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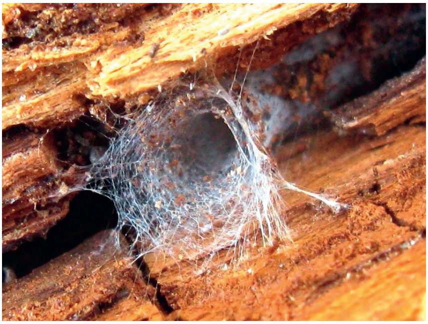
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THE WONDERFUL WORLD OF SPIDERING

"If the terrestrial world is a stage, then any predator as abundant and ubiquitous as the spider must be a major character in the ensuing ecological and evolutionary dramas" (Wise 1993).

Spiders can be found in almost every terrestrial ecosystem and have been reported from every continent, even Antarctica (Forster 1971). The World Spider Catalog currently states that over 49,000 species of spiders are known worldwide, and the number increases every year. North America (north of Mexico) is home to over 4,000 known species of spiders, but there is still a lot to learn; there are many species out there that have not been described. Spiders are a highly diverse group but often overlooked, especially as most of them are quite small.

Spiders tend to evoke strong emotions in many people. Some truly love these critters, some are apathetic to them, and some are completely terrified of them. Arachnophobia (the fear of spiders) is one of the most reported phobias in Western cultures, but the good news is that phobias can often be overcome. Exposure and education are two key aspects to overcoming fear. Trained therapists can also help people overcome their phobias, and there is no shame in seeking professional help if you need it. Some therapists are showing great success using virtual reality (Carlin, Hoffman, and Weghorst 1997), and as technology advances, the options to help people overcome their fears will also expand. If you have bought this field guide to help you overcome your phobia, I commend you; you have taken a brave first step to appreciating these wonderful creatures.

This field guide will describe what a spider is and give you some of the basic identification knowledge to be able to narrow down which spiders you find. This is not meant to be a way to identify all spiders to species. In many cases, you need to examine the genitalia of a mature species to confirm a species-level identification, and at times, this requires dissection of the specimen. There is no way that a field guide can cover all the species found in North America, so this guide will cover some of the more commonly encountered species and provide tips for identifying them to at least family level.

Identification is often achieved utilizing dichotomous keys, which present a series of choices based on physical structures at each step. Starting at the first couplet, you select the option that best matches the animal you are observing. This will direct you either to another couplet or to the identification.

For a simple example, let's consider the following candies: M&M's®, Hershey's Kisses, starlight mints, peanut butter cups, Skittles®, and gummi bears. The dichotomous key could be as follows:

1a. Covered in a hard shell ---------- **2**
1b. Not covered in a hard shell ---------- **3**

2a. Chocolate flavored ---------- **M&M's®**
2b. Fruit flavored ---------- **Skittles®**

3a. Hard and mint flavored ---------- **Starlight mints**
3b. Neither hard nor mint flavored ---------- **4**

4a. Chewy, somewhat soft, fruit flavored ---------- **Gummi bears**
4b. Not chewy, firm but not soft, not fruit flavored ---------- **5**

5a. Solid chocolate, usually wrapped in foil ---------- **Hershey's Kisses**
5b. Peanut butter core covered with chocolate ---------- **Peanut butter cups**

So with this example key, if you had Skittles®, you would start at number 1. As Skittles® are covered in a hard shell, you would go to number 2. They are fruit flavored, not chocolate, leading you to the identification of Skittles®. Be sure to read the couplets carefully, as in some cases, combinations of traits (not just one) are required to make the right choice.

In this field guide, you will find dichotomous keys for the class Arachnida and for family-level identification at the start of each of the guild chapters. Usually, the keys are most easily followed when you have a specimen, but clear photographs will often allow you to see the needed characteristics.

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Spider identification can be tricky. Sometimes lots of subtle traits need to be observed to make a conclusive identification, and sometimes a family-level identification will be the best you can do. Please don't let this discourage you.

WHAT IS A SPIDER?

