# ABUNDANCE AND SEASONAL ACTIVITY OF PILL BEETLES (COLEOPTERA: BYRRHIDAE) IN A RASPBERRY PLANTATION AND ADJACENT SITES IN SOUTHERN QUÉBEC (CANADA)[1]

**Claire Levesque, Gilles-Yvon Levesque[2]**

ABSTRACT: Four hundred and thirty eight adults of three Byrrhidae species were collected with pitfall traps and flight intercept traps, from early May through late October during 1987-1989, in a raspberry plantation and adjacent sites in southern Québec. The two most common species at the soil surface of the raspberry plantation were *Simplocaria semistriata* and *Chaetophora spinosa,* both adventive in North America. *Chaetophora spinosa* flight activity occurred mainly in May and June, in open sites near raspberry plants, and adult overwintering was probable. However, adults of *S. semistriata* were active mainly in October and this species probably overwinters chiefly as larvae.

The taxonomy of the 34 North American species of Byrrhidae has been treated recently by Johnson (1991*a*). In Canada and Alaska, this family is represented by 26 species, all of which are bryophagous and express microhabitat specificity (Johnson 1991*b*). The herbivorous larvae live in soil and feed generally on mosses and, incidentally, on liverworts, lichens, on roots of wild grasses, weeds, oats, clovers, and roots of young trees in forest nurseries or plantations (El Moursy 1961; Lindquist and Ingram 1968; Campbell *et al.* 1989).

Recently, Johnson (1990) argued that *Chaetophora spinosa* (Rossi) and *Simplocaria semistriata* (Fab.), both adventive in North America, inhabit cultural steppe, a semi-synanthropic environment containing numerous non-native insects. We collected both species in a raspberry plantation and adjacent sites in southern Québec, during a three-year study (1987-1989). To test Johnson's hypothesis, we present results on the abundance and seasonal activity of these byrrhid species.

## MATERIALS AND METHODS

Beetles were collected from early May through late October in a monocultural raspberry farm at Johnville, near Sherbrooke, in southern Québec, Canada. We sampled from fields of the Boyne cultivar in this conventionally cultivated plantation (about 7 ha on sandy soil).

Ground surface-active beetles were sampled with pitfall traps at the following sites: 1) a raspberry row planted in 1978 (**old plants**), 2) a raspberry row planted in 1985 (**young plants**), 3) a woods-field boundary (**boundary**),

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[2] 291 rue des Diamants, Fleurimont, Québec, Canada J1G 4A1.

and 4) an adjacent wooded site dominated by eastern white pine, *Pinus strobus* L . **(pine woods).** Pitfall traps consisted of glass jam jars (450 ml, 6.5 cm diameter at the top) partially filled with 100 ml of 4% formalin. Traps were inserted into the soil beneath the canopy as close to the cane of raspberry plants as possible at the first two sites. At each site, 20 traps were set in a row (5 m apart) and were emptied weekly.

In addition, we studied beetles flying close to the ground with flight intercept traps at four sites: 1) an open site near the center of the plantation **(A),** about 20 m from old plants; 2) an open site near a pond **(B),** about 5 m from young raspberry plants; 3) a woods-field boundary **(C);** and 4) a pine woods **(D).** 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 into which a few drops of detergent were added. We installed one flight trap at each site; however, the trap was operated in 1988 and 1989 only in the pine woods (D). Samples were collected twice a week and pooled on a weekly basis.

Levesque and Levesque (1992) presented detailed information about the sampling methods and study sites, including a sketch-map of the raspberry farm.

## RESULTS AND DISCUSSION

We collected 438 adults of three byrrhid species: 131 in pitfall traps and 307 in flight traps. The two adventive species, *S. semistriata* and *C. spinosa,* were common at the ground surface (98% of catches), primarily in raspberry rows (Table 1). However, only *C. spinosa* was abundant in the four flight traps (94% of catches); this species flew mainly in the two open sites (A and B) (Table 1). The third species, *Cytilus alternatus* (Say), a Nearctic byrrhid, showed a minor occurrence at Johnville (Table 1). Voucher specimens of both adventive species are deposited in the Canadian National Collection (Ottawa).

Adults of *Chaetophora spinosa* flew from early May to mid-September (Fig. 1); two flight periods occurred, the main peak between mid-May and mid-June, and a minor second peak in late summer. In addition, adults were active at the ground surface from early May until late October, without a defined capture peak (Fig. 1). This species probably overwinters as adults.

