



# The Lampyridae (Coleoptera) of Atlantic Canada

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## ABSTRACT

Knowledge of the Lampyridae of Atlantic Canada is surveyed. Eleven native, Nearctic species and one adventive, Palaearctic species (*Phosphaenus hemipterus* known from three localities in Nova Scotia) are present. Nine new provincial records of lampyrids are reported including *Pyractomena angulata*, *Lucidota atra*, *Photinus obscurellus*, *Pyropyga decipiens*, and *Photuris fairchildi*, which are newly recorded in Prince Edward Island; *Pyractomena linearis*, *Photinus obscurellus*, and *Photuris fairchildi* newly recorded in New Brunswick; and *Photinus obscurellus* newly recorded in Labrador. *Pyractomena borealis*, *Pyractomena linearis*, and *Photinus obscurellus*, are newly recorded on Cape Breton Island in Nova Scotia, and *Ellychnia corrusca* is newly recorded in Labrador. *Photuris pennsylvanica* is removed from the faunal list of all the provinces of Atlantic Canada. This species does not occur in Newfoundland and Labrador and previous records in the Maritime Provinces are, instead, ascribable to *Photuris fairchildi*. *Photinus ardens* is also removed from the faunal list of Newfoundland and Labrador as the previous record of this species was erroneously based on specimens collected on Cape Breton Island, Nova Scotia, and incorrectly attributed to insular Newfoundland. The distribution, relative abundance, and seasonal occurrence of all species in Atlantic Canada are illustrated. Keys to species are provided as well as colour habitus photographs to assist with identification. The biology of the family is briefly summarized and aspects of the biogeography, phenology, and bionomics of the individual species are discussed.

## RÉSUMÉ

Les connaissances sur les Lampyridae du Canada Atlantique sont recensées. Onze espèces néarctiques indigènes et une espèce paléarctique adventive (*Phosphaenus hemipterus*, signalée dans trois localités de Nouvelle-Écosse) sont présentes. Neuf additions aux faunes provinciales sont rapportées incluant *Pyractomena angulata*, *Lucidota atra*, *Photinus obscurellus*, *Pyropyga decipiens* et *Photuris fairchildi*, qui sont nouvellement signalées à l'Île-du-Prince-Édouard; *Pyractomena linearis*, *Photinus obscurellus* et *Photuris fairchildi* qui sont nouvellement signalées au Nouveau-Brunswick; et *Photinus obscurellus* qui est nouvellement signalée au Labrador. *Pyractomena borealis*, *Pyractomena linearis* et *Photinus obscurellus* sont nouvellement signalées sur l'Île du Cap-Breton en Nouvelle-Écosse et *Ellychnia corrusca* est nouvellement signalée au Labrador. *Photuris pennsylvanica* est retirée de la liste faunistique de toutes les provinces du Canada Atlantique. Cette espèce n'est pas présente à Terre-Neuve-et-Labrador et les signalements précédents de cette espèce dans les Provinces Maritimes sont attribués à *Photuris fairchildi*. *Photinus ardens* est aussi retirée de la liste faunistique de Terre-Neuve-et-Labrador car les signalements précédents de cette espèce proviennent de spécimens collectés sur l'Île du Cap-Breton en Nouvelle-Écosse et faussement attribués à l'Île de Terre-Neuve. La distribution, l'abondance relative et l'apparition saisonnière de toutes les espèces du Canada Atlantique sont illustrées. Des clés d'identification des espèces sont fournies, de même que des photographies couleurs de l'habitus. La biologie de la famille est brièvement résumée et des aspects de la biogéographie, de la phénologie et de la bionomie des espèces sont discutés.

## INTRODUCTION

The Lampyridae (fireflies) is one of the most fascinating and extensively investigated families of beetles. Their bioluminescent flashing has been a source of wonder to humanity for centuries. There are references to fireflies in the Popl Vuh, the post-classic (1000–1697 AD) mytho-historical Mayan narratives. Fireflies feature prominently

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on classical era (200–1000 AD) Mayan ceramics. Indeed the Mayan deity “Kuhkay-ek”, important to the denizens of Tikal and Dos Pilas, was named after the firefly (*kuhkay*) (Lopes 2004). The renowned Japanese poet Issa (1763–1827) composed over 70 haikus featuring fireflies (“*Sparkling fireflies, even the frog’s mouth, gapes.*” and “*The horse’s fart, wakes me to see, fireflies flitting.*”). Kastle and McDermott (1910) compiled a bibliography of over 800 references to fireflies in literature. Aristotle (384–322 BC) discussed fireflies in his *Historia Animalium*, as did Aristophanes (257–180 BC), Artemidorus (2nd century BC), and Pliny the Elder (23–79 AD), who in his *Historia Naturalis* wrote; “*The glow-worms, are named by the Greeks, Lampyrides, because they shine in the night like a sparkle of fire: and it is no more but the brightness of their sides and taile: for one while as they hold open their wings, they glitter; another while they keepe them close togithur, they be shadowed, and make no shew. These glowbardes never appeare before hay is ripe upon the ground, ne yet after it is cut downe.*” (Harvey 1957, pp. 29–30).

Fireflies have also been the subjects of considerable interest on the part of scientists. The ecology, behaviour, physiology, phylogeny, evolution, taxonomy and other elements of lampyrid biology have been intensively investigated in a large number of studies. An excellent recent survey of some aspects of their biology is provided by Lewis and Cratsley (2008) who reviewed over 130 studies conducted in the past 50 years. The following brief account is drawn largely from this review, and the papers cited therein.

A central element of the biology of lampyrids is, of course, their bioluminescent abilities, although not all taxa are bioluminescent. Recent phylogenetic studies suggest that bioluminescence arose in an early cantharoid lineage where it may have served as an aposematic (warning) display for unpalatable larvae. Most lampyrids contain or can produce a highly distasteful or even toxic class of steroidal pyrones known as lucibufagins. These repel, in varying degrees, most potential arthropod, bird, mammal, reptile, amphibian, and fish predators of lampyrids. The development of bioluminescence by adults for use in courtship and in other signaling is thought to have been a subsequent development in the evolutionary history of the Lampyridae. This bioluminescent signaling system appears to have evolved at least four times independently within the Lampyridae, and have reverted to a basal state, non-bioluminescent sexual signaling, at least three times. In what are considered ancestral lampyrid taxa, adults are diurnally active and females use pheromonal signals to attract males. Although the energetic costs of producing bioluminescence

are relatively small, such visual signaling exposes such lampyrid taxa to a significantly greater risk of predation.

Adult lampyrids produce bioluminescence in organs called “lanterns” situated on one or more abdominal segments. Although the peroxisomes (the light-producing organelles) in the photocytes (the light-producing cells) of all known lampyrids contain identical luciferin, the catalyzing agent, luciferase, varies and even single-amino acid substitution in it can alter the bioluminescence spectrum from yellow-green (~546 nm) through to orange (~590 nm). More important from the standpoint of sexual signaling, is that through transitory release and re-uptake of nitric oxide from nerve synapses to the photocytes, many lampyrids are able to quickly and precisely regulate the emission of bioluminescence from their lanterns and have, in some cases, developed complex signaling repertoires that can include twenty or more semantically distinct phrases. Some of these are used by males in flight, emitting neurologically precise patterns of flashes to attract potential mates, hence the well-known “flashing” behaviour of fireflies. Females, generally situated on the ground or in vegetation, can elect to respond, thence initiating a contact sequence of behaviors.

A series of studies have examined some parameters of this signaling system, its specific distinctiveness, intra-specific variation between populations, what signaling characteristics females find attractive, hence inducing them to respond, as well as how signaling varies with temperature and season of the year. A particularly interesting New World group of lampyrids are those belonging to the genus *Photuris*. *Photuris* fireflies do not themselves produce lucibufagins, although they do produce another defensive compound called betaine. Females are assiduous predators of male fireflies, particularly of the genera *Photinus* and *Pyroctomena*, luring males by mimicking the specific female response signals of those species. *Photuris* females devour the males, using the nutrients for somatic and reproductive purposes and to sequester the lucibufagins, which they transmit to their own eggs. These signaling systems, around which investigators have developed an analytic framework, are in many instances (i.e., *Photuris* spp.) important taxonomic characters that are used to distinguish between species in which differences in external morphology are slight to insignificant.

Some studies have suggested that the subsequent evolutionary reversal to non-bioluminescence has been in response to pressure from specialized predators such as *Photuris*. Species such as *Ellychnia corrusca*, *Lucidota atra*, *Pyropyga decipiens*, and *Pyropyga nigricans*, in

Atlantic Canada, are so-called “dark” fireflies in which males use female pheromones to locate potential mates. Other species such as *Phosphaenus hemipterus* have greatly reduced lanterns that emit only a pale glow, and do not produce neurologically precise flashing patterns. The brachypterous male *Phosphaenus hemipterus* “glowworms” locate the larviform females by means of pheromones.

