To Wayne Swank
with thanks —

Egg Parasite of the Elm Spanworm[1] Is Not *Telenomus alsophilae*[2]

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ABSTRACT

When *Telenomus alsophilae* Viereck was reported as attacking eggs of the fall cankerworm, *Alsophila pometaria* (Harris), and the elm spanworm, *Ennomos subsignarius* (Hübner), differences in parasite ovipositional behavior on the eggs of the 2 hosts were observed. These observations, field and laboratory tests, and re-examination of specimens submitted for specific determination indicate that *T. alsophilae* attacks eggs of the fall cankerworm and *T.* n. sp. parasitizes eggs of the elm spanworm.

At its population peak in 1960, the elm spanworm, *Ennomos subsignarius* (Hübner), defoliated trees on 1.6 million acres of forest land in the southern Appalachians. The collapse of this decade-long outbreak in 1964 was due, in large measure, to an egg parasite identified as *Telenomus alsophilae* Viereck (Ciesla 1963, 1964, Drooz 1964). Ciesla (1963) remarked that this parasite attacked the spanworm eggs in April and May, just prior to normal hatch. Drooz (1964) compared the time of parasitization by *T. alsophilae* of the 2 suspected hosts, the elm spanworm and another geometrid, the fall cankerworm, *Alsophila pometaria* (Harris), at the same time and location near Franklin, NC. Using serial collections he reported that the fall cankerworm was attacked as early as December, but the elm spanworm was not parasitized until April (Drooz 1964). Based upon 2 parasite emergence holes he observed, he incorrectly stated that *T. alsophilae* emerged from the fall cankerworm in April, and attacked the spanworm eggs. However, he questioned the apparent anomaly of time of attack on the spanworm eggs relative to the time of attack on eggs of the fall cankerworm. Were 2 species of *Telenomus* involved?

Methods

To resolve this question the parasite was baited, first to no avail, with unparasitized eggs of the elm spanworm, and more recently with eggs from both the spanworm and cankerworm. These recent field-baiting experiments, along with laboratory tests for corroboration, are reported here. During 1973–74 and 1974–75, elm spanworm eggs were exposed in the woods from October or November to the 3rd week of April, and fall cankerworm eggs were exposed from January or February to the 3rd week of April. The initial exposures were made in fall cankerworm infestations at the Coweeta Hydrologic Laboratory near Franklin, NC, and on Bull Run Mountain near Haymarket, VA. In 1975, eggs of both hosts were exposed in a burgeoning outbreak of the elm spanworm which also contained a high population of fall cankerworms in Clearfield Co., PA.

Additionally, 5 parasite-free egg masses of the spanworm and 5 of the cankerworm were exposed together in a clear plastic arena ($3.5 \times 9 \times 13$ cm) to 100 mated ♀ *T. alsophilae* from the cankerworm. Records were kept at hourly intervals for 3 h of the 1st day on the number of parasites on each egg mass, and later on the number of parasites emerging from the egg masses.

Results and Discussion

Cankerworm Sites

Annual exposures of 12–18 elm spanworm egg masses between 1965–73, in fall cankerworm outbreak sites in North Carolina and Virginia, yielded no egg parasites. Over the winter and early spring of 1973–74, 5 of the 9 fall cankerworm egg masses exposed at Coweeta produced the egg parasite, *T. alsophilae*. Parasitism was very low, amounting to 2.5%, and 61% of the eggs hatched normally (Table 1). At the same time, field-collected eggs showed parasitism of 27%.[5] At Bull Run Mountain, in Virginia, 7 out of 12 exposed fall cankerworm egg masses contained parasites and parasitism amounted to 6.3% and 67% of the eggs hatched normally (Table 1); background parasitism was 49%. No parasites issued from the 13 elm spanworm egg masses exposed at Coweeta, nor from the 10 elm spanworm egg masses at Bull Run Mountain. Hatch of the elm spanworm eggs was 86 and 87% from these sites, respectively. Field exposure of spanworm and cankerworm eggs in 1974–75, at Coweeta and Bull Run Mountain, resulted in no parasitism of the spanworm eggs, and *T. alsophilae* issued from one cankerworm mass out of 6 or less than 1% of the total eggs, at Bull Run Mountain (Table 1). Background percent parasitism was 7%[6] at Coweeta and 48% at Bull Run Mountain.

Mixed Sites

The picture was somewhat different for the egg exposure tests in a mixed spanworm/cankerworm outbreak in Clearfield Co., PA. Here 2 out of 5 spanworm masses collected in the outbreak in February, and exposed with 4 cankerworm masses, be-

[1] Hymenoptera: Scelionidae.

[2] Lepidoptera: Geometridae. Received for publication Feb. 12, 1976.

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[5] Memorandum of May 20, 1975, of John Flavell, USDA For. Serv. to Director, USDA For. Serv., Southeastern Forest Exp. Stn., Asheville.

[6] Ibid.

