

ARTICLES

MOSQUITOES AND MOSQUITO CONTROL IN CANADA *

C. R. TWINN

Ottawa, Ont.

In the vast Canadian territory extending from the Atlantic to the Pacific, and from the International Boundary to the Arctic, 59 species of mosquitoes belonging to 8 genera have been recorded. These include 39 species of *Aedes*; 5 species each of *Anopheles*, *Culex* and *Culiseta*; 2 species of *Psorophora*, and 1 species each of *Mansonia*, *Wyeomyia* and *Uranotaenia*. A summary of the recorded distribution of these species by provinces and territories is given in Tables 1 and 2.

The species of *Psorophora*, *Wyeomyia* and *Uranotaenia* have no significance as pests in Canada. Species of *Culex*, *Culiseta*, *Mansonia* and *Anopheles* are locally and seasonally troublesome in various parts of the Dominion. But the really important pests are the widespread and dominant transient water breeders, the *Aedes*. The species of this genus are well adapted to thrive and multiply in our northern climate. The long rigorous winter is passed in the egg stage on the ground beneath the ice and snow in low-lying places subject to flooding in the spring. For most of the species, exposure of the eggs to winter cold appears to be a prerequisite to hatching. Melting snow, rain and river floods produce the extensive temporary bodies of water that form a favorable environment for the teeming larvae.

In general, the greatest emergence of *Aedes* mosquitoes takes place in the spring. The insects may persist for several weeks, but their numbers usually diminish as mid-summer approaches. Because spring comes earlier the peak of abundance is reached earlier in southern Canada than

farther north in the sub-arctic forest or beyond the tree line. For instance, in the Ottawa region, mosquitoes are usually most troublesome in late May and June, whereas at Churchill, on Hudson Bay, the period is late June and July.

Although certain species are suspected of being implicated in the transmission of human and equine encephalomyelitis, mosquitoes are relatively unimportant as disease carriers in Canada. There is no question, however, as to their importance as pests. A majority of the species, and especially the *Aedes*, are avid bloodsuckers and often cause great annoyance and discomfort to man and beast. To some extent their presence may locally reduce land values, interfere with farming and lumbering operations and other outdoor employment, reduce the productivity of livestock and poultry and impede recreational activities.

So far, however, mosquito control has not been practised on a large scale in Canada, and probably not more than two dozen communities carry out regular, organized control efforts annually, and the expenditures involved usually are very modest. One reason for this may be that in most settled areas, mosquitoes are rarely very troublesome for periods longer than a few weeks. In many communities where they may sometimes be very annoying for short periods in spring or summer, severe and prolonged outbreaks occur too seldom to arouse the public sufficiently to bring about the establishment of control arrangements on a properly organized and permanent basis.

For many years (1926-1941) Dr. Arthur Gibson, formerly Dominion Entomologist, gave a yearly account of mosquito suppres-

* Contribution No. 2587, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Ontario.

TABLE 2

DISTRIBUTION BY PROVINCES OF MOSQUITO SPECIES IN CANADA - GENERA OTHER THAN AEADES -																				
PROVINCE	ANOPHELES					CULEX				CULISETA		OTHER GENERA								
	freeborni Aitken	occidentalis D. & K.	punctipennis Say	quadrimaculatus Say	walkeri Theo.	apicalis Adams	pipiens L.	restuans Theo.	salinarius Coq.	tarsalis Coq.	alaskaensis Indl.	impatiens Wlk.	incidens Thom.	inornata Will.	morsitans Theo.	Psorophora ciliata Fab.	Psorophora ferox Humb.	Mansonia perturbans Wlk.	Uranotaenia sapphirina O.S.	Wyeomyia smithii Coq.
Prince Edward Island																				
Nova Scotia	▲	▲		▲		▲	▲		▲					▲				▲		▲
New Brunswick		▲	▲		▲	▲	▲	▲				▲								
Quebec		▲	▲	▲	▲	▲	▲	▲						▲		▲		▲	▲	
Ontario		▲	▲	▲	▲	▲	▲	▲				▲		▲	▲	▲	▲	▲	▲	▲
Manitoba				▲		▲	▲	▲		▲		▲		▲		▲		▲		▲
Saskatchewan		▲				▲		▲		▲	▲			▲						
Alberta										▲	▲	▲	▲	▲						
British Columbia	▲	▲	▲		▲	▲	▲			▲	▲	▲	▲	▲				▲		
Yukon		▲									▲	▲	▲							▲
Northwest Territories												▲								

sion work in Canada before the annual meetings of the New Jersey Mosquito Extermination Association, in Atlantic City. These statements were published in the Proceedings of the Association. More or less routine control work is still being continued at most of the centres referred to in Dr. Gibson's reports.

