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Surprising phenomena in the life strategy of *Utricularia cornigera* in Brazil

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Abstract: The symbiotic relationships of the carnivorous plant *Utricularia cornigera* Studnička are documented and discussed, paying attention to the morphology of its seedlings. The life strategy of this bladderwort is rather different in subalpine plant communities and in alpine communities according to research in Serra dos Orgãos in SE Brazil. The life strategy of *Utricularia reniformis* is compared according to observations made in similar habitats in Serra da Mantiqueira.

Keywords: symbiosis, life strategy, *Utricularia*, *Eryngium*, *Vriesea*.

Introduction

Only three of the numerous non-aquatic (technically emerged) bladderworts have star-shaped seedlings which function as floats. These South American species are known as plants growing obligatorily (*Utricularia nelumbifolia* Gardn.) or occasionally (*U. cornigera* Studnička and *U. humboldtii* Rob. Schomb.) within phytotelmata in the leaf axils of certain petrophilous bromeliads (TAYLOR 1989). In a previous paper I clarified that *U. cornigera* had been mistaken for *U. reniformis* A.St.-Hil. (STUDNIČKA 2009). These species are different, amongst other things in their absolutely distinct seedlings: The true *U. reniformis* never has star-shaped floating seedlings. From this we can assume that only *U. cornigera*, *U. humboldtii* and *U. nelumbifolia* are capable of germinating within phytotelmata, while *U. reniformis* is not. The present paper is based on the photographic documents of *U. cornigera* growing closely together with its host plants. This relation to a species from the Apiaceae family is new for science.

Methods

Distribution of *U. cornigera* was observed on the mountain Pedra do Sino in Serra dos Orgãos (south-eastern Brazil), namely at subalpine and alpine levels ("campos rupestres" and "campos de altitude"). Precise geobotanical methods cannot be used in the hampered craggy terrain and non-homogeneous plant communities. Nevertheless, a radial sprawl of bladderwort from plants with phytotelmata is apparent there. Initially, the leaves of the bladderwort are seen in a circle around or within the leaf rosette of the host plant. Photographs of the phenomenon were taken as evidence. An old leaf rosette of *Vriesea atra* Mez was broken off its base and a circular rhizome of a symbiotic specimen of *U. cornigera* was also documented. Temperatures were measured using a calibrated digital thermometer.

Two expeditions focusing on the life strategy of *U. cornigera* were made with my colleagues from November 26th to December 10th 2000 and from November 8th to 28th 2005. In 2005 I also investigated the abundant similar species *U. reniformis* in Serra da Mantiqueira, searching for any signs of symbiotic growth. (In my experience, *U. reniformis* does not occur in Serra dos Orgãos and, vice versa, *U. cornigera* does not occur in Serra da Mantiqueira.)

Utricularia cornigera in a subalpine plant community

Plant communities rich in species of tall herbs (*Vriesea atra* Mez, *Anthurium solitarium* Schott, etc.) and suffrutexes (Gesneriaceae, Melastomataceae, Onagraceae, etc.) are developed on the granite slopes of Pedra do Sino 1800 – 2000 m a.s.l. There is strong interspecific competition. We have seen that occasional natural fires are an important factor affecting the structure of the vegetation. Seedlings of *U. cornigera* are probably very rare and I have not found any. Nevertheless, it is clear that phytotelmata of *Vriesea atra* present the only possible niche for very small seedlings of *U. cornigera*, because there are no free pools on the rocky slopes. The conclusion drawn by TAYLOR (1989) that there is a symbiotic relationship between *Utricularia cornigera* (but still confused and referred to as *U. reniformis*) was confirmed and corroborated by photographs probably for the first time

I examined 4 examples of *Vriesea* rosettes colonized by the bladderwort, growing in accessible margins of two isolated patches of the submontane scrub vegetation.

Utricularia cornigera in an alpine plant community.

The rupicolous vegetation of high mountain plateaus 2000 – 2200 m a.s.l. is known and described in the scientific literature as "campos de altitude" or, using a dubious term, "Brazilian páramos" (STAFFORD 2001; RIBEIRO, MEDINA et SCARANO 2007). On Pedra do Sino there is wet grassland on deeper soil in a mosaic with petrophytes on bare rocks.

In the grasslands, the small bamboo *Chusquea pinifolia* (Nees) Nees and the tussock-grass *Gynerium modestum* Döll are predominant. Lichens and mosses occur locally, and also hemiparasites [*Magdalenaea limae* Brade, *Agalinis*

ramosissima (Benth.) D'Arcy etc.]. The only rosette plants with phytotelmata are numerous hygrophilous *Eryngium fluminense* Urb. (Apiaceae family). In several of them the markedly tight growth of *U. cornigera* was seen, with the leaves of both species being intermixed.

