



The Eucnemidae (Coleoptera) of the Maritime Provinces of Canada: new records, observations on composition and zoogeography, and comments on the rarity of saproxylic beetles

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Abstract

The Family Eucnemidae in the Maritime Provinces of Canada is surveyed. Eleven species are now known from the region. Ten species are recorded in Nova Scotia, six in New Brunswick, and four on Prince Edward Island. Nine new provincial records (four from Nova Scotia, four from Prince Edward Island, and one from New Brunswick) are reported, and two species, *Microrhagus triangularis* (Say) and *Nematodes penetrans* (LeConte), are newly recorded in the Maritime Provinces as a whole. The four species reported from Prince Edward Island are the first records of the family Eucnemidae from the province. The composition of the fauna is in broad agreement with that of northeastern North America. The faunas on Prince Edward and Cape Breton Islands are diminished with respect to the mainland, but are more robust than that of other saproxylic groups. Many species of eucnemids have been very infrequently collected and may actually be rare. In this regard eucnemids are similar to many other groups of saproxylic beetles, although they are proportionately even less abundant than many other groups. A variety of studies that have reported on this phenomenon have pointed to the history of forest management in the region as potential being responsible for this scarcity. The eucnemids in this region are almost entirely associated with deciduous trees. The history of forest management in the Maritime Provinces, as well as that of introduced forest diseases, is such as to have had a major impact on the composition and structure hardwood forests, and hence potentially on insects such as eucnemids which are reliant on these hosts. Consequently further research is urged in order to better ascertain their status, and to develop appropriate conservation measures for these important indicator species of diverse forest structure.

Key words: Coleoptera, Eucnemidae, New Brunswick, Nova Scotia, Prince Edward Island, Maritime Provinces, Canada, biodiversity, biogeography, saproxylic insects, rare species, forest management impacts

Introduction

According to Muona (2000, pp. 2) the false click beetles (Coleoptera: Eucnemidae), "lead a fascinating hidden life that seems to reflect the diversity and age-class structure of the many types of forests they inhabit." Despite their common name they are able to "click" just as well as the nominal click beetles (Elateridae). The larvae of almost all species develop in decaying wood, principally that colonized by white rot fungi (Ascomycota and Basidiomycota), and feed on the hyphae using extraoral digestion. Adults can fly and disperse very well (Muona 2000, 2002). As such, eucnemids are important members of the community of saproxylic insects involved with the decay and decomposition of wood. Muona (2000) suggested that eucnemids play an important role in the interactions between trees, fungi, and forest regeneration and that they are good indicators of diverse forest structure. In Finland Siitonen and Martikainen (1994) showed that the removal of aspens (*Populus tremula* L.) in forests lead to the local extinction of *Hylochares cruentatus* (Gyllenhal). In his calculation of the Index of Ecological Continuity (an inverse of disturbance) in Great Britain, Alexander (2004) included

three species of eucnemids, *Melasis buprestoides* (L.), *Microrhagus pygmaeus* (F.), and *Eucnemis capucina* Ahrens.

Despite their potential importance in the process of wood decay and as indicator species, eucnemids have received relatively little attention in the Maritime Provinces of Canada. Bousquet (1991) listed six species from New Brunswick, three from Nova Scotia, and none from Prince Edward Island. Muona (2000) subsequently added four species to the provincial list of Nova Scotia. In the present study, a further contribution to ongoing efforts to document the baseline biodiversity of Coleoptera in the region, their zoogeographic origins, and their ecological associations, I survey the Eucnemidae of the Maritime Provinces. This initiative draws on both recent research on forest beetle communities in the region, as well as examining specimens in historical collections.

Method and Conventions

Specimens of Eucnemidae in collections in the region were examined. Codens of collections (following Evenhuis 2007) referred to in the text are:

CBU	Cape Breton University, Sydney, Nova Scotia, Canada
CGMC	Christopher G. Majka collection, Halifax, Nova Scotia, Canada
CNC	Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada
CUIC	Cornell University Insect Collection, Ithaca, New York, USA
DHWC	David H. Webster collection, Kentville, Nova Scotia, Canada
JCC	Joyce Cook Collection, North Augusta, Ontario, Canada
NBM	New Brunswick Museum, Saint John, New Brunswick, Canada
NSAC	Nova Scotia Agricultural College, Bible Hill, Nova Scotia, Canada
NSMC	Nova Scotia Museum collection, Halifax, Nova Scotia, Canada
NSNR	Nova Scotia Department of Natural Resources, Shubenacadie, Nova Scotia, Canada

The number of specimens examined is indicated below in parentheses. If not specified it is assumed to be one. For species where there were fewer than 25 specimens, all records are reported. For species where there were more than 25 specimens, a summary of specimens examined is given. The taxonomy follows that of Muona (2000, 2002).

Results

In the course of the present research, 135 specimens of Eucnemidae from the Maritime Provinces were examined. Eleven species are now known from the region. Ten have been recorded in Nova Scotia, six in New Brunswick, and four on Prince Edward Island. Nine new provincial records (four from Nova Scotia, four from Prince Edward Island, and one from New Brunswick) are reported and two species, *Microrhagus triangularis* (Say) and *Nematodes penetrans* (LeConte), are newly recorded in the Maritime Provinces as a whole. The four species reported from Prince Edward Island are the first records of the family Eucnemidae from the province. Specific details follow.

Subfamily: Melasinae

Tribe: Melasini

Isorhipis ruficornis (Say, 1823)

NOVA SCOTIA: Colchester Co.: New Britain, 15.vii.2004, D. MacDonald, flight-intercept trap, NSNR; **Cumberland Co.:** Moose River, 30.vi.1995, C. Corkum, young deciduous forest, flight-intercept trap, (4), NSMC; Parrsboro, 3.vii.2001, J. Uttaro, NSNR; Spencer's Island, 13.vii.1995, C. Corkum, old coniferous forest, flight-intercept trap, NSMC; Wentworth, 21.v.1965, B. Wright, (2), NSMC; **Lunenburg Co.:** Bridgewater, 30.vi.1965, B. Wright, (5), NSMC.

