

LATITUDINAL DISTRIBUTION OF QUEBEC TABANIDAE

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ABSTRACT. The latitudinal distribution of 79 of the 82 species of Tabanidae known from Quebec is presented and discussed. Six genera are present in the Temperate life zone: *Chrysops* (30 species), *Hybomitra* (22 species), *Tabanus* (13 species), *Atylotus* (3 species), *Stonemyia* (2 species) and *Haematopota* (1 species). Twenty-seven species have their northern limit in this zone and 3 their southern limit of distribution. *Tabanus* and *Haematopota* reach their general northern limit in the Subarctic life zone; *Atylotus* and *Chrysops* in the Holarctic life zone. Only 4 species of *Hybomitra* are known to be present in the true Arctic life zone.

Studies of Tabanidae in Quebec are quite limited. Only 4 monographs are presently available (Chagnon and Fournier 1943, Robert 1958, Pechuman 1964, Thibault 1978¹) all devoted to the southern part of Quebec, south of the 49th parallel. Several lists have also been published. Winn and Beaulieu's (1915) list of 28 species includes 2 synonyms (*Chrysops fugax* = *C. carbonarius* Walker; *Tabanus recedens* = *T. fusconervosus* Macquart) and a probably doubtful citation of *T. nigrovittatus* Macquart from Montreal (this species is characteristic of tidal marshes according to Pechuman 1964).

Hine (1923) indicated the presence of *Hybomitra sexfasciata* (= *H. longiglossa* Philip according to Teskey, pers. comm.) in Quebec. Stone recorded the presence of *C. montanus* Osten Sacken, *T. atratus* Fabricius and *H. minuscula* (Hine) (1930), *T. vicarius* (= *T. nigrovittatus* Macquart), *H. gracipalpis* (= *H. arpadii*, Szilády), *H. hearlei* (Philip), *H. typhus* (Whitney) and *H. liorhina* (Philip) (1938). A revised and expanded list of the Quebec Tabanidae was published by Petch and Maltais (1932). Brennan (1935) added *Stonemyia rasa* (Loew) and *C. proclivis* (= *C. furcatus* Walker var. *chagnoni*) to the 52 species previously known.

Chagnon and Fournier (1943) included new Quebec records in their monograph: *C. furcatus*, *C. shermani* Hine, *C. sordidus* Osten Sacken and *Atylotus pemeticus* (Johnson). Philip indicated the presence of *C. aberrans* Philip (1941), *T. lineola scutellaris* (= *T. similis* Macquard) (1942), *H. brennani* (Stone), *T. fairchildi* Stone and *T. trimaculatus* Palisot de Beauvois (1947), this last probably not present in Quebec; *C. aestuans* van der Wulf (var. *abaestuans*) (1950), *C. dawsoni* Philip and *A. duplex* (Walker) (1959). In 1953, Freeman, mapping the distribution of Tabanidae in the northern localities of Canada, included records of *C. nigripes* Zetterstedt, *Haematopota americana* Osten Sacken and *H. itasca* (Philip). One may note that only these

records and those of Hine (1923) were of the northern part of Quebec.

Pechuman (1960, 1964) published a "List of the Tabanidae (Diptera) of Quebec" and discussed the previous misidentifications, particularly of the 1915 and 1932 lists. Therein, 71 species are listed from Quebec. With the recent new records published by Pechuman and Teskey (1967), Thibault (1978), Teskey and Thomas (1979) and Thomas (1980), 78 species and subspecies were known to be present in Quebec. From 1977 to 1979, we made a thorough survey to establish their latitudinal distribution from 46°N to 55°N latitude (upper limit of the forest), particularly emphasizing the Middle-North. Four new records were discovered bringing to 82 the number of species now known for Quebec.

