A STUDY OF
MELAMPYRUM LINEARE

good —
it would have been informative
to have a list of all hosts verified
by you (not just "common" or
"preferred" ones), with some
suggestion of relative frequency —

Nancy Benninghouse
August 11,1976

Bot. 510

Melampyrum lineare, commonly known as cow wheat, is a hemiparasitic plant which can be seen growing in many places around the Biological Station campgrounds. Belonging to the Scrophulariaceae, this annual has small white flowers with yellow lips that are borne in the upper axils of opposite leaves. M. lineare is the only representative of the genus in North America. It can be found from Labrador to Alberta and British Columbia, south to Virginia, and along the mountains to Georgia. (Gleason 1952).

I observed this plant in order to compare the various host species of this root parasite in different habitats and in hopes of determining its pollinator(s). I observed M. lineare in four major sites in three different habitats:

1. On Biological Stations grounds beyond the upper drive along the foot path. Cheyboygan Co. MI.
2. Along edge of power lines between Burt Road and Riggsville Road. Cheyboygan Co. MI
3. The Jack Pine plains - Cheyboygan Co. South side of M-68, 2 mi. W. of Pigeon River.
4. Along edge of Thuja swamp which borders beach pools of Lake Huron at Grass Bay - Cheyboygan Co. MI.

Sites number 1 and 2 were dry and sandy, the type of habitat I most frequently observed M. lineare growing in. At camp, it lined the paths, becoming less frequent as one walked back into the woods. It was common around the cabins which were not too densely shaded.

The power lines were bordered on either side by aspen and had been sprayed with herbicides approximately five years ago. At this second site M. lineare was found growing along the strip between the woods and the open ground directly under the lines.

M. lineare, then, seems to prefer somewhat open, semi-shaded areas which border a disturbed place. Potential host species were present in both direct sun and dense shade, but the few that did grow in these places were small, stunted and sparsely branched.

Since M. lineare is a hemi-parasite it has a great advantage during the hot summer months when water requirements is a limiting factor for many other plants. As long as host species are present to supply water and other organic materials, it can grow happily in very dry soil. To economize on water, many semi-parasites have high transpiration rates and are the first to wilt when collected. This is ironic as M. lineare is most frequently found in dry places.

The kinds of plants that M. lineare was most commonly seen to parasitize in sites 1 and 2 were the following:

Pteridium aquilinum
Gaultheria procumbens
Fragaria virginiana
Diervilla lonicera
Vaccinium angustifolium
Danthonia spicata

I dug up M. lineare along with plants close to it (5-10" away) in order to observe the haustorial connections. The root system of this annual is shallow and the haustorial connections are almost microscopic and easily broken. Small swellings on the roots of M. lineare, however, indicate attachments to other plants. (Piehl 1962).

In both sites, plants such as Comptonia peregrina and Hypericum kalmianum were present, but rarely did I find M. lineare attached to these solitary plants. If they were found parasitizing such plant they were growing right next to the host (1" or so away).

In the Jack Pine plains, the hosts were very similar with a

few exceptions. The following species were the preferred hosts:

Carex pennsylvanica
Epigaea repens
Danthonia spicata
Vaccinium angustifolium
Pteridium aquilinum.

All the host species found in the first three sites are similar in that they are rhizomatous or stoloniferous. They spread out along the ground by below-ground stems which grow out laterally from the main plant. Often, M. lineare could be seen growing in lines along the length of a strawberry stolon. Such plants would provide easy access to M. lineare with its shallow root system since the rhizomes are so close to the soil surface. Plants such as Hypericum kalmianum, which send their roots vertically downward into the soil, would be poor hosts for this hemi-parasite, since it would be difficult to reach and attach to them.

A rhizome is an underground stem and in immature forms the xylem is arranged in bundles around the pith and surrounded by the phloem. A root, on the other hand, has its xylem in the center surrounded by the phloem. One could speculate the it would be easier for an attacking haustoria to reach the xylem of a rhizome than that of a root, and thus prefers rhizomatous plants.

Martin A. Piehl did a study of the parasitic behavior of M. lineare in 1962 with very similar results. However, he did observe haustorial connections with the roots of Populus grandidentata, Pinus resinosa, and Betula papyrifera. Since he did observe M. lineare parasitizing roots, the difference between xylem position in roots and rhizomes may be of little importance. The fact that that rhizomes and stolons are closer to the surface is of greater significance in the host species of M. lineare.