Table 1. Total catches of three Byrrhidae species in pitfall and flight traps at Johnville, Québec (1987-1989).

| Traps and sites | *Chaetophora spinosa* (Rossi) | *Cytilus alternatus* (Say) | *Simplocaria semistriata* (Fab.) | Total |
|---|---|---|---|---|
| PITFALL TRAPS | | | | |
| Old plants | 39 | 1 | 33 | 73 |
| Young plants | 13 | – | 33 | 46 |
| Boundary | 4 | 2 | 5 | 11 |
| Pine woods | 1 | – | – | 1 |
| Total | 57 | 3 | 71 | 131 |
| FLIGHT TRAPS | | | | |
| Open site near center (A) | 178 | 1 | 3 | 182 |
| Open site near pond (B) | 68 | 1 | 3 | 72 |
| Boundary (C) | 31 | 3 | 8 | 42 |
| Pine woods [a] (D) | 11 | – | – | 11 |
| Total | 288 | 5 | 14 | 307 |

[a] not sampled in 1987

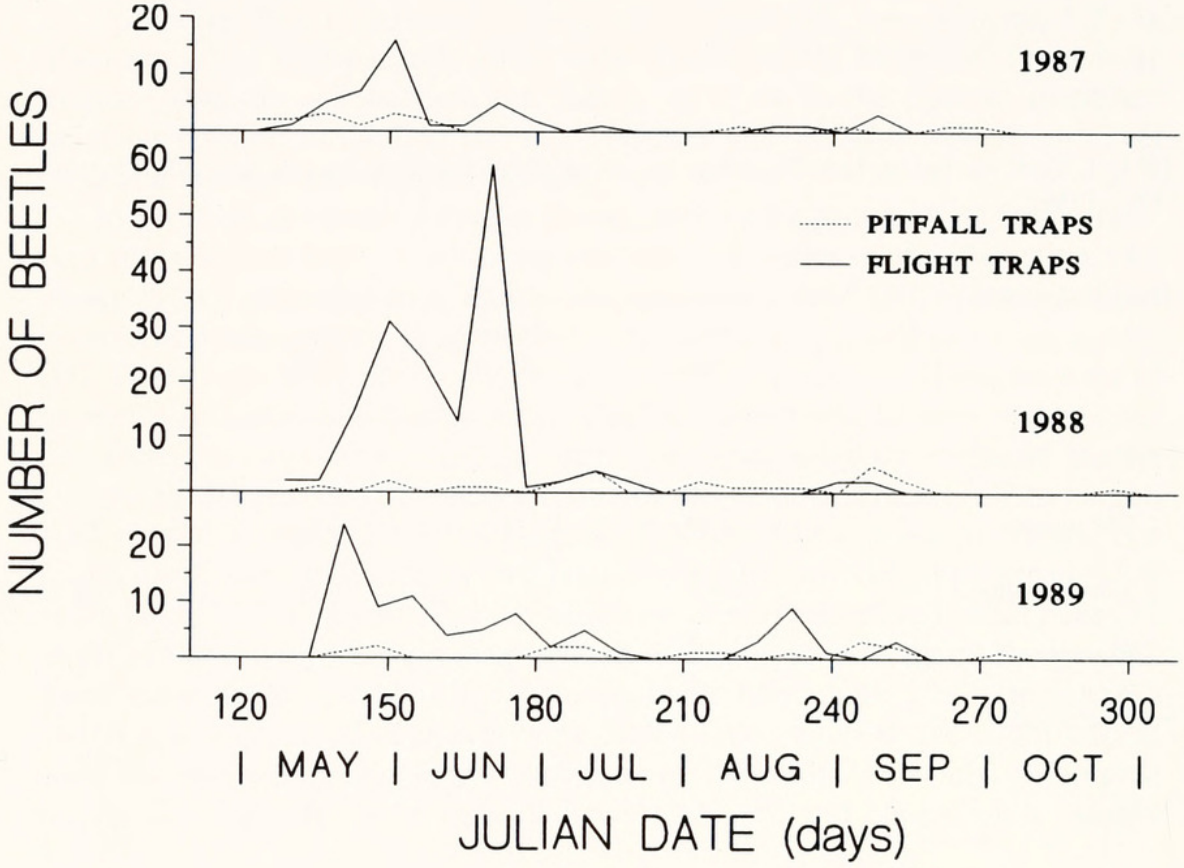


Fig. 1. Seasonal abundance of *Chaetophora spinosa* in pitfall and flight traps at Johnville, Québec.

By pitfall traps, we captured *Simplocaria semistriata* in autumn, mainly in October, and a few overwintered adults were also caught in May (Fig. 2). During the three-year study, we collected adults in flight traps, generally in September (11 of 14 individuals), probably during the dispersal period of the new generation preceding the mating period (Fig. 2). In addition, a teneral beetle was collected in a flight trap in September. According to Johnson (1990), sexually active adults were present in early October in Massachusetts, and overwintering was probably accomplished by the first instar larvae and senescing adults since live adults were not found during late spring and summer. However, at Johnville, the presence of two individuals in the flight trap C on July 10, 1988 suggests that a few adults would emerge early at the boundary. We did not collect byrrhid larvae and we did not examine gut contents.