MATERIALS AND METHODS

LIFE ZONE DELIMITATION. To present and discuss the latitudinal distribution of the Tabanidae in the Quebec-Labrador territory, we used the bioclimatic zones based on zonal vegetation successions presented by Francoeur (1979) for ants and by Maire and Aubin (1980) and Maire (1980) for mosquitoes.

i) The Temperate life zone (45–47°N latitude) includes 3 successive deciduous forest types: the *Acer saccharum* and *Carya ovata* formation or Low Temperate (LT); the *Acer saccharum* and *Tilia americana* formation or Middle Temperate (MT) and the *Acer saccharum* and *Betula lutea* formation or High Temperate (HT) (Grandtner 1966). It is the most studied life zone of Quebec. Mean annual temperatures are: 6.0°C, 5.3°C and 3.5°C respectively (Richard 1978).

ii) The Boreal life zone, *stricto sensu* (47–50°N latitude, approximately) is a transitional belt between the previous Temperate formation and the coniferous forest formation. It includes the fir forest communities dominated by *Abies balsamea* with *Betula lutea* in the southern part or Low Boreal (LB) and with *Betula papyrifera* in

¹ Thibault, J. 1978. Les Tabanidae (Diptera) de la station de biologie de Saint-Hippolyte. Thesis, M.Sc., Univ. Montréal, Québec. 102 pp.

the northern part or High Boreal (HB). Mean annual temperature is always above 0°C.

iii) The Subarctic life zone (50–55°N latitude, approximately) includes the spruce forests dominated by *Picea mariana* (Ducruc et al. 1976). Mean annual temperature is about -3°C (Richard 1978). Phytogeographers distinguish 3 subzones based on vegetational criteria: the Low Subarctic (LS), Middle Subarctic (MS) and High Subarctic (HS) (Ducruc et al. 1976).

iv) The Hemiartic life zone (55–58°N latitude) is a transitional zone (forest-tundra) corresponding to the upper limit of the forested lands. This vast ecotone is very typical in Quebec-Labrador (Rousseau 1952). Mean annual temperature is about -4.8°C (Richard 1978).

v) The Arctic life zone, north of 58°N latitude, is treeless. The vegetative season is very short, approximately 27 days without frost. Mean annual temperature is about -6.9°C (Richard 1978).

STUDY AREAS. Forty-three localities were visited, distributed across 4 of the previously described life zones. Subsequent examination of the specimens in the Canadian National Collection (CNC), Ottawa, provided data from 191 localities in Quebec and 14 in Labrador. These were distributed as follows: 111 in the Temperate (23 in the LT, 51 in the MT and 37 in the HT respectively), 60 in the Boreal, 15 in the Subarctic, 16 in the Hemiartic and 2 in the Arctic. In addition, all the published records were compiled.

COLLECTING METHODS. Insect hand nets were used to capture tabanids attracted to human collectors. This technique was most efficient in capturing *Chrysops* specimens. It may bias sampling if it is the only method used, as in the Boreal zone where collecting was less intense. Among the 43 localities surveyed, several were visited throughout 1 or 2 seasons. At these sites, CO₂ (dry ice) baited Malaise traps were utilized. Specimens were killed with a piece of Vapona strip (dichlorvos insecticide) and the collecting containers emptied twice a week or every other day. Malaise traps were used in Trois-Rivières (46°20'N) from May 25 to August 10, 1978; Gagnon (51°50'N) from June 20 to June 30, 1979 and from July 17 to July 26, 1979; Fort-George-LG1 (53°50'N) during July 1979, LG3 (53°45'N) from June 16 to July 24, 1977 and in Lake Delorme area (55°00'N) from July 8 to August 2, 1977 and from July 24 to August 12, 1978. In Fort-George-LG1, we also used a modified canopy trap (Catts 1970).

Most of the collected specimens, particularly those of the Middle-North, were preserved *en masse* in vials with ethanol (70%), a useful

method for field conditions. As specimens turn blackish with this preservation technique, it is necessary to submerge them in an acetic acid solution for several hours before identification. Another technique is to freeze them until needed for study. This prevents desiccation and discoloration. The classic technique of pinning dry specimens subjects them to breakage in the field, is very time-consuming and requires more storage space.

