Field Guide to Western North American Fireflies

By Larry Buschman (May 2015 Draft)

Fireflies are also known as **lightning bugs** or **glowworms**. They are popular insects because they produce their own light (bioluminescence). They are not "flies" or "bugs" but beetles (order Coleoptera) with leathery first wings.

Fireflies belong to the family "Lampyridae". Identify members of this family as follows:

a. They have an elongated body.
b. The head telescopes in and out under the pronotum (the thoracic shield).
c. The pronotum is usually large and shield-like.
d. The pronotum often has colorful markings with yellow, tan, red, or orange pigment.
e. Most species are 5-20 mm long.

Fig. 1. *Photinus* firefly

This Field Guide is intended for those who would like to identify the different fireflies in their environment. This guide covers the most common firefly species, but is not intended to be comprehensive.

North America is blessed with several hundred species of Lampyrids—the firefly family. Many of them fly around flashing and are called "Fireflies" or "Lightning Bugs". This Field Guide will focus on these fireflies. However, there are also some "Glowwarms" (Lampyrids that glow from the ground) and the "Dark Fireflies" (non-glowing Lampyrids).

For research I am obliged to take voucher specimens. However, many populations are so small, especially in the west, that loosing even a few specimens can be expected to have negative effects on their populations. I would encourage most firefliers not to take specimens (practice catch and release) unless they will be preserved for science. Fireflies should not be collected by children to decorate their bodies etc—not in the west!

How to Identify Fireflies

Many fireflies can be identified by their flash patterns, but this is not as easy as it would seem. As in bird identification, many birds can be identified by their calls, but it takes practice and experience to do this effectively. For beginners it is easier to identify them with visual clues and then one can learn to associate the bird with the call. With fireflies it is also helpful to have some visual clues, so it will be helpful to capture a specimen so one can see it and make sure it is what you think it is. But after you are familiar with fireflies in your area you will be able to identify them from the flash pattern. I once went to a new habitat and saw three flash patterns. I did not have a net so I could not capture them. I was sure there were three different fireflies present. The next visit I had a net and I found that the different flash patterns were being made by the same insects (a Photuris).

We need to clarify how to describe firefly flashes. A **"glow"** is a light emission that lasts from a few to many sec. The glow usually has a gradual on and a gradual off. The **"flash"** is pulse of light, usually with fast on and off transitions. The **"flash pattern"** is a flash or group of flashes that is repeated over and over as the firefly

flies/hovers in its typical habitat. These flashes are usually emitted slowly enough that they can be counted. The **"flicker"** is a group of fast flashes emitted so quickly that it is hard to count the individual flashes with the naked eye. Some flickers are so fast that it is hard to see them with the naked eye. Some single flashes may appear to flicker when the insect wiggles its abdomen from side to side or the wings flutter in front of the light organ. Be sure a flicker flash pattern is a real flicker. Multiple flash and flicker patterns are unusual in western fireflies.

Most firefly flashes are 0.2-0.3 sec long; however, it takes sophisticated equipment to measure such short intervals. So my practice is to use comparative descriptions. A "**normal flash"** is 0.2-0.3 sec long. A **"snappy flash"** is a faster than normal flash. A "long flash" is much longer flash—up to a sec long (like that of the common "Big Dipper" (*Photinus pyralis*) which lasts almost a sec).

The time between flashes (or flash patterns) is very useful in identifying fireflies. It is possible to make this estimate using the count "one thousand, two thousand, etc." to estimate seconds. This is usually accurate enough for identifying fireflies. In my research I record the flashes verbally on a voice recorder and then get the timing from the recorder.

Three important flashing Firefly Genera:

Fig. 2. The three genera of flashing fireflies.

