves with a slightly involute margin, up to 10 cm long and of a light green to brownish-red colour. The winter rosette, which develops rarely and only in case of a prolonged drought, is slightly heterophyllous. The flower is very similar to that of *P. agnata*: the corolla lobes are obovate, approximately oblong, white in colour with lilac-violet edges; violet-purple spots near the throat, while the tube is yellowish green. Flowering occurs from September till March.

P. laeana: see the very long tube and spur



PINGUICULA LAEANA

History: Alfred Lau, a famous German botanist, explorer and discoverer of dozens of new taxa across the American continent, moved to Mexico during the 1950s where he created a mission to welcome and educate the children of that region so that teachers, doctors, engineers could be trained from the local population. In 1973, during one of his expeditions with his boys on Sierra Mixe in the state of Oaxaca, he discovered a beautiful butterwort which had totally red flowers, a unique feature in the genus. These plants were later seen by Franz Fuchs who grew them in the Linz botanical garden. Fuch and Franz Speta officially described the butterworts in 1989 and named the species *P. laeana*. Currently, different cultivars and forms of this species exist in cultivation with some of them being quite different and maybe they deserve a deeper study.

Distribution and habitat: This species comes from the state of Oaxaca where it grows in wet pine tree and oak woods on volcanic mossy rocks, together with ferns and begonias between 2300 and 2500 m of altitude and in semi-shaded locations.

Description: The summer rosette has ovate leaves up to 5 cm long, light green to reddish in colour. The winter rosette has a small saucer shape. The flower is large, with a very long tube and spur (the sum of the two can reach 5 cm). This species was originally



included in the section *Orcheosanthus* but it was later more correctly placed into the section *Longitubus*. The corolla has cuneate to sub-rectangular lobes, approximately oblong, of a scarlet or carmine shade of red, depending on the form. It can show a yellow or whitish spot at the throat. It flowers at the beginning of the vegetative resumption.

PINGUICULA MIRANDAE

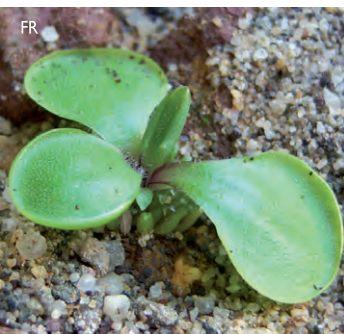
History: This species was described by Sergio Zamudio and Antonio Salinas in 1996.



Distribution and habitat: *P. mirandae* comes from the state of Oaxaca where it grows on limestone north-facing rock walls in the tropical deciduous forest area between 1250 and 1800 m of altitude, together with agaves and bromeliads.

Description: The summer rosette has obovate to spatulate leaves, up to 4 cm long, of a light green with a slightly involute margin. The winter rosette is small and saucer-shaped. The flower is up to 1.7 cm long including the spur; the corolla is sub-isolobate and formed by obovate to cuneate lobes, white to lilac in colour, and throat and tube of a darker purple. A peculiar tube narrowing (similar to that of *P. acuminata*) differentiates it from *P. conzattii*. It flowers during winter.



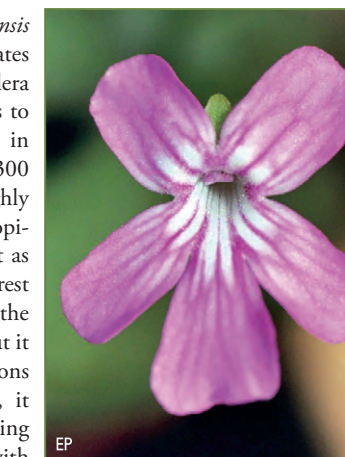
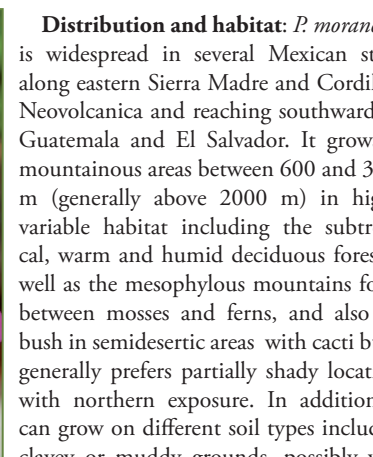


P. moranensis var. *neovolcanica*
at the beginning of vegetative
resumption

History: A polymorphous and widespread species, it is also common in collections where it can present countless forms and varieties, usually and simply indicated by the toponymous of the location, which should all be checked and replaced by taxonomical differentiations.

