

## The Fireflies (Coleoptera: Lampyridae) of British Columbia, with special emphasis on the light-flashing species and their distribution, status and biology

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### ABSTRACT

In British Columbia the family Lampyridae (fireflies) is poorly known. Ten species in five genera are recorded but adults of only two species produce flashed bioluminescent signals. Before 1997, museum collections that we examined held specimens of only one flashing species from three BC localities, despite recent and widespread reports of flashing fireflies in the province. A solicitation of specimens and sight records from entomologists and naturalists resulted in the discovery of 14 additional collection localities for the two species. Sight records are summarized but are not recorded in detail. As far as is known, *Photuris pennsylvanica* (DeGeer) (*sensu lato*), is restricted in BC to the southern Rocky Mountain Trench (East Kootenay region). *Photinus obscurellus* LeConte, herein recorded in BC for the first time, is widespread in the northeast, central and southern Interior of the province. This paper briefly summarizes the BC lampyrid fauna, examining the status, distribution and biology of the two flashing species in more detail.

**Key Words:** Lampyridae, fireflies, flashing species, *Photuris*, *Photinus*, British Columbia, distribution, identification

### INTRODUCTION

Beetles of the family Lampyridae (fireflies) are poorly known in British Columbia (BC). McNamara (1991) recorded nine species in four genera, but adults of only one of these species produce flashing signals. This paper briefly summarizes the BC lampyrid fauna but examines, in more detail, the status of the two flashing species, one in each of the genera *Photuris* LeConte and *Photinus* Laporte, now known to occur in BC. One of these species is recorded in the province for the first time.

Adults of nocturnal bioluminescent species use their flashed signals in courtship. Characteristics of these signals, such as flash number, flash duration and the inter-

val between flashes, are important in species recognition but, in some cases, such as in *Photuris*, are still not completely reliable for identification (Lloyd and Branham in press, Branham and Greenfield 1996, J.E. Lloyd pers. comm.). These beetles are chemically defended and, when handled or attacked, often exude defensive compounds from the body, especially the elytra (Eisner *et al.* 1978). As larvae, many lampyrid species are soil dwelling predators that eat insects, snails, worms and other invertebrates, while others are arboreal or aquatic and feed on snails (LaBella and Lloyd 1991). *Photinus* larvae are subterranean, seldom observed, and may specialize on eating

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earthworms; *Photuris* larvae are surface dwelling, omnivorous predators and scavengers of dead insects and fallen berries (Buschman 1984, Lloyd 2002). All lampyrid larvae have a luminous organ on abdominal segment 8 (Lloyd 2002); light production warns predators that these larvae are distasteful (Sivinski 1981, De Cock and Matthysen 2003).

Adults of the best known BC fireflies are diurnal, non-flashing species. These taxa use pheromonal communication for pair formation (Lloyd 2002, Branham and Wenzel 2003). *Ellychnia* Blanchard is the most diverse genus in BC with five species: *E. corrusca* (Linnaeus) (widespread), *E. facula* LeConte (Okanagan, central coast), *E. greeni* Fender (southern Interior), *E. hatchi* Fender (widespread on coast), and *E. lacustris* LeConte (Terrace). All but *E. corrusca*, which is transcontinental, are restricted in Canada to BC (McNamara 1991). *Phausis nigra* Hopping (southern Interior) is unknown outside BC but *Phausis rhombica* Fender (southern Interior) is also known from Alberta (McNamara 1991), Washington and Oregon (Fender 1961) and Montana (M.A. Branham pers. obs.) -- both are Cordilleran species. *Pyrogyga nigricans* (Say) (southern Interior) ranges from BC east to the Atlantic Ocean (McNamara 1991).

Before this study, collections of flashing

lampyrid adults in BC were rare. The only literature records for BC are a reference to *Photuris pennsylvanica* (DeGeer) in south-eastern BC (Fender 1961) and a subsequent inclusion of the species in the BC fauna by McNamara (1991). These references evidently refer to collections in 1928 and 1958 (in RBCM and UBC collections, respectively [see Specimens Examined]). Sightings of flashing fireflies, beginning in 1996 in the central and south-central Interior of the province, where no such species had been collected before, stimulated two of us, Cannings and McVickar, to solicit specimens and sight records of flashing beetles from the BC naturalist and entomological communities by word of mouth and through various newsletters (Cannings 1999).

