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Abundance and Flight Activity of Some Histeridae, Hydrophilidae and Scarabaeidae (Coleoptera) in Southern Quebec, Canada

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ABUNDANCE AND FLIGHT ACTIVITY OF SOME HISTERIDAE, HYDROPHILIDAE AND SCARABAEIDAE (COLEOPTERA) IN SOUTHERN QUEBEC, CANADA

Claire Levesque and Gilles-Yvon Levesque[1]

ABSTRACT

We collected adult beetles with four unbaited flight intercept traps in southern Québec, from early May through late October, in 1987, 1988 and 1989. We captured a total of 146 Histeridae (9 species), 668 Hydrophilidae (29 species) and 428 Scarabaeidae (25 species), including 25 Holarctic or introduced species in North America, mainly non-forest hydrophilids and scarabs. The Sphaeridiinae and Aphodiinae represented, respectively, 78% of hydrophilid catches and 86% of scarab captures. We suggest that adults of *Aphodius prodromus*, the most common scarab species, are generalist detritivores. Overwintered adults of this species, mainly females, flew in spring, and new generation adults occurred mainly in October. We also studied the seasonal flight activity of three histerid species (*Aeletes politus, Geomysaprinus obsidianus, Margarinotus lecontei*), ten hydrophilid species (*Anacaena* prob. *lutescens, Cercyon analis, C. assecla, C. haemorrhoidalis, C. lateralis, C. minusculum, C. pygmaeus, Cryptopleurum minutum, Helophorus orientalis, Hydrobius fuscipes*) and three other scarab species (*Aphodius granarius, A. rufipes, Dichelonyx albicollis*). All these species are probably univoltine in southern Québec.

The adults and larvae of Histeridae are chiefly predators of other insects and their larvae, and most species are associated with decaying organic material, dung, and carrion (Davies 1991). The Hydrophilidae can be divided into two groups: aquatic and terrestrial. The aquatic species occur in a wide range of habitats, but most prefer shallow standing water. The terrestrial species (only subfamily Sphaeridiinae in Canada) live in most kinds of decaying organic matter. Adults of most hydrophilid species, both aquatic and terrestrial, are scavengers (Roughley 1991). Species of the large family Scarabaeidae are found in a wide variety of habitats. Many species are dung feeders or scavengers, and adults of some groups provide the larvae with food (McNamara 1991). Many economically important species are phytophagous, with the larvae living in the soil and feeding on roots, and the adults feeding on leaves, flowers, and fruits. Larvae of other scarab species live in dead logs (Campbell et al. 1989). Coprophilous species of Histeridae, Hydrophilidae and Scarabaeidae are often studied together, particularly in research on pest fly control (see Ádám 1986; Geden and Stoffolano 1987; Červenka and Moon 1991; Peitzmeier et al. 1992). However, little is known of the abundance and seasonal activity of these three families in Canada, except for some scarab pests (see

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Campbell et al. 1989). It should also be noted that the ecological and economic importance of beetles associated with organic debris is largely unknown in Canada; it is true for aquatic and terrestrial species, particularly for histerids. We found many individuals of these three families in flight intercept traps, during a study of beetles in a raspberry (*Rubus idaeus* L.) plantation and adjacent sites in southern Québec. Some phytophagous scarabs may be pests in raspberry plantations (Campbell et al. 1989). We present results on the faunal composition of Histeridae, Hydrophilidae and Scarabaeidae in four sites adjacent to a raspberry plantation in southern Québec, and also the seasonal flight activity of some abundant species, over a three-year period (1987–1989).

MATERIALS AND METHODS

The beetles were collected from early May through late October on a raspberry farm at Johnville (45°26′N, 71°41′W, about 240 m a.s.l.), near Sherbrooke, in southern Québec, Canada. We studied beetles flying close to the ground with unbaited flight intercept traps at four sites: (1) an open site near the center of the plantation (A), about 20 m from raspberry plants; (2) an open site near a permanent pond (B), about 5 m from raspberry plants; (3) a pine woods-raspberry field boundary (C); and (4) an adjacent pine woods (D) dominated by eastern white pine, *Pinus strobus*. These traps were not located between rows of raspberry plants because of grower's activities and public access during harvest. Flight traps were modified from the large-area "window" trap design promoted by Peck and Davies (1980). Each consisted of a gray 1.5 mm mesh window screen (1.22 m height, 1.52 m width, about 1.85 m^2 of surface) fastened to a wooden frame. The frame itself was suspended by two lateral triangular wooden supports (1.83 m at the base, 1.25 m height), 2–4 cm over a set of two galvanized metal pans (25 by 61 cm at the top, 7.5 cm deep) which were placed directly on the ground. The insects were caught in the pans partially filled with 2% formalin solution into which a few drops of detergent were added. We installed one flight trap in each site. In the pine woods (D), the trap was operated in 1988 and 1989 only. Samples were collected twice a week and were pooled on a weekly basis. Levesque and Levesque (1992) presented detailed informations about study sites (including a sketch-map of the raspberry farm) and sampling method.

