

THE ODONATE FAUNA OF THE NORTHERN REGIONS OF QUEBEC-LABRADOR : REVIEW AND PERSPECTIVE

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The state of knowledge of the regional odonate fauna is reviewed. The distribution of species is analysed in relation to the bioclimatic zones.

INTRODUCTION

The ever increasing development of the northern areas of North America necessitates a knowledge not only of the composition of the animal fauna as a whole but also of the ecological roles of the different categories of organisms, as a prerequisite to any safe and logical manipulation of northern ecosystems. Death of thousands of caribou in northern Quebec in the mid-80's (related to human interference) is an illustration of deficiencies in our approach to the understanding of these northern ecosystems. As pointed out by AAGAARD (1986), northern insect conservation strategy should develop along two lines : macroscopic (biogeographic) and microscopic (biotopic).

The present paper is an attempt to review the data available on the composition of the odonate fauna of these northern regions and to look into some of the factors that could help to better understand these ecosystems.

TERRITORY AND STUDY

Quebec-Labrador is a vast territory of 1,825,780 km² in eastern Canada, situated between 45° and 62° 35' lat. N., and 55° 35' to 79° long. W. It is bordered to the north by the Hudson strait and the Ungava Bay, to the north-east and east by the Atlantic Ocean, to the south-west by the Province of New Brunswick and the Gulf of St Lawrence, to the south by the United States of America and to the west by the Province of Ontario (Fig. 1).

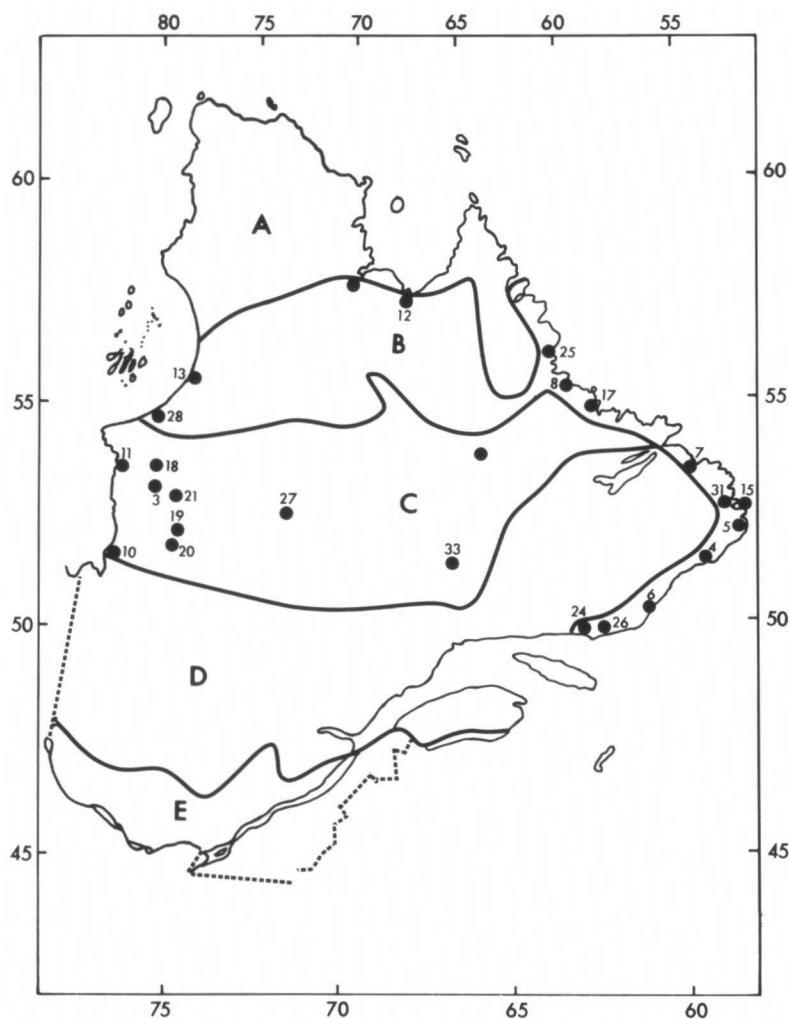


Fig. 1. Quebec-Labrador territory and localities from which Odonata were collected. A, arctic zone ; B, hemiarctic zone ; C, subarctic zone ; D, boreal zone ; E, cold temperate zone (Adapted from GILBERT *et al.*, 1985 ; LAPLANTE, 1985 ; LOPOUKHINE *et al.*, 1978 ; ROUSSEAU, 1974 ; ROWE, 1959).

Based on bioclimatic parameters (ROUSSEAU, 1974 ; WILSON, 1971 ; GILBERT *et al.*, 1985) the Quebec-Labrador territory can be divided into five zones : arctic, hemiarctic, subarctic, boreal and cold temperate (Fig. 1). The arctic, hemiarctic and subarctic zones are the ones considered in this study. DANKS (1979) has discussed the physical basis for the regional diversity of the Canadian insect fauna.