In 2010, an additional extensive compilation of observations made by naturalists, ranchers and others in the East Kootenay region was organized by the Columbia Wetlands Stewardship Partners (Jamieson 2010). This study, motivated by plans to promote fireflies as iconic wetland inhabitants and as a focus for conservation and wetland education, improved our knowledge of the distribution of *Photuris* in the area. No specimens were collected. The survey covered the East Kootenay Trench from the US border to Donald, (north of Golden), a distance of about 345 kilometres.

## RESULTS AND DISCUSSION

### Specimens examined

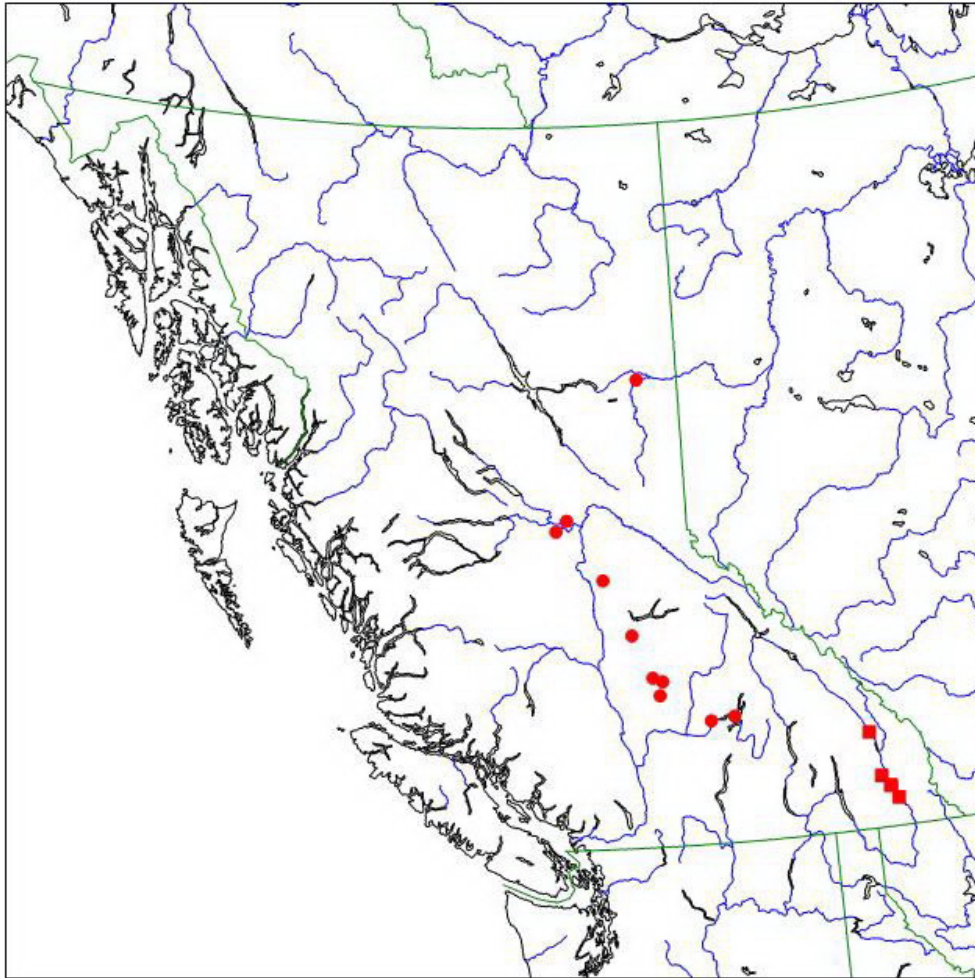
Specimens received by the RBCM were identified by Marc Branham and James Lloyd and are listed below along with those examined from museum collections (see also Fig. 1).

Museum collection abbreviations: CNC -- Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, ON; PFC -- Pacific Forestry Centre, Victoria, BC; RBCM -- Royal British Columbia Museum, Victoria, BC; UBC -- Spencer Entomological Collection, Beaty Biodiversity Museum, University of BC, Vancouver, BC. There are no BC specimens of *Photuris*

or *Photinus* in the E.H. Strickland Entomological Museum, University of Alberta, Edmonton AB, the Oregon State Arthropod collection, Oregon State University, Corvallis, OR or the California Academy of Sciences, San Francisco, CA, the museum that contains much of the Ralph Hopping and Hugh Leech beetle collections (including considerable BC material) and thus the US collection most likely to house significant numbers of BC beetles.

