Different wing in pitchers of the myrmecophagous species *Sarracenia minor* and *S. rubra*

Miloslav Studnička • Liberec Botanic Gardens • Purkyňova 630/1 • CZ-460 01 Liberec • Czech Republic • botangarden@volny.cz

Keywords: *Sarracenia*, ants, anatomy, hairs

Abstract: The pitcher wings of *Sarracenia minor* and *S. rubra* are compared. The vascular bundles are found to be different (2 *vs* 1), and the lateral indumenta are dissimilar. The dimensions of the wings, the shapes of the nectar roll, and its connection to the wing edge are also different. An interesting application of the system observed in the wing of *S. minor* was documented in station semaphores. *Sarracenia minor* is often described as a "primitive" species in the genus; evidence suggests this characterization is inaccurate.

Introduction

The hooded pitcher plant (*Sarracenia minor* Walt.) is well-known as a myrmecophagous species (Schnell 1976, 2002), but the sweet pitcher plant (*S. rubra* Walt.) is also a species preferring ants as prey (Moon *et al.* 2010). Myrmecophagy was also observed in 1920, but unpublished, by the entomologist F. M. Jones (Jones n.d.). Other species of *Sarracenia* can also trap ants, but only occasionally, under favourable conditions. *Sarracenia minor* is sympatric with *S. rubra* subsp. *rubra* (*sensu* Schnell 2002) and I am dealing with the question of whether the plants have similar adaptations to myrmecophagy.

Method

Observations were made on specimens cultivated in the Botanic Gardens of Liberec, Czech Republic (www.botanyliberec.cz), also depicted in the book Masožravé Rostliny (Carnivorous Plants; Studnička 2006). *Sarracenia rubra* subsp. *rubra*, *S. minor* var. *minor*, and *S. minor* var. *okefenokeensis* Schnell were used for observations. Microphotographs were made using a 160× objective lens and special 4× eyepiece for photography. All observations were made using fresh, vital material, taken from well developed pitchers during August 2011. The indumenta were studied while being backlit, to highlight subtle details.

Results

Overall pitcher structure for these species is well documented, but the different shapes of their nectar rolls should be highlighted. The pitcher mouth of *S. minor* is connected in an expedient manner with a furrow in the margin of the wing (Fig. 1).

Pitcher wings were compared using examples of 27 cm high pitchers in both species. In *S. minor* the upper part with a concave margin was 8 cm long (15.5 cm in *S. rubra*), the transitory flat part was 3 cm long (1 cm in *S. rubra*), and the lower part with a convex margin was 9 cm long (2.5 cm in *S. rubra*). However, the wing margin of *S. minor* is twice as wide as that of *S. rubra* (Figs. 2–4).

The vascular bundles of *S. minor* occur in two parallel bundles. This is unique in the genus—all the other species of *Sarracenia* have only one vascular bundle (Chrtek *et al*. 1992). The two bundles may supply the wing margin and the nectar roll with water and chemical substances much better than a common single input. Sections across the middle and basal part of the wing demonstrated that the twin vascular bundles run through the whole wing length (Figs. 5 and 6). Nectar is produced copiously, and glistens visibly on the channel below the nectar glands; it is also detectable by taste.

Figure 1: Different downslope of nectar rolls in *S. minor* and *S. rubra*. (Lids are cut off).

The indumentum of the wing margins of *S. rubra* is different from that of *S. minor* (Figs. 7 and 8). The indumentum in *S. rubra* is similar to other species of the genus, but hairs of *S. minor* are unique. They are parallel and bend upwards (Figs. 8 and 9). How do the hairs direct ants to the sweet pitcher nectar?

The picture examined in a microscope was vaguely familiar to me. I then followed my hunch, going to our railway station. Yes, semaphore columns were like a model of the photographed microscopic structures of the *S. minor* wing system. The hairs in Fig. 8 and the footboards or rails visible in the semaphores (Fig. 10) are similar. This is probably the answer to the question above.

Discussion

According to Schnell (2002) "many early botanists suggested that *S. minor* may be the most primitive member of the genus because the mature pitchers of this species look very much like seedling pitchers

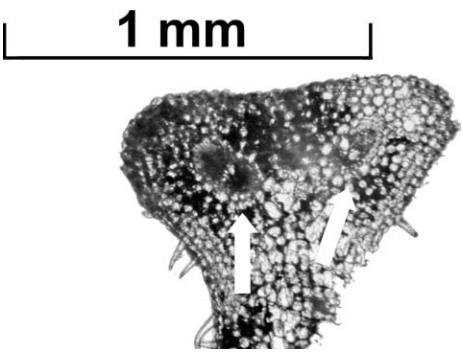

Figure 2: Transverse section through the upper part of the wing of *S. minor*, 2 cm downwards from the nectar roll. A concave edge and two vascular bundles go upwards to the nectar roll.

