

INVESTIGATIONS ON THE SENSORY BEHAVIOUR AND ECOLOGY  
OF BLACK FLIES SIMULIIDAE: DIPTERA IN THE  
WHITESHELL FOREST RESERVE, MANITOBA

A

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## ABSTRACT

This study of Simuliidae was carried out in the Whiteshell Forest Reserve and near La Salle, Manitoba in 1959 and 1960. The "helio-thermal" trap originally designed to capture Tabanidae (Thorsteinson, 1958) and improved by Bracken (1960) was further improved and used to monitor seasonal and diurnal activity of black flies and their response to motion. The diurnal activity of black flies was studied in relation to such meteorological factors as wind, light intensity, temperature, relative humidity and the time of day. It was found that flying conditions were optimal when it was calm or nearly so, cloudy with temperatures at about 70°F., and 75% relative humidities. On the average the greatest flying activity occurred between 7 and 9 in the morning.

Seasonal activity was monitored by counting the black flies captured at two locations in two traps maintained from May to September, 1960. The peak of seasonal activity occurred on May 31 near La Salle and on June 15 in the Whiteshell Forest Reserve.

The orientation to objects of various shapes and "degrees of brokenness" of contours was studied. It was found that black flies were attracted more to objects with solid contours. Black flies could recognize different shaped objects only by their differential "degree of brokenness" of contours. A stationary body suspended from underneath the trap increased the efficiency of the trap more than a moving body underneath the trap. Spheres were painted black, blue, red, yellow and green. It was found that the black, blue and red spheres attracted many more flies

than the yellow and green ones. However when wooden sticks were painted various colours and placed into the current, the flies laid more eggs on the yellow and green sticks than on any of the others.

Attempts were made to rear black flies from the egg stage in the laboratory by means of artificially circulated and aerated water.

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## CHAPTER I

### INTRODUCTION

#### Importance of Study

In five outbreaks of black flies prior to 1948 more than 1,000 head of livestock were killed in the area of the South Saskatchewan River in Central Saskatchewan. Simulium arcticum was the chief species causing the deaths. Beginning in 1948 DDT was applied to the South Saskatchewan River at a rate below the toxic level for fish. Black flies were thus controlled over a distance of 115 miles downstream (Fredeen, 1956). Species of Simuliids are particularly troublesome to man in Canada's far northern regions and Alaska. Since swarms of these insects may travel as far as 140 miles with a favourable wind (Fredeen, 1956), chemical control is very difficult indeed in these northern regions. Officials in resort areas such as the Whiteshell Forest Reserve do not apply DDT to the rivers. They fear harm would be done to the fish, not only through the direct action of the chemical, but also because the larvae seem to be an important source of food for game fish. The author has seen young lake trout (Cristivomer namaycush Walbaum) readily eating larvae. Therefore it is hoped to control the pest species of Simuliidae by means other than the use of insecticides. An increase in our knowledge of the life cycles, sensory physiology and behaviour of the noxious black fly species may lead to development of non-insecticidal control measures.

#### The Scope of the Study

The present study is concerned mainly with some aspects of behaviour

of certain Simuliid species occurring in the Whiteshell Forest Reserve in South Eastern Manitoba. Much of the information was obtained through the use of traps. The numbers of Simuliids captured in various types of traps provided information regarding the orientation behaviour of these insects as well as a picture of the seasonal abundance in the Whiteshell Forest and at La Salle, Manitoba. Only a small part of the material was identified to species.

### Organization of the Thesis

The topics and experiments in this thesis are diverse. Therefore only a short outline of the literature available on black flies and a general account of the materials and methods used are given at the beginning of the thesis. At the beginning of each chapter dealing with a particular experiment or investigation, a detailed review of the literature and a description of the pertinent materials and methods is presented, followed by the results and discussions.

