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Introduced leaf beetles of the Maritime Provinces, 9: *Chaetocnema concinna* (Marsham, 1802) (Coleoptera: Chrysomelidae)

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Abstract

The taxonomy, nomenclature, identification, introduction history, biology, and economic importance of *Chaetocnema concinna* (Marsham, 1802) are reviewed, and its status as pest or beneficial insect is discussed. While it is the most important pest of sugar beet in Europe, its economic importance has not yet been demonstrated in North America.

Chaetocnema concinna is widely distributed in Nova Scotia and Prince Edward Island and presently known from only two localities in New Brunswick. On the basis of voucher specimens available, we determined that it was introduced in these provinces in the late 1980s. Since *C. concinna* is associated with many species of plants and can be either harmful or beneficial, we consider that "brassy flea beetle" is the most appropriate popular name available.

Key words: Chrysomelidae, *Chaetocnema concinna*, brassy flea beetle, Maritime Provinces, Canada, adventive species, introduced Coleoptera

Introduction

The Palaearctic flea beetle, *Chaetocnema concinna* (Marsham, 1802) was first reported in North America by Hoebeke (1980) and Hoebeke & Wheeler (1983) from a female specimen collected on sudangrass (*Sorghum sudanense* (Piper) Stapf) in a farm in Hingham, Massachusetts in 1979. Subsequently, LeSage (1990) reported it in Canada from specimens collected on Prince Edward Island and on Cape Breton Island in Nova Scotia. White (1996) added Texas to its distribution in his revision of the North American fauna. Recently, Wescott *et al.* (2006) reported it for the first time in Oregon.

Chaetocnema concinna has been found in association with a large number of host plants with preferences for species in the Polygonaceae (Newton 1929; Clark *et al.* 2004). In Europe, larvae have been found feeding on the roots of buckwheat (*Fagopyrum* spp.), hemp (*Cannabis sativa* L.), sorrel (*Rumex* spp.), and rhubarb (*Rheum* spp.), and adults have often been reported to damage seedlings of sugar beets (*Beta vulgaris* L.) (Clark *et al.* 2004).

Several common names have been applied to *Chaetocnema concinna,* although none has yet been officially recognized: the *brassy* or *tooth-legged turnip-flea* (Ormerod 1881; Curtis 1883), the *hop flea* or *brassy hop flea* (Ormerod 1881), the *brassy flea-beetle* (Carpenter 1916), *brassy tooth-legged flea-beetle* (Newton 1929), the *beet flea beetle* (Dunning 1975; Cooke 1992), the *mangel flea beetle* (Nature Navigator 2004), the *mangold flea beetle* (Vappula 1965; Thomas *et al.* 1968; Brocks 1980; Davidyan 2006), and the *sugarbeet flea* (Gadzhieva (2002). The name *brassy flea beetle* referring to its coloration seems the most appropriate to us since *C. concinna* is found on a large variety of host plants.

In the present paper, we review the literature related to the biology and economic importance of *C. concinna* on a global basis since most of the available information has been published in Europe. In addition, we will examine its introduction history in North America, and more specifically its distribution and dispersal in the Maritime Provinces of Canada.

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Methods and conventions

Abbreviations (following Evenhuis 2009) of collections referred to in this study are:

ACNS	Agriculture and Agri-Food Canada, Kentville, Nova Scotia, Canada
ACPE	Agriculture and Agri-Food Canada, Charlottetown, Prince Edward Island, Canada
CBU	Cape Breton University, Sydney, Nova Scotia, Canada
CGMC	Christopher G. Majka Collection, Halifax, Nova Scotia, Canada
CNC	Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada
JCC	Joyce Cook Collection, (now at the New Brunswick Museum, Saint John, New Brunswick, Canada)
JOC	Jeffrey Ogden Collection, Truro, Nova Scotia, Canada
NSAC	Nova Scotia Agricultural College, Bible Hill, Nova Scotia, Canada
NSMC	Nova Scotia Museum Collection, Halifax, Nova Scotia, Canada
NSNR	Nova Scotia Department of Natural Resources, Shubenacadie, Nova Scotia, Canada
SMU	Saint Mary's University, Halifax, Nova Scotia, Canada
UPEI	University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada.

Taxonomy and nomenclature

The genus *Chaetocnema* was erected by Stephens (1831) with *C. concinna* (Marsham, 1802) subsequently designated by Westwood (1838) as the type species. In North America, several *Chaetocnema* species were sporadically described by early entomologists until LeConte (1878) provided the first identification key to the sixteen species known to him. Twenty-five were treated by Horn (1889) in his synopsis of the Halticini of boreal America, and this work has been, for many years, the only important publication on North American *Chaetocnema*. The first world catalog of the genus included over 400 species (Heikertinger & Csiki 1940). Gentner (1953) revised the North American species of genus for his doctoral dissertation, but unfortunately, never published his revision. The whole North American fauna was revised by White (1996). There are some unresolved questions with respect to the generic type species which will be addressed in a forthcoming revision of the European species of *Chaetocnema* (A. Konstantinov, pers. comm.).

Chaetocnema concinna is a very common Palaearctic species, originally described within the genus *Chrysomela* Linnaeus (Marsham 1802). It was redescribed by many authors and the reader is referred to the world catalogue of Heikertinger & Csiki (1940) for older references. Among the most recent works deserving mention is the synthesis of Doguet (1994) on the French fauna, which includes keys to all species, detailed descriptions of the adults, illustration of male and female genitalia, and information on the biology and distribution of species. The distribution of the flea beetles in the Palaearctic subregion (primarily Western Europe) was summarized by Gruev & Döberl (1997, 2005). *Chaetocnema concinna* was also treated in the textbook of Warchałowski (2003) on the leaf beetles of Europe and the Mediterranean area, in the Eastern European fauna of Bienkowski (2004), and in the atlas of the fauna of Britain and Ireland (Cox 2007).

Species of the genus *Chaetocnema* Stephens are often divided into the subgenera *Chaetocnema s. str.* and *Tlanoma* Motschulsky, 1845, but according to White (1996), the nasal keel which is supposed to distinguish the latter subgenus from the former is highly variable and therefore a poor character for grouping species. In addition, White (1996) argued that *Tlanoma* cannot be treated as a subgenus of *Chaetocnema* because both have the same type species (*C. concinna*). Instead, this author arranged the North American species within twelve species groups defined by several external features. *Chaetocnema concinna* was assigned to the *confinis* group which, among others, is characterized by having only a few large punctures above each eye, the elytral punctures arranged in regular rows, and usually being of small size. However, this arrangement was not employed in the most recent catalog of the North American Chrysomelidae (Riley *et al*. 2003).

Diagnosis and identification

Chaetocnema concinna adults are 1.5–2.3 mm long with an elliptical body. The body and the appendages are dark bronze (Fig. 1). The frontal carina is narrowly raised. The vertex is finely alutaceous, with 3–6 large punctures inserted beside the eyes. The elytral punctures are arranged in regular rows. The basal submarginal row of punctures is gradually obliterated towards the middle. The chromosomal formula of the spermatogonial cells of *Chaetocnema* species is usually 10 + Xy, and it seems that in this genus the numeric karyological evolution decreased by fusion (Petitpierre & Segarra 1985; Segarra & Petitpierre 1985; Petitpierre *et al*. 1988). Virkki (1988), who reviewed the cytotaxonomy of the Alticini (flea beetles), gave the general meiformula of *Chaetocnema* spp. as 10 to 12 + Xy_p (Xy_r).

Useful works for the identification of the northeastern North American adults of *Chaetocnema* species are Chagnon & Robert (1962), Downie & Arnett (1996), Riley *et al*. (2002), and Ciegler (2007).

Since *Chaetocnema concinna* is a Palaearctic species, the monography of Doguet (1994) on the French alticine fauna, the handbook of Konstantinov & Vandenberg (1996) on the Palaearctic flea beetles, the identification keys of the leaf beetle fauna of European and Mediterranean leaf beetle fauna by Warchałowski (2003), and the fauna of Eastern Europe by Bienkowski (2004) are useful as well. Borowiec (2008) provided color photographs of adults and male genitalia of all European species including *C. concinna*.

Chaetocnema concinna is almost impossible to distinguish externally from *C. picipes* Stephens, 1831 [= *C. laevicollis* (Thomson, 1866)] except, according to Doguet (1994), for the last antennomere which is slightly flattened in the male *C. concinna*, whereas it is regularly conical in the male *C. picipes*. In dorsal view, the sides of the aedeagus of *C. concinna* are evenly concave and the apex conical (Fig. 3) whereas the sides are slightly sinuous and narrowed before apex in *C. picipes*. In the female, the spermatheca varies from somewhat pear-shaped to subcylindrical in *C. concinna* (Fig. 4), and consequently very similar to that of *C. picipes*.