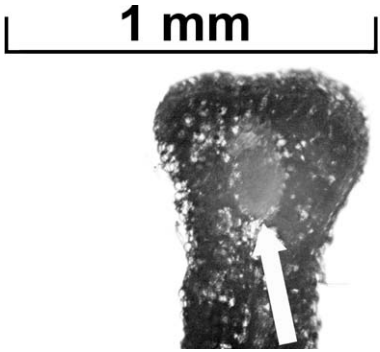

Figure 3: Transverse section through the wing margin of *S. rubra*, 2 cm downwards from the nectar roll. Single vascular bundle is conspicuous. It looks like that in other *Sarracenia* species except *S. minor*.

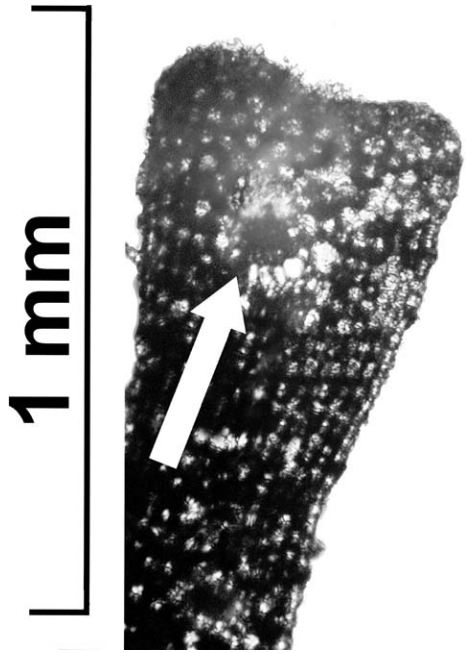

Figure 4: Transverse section through the wing margin of *S. rubra*, 4 cm downwards from the nectar roll. The margin is innervated by single vascular bundle.

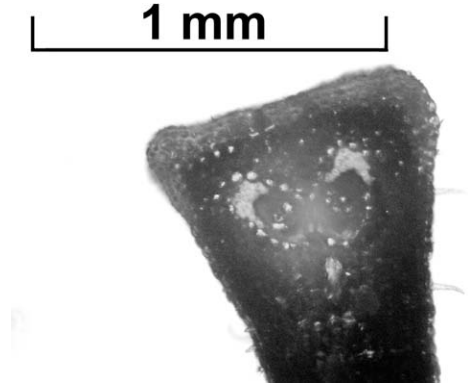

Figure 5: Transverse section through the lowest part of the wing of *S. minor*. A twin of vascular bundles supply the wing margin.

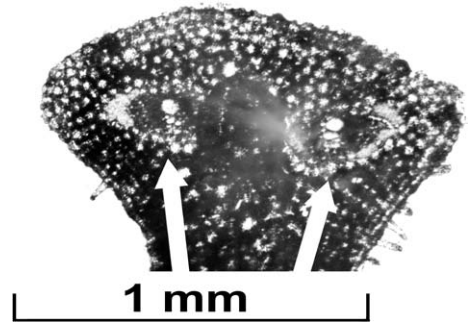

Figure 6: Transverse section through the middle part of the wing of *S. minor*, 8 cm downwards from the nectar roll. A convex edge and two vascular bundles are apparent.

of other species". If we consider the pitcher wing as connate leaf margins, the double vascular system in the wing margin documented in *S. minor* could support this idea (compare Chrtek *et al*. 1992). An interesting drawing in Lloyd (1942, plate 3, fig. 9), depicted the pair of vascular bundles close to the pitcher mouth for the first time. Nevertheless, there is an erroneous scheme of a single bundle on the prevalent part of the wing margin, the bifurcation being as far as close to the nectar roll (contrast with Figs. 2, 5, and 6). If we consider the seemingly primitive (but expedient) vascular pair together with modern signs like fenestrations and the strange specialized indumentum, we cannot regard *S. minor* as a primitive species.

Moon *et al*. (2010) also proved defensive benefits of ant luring by *S. minor*, because ants protect the plant from herbivorous caterpillars of *Exyra semicrocea*. If we put both benefits of ant presence in *S. minor* and *S. rubra* together, that is, nutrition and defense, we can also take into consideration the usual height and number of pitchers in a representative clump of either of the species. According to the pictures of natural localities (for example Schnell 1976: figs. 3-25 and 3-33), and also experience of long-term cultivation, *S. minor* has fewer major pitchers, whereas *S. rubra* has more slender pitchers. If it is true, the sympatric species probably occupy rather different ecological niches. I would be very curious as to whether anybody could compare the diversity of ant species found in pitchers of both species, especially if they grow together. Differences in quantities of various ant species shown in statistical data of populations could confirm the different niches and pertinently different life strategies and estimated cost/benefit relations.