Specimens were identified by using keys from Pechuman et al. (1961) and Pechuman (1981). Pechuman's (1981) and Leclercq and Olsufjev's (1981) classification and nomenclature were used. Abbreviations of genera used with the text were: *C.* = *Chrysops*, *H.* = *Hybomitra*, *T.* = *Tabanus*, *A.* = *Atylotus*, *S.* = *Stonemyia* and *Hae.* = *Haematopota*.

RESULTS AND DISCUSSION

LIST OF TABANIDAE IN THE QUEBEC-LABRADOR TERRITORY. Of the 132 species known to be distributed in Canada (Teskey 1979), 82 are present in Quebec-Labrador (Fig. 1). During our survey, 10,311 specimens were collected. They included 55 identified species, corresponding to 4 genera: *Chrysops* (26 species), *Hybomitra* (21 species and 1 complex), *Tabanus* (7 species) and *Atylotus* (1 species).

Specimens identified as of the *H. aequitincta/zonalis* complex were almost impossible to assign to either one species or the other. Theoretically, each species in this complex may be differentiated by the color of the prescutal lobe—black for *aequitincta* (Becker), red for *zonalis* (Kirby), and by the subcallus—denuded for *aequitincta*, tomentous in *zonalis*. We actually collected all the intermediate forms between these 2 well distinguished extremes, from specimens with a denuded subcallus but a red prescutal lobe to specimens with a tomentous subcallus but a black prescutal lobe. This indicates that either hybridization between the 2 species occurred or that it is a unique but polymorphic species. This phenomenon was previously noted by McAlpine (1961) for the *H. frontalis* (Walker) complex, recently considered as a subspecies of *H. montana* (Meigen) by Leclercq and Olsufjev (1981). We also observed the same phenomenon with *C. furcatus furcatus* and *C. f. chagnoni*, showing numerous intermediates forms from which we could not distinguish nor clearly identify one variety from the other.

LATITUDINAL DISTRIBUTION. In order to depict a quantitative distribution pattern of the Tabanidae from south to north in the Quebec-Labrador region, we have used our data from the 55 collected species and have taken into account all available complementary data (pre-

vious publications plus analysis of the CNC specimens). Together, these data account for 79 of the 82 species registered in the region. Figure 1 illustrates the abundance of each species in each life zone. Four classes were arbitrarily established according to a logarithmic progression. For each species, class I indicates between 1 and 9 specimens; class II between 10 and 99; class III, between 100 and 999; class IV, 1000 and more. A broken line indicates that only the presence of a species is known; a dotted line that the presence, even if unregistered, is probable (when the species is present in surrounding zones, for instance).

i) Temperate zone. *Chrysops* and *Hybomitra* represent more than 95% of the collected specimens (70.4% and 21.6% respectively); 3.3% of the specimens are *Tabanus* and less than 0.1% are *Stonemyia* and *Atylotus*. The most abundant species in this zone are: *C. excitans* Walker (3035 specimens), *C. aestuans* (958), *C. frigidus* Osten Sacken (791), *H. illota* (Osten Sacken) (753), *C. carbonarius* (718), *H. nitidifrons nuda* (McDunnough (681), *H. lasiophthalma* (Macquart) (410), *C. cuclux* Whitney (398), *C. ater* Macquart (396), *C. mitis* Osten Sacken (388), *H. pechumani* Teskey and Thomas (345) and *C. venus* Philip (329). Species having their optimal distribution in this life zone are *C. aestuans*, *H. illota*, *C. cuclux*, *C. venus*, *T. marginalis* Fabricius, *C. indus* Osten Sacken, *C. vittatus* Wiedemann, *C. montanus* Osten Sacken, *C. cincticornis* Walker, *T. similis* and *C. sackeni* Hine. Twenty-seven species reach their northern limit of distribution in this zone and 3 their southern limit: *C. nigripes*, *C. dawsoni* and *H. arpadii*.

