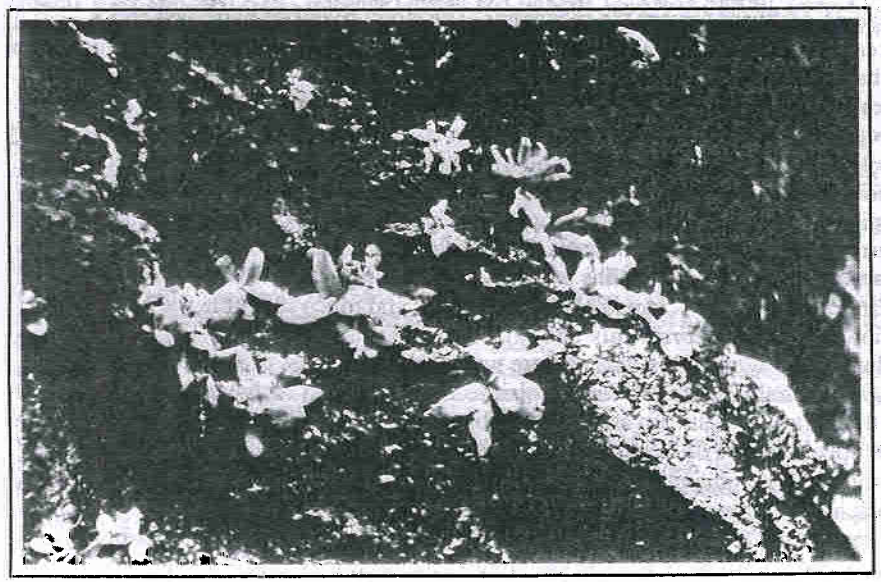
We can consider *P crystallina* to be a very hygrophilous and rather sciophilous species, tolerant of only moderate fluctuations in temperature on both a daily and seasonal basis.

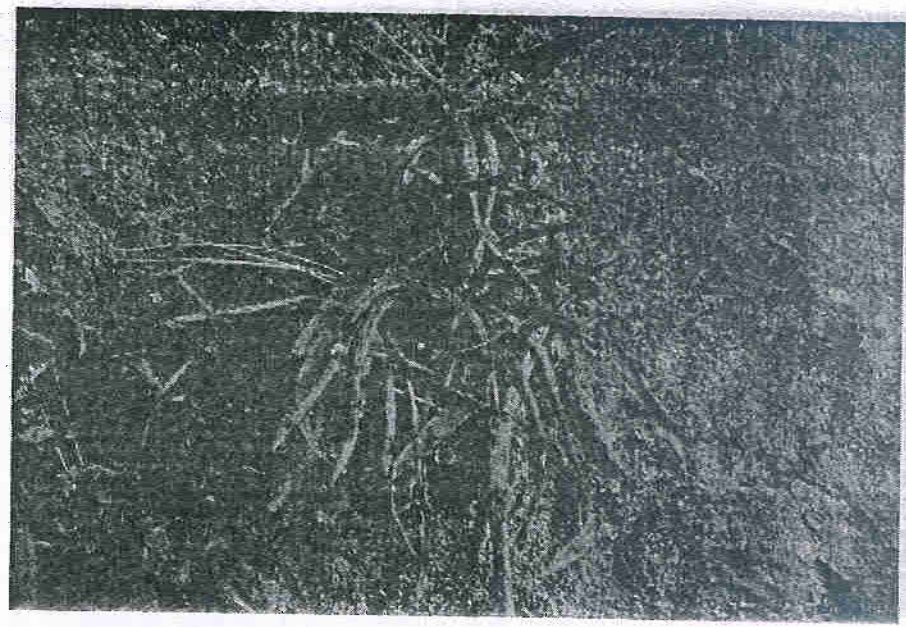
Pinguicula crystallina is clearly a highly susceptible and very demanding species, for which it has proved difficult to prepare suitable conditions in the greenhouse. I found them short-lived in cultivation at the Institute of Botany in Trebon.The three adult plants I collected flowered in the first two years, though capsules did not develop. The plants grew poorly, even though the roots were up to 25mm long, the old leaves decayed rapidly. Unfortunately, these and the three juvenile plants collected all died within three years.