### General Review of Literature

The literature on Simuliidae is largely restricted to works on taxonomy and life cycles, damage done to cattle and poultry and their annoyance to man. A few papers deal with the trapping of black flies and their responses to specific stimuli. Cameron (1918, in Davies and Peterson, 1956) describes the black flies attacking cattle. Twinn (1936) gives a very thorough account of the species occurring in Eastern Canada. Davies and Peterson (1956) investigated the habits, ecology and physiology of many species occurring in Algonquin Park, Ontario. Many papers from all parts of the world, such as Rubtzov (1939) in Russia, Smart (1945)

and Edwards (1921, in Davies and Peterson, 1956) in England, Nicholson (1950) in Minnesota, to mention only a very few, show the world wide importance of many members of this hematophagous family of flies. Two papers deal with the trapping of black flies in light traps (Williams, French and Hosni, 1955; Williams and Davies, 1957). Davies studied the landing ratio of black flies on different coloured cloth (1951) and the seasonal abundance and diurnal activity (1952). Wolfe and Peterson (1960) also made observations on the diurnal activity of Simuliids. Hocking (1960) provided a survey of literature on biting flies which includes Simuliidae.

#### Materials and Methods in General

The experiments were carried out in 1959 and 1960. In each of three locations one permanent trap was set up to monitor seasonal activity. This trap, which in its modifications was also used in other investigations, will be described in detail later. One of these was located near La Salle, Manitoba; the other two in the Whiteshell Forest Reserve in Southeast Manitoba. The same general type of trap, the silhouette of which was presumed to function as a visual dummy of a potential host, was used to obtain data on the orientation responses of Simuliidae. Silhouettes were suspended underneath the canopies of the traps. They were painted various colours and compared. The comparative efficiency of stationary and moving silhouettes underneath the traps was investigated with respect to the number of black flies captured. The perception of form by black flies was studied with shapes made from corrugated cardboard with the smooth side facing out. These were painted

black and smeared with tangle foot. Any black fly which touched the form became entangled in the sticky substance and could thus be counted. Oviposition behaviour on different coloured objects was studied by placing coloured, wooden sticks into the current of the river and weighing the eggs oviposited on them. The orientation of black flies to a filtered point source of light provided information on spectral sensitivity of black flies. A study of diurnal activity of black flies was made by collecting the trap catches every two hours for several days and keeping records of meteorological changes on these same days.

## CHAPTER II

### PRELIMINARY EXPERIMENTS AND MODIFICATIONS OF THE "HELIO-THERMAL TRAP"

#### A. Visual Factors

##### Review of Literature

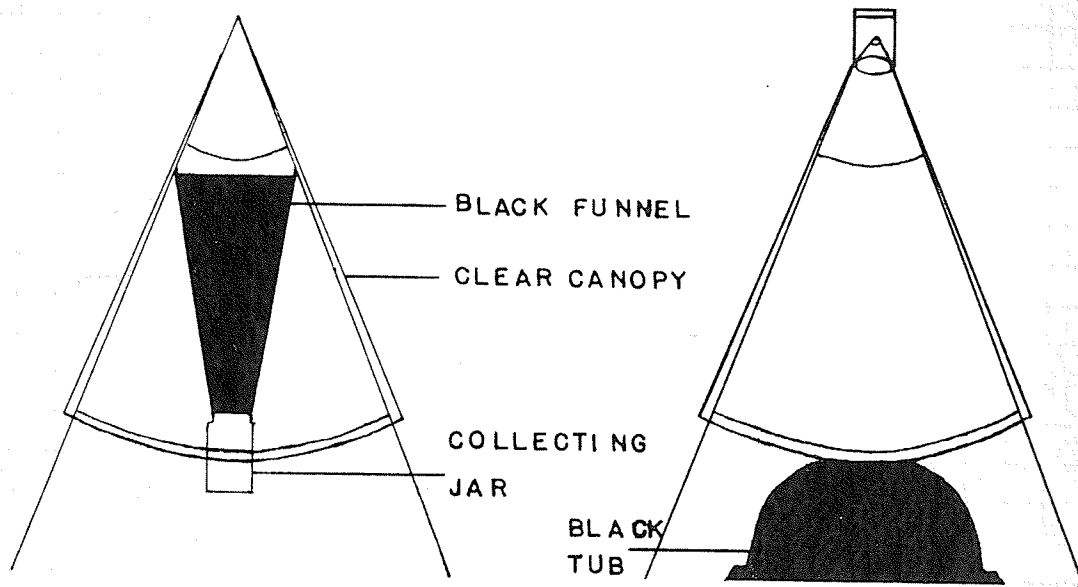
Two papers deal with the nocturnal trapping of black flies in light traps. Williams (1955) compared a 125 watt ultraviolet bulb with an ordinary 200 watt white bulb. The ultraviolet bulb proved to be more attractive. Williams and Davies (1957) report that they captured gravid and engorged female black flies in an ultraviolet trap of the Rothamsted type. Morris and Morris (1949) describe a trap used successfully to trap another group of hematophagous insects, the species of the genus Glossina. The tse-tse flies are diurnal insects and the trap design was based on such visual factors as shape, size, colour and type of material. A cylindrical shape of the trap was found to be very important. The efficiency of this trap was compared to the number of tse-tse flies that landed on and were caught by a negro boy. The fly boy was more attractive to anthropophilic species. Species previously known to prefer livestock and wild mammals were more attracted to the trap. Only one species was more attracted to moving than to stationary traps.

