

INTERNATIONAL
PINGUICULA
STUDY GROUP
OPEN DAY

SATURDAY 5th NOVEMBER 1994

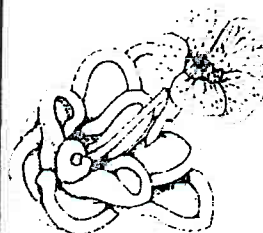
1pm. onwards...
at the invitation of
STAN LAMPARD
196, HOLT LANE
NORTHFIELD
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021 476 8586

You are welcome to view my collection of
Pinguiculas,
and to see slides of my field trip to
MEXICO

We will have a
BARBECUE & FIREWORKS DISPLAY
in the evening - weather permitting, so come
prepared with some Fireworks and a Bottle!

Details dependent upon numbers attending,
so please write enclosing an s.a.e.
if you would like to come.

THE
INTERNATIONAL
PINGUICULA
STUDY
GROUP



Newsletter No.5.
September 1994



Pinguicula vallisneriifolia

Photographed by Serge Lavayssiere growing on the
vertical limestone walls of a gorge called Cerrada de Elias
in the Spanish National Park known as Sierra de Cazorla.



Pinguicula vallisneriifolia



Pinguicula grandiflora "Rio Mundo"



Pinguicula vallisneriifolia



Rio Mundo . *Pinguiculas* to the right of fall



Pinguicula immaculata



Pinguicula reticulata



Pinguicula lilacina



Pinguicula takakii

INTERNATIONAL PINGUICULA STUDY GROUP

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AIMS OF THE I.P.S.G.

1. To meet with other collectors of the species and primary hybrids.
2. To exchange information between members and to provide a forum for the exchange of information.
3. To allow the exchange of seeds internationally to improve member's access to species so that they are perpetuated in cultivation. International exchange of plant material other than seed is more difficult As phyto-sanitary regulations have to be abided by. *In-vitro* tissue culture and micro-propagation may make this easier in the future.
4. To encourage the use of botanically correct names or otherwise the use of *nomina-nuda* until the plant has been officially described as a species.
5. To encourage accurate record keeping including such details as: location data, altitude, climate and soil type. collector's name if known.
6. To re-introduce "lost species" to cultivation.
7. To encourage the production and selection of new primary hybrids.
8. To encourage and help the preservation of habitats in all countries where the species grow wild.

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EDITORIAL

I am writing this just two weeks before Mid-summer's Day and could probably count the number of days when the temperature has risen above 20C on one hand! What do you do when the weather is so depressingly cold and wet?...Why..... retreat to the greenhouse and pollinate your *Pinguiculas* of course! There is something special about our plants and none of us should be content to simply own them for ourselves. Yes, I know only too well how much space propagation material can take up in an already over-cramped greenhouse, which is why I suggest raising seed. Please if you do so, send your surplus to Chris Heath, our seed bank organiser, who will offer it for sale in order to raise funds to subsidise this Newsletter. Seed should be supplied with full details, stating parentage; remember of greatest genetic worth is wild collected seed, followed by seed raised by cross pollination of different clones of a given species under controlled conditions, self pollination is often the only option available but should be used only as a last resort as 'inbreeding' is likely to reduce vigour.

Newsletter number 5 is another 'bumper' edition, which I'm sure you will enjoy!. Unfortunately, this results in increased costs, especially for postage, so we cannot continue doing this without asking you all to increase your financial support to **£2 per issue UK members, £3 abroad**. This is just enough to cover costs without relying upon subsidies from the seed bank!

This edition continues with a truly International flavour, containing contributions made by authors from Holland, France the U.K and Czechoslovakia, on a wide variety of subjects, which all goes to illustrate just how rapidly support, interest and knowledge on the subject of *Pinguiculas* has grown. In particular, we are most grateful to Miloslav Studnicka for granting full permission to reproduce his article, which it is hoped will stimulate further research in this interesting area of plant physiology.

We have been so encouraged by this that we propose to organise a '**Pinguicula Convention**' to take place next year as a follow-up to last year's Mexican Plant Convention. We wish to elevate the IPSG to a new high by inviting an international specialist in the field to address the meeting as well as including talks on range of topics to interest us all, such as discovery, conservation, cultivation, ecology, hybridisation, taxonomy, tissue culture, photography and so on. As with last year's immensely enjoyable Convention, we would also aim to make this a great social occasion by organising a conference meal, plant displays, demonstrations and so on. This can only be made economically possible if sufficient people are interested, so please feel free to give your suggestions, volunteer your help or, at least, register your support in principle, with no obligation, when you write back to us.

For those who cannot wait until next year, I will be showing slides of my trip to Mexico at the:

IPSG Open Day in Birmingham on Saturday 5th November ...
...a spectacular display of flowers followed by fireworks!

Stan Lampard.

THE DISCOVERY OF SPANISH BUTTERWORTS (part 1)

S.LAVAYSSIERE
Neauphle-le-Chateau
FRANCE

Despite the discovery of *Pinguicula vallisneriifolia*, my last visit to Spain during the summer of 1990 had been shadowed by a slight feeling of frustration, I was longing for the opportunity to return to such places. Housing difficulties had, indeed, restricted our(my wife and I) stay in *Sierra de Cazorla* to 3 short days. The discomfort and fatigue of semi-wild camping had forced us to return home, making me regret later on that we had not enough courage to pursue 200km further south to hunt down *Pinguicula nevadensis*. It was therefore with understandable excitement that we engaged again last August toward *Andalusia*. This time we placed advance reservations at campsites for an eight day long stay, having gathered information about campsites during our earlier trip.

After an enjoyable 3-day stay with Jean-Jacques Labat in Gers, France, we crossed the *pyrenees* at the *Bielsa* tunnel and advanced a further 70km through Spain (*Huesca, Zaragoza, Teruel, Albaceta,, Sierra de Cazorla*) in order to reach the *Fuente de la Pascuala* campsite. A spot was already waiting for us there in the very welcome shade of a pine forest.

Whether the parks of the *Sierras de Cazorla* and *Segura* are reached from the desertic province of *Murcie* on the east side or from *Andalusia* and its gigantic olive groves on the west side, both look like an oasis because of their Mediterranean forest, their innumerable springs, and all of their mountain streams that feed the high valley of the *Rio Guadalquivir*. The nature park of the *Sierras de Cazorla, Segura y las Villas* obtained protected status on February 5 1986. It covers 214,000 hectares, shared by 23 communal territories. Its mountain range has summits from 600 to 2,106 metres.

The high altitude as well as the rough character of this region have been efficient natural barriers giving protection against the wave of deforestation that has transformed most of the peninsula into a semi-desert. The park has the second most diverse flora in Spain, after *Sierra Nevada*, and hosts a vast number of endemics like the park's emblem *Viola cazorlensis* and of course *Pinguicula vallisneriifolia* which seems to have disappeared from all sites outside the park where it had previously been recorded : (*Sierra de Tejada, Sierra Alamilla....*). Centred around the *Rio Guadalquivir* valley, the park is crossed by the 50km long main road that goes along the river valley uniting campsites, hotels, inns, restaurants, a hunting ground, information centre and a botanic garden. Side roads and trails lead to some outstanding wild places. At every park entrance local authorities let people in only after recording their vehicle license plate number. Walks are permitted only upon specific trails, enforced by unceasing patrols of the *guarda civil*. Inside the park it is

possible to settle in a few campsites that offer comfort, but these are sadly permanently full with Spanish people who flee the over-populated coasts. Here and there it is possible to stay for free in wild campsites built around a water fountain..