One additional important feature of the mating systems of lampyrids is the production of spermatophores by males, which contain sperm within a coiled gelatinous structure subsequently broken down in a spermatophore-digesting gland in the female’s spermatheca. The derived proteins from these spermatophores are allocated to the females developing oocytes (eggs). The importance of these nuptial gifts varies from species to species depending on whether or not the lampyrids feed as adults and when reproduction takes place.

These signaling systems, and complex reproductive behaviour of the Lampyridae, have provided a superb opportunity for biologists to evaluate the comparative roles of sexual selection and natural selection in the evolution of this diverse group.

In North America some 125 species of lampyrids have been described, although Lloyd (2002) indicated that some 43 additional species in the genera *Pyraclomena*, *Photinus*, and *Photuris* remain to be described, and other genera such as *Ellychnia* and *Phausis* require revisionary fieldwork. McNamara (1991) reported 29 species of lampyrids in Canada, including 11 species found in Atlantic Canada. The addition of *Photinus consanguineus*, *Photinus curtatus*, *Photinus pyralis*, *Photinus sabulosus*, and *Lucidota punctate*, and the removal of *Photinus punctulatus* and *Photinus scintillans* (Luk et al. 2011) bring the current Canadian total to 32 species. In the past twenty years, considerably more has been learned about the lampyrid fauna of the region, and this study reports on recent studies and surveys that pertain to the fauna of Atlantic Canada.

## METHODS AND CONVENTIONS

The taxonomy and nomenclature employed in this study follows that of Lloyd (2002). Specimens of Lampyridae originating from Atlantic Canada were examined and identified. A total of 1,369 specimens were examined; 975 from Nova Scotia, 204 from New Brunswick, 116 from Prince Edward Island, and 74 from Newfoundland and Labrador. Abbreviations of collections (largely following Evenhuis 2011) referred to in the accounts below:

The seasonal distribution of species records was compiled by adding all the records for which there was

sufficiently precise data on collection date. This includes records collected by many investigators from across the region and gathered by many different collection techniques over the last century. The figures are an approximation of true phenology, but are affected by the vagaries of the collecting record. Despite such limitations, the results are the best information specifically available for Atlantic Canada. Similarly, the relative abundance figures are derived from a summation of all historical and contemporary data from throughout the region and are affected by the vagaries of the collecting record and the techniques used to collect specimens.

ACNL	Agriculture and Agri-Food Canada, St. John's, Newfoundland and Labrador, Canada
ACNS	Agriculture and Agri-Food Canada, Kentville, Nova Scotia, Canada
ACPE	Agriculture and Agri-Food Canada, Charlottetown, Prince Edward Island, Canada
AUC	Acadia University Collection, Wolfville, Nova Scotia, Canada
CBU	Cape Breton University, Sydney, Nova Scotia, Canada
CFNL	Canadian Forest Service, Corner Brook, Newfoundland and Labrador, Canada
CGMC	Christopher G. Majka collection, Halifax, Nova Scotia, Canada
CNAC	College of the North Atlantic collection, Carbonear, Newfoundland, Canada
CNC	Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada
DHWC	David H. Webster collection, Kentville, Nova Scotia, Canada
GSC	Gary Selig collection, Bridgewater, Nova Scotia, Canada
JCC	Joyce Cook collection (now at the New Brunswick Museum, Saint John, New Brunswick, Canada)
JOC	Jeffrey Ogden collection, Truro, Nova Scotia, Canada
MTC	Martin Turgeon collection, Saint-Basile, New Brunswick, Canada
MUN	Memorial University of Newfoundland collection, St. John's, Newfoundland, Canada (currently on long term loan to the Canadian Forest Service, Edmonton, Alberta)
NBM	New Brunswick Museum, Saint John, New Brunswick, Canada
NSAC	Nova Scotia Agricultural College, Bible Hill, Nova Scotia, Canada
NSMC	Nova Scotia Museum, Halifax, Nova Scotia, Canada
NSNR	Nova Scotia Department of Natural Resources Insectary, Shubenacadie, Nova Scotia, Canada
RWC	Reginald Webster collection, Charters Settlement, New Brunswick, Canada
SMU	St Mary's University, Halifax, Nova Scotia, Canada
STFX	St Francis Xavier University, Antigonish, Nova Scotia, Canada
UMNB	Université de Moncton, Moncton, New Brunswick, Canada
UPEI	University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada



## IDENTIFICATION

A key to species of Lampyridae [adapted from Lloyd (2002) and Luk et al. (2011)] found in Atlantic Canada is provided on pages 18&19. *Photuris pennsylvanica* is included in the key to assist in differentiating it from *Photinus fairchildi*.

## RESULTS

As a result of an examination of specimens of Lampyridae from Atlantic Canada, nine new provincial records are reported including *Pyractomena angulata*, *Lucidota atra*, *Photinus obscurellus*, *Pyropyga decipiens*, and *Photuris fairchildi*, newly recorded in Prince Edward Island; *Pyractomena linearis*, *Photinus obscurellus*, and *Photuris fairchildi*, newly recorded in New Brunswick, and *Photinus obscurellus*, recorded in Labrador. Additionally, three species, *Pyractomena borealis*, *Pyractomena linearis*, and *Photinus obscurellus*, are newly recorded on Cape Breton Island within Nova Scotia, and *Ellychnia corrusca* is newly recorded in Labrador. *Photuris pennsylvanica*, is removed from the faunal list of all the provinces of Atlantic Canada, and *Photinus ardens* is removed from the faunal list of Newfoundland and Labrador. Specific details follow.

### Lampyrinae Cratomorphini

#### *Pyractomena angulata* (Say, 1825)

**PRINCE EDWARD ISLAND:** 1974-1983 (1, UPEI); **Queens County:** St. Patricks, 25 July 2003, August 2003, old field (6, CGMC).

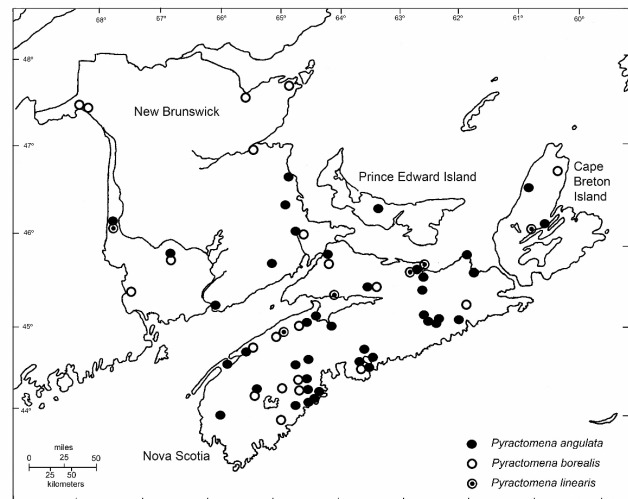
*Pyractomena angulata* (Figure 1) is newly recorded in Prince Edward Island. It was recorded from New Brunswick and Nova Scotia (Green 1957; Lloyd 1966; McNamara 1991) and is widely distributed in the region (Figure 2). The lack of records from northern New Brunswick is, in all probability, a result of insufficient collecting effort. The seasonal distribution of specimens is uni-modal with a peak in adult numbers from mid June until late July (Figure 3). Adults have been collected between 7 June and 4 September suggesting a single annual generation that hibernates as late-instar larvae or pupae with adults eclosing in early June (Archangelsky and Branham 1998).

In the Maritime Provinces, many specimens have been collected in deciduous, coniferous (red spruce (*Picea rubens* Sarg.), black spruce (*Picea mariana* (Mill.) BSP.), and eastern hemlock (*Tsuga canadensis* (L.) Carr.) (Pinaceae), and mixed forests, marshes, open areas, old fields, and along the seacoast. *Pyractomena* spp. larvae feed on gastropods

**Figure 1.** Dorsal habitus photograph of *Pyractomena angulata*. Photo credit: Stephen Cresswell, Buckhannon, West Virginia, USA.



**Figure 2.** Distribution of *Pyractomena angulata*, *Pyractomena borealis*, and *Pyractomena linearis* in the Maritime Provinces of Canada.



