

ACKNOWLEDGMENT

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ABUNDANCE AND SEASONAL DISTRIBUTION OF TABANIDAE IN A TEMPERATE AND IN A SUBARCTIC LOCALITY OF QUÉBEC

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ABSTRACT. The seasonal distribution of adult Tabanidae was studied in 2 Québec localities for 2 years: Trois-Rivières, located in the temperate zone (46°20'N) and the Lake Delorme area, in the high-subarctic (55°00'N). Of the 43 species collected in southern Québec, *Chrysops aestuans* was the dominant species, followed by *Hybomitra pechumani*, *H. lasiophthalma*, *C. frigidus* and *H. zonalis*. The flight period began in mid-May with the greatest abundance from mid-June to mid-July. Five phenological groups were distinguished by first appearance of the species and their respective abundance peaks. In the Lake Delorme area, 20 species were identified of which 12 were also present in the southernmost area. *Hybomitra arpadii* was the dominant species followed by *C. furcatus*, *C. excitans* and *H. zonalis*. The flight period began on July 8 with the most activity during the third week of July.

During 1977 and 1978, an adult survey was conducted in 2 localities of Québec Province, one located in the temperate zone, at Trois-Rivières (46°20'N), the other in the high-subarctic life zone (Ducruc et al. 1976), in the Lake Delorme area (55°00'N) along the Caniapiscau River. The objective of the study was to compare the phenology of Tabanidae in 2 climatically different areas, and to emphasize the activity patterns of adult Tabanidae.

MATERIAL AND METHODS

Trois-Rivières is located in the temperate life zone occupied by the deciduous forest forma-

tion of eastern North America, characterizing the Great-Lakes-St-Lawrence bioclimatic zone (Munroe 1956). More precisely, this is the climax hardwood forest dominated by *Acer saccharum* (Grandtner 1966), covering the southern part of Québec from approximately the 45th to 47th parallel. According to Treidl (1978), the mean annual temperature is 4.9°C (1941-70).

Lake Delorme area is included in the subarctic zone dominated by black spruce forests (Ducruc et al. 1976). The mean annual temperature is about -3°C (Richard 1978). Ecologists distinguish 3 subzones based on vegetation. The studied area is at the northern limit of the

northernmost subzone or high-subarctic (Ducruc et al. 1976). Air temperature data were provided by the Meteorological Service of the Natural Resources Ministry.

Three Malaise traps were used at Trois-Rivières during 1978; they were located in 2 bogs and visited twice a week from April 25 to September 10. During 1977, preliminary adult collections were made with insect nets.

Four Malaise traps were used during 1977 in the Lake Delorme area. All were located in string-bogs. Specimens were collected from July 8 to August 2. One trap was also used during 1978 and collections made from July 24 to August 12.

Most of the specimens collected from the north were preserved "en masse" in "whirl-packs" with ethanol (70%) due to logistic problems. As specimens became blackish with this technique, it was sometimes necessary to submerge them in an acetic acid solution for several hours before identification. Specimens from the south were frozen and pinned in pill boxes.

All specimens were identified by using a combination of the 2 keys included in "The Tabanidae (Diptera) of Ontario" (Pechuman et al. 1961) and "The horse flies and deer flies of New York (Diptera, Tabanidae)" (Pechuman 1981). Voucher specimens are preserved in the collection of the Research Group on Biting Flies of the Université du Québec à Trois-Rivières. Identifications of doubtful specimens were verified by H. J. Teskey and also by L. L. Pechuman.

Generic abbreviations used were: *C.* = *Chrysops*; *H.* = *Hybomitra*; *T.* = *Tabanus* and *A.* = *Alysiotus*.

RESULTS AND DISCUSSION

TROIS-RIVIÈRES AREA. From the 1977 and particularly the 1978 survey, 45 species were identified from approximately 3000 adult specimens (Table 1). Sixteen species had a relative frequency of more than 1% during the 1978 season, the season of greater abundance for adult collecting (Fig. 1). *Chrysops aestuans* was the dominant species (34.3%), followed by *H. pechumani* (11.9%), *H. lasiophthalma* (10.7%), *C. frigidus* (6.8%) and *H. zonalis* (4.7%); these being the major collected species.