In Nova Scotia (Fig. 1) found almost exclusively in deciduous forests. Reared from *Acer*, *Betula*, *Cornus*, *Fagus*, and *Platanus* spp. (Muona 2000). This species is widely distributed in North America but quite rare across the continent (Muona 2000).

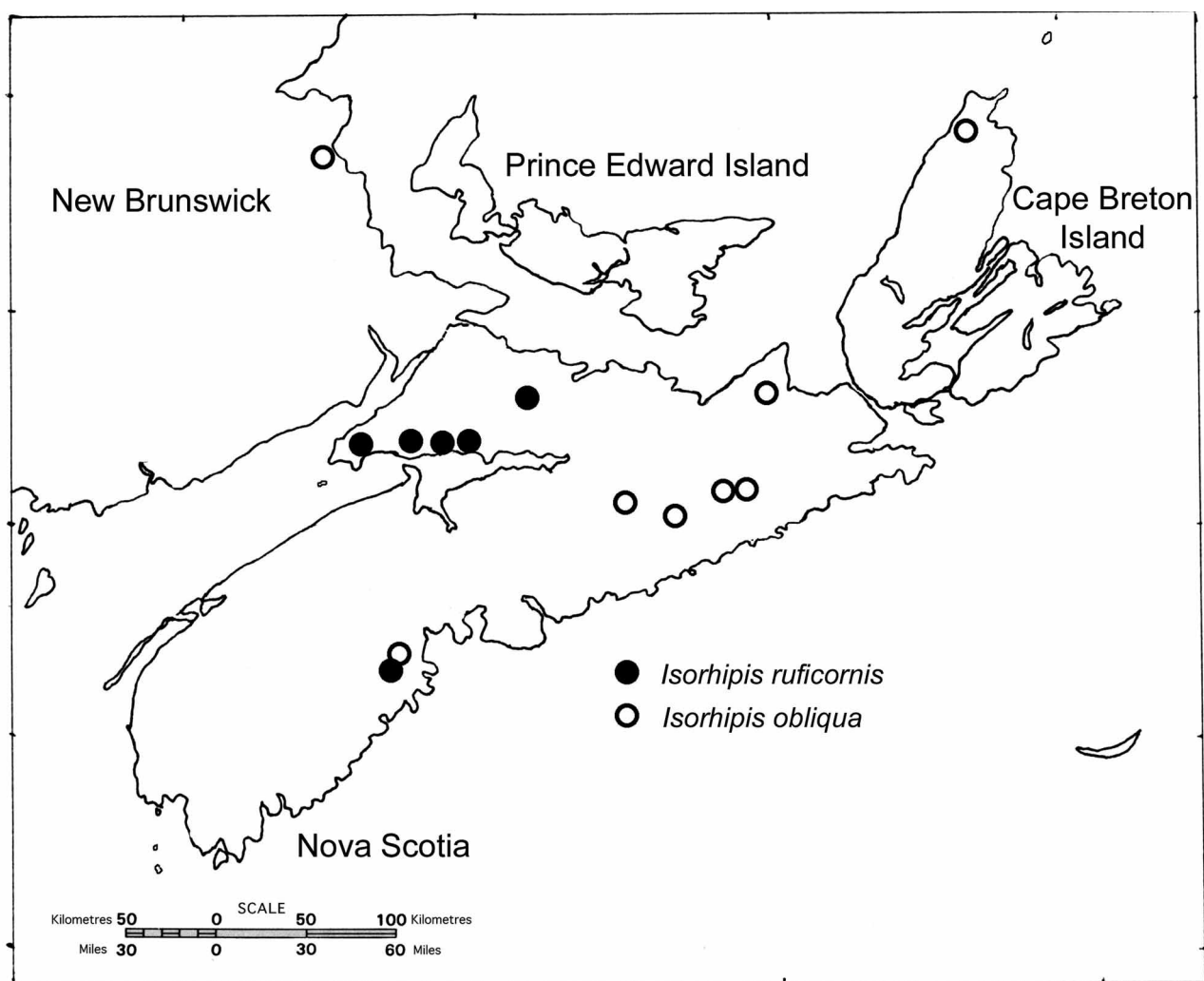


FIGURE 1. The distribution of *Isorhipis ruficornis* (Say) and *Isorhipis obliqua* (Say) in the Maritime Provinces of Canada.

Isorhipis obliqua (Say, 1836)

NOVA SCOTIA: Antigonish Co.: Beaver Mt., 14.viii.1995, J. Ogden, NSNR; **Colchester Co.:** Otter Brook, 20.vii.1994, D. Kehler, flight-intercept trap, NSMC; **Guysborough Co.:** Malay Lake, 16-29.vii.1997, D.J.

Bishop, red spruce forest, flight-intercept trap, NSMC; Melopseketch Lake, 13.vii.1995, C. Corkum, young deciduous forest, flight-intercept trap, NSMC; Melopseketch Lake, 16-29.vii.1997, D.J. Bishop, red spruce forest, flight-intercept trap, NSMC; Seloam Lake, 16-29.vii.1997, D.J. Bishop, red spruce forest, flight-intercept trap, NSMC; **Inverness Co.:** Lone Shieling, vii.1983, J.R. Vockeroth, malaise trap, (2), CNC; Lone Shieling, 9.viii.1983, J.E.H. Martin, CNC; **Lunenburg Co.:** Bridgewater, 30.vi.1965, B. Wright, NSMC.

In Nova Scotia (Fig. 1) found in both deciduous and red spruce (*Picea rubens* Sarg.) (Pinaceae) forests. Reared from *Acer*, *Betula*, *Cyrilla*, *Fagus*, and *Ulmus* spp. (Muona 2000). One of the most frequently collected eucnemids in eastern North America (Muona 2000).

Tribe: Epiphanini

Epiphanis cornutus (Eschscholtz, 1829)

NEW BRUNSWICK: Kent Co.: Kouchibouquac National Park, 1977, CNC. **NOVA SCOTIA:** 42 specimens recorded from Cumberland, Guysborough, Halifax, Hants, Inverness, Kings, Lunenburg, Queens, Victoria, and Yarmouth counties. The earliest record is from 1952 (**Hants Co.:** Sweets Corner, 14.vii.1952, V.R. Vickery, NSAC).