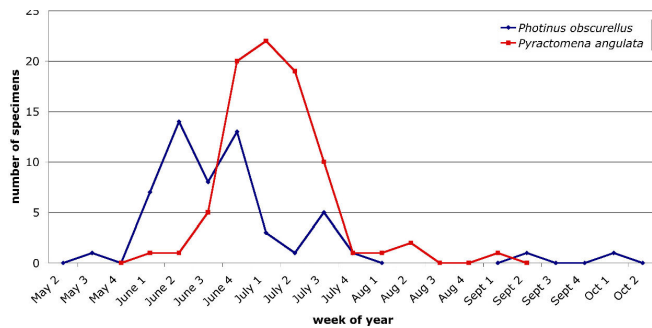
(Lloyd 2002); adults do not feed (Buschman 1984). Adults are nocturnal. Male flash patterns (amber) consist of a rapidly modulated emission with ~9–15 modulations in each flash, which is ~0.8 sec in duration. The flash pattern intervals average 4.3 sec at 19 °C (Lloyd 1966a).

#### *Pyractomena borealis* (Randall, 1838)

*Pyractomena borealis* (Figure 4) was recorded from Nova Scotia and New Brunswick by Green (1957), Lloyd (1966), Buschman (1974), and McNamara (1991). It is widely distributed throughout the region; however, it has not been recorded on Prince Edward Island (Figure 2). Specimens have been collected between 27 May and 15 October, although 75% of records are from the month of June.

In the United States, Lloyd (1966) recorded *Pyractomena borealis* in mesic forests and red maple (*Acer rubrum* L. (Sapindaceae)) stands. In the Maritime Provinces there are records in mixed and deciduous forests.

**Figure 3.** Seasonal distribution of *Photinus obscurellus* and *Pyractomena angulata* in the Maritime Provinces of Canada.



**Figure 4.** Dorsal habitus photograph of *Pyractomena borealis*. Photo credit: Richard Migneault, Edmundston, New Brunswick, Canada.



*Pyractomena* spp. larvae feed on gastropods (Lloyd 2002); adults do not feed (Buschman 1984). Adults are nocturnal. Male flash patterns (amber) consist of a single (rarely double) pulse with a duration of 0.20–0.25 sec. The pulse interval, if two pulses were given, is 0.60 sec with flash pattern intervals between 3.6–4.2 sec at 18–20 °C. Males begin flashing about 32 min after sunset and continue for approximately 20 min (Lloyd 1966a).

*Pyractomena linearis* LeConte, 1852

**NEW BRUNSWICK: Carleton County:** Meduxnekeeg Valley Preserve, 13 July 2004, R.P. Webster, hardwood forest (1, RWC). **NOVA SCOTIA: Victoria County:** Hume's River, 24 June 1945, collector not recorded (1, NSMC).

*Pyractomena linearis* (Figure 5) is newly recorded in New Brunswick and from Cape Breton Island. Buschman (1974) reported the species from Nova Scotia; however, this report was missed by McNamara (1991) in her compilation of Canadian records. There are scattered records from northern and central Nova Scotia, including Cape Breton Island, and one record from western New

**Figure 5.** Dorsal habitus photograph of *Pyractomena linearis*. Photo credit: Tom Murray, Groton, Massachusetts, USA.



Brunswick (Figure 2). Specimens have been collected between 17 June and 13 July, although 92% of records are from the month of June. Lloyd (1966a) characterized their typical habitat as being marsh-pastures. *Pyractomena* spp. larvae feed on gastropods (Lloyd 2002); adults do not feed (Buschman 1984). Adults are nocturnal. Male flash patterns (amber) consist of a single steady emission approximately 0.5 sec in duration with a mean flash interval of 5.9 sec at 17–19 °C. Males begin flashing 40–50 min after sunset and continue for about an hour (Lloyd 1966a).

## Photinini

### *Ellychnia corrusca* (Linnaeus, 1767) complex

*Ellychnia corrusca* (Figure 6) was recorded in Nova Scotia by Jones (1869) and Evans (1899), and from Nova Scotia, New Brunswick, and insular Newfoundland by McNamara (1991). It was reported from Prince Edward Island by Majka (2010). It is ubiquitous throughout the Maritime Provinces, certainly the most abundant (Figure 7) and widespread lampyrid found in the region (Figures 7, 8, & 9). The seasonal distribution of records shows a bimodal peak. The first annual cohort is abundant between the beginning of May and the middle of July, reaching a peak in the first half of June. The second cohort is found between the middle of August and the middle of October, reaching a peak in mid-September (Figure 10). Adults have been collected between 8 March and 10 November. This indicates an over-wintering generation of adults that are reproductively active in the spring, followed by an emerging fall generation that subsequently hibernates as adults, a life cycle also found by Rooney and Lewis (2000).

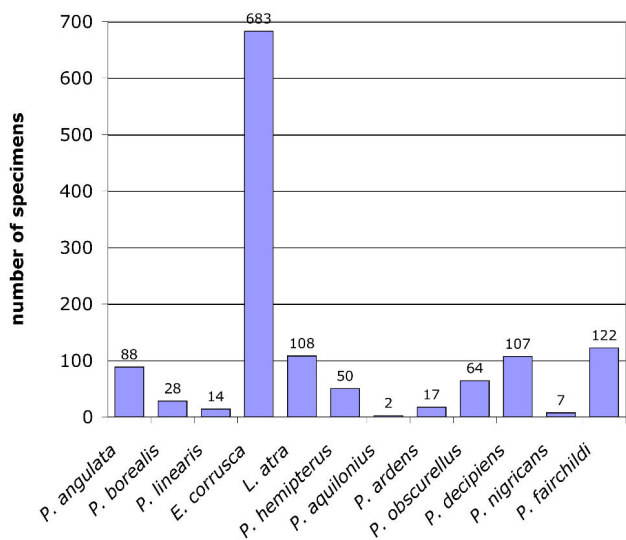


Majka (2010) found them common on sap flows from sugar maple trees. In general, adults are attracted to sugary sap flows and interstitial fluids from trees (Rooney and Lewis 2000). They are also unusual amongst lamproyrids in that females primarily allocate nutrient resources from spermatophores to somatic tissue (body fat) whereas most female lamproyrids (e.g., *Photinus* spp.) allocate such proteins to oocytes or eggs (Rooney and Lewis 1999).

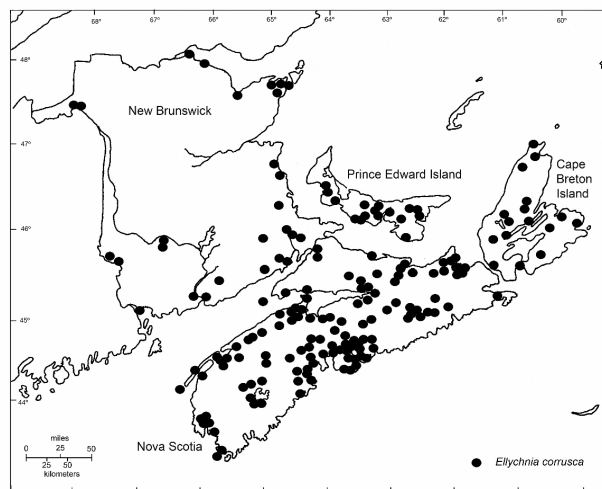
**Figure 6.** Dorsal habitus photograph of *Ellychnia corrusca*. **Photo credit:** Stephen Gingold, Amherst, Massachusetts, USA.



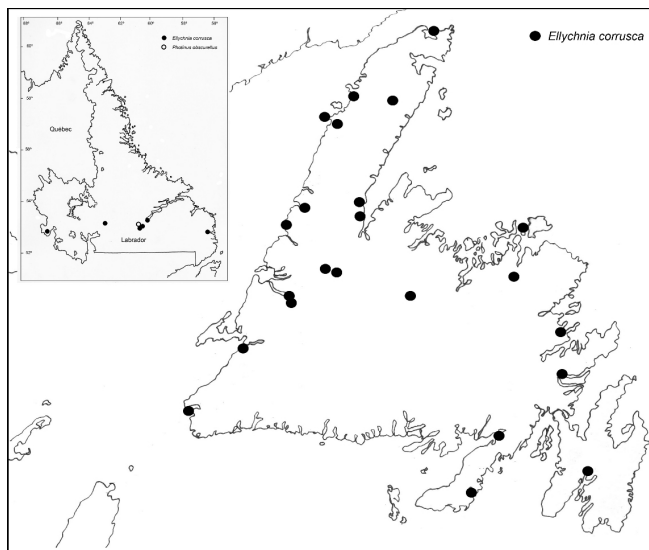
**Figure 7.** Relative abundance of Lamproyridae in the Maritime Provinces of Canada.



**Figure 8.** Distribution of *Ellychnia corrusca* in the Maritime Provinces of Canada.



**Figure 9.** Distribution of *Ellychnia corrusca* on insular Newfoundland; the inset map shows the distribution of *Photinus obscurellus* and *Ellychnia corrusca* in Labrador.