This presentation deals briefly with some of the more important mosquito problems in Canada as a whole. Those problems naturally vary greatly in different parts of the country depending on topography, vegetation, climate, prevailing species, and so on. Certain species are characteristic of particular kinds of habitats and it may be convenient, if somewhat arbitrary, to discuss them according

to such general groupings as floodwater, forest, salt marsh, prairie and arctic mosquitoes.

FLOODWATER MOSQUITOES

The flooding of low areas in spring and early summer by rivers swollen by melting snow and heavy rains is the cause of periodic outbreaks of certain species of mosquitoes. In wooded river valley bottoms the most important of these is *A. lateralis* Mgn., in British Columbia, and *A. sticticus* Mgn., in the more eastern provinces. Other species also occur in the floodwaters, but usually they represent only a small proportion of the infestation.

The Ottawa River Valley provides a

good example of an area in Eastern Canada that is periodically subjected to outbreaks of *A. sticticus* in spring and early summer. The occurrence and extent of these outbreaks is entirely dependent on the level attained by the Ottawa River at freshet time. At Ottawa, for instance, little or no flooding occurs when the river fails to rise higher than 140 feet above sea level. Between 140 and 144 feet extensive flooding of low-lying areas north of the city takes place, and from these areas enormous numbers of mosquitoes may emerge, if not controlled, and migrate distances up to four miles into Ottawa and neighboring municipalities. When the river level goes much above 144 feet, however, river and flooded areas are likely to become directly connected and, when this happens, much of the larval infestation may be swept away and destroyed.

Until 20-odd years ago these outbreaks were endured without effective action being taken. Then, following a careful study of the problem, the Division of Entomology gave leadership in a successful control demonstration carried on for the three years: 1927, 1928 and 1929. For many years now the Ottawa Federal District Commission has had the responsibility of combating the pests and has given the residents of the district a large measure of protection from these intermittent outbreaks.

In British Columbia, *A. lateralis* is the dominant pest species in flooded wooded bottom lands in river valleys such as the Fraser and Thompson. In flooded meadows and other open places *A. vexans* Mgn. usually predominates. These floods result from the rivers overflowing their banks at freshet time, and the severity of the infestation depends on the extent and duration of the floods. Mosquito conditions in the Lower Fraser Valley have been well described by Hearle (1). Control has been practiced on a modest scale for many years in a number of municipalities in the river valleys affected by these and other species of mosquitoes.

Unusually severe floods occurred in

British Columbia in the spring of 1948, causing extensive loss and damage to property. The floods also rather belatedly raised fears of the possibility of a tremendous outbreak of mosquitoes developing in the Lower Fraser Valley and adding to the general woe. The Provincial authorities thereupon engaged the services of a commercial pest control organization to combat the potential nuisance. Large areas were treated by aircraft and ground equipment, using DDT in oil solution, as an emulsion, and in dust form. The work was organized on very short notice and carried out largely by inexperienced personnel, to some extent using formulations that did not take proper advantage of the effectiveness and economy of DDT. For instance, very low concentrations would be used requiring the application of large quantities of larvicide per acre to attain a lethal dose.

Actually, there was some question as to the effectiveness of the control work, as it was started too late to destroy the bulk of the infestation before emergence. However, Mr. Colin Curtis, of the Dominion Livestock Insects Laboratory, Kamloops, B. C., who observed and reported on the operations and their results, noted that the general infestation of mosquitoes was light, a condition which may largely have been brought about by the height and extent of the flood, the current sweeping away the larvae to destruction in the river.

FOREST AND WOODLAND MOSQUITOES

Forest and scattered woodlands cover a large part of Canada south of the region where the ground is permanently frozen. A number of typical forest-loving species of *Aedes* inhabit the northern woods and have a widespread distribution. Included among these are *A. punctor* Kby., *A. communis* DeG., *A. impiger* Wlk., *A. intrudens* Dyar, *A. cinereus* Mgn., and *A. canadensis* Theo. More localized in distribution are *A. pionips* Dyar, *A. diantaeus* H.D. & K., and *A. cataphylla* Dyar. Although often a severe pest to animals and man in the forest, most of

these species rarely appear to be troublesome in open country, but may venture short distances from the shelter of woods after sunset and at other times when conditions are favorable.