ii) Boreal zone. A first analysis clearly indicates the predominance of *Chrysops*, with 66.5% of the collected specimens, followed by *Hybomitra* (31%), *Atylotus* (1.3%), *Stonemyia* (0.6%), *Tabanus* (0.5%) and *Haematopota* (0.2%). Although there is the bias introduced by the collecting technique (insect net) which favors *Chrysops* captures (Watson 1968)², other data provide similar results. Overall, *C. excitans* is a dominant species (295 specimens) with *C. ater* (260), *C. mitis* (144) and *H. lurida* (Fallen) (117).

The Boreal zone seems to be a transitional life zone for the Tabanidae as it is for vegetation from a phytogeographical point of view (transition between the Temperate deciduous forests and the northernmost coniferous spruce forests). Species having a temperate distribution (*C. shermani*, *C. aestuans*, *C. montanus*, *C. venus* and *C. cincticornis*) reach their northern

limit of distribution there. Other species with a boreotemperate distribution type (*H. trepida* (McDunnough), *C. niger* Macquart and *C. mitis*) or with a subarctic distribution type (*C. sordidus*, *H. lurida*) are relatively well represented. Several northern species reach their southern limit of distribution in this zone: *H. longiglossa*, *H. liorhina*, *H. aequitincta* and *A. sp. #2* (nr. *incisuralis*).

iii) Subarctic zone. *Hybomitra* and *Chrysops* constitute more than 99% of the specimens (50% and 49.6% respectively). *Tabanus* and *Haematopota* reach their general northern limit therein. The dominant species is always *C. excitans* (2718 specimens), followed by *H. arpadii* (1861), *H. zonalis* (836), *C. furcatus* (812), *H. aequitincta* (359), *H. lurida* (307), *C. ater* (206), *H. pechumani* (192), *H. hearlei* (182) and *C. nigripes* (161). Species having their optimal distribution in this zone are *H. montana frontalis*, *C. furcatus*, *H. arpadii*, *H. hearlei*, *H. aequitincta* and also *H. aequitincta/zonalis* intermediates. All the specimens of this complex were in fact found in this zone alone (more precisely in the eastern half of northern Quebec). Ten species reach their northern limit in this zone; one, its most southern known limit (*H. itasca*).

iv) Hemicarctic. Three genera are present in the forest-tundra: *Hybomitra* (57.9%), *Chrysops* (41.9%) and *Atylotus* (0.2%). It is also the known northern limit of the latter 2. *Hybomitra lurida* is the most abundant species (388 specimens), with *C. excitans* (264), *H. aequitincta* (81), *C. ater* (77), *H. zonalis* (66) and *C. furcatus* (63).

v) Arctic. Four species only are known to be present in the tundra. All are of the genus *Hybomitra*.

A synthesis of the latitudinal distribution of the principal genera is presented according to their species number in each life zone. The latitudinal distribution of *Chrysops*, *Hybomitra*, *Tabanus* and *Atylotus* are indicated in Table 1.

The general relative scarcity of the data in the Boreal zone is reflected by a greater discrepancy between the number of species collected in this zone and the probable maximum of species actually present.

Atylotus is represented by a small number of specimens. Pechuman (1981) indicated the same phenomenon for a genus whose species are known to be ubiquitous in New York state. We did not collect any *Stonemyia*, but, according to Pechuman (1981): "The species of this genus are not known to suck blood" and "... "none of the species are common" (p. 7). From a general point of view, there is an increase in the number of species from 30th to the 42nd parallel for *Tabanus* and *Chrysops* (Table 2). There are more species of *Tabanus* in the south and the center of the Nearctic (from the 33th to the 38th parallel

² Watson, R. L. 1968. The Tabanidae of Alabama and some aspects of their ecology. Thesis Ph.D., Auburn Univ. 230 pp.