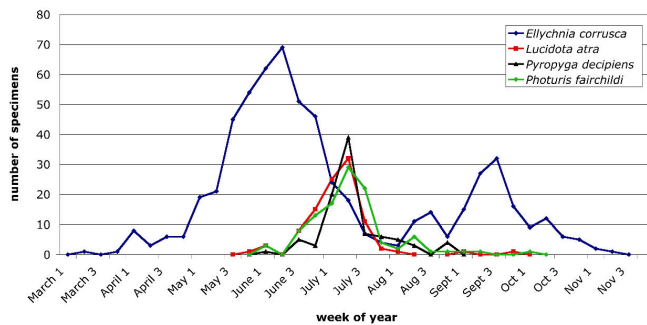


*Ellychnia corrusca* adults frequent tree trunks close to their over-wintering sites and mate in the spring. The larvae develop as predators in decaying wood (Luk et al. 2011). In Atlantic Canada they have been found in a wide variety of coniferous, deciduous, and mixed forests and in various open habitats such as along seashores, on coastal barren and salt marshes, in apple orchards, blueberry fields, grassy areas, wet meadows, old fields, agricultural fields, and along rivers, streams, and ponds. Adults are diurnal and are not bioluminescent.

Lloyd (2003) considers *Ellychnia corrusca* to be a species complex, the resolution of which requires further

research and investigation. Fender (1970) treated three such species complexes in eastern North America: the *Ellychnia corrusca*, *Ellychnia autumnalis*, and *Ellychnia lacustris* complexes, but even the distinctions between these are unclear. Fender (1970, pp. 31) wrote: “J. W. Green studied the genus *Ellychnia* for over 10 years before finally deciding the majority of its members were irreconcilable. At the end of this time he kindly (?) turned them over to me, hoping against hope that a fresh approach by another

**Figure 10.** Seasonal distribution of *Ellychnia corrusca*, *Lucidota atra*, *Pyropyga decipiens*, and *Photuris fairchildi* in the Maritime Provinces of Canada.



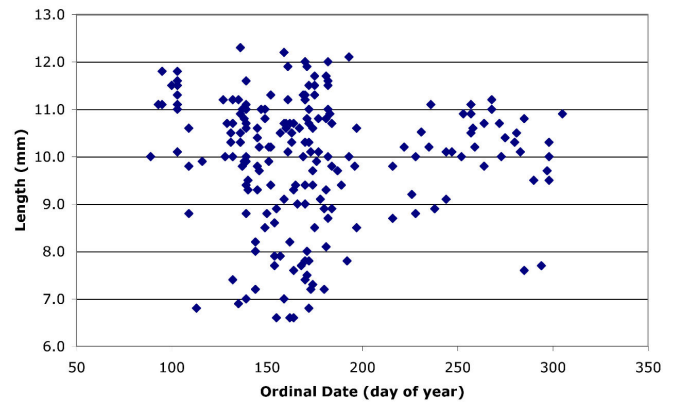
student might resolve the group. Since then I have similarly spent over 10 years in an attempt to understand these creatures. The work, to date, has been rather futile as far as the species from eastern North America are concerned.”

In relation to these eastern complexes Fender (1970, pp. 34) continued “Members of these eastern complexes have been seen from 4.5 to 15 mm long and all sizes in between. In all sizes, specimens have been seen with the elytra rather strongly costate or with the costae obliterated. There seems to be nothing consistent about them in any portion of their range.”

Could more than one species of *Ellychnia* be present in Atlantic Canada? One perspective is provided by Figure 11, which illustrates the length of 200 *Ellychnia corrusca* specimens from Nova Scotia according to ordinal collection date. The size of individuals varies considerably (from 6.6–12.3 mm) but the only seasonal pattern of this distribution would appear to be that the amplitude of this variation is less in the fall cohort, after ordinal date 200, than in the spring cohort. The significance of this is unclear and warrants further investigation. All the specimens examined fall within the 6.0–13.0 mm size range considered by Rooney and Lewis (2000) to constitute the *Ellychnia corrusca* complex.

The genus *Ellychnia* in eastern North America clearly requires further research to determine its members and

**Figure 11.** Size distribution of *Ellychnia corrusca* according to ordinal date (day of year).



composition. In Atlantic Canada there is considerable variation in specimen size and number and prominence of the elytral costae. Given the complex species and population structures of a number of genera of Lampyridae (i.e., the genus *Photuris*; see below), which are sometimes reflected little if at all in morphology, or even the structure of the genitalia, and the two decades of research by J.W. Green and K.M. Fender which failed to resolve the complexities of the eastern *Ellychnia* group, it seems highly unlikely that this can be resolved without molecular and/or genetic research.

#### *Lucidota atra* (Olivier, 1790)

**PRINCE EDWARD ISLAND:** 1974–1983 (3, UPEI); 1982 (1, UPEI); **Queens County:** Blooming Point, 18–21 July 2008, D. Giberson, malaise trap (1, CBU); Argyle Shore, 21 July 1992, D.F. McAlpine (1, NBM); Meadow Bank, 5 July 1970, R. Wenn, in stump (1, UPEI); Mount Herbert, 1920–1924, J.R. Mutch (1, UPEI); St. Patricks, 14 July 2002, C.G. Majka, coniferous forest along small stream (2, CGMC). **NOVA SCOTIA Mainland:** 67 specimens were examined from **Annapolis, Antigonish, Colchester, Cumberland, Halifax, Hants, Kings, Lunenburg, Pictou, Queens, Shelburne, and Yarmouth Counties.** The earliest record is from 1939 (Colchester County: Truro, 16 July 1939, C.A.R. (1, NSAC)).

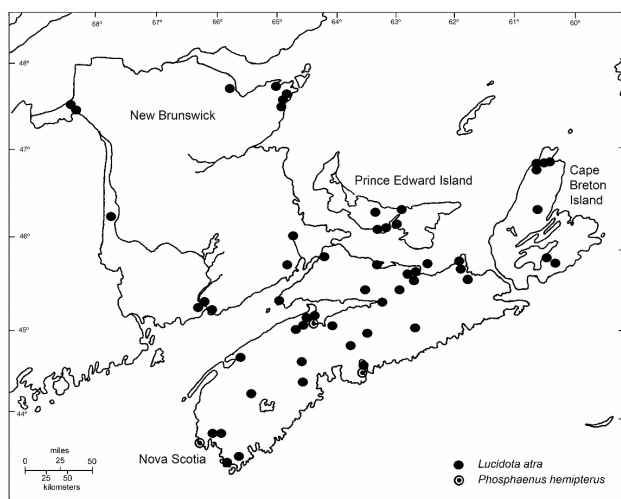
*Lucidota atra* (Figure 12) is newly recorded in Prince Edward Island and from the mainland of Nova Scotia. It was first recorded in Nova Scotia from Cape Breton Island by Campbell et al. (1987) and from New Brunswick by McNamara (1991). It is widespread in the Maritime Provinces (Figure 13) and moderately abundant, although much less so than *Ellychnia corrusca* (Figure 7). The seasonal distribution of specimens is uni-modal with a peak in adult



**Figure 12.** Dorsal habitus photograph of *Lucidota atra*. **Photo credit:** Richard Migneault, Edmundston, New Brunswick, Canada.



**Figure 13.** Distribution of *Phosphaenus hemipterus* and *Lucidota atra* in the Maritime Provinces of Canada.



numbers from late June to the third week of July. Adults have been collected between 27 May and 27 September. This would appear to indicate a single annual generation that hibernates as late-instar larvae or pupae, eclosing in late May and early June as reproductively active adults.

In the Maritime Provinces they have been found in deciduous and coniferous forests, in blueberry fields, grassy open areas, marshlands, and along forested streams. Larvae are predators of gastropods and other soft-bodied invertebrates in rotten wood (Branham and Archangelsky 2000; Luk et al. 2011). Adults are diurnal and are not bioluminescent.

*Phosphaenus hemipterus* (Goeze, 1777)

**NOVA SCOTIA: Halifax County:** south-end Halifax, 15 July 2010, C.G. Majka, garden (5, CGMC). **Kings County:** Wolfville, 22 July 2011, C. MacKay, woodlot on bolt of Norway spruce (1, AUC).

The biology and status of *Phosphaenus hemipterus*, the lesser glowworm, (Figure 14), an adventive Palearctic species in North America, was reviewed by Majka and

**Figure 14.** Dorsal habitus photograph of *Phosphaenus hemipterus*. **Photo credit:** Urs Rindlisbacher, St. Gallen, Wattwil SG, Switzerland.