Other widely distributed and important pest species that favor wooded areas, but attack freely in the open as well as in the shelter of trees are *A. stimulans* Wlk., *A. fitchii* F. & Y., *A. excrucians* Wlk., and *A. trichurus* Dyar. The larvae of these species are frequently found associated together in temporary pools in spring. *A. trichurus* is one of the earliest *Aedes* mosquitoes to appear on the wing.

The mosquitoes in the forest are of particular concern to the lumbering and mining industries and to all those who live in or have occasion to visit the woods. Where control is required in specific areas aerial spraying directed against the larvae or adults, or both, and applied after a suitable survey, is probably the most economical and effective method of combating them. Usually, the absence or scarcity of suitable roads and the nature of the terrain render difficult or impossible the satisfactory use of ground equipment, except on a very limited scale. On the other hand, the natural barrier provided by dense forest, and the usually limited flight range of the common forest species, should greatly enhance the effectiveness of area control as compared with similar treatment applied in more open country. Where control is not a practicable proposition, individuals must protect themselves by wearing suitable clothing, using repellents and providing fly-proof shelter for sleeping and relaxation.

SALT MARSH MOSQUITOES

It is doubtful that mosquitoes in this category anywhere in Canada ever attain the status as pests of the famed salt marsh mosquitoes of New Jersey. However, *A. sollicitans* Wlk., and *A. cantator* Coq., are locally troublesome in coastal regions of the Maritime Provinces, and in some seasons and in some places may become very numerous.

The towns of Amherst, N. S., and Moncton and Sackville, N. B., are greatly bothered by mosquitoes from the neighboring Tantramar marshes. These extend over more than 100 square miles and contain both brackish and fresh water areas which give rise to immense numbers of *A. cantator* and *A. vexans* when conditions are favorable. The extensive dykes that protect the area from the sea and the ditches that are supposed to drain the marshes have long suffered from neglect. Palliative measures such as applying larvicides to the breeding places near the towns are likely to give but indifferent results, because of the great extent of the infested area and the flight range of the marsh species. The problem probably can only be solved satisfactorily by a program of reclaiming the whole dykeland. This would not only deal with the mosquito pest, but would also greatly increase the agricultural value of the land.

In Pacific Coast areas the locally troublesome species breeding in tidal pools and salt marshes is *A. dorsalis* Mgn., which is an adaptable species with a wide distribution eastward across the Prairie Provinces into Eastern Canada.

PRAIRIE MOSQUITOES

On the open prairies of Manitoba, Saskatchewan and Alberta the four most common species are *A. spencerii* Theo., *A. flavescens* Müll., *A. campestris* D. & K., and *A. dorsalis*. The latter two, and *A. idahoensis* Theo., which is closely related to *A. spencerii*, are also very common in the open grasslands of the interior of British Columbia. All of them breed in temporary snow and rain pools and are abundant or scarce depending on the amount of surface water and prevailing weather conditions. In addition to the typical prairies, several of these species occur farther north in patches of grassland in the forest and on tundra-meadow near the tree line as observed at Churchill. Another species which is a widespread pest on the prairies in wet seasons is *A. vexans*. The latter is not confined to the prairies,

but occurs across Canada, favoring breeding places in the open, but not avoiding woods. All of these species appear to have migratory tendencies. Other species which are sometimes troublesome in the prairie region are *A. riparius* D. & K., *A. excrucians* and *A. fitchii*, which favor areas where poplars grow.

Control on a fairly large scale has been practised annually in the Winnipeg area for more than 20 years. The intensity and extent of the infestation that has to be combated varies from season to season depending on snowfall and spring and summer rains. A brief history of these control efforts was published by Dr. H. M. Speechly (4) in 1947.

The main pest species affecting Winnipeg are *A. spencerii* and *A. vexans*. When conditions such as a wet season favor the widespread abundance of these pests on the prairies, control in any restricted area is difficult because the insects invade the area from the surrounding countryside.

Saskatoon, Saskatchewan, is another prairie city where control is attempted from year to year. This largely takes the form of systematic oiling of the sloughs and temporary pools within a radius of three to five miles from the centre of the city. These modest efforts have been reported to give a considerable measure of relief even when heavy infestations were general outside the treated area.

Mosquito abundance on the prairies is largely regulated by the amount of snowfall and spring and summer rains, and in seasons of deficient precipitation when surface water is at a minimum there is likely to be little trouble from mosquitoes. As pointed out by Hearle (2) "plough and harrow have levelled low places and cultivation has made the soil porous," so that even in wet seasons mosquitoes are not nearly so serious a pest on the prairies as they were in early pioneer days.