RESULTS AND DISCUSSION

Abundance of catches in flight traps. We captured a total of 146 Histeridae (9 species), 668 Hydrophilidae (29 species) and 428 Scarabaeidae (25 species) (Table 1).

HISTERIDAE. *Aeletes politus* (LeC.) and *Geomysaprinus obsidianus* (Casey) were the two most abundant histerid species in the two open sites (A and B), whereas *A. politus* and *Margarinotus lecontei* Wenzel were the most common species at the woods-field boundary (C) (Table 1).

HYDROPHILIDAE. We collected 18 to 24 hydrophilid species in each of the three flight traps (A, B and C) near the raspberry plants. Only three species were captured in the adjacent pine woods (D) (Table 1). Fifteen of the 29 Johnville species belonged to the subfamily Sphaeridiinae (genera *Cercyon* Leach, *Cryptopleurum* Mulsant and *Sphaeridium* Fab.), and they included 78% of hydrophilid catches. *Cryptopleurum minutum* (Fab.) was the most abundant species in the two open sites (23% of catches in site A, 34% in site

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Table 1. Total catches of Histeridae, Hydrophilidae and Scarabaeidae species in flight traps at Johnville, Québec (1987-1989).

Family and species	Open site near center (A)	Open site near pond (B)	Boundary (C)	Pine woods[a] (D)	Total	Biogeography[b]
HISTERIDAE						
Acritus nigricornis (Hoffmann)	-	-	1	-	1	I
Aeletes politus (LeC.)	38	25	12	-	75	
Atholus sedecimstriatus (Say)	1	-	-	-	1	
Geomysaprinus obsidianus (Casey)	11	17	2	-	30	
Hister depurator Say	-	-	-	5	5	
Margarinotus egregius (Casey)	-	4	8	-	12	
Margarinotus lecontei Wenzel	-	2	14	1	17	
Platysoma coarctatum J.E. LeC.	-	-	-	1	1	
Platysoma lecontei Marseul	-	4	-	-	4	
Total	50	52	37	7	146	
Number of species	3	5	5	3	9	
HYDROPHILIDAE						
Anacaena prob. *lutescens* (Stephens)	25	16	6	-	47	H
Berosus striatus (Say)	4	4	-	-	8	
Cercyon analis (Payk.)	24	9	-	-	33	I
Cercyon assecla Smet.	15	5	79	83	182	
Cercyon haemorrhoidalis (Fab.)	23	11	32	-	66	I
Cercyon lateralis (Marsh.)	5	3	8	-	16	I
Cercyon minusculum Melsh.	-	-	15	7	22	
Cercyon pygmaeus (Ill.)	17	6	27	1	51	I
Cercyon quisquilius (L.)	4	-	2	-	6	I
Cercyon terminatus (Marsh.)	1	-	-	-	1	I
Cercyon unipunctatus (L.)	-	-	1	-	1	I
Cercyon ustulatus (Preyssler)	2	-	-	-	2	I
Crenitis digesta (LeC.)	3	2	2	-	7	
Crenitis monticola (Horn)	1	-	-	-	1	
Cryptopleurum minutum (Fab.)	50	49	25	-	124	I
Cryptopleurum subtile Sharp	2	6	2	-	10	I
Cymbiodyta blanchardi Horn	-	-	1	-	1	
Cymbiodyta vindicata Fall	7	3	-	-	10	
Helophorus angusticollis d'Orch.	1	1	-	-	2	
Helophorus frosti Smet.	1	-	-	-	1	
Helophorus grandis Ill.	2	4	-	-	6	I
Helophorus orientalis Mots.	11	9	6	-	26	H
Hydrobius fuscipes (L.)	14	10	1	-	25	H
Hydrochus sp.	1	-	-	-	1	
Laccobius reflexipennis Cheary	1	-	1	-	2	
Paracymus subcupreus (Say)	6	5	-	-	11	
Sphaeridium bipustulatum Fab.	1	1	1	-	3	I
Sphaeridium lunatum Fab.	-	1	1	-	2	I
Sphaeridium scarabaeoides (L.)	-	-	1	-	1	I
Total	221	145	211	91	668	
Number of species	24	18	18	3	29	
SCARABAEIDAE						
Aegialia humeralis Brown	-	-	-	1	1	
Aphodius aenictus Cooper & Gordon	-	-	-	1	1	
Aphodius distinctus (O.F. Müller)	5	-	1	-	6	I
Aphodius erraticus (L.)	2	-	-	-	2	I
Aphodius fimetarius (L.)	-	-	5	-	5	I
Aphodius granarius (L.)	7	9	16	-	32	I
Aphodius leopardus Horn	-	-	3	-	3	