Photinus:	***Pyractomena:***	***Photuris:***
Shield—medium size, half-moon shape, center black bar, red & yellow/tan markings	**Shield**—larger size, pentagon shape, center & two side black bars, red & yellow/tan markings	**Shield**—Smaller size, half-moon shape, center black bar, red & yellow/tan markings
Body—flattened	**Body**—flattened	**Body**—cylindrical, hump-backed
Legs—short (2-4 mm)	**Legs**—short (2-4 mm)	**Legs**—long (5-10 mm)

The three genera of flashing fireflies are enumerated in Fig. 2. that the beginner can easily learn to recognize. This is equivalent to knowing if a bird is a sparrow or a woodpecker or a duck. This usually requires capturing a specimen. Capturing a firefly is usually not too difficult—it's usually easiest to do it with an insect net, however, one must be careful to capture the insect you intend to capture (in the dark). Flashing males can also be attracted to a penlight by flashing the female response. You can identify the genus from the photos in figure 2

or using the characteristics in the accompanying table. Knowing the genus usually reduces the number of possible species under consideration. There will normally be only 2 or 3 common fireflies in each of these genera in any region/habitat). This allows one to state that he has a "double flashing Photuris" or a "single flashing Photinus". If you can give the time intervals that will usually identify the firefly (note—there are fireflies that can only be identified by carefully studying the morphology of the male sexual organ).

1. *Photinus pyralis* "The Big Dipper":

This is a fairly large firefly, 9-15 mm. It flies at dusk when people are out in their yards or in the park.

The **flash** is a yellowish-orange single long flash repeated every 4-6 seconds (Fig. 4). They make an exaggerated "J" motion as they flash, especially early in the evening. This behavior gives them their common name "Big Dipper". The female will answer with a single medium flash 2.8 sec later. Later in the evening the male flies a little higher and does not do the J as much. The female response is a medium flash (0.5 sec) ca. 2.5 sec after the male flash.

Fig. 3. *Photinus* fireflies, (male) left female(right).

Occurrence in Kansas*:* This is the most widespread firefly in Eastern North America. It is also the most common firefly in Kansas. It can be seen flying over lawns, pastures, meadows and even peoples yards or in parks throughout eastern Kansas and west all the way to Dodge City and Hays. Farther west it occurs in wetter habitats almost to the border with Colorado. I have seen them in roadside ditches from Wichita to Dodge City on US 50 and US 400 and from Great Bend to the Finney Co. line on KS 156. There is a nice population at Scott State Park.

Occurrence in Colorado: This firefly probably occurred along the Platte River and the Arkansas River all the way to the foothills until modern times. There are reports of fireflies, probably *P. pyralis,* in down town Denver in the 1950's. Currently there is only a small remnant population around a spring in SE CO. There is also an introduced population in a town in western CO where the lawns are very well irrigated.

2. *Photinus granulatus* "The Lawn Single Flash *Photinus*"

This is a small firefly, 5-9 mm. The **flash** is a fast yellowish-orange single flash repeated at about one second intervals. The female response is a long flash (1 sec) ca. 0.5 sec after the male flash.

