

FIREFLY SPECIES FACT SHEET
Belted firefly (*Photuris cinctipennis*)



Photo of adult male Photuris cinctipennis by [Roshan Vignarajah](#), CC BY-NC 4.0.

May 2024

Richard Joyce
Xerces Society for Invertebrate Conservation



Scientific Name:

Photuris cinctipennis Barber, 1951

Phylum: Arthropoda

Class: Insecta

Order: Coleoptera

Family: Lampyridae

Subfamily: Photurinae

Tribe: Photurini

Synonyms: None

(ITIS, 2023)

Common Name(s):

Belted firefly; Flicker Mother(Lloyd, 2018)

Taxonomic Note:

North American *Photuris* are difficult to identify, with positive ID depending on a combination of morphological characters (not aedeagus) and male courtship flash patterns (Lloyd, 2018). *Photuris cinctipennis* is a member of the *versicolor* group of *Photuris* species (McDermott, 1967), which contains many closely related and morphologically similar species that are largely differentiated based on male courtship flash patterns.

In his 2018 monograph on *Photuris* of North America, Lloyd informally placed *Photuris* species into groups based on their flash patterns and appearance (Lloyd, 2018). The “Cinctipennis Group” also includes *Photuris branhami* and *Photuris whislerae*, species in Florida and the southeast with pale hind coxae that were both described by Lloyd.

Conservation Status:

Global Status: G1- Globally Imperiled

National Status (United States): NNR — Not ranked

State Statuses: S4- Apparently Secure (DE); SNR (MD)

(NatureServe Explorer/Fallon, Walker, and Heckscher 2021)

Species of Greatest Conservation Need: Delaware, Tier 2 (Delaware Division of Fish and Wildlife, 2015)

IUCN Red List: Endangered

(Fallon et al., 2021)

Technical Description:

Adult: The overall appearance of *Photuris cinctipennis* is similar to that of other *Photuris* in the *versicolor* group (McDermott, 1967), with a hunched posture, long legs, and a central, narrow dark marking on the pronotum bounded by red or orange spots (Figure 1a). Dissection of adult male genitalia, which can often help with species-level identification in morphologically similar species, does not yield enough differentiation in this group to confidently assign identifications.

In his description of the species, Barber wrote, “The small size[11-12 mm], almost wholly white legs, white elytral epipleura, deep black elytral disc, broad pale elytral margins, and usually total absence of oblique median pale vitta make this form conspicuously distinct in collections” (1951). (See Figures 1a and 1b.)

Other distinctive morphological traits noted by McDermott (1967) include the following:

- Dark brown elytra with pale wide lateral margins and narrow sutural margins
- Dark brown elytra with unusually acute apices (Figure 1b)
- Pale margin on first 4 visible sternites
- White frons
- Dull white labrum with brown edge, a median point and two dull lateral denticles (Figure 2).