*Photuris pennsylvanica* (DeGeer 1774)

CANADA, BC, Fort Steele, 16.vi.1958, R.J. Andrews (8♂, UBC); Fort Steele, 25.vi.1959, Forest Insect Survey (41♂



**Figure 1.** Distribution of *Photuris pennsylvanica* (■) and *Photinus obscurellus* (●) in British Columbia as represented by specimens.

caught in flight, UBC; 4♂ caught in flight, RBCM); Fort Steele, CP railway tracks, south yard switch, 30.vi.1998, Greg Ross (3♂, RBCM); Haha Creek, between Haha Creek Rd. and Haha Creek, 11.vii.1998, Greg Ross (2♂, RBCM); Ta Ta Lake, 18.vi.1958, E.K. White (3♂, UBC); Windermere, 27.vi.1928, W.B. Anderson (1♂, RBCM).

*Photinus obscurellus* LeConte 1852

CANADA, BC, Bednesti Lake (53°51'11"N x 123°22'07"W), 30.vi.2007. R.V. Rea (1♂, RBCM); Bonaparte Lake, 17 km W at Moose Lake (51°18'14"N x 120°55'44"W), 15.vii.1997, Joe Cortese (1♀, PFC, with photos, Fig. 2). Fort St.

John, 20 km SW (56° 06'37"N x 121°04'59"W), 4.vii.2009, Mark Phinney (6♂, 1♀, RBCM); Fort St. John, 20 km SW (56° 06'47"N x 121°05'19"W), 4.vii.2009, Mark Phinney (3♂, RBCM); Horsefly, swamp 6 km S of Bells Lake, 3.vii.2002, Marcus Charles (1♂, RBCM); 100 Mile House, Horse Lake, Fawn Creek Rd., 10.vii.2002, Pat Griffin (4♂, RBCM); Prince George, Ness Lake, 9690 Anne Rd., 10.vii.1999, Marie Pearson (1♂, RBCM); Quesnel, Beryl Rd. (52° 57'22"N x 122°26'34"W), 10.viii.2010, Clint Tibideau (1♂, RBCM); Quesnel, Cottonwood House (53°05'20"N x 122°12'45"W), 13.vi.2005, John Massier (1♀, RBCM); Sheridan Lake,



**Figure 2.** *Photinus obscurellus* (♀): left, dorsal view; right, ventral view. Scale lines are 1 mm apart. Specimen photographed at Pacific Forestry Centre by Bob Duncan. Collected by Joe Cortese at Moose Lake, 17 km west of Bonaparte Lake (51°18'14"N x 120°55'44"W) on 15 July 1997 (Males look similar but have light-producing organs covering the 5<sup>th</sup> and 6<sup>th</sup> visible ventral segments (true abdominal segments VI and VII)).

vii.2003, Frank McFadden (4♂, RBCM); Shuswap Lake, Eagle Bay, Herman Lake, N end (50°55'08"N x 119°09'45"W), 24.vi.1997, Dawn Kellie (3♂, RBCM); same locality and date, Dennis St. John (4♂, RBCM); same locality and date, R.H. McVickar (2♂, RBCM; 1♂, CNC); same locality, 10.vii.1996, R.H. McVickar (2♂, RBCM); Skmana Lake, 7.vii.1998, R.H. McVickar (1♂, RBCM).