McIvor (2009) who newly recorded this species in Halifax, NS. It was hitherto known in North America from only two previous collections, in Yarmouth, NS in 1947 and Montréal, PQ in 1989. Subsequently, Luk et al. (2011) reported two specimens collected in Fergus, ON in 2006 and 2010. In 2010 CGM found several specimens in a garden in peninsular Halifax, 1.6 km west of the previous sites where the species had been recorded indicating that the distribution of the beetle is more extensive in the city than previously known. Also, in 2011 the species was collected in Wolfville, NS, on the Bay of Fundy and on the other side of peninsular Nova Scotia; a significant expansion of its known range in Nova Scotia (Figure 13).

*Phosphaenus hemipterus* is an unusual species in a number of regards. Both sexes are feebly bioluminescent, although they appear only to glow in response to disturbance and do not exhibit neurologically precise flashing patterns. Females are apterous; males are brachypterous and incapable of flight, and also have very small eyes. Males are able to locate females from distances as great as 20 m, presumably sensing pheromones with their large antennae (De Cock and Matthysen 2005). *Phosphaenus hemipterus* larvae feed exclusively on



earthworms (De Cock 2000) and Majka and McIvor (2009) observed them feeding on *Lumbricus terrestris* L. (Lumbricidae), an adventive European earthworm in Nova Scotia. Adults do not feed (De Cock 2000). No survey work has been conducted in Yarmouth, NS since 1947 to determine if *Phosphaenus hemipterus* still survives there, but in view of its recent discovery in Wolfville, NS, it would be worthwhile to survey other seaport towns in Nova Scotia to ascertain if *Phosphaenus hemipterus* occurs even more widely in the province (Figure 13). In Halifax, they are found in grassy lawns, often near rock walls, similar to habitats in which they occur in Europe (Majka and McIvor 2009). Adults are diurnally active.

*Photinus aquilonius* Lloyd, 1969

**NOVA SCOTIA: Kings County:** Aylesford, 20 June 1963, P.M. Taschereau (1, NSMC).

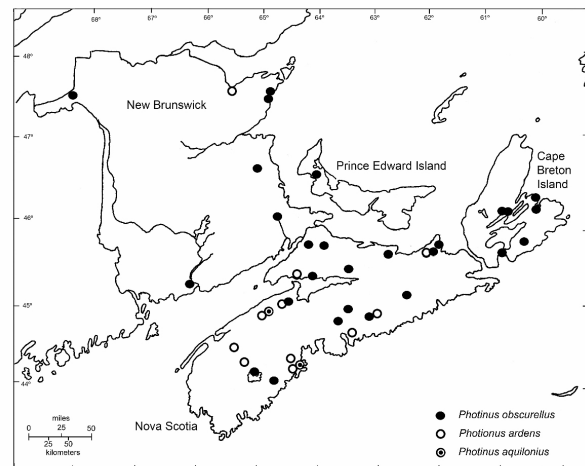
*Photinus aquilonius* (Figure 15) was described by Lloyd (1969) in part as a result of observations and specimens collected by L.L. Buschman who observed this hitherto unidentified species in Lunenburg, NS. Only two localities are known for this species in the region: Aylesford and Lunenburg in Nova Scotia (Figure 16). It appears to be absent from New Brunswick, Prince Edward Island, and northern Nova Scotia.

*Photinus aquilonius* appears to frequent marshes. Females, which apparently don't fly before mating, were commonly found on marsh plants surrounded by standing water (Lloyd 1969). *Photinus* spp. larvae are subterranean and feed on earthworms (Lloyd 2002). Adults are nocturnal. Male flash patterns (yellow) consist of a single flash of 0.25 sec duration with intervals between 3.7–12.0 sec at 18 °C (Lloyd 1969).

**Figure 15.** Dorsal habitus photograph of *Photinus aquilonius*. **Photo credit:** Stephen Luk, Guelph, Ontario, Canada.



**Figure 16.** Distribution of *Photinus aquilonius*, *Photinus ardens*, and *Photinus obscurellus* in the Maritime Provinces of Canada.



*Photinus ardens* LeConte, 1852

*Photinus ardens* (Figure 17) was first reported from Nova Scotia by Buschman (1974) and from New Brunswick by McNamara (1991). It is widely distributed on the mainland of Nova Scotia and absent from Cape Breton Island (Figure 16). There is only one record from New Brunswick, that being from Bathurst located in northeast NB. However, its apparent absence from other areas of the province may be due to insufficient collecting effort.

**Figure 17.** Dorsal habitus photograph of *Photinus ardens*. **Photo credit:** Bo Zaremba, Newburyport, Massachusetts, USA.



In a series of publications (Green 1956; Lloyd 1966; McNamara 1991; Luk et al. 2011) *Photinus ardens* has been listed as occurring in Newfoundland. This report originated with Green (1956) who synonymized *Photinus frigidus* Olivier, 1888 with *Photinus ardens* and wrote “Specimens

in the United States National Museum collection, labeled "Terre-Neuve," *Photinus frigidus* Ern. Oliv., "... undoubtedly belong to *Photinus ardens* and constitute the basis for the synonymy above proposed." Green (1956, pp. 612) listed the record within the jurisdiction of "Newfoundland." This record was subsequently included by Lloyd (1966b) who displayed a map of the distribution of the species with a point situated in the area of Terra Nova (=Terre-Neuve) on insular Newfoundland. McNamara (1991) subsequently included the record from Newfoundland on the basis of Green (1956) and then Luk et al. (2011) included Newfoundland in the distribution of the species on the basis of McNamara (1991). McNamara (1991), however, neglected to consult Lloyd (1969), who re-elevated *Photinus obscurellus* to specific status. *Photinus obscurellus* had been synonymized with *Photinus ardens* by Green (1956). Lloyd (1969) subsequently wrote that *Photinus obscurellus* was known from "Terre Nueve (sic), Newfoundland." Therefore, the species listed from Newfoundland by McNamara (1991) should instead have been *Photinus obscurellus*.

However, all these authors appear to have neglected to check the original description of *Photinus frigidus* in Olivier (1888, pp. 54) in which the type locality is given as "Terre-Neuve: cap Breton", a clear indication that the specimen was collected on Cape Breton Island and not on insular Newfoundland. Olivier (1888) appears to have been using the term Terre-Neuve (new land) to refer to Cape Breton as being in the New World, a reference that other authors subsequently misunderstood as referring to Newfoundland and/or the town of Terra Nova in the Province. Olivier (1888) continues "Je dois à l'obligeance de M. Künckel d'Herculais la connaissance de cette espèce, remarquable par son habitat septentrional." This refers to Philippe Alexandre Jules Künckel d'Herculais (1843–1918), a French entomologist who traveled to Argentina around 1885 to study grasshoppers (Jaussaud and Brygoo 2004). It appears that either enroute to or from Argentina, Künckel d'Herculais visited Cape Breton Island where he acquired the *Photinus* specimens, subsequently conveying them to Olivier, who delivered the paper describing *Photinus frigidus* on the 13 April 1887. The paper was subsequently published in June 1888.

There are, moreover, no voucher specimens of any species of *Photinus* originating from Newfoundland in the Canadian National Collection, nor in any collection in the province of Newfoundland and Labrador itself. None of the curators of any of these collections have ever observed a luminescent firefly in the province. On the basis of the above, *Photinus ardens* is removed

from the faunal list of Newfoundland and Labrador.

In the Maritime Provinces there are records of *Photinus ardens* between 20 June and 30 July. Lloyd (1969) reported that the species is found in marshes and pasture-marshes. *Photinus* spp. larvae are subterranean and feed on earthworms (Lloyd 2002). Adults are nocturnal. Male flash patterns (yellow) consist of two, three, and rarely four pulses each lasting 0.30–0.41 sec with a pulse interval varying from 0.66–1.0 sec. Flash pattern intervals are between 10–20 sec, all at 18 °C. Males begin flashing about one hour after sunset and continue for about an hour. (Lloyd 1969).