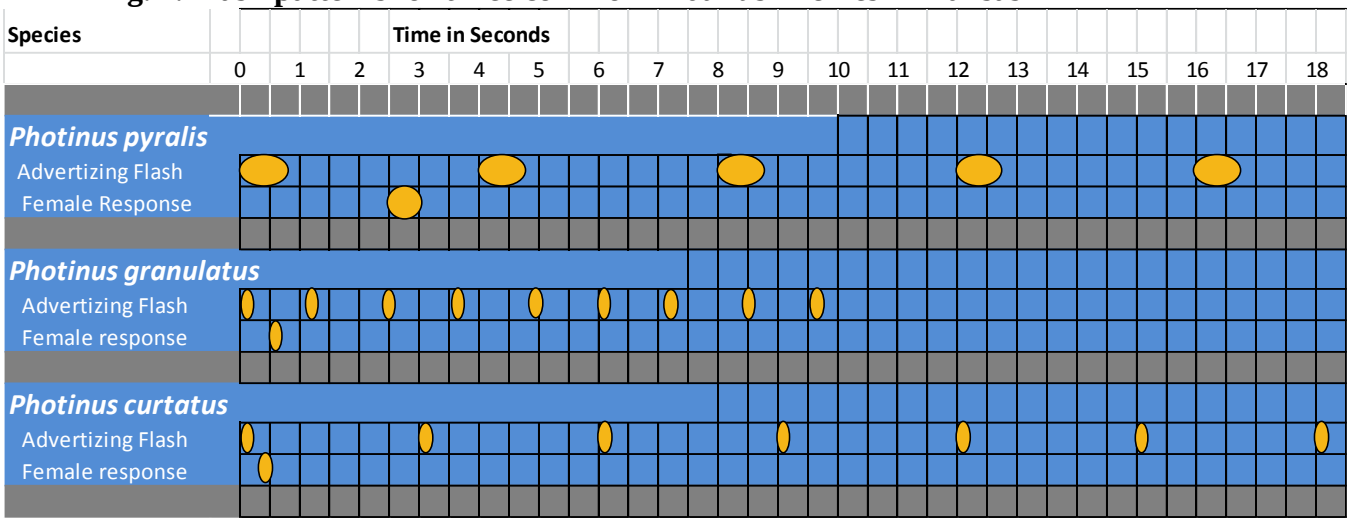
Occurrence in Kansas: This is also a common firefly in Eastern and Central Kansas. This firefly is common in central Kansas—Wichita area. Is flies over lawns and meadows.

3. *Photinus curtatus* "The Brush Single Flash *Photinus*"

This is a small firefly, 5-9 mm. The **flash** is a fast yellowish-orange single flash repeated at about three second intervals. The female response is a short flash (0.2 sec) ca. 0.3 sec after the male flash.

Occurrence in Kansas: This is also a common firefly in Eastern and Central Kansas. This firefly is common in central Kansas—Wichita area. If flies among the brush and undergrowth in wooded habitats.

Fig. 4. Flash patterns for three common *Photinus* fireflies in Kansas



4. *Photuris divisa* "The Flint Hills *Photuris*":

Photuris divisa is medium sized brown firefly, 10-14 mm, with unique double black spots on the thoracic shield and no red pigment (as opposed to the vertical black line and red pigment in Fig. 5).

The **male advertising flash pattern** is two snappy yellowish or greenish flashes, (ca. half sec apart) repeated every 4 sec. (Fig. 6). It flies just over the tall prairie grass. The **female response** is 1-6 short flashes (0.1 sec) at 0.5 sec intervals starting ca. 1.5 sec after the male flash.

***Occurrence in Kansas**:* This is a common firefly in the tall grass prairie of the Flint Hills of Kansas—an 80 mi north-south strip of limestone hills just east of Wichita. It also occurs north to Lincoln NE.

5. *Photuris versicolor* "The Multi-flash Predator *Photuris*"

Photuris versicolor the largest firefly in Kansas, the male is 10-15 mm, the female is 15-18 mm. It usually has a prominent diagonal stripe from the outside shoulder toward the median line on each wing cover.

The **male advertising flash pattern** is a fast double flash (triple flash farther east) with the flashes decreasing in intensity. The flashes are so fast that they often seem to blend. The separate flashes can be seen more easily when the male is flying rapidly. This flash pattern is repeated every 3 sec. Males also produce cruising flashes which are single flashes repeated ca. every sec. The **female response** is 1-6 long flashes (0.5-6 sec) at 0.5 sec intervals starting ca. 0.5 sec after the male flash.

Occurrence in Kansas: This is probably the most widespread *Photuris* in Eastern North America. I have seen them at most firefly locations in Eastern Kansas and also in western Kansas. This is the predator firefly that we read about—the aggressive mimic. However, I have not seen this behavior in Kansas. This firefly occurs mostly in wooded areas, but will fly around the edges of clearings.