The most widely distributed and abundant eucnemid in Nova Scotia (Fig. 2). In Nova Scotia recorded in red spruce (*Picea rubens*), white pine (*Pinus strobus* L.), and eastern hemlock (*Tsuga canadensis* (L.) Carr.) (Pinaceae) forests ranging from younger than 40 to older than 120 years of age; associated almost exclusively with conifers except for one specimen found on white ash (*Fraxinus americana* L.) (Oleaceae). Muona (2000) reported it from under the bark of *Picea* and *Abies* spp. Widespread in North America; reported to be a Holarctic species (Muona 2000).

Hylis terminalis (LeConte, 1866)

NOVA SCOTIA: Guysborough Co.: Dayspring Lake, 16-29.vii.1997, D.J. Bishop, red spruce forest, flight-intercept trap, NSMC; **Halifax Co.:** Grassy Lake, 16-29.vii.1997, D.J. Bishop, red spruce forest, flight-intercept trap, NSMC; **Hants Co.:** Smiley's Provincial Park, 13.viii.2004, D. MacDonald, flight-intercept trap, (5), NSNR; **Kings Co.:** Kentville, 24.vii.2004, D.H. Webster, on elm firewood, DHWC. **PRINCE EDWARD ISLAND: Queens Co.:** St Patricks, 22.vii.2001, C.G. Majka, old field surrounded by mixed forest, CGMC.

Newly recorded in Nova Scotia, Prince Edward Island, and the Maritime Provinces as a whole (Fig. 2). One specimen found on *Ulmus americana* L. (Ulmaceae). Reported from *Carya*, *Fagus*, and *Ulmus* spp. (Muona 2000). Widespread in eastern North America (Muona 2000).

Tribe: Dirhagini

Microrhagus pectinatus LeConte, 1866

NEW BRUNSWICK: Kent Co.: Kouchibouquac National Park, 27-29.ix.1977, S.J. Miller, CNC. **NOVA SCOTIA: Halifax Co.:** Big St. Margarets Bay, 16-29.vii.1997, D.J. Bishop, old red spruce forest, flight-intercept trap, NSMC; Ten Mile Lake, 1-16.vii.1997, D.J. Bishop, red spruce forest, flight-intercept trap, NSMC; **Hants Co.:** Little Armstrong Lake, 1-16.vii.1997, D.J. Bishop, red spruce forest, flight-intercept trap, NSMC; **Inverness Co.:** Lone Shieling, 19.vi.1983, Y. Bousquet, flight-intercept trap, CNC; Lone Shieling, 1.vii.1983,

J.R. Vockeroth, malaise trap, CNC; **Lunenburg Co.:** 30.vi.1965, B. Wright, (2), NSMC; **Pictou Co.:** Green Hill, 2.vii.2004, D. MacDonald, flight-intercept trap, NSNR.

In Nova Scotia several specimens collected red spruce (*Picea rubens*) forests (Fig. 3). Reared from *Fagus*, *Platanus*, and *Ulmus* spp. (Muona 2000). Widespread in both eastern and western North America (Muona 2000).

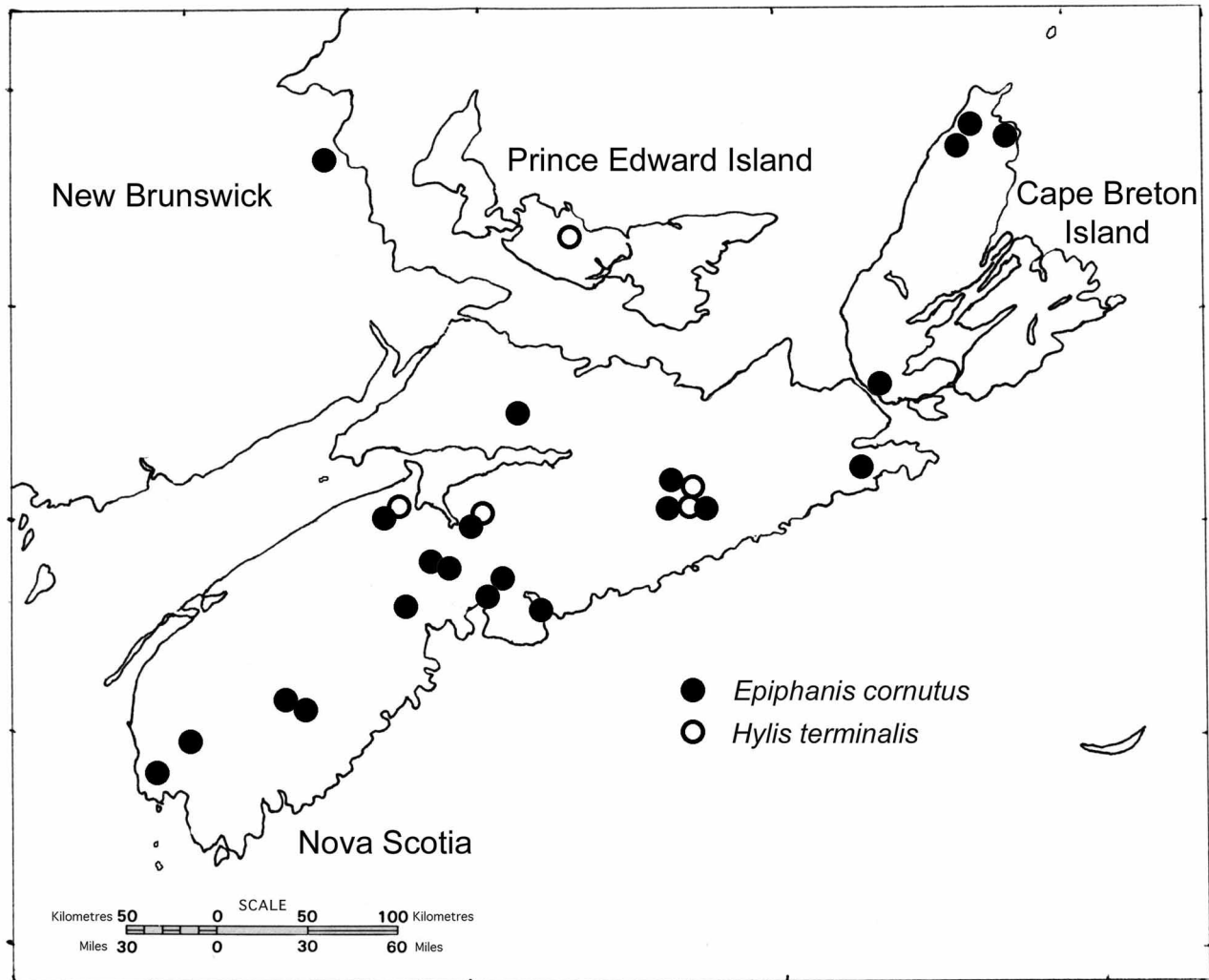


FIGURE 2. The distribution of *Epiphany cornutus* (Eschscholtz) and *Hylis terminalis* (LeConte) in the Maritime Provinces of Canada.