	TEMPERATE			BOREAL		SUBARCTIC			HEMI- ARC- TIC	ARC- TIC
	low	middle	high	low	high	low	middle	high		
<i>T. similis</i>										
<i>H. sodalis</i>										
<i>C. niger</i>										
<i>C. calvus</i>										
<i>H. microcephala</i>										
<i>H. nuda</i>										
<i>Hae. americana</i>										
<i>A. pematicus</i>										
<i>T. vivax</i>										
<i>T. marginalis</i>										
<i>C. zinzalus</i>										
<i>H. distinguenda contigua</i>										
<i>H. frosti</i>										
<i>H. aequitincta-zonalis</i>										
<i>H. minuscula</i>										
<i>H. illota</i>										
<i>H. lasiophthalma</i>										
<i>H. affinis</i>										
<i>C. carbonarius</i>										
<i>C. mitis</i>										
<i>H. frontalis</i>										
<i>H. astuta</i>										
<i>H. pechumani</i>										
<i>C. sordidus</i>										
<i>C. frigidus</i>										
<i>H. zonalis</i>										
<i>C. furcatus</i>										
<i>C. ater</i>										
<i>H. lurida</i>										
<i>C. excitans</i>										
<i>C. nigripes</i>										
<i>C. dawsoni</i>										
<i>H. longiglossa</i>										
<i>A. sp. 2 near incisuralis</i>										
<i>H. itasca</i>										
<i>H. arpadi</i>										
<i>H. liorhino</i>										
<i>H. hearlei</i>										
<i>H. aequitincta</i>										

Fig. 1. List of Quebec Tabanidae and their respective semi-quantitative abundance in the life zones across the Quebec-Labrador region. Solid lines: class I indicates between 1 and 9 discovered specimens; class II, between 10 and 99; class III, between 100 and 999; class IV, 1000 and more. A broken line indicates that only the presence of a species is known; a dotted line, that the presence, even if unregistered, is probable. *Tabanus fairchildi* Stone and *T. callens* Linnaeus are not listed (no distributional data).

Table 1. Latitudinal distribution of Tabanidae species in eastern North America.

Life zone	<i>Chrysops</i> spp.			<i>Atylotus</i> spp.			<i>Tabanus</i> spp.			<i>Hybomitra</i> spp.		
	Curr. ¹	Tot. ²	Ant. ³	Curr.	Tot.	Ant.	Curr.	Tot.	Ant.	Curr.	Tot.	Ant.
Arctic	—	0	0	—	0	0	—	0	0	—	4	4
Hemiarctic	4	9	9	0	1	1	0	0	0	7	15	15
High Subarctic	9	9	10	0	0	1	0	0	0	11	13	17
Mid-Subarctic	8	8	10	1	1	2	1	2	2	7	8	17
Low Subarctic	7	11	12	0	0	2	1	5	5	13	22	22
High Boreal	7	11	15	1	1	2	0	1	5	6	15	21
Low Boreal	8	17	20	0	0	1	0	1	5	5	17	19
High Temperate	14	22	25	0	2	2	1	5	8	5	19	19
Mid-Temperate	23	29	30	1	4	4	6	11	13	13	18	19
Low Temperate	—	22	29	—	2	4	—	8	12	—	18	21
New York State	—	41	—	—	4	—	—	34	—	—	21	—

¹ Current: results of present survey.

² Total: Total collecting effort, including the CNC and bibliographic references.