Figure 2 shows the total number of specimens of all species collected during the 1978 season and the daily maximum temperatures registered at Trois-Rivières. The greatest flight period for the Tabanidae in this bioclimatic zone is approximately from June 15 to July 20, with a maximum abundance during the first 2 weeks

of July. During our study, the principal flight period for the Tabanidae was 5 weeks, preceded by a first group corresponding to the earliest emerging species (second part of May) and followed by a second group of the latest emerging species (from the third week of July until September). All the collections correspond to an average maximum air temperature above 20°C. The first appearances, from May 27 to May 29, correspond to daily maximum temperatures above 30°C; during the flight period, the peak collections correspond to simultaneous maximum temperature peaks between 25 and 30°C (June 6–9, 15–16, 25–29). The year 1977 had a warmer spring period than 1978, namely one week sooner. This was reflected in the dates of the earliest appearance of Tabanidae (Table 1).

A detailed analysis of the seasonal succession of the species (Table 1 and Fig. 3) indicates there are 5 phenological groups of species, according to their first appearance. The earliest species is undoubtedly *H. nuda*, first collected a few days before *C. mitis*, *C. ater*, *C. cuculx*, *C. carbonarius*, *C. calvus* and *C. sordidus*. A second group includes species collected at the end of May and the beginning of June: *H. affinis*, *H. lasiophthalma*, *H. illota*, *C. niger*, *C. zinzalus*, *C. indus*, *C. excitans*, *C. frigidus* and *C. sackeni*. A third group is composed of species occurring during the greatest flight period, from mid-June to mid-July: *C. lateralis*, *H. zonalis*, *H. trepida*, *H. epistates*, *C. montanus*, *C. vittatus*, *T. similis* and *C. nigripes*. The fourth group corresponds to the July appearing species also in

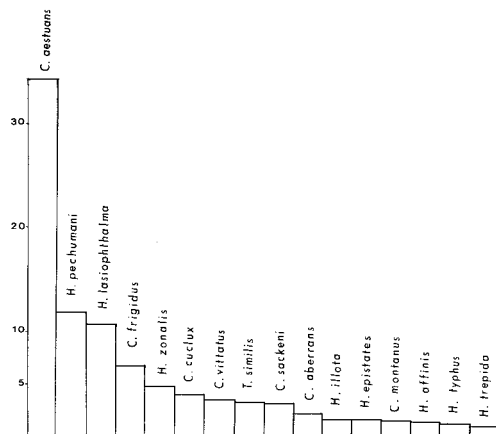


Fig. 1. Relative abundance of adult tabanids during the 1978 fly season at Trois-Rivières, Québec.

Table 1. Observed flight period of Tabanidae during the 1977 and 1978 seasons (dates of abundance peaks in parentheses) at Trois-Rivières (46°20'N).

Species	1977	1978
<i>H. nuda</i>	18V -30V	24V -13VIII
<i>C. mitis</i>	18V -06VI	06VI -6VII
<i>C. ater</i>	23V -02VI	30V -21VI
<i>C. cuclux</i>	23V -10VII	30V -10VI (16VI)
<i>C. carbonarius</i>	23V -10VII	30V -21VI
<i>C. calvus</i>	26V	30V
<i>C. sordidus</i>	—	30V -10VI
<i>H. affinis</i>	—	30V -21VII (21VI)
<i>H. lasiophthalma</i>	30V	30V -13VII (21VI)
<i>H. illota</i>	30V	06VI-06VII (15VI)
<i>C. niger</i>	—	06VI -06VII
<i>C. zinzhals</i>	06VI -06VII	—
<i>C. indus</i>	06VI -13VII (15VII)	10VII
<i>C. excitans</i>	—	06VI -28VI
<i>C. sackeni</i>	07VI -06VII (21VI)	06VII
<i>C. frigidus</i>	01VI -06VII	06VI -26VII (7VII)
<i>C. lateralis</i>	04VII-06VII	15VI -12VII
<i>H. zonalis</i>	13VII	15VI -12VII (21VI)
<i>H. trepida</i>	—	15VI -06VII (21VI)
<i>H. epistates</i>	—	15VI -12VII (21VI)
<i>C. montanus</i>	—	21VI -27VII (4-6VII)
<i>C. vittatus</i>	10VIII	15VI -30VII (5VII; 20VII)
<i>T. similis</i>	—	15VI -08VIII (6VII; 21VII)
<i>A. pemeticus</i>	—	16VI
<i>C. nigripes</i>	—	21VI -21VII (6VII)
<i>C. aberrans</i>	—	21VI -30VII (23VII)
<i>H. frontalis</i>	—	21VI
<i>H. pechumani</i>	07VII	21VI -21VII (12VII)
<i>T. marginalis</i>	—	26VI -20VII (12VII)
<i>C. aestuans</i>	08VII	26VI -30VII (06-12VII)
<i>H. minuscula</i>	—	06VII-08VIII (13VII)
<i>H. typhus</i>	—	06VII-08VIII (06VII)
<i>C. striatus</i>	—	06VII-24VII
<i>T. quinquevittatus</i>	—	06VII-30VII
<i>C. cincticornis</i>	06VII	08VII
<i>C. shermani</i>	08VII-15VII	—
<i>H. sodalis</i>	06VII	13VII-08VIII
<i>H. frosti</i>	06VII	21VII-11VIII
<i>C. venus</i>	08VII	—
<i>C. moechus</i>	10VII	—
<i>C. univittatus</i>	—	21VIII-24VII
<i>T. lineola</i>	—	21VII
<i>T. atratus</i>	—	21VII
<i>C. callidus</i>	—	21VII
<i>T. catenatus</i>	—	28VII-30VII

