water but to restrict the movement of adult mosquitoes. This study was a follow-up on that suggestion.

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RELATIVE ABUNDANCE AND SEASONAL DISTRIBUTION OF ADULT MOSQUITOES IN SOUTHERN QUEBEC

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ABSTRACT. The relative abundance and seasonal distribution of adult mosquitoes in southern Quebec, Canada, were studied using CDC light traps baited with carbon dioxide. Samples were collected twice a week from late May to early October 1977. Over 63,000 mosquitoes from 26 species in 7 genera were collected. *Mansonia perturbans*, *Aedes aurifer* and *Anopheles walkeri* were the most abundant, comprising 60%, 31% and 4% of the total collection respectively.

INTRODUCTION

Cattail marshes are extensively used for human recreation and/or as refuge for waterfowl, and many produce huge numbers of mosquitoes that cause discomfort to humans and many have an economic impact on livestock. This habitat is widespread in central and southeastern Canada, and few data are available on the mosquito fauna near such areas. The purpose of this investigation was to study the seasonal abundance of host-seeking mosquitoes near cattail marshes in southern Quebec.

MATERIALS AND METHODS

Lac Boivin, near the city of Granby (45°14′N; 72°44′W), Quebec, is a typical permanent cattail marsh. It is surrounded by Granby to the south and west, forest and dairy farms to the east, and a nature trail to the north. Cattail (*Typha* spp.) and burreed (*Sparganium* spp.) covered 80% of the surface occupied by emergent aquatic vegetation. The dominant trees bordering the shoreline were willow (*Salix* spp.), rough alder (*Alnus rugosa* (DuRoi) Sprengel), red maple (*Acer rubrum* Linnaeus) and aspen (*Populus tremuloides* Michaux). A more complete description of the vegetation is given by Leprince (1980)[1].

[1] Leprince, D. J. 1980. Les culicides (Diptera) du lac Boivin, Granby, Québec, M.Sc. Thesis, Université de Montréal, 72 pp.

Adult mosquitoes were sampled in 6 stations twice a week from 26 May to 31 August and then weekly until 4 October, 1977. CDC light traps were set in operation between 1600 hr to 2000 hr; specimens were collected between 0800 hr and 1200 hr the following morning. Traps were suspended one meter above the ground on alder trees at the interface of the marsh and the forest. Two kg of dry ice, wrapped in newspaper, were placed above each trap; the paper was torn to facilitate the sublimation of carbon dioxide. Although this type of trap samples different mosquito species unequally (Service 1976), it is useful for collecting large numbers of host-seeking mosquitoes and for revealing their pattern of abundance over time. Specimens collected were killed in a potassium cyanide (KCN) bottle, stored in a freezer at −10°C, and subsequently identified using the keys of Wood et al. (1979).

RESULTS AND DISCUSSION

Seven genera and 26 species of mosquitoes were collected (Table 1). The most abundant species, *Ma. perturbans, Ae. aurifer,* and *An. walkeri,* comprised 60%, 31% and 4% of the mosquitoes respectively. Mosquitoes were abundant (and most troublesome to humans) from late May to mid-July, after which they remained in low numbers until the end of the sampling period in October. Their seasonal succession is presented in Fig. 1; the flight period of 11 species extended for more than 100 days. Species diversity was greatest in June and July.

Aedes aurifer females were abundant from late May to late June (Fig. 1). Males were present during periods of peak female abundance. Since more than 66% of *Ae. aurifer* females were collected at 2 stations dominated by willow trees (*Salix interior* Rowlee), this habitat was suspected to be a preferential resting site. During the day this species was the most severe pest where there was tree cover, although it was not annoying in open areas.

Aedes cinereus females were present throughout the sampling period, and were most abundant in mid-June and mid-September; few were collected in August. Males were collected in early July and late September to early October; the late season males may have come from late-developing larvae hatching from non-diapausing eggs which can comprise half of the egg population (Brust 1968), or from delayed hatching of

Table 1. Mosquitoes collected with CO_2-baited CDC light traps at lac Boivin, Granby, Quebec in 1977.