***Microrhagus subsinuatus* LeConte, 1852**

NOVA SCOTIA: **Cape Breton Co.:** George's River, 21.viii.1994, D.B. McCorquodale, CBU; **Colchester Co.:** Shubenacadie, 4.viii.2004, D. MacDonald, flight intercept trap, NSNR; Truro, CUIC; **Inverness Co.:** Port Hood: MacFarlane Woods, 29.vii.1986, B. Wright and A. Wilson, NSMC. **PRINCE EDWARD ISLAND:** **Kings Co.:** Woodville Mills, 26.vii.2005, C.G. Majka, shoreline vegetation beside beaver pond, CGMC.

Newly recorded from Prince Edward Island (Fig. 3). Reared from *Fagus grandifolia* Ehrh. (Fagaceae) (Muona 2000). A widespread and fairly common species in eastern North America (Muona 2000).

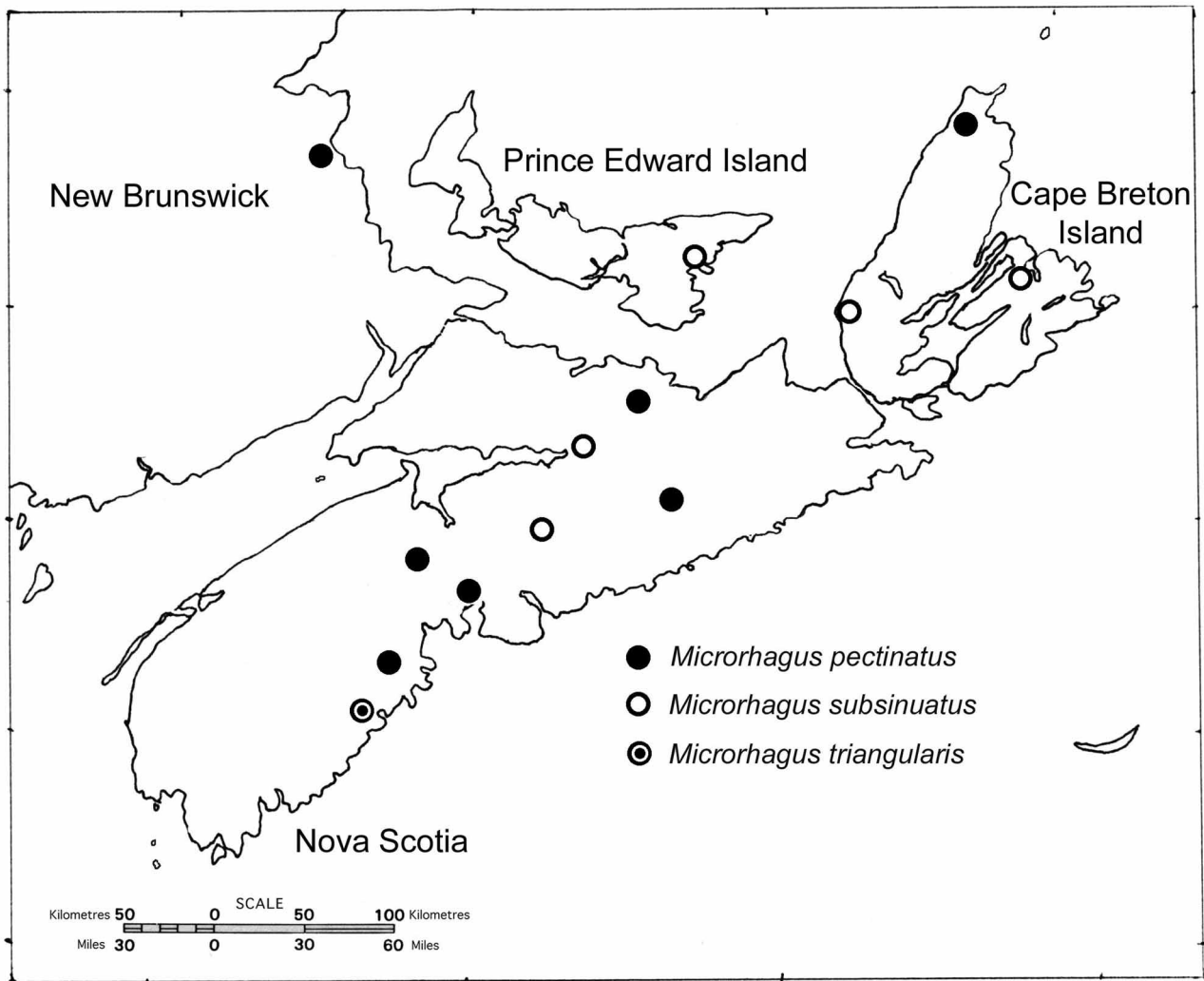


FIGURE 3. The distribution of *Microrhagus pectinatus* LeConte, *Microrhagus subsinuatus* LeConte, and *Microrhagus triangularis* (Say) in the Maritime Provinces of Canada.

***Microrhagus triangularis* (Say, 1823)**

NOVA SCOTIA: Queens Co.: Medway River, 13.vii.1993, J. Cook and T. Cook, car net, JCC.

Newly recorded in Nova Scotia and in the Maritime Provinces as a whole (Fig. 3). Very little is known of its biology; found on *Cornus* logs (Muona 2000). A widespread and common species in eastern North America (Muona 2000).