The arctic zone (Fig. 1) is an area where the number of day-degrees above 5°C is always less than 600. It refers to the cold northern regions beyond the northern limits of trees (DANKS, 1981). This is the arctic tundra of HUSTICH (1949), HARE (1950), ROUSSEAU (1974) and ROWE (1959). Permafrost is characteristic of this zone, where only the first few centimeters of soil are subjected to freezing and thawing. Because of this, there are large bogs where the ground is low and water-logged but, on higher elevation, the ground is drier and vegetation scant and scattered. In the northern part of this zone there is a grassy tundra, while in the southern part, there is a shrubby tundra. The shrubby tundra is mainly composed of glandular birch (*Betula glandulosa* Michx.), willows (*Salix anglorum* Cham., *S. planifolia* Pursch.) and green alders (*Alnus crispa* (Ait.) Pursch.). The following Ericaceae are also found : *Ladum palustre decembena* (Ait.) Lodd., *Andromenicum polifolia* L., *Cassiope tetragona* (L.) D. Don., *Rhododendron lapponicum* (L.) Wahl., and *Vaccinium vitis-idaea minus* Lodd (RICHARD, 1977). The grassy or herbaceous tundra (DANSEREAU, 1972 ; RICHARD, 1977), in dry areas, is mainly formed by a continuous carpet of the lichen *Cladonia* while, in moist areas, it is occupied by the moss *Rhacomytrium lanuginosum*. In this type of tundra are also found the Gramineae *Hierochloe odorata* (Sw.) Wahl. and the Ericaceae *Cassiope tetragona* (L.) D. Don. (RICHARD, 1977).

The hemiarctic zone (Fig. 1) is a transition zone between the arctic (tundra) and the subarctic (taïga) zone, where the number of day-degrees above 5°C are between 600 and 800. This is also an environment with a very harsh climate. This zone is the forest tundra of HUSTICH (1949), HARE (1950), GRANTNER (1966) and ROUSSEAU (1974). In this area, the arctic tundra is established on higher ground between rivers, while the forest tundra is situated along streams and rivers, and around lakes and bogs. The forest tundra is a stunted forest composed of white spruce, *Picea glauca* (Moench) Voss, black spruce, *Picea mariana* (Mill.) B.S.P. and larch, *Larix laricina* (Du Roi) K. Koch. Willows and alders are also found. White spruce is the dominant species in forest tundra along the Hudson Bay area, while black spruce and larch are co-dominant inland.

The subarctic zone (Fig. 1) is roughly situated between the 48° and 55° lat. W. The number of day-degrees above 5°C is between 800 and 1,500. This is an area occupied by either taïga (HUSTICH, 1949) or subarctic forest (ROWE, 1959). In this zone are found many bogs, marshes, streams, rivers and lakes (close to 20% of the surface). The forest is mainly composed of black spruce, *Picea mariana* (Mill.) B.S.P. on humid soils ; balsam fir, *Abies balsamea* (L.) Mill., and jack pine, *Pinus banksiana* Lamb. on drained soils. At the southern edge of this zone, white birch, *Betula papyrifera* Marsh. and balsam poplar, *Populus balsamifera* L. can also be found. This is an open forest where trees are far apart and the soil is covered with vast areas of lichen in which *Cladonia* is predominant.

COLLECTION SITES

In Figure 1 are shown the location of the sites where collections of Odonata were made. These are : Ashwanipi river (1), Aux Feuilles river (2), Bradore Bay (4), Cape St Charles (5), Cartwright (Winthem) (7), Davis Inlet (8), Eastmain river (10), Fort George (11), Fort Chimo (12), Golfe de Richmond (archipel des Hybrides, Île au Béluga, Île aux Parnassies, À l'Eau Claire river) (13), Great Caribou (15), Hopedale and Cape Hope (17), James Bay (Aux Castors river, lake Attila, lake Hélène, lake Julie, lake Nathalie, bogs and marshes) (3), La Grande river (18), lake Low (19), lake Opinaca (20), lake Sakami (21), Mecatina river (6), headwaters of the Moisie river (33), Nabisipi river (24), Nain (25), Natashquan (26), Nichequon (27), Poste de la Baleine and La Grande Baleine river (28), Shefferville (Knob lake) (29), St Lewis Inlet (31). The numbers in parentheses correspond to those in Figure 1. For each locality is given the list of authors referring to it and the year of publication of their articles.