The holotype was collected by Humboldt and Bompland in Sierra de Pachuca during the famous expedition of 1799-1804 and was described in “*Nova Genera et species Plantarum*” (1817) with many other plants from Latin America discovered during the same trip. Since the second half of the 1800s, several taxa related to *P. moranensis* have been described that Casper later considered to be synonyms. Until recently, some of those names (*P. bakeriana*, *P. caudata*) have been incorrectly used to indicate *P. moranensis*. More confusion is added by the numerous so-called varieties of *P. moranensis* so frequently found in cultivation (‘alba’, ‘superba’, ‘caudata’, ‘mexicana’, ‘rosei’, etc), whose names are often not accepted by taxonomists yet commonly used by growers. A number of studies have been conducted on this species; among the most recent ones, two are notable: that by the Mexican butterworth expert Sergio Zamudio, who groups “*moranensis* complex” plants into only two varieties (*P. moranensis* var. *moranensis* and *P. moranensis* var. *neovolcanica*) and another study that, on the basis of molecular analysis, also leads to the exclusion of *P. moranensis* from section *Orcheosantus*.

Plants of the same population
show great variability in rosette
and flower shape and colours



Distribution and habitat: *P. moranensis* is widespread in several Mexican states along eastern Sierra Madre and Cordillera Neovolcanica and reaching southwards to Guatemala and El Salvador. It grows in mountainous areas between 600 and 3300 m (generally above 2000 m) in highly variable habitat including the subtropical, warm and humid deciduous forest as well as the mesophyllous mountains forest between mosses and ferns, and also the bush in semidesertic areas with cacti but it generally prefers partially shady locations with northern exposure. In addition, it can grow on different soil types including clayey or muddy grounds, possibly with

high organic share, or on volcanic, calcareous or sandstone rocks, and even on tree trunks. In short, this species grows almost everywhere.

Description: The summer rosette has very big leaves, up to 15 cm long, elliptic, obovate, slightly involute, flat to the ground or semi-erect, light green to reddish in colour. The winter rosette is much smaller, saucer-shaped and epigeal (*P. moranensis* var. *moranensis*) or bulb-like and hypogean (*P. moranensis* var. *neovolcanica*). The flowers are produced on long scapes, up to 30 cm long, and are large and beautiful, up to 5 cm wide, with oblong corolla lobes obovate to sub-rectangular in shape. The flowers have a wide range of colour from bright scarlet to deep pink, to violet, to dark violet and pure white. Near the throat there are often darker spots and some forms show veined lobes. Flowering is abundant and year-round in *P. moranensis* var. *moranensis*, while *P. moranensis* var. *neovolcanica* flowers from June to October.

Clockwise from top left, several forms of *P. moranensis*: S. Joachin from, white form, ‘orchidioides’, ‘flos-mulionis’, ‘caudata’

Species

PINGUICULA PILOSA

History: This species is related to *P. agnata* and was discovered in the early 1980s by Alfred Lau. It was introduced to cultivation with the name *P. sp.* "Sierra de Tamaulipas" and was described as *P. pilosa* by Hans Luhrs, Miloslav Stucnicka and Oliver Gluch in 2004.

Distribution and habitat: It comes from a very restricted area in the state of Tamaulipas but data on habitat and ecology are still unknown.

Description: The summer rosette has up to 4 cm long leaves, obovate to suborbicular in shape with a very short petiole and lightly involute leaf margin. The winter rosette is slightly heterophyllous. The corolla is subislobate, up to 3 cm in diameter; lobes obovate to cuneate in shape, violet on the apex and white at the base, with a white down on the upper surface; yellow-greenish throat with pubescence. Flowering occurs from the winter rosette.



W



Right: see the hairiness of the petals of *P. pilosa*



MV

PINGUICULA POTOSIENSIS

History: *P. potosiensis* vividly recalls *P. moranensis*, as it looks like the latter only a little smaller, and some consider them to be synonymous. The species was described in 1989 by Franz Speta and Franz Fuchs.

Distribution and habitat: It comes from the state of San Luis Potosí where it grows on north-facing slopes at about 2000 m of altitude.

Description: The summer rosette has obovate to spatulate leaves, up to 8.5 cm long, light green to reddish in colour, with slightly involute leaf margins. The winter rosette is small and saucer-shaped. The flower is violet with a white spot and darker veins; corolla lobes are cuneate to subrectangular. Flowering occurs at the vegetative resumption.



MV



MV

PINGUICULA RECTIFOLIA

History: This species was first collected in 1987 by Stefan Schatzl on the Sierra Madre del Sur in the state of Oaxaca. Thereafter, it was brought to and cultivated at the botanical garden in Linz where it was described by Franz Speta and Franz Fuchs in 1989.

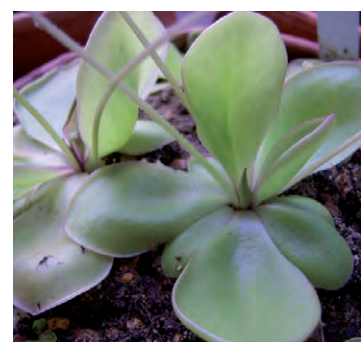
Distribution and habitat: *P. rectifolia* has been discovered in the state of Oaxaca at an altitude of 1340 m.