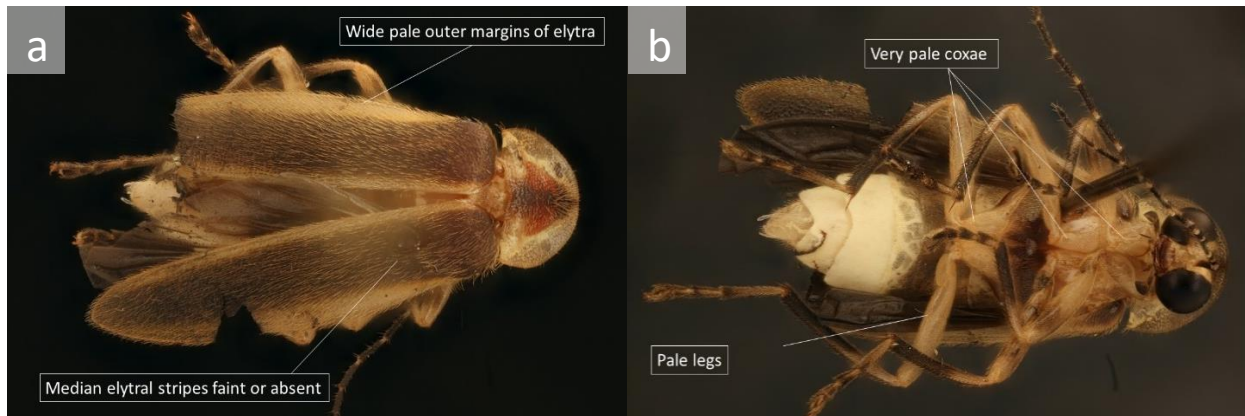


Figure 1. (a) Dorsal view of *Photuris cinctipennis* specimen. (b) Ventral view of *P. cinctipennis* specimen. Photos by [Roshan Vignarajah](#), CC BY-NC 4.0, annotated by Richard Joyce.



Figure 2. Photo by [Roshan Vignarajah](#), [CC BY-NC 4.0](#), cropped and annotated by Richard Joyce.



Figure 3. Views of a male *Photuris cinctipennis* from Sussex County, Delaware. Median pale elytral vittae are present, but short and faint. Photos courtesy of Christopher Heckscher.

Immature: The larvae of *Photuris cinctipennis* have not been described. *Photuris* larvae can be recognized by their flattened, oval body shape (see Figure 4), and are usually detected by the glow that they emit while foraging on the soil or leaf litter surface at night.



Figure 4. A larval *Photuris* feeds on a snail in Tennessee. (Photo by [Will Kuhn CC BY 4.0](#)).

Life History:

Flash Behavior

Unfortunately, the type specimen of *Photuris cinctipennis* is not associated with any flash pattern details other than the observation that flash patterns observed during the night of collection were brief and single (Barber, 1951). The flash pattern chart that accompanies the description shows a short, single, weak flash emitted at 4 second intervals, but this may be based more on speculation than observation (Lloyd, 2018). At a Maryland locality, Lloyd identified as *Photuris cinctipennis* a firefly that was emitting modulated (flicker) flashes at intervals of about 2.5 seconds at 77° Fahrenheit (Lloyd, 2018). Males flickered while flying low over short trees and bushes. A 2021 specimen identified as *P. cinctipennis* had been emitting a 0.33 second flash every 0.64 seconds (H. Morgan pers. comm.)

Phenology

Photuris cinctipennis has been documented as early as 24 June and as late as 27 July. Most records are from July.

Modified growing degree days (mGDD) are a measure of heat accumulation on a given date and over the course of the growing season, and are used to take seasonal variation into account when making phenology predictions (Faust and Weston 2009). In general, mGDD values of under 1000 correspond to the spring season, while values between 1000 and 1800 are early summer and values above this are summer into early autumn (Faust 2017). The accumulated mGDD values for *Photuris cinctipennis* occurrence records range from 1196 to 2366. See Figure 5 for a visual summary of phenology records in terms of day of year and mGDD.