ODONATE FAUNA

From the many early voyages of exploration prior to 1900 and the arctic expeditions of the 20th century made in Quebec-Labrador, only PACKARD (1888) reported from Caribou Island (Labrador) two odonate species. After the Second World War, the Northern Biting Fly Survey and the Northern Insect Survey contributed much to the collections of arctic and subarctic insects, mainly from Alaska, Greenland and Canada (ROSENBERG *et al.*, 1979). WALKER (1943, 1947, 1951) had the opportunity to examine the odonate species collected by those surveys. For western Canada, this author had also access to the material of the Limnological Survey of the Fisheries Board of Canada. But it has to be acknowledged that many data were obtained during short collecting trips in widely scattered localities. The names of the species used in this paper are in accordance with the systematic list proposed by DAVIES & TOBIN (1984, 1985).

LIST OF SPECIES

Lestes disjunctus SELYS

- Arctic zone : nil.
- Hemiarctic zone : ROBERT (1963) mentions that this species is found as far as the Ungava peninsula.
- Subarctic zone : Eastmain : WALKER (1943, 1953) ; James Bay (bogs, lake Julie) : PILON *et al.* (1978).

Coenagrion resolutum (HAGEN)

- Arctic zone : nil.
- Hemiarctic zone : MUTKOWSKI (1910) mentions that this species inhabits the Hudson Bay area while ROBERT (1963) mentions it in Nouveau-Québec.

- Subarctic zone : Eastmain : WALKER (1934, 1943, 1953), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978), HUTCHINSON (1975) ; Baie James (bogs, lake Hélène) : PILON *et al.* (1978) ; Natashquan : WALKER (1934, 1943, 1953), HUTCHINSON (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978) ; Shefferville : WALKER (1953), HUTCHINSON (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978).

***Coenagrion interrogatum* (HAGEN)**

- Arctic zone : nil.
- Hemiarctic zone : nil.
- Subarctic zone : James Bay (lake Hélène, lake Julie, bogs and streams) : PILON *et al.* (1978) ; Nabisipi : HARPER *et al.* (1975), PILON *et al.* (1978).

***Enallagma deserti* SELYS**

- Arctic zone : nil.
- Hemiarctic zone : Poste de la Baleine (28) : HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978). MUTTKOWSKI (1910) also lists this species for the Hudson Bay area ; ROBERT (1963) lists it for the Nouveau-Québec.
- Subarctic zone : James Bay (lake Hélène, bogs) : PILON *et al.* (1978) ; lake Low : PILON *et al.* (1978) ; Nabisipi : HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977).

***Enallagma cyathigerum* (CHARPENTIER)**

- Arctic zone : nil.
- Hemiarctic zone : Poste de la Baleine : HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977).
- Subarctic zone : Nabisipi : HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977).

***Enallagma hageni* (WALSH)**

- Arctic zone : nil.
- Hemiarctic zone : nil.
- Subarctic zone : James Bay (lake Hélène, Lake Julie, lake Nathalie, bogs) : PILON *et al.* (1978).

***Aeshna eremita* SCUDDER**

- Arctic zone : nil.
- Hemiarctic zone : Hopedale : WALKER (1912, 1943, 1958), PILON *et al.* (1978). Labrador and Hudson Bay are also listed by MUTTKOWSKI (1910).
- Subarctic zone : Bradore : WALKER (1912, 1934, 1943, 1958), HUTCHINSON (1976), HUTCHINSON & LAROCHELLE (1977) ; Fort George : WALKER (1912, 1934, 1943, 1958), HUTCHINSON (1976), HUTCHINSON & LAROCHELLE (1977). PILON *et al.* (1978) ; James Bay (lake Attila) : PILON *et al.* (1978) ; Lake Opinaca : PILON *et al.* (1978) ; Lake Low : PILON *et al.* (1978) ; Lake Sakami : PILON *et al.* (1978) ; Nabisipi : HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977) ; Natashquan : WALKER (1934, 1943, 1958), HUTCHINSON & LAROCHELLE (1977).

***Aeschna interrupta* WALKER**

- Arctic zone : nil.
- Hemiarctic zone : nil.

- Subarctic zone : James Bay (Aux Castors river, lake Julie, lake Nathalie) : PILON *et al.* (1978).

