

NOTES ON THE LIFE CYCLES OF THREE PARASITES OF THE PITCH TWIG MOTH

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Four species of parasites, 3 primary and 1 secondary, have been reared by the writer from the pitch twig moth, *Petrova comstockiana* (Fernald) (Lepidoptera, Olethreutidae) in Ohio. In descending order of frequency of parasitization, the parasites are *Agathis pini* (Muesebeck), *Perilampus fulvicornis* Ashmead (secondary through *Agathis pini*), *Hyssopus thymus* Girault, and *Calliephialtes comstockii* (Cresson)¹. *Agathis pini* was found to be a major influence in the natural control of the pitch twig moth in Ohio. This paper contains information on all parasites listed above except *Calliephialtes comstockii*. Methods of handling and observing parasites were the same as reported in a previous work (Miller, 1953).

The host develops in current growth twigs of various species of pine. It has a univoltine life cycle. The partly grown larva overwinters, and adults issue in May and June. A detailed account of the biology of the pitch twig moth is in preparation.

Agathis pini

The number of larval instars was not determined, but two general types of larvae were recognized: polypodeiform and fusiform. Polypodeiform (first instar) larvae were commonly found within young pitch twig moth caterpillars during the summer after July 1. Parasite larvae collected in July and August measured approximately 0.8 mm. in length. (Hosts had been killed in Peterson's K. A. A. D. killing mixture and preserved in 95 percent ethanol.) The polypodeiform larvae persisted in their hosts with only slight increase in size until the following spring. Meanwhile, the parasitized caterpillars proceeded normally in development and activity.

In the latter part of April, the parasite larvae began to grow rapidly. By April 23, 1952, two out of 8 larvae had transformed into fusiform individuals. Two weeks later the majority of larvae were fusiform and were from one-half to two-thirds the length of their hosts. The dissection records reveal that 100 percent of the twig moths found in the larval stage after May 1 had been parasitized by *A. pini*. Parasitized caterpillars never attained the pupal stage. They usually remained active until they completed the normal adult exit routes which later were used by the parasite adults. At maturity, beginning about May 10, *A. pini* larvae left the bodies of their hosts and spun cocoons in the host burrows. Nine days later only a few parasite larvae were still in their hosts. In an earlier paper (Miller, 1953), it was incorrectly stated that larvae of this species were external feeders. Cocoons prepared by the parasite larvae were cylindrical, white, and usually thick and opaque toward the cephalic end and thin and translucent toward the caudal end. Small portions of the cocoons were removed in the insectary so that the occupants could be observed. Several opened cocoons were completely repaired by the insects and had to be reopened for observation. Meconia were expelled in the cocoons from 2 to 4 days before pupation. Five larvae (2 males and 3 females) that were under observation transformed to pupae between May 20 and 27, 1952. The duration of their pupal periods varied from

¹Braconidae, Chalcidoidea, and Ichneumonidae determined respectively by C. F. W. Muesebeck, B. D. Burks, and L. M. Walkley, of the Insect Identification and Parasite Introduction Section, U. S. Department of Agriculture, Washington, D. C.

10 to 21 days and averaged 15 days. At every stage of development *A. pini* individuals were observed to be solitary.

In 1951 the single annual brood of adults emerged throughout June (Miller, 1953), and in 1952 they issued from June 10 through 19. On the initial dates of parasite emergence, host emergence was still underway in 1951, but complete in 1952.

Polypodeiform larvae never occupied any particular site within their hosts. However, during the latter part of larval development, the fusiform larvae were always situated in the caudal ends of hosts. Also, in 13 out of 15 instances, fusiform larvae were oriented with their heads in the same uniform direction as the heads of their hosts. This position of parasites and hosts corresponds with the location of the exits prepared by the hosts.

The short host list for *Agathis pini* (Muesebeck and Walkley, 1951) and the high frequency with which the parasite occurs on the pitch twig moth suggest that *A. pini* is highly host specific for this moth. The parasite has also been recorded from the pitch twig moth in New York and Maine (Muesebeck, 1940).

The 3-year insectary emergence record indicated that 40 percent of *A. pini* individuals had been parasitized by the hyperparasite *Perilampus fulvicornis*.

Perilampus fulvicornis

Three larval instars were distinguished by general appearance of developing larvae: first, the planidiform larva; second, the apoid larva; and third, the mature larva which is characterized by fleshy, segmental protuberances on the lateral aspect of the abdomen.

