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BEHAVIOURAL AND PHENOLOGICAL STUDIES OF WOODLAND MOSQUITOES IN THE WINNIPEG AREA

by

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ABSTRACT

A study was carried out in the woodlands of Charleswood and Fort Whyte within Winnipeg to determine whether these areas contribute to Winnipeg's pest mosquito populations. The species composition, density and seasonal abundance of larvae were monitored throughout the 1973 season. Snow-melt flooding of woodland pools was minimal in 1973 which greatly reduced the spring, univoltine species production. Heavy precipitation throughout the season reflooded some of these pools and produced broods of multivoltine Aedes.

The seasonal succession and abundance of woodland adult mosquitoes was monitored using weekly CO_2-baited traps and 10 minute biting-counts, throughout the 1972 and 1973 mosquito seasons. During 1972, spring univoltine species accounted for the major annoyance during late May and early June. During 1973, maximum trap catches were recorded in mid-July and consisted almost entirely of Aedes vexans. The occurrence of multivoltine Aedes was found to be dependent on the intensity and duration of summer rainfall. Although few A. vexans were produced in the woodland areas this species does appear to seek shelter there during the day. Thermal fogging with 5% Malathion proved unsuccessful in reducing mosquito

populations in a wooded area along the La Salle River. A. vexans was shown to display a crepuscular activity rhythm which is probably initiated by the changing light intensities at dusk and dawn. Temperature and wind were shown to limit the nocturnal activity of A. vexans.

CHAPTER I

INTRODUCTION

The Winnipeg Mosquito Abatement District was begun in 1927 with an effective larviciding program using oil, kerosene or diesel fuel. By the 1940's this oiling was carried out within a 15 mile radius of Winnipeg during June, July and August. In 1947 the program was changed to consist mainly of pre-season application of insecticidal granules and oil sprays for larval control and space fogging of parks and residential areas for adult control. From 1947 until 1969, DDT granules were broadcast at the rate of one pound per acre over the woodland areas of Winnipeg (approximately 25 - 40,000 acres). This has resulted in the accumulation of substantial residues (13 - 39 ppm DDT and derivatives) in the soils and overlying vegetation within the control areas (Brust 1971).

Since a knowledge of the behaviour and ecology of pest mosquitoes will improve the effectiveness of control measures, an adult and larval survey was conducted to determine whether woodland areas within Winnipeg are contributing to pest mosquito populations.

The objectives of this study were as follows:

1) To monitor the abundance and seasonal succession of mosquito pest species in woodland areas within the

Winnipeg district.

2) To test the response of mosquitoes to various sampling methods.

3) To determine what influence various meteorological factors have on mosquito abundance and activity.

4) To test the effectiveness of insecticidal space fogging in reducing woodland mosquito populations.

CHAPTER II

BIONOMICS OF MOSQUITOES AND SPECIES RECORDS FROM MANITOBA

Trimble (1971) lists forty-five species comprising six genera of mosquitoes as having been recorded from Manitoba. These species may be divided into two classes depending on whether or not their eggs enter into a period of dormancy (diapause). Species belonging to the genera Anopheles, Culex, Culiseta, Mansonia and Wyeomyia lay non-dormant eggs. Aedes species lay dormant eggs.

Eggs of non-dormant species are laid on the water surface and are adapted for floating. Culex, Culiseta, and Mansonia species lay rafts of eggs while Anophelini species lay their eggs singly. Permanent or semi-permanent bodies of water are usually chosen as oviposition sites allowing continuous breeding throughout the season. The eggs develop and hatch within a few days depending on the temperature.

Anopheles, Culex and Culiseta species overwinter as adults in cellars, old mines, caves, mammal burrows, rock piles and similar places. Mansonia and Wyeomyia species overwinter as larvae.

Eggs of Aedes species are laid on the moist edges of breeding places, undergo a certain amount of development, then enter dormancy until proper conditions ensue.

Egg hatching depends on fluctuations in the water levels of the breeding sites from irrigation, river flooding, rainwater or snow melt water. Because Aedes eggs are not laid directly on the water surface they are much less susceptible to desiccation than non-dormant eggs. Some eggs may remain viable for up to four years if not flooded (Gjullin et al 1950).

Aedes species may be further subdivided into univoltine or multivoltine groups. Eggs of univoltine species enter obligatory diapause upon being laid. They require several months of cold conditioning to break this diapause. Thus, eggs laid one year do not hatch until the following spring. Eggs must be exposed to cold temperatures, and this results in the development of only one generation per year. Univoltine eggs generally hatch in pools formed by snow melt in the spring. These pools are usually more permanent than rain pools in which summer multivoltine species develop. This allows for the increased development time required by univoltine species to reach maturity at the lower water temperatures of snow melt pools. A small per centage of univoltine eggs will hatch if reflooded by summer rains.

The eggs of multivoltine species experience facultative diapause. This allows continuous breeding as long as proper environmental conditions exist. During the fall, lower temperatures and decreasing photoperiod initiate diapause in these species. Several months of cold

temperatures are then required to break diapause. Multivoltine species such as Aedes vexans, do not generally hatch in snow melt pools as they require a minimum temperature of 21°C (Brust and Costello 1969). They will hatch when inundated with warmer water later in the season and are thus usually found in floodwater and rainwater pools.

Eggs of Aedes species require flooding with water low in oxygen to initiate hatching. The lowered oxygen tension of the water results from bacterial action on organic debris and ensures that the larvae will have adequate food when they hatch.