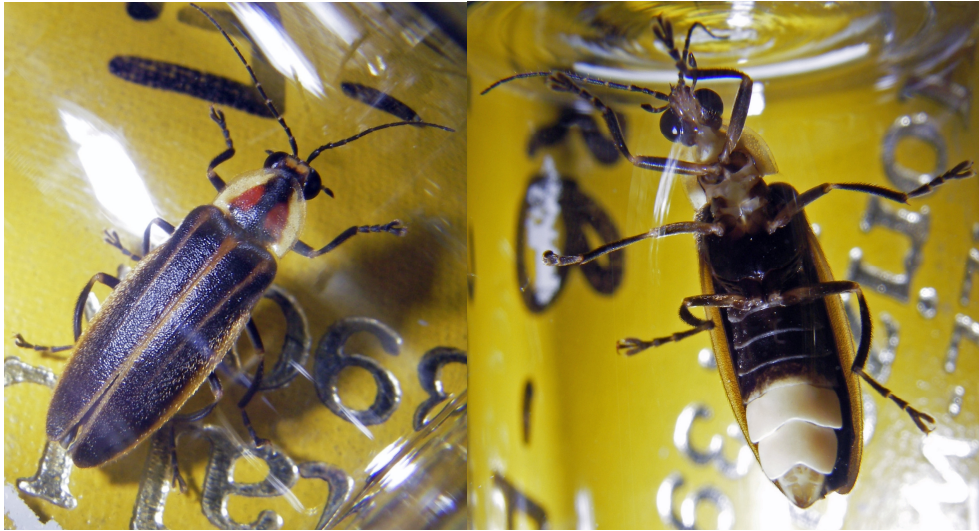
#### Sight records

In addition to the collections and associated observations listed above, numerous sightings of flashing fireflies were reported by 40 respondents across the province. Sixteen people participated in the 2010 survey in the East Kootenays; observations included direct sightings as well as hearsay, past and present. Some recent sightings included exact coordinates and dates or even photographs; others were less precise. Unless an observer is experienced, sightings of flashing fireflies are difficult to assign to species, and most of the sight records gathered were not verified by voucher specimens. For these reasons and because, for the most part, collected specimens fall within the known distributions of the two flashing species in BC (Fig. 1), sight records are not listed in detail. They do, how-

ever, support the notion that these beetles are not rare and that their populations, especially those of *Photinus*, are widespread. We have reports from two areas outside the generally known ranges of *Photuris* and *Photinus* in BC. There are three from the West Kootenay region (two in the Nelson area, one near Trout Lake) (Jakob Dulisse, pers. comm.). Nelson is not far from the Cranbrook populations of *Photuris*, but the two areas are separated by extensive mountainous terrain. Trout Lake is closer to the Shuswap region where *Photinus* is found. Three other unsubstantiated reports come from Vancouver Island (Campbell River, Parksville, Sidney) (R.A. Cannings, unpubl. data) but there are no others from the BC coast and no specimens have been seen or reported from west of the Coast Mountains.

#### *Photuris pennsylvanica*

Before the 2010 survey, sightings were reported from nine localities in the East Kootenay region (some the same as specimen localities), all presumably for *Photuris*. Dates range from 1966 to 2008 and localities range from Canal Flats south to Haha Creek and the Bull River Fish Hatchery near Wardner. Photographs of specimens (no vouchers collected) accompany the record documented by Barb Houston at



**Figure 3.** *Photuris pennsylvanica* (♂): left, dorsal view; right, ventral view. Live male specimen photographed in vial by Barb Houston at Bummers Flats, north of Cranbrook (49°39'20"N x 115°40'29"W) on 19 June 2008.

Bummers Flats (49°39'20"N x 115°40'29"W) on 19.vi.2008 (Fig. 3). In the 2010 information survey, 16 additional localities were reported, ranging from Brisco in the north to Newgate near the US border in the south. Most of these observations were actually made in earlier years but seven were of fireflies seen in 2010. However, only three of these records represent sites not recorded before 2010 (Jamieson 2010).

#### *Photinus obscurellus*

About 20 of the sight records reported came from within the known range of *Photinus obscurellus*; they are assumed to be of this species. Even as long ago as the 1920s, anecdotal records from localities as far apart as Enderby, Prince George and the Kiskatinaw River in the Peace River region embraced the present known latitudinal range of the species. Other general areas represented are Prince George north to McLeod Lake, Quesnel and the Shuswap region. The most westerly sightings range from Vanderhoof in the north, to Nazko Lakes Provincial Park (Pynn 1996) on the Chilcotin Plateau, to the Carpenter Lake area in the south.

#### **The identification of *Photuris* and *Photinus* in BC**

Adults of the two known species of flashing fireflies in BC can be distinguished from the other lampyrids in the province by the presence of pale, light-producing organs on the underside of the abdomen (Figs. 2, 3). They completely cover the 5th and 6th visible ventral segments in males but form a more restricted band in females.

These species can be separated from each other by the structure of the fore and mid tarsal claws -- in *Photuris* these claws are bifid (one of the two claws is "split") while those of *Photinus* are simple (Lloyd 2002). In *Photuris*, the legs are long and slender (Fig. 3); in *Photinus* they are shorter and more flattened (Fig. 2).