The consequence of the overwhelming presence of the park guards is an astonishingly well preserved area. If the flora deserves such protection, the fauna equally benefits from it. Numerous birds of prey (king eagle, vulture, falcon, hawk...) can be observed, as well as badgers, hares, ibex, and wild goats. But the most impressive and common encounter is with stags. An old male even comes every evening to eat from the rubbish of a local restaurant!

Since the entire region used to be submerged underneath primitive oceans 180 million years ago, an important layer of sediments has been deposited over the plinth of the iberic peninsula which mostly consists of crystalline rock and schist. The current mountain chains of the iberic peninsula, including *Sierra Nevada* and *Sierra Morena*, developed during the miocene period 22 million years ago as a consequence of the rising alps. The soils of the *Sierra Cazorla* and *Segura* are therefore alkaline and contain a lot of sediments.

The particular orientation of the massif allows good protection from the north winds and the benefit of oceanic rains, creating a variety of local climates. Though precipitation is non-existent from June until September, it is heavy from October to May, with a break in January and February. Rainfall volume varies according to altitude and orientation, the lowlands receive 500mm water per year, the summits obtain 2000mm during the same period. These variations are further exaggerated by specific orientation at each site. Average temperatures range from 4C in January to 30C in July/August. These are averages but some nights can be much colder, many park signs warn against frost, whilst some days can be much warmer!

After a good night's sleep, our first objective was to return to a site already visited in 1990. Six km below the campsite stands the information centre of the *Torre del Vinagre*. Further down a road crosses the *Rio Guadalquivir* and leads to a fishfarm where walkers must leave their vehicles. The road is indeed closed to all vehicles, except to park guards' by a chain, this is where we embarked upon the dirt road upward along the *Rio Borosa*. The Mediterranean type forest comprises several types of resinous trees, green oaks, juniper trees, pistachio trees and many fragrant plant species as ground cover including rosemary and lavender. After walking for about 5km we left the trail in order to follow a path toward *Cerrada de Elias*. The path crossed the Rio several times, we welcomed the shaded left bank, unveiling several humid spots with springs and streams. After crossing a final bridge we were in sight of a narrow gorge called *Cerrada de Elias*. The east-west orientation of the gorge and an elevation of 1000metres creates a fresh atmosphere kept humid by the river water. It is in this place, on both banks, that *Pinguicula*

vallisneriifolia is to be found, rooted into vertical calcareous cliffs, alongside *Adiantum* fern and a white flowered *Potentilla* possibly *P. caulescens*. The leaves of the latter are surprisingly gluey but do not capture as much prey as the more efficient Butterwort leaves. This made me wonder again about the possibility of evolutionary convergence toward carnivory. A strange discovery, but one which did not distract me for long from the main goal of our visit!

Pinguicula vallisneriifolia is endemic to *Sierra de Cazorla* and to some mountains in south-east Spain from where it has now undoubtedly disappeared. The genus *Pinguicula* is so well known amongst CP fans, yet the word *vallisneriifolia* seems foreign. It simply means that this butterwort's leaves resemble those of *Vallisneria spiralis* an aquatic plant with ribbon like leaves to 90cm in length! Even though the leaves of this butterwort never reach more than 30cm it is still a giant in the genus. At the site we visited none had leaves reaching 30cm though the most beautiful individuals were 25cm long!.

From the basal rosette the linear leaves reach up to 25cm in length and 3cm in width before ending with a rounded tip. The leaf margins don't roll upward as for *P. vulgaris* but rather downward as with *P. longifolia*. The upper surface only is covered with glands whilst on the underside a central midrib a few millimetres wide is highly visible. The leaves are thin not fleshy like many Mexican species, giving an impression of weakness. Indeed, the leaves lack the necessary rigidity to stay straight for more than 10cm and bend under their own weight forming trickling cushions on the rocks. At the driest spots the plants seem to enter dormancy prematurely. The rosettes produce shorter and shorter leaves before building a compact hibernaculum as the north European species do.

I have to admit at that very moment I just couldn't repress a photographic frenzy that slowly but surely took control of my soul! After having captured some views of pretty tufts, I got closer to immortalise the apparent fragility of the leaves. Some plantlets displayed short rounded leaves a few mm long, while others were made of only two or three narrow leaves 4-5cm long. At this point I realised that the first leaf form is typical of seedlings, whilst the lance leaf form develops from the tip of whitish stolons produced by adult plants. More careful reading of Adrian Slack's book "Insect Eating Plants" should have prepared me for this discovery, but this unusual phenomenon has to be seen on live specimens to accept it!

After having exposed two rolls of film I judged it wise to stop and moved on to my second goal task of collecting seed. There were plenty of capsules as flowering takes place in April and May, but all were open and had long since scattered their contents. Some seeds could even have already germinated. Even so, I reaped all capsules within reach and gathered a small quantity of seeds, sufficient to share with a few other enthusiasts though not enough for the seed bank.

It was time to continue our walk. As we were going upward out of the gorge, the high walls became further from the Rio leaving more space for the trail. As I saw a new spring wetting the soil and rocks on the right side I noticed a few leaves emerging from a horizontal cornice about 1.8m above the ground. This was again *P. vallisneriifolia*, this time growing horizontally. There were about 10 plants and three fully opened flowers, though these were past their best being white and feeble, without any bluish margins of their youth. Inspite of the uncomfortable position this discovery still required the taking of a few more shots!

Upon our return to *Torre del Vinagre* we took advantage of the fact that the visitors centre was still open and quenched our thirst whilst engaging the flora specialist there in fruitful conversation. We declared our surprise at finding open flowers, but according to him this wasn't exceptional since these plants bloom a second time in the fall, when drought subsides. Without doubt the humid growing conditions of these plants would explain this early flowering. We also learned that *P. vallisneriifolia* could be seen in a fountain display along with *P. grandiflora* at the botanic garden. It was sadly too late to go and visit that day, but that set our priorities for the next day. The fatigue of our wisely modest programme, having remained hidden by our earlier excitement, was now starting to weigh heavily.

The second day was spent at the botanic garden where some Butterworts could indeed be found, but they were far less beautiful than the ones seen in their natural environment. The feeble leaves though thoroughly rinsed with dripping water looked very pitiful and had nothing to suggest their original shape. Likewise, the *P. grandiflora* present were in a very sad state, a sight which did not encourage us to stay longer. Still, I was hooked and would have no peace until I had also seen this species in its natural setting! We therefore returned to the information desk to extort some more information. Before satisfying our initial curiosity a botanist told us that two sub-species of *P. vallisneriifolia* very likely exist, and the results of this research should be published in a year or so! He also told us that the *P. grandiflora* we had seen was an endemic subspecies and was the subject of a further manuscript in preparation. With hard-beating heart I had to ask him the question that was burning my lips, though well remember his reluctance to tell us about *Cerrada de Ellis* 3 years ago. I was therefore very surprised to see him open up a map and show us the source of the *Rio Mundo* 70km north-east. This was to be our goal on the next day.

