

# Releases and first recovery of *Lathrolestes ensator* (Hymenoptera: Ichneumonidae) in North America, a parasitoid of *Hoplocampa testudinea* (Hymenoptera: Tenthredinidae)

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The European apple sawfly, *Hoplocampa testudinea* (Klug), is a pest of apple, *Malus pumila* Bork. (Rosaceae), in orchards. Introduced from Europe onto Long Island, New York, in 1939, it gradually invaded the New England states (Pyenson 1943). Downes and Andison (1942) also reported the apple sawfly on Vancouver Island in 1940. In 1979, *H. testudinea* was discovered for the first time in southern Quebec (Paradis 1980), after which it spread throughout the apple-growing areas of this province (Vincent and Mailloux 1988). There are no published records on any natural enemies of *H. testudinea* in North America.

*Lathrolestes ensator* Brauns (Hymenoptera: Ichneumonidae) is a solitary larval endoparasitoid known to attack only the European apple sawfly (Cross *et al.* 1999). It has been found in Poland (Jaworska 1987), the Netherlands (Zijp and Blommers 1993), Germany (Babendreier 1998), Switzerland (Babendreier 1998), and Italy (U Kuhlmann, unpublished data). *Lathrolestes ensator* is univoltine and is well-synchronized with its host. Only late first and second instar larvae can be parasitized successfully, even when there is a preponderance of third instars available (Babendreier 1996, 1998). A classical biological control program was initiated to introduce *L. ensator* to Canada by Agriculture and Agri-Food Canada in collaboration with CABI Bioscience Centre (formerly International Institute of Biological Control).

To collect *L. ensator*, apples damaged by *H. testudinea* were collected in Switzerland, Germany, and The Netherlands and transferred to the CABI Bioscience Centre laboratory in Delémont, Switzerland, where they were placed on wire screens over plastic trays to allow for emergence of *H. testudinea* larvae from the fruit and subsequent evaluation of parasitism. All larvae collected were examined individually for parasitism by *L. ensator* using a dissecting microscope. The parasitized host larvae (typically showing a dark spot inside) were placed onto soil into which they burrowed and formed cocoons. These cocoons were overwintered in a subterranean insectary. Prior to shipment to Canada, they were stored in darkness at 5°C to delay development and to allow for optimal host–parasitoid synchronization for release in Canada. In spring each year (1995–1999), cocoons were flown to the Agriculture and Agri-Food Canada National Quarantine facility in Ottawa. In May, a few weeks before the bloom stage of ‘MacIntosh’

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**Table 1. Releases of *Lathrolestes ensator* adults in Frelighsburgh, Quebec, 1995–1999.**

Release date	Apple tree phenological stage	Country of origin*	No. of <i>Lathrolestes ensator</i> released		
			Males	Females	Total/year
1 June 1995	Petal fall	CH	64	74	138
30 May 1996	Petal fall	CH	9	3	
4 June 1996	Petal fall	CH	10	8	30
5 June 1997	Bloom	CH	12	7	19
20 May 1998	Fruit set	CH, GER, NL	27	126	
22 May 1998	Fruit set	CH, GER, NL	18	10	
26 May 1998	Fruit set	CH, GER, NL	22	82	
29 May 1998	Fruit >1 cm	CH, GER, NL	18	23	326
21 May 1999	Full bloom	CH	18	52	
26 May 1999	Full bloom	CH	14	7	91
Total			212	392	604

\* CH, Switzerland; GER, Germany; NL, The Netherlands.

apple trees at the release site in Frelighsburgh (45°03'N, 75°50'W), Quebec, the cocoons were stored at 16°C for a few days and at 18°C to allow emergence of the adult parasitoids in the quarantine facility. Emergence of *L. ensator* adults started in May and lasted for several days under quarantine laboratory conditions at 18°C; protandry was observed. All male *L. ensator* emerged in the first 5 d. Females began to emerge on the fourth day. Upon emergence, adults were kept in groups and allowed to mate. They were shipped by ground to the Horticultural Research and Development Center at Saint-Jean-sur-Richelieu, Quebec.

*Lathrolestes ensator* adults were released for 5 consecutive years in an insecticide-free apple orchard located on the experimental farm of Agriculture and Agri-Food Canada at Frelighsburgh, Quebec (Table 1). This 0.66-ha orchard, composed chiefly of 12-year-old 'MacIntosh' trees, has historically harbored high populations of *H. testudinea* (Vincent and Mailloux 1988). To measure the importance of sawfly populations, an assessment of primary (*sensu* Miles 1932, *i.e.*, fruit showing ribbon scars on the epidermis) damage to the fruit was done at harvest each year. There was 2.6, 1.2, 1.0, 1.4, 1.8, and 7.2% ( $n = 500$  fruit) of fruit showing primary damage at harvest in 1993, 1994, 1995, 1996, 1997, and 1998, respectively.

To verify if *L. ensator* could successfully overwinter, fruitlets showing *H. testudinea* secondary (*sensu* Miles 1932, *i.e.*, fruitlets pierced with circular holes showing frass at the entry point) damage were collected on 3 and 11 June 1998. Six plots randomly positioned within the orchard were prepared by digging 60 × 90 × 20 cm (length × width × depth) of soil underneath apple trees. A geotextile membrane was installed in the bottom and filled with soil that had been sieved (6 mm mesh size). Six hundred fruit (about 1.5 cm in diameter) showing secondary damage were placed on the sieved soil of each plot. They were covered with a screen (2 mm mesh size) to allow them to overwinter in the orchard. Dissection of 300 fruit from the same lot revealed that each fruit contained one larva.

On 4 May 1999, the soil of each of the six plots was sieved (3 mm mesh size) and 474, 363, 384, 400, 72, and 421 sawfly cocoons were found in these plots. The cocoons were transferred at 20°C in an incubator. A total of 1401 sawfly adults emerged between 11 May and 4 June 1999. Two female adult *L. ensator* emerged, demonstrating the first recovery of this parasitoid in North America. These two females were released on 1 and 8 June 1999 in the Frelighsburgh orchard (*i.e.*, fruit about 1 cm in diameter).

Three other specimens were deposited as vouchers in the National Insect collection in Ottawa. Their identification was confirmed by Andy Bennett, Royal Ontario Museum, Toronto, Ontario.

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