

International Carnivorous Plant Society

SEED BANK*

Patrick Dwyer (St. Michael's Episcopal Church,
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<i>Byblis liniflora</i> (8)	<i>D. peltata</i>	<i>P. grandiflora pallida</i> (6)
<i>Darlingtonia californica</i>	<i>D. pygmaea</i> (4)	<i>P. vulgaris</i>
<i>Dionaea muscipula</i>	<i>D. rotundifolia</i>	<i>P. vulgaris bicolor</i> (2)
<i>Drosera aliciae</i> (4)	<i>D. spatulata</i> (Formosa) (8)	<i>Sarracenia alata</i> (12)
<i>D. auriculata</i> (10)	<i>D. spath.</i> (Kansai)	<i>S. flava</i>
<i>D. burkeana</i> (10)	<i>D. spath.</i> (Kanto)	<i>S. leucophylla</i>
<i>D. capensis</i>	<i>D. spath.</i> (white fl.)	<i>S. purpurea purpurea</i>
<i>D. capensis</i> (narrow) (5)	<i>Drosophyllum lusitanicum</i> (10)	<i>S. rubra</i> (3)
<i>D. capillaris</i>	<i>Nepenthes gracilis</i>	<i>S. × chelsonii</i> (8)
<i>D. indica</i> (10)	<i>N. khasiana</i>	<i>S. flava × minor</i> (2)
<i>D. intermedia</i>	<i>N. mirabilis</i>	<i>S. leuco × alata</i> (5)
<i>D. lovellae</i> (10)	<i>Pinguicula alpina</i> (10)	<i>S. rubra × leuco</i> (5)
<i>D. montana</i> (2)	<i>P. corsica</i> (10)	

*For details on how to send or order seed, please see *CPN*, March 1983, page 4.

A Preliminary Report on the Pollination of *Sarracenia purpurea* in a Forest-Swale Ecotone

by

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Abstract

This study was conducted during the summer of 1979 while the author was a student at the University of Michigan Biological Station, near Pellston.

Sarracenia purpurea flowers (161 flowers) were studied for a period of 29 hours during anthesis over a nine-day interim. Visitors to the flowers were collected in hope of establishing the pollinator(s) of the plant. Members of the Halictidae (a cosmopolitan family of small black or brightly metallic solitary bees) primarily were caught and thought to be acting as pollinators. *Bombus terricola* (bumblebee) females were also collected and may play a minor role in pollination. Other insects, including flies and beetles, were found as visitors, although they were unlikely pollinators.

Introduction

Sarracenia purpurea L. is an insectivorous plant that grows commonly in Northern sphagnum bogs. Although first described in 1601, it was not until a century later that Dr. Michael Sarrasin of Quebec sent specimens of this plant to Tournefort in Paris (Harper, 1918). Work on *Sarracenia* has focused on the insectivorous nature of the plant and the ecological interactions within the pitcher-shaped leaves (Istock et al., 1975).

Pollination studies, by comparison, have been fewer and less detailed. Schnell (1978) mentions a small species of *Bombus* as a possible pollinating agent for *Sarracenia rubra*. In 1965, Adrienne Mandossian of Michigan State University completed a doctoral thesis on the life history of *Sarracenia purpurea* in a sphagnum bog habitat

in Northern Michigan. In it, she concluded that major visitors to her plants were: *Sarcophaga sarraceniae* (a fly), *Bombus impatiens*, *B. grisecollis*, *B. terricola*, *B. vagans*, *Apis mellifera* and several species of ants. Results of her study also indicated that cross-pollination provided a larger amount of seed set than self-pollination, and that non-pollination provided almost no seed set.

In *Sarracenia purpurea*, flowers are borne on peduncles 3-5 mm high with five dark red petals that droop. There are five persistent sepals and three bracts. The flower goes through three main stages: young, medium, and old. Young flowers are those that have recently opened and still bear petals and anthers. Medium-aged flowers have dropped petals and most of the stamens. Older flowers have no petals or stamens left. At functional maturity the flower is held upside down at the tip of the bent-over flowering stem. During anthesis, nectar is secreted at the base of the barrel-shaped ovary. Should nectar be unremoved from the plant it collects and runs down the ovary.

Materials and Methods

The study site was a wet forest-swale (low dunes) ecotone along the shore of Lake Michigan located at Grass Bay, in section 25 of T38N, RIW, and section 30 of T38N, RIW, Cheboygan County, Michigan.