Despite the beauty of the places we crossed and the many stops we couldn't resist, I will save time and place the reader directly in *Nacimiento del Rio Mundo*. As soon as we arrived we felt like turning back as the place was full of tourists attracted by restaurants bars and wide parking areas, certainly nothing that would have invited us on tour if there had not been the

hope of finding an endemic butterwort! Wearing walking boots we followed the dense waves of tourists along the single trail in the direction of the view point or 'Miradors'. After a couple of hundred metres, the Rio appeared on the left side of the trail so we judged it preferable to leave the overused trail to go upward along the river. We gradually understood what attracted so many people. We were at the bottom of a north-west oriented natural cirque that was cool and humid and supported a rich vegetation. The descending torrent flowed down through numerous inter-connected pools (*Caldereta*) which competed in beauty for numerous tourists scattered over the entire area. We went from caldereta to fall, from torrent to pool, past caves hidden by curtains of water and moss covered boulders with impatience in search of the first carnivorous plant. Then around a caldereta my eye was caught by the long-awaited sight of light green rosettes huddled upon a humid rock in the shade of a couple of trees. This really was *P. grandiflora*, impossible to confuse with her big sister with vallisneria type leaves. About fifteen plants were sharing the vertical side of a rock that otherwise only housed a few mosses. The largest butterworts did not exceed 15cm in diameter and had about 10 oblong leaves with upturned, sometimes undulate margins. A few plantlets could be seen but without any stolons, all were small replicas of the larger plants and were most likely seedlings. I hurried to collect any possible seed at the bottom of the dried seed capsules, though sadly most were empty. We then continued our ascent without seeing any further butterworts until reaching the place that had attracted so many people. The trail that we had left earlier led to the right side of a large pool about 15m wide at the bottom of a basin. The vertical wall behind the basin was vaguely concave and about 10m high and covered by a stream of water that fed the pool. These walls were covered in Pinguiculas necessitating our stop. The many tourists paid no attention to them and my intense photographic activity must have seemed very strange to them! Most plants were out of reach, leaving me confident of their survival. It was obvious that the water originated somewhere higher up but there was no easy way along the river so we returned to the trail and took a large detour to the upper caldereta, eventually arriving on top of the wall that dominated the lower basin. A sign read 'Mirador 1' just before the end of the trail, there was no more fence and disciplined walkers continued no further. However, in spite of there being no track and the wet and slippery rocks we had to go on and under the astonished look from other walkers, guessing their thoughts "*Franceses locos*", we engaged in climbing the few metres that separated us from the next stage.

Again, once and a while, the rocks were covered with butterworts, all different and more desirable before our insatiable gaze, of course. Eventually we arrived at the bottom of a cirque, with a setting that still makes me shiver as I write these lines. In front of us was a wall more than 100metres high, from the middle of which the waters of the *Rio Mundo* plunged into the air before being dispersed by the wind all around the bottom of the cirque. Because of this unceasing rain the soil was damp and many rocks were washed clean of vegetation, while others were clothed with thousands of Butterworts!

Even on vertical walls there was sufficient water oozing out to allow these plants to adhere and grow several tens of metres above the ground. I still wonder how the seeds first managed to conquer such inaccessible places. Twenty metres higher on our right hand side, though still far below the water output, is Mirador 2 which is accessible by another trail and gives a plunging view of the site. We also went there of course, but no butterworts could be found. Our curiosity was further aroused by the sight of a couple of walkers half way up on the cliff just at the place where the Rio emerges. Starting all the way back at the parking lot is a different trail which goes to this place in the direction of *la Cueva*, so we went back down to follow that track. After climbing for one and a half hours, past impressive views at the edge of the precipice, we reached the source of the *Rio Mundo*: an underground river emerging from a cave. The walk did not need to end here but could be continued, with the aid of an electric torch, for a further kilometre or more into the cave to find an immense chamber the roof of which had collapsed to allow the sunlight to shine down from hundreds of metres above!

At last, now fully satisfied with all these butterworts, we ended the week with walks and hikes to many more interesting sites within the park.

After a week, the time had come for us to get back on the road, not homeward, but further southward in a more exciting quest for *Pinguicula nevadensis*, a species which for the time being, was only a name in books without accompanying photographs. In "*Monographie die Gattung Pinguicula L.*" by S.J. Casper, the author talks about *Nival zone of Pico de Veleta and Mulhacen* which are nothing less than the two highest summits of the *Sierra Nevada*, over 3400m high.... So, "en route" to *Granada*.

MILOSLAV STUDNÍČKA

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Interesting Succulent Features in the *Pinguicula* Species from the Mexican Evolutionary Centre

KEYWORDS

Photosynthesis, *Pinguicula*, Succulent, Vascular bundles

ABSTRACT

STUDNÍČKA M. (1991): Interesting succulent features in the *Pinguicula* species from the Mexican evolutionary centre. - *Folia Geobot. Phytotax.*, Praha, 26: 459-462. - This paper deals with the carnivorous plants of the genus *Pinguicula* occurring particularly in wet habitats. Nevertheless, some species are able to survive longer dry periods in the course of which they form succulent rosettes. Leaf anatomy has been investigated in 6 Mexican species of this kind. The following features frequent in typical succulents have been found: green sheaths of vascular bundles (indicating the C₄-pathway of CO₂ assimilation in photosynthesis) and the chlorenchyma located in the lower (abaxial) part of the mesophyll, under a layer of translucent water-storage tissue. These features are discussed with regard to phylogenetical relationship within the genus *Pinguicula*.

INTRODUCTION

Typical wetland species make up 67% of the genus *Pinguicula*. The remainder consists of Mexican species adapted to a subtropical climate with rainy summers and dry winters (Fig. 1). Some of these species turn dormant in the dry period (*P. heterophylla* BENTH., etc.). The majority of Mexican butterworts vegetate all year round.

Their summer phase is carnivorous (as in all butterworts), but in their winter phase the plants are purely autotrophic and resemble rosetted succulents (CASPER 1966, KIRCHNER 1981, SPETA et FUCHS 1982, STUDNÍČKA 1985). As a rule some flower in the succulent winter phase (*P. esseriana* KIRCHNER, *P. rotundiflora* STUDNÍČKA, etc.), some only in the summer phase (*P. gypsicola* Brandeg., *P. zecheri* SPETA et FUCHS) while other may flower in both phases (*P. agnata* CASPER, *P. moranensis* H.B.K.). The question is, what anatomical adaptations to subtropical semiarid conditions in often sunny habitats may be found in these peculiar plants.

MATERIAL

Preparations were made of living leaves of the temporarily drought-leaving butterworts

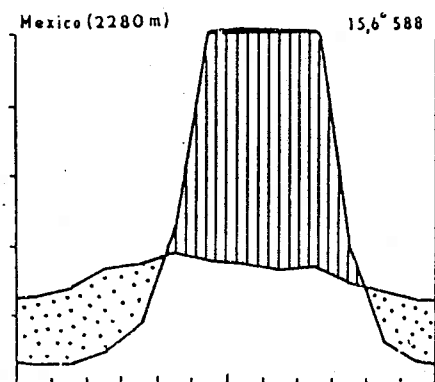


Fig. 1. - The macroclimate in the area of the butterworts studied, with the characteristic dry winter period (dotted). (Climadiagram according to WALTER and LIETH 1964.)

Pinguicula agnata, *P. esseriana*, *P. gypsicola*, *P. moranensis*, *P. rotundiflora* and *P. zecheri*. The leaves were taken from plants cultivated in the Liberec Botanical Garden (Czechoslovakia).

RESULTS

Wreath-like vascular bundles were observed in the winter succulent leaves of all the species studied. The bundles present deep green sheath surrounded by radial, paler green cells of the mesophyll (Tab. 10 - 13).

A prominent layer of the chlorenchyma is also found in the abaxial part of the mesophyll. The upper part of the mesophyll consists of translucent water-storage tissue. The upper, adaxial epidermis is colourless.