Subfamily: Macraulacinae

Tribe: Macraulacini

***Onichodon canadensis* (Brown, 1940)**

NEW BRUNSWICK: Saint John Co.: Saint John, 6.viii.1900, W. McIntosh, NBM. **NOVA SCOTIA: Annapolis Co.:** Durland Lake, 12.vii.2003, P. Dollin, mixed hemlock, balsam fir, and black spruce forest,

NSMC; **Antigonish Co.:** Beaver Mountain Park, 14.viii.1995, J. Ogden, NSNR; **Halifax Co.:** Point Pleasant Park, 5.viii.2001, C.G. Majka, red spruce forest, CGMC; **Kings Co.:** Forest Home, 8.vii.2006, D.H. Webster, deciduous forest, DHWC; **Pictou Co.:** Waterside, 11.viii.2004, D. MacDonald, flight intercept trap, (4), NSNR; **Queens Co.:** Kejimkujik National Park, Lake Kejimkujik, 5.viii.1961, D.C. Ferguson, NSMC; Tobetic Lake, 1.viii.2003, P. Dollin, red spruce forest, funnel trap, NSMC. **PRINCE EDWARD ISLAND:** **Kings Co.:** Lakeside Beach, 3.viii.1997, D.B. McCorquodale, CBU.

Although Bousquet (1991) listed this species from both New Brunswick and Nova Scotia, Muona (2000) did not record it from either province and there are no specimens in the CNC or in any other collection examined. Thus the above records establish the species' presence in both provinces. It is additionally newly recorded from Prince Edward Island (Fig. 4). Reared from yellow birch (*Betula allagheniensis* Britt.) (Betulaceae) and found associated with red spruce (*Picea rubens*) and American beech (*Fagus grandifolia*) (Muona 2000). Restricted in its distribution to northeastern North America (Muona 2000).

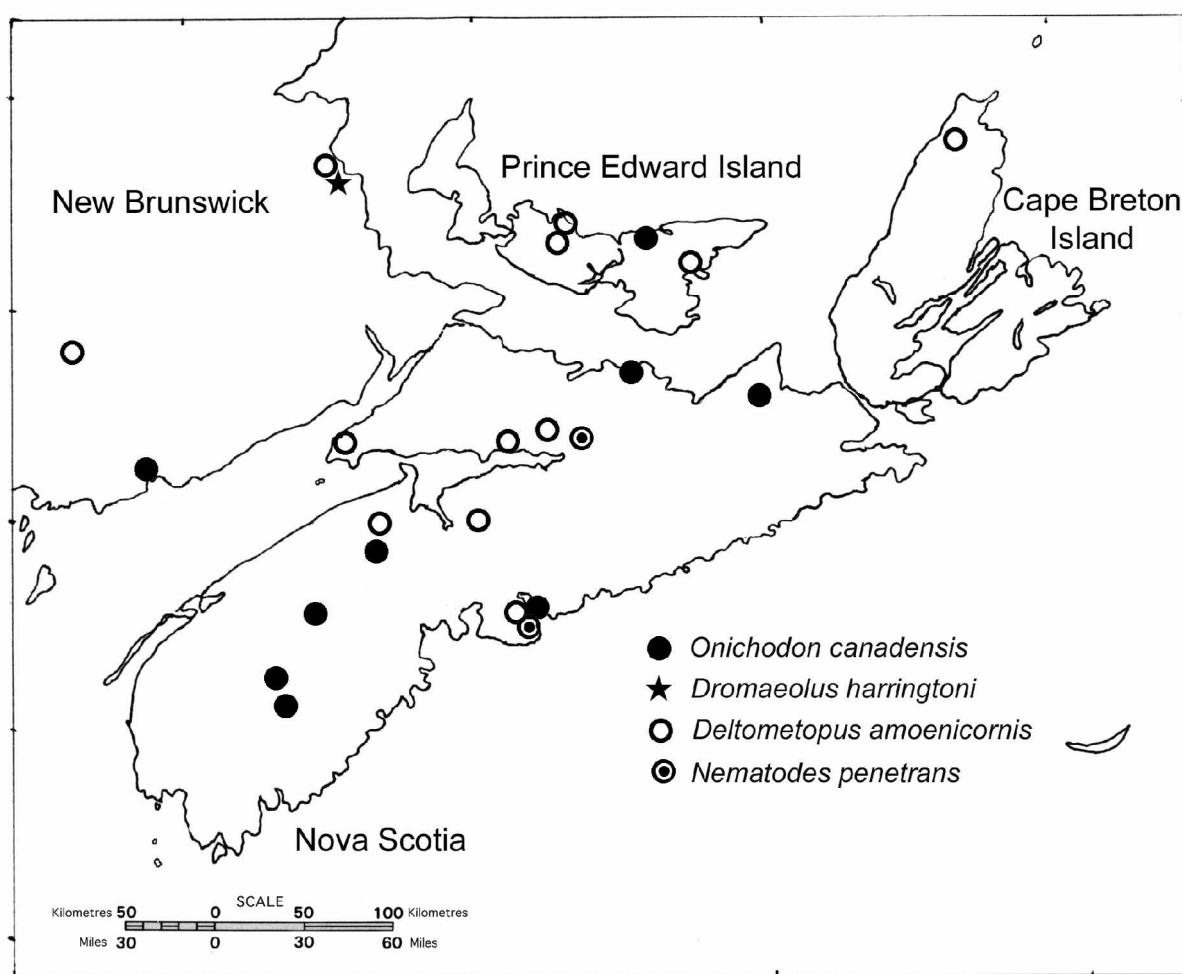


FIGURE 4. The distribution of *Onichodon canadensis* (Brown), *Dromaeolus harringtoni* Horn, *Deltometopus amoenicornis* (Say), and *Nematodes penetrans* (LeConte), in the Maritime Provinces of Canada.

Dromaeolus harringtoni Horn, 1886

NEW BRUNSWICK: Kent Co.: Kouchibouquac National, 30.viii.1977, S.J. Miller, CNC.

Collected on *Fagus* (Muona 2000). A rare species restricted to northeastern North America; it appears to have declined in the United States (Muona 2000).