Species	No. of females	No. of males
Aedes		
abserratus (Felt and Young)	102	
aurifer (Coquillett)	19770	5
canadensis (Theobald)	10	
cinereus Meigen	282	35
dorsalis (Meigen)	1	
euedes Howard, Dyar and Knab	1	
excrucians (Walker)	12	
intrudens Dyar	4	
provocans (Walker)	2	
punctor (Kirby)	15	
riparius Dyar and Knab	2	
stimulans (Walker)	30	
triseriatus (Say)	2	
vexans (Meigen)	719	18
Anopheles		
earlei Vargas	451	96
punctipennis (Say)	37	4
walkeri Theobald	2592	1
Culex		
pipiens Linnaeus	343	
restuans Theobald	195	15
territans Walker	14	41
Culiseta		
melanura (Coquillett)	15	1
minnesotae Barr	469	12
morsitans (Theobald)	173	8
Mansonia		
perturbans (Walker)	36466	1860
Psorophora		
ciliata (Fabricius)	2	
Uranotaenia		
sapphirina (Osten Sacken)	3	2
Total	61712	2098

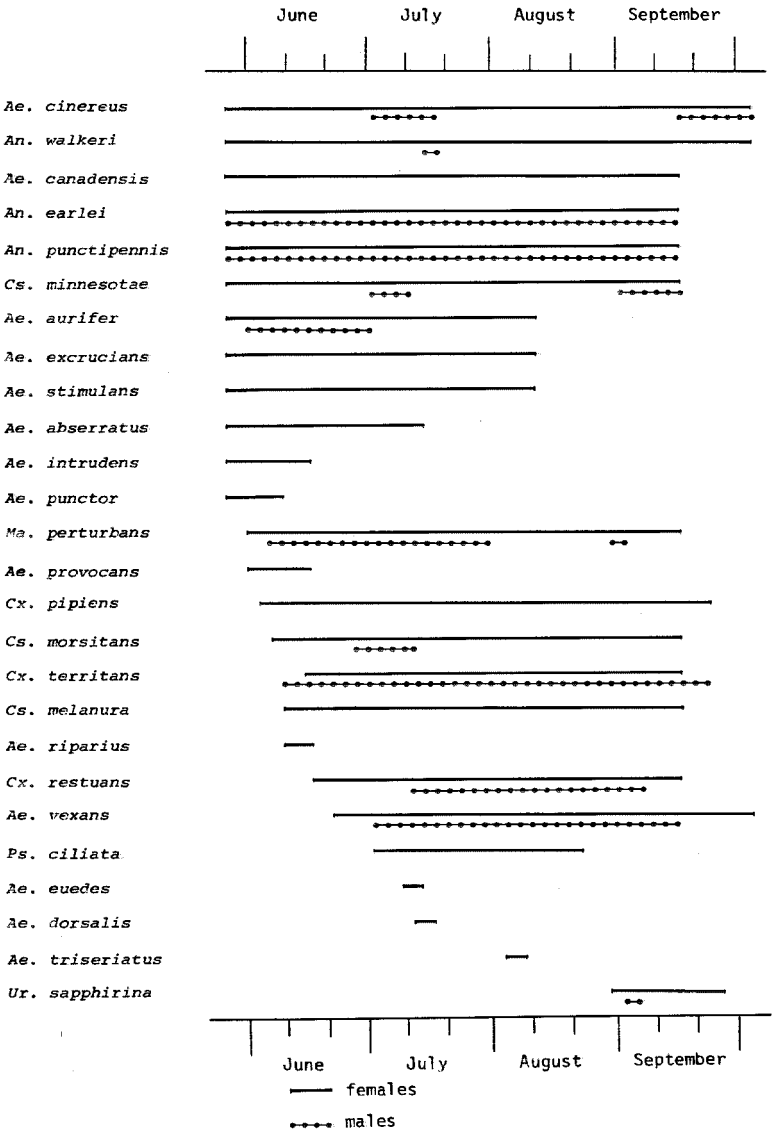

Fig. 1. Seasonal succession of mosquitoes collected with CO_2-baited CDC light traps at lac Boivin, Granby, Quebec, in 1977.

overwintering eggs, or both. This species is known to breed from early April to mid-September in southern Quebec (Harrison et al. 1980), therefore it may be bivoltine at lac Boivin.

