

THE *HIPPELATES* EYE FLIES IN BERMUDA (DIPTERA-CHLOROPIDAE)¹

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ABSTRACT. Eye flies in the genus *Hippelates* were studied over a 2-year period on the island of Bermuda. *H. pusio* Loew, a highly pestiferous species, comprised 90% of the total population captured with putrefied egg attractant, while *H. dorsalis* Loew, another pestiferous species, comprised the remaining 10%. *H. convexus* Loew, a non-pest species, was recovered from sweepings of plants.

INTRODUCTION

Bermuda consists of several islands lying in the western Atlantic Ocean at a distance of about 600 miles from Cape Hatteras, North Carolina. The main chain of islands extends about 22 miles, has a maximum width of 2 miles and a surface area of about 13,000 acres or 20 square miles.

The fauna and flora of Bermuda have tropical to subtropical affinities. The mean annual rainfall is about 56 inches and is distributed fairly evenly throughout the year.

Agriculture on the island is a market garden venture; vegetables and fruit crops are grown in backyard plots. The main industry on the island is tourism, being heaviest during the months of April-November.

Eye flies (*Hippelates* spp.) were reported from the island more than 60 years ago. Johnson (1913) collected two species of *Hippelates* (*H. plebejus* Loew and *H. pusio* Loew) in Bermuda during the month of June and three non-pest chloropid species

belonging to the genus *Oscinis*. Ogilvie in 1928 listed five species of chloropids occurring in Bermuda. Of these, two species were in the genus *Hippelates* (*H. plebejus* and *H. pusio*) and three species in the closely related genus *Oscinis*. Residents of the island report that the eye fly problem has intensified since the early 1950's, a date which coincides with the decimation of the endemic juniper forests, (*Juniperus bermudiana* Linn.) by the juniper scale, *Carulaspis minima* (Shrank), accidentally introduced in the early 1940's. Bennett and Hughes (1959) have presented a detailed discussion of the biological control programme directed against the juniper scale. Ecological changes resulting from the loss of the juniper forests may well have favored eye fly populations, a view which is certainly held by laymen in Bermuda.

During 1963, Legner and Bay (1965a,b) and Legner (1969) made eye fly collections from Bermuda and collected *H. pusio* only. They considered this species to be highly pestiferous and equal to *H. collusor* (Townsend) of the southwestern United States in this respect.

The studies reported here were initiated in 1970 with a view towards gathering data on species composition, distribution, seasonal abundance, resting behaviour and the pestiferous nature of the *Hippelates* eye fly species in Bermuda.

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MATERIALS AND METHODS

Hippelates were collected by net sweeps from plants and animals. They were sexed and identified to species. (Dr. Curtis Sabrosky of the U.S. National Museum confirmed identifications).

To determine seasonal abundance, 20 bait traps were set in various habitats on the island, cleared twice weekly during the period June-September and once a week for the rest of the year. The trap was modified after Mulla (1964) and consisted of two 1-pint jars joined together with a 2-inch wide sheet metal ring, provided with small holes to permit entry of eye flies and to exclude large flies which were attracted. The perforated ring was welded to the metal tops of the jars. One jar served as a bait container and the other as a collection chamber. The collection chamber was provided with a screen cone to allow flies to enter the chamber but to prevent escape. The jars were provided with small chunks of dichlorvos resin strip or a deposit of this knockdown chemical in order to kill the flies.

The bait was prepared by making a 2% suspension of dry whole egg powder in water and allowing it to ferment for a few days before placing it in the traps. Once a month, the bait was completely changed. The flies in the collection jars were brought to the laboratory, counted, and identified to species.

An attractant prepared by freeze-drying putrefied whole egg suspension in water (Mulla 1973, Mulla et al. 1973) was also evaluated against the eye flies. About one gram of the attractant and a small quantity of dichlorvos (0.1%) sugar bait or 2% dichlorvos resin regrinds were placed on the top of local sand in a 1-pint cup. The attractant-toxicant mixtures were exposed to wild populations in the field. Eye flies and other insects attracted were quickly killed by the toxicant. After termination of the exposure period, the dead insects were sorted to species and counted.

RESULTS AND DISCUSSION

RESTING AND FEEDING BEHAVIOR. When undisturbed, *Hippelates* flies rest on vegetation and the ground. Here both males and females are found. Sweeping of flowering sweet fennel plants (*Foeniculum vulgare* (L.) Gaertn) and other plants yielded both males and females of two species, *H. pusio* and *H. convexus* (Table 1). In general, a majority of the eye flies resting on vegetation were males. It is possible that females rest in vegetation to a lesser degree, or that they are in flight seeking suitable animal hosts during the day.

Collections and sweepings from animals yielded females of *H. pusio* only. This indicates that this is the main pestiferous species in Bermuda. As found for other spe-

Table 1. Recovery of *Hippelates* flies by net sweeping from plants or animals in Bermuda (June 1970).

Location	Plant or host	No. collected	<i>Hippelates</i> spp. and sex			
			pusio		convexus	
			♂	♀	♂	♀
Southampton	Corn	68	48	8	7	4
	Fennel	2	2	0	0	0
Warwick	Grass-weeds	108	61	41	4	2
	Corn (next to boat)	21	2	19	0	0
	Horse	19	0	19	0	0
Paget	Human	17	0	17	0	0
	Dog	17	0	17	0	0
	Cow	19	0	19	0	0

cies of *Hippelates*, only the females are attracted to domestic animals and man.