##### Materials and Methods

The traps used in this study were modifications of the type described by Thorsteinson (1958) (Figure 1 A). The large black funnel underneath the trap with a collecting jar screwed onto the narrow end

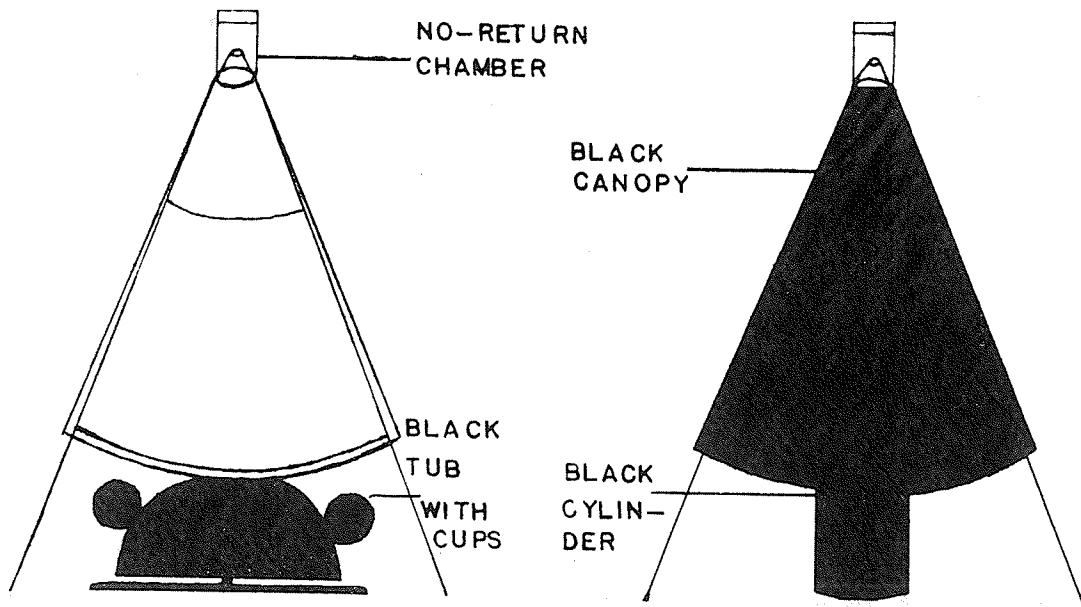
Figure 1. Modifications of the "Helio-thermal Trap"

- A. The 1957 variety with a large funnel and a collecting jar underneath a clear canopy.
- B. The 1958 variety with a black tub on the ground underneath the trap. The tub was raised to the same level as the one in C. A no-return chamber replaced the large black funnel. Clear canopy.
- C. The 1958 variety with a black tub fitted on a central shaft and a bicycle front wheel bearing. Four cones were mounted to the sides. Clear canopy.
- D. In 1959 the black tub was replaced by a black cylinder (45 x 61 cm.) suspended on a string from underneath the trap. The black cylinder could swing freely in any wind. The clear canopy was replaced by a black, opaque one.



A

B



C

D