Description: It is another species similar to *P. moranensis*; its summer rosette has leaves pale green in colour, erect to semi-erect, obovate in



FR

shape with rounded to pointed apex and margins that are slightly involute. The winter rosette is pulvinate, relatively large and not very compact. The flower is quite large, carmine to violet in colour (or sometimes completely white) with a white-yellow spot on the throat and dark veins; corolla lobes are cuneate to subrectangular with rounded to truncated apex and slightly undulated. Flowering occurs from the vegetative resumption until autumn.



Left: variability of flowers of *P. rectifolia* in the wild

PINGUICULA ZECHERI

History: *P. zecheri* was discovered during a 1981 trip by the Austrian botanists Ernst Zecher and Stefan Schatzl and was described in 1982 by Speta and Fuchs. The close resemblance to *P. moranensis* leads some experts to consider it to be a form of the latter, very widespread and variable species.

Distribution and habitat: The species comes from the state of Guerrero where it grows on moist, mossy slopes in humid pine forests between 2250 and 2400 m of altitude.

Description: The summer rosette is large; the leaves reach a length of 8 cm and are ovate to obovate in shape, light green to brownish in colour with slightly involute margins. The small saucer-shaped winter rosette is up to 5 cm wide. The flower is very large (up to 5 cm, including the spur), showy, usually violet in colour, seldom pink or pale pink, with white strips, and faint veins at the throat. Corolla lobes are obovate to spatulate or even cuneate, tangent or overlapping, slightly undulated. Flowering occurs at the vegetative resumption.



FR

Species by species

B1) LARGE ROSETTED SPECIES WITH SPATHULATE TO OBOVATE-OBLONG LEAVES

PINGUICULA AGNATA

History: The holotype was collected in 1948 by H. E. Moore and C. E. Wood but was not described until 1963 by Casper who gave it the name *P. agnata*. Several forms of this species exist with features that may significantly differ from the typical species. A few plants previously belonging to the 'agnata complex' were later described as distinct species. This is the case for *P. sp. 'Ayautla'* becoming *P. gigantea*, and for *P. sp. 'Sierra de Tamaulipas'* which is now known as *P. pilosa*.



Distribution and habitat: *P. agnata* comes from the states of Hidalgo, Querétaro and Guanajuato where it lives on calcarous rocks, often on vertical, north-facing cliffs, in a semi-arid environment inhabited by agaves and cacti at an altitude between 350 and 2000 m, in the tropical deciduous forests, oak forests and sub-mountain arid scrubs.

Description: The summer rosette is made of obovate, spatulate leaves, elongate or rounded according to the different varieties, semierect, up to 10 cm long, green-yellowish in colour or sometimes, of a nice red-dish-orange hue. The winter rosette is slightly heterophyllous. Flowers, too, differ in shape and colour, from pure white to violet-blue, and are sometimes fragrant-smelling. The corolla, however, is usually white with violet lobe margins and violet spots in the throat while the tube is yellowish-green. The corolla is sub-isolobate: the homogeneous lobes are obovate, roughly oblong. The flowering is long-lasting, especially in cultivation, and occurs from the winter as well as from the summer rosette.



Above: typical form and white form 'El Lobo' of *P. agnata*.



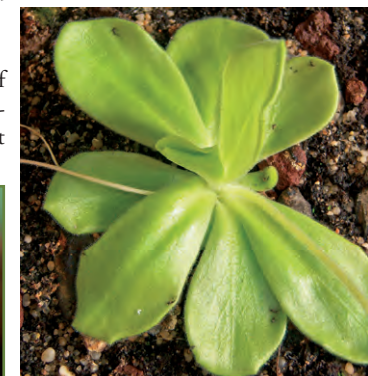
PINGUICULA COLIMENSIS

History: In 1963, Rogers McVaugh and John T. Mickel described *P. colimensis* using a few specimens previously - and mistakenly - considered to be forms of either *P. moranensis* or *P. macrophylla*. Since then, there has been a long period of uncertainty amongst botanists and growers about the correct identification of this butterwort. Until a few years ago, most of the *P. colimensis* plants in cultivation were actually varieties of *P. moranensis* and in fact, even a neophyte should be able to spot the differences between these two species. Now that true *P. colimensis* have entered into cultivation, there should be no longer such errors.

Distribution and habitat: *P. colimensis* is found in the states of Colima, Guerrero and Michoacán where it grows at 350-450 m of altitude on gypsum and north-facing slopes in a partly shady environment throughout the tropical deciduous forests.



Description: The winter rosette is a very compact, semi-ipocean small cup, up to 3.5 cm in diameter that is formed by several small succulent leaves covered by a fine white hair that recalls a spiderweb. The summer rosette leaves are semi-erect, obovate, oblong with rounded apex, pale green in colour, up to 12 cm long. Peculiar to this species are the slightly revolute leaf margins and the glandular tentacles which are among the largest in the genus. The flower is very pretty (hence the name used for this species by Casper: *P. pulcherrima*), up to 4 cm wide; corolla lobes are obovate to sub-orbicular, variably overlapping, rose to deep carmine in colour, spur is very long (up to 4 cm) and narrow. Flowering occurs at the vegetative resumption, around May.