Field observations were made by checking flowers along a 290 meter transect that ranged from 5 to 10 meters in width. Flowers were observed between 0830 and 1630 hours. 161 *Sarracenia* flowers were checked for visitors during 29 hours of observation spread over 9 days.

Flower visitors were normally not visible until the petals were cautiously pulled back. If an insect was inside, the petals were replaced and a net placed over the flower. The time was recorded and the insect captured upon exiting from the flower. It was necessary to allow the insect to leave the plant of its own accord so that pollen present on its body would be the result of its own activity rather than a by-product of the capture procedure. Captured insects

were placed in a potassium cyanide killing vial and later pinned for a voucher collection.

Insects were examined for pollen loads under a dissecting microscope. Pollen loads were removed from some of the halictid bees and treated with glycerine jelly, 95% alcohol and methyl green using a method described by Kapp (1969). The loads were then examined under a compound microscope to determine whether or not *Sarracenia* pollen was present.

Flowers that were at the young, medium and old stage of anthesis were bagged with cotton gauze and left covered from mid-afternoon July 6, 1979 until the morning of July 8, 1979. Nectar was sampled from these flowers with micropipets and placed on a pocket refractometer in order to measure sugar concentration.

To establish that flowers were actually being pollinated, a return visit to the site was made on August 12th to check for capsule and seed production.

Results

A total of sixteen types of insects were found visiting the inner portion of the *Sarracenia* flower. The stage of anthesis seemed to affect the nature of visitor. Twelve insect types were found visiting the young and medium-aged plants whereas four types were found on old flowers.

Bees gathered from the flowers were determined as follows: one visitor was an *Osmia* sp. (Megachilidae); two bumblebees were identified as *Bombus terricola* (Apidae) females; and 43 Halictidae, although not officially identified, were thought to be the same species of small bee.

One of the *Bombus* was found inside a flower. It had forced its way in between a petal and the stigma. The other *Bombus* was observed crawling in over the stigma and exiting between a petal and sepal. Microscopic examination revealed white *Sarracenia* pollen on both bees. Only on two other occasions were *Bombus* seen near the plants. Of these, one was in flight and the other approached a pitcher flow-

Preservation of *Nepenthes* Pitchers by Freeze Drying

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Dried and pressed herbarium specimens of *Nepenthes* do not clearly exhibit many of the characteristics of the living plant. In particular dried pitchers often lose their original shape and form. However, it is often the shape of the pitcher which has been used to identify the many species and natural hybrids of *Nepenthes*.

Curators of zoological museums have preserved small animals by the method of freeze drying. This method of preservation has a wider application in microbiology and packaging certain foodstuffs.

The method of freeze drying requires leaving the material to be preserved in a vacuum at a temperature of about -50°C . The period of time that material is left in the freeze drier depends upon the nature

of the material. Bacterial cultures are generally freeze dried for 4 hours, whereas a small bird may require a week of freeze drying.

Nepenthes pitchers were freeze dried for 24 hours using the apparatus available at the Zoology Department, National University of Malaysia. The pitchers maintained their original shape and to a certain extent their colour. Pitchers preserved by this method were obtained from plants of *Nepenthes macfarlanei*, *Nepenthes sanguinea*, *Nepenthes albo-marginata* and *Nepenthes ampullaria*. The freeze dried pitchers were only slightly brittle and durability might be obtained by coating the pitchers with a clear varnish paint or spray.

Pollination (from page 61)

er and at the last second avoided it.

The Halictid bees were found inside the pitcher blossoms repeatedly. Several times they were found perched amongst the stamens, with their heads facing the base of the ovary. Most commonly, they were found wandering around inside on the stylar disc which was covered with pollen. Usually they exited a pitcher plant blossom between the petals and the sepals, or between the stylar disc and petal, nearly always making a short flight to the sepals and resting there while combing gathered pollen onto the tibia of their hind legs. On two occasions, bees were observed leaving the flower across the stigmatic surface.

The other bee collected was not seen on any other occasion. It was an *Osmia* sp. and carrying pollen on the underside of the abdomen.

Twenty-eight members of the family Sarcophagidae, probably *Sarcophaga*, were seen on pitcher blossoms. These flies were rarely found in the young flowers. Instead they were noted on flowers of medium and

old ages.

