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Synopsis of adventive species of Coleoptera (Insecta) recorded from Canada

Part I: Carabidae



# **Synopsis of adventive species of Coleoptera (Insecta) recorded from Canada**

## **Part I: Carabidae**

*by*

Jan Klimaszewski, David Langor, Ricky Batista, Julie-Anne Duval,  
Christopher G. Majka, Geoff G.E. Scudder & Yves Bousquet



Sofia–Moscow

2012

SYNOPSIS OF ADVENTIVE SPECIES OF COLEOPTERA (INSECTA) RECORDED FROM CANADA.  
PART I: CARABIDAE

by

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## Introduction

Ground beetles (Carabidae) represent one of the most taxonomically diverse and well-studied beetle families in Canada and North America. Of the 962 species known in Canada (Bousquet and Laroche 1993; Bousquet unpublished data), adults of the vast majority of species are generalist, ground-dwelling predators and opportunistic scavengers, and some species feed on plant seeds (Lindroth 1961-1969). The habits of larvae are more poorly understood, but many species are found in the litter and organic soil layers where they are predators or scavengers (Lindroth 1961-1969). Adult ground beetles range in size from 1.3 mm (*Tachys* spp.) to 36 mm (*Calosoma* spp.). In most species adults are capable of flight, but some species are not capable of flight or only a portion of adults are flight-capable. Carabids are found in a wide variety of habitats, from xeric to hygric moisture conditions and from open soil and sand to dense forests to marshes and riparian areas (Lindroth 1961-1969). Most adventive species are strongly synanthropic and thrive in disturbed habitats (Lindroth 1961-1969).

Thanks largely to the seminal work of Carl Lindroth that resulted in a comprehensive taxonomic treatment and ecological synopsis of the family in Canada (Lindroth 1961-1969), the high diversity of species, and the ubiquitous and conspicuous nature of many species, ground beetles have become very popular subjects of study, attracting the attention of amateur and professional entomologists alike. The abundance of attention on ground beetles over the last 70+ years in Canada has resulted in a body of work that makes this family one of the best known in the country in terms of diversity and distribution of species and ecological affinities.

As explicitly recognized and discussed by Lindroth (1954b), a large number of beetle species associated with litter and soil were accidentally introduced into eastern North America from Europe, many of them likely centuries ago. One major mode of entry was in ballast brought from Europe to North America on sailing ships, which was then dumped on land along with its biological contents (invertebrates and plants). Other soil- and litter-dwelling species are thought to have been introduced in association with soil in potted plants. Of the more recent species introduced into Canada, a larger proportion is from Asia, reflecting the greatly increased trade with Asia over the last 2-3 decades.

Subsequent to Lindroth's early work, there have been a number of regional treatments of the adventive carabid fauna in Canada, including Newfoundland and Labra-



dor (Larson and Langor 1982), the Atlantic provinces (Majka et al. 2006, 2007, 2008), eastern Canada (Klimaszewski et al. 2010), and British Columbia and Alberta (Spence and Spence 1988), but there has been no overall national synthesis about adventive carabids, or for any beetle family. Building on a review of adventive species of Coleoptera of eastern Canada (Klimaszewski et al. 2010), a synopsis of all adventive species of Coleoptera recorded from across Canada has been initiated. The first contribution in this series is focused on the Carabidae. Every species is illustrated by a colour external body image and when necessary, additional genitalia including those of genitalia are illustrated or referred to. Included is an ecological synopsis for each species and information on approximate time and place of introduction and current distribution. The present format will be followed in subsequent volumes. This national treatment of adventive beetle species will provide a modern tool for species diagnostics and a linkage to key literature. We hope that the synopsis will encourage and facilitate further studies on adventive species.

## Materials and methods

**Structure and convention.** This review is based mainly on published literature records and information from specimens in some major Canadian insect collections. The classification of species follows that in Bousquet and Larochelle (1993). Genera and species are arranged phylogenetically, and the references to original and selected subsequent publications are included.

We use the term adventive species to mean species that arrived in Canada from other countries either through natural dispersal or through inadvertent or deliberate human actions (Wheeler and Hoebeke 2009). We do not include coverage of native Canadian species that have been translocated to novel jurisdictions and habitats within the country.

**Images.** We provide 55 colour images of all adventive carabid species recorded from Canada (Figs. 1-55). Major morphological terms used in the text are after Bousquet (2010).

**Distribution.** Every valid species is cited with its current known distribution in North America. The following abbreviations are used in the text for Canadian provinces and territories and for the French islands of St. Pierre and Miquelon near the coast of Newfoundland:

AB	Alberta	NU	Nunavut
BC	British Columbia	ON	Ontario
LB	Labrador	PE	Prince Edward Island
MB	Manitoba	PM	St. Pierre and Miquelon
NB	New Brunswick	QC	Quebec
NL	Newfoundland and Labrador	SK	Saskatchewan
NS	Nova Scotia	YT	Yukon Territory
NT	Northwest Territories		

Data for distribution maps were extracted from specimens in the following collections:

Agriculture and Agri-Food Canada, Charlottetown, Prince Edward Island, Canada

Agriculture and Agri-Food Canada, Kentville, Nova Scotia, Canada

Agriculture and Agri-Food Canada, St. John's, Newfoundland and Labrador, Canada

Atlantic Canada Conservation Data Centre, Sackville, New Brunswick, Canada  
Atlantic Forestry Centre, Corner Brook Lab, Corner Brook, Newfoundland and  
Labrador, Canada  
Canadian National Collection of Insects and Arachnids, Agriculture and Agri-  
Food Canada, Ottawa, Ontario, Canada  
California Academy of Sciences, San Francisco, California, U.S.A.  
Cape Breton University, Sydney, Nova Scotia, Canada  
Christopher G. Majka Collection, Halifax, Nova Scotia, Canada  
Joyce Cook Collection, North Augusta, Ontario, Canada  
Jeffrey Ogden Collection, Truro, Nova Scotia, Canada  
Kent Island Collection, Bowdoin College, Brunswick, Maine, U.S.A.  
Laurentian Forestry Centre, Quebec, Quebec, Canada  
Martin Turgeon Collection, Saint-Basile, New Brunswick, Canada  
Memorial University of Newfoundland, St. John's, Newfoundland and Labrador  
(on loan to David Langor, Edmonton), Canada  
Northern Forestry Centre, Canadian Forest Service, Edmonton, Alberta, Canada  
Nova Scotia Agricultural College, Bible Hill, Nova Scotia, Canada  
Nova Scotia Department of Natural Resources, Shubenacadie, Nova Scotia, Canada  
Nova Scotia Museum, Halifax, Nova Scotia, Canada  
Oregon State University, Corvallis, Oregon, U.S.A.  
Pacific Forestry Centre, Canadian Forest Service, Victoria, British Columbia, Canada  
Rebecca Goreham Collection, St. Andrews, New Brunswick, Canada  
Royal British Columbia Museum, Victoria, British Columbia, Canada  
Saint Francis Xavier University, Antigonish, Nova Scotia, Canada  
Simon Fraser University, Burnaby, British Columbia, Canada  
St. Mary's University, Halifax, Nova Scotia, Canada  
University of Alberta, E.H. Strickland Entomological Museum, Edmonton, Alberta,  
Canada  
University of British Columbia, George J. Spencer Entomological Museum,  
Vancouver, British Columbia, Canada  
University of Manitoba, J.B. Wallis Museum, Winnipeg, Manitoba, Canada  
University of New Brunswick, Fredericton, New Brunswick, Canada  
University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada

Geographic coordinates were standardized using NAD83 datum, and maps pro-  
jected onto a Lambert Conic Conformal using ESRI ArcMap version 10 for Windows.  
Star-shaped map symbols represent the first collection record for that species in Can-  
ada, and solid circular symbols represent the current range of that species in Canada.

## List of adventive species in Canada

### Nebrini

*Leistus (Leistus) ferrugineus* (Linnaeus)

*Nebria (Nebria) brevicollis* (Fabricius)

### Notiophilini

*Notiophilus biguttatus* (Fabricius)

*Notiophilus palustris* (Duftschmid)

### Carabini

*Carabus (Archicarabus) nemoralis nemoralis* O.F. Müller

*Carabus (Carabus) granulatus granulatus* Linnaeus

### Clivinini

*Clivina (Clivina) collaris* (Herbst)

*Clivina (Clivina) fossor* (Linnaeus)

*Dyschirius globosus* (Herbst)

### Broscini

*Broscus cephalotes* (Linnaeus)

### Trechini

*Blemus discus* (Fabricius)

*Trechus (Trechus) obtusus* Erichson

*Trechus (Trechus) quadristriatus* (Schrank)

*Trechus (Trechus) rubens* (Fabricius)

### Bembidiini

*Bembidion (Leja) lampros* (Herbst)

*Bembidion (Leja) properans* (Stephens)

*Bembidion (Phyla) obtusum* Audinet-Serville

*Bembidion (Peryphanes) stephensii* Crotch

*Bembidion (Peryphus) bruxellense* Wesmael

*Bembidion (Peryphus) femoratum* Sturm

*Bembidion (Peryphus) tetracolum* Say

*Elaphropus (Tachyura) parvulus* (Dejean)

*Porotachys bisulcatus* (Nicolai)

Pterostichini

- Stomis (Stomis) pumicatus* (Panzer)
- Pterostichus (Argutor) vernalis* (Panzer)
- Pterostichus (Phonias) strenuus* (Panzer)
- Pterostichus (Morphnosoma) melanarius* (Illiger)
- Abax parallelepipedus* (Piller and Mitterpacher)

Zabrini

- Amara (Curtonotus) aulica* (Panzer)
- Amara (Bradytus) apricaria* (Paykull)
- Amara (Bradytus) fulva* (O.F. Müller)
- Amara (Celia) bifrons* (Gyllenhal)
- Amara (Amara) ovata* (Fabricius)
- Amara (Amara) aenea* (DeGeer)
- Amara (Amara) communis* (Panzer)
- Amara (Amara) eurynota* (Panzer)
- Amara (Amara) familiaris* (Duftschmid)
- Amara (Amara) anthobia* A. Villa & G.B. Villa

Harpalini

- Anisodactylus (Anisodactylus) binotatus* (Fabricius)
- Bradycellus (Bradycellus) harpalinus* (Audinet-Serville)
- Acupalpus (Acupalpus) meridianus* (Linnaeus)
- Ophonus (Metophonus) puncticeps* Stephens
- Ophonus (Metophonus) rufibarbis* (Fabricius)
- Harpalus (Pseudoophonus) rufipes* (DeGeer)
- Harpalus (Harpalus) affinis* (Schrank)
- Harpalus (Harpalus) rubripes* (Duftschmid)

Platynini

- Calathus (Calathus) fuscipes* (Goeze)
- Laemostenus (Laemostenus) complanatus* (Dejean)
- Laemostenus (Pristonychus) terricola terricola* (Herbst)
- Paranchus albipes* (Fabricius)
- Agonum (Agonum) muelleri* (Herbst)
- Metacalpodes buchmanani* (Hope)

Perigonini

- Perigona nigriceps* (Dejean)

Lebiini

- Dromius (Dromius) fenestratus* (Fabricius)
- Philorhizus melanocephalus* (Dejean)

# Taxonomic review

## Family Carabidae Latreille, 1802 [the ground beetles]

**Diagnosis** (after Klimaszewski et al. 2010). Length 1.4-40 mm (usually 3-8.5 mm). Body with head narrower than pronotum and pronotum narrower than elytra in most species, with several punctures of fixed position bearing tactile setae; integument glossy and black or reddish brown in most species, with some species brilliantly and metallicly coloured; antennae 11-articled, usually filiform, inserted between eyes and bases of mandibles (exception Cicindelinae); eyes prominent; pronotum margined and smooth in most species; elytra usually with longitudinal grooves (striae); legs strong, long and suitable for running in most species; procoxae often globose with open or closed cavities; tarsal formula 5-5-5.

### 1. *Leistus (Leistus) ferrugineus* (Linnaeus)

(Fig. 1; Map 1)

**Diagnosis.** This species is distinguished by the following combination of character states: length 5.5-7.0 mm; with several long finger-like processes, each bearing a stout apical spine, on the latero-ventral edge of the stipes; presence of a semicircular row of long, stout setae on the submentum; noticeably long palpi.

#### **Distribution:**

Origin	Palearctic (Europe)
Earliest records	The earliest Canadian and North American record is from St. John's, NL in 1977.
Distribution	Canada: NL: St. John's and vicinity
References	Bousquet 1991, 1992, 2010; Bousquet and Laroche 1993; Hoebeke and Wheeler 1983; Klimaszewski et al. 2010; Larson 1978; Larson and Langor 1982

**Bionomics.** This species is found in mixed forests. Adults are nocturnal, capable of flight, and are fast runners. Adults can be collected using pitfall traps (Laroche and Larivière 2003).

## 2. *Nebria (Nebria) brevicollis* (Fabricius)

(Fig. 2; Map 2)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 10-14 mm; dark brownish black to almost black, appendages reddish; frons without reddish spots; mandible with latero-basal seta; apical maxillary palpomere long; pronotum with mid-lateral setae; prosternal apophysis coarsely margined at apex; procoxa open; elytral striae deep, coarsely punctate; scutellar stria short; meso- and meta-tarsomeres 1-4 with sparse small setae on dorsal surface.

### Distribution:

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest Canadian and North American record is from St. Césaire, QC in 1930. Lindroth suggests that the specimen was found dead as it was in very poor condition. A specimen was collected from the French island of Miquelon, off the south coast of Newfoundland, in 1937. There is some doubt about whether this species is established in Canada; however, it is established in northwest OR and southwest WA.
Distribution	Canada: QC; USA: WA, OR; France: PM
References	Bousquet 1991; Bousquet and Laroche 1993; Klimaszewski et al. 2010; Lindroth 1955, 1961-1969; Morris 1983

**Bionomics.** Adults are found mostly in deciduous forests, are capable of flight and are fast runners (Laroche and Larivière 2003).

## 3. *Notiophilus biguttatus* (Fabricius)

(Fig. 3; Map 3)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 4.7-6.0 mm; body black with first four antennomeres and tibiae pale; apical half of elytral interval 3-7 contrastingly paler than intervals 1 and 2; frons with six or more carinae; procoxa open; elytron with two preapical setigerous punctures; elytral interval 2 wide, its width behind discal seta subequal to width of intervals 3-6 combined; elytral intervals 8 and 9 without microsculpture.

**Distribution:**

Origin	Palaeartic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from 1923 from St. John's, NL. The first record from BC is from 1957. This likely represents a separate introduction from the Palaeartic or a translocation from eastern North America.
Distribution	Canada: NL, NS, PE, NB, QC, BC; USA: CT, ME, NH, RI; France: PM
References	Bousquet 1991, 1992; Bousquet and Larochelle 1993; Klimaszewski et al. 2010; Larson and Langor 1982; Lindroth 1955, 1961-1969; Majka et al. 2006, 2007, 2008

**Bionomics.** Adults are found mostly in forests, as well as in cultivated fields, vacant lots, along clearings, roads and edges. This species is mostly diurnal. It is considered to be a fast runner and incapable of flight (Larochelle and Larivière 2003).

**4. *Notiophilus palustris* (Duftschmid)**

(Fig. 4; Map 8)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 5.0-6.1 mm; elytra without colour contrast, their apices not paler than disc; frons with six or more carinae; side of pronotum with deep sinuation in basal half; procoxa open; elytron with 2 preapical setigerous punctures; elytral intervals 4-7 without microsculpture.

**Distribution:**

Origin	Palaeartic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from Armdale, NS in 1967.
Distribution	Canada: NS, PE
References	Bousquet 1991, 1992, 2010; Bousquet and Larochelle 1993; Klimaszewski et al. 2010; Larochelle and Larivière 1990; Majka et al. 2007, 2008

**Bionomics.** Adults are found at edges of cultivated fields, are diurnal, probably capable of flight, and are fast runners. Adults may be collected using pitfall traps, and from drift material along lake margins (Larochelle and Larivière 2003).



### 5. *Carabus (Archicarabus) nemoralis nemoralis* O.F. Müller

(Fig. 5; Map 4)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 21-26 mm; black, with upper surface cupreous or greenish-bronze, and with sides of pronotum and usually also those of elytra bluish-purple; mandible dorsally smooth, without latero-basal seta; antennomere 3 less than twice as long as antennomere 2; mentum tooth very small, often indistinct; apical labial and maxillary palpomeres only moderately expanded apically; procoxa open; elytron with three rows of foveae and each interval with a suggestion of five irregular and confluent ridges giving a scaly look; elytral edge smooth behind humerus; metacoxae contiguous along midline.

#### Distribution:

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from NB (St. John) in 1890. The species was collected in QC and BC by 1913 and 1925, respectively. It was widespread in Newfoundland by 1949, indicating a much earlier introduction.
Distribution	Canada: NL, NS, PE, NB, QC, ON, SK, AB, BC; USA: eastern USA south to PA, western USA south to CA, UT, WY
References	Bousquet 1991; Bousquet and Laroche 1993; Brown 1940; Mercado Cárdenas and Buddle 2007; Hatch 1953; Kavanaugh 1992; Klimaszewski et al. 2010; Laroche 1975; Larson and Langor 1982; Lindroth 1954a,b, 1955, 1961-1969; Majka et al. 2007

**Bionomics.** The species is strongly synanthropic. Adults are found in parks, gardens, lawns, cultivated fields, ski fields, and vacant lots, as well as in gravel and sand pits, roadside ditches, dumps, thickets, hedges, and deciduous and mixed forests. This species is mostly nocturnal and adults are incapable of flight, and are moderate runners. It may be collected using pitfall traps, by turning stones and wood, and on sidewalks at night (Laroche and Larivière 2003).

### 6. *Carabus (Carabus) granulatus granulatus* Linnaeus

(Fig. 6; Map 5)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 16-24 mm; black, upper surface usually with brassy or greenish shine; mandible dorsally smooth, without latero-basal seta; antennomere 2 cylindrical

cal, antennomere 3 less than twice as long as antennomere 2 and not or only slightly compressed on basal half; procoxa open; elytral edge smooth behind humerus; elytron with three longitudinal rows of strong tubercles alternating with two unbroken ridges; metacoxae contiguous along midline.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from St. John, NB in 1890. The species was first recorded from NS and QC in 1910 and 1913, respectively. In the west, this species was first collected in WA in 1909 and in BC by 1926. The specimen from Norman Wells, NT reported by Lindroth (1961-1969) was found in frozen strawberries so likely does not represent an established population.
Distribution	Canada: NL, NS, PE, NB, QC, ON, MB, AB, BC; USA: MA, MN, WA; France: PM
References	Bousquet 1991, 1992; Bousquet and Laroche 1993; Brown 1940; Hatch 1953; Kavanaugh 2010; Klimaszewski et al. 2010; Laroche 1975; Larson and Langor 1982; Lindroth 1954a, 1961-1969; Majka et al. 2007

**Bionomics.** Adults are found in deciduous forests, swamps, borders of marshes, pools, and roadside ditches, as well as in cultivated fields, orchards and gardens. This species is mostly nocturnal. Wing structure is dimorphic although this species is described as being incapable of flight. It is also considered to be a moderate runner and a frequent climber, and can be collected using pitfall traps, under loose bark on trees, and by beating or sweeping vegetation (Laroche and Larivière 2003).

**7. *Clivina (Clivina) collaris* (Herbst)**

(Fig. 7; Map 6)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 5.0-5.5 mm; body pedunculate; upper surface reddish to dark reddish brown, with disc of pronotum distinctly darker than disc of elytra and elytra with a dark sutural macula on apical half in most specimens; pronotum without longitudinal furrows, with lateral bead reaching basal edge; elytron with four setae on interval 3; abdominal sternite 4 with microsculpture between ambulatory setae, except along posterior edge; last abdominal sternite with convex microsculpture; mesotibia with long, acuminate preapical protuberance, its seta located laterally.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	This species was present in MA before 1838. The earliest Canadian record is from 1948 in Ontario. The species was first recorded in QC and BC in 1950 and 1954, respectively. Populations in the west (BC, WA) may represent an independent introduction from those in the east.
Distribution	Canada: QC, ON, MB, BC; USA: MA, NH, OH, WA
References	Bousquet 1991, 1992; Bousquet and Larochelle 1993; Hatch 1953; Klimaszewski et al. 2010; Larochelle 1975; Lindroth 1961-1969; Pollock 1991b

**Bionomics.** Adults are found in cultivated fields, gardens, and vacant lots as well as in gravel pits. This species is nocturnal, can fly and is described as being a slow runner and a strong burrower. It can be collected using pitfall traps (Larochelle and Larivière 2003).

**8. *Clivina (Clivina) fossor* (Linnaeus)**

(Fig. 8; Map 7)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 5.5-6.5 mm; body pedunculate; reddish black, with disc of pronotum of same coloration or paler than disc of elytra and elytra without sutural macula; pronotum without longitudinal furrows, with lateral bead reaching basal edge; elytron with four setae on interval 3; abdominal sternite 4 with microsculpture between ambulatory setae, except along posterior edge; last abdominal sternite with flat microsculpture; mesotibia with long, acuminate preapical protuberance, its seta located laterally.

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest Canadian and North American record is from Montreal, QC in 1915. The earliest records from NS, NL and NB are 1922, 1924 and 1928, respectively.
Distribution	Canada: NL, NS, PE, NB, QC, ON, SK, AB, BC; USA: eastern USA south to PA, also OR, WA; France: PM
References	Bousquet 1987, 1991, 1992; Bousquet and Larochelle 1993; Brown 1950; Mercado Cárdenas and Buddle 2007; Hatch 1953; Klimaszewski et al. 2010; Larochelle 1975; Larson and Langor 1982; Lindroth 1954a,b, 1955, 1961-1969; Majka et al. 2007, 2008

**Bionomics.** Adults are found in cultivated fields, pastures, meadows, vacant lots, parks and orchards, as well as in gravel and sand pits. They can also be found near edges of pools, ponds, marshes, lakes, slow rivers, as well as in open forests and flood-plain forests. This species is mostly nocturnal and is considered to be a frequent flier (even though wings are polymorphic), slow runner, and frequent climber. It can be collected using pitfall and light traps, as well as by splashing water over the ground or sweeping plants (Larochelle and Larivière 2003).

### 9. *Dyschirius globosus* (Herbst)

(Fig. 9; Map 9)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 2.2-3.0 mm; body pedunculate; pronotum with lateral depression abbreviated, reaching about level of anterolateral seta; elytron with 3 discal, 3 sub-humeral, and 2 preapical setae; striae markedly punctate in anterior half.

#### Distribution:

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest Canadian and North American record is from Surrey, BC in 1978.
Distribution	Canada: BC
References	Bousquet 1996, 2001

**Bionomics.** The microhabitat and dispersal ability of this species is unknown. It was recorded in BC from under grass clippings (Larochelle and Larivière 2003). In the Palearctic, it is known to occur close to seas, riparian habitats, and pastures, and is a burrowing species.