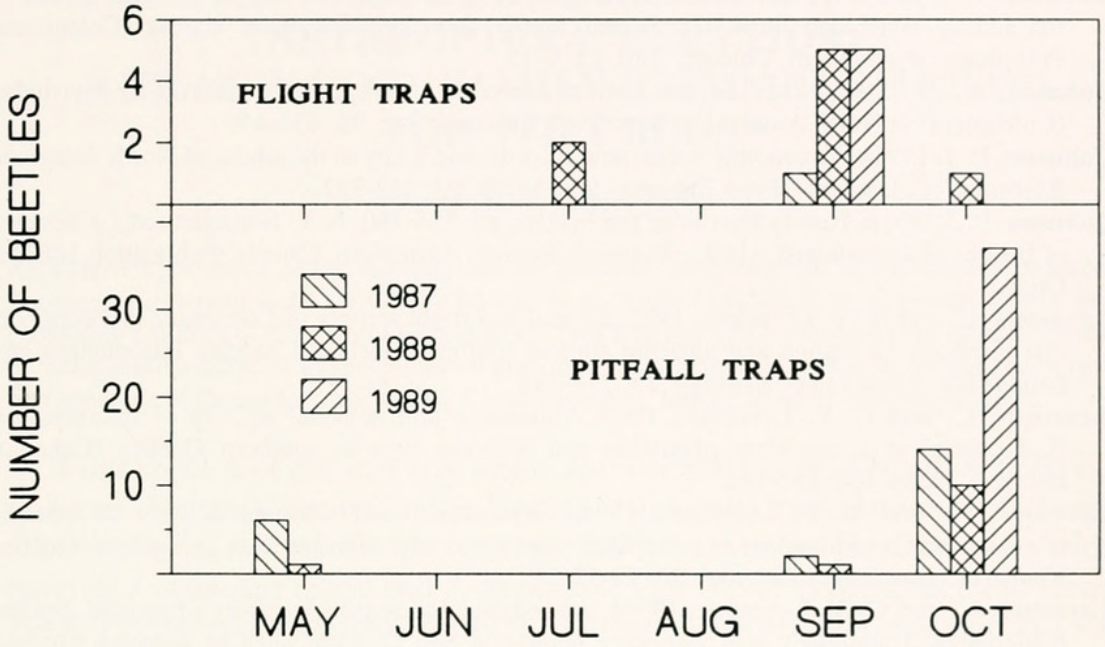


Fig. 2. Seasonal abundance of *Simplocaria semistriata* in pitfall and flight traps at Johnville, Québec.

Like Johnson (1990), we believe that *C. spinosa* and *S. semistriata* may be associated with various agroecosystems in North America, such as cultural steppes containing numerous non-indigenous insects. In addition, the beetle fauna near raspberry plants included many other adventive species, sometimes captured in large numbers, such as *Clambus armadillo* (DeGeer) (Clambidae), *Otiorhynchus ovatus* (L.) and *Sciaphilus asperatus* (Bonsd.) (Curculionidae), and *Pterostichus melanarius* (Ill.) (Carabidae) (Levesque and Levesque 1993, 1994a, 1994b).

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## LITERATURE CITED

**Campbell, J. M., M. J. Sarazin and D. B. Lyons.** 1989. Canadian beetles (Coleoptera) injurious to crops, ornamentals, stored products, and buildings. Research Branch, Agriculture Canada, Publication 1826, Ottawa.

**El Moursy, A. A.** 1961. A tentative classification of and a key to the North American genera of the family Byrrhidae (new sense) and family Syncalyptidae (new status) (Coleoptera, Polyphaga, Byrrhoidea). Coleopt. Bull. 15: 9-15.

**Johnson, P. J.** 1990. Notes on the naturalization of two species of European Byrrhidae (Coleoptera) in North America. J. New York Entomol. Soc. 98: 434-440.

**Johnson, P. J.** 1991*a*. Taxonomic notes, new records, and a key to the adults of North American Byrrhidae (Coleoptera). Proc. Entomol. Soc. Wash. 93: 322-332.

**Johnson, P. J.** 1991*b*. Family Byrrhidae pill beetles, pp. 158-160, *In* Y. Bousquet (ed.), Checklist of beetles of Canada and Alaska. Research Branch, Agriculture Canada, Publication 1861/E, Ottawa.

**Levesque, C. and G.-Y. Levesque.** 1992. Epigeal and flight activity of Coleoptera in a commercial raspberry plantation and adjacent sites in southern Québec (Canada): Introduction and Nitidulidae. Great Lakes Entomol. 25: 271-285.

**Levesque, C. and G.-Y. Levesque.** 1993. Abundance and seasonal activity of Eucinetoidea (Coleoptera) in a raspberry plantation and adjacent sites in southern Québec (Canada). Entomol. News 104: 180-186.

**Levesque, C. and G.-Y. Levesque.** 1994*a*. Abundance and seasonal activity of weevils (Coleoptera, Curculionidae) in a raspberry plantation and adjacent sites in southern Québec (Canada). Great Lakes Entomol. 26: 23-37.

**Levesque, C. and G.-Y. Levesque.** 1994*b*. Abundance and seasonal activity of ground .beetles (Coleoptera: Carabidae) in a raspberry plantation and adjacent sites in southern Québec (Canada). J. Kansas Entomol. Soc. 67: 73-101.

**Lindquist, O. H. and W. Ingram.** 1968. The pill beetle, *Cytilus alternatus* (Coleoptera: Byrrhidae), a nursery pest in Ontario. Can. Entomol. 100: 1113-1114.

**Peck, S. B. and A. E. Davies.** 1980. Collecting small beetles with large-area "window" traps. Coleopt. Bull. 34: 237-239.