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## HORSE FLIES AND *Elaeophora schneideri* IN THE GILA NATIONAL FOREST, NEW MEXICO\*

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**Abstract:** During June and July, 1970 and 1971, 3697 of 15,223 horse flies (Diptera: Tabanidae) belonging to seven species were dissected and examined for larval *Elaeophora schneideri* Wehr and Dikmans, 1935, in the Gila National Forest, New Mexico. *Hybomitra laticornis* (Hine) comprised 90 percent of the six infected species. Almost 13,300 larvae were recovered with an average of 25 larvae per infected fly. Infective larvae were found in four species. Based on occurrence in collections, prevalence of infection and larval recovery, *H. laticornis* is considered to be the most important horse fly vector of this filarial parasite in southwest New Mexico. *H. tetrica rubrilata* (Philip) and *Tabanus eurycerus* Philip may be important vectors in other areas.

### INTRODUCTION

In 1968, researchers in southwest New Mexico discovered that horse flies (Diptera: Tabanidae) were intermediate hosts for *Elaeophora schneideri*.<sup>2</sup> Further work with mule deer (*Odocoileus hemionus*) and domestic sheep resulted in experimental completion of the biological cycle<sup>4</sup> of this filarial parasite which has been incriminated as the causative agent of "clear-eyed blindness" in North American elk (*Cervus canadensis*)<sup>3</sup> and moose (*Alces alces*).<sup>6</sup> Subsequent work in the Gila National Forest (Grant and Catron Counties) revealed that knowledge of horse fly involvement in transmission of the parasite was incomplete.<sup>5</sup> An intensive study of these insects was conducted in the summers of 1970 and 1971 in the Forest. A more detailed account of this study may be found in another report.<sup>1</sup>

### METHODS AND MATERIALS

Flies were collected using two aspects of horse fly behavior, the attractance of both sexes to limited areas of standing

water and the requirement of the female for blood. Collections were made with standard insect nets equipped with light-weight aerial bags as the flies approached water or a captive horse or mule. Observations of ambient temperature, relative humidity, wind speed and direction, cloud cover, precipitation, proximity to water, and habitat type were also recorded on a standard field collection form.

At the termination of each collection, the captive flies were transferred from the nets to a clear plastic bag in which an appropriate label was placed. The bags were retained in a styrofoam cooler containing ice for the return trip to the field laboratory provided by the New Mexico Game and Fish Department. From previous experience in this area, it was learned that flies must be handled in this manner in order to prevent desiccation and excessive mortality. Living flies were preferred for dissections.

The species present was identified with the aid of a key to New Mexico Tabanidae provided by Dr. L. L. Pechuman, Cornell University. The males were then

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discarded (only females require blood). Females were then dissected in physiological saline solution, using needles and forceps, with the aid of a binocular dissecting microscope and examined for the presence of larval stages of *E. schneideri*. A random sample of 25 flies from each collection was dissected. This number was chosen because of constraints placed on time and manpower to effectively survey a large area.

### RESULTS

Two hundred forty-seven individual collections from 54 sites in the Gila National Forest were made in June and July, 1970 and 1971. The following seven species were recorded: *Hybomitra laticornis* (Hine), *H. phaenops* (Osten Sacken), *H. tetrica rubrilata* (Philip), *Tabanus abditus* Philip, *T. eurycerus* Philip, *T. gilanus* Townsend and *T. punctifer* Osten Sacken. Females equalled 54 percent of the 15,233 flies collected.

Larval *E. schneideri* were found in six of the seven species collected in the Forest (Table 1). *T. punctifer* was the only uninfected species. *H. laticornis* comprised approximately 90 percent of all infected flies and had a 16 percent frequency of infection. *T. abditus* and *T. eurycerus*, each with a frequency of in-

fection over 23 percent, equalled less than 4 percent of the infected flies. *H. laticornis* was the only species found at all sites where flies were collected and was dominant in each of the four regions of the Forest.

*H. laticornis* comprised approximately 83.6 percent of the collections, *H. phaenops* 0.2 percent, *H. tetrica rubrilata* 9.3 percent, *T. abditus* 0.3 percent, *T. eurycerus* 1.6 percent, *T. gilanus* 4.8 percent and *T. punctifer* 0.2 percent. The seven species were generally dissected in similar proportions to their occurrence in the collections. In 1970, only *H. laticornis* was dissected in a lesser percentage than its appearance in total collections. The next year, *H. phaenops* and *T. gilanus* were also in that category but by 0.6 percent or less.