The large *Vriesea atra*, mentioned in the previous chapter as a symbionte, occurs only on rocks there at the alpine level. I could not find any *U. cornigera* there in its rosettes, probably because the rupicolous habitat (deficiency of soil) is generally not hospitable to rhizomes of mature specimens of the bladderwort. It is possible that different temperature regimes in the soil accumulations and on the rocks also play a special role in the distribution of plant species in the vegetational mosaic of "campos de altitude". On November 14th at 8.00 a.m. (after a clear night), for example, I measured temperatures from 6.9 °C (on a surface of deep peaty soil) to 12.4 °C (in a thin l ayer of soil on rocks).

The sisterhood of the *Eryngium* and the bladderwort was frequent along the footpath in the alpine vegetation and so it was easy to make 10 more or less obvious illustrations there. I also inspected three large populations of the true *U. reniformis* in Serra da Mantiqueira, in subalpine and alpine plant communities. I never found any signs of symbiotic growth of the bladderwort there.

Discussion

Previous mentions of the symbiosis of bromeliads and a larger form of *Utricularia reniformis* (Taylor 1989) date back to a time when *U. cornigera* had not yet been distinguished from *U. reniformis*. It was later revealed that the seedlings of the true *U. reniformis* are quite different from the seedlings of the large bladderwort from Pedra do Sino (i.e. *U. cornigera*). The former is similar to the seedlings of the related bryophilous species *U. geminiloba* Benj. or *U. nephrophylla* Benj., but the latter is similar to the floating seedlings of *U. nelumbifolia*, a species symbiotic with *Vriesea extensa* L.B.Sm. or *V. regina* Beer. (STUDNIČKA 2005). The true *U. reniformis* does not germinate in water (STUDNIČKA 2009).

The documented occurrence of bladderwort rhizomes in *Vriesea* should be accepted as proof of germination there within the leaf rosette, because *U. cornigera* has no organs which are capable of penetrating into phytotelmata, i.e. from the surrounding soil upwards. However, a young bladderwort can grow from the rosette into the soil when the lower leaves of the *Vriesea* die off.

This phenomenon is as surprising as the close growth of the bladderwort and *Eryngium fluminense*. It should be said that the phytotelmata of the erynge are too small for the rhizomes of a mature *Utricularia*, but voluminous enough allow germination. There is interesting information on the similar Argentinean species *Eryngium cabrerae* Pontiroli and *E. pandanifolium* Cham. & Schltdl.: The reproduction of mosquitoes in their phytotelmata is described (CAMPOS et LOUNIBOS 1999). Similar conditions in *E. fluminense* should also no doubt be satisfactory for bladderwort seedlings, being approximately the same size as mosquito larvae. That is why rosettes of *E. fluminense* are almost certainly the starting point in the oecesis of *U. cornigera* in "campos de altitude".

Fig. 1. *Utricularia cornigera* (the reniform leaves) in symbiosis with *Vriesea atra* growing in a subalpine plant community on Pedra do Sino, observed on December 8th 2000 at about 1800 m a.s.l..

Fig. 2. The substructure of an old rosette of *Vriesea atra* with circular white rhizomes of symbiotic *Utricularia cornigera* (see the black arrows)..

Fig. 3. Leaves of *Utricularia cornigera* surrounding a rosette of *Eryngium fluminense* growing in an alpine plant community on Pedra do Sino, observed on November 14th 2005 at about 2150 m a.s.l..

Fig. 4. The radial sprawl of *Utricularia cornigera* from a large rosette of *Eryngium fluminense*.

Fig. 5. *Eryngium fluminense*, the host plant for *Utricularia cornigera* on Pedra do Sino, frequently occurring in "campos de altitude" there.

Conclusions

The symbiotic relationship of *U. cornigera* and *Vriesea atra* has been supported by evidence. This is probably not a new discovery, but confirmation of the previous information erroneously attributed to *U. reniformis*.

It is highly likely that there is a symbiotic relationship between *U. conigera* and *Eryngium fluminense*. Germination within the phytotelmata of species of the Apiaceae family would be unique among bladderworts.

The bromeliad *Vriesea atra* occurs in both subalpine and alpine communities, as does *U. cornigera*. Nevertheless, I found the symbiosis of these two species only at the subalpine level. At the alpine level *Eryngium fluminense* probably replaces *Vriesea atra* as a symbionte, but only as a host plant for small seedlings.

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