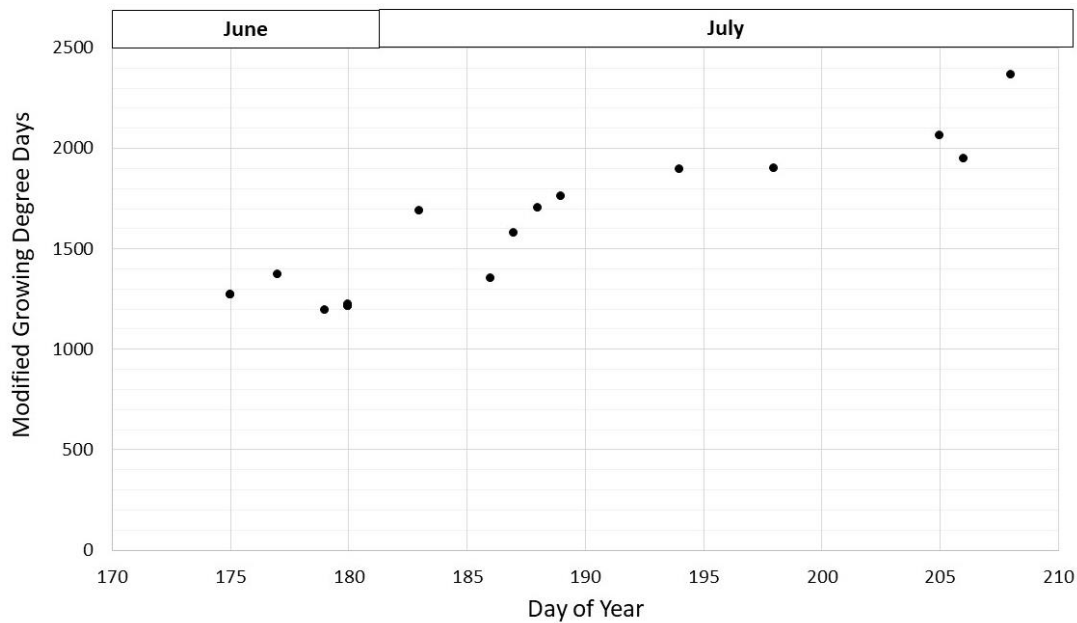


Figure 5. Visual summary of record phenology for *Photinus cinctipennis*, showing day of year on the X-axis and modified Growing Degree Days on the Y-axis. Most records are from the month of July. Day of year range is 175-208 (24 June-27 July) and mGDD range is 1196 to 2366.

Dispersal capacity

Fireflies are weak fliers and rarely disperse beyond the habitat in which they were born (Lewis, 2016), although some species, such as *Photinus signaticollis*, are capable of dispersing across large distances (Koken et al., 2022). *Photuris* fireflies in general may have greater dispersal capacity than other firefly genera due to their larger size.

Similar and co-occurring species

Photuris cinctipennis has been observed to co-occur in season and locality with *Photuris lucicrescens*, *Photuris hebes*, and *Photuris salina* (Barber, 1951). Of these, *Photuris hebes* may be the most similar in having a small size and pale hind coxae. *Photuris hebes* differs in that it has a short crescendo flash—that is, the flash increases in brightness and then stops abruptly.

Larvae and pupae

The natural history of immature stages of *Photuris cinctipennis* fireflies has not been studied. *Photuris versicolor* complex females, such as those of the *Photuris cinctipennis*, typically lay eggs a few at a time over multiple days or weeks (Lloyd, 2018). Larvae hatch in two or three weeks and go through four to seven instars over a one to two year period, diapausing over the winter (L. Faust, 2017; Lloyd, 2018). Larvae are likely active spring through fall and hunt along the soil surface, looking for soft bodied organisms such as slugs, snails, earthworms, and other invertebrates to feed on. They pupate in chambers just under the soil surface or under logs for one to three weeks and emerge as adults in early summer (Bauer et al., 2013; Lloyd, 2018).

Range, Distribution and Abundance:

Type locality: The type locality of *Photuris cinctipennis* is Sherwood Forest, Anne Arundel County, Maryland, USA, a peninsula on the west side of the Severn River (Barber, 1951).

Range: *Photuris cinctipennis* has been documented in Maryland and Delaware, on both sides of the Chesapeake Bay (Figure 6).

Distribution: *Photuris cinctipennis* was first collected in Breton Bay, Saint Mary's County, Maryland, in 1923 and was collected again not long after in Sherwood Forest, Anne Arundel County, Maryland (the type locality), in 1927. The species was not reported again until 1978, when James E. Lloyd observed and collected it at Cedarville State Forest, Prince George's County, Maryland, in 1978. In the early 2000s, multiple specimens were collected in Kent County, Delaware (Heckscher, 2010). Most recently, specimens have been collected in Prince George's County, Howard County, and Montgomery County, Maryland and in Sussex County, Delaware.

Documented

As of 2023, the belted firefly has been recorded on the following public lands:

- Milford Neck Wildlife Management Area, Kent County, Delaware
- Cedarville State Forest, Prince George's County, Maryland.
- Patuxent Research Refuge, Prince George's County, Maryland

These sites fall within the Chesapeake Rolling Coastal Plain, Delaware River Terraces and Uplands, and Delmarva Uplands Level IV Ecoregions.

Suspected

It is possible that *Photuris cinctipennis* also occurs in other Mid-Atlantic states further from the type locality, such as New Jersey, Pennsylvania, or Virginia. Table 1 provides a non-exhaustive list of public lands in Maryland that have potential as *P. cinctipennis* survey sites because of their habitats and their proximity to known localities.

