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**BIOLOGY OF THE HYPERPARASITIC WASP
PERILAMPUS SIMILIS (HYMENOPTERA: PERILAMPIDAE)**

Foster Forbes Purrington¹

ABSTRACT

Planidia of the hyperparasitic wasp, *Perilampus similis* Crawford, enter their braconid host, *Agathis metzneriae* Muesebeck, during that host's active growth phase, returning to the outer surface when the host is prepupal. Second instar perilampids search for and destroy conspecific larvae on the surface of the braconid prepupae, thus eliminating superparasitism. Planidia in primary hosts, *Metzneria lappella* Zeller moth larvae in burdock seeds, unparasitized by the braconid persist without further development through pupation and occur in various tissues of the adult moth.

Perilampid wasps (Hymenoptera: Perilampidae) are most frequently recorded as parasites of Lepidoptera via hymenopterous and dipterous primary parasites (Clausen, 1940). First instars are planidia that hatch from eggs deposited on host plant surfaces where they await encounters with primary hosts which they enter via the cuticle. In hyperparasitic species the planidium eventually begins feeding in response to some physiological/behavioral event, usually incipient pupation, in the development of its host, a primary parasite (Clausen, 1940). This paper reports biological observations on *Perilampus similis* Crawford and the fate of its planidia in primary hosts not parasitized by primary parasites.

P. similis parasitizes *Agathis metzneriae* Muesebeck (Hymenoptera: Braconidae), a solitary univoltine primary parasite of *Metzneria lappella* Zeller (Lepidoptera: Gelechiidae) in eastern North Dakota (Purrington, 1970). This seed-eating gelechiid moth is a common and widely distributed inhabitant of burdock (*Arctium* spp.) burs in North America and Europe. It is univoltine and emerges in early summer after overwintering as a larva.

MATERIALS AND METHODS

Larvae and adults of *M. lappella* were obtained from burdock collections made in December, 1968, at Grand Forks, North Dakota; October, 1968 at Winnipeg, Manitoba; and in February, 1977, at Wooster, Ohio. Twelve adults and 20 larvae from Grand Forks were cleared in KOH, mounted in Canada balsam on glass slides, and examined for planidia with a compound binocular microscope. Laboratory observations of living material were made with a stereo dissection microscope. Field observations were made in Grand Forks County, North Dakota, in 1969.

RESULTS AND DISCUSSION

Two major risks face the planidium of *P. similis* as it awaits an encounter with the larva of *M. lappella* on the bur surface. First, it may contact and enter an insect other than *M. lappella*, a risk offset by good reproductive synchrony with this moth, by the ubiquity and infestation rate of *M. lappella* in burdock (this moth species typically occurs in about 90% of all burs, as many as 30 1st instars per bur eventually thinning to about three), and by the probably absolute specificity of burdock as host for *M. lappella*. Furthermore, no other species of lepidopterous larvae are intimately involved with the burdock bur. A dipteran

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larva, probably Cecidomyiidae, occurred commonly in burs but examinations revealed no planidia, either attached to the cuticle or internal. Thrips were occasionally found in burs and have been reported as probable inadvertent hosts for eucharitid (Hymenoptera: Eucharitidae) planidia (ant parasites) on other plants (Beshear, 1974; Wilson and Cooley, 1972). *P. similis* planidia may attach to thrips but undoubtedly do not develop further.

The second risk is the possibility that the *M. lappella* larva entered by the perilampid planidium is not presently and will not later be parasitized by *A. metzneriae*, the host for *P. similis* (Fig. 1). This risk is offset by the ubiquity of the braconid, widely distributed in the eastern U.S. (Juhala, 1967), the high rate at which it parasitizes *M. lappella* (averaging about 40% of 2100 in Grand Forks in 1968, 53% of 600 in Wooster in 1977, and all of 24 larvae from Winnipeg in 1968—unpublished data), and by its host specificity (recorded only from *M. lappella*).

Examination of moth larvae showed up to five planidia distributed throughout the body, most often in head and thoracic tissues. Some larvae carried more than one planidium in the head, and one carried five there (this larva also bore a first instar *A. metzneriae* and was sluggish). In one larva a planidium was positioned directly beneath the ocellar zone and a tissue deformation including lack of ocelli had developed, possibly in conjunction with the planidial invasion.

Both Tripp (1962) and Hinks (1971), in detailed studies of *P. hyalinus*, acting as a primary parasite of *Neodiprion* spp. sawflies, found frequent encapsulation of planidia in the haemocoel. No encapsulation of planidia was observed in either *M. lappella* or in *A. metzneriae*.