³ Anticipated: Total number of species anticipated in each life zone (when a species is present in surrounding life zones).

approximately); *Chrysops* have their greatest diversity between the 35th and 43rd parallels. Otherwise the general pattern of *Chrysops* distribution is more northern than that of *Tabanus*, with species having their northern limit of distribution at more northern latitudes. *Tabanus* have their northern limit in the Subarctic whereas *Chrysops* are represented up to the Hemiarctic. *Hybomitra* have an inverted profile. They are indeed less diversified in the south (4 species) than other genera. However, their species number increases with northern latitude localities with an apparent maximum at 52°N (23 species). But *Hybomitra* species may be underestimated between the 47th and the 51st parallel, in the Boreal. Of the 9 species of Tabanidae known to be holartic, i.e., those with a circumboreal distribution (Chvala et al. 1972, Leclercq and Olsufjev 1981), 8 are *Hybomitra* species (*H. aequineta*, *H. arpadi*, *H.*

astuta, *H. epistates* (= *H. distinguenda contigua* Olsufjev), *H. lurida*, *H. montana* (Meigen), *H. nitidifrons* (Szilady) and *H. sexfasciata* (Hine)) and the other is *C. nigripes*.

One may conclude, from these results, that it would be useful to intensify surveys in other northern areas, particularly in the Boreal and the Hemiarctic zones. It should be of interest to specify by surveys in the Appalachian and among the northern life zones whether species of arctic or arctico-alpine type are present. Also, the *H. aequineta/zonalis* complex particularly requires more detailed attention.

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References Cited

- Brennan, J. M. 1935. The Pangoniinae of Nearctic America (Diptera: Tabanidae). Univ. Kans. Sci. Bull. 22:249-401.
 Catts, E. P. 1970. A canopy trap for collecting Tabanidae. Mosq. News 30:472-474.

Table 2. Comparative latitudinal distribution of *Tabanus*, *Chrysops* and *Hybomitra* in eastern North America.

Latitude	<i>Tabanus</i> spp.	<i>Chrysops</i> spp.	<i>Hybomitra</i> spp.
60°	0	0	4
57°	0	9	15
55°	0	10	17
53°	2	10	17
52°	5	12	22
50°	5	15	21
48°	5	20	19
47°	5	25	19
46°	13	30	19
45°	12	29	21
42°	34	41	21
37°	53	46	11
30°	44	32	4