***Deltometopus amoenicornis* (Say, 1836)**

NEW BRUNSWICK: Kent Co.: Kouchibouquac National Park, 27-29.ix.1977, I. Smith, CNC; **York Co.:** Fredericton, 16.vii.1928, W.J. Brown, (2), CNC. **NOVA SCOTIA: Colchester Co.:** Debert, 30.vii.1994, E. Georgeson, NSNR; Debert, 4.viii.1993, E. Georgeson, (2), NSNR; Portapique, CNC; **Cumberland Co.:** Eatonville, 9.vii.1955, D.C. Ferguson, NSMC; **Halifax Co.:** Point Pleasant Park, 20.vii.2002, C.G. Majka, in small marsh, CGMC; **Hants Co.:** Smiley's Provincial Park, 30.vii.2004, D. MacDonald, flight-intercept trap, NSNR; **Inverness Co.:** Lone Shieling, 18-21.vii.1983, D.E. Bright, flight-intercept trap, CNC; Lone Shieling, 9.viii.1983, J.E.H. Martin, CNC; **Kings Co.:** Gaspereau Lake near Welton Landing, 14.vii.2006, D.H. Webster, flying near woods, DHWC. **PRINCE EDWARD ISLAND: Kings Co.:** Woodville Mills, 23.vii.2001, C.G. Majka, coniferous forest, CGMC; **Queens Co.:** Cavendish, 19.vii.2001, C.G. Majka, on seashore vegetation, CGMC; St. Patricks, 14.vii.2002, C.G. Majka, along small stream in mixed forest, CGMC.

Newly recorded on Prince Edward Island (Fig. 4). Breeds in many species of deciduous trees; possibly also in conifers. Reared from decayed *Fagus grandifolia*. (Muona 2000). This is the commonest eucnemid in eastern North America (Muona 2000).

Tribe: Nematodini***Nematodes penetrans* (LeConte, 1852)**

NOVA SCOTIA: Colchester Co.: North River, 20.viii.2004, D. MacDonald, flight-intercept trap, NSNR; **Halifax Co.:** Point Pleasant Park, 28.vii.2001, C.G. Majka, on red spruce in coniferous forest, (2), CGMC.

Newly recorded in Nova Scotia and in the Maritime Provinces as a whole. Reared from *Acer*, *Fagus*, and *Ulmus* (Muona 2000). A widespread species in North America (Muona 2000).

Discussion

As a result of investigations to date, 11 species of Eucnemidae are known from the Maritime Provinces of Canada. Ten species are recorded in Nova Scotia, six in New Brunswick, and four on Prince Edward Island. Nine new provincial records (four from Nova Scotia, four from Prince Edward Island, and one from New Brunswick) are reported and two species, *Microrhagus triangularis* and *Nematodes penetrans*, are newly recorded in the Maritime Provinces as a whole. The four species reported from Prince Edward Island are the first records of the family Eucnemidae from the province. There are no introduced species and only one Holarctic species, *Epiphanis cornutus*.

The composition of the fauna of the Maritime Provinces is in broad agreement with that of other portions of northeastern North America (Table 1). All the species found in the region are also found in Québec, where an additional 10 species have been recorded from southern and western portions of the province (Muona 2000). In Maine all species recorded in the Maritime Provinces except for *Isorhipis ruficornis* and *Microrhagus triangularis* have also been found. *Onichodon orchesides* Newman, *Isarthrus calceatus* (Say), and *Entomophthalmus rufiolus* (LeConte) have also been recorded in Maine (Muona 2000). Insular Newfoundland has a much-diminished fauna with only *Epiphanis cornutus* having been recorded (Muona 2000).

TABLE 1. Maritime Provinces Eucnemidae.

Species	Nova Scotia	Prince Edward Is.	New Brunswick	Regional Distribution in Northeastern North America	Bionomic Associations
Subfamily Melasinae					
Tribe Melasini					
<i>Isorhipis ruficornis</i> (Say)	1			CT, MA, NH, NS, NY, ON, QC, RI, VT	deciduous
<i>Isorhipis obliqua</i> (Say)	1		1	CT, MA, ME, NB, NH, NS, NY, ON, QC, VT	deciduous
Tribe Epiphanini					
<i>Epiphanis cornutus</i> (Eschscholtz)	1		1	MA, ME, NB, NF, NH, NS, NY, ON, QC	coniferous
<i>Hylis terminalis</i> (LeConte)	1	1		ME, NB, NH, NS, NY, ON, PE, QC	deciduous
Tribe Dirhagini					
<i>Microrhagus pectinatus</i> LeConte	1		1	MA, ME, NB, NH, NS, NY, ON, QC, RI	deciduous
<i>Microrhagus subsinuatus</i> LeConte	1	1		CT, ME, NH, NS, NY, ON, PE, QC, VT	deciduous
<i>Microrhagus triangularis</i> (Say)	1			CT, MA, NH, NS, NY, ON, QC	deciduous
Subfamily Macraulacinae					
Tribe Macraulacini					
<i>Onichodon canadensis</i> (Brown)	1	1	1	MA, ME, NB, NH, NS, NY, ON, PE, QC	deciduous
<i>Dromaeolus harringtoni</i> Horn			1	MA, ME, NB, NH, NY, ON, QC	deciduous
<i>Deltometopus amoenicornis</i> (Say)	1	1	1	CT, MA, ME, NB, NH, NS, NY, ON, PE, QC, RI, VT	deciduous and coniferous (?)
Tribe Nematodini					
<i>Nematodes penetrans</i> (LeConte)	1			ME, NH, NS, NY, ON, QC	deciduous
Total species	10	4	6		

Note: For the purposes of this treatment, northeastern North America is taken to consist of the following jurisdictions: Connecticut (CT), Labrador (LB), Massachusetts (MA), Maine (ME), New Brunswick (NB), Newfoundland (NF), New Hampshire (NH), Nova Scotia (NS), New York (NY), Ontario (ON), Prince Edward Island (PE), Québec (QC), Rhode Island (RI), Saint-Pierre et Miquelon (PM), and Vermont (VT).

Regional distributional information is derived from Bousquet (1991), Chandler (2001), Muona (2000), and Sikes (2004) as well as the present study.