### 10. *Broscus cephalotes* (Linnaeus)

(Fig. 10; Map 10)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 16-23 mm; body dull black, pedunculate; head with only one supra-orbital seta on each side of frons; mandible with latero-basal seta; pronotum with postero-lateral seta; elytron without subbasal ridge; striae finely impressed.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American records are from Inverness Co., NS (multiple locations) and Kings Co., PEI in 1987.
Distribution	Canada: NS, PE
References	Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Larochele and Larivière 1989a; Majka et al. 2007

**Bionomics.** Adults are found in sand dunes and near beaches. This species is nocturnal, probably incapable of flight, slow running and a strong burrower that can be caught using pitfall traps and hand picked from under logs (Larochele and Larivière 2003).

### 11. *Blemus discus* (Fabricius)

(Fig. 11; Map 11)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 4.4-5.5 mm; elytra pubescent, bright reddish-yellow with a dark, broad transverse fascia behind middle; frons with two supraorbital setae on each side; frontal furrows markedly diverging posteriad, circularly surrounding the eyes; mandible with latero-basal seta; apical maxillary palpomere as long as penultimate palpomere; procoxa closed.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from Lanoraie, QC in 1933. The earliest records from ON and NS are 1934 and 1970, respectively.
Distribution	Canada: NS, PE, NB, QC, ON; USA: eastern USA south to PA
References	Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Brown 1940; Larochele 1975; Lindroth 1961-1969; Majka et al. 2007, 2008

**Bionomics.** Adults are mostly found near rivers, brooks, pools, ponds, lakes and swamps, as well as in gravel pits and cultivated fields. This species is nocturnal and considered to be a frequent flier, a fast runner, and a strong burrower. It may be collected using light traps, hand picked from under stones, and by splashing water over the ground (Larochele and Larivière 2003).

**12. *Trechus (Trechus) obtusus* Erichson**

(Figs. 12, 56; Map 12)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 3.6–4.1 mm; upper surface reddish-brown to brown with head darker; frons with two supraorbital setae on each side; frontal furrows markedly diverging posteriad, circularly surrounding the eyes; mandible with latero-basal seta; apical maxillary palpomere as long as penultimate palpomere; pronotum with posterior edge oblique toward posterior angle; base with sharp, transverse, linear impression on each side; side of pronotum with very short, almost imperceptible sinuation in front of posterior angle. Median lobe of aedeagus as illustrated (Fig. 56).

**Distribution:**

Origin	Palearctic (Europe, North Africa)
Earliest records	The earliest North American record is from North Creek, WA in 1925. The species was first recorded from Colwood, BC in 1932.
Distribution	Canada: BC; USA: WA south to CA
References	Bousquet 1991; Bousquet and Larochelle 1993; Hatch 1953; Kavanaugh 1992; Kavanaugh and Erwin 1985; Klimaszewski et al. 2010

**Bionomics.** Adults are found in disturbed habitats close to urban and rural sites, such as cultivated fields, parks, orchards, city lawns, forest edges, roadsides, gravel pits and wastelands. This species is nocturnal and is considered an occasional flier and a moderate runner. Adults may be collected using pitfall traps, by turning stones and by raking the leaf litter (Larochelle and Larivière 2003).

**13. *Trechus (Trechus) quadristriatus* (Schrank)**

(Figs. 13, 57; Map 13)

**Diagnosis.** Morphologically very similar to *T. obtusus* but differing by the following character states: eyes generally larger and more convex; anterior supraorbital seta situated closer to eye; posterior angle of pronotum usually more distinct; elytra generally longer and less arcuate; elytral striae usually more impressed; body length 3.6–4.1 mm. Median lobe of aedeagus as illustrated (Fig. 57).

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest North American and Canadian record is from Peel Co., ON in 1965.

Distribution	Canada: NS, QC, ON; USA: MD, MI, NY, PA, WI, WV
References	Bousquet 1991, 1992, 2010; Bousquet and Larochelle 1993; Bousquet et al. 1984; Klimaszewski et al. 2010; Majka et al. 2006, 2007

**Bionomics.** This species is found in disturbed habitats such as cultivated fields, field edges, gardens and vacant lots. It is both nocturnal and diurnal, and is considered a frequent flier and a moderate runner. Adults may be collected by using light and pitfall traps or by raking leaf litter and turning stones (Larochelle and Larivière 2003).

#### 14. *Trechus (Trechus) rubens* (Fabricius)

(Fig. 14; Map 14)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 5.0-6.5 mm; upper surface dark brown to brownish-black with elytra usually slightly paler and head slightly darker; pronotum and elytra iridescent; frons with two supraorbital setae on each side; frontal furrows markedly diverging posteriorly, circularly surrounding the eyes; mandible with latero-basal seta; apical maxillary palpomere as long as penultimate palpomere; side of pronotum with long sinuation in front of posterior angle.

#### Distribution:

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from NS (locality unspecified) where it was established by 1863. The earliest record from QC (Lauzon) is 1925.
Distribution	Canada: NL, NS, PE, NB, QC; USA: ME, NH, VT; France: PM
References	Bousquet 1991, 1992; Bousquet and Larochelle 1993; Brown 1940, 1950; Klimaszewski et al. 2010; Larochelle 1975; Larson and Langor 1982; Lindroth 1955, 1961-1969; Majka et al. 2007, 2008

**Bionomics.** Adults are found in wet areas such as borders of pools, ponds, lakes, marshes, swamps, slow rivers, brooks and roadside ditches. This species is crepuscular and nocturnal and is considered a frequent flier, a fast runner, a strong burrower, and a good swimmer. It may be collected by using light traps, pouring water over the ground, turning wood and stones, and from the walls of beaver dens (Larochelle and Larivière 2003).

**15. *Bembidion (Leja) lampros* (Herbst)**

(Fig. 15; Map 16)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 3.0-4.4 mm; upper surface shiny black with bronze or brass lustre, elytra without spots; pronotum and elytra without evident microsculpture; last maxillary palpomere rudimentary, much shorter than palpomere 3; frontal furrows slightly sinuate; side of pronotum with short but markedly deep sinuation in front of posterior angle; elytral stria 7 indistinct or represented in basal half by very fine punctures much smaller than those of stria 6; elytron with lateral margin angular at level of humerus and extended medially.

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest Canadian and North American record is from Langley Prairie, BC in 1947. The species was well established in St. John's, NL by 1949. Undoubtedly there were separate introductions on the Atlantic and Pacific coasts of Canada.
Distribution	Canada: NL, BC; USA: OR, WA
References	Bousquet 1991, 1992; Bousquet and Larochelle 1993; Hatch 1953; Langor and Larson 1983; Larson and Langor 1982; Lindroth 1955, 1961-1969; Westcott et al. 2006

**Bionomics.** The species is synanthropic and adults are found in cultivated and abandoned fields, in gardens, parks, and backyards. This species is diurnal, and has polymorphic wings, meaning that some have flight ability and some do not (Langor and Larson 1983). They are considered fast runners and occasional climbers, and can be caught using pitfall and window traps and by sweeping plants (Larochelle and Larivière 2003).

**16. *Bembidion (Leja) properans* (Stephens)**

(Fig. 16; Map 15)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 3.5-4.2 mm; upper surface shiny black with bronze or brass lustre, elytra without spots; pronotum and elytra without evident microsculpture; last maxillary palpomere rudimentary, much shorter than palpomere 3; frontal furrows straight; side of pronotum with short but markedly deep sinuation in front of posterior angle; elytral stria 7 distinct in basal half, represented by punctures as large or almost so as those of stria 6; elytron with lateral margin angular at level of humerus and extended medially.



**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from Halifax, NS in 1942. The earliest record from NL is in 1979.
Distribution	Canada: NL, NS, PE, NB, QC; USA: ME
References	Bousquet 1987, 1991, 1992; Bousquet and Laroche 1993; Laroche 1975; Larson and Langor 1982; Lindroth 1954a,b, 1961-1969; Freitag et al. 1973; Majka et al. 2007, 2008

**Bionomics.** The species is synanthropic and adults are found in grasslands, field edges, meadows, and gardens, vacant and cultivated fields. This species is predominantly nocturnal, although occasionally active in full sunshine. Adults have flight ability and are considered to be fast runners. They can be caught using pitfall traps, and by turning stones and leaf litter (Laroche and Larivière 2003).

**17. *Bembidion (Phyla) obtusum* Audinet-Serville**

(Fig. 17; Map 17)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 2.8-3.5 mm; upper surface brown or reddish brown, without lustre, elytra slightly iridescent, without spots; pronotum and elytra without evident microsculpture; last maxillary palpomere rudimentary, much shorter than palpomere 3; side of pronotum without sinuation in front of posterior angle; pronotum with latero-basal carina poorly developed, indistinct or very short; elytron with lateral margin angular at level of humerus and extended medially; elytral striae clearly punctate.

**Distribution:**

Origin	Palearctic (Europe)
Earliest records	The earliest Canadian and North American record is from York County, ON in 1956.
Distribution	Canada: PE, QC, ON; USA: MI, NY, OH, PA, VT
References	Bousquet 1991, 1992; Bousquet and Laroche 1993; Mercado Cárdenas and Buddle 2007; Hoebeke et al. 1991; Lindroth 1961-1969; Majka et al. 2007, 2008

**Bionomics.** Adults are found in meadows, fields, and cultivated pastures, on roadsides, in gravel pits, sand pits, forest edges and open forests. They can also be found near water such as irrigation canals, brooks, and rivers. This species is mostly nocturnal, but is occasionally active on roads in spring sunshine. Adults are incapable of flight, are

moderate runners and occasional climbers, and can be caught using pitfall traps and by raking leaf litter (Laroche and Larivière 2003).

### 18. *Bembidion (Peryphanes) stephensii* Crotch

(Fig. 18; Map 18)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 5.2-6.1 mm; upper surface dark brown or black, with bluish or greenish lustre, with palpi and antennomeres 1-3 entirely pale; elytra without spots; last maxillary palpomere rudimentary, much shorter than palpomere 3; pronotum with latero-basal carina straight posteriorly, not reaching lateral bead; elytron with lateral margin rounded at level of humerus and not extended medially; elytral striae clearly punctate in basal half; elytral stria 7 with punctures of same size or only slightly finer than those of stria 6; metasternal process widely margined all around.

#### Distribution:

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from Ottawa, ON in 1891. The species was present in QC by 1898 and in NL by 1951.
Distribution	Canada: NL, NS, PE, NB, QC, ON; USA: eastern USA, south to MA and northern OH; France: PM
References	Bousquet 1991, 1992; Bousquet and Laroche 1993; Laroche 1975; Larson and Langor 1982; Lindroth 1955, 1961-1969; Majka et al. 2007, 2008

**Bionomics.** Adults are found in wet areas such as steep slopes with trickling water, and near brooks, pools, and ponds. Adults can also be found in gravel, clay, and sand pits and by roadsides and in vacant lots. This species is predominantly nocturnal, is an occasional flier, a moderate runner, and a strong burrower. It may be collected by lifting small embedded stones, and by pouring water over the ground (Laroche and Larivière 2003).

### 19. *Bembidion (Peryphus) bruxellense* Wesmæl

(Fig. 19; Map 19)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 4.0-5.2 mm; elytra with spots in both anterior and posterior halves; pronotum with distinct, transverse microsculpture, elytra with linear microsculpture; last maxillary palpomere rudimentary, much shorter than palpomere 3; head without

coarse punctures medially near posterior edge of eye; pronotum with well-developed latero-basal carina; posterior edge of pronotum straight, without sinuation near posterior angle; elytron with anterior discal setigerous puncture touching stria 3; metasternal process entirely margined.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from Codroy, NL in 1907. The species was recorded from QC (Anticosti Island), NS and NB by 1909, 1910 and 1926, respectively.
Distribution	Canada: NL, NS, PE, NB, QC; USA: ME; France: PM
References	Bousquet 1991, 1992; 2010; Bousquet and Laroche 1993; Laroche 1975; Larson and Langor 1982; Lindroth 1955, 1961-1969; Majka et al. 2007, 2008

**Bionomics.** Adults are found in the borders of wetlands such as temporary pools, marshes and slow-flowing brooks. They are also found in gardens, meadows, vacant lots, and in sand and gravel pits. This species is nocturnal and is considered to be an occasional flier and a moderate runner. Adults can be collected using pitfall traps and from under stones (Laroche and Larivière 2003).

**20. *Bembidion (Peryphus) femoratum* Sturm**

(Fig. 20; Map 20)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 4.3-5.0 mm; antennomeres 2 and 3 infuscated, penultimate maxillary and labial palpomeres dark, reddish-black, pale elytral spots isolated along lateral margin; last maxillary palpomere rudimentary, much shorter than palpomere 3; head without coarse punctures medially near posterior edge of eye; pronotum without microsculpture, with well-developed latero-basal carina; posterior edge of pronotum straight, without sinuation near posterior angle; elytron with anterior discal setigerous puncture touching stria 3; elytral stria 7 with punctures fine and noticeably smaller than those along stria 6; metasternal process entirely margined.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from Lawrencetown, NS in 1967. The species was present in NB (St. John) by 1988.

Distribution	Canada: NS, NB; USA: WA
References	Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Majka 2005; Majka et al. 2007

**Bionomics.** This species is synanthropic and usually found in abandoned fields. Adults are mostly nocturnal, but sometimes are active in sunlight. It has the ability to fly, and is considered a moderate runner. Adults can be caught from under stones (Larochele and Larivière 2003).

## 21. *Bembidion (Peryphus) tetracolum* Say

(Fig. 21; Map 21)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 4.9-6.1 mm; antennomeres 2, often also 3 not or barely infuscate at apex, penultimate maxillary and labial palpomeres pale, pale elytral spots isolated along lateral margin; last maxillary palpomere rudimentary, much shorter than palpomere 3; head without coarse punctures medially near posterior edge of eye; pronotum without microsculpture, with well-developed latero-basal carina; posterior edge of pronotum straight, without sinuation near posterior angle; elytra with linear microsculpture; elytron with anterior discal setigerous puncture touching stria 3; elytral stria 7 with punctures relatively coarse, at most slightly smaller than those along stria 6; metasternal process entirely margined.

### Distribution:

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The first North American record is from Boston, MA between 1650 and 1700. The first Canadian record is from QC (unspecified locality) in 1850. It was present in NB by 1902, NL (Codroy) by 1905, NS (Port Medway) by 1910 and BC (Vancouver) by 1910. There may have been separate introduction events on the east and west coasts of North America.
Distribution	Canada: NL, NS, PE, NB, QC, ON, BC; USA: Most of USA south to CA, UT, SD, VA; France: PM
References	Bain 1998, 1999; Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Larochele 1975; Larson and Langor 1982; Lindroth 1955, 1961-1969; Majka et al. 2007, 2008

**Bionomics.** This species is synanthropic and is found in vacant lots, meadows, pastures, gardens, clay, gravel, and sand pits; however, adults are also found on river banks, marsh borders, and lakeshores. This species is predominantly nocturnal, al-

though sometimes may be active in the sunshine. It has dimorphic wings and is considered an occasional flier, a moderate runner, and an occasional climber. Adults may be caught using pitfall traps, and by turning stones and sweeping plants (Larochelle and Larivière 2003).

## 22. *Elaphropus (Tachyura) parvulus* (Dejean)

(Fig. 22; Map 22)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 1.8-2.2 mm, very convex and shiny; pronotum and elytra without microsculpture; last maxillary palpomere rudimentary, much shorter than palpomere 3; mentum without deep foveae; elytron with sutural stria recurved at apex and divergent from lateral margin; elytral stria 8 entire, evident also at middle.

### Distribution:

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest North American record is from Seattle, WA in 1940. The first Canadian record is from Galiano Island, BC in 1981.
Distribution	Canada: BC; USA: ID, OR, WA
References	Bousquet 1991, 2010; Hatch 1953; LaBonte and Nelson 1998

**Bionomics.** Adults are found on banks of rivers, lakes, and brooks, as well as near the sea. This species is mostly diurnal. Adults are able to fly, and are considered fast runners, and may be collected by pouring water over the ground, and by raking the soil (Larochelle and Larivière 2003).

## 23. *Porotachys bisulcatus* (Nicolai)

(Fig. 23; Map 24)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 2.8-3.2 mm; upper surface uniformly yellowish-red, the elytra convex; pronotum and elytra with very fine and dense linear microsculpture; last maxillary palpomere rudimentary, much shorter than palpomere 3; mentum with a pair of large, deep foveae; elytron with sutural stria recurved at apex but not prolonged anteriorly beyond posterior discal seta; elytron with three or four sparsely and finely punctate striae.

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest North American records are from MA, NY and PA before 1900. The wide distribution at this time suggests that the species was present in North America decades before this. The species was first recorded in Canada in York Co., NB in 1928. The first records for QC, ON and BC were 1944, 1959 and 1988, respectively. There were likely separate introductions on the east and west coasts of North America.
Distribution	Canada: NS, NB, QC, ON, BC; USA: eastern USA south to PA and NJ, west to ND, also WA, OR
References	Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Klimaszewski et al. 2010; Larochele 1975; Lindroth 1961-1969; Majka et al. 2006, 2007; Westcott et al. 2006

**Bionomics.** Adults are found mostly in coniferous forests, in sawmill yards, vacant lots and beaver dens, and near river banks. This species is crepuscular and nocturnal, and is considered to be a frequent flier and a moderate runner. Adults may be collected by using light traps, and by sifting through fermenting sawdust, pieces of bark, and wood chips (Larochele and Larivière 2003).

**24. *Stomis (Stomis) pumicatus* (Panzer)**

(Fig. 24; Map 23)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 6.8-8.3 mm; mandible elongate; antennomere 1 as long as antennomeres 2 and 3 combined; penultimate labial palpomere with two setae along anterior edge; lacinia with blunt apex; pronotum cordiform; elytron without discal setae on interval 3; scutellar stria absent; elytral striae deep, punctate; elytral plica present.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The first Canadian and North American record is from Cape Breton Highlands National Park, NS in 1984.
Distribution	Canada: NB, NS, PE. New provincial record for NB: Madawaska County: Kent County: Saint-Joseph-de-Kent, 30 June 2009, 27 July 2009, 17 August 2009, C. Comeau, raspberry field, pitfall trap (5 ex., University of New Brunswick Collection and Chris Majka Collection).

References	Bousquet 1987, 1991, 1992, 2010; Bousquet and Laroche 1993; Klimaszewski et al. 2010; Lindroth 1961-1969; Majka et al. 2007
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**Bionomics.** Adults are found in grasslands, cultivated fields, deciduous forests and at forest edges. This species is nocturnal, considered incapable of flight and is a moderate runner. Adults may be collected using pitfall traps and by raking leaf litter (Laroche and Larivière 2003).

## 25. *Pterostichus (Argutor) vernalis* (Panzer)

(Fig. 25; Map 27)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 6.0-7.5 mm; upper surface without metallic lustre; frons with two supraorbital setae along medial edge of each eye; pronotum with denticulate posterior angle and punctate base; elytron without scutellar stria, with three discal setae along interval 3; elytral plica present; metatrochanter with seta; metatarsomeres 1-3 with median carina dorsally; last tarsomere without setae underneath.

### Distribution:

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The first Canadian and North American record is from Montreal, QC in 1915. However, it is likely that this specimen is mislabelled. There is no further record of this species until 1998 when it was found in Iberville, QC.
Distribution	Canada: QC; USA: VT
References	Bousquet 2010; Bousquet and Webster 2004; Klimaszewski et al. 2010; Lindroth 1961-1969

**Bionomics.** Adults are usually found near bodies of water such as temporary pools, marshes, and fens. Adults have dimorphic wings and their flight ability is unknown (Lindroth 1961-1969).

## 26. *Pterostichus (Phonias) strenuus* (Panzer)

(Fig. 26; Map 25)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 6.0-7.2 mm; upper surface without metallic lustre; frons with two supraorbital setae along medial edge of each eye; pronotum with posterior angle more or less right, the side with short sinuation before the posterior angle; proepisternum over anterior half and usually prosternum laterally punctate; elytron with scutellar stria, with

three discal setae along interval 3; elytral plica present; metatrochanter with seta; meta-tarsomeres 1-3 without median carina dorsally; last tarsomere with setae underneath.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The first Canadian and North American record is from Renewes, NL in 1937. The earliest record from BC is 1975. There were undoubtedly separate introductions on the east and west coasts.
Distribution	Canada: NL, BC
References	Bousquet 1991, 1992, 2010; Bousquet and Laroche 1993; Klimaszewski et al. 2010; Larson and Langor 1982; Lindroth 1955, 1961-1969; Spence and Spence 1988

**Bionomics.** This species is found mostly in grasslands but may occur in cultivated fields and forests. Adults are nocturnal, moderate runners and incapable of flight. Adults may be collected using pitfall traps and by raking leaf litter (Laroche and Larivière 2003).

**27. *Pterostichus (Morphnosoma) melanarius* (Illiger)**

(Fig. 27; Map 26)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 12-19 mm; black, without metallic lustre; frons with two supra-orbital setae along medial edge of each eye; posterior angle of the pronotum denticulate, basal fovea bistriate, and latero-basal carina well developed; elytron with two discal setae along interval 3; striae relatively deep, intervals convex; elytral plica present; metatrochanter without seta; last tarsomere with setae underneath.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American records is from Pugwash, NS in 1926. The earliest record from western Canada is from North Vancouver, BC in 1932. The species was undoubtedly independently introduced in both eastern and western Canada.
Distribution	Canada: NL, NS, PE, NB, QC, ON, MB, SK, AB, BC; USA: Most of the USA south to CA, CO, IA, OH, PA, and UT
References	Bousquet 1991, 1992, 2010; Bousquet and Laroche 1993; Brown 1950; Mercado Cárdenas and Buddle 2007; Freitag et al. 1973; Hatch 1953; Klimaszewski et al. 2010; Laroche 1975; Larson and Langor 1982; Lindroth 1954a,b, 1955, 1961-1969; Majka et al. 2007, 2008; Niemelä and Spence 1991



**Bionomics.** This species is found in many kinds of undisturbed and disturbed habitats, including gardens, grasslands, vacant lots, meadows, rangelands, gravel and sand pits, roadsides, forests and tree plantations. The species is wing dimorphic and the long-winged form is capable of flight. Adults are also moderate runners and occasional climbers. Adults may be collected using pitfall traps and by turning pieces of wood and stones (Larochelle and Larivière 2003).

### 28. *Abax parallelepipedus* (Piller and Mitterpacher)

(Fig. 28; Map 28)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 18-22 mm; upper surface black, without lustre; frons with two supraorbital setae along medial edge of each eye; apical labial palpomere not widened toward apex; elytral interval 3 without discal setae; elytral interval 7 carinate anteriorly and posteriorly; elytral plica present; mesotrochanter without seta; last tarsomere with setae underneath.

#### Distribution:

Origin	Palearctic (Europe)
Earliest records	The first Canadian and North American record is from Sydney, NS in 1965. The species was first recorded from NL (Corner Brook) in 1989.
Distribution	Canada: NL, NS
References	Bousquet 1991, 1992, 2010; Bousquet and Larochelle 1993; Brown 1967; Klimaszewski et al. 2010; Lindroth 1961-1969

**Bionomics.** Adults are nocturnal and found mostly in forests and in shaded areas. They are unable to fly, are moderate runners, and are collected using pitfall traps (Larochelle and Larivière 2003).