In North America, keys to adults of *C. concinna* were provided by White (1996). Downie & Arnett (1996) did not include this species in their work on the beetles of Northeastern North America although this flea beetle was previously reported from this area by Hoebeke (1980), Hoebeke & Wheeler (1983), and LeSage (1990).

The *Chaetocnema* fauna of the Maritime Provinces of Canada is probably richer than the current literature indicates, but to this point only three native species have been reported in addition to the introduced *C. concinna* (LeSage 1991). In *Chaetocnema cribrata* LeConte, 1878, the elytral punctures are irregular at base, whereas they are arranged in regular rows from base to apex in *C. concinna* (Fig. 1). The head punctures are numerous, minute, and evenly distributed in *C. minuta* Melsheimer, 1847, but there are usually 3–4 (occasionally up to 8) large punctures above the eyes in *C. concinna*. The antennae and legs are reddish yellow and markedly paler than the body color in *C. confinis* Crotch, 1873, whereas they are dark brown, as dark as the body color in *C. concinna* (Fig. 1).

The eggs of *C. concinna* are still unknown and the microsculpture of the chorion of any *Chaetocnema* species has yet to be illustrated. Poos (1955) stated that the eggs of *C. pulicaria* Melsheimer, 1847 were white and cylindrical (0.19 mm x 0.41 mm) with the surface "finely, irregularly and densely punctate", while those of *C. denticulata* Illiger, 1807 were pale yellow and 0.6 mm long. The egg of *C. ectypa* is minute (0.35 x 0.15 mm), its microsculpture with a creamy white luster (Wildermuth 1917a).

The larvae of *C. concinna* have not yet been fully described, although it is one of the commonest species of the genus. *Chaetocnema* larvae are white, whereas the head, pronotal dorsal plate, legs, and abdominal sclerites are black (Fig. 5a). The dorsal plate of the ninth abdominal segment varies in shape and chaetotaxy with species (Fig. 5e, f). The size of full grown larvae ranges between 4 to 5 mm. In his treatment of the Danish leaf beetle larvae, Henriksen (1924) mentioned that *Chaetocnema* larvae can be distinguished from those of *Phyllotreta* by the body shape and setal pattern but provided no further details. Ogloblin (1927) described and illustrated in detail the mouth parts, head chaetotaxy, appendages, and body sclerites of the larva of *C. breviuscula* Faldermann, 1837. According to Newton (1929), full grown *Chaetocnema* larvae possess three pairs of long submental setae and similar head chaetotaxy, irrespective of species. However, the

FIGURE 1. *Chaetocnema concinna,* habitus in dorsal view. Length 1.8–2.2 mm.

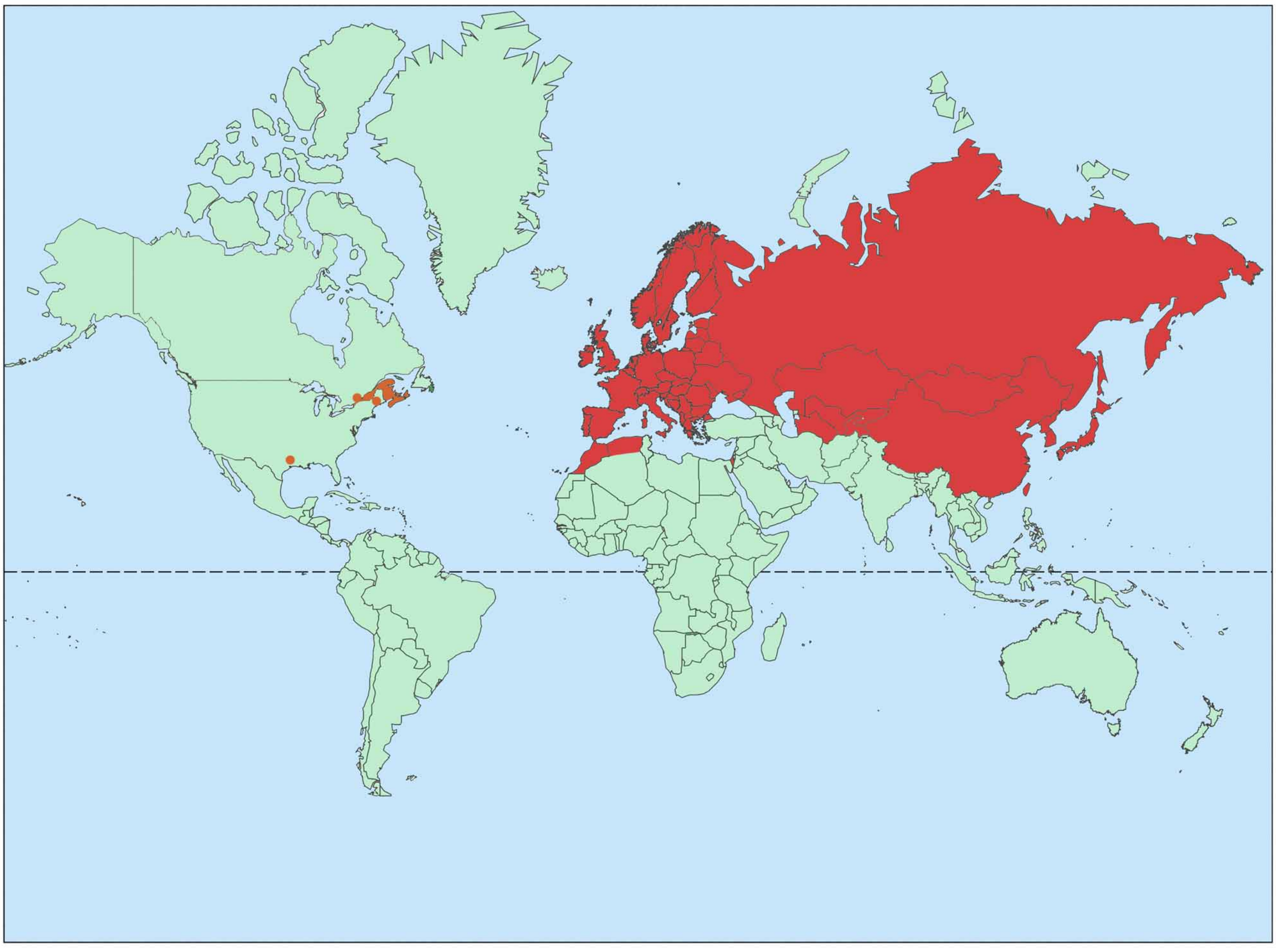

FIGURE 2. World distribution of *Chaetocnema concinna*. Natural Eurasian distribution indicated in red (on a country-by-country basis), introduction zones in North America indicated in orange.

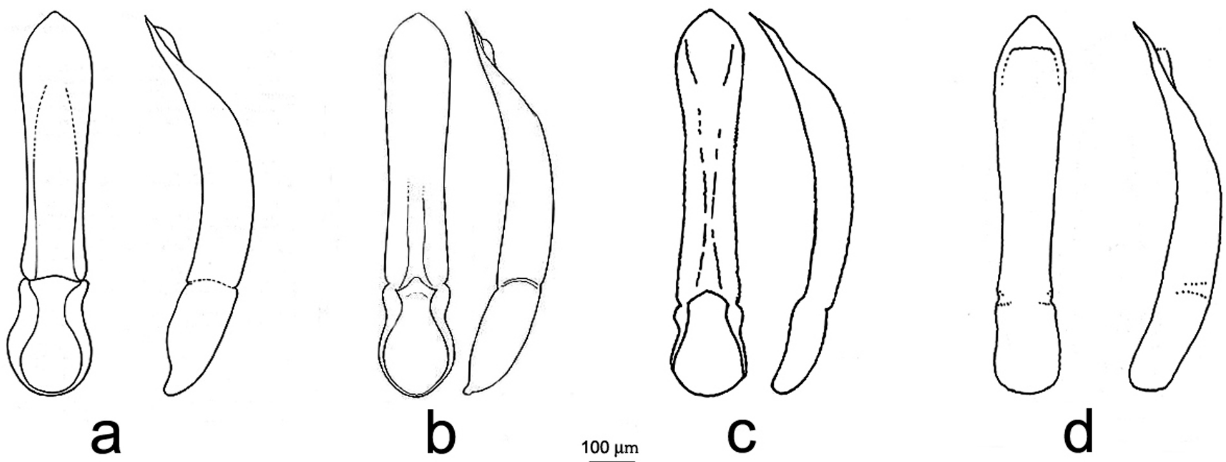

FIGURE 3. Median lobe of the aedeagus of *Chaetocnema concinna* as illustrated by various authors: a, LeSage (1990); b, Fogato & Leonardi (1980); c, Doguet (1994); d, White (1996).

scutal sclerites of the dorsal plates are medially fused or separated according to species (Figs. 5b, c, d). The dorsal and lateral habitus of the larva of *C. aridula* (Gyllenhall, 1827), which feeds on oats, were first illustrated by Mesnil (1930), and later reproduced by Balachowsky & Mesnil (1935). Both are excellent guides for the recognition of *Chaetocnema* larvae in general. The identification keys of Medvedev & Zaitsev

(1978), or Doguet (1994), use the arrangement and shape of the dorsal sclerites of the abdomen, relying little on the chaetotaxy, the morphology of the mouth parts or the characters of the legs.