6. *Photuris lucicrescens* "The Crescendo Photuris"

Fig. 5. *Photuris* adult fireflies

Photuris lucicrescens looks a lot like *P. versicolor*. They are late season fireflies—present in July, not in June. They usually have a prominent diagonal stripe from the outside shoulder toward the median line on each wing cover.

The **male advertising flash pattern** is a long crescendo that lasts 0.5-1.0 sec and shuts off abruptly. This flash is repeated at 3-4 sec. intervals. The males hover in the underbrush in wooded areas. There may also be crescendo flashes that go for 2 sec that may represent another species. They produce cruising flashes which are single flashes repeated ca. every sec. The **female response** is believed to be a single medium flash starting ca. 0.5 sec after the male flash.

Occurrence in Kansas: This firefly apparently is widespread in Eastern North America. In Kansas I have seen it at several locations in eastern KS in wooded habitats. This firefly occurs late in the season, July and Aug.

7. "Continuous Single Flashing *Photuris*"

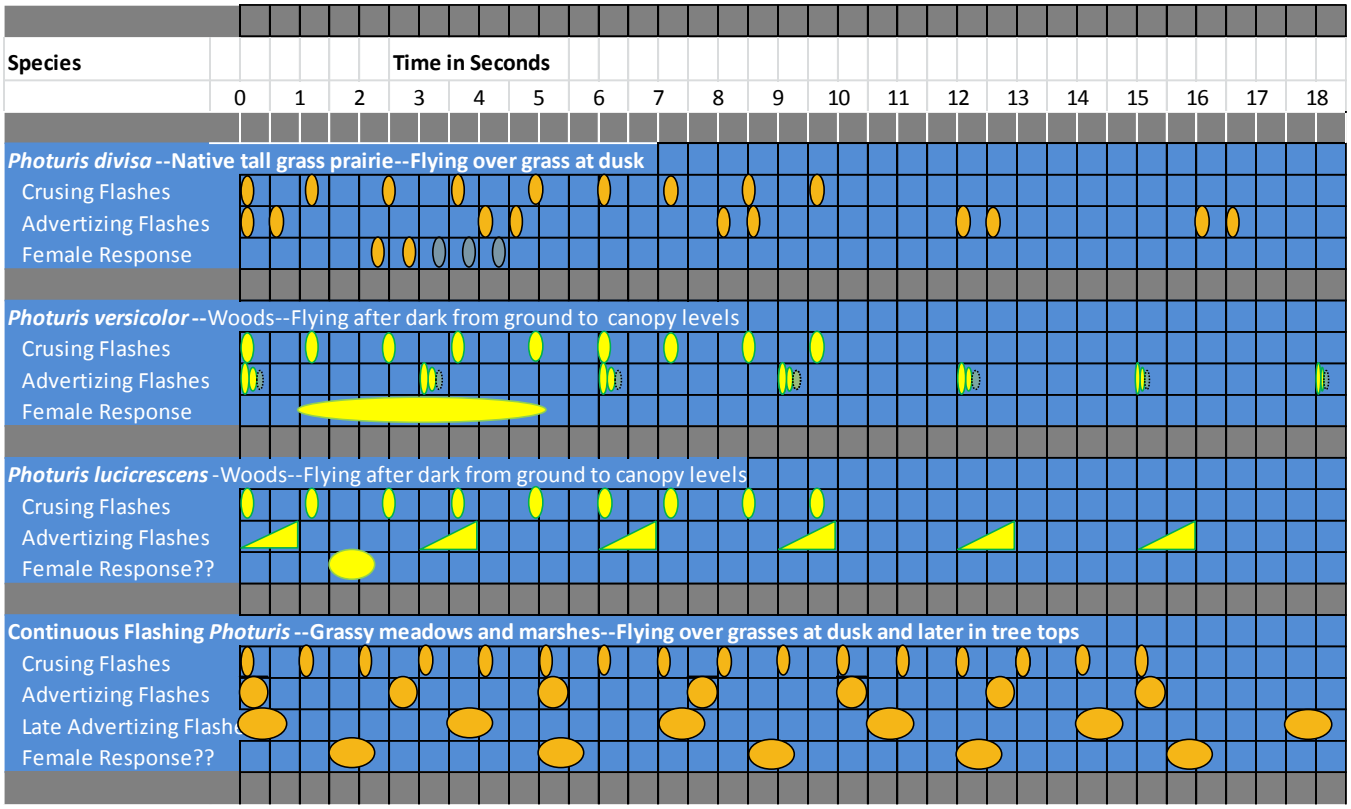
These are confusing fireflies. They may be *Photuris missouriensis* which is described from Missouri, but the original description is cryptic and does not match very well. I need to visit the type locality. These fireflies generally look like the other *Photuris*, but they may lack the diagonal line on the back.

