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# TEMPORAL OCCURRENCE OF THIRD-STAGE LARVAE OF *ELAEOPHORA SCHNEIDERI* IN *TABANUS LINEOLA HINELLUS* ON SOUTH ISLAND, SOUTH CAROLINA

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ABSTRACT: The occurrence of third-stage larvae of the arterial worm (*Elaeophora schneideri*) in populations of the horse fly, *Tabanus lineola hinellus*, was studied on South Island, Georgetown County, South Carolina. Over the period from mid-April to mid-October 1982, horse flies had a bimodal pattern of abundance with peak populations in June and September. During individual bimonthly horse fly collections, the prevalence of infection of *T. l. hinellus* ranged from 0 to 1.23%. Prevalence of infected horse flies was biphasic with peaks in mid-May (1.23%) and mid-August (1.22%), 2 to 4 wk prior to peaks in horse fly populations. The intensity of infection of *T. l. hinellus* increased as time progressed and was highest in late summer. This increase resulted in greater recovery of infective larvae during August–September (mean intensity = 25) than in May–June (mean intensity = 4). Both prevalence and intensity of infection of *T. l. hinellus* were low compared to primary intermediate hosts of *E. schneideri* in the western U.S.

## INTRODUCTION

Records of intermediate hosts of the arterial worm in the southeastern United States are restricted to a single report. Couvillion et al. (1984) found two species of horse flies, *Tabanus lineola hinellus* and *T. nigrovittatus*, infected with third-stage larvae of *E. schneideri*; and *T. l. hinellus* was considered the primary intermediate host.

The transmission of arterial worms is seasonal since it depends on the patterns of activity of horse flies, as well as seasonal aspects of the life history of the parasite in horse flies. Clark (1972) and Clark and Hibler (1973) provided data on the seasonal occurrence of horse flies and larval *E. schneideri* in the western United States. The objective of this paper was to describe the temporal patterns of occurrence of *E. schneideri* in *T. l. hinellus* on South Island, South Carolina.

## MATERIALS AND METHODS

The study was conducted on the Tom Yawkey Wildlife Center, an island complex comprised of South, Cat, and North islands in Georgetown County, South Carolina. It was selected as the study site because white-tailed deer (*Odocoileus virginianus*) infected with *E. schneideri* have been found on the South Island portion of the area (Hibler and Prestwood, 1981) and also because potential intermediate hosts were abundant. This study was conducted on a 48-ha hammock on the northern section of South Island. Detailed description of the area has been given by Epstein (1983).

In 1981, female *T. l. hinellus* were trapped for consecutive 3-day periods at monthly intervals from July through September. In 1982, trapping was done for consecutive 2-day periods every 2 wk from mid-April through mid-October. Six canopy traps and two malaise traps (Roberts, 1976) were placed in openings adjacent to woodlands alongside a north–south road. Traps were set and baited with dry ice at daylight. Horse flies were removed alive at midday and again when trapping was terminated at dusk. Following transport to the laboratory, live horse flies were dissected in search of third-stage larvae of *E. schneideri* (Couvillion et al., 1984) and larvae were counted.

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TABLE 1. Numbers of female *Tabanus lineola hinellus* collected, examined, and found positive for third-stage larvae of *Elaeophora schneideri* and intensity of infection.