Top: summer leaves sprouting from the winter rosette of *P. colimensis*

Species

PINGUICULA GIGANTEA

History: This species was discovered in 1987 by Alfred Lau on a south-facing wall in the Ayautla region of the Mexican state Oaxaca. For years it has been cultivated as *P. sp.* 'Ayautla', until Hans Luhrs described it in 1995 as *P. gigantea*.

Distribution and habitat: *P. gigantea* grows on south and east-facing slopes at rather low altitudes (500-800 m) amid tillandsias and agaves.



Description: The summer rosette is very large and is formed by semi-erect obovate-oblong, slightly revolute leaves, pale green-yellow in colour and up to 16.5 cm in length. Special feature: it is sticky on both leaf sides. In winter, there is no real heterophyllous rosette. The flower is up to 3.3 cm long and similar to that of *P. agnata*: subisolate corolla with obovate lobes, lilac to violet in colour with darker edges, or sometimes completely white and slightly veined. Throat and tube are yellow-greenish. Flowering occurs from the summer rosette until the beginning of the winter resting period.



PINGUICULA LAXIFOLIA

History: *P. laxifolia* was described in 1995 by Hans Luhrs who, in order to do this, also created the new section *Orchidioides* into which he recorded it.

Distribution and habitat: *P. laxifolia* is only known from a very small area in the Mexican state of Tamaulipas where it lives in the mesophyllous mountain forest between 1900 and 2070 m of altitude on calcareous, shady, rather dry slopes from which its elongated leaves often hang in the void.

Description: Summer leaves are semi-erect or prostrate, have spatulate to oblanceolate, slightly convex lamina that narrows in a thin petiole and that are up to 7 cm long, pale green to reddish-green in colour, sometimes veined. Winter leaves are smaller (1-1.7 cm), numerous and spatulate. Flower is 3-3.9 cm long including spur. Corolla lobes are obovate, rose to violet in colour; throat is white, veined, with a yellowish spot.

PINGUICULA MARTINEZII

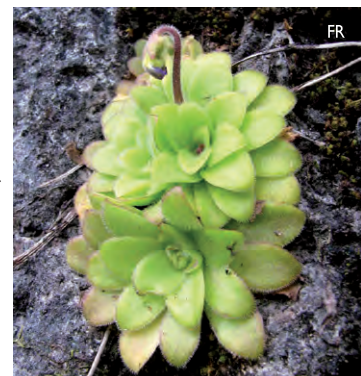
History: This species was only recently described by Zamudio (2005) who named it after the Mexican flora expert Maximino Martinez.

Distribution and habitat: *P. martinezii* is similar to *P. agnata* and comes from the state of Querétaro where it grows on calcareous slopes in the mesophyllous mountain forest between 2000 and 2400 m.

Description: The summer rosette is formed by elongated, spatulate, semi-erect leaves pale green in colour, up to 10 cm long; the winter rosette is slightly heterophyllous. The flower recalls that of *P. agnata*, but is smaller (usually 2.5 cm including spur). Corolla lobes are obovate to cuneate, white in colour with violet margins; throat yellowish with violet spots. Flowering occurs from the winter rosette.



Above: a very rare photo of *P. laxifolia* in flower, by Sergio Zamudio



P. martinezii: winter rosette (above) and summer rosette (left); by Sergio Zamudio

B2) ROSETTED SPECIES WITH LINEAR TO LANCEOLATE LEAVES

PINGUICULA CALDERONIAE

History: A recently discovered species, *P. calderoniae* was described by Zamudio in 2001. It is quite rare in nature and its cultivation has not yet spread amongst growers.

Distribution and habitat: This species comes from the states San Luis Potosí and Querétaro where it lives on calcareous, often vertical walls, in the mesophyllous mountain forest region at 2200-2300 m of altitude.

Description: *P. calderoniae* is a long-leaved species that forms a semi-epigeal bulb during winter. Summer leaves are erect, lanceolate, linear, 6 to 26 cm long, with revolute margins. Flowers are quite large, bilabiate, with oblong lobes red-violet in colour and a long, narrow spur. The species flowers at the growth resumption, around June.

A very rare photo of *P. calderoniae* in nature, by Sergio Zamudio

Below: a red plant of *P. gypsicola* in Buena Vista



PINGUICULA GYPSICOLA

History: Carlos Alberto Purpus was an indefatigable explorer and collector of plants, animals and archaeological finds. In 1910 he found a very peculiar lithophyte, long-leaved butterwort in a semi-desertic area about a hundred km northwards from the town of San Luis Potosí. Specimens were sent to the Californian botanist Townshend Stith Brandegee who, one year later, described it as *P. gypsicola*. Purpus also provided living specimens to other botanical gardens such as the one in Darmstadt and it is thanks to him that *P. gypsicola* was introduced to cultivation in Europe.