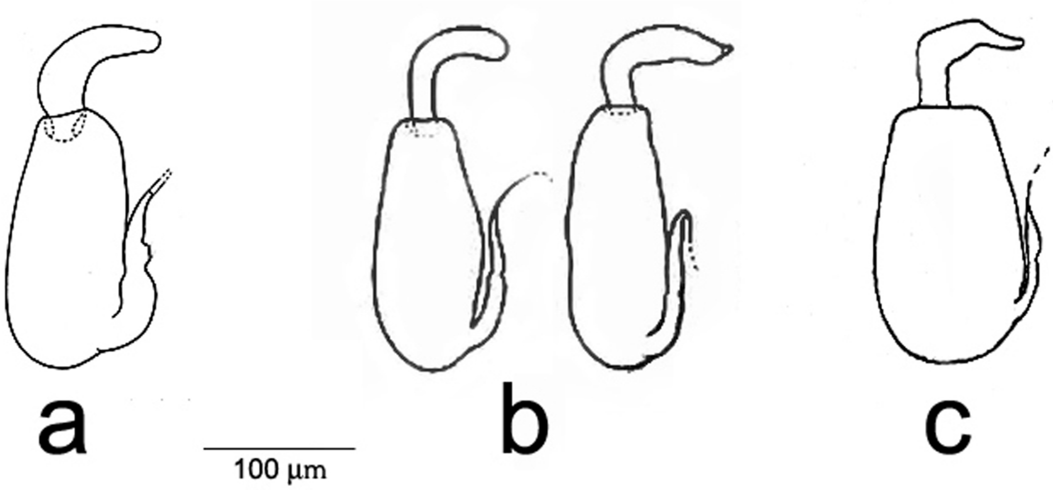

FIGURE 4. Spermatheca of *Chaetocnema concinna* as illustrated by various authors: a, LeSage (1990); b, Fogato & Leonardi (1980); c, Doguet (1994).

In North America, Smith (1909) provided a rough illustration the larva of *C. confinis* collected from the roots of sweet potato (*Ipomoea batatas* (L.) Lam.), but his illustration does not allow for the identification of the larva, even at a generic level. Bøving & Craighead (1931) sketched an undetermined *Chaetocnema* larva possibly of *C. denticulata* Illiger, 1807. Anderson (1938) detailed the larva of *C. denticulata* and *C. pulicaria* with good illustrations of the body sclerites and head chaetotaxy. He stated that in *C. concinna* and *C. pulicaria,* the scutal sclerites were united across the mid-dorsal lines, whereas these sclerites were separated in *C. denticulata*.

Egg bursters are present on meso- and metathorax in *Chaetocnema* larvules as in *Phyllotreta*, some *Longitarsus*, *Epitrix*, etc. In addition, there are two small ventral setae on the egg burster tubercles of *C. concinna* and *C. hortensis* (Fourcroy, 1785; Cox 1988, 1994a).

Wildermuth (1917a) illustrated the pupa of *Chaetocnema ectypa* Horn, 1889, but his illustration is very sketchy and of little utility since it shows the ventral view, whereas the diagnostic characters are on the dorsal surface. According to Newton (1929), the pupa of *C. concinna* is very similar to that of *Phyllotreta cruciferae* Goeze, 1777. In the pupae of both species, there are three pairs of large setae on head, and two transverse pairs on the mesothorax, metathorax, and the first six abdominal segments. The last segment is dorsally roughened into a dorsal plate which bears three pairs of lateral setae, and which is apically prolonged into a pair of acute, inwardly-curved urogomphi (Fig. 6). The large urogomphi protect the posterior part of the body from abrasion since they are present only in pupae with head positioned upright (Cox 1998).

Historical review

Chaetocnema concinna is widely distributed throughout much of Europe (except for Iceland and Sardinia) and North Africa, east across the Middle East, central Asia, Kazakhstan, Mongolia, Russia, and Siberia to China, Korea, and Japan (Gressitt & Kimoto 1963; Lopatin 1977; Gruev & Döberl 1997, 2005; Davidyan 2006; Biondi 2010; Cox 2007) (Fig. 2).

As noted earlier, in North America, *C. concinna* was first reported by Hoebeke (1980) and Hoebeke & Wheeler (1983) from a specimen collected in Massachusetts in 1979. Subsequently, LeSage (1990) reported several individuals collected in 1983 from Cape Breton Island, Nova Scotia, and from Prince Edward Island collected between 1985–1989. Lévesque & Lévesque (1998) reported it from Québec, from specimens collected in 1987–1989, and Riley *et al*. (2003) listed additional records from New Brunswick and Ontario in Canada, and Maine and Texas in the United States. Nugent (2005) and Westcott (2006) reported specimens collected in 2004 in Oregon, the first record of this species in western North America.

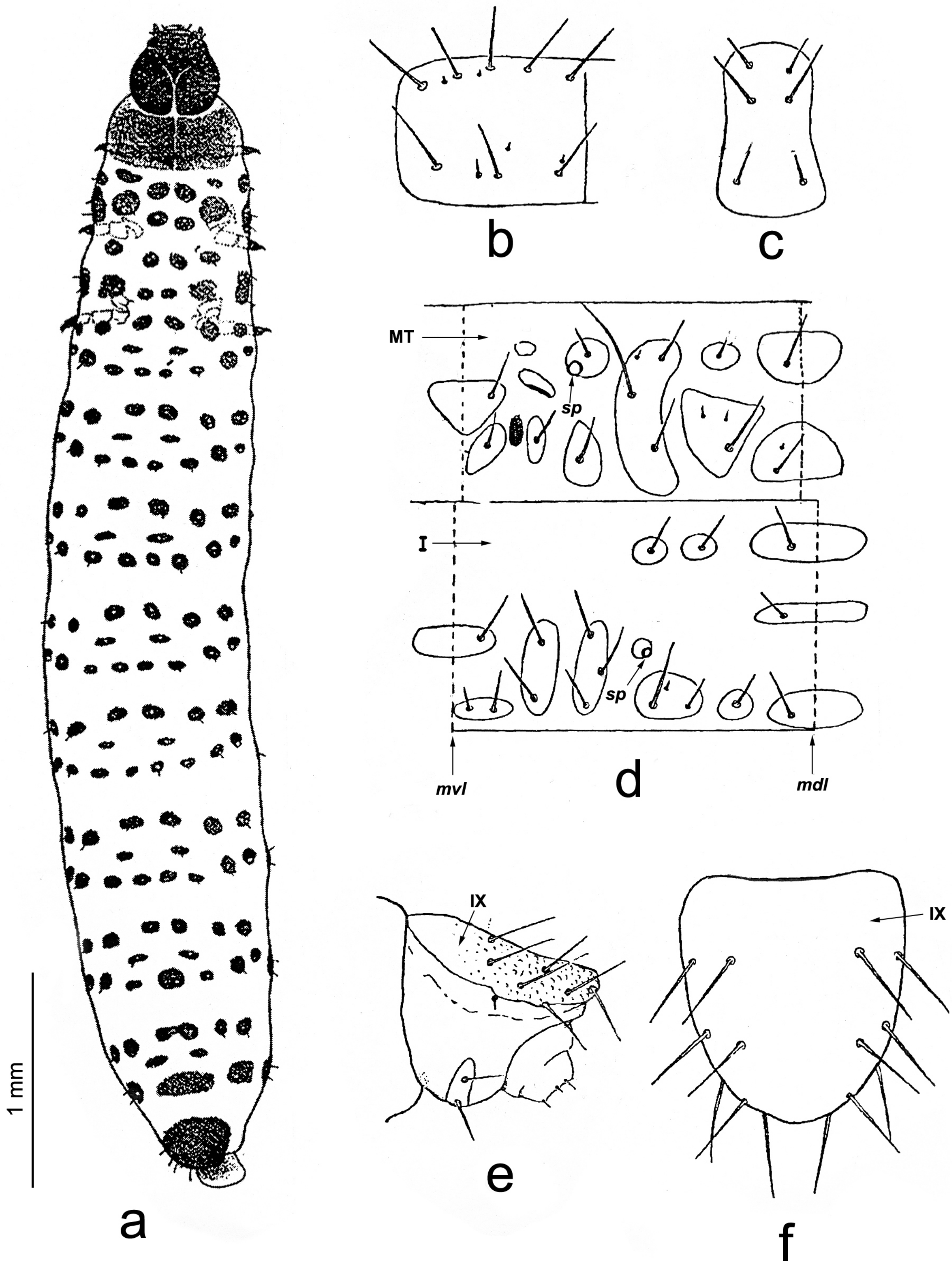

FIGURE 5. Larva of *Chaetocnema aridula*: a, habitus of larva, dorsal view, after Mesnil (1930). Sclerites of the larva of *C. concinna* after Newton (1927): b, left half of the prothoracic sclerite; c, prothoracic sternal plate; d, sclerites of metathorax (MT) and first abdominal segment (I).; e, lateral view of last abdominal segment (IX); f, tergite of abdominal segment IX. Abbreviations: *mdl*, mid dorsal line; *mvl*, mid ventral line; *sp*, spiracle.