Aedes vexans females were particularly abundant near open areas in early July and early September. Males were present from July to mid-September, suggesting that this species is breeding continuously throughout this period.

Anopheles earlei and *An. walkeri* were most abundant from mid-May to mid-June; minor peaks occurred in mid-July and early September. Males of *An. earlei* were collected throughout the sampling period; males of *An. walkeri* were collected in mid-July. *Anopheles walkeri* males are not strongly attracted to CO_2-baited CDC light traps (Table 1), but were frequently collected at dusk in open areas with an insect net. They appeared to be swarming about 1–2 meters above ground. Since larvae of both species have been collected from early May to October in Quebec (Harrison et al. 1980, Maire and Aubin 1980), they are probably at least bivoltine in lac Boivin.

Numbers of *Cx. pipiens* and *Cx. restuans* increased gradually during June becoming most abundant between mid-August and early September. Both species are probably multivoltine in lac Boivin. *Culex territans* males were more abundant and had a longer flight period than females, although it has been reported that females are not strongly attracted to light traps (Crans, 1970). This species is known to breed from mid-May to late October in southern Quebec (Harrison et al. 1980).

Culiseta minnesotae females were most abundant from late May to mid-July, after which they occurred in low numbers until mid-September. Males were collected primarily in early July and September. According to Wood et al. (1979), *Cs. minnesotae* females, like *An. earlei* and *An. punctipennis* overwinter as nonbloodfed adults and undergo successive summer generations. Females were rare in September despite the presence of males; climatic conditions at the end of the season may have prepared females for overwintering and modified their behavior toward the light traps. Based on male occurrence, *Cs. minnesotae* is at least bivoltine in the lac Boivin area.

Culiseta morsitans females showed 3 distinct peaks of abundance (although progressively smaller): mid-June, mid-July and mid-August; males were collected from late June to mid-July. This pattern of female abundance could represent distinct gonotrophic cycles since parous specimens are readily attracted to light traps (Morris et al. 1976). Because *Cs. morsitans* is known to have 2 generations in eastern Canada (Lewis and Bennett 1979) and one in New York State (Morris et al. 1976), its status as a univoltine species at lac Boivin is uncertain.

The seasonal distribution of *Ma. perturbans* is shown in Fig. 1. Females were most abundant from mid-June to mid-July, when 96% of the specimens were caught; this corresponds to the timing of peak abundance in southwestern Ontario (Allan et al. 1981), but is a little earlier than that reported by Lewis and Bennett (1980) in eastern maritime Canada. Males were collected from the beginning of June to the end of July and also a month later in early September. On 29 August and 1 September, 27 of the 47 females and 2 of the 6 males collected possessed almost all their scales, suggesting that they had recently emerged. *Mansonia perturbans* is thought to be univoltine in Canada (Wood et al. 1979, Lewis and Bennett 1980); the occurrence of males in late August and early September could have come from late developing larvae. Allan et al. (1981) reported adult emergence as late as 24 August in southwestern Ontario. *Mansonia perturbans* is thought to be univoltine at lac Boivin, but the possibility of a second generation requires further investigation. Cattail and burreed are known to be suitable attachment sites for immatures of *Ma. perturbans* (Lewis and Bennett 1980). Since nearly 80% of the aquatic emergent vegetation in lac Boivin consists of these plants, and because of the trapping tech-

nique used, the observed density of the adult population of *Ma. perturbans* was expected.

Only 2 specimens of *Ps. ciliata* were collected at lac Boivin; Leprince et al. (1978) previously reported it to be rare in Quebec.

Uranotaenia sapphirina is also a rare species and has been reported previously from Quebec by Fournier and Gauthier (1944), Twinn (1949), and Durand and de Oliveira (1977).

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