#### *Photinus obscurellus* LeConte, 1852

**LABRADOR:** Churchill River, 60.948° N, 53.176° W, 1 July 2009, D. Langor and S. Pardy, shoreline (1, MUN). **NEW BRUNSWICK: Gloucester County:** Sheila, 19 July 1978, L. Basque (1, UMNB); Tracadie, 13 June 1978, J-M Maltais (1, UMNB); **Kent County:** Acadieville, August 1984, G. Thébeau (1, UMNB); **Kings County:** Grand Bay, 26 June 1990, D.F. McAlpine (1, NBM); Madawaska County: 15 September 1982, M. Desjardains (1, UMNB); **Westmorland County:** Moncton, 7 October 1985, S. Roussel (1, UMNB). **NOVA SCOTIA: Cape Breton County:** Coxheath, 25 June 1998, T.A. Jones, (1, CBU); Florence, 21 June 1994, J.M. Francis (1, CBU); **Richmond County:** Lake Uist, 3-6 July 1990, B. Wright (1, NSMC); St. Peters, 11 July 1993, E. Georgeson, light trap (1, NSNR); **Victoria County:** Baddeck, 20 June 1990, 28 June 1990, 2 July 1987, 9 June 1987, E. Georgeson, light trap (5, NSNR); Baddeck, 1 July 1945, D.C. Ferguson (5, NSMC); Baddeck Bridge, 29 July 1970, B. Wright (1, NSMC). **PRINCE EDWARD ISLAND:** 1974-1983 (1, UPEI); **Prince County:** Mount Pleasant, 20 June 1981, Doyle & Hogan, light trap (12, UPEI).

*Photinus obscurellus* (Figure 18) is newly recorded in New Brunswick, Cape Breton Island, Prince Edward Island, and Labrador (Figures 9 & 16). Lloyd (1969) reported the species from mainland Nova Scotia (Debert) based on collections made by L.L. Buschman. However, this report was missed by McNamara (1991) in her compilation of Canadian records.

Lloyd (1969) also reported *Photinus obscurellus* from "Terre Nueve, Newfoundland" (sic), a misspelling of Terre Neuve = Terra Nova. As outlined above in the account of *Photinus ardens*, this report erroneously refers to a specimen actually collected on Cape Breton Island in Nova Scotia. The discovery of this species on the Churchill River in Labrador, however, is a noteworthy one and constitutes a significant northern range extension.



**Figure 18.** Dorsal habitus photograph of *Photinus obscurellus*. **Photo credit:** Stephen Luk, Guelph, Ontario, Canada.



*Photinus obscurellus* is widely distributed in the Maritime Provinces (Figure 16). The seasonal distribution of specimens is uni-modal with a peak in adult numbers during the month of June (Figure 3). Adults have been collected between 29 May and 7 October. This would appear to indicate a single annual generation which hibernates as late-instar larvae or pupae, eclosing in early June as reproductively active adults. Lloyd (1966b) reported *Photinus obscurellus* (then as *Photinus ardens*) as occurring in low wet pastures that had streams flowing through or adjacent to them with hummocks and depressions with *Sphagnum* growing on the ground between the grass. *Photinus* spp. larvae are subterranean and feed on earthworms (Lloyd 2002). Adults are nocturnal. Male flash patterns (yellow) consist of two or three pulses; each lasting 0.20–0.34 sec with intervals between 0.6–0.7 sec at 17–22 °C. Mean flash-pattern intervals are 6.4 sec at 18 °C. Males begin flashing 21–34 min after sunset and continue for 1–2 hours (Lloyd 1966b).

*Pyropyga decipiens* (Harris, 1836)

**PRINCE EDWARD ISLAND:** 1974–1983 (14, UPEI); **Kings County:** Bangor, 11 July 1970, R. Wenn, field (1, UPEI); Woodville Mills, 23 July 2001, C.G. Majka, old field (1, CGMC); Woodville Mills 30 June 2003, 16 August 2002, C.G. Majka, shore of beaver pond (2, CGMC); **Queens County:** Lake Verde, 16 July 2001, C.G. Majka, shore of lake (1, CGMC); St. Patricks, 17 July 2001, 19 July 2001, C.G. Majka, old field (4, CGMC); St. Patricks, 21 July 2001, C.G. Majka, along stream (1, CGMC).

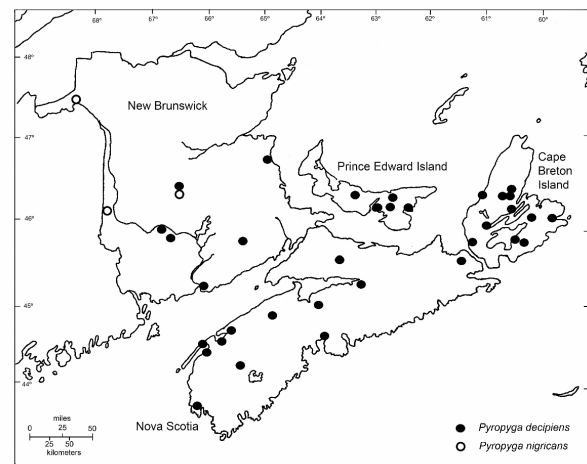
*Pyropyga decipiens* (Figure 19) is newly recorded in Prince Edward Island. It was recorded from New Brunswick and Nova Scotia by McNamara (1991). It is widely distributed in the region (Figure 20). The lack of records from northern New Brunswick is, in all probability, a result of insufficient collecting effort. The seasonal distribution of records shows a sharp peak during the first half of July (Figure 10) with

specimens having been recorded between 2 June and 30 August. This would appear to indicate a single annual generation that hibernates as late-instar larvae or pupae, eclosing in early June as reproductively active adults.

**Figure 19.** Dorsal habitus photograph of *Pyropyga decipiens*. **Photo credit:** Tom Murray, Groton, Massachusetts, USA.



**Figure 20.** Distribution of *Pyropyga decipiens* and *Pyropyga nigricans* in the Maritime Provinces of Canada.



Little bionomic research has been done on species of *Pyropyga*. However, Archangelsky and Branham (2001) successfully fed larvae of *Pyropyga nigricans* both earthworms and gastropods. In the Maritime Provinces, adults have been collected in marshlands, grassy fields, alder swales, old fields, roadsides, and along the shores of streams, lakes, and ponds. They are diurnal fireflies and adults are not bioluminescent.

As noted by Green (1961), the pronotal colouration of *Pyropyga decipiens* can be highly variable, from largely pale with a dark median vitta and obscurely darker



margins, to almost entirely dark with pale lateral areas almost completely eliminated. Specimens of the latter type can externally strongly resemble those of *Pyropyyga nigricans*. In such instances only the examination of male genitalia can differentiate between species.

*Pyropyyga nigricans* (Say, 1823)

*Pyropyyga nigricans* (Figure 21) was recorded from New Brunswick by McNamara (1991). At present there are few records of it from the Province (Figure 20). Further field work is required to better determine its status in the province.

**Figure 21.** Dorsal habitus photograph of *Pyropyyga nigricans*. **Photo credit:** Richard Migneault, Edmundston, New Brunswick, Canada.



*Pyropyyga nigricans* are diurnal fireflies and adults are not bioluminescent. They have been collected from a creek margin and the larvae are presumably riparian, or possibly even semi-aquatic (Archangelosky and Branham 2001).

## Photurinae

*Photuris fairchildi* Barber, 1951

Fireflies called *Photuris pennsylvanica* (DeGeer, 1774) have been reported in the region since Jones (1869) reported it from Nova Scotia writing “Our common fire fly. The light emitted is sufficient to enable the collector to read the lines of his notebook when the insect is held close over it. It generally appears about the end of June, but I have seen it much earlier. It seems to delight in dark nights with a close humid atmosphere.”

McNamara (1991) reported the species from New Brunswick, Nova Scotia, and Prince Edward Island. Barber (1951), however, described *Photuris fairchildi* on the basis of a series of ten specimens collected by Graham Fairchild, an American entomologist and grandson of Alexander

Graham Bell, on 14 July 1927 in Baddeck on Cape Breton Island in Nova Scotia. In Frank MacDermott’s addendum to the paper (Barber 1951, pp. 37–56), which includes detailed descriptions of all species treated in this review of the genus *Photuris*, these two species can be distinguished on the basis of the following external characters:

*Photuris pennsylvanica*: body length 9.0–10.0 mm; body width 3.0–3.5 mm; pronotum with median black or very dark brown median T-shaped area; antennae relatively short (4.2 mm); head white.

*Photuris fairchildi*: body length 12.0 mm; body width 4.0 mm; pronotum with median black or very dark brown media area, lacking the cross-bar on the T-shaped area; antennae relatively long (6.1 mm); frons white, vertex brownish under pronotum.

After initially believing that *Photuris* specimens originating in the Maritime Provinces were *Photuris pennsylvanica*, I have re-examined a large number of specimens from New Brunswick, mainland Nova Scotia, Cape Breton Island, and Prince Edward Island. The body length of 95% of specimens ranges between 10.9–12.2 mm. Only 5% of specimens ranged below 10.2 mm or up to 13.1 mm length. The body width of specimens ranged between 3.6–4.2 mm. Antennae and individual antennomeres were relatively long, in the range of 6.0 mm. In the majority of specimens the frons of the head was white, the vertex becoming brownish under the pronotum. In a small number of specimens the head was brownish throughout. In none of the specimens was it white throughout. In all these respects, all the specimens agreed with the description of *Photuris fairchildi* and not with *Photuris pennsylvanica*. In terms of the pronotal markings, the dark median area of specimens varied from having almost no discernible cross-bar (the T-shaped area) to having a clearly discernible cross-bar.