M. lineare is also found, but less frequently, in wet habitats, such as Thuja swamps and bogs. I observed it growing on the outer most edge of the Thuja swamp at Grass Bay which borders the shoreline beach pools. Again, stoloniferous or rhizomatous plants were being parasitized by M. lineare:

Arctostaphylos uva-ursi (L.) Spreng.
Iris lacustris Nutt.
Linnaea borealis L.

M. lineare grew in large numbers among these plants and was not observed attached to other conspicuous plants such as Lobelia kalmii and Lysimachia terrestris.

On our Canadian class trip, I observed M. lineare growing on a wet, mossy bank next to an old logging road among Linnaea borealis. Even in wet areas, it seems to prefer somewhat disturbed ground. In the Picea swamp at Black Fox Lake, M. lineare was growing on Sphagnum hummocks among Vaccinium macrocarpon, and I found a plant attached to Gaultheria hispidula. Martin Piehl found that occasionally this root parasite will be found attached to Sphagnum. This may have been occurring on the hummock at Black Fox Lake, but I couldn't find any such attachments.

There are many other factors which should be considered when drawing conclusions about host species of semi-parasitic plants. M. lineare may have many other potential hosts in the areas I observed but they are placed out of reach of the plant because of certain environmental or physiological limitations. Being a shade intolerant plant, M. lineare cannot take advantage of plants growing in densely shaded areas. Physical barriers, such as cork formation on the roots, may prevent haustorial attack. A semi-parasite

may be found attached to another plant but is drawing no water or nutrients from it but rather utilizing the supposed host as a means for support. A host plant may be biochemically incompatible with the parasite and so the haustoria cannot affect penetration.

Job Kuijt, who studied M. lineare, warned that"a parasite reported to be restricted to a certain host species may in fact be confined to a vegetational zone where the "favorite host" is dominant"(Kuijt 1969). M. lineare prefers disturbed, dry areas and indeed most of the hosts observed do well in this type of habitat. In the Jack Pines many of the plants developed large underground parts as an adaption to fires with thick rhizomes running close to the soil surface. i.e. Pteridium aquilinum. M. lineare simply takes advantage of these subsurface stems in the Jack Pine plains and other similar structures in dry and wet habitats.

Previously, M. lineare was thought to be a self-pollinating plant.F. W. Pennell, who studied the pollination mechanism of this plant, stated that he never noticed any bees visiting it and concluded that it was wholly dependent on self-pollination. He also said that the anthers were not in the correct position to be transferred by a bee should it visit a flower. The stamens, 4 paired, ascend under the upper lip.

I observed M. lineare at different hours of the day for several weeks before I finally saw an insect visit it. At the third site I collected a small bee which Dr. C. Berg identified as Bombus ternarius. This is a Canadian bee which makes its home in abandoned holes of field mice or other such openings in the ground. It can be found all the way south to Connecticut. I

observed this bee visiting many flowers of M. lineare and the insect's head and belly were obviously brushed with pollen as it made contact with each flower. Bombus ternarius was very obviously homing in on M. lineare even though there were other open flowers in the immediate vicinity. Also, it somehow seemed to sense if a flower had already been visited, hovering close, but not landing on it, and moving to the next flower.

On the Biological Station grounds, at the edge of the woods near the Grand Sable dunes, and in Canada at Katherine Cove, I observed another species of Bombus pollinating M. lineare. I watched this bee for a long time at camp and it behaved in a similar fashion to Bombus ternarius. It too was specifically visiting M. lineare but it was a bit larger and was entirely black and yellow. Unfortunately, I was unable to collect this bumblebee for exact identification.

M. lineare, therefore, definitely has two bumblebees pollinating it. With further observation possibly more would be observed.

LITERATURE CITED

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Piehl, M. 1962. The Parasitic Behavior of Melampyrum lineare and a Note on its Seed Color. Rhodora. Vol. 64 p. 15-23.

What about the papers by Carlson et al.?

on pollination of M. pratense (bees) see Meidell, O. 1945. Bergens Mus. arb. 1944, Natv. nk. 11.