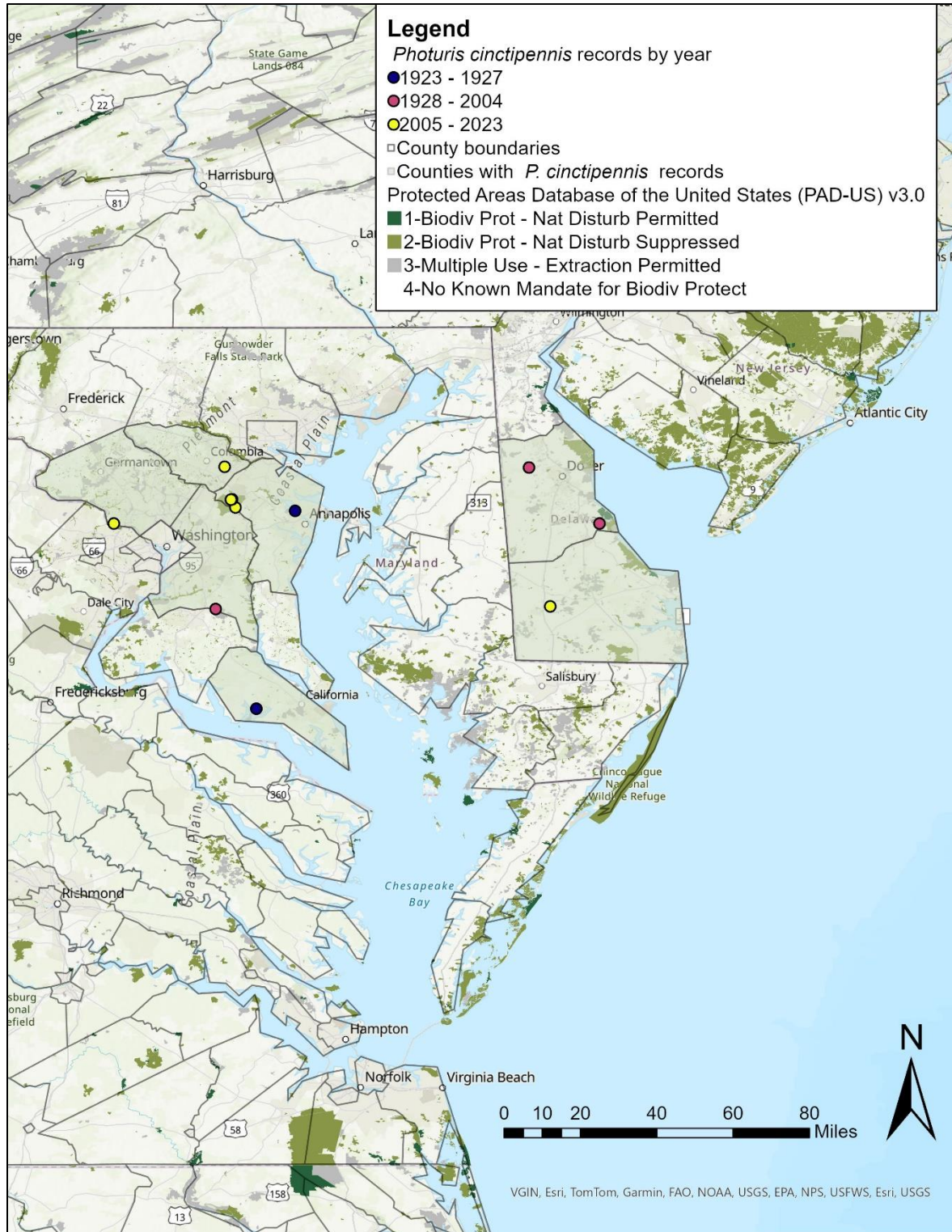


Figure 6. Map of locations where *Photuris cinctipennis* has been documented, symbolized by year recorded (oldest records are yellow and most recent records are red). Also shown, in gray and green, are protected areas by GAP status, as well as county outlines.

Table 1. Potential survey sites in Maryland for *Photuris cinctipennis*.