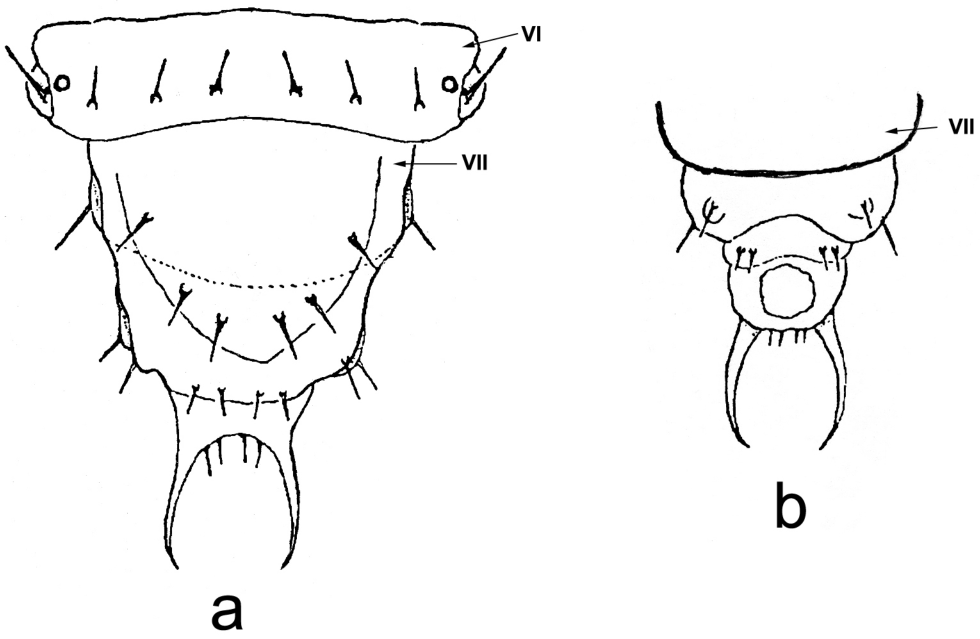

FIGURE 6. Pupa of *Chaetocnema concinna*. Last abdominal segments: a, dorsal view; b, ventral view, both modified from Newton (1927).

Biology

Chaetocnema concinna is found in a wide variety of habitats, in forests as well as fields and prairies. In Hungary, it is a common element of the leaf beetle assemblages in basswood and maple canopies, but only as visiting or "tourist" species (Vig & Markó 2004, 2005). It is also found in abandoned pear and apple orchards, however, the flying adults come from the neighboring vegetation since these fruit trees are not their host plants. *Chaetocnema concinna* was among the most abundant species in various moist habitats in Isparta and Burdur in Turkey (Gök & Aslan 2006) and in montane field habitats in Austria (Pjaniĉ & Thaler 1981). LeSage *et al*. (2009) considered *C. concinna,* and several other flea beetle species, as companion species of grape pests in two vineyards of the Eastern Townships in Québec, Canada, since these flea beetles were thriving on various weeds within the vineyards, but not on grape itself. It was the third most common leaf beetle species at the *L'Orpailleur* vineyard and the fourth at *Dietrich-Jooss* amongst the 59 species of leaf beetles collected in these two vineyards in 1997–1999. It was a negligible element of the leaf beetle fauna in raspberry fields at Johnville in southern Québec where it was replaced by the native *C. minuta* (Lévesque & Lévesque 1998).

Most of the present information on the biology of *C. concinna* was compiled from European literature since the species has been little investigated in North America. In Europe, *C. concinna* overwinters as adults which emerge at the end of March and the beginning of April when the temperature is above 8–9°C. They search for appropriate host plants, and the feeding of adult *C. concinna* is characterized by numerous small holes bordered by a narrow line of dead brown leaf paremchym (Jourdeuil 1963). Under unusual conditions, they are probably able to disperse over considerable distances like the adults of *C. pulicaria* which were caught by airplane very high in the air in Louisiana (Poos 1936). Most of the time, however, they fly at ground level like *C. pulicaria* which was most common at only 0.3 m from the ground (Esker *et al*. 2004). The wingless condition is known in *Chaetocnema* but not in *C. concinna*. Clark & Johnson (2007) recorded the first wingless species, *C. labiosa* White, 1996, an unusual condition which was overlooked by White (1996).

Oviposition occurs from early June until the end of July. Eggs are laid in groups of 2–6 in the soil at the base host plants at a depth of 3–5 cm (Davidyan 2006). Fecundity is about 40 eggs/female. Incubation period lasts 2–3 weeks (Doguet 1994).

Larvae are root feeders and make tunnels in host plant roots, only in species of Polygonaceae according to Jourdeuil (1963). Larval development lasts about one month (Doguet 1994). If the habits of the larvae of *C. concinna* are similar to those of *C. ectypa,* which feed on corn roots, soon after they hatching begin to eat the succulent roots of their host plant and bore into the cortex. Tunnels often appear to be formed between the cortex and central portion of the roots (Wildermuth 1917a). When feeding is prolonged, entire roots may be tunneled, some being entirely hollowed out, while in others a groove is excavated along one side of the root.

Pupation of *C. concinna* occurs at the base of host plants in an earthen cell, as observed in *C. ectypa* (Wildermuth 1917a). The duration of the pupal stage is unknown in *C. concinna*. It averaged 5.6 days (3–12 days) under laboratory conditions in *C. ectypa* and should be of this order for *C. concinna*. In dry soil, the larvae pupate up to 10+ cm, but in extremely moist soil the pupal cell is formed on the top of the ground under decaying vegetable matter.

According to Davidyan (2006), *C. concinna* is primarily univoltine in Russia and should be so in Canada, but may have more than one generation per year at lower latitudes.

Parthenogenesis exists in *Chaetocnema*. Cox (1996) stated that there is a statistical evidence for a geographic parthenogenesis in *C. confinis*. While the male/female ratio is 1:1 in Indiana (United States), males are unknown in the Caribbean Islands, and the Indian Ocean and Pacific region and Afrotropical region including Madagascar. In Puerto Rico, Virkki *et al*. (1989) concluded that the absence of males in *C. perplexa* Blake, 1941 was an indication of parthenogenesis, and Blake (1941) suspected that there might be a different race for each island of the West Indies. However, parthenogenesis has not yet been reported in *C. concinna*.

Parasites

Laboulbeniales are small fungal parasites of Coleoptera, Diptera, Diplopoda, and Acari. The classic work of Thaxter (1914, 1915) was supplemented by Benjamin (1971) and these fungi have been extensively treated in a monograph by Tavares (1985). Balazuc (1988) reviewed their occurrence in Chrysomelidae, their host specificity being more or less strict. In the Chrysomelidae, these parasitic fungi most frequently occupy the posterior part of the elytra but also the pronotum, the under part of the body, the antennae or the legs. Three species of *Laboulbenia* are currently known to parasitize adults *Chaetocnema*: *L. chaetocnemae* (Thaxter, 1914) on *C. minuta* from Trinidad and on an undetermined *Chaetocnema* from Amazonia in Brazil, *L. dislocata* (Thaxter, 1914) on *C. minuta* from Trinidad, and *L. temperei* Balazuc, 1973 on *C. aerosa* Letzner, 1846, *C. arida* Foudras, 1860, and *C. hortensis* from France (Balazuc, 1973). Laboulbeniales have not been discovered on *C. concinna.*

The protozoan gregarines are obligate parasites of invertebrates and especially frequent in the digestive tract of Coleoptera. Their life cycle and occurrence in Chrysomelidae were reviewed by Théodoridès (1988). They are not known to infect *C. concinna,* however *Gregarina chaetocnemae* Sarkar, 1984 was described from the midgut of adult *C. concinnipenis* Baly, 1877 in West Bengal (Sarkar 1984), and *Nosema chaetocnemae* Yaman & Radek, 2003 from *C. tibialis* (Illiger, 1807), a major pest of sugar beet in Turkey (Yaman & Radek 2003; Yaman 2004).