The **male advertising flash** appears to be a single medium flash repeated at 1-4 sec intervals. The flash duration as well as the flash interval increases later in the evening. They advertise over meadows and marshy areas even spreading out over cultivated farm field as well as up into the tree tops in some populations. There is one population, in Wray, CO, that flickers and occasionally produces single flashes (as in Fig. 8). They also produce cruising flashes. The **female response** is unknown, but may be many medium flashes produced in a duet with the male flashes.

Occurrence in Kansas: I have seen continuous flashing *Photuris* across the state, but there are behavior differences from population to population. There may be several cryptic species, so research is continuing on this matter. In the west they are found in marshy areas (rivers and springs) while in the east they can be found on meadows near wooded areas.

Occurrence in Colorado: This is the most common of the flashing fireflies in Colorado. They normally occur below 6000 ft, but can occur higher around hot springs. They are found only near permanent water: marshes near streams, springs or hot springs and water seeps such as around springs and below dams or irrigation ditches. One needs to go to known firefly sites to see the fireflies—they do not fly in yards like they do in eastern Kansas.

Fig. 6. Flash patterns for four common *Photuris* fireflies in Kansas



8. *Pyractomena borealis* "The Spring Tree-Top Flasher"

This is a large typical *Pyractomena* firefly with a large head shield with black markings in the center and on both lateral edges. There is a small longitudinal ridge on the head shield. These fireflies are best known because they occur so early in spring, April-May. One usually sees only one or two individuals at a time.

The **male advertising flash pattern** is a single medium orange-yellow flash repeated every 4 sec. These fireflies fly in tree-tops of tall trees and seldom coming down within reach of the insect net. The female response is a medium flash (0.5 sec) ca. 0.5 sec after the male flash.

Fig. 7. *Pyractomena* fireflies; male on left & female on left

Occurrence in Kansas: This firefly has been found only in eastern Kansas flying in tall trees along the major rivers.

9. *Pyractomena angulata* "The Candle Firefly"

This is a large typical *Pyractomena* firefly, just a little wider than *Py. borealis*. One usually sees only one or two individuals at a time.

The **male advertising flash** is a long orange-yellow flicker flash (0.08) repeated every 4-5 sec. The males hover in in wooded areas, usually within the understory. They usually fly out of reach of the insect net but eventually they will come down within reach of the net. The **female response** is unknown.

Occurrence in Kansas: This firefly apparently also is widespread in Eastern North America. In Kansas I have seen it at several locations in eastern KS in wooded habitats.