### 29. *Amara (Curtonotus) aulica* (Panzer)

(Fig. 29; Map 29)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 11.0-14.3 mm; frons with two supraorbital setae along medial edge of each eye; anterior edge of penultimate labial palpomere with three or more setae; pronotum with posterior angle protruding laterad, acute, the lateral bead confluent with the latero-basal carina; pronotal base densely punctate; prosternal apophysis un-

margined; elytron without discal setae along interval 3, with only one preapical seta; elytral plica present.

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The first North American record is from Louisburg, NS in 1929. The species was well established in NL by 1949. The record from BC reported by Smith et al. (2004) is a misidentification.
Distribution	Canada: NL, NS, PE, NB, QC; USA: ME; France: PM
References	Bousquet 1991, 1992, 2010; Bousquet and Larochelle 1993; Brown 1940, 1950; Klimaszewski et al. 2010; Larochelle 1975; Larson and Langor 1982; Lindroth 1954a,b, 1955, 1961-1969; Majka et al. 2007, 2008

**Bionomics.** Adults are found usually in disturbed habitats such as meadows, pastures, vacant lots, playgrounds, and along roadsides and gravel pits. Adults are diurnal and nocturnal, frequent fliers and climbers, moderate runners, and may be collected using pitfall and light traps, or by sweeping or beating vegetation (Larochelle and Larivière 2003).

**30. *Amara (Bradytus) apricaria* (Paykull)**

(Fig. 30; Map 30)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 6.5-9.0 mm; upper surface reddish-black to black; frons with two supraorbital setae along medial edge of each eye; anterior edge of penultimate labial palpomere with three or more setae; pronotum with latero-basal carina, with posterior angle slightly acute, the anterior angle not or only slightly projecting anteriorly, the side with very shallow but usually distinct sinuation in front of posterior angle; prosternal apophysis margined apically; elytron without discal setae along interval 3, with one preapical seta; elytral striae relatively coarsely punctate; the scutellar stria relatively long; elytral plica present.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from Quebec (locality unspecified) in 1865. It was recorded in Peachland, BC by 1909 and in NL (Spruce Brook) by 1912.

Distribution	Canada: NL, NS, PE, NB, QC, ON, MB, SK, AB, BC, NT; USA: Most of USA south to CA, CO, KS, VA, also AK; France: PM
References	Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Hatch 1953; Klimaszewski et al. 2010; Larochele 1975; Larson and Langor 1982; Lindroth 1955, 1961-1969; Majka et al. 2007, 2008

**Bionomics.** This species has a strong preference for open ground. Adults are found in disturbed habitats such as cultivated fields, grasslands, meadows, gardens, parks, vacant lots, golf courses, and in gravel and sand pits, sand dunes, roadsides and forest clearings. It is mostly diurnal and is a frequent flier and moderate runner. Adults may be collected using pitfall, light, and window traps (Larochele and Larivière 2003).

### 31. *Amara (Bradytus) fulva* (O.F. Müller)

(Fig. 31; Map 31)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 8.0-10.4 mm; upper surface brownish-red; frons with two supraorbital setae along medial edge of each eye; anterior edge of penultimate labial palpomere with three or more setae; submentum with one pair of setae; pronotum with latero-basal carina, with posterior angle slightly acute, the side with distinct sinuation in front of posterior angle; prosternum of male with punctate median area; prosternal apophysis margined apically; elytron without discal setae along interval 3, with one preapical seta; elytral striae relatively finely punctate, the scutellar stria relatively long; elytral plica present.

#### Distribution:

Origin	Palaeartic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from Codroy, NL in 1905. It was recorded in NS (Cheticamp) by 1917, Quebec (Natashquan) by 1929, and New Brunswick (various localities) by 1939.
Distribution	Canada: NL, NS, PE, NB, QC
References	Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Brown 1940, 1950; Klimaszewski et al. 2010; Larochele 1975; Larson and Langor 1982; Lindroth 1954a,b, 1955, 1961-1969

**Bionomics.** Adults are found in vacant lots and near sand dunes, upper reaches of river banks and sea beaches. This species is nocturnal and is considered a frequent flier, and a moderate runner. Adults may be collected using window and pitfall traps, and by sweeping plants (Larochele and Larivière 2003).

**32. *Amara (Celia) bifrons* (Gyllenhal)**

(Fig. 32; Map 32)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 5.2-7.2 mm; upper surface dark reddish-brown, antennae entirely pale; frons with two supraorbital setae along medial edge of each eye; anterior edge of penultimate labial palpomere with three or more setae; pronotum with sides subparallel in basal half, with base relatively coarsely punctate; anterior angle of pronotum not or only slightly projecting anteriorly; prosternum of male without punctate median area; prosternal apophysis without setae; elytron without parascutellar seta, without discal setae along interval 3, with two preapical setae; elytral plica present; last visible abdominal sternite of male with one pair of setae along apical edge; protibia with apical spur simple, not trifid.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from Glace Bay, NS in 1929. The species was present in NL, QC and NB by 1930, 1930 and 1954, respectively.
Distribution	Canada: NL, NS, PE, NB, QC; USA: MA, ME, NH; France: PM
References	Bousquet 1991, 1992, 2010; Bousquet and Larochelle 1993; Brown 1950; Klimaszewski et al. 2010; Larochelle 1975; Larson and Langor 1982; Lindroth 1954a,b, 1955, 1961-1969; Majka and Klimaszewski 2004; Majka et al. 2007, 2008

**Bionomics.** Adults are found in vacant lots, pastures, meadows, open forests, roadsides, sand dunes, sand pits, and gravel pits. This species is mostly nocturnal, and is a frequent flier and moderate runner. Adults may be collected using pitfall, window, and light traps, and by turning stones and raking leaf litter (Larochelle and Larivière 2003).

**33. *Amara (Amara) ovata* (Fabricius)**

(Fig. 33; Map 33)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 7.8-9.3 mm; tibia not or barely paler than femur; frons with two supraorbital setae along medial edge of each eye; anterior edge of penultimate labial palpomere with three or more setae; pronotum with sides slightly but evenly rounded in basal half; elytron with parascutellar seta, without discal setae along interval 3, and

with three or four preapical setae; elytral plica present; protibia with apical spur simple, not trifid.

**Distribution:**

Origin	Palearctic (Europe, Asia), Oriental
Earliest records	The earliest North American record is from Massachusetts in 1925. The earliest Canadian record is from Toronto, ON in 1928. The earliest record in western Canada is from Fernie, BC in 1936.
Distribution	Canada: NS, PE, NB, QC, ON, AB, BC; USA: eastern USA south to VA
References	Bousquet 2010; Bousquet and Laroche 1993; Hieke 2000; Klimaszewski et al. 2010; Majka et al. 2006, 2007; Webster and Bousquet 2008

**Bionomics.** Adults are found in vacant lots, along roadsides, in open forests and in the upper zones of river banks. This species is predominantly nocturnal, has flight ability, and is a moderate runner and occasional climber. Adults may be collected by using pit-fall traps and by sweeping plants and raking leaf litter (Laroche and Larivière 2003).

**34. *Amara (Amara) aenea* (DeGeer)**

(Fig. 34; Map 34)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 6.2-8.8 mm; upper surface black with aeneous or brass lustre, antennomeres 1-3 entirely pale, antennomeres 4-11 infuscate, femur dark, reddish-black to black; eye flat; frons with two supraorbital setae along medial edge of each eye; anterior edge of penultimate labial palpomere with three or more setae; pronotum with sides subparallel in basal half, the anterior angle markedly, triangularly projecting anteriad; elytron without parascutellar seta, without discal setae along interval 3, and with three preapical setae; elytral plica present.

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	This species was in northeastern North America (locality unspecified) by 1828. It was recorded from Cape Breton Island, NS by 1931. It was well established in NL by 1949.
Distribution	Canada: NL, NS, PE, NB, QC, ON, MB, AB, BC; USA: eastern USA south to LA and FL

References	Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Brown 1950; Jarrett and Scudder 2001; Klimaszewski et al. 2010; Larochele 1975; Lindroth 1955, 1961-1969; Majka et al. 2007, 2008
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**Bionomics.** Adults are found in parks, meadows, cultivated fields, vacant lots, gardens, orchards, and along roadsides and in sand pits. This species is mostly diurnal, and is a frequent flier, a moderate runner, and a good climber. Adults may be collected using pitfall traps and light traps, or by beating vegetation (Larochele and Larivière 2003).

### 35. *Amara (Amara) communis* (Panzer)

(Fig. 35; Map 35)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 6.0-7.5 mm; antennomeres 1-2 and base of 3 pale, antennomere 3 over apical half or third and antennomeres 4-11 infuscate; frons with two supraorbital setae along medial edge of each eye; anterior edge of penultimate labial palpomere with three or more setae; pronotum with anterior angle markedly projecting anteriorly and base punctate around basal impressions; elytron without parascutellar seta, without discal setae along interval 3, and with three preapical setae; elytral plica present; last visible abdominal sternum with only two subapical setae in the female.

#### Distribution:

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American records are from NB (Saint John County and Albert County) in 1988.
Distribution	Canada: NS, PE, NB; USA: CT
References	Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Klimaszewski et al. 2010; Majka 2005; Majka et al. 2008

**Bionomics.** Adults are found in forests and meadows, are nocturnal, flight-capable and moderate runners. They may be collected by using pitfall traps and by turning stones (Larochele and Larivière 2003).

### 36. *Amara (Amara) eurynota* (Panzer)

(Fig. 36; Map 36)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 9-11 mm; tibia not or barely paler than femur; frons with two supraorbital

setae along medial edge of each eye; antennomeres 2 and 3 carinate; anterior edge of penultimate labial palpomere with three or more setae; pronotum with sides subparallel or slightly divergent in basal half, the posterior angle slightly projecting posteriad; elytron with parascutellar seta, without discal setae along interval 3, and with three or four preapical setae; elytral plica present; protibia with apical spur simple, not trifid.

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest Canadian and North American record is from St. John's, NL in 1971.
Distribution	Canada: NL
References	Bousquet 1987, 1991, 1992, 2010; Bousquet and Laroche 1993; Klimaszewski et al. 2010

**Bionomics.** Adults are found in open, disturbed habitats such as fallow fields and wastelands. This species is able to fly, and is considered to be a moderate runner. Adults are collected using pitfall traps (Laroche and Larivière 2003).

**37. *Amara (Amara) familiaris* (Duftschmid)**

(Fig. 37; Map 37)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 5.6-7.2 mm; antennomeres 1-3 pale, antennomeres 4-11 infuscate; femur and tibia pale, yellow to reddish-yellow; frons with two supraorbital setae along medial edge of each eye; anterior edge of penultimate labial palpomere with three or more setae; pronotum with anterior angle markedly projecting anteriad and base usually punctate around basal impressions, the sides subparallel in basal half; elytron without parascutellar seta, without discal setae along interval 3, and with three preapical setae; elytral plica present; last visible abdominal sternum with four subapical setae in the female.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest North American record is from Rhode Island in 1901. The earliest Canadian record is from Agassiz, BC in 1919. The earliest records from NS, ON, QC and NB are 1924, 1925, 1927 and 1928, respectively. There were likely separate introductions into eastern and western North America.
Distribution	Canada: NL, NS, PE, NB, QC, ON, MB, SK, AB, BC; USA: Eastern USA south to MS and FL, western USA south to CA and MT, also AK; France: PM

References	Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Brown 1950; Hatch 1953; Hieke 1990; Klimaszewski et al. 2010; Larochele 1975; Larson and Langor 1982; Lindroth 1954b, 1955, 1961-1969; Majka et al. 2007, 2008
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**Bionomics.** This species is synanthropic and generally prefers open habitats in forests, gardens, cultivated fields, meadows, pastures, golf courses, along roadsides, in sand and gravel pits, and in sand dunes. Adults are mostly diurnal, frequent fliers, moderate runners, and occasional climbers. Hibernation occurs in the adult stage. Adults may be collected by using pitfall, window, and light traps, and by raking leaf litter and sweeping or beating plants and trees (Larochele and Larivière 2003).

### 38. *Amara (Amara) anthobia* A. Villa & G.B. Villa

(Fig. 38; Map 38)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 5.2-6.8 mm; antennomeres 1-3 and basal half of 4 pale, antennomeres 4 (apical half)-11 infuscate; femur and tibia pale, yellow to reddish-yellow; frons with two supraorbital setae along medial edge of each eye; anterior edge of penultimate labial palpomere with three or more setae; pronotum with anterior angle slightly projecting anteriorly and base usually punctate around basal impressions, the sides subparallel in basal half; elytron with parascutellar seta, without discal setae along interval 3, and with three preapical setae; elytral plica present; last visible abdominal sternum with four subapical setae in the female.

#### Distribution:

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest North American record is from southwestern WA in 1929. The earliest Canadian record is from Hope, BC in 1980. Records from Wellington and Merritt, BC reported by Jarrett and Scudder (2001) were misidentifications.
Distribution	Canada: BC; USA: CA, MD, NY, OR, VA, WA
References	Jarrett and Scudder 2001

**Bionomics.** Adults are found in lowlands and mountains in a variety of habitats including moraines, grasslands, meadows, cultivated fields, vacant lots and fencerows. They occur on open ground and on firm soil with some vegetation. Adults are noctur-



nal, occur under vegetable debris during the day, and are frequently captured in June and August (Larochelle and Larivière 2003).

### 39. *Anisodactylus (Anisodactylus) binotatus* (Fabricius)

(Fig. 39; Map 39)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 10.0-12.8 mm; upper surface black, with antennomeres 1 and 2 reddish; frons with one supraorbital seta on each side; clypeus with only one pair of setigerous punctures; mentum and submentum partially or entirely fused, not completely separated by suture; penultimate labial palpomere with more than three setae along anterior edge; pronotum with midlateral seta but without postero-lateral seta, with short pubescence laterally on base and along side, the posterior angle denticulate; elytra with short apical and lateral pubescence; apical spur of protibia simple, not trifold, but swollen at base; protarsomeres 1-3 of male with spongy pubescence underneath.

#### Distribution:

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest Canadian and North American record is from Portland, OR in 1911.
Distribution	Canada: BC; USA: south to OR
References	Bousquet 1991; Hatch 1953; Lindroth 1961-1969; Spence and Spence 1988

**Bionomics.** Adults are found in urban areas in cultivated fields and frequently near water, in dumps, lawns, and upper zones of the banks of reservoirs and lakes. This species is nocturnal, able to fly, and is a moderate runner. Adults may be collected by using pitfall traps and by turning stones and drift material (Larochelle and Larivière 2003).

### 40. *Bradycellus (Bradycellus) harpalinus* (Audinet-Serville)

(Fig. 40; Map 40)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 3.8-4.2 mm; frons, pronotum and elytra without microsculpture; antennomeres 2 and 3, prosternum medially, and abdominal sterna with short pubescence; frons with one supraorbital seta on each side; mentum with median tooth; penultimate labial palpomere with two or three setae along anterior edge; pronotum with posterior angle markedly obtuse, almost rounded, with mid-lateral seta but without

postero-lateral seta; elytron with parascutellar seta and one discal setigerous puncture in interval 3; elytral striae impressed.

**Distribution:**

Origin	Palearctic (Europe, North Africa)
Earliest records	The earliest Canadian and North American record is from Vancouver, BC in 1951.
Distribution	Canada: BC; USA: OR, WA
References	Bousquet and Larochelle 1993; Klimaszewski et al. 2010; Lindroth 1961-1969; Westcott et al. 2006

**Bionomics.** Adults are diurnal and nocturnal, and mostly found in disturbed habitats such as gravel pits, vacant lots, and roadsides. This species is wing dimorphic, and the long-winged form is capable of flight. Adults are also moderate runners and frequent climbers, and may be collected by using pitfall and window traps, and by raking leaf litter (Larochelle and Larivière 2003).

**41. *Acupalpus (Acupalpus) meridianus* (Linnaeus)**

(Fig. 41; Map 42)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 3.2-3.8 mm; elytra with a sharp spot at each shoulder usually reaching suture; pronotum and elytra without microsculpture; frons with one supraorbital seta on each side; mentum without median tooth; penultimate labial palpomere with two or three setae along anterior edge; pronotum with mid-lateral seta but without postero-lateral seta; prosternum and abdominal sterna with short pubescence; elytron with one discal seta on interval 3, the posterior group of eight umbilical setae not divided in two groups of four setae each; tarsomere 5 with one pair of setae underneath near apex.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest North American record is from Seattle, WA in 1931. The earliest Canadian record is from Saanich, BC in 1948. The earliest record from QC is in 1969.
Distribution	Canada: QC, SK, AB, BC; USA: ID, OR, WA
References	Bousquet 1991, 1992, 2010; Bousquet and Larochelle 1993; Hatch 1953; Klimaszewski et al. 2010; Larochelle 1975; Lindroth 1961-1969; Pollock 1991a

**Bionomics.** Adults are found in lowlands, vacant lots, gardens, and in open ground. This species is nocturnal, and is an occasional flier and moderate runner. Adults may be collected using pitfall traps, and on plants (Larochelle and Larivière 2003).

#### 42. *Ophonus (Metophonus) puncticeps* Stephens

(Fig. 42; Map 41)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 6.5-9.0 mm; frons and temples with short setae; frons with one supraorbital seta on each side; mentum and submentum entirely separated by suture; penultimate labial palpomere with more than three setae along anterior edge; pronotum with one or two mid-lateral setae on each side, without postero-lateral seta, the disc with dense punctation; elytra with pubescence; elytral interval 3 without discal setae; humeral tooth not protruding; protarsomeres 1-3 of male with biseriate adhesive vestiture ventrally.

#### Distribution:

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest North American record is from Long Island, NY in 1954. The earliest Canadian record is from Granby, QC in 1985. Given its wide distribution in Canada, it was probably present much earlier than 1985 or has a very fast rate of spread.
Distribution	Canada: NS, PE, NB, QC, ON; USA: northeastern states. New provincial record for New Brunswick: Madawaska County: East Iroquois River, 9 September 2001, M. Turgeon, woodlot (1 ex., M. Turgeon Collection).
References	Bousquet 1991, 1992, 2010; Bousquet and Larochelle 1993; Klimaszewski et al. 2010; Larochelle and Larivière 1989b; Lindroth 1961-1969; Majka et al. 2006, 2007, 2008

**Bionomics.** Adults are found on dry, open ground such as vacant lots, cultivated and old fields, meadows, roadsides, gravel and sand pits, as well as in open forests and orchards. This species is mostly nocturnal and sometimes diurnal. Adults are frequent fliers and climbers and moderate runners, and may be collected using pitfall and light traps, and by turning stones and sweeping plants (Larochelle and Larivière 2003).

#### 43. *Ophonus (Metophonus) rufibarbis* (Fabricius)

(Fig. 43; Map 43)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 6.2-9.5 mm; frons and temples with short setae; frons with one

supraorbital seta on each side; mentum and submentum entirely separated by suture; penultimate labial palpomere with more than three setae along anterior edge; pronotum with two to four mid-lateral setae on each side, without postero-lateral seta, the disc with sparse punctation; elytra with pubescence; elytral interval 3 without discal setae; humeral tooth slightly protruding; protarsomeres 1-3 of male with biseriate adhesive vestiture ventrally.

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest Canadian and North American record is from Montreal, QC in 1953.
Distribution	Canada: QC
References	Bousquet 1991, 1992, 2010; Bousquet and Laroche 1993; Klimaszewski et al. 2010; Laroche 1975; Lindroth 1961-1969

**Bionomics.** Adults are found in meadows, vacant lots, and on lawns. This species is nocturnal, and is an occasional flier, moderate runner, and frequent climber. Adults may be collected by pitfall traps, by turning stones, and by sweeping plants (Laroche and Larivière 2003).

**44. *Harpalus (Pseudoophonus) rufipes* (DeGeer)**

(Fig. 44; Map 45)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 10.0-16.7 mm; frons and temples without short setae; frons with one supraorbital seta on each side; mentum and submentum entirely separated by suture; penultimate labial palpomere with more than three setae along anterior edge; pronotum with pubescence at base, with one mid-lateral seta on each side but without postero-lateral seta; posterior angle of pronotum sharp, slightly acute or right; elytra evenly punctate and with dense, yellowish pubescence, without discal punctures on interval 3; protarsomeres 1-3 of male with biseriate adhesive vestiture ventrally.

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest Canadian and North American records are from PEI (Charlottetown and Summerside) in 1937. The earliest records from NS, NB and QC are 1938, 1939 and 1949-51, respectively.
Distribution	Canada: NL, NS, PE, NB, QC; USA: CT, MA, ME, NH, RI, VT; France PM

References	Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Brown 1940, 1950; Dunn 1981; Hoebeke and Wheeler 1983; Klimaszewski et al. 2010; Larochele 1975; Larson and Langor 1982; Lindroth 1961-1969; Majka et al. 2008; Mercado Cárdenas and Buddle 2007
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**Bionomics.** Adults are found in many types of open and disturbed sites such as cultivated fields, pastures, meadows, parks, vacant lots, sand dunes, gravel pits, dumps, forests, and forest edges. This species is mostly nocturnal but is at times active in sunlight. Adults are frequent fliers, moderate runner, and occasional climbers, and can be caught using light and pitfall traps, and by sweeping plants and turning stones and wood (Larochele and Larivière 2003).

#### 45. *Harpalus (Harpalus) affinis* (Schrank)

(Fig. 45; Map 46)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 8.5-12.0 mm; pronotum and elytra with greenish, more rarely brassy, coppery or bluish lustre; frons and temples without short setae; frons with one supraorbital seta on each side; mentum and submentum entirely separated by suture; penultimate labial palpomere with more than three setae along anterior edge; pronotum with one mid-lateral seta on each side but without postero-lateral seta; elytron with intervals 7-9 pubescent at least over apical half, interval 7 without row of setigerous punctures on apical fourth; elytron without or with one discal puncture on interval 3; protarsomeres 1-3 of male with biseriate adhesive vestiture ventrally.

#### Distribution:

Origin	Palearctic
Earliest records	The species was present in Pennsylvania by 1798. The earliest Canadian record is from the Magdalen Islands, QC in 1883. The species was well established in Newfoundland by 1905.
Distribution	Canada: NL, NS, PE, NB, QC, ON, AB, BC; USA: Eastern USA south to KS and WV, also FL, ID, OR, WA; France: PM
References	Bousquet 1991, 1992, 2010; Bousquet and Larochele 1993; Hatch 1953; Klimaszewski et al. 2010; Larson and Langor 1982; Lindroth 1955, 1961-1969; Majka et al. 2007, 2008; Mercado Cárdenas and Buddle 2007

**Bionomics.** This species is found in open, disturbed sites such as gardens, cultivated fields, lawns, golf courses, gravel and sand pits, sand dunes and roadsides. Adults are

mostly diurnal, frequent fliers, moderate runners, and occasional climbers. They can be caught using pitfall and light traps, and by digging at base of plants (Larochelle and Larivière 2003).

#### 46. *Harpalus (Harpalus) rubripes* (Duftschmid)

(Fig. 46; Map 44)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 8.5-12.2 mm; pronotum and elytra with bluish green lustre quite evident on the male, not or only slightly evident in the female; frons and temples without short setae; frons with one supraorbital seta on each side; mentum and submentum entirely separated by suture; penultimate labial palpomere with more than three setae along anterior edge; pronotum with one mid-lateral seta on each side but without postero-lateral seta; elytral interval 7 with row of setigerous punctures on apical fourth; elytron with one discal puncture on apical third of interval 3; protarsomeres 1-3 of male with biseriate adhesive vestiture ventrally.