In addition to external morphology, these two *Photuris* species can be distinguished on the basis of male flashing patterns. Those of *Photuris pennsylvanica* consist of a short (~0.2 sec in duration) flash followed by a long (~2.5 sec) attenuated flash at intervals of ~7.5 sec (Barber 1951). Those of *Photuris fairchildi* consist of one to six short (~0.2 sec) flashes that are repeated every 2.5 sec (Buschman 1974). Buschman (1974) investigated *Photuris* fireflies in Nova Scotia in 1968 and 1969 in Lunenburg, Kings, Halifax, and Colchester counties. On the basis of flashing patterns he identified all the specimens he observed in the province as *Photuris fairchildi*, except for two individuals

that displayed unusual flashing patterns, whose identity he was not able to determine. The author has observed flashing patterns of *Photuris* fireflies on Prince Edward Island consistent with the patterns of *Photuris fairchildi*.

Therefore, on the basis of both external morphology and Buschman's (1974) observations of flashing patterns, it would seem probable that *Photuris* populations in the Maritime Provinces consist of *Photuris fairchildi*. None of the specimens I examined fit the description of *Photuris pennsylvanica*. As such, *Photuris fairchildi* is newly recorded in New Brunswick and Prince Edward Island, and *Photuris pennsylvanica* is removed from the faunal lists of all three Maritime Provinces. This finding, however, should be placed in the context of the ongoing revision of the genus *Photuris* being conducted by J.E. Lloyd and M.E. Branham and which is expected to result in the description of at least 28 new species in this genus (Lloyd 2002; Luk et al. 2011). What this may mean in terms of the number of *Photuris* species found in the Maritime Provinces will have to await the publication of this revision.

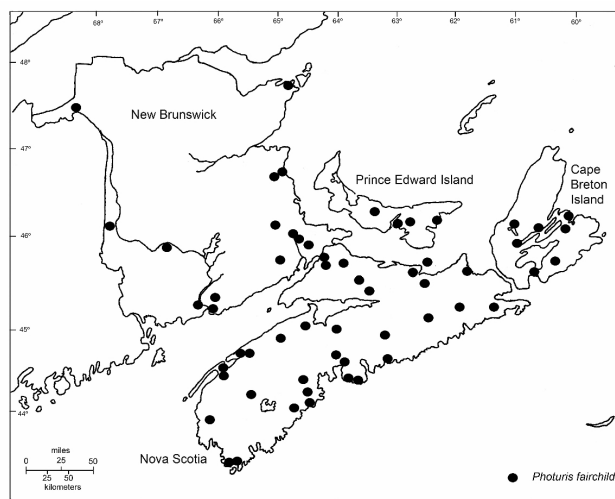
McNamara (1991) also indicated that *Photuris pennsylvanica* was found on insular Newfoundland. There are however, no records of any species of *Photuris* from Newfoundland in any publication I have consulted. There are no voucher specimens in the Canadian National Collection, the Memorial University Collection, the Newfoundland Department of Environment and Conservation Collection, the Atlantic Cool Climate Crop Research Centre Collection, the Atlantic Forestry Centre Collection, the College of the North Atlantic, and the Newfoundland Insectarium. No entomologist with Newfoundland field experience has ever seen a bioluminescent firefly in Newfoundland and, if present, luminescent fireflies are relatively conspicuous (Patricia Baines, Peggy Dixon, Barry Hicks, Lloyd Hollet, David Langor, David Larson, Shelley Parry-Moores, and Carolyn Parsons, personal communication). On this basis, I conclude that the report of *Photuris pennsylvanica* from Newfoundland in McNamara (1991) is erroneous, and this species is removed from the list of the Newfoundland and Labrador fauna.

*Photuris fairchildi* (Figure 22) is widely distributed in the region (Figure 23) and one of the most abundant lampyrids in the Maritimes (Figure 7). The seasonal distribution of specimens is uni-modal with a peak in adult numbers from the third week of June to the end of July (Figure 10). Adults have been collected between 5 June and 7 October. This would appear to indicate a single annual generation which hibernates as late-instar larvae or pupae, eclosing in early June as reproductively active adults.

**Figure 22.** Dorsal habitus photograph of *Photuris fairchildi*. **Photo credit:** Christopher G. Majka, Nova Scotia Museum, Halifax, Nova Scotia, Canada.



**Figure 23.** Distribution of *Photuris fairchildi* in the Maritime Provinces of Canada.



Barber (1951) found the species on marshy ground and Buschman (1974) reported it as common in moist habitats such as marshes and spruce forests. In Prince Edward Island, I have collected them frequently in a hollow in an old field ecosystem where mist collects at night, 200 m from a small alder-lined river. Larvae of *Photuris* spp. are omnivorous and semi-aquatic (Lloyd 2002; Luk et al. 2011). Buschman (1974) investigated the courtship and mimicry behaviour of adult *Photuris fairchildi*. In common with other species of *Photuris*, female are aggressive mimics that answer the signals of males of other species of fireflies. Buschman (1974) observed predation of *Photuris fairchildi* females on males of *Pyraclomena borealis* and *Pyraclomena linearis* and also observed a male *Photinus ardens* being lured by a *Photuris fairchildi* female.

**Table 1.** Lampyridae fauna of Atlantic Canada.

	NB	PE	mNS	CB	NF	LB	Distribution in Northeastern North America
<b>Lampyrinae</b>							
<b>Cratomorphini</b>							
<i>Pyractomena angulata</i> (Say)	1	1	1	1			CT, ME, NB, NH, NS, ON, PE QC, RI
<i>Pyractomena borealis</i> (Randall)	1		1	1			CT, MA, ME, NB, NH, NS, ON QC, RI
<i>Pyractomena linearis</i> LeConte	1		1	1			MA, ME, NB, NH, NS, ON, QC
<b>Photinini</b>							
<i>Ellychnia corrusca</i> (Linnaeus)	1	1	1	1	1	1	CT, LB, MA, ME, NB, NF, NH NS, ON, PE, QC, RI, VT
<i>Lucidota atra</i> (Olivier)	1	1	1	1			CT, ME, NB, NH, NS, ON, PE QC, RI, VT
<i>Phosphaenus hemipterus</i> (Goeze) †			1				NS, ON, QC
<i>Photinus aquilonius</i> Lloyd			1				MA, ME, NS, ON, QC
<i>Photinus ardens</i> LeConte	1		1				CT, MA, ME, NB, NH, NS, ON QC, RI
<i>Photinus obscurellus</i> LeConte	1	1	1	1		1	CT, LB, MA, ME, NB, NH, NS ON, PE, QC, RI
<i>Pyropyga decipiens</i> (Harris)	1	1	1	1			CT, MA, ME, NB, NH, NS, ON PE, QC, RI, VT
<i>Pyropyga nigricans</i> (Say)	1						CT, ME, NB, NH, ON, QC
<b>Photurinae</b>							
<i>Photuris fairchildi</i> Barber	1	1	1	1			ME, NB, NS, PE
Total	10	6	11	8	1	2	

† = adventive Palaearctic species.

**NOTE:** NB = New Brunswick; PE = Prince Edward Island; mNS = mainland Nova Scotia; NF = insular Newfoundland; LB = Labrador. Distribution in northeastern North America: ON = Ontario; PM = Saint-Pierre et Miquelon; QC = Québec; CT = Connecticut; MA = Massachusetts; ME = Maine; NH = New Hampshire; NY = New York; RI = Rhode Island; and VT = Vermont.

## DISCUSSION

The present survey reveals that since the time of McNamara's (1991) compilation, nine new provincial records have been added to the region's provincial faunal lists. Additionally, *Pyractomena borealis*, *Pyractomena linearis*, and *Photinus obscurellus*, are all newly recorded on Cape Breton Island, and *Photinus obscurellus* and *Ellychnia corrusca* are newly recorded in Labrador. *Photuris pennsylvanica*, is removed from the faunal list of all the provinces of Atlantic Canada, and *Photinus ardens* is removed from the faunal list of Newfoundland and Labrador. Overall, one species, *Photinus obscurellus*, has been added to the Atlantic Canadian

faunal list, and one species, *Photuris pennsylvanica*, has been removed from the regional fauna list in the past two decades. Of the 12 species found in Atlantic Canada, 11 are native, whereas one, *Phosphaenus hemipterus*, is an adventive Palaearctic species found in Nova Scotia.

