

THE *MIRABILIS*—INSECT COMMUNITY IN ILLINOIS

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Like the human community, the natural communities consist of producers, parasites, predators, scavengers, visitors and vagabonds. In the *Mirabilis*-insect community, as now known in central Illinois, only the producing, predacious and parasitic classes, groups or strata have been observed. However, more extensive and intensive studies, at other times and places, would almost certainly reveal additional classes and species, for the community is not static. The thirteen organisms now known for this community represent four ecological groups. The umbrella-wort, *Mirabilis nyctaginea* (Michx.), Nyctaginaceae, constitutes the primary producing center of the community in that it directly supplies the food and shelter for five phytophagous insects, and indirectly makes possible the life of a predator and six species of parasites that subsist on the phytophags, the latter thus being secondary producers in this organic complex.

Specific Components of the Groups.

(1) *Mirabilis nyctaginea*, the primary producing center, or *sine qua non* of the community. (2) Phytophags: *Heliodines nyctaginella* Gibson and *H. ionis* Clarke, Heliodinidae, Lepidoptera; *Celerio lineata* Fabr., Sphingidae, Lepidoptera; *Onychobaris subtonsa* LeConte, Curculionidae, Coleoptera; and *Catorhintha mendica* Stål, Coreidae, Hemiptera. (3) Predator: *Orius in-*

sidiosus (Say), Anthocoridae, Hemiptera. (4) Parasites: *Bracon caulicola* (Gahan) and *B. gelechia* Ashm., Braconidae; *Tetrastichus coerulescens* Ashm., Eulophidae; *Eupelmus allynii* (French) and *E. cyaniceps* Ashm., Eupelmidae; *Neocatolaccus tylodermae* (Ashm.), Pteromalidae, (all Hymenoptera).

Characteristics of the Species. Although the species composing each group have food preferences in common, each also has distinctive structural characteristics that implement its specific role in the community. The concrete habits and structures that appear to fit each species to perform its own role are described briefly here. More details on certain life histories may be had in the articles by Balduf and Wester, as cited among the references below.

Mirabilis nyctaginea, as the producing center of the community, is well suited to support its phytophagous insect dependents. It is a perennial herb with a fleshy rootstock, sturdy stems and lush ovate leaves. Even the clusters of small pink flowers afford some food to the insects. At least on railroad embankments, where section crews mow it, the plant grows two crops of leaves and seeds annually, in May - June and in August - September, with a period of bare woody stalks intervening. Through the natural spread of seeds and extension of its root system, and especially when

aided by human conveyances, *M. nyctaginea* is capable of rapid spread; this feature accounts for the mobility of the community. In the process of spreading, it is favored by its predilection for well-drained gravelly soil, such as prevails on railroad trackways, where it is now common in Illinois. Indigenous to the Great Plains west of the Mississippi river and the western part of Illinois, its spread eastward began about 1855, when the first railway spanned the river, connecting those new agricultural regions with the populous urban centers along the Atlantic (Balduf, 1957).

The Phytophagous Species of the Community. *Catorhintha mendica* is unique among the phytophags in being heterometabolous, and that all the stages live exposed on the surfaces of the leaves or branches. Both adults and nymphs feed on plant sap obtained by piercing-sucking mouth parts. Both stages move rapidly on foot, and the adult flies readily. So far as known, *C. mendica* feeds only on *M. nyctaginea*, but possibly also utilizes other species of *Mirabilis*, three of which occur infrequently in Illinois (Jones and Fuller, 1955). It is the only species of the community that Hart (1909) included in his list of all insects found in the sand regions of the Illinois and Mississippi river valleys. Stål (1870) described *C. mendica* from specimens obtained, possibly by Belfrage (Geiser, 1933), from Texas and Mexico. Probably employing its own means of locomotion, it escaped the Great Plains since 1850, moving down the east-bound railroads where its food plant was previously established. It is

common wherever *M. nyctaginea* occurs on trackways in Illinois north from Quincy and Urbana, and since Evers (1960) discovered the host plant on railroads south from Madison county, the bug is probably extending its range also in that direction.