***Aeshna juncea* (LINNAEUS)**

- Arctic zone : nil.
- Hemiarctic zone : Hopedale : WALKER (1943, 1958), GIBSON (1918), PILON *et al.* (1978) ; Nain : WALKER (1943, 1958), PILON *et al.* (1978) ; Poste de la Baleine : WALKER (1951, 1958), HARPER *et al.* (1975), PILON *et al.* (1978) ; Fort Chimo : WALKER (1951, 1958), PILON *et al.* (1978) ; Golfe de Richmond (Île aux Béluga) : HARPER *et al.* (1975), HUTCHINSON (1976), HUTCHINSON & LAROCHELLE (1977). MUTTKOWSKI (1910) mention the Hudson Bay area.
- Subarctic zone : Bradore : WALKER (1934, 1943), PILON *et al.* (1978) ; Eastmain river : PILON & PELLERIN (1974), PILON *et al.* (1978) ; Fort George : WALKER (1941, 1943, 1958), PILON *et al.* (1978) ; James Bay (aux Castors river, lake Hélène, lake Julie, bogs, marshes) : PILON *et al.* (1978) ; lake Low : PILON *et al.* (1978) ; Mecatina river : WALKER (1958), HUTCHINSON & LAROCHELLE (1977) ; Natashquan : WALKER (1934, 1943, 1958), PILON *et al.* (1978) ; Shefferville : WALKER (1951), PILON *et al.* (1978).

***Aeshna subarctica* WALKER**

- Arctic zone : nil.
- Hemiarctic zone : nil.
- Subarctic zone : Eastmain : PILON & PELLERIN (1974), PILON *et al.* (1978) ; Fort George : WALKER (1934, 1943, 1958), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978). ROBERT (1963) and WALKER (1958) mention the James Bay area.

***Aeshna sitchensis* HAGEN**

- Arctic zone : nil.
- Hemiarctic zone : Hopedale : GIBSON (1918), WALKER (1943, 1958), PILON *et al.* (1978) ; Grande Baleine : WALKER (1951, 1958), PILON *et al.* (1978). MUTTKOWSKI (1910) mentions the Hudson Bay area.
- Subarctic zone : Fort George : WALKER (1934, 1943, 1959), HUTCHINSON (1976), HUTCHINSON & LAROCHELLE (1977) ; James Bay (lake Julie) : PILON *et al.* (1978) ; Lake Sakami : PILON *et al.* (1978).

***Aeshna septentrionalis* BURMEISTER**

- Arctic zone : nil.
- Hemiarctic zone : Cape Hope : WALKER (1934, 1943, 1958), ROBERT (1963) ; Davis Inlet : WALKER (1943, 1958) ; Fort Chimo : WALKER (1951, 1958), ROBERT (1963), HUTCHINSON & LAROCHELLE (1977), ROBERT (1963), HUTCHINSON (1976) ; HOPEDALE : HAGEN (1875), GIBSON (1918), WALKER (1943, 1958) ; Poste de la Baleine : HARPER *et al.* (1975), HUTCHINSON (1976). One male and one female were collected by PERRON and HAMAN at Aux Feuilles river in 1979 and identification was made by the senior author. Specimens are deposited in the Provencher Collection. HAGEN (1861) and WALKER (1912) mention Labrador as within the range of this species while MUTTKOWSKI (1910) mentions the Hudson Bay area.
- Subarctic zone : Bradore : WALKER (1934, 1943, 1958), ROBERT (1963), HUTCHINSON (1976), HUTCHINSON & LAROCHELLE (1977) ; Fort George : WALKER (1934, 1943, 1958), ROBERT (1963), HUTCHINSON (1976), HUTCHINSON & LAROCHELLE (1977).

Aeshna umbrosa WALKER

- Arctic zone : nil.
- Hemiarctic zone : HAGEN (1861, 1875), WALKER (1943, 1958) and PILON *et al.* (1978) mention the Labrador area as within the range of this species.
- Subarctic zone : James Bay (Aux Castors river, lake Hélène, lake Julie, lake Nathalie, streams, bogs and marshes) : PILON & PELLERIN (1974), PILON *et al.* (1978).

Aeshna constricta SAY

- Arctic zone : nil.
- Hemiarctic zone : nil.
- Subarctic zone : James Bay (lake Hélène, lake Nathalie, streams, bogs) : PILON *et al.* (1978).

Ophiogomphus colubrinus SELYS

- Arctic zone : nil.
- Hemiarctic zone : Hudson Bay area : (SELYS-LONGCHAMPS & HAGEN (1858), HAGEN (1861, 1875), WALKER (1943, 1958), HUTCHINSON (1976), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978).
- Subarctic zone : James Bay (Aux Castors river) : PILON *et al.* (1978) ; Eastmain : PILON & PELLERIN (1974), PILON *et al.* (1978) ; Nabisipi : HUTCHINSON (1976), HUTCHINSON & LAROCHELLE (1977).

Cordulegaster macula SELYS

- Arctic zone : nil.
- Hemiarctic zone : nil.
- Subarctic zone : James Bay (Aux Castors river, lake Hélène) : PILON *et al.* (1978).

Somatochlora walshii (SCUDDER)

- Arctic zone : nil.
- Hemiarctic zone : ROBERT (1963) mentions the Hudson Bay area as within the range of this species.
- Subarctic zone : Eastmain : WALKER (1925, 1943), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978) ; James Bay (lake Nathalie) : PILON *et al.* (1978).