County	Public lands
Anne Arundel County	<ul style="list-style-type: none"> • Brewer Pond Natural Area • Sandy Point State Park • Greenbury Point Conservation Area (Department of Defense/Naval Academy) • Severn Run Natural Environment Area
Prince George’s County	<ul style="list-style-type: none"> • Patuxent River Park- Jug Bay Natural Area
Saint Mary’s County	<ul style="list-style-type: none"> • Newtowne Neck State Park • St. Mary’s River State Park • St. Mary’s State Park • Salem State Forest
Calvert County	<ul style="list-style-type: none"> • Hall Creek Natural Resource Management Area

Habitat Associations:

Photuris cinctipennis has been found in forested and shrubby habitats. The type locality, Sherwood Forest, is a now partially developed forested peninsula with mostly deciduous trees along the tidal Severn River. Other habitats where it’s been found include moist hardwood forests near waterways (Fallon et al., 2021), grassy areas near mixed deciduous forest (H. Morgan pers. comm. 2024), and in an old field overgrown with shrubs and young trees (Lloyd, 2018).

Threats:

The area where *P. cinctipennis* is known to occur, Maryland and Delaware, has lost a significant portion of its forests and wetlands to urban development and agriculture. These land cover changes may be contributing to the destruction, degradation and fragmentation of *P. cinctipennis* habitat (Fallon et al., 2021).

Pesticides pose a threat to fireflies generally through lethal and sublethal effects resulting from various exposure routes: aerial spraying, contaminated soil, runoff in waterways, and consumption of contaminated prey. Pesticide uses that are of particular concern for *Photuris cinctipennis* include aerial spraying of mosquito adulticides (often pyrethroids) and the use of neonicotinoids in soil for agricultural, landscaping, and silvicultural purposes.

Artificial light at night (ALAN, also known as light pollution) has been shown to have wide range of negative effects on insects generally (Owens et al., 2020) and fireflies specifically (Owens et al., 2022; Owens & Lewis, 2022), causing interference with courtship communication and lowering reproductive success. Because *P. cinctipennis* is nocturnal rather than crepuscular, it is particularly vulnerable to the disruption of its reproduction by ALAN.

Conservation Considerations:

Research Needs

Despite recent work to assess the belted firefly's conservation status and compile a comprehensive database of known occurrence records, our understanding of this species' distribution, abundance, and population trends is poorly understood or completely unknown, which hinders our ability to effectively conserve the species. Basic details regarding this firefly's life history, microhabitat requirements, and vulnerability to various threats are also largely unknown, further impeding conservation efforts. Work by Lloyd (Lloyd, 2018), Heckscher (2010), and Morgan (Morgan, 2014) to establish its habitat use, flash behavior and distribution in the Mid-Atlantic formed an initial foundation. However, there remain critical data gaps that must be addressed to inform conservation efforts for the belted firefly, including:

Natural history

- What is the larval diet? Are they generalists or specialists?
- What are the diagnostic characteristics of the immature life stages?
- What microhabitat features are important to adults? To the larvae?
- What habitat associations and factors affect the persistence of *P. cinctipennis* populations?

Species range and distribution

- What is the full extent of this species' range?
- What can species distribution modeling tell us about focusing future survey efforts?
- Can we use occupancy modeling to determine the survey- and site-level variables that influence the detection and presence of fireflies at known sites?
- What is the dispersal capacity of this species?

Population size, trends, and abundance

- What are the global and local population sizes and trends for this species?
- What monitoring protocols and/or programs do we need to develop to answer this question?
- What is the most reliable index of abundance for this species?
- What is the geographic pattern of genetic differentiation?

Threats

- To what extent do known threats impact the species?
- Can we model the impacts of sea level rise and other climate change impacts on their populations? What about the impacts of increasing development and light pollution?

Conservation impacts

- How do different management activities impact firefly populations?
- How can we use this information to guide conservation and restoration activities?

