THE HOST RELATIONSHIP OF A MILTOGRAMMID FLY SENOTAINIA TRILINEATA (VDW).

S. S. RISTICH[1]

Department of Zoology and Entomology, The Ohio State University, Columbus 10

The fossorial hymenoptera and their predator-parasite complex have fascinated entomologists since the days of Fabre. The paucity of data, however, in America, about the habits of the sarcophagid flies of the tribe miltogrammini, leaves many gaps in the understanding of their behavior patterns.

Fabre (1917) published a detailed and interesting acount of the habits of a miltogrammid, although inaccuracies are apparent. Smith (1923) watched *S. trilineata* and another species of Senotainia dart into the hole after a species of *Bicyrtes* as it brought in its prey. Evans (1953) published a note on the host of *S. trilineata* and of *S. littoralis* Allen. Krombein (1953) included a few notes on the habits of *littoralis.* Allen (1926) compiled the most complete observations in America, of the habits of *S. trilineata, S. vigilans* Allen, *Phrosinella fulvicornis* (Coq.) and *Metopia leucocephala* (Rossi). Other authors have published papers on the habits of other species in this tribe. Newcomer (1930) wrote a short but accurate report on *Hilarella hilarella* (Zett.) and LaRivers (1944) described the habits of *Eumacronychia elita* Town. and its relationship to the Mormon cricket.

Although *trilineata* is the best known species in this tribe, its elusive habits have discouraged many entomologists. Detailed life history studies have not been published and information is scarce, incomplete and inaccurate on the host relationship of these flies.

In the New World, Allen (1926) has published the best paper on the habits of *trilineata,* also. He surmised that this pesky fly is stimulated to larviposit only in the presence of a wasp bringing in prey. Allen has said,[2] "The habit of shadowing the host as it carries its prey to its nest seems to be more highly developed in this genus than in any other group. Except for *Pachyopthalmus, Senotainia* is the only genus in which the facets in the front part of the eye, of the female, are very large as compared with the facets of the male." Fabre said of some miltogrammid, "It is an absolute rule that the Gnat never enters the burrow."

Allen says that J. B. Parker captured *S. vigilans* emerging from a hole dug by *Bembix spinolae* Lep. Allen, however, implies that *vigilans* is also stimulated to larviposit in a situation where the wasp is transporting its prey. Although *vigilans* is not as abundant as *trilineata,* in Maine, I have yet to see *vigilans* crawling into the burrows unless it was pursuing a wasp.

In my studies of the predator-parasite complex of *Chlorion ichneumoneum* (L.) in Ithaca, I frequently observed *Metopia campestris* Fall. and *M. leucocephala* crawl into the burrows but never *trilineata.* Many observations were made, however, of *trilineata* chasing a wasp carrying a long-horned grasshopper. In these situations the wasp was always carrying its prey. Frequently one wasp was pursued by as many as four flies. These persistent flies chased the great-golden digger wasp back and forth—as many as fifteen times. When a fatigued wasp dropped to the ground, the flies stopped their stalking. When the wasp moved the flies resumed their hovering positions. Commonly the harassing miltogrammids darted near the hole after the wasp but retreated immediately, after the wasp deposited the tettigoniid at the entrance. Likewise the flies withdrew if a distraught wasp abandoned the long-horned grasshopper.

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[1]Present address. Olin Mathieson Chemical Corporation, Port Jefferson, L. I., N. Y.
[2]Page 20.

At that time I did not have the vision to examine the prey for maggots which undoubtedly the flies deposited on the grasshopper being transported by the wasp. In the summer of 1953, while study the digging hymenoptera in the so-called "Deserts of Maine", (Freeport and Leeds), figure 1, I began examining the prey caught by *Philanthus solivagus* Say, *Aphilanthops frigidus* (Sm.) and *Microbembex monodonta* (Say). The kind of prey are listed in table 1 but only the winged ants which *Microbembex* carried were inspected.

Most of the winged ants carried by *Aphilanthops* had one or more maggots on some parts of its anatomy. Some ants had as many as nine maggots distributed over their appendages either singly or in groups. Many of the bees captured by *Philanthus*, however, were either free of maggots or had only several.