#### Distribution:

Origin	Palearctic
Earliest records	The earliest North American record is from New Hampshire in 1981. The earliest Canadian record is from Boucherville, QC in 1983.
Distribution	Canada: NS, PE, NB, QC; USA: eastern USA south to PA
References	Bousquet 1992; Chantal 1994; Klimaszewski et al. 2010; Krinsky and Oliver 1988; Majka et al. 2006, 2007, 2008; Webster and Bousquet 2008

**Bionomics.** Adults are found in open, disturbed habitats including cultivated fields, vacant lots and roadsides. Although mostly nocturnal, adults can also be active in sunshine. Adults are occasional fliers, moderate runners and strong burrowers. They can be caught using pitfall traps, by turning stones and under drift material in riparian zones (Larochelle and Larivière 2003).

#### 47. *Calathus (Calathus) fuscipes* (Goeze)

(Fig. 47; Map 47)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 10-15 mm; frons with two supraorbital setae on each side; mandible without latero-basal seta; pronotum with basal impressions coarsely punctate;

prosternum margined at apex; elytron with numerous discal setae on intervals 3 and 5; edge of elytron more or less rounded toward apex, not truncate or obliquely truncate; elytral plica absent; tarsal claws denticulate.

**Distribution:**

Origin	Palearctic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from North Lonsdale, BC in 1927.
Distribution	Canada: BC; USA: OR, WA
References	Bousquet 1991; Hatch 1953; Lindroth 1961-1969; Westcott et al. 2006

**Bionomics.** Adults are nocturnal and found in open, disturbed habitats including cultivated fields, grasslands, meadows, and vacant fields, at roadsides and near human habitation. Although the species has dimorphic wings, it is not known whether long-winged individuals can fly. Adults may be collected using pitfall traps and by raking the leaf litter (Larochelle and Larivière 2003).

**48. *Laemostenus (Laemostenus) complanatus* (Dejean)**

(Fig. 48; Map 48)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 12.5-16 mm; frons with two supraorbital setae on each side; mandible without latero-basal seta; pronotum cordiform; elytra without pubescence and without discal setae on interval 3; edge of elytron more or less rounded toward apex, not truncate or obliquely truncate; elytral plica absent; male with protarsomeres 1-3 dilated; metatibia without dense pubescence along apical half; tarsal claws denticulate at base.

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia), Cosmopolitan
Earliest records	The earliest North American record (locality unspecified) was reported in 1873. The earliest Canadian record is from BC (Vancouver Island, between Victoria and Nanaimo) in 1905.
Distribution	Canada: BC; USA: WA, OR, CA, HI
References	Bousquet 1991; Hatch 1953; Klimaszewski et al. 2010; Lindroth 1961-1969

**Bionomics.** Adults are found in ports and near or in human habitations such as in cellars, and in alleys, gardens, greenhouses, fields, and stables. This species is nocturnal,

probably capable of flight and a moderate runner. Adults may be collected by turning pieces of wood on the ground (Larochelle and Larivière 2003).

#### 49. *Laemostenus (Pristonychus) terricola terricola* (Herbst)

(Fig. 49; Map 49)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 13.0-17.5 mm; frons with two supraorbital setae on each side; mandible without latero-basal seta; pronotum cordiform; elytra without pubescence and without discal setae on interval 3; edge of elytron more or less rounded toward apex, not truncate or obliquely truncate; elytral plica absent; male with protarsomeres 1-4 dilated; metatibia with dense pubescence along apical half; tarsal claws smooth, not denticulate at base.

#### Distribution:

Origin	Palearctic (Europe, Asia), Cosmopolitan
Earliest records	The earliest Canadian and North American record is from NS (unspecified locality) from before 1894. The earliest records for NB, QC and NL are 1900, 1936 and 1937, respectively. The first record from BC (Creston) is in 1980, and this undoubtedly represents a separate introduction event.
Distribution	Canada: NL, NS, PE, NB, QC, BC; USA: MA; France: PM
References	Bousquet 1987, 1991, 1992, 2010; Bousquet and Larochelle 1993; Brown 1940; Klimaszewski et al. 2010; Larochelle 1975; Larson and Langor 1982; Lindroth 1954, 1961-1969; Majka et al. 2007, 2008

**Bionomics.** Adults are found near human habitations such as in cellars, stables, barns, and forests. This species is nocturnal, flightless and has moderate running capability. Adults may be collected by turning boards and vegetables stored in the cellars of houses (Larochelle and Larivière 2003).

#### 50. *Paranichus albipes* (Fabricius)

(Fig. 50; Map 50)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 6.8-9.0 mm; upper surface brownish-black with lateral margins and first intervals of elytra more or less reddish; frons with two supraorbital setae on each side; mandible without latero-basal seta; mentum with median tooth; pronotum with mid-lateral and postero-lateral setae, the base markedly punctate; elytron without pubes-



cence, with two discal setae on interval 3; edge of elytron more or less rounded toward apex, not truncate or obliquely truncate; elytral plica absent; meso- and metatarsomeres 1-4 with strong median sulcus on dorsal surface; tarsal claw smooth, not denticulate.

**Distribution:**

Origin	Palaeartic (Europe, North Africa, Asia)
Earliest records	The earliest Canadian and North American records are from Newfoundland (unspecified locality, but likely on the Avalon Peninsula) in 1840. The earliest records for NS and NB are 1859 and 1890, respectively.
Distribution	Canada: NL, NS, NB; USA: ME
References	Bousquet 1991, 1992, 2010; Bousquet and Laroche 1993; Klimaszewski et al. 2010; Larson and Langor 1982; Lindroth 1954a,b, 1955, 1961-1969; Majka et al. 2007

**Bionomics.** Adults are found in wet areas such as steep slopes along seashores, shores of lakes and ponds and near the banks of rivers and brooks. This species is nocturnal, probably incapable of flight, and is a moderate runner. Adults may be collected from under stones (Laroche and Larivière 2003).

**51. *Agonum (Agonum) muelleri* (Herbst)**

(Fig. 51; Map 52)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 7.2-9.5 mm; head and pronotum with greenish lustre, elytra with uniform bronzy or bluish lustre; head without transverse impression; frons with two supraorbital setae on each side; mandible without latero-basal seta; antennomere 3 without pubescence in apical half; mentum with median tooth; pronotum with mid-lateral and postero-lateral setae, with basal bead not extended medial to basal impression; elytron without pubescence, with three non foveolate discal setae on interval 3; edge of elytron more or less rounded toward apex, not truncate or obliquely truncate; elytral plica absent; tarsomere 5 with several setae underneath; tarsal claws smooth.

**Distribution:**

Origin	Palaeartic (Europe, Asia)
Earliest records	The earliest Canadian and North American record is from Newfoundland in 1840-1850. The earliest records for QC, NS, PE and BC are 1881, 1890, 1920 and 1931, respectively. The species was likely introduced separately on the east and west coasts of North America.

Distribution	Canada: NL, NS, PE, NB, QC, ON, AB, BC; USA: eastern USA south to IA and WV; France: PM
References	Bousquet 1991, 1992, 2010; Bousquet and Laroche 1993; Brown 1950; Hatch 1953; Klimaszewski et al. 2010; Krinsky and Oliver 1988; Laroche 1975; Larson and Langor 1982; Lindroth 1954a,b, 1955, 1961-1969; Majka and Klimaszewski 2004; Mercado Cárdenas and Buddle 2007

**Bionomics.** This species is found in many open and disturbed habitats, including gardens, parks, meadows, abandoned fields, pastures, cultivated fields, ski hills, along roadsides, in gravel and sand pits, and on lake and river shores. Adults are chiefly diurnal, but can be sometimes active at night. This species is considered to be a frequent flier and a moderate runner, and can be caught using pitfall traps, and by turning stones (Laroche and Larivière 2003).

## 52. *Metacolpodes buchani* (Hope)

(Fig. 52; Map 51)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 11.0-13.2 mm; upper surface dark reddish-brown, the elytra with bright metallic green lustre, the femora darkened at apex; frons with two supraorbital setae on each side; mandible without latero-basal seta; antennomere 3 without pubescence in apical half; mentum with median tooth; pronotum with mid-lateral and postero-lateral setae; elytron without pubescence, with three non foveolate discal setae on interval 3; edge of elytron more or less rounded toward apex, not truncate or obliquely truncate; sutural apex of elytron with a minute tooth; elytral plica absent; tarsal claws smooth.

### Distribution:

Origin	Palearctic (Asia), Oriental
Earliest records	The earliest North American record is from OR in 1931. The earliest Canadian record is from Haney, BC in 1999.
Distribution	Canada: BC; USA: WA, OR, ID
References	Hatch 1953; Jarrett and Scudder 2001

**Bionomics.** In BC, adults were found in a forest, and elsewhere under dry cow manure. This species is capable of flight (Laroche and Larivière 2003).

**53. *Perigona nigriceps* (Dejean)**

(Fig. 53; Map 53)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 2.0-2.5 mm; elytra brownish yellow, the head and also usually pronotum darker; frons with two supraorbital setae on each side; mandible without latero-basal seta; eyes markedly protruding; antennomere 2 and following pubescent; last maxillary palpomere as long as penultimate palpomere; pronotum with mid-lateral and postero-lateral setae; elytron with intervals 8 and 9 with short, fine pubescence; elytral stria 8 sulciform in posterior third; edge of elytron more or less rounded toward apex, not truncate or obliquely truncate; elytral plica absent.

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia), Afrotropical, Subcosmopolitan
Earliest records	The earliest North American record is from Georgia and "Carolina" (localities unspecified) in 1853. The earliest Canadian record is from La Trappe, QC in 1922.
Distribution	Canada: NS, NB, QC, ON; USA: eastern USA south to LA and FL, also OR and CA
References	Bousquet 1991, 2010; Bousquet and Laroche 1993; Hatch 1953; Klimaszewski et al. 2010; Krinsky and Oliver 1988; Laroche 1975; Lindroth 1961-1969; Majka et al. 2007; Webster and Bousquet 2008

**Bionomics.** Adults are found in gardens, and on the shores of ponds, lakes and rivers. This species is crepuscular and nocturnal, and adults are frequent fliers and moderate runners. Adults may be collected using light traps, or by sifting through and lifting compost heaps (Laroche and Larivière 2003).

**54. *Dromius (Dromius) fenestratus* (Fabricius)**

(Fig. 54; Map 54)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 5.3-6.5 mm; elytron with oval, yellowish medial spot; frons with two supraorbital setae on each side; mandible without latero-basal seta; side of pronotum with long sinuation in basal half; pronotum with basal edge straight, not lobed; elytron without parascutellar or discal setae in interval 3; elytral intervals without pubescence; edge of elytron truncate; elytral plica absent; tarsomere 4 of each leg slightly emarginate, not cleft; tarsal claws denticulate.

**Distribution:**

Origin	Palearctic (Europe)
Earliest records	The earliest Canadian and North American record is from Armdale, NS in 1952. The species was first collected in NL (St. John's) in 1994.
Distribution	Canada: NL, NS
References	Klimaszewski et al. 2010; Larson 1998; Majka and Klimaszewski 2004; Majka et al. 2007

**Bionomics.** Adults are found in forests, and are nocturnal, capable of flight, moderate runners and frequent climbers (Larochelle and Larivière 2003).

**55. *Philorhizus melanocephalus* (Dejean)**

(Fig. 55; Map 55)

**Diagnosis.** This species is distinguished by the following combination of character states: body length 2.5-3.4 mm; head brownish-black to black, pronotum yellow, in some specimens with the disc slightly darker, elytra yellowish with the scutellum and suture usually darker; frons with two supraorbital setae on each side; mandible without latero-basal seta; pronotum with basal edge straight, not lobed; elytron with parascutellar seta, without discal setae in interval 3; elytral intervals without pubescence; edge of elytron truncate; elytral plica absent; tarsomere 4 of each leg slightly emarginate, not cleft; tarsal claws denticulate.

**Distribution:**

Origin	Palearctic (Europe, North Africa, Asia)
Earliest records	The earliest Canadian and North American record is from Vancouver Island (Island View Beach) in 1996.
Distribution	Canada: BC
References	Bousquet 2004

**Bionomics.** Adults are most commonly found in wet areas such as in vegetation litter near freshwater as well as near marshes and lakeshores. This species can also be found in tufts of grass-like vegetation and in sand dunes and is considered to be a climbing species.



## Analyses and discussion

The adventive carabid fauna of Canada is very rich and contains no less than 55 species. Undoubtedly there are other non-native species in Canada that have not yet been detected. For example, *Carabus auratus* L. and *Asaphidion flavipes* (L.) are both found in the northeastern USA in very close proximity to the Canadian border, and there is high probability that these species may already be in Canada. Additional sampling of Canadian localities close to the USA border, as well as in the vicinity of major ports may well yield new Canadian and North American records of non-native species.

The species richness of adventive carabids across Canadian provinces and territories is quite variable (Table 1). The highest numbers of species is found in the Atlantic Provinces (including the islands of St. Pierre and Miquelon), QC and BC. This is not surprising given that the ports in these regions have had a long history of trade with Europe and Asia. In terms of the percentage of fauna represented by non-native species, the highest percentages are found in PM, PEI, NF and NS (Table 1), reflecting the high species richness of adventives and the low to medium native species richness. Clearly, the prairie provinces (AB, SK, MB) and northern territories and regions (YK, NT, NU, LB) have experienced the least invasion by carabids. A similar pattern is observed for insect species on woody plants (Langor et al. 2008). This pattern is likely explained by the fact that these areas are the most distant from traditional ports of entry. However, the urban areas of these provinces and territories have not been particularly well sampled, so undoubtedly the non-native carabid fauna is somewhat more diverse than hitherto detected. As the north warms and access by ships becomes more commonplace due to longer periods without pack-ice, it is anticipated that the north will become more extensively invaded.

The date of first detection of a non-native species in Canada only roughly approximates the time of establishment. As sampling of insects in Canada commenced only in the late 19<sup>th</sup> century, with the exception of a few localized efforts in the early-to-mid 19<sup>th</sup> century, the earliest adventive species were collected for the first time long (perhaps centuries) after their introduction. It is reasonable to assume that some carabid species could have been introduced into Canada as early as the 17<sup>th</sup> century in ballast from sailing ships. Three species, *Agonum muelleri*, *Paranchus albipes* and *Bembidion tetracolum* were all reported from Canada in the first half of the 19<sup>th</sup> century. An additional seven species were recorded from the second half of the 19<sup>th</sup> century, but of those, *Harpalus affinis* was undoubtedly present much earlier than that as it was already present in PA by 1798.

Nine additional species were detected in the first quarter of the 20<sup>th</sup> century, and the peak rate of introduction was achieved in the next quarter-century as 17 new adventive species were first detected. From 1951-1975 and 1976-2000, nine and ten species, respectively, were detected. No new introductions have been detected in Canada since 1999.

The number of introduction events for each species is difficult (or impossible) to ascertain. For a few species, e.g., *Bembidion lampros* and *Notiophilus biguttatus*, there were most likely separate introduction events on the east and west coasts, but it is unknown whether these introductions were direct (from native countries) or represent translocation of the species from one part of North America to another. Only detailed genetics analyses might be able to provide insight into patterns of introduction.

At least 53 of the 55 recorded adventive species originated in the Palearctic, with two, *Perigona nigriceps* and *Metacarpodes buchmanani*, that originated in either the Orient or Palearctic. It seems reasonable to expect that most introductions into eastern Canada originated in Europe while those on the west coast could have originated from Asia or Europe. However, human-assisted translocations from one coast to another also may have occurred.

Thirty-seven species appear to have been directly introduced into Canada while the remainder likely were first introduced into the USA and then subsequently spread across the border with or without human assistance. Twenty-three of the 37 directly introduced species first established in the Atlantic provinces, seven in QC, four in BC and three in ON. The most common points of entry were St. John's, NL (5 spp. introduced), lower mainland of British Columbia (4 spp.), Montreal and vicinity, QC (4 spp.) and Halifax and vicinity, NS (3 spp.). Of the 18 species that appear to have spread to Canada from original points of introduction in the USA, eight first appeared in the lower mainland of BC or southern Vancouver Island. The remainder spread across the border in southern BC, ON and NB.

**Table 1.** Summary of the native and adventive carabid fauna of Canada by province and territory and of the French islands of St. Pierre and Miquelon (PM). The estimates of the non-native species richness are updated from Bousquet and Larochelle (1993).

	YK	NT	NU	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	LB	PM
Total number of species in fauna	200	216	29	505	413	341	367	530	479	329	292	173	178	95	66
Number of native species	200	215	29	477	402	335	362	511	446	299	257	144	151	91	50
Number of adventive species	0	1	0	28	11	6	6	19	33	30	35	29	27	4	16
Percent of adventive fauna	0.0	0.5	0.0	5.5	2.7	1.8	1.6	3.6	6.9	9.1	12.0	16.8	15.2	4.2	24.2

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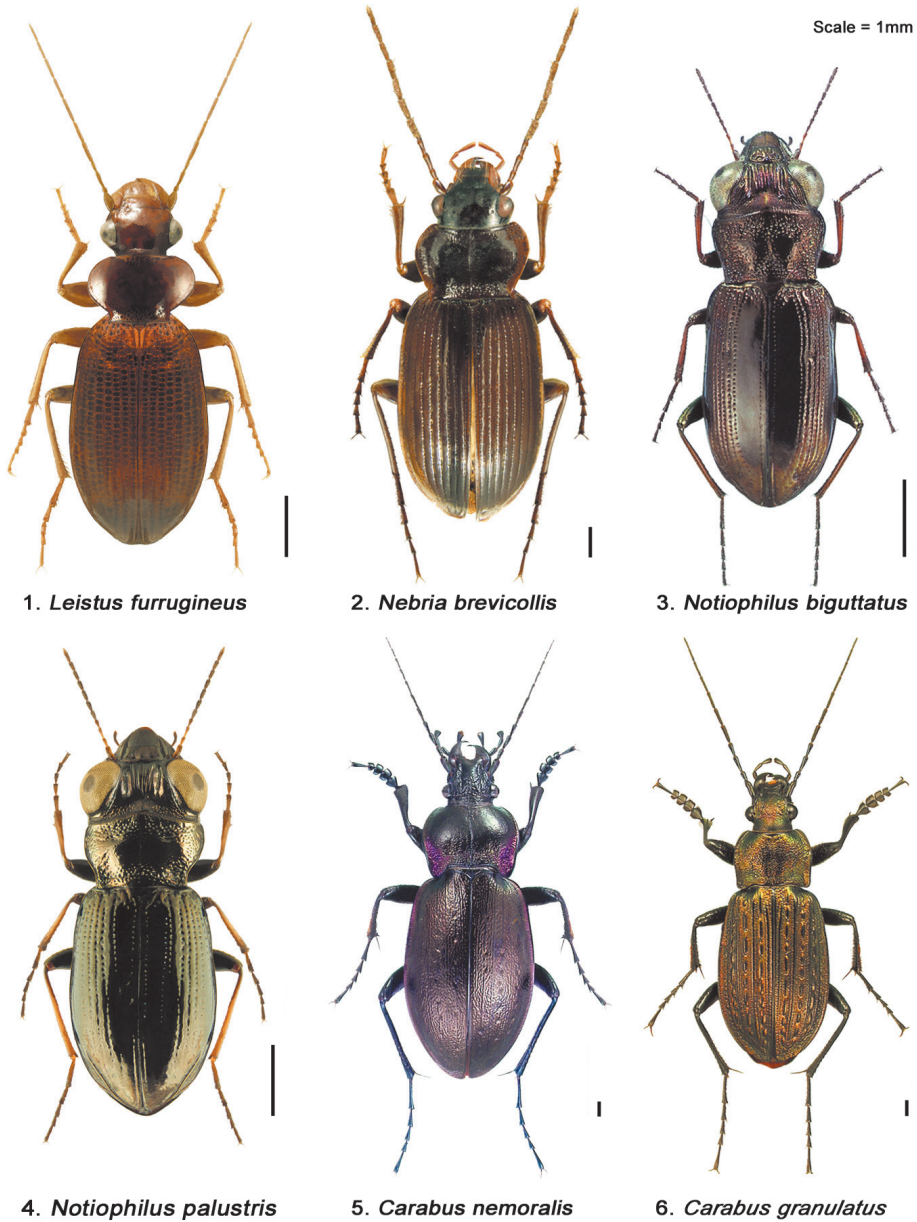
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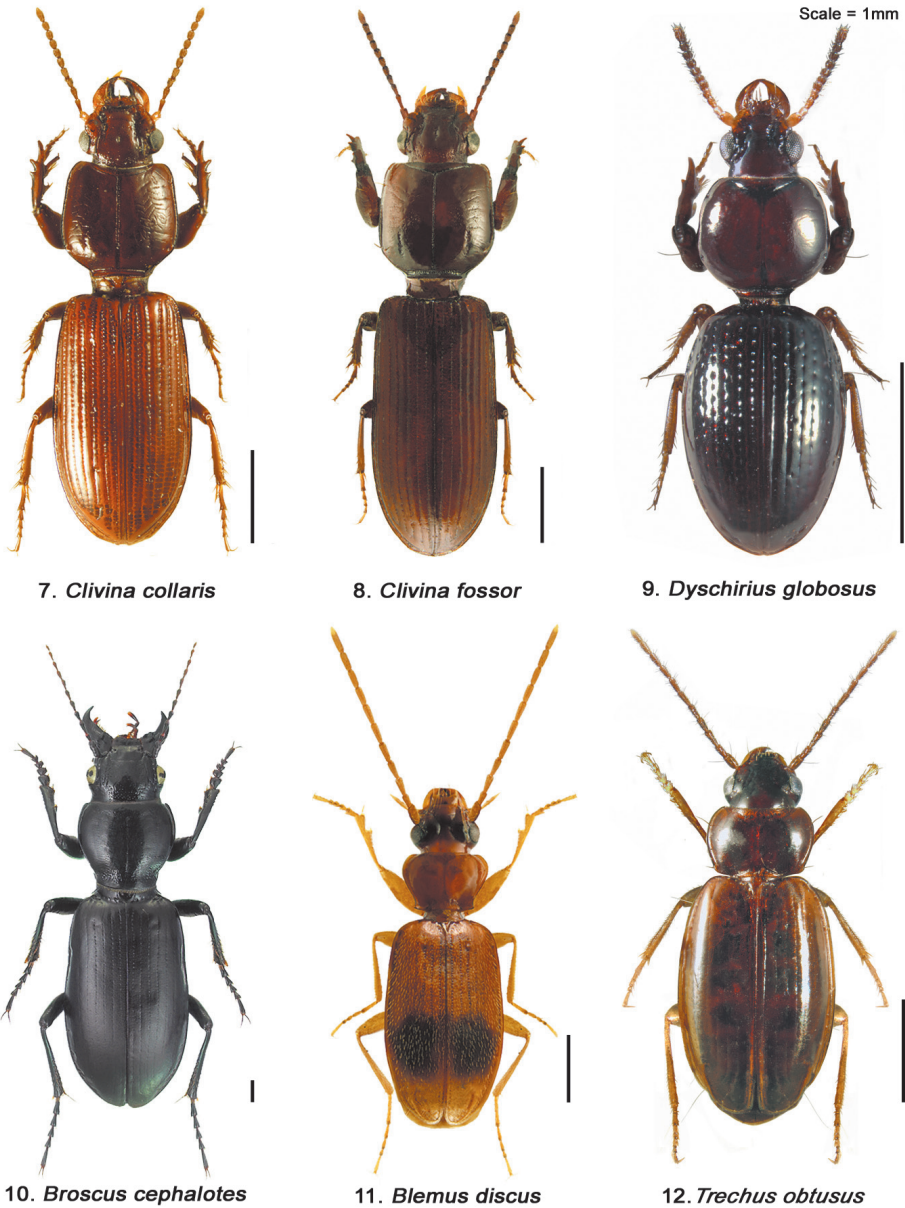
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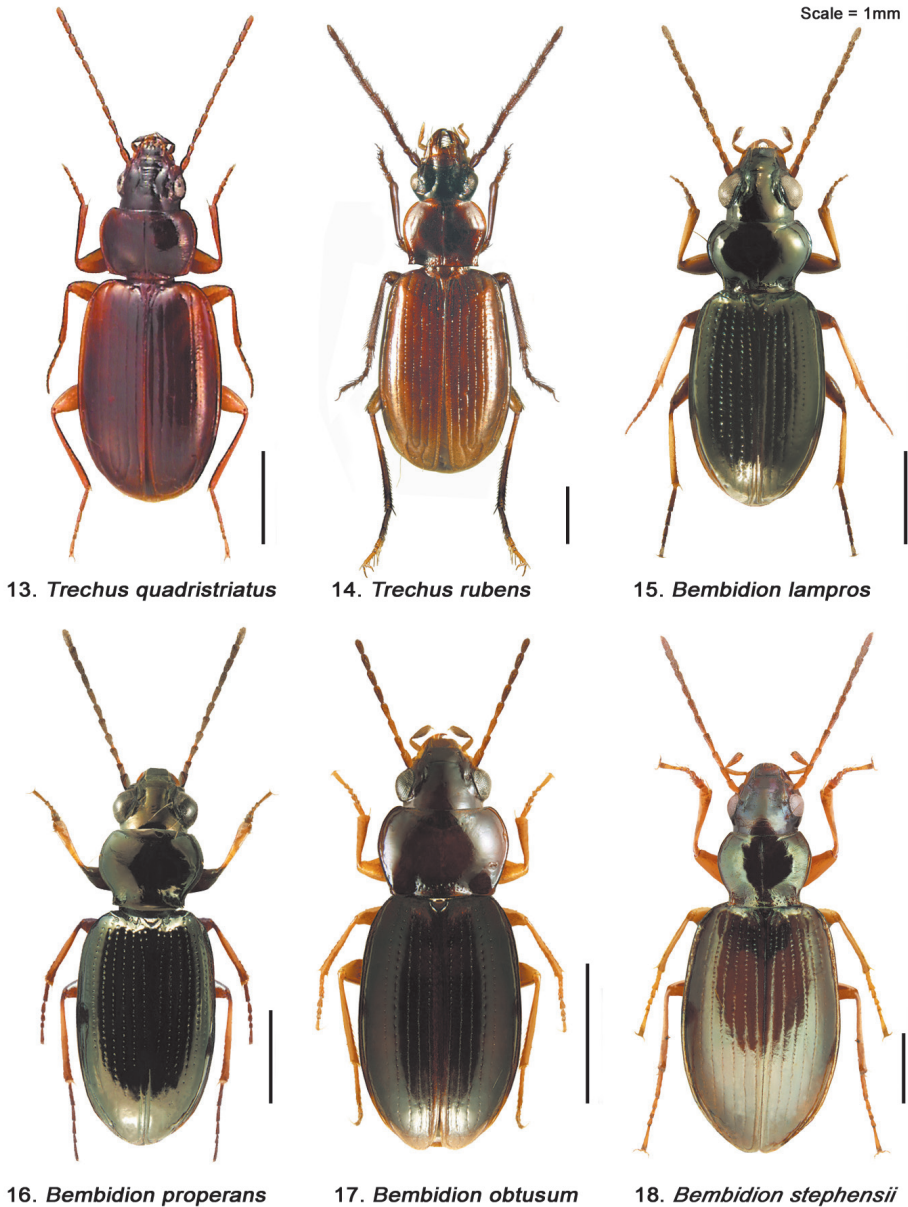