Somatochlora minor CALVERT

- Arctic zone : nil.
- Hemiarctic zone : ROBERT (1963) mentions the Hudson Bay area as within the range of this species.
- Subarctic zone : Bradore : WALKER (1934), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978) ; Eastmain : WALKER (1925, 1934, 1943), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978).

Somatochlora franklini (SELYS)

- Arctic zone : nil.
- Hemiarctic zone : Fort Chimo : WALKER (1951), ROBERT (1963), WALKER & CORBET

- (1975), HUTCHINSON & LAROCHELLE (1977); Golfe de Richmond (Eau claire river): HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977); Hopedale: GIBSON (1918), WALKER (1925, 1943), WALKER & CORBET (1975); Nain: WALKER (1925, 1943), WALKER & CORBET (1975); Poste de la Baleine (a male collected by J. M. PERRON in 1980 was identified by the senior author). HAGEN (1861), MUTTKOWSKI (1910), ROBERT (1963) and HARPER *et al.* (1975) also included this species for the Hudson Bay area.
- Subarctic zone: Bradore: WALKER (1934), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978); Eastmain: WALKER (1925, 1934, 1943), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978).

***Somatochlora forcipata* (SCUDDER)**

- Arctic zone: nil.
- Hemiarctic zone: Cartwright: WALKER & CORBET (1975); Hopedale: WALKER (1925, 1943), WALKER & CORBET (1975), PILON *et al.* (1978). MUTTKOWSKI (1910) mentions the Hudson Bay area.
- Subarctic zone: Ashwanipi river: WALKER (1934, 1943), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978); James Bay (bogs): PILON *et al.* (1978); Natashquan: WALKER (1934, 1943), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978).

***Somatochlora whitehousei* WALKER**

- Arctic zone: nil.
- Hemiarctic zone: Hopedale: GIBSON (1918), WALKER (1925, 1943), WALKER & CORBET (1975), PILON *et al.* (1978); Poste de la Baleine: HARPER *et al.* (1975), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978).
- Subarctic zone: James Bay (Aux Castors river): PILON *et al.* (1978); Eastmain: HUTCHINSON & LAROCHELLE (1977); La Grande river: HUTCHINSON & LAROCHELLE (1977).

***Somatochlora septentrionalis* (HAGEN)**

- Arctic zone: nil.
- Hemiarctic zone: Cape Charles: WALKER (1943), WALKER & CORBET (1975); Hopedale: GIBSON (1918), WALKER (1925, 1943), WALKER & CORBET (1975); Poste de la Baleine: HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977). HAGEN (1861, 1875) mentions Labrador and MUTTKOWSKI (1910) the Hudson Bay area, as within the range of this species.
- Subarctic zone: ROBERT (1963) mentions the James Bay area as within the range of this species.

***Somatochlora albicincta* (BURMEISTER)**

- Arctic zone: nil.
- Hemiarctic zone: Cartwright: WALKER & CORBET (1975); Fort Chimo: WALKER (1951), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978); Golfe de Richmond (Îles aux Parnassies): HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978); Hopedale: WALKER (1925, 1943), WALKER & CORBET (1975), PILON *et al.* (1978); Nain: WALKER & CORBET (1975), PILON *et al.* (1978); Poste de la Baleine: WALKER (1951), HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978). A specimen collected in 1979 at aux Feuilles river by PERRON and HAMAN was identified by the senior author. HAGEN (1861), SELYS-

LONGCHAMPS (1871), WALKER (1943), PILON *et al.* (1978) also mention the Labrador area. MUTTKOWSKI (1910) mentions the Hudson Bay and the Labrador area.

- Subarctic zone : Bradore : WALKER & CORBET (1975) ; Eastmain : WALKER (1943), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978) ; James Bay (Aux Castors river, lake Hélène, lake Julie, lake Nathalie, bogs, streams) : PILON *et al.* (1978) ; Nabisipi : HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977) ; Shefferville : WALKER (1951), HUTCHINSON & LAROCHELLE (1977).

***Somatochlora cingulata* (SELYS)**

- Arctic zone : nil.
- Hemiarctic zone : Golfe de Richmond (archipel des Hybrides) : HARPER *et al.* (1975), ROBERT (1963), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978) ; Great Caribou : WALKER (1943), WALKER & CORBET (1975) ; HOPEDALE : WALKER (1925, 1943), WALKER & CORBET (1975). Poste de la Baleine (specimen collected by J. M. PERRON in 1979 and identified by the senior author). MUTTKOWSKI (1910) also mentions the Labrador and the Hudson Bay areas.
- Subarctic zone : Eastmain : HUTCHINSON & LAROCHELLE (1977) ; James Bay (lake Attila) : PILON *et al.* (1978) ; lake Low : PILON *et al.* (1978) ; lake Opinaca : PILON *et al.* (1978) ; lake Sakami : PILON *et al.* (1978) ; Moisie river (head waters) : EIDMANN (1935), WALKER (1925, 1934), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977) ; Nitchequon : HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978) ; Opinaca river : PILON *et al.* (1978).