The leaves of the summer rosettes were investigated in *P. moranensis* (growing in more moisture-demanding plant communities) and in *P. gypsicola* (growing in xerophilous communities). The summer and the winter leaves are of a different shape, but of similar anatomy and with identical vascular bundles, the mesophyll is thinner in the summer leaves (Fig. 2).

DISCUSSION

Succulents may show the normal C_3 -pathway of carbon dioxide assimilation in photosynthesis, or the C_4 -pathway, or CAM = crassulacean acid metabolism, the CAM being the most, and the C_3 , the least ecophysiologicaly advantageous assimilation in arid conditions. The C_4 -pathway of assimilation is known not only in succulents, but also in many sun-loving non-succulent plants (Larcher 1988: 111). The green bundle sheaths of the *Pinguicula* species indicate the C_4 -pathway of CO_2 assimilation (WELKIE et CALDWELL 1970, NYANANYO 1988). The contingent occurrence of CAM in the Mexican butterworts remains questionable.

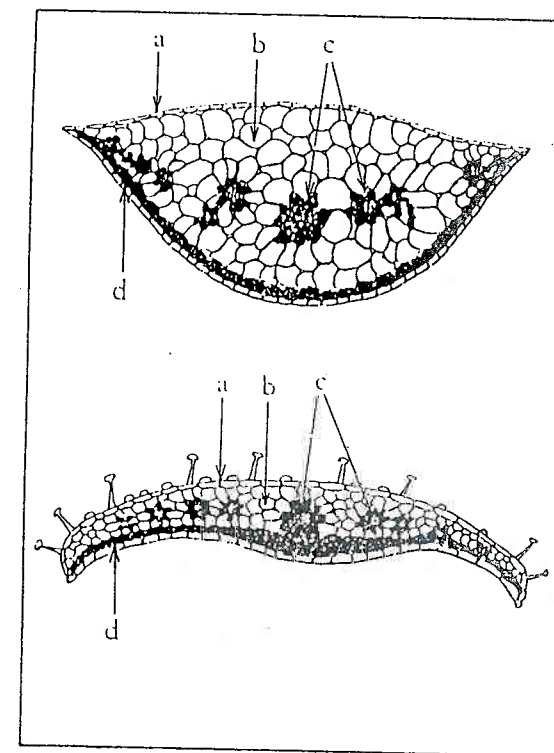


Fig. 2. - Transverse sections of the winter leaf of *Pinguicula zecheri* (above) and the summer leaf of *P. gypsicola* (below); a - colourless epidermis, b - translucent water-storage tissue, c - vascular bundles with green sheaths, d - chlorenchyma.

C_4 anatomy was found in the evolutionarily archaic *P. agnata* and *P. rotundiflora* with isolobate corolla (subgenus *Isoloba* BARNH. em. CASPER) as well as in the derived *P. esseriana*, *P. gypsicola*, *P. moranensis* and *P. zecheri* with distinctly bilobate corolla (subgenus *Pinguicula* CASPER). The latter group is consequently closely related to the majority of European species pertaining to the same subgenus (CASPER 1966). The European species, however, occur in an isolated centre far from the tropical zone. Further study should determine correspondence or difference between the vascular bundles of the Mexican and the European *Pinguicula* species. According to other authors experience, different species of the same genus may be adapted to different modes of CO_2 assimilation in photosynthesis (DOWNTON, BERRY et TREGUMMA 1969, LARCHER 1988).

CONCLUSIONS

Six Mexican succulent species of the subgenera *Isoloba* and *Pinguicula* were investigated. The vascular bundles characteristic of the C_4 -pathway of carbon dioxide assimilation in photosynthesis were found in all these species. An outstanding succulent anatomical feature, a thick water-storage tissue located above the chlorenchyma layer, was observed both in winter and summer leaves. The Mexican species investigated may be considered true succulents. The development of this character ran a parallel course in different evolutionary branches of the genus *Pinguicula*.

SUMMARY

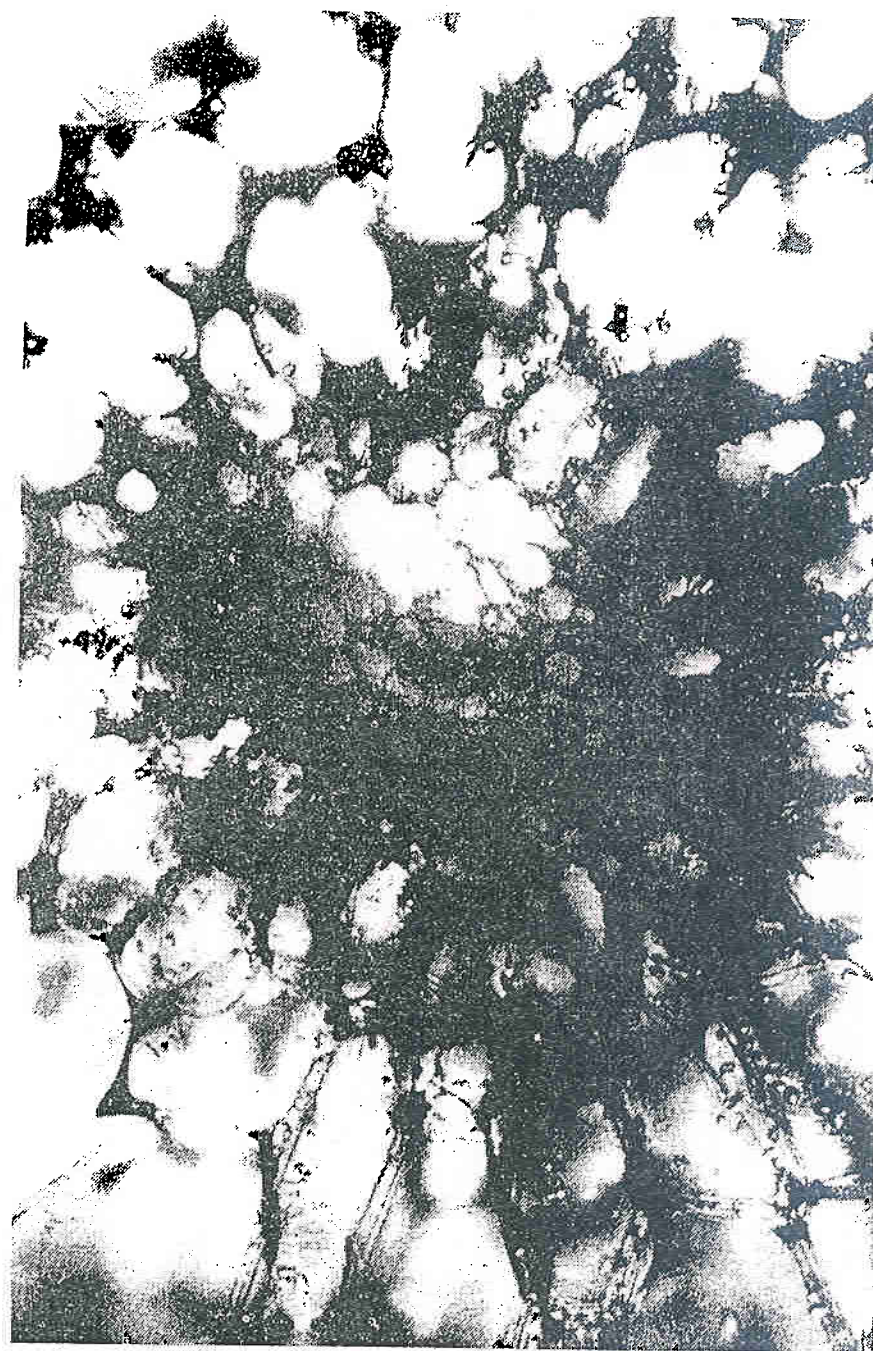
The anatomy of the winter-rosette leaves was investigated in six selected Mexican butterworts of the subgenera *Isoloba* BARNH. em. CASPER and *Pinguicula* CASPER. Vascular bundles with green sheaths and a layer of chlorenchyma in the lower part of the mesophyll were observed in all these species. A layer of translucent water-storage tissue and a colourless epidermis are located above the chlorenchyma. Such anatomical organisation frequently occurs in typical succulents. It has evolved parallelly in both the evolutionarily older types of the subgenus *Isoloba* and in derived types of the subgenus *Pinguicula*.