**Figs. 1-6.** Images of adventive Carabidae from Canada: 1, *Leistus ferrugineus* (Linnaeus); 2, *Nebria brevicollis* (Fabricius); 3, *Notiophilus biguttatus* (Fabricius); 4, *Notiophilus palustris* (Duftschmid); 5, *Carabus nemoralis nemoralis* O.F. Müller; 6, *Carabus granulatus granulatus* Linnaeus.

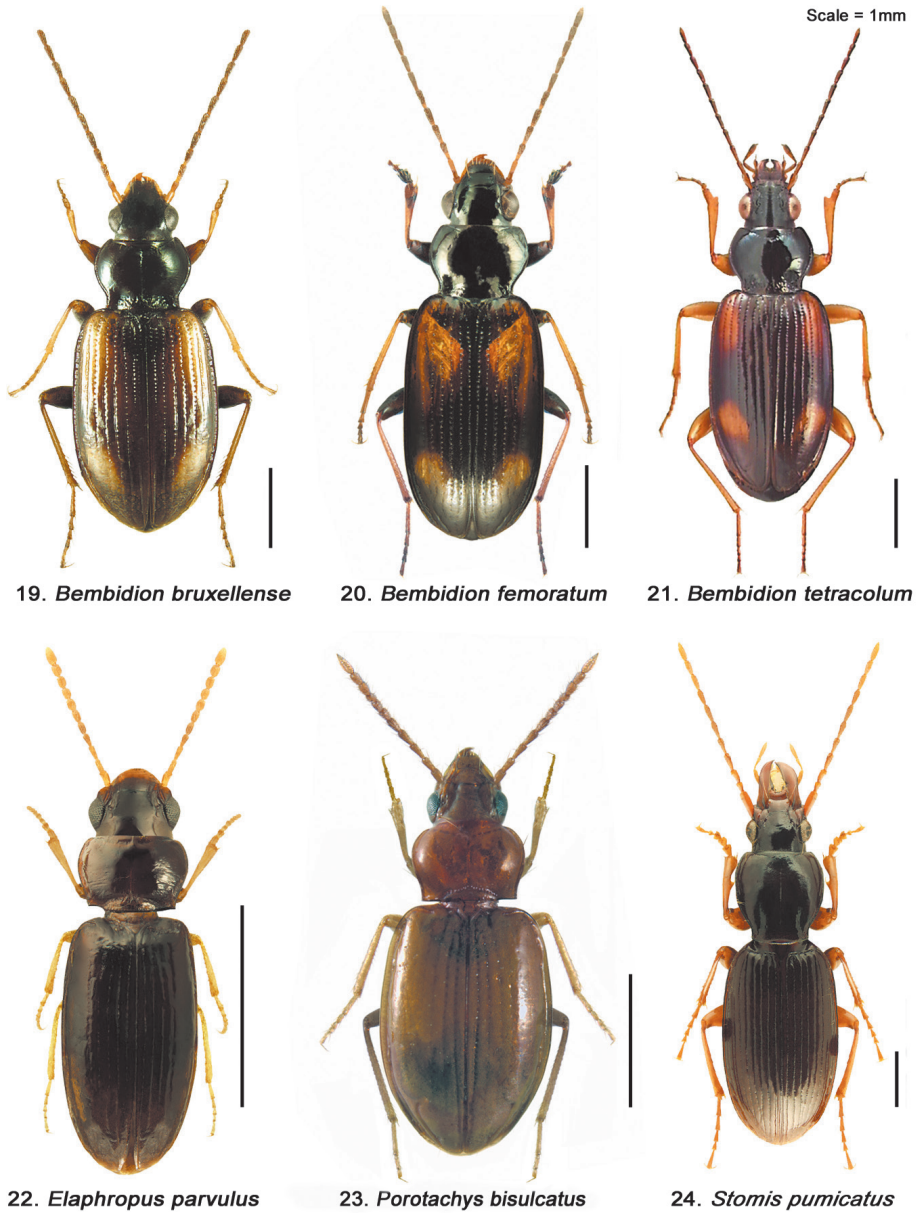




**Figs. 7-12.** Images of adventive Carabidae from Canada: 7, *Clivina collaris* (Herbst); 8, *Clivina fossor* (Linnaeus); 9, *Dyschirius globosus* (Herbst); 10, *Broscus cephalotes* (Linnaeus); 11, *Blemus discus* (Fabricius); 12, *Trechus obtusus* Erichson.



**Figs. 13-18.** Images of adventive Carabidae from Canada: 13, *Trechus quadristriatus* (Schrank); 14, *Trechus rubens* (Fabricius); 15, *Bembidion lampros* (Herbst); 16, *Bembidion properans* (Stephens); 17, *Bembidion obtusum* Audinet-Serville; 18, *Bembidion stephensii* Crotch.



**Figs. 19-24.** Images of adventive Carabidae from Canada: 19, *Bembidion bruxellense* Wesmael; 20, *Bembidion femoratum* Sturm; 21, *Bembidion tetracolum* Say; 22, *Elaphropus parvulus* (Dejean); 23, *Porotachys bisulcatus* (Nicolai); 24, *Stomis pumicatus* (Panzer).

Scale = 1mm



25. *Pterostichus vernalis*



26. *Pterostichus strenuus*



27. *Pterostichus melanarius*



28. *Abax parallelepipedus*



29. *Amara aulica*



30. *Amara apricaria*

**Figs. 25-30.** Images of adventive Carabidae from Canada: 25, *Pterostichus vernalis* (Panzer); 26, *Pterostichus strenuus* (Panzer); 27, *Pterostichus melanarius* (Illiger); 28, *Abax parallelepipedus* (Piller and Mitterpacher); 29, *Amara aulica* (Panzer); 30, *Amara apricaria* (Paykull).

Scale = 1mm



31. *Amara fulva*



32. *Amara bifrons*



33. *Amara ovata*



34. *Amara aenea*



35. *Amara communis*



36. *Amara eurynota*

**Figs. 31-36.** Images of adventive Carabidae from Canada: 31, *Amara fulva* (O.F. Müller); 32, *Amara bifrons* (Gyllenhal); 33, *Amara ovata* (Fabricius); 34, *Amara aenea* (DeGeer); 35, *Amara communis* (Panzer); 36, *Amara eurynota* (Panzer).

Scale = 1mm

37. *Amara familiaris*38. *Amara anthobia*39. *Anisodactylus binotatus*40. *Bradycellus harpalinus*41. *Acupalpus meridianus*42. *Ophonus puncticeps*

**Figs. 37-42.** Images of adventive Carabidae from Canada: 37, *Amara familiaris* (Duftschmid); 38, *Amara anthobia* A. Villa & G.B. Villa; 39, *Anisodactylus binotatus* (Fabricius); 40, *Bradycellus harpalinus* (Audinet-Serville); 41, *Acupalpus meridianus* (Linnaeus); 42, *Ophonus puncticeps* Stephens.

Scale = 1mm



43. *Ophonus rufibarbis*



44. *Harpalus rufipes*



45. *Harpalus affinis*



46. *Harpalus rubripes*

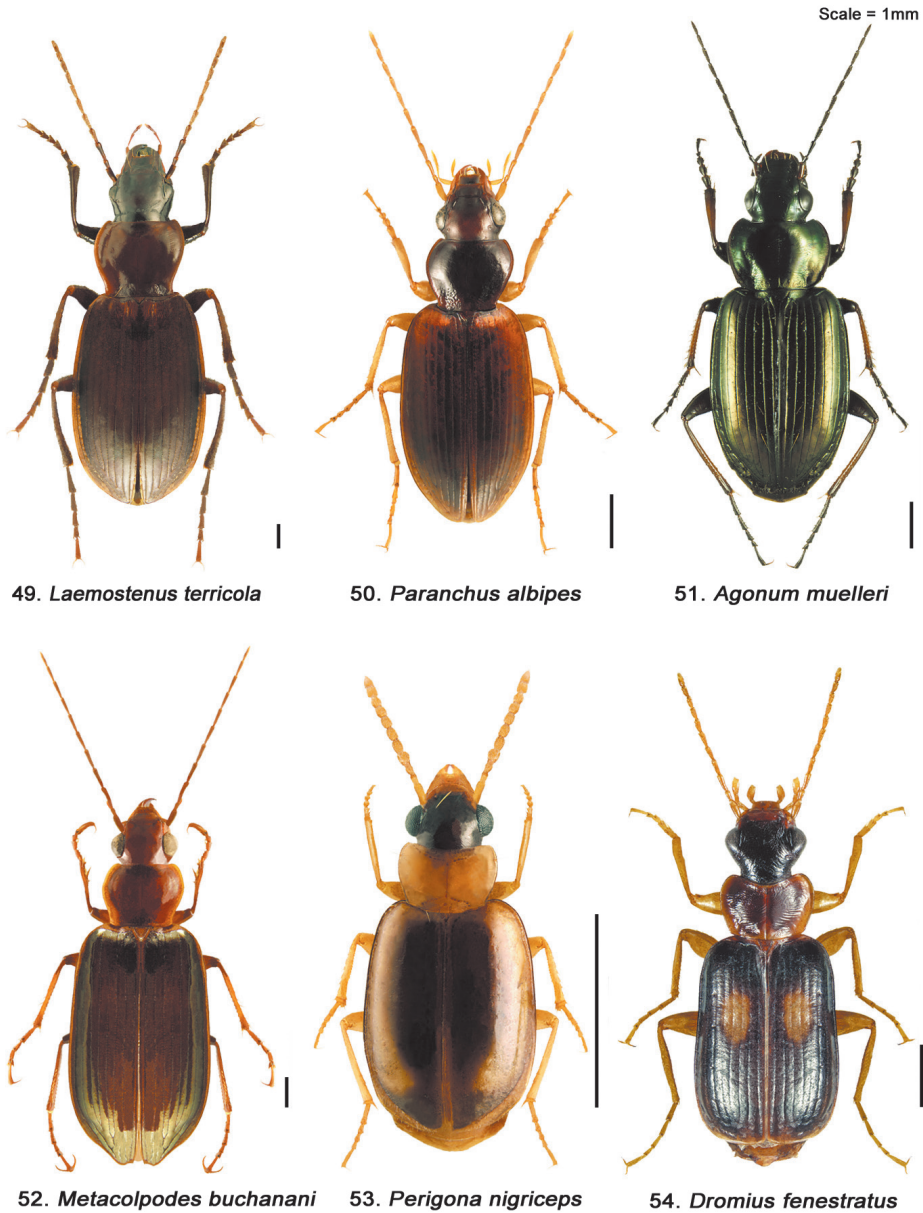


47. *Calathus fuscipes*



48. *Laemostenus complanatus*

**Figs. 43-48.** Images of adventive Carabidae from Canada: 43, *Ophonus rufibarbis* (Fabricius); 44, *Harpalus rufipes* (DeGeer); 45, *Harpalus affinis* (Schrank); 46, *Harpalus rubripes* (Duftschmid); 47, *Calathus fuscipes* (Goeze); 48, *Laemostenus complanatus* (Dejean).



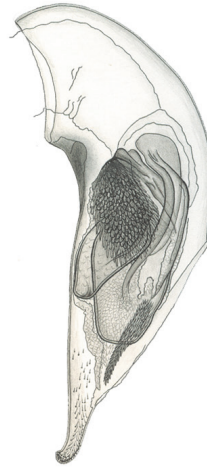
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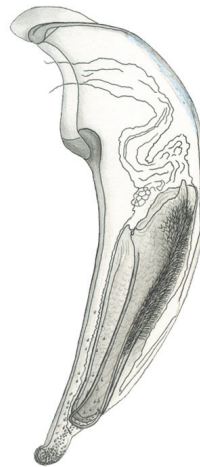
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55. *Philorhizus melanocephalus*



56. *Trechus obtusus*

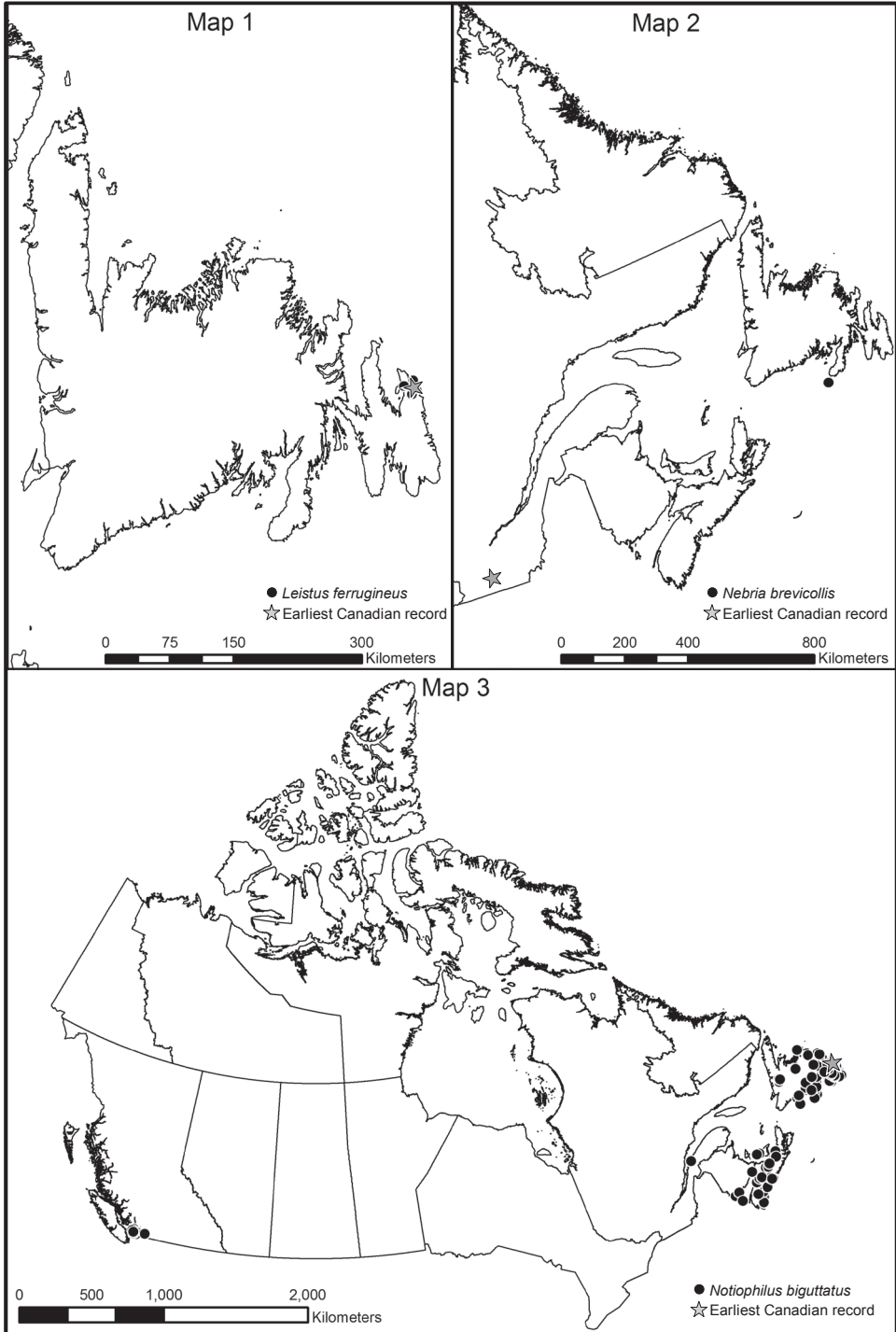


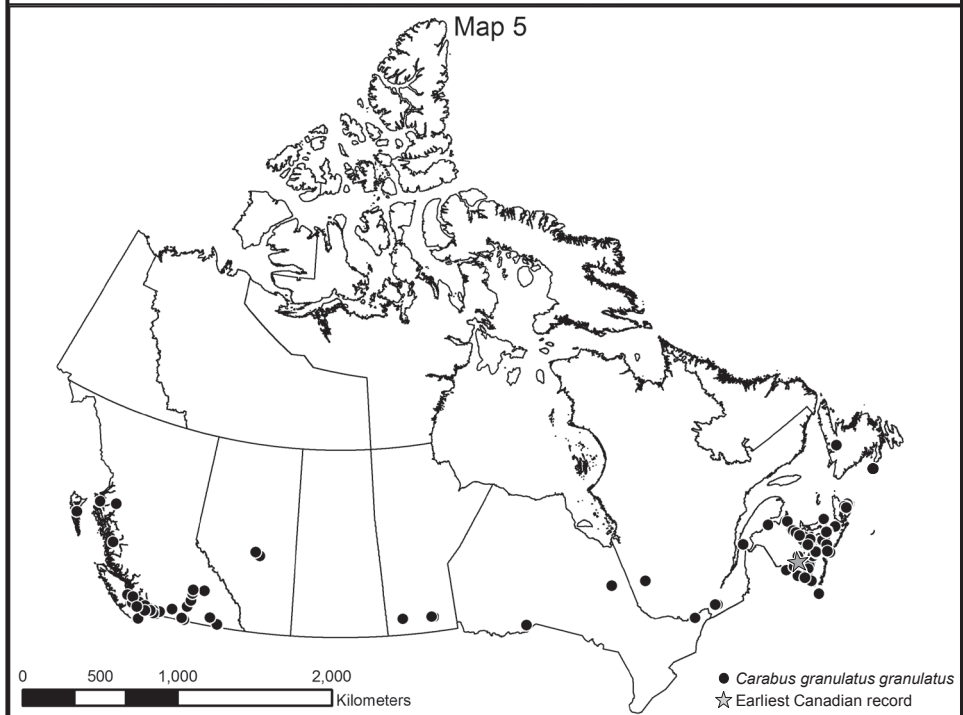
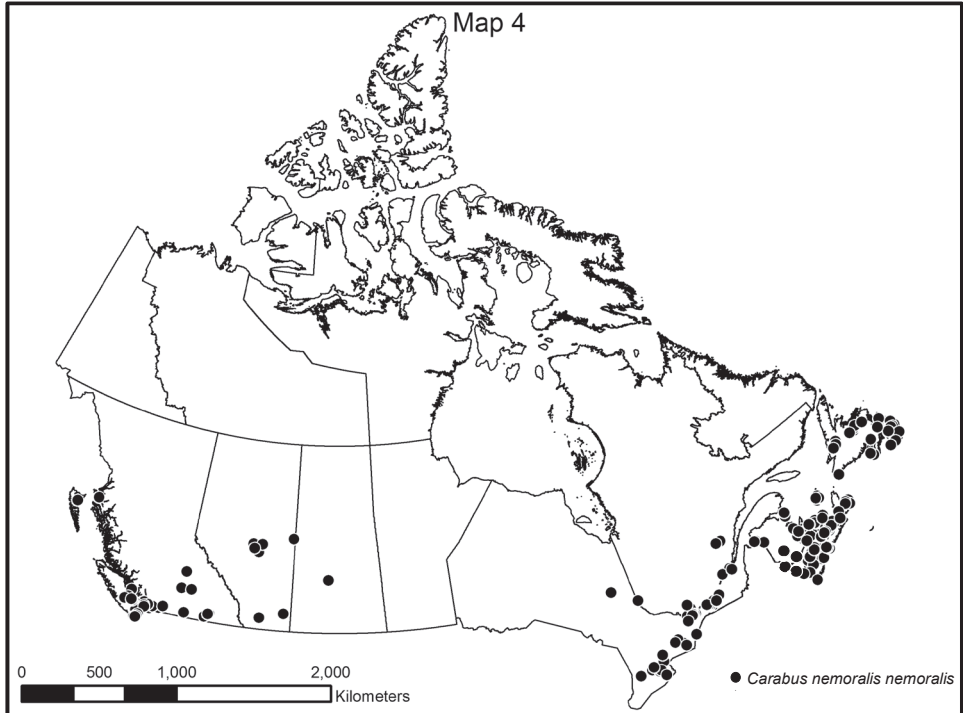
57. *Trechus quadristriatus*