Distribution and habitat: As the name suggests, *P. gypsicola* grows on gypsum, in the *matorral submontano* at an altitude of around 1300 m, an environment mostly inhabited by cacti, agaves and spikemosses, in the state of San Luis Potosí. Precipitation here is scarce, even in summer, and the plants are likely to profit from night dew and from the hygroscopicity of gypsum.

Description: The summer rosette of this species is formed by several linear-lanceolate revolute leaves, up to 7 cm long and 4-8 mm broad that unroll in a spiral manner from the centre. Leaf colour varies from light green to red-brownish. The winter rosette is saucer-shaped and hairy. The



flower, of a middle size, is usually up to 2 cm, with a violet corolla and oblong, rather narrow, divergent lobes, whose apex is either rounded or nearly truncated. Flowering occurs from the summer rosette from June to November.

PINGUICULA HETEROPHYLLA

History: Like *P. acuminata*, *P. heterophylla* was first collected by Karl Theodor Hartweg and then described by George Bentham in 1839, thus becoming the first long-leaved Mexican butterwort to be discovered.

Distribution and habitat: It comes from the states of Oaxaca, Guerrero and Michoacán where it is to be found on clayish-sandy slopes or on magmatic rocks, sometimes also on gypsum, in pine and oak forests between 1500 and 3000 m of altitude.

Description: The summer rosette is formed by upright, linear, revolute leaves up to 15 cm long and up to 0.5 cm wide; bright green to brown-reddish in colour. In winter it builds a very compact bulb concealed in the ground and protected by a layer made of its own withered dead leaves. The flower is up to 2.4 cm long, spur included; the sub-lobate corolla has obovate-oblong lobes lilac to white in colour, darker on margins, with the external surface of the tube being also of a darker violet. Flowering occurs in May and June.

PINGUICULA IMITATRIX

History: A mystery, this species was described by Casper in 1963 on the basis of withered specimens collected by George Hinton in 1939.

Distribution and habitat: Hinton found this species in the state of Guerrero, at an altitude of 3000 m; since then, however, it has never been observed again in the wild.

Description: *P. imitatrix* is an heterophyllous species with oblanceolate, highly revolute leaves up to 5 cm long and 3 mm wide similar to those of *P. heterophylla* (hence the name "imitatrix"). The flower, somewhat recalling that of *P. gypsicola*, seemed different to Casper, so that, even though he put the species into the section *Heterophyllum*, he created the new subsection *Orcheosanthopsis*. *P. imitatrix* may actually be a synonym of *P. heterophylla*, or perhaps an hybrid between that and *P. moranensis*, or something similar. The herbarium specimen collected in March 1939 has flowers.



P. imitatrix, photo from C. V. Starr Virtual Herbarium

PINGUICULA MEDUSINA



P. medusina in nature at Laguna Encantada



MS



MS



VB

P. medusina: plantlet at the apex of the leaf

Distribution and habitat: *P. medusina* grows on gypsum in xerophytic environments, together with spikemosses and agaves at 1600-1700 m in the state of Oaxaca.

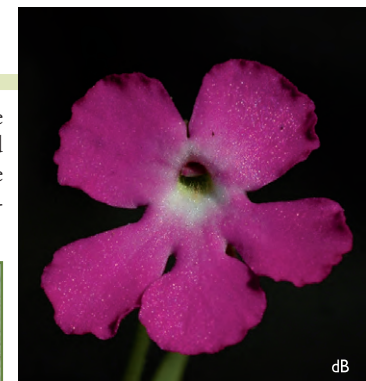
Description: The summer rosette has linear to lanceolate leaves up to 19 cm long, strongly revolute, green-brownish to red in colour; these leaves usually build new plantlets at their apex. In winter, the plant withdraws into a compact, underground bulb. The flower is similar to that of *P. heterophylla*, although a little smaller and narrower; corolla lobes are white to whitish in colour with lilac edges, and have less rounded lobes apices; tube is violet and the throat has a green-yellowish spot. Plants flower at the vegetative resumption in June and July.

PINGUICULA MOCTEZUMAE

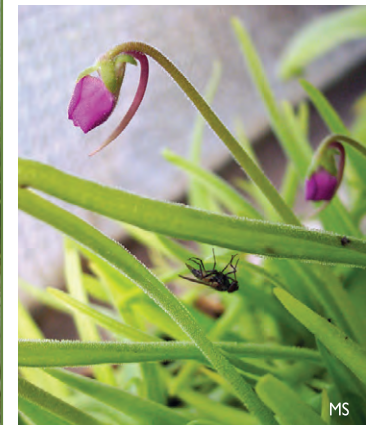
History: This interesting long-leaved species was discovered in the early 1990s during in-field environmental impact studies conducted prior to the building of an artificial lake along Rio Moctezuma, at the edges of the Mexican states Hidalgo and Querétaro. It was then described by Sergio Zamudio and Ricardo Ortega in 1994.



FR



dB



MS

Distribution and habitat: *P. moctezumae* appears to be strictly endemic to the Rio Moctezuma canyon where it grows on calcareous, dripping cliffs at 900 to 1100 m.