Infective, third stage larvae were found in four of the six infected species (Table 2). Almost 13,300 larvae were recovered from the 3697 dissected flies. An average of 31 infective larvae was found in flies containing the third stage. Approximately 91 percent of all infective larvae were recovered from *H. laticornis*. In addition, one deer fly, *Silvius (Griseosilvius) quadrivittatus* (Say), of 25 dissected, yielded a single third stage larva. In 1970 and 1971, an average of 25 larval *E. schneideri* was found per infected horse fly.

TABLE 1. Horse flies dissected and found infected with larval *E. schneideri* in the Gila National Forest, New Mexico.

Species	1970		1971		Both Years	
<i>H. laticornis</i>	327/1768 (18.5)	91.6*	154/1220 (12.6)	85.6	481/2988 (16.1)	89.6
<i>H. phaenops</i>	0/3 (0.0)	0.0	1/5 (20.0)	0.6	1/8 (12.5)	0.2
<i>H. tetrica rubrilata</i>	11/212 (5.2)	3.1	16/233 (6.9)	8.8	27/445 (6.1)	5.0
<i>T. abditus</i>	4/17 (23.5)	1.1	0		4/17 (23.5)	0.7
<i>T. eurycerus</i>	9/43 (20.9)	2.5	8/29 (27.6)	4.4	17/72 (23.6)	3.2
<i>T. gilanus</i>	6/111 (5.4)	1.7	1/50 (2.0)	0.6	7/161 (4.3)	1.3
<i>T. punctifer</i>	0/3 (0.0)	0.0	0/3 (0.0)	0.0	0/6 (0.0)	0.0
TOTAL	357/2157 (16.6)	100.0	180/1540 (11.7)	100.0	537/3697 (14.5)	100.0

\* No. inf./No. diss. (Percent infected) Percent of infected flies

The three larval stages were initially found on similar dates but in slightly different proportions each year (Table 3). It appears that about 1 week is required to go from first to second and likewise from second to third stage. Infective parasites comprised almost 70 percent of the larvae recovered.

TABLE 2. Larval *E. schneideri* recovered from horse flies in the Gila National Forest, New Mexico.

Species (Range)	No. Inf.	Larval Stage			Total ( $\bar{X}$ )*
		First ( $\bar{X}$ )*	Second ( $\bar{X}$ )*	Third ( $\bar{X}$ )*	
<i>H. laticornis</i> (1-497)					
1970	327	1147(11)	1221(17)	5739(31)	8107(25)
1971	154	832(15)	570(21)	2657(34)	4059(26)
<i>H. phaenops</i> (13)					
1970	0				
1971	1	13(13)	0	0	13(13)
<i>H. tetrica rubrilata</i> (1-108)					
1970	11	18( 9)	128(26)	59(12)	205(19)
1971	16	50(17)	4( 4)	278(23)	332(21)
<i>T. abditus</i> (2-30)					
1970	4	56(28)	17( 8)	0	73(18)
1971	0				
<i>T. eurycerus</i> (1-176)					
1970	9	4( 4)	13( 6)	332(47)	349(39)
1971	8	17( 8)	3( 2)	47(12)	67( 8)
<i>T. gilanus</i> (1-75)					
1970	6	5( 2)	11( 3)	1( 1)	17( 3)
1971	1	0	0	75(75)	75(75)
TOTAL					
1970	357	(11)	(16)	(31)	(24.5)
1971	180	(15)	(19)	(32)	(25.3)

\*( $\bar{X}$ ) is the number of larvae recovered in this stage divided by the number of flies infected with this stage.

TABLE 3. Total number of larval *E. schneideri* recovered from horse flies and dates on which earliest recoveries were made.

Larval Stage	1970			1971			Both Years	
	No.	Percent	Date	No.	Percent	Date	No.	Percent
First	1230	14.1	4 June	912	20.1	3 June	2142	16.1
Second	1390	15.9	10 June	577	12.7	10 June	1967	14.8
Third	6131	70.1		3057	67.2		9188	69.1
(first fly)			12 June			16 June		
(many/fly)			19 June			16 June		
TOTAL	8751	100.0		4546	100.0		13297	100.0

The 2-year prevalence of infection in the four collection regions of the Forest is depicted in Fig. 1. The southern region had a 24 percent and an 18 percent prevalence of infection in 1970 and 1971, respectively. In 1970, during the 4-week period beginning 19 June and continuing through 17 July, the average daily prevalence in this region was 30 percent. Third stage larvae were found in 76 percent of the infected flies. During the corresponding period of 1971, 27 percent of the flies were infected and 78 percent of the larvae were third stage.

#### DISCUSSION

To our knowledge, this is the first published report of the horse fly species known to transmit *E. schneideri*. In California, Weinman (pers. comm.) found that 30 to 40 percent of the parous *H. procyon* harbored infective larvae. He added that *T. kesseli* was less frequently infected. These two species do not occur in New Mexico (Pechuman pers. comm.).