Continued

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Table 1. Continued.

Family and species	Open site near center (A)	Open site near pond (B)	Boundary (C)	Pine woods[a] (D)	Total	Biogeography[b]
SCARABAEIDAE (cont.)						
Aphodius manitobensis Brown	–	–	4	–	4	
Aphodius prodromus (Brahm)	92	60	117	6	275	I
Aphodius rubripennis Horn	–	–	2	1	3	
Aphodius rufipes (L.)	–	–	19	–	19	I
Aphodius ruricola Melsh.	2	1	1	–	4	
Aphodius stercorosus Melsh.	1	–	–	–	1	
Ataenius strigatus (Say)	–	3	–	–	3	
Bolboceras liebecki (Wallis)	1	–	7	–	8	
Dialytes striatulus (Say)	–	–	7	–	7	
Dichelonyx albicollis (Burm.)	–	–	24	2	26	
Diplotaxis tristis Kirby	–	–	1	–	1	
Hoplia trifasciata Say	1	–	1	–	2	
Macrodactylus subspinosus (Fab.)	1	1	2	–	4	
Onthophagus nuchicornis (L.)	–	–	1	–	1	I
Phyllophaga sp.	–	1	4	–	5	
Serica atracapilla (Kirby)	–	–	1	2	3	
Trichiotinus assimilis (Kirby)	2	–	–	–	2	
Trox variolatus Melsh.	–	–	5	5	10	
Total	114	75	221	18	428	
Number of species	10	6	19	7	25	

[a] Not sampled in 1987.
[b] H = Holarctic species, I = Introduced species in North America.

B), while *Cercyon assecla* Smetana was common at the woods-field boundary (37% of catches) and in the pine woods (91% of catches). Seventeen Holarctic or introduced species in North America mentioned by Roughley (1991) were present at Johnville (63% of all hydrophilid catches). Almost all these individuals were collected in the three flight traps (A, B and C) near the raspberry plants (Table 1).

Anacaena prob. *lutescens* (Stephens), *Helophorus orientalis* Mots. and *Hydrobius fuscipes* (L.) were the most abundant aquatic Hydrophilidae collected at Johnville (Table 1). These two later species may frequent a wide range of aquatic habitats, particularly shallow standing pools with plenty of vegetation (Smetana 1988).

SCARABAEIDAE. The Scarabaeidae were most diverse at the woods-field boundary, characterized by a very heterogenous vegetation, with 19 of the 25 scarab species collected at Johnville (Table 1). Fifteen aphodiine species (genera *Aegialia* Latreille, *Aphodius* Illiger, *Ataenius* Harold and *Dialytes* Harold) represented 86% of all scarab catches. *Aphodius prodromus* (Brahm) (64% of all scarab catches), an exotic species, was predominant in the three sites (A, B and C) near the raspberry plants (Table 1). Only seven species from Johnville were introduced in North America according to McNamara (1991), but these represented 79% of catches in the four flight traps. We captured only four adults of *Macrodactylus subspinosus* (Fab.) (Table 1), one of the eight pest scarab species known to attack raspberry in Canada (Campbell et al. 1989).

THREE FAMILIES. Almost all the histerids belonged to native species in the four sites (Table 1). Native hydrophilids constituted 18% of catches in the site

A, 14% in the site B, 46% in the site C, and 99% in the site D. Nearctic scarabs represented about 7% of captured individuals in the two open sites (A and B), 28% at the boundary and 67% in the pine woods. Hence, individuals of non-native species of Hydrophilidae and Scarabaeidae were more frequently caught in the traps A, B and C than in the pine woods. We observed a depauperate fauna of the three families in the site D.