month: *C. aberrans*, *H. pechumani*, *H. frontalis*, *T. marginalis* and *C. aestuans*. The fifth group is composed of the latest emerging species: *H. minuscula*, *H. typhus*, *C. striatus*, *T. quinquevittatus*, *C. cincticornis*, *C. shermani*, *H. sodalis* and *H. frosti*. Flight periods of typical species for each of these 5 groups are illustrated on Fig. 3.

Chrysops ater has the shortest flight period (23-V to 2-VI in 1977, 30-V to 21-VI in 1978). *Chrysops carbonarius* also has a relatively short one. However, *H. affinis*, *C. frigidus*, *H. lasiophthalma*, and *T. similis* have a relatively long flight period (9, 7, 8, 9 weeks respectively). Spe-

cies of the third group have abundance peaks similar to those of the second group, i.e., the 6 *Hybomitra* species: *affinis*, *lasiophthalma*, *illota*, *zonalis*, *trepida* and *epistates*, have a common abundance peak in June (15-VI for *illota*, 16-VI for *cuclux* and 21-VI for the others). *Hybomitra zonalis* has a second peak on July 6 like *C. aestuans* which has a first peak on July 6 and a second on July 12.

In general, *Chrysops* constitute the greatest part of the relative abundance of the earliest species. As of June 9, 1978, 48% of the *Chrysops* species emerged while only 30% of the