10. *Pyractomena dispersa* complex: "The Wiggle Dancer"

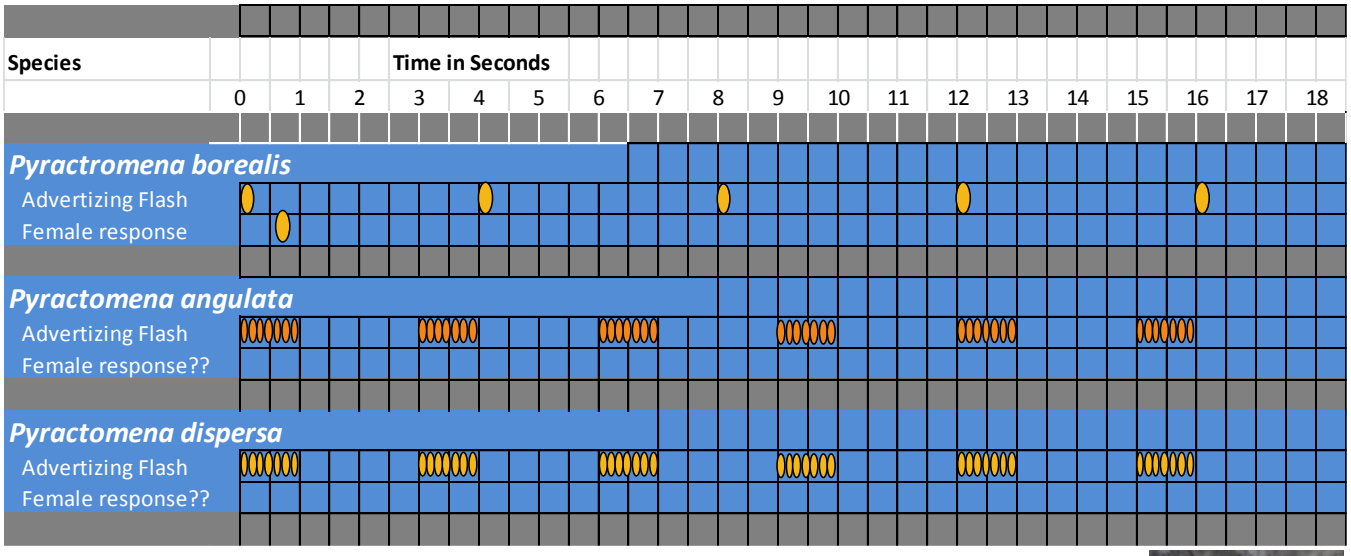
This is a medium sized *Pyractomena* firefly-smaller and slimmer that *Py. borealis* or *Py. angulata*. There fireflies can occur in large numbers flying over permanent marsh areas. This appears to be a species complex with at least a western species and several eastern species.

The **male advertising flash** is a orange-yellow flicker flash repeated every 4-5 sec. The males hover in marshy areas. However, other flash patterns are recorded from different areas across eastern North America so this may be a species complex.

Occurrence in Kansas: I saw this firefly once in western Kansas. I have not seen it recently but it should be present in marshy areas. I remember collecting one at Scott State Park many years ago

Occurrence in Colorado: The western species occurs in Colorado at high elevation, 7-8000 ft. It occurs in permanent marshy areas.

Fig. 8. Flash Patterns for 3 species of Pyractomena.



11. *Microphotus pecosensis*: "Mountain Glow warm":

The biology of western glow warms is poorly understood. There are several species from the deserts of Southwest North America. The female is wingless with a large light organ on the tip of the abdomen (Fig. 9) The male is winged but non-luminous (although young males may show some light from larval light organs.

Fig. 9. Female *Microphotus* firefly

Occurrence in Colorado*: Microphotus* fireflies have been recorded from several sites in the mountains of Colorado. They are not known in Kansas.

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12. Dark Fireflies:

Pyropyga minuta "Flower Elf" and

Ellychnia corrusca complex "Winter Firefly"

These are **dark fireflies**—non-luminous. *P. minuta* is a small, ca 10 mm long, with black and red markings on the head shield (Fig. 10). *E. corrusca* spp are a little larger, ca. 15 mm, with black and red marking on the head shield. Both are active during the day. These fireflies can be fairly common.

Females use chemical pheromones to attract males and not bioluminescence.