Most exotic Sphaeridiinae and Aphodiinae caught at Johnville are coprophilous species that often coexist in European and North American pastures (e.g. Kessler and Balsbaugh 1972, Merritt and Anderson 1977, Hanski 1980a, Heijerman 1990, Cervenka and Moon 1991, Peitzmeier et al. 1992). All the species of *Cercyon* and *Cryptopleurum* from Johnville occur in various kinds of decomposing organic matter (Smetana 1988). According to Gordon (1983), the introduced species of *Aphodius* in North America are mostly generalist dung feeders. *Aphodius rufipes* (L.) occurs in the forested mountain regions in the northeastern North America, whereas the other species prefer open pastures and bovine dung (Gordon 1983). Large numbers of *Aphodius prodromus* in the unbaited flight traps at Johnville would indicate that adults of this species feed on other kinds of decomposing organic matter and they would be generalist detritivors. Larvae of *Aphodius granarius* (L.) may damage the roots of grasses and sprouting corn in North America (Campbell et al. 1989).

Merritt and Anderson (1977) studied the dynamics of insects in cattle droppings in four Californian ecosystems; they argued that the numbers of species and individuals were lowest in areas where environmental factors were more limiting. Apparently it was also the case at Johnville since the pine woods (D), a site with very sparse vegetation, supplied little opportunities for most species of Histeridae, Hydrophilidae and Scarabaeidae, except for *Cercyon assecla*. Most species captured at Johnville would be associated with organic debris, probably decaying vegetable matter; the vegetation was richest in the three sites near raspberry plants than in the pine woods (see Levesque and Levesque 1992).

Seasonal flight activity of some abundant species. HISTERIDAE. The microhisterid *Aeletes politus* flew primarily from May to July (Fig. 1). Over the three-year period (1987–1989), we observed one flight period in *Geomysaprinus obsidianus* (in summer, mainly in July) and in *Margarinotus lecontei* (from May to July) (Table 2). We suggest that the flight period of these three species would be their reproduction period, and that *A. politus* and *M. lecontei* overwinter as adults, whereas *G. obsidianus* overwinters as larvae.

HYDROPHILIDAE. The aquatic hydrophilids *Anaceana* prob. *lutescens, Helophorus orientalis* and *Hydrobius fuscipes* flew mainly in May at Johnville (Table 2). We observed two tenerals of *H. fuscipes* in July-August. Apparently, these three species are univoltine and overwinter as adults in southern Québec. Adults of these species flew probably from terrestrial overwintering sites towards aquatic habitats in May. According to Larson (1987), all Canadian aquatic hydrophilid species are probably univoltine, with overwintering in the adult stage. In Europe, *H. fuscipes* probably breeds during early summer, and the new generation adults would emerge in late summer or during autumn (Obrtel 1972, Landin 1976). However, *H. orientalis* females from Waterloo (southern Ontario) flew from late April until early November, the largest numbers occurring during June and July (Angus 1970).

Cercyon analis (Paykull) flew from May until August, mainly in July (Table 2). We observed the flight of *Cercyon assecla* from May to October, chiefly in spring and early summer (May-July), and we captured three tenerals in July-August (Fig. 1).