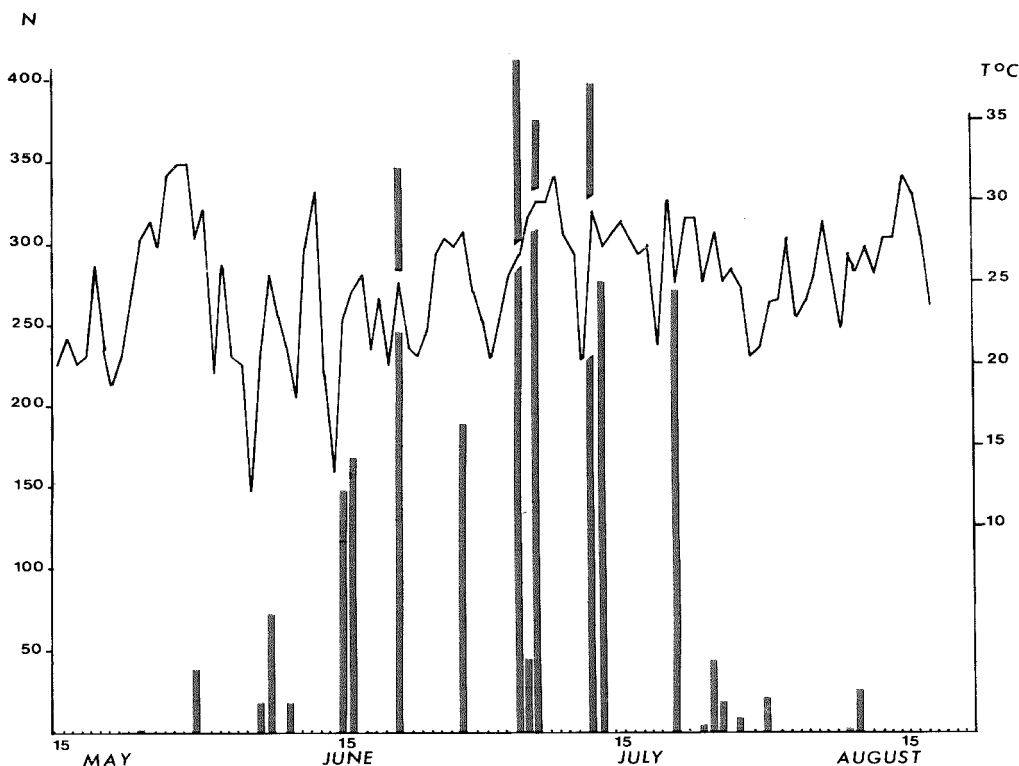


Fig. 2. Seasonal abundance of adult tabanids trapped during the 1978 fly season at Trois-Rivières, related to maximum air temperature.

Hybomitra have done so (Table 2). Species of *Tabanus* are the latest to emerge; none has been collected before mid-June and most of the species emerge in July (66%). This confirms the previous observations made by Davies (1959) in Ontario which indicates that *Chrysops* species appear 1 to 2 wk before both *Hybomitra* and *Tabanus*. Gojmerac and Devenport (1971) also

reported that *Chrysops* were more abundant during spring and early summer.

Our data agree with previously published results from surrounding countries: New Jersey (Thompson 1967, 1969); New York State (Pechuman and Burton 1969, Matthyse et al. 1972); Wisconsin (DeFoliart et al. 1967); Guelph, Ontario (Golini and Wright 1978); Al-

Table 2. Breakdown of the species number for each genus relative to their seasonal succession at Trois-Rivières during 1978.

Date	Earliest species				Mid-season species				Latest species		Total
	May 18-30		June 6-9		June 15-16		June 21-30		July		
	No.	%	No.	%	No.	%	No.	%	No.	%	
Genus											
<i>Chrysops</i>	5	20	7	28	2	8	4	16	7	28	25
<i>Hybomitra</i>	3	23	1	7	3	23	2	15	4	31	13
<i>Tabanus</i>	—	—	—	—	1	17	1	17	4	66	6