The nematode *Neoaplectana carpocapsae* Weiser, 1955 was tested in many field trials for the biocontrol of various agricultural pests including *C. concinna* (Edwards & Oswald 1981; Poinar 1988). The ensheathed dauerlarvae of *Neoaplectana* species enter the host's haemocoel either directly by cuticular penetration or indirectly by penetrating the gut wall after being ingested by the feeding insect. The infective larvae harbour within their intestine the bacterium *Achromobacter nematophilus* Poinar & Thomas which is released via their anus into the host's haemolymph. This causes a lethal specticemia which provides large bacterial populations upon which the nematodes feed (Poinar 1966; Gordon & Webster 1974; Webster 1980). After the death of the host, the nematodes feed on the dead host's tissues, and bacteria reproduce, and pass through several generations. The entomolophilic nematode literature was reviewed by Welch (1965) and Gordon & Webster (1974), the life cycle of *Neoaplectana* nematodes by Dutky (1959).

The level of parasitism by *Howardula* nematodes of some economically important leaf beetles was studied by Elsey (1977) in North Carolina. Adults of *C. confinis* were parasitized at levels of 13.1% while those of *C. pulicaria* were parasitized at 14.4%. In Puerto Rico, Virkki *et al*. (1989) found that *C. perplexa* adults were infested by an undetermined *Howardula,* and that this nematode could suppress the oogenesis in over 50% of the females. The role of the nematode in combination with other unknown factors may explain the observed parthenogenetic populations in this flea beetle.

Pyemotes sp. mites (Acarina: Pyemotidae) were listed as predators of *C. ectypa* in the United Stated but with no further information (Thompson & Simmonds 1964; Santiago-Blay & Fain 1994). Wildermuth (1917a, b) reported that many adult *C. ectypa* had their body almost covered *Pyemotes* mites (as *Pediculoides* sp.). Since the feeding of these mites has little effects on the mortality of their hosts, most *Pyemotes* species are currently considered ectoparasites of insects of all stages, although some may be phoretic (O'Connor & Klimov 2004; Wu, pers. comm.).

The hymenopteran mymarid egg parasite *Anaphes pullicrura* (Girault, 1910) was reared at the Arlington Experimental Farm (Virginia) from the eggs of *C. denticulata* (Poos 1955; Huber 1986).

Neurepyris sp. (Hymenoptera: Bethylidae) parasitized larvae and pupae of *Chaetocnema ectypa* at Tempe (Arizona) (Wildermuth 1917a, 1917b: Thompson & Simmonds 1964).

Species of the genus *Microctonus* belong to the Euphorinae, a large subfamily within Braconidae (Hymenoptera). Euphorines are koinobiont endoparasitoids of various adult beetles and were recorded from several kinds of flea beetles. *Microctonus cerealium* (Haliday, 1835) attacks *Psylliodes attenuata* (Koch, 1803) and *Chaetocnema hortensis* adults (Cox 1994b). Meyer (1934) listed *C. hortensis* as a host of this parasitoid in Leningrad. The record of *M. terminalis* Westwood 1840, which has been reported to parasitize *C. aridula* and *C. hortensis* in cereal fields in Russia (Kurdjumov 1917; Kurdjumov & Znamenskii 1917; Cox 1994b) is doubtful since this name was placed in synonymy with *Dinocampus coccinellae* (Schrank, 1802), a cosmopolitan species parasitizing exclusively coccinellid beetles (Shenefelt 1969).

Haeselbarth & Loan (1983) isolated a species group of parasites restricted to leaf beetles within the large *Microctonus-Perilitus* complex and described it as a separate new genus, *Townesilitus* Haeselbarth & Loan, 1983. *Townesilitus bicolor* (Wesmael, 1835) is known to parasitize *C. aridula* and *C. hortensis* as well as *Phyllotreta vittula* (Redtenbacher, 1849), and *Aphthona euphorbiae* (Schrank, 1791) (Pavlov, 1960). According to Haeselbarth & Loan (1983), a *T. bicolor* female leaps onto the elytra of the host, and with her body parallel to the body of the host, immediately inserts its ovipositor into the apex of the host abdomen. The habits of this parasite were studied in detail by Pavlov (1960) in cereal fields of the Voronezh region of Russia. In summary, the adult parasites lay their eggs from June through to the autumn. Beetles infested with larval parasites do not usually fly but remain in their wintering sites. The first and second instar parasitic larvae overwinter in the body cavity of the beetles. They begin to develop rapidly in spring when the beetles awake from their winter torpor. In the last hours, the larvae eat all the fat body and other tissues of the host. Full grown parasitic larvae emerge from the flea beetles' body and construct an oval cocoon on the ground. The injury inflicted is always lethal and the parasitized beetles die a few days after the emergence of the parasitic larva.

Also in Euphorinae, *Streblocera fulviceps* Westwood, 1833 was reared from adults of *C. cylindrica* (Baly, 1874) at the Agricultural Experimental Station of Jilin, China (Chen & Van Achterberg 1997).
Ichneumonids are another important hymenopteran group of parasitoids known to parasitize leaf beetles. The vast majority are intimately associated with single hosts. Meyer (1934), gave *C. aridula* as the host of *Mesochorus curvulus* Thomson, 1885, a record included by Jolivet (1950) in his list of parasites of the French-Belgian fauna.

Predators

Ford *et al*. (1938) and Potts (1970) both found that *C. concinna* was included in the diet of the grey partridge (*Perdix perdix* Linnaeus, 1758).

Miller & Kurczewski (1972) reported that *C. concinna* was one of the species of flea beetles utilized by the wasp *Entomognathus brevis* (van der Linden, 1829) (Hymenoptera: Sphecidae) as food sources in the brood chambers of their larvae. Wasps in the genus *Entomognathus* specialize in hunting flea beetles (Alticini). Another sphecid, *Cerceris finitima* Cresson, 1865, was reported to prey on *C. pulicaria* (Krombein *et al.* 1979).

Larvae of the neuropteran chrysopid, *Chrysopa perla* (Linnaeus, 1758), were observed to feed on adult *C. breviuscula* (Faldermann, 1884) in sugar beet fields of the Saratov region in Russia (Pilyugina 1937). Chrysopid larvae are generalist predators that would be expected to feed on adult *C. concinna* as well.

Nabid Heteroptera are potential predators of *C. concinna* adults since both nymphs and adult *Nabis americoferus* Carayon, 1961 were observed preying on desert corn flea beetle adults, *C. ectypa*, at Holtville, California. Wildermuth (1917a, b) erroneously identified this predator as a reduviid [*Reduviolus ferus* (Linnaeus)]. The latter is a European species while the Nearctic records of *Nabis ferus* likely all refer to *Nabis* (*Reduviolus*) *americoferus* Carayon, a transcontinental North American species (E. Maw, pers. comm.)

Host plants

Clark *et al.* (2004) listed several records of *C. concinna* in association with a large number of host plants in the families Amaranthaceae, Asteraceae, Brassicaceae, Cannabaceae, Chenopodiaceae, Fabaceae, Poaceae, Polygonaceae, Rosaceae, and Salicaceae and concluded that polygonaceous plants were the preferred hosts. LeSage (1990) reported specimens collected in potato fields with pan traps on Prince Edward Island, but this collecting technique did not allow the identification of the host plants; five specimens were also found on *Polygonum persicaria* L. but the collecting technique was not mentioned. Hundreds of specimens were collected in vineyards of the eastern Towships of Québec in the late nineties. Since they did not touch grape, LeSage *et al.* (2008) concluded that *C. concinna* was a companion species thriving on weeds. Wescott *et al.* (2006) reported that *C. concinna* was feeding on strawberry leaves in the fall but could not find larvae on this host, probably because it switched from weeds to strawberry as in vineyards.

In his key to Central European *Chaetocnema* species, Mohr (1966) gave the Polygonaceae as host-plants, in particular *Polygonum aviculare* L.

In England, Curtis (1883) and Ormerod (1881) stated that *C. concinna* attacked turnips and hops, but Newton (1929) demonstrated that turnips and hops were not eaten by choice, and that the true host plants of this flea beetle were among the Polygonaceae (*Fagopyrum sagittum* L., *Polygonum convolvulus* L., *Rheum palmatum* L., *Rumex acetosa* L., *R. acetosella* L.).