Two flight periods were observed in *Cercyon haemorrhoidalis* (Fab.), from

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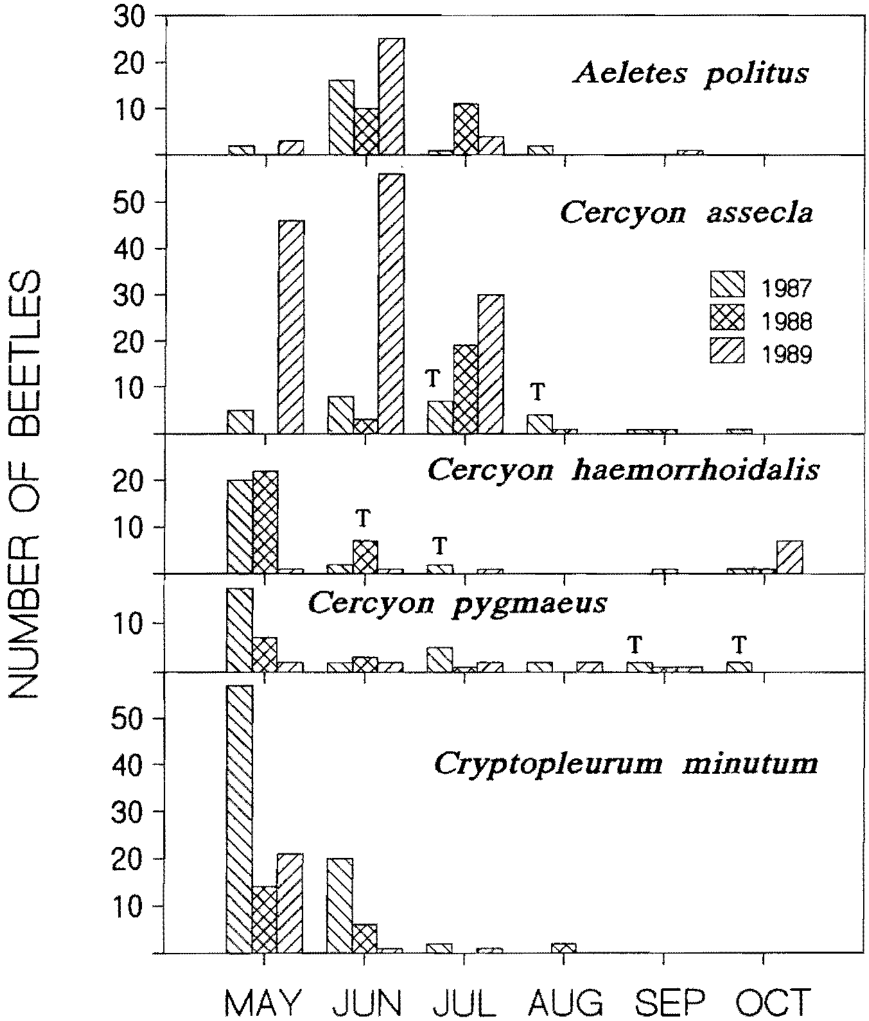

Figure 1. Seasonal abundance of *Aeletes politus, Cercyon assecla, Cercyon haemorrhoidalis, Cercyon pygmaeus* and *Cryptopleurum minutum* at Johnville (Québec).

May until July, and in September-October (Fig. 1). Peak captures occurred in May and a few tenerals were present during the first period. In Illinois, Johnson (1975) found this species in small-mammal carcasses in a sugar maple forest, from April through October, chiefly during September and October. In southern England, Hanski (1980b) collected adults in dung-baited pitfall traps

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Table 2. Seasonal abundance of some species in flight traps at Johnville, Québec (1987–1989).

Family and species	Beetles caught					
	May	June	July	Aug.	Sept.	Oct.
HISTERIDAE						
Geomysaprinus obsidianus		8	19	3		
Margarinotus lecontei	5	8	4			
HYDROPHILIDAE						
Anacaena prob. *lutescens*	37	4	3	2	1	
Cercyon analis	7	6	19	1		
Cercyon lateralis	7	3	2	1		3
Cercyon minusculum	1	13	4	4		
Helophorus orientalis	23	1			2	
Hydrobius fuscipes	16	5	3T	1T		
SCARABAEIDAE						
Aphodius granarius	20	11	1			
Aphodius rufipes			9	9	1	
Dichelonyx albicollis	2	22	2			

T = Tenerals.

from April until October, and they were very common from June to September.

We caught *Cercyon lateralis* (Marsh.) from May until August, and also a few adults in October (Table 2). In Poland, Klimaszewski and Peck (1987) found this species in large numbers during May (386 beetles), and only two individuals in August, in the fungus *Polyporellus squamosus*. However, in southern England, *Cercyon lateralis* occurred throughout the whole season (April-October) in baited pitfall traps, mainly in May-June and August-September (Hanski 1980b). According to Kessler and Balsbaugh (1972), this species was common from mid-June to late September in bovine manure in South Dakota.

We collected *Cercyon minusculum* Melsh. from May to August, mainly in June (Table 2). *Cercyon pygmaeus* (Ill.) flew from May to October, and two tenerals were caught in autumn (Fig. 1). This species was common between mid-June and late September in bovine manure in South Dakota (Kessler and Balsbaugh 1972). In southern England, adults of this species were captured in baited pitfall traps from May to October (Hanski 1980b).