***Cordulia shurtleffi* SCUDDER**

- Arctic zone : nil.
- Hemiarctic zone : Poste de la Baleine : HARPER *et al.* (1975), WALKER & CORBET (1975), PILON *et al.* (1978). MUTTKOWSKI (1910) mentions the Hudson Bay area.
- Subarctic zone : James Bay (Aux Castors river, lake Hélène, lake Julie, lake Nathalie, streams) : PILON *et al.* (1978) ; lake Low : PILON *et al.* (1978) ; Nabisipi : HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978) ; Opinaca river : PILON *et al.* (1978).

***Dorocordulia libera* (SELYS)**

- Arctic zone : nil.
- Hemiarctic zone : nil.
- Subarctic zone : lake Low : PILON *et al.* (1978) ; lake Opinaca : PILON *et al.* (1978).

***Libellula quadrimaculata* LINNAEUS**

- Arctic zone : nil.
- Hemiarctic zone : Hopedale : WALKER & CORBET (1975).
- Subarctic zone : Nabisipi : HARPER *et al.* (1975), HUTCHINSON & LAROCHELLE (1977).

***Sympetrum danae* (SULZER)**

- Arctic zone : nil.
- Hemiarctic zone : nil.
- Subarctic zone : James Bay (bogs) : PILON *et al.* (1978) ; ROBERT (1963) mentions the James Bay area.

***Sympetrum internum* MONTGOMERY**

- Arctic zone : nil.
- Hemirctic zone : nil.
- Subarctic zone : Natashquan : WALKER (1934), WALKER & CORBET (1975), HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977).

***Leucorrhinia hudsonica* (SELYS)**

- Arctic zone : nil.
- Hemirctic zone : Cartwright : WALKER & CORBET (1975) ; Fort Chimo : WALKER (1951), ROBERT (1963), WALKER & CORBET (1975), HUTCHINSON & LAROCHELLE (1977), HUTCHINSON (1977) ; Great Caribou : WALKER (1943), WALKER & CORBET (1975) ; Hopedale : WALKER (1943), WALKER & CORBET (1975) ; Poste de la Baleine : HARPER *et al.* (1975), HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977), WALKER & CORBET (1975) ; St Lewis Inlet : WALKER (1943), WALKER & CORBET (1975). Specimens collected at Aux Feuilles river in 1979 by PERRON & HAMAN were identified by the senior author. HAGEN (1861) and MUTTKOWSKI (1910) also mention the Hudson Bay area.
- Subarctic zone : Eastmain : HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977) ; James Bay (lake Attila, lake Julie, bogs) : PILON *et al.* (1978) ; La Grande river : HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977) ; Mecatina river : WALKER (1934), WALKER & CORBET (1975), HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977) ; Nabisipi : HARPER *et al.* (1975), HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978) ; Nitchequon : HARPER *et al.* (1975), HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977) ; Opinaca river : PILON & PELLERIN (1974), PILON *et al.* (1978) ; Shefferville : WALKER (1951), WALKER & CORBET (1975), HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977).

***Leucorrhinia patricia* WALKER**

- Arctic zone : nil.
- Hemiarctic zone : nil.
- Subarctic zone : Eastmain : HUTCHINSON & LAROCHELLE (1977) ; James Bay (bogs) : PILON *et al.* (1978) ; La Grande river : HUTCHINSON & LAROCHELLE (1977) ; lake Sakami : PILON & PELLERIN (1974), PILON *et al.* (1978).

***Leucorrhinia glacialis* HAGEN**

- Arctic zone : nil.
- Hemiarctic zone : nil.
- Subarctic zone : Eastmain : PILON & PELLERIN (1974), HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977), PILON *et al.* (1978) ; James Bay (lake Attika, bogs) : PILON & PELLERIN (1974), PILON *et al.* (1978) ; La Grande river : HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977) ; Nabisipi : HARPER *et al.* (1975), HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977) ; Opinaca river : PILON & PELLERIN (1974), PILON *et al.* (1978).

***Leucorrhinia proxima* CALVERT**

- Arctic zone : nil.
- Hemiarctic zone : nil.
- Subarctic zone : Eastmain : HUTCHINSON (1977) ; La Grande river : HUTCHINSON (1977), HUTCHINSON & LAROCHELLE (1977) ; lake Sakami : PILON & PELLERIN (1974), PILON *et al.* (1978).