Description: The summer rosette is formed by semi-erect, lanceolate leaves up to 13 cm long and up to 1 cm wide; during winter this species is slightly heterophyllous although in particularly dry periods, it may build a very compact, smaller rosette. The showy, large flower is up to 6 cm long (including spur), pink to carmine red in colour with white throat; the corolla lobes are obovate-suborbicular in shape and tangent. Flowering is abundant and can occur throughout the whole year.



Part III

Cultivation Guidelines

As briefly stated in the historical introduction, Mexican butterworts have been cultivated for a relatively short time when compared to other CP genera. In the last thirty years, however, their cultivation has much improved thanks to the increasing amount of available information about their natural habitats and about growing experiences including techniques developed by the first growers whose initial efforts were often just tentative. To date, even considering the great variety of cultivation methods and materials, some basic and easy principles do exist which allow one to start keeping Mexican butterworts with absolute confidence.

Substrate and containers

Gone at last are the days when *Pinguicula moranensis* was cultivated in the same way as *Drosera capensis* or *Sarracenia purpurea*, that is, keeping it in a peat-and-sphagnum substrate; growers now tend to adopt an extremely draining substrate with a very small portion of organic material.

An example of such is the following mix which I have successfully used for a long time for most species: peat, sand and pebbles 1:1:1, sprinkled with rock fragments of any kind (sandstone, limestone or, most frequently, ophiolite).

For a few years I've been testing a more porous, inorganic mix: peat, sand, pebbles and volcanic stone 1:1:1:1, plus a small clay addition.

Many growers prefer a totally organic-free

substrate using variable portions of (more or less fine) sand, vermiculite and perlite, volcanic stones, pumice, clay, limestone, gypsum. Those who have tried such substrates deem that they result in a slower growth but also in enhanced vigour of the root system and of the plant itself.

As regards to containers, both plastic and clay pots are suitable. I prefer the latter for both aesthetic and functional reasons since clay helps keeping the substrate fresh through transpiration. Plastic pots are more practical, lighter and hold humidity longer but the black ones absorb light radiation, thus letting the substrate heat. An interesting option is to place the plants on porous and absorbing rocks (i.e. tufa, sponge rock), put in trays, and partially submerge with water.

Watering and air humidity

I think that, rather than the soil composition, correct watering is among the key factors to consider if one is to successfully grow Mexican *Pinguicula*. In this regard, the first aspect to keep in mind is the bi-seasonal climate peculiar to the natural habitat of these species. As we have already seen, most of them build their vegetative rosette between May-June and October-November; during this period they need water although there are different opinions: some suggest to let the substrate totally dry between waterings while others do not; some use a tray system whereas others drop

water only from above; some also say that leaves must never be touched by water. As for me, I usually keep the pots in trays with 2-3 cm of water during the growing season, dampening both from above and from the bottom, and sometimes I also vaporize the leaves. Since mine are clay pots at least 10 cm in height, the top of the substrate is never soaking wet but is, however, always moist. Concerning water, it is not necessary to use demineralized water, like for other carnivorous plants, but any pure source water does well. The soils where Mexican butterworts grow, are never wet, not even in rainy or foggy days or in misty mornings, because they are naturally well-drained and usually steep and then water is not retained. As a general rule for the summer growing season, this may suggest that soil should be just damp, never soaked. However, the water requirements of plants vary according to many factors such as soil composition, relative air humidity, and exposure.

During the winter dormancy, plants should be kept dry, although again, the specific conditions of every single grower's context matter. A particularly dry, bright and tepid environment, for example, might lead to the risk of the plant's complete dehydration. As a general rule, I would suggest keeping plants completely dry, as if they were succulents, that is, watering them sparingly and only occasionally, and only just enough to slightly rehydrate the substrate on warmer days that may occur. In any case, the plant must not remain damp for a long time. But when and how is watering supposed to be suspended? This appears to be the most fundamental issue since plants are most likely to rot during the transitions between their resting and growing periods. Provided that the plant is vigorous and that the cultivation method is correct, there should actually be no consequences for suddenly and completely rehydrating the substrate at the

beginning of the growing season. However, a more cautious method is to wait for the first signs of waking up (new leaves emerge from the rosette center) and once they appear, to slightly dampen the soil. Let the soil dry before the next watering and then gradually increase watering frequency until the summer rosette of the plant is almost done. From that moment onwards, the pot can be kept in tray system.

At the end of the growing season, the same concept can be reversed by gradually suspending watering.

This method is suitable for heterophyllous species. In cultivation, annual species may behave as biannual or perennial species, and in this case, temperature and humidity parameters have to remain stable. As for relative air moisture, Mexican butterworts require fresh and humid environments since they usually come from middle-mountain and highland regions. Even those species from semi-desert zones live in habitats with a microclimate that allows a certain amount of moisture to always be present. In cultivation, a minimum level of at least 60% r.h. is advisable, but very high values in air moisture make good air circulation also necessary.