With few exceptions, North American *Photuris* cannot be accurately identified to species using either morphological or flash pattern characters. Although the morphology and scarce behavioural observations that are available for *Photuris* specimens collected in BC are consistent with characteristics of *Photuris pennsylvanica* (J.E. Lloyd, pers. comm.), this identification should not be considered more than a convenient and useful referent and working designation. Nevertheless, we are using the name here because it is already in use for the BC records (Fender 1961, McNamara

1991) of *Photuris*.

An understanding of the complex taxonomic history of *Photinus obscurellus* is useful for those attempting to identify Nearctic *Photinus* specimens. LeConte (1852) described the species but in his synopsis (LeConte 1881) he considered it a synonym of *Photinus ardens* LeConte. Lloyd (1966), describing the behaviour of *Photinus ardens* (p. 47-49), is actually referring to *Photinus obscurellus*; at the time he was following LeConte (1881) and Green (1956). But his field studies later revealed that *Photinus obscurellus* deserved formal recognition, and in 1969 he described the flashing behavior of the true *Photinus ardens* and restored *Photinus obscurellus* to species status (Lloyd 1969). Because *Photinus obscurellus* was treated as a synonym of *Photinus ardens* in Green's (1956) widely used identification key, specimens of *Photinus obscurellus* in museum collections are almost always misidentified as *Photinus ardens*.

#### Behaviour and habitat

##### *Photuris pennsylvanica*

We have little information on details of the behaviour of *Photuris pennsylvanica* in southeastern BC. Six collection records in the East Kootenay region range from 16 June to 11 July; sight records extend this period only one day earlier. At Haha Creek on 11 July 1998 Greg Ross collected two specimens and noted that individuals irregularly produced a 1-second flash every 8 or 9 seconds.

Jamieson (2010) notes that in the East Kootenays, the species inhabits pothole wetlands on the benches of the main valley (Hahas, Ta Ta, Butts and Cub Lakes) as well as the wetlands along the major rivers -- the Kootenay (Fort Steele, Bummers Flats, and so on) and the Columbia (Canal Flats, Luxor Creek, Brisco areas). These habitats are typically associated with springs or small creeks that flow year-round. The springs sometimes emerge in the bottom of wetlands or ponds.

##### *Photinus obscurellus*

In BC, 14 collection records range from 13 June to 10 August; the latter date is a

month later than any others. At Herman Lake near Shuswap Lake, McVickar recorded flashing in May 1996 and it continued for six weeks. In 1997 the onset was later but continued into July and was not finished by 8 July. The site is a cattail (*Typha latifolia* Linnaeus) marsh bordering a small lake about 250 m long; the fireflies mostly flash in and above the cattails but are active up to 250 m inland from the marsh. The first flashes appear when the last light is fading but the full performance commences during complete darkness, about midnight in June. Before the onset of the full flashing display there appears to be a warm-up period, which begins before the onset of full darkness. Females emit as many as 7 or 8 flashes in quick succession. Males settle into a pattern of two or three flashes produced while flying in a straight line followed by another flash given on a curved flight path. The most common pattern is: flash, flash, curving flash. Females settle into a pattern of single flashes given at considerable intervals.

On warm nights between 1 and 21 July 2002 near Horse Lake in the Cariboo, about 15 insects at a time flew and flashed. Specimens were collected on 10 July about 22:15 PDT, just after dark (Pat Griffin, pers. comm.). Marie Pearson (pers. comm.) observed at least 100 fireflies (and collected one) flashing at 23:30 PDT near Ness Lake northwest of Prince George on 10 July 1999. The habitat consisted of a small, spring-fed marsh, flooded in spring but only moist in summer; typical ground cover is moss, willows (*Salix* spp.), Buckbean (*Menyanthes trifoliata* Linnaeus) and Bog laurel (*Kalmia microphylla* (Hook.) Heller). In 1997, *Photinus obscurellus* individuals were active between mid-July and 5 August; the Pearsons have seen them there since 1983.

In the Peace River region near Fort St. John, Mark Phinney collected specimens in sedge meadow wetlands within a forested landscape from 00:30 to 01:15 MDT on 4 July 2009. At one site about 25 were flashing, not flying, but perched on the tops of willows and sedges. The signals usually

consisted of two long flashes, each about 2 seconds in duration, separated by about 1 second. The time between these sessions was variable and seemed affected by the flashes of neighbours.