Table 1.—Parasitism of elm spanworm and fall cankerworm eggs resulting from exposure in the field at Coweeta, NC, Bull Run Mountain, VA, and Clearfield Co., PA.[a]

Year	Location	Host species	Egg masses: Number	Egg masses: Parasitized	Total eggs	Eggs (number): Hatched	Eggs (number): Unhatched	Eggs (number): Parasitized
1973/74	Coweeta	Elm spanworm (L)[b]	13	0	998	798	200	0
	Coweeta	Fall cankerworm	9	5	765	535	219	11
	Bull Run Mtn.	Elm spanworm (L)	10	0	963	835	128	0
	Bull Run Mtn.	Fall cankerworm	12	7	1549	1111	381	57
1974/75	Coweeta	Elm spanworm (L)	15	0	1391	1107	284	0
	Coweeta	Elm spanworm (P)[c]	5	0	266	233	36	0
	Coweeta	Fall cankerworm	5	0	511	459	52	0
	Bull Run Mtn.	Elm spanworm (L)	13	0	1234	828	406	0
	Bull Run Mtn.	Elm spanworm (P)	4	0	263	233	30	0
	Bull Run Mtn.	Fall cankerworm	6	1	842	725	117	2
	Clearfield Co.	Elm spanworm (L)	7	0	507	190	317	0
	Clearfield Co.	Elm spanworm (P)	5	2	624	463	198	2
	Clearfield Co.	Fall cankerworm	4	2	300	245	55	49

[a] Fall cankerworm populations high at Coweeta and Bull Run Mountain. Elm spanworm populations high and fall cankerworm populations noticeable in Clearfield Co.
[b] (L) = Laboratory produced eggs.
[c] (P) = Natural eggs from Clearfield Co., PA.

came parasitized by what was considered *Telenomus alsophilae* in April, amounting to less than 1% of the total number of eggs exposed. We have no estimates of background parasitism in Clearfield Co. *T. alsophilae* emerged from 2 of the cankerworm masses, or 16% of the exposed eggs. None of the 7 laboratory-reared spanworm egg masses yielded parasites. Whether there is anything significant in this fact remains to be seen, and further investigation is warranted to learn if eggs from laboratory-reared spanworms are attractive and useful to *Telenomus* n. sp. for reproduction.

Laboratory Tests

In a free-choice arena *T. alsophilae* did not parasitize the elm spanworm (Table 2). Observations made at hourly intervals for 3 h revealed no parasites on the spanworm eggs in contrast to the parasite's presence on the cankerworm eggs (Table 2). In addition, there was no parasite emergence from the spanworm eggs, but an avg. 40 (range 14–78) *T. alsophilae* emerged from the fall cankerworm egg masses. In a separate instance, 2 of us (G. F. Fedde and A. T. Drooz) confirmed attack by *T. alsophilae* in a laboratory-reared egg mass of the elm spanworm. However, there was no parasite emergence, and subsequent dissection of host eggs revealed no evidence of parasite development. In unpublished laboratory studies Fedde has shown that *T. alsophilae* can utilize 10 species of geometrids and 2 species of noctuids for host material, so it could be considered unusual that this parasite did not develop in the spanworm eggs.

Table 2.—Laboratory test of host selection in a free choice arena for the egg parasite, *Telenomus alsophilae*, vs. the elm spanworm and fall cankerworm.

Time (hr)	Egg mass number 1	2	3	4	5
	Number *T. alsophilae* on host eggs				
Elm Spanworm					
1120	0	0	0	0	0
1220	0	0	0	0	0
1320	0	0	0	0	0
Fall Cankerworm					
1120	3	2	7	2	5
1220	0	3	4	2	3
1320	0	3	2	0	0

The results of these field and laboratory studies support the conclusion that the parasite which emerged from elm spanworm eggs is a distinct species, and not *T. alsophilae*. Reexamination of specimens from the 2 geometrid hosts has led P. M. Marsh and C. F. W. Muesebeck to conclude the separate specific status of the *Telenomus* from the elm spanworm.[7] Therefore, there are morphological as well as biological differences between these egg parasites from the 2 host species.

Recent unpublished studies have cast considerable light on the biology and ecology of *T. alsophilae* on the fall cankerworm. Since the egg parasite of the elm spanworm is a new species, separate research will be needed to define its host range and its biology.

The questions asked by Drooz (1964) remain: (1) Where is *Telenomus* n. sp. between July and the following April? (2) Why does *Telenomus* n. sp. not attack freshly deposited elm spanworm eggs in July?

The importance of *Telenomus* n. sp. in the control of the elm spanworm in the southern Appalachians and Connecticut is a matter of record (Ciesla 1964, Anderson and Kaya 1974). It behooves us to study this valuable egg parasite so that we can use it directly to control the elm spanworm in future outbreaks, and also understand its possible value against other forest defoliators.

[7] Correspondence from G. Gordh, USDA, ARS, Sys. Ent. Lab.

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