In France, Bedel (1894) observed the preferences of *C. concinna* for knotweeds including *Polygonum aviculare*, *P. hydropiper* L., and *P. mite* Schrank. Jourdeuil (1963) stated that *C. concinna* was associated with Polygonaceae, especially *Polygonum* spp. and *Atriplex* spp.

In Finland, Laitinen & Raatikainen (1975) stated that *C. concinna* developed primarily on polygonaceous plants without providing specific information. It was especially common in early and late summer sweep samples. According to Arja *et al.* (1986), *C. concinna* was the only adult flea beetle species damaging sugar beet in that country.

In Bulgaria, *C. concinna* was reported as the most frequent species of the genus in the country, being widely distributed from the coast up to 2300 m. elevation, and feeding on *Chenopodium* spp. and *Polygonum* spp. (Vig 1992; Vig & Rozner 1996).

In Slovakia, *C. concinna* was reported as amongst the most common species to feed on *Convolvulus arvensis* L. together with *Chaetocnema hortensis*, *C. tibialis* (Illiger, 1807), *Longitarsus longipennis* Kutschera, 1863, *L. pellucidus* (Foudras, 1860), and *Phyllotreta vittula* (Tóth *et al.* 2006). In the same country, out of four species of *Amaranthus* studied, *A. caudatus* L. appeared to be most damaged by *C. concinna* and *C. tibialis* (Prasli*č*ka 1996). However, in assessing the potential of flea beetles as biological agents against this weed, Cagán *et al.* (2000) found that *C. tibialis* represented 41–98% of the flea beetles collected, and *C. concinna* did not comprise more than 1% of the *C. tibialis* populations.

In Turkey, *C. concinna* was found closely associated with *Amaranthus retroflexus* L. together with nine other species of flea beetles (Aslan *et al*. 2003).

Pest status

Although it has been associated with crops and cultivated plants, *C. concinna* cannot yet be considered a pest in North America. LeSage (1990) reported one specimen collected on *Polygonum persicaria* in a potato field in Prince Edward Island. LeSage *et al*. (2008) found it in numbers in Québec vineyards, but grape was ignored as a food plant; very likely *C. concinna* was thriving on weeds but none could be specifically identified. Wescott *et al*. (2006) noticed fall feeding on strawberry leaves, however it is the fruits that are of economic importance, not the leaves.

The European and Mediterranean Plant Protection Organization (EPPO 2007) described the standards for evaluating and testing the efficiency of insecticides against *C. concinna* and other important pests of sugar beet crops.

In Finland, Vappula (1965) reported that *C. concinna* was a pest of beet seedlings, but injury has been observed almost exclusively in the southern part of the country. This author also mentioned that *C. concinna* was one of the pests causing the most damage to rhubarb by eating holes or creating brown pits in the leaves. Varis (1976) studied the effect of acidification of insecticides in pest control of sugar beet seedlings. After field experiments, conducted between 1958 and 1973, Varis & Rautapaa (1976) concluded that dimethoate gave the highest increase in sugar beet root yields. A control level of 43–58% of *C. concinna* was obtained with lindane seed dressing at a rate of 6–7.5 g of active ingredient (a.i.) per 1 kg of seed and 52% with dimethoate sprays at 2.2 X 200–300 g a.i./ha (Varis 1975). The flea beetle and capsid bugs (*Lygus rugulipennis* (Poppius, 1911) were also controlled with thiamethoxam or imidacloprid (Biddle 2001). Control of pests on red beet was achieved with five applications of 0.2% pyrethrins synergised with piperonyl butoxide, as compared with three applications of 0.2% malathion (Tittanen 1978). After several surveys of the incidence of flea beetles on sugar beet and rapeseed in eight localities in southern and central Finland, it was estimated that only *Phyllotreta undulata* (Kutschera, 1860) (80–90%) and *P. striolata* (Fabricius, 1801) (10%) were of any importance as pests of rapeseed, while sugar beet was only damaged by *C. concinna* (Augustin *et al*. 1986; Tulisalo & Korpela 1986). The first peak of abundance was formed by the overwintered adults in late May, whereas the second peak, in July, corresponded to the adults of the new generation. Flea beetles (*C. concinna*) and capsid bugs (*Lygus rugulipennis*) were controlled by treatments of sugar beet seeds with thiamethoxam and imidacloprid (Eronen *et al*. 2001).

The protective effect of Decis Prime 415 EC was very high against *C. concinna* and other sugar beet pests in Poland (Szymczak-Nowak & Wasacz 1998). A mixture of deltamethrin and chlorpyrifos-methyl should be applied at 0.5 litre/ha for best results. In Skierniewici in Poland, Szwejda & Rogowska (2004) conducted an extensive survey of insects feeding on rhubarb in 2002–2003. They collected 5117 specimens representing 8 orders of phytophagous insects, and *C. concinna* accounted for more than 30% of all the collected insects.

In Czechoslovakia, *C. concinna* was one of the main pests of sugar beet. Preventive pesticide application remained the basic practice to ensure high field seedling emergence and optimum plant stands (Rimsa 1980).

Hiiesaar *et al*. (2004) identified nine chrysomelid species on the summer rape variety *Mascot* in Estonia. *Chaetocnema concinna* did not damage the rape plants, but was found on almost 40 species of weeds growing in the same area.

Information resulting from surveys in England between 1947 and 1974 revealed that various sugar beet pests have declined. In the case of *C. concinna*, the decline was attributed to prophylactic seed and spray treatments (Dunning 1975). The history and economics of the cultivation of sugar beet in the United Kingdom was reviewed by Cooke (1992). Dewar & Asher (1996) reviewed the same subject but only for the year 1995. In summary, *C. concinna* caused widespread damage to beet crops especially in the drier eastern side of the country, and many affected fields had to be replanted. Seedlings could be protected against *C. concinna* and other soil pests using a granular formulation of bendiocarb applied in the furrow with the seeds at the time of drilling (Bryan 1980). Decreased populations of *C. concinna* were observed in sugar beet fields treated with 2.8 kg/ha pyrazon (Edwards 1991). Sugar beet seeds treated at 16 g a.i./100 000 seeds, carbosulfan at 90 g or JF-9147 at 90 g resulted in the least damage (Winder & Dewar 1985). A seed pellet treatment with imidacloprid (*Gaucho*®) at 70 and 90 g a.i./100 000 seeds also achieved superior control of *C. concinna* and other sugar beet pests (Heatherington & Bolton 1992; Heatherington & Meredith 1992).

In Austria, *Chaetocnema concinna* together with *C. tibialis* caused the most damage to sugar beet (Glaeser 1979).

In France, Simonin & Morin (1976) tested eight insecticides in industrial sugar beet fields and recommended albicarb, carbofuran, chlormephos, or terbufos for the protection of seeds in the field.

In Russia, a modified drill enabling insecticide granules to be applied in a column below sugar beet seeds rather than in tighter groups on either side, elevated the control level of *C. concinna* to 70–85% (Sanin *et al.* 1990).

In Belorussia, Turishcheva (1980) identified 63 species of insects and two molluscs attacking sugar beet crops, including *C. concinna* which was among the most serious pests. In the Baltic coastal region of the former U.S.S.R, Kulikova (1981) noticed that the vegetation around cultivated fields harbored *C. concinna* and other pests in soya bean fields sown in cleared forest regions. In a long standing rotation system, at Biysk, Siberia, Mostovaya (1994) observed that numbers of *C. concinna* were greatest in sugar beet fields, lower in alfalfa, and that cold, late springs were a decisive reducing factor. *Chaetocnema concinna* was also a main pest in oriental goat's rue (*Galega orientalis* Lam.) and *Rumex patientia* x *R. tianschanicus* hybrid fodder crops in Vologda; these plants were selected for their high productive longevity, their resistance to cold and frost, and high seed production (Vasil'eva 2004).

In Karakalpakstan (Uzbekistan), *C. concinna* was the main pest of sugar beet with the sugar beet weevil (*Bothynoderes punctiventris* Germar, 1824) and the sugar beet bug (*Piesma quadratum* Fieber, 1844) (Toreniyazov 1999).

In Slovakia, Prasličk a (1996) observed that the occurrence of aphids and damage caused by the flea beetles *C. concinna* and *C. tibialis* were to a certain extent affected by sowing dates and species of amaranth involved (*Amaranthus caudatus*, L., *A. cruentatus* L., *A. hypochondriacus* L., *A. paniculatus* (L.) Hejný). The highest occurrence of aphids and the highest damage by *Chaetocnema* flea beetles was recorded at the latest date of sowing of *A. caudatus* (May 22, 1995).