PERSPECTIVE

There are three major difficulties in analysing the odonate fauna of Quebec-Labrador. Firstly, most northern regions are inaccessible, even to-day ; because of this, most of the available data stem from short collecting trips to wide scattered areas. Secondly, the inclemency of the northern weather often results in small and unrepresentative collections. Thirdly, as DANKS (1981) pointed out, many localities are insufficiently precisely recorded. In the study area, "Labrador", "James Bay", "Nouveau-Quebec", «Hudson Bay", "Ungava" are too often used, especially in early works. When this is, as in the case of some species, the only locality data available, it is difficult to include such a species in the known fauna because of the lack of a precise locality record. Because of these problems, it is doubtful that those collections are truly representative of the fauna.

CORBET (1979a) stated that, Odonata being predominantly tropical and sub-tropical, the number of their species declined towards the northern regions of Canada, with no species occurring significantly beyond the tree line. CORBET (1979a) and DAVIES & TOBIN (1985) added a quantitative aspect to this statement, estimating that out of the 4,875 species in the world about 194 were occurring in Canada. The present study permits a better estimation for the territory under study. Figure 2 shows the number of species in each of the bioclimatic zones : none in the arctic, 15 in the hemiarctic, 32 in the subarctic, 62 in the boreal and 128 in the cold temperate zones. The evolutionary history of this group of insects appears to really prevent their extension towards northern regions. One of the factors involved could be, as shown in Figure 3, a possible relationship between the day-degree values in each of the bioclimatic zones and the number of odonate species.

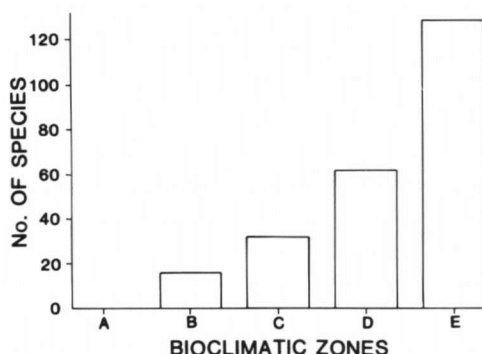


Fig. 2. Number of odonate species in each of the bioclimatic zones of Quebec-Labrador. A, arctic zone ; B, hemiarctic zone ; C, subarctic zone ; D, boreal zone ; E, cold temperate zone.

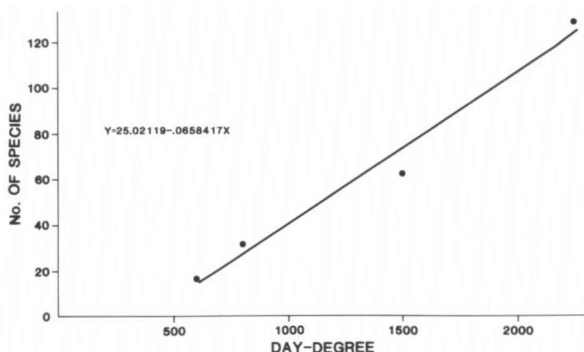


Fig. 3. Possible relationship between the number of odonate species and the day-degree values of each bioclimatic zone.

West of the Hudson Bay (Tab. I), based on WALKER (1947, 1951, 1953, 1958), WEBER (1950), WALKER & CORBET (1975) and CORBET (1979), *Enallagma deserti*, *Aeshna interrupta lineata* and *A. septentrionalis* were reported to occur in the arctic zone. In Quebec-Labrador, no species has yet been found in this zone. However, since *E. deserti* and *A. septentrionalis* occur in other bioclimatic zones of Quebec-Labrador, it is possible that they could occur in this arctic zone.

Based on the works of WALKER (1947, 1951, 1953, 1958) and WALKER & CORBET (1975), 18 species (Tab. I) inhabit the hemiarctic zone of Canada west of the Hudson Bay. In this zone of Quebec-Labrador, 15 species were found to occur by the present authors. However, we have excluded *Lestes disjunctus*, *Coenagrion resolutum*, *Aeshna umbrosa*, *Ophiogomphus colubrinus*, *Somatochlora walshii* and *S. minor* (HAGEN, 1861, 1865; MUTKOWSKI, 1910; WALKER, 1943, 1958; ROBERT, 1963; PILON *et al.*, 1978), even though they have been reported as inhabiting this zone, because of the lack of precise locality records. West of Hudson Bay, except for *Aeshna umbrosa*, these species occur in this bioclimatic zone. Along with *Lestes dryas*, *L. congener* and *Sympetrum internum*, which are listed for this zone west of Hudson Bay (WALKER, 1947, 1951, 1953, 1958; WALKER & CORBET, 1975), these species are all considered as potential inhabitants of this zone in Quebec-Labrador. The actual total for the odonate fauna of the hemiarctic zone of Quebec-Labrador probably exceeds 24 species.