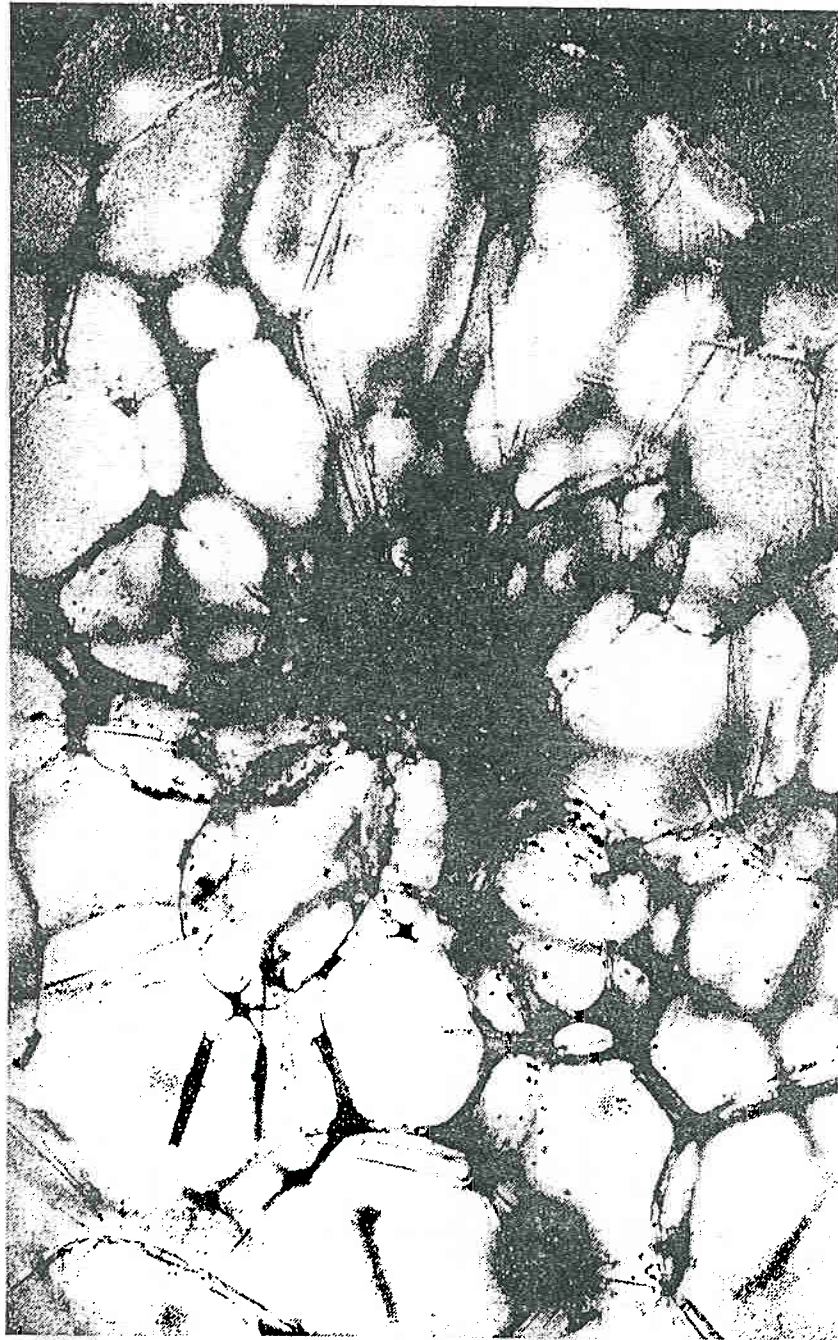
The leaves of the winter rosettes have also been compared with those of the summer rosettes of the species *P. gypsicola* and *P. moranensis*. The anatomy is similar, although the plants pronouncedly favour a wet-ground habitat in the summer period.

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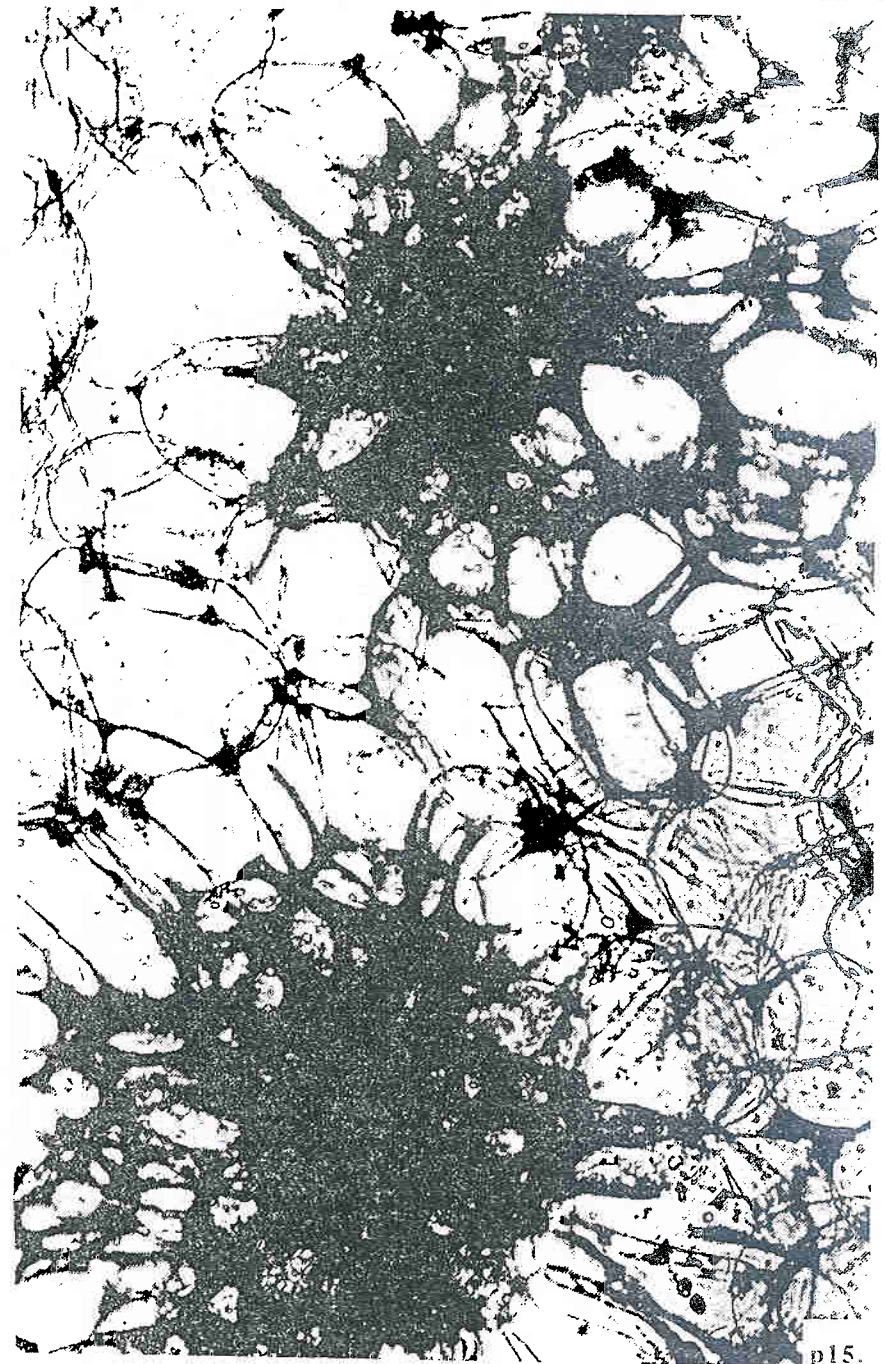




Wreath-like vascular bundle in *Pinguicula esseriana* KIRCHNER.