Celerio lineata (the white-lined sphinx, Clemens, 1859). In the years 1938-1941, I swept *M. nyctaginea* extensively in Champaign county while making a study of *Catorhintha mendica* (Balduf, 1942). Larvae of *C. lineata* were taken on only two occasions. Five almost full-grown individuals, all about two inches long, were obtained near Tolono on October 5 and 11, 1941, and other large ones near Mahomet, along railroads in both cases. The identifying specialist commented that the larvae are darker than usual. Having a long list of food plants of divers taxonomic relations, this common hornworm is a facultative member of the *Mirabilis* community.

Heliodines nyctaginella. This leaf-skeletonizing micromoth was described by Gibson (1914) from adults reared by Criddle at Aweme, Manitoba, from larvae found feeding on *M. nyctaginea*, "a widely occurring representative of the Nyctaginaceae in Canada." This brief account shows that both the food plant and the insect occur even in the extreme northern part of the Great Plains. I found it commonly on railways in the northern half of Illinois wherever its host occurred. While investigating its life history, Wester (1956) found it in 20 counties across central Illinois. During the seasons of bud clusters, most of the eggs are laid on the outside of

the involucre; otherwise usually on leaves near the top of the plant. Excepting the first instars, the larvae live under webs spun over the clusters of flower-buds and on the leaves. Usually one larva inhabits a web. When it has consumed the tissue, excepting the veins, enclosed by its web, the larva emerges through the opening left at the base of the leaf, crawls down to the next leaf and spins a second web where feeding is resumed. Such changes in location and web-spinning continue until the larva is full-grown, whereupon it apparently descends to debris on the ground for pupation. Wester concluded that the chrysalises of the last, *i.e.* fifth, generation pass the winter.

Heliodines ionis (a stem borer). Previous to the studies by Wester (1954, 1956), only one species of *Heliodines*, *i.e.* *nyctaginella*, was recognized from *M. nyctaginea*. He discovered larvae similar to those of *H. nyctaginella* boring in the stems. Moths reared from such larvae by Wester proved to be a new species, which Clarke (1952) named *H. ionis*. It was reported from Champaign, Macoupin and Mason Counties, Illinois, and Wyandotte County, Kansas.

Although the adults are very similar, the two species possess striking differences in habits. *H. nyctaginella* attach their eggs to leaves and clusters of buds, where the larvae develop mostly under webs, then pupate on the ground, and winter as pupae. In contrast, *H. ionis* oviposits in such secluded sites as the paired axial buds, old exits from which previous adults emerged from the stem, and in natural splits in

stems. From these positions, the small larvae enter the stems and develop by feeding on the succulent pithy center. When almost full-grown, the borer enlarges its tunnel locally and packs its accumulated excrement in both ends of the enlargement, thereby forming its pupal chamber. But before transforming, the larva lines the chamber with silk and chews a hole through the stem wall to provide for its subsequent exit as an adult. Wester calculated that *H. nyctaginella*, the leaf-skeletonizer, develops five generations in a year as against only three for its boring congener.

Onychobaris subtonsa (a stem borer). Like those of *Heliodines ionis*, the larvae of *O. subtonsa* live as stem borers. However, their activities in relation to the community center differ sharply in several respects. The siphon of *H. ionis* limits it to ingesting free fluids, if it feeds at all, and, lacking a penetrating ovipositor, this micromoth lays the eggs on surfaces. In contrast, the sturdy proboscis of the adult *O. subtonsa*, bearing mandibles at its apex, serves both to feed and as an aid to oviposition. Apparently both sexes feed in the spring on incipient leaves, clusters of flower buds, green seeds and eventually only on the stems (Wester, 1956a). The female places the eggs only in the stems. A pit is prepared with the proboscis for reception of the egg; after the egg is placed, the snout is employed again, probably, in Wester's opinion, to force the egg deeper. Plant sap emanating from the wounded tissue is said to envelope the egg and congeal to form a protective covering.