Other insects collected from the flowers included fireflies (Lampyridae) – old flower; click beetle (Elateridae) – medium flower; wasps (Sphecidae) – young flower; midges; ants; cranefly; mosquito. None of these was considered to be involved with pollination.

When Halictid pollen loads were examined, *Sarracenia* pollen was determined to be white in color. Its stephanolcolporate pollen grains were easily identifiable under high-power magnification. Four out of fourteen bees examined had pollen from at least one other species in addition to *Sarracenia* pollen.

Nectar results showed a sugar concentration ranging from 17.2% (wt/wt) in old flowers to 35.2% (wt/wt) in young flowers. The nectar production was also found to decrease with flower age.

Discussion

Since the *Sarracenia* flowers were already opened when the study period began it was not possible to undertake manipula-

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tions of plants which would have yielded information about cross-pollination, self-pollination, and actual seed set. Thus it will be necessary to attempt interpretations of the results while bearing in mind that the project was started a bit late for yielding conclusive results.

In Mandossian's thesis (1965), she reports four species of *Bombus* including *Bombus terricola* as frequent visitors to *Sarracenia* flowers. She observed them to be extremely active through most of the day, moving constantly from flower to flower, never staying long inside. She also reported entrance to be over the stigma. Mandossian observed large pollen loads on the *Bombus*.

The two *Bombus terricola* females caught in this study were the only two found in the flowers during the entire study period. They did have a fair amount of pollen grains on their bodies. Of the bee visitors, *Bombus* comprised only 4% of total insect visits. While it is possible that *Bombus* are pollinating *Sarracenia* at this site, it seems likely that they play only a very minor role, if at all.

Halictid bees seem to be the primary visitors to *Sarracenia* flowers.* They account for 95% of flower visitations. While they were observed to occasionally exit flowers across the stigma, and thus it could be suggested that the pollen which they gather while crawling about inside the flowers is deposited on the stigmatic surface and effects self-pollination, it is more reasonable to assume that since they normally enter the flower across the stigmatic surface (and exit between petal and stigma) that they are cross-pollinating the flower by depositing pollen as they enter.

Mandossian (1965) found that only 29% of flowers produced seeds that had insect visitors excluded and were left untouched. Sixty-four percent of the flowers which she self-pollinated produced seed, while 97% of the flowers that were cross-pollinated produced seed. This indicates that *Sarracenia purpurea* is self-compatible and can produce seed even in the absence of pollinators. It also shows, however, that insect

visits that result in self-pollination can be beneficial. Unfortunately, it is impossible to evaluate the relative extent to which the Halictids cross- and self-pollinate *Sarracenia* in the present study. Interestingly, Mandossian (1965) does not mention Halictids as visitors at all. It is possible that this difference could be accounted for by habitat differences.

Decidedly, this study should be repeated for more conclusive results. It would be necessary to start much earlier — as early as the emergence of buds in order to determine quantitatively what is occurring in the flowers. This would enable bagging of plants, exclusion of visitors, outcrossing and self-crossing experiments. Specific plots could be designed wherein records of the visits to each plant could be kept. The period of stigma receptivity and pollen maturity should be determined as well. It might not be a bad idea to check the flowers a few more times at night — to eliminate or establish the possibility of moth visitors. Despite Mandossian's thesis on the life history of *Sarracenia* (1965), it might be a productive study if *Sarracenia* flowers were watched at a bog site and at this swale site during the same season. Thus, it could be established whether or not visitors to *Sarracenia* are specific to the plant and differ by latitude or whether they are specific to the habitat in which the plants exist.

Literature Cited

- Harper, Roland M. 1918. The American pitcher plants. *J. Mitchell Soc.*, Sept., 110-125.
- Istock, C.A., S.E. Wasserman, and H. Zimmer. 1975. Ecology and evolution of the pitcher-plant mosquito: I. Population dynamics and laboratory response to food and population density. *Evolution* 29: 296-312.
- Kapp, R.O. 1969. How to know pollen and spores. Wm. C. Brown Co. Publishers, Dubuque. 249 pp.
- Mandossian, A.J. 1965. Some aspects of the ecological life history of *Sarracenia purpurea*. Unpubl. PhD. thesis, Michigan State Univ.
- Schnell, D.E. 1978. Systematic flower studies of *Sarracenia*. *Castanea* 43: 211-220.