It is important to note that the selection of the sample for dissection did not take into account whether the females

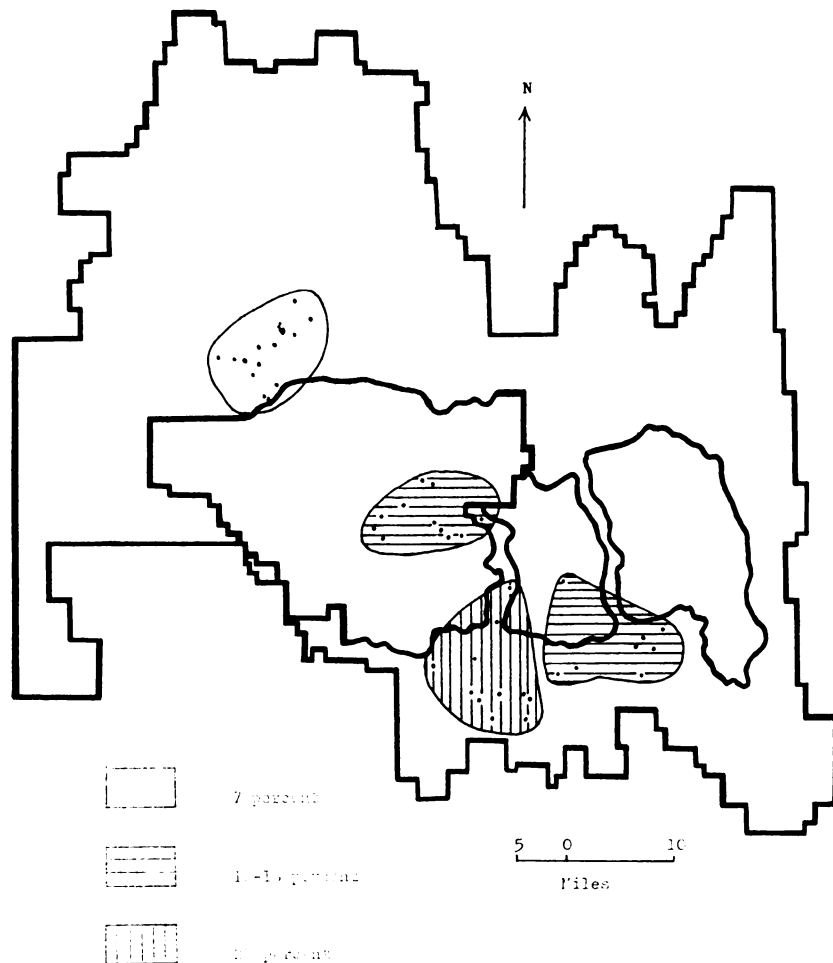


FIGURE 1. Prevalence of *E. schneideri* infection among horse flies in four regions of the Gila National Forest, New Mexico, 1970 and 1971.

had previously ingested a blood meal. The frequency of infection data reported here are regarded as samples of a natural situation, i.e. 24 percent of 85 horse flies dissected in the southern region of the Forest on 27 June 1970 were infected with larval *E. schneideri*. Obviously, the females which had not fed on blood could not contain larvae of the parasite under consideration. But, if one were to include in a sample only those flies that had previously taken blood, an unrealistic picture of the situation facing big game populations in a specific area would be presented.

Three criteria were combined to ascertain the role or relative importance of each species in the transmission of *E. schneideri*. The number of females collected was multiplied by the species' prevalence of infection. This value was then multiplied by the mean number of larvae per species to give the projected larval output. A similar analysis was also made for infective parasites. This procedure expanded the dissection results to the total collection. *H. laticornis* was projected to yield 19,388 third stage larvae and 27,712 total larvae; 30 times more than the 692 infective larvae from

*T. eurycerus* and 937 larvae from *H. tetrica rubrilata*.

Although some species have not been found to carry third stage larvae, on isolated occasions they may do so. If one of the basic criteria used to measure vector efficiency is low or absent, the significance of that vector species is greatly diminished. Both *H. tetrica rubrilata* and *T. eurycerus* appeared to have the potential of being important intermediate hosts for *E. schneideri* in areas where these species are more numerous.

The importance of a deer fly yielding *E. schneideri* larvae, although a new intermediate host record, is not regarded as significant. These insects are approximately one half the size of most horse fly species and, because of this morphological difference, their ability to liberate larvae 0.5 cm in length is postulated as being quite remote. In addition, deer flies were encountered only in limited foci and not in large numbers.

Based on our findings, *H. laticornis* was the most important horse fly vector of *E. schneideri* in the Gila National Forest. As a species, it yielded approximately 30 times as many infective larvae as any other species collected.

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