I used a moderately alkaline soil mixture of fen soil and ground limestone and kept the plants well shaded and frequently sprayed with tap water. The key to more successful cultivation might be to use a very thin soil through which fresh water is allowed to percolate continuously to ensure that there is always sufficient oxygen at the roots.

Should any readers visit the SE tip of Turkey it would be of great interest to further investigate the distribution of this species.



Pinguicula crystallina in SE Turkey



Pinguicula vallisneriifolia
"Cerrada de Elias", Sierra de Segura.

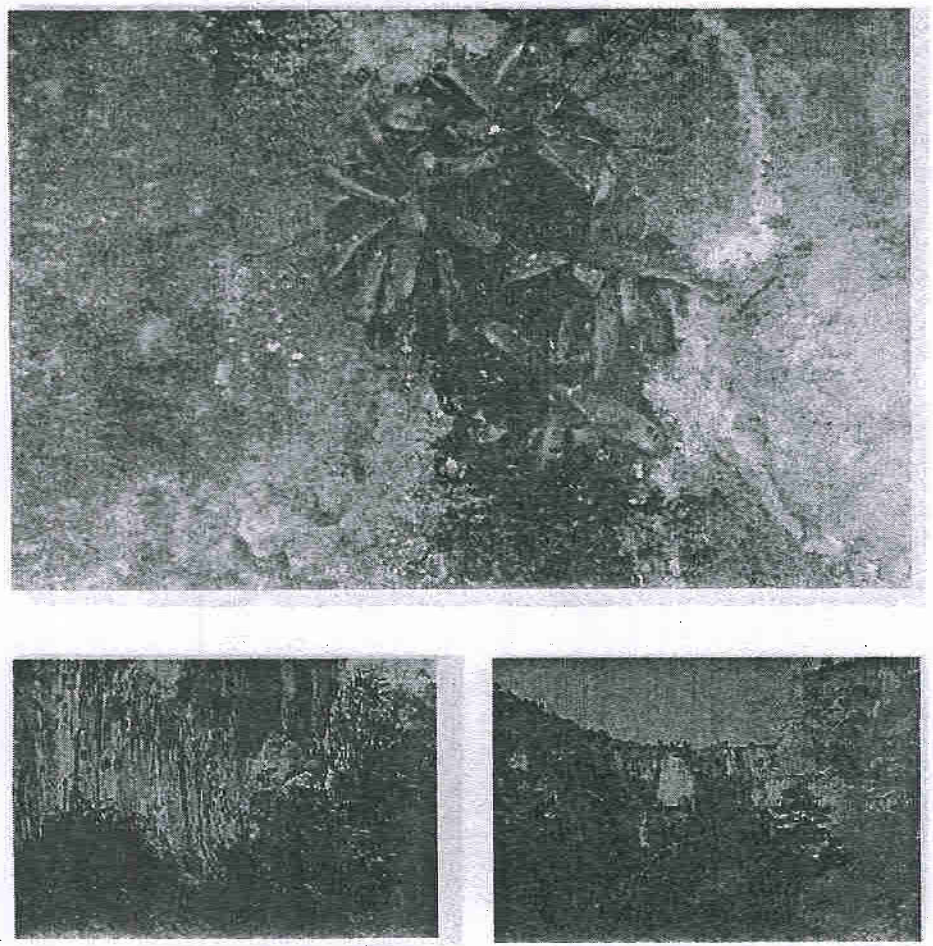
top: plants growing on the side of the gorge.
bottom left: flower, front view
bottom right: flower, side view

Pinguicula mundi
"Nascimiento del Rio Mundo",
Calar del Mundo.

top: plants growing on the vertical rock face.
bottom left: flower, front view.
bottom right: flower, side view.

Pinguicula nevadenis
"Aguas verdes" & "Laguna del Majano",
Sierra Nevada.

top: plants growing amongst sedges.
bottom left: flower, front view
bottom right: flower, side view



Pinguicula submediterranea
"Hoz de Beteta"
Serrania de Cuenca.

top: plants growing in crevices on vertical limestone cliff face.
bottom left: population in the shelter of shrubs beneath overhang.
bottom right: canyon, the butterworts are on the lower part of the cliff, right.