#### **Distribution and status**

##### *Photuris pennsylvanica*

Species of *Photuris* range from Canada to Argentina, with 22 known species in North America and 28 new species descriptions in preparation (J.E. Lloyd, pers. comm.). They range mostly in the eastern United States, west to Colorado and south-west Texas (Lloyd 2002).

As mentioned above, no detailed statement can be made about the geographical distribution of *Photuris pennsylvanica*, as the majority of “determined” specimens in collections are questionably identified. The six BC collection records from the Kootenay and Columbia valleys range from Windermere in the north to Haha Creek in the south (Fig. 1). Sight records extend this almost linear distribution in the Rocky Mountain Trench from Brisco in the north to Newgate in the south. In general, according to the anecdotal information gathered from residents in the region, populations probably have declined in the past several decades. Specimen and sight records come from 25 localities between 2001 and 2010, while at 10 additional sites, beetles have not been seen since they were reported between 1950 and 2000 (Jamieson 2010).

Because the genus needs revision based on behavioural, morphological and molecular data and because the flash patterns of the BC species have not been studied, the specific identity of the BC population remains provisional at this time.

##### *Photinus obscurellus*

Species of *Photinus* range from Canada to Argentina, with 34 described species in North America and an additional 13 known but undescribed (J.E. Lloyd, pers. comm.). The genus is widely distributed on the continent but there are only scattered populations west of Texas and Kansas (Lloyd 2002).

*Photinus obscurellus* ranges from Newfoundland, Nova Scotia, New Brunswick

and Maine through southern Quebec and Ontario west to North and South Dakota, Manitoba and Saskatchewan (Lloyd 1969, unpublished CNC data) with an outlying population in BC. We are unaware of any collection records from Alberta, Washington, Idaho or Montana. In BC the species appears restricted to the Peace River region and the central Interior from about Mackenzie south to the Shuswap Lake area (Fig. 1). A sight record of this species extends the range west to the central Chilcotin.

The dates of all BC collections of *Photinus* range from 1996 to 2010, the result of the present study aided by the BC naturalist community. Why no specimens were collected before this time is a mystery because many entomologists have collected insects in central BC over the last century. Canning has never seen a flashing firefly in BC despite having a strong interest in insects in the province for almost 50 years; until the present project was begun, he had never heard of any reports from the central Interior. Why did Ralph Hopping, Hugh Leech or James Grant, all avid, professional coleopterists working at various times between about 1920 and 1980 within the southern part of the present range of *Photinus obscurellus*, apparently never collect any? On the other hand, as reported above, the population of *Photuris* in the East Kootenays was known from collections as far back as 1928.

A lack of collections might be attributed in part to a lack of communication between residents and entomologists interested in these beetles. When directly asked in this study, naturalists and ranchers responded with numerous memories of flashing fireflies as far back as the 1920s in the Shuswap, Prince George and Peace River regions, but professional entomologists may not have heard such accounts.

Although a reason for the significant separation of *Photinus* records between northern Saskatchewan and northeastern BC (approximately 800 km) might be lack of collecting in this geographical gap, this hiatus and the historical lack of specimens

from BC have suggested to some that *Photinus obscurellus* might be recently introduced to BC from the East. However, the widespread distribution of the species in BC and the newly reported sight records in the province from many areas over many decades indicate that this is unlikely. It is possible that the beetle arrived in BC via the railways and was somehow helped in its spread by various railway lines. Even today, most of the sightings and collection records occur within 30 km of a railway. Similarly, in the East Kootenay region of southeastern BC, *Photuris pennsylvanica* apparently inhabits wetlands of the Rocky Mountain Trench, about 220 km from north to south, with all records close to railway tracks. Members of this genus exhibit a very patchy distribution in western North

America; this or other species of *Photuris* also occur in Montana, just southeast of the BC population (M. Ivie, pers. comm.). The apparent association between these firefly distributions and railway lines is interesting and raises several points for consideration. Wetland habitats are commonly situated in valleys where many railroads are located. In addition, the presence of a railroad berm and the additional weight it applies to the surrounding soil might be in part responsible for the creation of new wetland habitat (M. Ivie, pers. comm.).

We hope this paper stimulates future systematic, ecological and behavioural research on these firefly populations and that more targeted studies are able to evaluate hypotheses concerning these interesting distribution patterns.

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