| Date | Number of horse flies | | | Number of larvae in infected horse flies | |
|---|---|---|---|---|---|
| | Collected | Examined | Positive (%) | Average | Total |
| 1981 | | | | | |
| 6 Jul[a] | 130 | 130 | 0 (0) | 0 | 0 |
| 4Aug | 69 | 66 | 1 (1.50) | 15 | 15 |
| 8 Sep | 745 | 517 | 0 (0) | 0 | 0 |
| 29 Sep | 1,293 | 1,276 | 4 (0.31) | 24 | 95 |
| Totals/means | 2,237 | 1,989 | 5 (0.25) | 22 | 110 |
| 1982 | | | | | |
| 13 Apr[b] | 0 | 0 | 0 (0) | 0 | 0 |
| 21 Apr | 0 | 0 | 0 (0) | 0 | 0 |
| 30 Apr | 0 | 0 | 0 (0) | 0 | 0 |
| 4 May | 61 | 51 | 0 (0) | 0 | 0 |
| 13 May | 170 | 163 | 2 (1.23) | 5 | 10 |
| 22 May | 321 | 314 | 0 (0) | 0 | 0 |
| 8 Jun | 1,970 | 1,940 | 13 (0.67) | 4 | 55 |
| 22 Jun | 477 | 456 | 1 (0.22) | 1 | 1 |
| 6 Jul | 173 | 158 | 0 (0) | 0 | 0 |
| 20 Jul | 525 | 518 | 0 (0) | 0 | 0 |
| 3 Aug | 86 | 81 | 0 (0) | 0 | 0 |
| 17 Aug | 253 | 246 | 3 (1.22) | 15 | 45 |
| 31 Aug | 2,086 | 2,072 | 2 (0.10) | 3 | 6 |
| 14 Sep | 1,492 | 1,473 | 4 (0.27) | 38 | 152 |
| 28 Sep | 648 | 637 | 1 (0.16) | 51 | 51 |
| 12 Oct | 452 | 442 | 0 (0) | 0 | 0 |
| Totals/means | 8,714 | 8,551 | 26 (0.30) | 12 | 320 |
| Overall totals/means | 10,951 | 10,540 | 31 (0.29) | 14 | 430 |

[a] First day of consecutive 3-day collection period.
[b] First day of consecutive 2-day collection period except for 21 April through 22 May which were 1-day collection periods.

To confirm the presence of infected deer on the study area, 12 deer were examined at necropsy in search of *E. schneideri*. Samples of forehead skin were examined histologically for microfilariae. Representative specimens of adult *E. schneideri* and histologic sections of skin with microfilariae were deposited in the U.S. National Parasite Collection, Beltsville, Maryland (Accession Nos. 78487, adults; 78488, histologic sections).

## RESULTS

Data on *T. l. hinellus* collected and examined for third-stage larvae of *E. schneideri* are summarized in Table 1. Overall, 10,951 *T. l. hinellus* were captured, and 10,540 were dissected for third-stage larvae (Couvillion et al., 1984). Similar proportions of infected horse flies were captured at different ($P > 0.05$) traps.

During 1982, *T. l. hinellus* were present during all trapping periods over 22 wk from May through mid-October (Table 1; Fig. 1). Following the first appearance of *T. l. hinellus* on 4 May, the population increased rapidly, reaching a peak on 8 June (Fig. 1). Abundance then decreased until late August/early September, when there was another pronounced increase in numbers of horse flies captured. Horse flies were not trapped during May and June in 1981; therefore a complete assessment of temporal changes in abundance cannot be made for that year.

Overall, 0.29% of *T. l. hinellus* har-

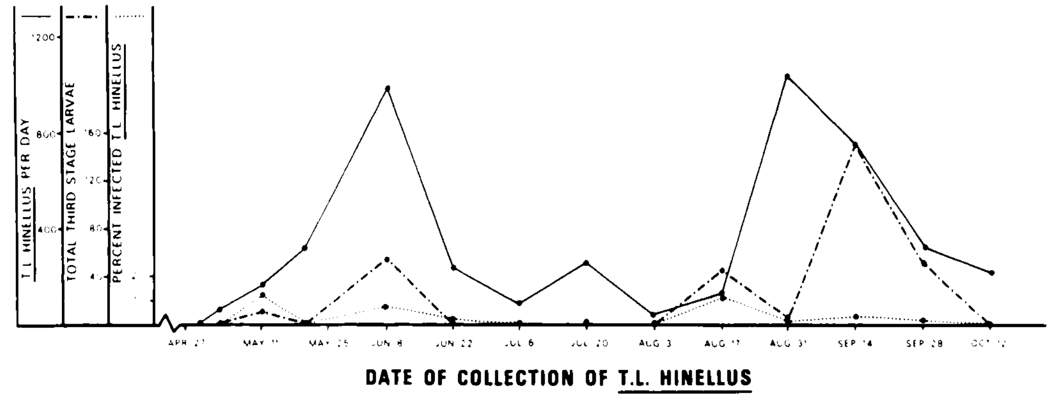


FIGURE 1. Temporal distribution of the abundance of *T. l. hinellus*, percent infected with third-stage larvae, and total number of third-stage larvae.