As is typically the case with islands, the fauna (species richness) of Cape Breton and Prince Edward Islands are diminished in comparison with that of the neighbouring mainland (Table 2). The fauna of Cape Breton is 45% that of the combined Maritime Provinces fauna, while that of Prince Edward Island is 36%. This may represent an island-associated diminution, an area effect, a paucity of collecting, or a combination of all these factors. Table 2 presents information on the number and proportion of native species of various

saproxylic groups of beetles found on both Cape Breton and Prince Edward Islands in comparison with the mainland fauna of the Maritime Provinces. There is some variability from group to group, however, overall the proportion of species found on Prince Edward Island fauna is 30% that of the mainland whereas on Cape Breton Island it is 33%. In this regard the eucnemid fauna would appear to be well-represented on Cape Breton Island. This is in interesting contrast to the situation on insular Newfoundland where only one species, *Epiphanis cornutus*, has been recorded. The beetle fauna of Newfoundland is relatively depauperate. Amongst saproxylic taxa the number of species recorded on Newfoundland is only 28% that of the Maritime Provinces (Table 2). This may be due in part to its geographical isolation and its more northern latitude, but it could also be due to insufficient collecting to fully discern the fauna. For instance in relation to the Newfoundland Carabidae, which were very thoroughly investigated by Lindroth (1955), the number of species found are 50% of that of the Maritime Provinces (Majka *et al.* 2007b), a suggestive indication that collecting effort for other families has been less than adequate.

TABLE 2. Numbers and proportions of native species of saproxylic groups of Coleoptera in Atlantic Canada.

	Maritimes number	Prince Edward Island number	%	Cape Breton Island number	%	specimens/ species	Newfoundland number	% of Maritime fauna
Eucnemidae	11	4	36%	5	45%	12	1	9%
Derodontidae	2	0	0%	2	100%	3	0	0%
Bostrichidae	6	2	33%	1	17%	5	0	0%
Anobiidae	24	6	25%	2	8%	9	4	17%
Tetratomidae	7	2	29%	1	14%	10	1	14%
Melandryidae	24	4	17%	9	38%	17	13	54%
Mordellini	6	3	50%	1	17%	16	0	0%
Colydiidae	2	0	0%	0	0%	7	1	50%
Synchroidae	1	1	100%	0	0%	17	0	0%
Myceteridae	1	0	0%	0	0%	1	0	0%
Boridae	2	0	0%	0	0%	7	0	0%
Pythidae	5	2	40%	3	60%	15	2	40%
Pyrochoridae	5	3	60%	4	80%	30	1	20%
Salpingidae	2	0	0%	1	50%	48	2	100%
Scraptiidae	5	3	60%	3	60%	157	3	60%
Cerambycidae	105	38	36%	40	38%	36	23	22%
Cossoninae	8	2	25%	2	25%	20	3	38%
Scolytinae	67	15	22%	20	30%	106	26	39%
Total	283	85		94			80	
Mean			30%		33%	29		28%

Notes: Percentages expressed are of the Maritime Provinces fauna for each group. Data is derived from the following sources: Bostrichidae and Anobiidae (Majka 2007); Tetratomidae, Melandryidae, Synchroidae, and Scraptiidae (Majka and Pollock 2006); Mordellini (Majka and Jackman 2006); Colydiidae (Majka *et al.* 2006); Mycteridae, Boridae, Pythidae, Pyrochoridae, and Salpingidae (Majka 2006); Cerambycidae (McCorquodale in press, Majka *et al.* 2007c); Cossoninae and Scolytinae (Majka *et al.* 2007a).

Several eucnemids found in the region have been very infrequently collected, and with the possible exception of *Epiphanis cornutus*, none could be considered common. *Microrhagus triangularis*, *Dromaeolus*

harringtoni, and *Nematodes penetrans* are all known from fewer than five specimens. Although it could be the case that these species have not adequately sampled by the spectrum of collecting techniques that have been employed by researchers in the region, it is also possible that these species are genuinely rare. An examination of the specimens/species data presented in Table 2, which are a rough indicator of the abundance of these species in collections compared to native species in other saproxylic groups, shows a value for eucnemids which is only 40% that of the mean for saproxylic beetles. To give a rough indication of the absolute scale of this scarcity, in the course of the present author's research on the biodiversity of Coleoptera in the region 101,540 beetles collected over a span of over 110 years by a large number of collectors employing a great variety of techniques have been examined. Thus the 135 specimens of eucnemids found during the course of the present research represent 0.13% of specimens, whereas the 11 species of eucnemids represent roughly 0.46% of the species recorded in the region, another rough indication that eucnemids are proportionally less abundant than other beetles.

Majka (2006, 2007), Majka and Pollock (2006), and Majka *et al.* (2006) have all drawn attention to the apparent scarcity of certain saproxylic beetles in the Maritime Provinces. Table 3 lists 59 species of saproxylic beetles from 14 families that have been recorded in the region from five or fewer specimens (representing $\leq 0.005\%$ of specimens examined from the region). All these studies have noted that the apparent scarcity of such species could be indicative of a diminution of habitat as a result of forest management practices. For instance, in Nova Scotia although 78% of the land base is forested less than 1% of that land is comprised of old-growth forests¹(Loo and Ives 2003). In this context it is important to bear in mind that diversity of saproxylic species may depend on subtle variation in habitat characteristics that are not apparent at a landscape-level analysis of forest diversity (Hammond *et al.* 2004).