ARCTIC MOSQUITOES

Generally speaking, the number of species of mosquitoes diminishes as one goes northward. For example, in the

vicinity of Ottawa, in the Ottawa Valley, 28 species belonging to 7 genera have been recorded. These include 4 species of *Anopheles*, 17 species of *Aedes*, 3 species of *Culex*, and 1 species each of *Culiseta*, *Mansonia*, *Wyeomyia* and *Uranotaenia*. In the vicinity of Churchill on Hudson Bay, about 1200 miles (as the plane flies) northwest by north of Ottawa, where swampy, sub-arctic coniferous forest gives way to treeless tundra, 12 species of only 2 genera of Culicinae have been identified, including 10 species of *Aedes* and 2 of *Culiseta*. On the arctic tundra at Baker Lake, N.W.T., about 400 miles due north of Churchill only 3 species of one genus (*Aedes*) have been found.* These are *A. nigripes* Zett., *A. nearcticus* Dyar, and a form closely resembling, if not identical with *A. punctor* Kby., a forest species of wide distribution farther south. During 1948, several small survey parties working under the direction of the Division of Entomology collected and reared biting flies and other insects at various points in the arctic, but the results from this work have not yet been fully evaluated. Studies so far indicate that *A. nigripes* and *A. nearcticus* are widespread in arctic and sub-arctic Canada, and are dominant pests on the tundra, or so-called barren lands.

Although species are few in the Far North this is often more than compensated for by their extraordinary numbers. An important factor contributing to this abundance is doubtless the permanently frozen condition of the ground beneath the surface, which results in poor drainage in spring and summer, and the formation of innumerable shallow pools which serve as mosquito breeding places. When weather conditions favor mosquito activity the insects may attack their hosts both day and night, and, in areas of heavy infestation, by their incessant attempts to obtain blood may make life difficult even for the most hardy individuals, properly dressed and equipped with head nets and repellents though they may be. An

* Coll. by Dr. T. N. Freeman, July-Aug. 1947.

interesting review of the rather horrendous accounts by various travellers and explorers of the abundance and ferocity of the mosquitoes in arctic regions is included in Natvig's (3) recently published book on the Danish and Fennoscandian mosquitoes.

These mosquitoes of the tundra are strong fliers and, like the prairie species to the south, appear to migrate freely, no doubt often aided by the wind. This matter of the flight or migration range of mosquitoes, particularly the species inhabiting treeless areas, is of great importance in relation to the planning and carrying out of control measures, but unfortunately it is a subject about which there is still little exact information.

It may be of interest to mention that a study of the biology and control of mosquitoes and other species of biting flies in the north was incepted at Churchill, Manitoba, on the western shore of Hudson Bay, in the early spring of 1947, and continued during 1948. This was a joint project of the Division of Entomology, on behalf of the Canadian Defense Re-

search Board, and the U. S. Bureau of Entomology and Plant Quarantine, on behalf of the Surgeon General, Dept. of the U. S. Army. A preliminary report of the results of the biological studies has been published by Twinn *et al.* (5) and papers on other aspects of the work are under preparation or in press.

References

1. HEARLE, E. The mosquitoes of the Lower Fraser Valley, British Columbia, and their control. N.R.C. Ottawa, Can., Rpt. No. 17, 94 pp., illus., 1926.
2. HEARLE, E. The life-history of *Aedes flavescens* Müll. Trans. Roy. Soc. Canada, 23:85-102, 1929.
3. NATVIG, LEIF R. Contributions to the knowledge of the Danish and Fennoscandian mosquitoes. Culicini. Norsk Entomologisk Forening. Suppl. I 567 pages, 148 figs., 41 tables, 12 plates, 1 map. Oslo: A. W. Broggers Boktrykkeri A/S, 1948.
4. SPEECHLY, H. M. Twenty years of mosquito control in and around Winnipeg, Canada, 1927-1946. Proc. 34th Ann. Meet. N. J. Mosq. Ext. Assoc. pp. 98-101, 1947.
5. TWINN, C. R., B. HOCKING, WM. C. McDUFFIE AND H. F. CROSS. A preliminary account of the biting flies at Churchill, Manitoba. Can. Jour. of Res. Vol. 26, Sec. D, Dec. 1948.

ADVERTISING RATES

FOR

Mosquito News

	1 issue	4 issues
Full-Page	\$40.00	\$144.00
Half-Page	\$24.00	\$86.40
Quarter-Page	\$16.00	\$57.60

Preferential Positions — \$5.00 an issue extra

1. Facing Front Cover
2. Facing First Article
3. Facing Back Cover

For Information Write

ROBERT L. VANNOTE

Advertising Manager,

3 Franklin Place, Morris Plains, N. J.