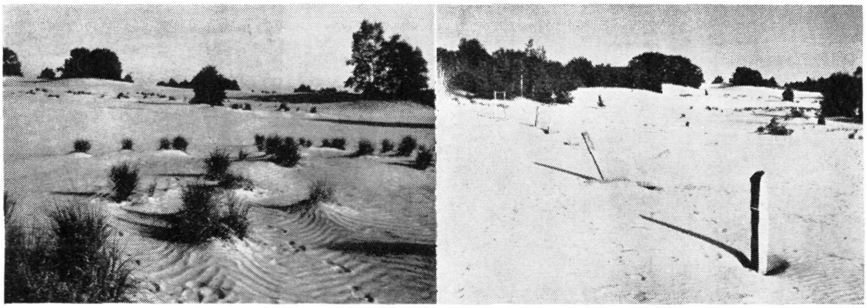

FIGURE 1. Desert of Maine, Freeport, Maine. (Courtesy of Mike Roberts Color Production)

TABLE 1

List of prey captured by digging hymenoptera at the "Deserts of Maine". (Freeport and Leeds)—1953

Aphilanthops frigidus	Philanthus solivagus	*Microbembex monodonta*
Formica fusca var. *subsericea* Say (all winged)	*Halictus ligatus* Say	*Halictus pectoralis* (alive)
	H. pectoralis Sm.	*Formica fusca* (alive)
	H. rubicundus (Christ.)	Other ants (dead and alive)
	Ectemnius sp.	Chrysomelid larva (dead)
	Andrena sp.	*Heliria* (Membracid) (dead)
	Eumenes sp.	*Brachyrhinus ovatus* (L.) (dead)
		Psylla sp. (alive)
		Vespula parts of
		Coccinella transversaquattata Fald. (dead and alive)
		Histerid, part of a

That the maggots were more common on the ants than on the bees can be attributed to the habits of the wasps. *Aphilanthops* carries its prey loosely, thus it provides a visible target for the swift, harassing flies, whereas *Philanthus* carries the bees tightly against its venter.

Bees and ants were intercepted from the homing wasps and examined. About fifty maggots were collected on the hosts. These "parasitized" prey were placed in shallow jelly glasses and covered with moist sand from the area. A perforated lid was placed on each glass. The glasses were stored at 80° F. ± 2, one week later. Water was added at least once weekly to keep the soil moist.

Table 2 shows that the larval period lasted 7 to 10 days. Approximately ⅓ of the puparia were small. The food supply may have controlled the size of the larvae and the length of the larval period. One glass container with seventeen maggots contained most of the small puparia.

The amazing situation, however, was the erratic and prolonged pupation period. Most of the maggots pupated within several days of each other, yet the adults emerged over a four month period. Three of the flies may have emerged six months after the maggots pupated. Schmeider (1933) showed that in *Melittobia*, a gregarious Eulophid parasite, the larval nutrition determined the incidence

TABLE 2

Biological notes on the Miltogrammid fly Senotainia trilineata and its host relationship—Freeport and Leeds, Maine—1953

Date Larvae Collected, Number, Larval Period	Date of Adult Emergence at 80 F	Sex	Time Emerged	Wasp Which Collected prey	Prey Upon Which Larvae Found	Location and Number of Larvae on Host
8-15-53 (17)*	(1) 11-23-53	male	early morn	*Aphilanthops*	(2) *Formica fusca*	(a) (2) tip of abdo-
	(1) 11-30-53	female	" "	*frigida* (sm.)	var. *subsericea*	men, (3) left side
7 to 9 days counting	(1) 1-29-54	male	4 PM		(winged only)	of abdomen, (4)
the prepupal period	(1) 2-21-54	female	night			neck ventral
	(1) 2-23-54 **	male	5 PM			(b) (4) on mentum, (1) mandibles
	(1) 3-17-54	female	night			(c) (2) abdomen dorsal
	(1) 3-24-54	male	———			
	(1) 3-31-54***	female	8 AM			(d) (1) middle femur
	(1) 6-14-54	male (70% Emergence)	———			(e) (2) right side of abdomen
						(f) Two without larvae
8-12-53 (13)*	(1) 11-10-53	male	———	*Aphilanthops*	(1) *Formica fusca*	
	(1) 11-14-53	female	morn	*frigida* (Sm.)	var. *subsericea*	
9 to 11 days counting	(1) 11-30-53	male	night		(winged only)	
the prepupal period	(1) 1-21-54	female	night			
	(1) 1-27-54	male	"			
	(1) 2-16-54	male	"			
	(1) 3- 5-54**	female	"			
	(1) 3-16-54	male	5 PM			
	(1) 3-31-54***	male	night			
	(2) 6-14-54	female, male (100% Emergence)	———			
8-14-53 (4)	(1) 12- 1-53	female	8 PM	*Philanthus*	(2) *Halictus* Sp.	(a) (2) on middle femur
	(1) 1-25-54	male	night	*solivagus* Say	*Andrena* Sp.	
10 days, counting	(1) 1-28-54	female	4 PM			(b) (2) abdomen dorsal
the prepupal period	(1) 3-17-54	female (100% Emergence)	5 PM			(c) many without larvae
8-12-53 (5)	(1) 11-24-53	female	———	*Microbembex*	(2) *F. fusca*	
	(1) 1- 9-54	male	morn	*monodonta*	var. *subsericea*	
	(1) 1-26-54	female	———			
	(1) 2- 6-54	male	5 PM			
	(1) 3- 6-54	male (100% Emergence)	———			