H. dorsalis Loew, although not collected by sweeping, is also pestiferous on the island and was collected in bait traps (see below).

SEASONAL POPULATION TRENDS. The seasonal population trends in 1970 and 1971 are shown in Fig. 1. As expected, *Hippelates* activity varied from one location to the other on the island. It is of great significance that high activity did not commence until June. In both 1970 and 1971, the fly activity increased markedly from June into July, August, and September. The activity dropped in October, reaching a very low level in November. It is quite apparent that eye fly populations were higher during 1971 than in 1970. Rainfall and wind were light during the summer and fall of 1971, producing conditions conducive to higher activity of the gnats.

About 90% of the *Hippelates* collected in bait traps were *H. pusio* and 10% were *H. dorsalis*. The latter species was not reported previously from this island and it was probably misidentified as *H. plebejus* as reported by Johnson (1913) and Ogilvie (1923) as these two species are quite similar. A few *H. covexus* were also collected in the bait traps, but this species has not been observed to feed on man and domestic animals and is not considered pestiferous.

From these studies, it is apparent that eye flies (pestiferous species of *Hippelates*) pose a nuisance problem during 3-4 months of the year in Bermuda. The eye fly populations are localized, becoming a serious problem in areas where sandy soils prevail and where the breeding grounds are frequently tilled for farming and golf course management.

OCCURRENCE IN OPEN AND WOODED AREAS. Lursect, a freeze-dried fermented egg attractant (Mulla 1973, Mulla et al.

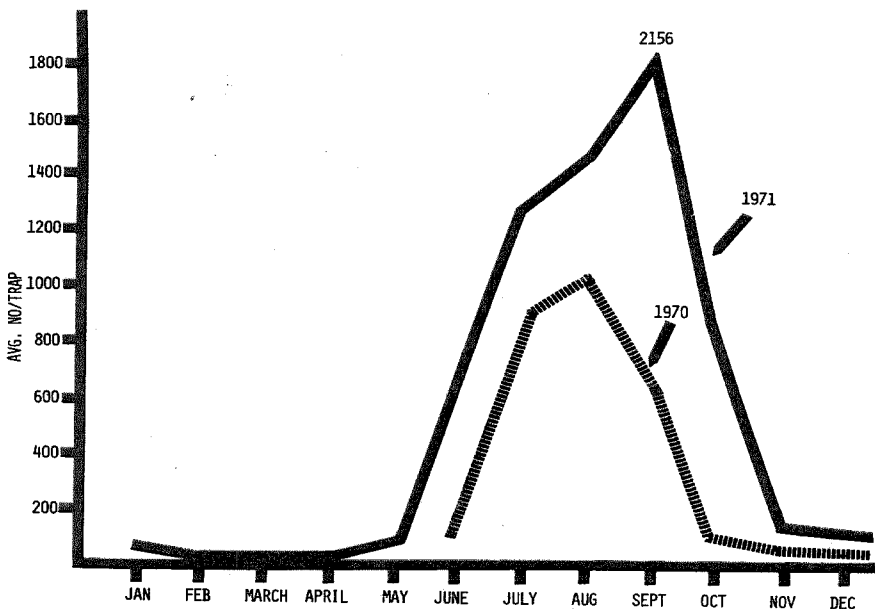


Fig. 1. Population trends of *Hippelates* flies (*H. pusio* 90%, *H. dorsalis* about 10%) on the island of Bermuda.

1973) in combination with dichlorvos (0.1%) sugar bait, was placed in cups on damp sand. The cups were placed in pairs in open terrain and in wooded areas just a few feet away from the cups in the open. The attractant-toxicant formulation was exposed for 24 hours. The average numbers of insects attracted per cup were:

	Open Wooded	
<i>H. pusio</i>	75	1
<i>Drosophila</i> sp.	10	60
<i>Millichhiella lacteipennis</i> (Leow)	17	1

From these studies, it is apparent that *H. pusio* does not fly or wander into wooded areas, even though a host or an attractant is located in the area.

ATTRACTANTS ON DRY VS DAMP SUBSTRATE. Lursect, in combination with 2% dichlorvos resin regrinds, each at one gram/cup was evaluated for attractancy on wet and dry sand. The treatments, replicated three times, were set as matched pairs on open ground and exposed to insects from 09–21 hours. There was no rain during the test period and RH ranged from 60–70%.

The average numbers of insects per cup attracted to Lursect placed on damp and dry substrates were as follows:

	Damp	Dry
<i>H. pusio</i>	20	0
<i>Musca domestica</i> L.	103	7
<i>Millichhiella lacteipennis</i>	401	0

In the test area, the *Hippelates* population was low compared to other areas on the island. It is thus apparent that a film of water is essential for the elaboration of

attractant principles contained in the attractant formulation. This fact is amply researched against both *Hippelates* and house flies (Mulla et al. 1973). Therefore, attractant formulations employed for the control of eye flies have to be placed on damp ground or substrate for maximum effectiveness.

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