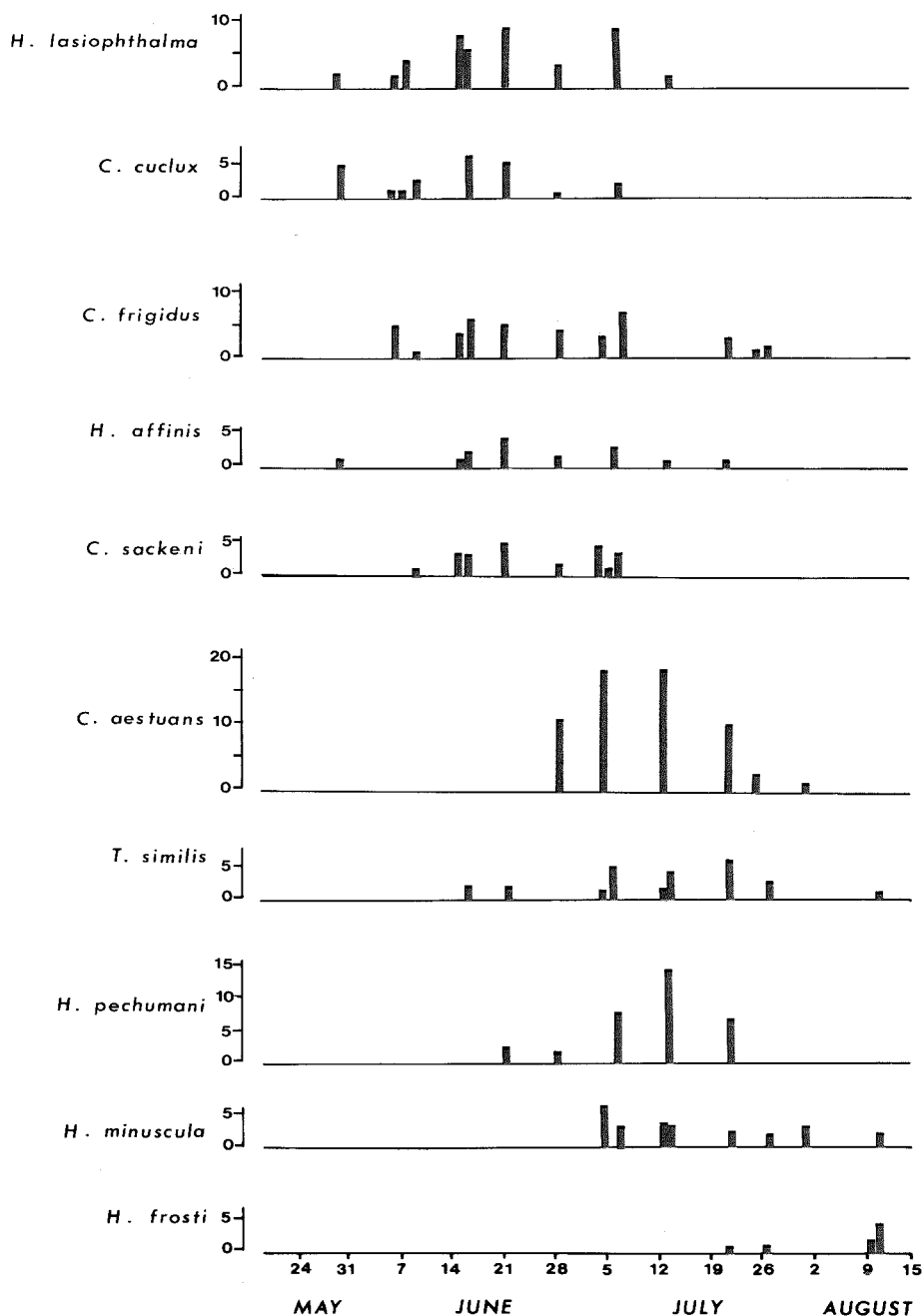


Fig. 3. Seasonal abundance of the major tabanid species trapped at Trois-Rivières during the 1978 fly season.

gonquin National Park, Ontario (Davies 1959, Smith et al. 1970, Troubridge 1973¹); Laurentides, Québec (Robert 1958, Thibault 1978²); New Brunswick (Thomas 1969); and the Maritimes Provinces of Canada (Lewis and Bennett 1977). *Hybomitra nuda* is the earliest species collected; as early as mid-May in Wisconsin, Trois-Rivières and Laurentides. However, it was collected during the first week of June in the Maritimes, where the season begins 2 wk later than in the first localities. Three regularly occurring early season species include *C. ater*, *C. cuclux* and *C. mitis*. *Hybomitra lasiophthalma*, *H. illota*, *C. carbonarius*, *C. indus* and *C. niger* form a second group of species generally collected during the first week of June.

Haneck and Bracken (1964) distinguished 3 flight periods in Manitoba: one from the last of May to mid-June characterized by *H. lurida*, *H. nuda* and *H. illota*; a second one corresponding to the second half of June during which *H. lasiophthalma*, *H. epistates* and *H. frontalis* were abundant; and a last group of summer abundant species composed of *C. aestuans* and *H. typhus*.

LAKE DELORME AREA. During 1977 and 1978, 20 species of Tabanidae were identified from

approximately 6000 collected specimens (Table 3). Twelve of these species are also present at Trois-Rivières.

The relative abundance of the species during 1977 (Fig. 4) indicates a dominance of *H. arpadii* (42.5%), followed by *C. furcatus* (16.3%), *C. excitans* (14.9%) and *H. zonalis* (14.2%). The other species have a relative abundance of less than 5%.

The flight period for all the species of Tabanidae during 1977 began the second week of July (Fig. 5), 7 wk later than at Trois-Rivières and lasted until the beginning of August. During 1978, specimens were collected up to August 14. This agrees quite well with the observed flight period at Churchill, Manitoba (Miller 1951), from July 5 to August 2 in 1947-49. The greatest flight period at Lake Delorme was from July 12 to July 23, with 2 abundance peaks, the most important on July 12, the second on July 23. At Churchill, Miller also observed an abundance peak on July 20.