THE DISCOVERY OF SPANISH BUTTERWORTS
(part 2)
(Continued from part 1, IPSG News No.5)

S.LAVAYSSIERE
Neauphle-le-Chateau
FRANCE

Having arrived in Grenada early in the afternoon, our first aim was to have a quick glance at the site since we had no idea of what was awaiting us in the Sierra. Access was easy because the Spanish ara very proud of their "*Carratera la mas alta de Europa* ", the most elevated road in Europe, which rises to 3370m, close to the top of the *Pico de Veleta*. We had no need to go higher than that since *Pinguicula nevadensis* is believed to grow at such an altitude around *Pico de Veleta* and *Mulhacen* , twin peaks which rise with only a few hundred metres between them..

Initial visit.

Immediately on leaving Granada the inexorable ascent begins. Even though long enough by car, it doesn't seem to discourage the many cyclists (Indurian syndrome !!).For the first eight kilometres the road passes through the suburbs of Granada (*Lancha de Cenes, Cenes de la Vega*..)Upon leaving the urban area at 800m the vegetation is typically mediterranean: olive, orange, juniper, hawthorn and fig trees, the cactus *Opuntia ficus-indica*, and xerophytic herbs such as sage, lavender, rosemary and thyme. The last gas station, (not to be missed), is at the 22nd kilometre at 1600m. high. At the 31st kilometre at an altitude of 2100m is the ski resort. Above 2,500m the vegetation becomes sparse, with lichens and lithophytes such as saxifrages scattered between the schist rocks. Once and a while, some small moist depressions appear beside the road giving us some hope of finding
P. nevadensis in these green oases. The road finally ends about 20 metres from the summit of the "*Pico de Veleta*" (3,394m); a windy and cold spot even at mid-afternoon in mid-summer. Thus we descend, convinced that our quest will be an easy one since the sites with potential for supporting *Pinguicula* seem to be both small in number and area.

The next day, taking advantage of the fact that we had some shopping to do in town, we paid a visit to a specialist bookstore (address at end of article) Here we acquired excellent maps (1/25,000 scale) and read through a flora that displayed a picture of *P. nevadensis*. Though of poor quality, the picture showed the resemblance of this species to *P. vulgaris*, as much by its leaves as in its flower. As we expected, its habitat lies within the " *Borreguiles*", the elevated moist lawns. So, we were finally ready for the next day.

Before going any further on the discovery of this plant, it will be useful to know more about its highly unique environment.

Formation of the *Sierra Nevada*

The emergence of the Sierra Nevada dates back 20 million years ago and is a consequence of the collision of the African and Eurasian tectonic plates. The African plate has been elevated, with the result that the northern faces of the Sierra are more abrupt than the southern slopes. The basal rocks making up the mountain chain are metamorphic, formed 200 million years ago at the bottom of the "Tetris" ocean from siliceous sediments and animal remains which have now been transformed into graphite, explaining the dark grey colour of the present day schists. Equally numerous are the inlays of more recent materials (180 million years ago) : marble, granite, serpentine, gneiss, these latter ones having volcanic origin.

Even though the last period of glaciation 1 million years ago did not reach the Iberian peninsula, it significantly affected the original African savannah fauna and flora. Thus, the history of African, north European and Mediterranean influence, combined with the natural isolation caused by its great elevation, have transformed the *Sierra Nevada* into an 'island of evolution' supporting a flora and fauna with highly pronounced endemic characteristics.

Climate

Because of the oceanic influence, generating eastward winds, combined with the proximity of the Mediterranean (50 km south) and steep slopes, atmospheric conditions vary greatly from one spot to the next.
Since *P. nevadensis* is restricted to the most elevated summits , we need only consider conditions above 2,500 m.

January:	max.	2C
	min	-10C
August:	max.	14C
	min	0C

A few lakes remain partially frozen until the end of June!
Virtually no rain falls in July and August, though there can be severe storms in May and June as well as September and October.
There is snow cover from October until May, sometimes June.