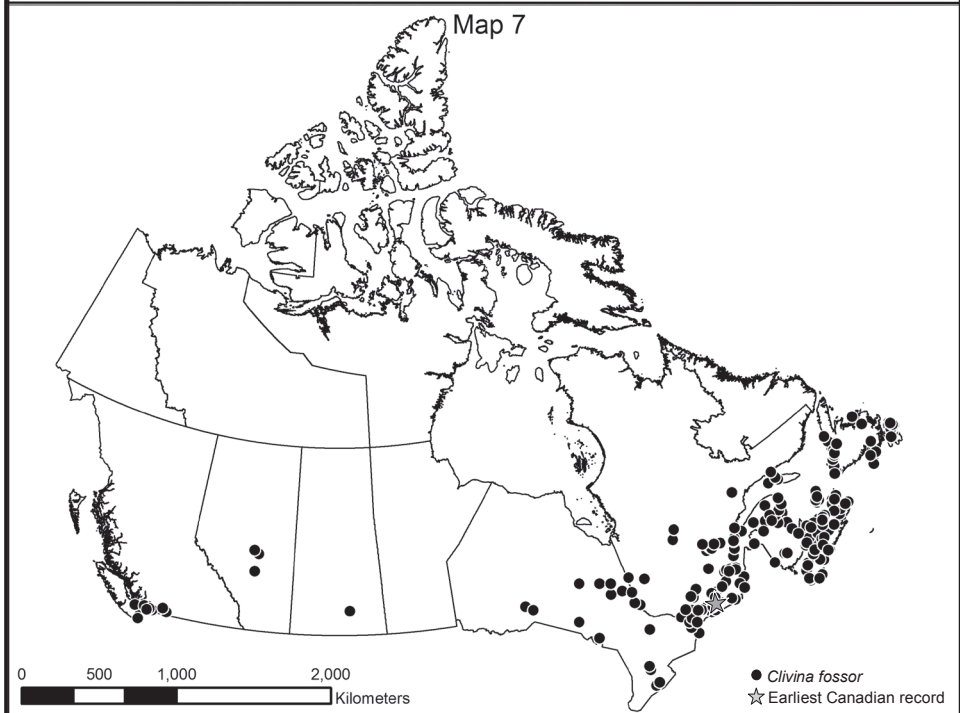
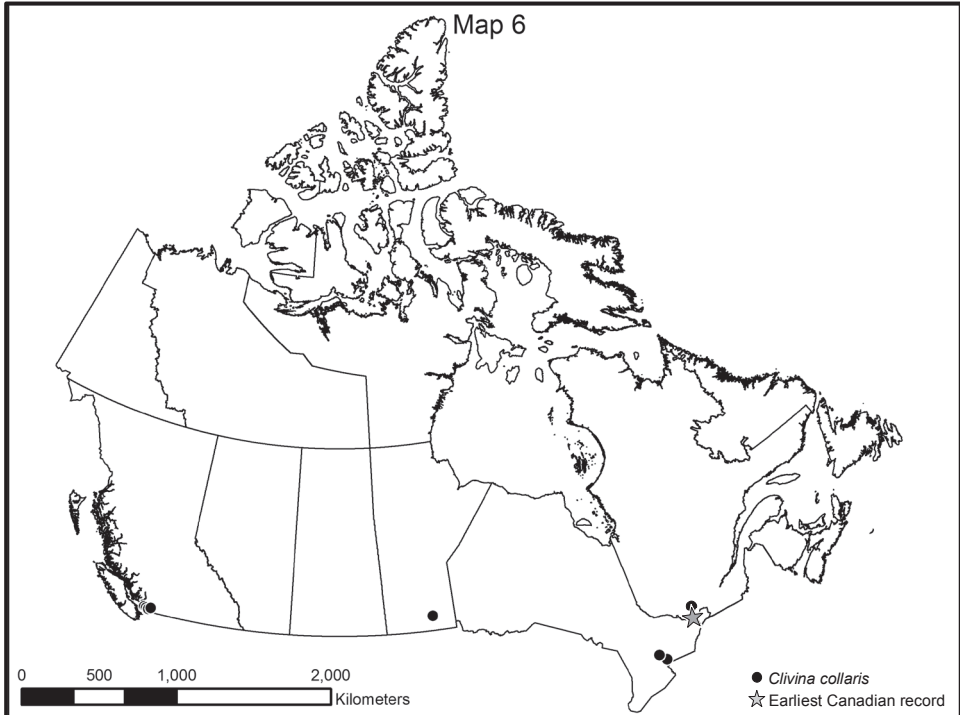
**Figs. 55-57.** Body image and median lobe of aedeagus in lateral view: 55, *Philorhizus melanocephalus* (Dejean); 56, *Trechus obtusus* (Erichson), and 57, *Trechus quadristriatus* (Schrank) (after Bousquet et al. 1984).

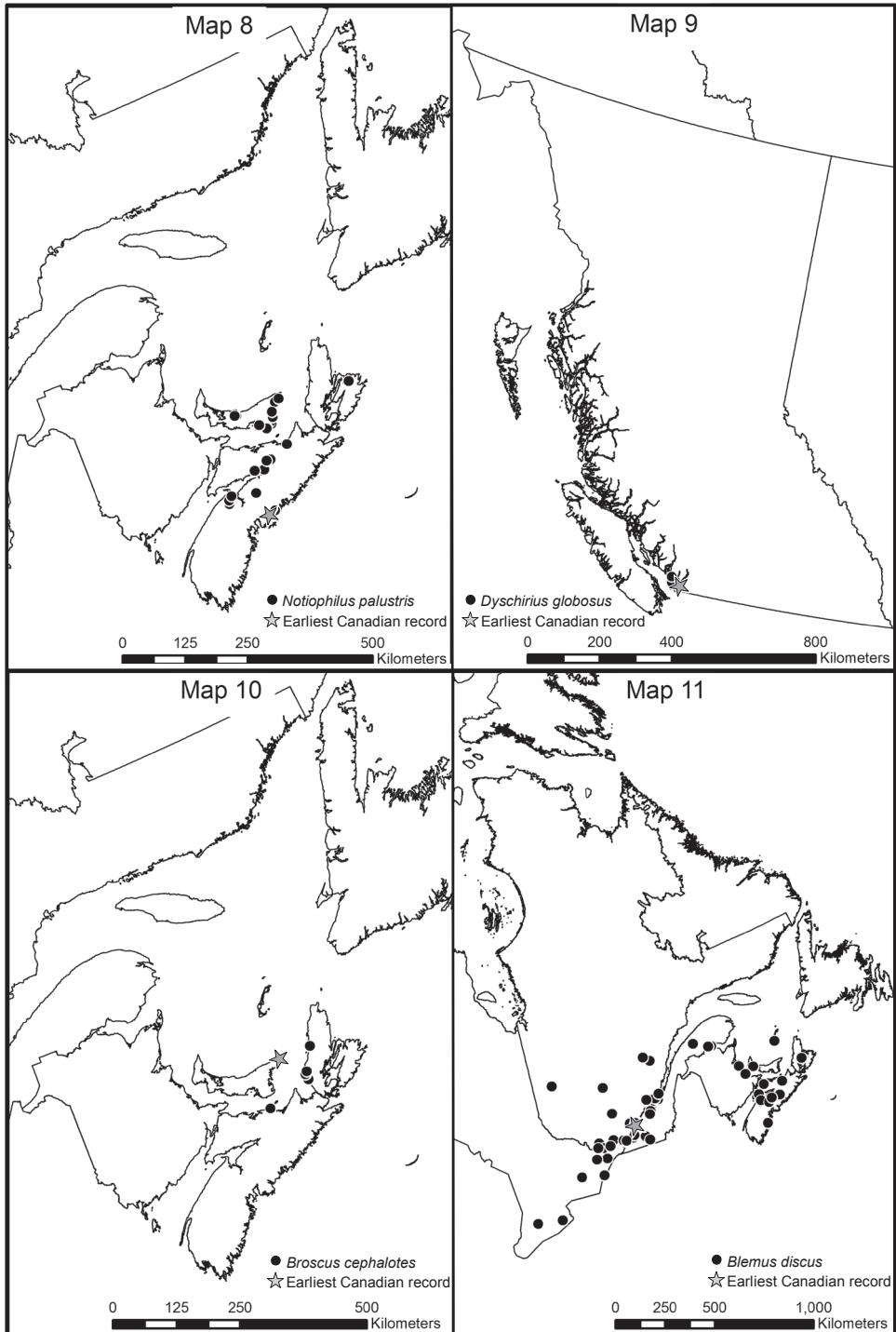
# Maps

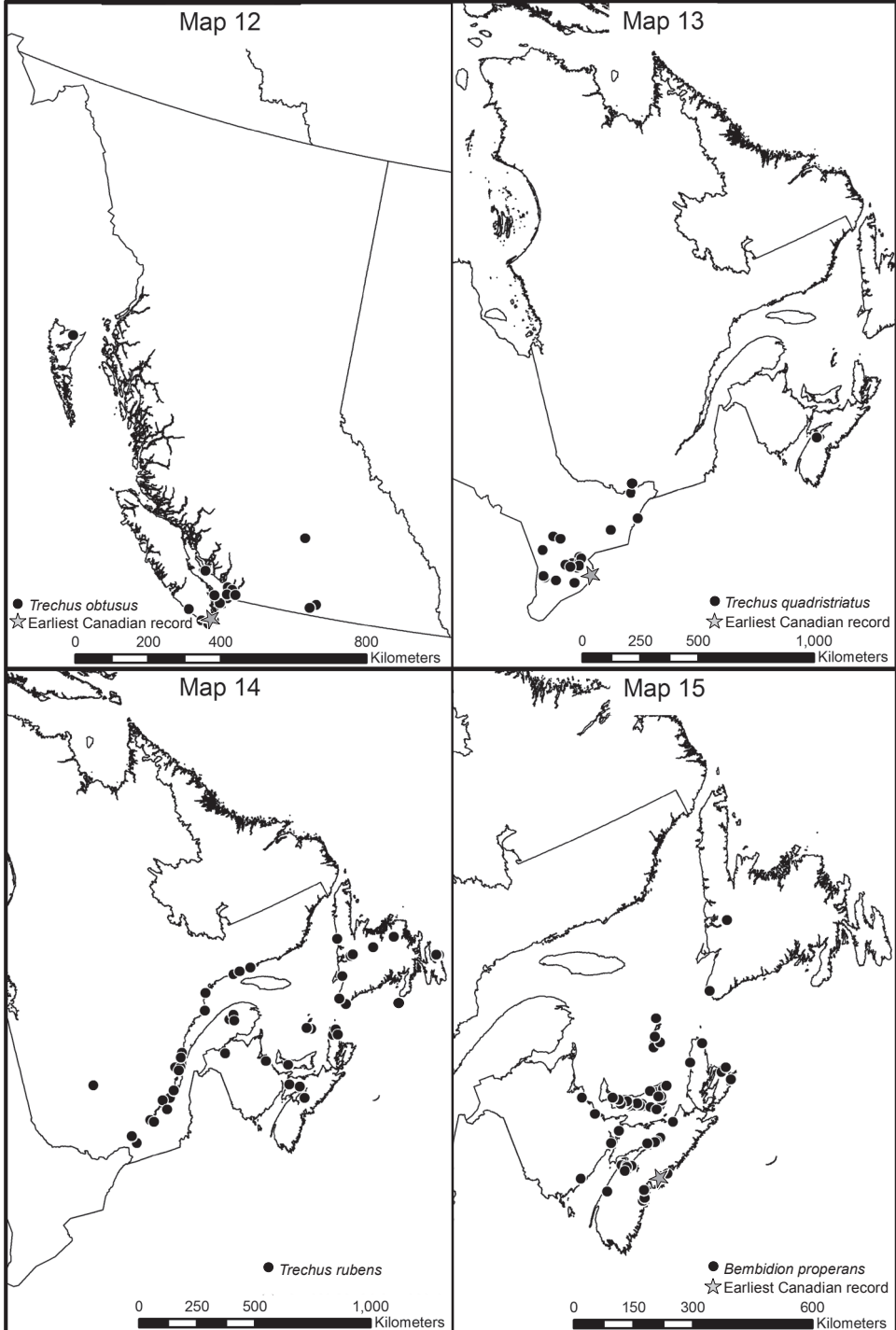




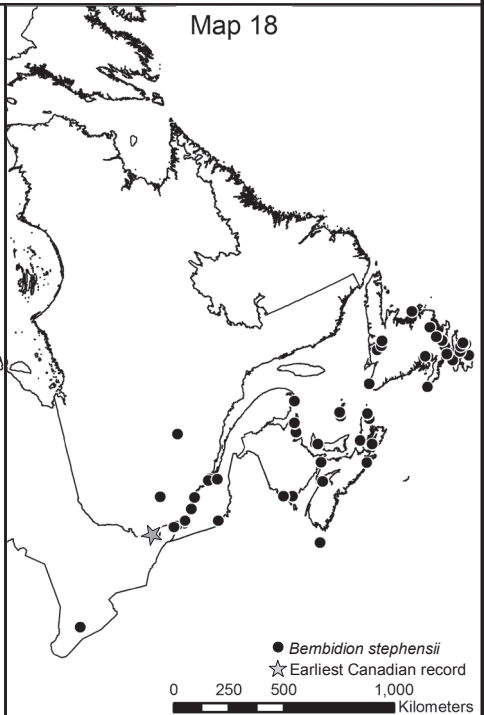
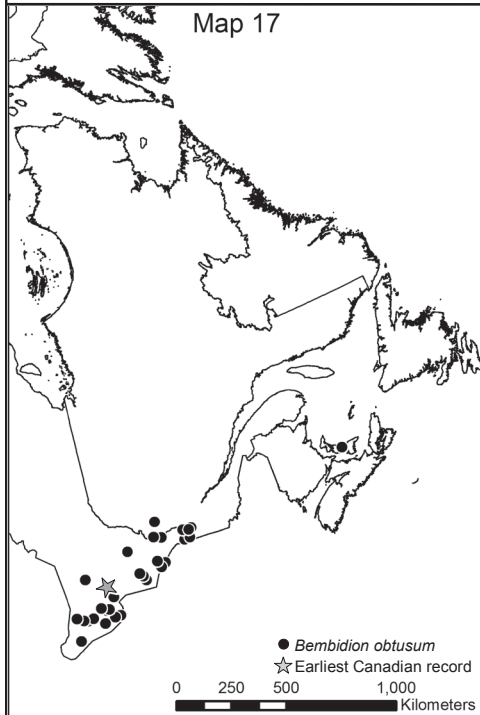
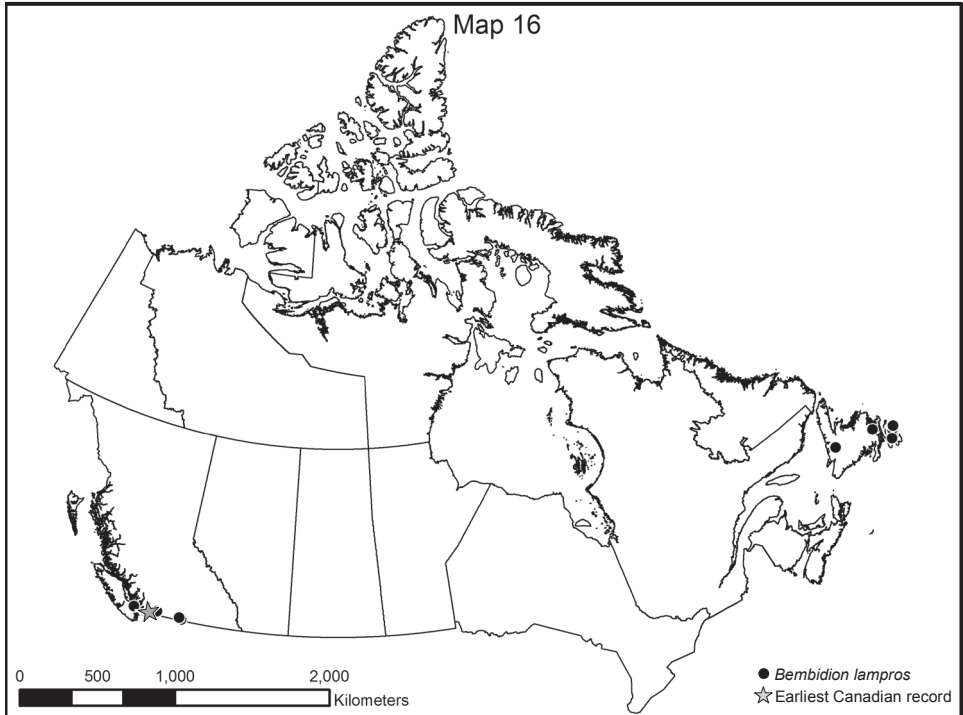