All the collections correspond to a daily maximum temperature above 13°C (Fig. 5), that being very different from the higher temperatures observed in the southernmost areas. During 1977, the warmest period occurred during the second half of June, while the first

Table 3. Observed flight period of Tabanidae during the 1977 and 1978 seasons at Lake Delorme (55°00'N) (dates of abundance peaks in parentheses).

Species	1977	1978
<i>H. lurida</i>	07VII-23VII (12VII)	24VII-02VIII
<i>H. aequitincta</i>	07VII-30VII (12VII)	24VII-28VII
<i>H. arpadii</i>	07VII-02VIII (12VII)	24VII-10VIII (24VII)
<i>C. excitans</i>	07VII-02VIII (12-14VII; 23VII)	24VII-08VIII
<i>H. zonalis</i>	10VII-30VII (12VII)	24VII-08VIII (24VII)
<i>C. nigripes</i>	07VII-30VII (23VII)	26VII-02VIII (30VII)
<i>C. furcatus</i>	07VII-02VIII (23VII)	24VII-10VIII (26VII)
<i>C. mitis</i>	12VII-19VII	—
<i>H. aequitincta/zonalis</i>	12VII-23VII (12VII)	24VII-26VII
<i>C. frigidus</i>	12VII-02VIII (12-19VII)	23VII-02VIII)
<i>C. sordidus</i>	12VII-25VII	23VII-26VII
<i>H. epistates</i>	12VII	—
<i>H. astuta</i>	12VII-30VII	28VII
<i>C. ater</i>	12VII-02VIII	14VIII
<i>H. frontalis</i>	19VII-30VII	24VII-08VIII
<i>H. hearlei</i>	23VII	24VII-08VIII
<i>C. carbonarius</i>	23VII-02VIII	—
<i>H. frosti</i>	21VII-08VIII	24VII (24VII)
<i>C. zinzalus</i>	—	28VII-02VIII
<i>C. itasca</i>	—	24VII-10VIII

¹ Troubridge, D. A. 1973. Seasonal distribution, diurnal periodicity and physiological age of host seeking tabanids (Diptera: Tabanidae). M. Sc. Thesis, McMaster Univ., Hamilton, Ontario. 103 pp.

² Thibault, J. 1978. Les Tabanidae (Diptera) de la station de biologie de Saint-Hippolyte. M. Sc. Thesis, Univ. Montréal, Québec. 102.

captures began the second week of July. The immature stages (last instar and pupa) probably require this previous warm period to achieve maturation in a bioclimatic zone with a long cold season and deeply frozen ground.

The observed flight periods of the 20 col-

lected species are presented in Table 3. Note that there is not an equivalent difference in the phenological successions as observed in the southernmost areas. All the species, except *H. frosti*, emerged at the same time. Nevertheless, taking in account the respective abundance peak of the species, 3 groups may be delineated: species with an early abundance peak a few days after their first appearance (*H. lurida*, *H. aequitincta*, *H. arpadi*, *H. aequitincta/zonalis* and *C. frigidus*); species with a peak at the end of July (*C. nigripes*, *C. furcatus*); species without any apparent peak (*C. excitans* particularly and *H. zonalis*). However, these 2 species were relatively more abundant at the beginning of their flight period. Figure 6 illustrates the observed flight periods and the daily abundance of these species during 1977.

Results of the 1978 survey, compared with those of 1977, indicate that the abundance peak of the earliest species was missed. Only the

abundance peaks of *C. furcatus*, *C. nigripes*, *H. arpadi* and at least a part of *H. zonalis* were obtained. There is also a general delay in the peaks of about one week, as observed at Trois-Rivières.

It would be interesting to establish the progressive delay in emergence from south to north in order to predict the emergence periods of the Tabanidae in whichever area is surveyed. Hopkins (1934) attempted to establish a predictable phenological model of emergence quantitatively calculating the latitudinal and longitudinal gradients from south to north and from west to east for the North American continent. Several entomologists mapped an isophase distribution of insect emergences using the Hopkins method (Ide et al. 1958 and Shewell, personal communication, for the Simuliidae; Wood et al. 1979 for the Culicidae). Another method consists of calculating the cumulative number of day-degrees corresponding to the emerging time of the adult populations. This last method (even if often empirical) is largely applicable to agriculture, particularly for plant phenology.