In Japan, Honma & Akiyama (1981) reported *C. concinna* and *C. discreta* Baly as injurious to sugar beet.

Biocontrol

The nematodes with the greatest biocontrol potential are a few *Neoaplectana* species (Steinernematidae), especially the strain DD-136 of *N. carpocapsae* discovered and reared from codling moth larvae (*Cydia pomonella* Linnaeus, 1758) (Dutky & Hough 1955; Dutky 1959). However, their high susceptibility to desiccation and moisture requirements severely limited their usefulness. For instance, Welch & Briand (1960, 1961) concluded after exhaustive field trials that the Ontario climate precluded the use of DD-136 nematodes against insect pests which feed on exposed plant surfaces such as the potato beetle (*Leptinotarsa decemlineata* Say, 1824) or the imported cabbage worm [*Pieris rapae* (Linnaeus, 1758)] (Welch 1961b). Three applications of the nematodes to small field plots of sweet potato at Charleston (South Carolina) did not give adequate protection against five targeted pests including *C. confinis* (Creighton *et al.* 1968). Nematodes were tested against *C. concinna* in small sugar beet plots at the Rothamsted Experimental Station (England) by Edwards & Oswald (1981). A decline in the flea beetle adult numbers was observed 5–8 weeks after treatment and during the following year but the data were insufficient to assess the optimum level of treatment. Consequently, the challenge still remains to select a strain adapted to each pest and to discover an efficient method of application of the parasitic nematodes at the right period of the host development.

Beneficial status

After a survey of the beetle fauna in oats fields of western Finland, Laitinen & Raatikainen (1975) considered *C. concinna* beneficial because it developed on polygonaceous weeds.

In Turkey, Aslan *et al.* (2003) investigated potential candidates for the biocontrol of the redroot pigweed, *Amaranthus retroflexus* L. *Chaetocnema concinna* was among ten species closely associated with the weed although *C. hortensis* and *C. tibialis* were most abundant. Similar results were obtained by Cagán *et al.* (2000) in Slovakia. *Chaetocnema concinna* was identified as a potential biocontrol agent of *Amaranthus* spp. among 13 insect species collected on these weeds. *Chaetocnema tibialis* represented 41–97% of the flea beetle populations and was present at all localities and peaked at 95–99% of the flea beetles on the cultivated *A. caudatus*.

Tóth *et al.* (2004) looked at potential biocontrol agents of the field bindweed (*Convolvulus arvensis* L.) at Vrable and Kamenica nad Hronom, in Slovakia. Nineteen flea beetle species were collected, including *C. concinna,* which was among the common ones. However, only *Longitarsus pellucidus* (Foudras, 1859) seemed able to increase its population to a size large enough to suppress the weed.

Economic importance

In North America, *C. concinna* has no economic importance, although is has been observed in potato fields (LeSage 1990), in vineyards (LeSage *et al.* 2008), and in strawberry fields (Wescott *et al.* (2006).

In Slovakia, Tóthová *et al.* (2003) observed that *C. concinna* and *C. tibialis* were using the pigweeds *Amaranthus retroflexus* L. and *A. powellii* S. Watson as alternate hosts in sugar beet fields, but *C. concinna* did not consititute more than 0.5% of the entire flea beetle population. Praslička (1996) found that damage by the cowpea aphid (*Aphis craccivora* Koch, 1854), the flea beetles *C. concinna* and *C. tibialis* were highest on *A. caudatus*. This weed is known for its pharmacological uses.

In Russia, Davidyan (2006) noted that *Polygonum lapathifolium* L. was the most attractive plant for ovipositing females of *C. concinna*; larvae also preferentially fed on the roots of this weed. Buckwheat (*Fagopyrum esculentum* P. Mill.), hemp (*Cannabis sativa* L.), sorrel (*Rumex* spp.) and rhubarb (*Rheum rhabarbarum* L.) were utilized to a lesser degree. Adults also fed on the foliage of some Chenopodiaceae, notably sugar beets (*Beta vulgaris* L.) and could cause economically significant damage to them. Adults fed on sugar beet plants for a period of two weeks in the spring before migrating to Polygonaceae. Damage could be greater after droughts.

In Poland, the Plant Protection Service established that *C. concinna* was currently the most, or one of the most, important pests of beet in this country (Walczak *et al.* 1998, 1999, 2000). Szwejda (2002) and Swejda & Rogowska (2004) identified *C. concinna* as one of the four dominant phytophagous insects on rhubarb.

In Belarus, fertilizers that hastened sugar beet growth and development decreased the danger of damage by *C. concinna* and the carrion beetle *Aclypea opaca* (L. 1758) (Gadzhieva (2002).

In Ukraine, a spread of *C. concinna* and other pests in sugar beet fields was observed in 2001–2002 (Sabluk *et al.* (2002).

In Great Britain, flea beetles, including *C. concinna*, were major pests of brassica crops up to the mid-1950s, after which attacks were less common and less severe until recent years when more damage has occurred (Saynor 1985). *Chaetocnema concinna* was the second most abundant leaf beetle out of 44 species in the canopies of apple and pear orchards, but the reasons for its occurrence and potential role in this habitat are still poorly understood (Vig & Markó 2004). Control measures include sowing sugar beet earlier, using fertilizers to accelerate seedling development, and eradication of weeds from fields. Pesticide treatment is necessary in spring after the beetles' mass emergence following hibernation.

Elliot & Poos (1934, 1940) first demonstrated that Stewart's disease of corn was transmitted by the corn flea beetle, *C. pulicaria*. This plant disease is caused by the bacterium *Pantoea* (*Erwinia*) *stewartii stewartii* (Smith) Dye which is a nonmotile, non-spore-forming, capsule-forming gram-negative insect borne pathogen

(Mergaert *et al*. 1993; Menelas *et al*. 2006). The bacterium is particularly virulent as the symptoms develop in only 3–4 days and the plants die soon after. In addition, high densities of corn flea beetle adults can result in the skeletonization of the leaves and the death of the seedlings (Poos 1955; Pataky & du Toit 1995; Cook *et al*. 2005).

Distribution in the Maritime Provinces

Specimens of *C. concinna* recorded in the literature are listed below in square brackets in addition to the voucher specimens examined for the present study.