We believe that *Cercyon analis, C. assecla, C. haemorrhoidalis, C. lateralis, C. minusculum* and *C. pygmaeus* are univoltine in southern Québec. However, Hanski (1980b) argues that all the species of *Cercyon* are multivoltine in southern England where climatic conditions are milder than in Québec.

Cryptopleurum minutum flew from May until August, with peak captures in May (Fig. 1). In Missouri, this species preferred older cattle manure and was most abundant during the first week of August (Wingo et al. 1974). In southern England, adults were collected in baited pitfall traps from April until September, mainly in August (Hanski 1980b). Differences between our observations and those of previous studies may be associated with the overwintering stage, the type of activity (flight or breeding), the use of bait and/or climatic differences between sites.

SCARABAEIDAE. Overwintered adults of *Aphodius granarius* flew in spring and in early summer (Table 2). This species is possibly univoltine in southern Québec, while Campbell et al. (1989) suspect the presence of two generations per year in southern Ontario. This species was most abundant in May in fresh cattle manure dung pats in Minnesota (Cervenka and Moon 1991). Heijerman

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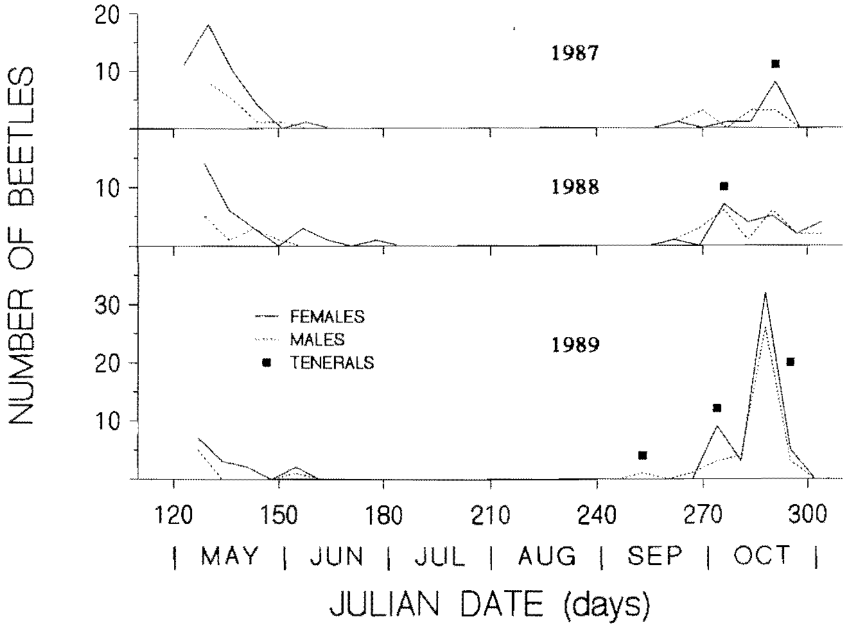

Figure 2. Seasonal abundance of females and males of *Aphodius prodromus* at Johnville (Québec).

(1990) argued that *A. granarius* was a summer species in mammal faeces in The Netherlands. However, in southern England, this species was collected in baited pitfall traps from April until July, and mainly in June (Hanski 1980b).

We observed two flight periods in *Aphodius prodromus*: the first in early season (May-June) probably during the breeding period of overwintered adults, and the second in late season (September-October) characterized by the presence of several new generation adults (Fig. 2). Over the three-year study, we collected more females than males (2.3♀: 1.0♂) during the first flight period, and the sex ratio was more close to one (1.2 ♀: 1.0♂) over the second flight period. Our observations agreed generally with previous studies in Minnesota and in Europe (Hanski 1980b, Holter 1982, Ádám 1986, Cervenka and Moon 1991).

Aphodius rufipes was primarily captured in July and August (Table 2). This species is univoltine and overwinters as prepupae (Holter 1979). In Europe, this species is also captured mainly in late summer (August), and coprophagous adults are observed from April until October (Hanski 1980b, Holter 1979, 1982).

Dichelonyx albicollis (Burm.) flew from May until July, mainly in June (Table 2). This melolonthine species possibly overwinters as larvae, and new emerged adults are active only during the breeding period. According to Dillon and Dillon (1972), this species occurs in late spring and feeds on pine foliage in eastern North America.

THREE FAMILIES. Most of the abundant species flew mainly in spring and/or

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in early summer (June-July) in the four sites at Johnville. All the abundant species are probably univoltine in southern Québec.

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