- Chagnon, G. and O. Fournier. 1943. Les Tabanides du Québec. Nat. Can. 70:49-84.
- Chvala, M., L. Lyneborg and J. Moucha. 1972. The horse flies of Europe (Diptera: Tabanidae). Entomol. Soc. Copenhagen. 500 pp.
- Danks, H. V. 1979. (ed.). Canada and its insect fauna. Mem. Entomol. Soc. Can., Ottawa 108. 573 pp.
- Ducruc, J. P., R. Zarnovican, V. Gérardin and M. Jurdant. 1976. Les régions écologiques du territoire de la baie de James. Caractéristiques dominantes de leur couvert végétal. Cah. Géogr. Québec 20:423-425.
- Francoeur, A. 1979. Les fourmis du Québec. 1. Introduction. 2. La famille des Formicidae. 3. La sous-famille des Ponerinae. Ann. Soc. Ent. Québec 24:12-47.
- Freeman, T. N. 1953. Interim report of the distribution of the tabanids obtained in the northern insect survey. Defence Res. Board EP Tech. Report 4:1-35.
- Grandtner, M. M. 1966. La végétation forestière du Québec méridional. P. Univ. Laval Québec. 216 pp.
- Hine, J. S. 1923. Horse flies collected by Dr. J. M. Aldrich in Alaska in 1921. Can. Entomol. 55:143-146.
- Leclercq, M. and N. G. Olsuffjev. 1981. Nouveau catalogue des Tabanidae paléarctiques (Diptera). Notes fauniques de Gembloux 6. 51 pp.
- Maire, A. 1980. Ecologie comparée des espèces de moustiques holarctiques (Diptera: Culicidae). J. Can. Zool. 58:1582-1600.
- Maire, A. and A. Aubin. 1980. Les moustiques du Québec (Diptera: Culicidae): Essai de synthèse écologique. Me. Soc. Entomol. Québec 6. 107 pp.
- McAlpine, J. F. 1961. Variation, distribution and evolution of the *Tabanus (Hybomitra) frontalis* complex of horse flies (Diptera: Tabanidae). Can. Entomol. 93:894-924.
- Pechuman, L. L. 1960. Some new and little-known North American Tabanidae (Diptera). Can. Entomol. 92:793-799.
- Pechuman, L. L. 1964. A list of the Tabanidae (Diptera) of Quebec. Can. Entomol. 96:1495-1499.
- Pechuman, L. L. 1981. The horse flies and deer flies of New York (Diptera: Tabanidae). Search: Agriculture. Ithaca, N.Y. (Cornell Univ. Agric. Exp. Stn) 18. 68 pp. (2nd ed.).
- Pechuman, L. L. and H. J. Teskey. 1967. A new Eastern Nearctic Chrysops (Diptera: Tabanidae). Can. Entomol. 99:645-650.
- Pechuman, L. L., H. J. Teskey and D. M. Davies. 1961. The Tabanidae (Diptera) of Ontario. Proc. Entomol. Soc. Ont. 91:77-121.
- Petch, C. E. and B. Maltais. 1932. A preliminary list of the insects of the province of Quebec. Part II—Diptera—Revised and supplemented by Petch, C. E. and B. Maltais. In Winn, A. F. and G. Beaulieu. Suppl. 24th Rep. Soc. Qué. Prot. Plant.:29-31.
- Philip, C. B. 1941. Notes on Nearctic Pagoniinae (Diptera: Tabanidae). Proc. Entomol. Soc. Wash. 43:112-130.
- Philip, C. B. 1942. Notes on the Nearctic Tabanidae. Part III. The *Tabanus lineola* complex. Psyche 49:25-40.
- Philip, C. B. 1947. A catalog of blood-sucking fly family Tabanidae (horse flies and deer flies) of the Nearctic north of Mexico. Am. Midl. Nat. 37(2):257-324.
- Philip, C. B. 1950. Corrections and addenda to a catalog of Nearctic Tabanidae. Am. Midl. Nat. 43:430-437.
- Philip, C. B. 1959. New North American Tabanidae. X. Notes on synonymy and description of a new species of *Chrysops*. Trans. Am. Entomol. Soc. 85:193-217.
- Richard, P. 1978. Aires ombrothermiques des principales unités de végétation du Québec. Nat. Can. 105:195-207.
- Robert, A. 1958. Les Tabanidae du Parc du Mont Tremblant. Ann. Entomol. 4:25-32.
- Rousseau, J. J. 1952. Les zones bioclimatiques de la péninsule Québec-Labrador et l'Hémiarctique. J. Can. Bot. 30:436-474.
- Stone, A. 1930. The bionomics of some Tabanidae (Diptera). Ann. Entomol. Soc. Am. 53:261-304.
- Stone, A. 1938. The horse flies of the subfamily Tabanidae of the Nearctic region. U.S. Dept. Agric., Miscell. Publ. 105. 171 pp.
- Teskey, H. J. 1979. Suborder Brachycera. In Danks, H. V. (ed.): Canada and its insect fauna. Mem. Entomol. Soc. Canada 108:405-407.
- Teskey, H. J. and A. W. Thomas. 1979. Identify of *Hybomitra typhus* and description of a new species previously confused with it (Diptera: Tabanidae). Can. Entomol. 111:343-350.
- Thomas, A. W. 1980. New records for some Canadian horse flies and deer flies (Diptera: Tabanidae). Entomol. News 91:59-60.
- Winn, A. F. and G. Beaulieu. 1915. A preliminary list of the insect of the province of Québec. Part II. Diptera. Suppl. 7th Rep. Que. Soc. Prot. Plant:122-123.