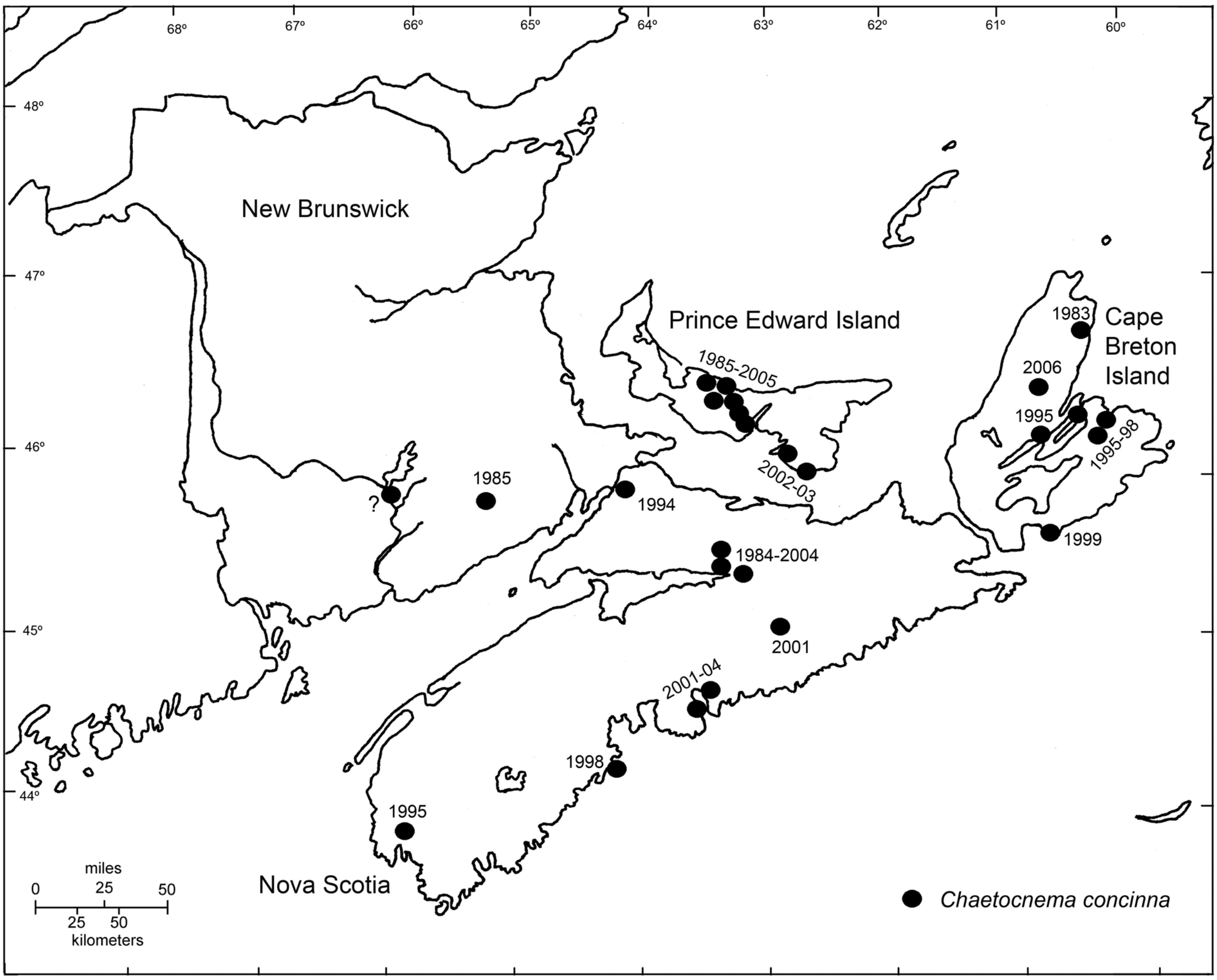

FIGURE 7. Distribution of *Chaetocnema concinna* in the Maritime Provinces of Canada. **Notes:** Collection dates are indicated adjacent to collection localities.

NEW BRUNSWICK: Kings Co.: Penobsquis, 8.VII.1985, L. LeSage, sweeping edge of forest, alders, *Kalmia, Solidago, Spiraea* (1, CNC); **Queens Co.:** Jemseg [White 1996: 49].

NOVA SCOTIA: Cape Breton Co.: Sydney Forks, Blacketts Lake, 26.VIII.1990, D.B. McCorquodale (1, CBU); Point Aconi, 12.VI.1994, D.B. McCorquodale, (1, CBU); Sydney Tar Ponds, 6.VI.1995, G. MacPherson (1, CBU); Sydney Tar Ponds, 3.VI.1996, 7–13.VI.1996, 13–19, 1996, 28.VI–4.VII.1996, pan traps, L.A. Hudson (5, CBU); Sydney Tar Ponds, 13–19, 1996, 28.VI–4.VII.1996, pan traps, L.A. Hudson (3, CBU); Sydney Tar Ponds, 6.VI.1995, B.L. Musgrave (1, CBU); North Sydney, Munroe Park, 5.VI.2006, D.B. McCorquodale (1, CBU); Scatarie Island, 20.VII.1996, D.B. McCorquodale, (1, CBU). **Colchester Co.:** Bible Hill, NSAC Pasture, 45° 21’ N, 63° 15’ W, 22.VII.2004, K. Aikens, (1, CBU), 31.V.2005, sweep A-8

[1], sweep B-4 [1], sweep D-5 [1], sweep D-8 [1], 14. VI.2005, sweep A-2 [1], sweep A-4 [1], sweep C-2 [1], Sweep C-4 [1], sweep D-7 [2], sweep D-7 [1], 12.VIII.2005, sweep C-2 [1], S.M. Thomson, (12, CBU); Debert, 6.V.1994, 31.V.1994 13.VII.1994, 26.V.1996, 2.VI.1996) (1, CNC; 2, NSNR); 2.VI.1996, Malaise trap, E. Georgeson, (1, NSNR); Masstown, 15.VI.1990, T.D. Smith, (2, NSNR); Masstown, 29.VI.1990, light trap, T.D. Smith, (1, CNC; [White 1996:49]). **Cumberland Co.:** Amherst, 22.V.1994, "aerial", J. Ogden (1, CNC). **Halifax Co.:** Point Pleasant Park, 19.V.2001, in grass, C.G. Majka, (1, CGMC). **Richmond Co.:** Point Michaud, 19.VI.1999, S.P. Roach, (2, CBU). **Victoria Co.:** Cape Breton National Park, [White 1996:49]; Kelly Road, 26.VI.2006, Malaise trap, J. Ogden (1, JOC); Baddeck, 2.VI.1995, G.R. MacPherson (1, CBU); Ingonish Centre, 18.VI.1983, on beach grass, R. Vockeroth [LeSage 199: 648].

PRINCE EDWARD ISLAND: Kings Co.: Launching, 23.VII.2001, old field, C. Majka (1, CGMC); Woodville Mills, 6.IX.2001, deciduous vegetation, C. Majka (1, CGMC) **Queens Co.:** Charlottetown: 20.VI.1985, L.S. Thomson, sweep at station (2, CNC), 27.VI.1985, L. LeSage, sweeping vegetation around a pond (1, CNC; [LeSage 1990: 648]; Charlottetown [White 1996:49]; Harrington: 24.VIII.1982, 9.VII.1987, summer 1987, 18.VII.1988, 4–10.VII.1989, M.E.M. Smith, potato field, pan trap (26, CNC); Harrington, 24.VIII.1987, M.E.M. Smith, on Lady's thumb (*Polygonum persicaria* L.) in potato field [LeSage 1990: 649]; Harrington, 9.VI.1987, J.G. Steward, pan trap in potato field, (9, CNC; [LeSage 1990: 649]); Harrington [White 1996:49]; West Royalty, 15.X.1986, M.E.M. Smith, eugenol trap near potato field [LeSage 1990: 649]; New Glasgow, 13.VII.2002, meadow by Hunter River, (1, CGMC); West Royalty [White 1996:49]; Wood Islands, 20.VIII.2002, costal dunes, C. Majka (1, CGMC).

From the records listed above it can be concluded that *Chaetocnema concinna* is generally distributed in both Nova Scotia and Prince Edward Island, and at least locally present in New Brunswick (Fig. 2).

Discussion

Jolivet (2001) hypothesized that *C. concinna*, had been accidentally introduced into North America with Polygonaceae or Chenopodiaceae. Based on available material it appears that *C. concinna* may be a fairly recent introduction.

Although *C. concinna* is almost cosmopolitan (Fig. 2), and one of the worst pests of sugar beet and rhubarb, basic taxonomic research still needs to be conducted for the identification of its immature stages. Its eggs have not yet described, and the microsculpture of the chorion has not yet been illustrated. Its larvae are still undescribed although it is suspected that their habitus and morphology are similar to related species in the genus. Its pupa is also still unknown.

The present study brings the documented introduction of *C. concinna* into North America to the beginning of the 1980's. Although unidentified specimens may still be present in museums the probability of finding such specimens is low since White (1996) examined 22,850+ specimens for his revision of the North American species of *Chaetocnema*. On the other hand, archeological sites such as old latrines may offer possibilities for finding evidence of earlier introduction timelines. For instance, the elytra of the common striped cabbage flea beetle *Phyllotreta striolata* (Fabricius, 1803) was found in a latrine, providing evidence that the beetle was present in North America a century earlier than previously known (Bain & LeSage 1998).

Chaetocnema concinna does not seem to be an economic pest of any crops in Canada. However, its presence in various agricultural settings has been underestimated. LeSage *et al*. (2009) concluded that *C. concinna* was not problematic for grapes and seemed restricted to weeds within vineyards. Lévesque & Lévesque (1998) did not find it in raspberry fields. Wescott *et al*. (2006) reported feeding of this species on strawberry leaves but not on the fruits, and we are not aware of any problem attributed to this flea beetle in sugar beet production in Canada, whereas it is a major pest of this crop in Europe.

Since *C. concinna* thrives on ubiquitous weeds such as pigweeds (*Amaranthus* spp.) or knotweeds (*Polygonum* spp.) it could be a secondary host for the transmission of Stewart bacterial wilt. Elliot & Poos (1940) demonstrated that this disease was mainly transmitted by *C. pulicaria*, but also to a lesser extend by *C. denticulata* and *C. confinis*. The recently introduced *C. concinna* could be another vector.

Control measures in sugar beet fields include sowing sugar beet earlier, using fertilizers to accelerate seedling development, and eradication of weeds from fields. Pesticide treatment is necessary in early spring, immediately after the emergence of adults from hibernation to protect the fragile seed cotyledons from grazing by hungry adults.

The potential of *C. concinna* as biocontrol agent remains controversial since the flea beetle thrives on both noxious weeds and cultivated plants. However, it might be useful against some weeds (e.g., *Amaranthus* spp.) in areas where sugar beet or rhubarb, the most commonly attacked cultivated plants, are not grown.

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