Inventory and Monitoring

In addition to addressing data gaps, continued surveys for *Photuris cinctipennis* are needed to determine the full extent of this species' range. We recommend that managers of public lands/conservation areas in low elevations of the Mid-Atlantic region with moist forests and floodplains conduct surveys to determine the following:

Management actions

The belted firefly is known to occur in a small number of sites in Delaware and Maryland. Although some known sites where it occurs are considered protected areas (Protected Planet, 2023), the passive protection afforded by such designations are inadequate to protect the species from extinction. Therefore, targeted protection and restoration of the habitats where it is known to occur is crucial. Land managers can play a key role in ensuring that known and potential habitat is not disturbed by recreation, development, harmful pesticide applications, light pollution, or other management activities. Key actions that could help this firefly include:

- establishing and maintaining natural buffers around forested wetlands to maintain hydrology, protect groundwater, and reduce stormwater, pollution, and nutrient run-off
- rerouting roads and trails around sensitive habitat areas
- installing boardwalks or bridges if passage through the site is required
- removing or modifying artificial light sources such as streetlights that may be negatively impacting populations (e.g., using motion sensors on existing lights, or replacing bright LEDs with dim red bulbs that don't interfere with firefly flash communication)
- protecting occupied sites from excessive or unnecessary pesticide application
- removing invasive plants such as the common reed *Phragmites australis*, which may alter native plant communities and make them uninhabitable for fireflies,
- restoring natural hydrology by removing impoundments and ditches
- setting up long-term monitoring programs at a subset of occupied sites to gather baseline population data to better understand population trends and conservation status of this species over time, as well as insights into the impacts that various management activities have on firefly health and abundance.

Survey Protocol:

Where:

- Forested and shrubby areas, especially near streams or rivers, in the Mid-Atlantic region of the US, including Maryland, Delaware, Pennsylvania, New Jersey and Virginia.
- Both new survey sites and known population localities are worth surveying.

When:

- Late June to late July, between 1100 and 2400 modified Growing Degree Days (mGDD).
- Surveys should begin at the end of dusk, as it is getting dark.
- Air temperature should be at least 60° Fahrenheit (15.5° Celsius)
- Beaufort wind scale should be Force 2 or lower (0-7 mph)
- Moon phase should ideally be last quarter, waning crescent, new moon or waxing crescent.

How:

- Review survey protocols and print data sheets from the Firefly Atlas (www.fireflyatlas.org)
- If needed, secure the appropriate permits and/or site access permissions prior to conducting surveys
- Walk slowly in appropriate habitat, looking for greenish flashes of *Photuris* fireflies.
- If permitted, net several individuals after recording their flash pattern details and take high quality dorsal and ventral photos, including a scale to show the length of the firefly.
- Consider recording observations using a voice memo app on a cell phone or a voice recorder, using the data sheet as a guide.
- If permitted, voucher specimens should be retained for examination and species verification. In the field, distinctive morphological traits to observe include pale leg segments and very pale coxae.
- Use artificial light sparingly to maintain night vision and avoid disturbing fireflies; a dim red headlamp or a flashlight wrapped in red cellophane can be used as needed to navigate the site
- Submit survey data and photographs to the Firefly Atlas (regardless of whether fireflies were observed)

Additional Resources:

- Conserving the Jewels of the Night: Firefly-Friendly Lighting Practices : <https://xerces.org/publications/fact-sheets/firefly-friendly-lighting>
- Conserving the Jewels of the Night: Guidelines for Protecting Fireflies in the United States and Canada: <https://xerces.org/publications/guidelines/conserving-jewels-of-night>
- State of the Fireflies of the United States and Canada: Distributions, Threats, and Conservation Recommendations: <https://xerces.org/publications/scientific-reports/state-of-fireflies-of-united-states-and-canada>

Acknowledgements:

Candace Fallon reviewed this fact sheet. Thank you to Christopher Heckscher, Roshan Vignarajah, and Heloise Morgan for reviewing the fact sheet and sharing their expertise, occurrence records, and photographs.

Recommended Citation:

Joyce, R. 2024. Firefly Species Fact Sheet: Belted Firefly (*Photuris cinctipennis*). The Xerces Society for Invertebrate Conservation. 15 pp. Available at <https://www.fireflyatlas.org/threatened-species-fact-sheets>.