We attempted to apply this method to our results and previously published information on the phenology of Tabanidae. Arbitrarily, the basis we used for the calculation was: the summation of the daily mean temperature minus 5°C. Nothing significant resulted from these calculations. Too many variations were observed from one year to another in the same

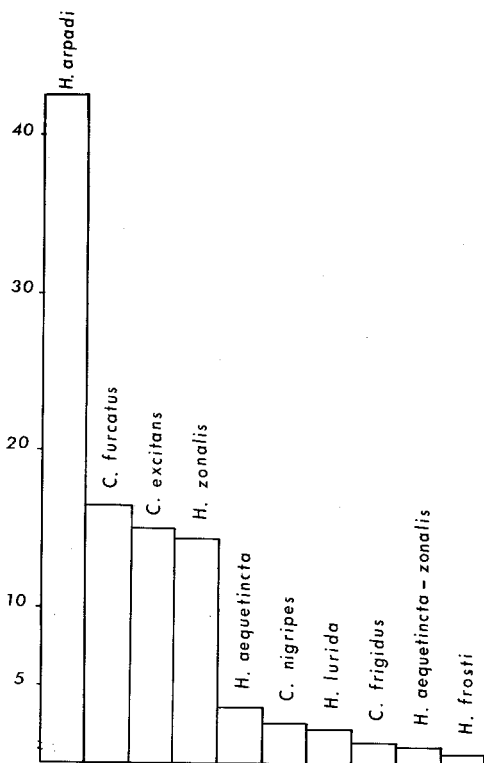


Fig. 4. Relative abundance of adult tabanids during the 1977 fly season in the Lake Delorme area, Québec.

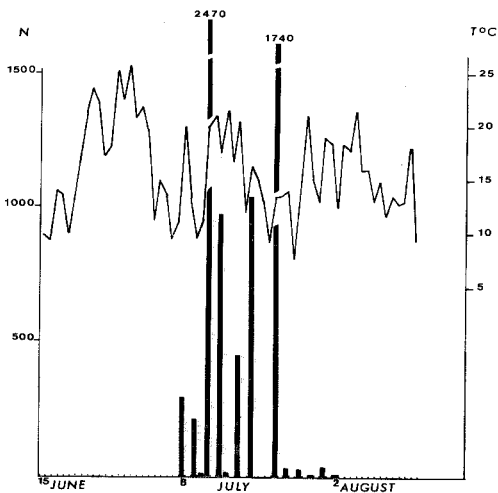


Fig. 5. Seasonal abundance of adult tabanids trapped during the 1977 fly season in the Lake Delorme area, related to maximum air temperature.

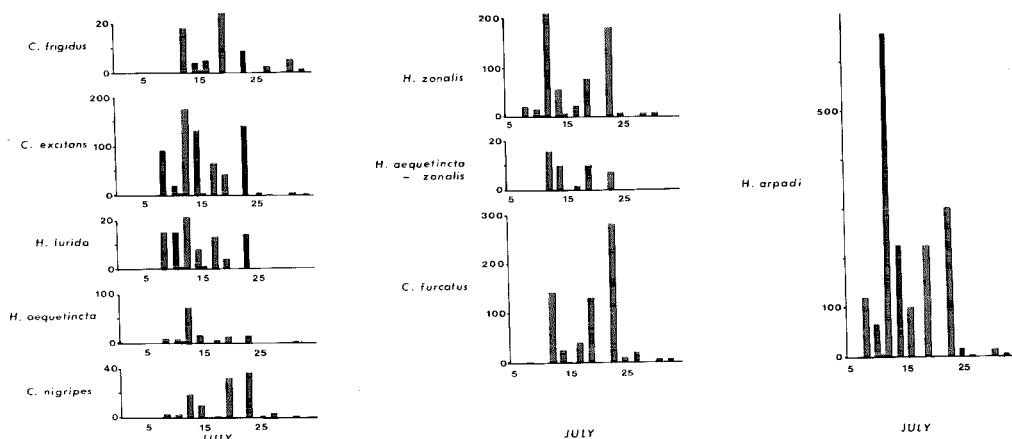


Fig. 6. Seasonal abundance of the major tabanid species trapped in the Lake Delorme area during the 1977 fly season.