TABLE 3. Apparently rare saproxylic species in the Maritime Provinces of Canada.

species	specimens	
Eucnemidae		Mordellidae: Mordellini
<i>Microrhagus triangularis</i> (Say)	1	<i>Tomoxia lineella</i> LeConte 2
		<i>Mordella melaena</i> Germar 1
<i>Dromaeolus harringtoni</i> Horn	1	
<i>Nematodes penetrans</i> (LeConte)	3	Colydiidae
		<i>Lasconotus borealis</i> Horn 4
Derodontidae		
<i>Derodontus esotericus</i> Lawrence	4	Mycteridae
<i>Derodontus maculatus</i> Melsheimer	1	<i>Lacconotus punctatus</i> LeConte 1
Bostrichidae		Boridae
<i>Lichenophanes bicornis</i> (Weber)	1	<i>Boros unicolor</i> Say 4
<i>Prostephanus punctatus</i> (Say)	3	
<i>Stephanopachys rugosus</i> (Olivier)	2	Pythidae
<i>Stephanopachys substriatus</i> (Paykull)	1	<i>Pytho seidlitzi</i> Blair 1
		<i>Pytho strictus</i> LeConte 1
Anobiidae		
<i>Ernobius filicornis</i> LeConte	1	Pyrochroidae
<i>Ernobius granulatus</i> LeConte	4	<i>Neopyrochroa femoralis</i> (LeConte) 1

¹. In the Maritime Provinces the term "old growth" is employed with some variability, however, it is generally taken to indicate relatively undisturbed stands of climax or sub-climax composition where the majority of dominant trees in the upper canopy have attained at least half the maximum longevity for that species. In practice this means stands where trees average 150 years (sugar maple, yellow birch, beech), 200 years (red spruce and white pine) or 300 years (eastern hemlock) depending on species composition.

<i>Ernobius schedli</i> Brown	1	Salpingidae	
<i>Utobium marmoratum</i> Fisher	2	<i>Sphaeriestes virescens</i> (LeConte)	5
<i>Xestobium gaspensis</i> White	4		
<i>Hemicoelus umbrosus</i> (Fall)	1	Scraptiidae	
<i>Platybregmus canadensis</i> Fisher	3	no rare species	
<i>Ptilinus lobatus</i> Casey	4		
<i>Ptilinus pruinosus</i> Casey	2	Curculionidae: Cossoninae	
<i>Euvrilletta peltata</i> (Harris)	1	<i>Cossonus americanus</i> Buchanan	4
<i>Vrilletta laurentina</i> Fall	1	<i>Stenoscelis brevis</i> (Boheman)	3
<i>Xyletinus fucatus</i> LeConte	3	<i>Phloeophagus apionides</i> Horn	1
<i>Byrrhodes intermedius</i> (LeConte)	1		
<i>Sculptotheca puberula</i> (LeConte)	2	Curculionidae: Scolytinae	
<i>Stagetus profundus</i> (LeConte)	1	<i>Hylastinus obscurus</i> (Marsham)	2
		<i>Phloeotribus liminaris</i> (Harris)	2
Tetratomidae		<i>Phloeosinus pini</i> Swaine	1
<i>Eustrophopsis confinis</i> (LeConte)	1	<i>Lymantor decipiens</i> (LeConte)	5
<i>Eustrophus tomentosus</i> Say	3	<i>Pityophthorus concavus</i> Blackman	3
<i>Holostrophus bifasciatus</i> (Say)	1	<i>Pityophthorus consimilis</i> LeConte	1
		<i>Pityophthorus ramiperda</i> Swaine	1
Melendryidae		<i>Corthylus columbianus</i> Hopkins	1
<i>Orchesia ovata</i> Laliberté	2		
<i>Spilotus quadripustulatus</i> (Melsheimer)	1		
<i>Scotochroa atra</i> LeConte	5		
<i>Enchodes sericea</i> (Haldeman)	2		
<i>Zilora hispida</i> LeConte	4		
<i>Phryganophilus collaris</i> LeConte	3		

¹ Species recorded from five or fewer specimens representing $\leq 0.005\%$ of specimens from the region.

Information is compiled from Majka (2006, 2007), Majka and Jackman (2006), Majka and Pollock (2006), (Majka *et al.* 2006, 2007a).

Almost all the eucnemids found in the region are exclusively associated with deciduous trees, although *Deltometopus amoenicornis* may be associated with both deciduous and coniferous trees (Table 1). Indeed, the only commonly collected species in the region, *Epiphaniis cornutus*, is the only species that is associated only with conifers. Loo and Ives (2003) document in considerable detail the long history of human-related impacts on deciduous forests in the region. For example, tolerant hardwoods which once dominated the Saint John River Valley and surrounding areas of New Brunswick, now occupy less than 1% of the land base, and much of that is in a highly fragmented condition. Dutch elm disease has had a major impact on elm (*Ulmus americana*) populations in the region. Sugar maple (*Acer saccharum*) and birch (*Betula* spp.) decline, two poorly understood phenomena in the latter half of the 20th century, have also caused widespread mortality. Beech bark disease has swept through the entire region except for the northern third of New Brunswick. No statistics for the Maritime Provinces are provided, but in portions of New England up to 85% of American beech (*Fagus grandifolia*) died in the initial wave of the disease. "Considering that beech was one of the most common species in the region, the impact of the disease has been significant for the ecology of the Maritimes forests" (Loo and Ives 2003, pp 468).

Amongst Maritime Provinces eucnemids, almost all species (except for the coniferous-associated *E. cornutus*, and *M. triangularis*, for which almost no bionomic information is available) are to varying degrees associated with beech, and many have also been reared from *Ulmus*, *Acer*, and *Betula* spp. Given the impact that forest management practices and disease have had on these and other deciduous species of the region, it is not implausible to suppose that the apparent scarcity of almost the entire eucnemid fauna in the region might be related to these factors. If it is the case, as Muona (2000) suggests, that eucnemids are good indicators of

diverse forest structure, the currently diminished state of the Eucnemidae may be an indicator of the impoverished state of that diversity in the region. It may be instructive to take heed of what these beetle populations may be telling us about how forests are being managed. Furthermore, the 59 rare species listed on Table 3, comprise 33% of the saproxylic species within these Coleoptera families, a seemingly large proportion of species. This would indicate that eucnemids are not alone amongst saproxylic Coleoptera in having a sizeable spectrum of species existing at what would appear to be very low population levels.

With respect to European saproxylics Grove (2002, pp. 14-15) wrote that, "Many saproxylic species now survive ... only as relictual populations, 'hanging on by the tips of their tarsi' ... In the absence of positive management, the ultimate extinction of some such species (truly the 'living dead') is almost inevitable through stochastic events." It is therefore worth echoing Majka's (2006, pp 48-49) conclusion that, "Further research needs to be done in this region to determine the status of saproxylic beetles, the impact that forest practices may have had on them, and measures which might lessen or ameliorate habitat fragmentation, the disappearance of old-growth forests, the diminution of coarse woody debris, and other parameters of forests of significance to this functional group of beetles."

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