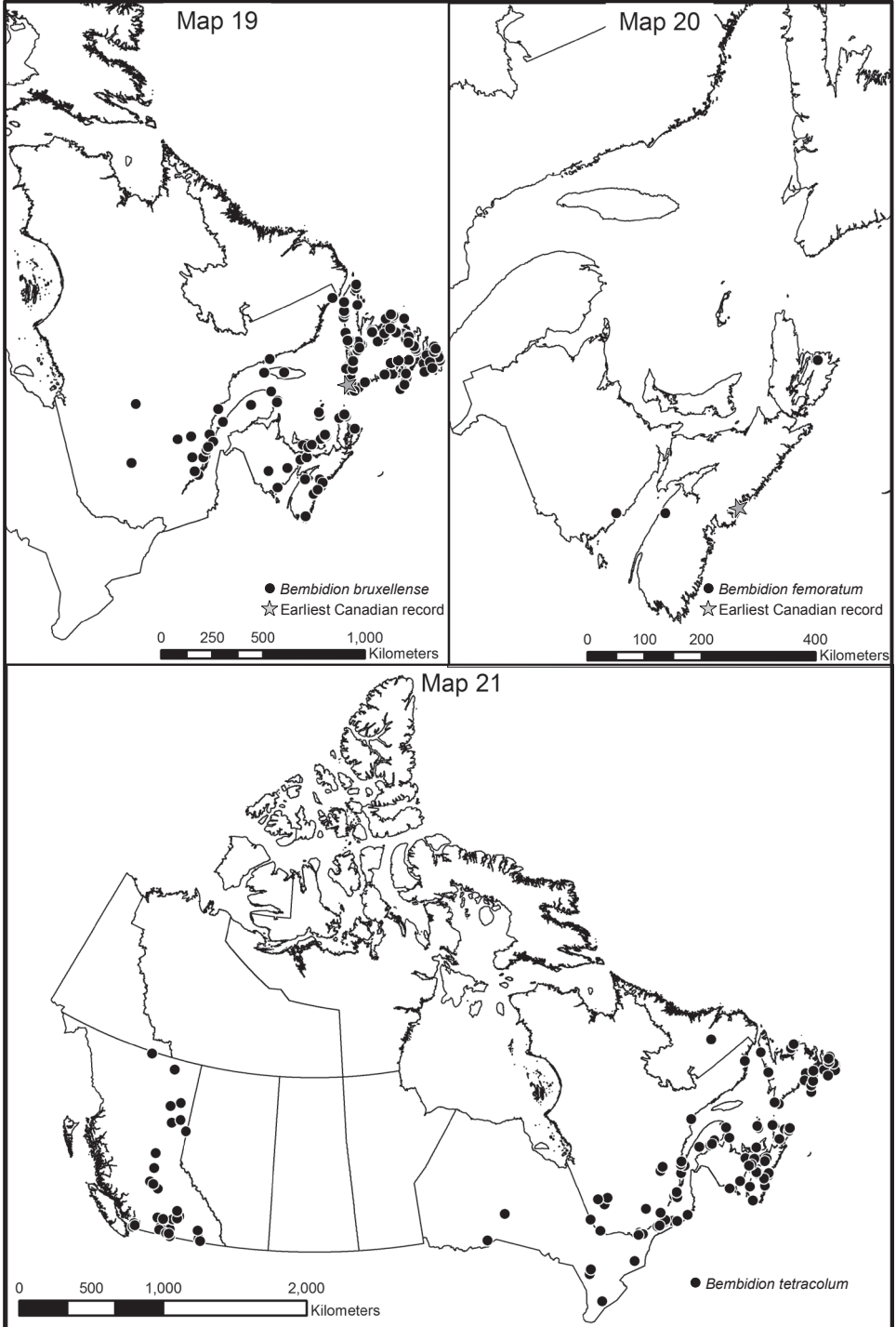


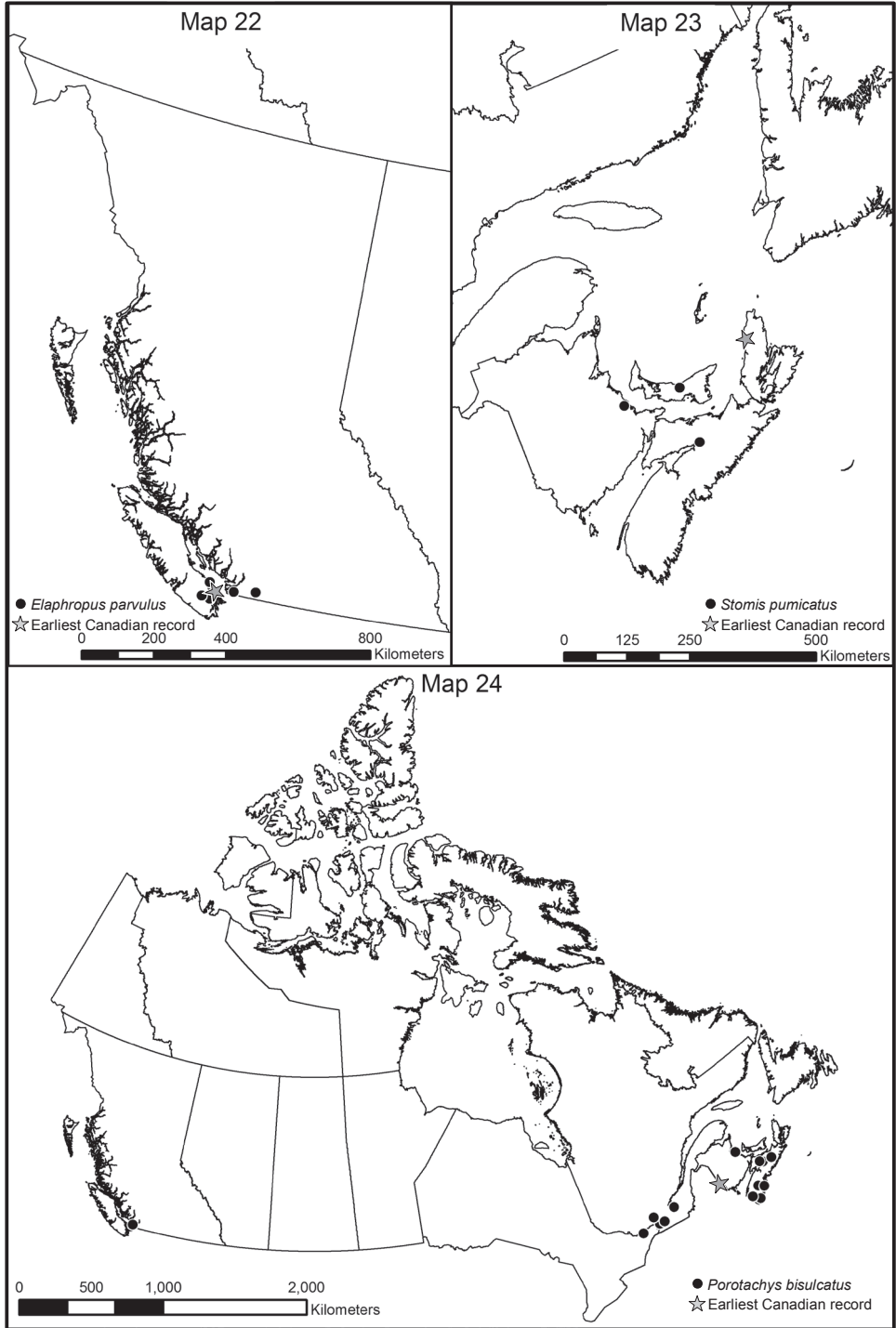


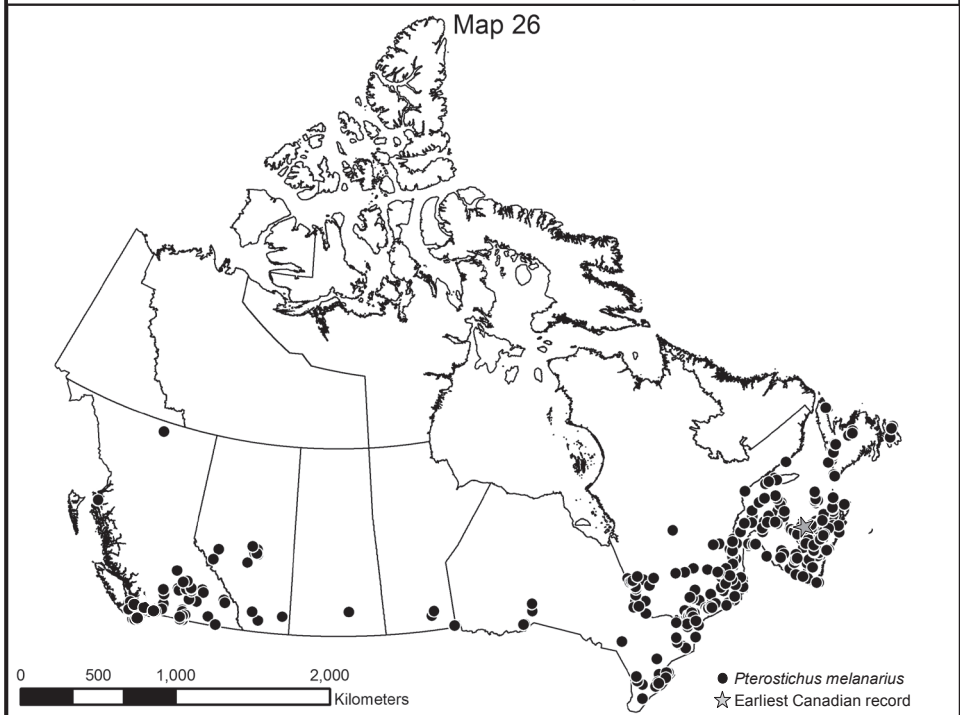
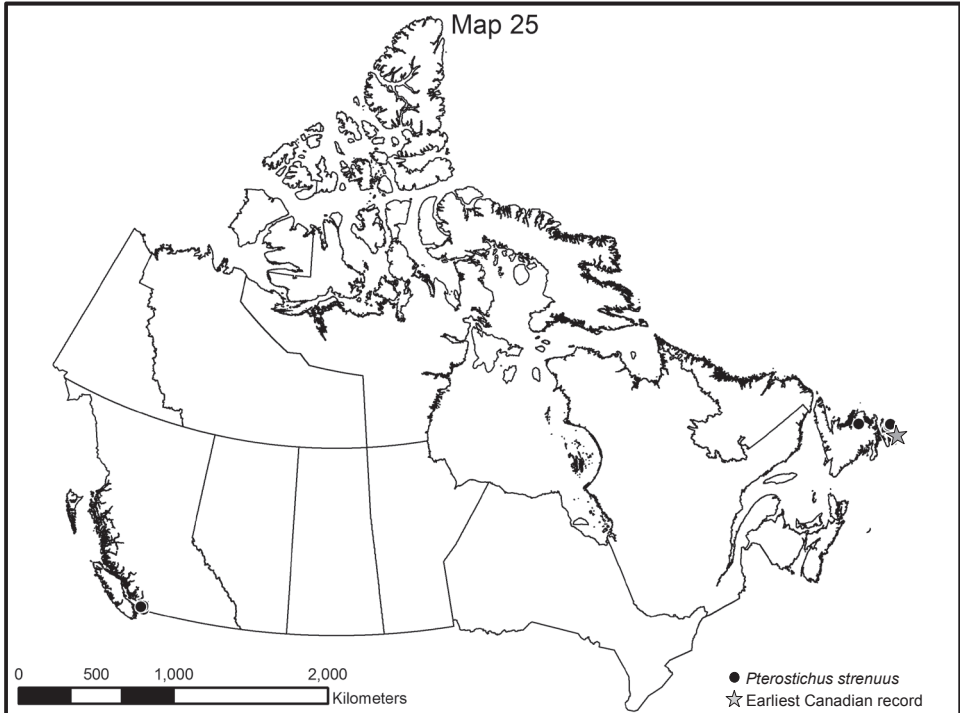


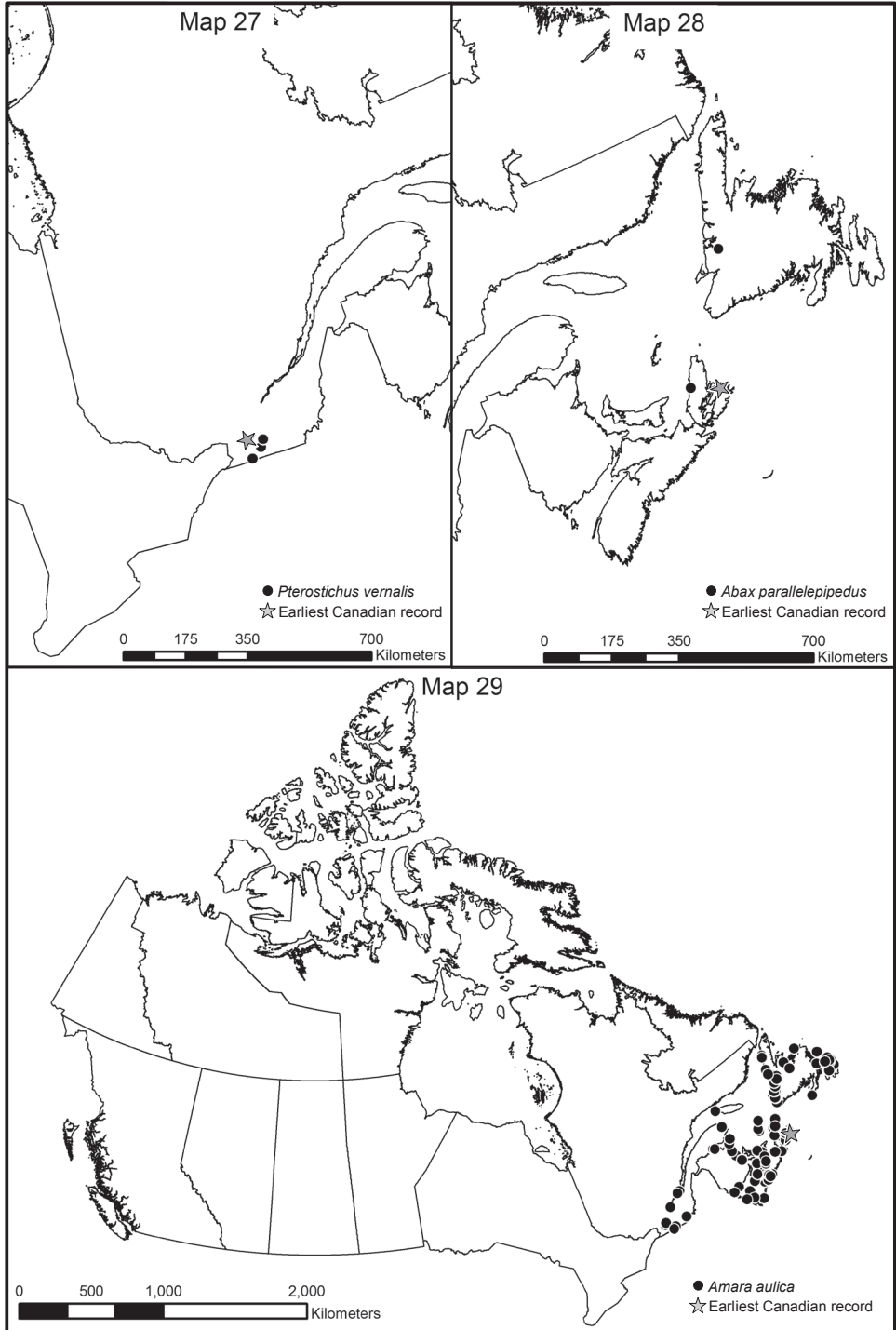


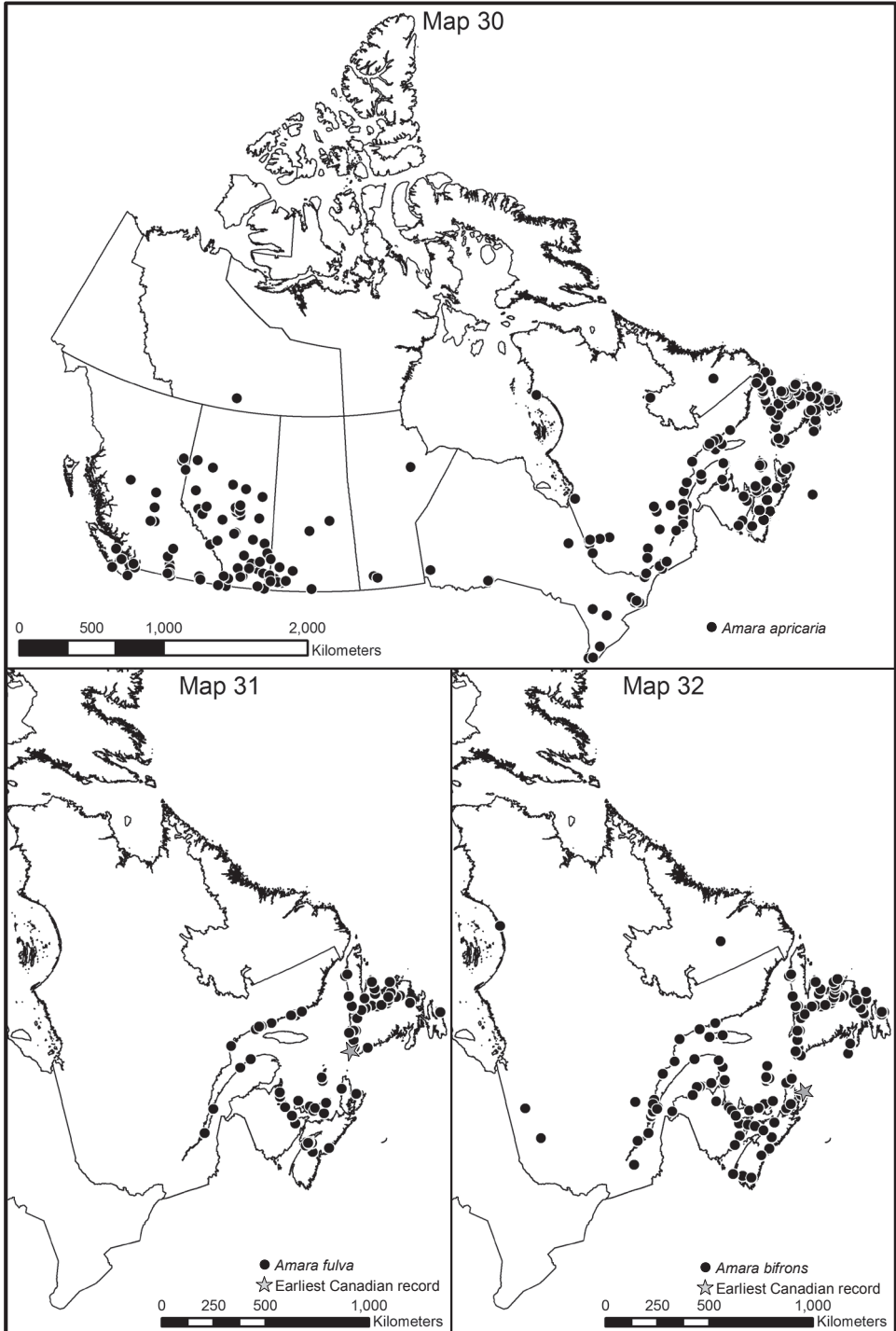


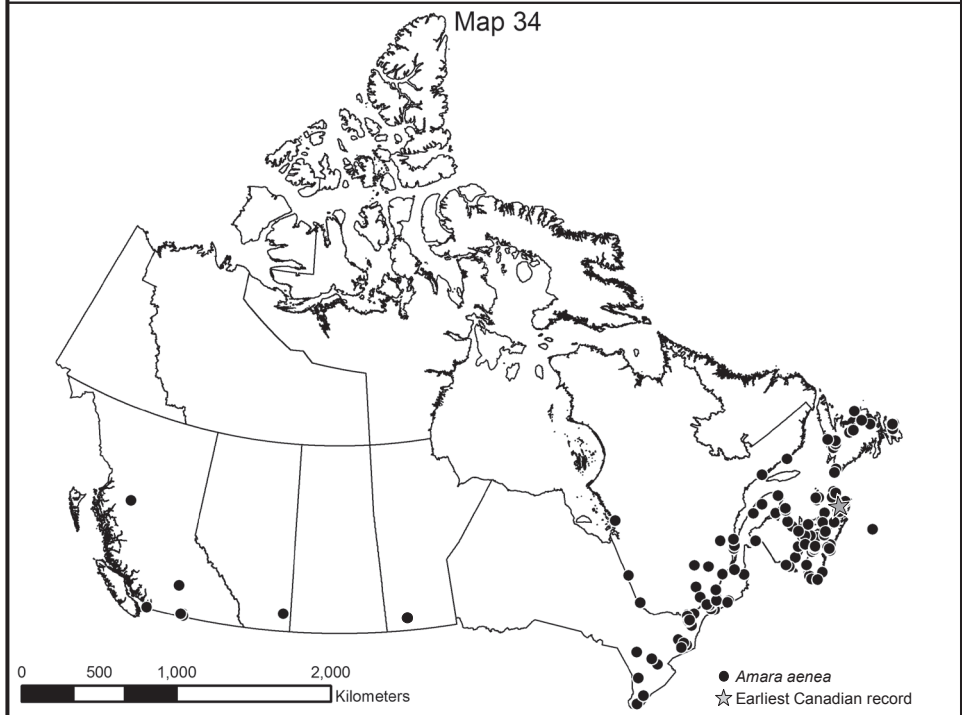
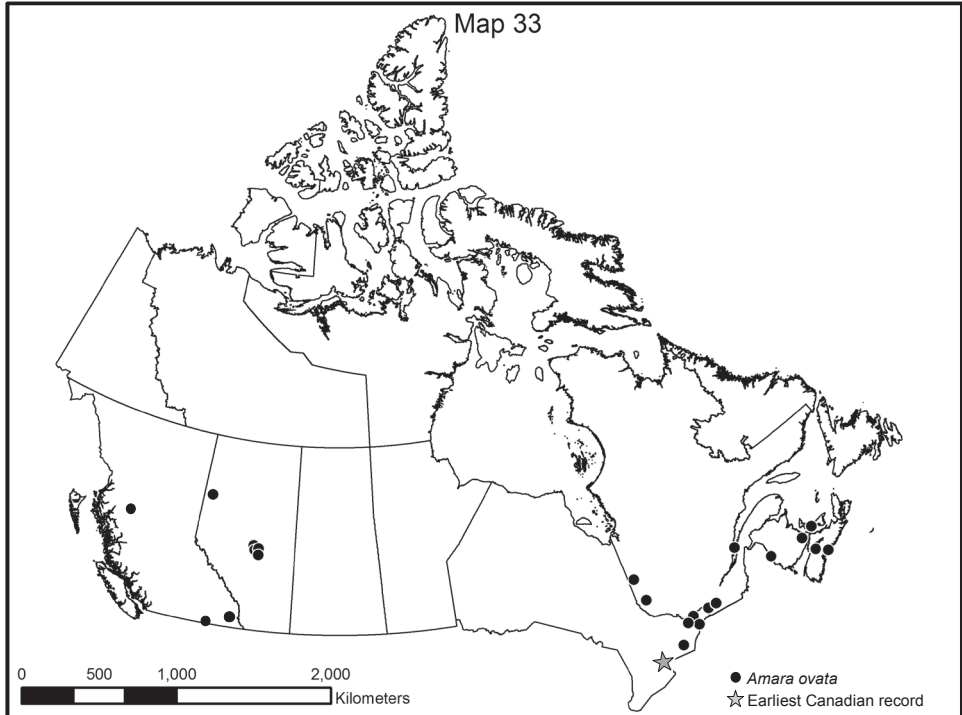