Photo 2

p14.



p15.



PINGUICULAS IN THE MIST!

An account of a Botanical Expedition to Mexico Jan-Mar 1994.

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We certainly saw Mexico! In five weeks we travelled a total of 6000km, covering the length and breadth of the Sierra Madre Oriental, from Mexico City in the centre of the Country, north to Monterrey near the U.S. border; from the tropical Gulf Coast to the desert interior in our search for Butterworts. We were hoping to see twenty of the thirty five or so species of *Pinguicula* currently described from Mexico, and where ever possible we intended visiting all known distinct populations of each. In fact we managed to see all but four of the species on our list. In consolation for those that eluded us, we discovered isolated and distinctive populations of several species which will probably be described as new sub-species, as well as finding the first known natural hybrid from Mexico!

A range of climatic zones were encountered including the hot, humid coastal plateau with rain forest, mostly now replaced by citrus, banana and sugar cane plantations, rising through deciduous rainforest and at higher altitudes cloud forests draped with hosts of epiphytes, until eventually the conifers gave way to lower growing montane/alpine vegetation at the highest altitudes over 3000m. Inevitably, such mountains cast a rain shadow over the interior high plateaus which were characterised by an impressive diversity of succulents and other xerophytic plants. However interesting these other vegetation types are in their own right, we had to view them superficially with suppressed curiosity, the constraints of time obliging us to overlook many fascinating plants and animals in order to achieve our quest. Afterall, few if any expeditions have taken place to Mexico in the past with the specific aim of discovering and studying *Pinguiculas*, whilst many books have been written about *Cactus*, *Orchids* and *Bromeliads* !.

It was upon the North facing mountain cliffs, towering above desert or forest that we had to seek *Pinguiculas*, many of these proving to be near inaccessible because of the merciless thorn scrub and dense vegetation on the foothills and slopes that had to be crossed first, most of the way on foot following vagarious tracks made by donkey, goat or much worse.. in the imagination! . I rapidly came to despise *Acacia*, *Agave* and *Opuntia* as their defensive armories penetrated and tore clothing and flesh, making many of our daily hikes painfully unpleasant and protracted. We were lucky on several occasions to find good populations of several *Pinguicula* species colonising roadside cliffs where mountain tracks crossed over the Sierras, as it spared us the sweat, agony and time required to locate them in their primary habitat.

Of course, the plants do not discriminate between man-made or natural cliff sites, requiring only that certain climatic, edaphic and biotic conditions are satisfied. However, in spite of the difficulties experienced in getting to natural cliff sites, it was invariably much more rewarding to meet this

challenge both aesthetically and from the greater sense of achievement gained, compared to readily accessible roadside sites which were cheapened by the ubiquitous presence of litter, the dust, the smell of fumes and the roar of traffic on all but the quietest dirt tracks. Never-the-less we were grateful for these sites as a number of species could only be located in this way.

There were inevitably times when spirits were low, especially in the beginning when we were inexperienced hunters; then a sense of humour helps.

At these times Thomas 've have vays of making you laugh' Carow, the philosopher amongst us, tried to ease the frustration by singing that well known song "Always look on the bright side"..., this was sung with great Continental flavour by a chorus line-up comprising: Thomas from Germany, Hans 'adler augen' Luhrs from Holland, 'crazy' Johan van Marm from Austria, as well as myself. As we learned more about the requirements of Mexican *Pinguiculas*, the lyrics were modified to form the 'expedition theme tune' "Always look on the North side" .(of the cliff), though all attempts at composing further suitable verses failed!

Mexican *Pinguiculas*, you gather, grow on the Northern cliff faces, preferring temperatures at least 10 degrees lower in the shade compared with the intense dessicating heat of the sun on the Southern faces which remained virtually bare of vegetation. The majority of species seem to be obligate lithophytes, invariably perched on near vertical surfaces, so keeping themselves permanently out of direct sunlight, growing either in crevices, or small pockets of humus or on moist patches of bare rock. Few other plants succeed in adopting the 'bare-rock' lifestyle exploited by the *Pinguiculas* which are thus largely freed of competition.

Companion plants observed most commonly include the so called "resurrection plant" *Selaginella*, xerophytic ferns and mosses, succulents such as *Agave*, *Echeveria* and dwarf cacti from genera such as *Mammillaria*, *Gymnocactus* etc., xerophytic bromeliads such as *Tillandsia*, *Catopsis* and *Hechtia* species, as well as occasional orchids. A common feature of all these plants is their ability to survive periods of water stress, most acute during the dry Winter months from the end of October to the end of April. These plants show a range of xerophytic adaptations such as thick, leathery, wax coated leaves and stems, succulent water storage tissues, deep penetrating roots, white often hairy coverings to cut down the heating effect of the sun and evaporative effect of the wind etc.

In common with other carnivorous plants, *Pinguiculas* are normally considered to be 'bog plants' for which any degree of water stress should prove fatal. How then do these 'Mexican pioneers' of the genus survive? Close examination of plants in habitat as well as back up studies in the laboratory have exposed several cunning strategies.

The preference for cliff sites shown by *Pinguiculas* is combined with a love of heights well above 1000 metres by all but one species, *P. lilacina*, which was found at an altitude range between 800-1000 metres. Even in the tropics conditions at high altitude are almost alpine, though snow is very rare, night temperatures near freezing are common-place with the result that mists

and fogs appear over the mountains as part of a daily cycle. As the moisture which has been sucked from the land or evaporated from the sea during the heat of the day condenses during the cool of night, relief is brought to plants and animals alike which exploit this valuable atmospheric moisture in a variety of ways.

The 'crevice' microhabitat is not only shadier, cooler, and more humid, but is also likely to act as drainage channel and reservoir, containing small amounts of humus and maybe mosses to act as a 'sponge'. There will be strong competition for this microhabitat amongst alpine plants. However 'alpine' *Pinguiculas* gain the advantage by possessing hairs and hygroscopic glands which focus the process of condensation, encouraging dew to form on their surfaces; (see photo 1) furthermore, the glands which are so well adapted to absorbing the products of digestion by these carnivorous plants must also serve to aid imbibition. Recent evidence also suggests that *Pinguiculas* have adopted a reversed stomatal rhythm, a characteristic common in succulent plants such as *Cactus* and *Crassula*.. Instead of opening during the day in order to obtain carbon dioxide needed for photosynthesis, the inevitable parallel loss of water caused by diurnal stomatal transpiration is much reduced by nocturnal opening of the stomata. Carbon dioxide is absorbed during the cool of the night and stored temporarily as an organic acid which is broken down during the daytime to provide carbon dioxide when needed. This habit seems to particularly suit succulent xerophytes possibly because their water filled tissues keep the acids diluted to harmless levels, though this hypothesis is personal speculation it may be more than just coincidence then that the 'winter' rosettes of the perennial Mexican *Pinguiculas* are made up of highly succulent leaves. (see photo 2) In the lithophytic species these are borne in rosettes resembling *Sempervivums*, wherever possible pulled down tightly into crevices, moss cover or humus. A few species live on the banks of erosion gulleys where crumbling mineral sub-soils provide a deeper foothold. Here are found species with succulent winter resting stages which are bulbous and buried below ground, gaining extra protection against predation as well as dessication. *P. acuminata* and *P. macrophylla* provide the best examples, though at least one population of *P. moranensis* seems also to be evolving in this direction.