Of the 12 adult *M. lappella* examined, three contained perilampid planidia; one contained two planidia. Probably more moths contained them but extensive chitinous host tissue made observation difficult, especially since KOH cleared planidial chitin to a similar degree. Nevertheless, all four planidia were clearly lodged internally, one beneath the frons area, the other three in mid-abdomen, indicating they were acquired by the moth larvae and survived pupal reorganization and adult eclosion. Whether they persist alive in moths and what effects they have are open questions.

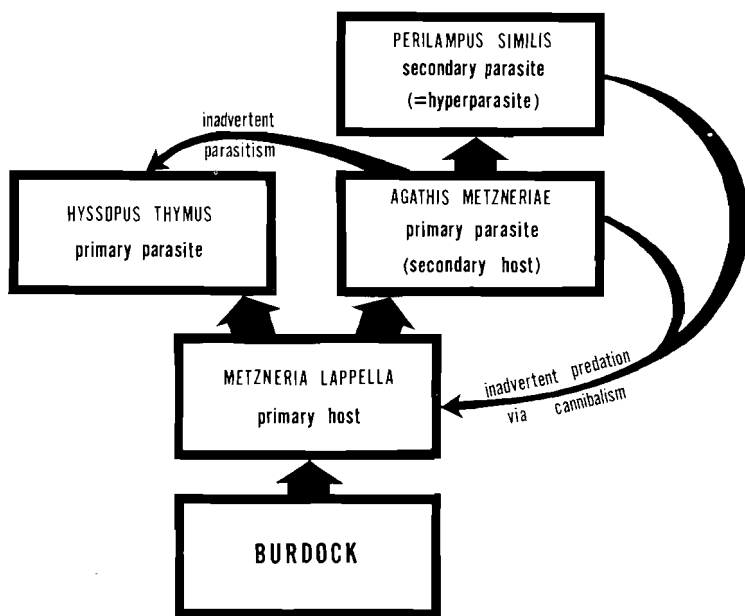


Fig. 1. Trophic relationships (simplified) among insects associated with burdock.

Even having overcome the risk of entering the improper primary host and the risk of finding no secondary host in *M. lappella*, a third difficulty arises: superparasitism of *A. metzneriae* by *P. similis* inevitably results in agonistic behavior in which only one perilampid larva survives (Purrington, 1970). Duels occur on the surface of *A. metzneriae* prepupae during a period of active wandering and intermittent feeding by early 2nd instar perilampids. [The entire planidial complement of *M. lappella* overwinters in various tissues of this moth larva and enters the *A. metzneriae* larva en masse at some point in the braconid's post-overwintering rapid growth phase. They remain just beneath the cuticle until the braconid has completed a cocoon inside its host's hibernaculum in the bur, at which point the planidia cut through the braconid cuticle and begin active external development (Purrington, 1970)].

Only one *P. similis* ever completes development on its braconid host, as is also the case with *A. metzneriae* on *M. lappella* (Purrington, 1970). Whereas responsibility for eliminating superparasitism in *P. similis* rests with 2nd instars (via combat), *A. metzneriae* females apparently avoid superparasitism by chemosensing prior conspecific attacks with ovipositors, as do female endophagous parasitic wasps of many species in several families (Salt, 1961; Fisher, 1961; Wylie, 1967).

During the period of planidial invasions early stage *M. lappella* larvae are migrating among the overlapping bracts and corolla bases of the burdock inflorescence, exposed to attack both by *P. similis* planidia and by *A. metzneriae* females which oviposit directly into moth larvae. After this period of intense parasite activity when *M. lappella* larvae are entering seeds, they encounter each other and often fight to the death. This cannibalism, along with other factors including parasitism by the gregarious eulophid wasp, *Hyssopus thymus* Girault (Hymenoptera: Eulophidae) (Purrington, 1970; Purrington and Uleman, 1972), results, by fall of the year, in an about 10-fold reduction in numbers. Beyond the reduced intraspecific competition for resources that cannibalism entails it obviously results in occasional predation, albeit inadvertent, by *M. lappella* upon two members of its parasite fauna, namely *A. metzneriae* and *P. similis* (Fig. 1). One possible outcome is ingestion by the cannibal of entire living *P. similis* planidia that may subsequently escape through the gut wall into the haemocoel, thereby salvaging an opportunity to develop further, presuming their braconid host is present in the cannibal.

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