WALKER (1947, 1951, 1953, 1958) and WALKER & CORBET (1975) estimated that the odonate fauna of the subarctic zone of the territory west of Hudson Bay comprises 33 species (Tab. I). In the territory under study, 32 species are known to occur in this zone (Tab. I). Moreover, 6 species not so far found in the territory under study, but occurring in other bioclimatic zones of Quebec-Labrador, have been found to occur in this zone west of Hudson Bay. They are *Lestes dryas*, *L.*

Table I

Species of Odonata of the arctic, hemiarctic and subarctic zones of Quebec-Labrador and of Canada west of the Hudson Bay and James Bay and east of the Rocky mountains.
 A : arctic zone ; B : hemiarctic zone ; C : subarctic zone ; + : species recorded in a bioclimatic zone ;
 * : species reported as inhabiting a given bioclimatic zone but there is no specific locality mentioned ;
¹ : species not found east of the Hudson Bay and James Bay ; ² : according to CANNINGS (1987), this species is inhabiting regions north of the subarctic zone

species	Quebec-Labrador			Canada west of Quebec-Labrador		
	A	B	C	A	B	C
<i>Lestes dryas</i>					+	+
<i>Lestes congener</i>					+	+
<i>Lestes disjunctus</i>		*	+		+	+
<i>Nehalennia irene</i>						+
<i>Coenagrion interrogatum</i>			+			+
<i>Coenagrion resolutum</i>		*	+		+	+
<i>Coenagrion angelatum</i> ¹						+
<i>Enallagma deserti</i>		+	+	+	+	+
<i>Enallagma cyathigerum</i>		+	+			+
<i>Enallagma hageni</i>			+			
<i>Aeshna eremita</i>		+	+		+	+
<i>Aeshna interrupta interrupta</i>			+			
<i>Aeshna interrupta lineata</i> ¹				+	+	+
<i>Aeshna canadensis</i>						+
<i>Aeshna juncea</i>		+	+		+	+
<i>Aeshna subarctica</i>			+		+	+
<i>Aeshna sitchensis</i>		+	+		+	+
<i>Aeshna septentrionalis</i>		+	+	+	+	+
<i>Aeshna umbrosa</i>		*	+			+
<i>Aeshna constricta</i>			+			
<i>Ophiogomphus colubrinus</i>		*	+			+
<i>Cordulegaster maculata</i>			+			
<i>Somatochlora walshii</i>		*	+			
<i>Somatochlora minor</i>		*	+			+
<i>Somatochlora franklini</i>		+	+			
<i>Somatochlora kennedyi</i>						+
<i>Somatochlora forcipata</i>		+	+			
<i>Somatochlora whitehousei</i>		+	+			
<i>Somatochlora septentrionalis</i>		+			+	
<i>Somatochlora sahlbergi</i> ¹					+	
<i>Somatochlora albicincta</i>		+	+		+	+
<i>Somatochlora hudsonica</i> ¹					+	+
<i>Somatochlora cingulata</i>		+	+			+
<i>Cordulia shurtleffi</i>		+	+		+	+
<i>Dorocordulia libera</i>			+			
<i>Libellula quadrimaculata</i>		+	+			+
<i>Sympetrum medidum</i> ^{1,2}						+
<i>Sympetrum costiferum</i>						+
<i>Sympetrum danae</i>			+			+
<i>Sympetrum internum</i>			+		+	+
<i>Leucorrhinia borealis</i> ¹						+
<i>Leucorrhinia hudsonica</i>		+	+		+	+
<i>Leucorrhinia patricia</i>			+			+
<i>Leucorrhinia glacialis</i>			+			
<i>Leucorrhinia proxima</i>			+			+

congener, *Nehalennia irene*, *Aeshna canadensis*, *Somatochlora kennedyi* and *Sympetrum costiferum* (WALKER, 1947, 1951, 1953, 1958 ; WALKER & CORBET, 1975).

Although it is possible to draw up a list of the Odonata inhabiting the three northern bioclimatic zones, the work of PILON *et al.* (1978) is the only reliable source of data for the northern regions of Quebec-Labrador. It analyses the fauna of an area over a period of three years, from early spring to late autumn. The repeated samplings allow interpretation of yearly differences and the effects of day-by-day changes in weather, two of the major difficulties mentioned above. *Ischnura verticalis* has to be eliminated from the possible species inhabiting the northern region mentioned by PILON *et al.* (1978), because WALKER (1934, 1953) listed, as one of the localities, Eastman and not Eastmain as stated by those authors. This was an error in paronyms.

There is still much work to be done to really understand the role of Odonata in these northern ecosystems. But, a basic requirement is certainly to improve the knowledge of the composition of this fauna and its distribution (AAGAARD, 1986).

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