Bionomic grouping of Aedes species found during this study are listed in Table I. Brust (1968) has shown that A. cinereus, A. canadensis, A. campestris and A. spencerii will lay both diapause and non-diapause eggs and are classified as being partly multivoltine species.

Table I

Bionomic Grouping of Aedes species

found in Winnipeg Area

1972 & 1973

WHOLLY UNIVOLTINE	WHOLLY MULTIVOLTINE	PARTLY MULTIVOLTINE
A. excrucians	A. vexans	A. cinereus
A. barri	A. triseriatus	A. canadensis
A. flavescens	A. dorsalis	A. campestris
A. stimulans	A. nigromaculis	A. sticticus
A. fitchii		A. spencerii
A. riparius		
A. implicatus		
A. communis		
A. abserratus		
A. punctor		
A. trichurus		
A. intrudens		

CHAPTER III

DESCRIPTION OF STUDY AREAS

The study area was limited to three sites near Winnipeg; Charleswood - Fort Whyte area within Winnipeg, St. Adolphe (approximately 15 miles south of Winnipeg) and Sanford (approximately 20 miles south west of Winnipeg) - Figures 1, 14, 16. Most of this region is characterized by heavy lacustrine sediments which results in poor drainage and the formation of many temporary rain and snow melt pools ideal for mosquito production.

PLANT AND ANIMAL COMMUNITIES

This area has been classified as Aspen Parkland (Bird 1961) a transition zone between the great plains of central North America and the coniferous forests of the Pre-cambrian Shield. It contains two major plant communities, forest and grassland in irregularly isolated patches and more or less solid stands. Most of the prairie component of the area is now under cultivation in Manitoba.

The predominant vegetation of the forest component of the parkland is aspen poplar (Populus tremuloides Michx). In poorly drained soil it may be associated with balsam poplar (Populus balsamifera L.) Willows (Salix sp.) are found where there is an abundant water supply. The

shrub strata as listed by Bird (1961) is composed of hazelnut (Corylus Americana Walt), redosier dogwood (Cornus stolonifera Michx), hazelnut, highbush cranberry (Viburnum opulus L.), choke cherry (Prunus virginiana L.), pin cherry (Prunus pennsylvanica L.) and snowberry (Symphoricarpos occidentalis).

Flood plains along the Red, Assiniboine and other Parkland rivers are covered with forests composed principally of Manitoba Maple (Acer negundo) lance-leaved ash (Fraxinus pennsylvanica Marsh) American elm (Ulmus americana L.) and bur oak (Quercus macrocarpa Michx). This type of forest community characterizes the Sanford experimental site.

The major mammal component of these forest areas is composed of snowshoe rabbit (Lepus americanus americanus Erxleben), Virginia white-tailed deer (Odocoileus virginianus dacotensis Goldman & Kellog), beaver (Castor canadensis canadensis Kuhl), red squirrel (Tamiasciurus hudsonicus), red-backed mouse (Clethrionomys gapperi loringi (Bailey)) and skunk (Mephitis mephitis hudsonica Richardson).

CLIMATIC DATA

Winnipeg has a continental type climate with relatively large temperature variations throughout the year. The normal temperature curve is at its lowest (-1^{o}F)

during the period January 17 - 27 and its highest (70°F) from July 19 - 27. The average date of last frost in spring is May 24 and the average first frost in fall is September 18 giving an average frost free period of 116 days. The average period when Winnipeg is free from killing frost (29.5°F) is 131 days. Northwest winds predominate in January, February, March and November, north winds in April and May and south winds in all the other months. The 30 year average winter snowfall is 51.7 inches. Precipitation (30 year average) is 21.06 inches over the year, mostly falling during the summer (Annual Meteorological Summary - Winnipeg Atmospheric Environment Service)

CHAPTER IV

MOSQUITO LARVAL SURVEY 1973

(i) INTRODUCTION

Larval collections were made from woodland areas within Winnipeg during the spring and summer of 1973, for the purposes of:

1) determining what species of mosquitoes were breeding in the wooded areas around Winnipeg and whether these areas were contributing to mosquito annoyance within Winnipeg,
2) determining the seasonal succession of the mosquito species found in the Winnipeg area,
3) recording the development of larval breeding in relation to rainfall throughout the summer,
4) observing the development time to emergence required by the various species of mosquitoes

(ii) METHODS

A section of Fort Whyte and Charleswood between Pembina Highway and the Perimeter on the east and west and McGillivary and Grant Avenue to the north and south was chosen as the test area to be sampled for larvae. Much of this land remains as agricultural land and aspen woodland. Ten sites containing snow melt pools were chosen as sampling plots (Figure 1).

Sampling began with the first evidence of mosquito hatching following the spring thaw. Weekly sampling of larvae continued until the pools dried. The sites were checked for reflooding and larval activity following every major rainfall (greater than one inch) throughout the summer.

The length and width of each pool was estimated and larval samples were taken using a white enamel 850 c.c. dipper. Various numbers of samples were taken depending on the size of the pool. Water temperatures and pH readings for each pool were taken at the time of sampling.

Larval samples were put in styrofoam food containers and returned to the laboratory to be counted, reared to fourth instar and identified. The rearing techniques used are described in Section E-ii Larval Development.

Figure 1

Location of Larval and Adult Sampling Sites within the Charleswood Fort Whyte area