Temperatures

Although geographically-speaking the native area of growth is in the tropics, temperatures in the Mexican mountains are mild and species from semi-desert environments are usually found on north facing slopes where temperatures show a substantial difference when compared to those of fully exposed sunny zones. In addition, many of the semi-desert species grow in rock gorges or on high-reflecting, hygroscopic soils (gypsum). For cultivation, most of the Mexican butterworts thrive when grown at not extreme summer temperatures, the best being between 18 and 28 °C. With higher values,

during hot spells or the hottest times of day, the plants should be moved to shadier and cooler places. In winter, most of the species can tolerate temperatures around 0 °C and several species also accept short, light frosts. To achieve a good dormancy period, however, the best temperature range is between 4 °C and 10 °C.

Light

The considerations about temperature apply similarly to light: although light is very strong in the tropics, almost all of the Mexican butterworts grow in the shade of rocks and bushes (it is however true, indeed, that tropical shade is "brighter" than that in temperate regions, such as Italy!). Species that do not observe the "north-facing-cliff-rule" are those that live in the more humid peaks, but they, too, grow sheltered in the shade of trees. In cultivation, a bright place is advisable to favour a nice and strong coloration of the leaves but it should not be in full sunlight. A good solution would be a position exposed to direct sunlight in the morning and late afternoon, leaving plants in the shade during the hottest hours and days.

Reproduction

Propagating Mexican butterworts is really

very easy. As years go by, most of the species naturally tend to form new sprouts through the self-division of the original rosette, thus originating a colony of new plants that can be separated. Some species, especially those from section *Crassifolia*, build a rather loose succulent rosette during winter when the leaves easily detach and form new plants without any intervention. This characteristic is likely to be peculiar to plants in the wild as well as a natural way for the agamic spread of the species which can be exploited when making leaf cuttings.

Leaf cutting is a quick, easy method that is suitable for all heterophyllous species (whereas it appears to be inapplicable to homophyllous species); both winter and summer leaves can be employed although the small, thick winter leaves generally yield better results. Around late April, I pull off a few leaves from the still resting rosette, choosing among the more external ones. Next, I put the leaves on a slightly damped substrate in a well-lit position, making sure that the relative air humidity remains high (for instance, by almost totally covering the container with glass or transparent film). New plants that possibly develop from the leaves are ready for their final settling after a couple of months.



Seed reproduction is also easy: just scatter the seeds on damp soil (either the same substrate used for adult plants or a 1:1 peat-sand mix) and keep the containers in trays with about 1-2 cm of water in a luminous, humid place. With fresh seeds, germination usually occurs within a month and in a quite high percentage; when plantlets are big enough to be handled, transplant them to their final location.

Cross-breeding

Because of their geographical isolation, natural hybrids are rare among Mexican butterworts (and almost unmentioned in literature) but almost all of the species treated here can be artificially crossbred. As an exception, homophyllous species do not hybridize thus confirming their genetic peculiarity within the group. Since the 1980s, when the first, epoch-making hybrids of *P. moranensis* and *P. ehlersiae* were created (resulting in the famous cultivars *P. 'Weser'* and *P. 'Sethos'*), a large amount of hybrids have been entered in cultivation that either bear features intermediate to those of their parents or have been selected for their showy flowers and/or their higher vigorousness.

Besides the two cultivars mentioned above, an incomplete list may include the following ones: *P. 'George Sargent'* (*moranensis* x *gypsicola*) by G. Sargent; *P. 'Tina'* (*zecheri* x *agnata*) by H. Weiner; *P. 'Titan'* (*agnata* x *macrophylla*) by L. Song; *P. 'Aphrodite'* (*agnata* x *moctezumae*) by J. Flisek and K. Pasek; *P. 'Florian'* (*jau-mavensis* x *debbertiana*) by O. Gluch; *P. 'John Rizzi'*, created by P. D'Amato's humming-birds.

Pests and diseases

Mexican butterworts are usually robust plants whose cultivation should not present any problems when kept properly. As a general rule, there are no specific parasites

able to seriously damage the plants; slugs and snails can occasionally nibble the leaves, but are easy to spot and eliminate. Larvae of *Sciaridae* and nematodes are more insidious as they attack roots and represent a serious threat to young or weak plants. They can be fought against by treating the soil with insecticides and nematocides or via biological fight, i.e. introducing parasites of the parasites (antagonist nematodes, chitin-destroyer fungi), using adhesive strips (adult leaves of butterworts are anyway a very good remedy against adult gnats) and improving the general growing conditions (check especially for poorly illuminated places and excessively humid and peaty substrates).

Another common threat is represented by some harmful fungi. Although there are a number of specific products available in the market to fight them, it is better to prevent the onset of fungi. This can be done by keeping plants and pots clean and by removing any dead leaves (which is also an aesthetic plus), letting the soil dry out in winter and most importantly, making sure that there is always a certain level of air circulation in the place where the plants are cultivated. In the worst cases, illnesses caused by fungi are incurable (as, for example, the rotting caused by *Fusarium* organisms which usually appears in early summer). In this circumstance, ill plants must immediately be taken away from the others.