Dissections of over 100 twig moth larvae revealed 5 *Perilampus fulvicornis* planidia. One planidium was found in a caterpillar collected on July 18, 1952. This caterpillar apparently was not parasitized by *Agathis pini*. The remaining 4 planidia were solitary and were attached externally to the bodies of *A. pini* fusiform larvae removed from caterpillars collected in May, 1952. These planidia averaged 0.30 mm. in length. Due to their small size and inconspicuous coloration, many planidia may have been missed in the dissections.

A little later, larger planidia were discovered on 11 cocooned *A. pini* larvae that were developing under observation in the insectary. In two instances, two planidia were seen on the same host. At maturity, however, the hyperparasites were always solitary. There was never any indication that individuals completed development as primary parasites of the twig moth in the absence of parasitization by *A. pini*. The earliest transformation to the apoid larva took place in the insectary on May 25, 1952, and all individuals had attained this stage 4 days later. These transformations occurred from 5 to 10 days, or an average of 8 days, after expelling of meconia by host individuals. The immediate hosts (*A. pini*) did not live to pupation. The apoid period lasted from 4 to 6 days. The mature larvae were present 4 to 6 days prior to pupation. There was a 1 to 3-day prepupal period (Miller, 1953). Four individuals that reached the adult stage had pupal periods within the 8 to 13-day range noted in the earlier paper. In 1951, adults emerged over a 16-day period beginning on June 23 (Miller, 1953), and in 1952 over a 7-day period beginning June 18. When the first adults of *Perilampus fulvicornis* emerged, pitch twig moth emergence was complete, and *Agathis pini* emergence was nearly complete.

There is one hyperparasite generation annually, but most of the development of individuals takes place in less than one month. Approximately 10 months are spent in the first or planidial instar.

The species is recorded by Peck (1951) from many different hosts. It seems probable that there is a population within the species that maintains itself solely on the *Petrova comstockiana*-*Agathis pini* association.

Hyssopus thymus

The larvae are ectoparasitic and occur in aggregations of several individuals to a host. The winter is passed in the pupal stage within host burrows. In the insectary in 1953, the overwintering pupae produced adults from April 6 through 22. Adults of the next (summer) generation appeared about 6 weeks later, from May 25 through June 3. There is some evidence that at least a partial brood of adults emerged between the summer generation just mentioned and hibernation. Occasionally, adults and pupae were encountered in the field in August. The adults might have been long-lived members of the summer generation, but it seems improbable that pupae of the overwintering generation would occur this early in the season.

The number of individuals (pupae) per aggregation in 15 overwintering aggregations varied from 1 to 6 and averaged 2.5. The size of 6 summer aggregations varied from 1 to 19 pupae or mature larvae and averaged 10. Adults from two aggregations were sexed. One aggregation consisted of 7 females and 4 males, and the other consisted of 7 females and 1 male. From the time seven observed summer generation larvae expelled meconia to the time they pupated, a period of 1 to 4 days, averaging 3 days, elapsed. The pupal stage of 13 individuals of the summer generation ranged from 18 to 23 days and averaged 20 days in length. Previously, a shorter pupal period was reported for the species (Miller, 1953), but that observation was made on individuals from *Rhyacionia buoliana* (Schifferrmüller) later in the season under warmer weather conditions. Pupae were always found to be oriented with their ventral surfaces upward. Adults from *Petrova comstockiana* were noted to be larger than those from *Rhyacionia buoliana*.

Hyssopus thymus appears capable of maintaining itself solely on *Petrova comstockiana*.

LITERATURE CITED

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- Muesebeck, C. F. W. 1940. Two new reared species of *Bassus* (Hymenoptera: Braconidae). *Entom. Soc. Wash. Proc.* 42: 91-93.
- , and L. M. Walkley. 1951. Family Braconidae. In C. F. W. Muesebeck, K. V. Krombein, and H. K. Townes. *Hymenoptera of America north of Mexico.* (U. S.) Agric. Monogr. 2: 1-1420. p. 90-184.
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ERRATA

In the article by Edward E. Terrell, *Ohio Jour. Sci.* 55: 1955, line 4 page 238, should read: *Heliopsis helianthoides* (L.) Sweet var. *helianthoides*. Ox-eye. Common along roadsides and in bottomlands; often with *Helianthus tuberosus*, (for in bottomlands; often with *Helianthus tuberosus*).