The drought period is seemingly exploited by ephemeral annuals such as *P. lilacina* and *P. takakii*, (see photo 3) two delightful miniatures which I judged to be coming to the peak of their lifecycle in the middle of Winter as they were flowering and setting seed in abundance. Possibly, by growing while other larger plants are dormant competition can be reduced. Thriving colonies of *P. lilacina* were certainly exploiting 'windows' in the canopy of herbs by growing on disturbed soils, particularly unstable banks beside tracks and fallen trees. *P. takakii* grew on eroding gypsum slopes scattered amongst dense colonies of *Selaginella*, the rosettes of which would cover them as they expand during the rainy Summer months. However, close association with this companion plant during the winter has a number of advantages : they provide shade & humidity whilst the spin off invertebrate fauna from this miniature

forest is a bonus satisfying the carnivore's desire for flesh. Dessication of the thin membranous leaves of both these species is avoided by keeping them closely adpressed to the soil, trapping moist air beneath them and encouraging condensation to form where it will be of most benefit to the roots. Gypsum is a relatively rare mineral form of magnesium sulphate which forms scattered outcrops throughout the central plateau of the high Sierra Madre Oriental. It has been utilised by man for the production of plaster and talcum powder, exploiting its hygroscopic water absorbing capacity in different ways. We are not the first organisms to have exploited this property! Gypsum hills behave like an 'oasis' in the desert. The startling whiteness of this substrate gives an illusion of barren hostility. However, this is most probably a result of intense overgrazing followed by erosion of these surprisingly soft rock formations. By contrast the steeper hillsides and gulleys abound with wildlife. These miniature canyons were a paradise! The cool atmosphere within is no doubt mainly due to shade, but judging by the high humidity within, has also been chilled by evaporative cooling as the gypsum cycles moisture yielding vapour by day and reabsorbing it by night. No less than six species of *Pinguicula* were found indulging in these oases, including *P. takakii*, *P. ehlersae*, *P. gypsicola*, *P. immaculata* (photo 4), *P. immaculata* ssp. 'Zaragoza' ? & *P. rotundiflora*.

Of course colonising rocks, whether limestone, basalt or gypsum is not without its drawbacks. Lack of soil means lack of certain essential nutrients - compounds of nitrogen, phosphorus and sulphur being both rare And in high demand. Carnivory provides the solution and therefore a distinct advantage for *Pinguiculas*!

Indeed, combinations of these strategies have proven so successful that Mexican *Pinguiculas* do not merely survive, but thrive where plants from the majority of other plant families have failed to meet the challenge.!

OBSERVATIONS ON *Pinguicula grandiflora* IN HABITAT. VALL D'INCLÉS, ANDORRA. - 6th June 1994.

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Whilst on holiday in south western France I took the opportunity to travel into the Pyrenees and across the boarder into Andorra. Andorra has an incredible number of recorded plant species given the tiny size of the country, and thus is an ideal area to investigate the plants of the Pyrenees (ref.1). As this was a day trip with only a few hours to do some exploration, I chose the Vall d'Inglés as my destination partly because this is a known site for *Pinguicula grandiflora*, and also the relative ease of access via the town of Soldeu.

Upon reaching Soldeu, the Vall was reached by turning off the main road and past the few resort developments that have encroached on the base of the valley. Within a short distance these fairly unattractive buildings are no longer visible leaving the breath taking beauty of the valley with it's accompaniment of snow capped mountains. The valley slopes from north to south, with the northern end surrounded by a series of mountain peaks forming the boarder with France. After travelling about one and a half miles down the "farm track" road a spot was found to leave the car. The track lies on the eastern facing side of the valley approximately 100 yards or so above the fast running stream at the bottom of the valley.

The first *Pinguicula* was found in flower, growing on the side of one of the many small streams coming off the surrounding mountains, and was encountered as we made our way towards the main stream. This proved to be one of the few plants located in the damp meadows surrounding the main stream. In a few places a scattering of a few very small plants could be seen, though these gave the impression of being plants that had grown from the previous season's gemmae. Although I was pleased to find these plants, I was somewhat disappointed that they were not more numerous. The very wet areas of these meadows did show signs of damage courtesy of the cattle that inhabit the valley, and it made me wonder if this kept the *Pinguicula* numbers low.

After lunch by the stream, I turned my attention to the areas higher up the valley side as the different colours and textures indicated quite varied vegetation occurred there. From the track, the side of the eastern facing valley had the appearance of a patchwork consisting of relatively dry areas still brown with the dead stems of grasses from the previous year. The brown areas of the valley side were punctuated with patches of dark green with splashes of yellow, white and purple. The tiny streams carrying the melt water from the mountain tops gave rise to dark green bands of colour winding towards the valley bottom. The dark green patches were associated with damp

areas which contained large numbers of the Elder-flowered Orchid, *Dactylorhiza sambucina*, and the white and yellow flowers of *Narcissus pallidiflorus*, though no *Pinguicula* were to be seen. However on investigation of the many small streams large quantities of *Pinguicula grandiflora* were to be found in flower upon the banks, and upon moss covered rocks within the streams. The flowers of these plants were a particularly dark purple colour, so much so as to make the flowers on my own plants seem pale by comparison.

Every one of the small streams contained large numbers of *Pinguiculas* from just above the road track to the point on the valley side where coniferous woods become the dominant vegetation. I estimate that these plants were growing at an altitude of just over 2000M. Due to time constraints I didn't continue further up the valley side to see what was growing above the pine woods at higher altitudes (the highest peak on the western side of the valley is the Pic de la Portaneille at 2755M).

Given the south easterly aspect of the meadows through which the streams flow, the *Pinguiculas* were thus growing in good light with only the shade provided by accompanying grasses and herbs. In addition, I estimate the temperature rose to the mid 20'sc during the early afternoon. From my observations on these meadows it was apparent that the *Pinguiculas* only grew in areas where there is water flow (such as the stream banks), where as the plants were totally absent from the damp hollows (devoid of water movement). The water in the streams was rather cold (several shoes full of water established this !) as would be anticipated seeing how it originated from the melt water from the higher areas. It struck me that as a consequence, the temperature of the substrate in which the *Pinguiculas* were growing was considerably below the air temperature. This made me wonder if these plants could be grown at higher temperatures in cultivation if provided with regular watering with cool water from above similar to the treatment normally recommended for *Darlingtonia californica*. In a recent IPSG article, Miloslav Studnička recommended similar treatment for *Pinguicula bohemica* (ref.2).