bored third-stage larvae (Couvillion et al., 1984). Average prevalence of infected *T. l. hinellus* was 0.25% for 1981 and 0.30% for 1982. Prevalence of infected *T. l. hinellus* varied among collection periods and ranged from 0 to 1.5% and 0 to 1.23% during 1981 and 1982, respectively (Fig. 1). Prevalence of infected *T. l. hinellus* was similar among collection periods for 1981 ($P > 0.05$, $\chi^2 = 6.028$); however, highly significant differences ($P < 0.01$, $\chi^2 = 22.69$) were noted during 1982. In 1982, prevalence of infected horse flies, like horse fly abundance, was biphasic with peaks occurring in mid-May (1.23%) and mid-August (1.22%) immediately preceding peaks in *T. l. hinellus* populations.

The mean number of third-stage larvae in infected *T. l. hinellus* was 14 for the two seasons combined, ranging from one to 47 ($\bar{x} = 22$) in 1981 and from one to 64 ($\bar{x} = 12$) in 1982 (Couvillion et al., 1984) (Table 1). During 1982 the intensity of infection of *T. l. hinellus* increased as time progressed ($r = 0.644$). A quadratic regression model fit the data more precisely ($r = 0.728$) and indicated that the intensity of infection varied non-linearly with time and increased to the highest level in late summer. This increase resulted in greater recovery of infective larvae during August–September (mean intensity = 25) than in May–June (mean intensity = 4) (Fig. 1).

Examinations for adult *E. schneideri* were done on 12 white-tailed deer over the 2-yr period. Of 10 deer collected in May and June of 1981, eight harbored adult *E. schneideri* and two were positive for microfilariae on histologic examination. In 1982, two deer were examined for adult *E. schneideri* in June and October. Microfilariae were found only in the deer examined in June; however, only a single dead adult worm was found in the carotid artery of the deer examined in October. Overall, infected deer harbored one to 31 ($\bar{x} = 6.5$) adult nematodes. The intensities of infection with adult *E. schneideri* in deer with and without microfilariae were nine to 31 ($\bar{x} = 18$) and one to three ($\bar{x} = 1.5$), respectively. Few microfilariae were seen in deer that were positive. Four deer without microfilariae harbored one nematode each.

## DISCUSSION

The production of two generations of adult *T. l. hinellus* on South Island in 1982 was similar to the situation for *T. l. hinellus* in coastal Texas (Thompson, 1973) and *T. l. lineola* in Alabama (Burnett and Hays, 1977) and South Carolina (Sheppard, 1972). This is in contrast to most temperate climate species of horse flies that produce only one generation per year (Harwood and James, 1979).

Differences among trapping periods in prevalence of infected horse flies were attributed in part to fluctuations in the ratio of blood-fed (potentially infected) to unfed horse flies. For instance, during peaks in *T. l. hinellus* populations, the ratio of blood-fed to unfed horse flies would be small because large numbers of newly emerged *T. l. hinellus* were attracted to traps while seeking their first blood meal.

Although deer were not examined to determine whether there was a seasonal change in numbers of microfilariae in forehead skin, the temporal change in the intensity of infection of horse flies raises the question of a circannual rhythm of microfilariae in deer, with highest levels in late summer. Circannual rhythms of microfilariae have been reported for *Onchocerca gutturosa*, a filarial parasite of cattle (*Bos taurus*) in which microfilariae reside in skin (Eichler, 1973).

Compared to primary intermediate hosts of the arterial worm in the western United States, the prevalence and intensity of infection of *T. l. hinellus* on South Island were low. The average prevalence of infection for *Hybomitra* spp. was as high as 19.1% in one area of New Mexico (Hibler et al., 1971). Average prevalences of *H. laticornis* and *H. aatos* with third-stage larvae in New Mexico were 8.8% and about 2.0%, respectively (Clark and Hibler, 1973; Davies, 1979). The mean intensity of infection of *T. l. hinellus* with third-stage larvae was less than half of that reported for infected horse flies in the western United States by Clark and Hibler (1973), and only about one-fourth of that of *H. aatos* (Davies, 1979). The low prevalence and intensity of infection of *T. l. hinellus* probably were due to the low prevalence and few microfilariae of patently infected deer and/or to biological and behavioral characteristics of horse flies that affect uptake and development of microfilariae.

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