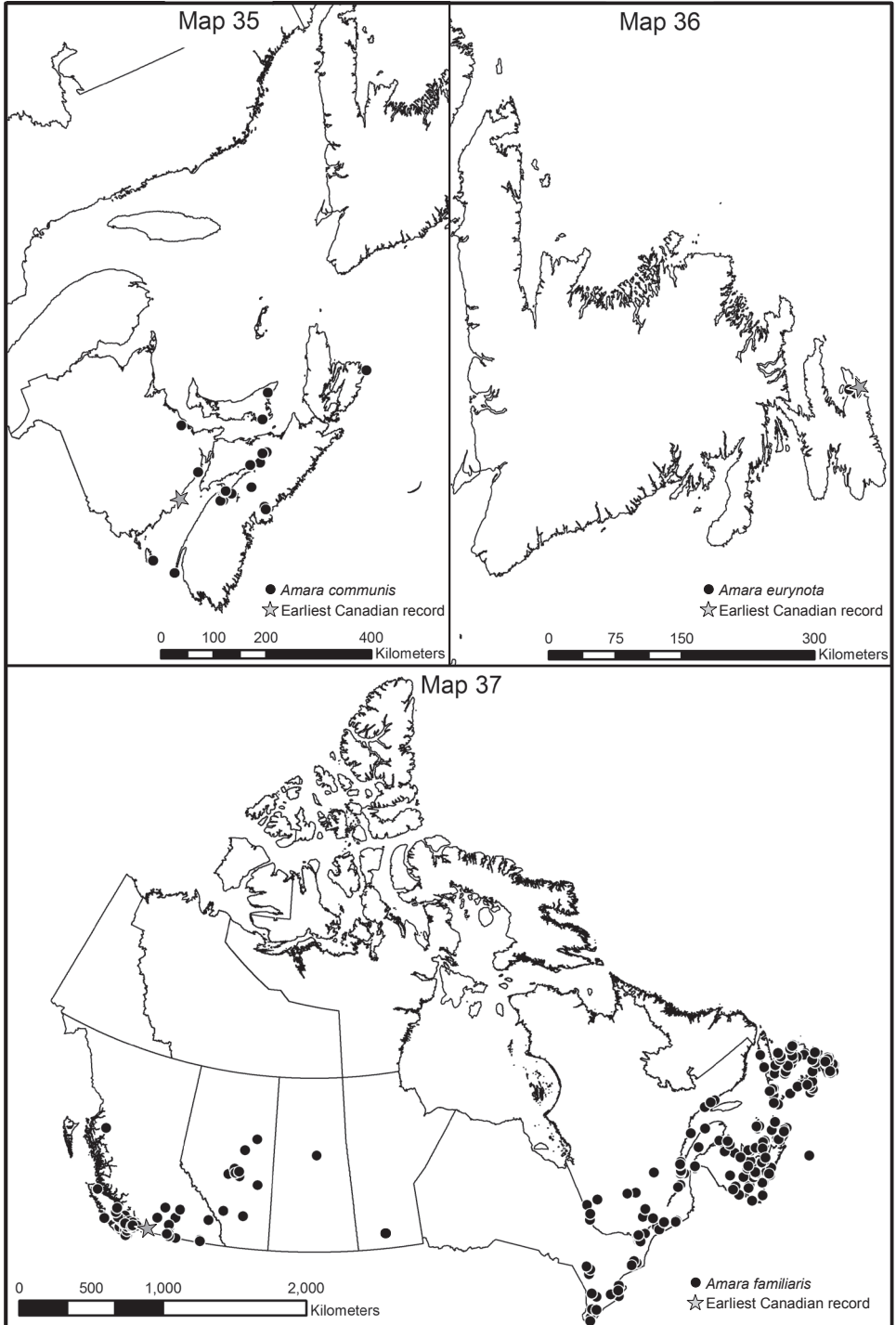




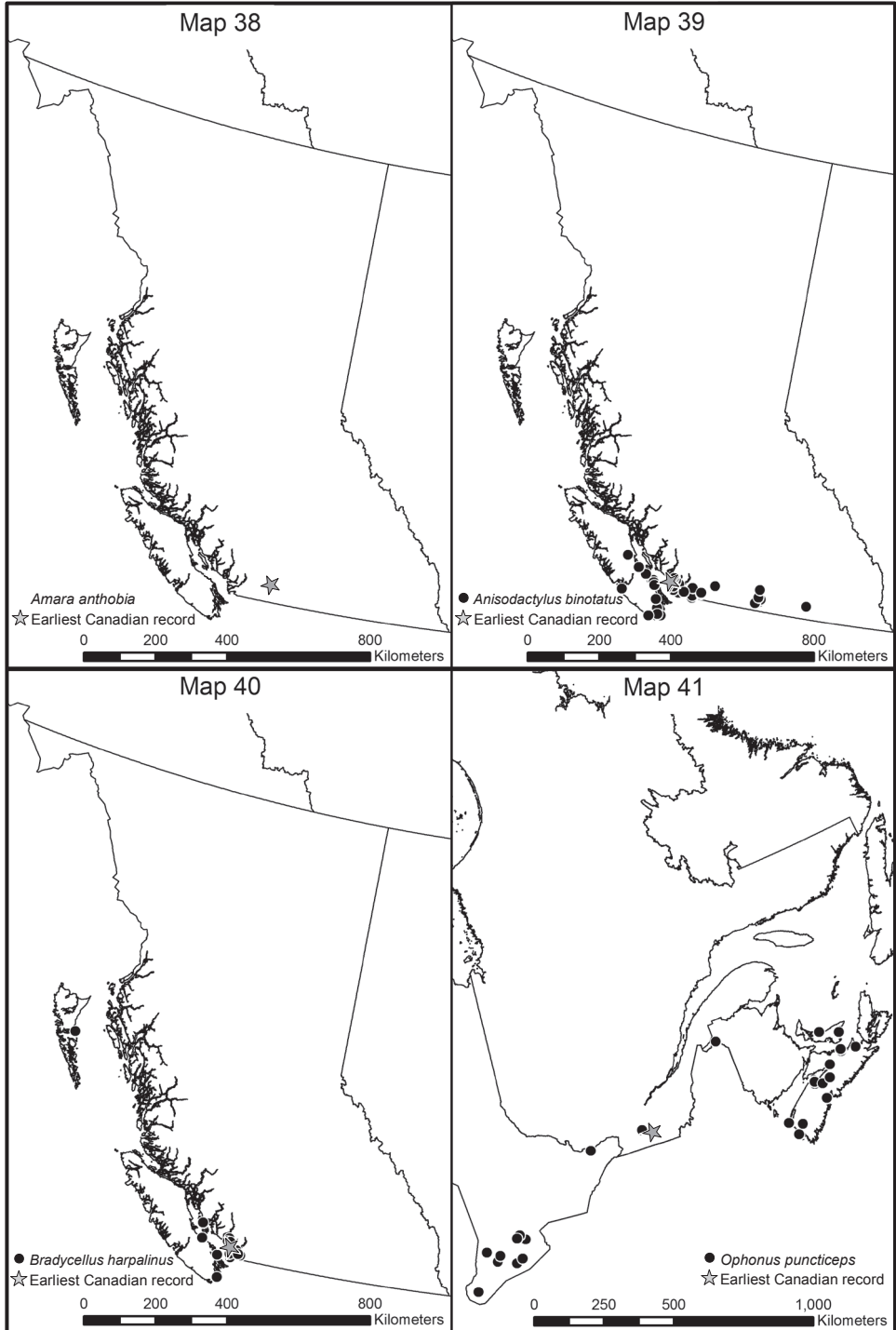


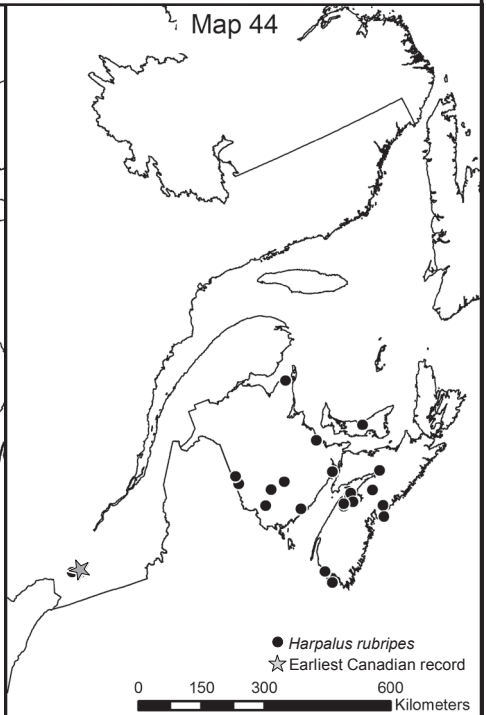
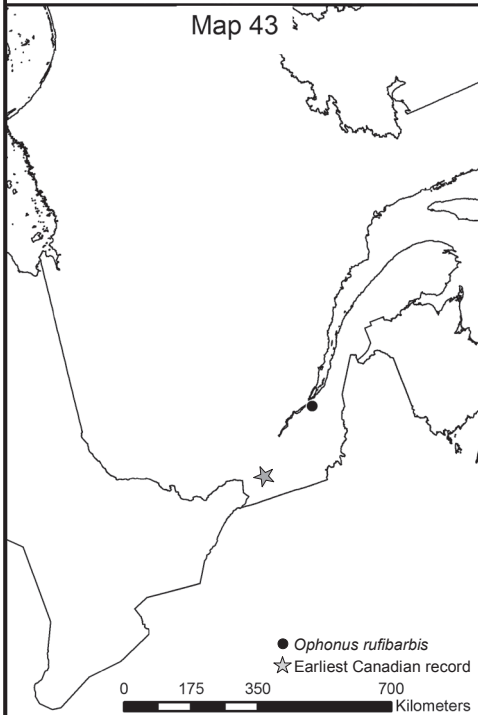
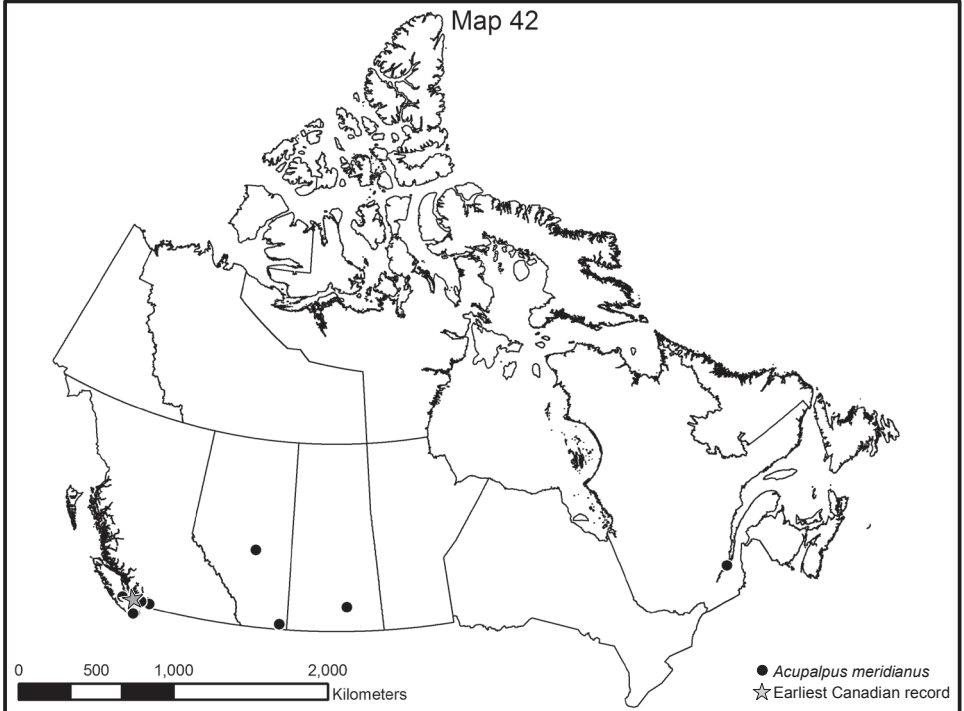


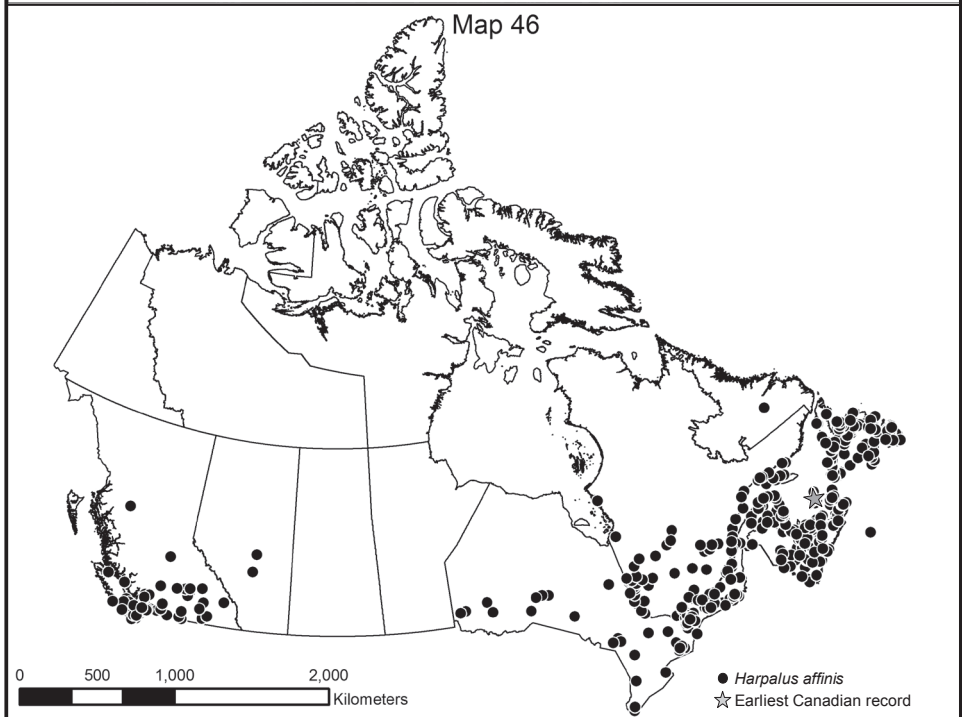
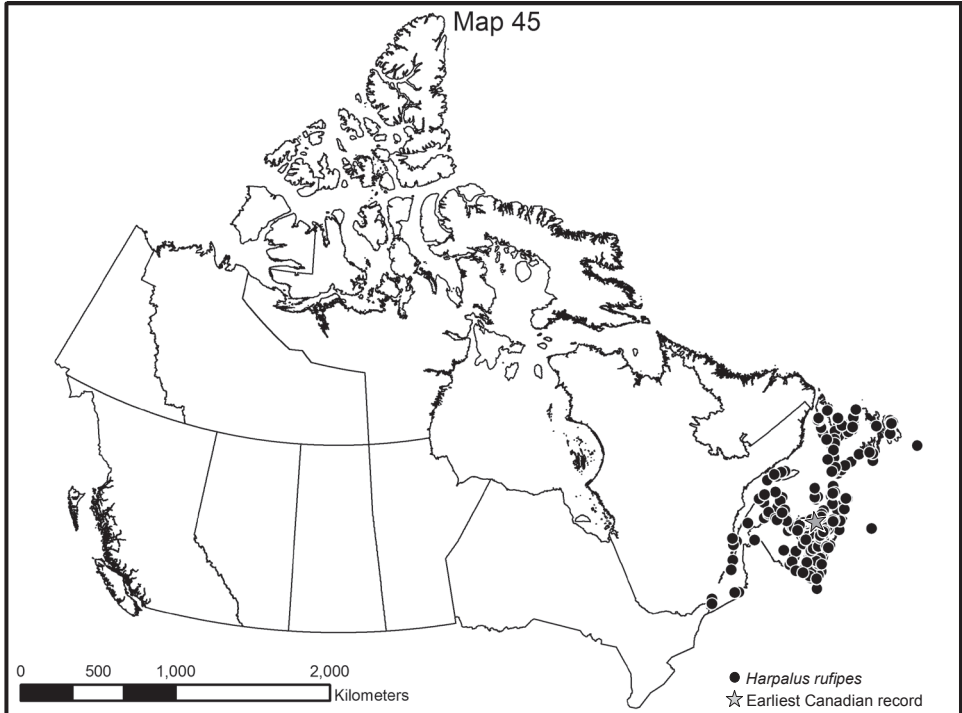


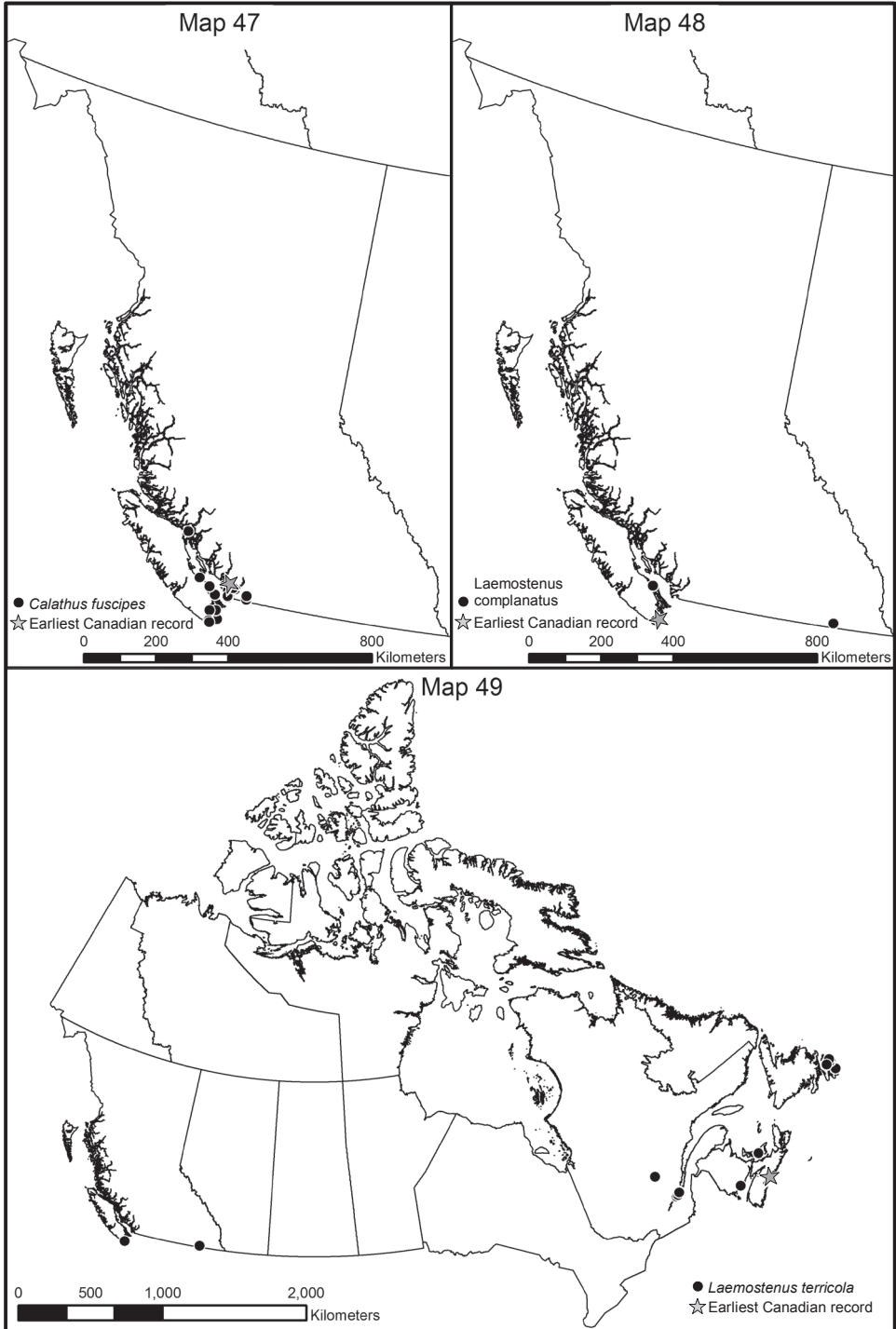


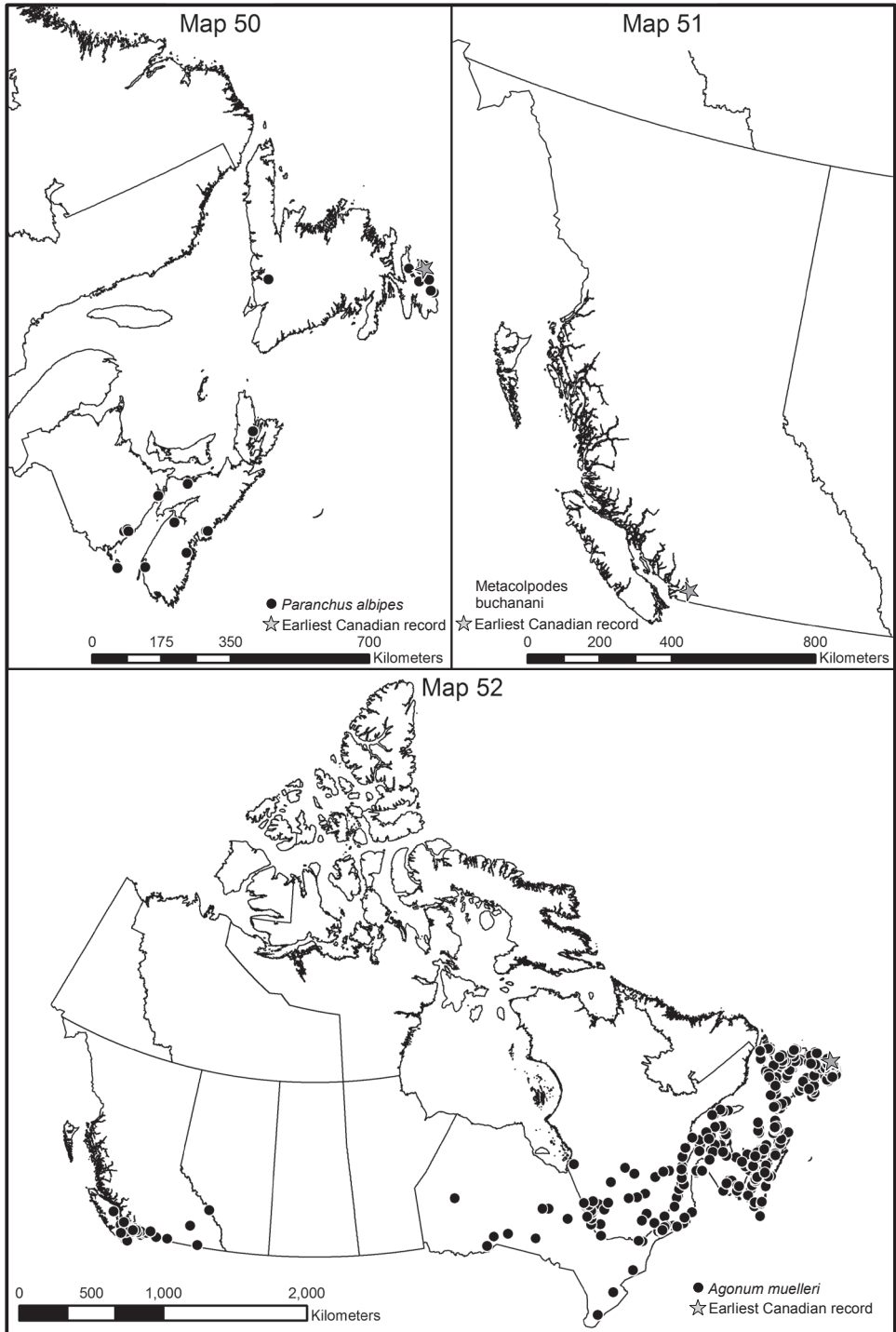


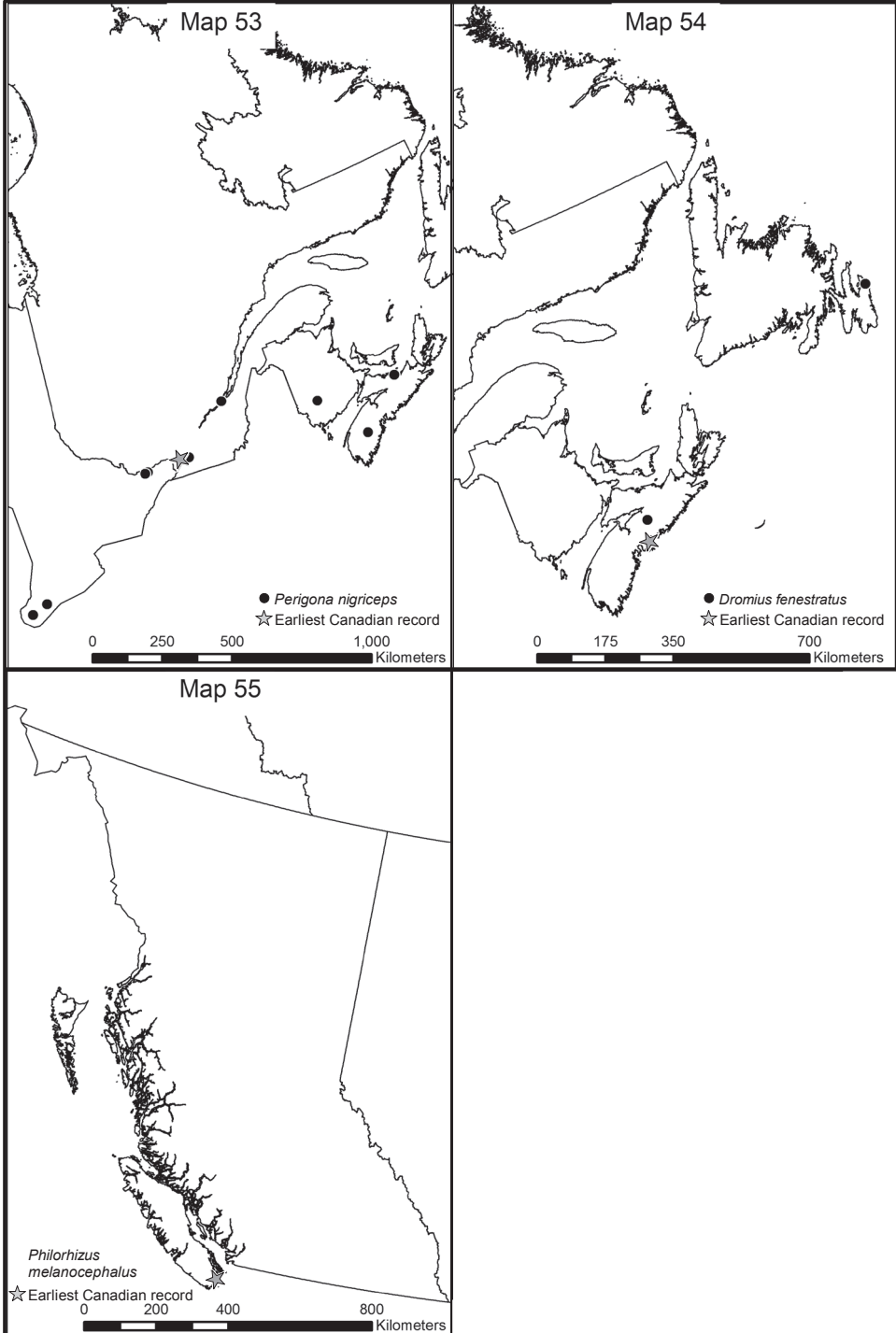














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