Pinguicula gypsicola in cultivation



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www.pinguicula.org (Eric Partrat)

www.omnisterra.com/bot/cp_home.cgi

www.karnivoren-in-kultur.de (Markus Welge)

www.gluch.info (Oliver Gluch)

www.cpphotofinder.com

Credits

W Markus Welge (from website)

MF Marcello Ferrazzano

MP Marco Pezzotta

MS Maurizio Saroldi

dB Chiara di Biase

S Scott Strauss

vW Marcel van Wilgenburg

MV Markus Vieweg

UW Uwe Westphal

All unmarked photos are by Gabriele Basso

From E. Partrat's website:

BB "barefoot boys" N. Elhart & F. Conrad

VB Vic Brown

G Oliver Gluch

EG Edward Greenwood

K Oliver Komar

LL Laurent Legendre

EP Eric Partrat

ER Ed Reed

FR Fernando Rivadavia

Glossary

Agamic:	a type of asexual propagation that consists of detachment of a part of the plant which forms a new individual identical to the parent plant.
Alveolate:	covered with dimples (alveolus).
Bilabiate:	the calyx or corolla which are divided into two distinct parts: the upper and lower lips.
Biocoenosis:	describes all of the interacting species living together in a specific biotope, an area where physical-chemical and environmental conditions are constant.
Cordiform:	heart-shaped, with the apex upward.
Crenate:	the edge of a leaf, sepal, petal or bract having margins with teeth not strongly marked.
Cuneate:	wedge-shaped.
Cytology:	also called cellular biology; the science that studies the cell from the morphological and functional point of view.
Dormancy:	resting conditions where a plant takes refuge when it is under unfavourable conditions.
Emarginate:	the edge of a leaf, sepal, petal or bract having margins with shallow and rounded incisions.
Embricate:	overlapping, such as tiles on a roof.
Endemism:	species exclusive to a well-defined geographic area.
Epigean:	occurring above the soil surface.
Epiphyte:	a plant growing attached to another plant, but not parasitic.
Heterophyllous:	with leaves changing significantly in shape and appearance in relation to the changing seasons.
Gamopetalous:	referring to the corolla when the petals are welded together, at least at the baseline.
Globose:	nearly spherical shape.
Habitus:	the appearance of a plant.
Hibernaculum:	the winter-resting body, usually a compact, bud-like structure in which a plant remains dormant to overcome the cold season.
Holotype:	the specimen taken as a reference for describing a new species.
Homophyllous:	with leaves changing just a little in shape and appearance in relation to the changing seasons.
Hygroscopic:	able to absorb atmospheric water and humidity.
Hypogean:	occurring under the soil surface.
Infraspecific:	a taxonomic group of lower rank than species (subsp., var., form, etc.).
Involute:	rolled toward the upper surface.
Isolobate:	with nearly equal lobes.

Lanceolate:	shaped like a lance-head with the narrow part upward.
Linear:	narrow and long.
Lithophyte:	a plant that grows on rocks.
Lobe:	the rounded segment of a leaf or a flower; in this article, the part of the petal not welded to the tube.
Mesophyllous:	with intermediate needs in relation to several environmental factors; any organism that doesn't respond well to high and low temperatures and/or grows in any area not particularly dry or particularly wet.
Oblanceolate:	shaped like a lance-head with the narrow part downward.
Obovate:	shaped like the profile of an egg with the widest part upward.
Orbicular:	nearly circular in shape.
Ovate:	shaped like the profile of an egg with the widest part downward.
Petiolate:	having a petiole.
Phenology:	the science that studies the major events in the development of organisms.
Polyphyly:	referring to a group of species whose members do not have a common ancestor.
Pulvinate:	referring to a plant or a colony having a subglobose shape, cushion-like.
Revolute:	rolled toward the bottom surface.
Saccate:	sac-shaped, deeply concave.
Spathulate:	the shape of a leaf with a rounded apex and narrowing toward its base.
Speciation:	the evolutionary process by which new species arise and develop from the pre-existing ones.
Stolon:	a particular branch produced by some species which, standing on the ground, produces buds from which new plants develop.
Succulent:	fleshy plants or parts of these, characterized by tissues rich in water.
Sub-:	prefix meaning somewhat, almost.
Taxon	(plural: taxa): a grouping of organisms, genetically and morphologically distinguishable from others and recognizable as Systematic units, which are arranged in a gerarchic structure of scientific classification.
Taxonomy:	the scientific discipline that deals with the types of classification according to different criteria; processed and studied by Systematics.
Throat:	the point where the petals are united and the corolla become tubular.
Toponimous:	the name of a geographical place.
Utricle:	a small, bladder-like structure.
Xerophyte:	a plant adapted to live under very dry conditions.
Zygomorphic:	with only one plane of symmetry.



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