1. Freeport
2. Leeds

* Preserved Several
** Test temporarily abandoned, soil dry
*** Test abandoned 3-31-54, soil dry

of diapause. Simmonds (1948) demonstrated that the age of the adult and temperature, at least in *Spalargia drosophilae* Ash., a hymenopterous parasite, controlled the number of pupae that diapaused. These, of course, are examples from another order. The first flies emerged in November, about three months after the maggots were collected. The next series did not appear until January—

a lapse of 6 to 8 weeks! In three of the glasses, the third series did not appear for 3 to 6 weeks. The last series, under controlled conditions, emerged in March, 3 to 4 weeks later. After March 5, the sand was not moistened, nevertheless five flies survived and came through two and three weeks hence. On March 31, the experiment was discontinued but the contents of the glasses were not sifted. Three more adults were found on the sand on June 14.

Eight-three percent of the maggots metamorphosed into adults, and all of these flies were *S. trilineata*!

From this small, random sample we could surmise that only *trilineata*, in this area, larviposits on the prey while the prey is being carried by a fossorial hymenopteron. This sample of prey and maggots may not be representative, therefore a more exhaustive survey should be made in areas where *S. vigilans* is more abundant and *S. littoralis* is present.

Phrosinella fulvicornis[3] was the most common sarcophagid in these "sand deserts" but it is a "hole searcher" like *Opsidia gonioides* (Coq.), therefore the larviposition response could be initiated in situations other than a wasp bringing in its prey. *Metopia campestris* and *M. leucocephala* are "hole crawlers", so here again larviposition on the prey in flight would be an exception to the pattern.

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LITERATURE CITED

Allen, H. W. 1926. North American species of two-winged flies belonging to the tribe Miltogrammini. Proc. U. S. Nat. Mus. 68: (Art. 9) 1–106.

Curran, C. H. 1923. A few notes on *Senotainia trilineata*. Can. Ent. 55: 174.

Evans, H. et al. 1953. A biological study of *Anoplius apiculatus autumnalis* (Banks) and its parasite *Evagetes mohave* (Banks). Jour. New York Ent. Soc. 61: 71.

Fabre, J. H. 1920. A parasite of the Bembex. p. 316. In—The Hunting Wasps. Dodd, Mead & Co., New York.

Krombein, K. V. 1952. Biological and taxonomic observations on the wasps of a Costal Area of North Carolina. Wasmann Jour. Biol. 10:(3) 257–341.

LaRivers, I. 1944. A summary of the Mormon cricket (*Anabrus simplex*) Ent. News. 55:(3) 71, (4) 97–102.

Newcomer, E. J. 1930. Notes on the habits of (Podalonia and its Parasites, Hilarella and Taxigramma). Ann. Ent. Soc. Amer. 23: 552–63.

Ristich, S. S. 1953. A study of the prey, enemies and habits of the great-golden digger wasp, *Chlorion ichneumoneum* (L.) Can. Ent. 85(10) 374–86.

Schmeider, R. G. 1933. The polymorphic forms of *Melittobia chalybii Ash.* and the determining factors involved in their production. (Hymen., Chal. Eulophidae). Biol. Bul. Woods Hole. 65: 338–354.

Simmonds, F. J. 1948. The influence of maternal physiology on the incidence of diapause. Phil. Trans. Roy. Soc. London 233: 385–414.

Smith, M. R. 1923. The life history and habits of *Bicyrtes quadrafasciatus* Say. Ann. Ent. Soc. Amer. 16: 238–246.

[3] I have several records of *P. fulvicornis* hovering over *Bembix spinolae* and harassing the wasp.