Thus prepared, we take off in the early afternoon, stopping for our first break beside a small mountain stream, 2,500m high up. It moistened a meadow spangled with small alpine flowers growing at ground level. These included Gentians, Campanulas, Ranuncules as well as the superb endemic *Plantago nivalis*, whose Spanish name "Estrella de las Nieves", meaning "snow star", gives an accurate description of its appearance. The prostrate leaf rosette is 10 cm in diameter and is made of triangular leaves covered with a whitish fleece. We searched here for P. nevadensis for an hour without success before moving on to higher altitudes. We spent the rest of the afternoon exploring all of the "Borreguiles" alongside the road without any luck.

A little discouraged, we walked along a stony track which deviated from the main road a couple of hundred metres from the summit of *Pico de Veleta*, heading towards *Mulhacen*. A short stop at the Felix Mendes mountain house next to the lakes called " Lagunas de Rio Seco" revealed nothing new to us, so we decided to keep going further to end our day-trip at "Laguna de la Caldereta" a few hundred metres down the trail to the base of *Mulhacen*.

This site is much visited, since there were many cars parked beside the road and a few walkers circling the lake at the bottom of a kind of crater. Because of the lack of vegetation next to the lake, and our tired and aching legs, we decided to end our day's search . A last look at the map to decide where to resume our search the next day revealed the existence of a tiny lake 750m south of the road. The contour lines were well spaced indicating that the slopes were not steep, so we decided to head for that spot, knowing that the decreasing light intensity would not leave us much free time.

Luckily, we were descending, and right beyond a rocky spur, we noticed a wide expanse of green, facing south at an altitude of 2,950m, with small scattered pools and winding streams. A few Ibexes, surprised in the middle of their meal, watched us with distracted eye but didn't quit eating for long. We approached the site at a slow pace, finding again the same vegetation as before. Just at the point when we decided to finally return to the car, I narrowly missed treading on a tiny green rosette, just 3cm wide. There was no doubt that this really was a butterwort, it could only be *P. nevadensis.*!

This was the first one to show up, then, as we got closer to the pools we found many more covering the spongy soil. By now we were on all fours in order to better appreciate our exciting find. This reassured the Ibexes which now encircled us, the more reckless ones grazing a couple of metres away from us!

The largest plants approached 5 cm in diameter, with leaves, some with a pinkish tint, curled at the margin to form an upward facing bowl. Numerous flower stems bore visible but fading flowers, with many seed pods ripening nicely. As they approach maturity, the ovoid seed pods develop a wine-red tint, becoming almost black as they open. We discovered two pods that had already split open.

Sadly, it was soon nightfall and we had to return to the car, with our heads and cameras full of unforgettable images. We stayed one more week in Granada before heading back on the return journey. During a stop-over with J.J. Labat, he suggested that we might want to stop 130 km east of Madrid in the " *Serrania de Cuenca*" where S.J. Casper had reported the existence of *P. vallisneriifolia* at a place called " *Hoz de Beteta*".

After following the gorge of *"Rio Guadiela"* we reached Beteta, a mountain village. Here white cliffs overhang the road and stream in marked contrast to the *"Sierra Nevada"* . Upon arrival we were unable to find any tourist information centre, from which to gain precise information or maps, so we retraced our steps to a campsite close to the village of Canizares.

The next day, while on route back to Beteta, we decided to stop at a picnic site next to the " *Rio Guadiela"* called *"Fuente de los Tilos"*. A trail led half way to the top of the cliff on the left bank of the Rio before following the gorge. At an altitude of nearly 1,200 m, a couple of butterworts could be seen hanging upon an apparently dry natural wall. They were clearly not *P. vallisneriifolia.* They looked more like a form of *P. longifolia* judging by their downward curled leaf margins and the smaller sized rosettes none of which exceeded 15 cm in diameter. By mid-afternoon the sun reached into the valley because of its south west/ north east orientation. This did not seem to harm the plants, even though the smaller seedlings, just a few mm wide were turning reddish brown. After taking some photographs and collecting some of the seeds remaining at the bottom of the seed pods, we continued on the trail. We reached a more humid area where the rock face was tightly packed with butterworts! On our return to the car, with eyes well acquainted with the plants, we noticed many more specimens growing on the cliff face at inaccessible heights.