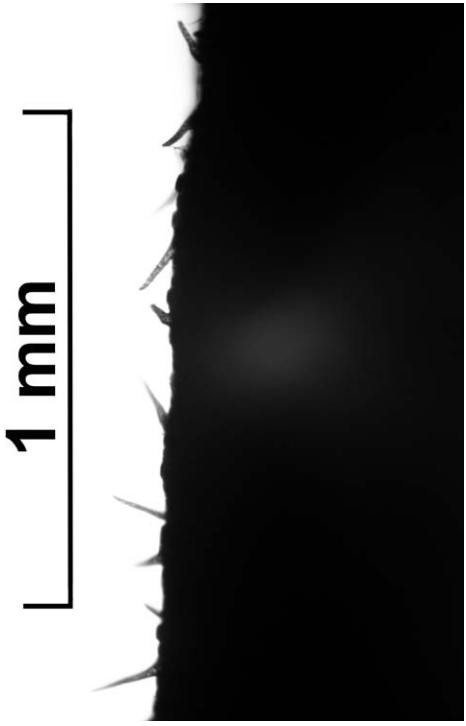

Figure 7: Frontal view of the wing margin in *S. rubra*. Hairs of wing margins are straight and bristled to various directions.

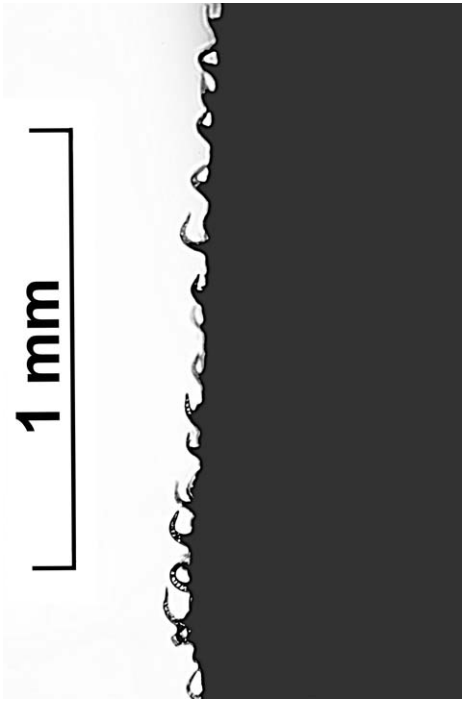

Figure. 8: Frontal view of the wing margin in *S. minor*. Hairs of wing margins are hooked and pointed upwards. Such indumentum is unique within the genus.

Conclusions

1. Anatomy of pitcher wings in *Sarracenia minor* and *S. rubra* subsp. *rubra* is different, namely in the number of vascular bundles.

2. Morphology of the wings is also different, namely the concave margin, the conjunction with the nectar roll and the indumentum.

3. *S. rubra* is more comparable with other species (not specialized for myrmecophagy) than *S. minor*, which seems to be a highly specialized species.

Acknowledgement: I would like to thank Barry Rice for language editing this article.

References

Chrtek, J., Slavíková, Z., and Studnička, M. 1992. Beitrag zur Morphologie und Taxonomie der Familie Sarraceniaceae. Preslia 64: 1-10.

Jones, F.M. n.d. Ants and insectivorous plants. In: Harvard Forest (Harvard University). Retrieved November 7, 2012, from http://harvardforest.fas.harvard.edu/ants-and-insectivorous-plants.

Lloyd, F.E. 1942. The Carnivorous Plants. Reimpr. 1976, Dover Publications, Inc., New York.

Moon, D.C., Rossi, A.M., Depaz, J., McKelvey, L., Elias, S., Wheeler, E., and Moon, J. 2010. Ants provide nutritional and defensive benefits to the carnivorous plant *Sarracenia minor*. Oecologia 164: 185-192.

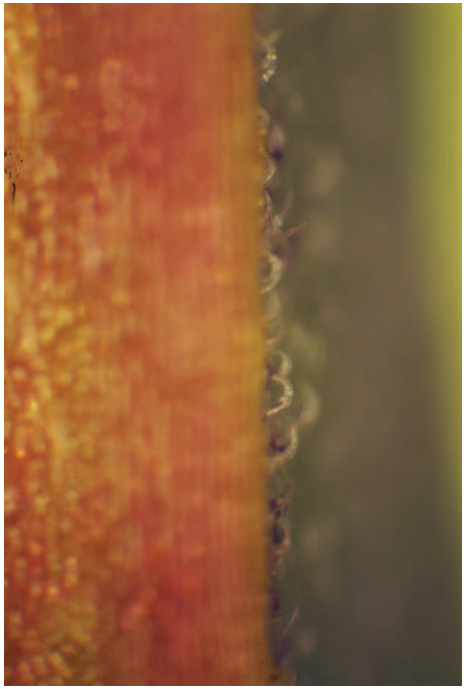

Figure 9: Ant's-eye view on the wing margin. The sweet path is red; the colorless hairs bent upwards are visible on the right side (the same being also on the left side, out of the picture).

Figure 10: Semaphore poles in a train station are rather similar to the observed microscopic structures of the *Sarracenia minor* wing.

Schnell, D.E. 1976. Carnivorous Plants of the United States and Canada. John F. Blair Publisher, Winston-Salem.

Schnell, D.E. 2002. Carnivorous Plants of the United States and Canada. 2nd ed. Timber Press, Portland.

Studnička, M. 2006. Carnivorous Plants, an Object for Explorers, Adventurers and Dreamers. Academia, Prague. [Czech]