Eleven species are known from the mainland Nova Scotia, ten from New Brunswick, eight from Cape Breton Island, six from Prince Edward Island, one from insular Newfoundland, and two from Labrador (Table 1). Many species are widely distributed in the Maritime Provinces. Six, *Pyractomena angulata*, *Ellychnia corrusca*, *Lucidota atra*, *Photinus obscurellus*, *Pyropyga decipiens*, and *Photuris*



**Table 2.** Summary of biology of Atlantic Canadian Lampyridae.

	Habitat	Diel activity	Annual cohorts	Adult diet	Larval diet	Luminescence
<b>Lampyrinae</b>						
<b>Cratomorphini</b>						
<i>Pyractomena angulata</i>	coniferous forests	nocturnal	1	does not feed	gastropods	neurologically precise
<i>Pyractomena borealis</i>	deciduous & mixed forests	nocturnal	1	does not feed	gastropods	neurologically precise
<i>Pyractomena linearis</i>	marshlands-pastures	nocturnal	1	does not feed	gastropods	neurologically precise
<b>Photinini</b>						
<i>Ellychnia corrusca</i>	coniferous & deciduous forests	diurnal	2	sap flows	soft-bodied invertebrates	non-bioluminescent
<i>Lucidota atra</i>	coniferous & deciduous forests	diurnal	1	pollen? nectar?	soft-bodied invertebrates	non-bioluminescent
<i>Phosphaenus hemipterus</i>	rock walls adjacent to fields	diurnal	1	does not feed	earthworms	weakly-bioluminescent
<i>Photinus aquilonius</i>	marshlands	nocturnal	1	does not feed	earthworms	neurologically precise
<i>Photinus ardens</i>	marshlands-pastures	nocturnal	1	does not feed	earthworms	neurologically precise
<i>Photinus obscurellus</i>	wet pastures	nocturnal	1	does not feed	earthworms	neurologically precise
<i>Pyropyga decipiens</i>	marshlands, moist habitats	diurnal	1	? earthworms & gastropods		non-bioluminescent
<i>Pyropyga nigricans</i>	marshlands, moist habitats?	diurnal	1	? earthworms & gastropods		non-bioluminescent
<b>Photurinae</b>						
<i>Photuris fairchildi</i>	marshlands, wet forests	nocturnal	1	other lampyrids	omnivorous	neurologically precise

*fairchildi* – one in each of the six native genera – are found throughout the Maritime Provinces. *Pyractomena borealis* is almost equally widely distributed, being absent only from Prince Edward Island. *Pyractomena linearis* and *Photinus ardens* appear generally distributed, although relatively uncommon (Figure 7), on the Nova Scotia mainland, but records in other areas are few to nonexistent. *Photinus aquilonius* has not been found beyond a couple of localities in south-central Nova Scotia, and *Pyropyga nigricans* has only been found in northwestern New Brunswick. The introduced *Phosphaenus hemipterus* is known from only three localities in Nova Scotia, but should be sought in other seaport locales in Atlantic Canada.

*Ellychnia corrusca* is by far and away the most abundant species in the region, comprising 53% of the specimens collected in the Maritime Provinces (Figure 7). It is also distinctive within the regional fauna being the only species that has two annual cohorts, the first appearing between the beginning of May and the middle of July and reaching a peak in the first half of June, and the second between the middle of August and the middle of October, reaching a peak in mid-September (Figure 10). Other lampyrids found in the region have only a single annual cohort (Figures 3 & 10).

Table 2 provides a brief summary of some aspects of the biology of Atlantic Canadian Lampyridae and gives some indication of the way in which environmental resource partitioning is allocated within the members of this family in the region. Although there is considerable

overlap, it is clear that there are aspects of the bionomics of the species that differentiate them. For example, of nocturnally active lampyrids, *Pyractomena* spp. larvae feed on gastropods whereas *Photinus* species specialize in feeding on earthworms. The larvae of *Photuris fairchildi* are omnivorous. Within *Pyractomena*, *Pyractomena angulata* favours coniferous forests, *Pyractomena borealis* mixed and deciduous forests, and *Pyractomena linearis* is found in marshlands and pastures. Amongst diurnally active species, *Ellychnia corrusca*, with two annual cohorts, and *Lucidota atra*, with one annual cohort, are found in forested environments; *Pyropyga* species in marshlands and wet forests; the adventive *Phosphaenus hemipterus* is found in open habitats. There is certainly more to be learned about the biology of lampyrid species, the niches that they occupy, and the degree to which competitive exclusion is a factor in their ecology.

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## A Key to Species of Lampyridae Found in Atlantic Canada [adapted from Lloyd (2002) and Luk et al. (2011)]

1. Anterior claws of pro-and meso-tarsi bifid (two-pronged) (Photurinae) .....2  
 – Anterior claws of pro-and meso-tarsi simple (Lampyrinae) .....3
- 2(1). Body length 9.0–10.0 mm; body width 3.0–3.5 mm; antenna relatively short (~4.2 mm); head white ..... *Photuris pennsylvanica*  
 – Body length 10.2–13.1 mm (in 95% of specimens, 10.9–12.2 mm); body width 3.6–4.2 mm; antenna relatively long (~6.0 mm); frons white, vertex brownish under pronotum (Fig. 22) .....  
 ..... *Photuris fairchildi*
- 3(1). Elytra very short leaving at least five abdominal tergites exposed, all strongly, laterally lobed (Fig. 14) [length 7.0–10.0 mm] ..... *Phosphaenus hemipterus*  
 – Elytra covering all or most of abdomen, abdomen not or only slightly lobed .....4
- 4(3). Light organ (pale enamel-like cuticle) present on one or two abdominal ventrites .....5  
 – Light organ completely absent or merely a small median spot on one ventrite .....10
- 5(4). Median line of pronotum with a distinct though low ridge along most or all of its length; pronotum sub-pentagonal (*Pyractomena*) .....6  
 – Median line of pronotum without such a ridge, instead flat or with a shallow, often discontinuous groove; pronotum not distinctly sub-pentagonal (*Photinus*) .....8
- 6(5). Form broad, 2.3–2.7 times as long as wide; elytron dark .....7  
 – Form narrower, 2.6–2.9 times as long as wide; elytron pale (Fig. 5) [length 7.5–11.0 mm] .....  
 ..... *Pyractomena linearis*
- 7(6). Pale lateral borders of elytron wide, broadening basally; epipleuron pale; femora pale basally (Fig. 1) [length 7.5–14.0 mm] ..... *Pyractomena angulata*  
 – Pale lateral borders of elytron narrow throughout, sometimes obliterated; epipleuron dark, at least basally; femora uniformly dark (Fig. 4) [length 12.0–18.0 mm] ..... *Pyractomena borealis*
- 8(5). Apex of pygidium tapered to a narrowly rounded point .....9  
 – Apex of pygidium truncate or broadly rounded (Fig. 15) [length 5.8–8.9 mm] .....  
 ..... *Photinus aquilonius*
- 9(8). Pale; pronotum always with distinct median stripe and pale lateral margin; pale borders of elytron diffuse (Fig. 17) [length 7.0–12.5 mm] ..... *Photinus ardens*  
 – Dark; pronotum with diffuse (usually) or distinct (infrequently) median stripe and lateral margins pale, varying to dark, appearing darker overall than in previous species; pale borders of elytron well-defined (Fig. 18) [length 7.0–12.0 mm] ..... *Photinus obscurellus*

- 10(4). Second antennomere longer than wide; pronotal vitta typically parenthesis-shaped; elytral pubescence golden-coloured (Fig. 6) [length 6.0–13.0 mm] ..... *Ellychnia corrusca*  
 – Second antennomere broader than long; pronotal vitta not parenthesis-shaped; elytral pubescence dark.....11
- 11(10). Antennae strongly compressed and serrate; light organs reduced to small median spots on the apical ventrites (Fig. 12) [length 8.0–11.5 mm] ..... *Lucidota atra*  
 – Antennae weakly compressed, light organs entirely absent (*Pyropyga*) .....12
- 12(11). Pronotum usually with a dark border (Fig. 21); lateral lobe of the aedeagus no more than one third of the total length of the aedeagus with inner dorso-basal processes; median lobe of the aedeagus straight with sinuate inner margin; median lobe reaching the tip of the lateral lobes [length 4.2–8.5 mm] ..... *Pyropyga nigricans*  
 – Pronotum often with pale border (Fig. 19); lateral lobe of the aedeagus exceeding half the total length of the aedeagus, expanded apically and lacking inner dorso-basal processes; median lobe of the aedeagus decurved, rounded apically, and not reaching the tip of the lateral lobes [length 4.5–7.2 mm] ..... *Pyropyga decipiens*