All the plants seen on our trip to Spain are of great interest, some may even prove to be new species or sub-species *. We took great care not to contribute in any way to the spoilage of their natural habitats . Bear in mind that the plants that have survived in nature are those that are best adapted to their natural environment. However, they will have little chance of survival if removed. By contrast,the seeds collected will harbour wide ranging yet slight genetic differences. The process of selection will also occur in cultivation, with the result that only plants best adapted to your growing conditions will germinate and thrive. For these reasons we collected a few seeds and no plants.The seeds collected during our trip have germinated very well, especially *P. grandiflora "Rio Mundo"* (see IPSG Newsletter 5) . The only exception is *P. nevadensis* for which I cannot provide the alpine conditions required. We did not collect enough seed to donate to the seedbank but were able to send some to J.J.. Labat, J. Steiger and S. Lampard. I hope that between us we will succeed in bringing these new plants into flower so that they can be further studied in cultivation, permitting precise identification and eventually a broader circulation of these plants.

References:

Asenjo (C.), Gonzales (C.),Guia Criscar de Sierra Nevada.
Pamphlet available at campsites and bookstore.

***Editorial note**: The two butterworts named by location as *P. "Rio Mundo"* (IPSG Newsletter No.5) and *P. Hoz de Beteta"* have since been described as *Pinguicula mundi* and *P. submediterranea* respectively,
by: **Zamora R, Jamilena M, Ruiz Rejon M & Blanca G. 1996.**
Two new species of the carnivorous genus *Pinguicula* (Lentibulariaceae) from Mediterranean habitats.
Plant Systematics and Evolution, 1996. Vol. 200: p. 41-60

Pinguicula moctezumae : A new species in culture.

Miloslav Studnička
Botanic Gardens, 460 01 Liberec
Czech Republic.

Pinguicula gypsicola was discovered in 1910 and was described as a "botanical bomb" (Brandegee 1911, Purpus 1912). *P. gypsicola* has been regarded as a unique phenomenon within the genus and nobody imagined that there were any other similar species. However, in 1994, several decades later, R.Z. Ortega discovered *P. moctezumae* Zamudio et Ortega, a species that strongly resembles *P. gypsicola* !

Both species are so-called stenoendemites (species restricted to a very small area) from central Mexico. The location of *P. gypsicola* (San Luis Potosi, Minas de San Rafael, near Villa Juarez) is situated about 170km in a bee-line north of the *P. moctezumae* locations in the Rio Moctezuma canyon (Queretaro & Hidalgo; see Zamudio & Ortega 1994). They are isolated by a deeply furrowed, arid landscape.

Habitat

According to the authors, the new species is bound to semiaquatic sites, close to streams on dripping wet calcareous rocks, at 900 -1100 m altitude. The habitat is quite different to that of *P. gypsicola* , especially with respect to soil moisture. Despite the fact that both species grow at comparable altitudes (*P. gypsicola* only about 250m higher) and both are petrophilous, (rock growers), *P. gypsicola* is a xerophyte.

Of course, the erect filiform leaves formed during the summer season by both species are very similar, and at this time *P. gypsicola* does not look like a xeromorphic plant. It seems likely that this feature is an adaptation in both species for absorbing atmospheric moisture especially the night dews. The accompanying vegetation to *Pinguicula gypsicola* mentioned by authorities (Purpus 1912, Ruiz & Rzedowski 1986) is essentially xerophytic :
Agave striata, Dasylirion longissimum, Dodonaea viscosa, Hechtia glomerata, Selaginella cuspidata and Cactaceae.

Behaviour in artificial conditions.

Thanks to Dr. Sergio Zamudio who kindly afforded seeds of *P. moctezumae* to the Botanical Gardens Liberec for scientific purposes, we are able to write more about the ecology of the new butterwort.

The previous comments suggest that the growing conditions for *P. gypsicola* and *P. moctezumae* differ. I have previously described a method for cultivating butterworts in pots, ensuring movement of water through the soil (Studnicka 1994). This has proved very appropriate for *P. moctezumae* including the recommended sustratum (o.c., p.16).