References

- Barber, H. (1951). North American Fireflies of the Genus *Photuris*. *Smithsonian Miscellaneous Collections*, 117(1), 1–58.
- Bauer, C. M., Nachman, G., Lewis, S. M., Faust, L. F., & Reed, J. M. (2013). Modeling effects of harvest on firefly population persistence. *Ecological Modelling*, 256, 43–52.
<https://doi.org/10.1016/j.ecolmodel.2013.02.018>
- Delaware Division of Fish and Wildlife. (2015). Chapter 1: Delaware’s Wildlife Species of Greatest Conservation Need. In *Delaware Wildlife Action Plan*.
<https://documents.dnrec.delaware.gov/fw/dwap/2015%20Submitted%20Documents/Chapter%201.pdf>
- Fallon, C., Walker, A., & Heckscher, C. (2021, December 23). *Photuris cinctipennis* | *NatureServe Explorer*.
https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.737326/Photuris_cinctipennis
- Faust, L. (2017). *Fireflies, glow-worms, and lightning bugs: Identification and natural history of the fireflies of the eastern and central United States and Canada*. University of Georgia Press.

- Faust, L. F. (2017). *Fireflies, glow-worms, and lightning bugs! Identification and Natural History of the Fireflies of the Eastern and Central United States and Canada*. University of Georgia Press.
- Faust, L. F., & Weston, P. A. (2009). Degree-Day Prediction of Adult Emergence of *Photinus carolinus* (Coleoptera: Lampyridae). *Environmental Entomology*, *38*(5), 1505–1512.
<https://doi.org/10.1603/022.038.0519>
- Heckscher, C. M. (2010). Delaware Photuris Fireflies (Coleoptera: Lampyridae): New State Records, Conservation Status, and Habitat Associations. *Entomological News*, *121*(5), 498–505.
<https://doi.org/10.3157/021.121.0513>
- ITIS. (2023). *ITIS - Report: Photuris cinctipennis*. <https://www.itis.gov/servlet/SingleRpt/SingleRpt#null>
- Koken, M., Guzmán-Álvarez, J. R., Gil-Tapetado, D., Romo Bedate, M. A., Laurent, G., Rubio, L. E., Rovira Comas, S., Wolfler, N., Verfaillie, F., & De Cock, R. (2022). Quick Spreading of Populations of an Exotic Firefly throughout Spain and Their Recent Arrival in the French Pyrenees. *Insects*, *13*(2), 148. <https://doi.org/10.3390/insects13020148>
- Lewis, S. (2016). Silent Sparks: The Wondrous World of Fireflies. In *Silent Sparks*. Princeton University Press. <https://doi.org/10.1515/9781400880317>
- Lloyd, J. E. (2018). *A Naturalist's Long Walk Among Shadows of North American Photuris: Patterns, Outlines, Silhouettes... Echoes*. Bridgen Press.
- McDermott, F. A. (1967). The North American Fireflies of the Genus *Photuris* Dejean a Modification of Barber's Key (Coleoptera; Lampyridae). *The Coleopterists Bulletin*, *21*(4), 106–116.
- Morgan, H. (2014, August). *Hope for Barber's Fireflies: Photuris in the Washington, DC Area and in Rehoboth Beach, Delaware*. International Firefly Symposium, Gainesville, Florida, USA.
<https://conference.ifas.ufl.edu/firefly/Poster%20Presentations/11%20-%20Morgan.pdf>
- Owens, A. C. S., Cochard, P., Durrant, J., Farnworth, B., Perkin, E. K., & Seymoure, B. (2020). Light pollution is a driver of insect declines. *Biological Conservation*, *241*, 108259.
<https://doi.org/10.1016/j.biocon.2019.108259>
- Owens, A. C. S., & Lewis, S. M. (2022). Artificial light impacts the mate success of female fireflies. *Royal Society Open Science*, *9*(8), 220468. <https://doi.org/10.1098/rsos.220468>
- Owens, A. C. S., Van den Broeck, M., De Cock, R., & Lewis, S. M. (2022). Behavioral responses of bioluminescent fireflies to artificial light at night. *Frontiers in Ecology and Evolution*, *10*.
<https://www.frontiersin.org/articles/10.3389/fevo.2022.946640>
- Protected Planet. (2023). *The World Database on Protected Areas (WDPA)*. www.protectedplanet.net