Occurrence in Kansas and Colorado: Both are found throughout Kansas and eastern Colorado, particularly in irrigated corn fields and lawns. *E. corrusca* spp. overwinter as adults and can be found on warm days throughout the winter. They hide in the bark of large trees.

Fig. 10. Two non-luminous lampyrids, *Pyropyga* on left and *Ellychnia* on right

Life History and Habits: Firefly larvae are predators of snails, slugs, earthworms and soft-bodied insects. They typically hunt in marsh areas near springs, ponds and creeks. Most fireflies spend the winter in the larval stage, but the *Ellychnia* spend the winter as adults. In northern climates like Kansas larvae may need several years to complete development. Most fireflies pupate and emerge as adults in late spring, June and July. All known Lampyrid larvae glow from two light organs near the tip of the abdomen.

Adult fireflies generally do not feed except to drink and take in nectar and honeydew. Only the females of *Photuris* are known to be predators. Some of these females are able to attract males of other firefly species and prey on them. Those species that produce light are active at night while the non-luminescent species are day active. After mating eggs are laid in moist soil.

Bioluminescence: The ability of fireflies to produce light is achieved by specialized organs located at the tip of the abdomen. Light production comes from chemical reaction between luciferin and luciferase with the participation of oxygen, ATP and water. The light production is so efficient that there is little heat released. Fireflies are able to produce different flashes and flickers. Males usually have two enlarged segments of the abdomen that hold the light organ. Females usually have smaller light organs that have different shapes in different fireflies.

Fig. 11. Firefly larvae: *Photinus* (left), *Pyractomena* (center) and *Photuris* (right).

Fireflies use light flashes as signals for communication between male and female. There are two communication systems. In the Signal System I the female has the large light organ which she lights up in the evening--this is not a flash but a steady glow. These fireflies are often called glow-worms. The females glow to attract males who often lack a light organ. I am not aware of any Signal System I in western Kansas. In Signal System II the male has the larger light organ. He flies about in the habitat producing the species specific advertising flash pattern. When the female, who is waiting on the vegetation, sees the right flash signal she responds with a species specific flash response. If the male sees the response he will fly and crawl to the female to mate with her. Understanding these flash signals is important when studying fireflies and it is essential for identifying firefly species. In the future we will explain these signals in more detail. In the non-luminescent fireflies the female produces a chemical pheromone to attract the male

Fig. 12. Firefly flashes in the dark. Photo Hugh Faust

Where to see Fireflies in Kansas:
Naturalist led tours at Nature Centers: None known to me.

Parks and other areas open to the public:

Scott Lake: Scott State Park, Big Dipper, *Photuris* and possibly *Pyractomena dispersa*.
Cheyanne Bottoms near Great Bend: Big Dipper and *Photuris*
Lake Sibelius near Norton: Big Dipper and *Photuris*

Where to see Fireflies in Colorado:
Naturalist led tours (In the past programs have been offered in June and July):

Carbondale, CO Filoha Meadows, http://www.roaringfork.org/sitepages/ pid3.php:
Denver, CO Audubon Nature Center: http://www.denveraudubon.org/programs/local-field-trips/.
Fountain, CO Fountain Nature Center: http://adm.elpasoco.com/CommunityServices/RecandCulturalSvc/Pages/FCNCPrograms.aspx

Parks and other areas open to the public:

Denver, CO Chatfield State Park, Plum Creek marsh and Audubon Nature Center:
Boulder, CO Sawhill Ponds County Open Space, near railroad tracks:
Fort Collins, CO Riverbend Ponds Natural Area on the boardwalk and other hiking trails.
Villa Grove, CO Valley View Hot Springs; http://www.tripadvisor.com/ShowUserReviews-g33680-d658090-r114584987-Orient_Land_Trust-Villa_Grove_Colorado.html

This is a limited list. We are eager to hear about other tours and parks where fireflies can be seen.