The final area I investigated was further north up the valley past the small farming community at la Baladosa. Here a bridge takes the track over the valley floor to the western facing side of the valley. Travelling further north, the west slope of the valley forms a rocky bank to the track. At this point the bank is quite wet with water draining onto the track to form a small trickle of water down one side of the track. Here and there, the occasional small patch of snow could be found in particularly shaded spots. Numerous *Pinguicula grandiflora* were to be found clinging to the moss clad bank, and growing amongst the moss found at the edge of the track. Many of the plants growing in the cool and shady environment at these higher points on the western side were only just breaking dormancy. In the brighter spots some plants had developing flower buds in the centres of the rosettes. The plants found growing amongst the moss on the side of the track were very small, and had probably developed from gemmae that had been washed from the plants growing higher up the bank. The damage caused by what few

vehicles had travel along the track so far this year suggesting why no adult plants were present in this moss.

Thus this northern site was quite different to that encountered further down the valley, and suggested that the flowering period for these plants is greatly prolonged in the valley due to the differences in altitudes and microclimates in which the plants grow. However one thing that the two sites had in common was that the plants were only found growing in areas with water seepage.

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1. Flowers of South-West Europe a Field Guide - Oleg Polunin and B.E.Smythies
2. "Difficult" *Pinguicula* species - M.Studnička IPSG Newsletter No.4. Feb. 1994

THE PRESENCE OF GLANDS ON THE UNDERSIDES OF LEAVES OF *Pinguicula longifolia* ssp *longifolia*

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In an article in IPSG newsletter No.3. Alfred Lau wrote about the discovery of *Pinguicula* "Ayautla". One of the interesting features of the plant was the presence of trapping mucilaginous glands on both the upper and lower surfaces of the leaf. This aspect of *P.*"Ayautla" was considered to be unique to this plant.

Last year I noticed the presence of a few glands on the underside of leaves of *Pinguicula longifolia* ssp *longifolia*, although these were restricted to the mid rib. This year my largest plant has got large numbers of glands over much of the undersides of the leaves. These are particularly obvious on the longer strap shape leaves that are held erect over the rosette formed by the first spring leaves. I suspect that the glands are more apparent this year due to the higher humidity conditions that the plants are growing in. (This year they are growing in a cold frame rather than the conservatory).

As the presence of glands on the undersides of leaves is not confined to *P.*"Ayautla" alone it may be worth while to look for them on other species. In particular plants with erect foliage (like *P.*"Ayautla" and *P.longifolia* ssp *longifolia*) should be considered as glands on both surfaces would increase the plants' effectiveness in capturing prey. *Pinguicula agnata* and *Pinguicula vallisneriifolia* would thus make worthy candidates for such a study. In addition the role of humidity on the presence of such glands should also be considered.

OUT OF SYNCHRONY.

By Menno Saker, Holland & Phil Wilson, England.

Everyone will have been amazed by the circadian rhythms in nature. Amongst carnivorous plants the most impressive examples are the Australian tuberous sundews. When you import a tuber it starts to grow in the summer because this corresponds to the Australian winter growing season. In time it adjusts to grow in the northern hemisphere winter. In *Pinguicula* we have also observed that the natural cycle of the plant can be disrupted, certain factors causing the plant to go dormant at the wrong time of year.

A specimen of *Pinguicula* sp. "Santiago Nuyoo Pass" obtained at the Mexican Plant Convention last year was potted up in a mixture of vermiculite & perlite upon return. After keeping it drier throughout the summer and autumn it remained dormant until the end of November. I started re-watering, treating the plant as if it was in its summer growth period. It has continued thus until the time of writing this article (January). The same phenomenon has also been observed with a tissue cultured plant of *P. oblongiloba*. A few weeks after receipt in May the plant entered dormancy. It came back into growth in the latter part of August and continued to grow until the early winter when it once again entered dormancy as expected normally. In contrast a newly acquired plant can miss out dormancy altogether. A tissue cultured plant of *P. gypsicola* received in November from the USA continued to grow for almost a year before going to rest at the appropriate time of year. It is presumed that all these plants will eventually settle down to a more normal growth cycle.

It may be that tissue cultured plants are more susceptible to disruption of the growth pattern than those propagated by conventional means. Tissue cultured plants are known to retain a "memory" of the growth pattern forced upon them by hormone in the agar which continues after they have been weaned. For example, the tendency of plants to multiply rapidly and repeatedly while in culture continues, albeit at a lower rate, for months after weaning has taken place. It is possible then that a plant just about to enter dormancy in culture may continue to do so after transplantation.

Advice: It is of course possible to force the plant into dormancy at the time you think it's right. This could be done by gradually drying out the pots, lowering the temperature and reducing the photoperiod, an exercise which could involve a fairly expensive set-up with artificial lighting and air-conditioning! We think, however, that this is neither advisable nor necessary since apart from any other factors the plant may have its own physiological reason for changing its growth pattern. (such as lack of food which can only be replenished by photosynthesising leaves.)

In conclusion, don't worry, allow the plant to take its own course since it will eventually find its own feet (roots!) and return to a normal pattern of growth (or else die!).

DORMANCY? Stan Lampard.

It is generally true that the dimorphic growth pattern of many perennial Mexican *Pinguicula* results in the production of several large carnivorous leaves in the warm wet summer months and a larger number of much smaller succulent leaves in the dry cooler winter period. Most species from Mexico lie within the belt just above the Tropic of Cancer from around about latitude 25° (*P. gracilis*) down to around about latitude 15° (*P. utricularioides*). In their natural environment, there is not such a great seasonal variation in either daylength or temperature, (though the latter may fluctuate quite dramatically on a daily basis at higher altitudes,) as there is in rainfall which precipitates mainly in the Summer. That is not to say that moisture is not available at all during the winter as at this time mists are a daily phenomenon over mountain ridges where many of these plants tend to grow. However, I believe this transition from mesophytic to xerophytic leaf form is most likely in response to 'water stress' as the plant attempts to conserve water by reduction of leaf surface area, rather than a response to the slighter decline in temperature or photoperiod.

When managing such plants in cultivation in more temperate climates, we feel safer reducing the amount of water given in winter as this reduces the incidence of fungal attack, of which there is a much greater risk in the static atmosphere of the greenhouse when the vents and doors are closed to conserve heat. This coincidentally and conveniently imposes 'dormancy' upon the plants. However, it was observed that plants will continue to grow, producing large actively carnivorous leaves throughout the winter if given sufficient 'moisture'. This can be in the liquid state, as seen in nature for example in '*moranensis*' types' which we observed from the vicinity of Molango. Plants were in full growth during January and February on a limestone cliff which was continuously soaked by moisture laden winds blowing over the warm Gulf seas. Plants of the '*moranensis*' type are well known to respond similarly in cultivation, if kept above 10°C and watered throughout winter they will 'skip dormancy', a fact testified by orchid growers who traditionally have used Mexican *Pinguiculas* for year-round control of sciarid fly. Water vapour in the form of mists can also sustain limited growth even while the plant is in the more compact 'xerophytic' rosette state, this has been observed recently with species such as *P. gypsicola* and *P. reticulata*, in habitat as well as in the greenhouse! So perhaps we should no longer think of these rosettes as truly 'dormant' since they are still growing and many even flower at this time. Instead, we should consider them as 'water-stress' rosettes formed during the dry season, which for most, happens to be Winter. Observations of plants in cultivation point to this conclusion also: transplant at the wrong time or allow your plants to dry out too much in the summer and they will surely reduce leaf surface area, only to try again perhaps later in the year if water is given when evaporation rates are lower.

The only truly dormant Mexican species are the annuals that rest briefly as seed, and the perennials with subterranean 'bulbs' such as *P. macrophylla*, *P. acuminata* and *P. heterophylla*, which over-winter in very dry soils.