The young larvae first feed in the epidermis and the cortex of the stem, then tunnel into the pith where they feed until full-grown. Throughout its development, the larva is white, with head light brown, robust, curved and legless. So they are easily distinguished from the above boring lepidopterous larvae. Their last functions are (1) to prepare a pupal cell in the tunnel, employing excrement, and splinters of the woody cortex glued together with excretions from the malpighian tubes, and (2) to chew an exit hole through the cortex to, but not including, the epidermis. From this opening the young adult emerges the following spring. The full-grown larva winters in the tunnel; pupation is delayed until April of the next year. Only one generation is completed annually.

I found *Q. subtonsa* to be common wherever *M. nyctaginea* occurred in the northern half of Illinois and Wester collected it from 16 counties in Central Illinois. LeConte (1876) describes this species from a single specimen taken in Texas by G. W. Belfrage (see Geiser, 1933).

The Entomophagous Species of the Community. The predatory bug, *Orius insidiosus* and the six hymenopterous parasites, reported by Wester (1956b), occurred in small numbers compared with their phytophagous hosts already described above. Both *Orius* and the parasites are facultative in this community since they have previously been shown to utilize also other species of prey and hosts living outside the *Mirabilis* center. (Muesebeck et al, 1951.) This means they have probably entered the *Mirabilis* communi-

ty from others, where they attacked alternate hosts.

The parasitic forms are equipped with exerted or exsertile ovipositors which enable them to implant their eggs upon or into the host invisible beneath a web or in a tunnel in the stem of *Mirabilis*. Also a high level of sensitivity must be presumed to account for this ability. Previous to oviposition, certain of these parasites inject a venom via the hollow terebra into the host, thus paralyzing it temporarily or permanently, particularly in case of ectoparasites. Wester found that five of the six Hymenoptera are solitary and ectoparasitic on host larvae, i.e. a single larva feeds and grows to maturity from the outer surface of a given individual host. Only *Tetrastichus coeruleus* deviates from that pattern of relationship. Here numbers of the larvae develop, all internally. Moreover, the host is not a larva, but the pupa or chrysalis of *Heliodines ionis*. Such are described as gregarious endoparasites.

The host relations and habits of the six species, as reported by Wester (1956b), are briefly summarized herewith.

I. Braconidae.

1. *Bracon caulicola*, solitary ectoparasite on the boring larvae of *Heliodines ionis*, micromoth, and *Onychobaris subtonsa*, snout beetles, in tunnels of *Mirabilis* stems. Host larvae suffer permanent paralysis. Pupation occurs in a cocoon in the host tunnel, and the new adult chews a hole in the tunnel wall for escape.

2. *Bracon gelechiaae*. In all bionomic respects like *B. caulicola*, but attacks the advanced larvae of

Heliodines nyctaginella, which live more accessibly under webs on leaves.

II. Eulophidae.

3. *Tetrastichus coerulescens*, a gregarious endoparasite in pupae of *H. ionis* in tunnel of *Mirabilis* stem. Wester believed the adult female enters the host tunnel via the hole chewed in wall of stem tunnel by the host larva, and there parasitizes the mature host. He obtained from 10 to 40 adult *coerulescens* per host pupa.

III. Eupelmidae.

4. *Eupelmus allynii*, a solitary ectoparasite on the boring larvae of *Heliodines ionis* in burrow in stem of *Mirabilis*. The host larva is permanently paralyzed. The parasite winters as a mature larva in the host's burrow, where it also pupates in the spring. The new adults emerge through holes which they chew in the plant stem.

5. *Eupelmus cyaniceps*, a solitary ectoparasite of *H. ionis*. Its relations to the host, also its life cycle, are in all respects as stated above for *E. allynii*.

IV. Pteromalidae.

6. *Neocatolaccus tylodermae*, a solitary ectoparasite on larvae of the black snout beetle, *Onychobaris subtonsa*, in burrow in stem of *Mirabilis*. All hosts previously reported for this species are larvae of snout beetles (Muesebeck, 1951).

7. *Orius insidiosus*. When performing in the *Mirabilis* community, this small predatory bug attacked chiefly the first instars of *Heliodines nyctaginella*, which do not spin a protective web. Both nymphs and

adults engaged in the attack. Wester observed them circle around a prospective larva several times, before they rammed it with the extended proboscis and started to feed. Many predatory Hemiptera first employ the forelegs to capture their victims.

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