area, and aberrant data were obtained from southern places comparative to the northern localities. For instance, *H. astuta* was collected at 1200 day-degrees at St-Hippolyte in 1975 (Thibault 1978²) but at 223 day-degrees at Lake Delorme in 1977; on the other hand, *C. ater* needed 276 day-degrees during 1977 but 309 during 1978 at Trois-Rivières; *H. frosti* was collected at 815 day-degrees at Trois-Rivières in 1977 but at 1013 day-degrees in 1978. Theoretically, the same quantity of day-degrees should be required for the same species in the same area, whichever season is observed.

The problem with the Tabanidae results from the collecting methods generally used. These do not trap the emergent adults but the first host-seeking specimens. This generates a more or less important delay according to the ecological surrounding factors: climatic, physiognomic and biotic. Consequently, there is a systematic bias introduced. We believe that the day-degree method should be useful to precisely establish the phenological gradients in the emergences of the species. However one must know when to start the calculations. Questions to be considered are: What is the duration of the larval and pupal growth ecophase? What is the corresponding ground temperature in habitats, taking in account the respective physiognomy of these sites (open or forested, dried or aquatic, sphagnum type or silty type)?

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SEASONAL SUCCESSION AND RELATIVE ABUNDANCE OF MOSQUITOES ATTACKING CATTLE IN CENTRAL ALBERTA

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ABSTRACT. At George Lake, 63 km northwest of Edmonton, Alberta, from April to September 1973-75, mosquitoes were caught from cattle in the open and from a calf-baited stable trap. Mosquitoes of 15 species or species groups were collected in nearly the same proportions in the stable trap as on cattle in the open. Combined attack rates of all species were highest in late July and early August when the mosquitoes arrived at a tethered calf faster than they could be collected. The stable trap caught more mosquitoes, but still underestimated the relative abundance of some species because it hindered their entry. The most abundant mosquitoes were *Aedes vexans*, *Ae. communis* group, *Culiseta inornata*, *Cs. alaskaensis*, *Ae. spencerii*, *Ae. fitchii* group and *Ae. flavescens*. Cattle in fields were severely disturbed by mosquitoes in late May (chiefly *Ae. spencerii*), and from mid-July to early August (chiefly *Ae. vexans*, *Ae. spencerii* and *Cs. inornata*).

INTRODUCTION

In central Alberta, mosquitoes are sometimes severe enough pests to stop cattle feeding and to provoke stampedes in which calves are killed. Four plagues of mosquitoes from June to September 1973 were estimated to have cost \$31 million in reduced weight gains of beef cattle (Dixon 1974). The pest species in 1973 were *Aedes vexans* (Meigen) and *Ae. dorsalis* (Meigen).

During a study of the seasonal biology of *Anopheles*, *Culex*, and *Culiseta* mosquitoes,¹ females were collected from cattle because they rarely or never came to man.

MATERIALS AND METHODS

STUDY AREA. Mosquitoes were caught on a farm at George Lake, 60 km northwest of Ed-

monton, Alberta, from April to September during 1973-75. George Lake lies in a transition zone between aspen parkland and boreal forest (taiga) where large areas have been cleared for pasture, hay and grain fields. The farm had about 100 dairy and beef cattle of various breeds at the time of the study.

COLLECTING METHODS. From April to September 1973 and from April to June 1974, female mosquitoes were caught by aspirator from 10-20 unrestrained calves in a feedlot and a pasture next to the farmyard. However, when mosquitoes were abundant, the cattle would not allow the collectors to go near them and sometimes stampeded. For the rest of 1974 and the entire 1975 season, mosquitoes were caught from single calves, haltered and tied to a fence post. Dairy calves of various breeds, weighing 150-400 kg, were used to attract mosquitoes. Catch periods were from sunset to one hr after sunset in summer, and from 2-3 hr before to one hr after sunset in spring and fall. Civil twilight lasted 37-55 min, so catches were completed with the aid of a flashlight. The results

¹ Hudson, J. E. 1977. Seasonal biology of *Anopheles*, *Culex* and *Culiseta* in central Alberta (Diptera: Culicidae). Ph.D. thesis, University of Alberta. 388 pp.