Spiders are in the order Araneae and part of the class Arachnida. Many people are easily confused about the class, as arachnophobia usually refers to an irrational fear of spiders, but other animals than spiders are in this class.

A Quick Biology Reminder

All living things are categorized, and all the organisms in a category share some similar traits that distinguish them from other living things. One simple way to remember the order of classification is using mnemonics. For example: "Divine kings play chess on fancy glass stools" or "Do kindly place candy out for good students." By using the first letter of each word, one can remember the taxonomic ranks:

DOMAIN	Divine	Do
KINGDOM	Kings	Kindly
PHYLUM	Play	Place
CLASS	Chess	Candy
ORDER	On	Out
FAMILY	Fancy	For
GENUS	Glass	Good
SPECIES	Stools	Students

All spiders (and all other animals) are in the domain Eukarota and the kingdom Animalia. The phylum Arthropoda (which roughly translates to "jointed foot") includes animals with an exoskeleton, a segmented body, and paired jointed appendages. Members of the class Arachnida have eight walking legs (although these can be modified in some cases). They have chelicerae—appendages on the anterior of the prosoma, each of which is composed of a basal segment and fang—and a pair of pedipalps, small leglike appendages near the front of the animal. Their bodies are divided into two tagmata, or body regions: the prosoma or head, and the opisthosoma or abdomen, although these can be fused and difficult to see in some cases. (In contrast, insects have three body regions and three pairs of walking legs.)

KEY TO THE EXTANT (NOT EXTINCT) ARACHNIDS

1a. Taillike appendage at end of opisthosoma (abdomen) ---------- **2**
1b. No taillike appendage at end of opisthosoma (abdomen) ---------- **6**

2a. Segmented tail with a modified telson (terminal segment) containing a venom bulb and stinger ---------- **Scorpiones (Scorpions)**
2b. Tail not segmented and lacks venom bulb and stinger ---------- **3**

3a. Tail short, sometimes uniquely shaped ---------- **Schizomida (Shorttailed whipscorpions)**
3b. Tail usually long and thin ---------- **4**

4a. Marine animal with hard shells over prosoma (cephalothorax) and opisthosoma (abdomen) ---------- **Xiphosura (Horseshoe crabs)**
4b. Not as above ---------- **5**

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5a. Very small (less than 5 mm), pedipalps used in locomotion -- **Palpigradi (Microwhip scorpions)**
5b. Larger (usually 25–85 mm), pincerlike pedipalps, sprays acetic or octanoic acid when disturbed -------- **Thelyphonida (Whipscorpions)**

6a. Pedipalps appear clawlike or raptorial -------- **7**
6b. Pedipalps neither clawlike nor raptorial -------- **8**

7a. Pedipalps look like scorpion claws, usually small (2–8 mm) -------- **Pseudoscorpions**
7b. Pedipalps raptorial, larger (5–70 mm) -------- **Amblypygi (Tailless whipscorpions)**

8a. Body regions fused, making them appear to have only one body section -------- **9**
8b. Body regions not fused, with clear delineation between prosoma and opisthosoma -------- **10**

9a. Legs usually fairly stout -------- **Acari (Mites and ticks)**
9b. Legs usually thin and long -------- **Opiliones (Harvestmen)**

10a. Cucullus or hood covering anterior of prosoma (cephalothorax) -- **Ricinulei (Hooded tickspiders)**
10b. No cucullus present -------- **11**

11a. Chelicerae modified and pincerlike -------- **Solifugae (Wind scorpion)**
11b. Chelicerae not modified to be pincerlike -------- **Araneae (Spiders)**

Scorpiones: Scorpions (fig. 1). These animals are best known for a modified telson (terminal tail segment) that has a venom bulb and stinger. The pedipalps are modified into large, grasping, pincerlike claws. Many species are known to fluoresce under black light.

Schizomida: Shorttailed whipscorpions (fig. 2). These are small animals (less than 5 mm) that usually occupy leaf litter or caves. The first pair of legs is antenniform. The tail or flagellum has only one to four segments and may be uniquely shaped.


Fig. 1


Fig. 2

Xiphosura: Horseshoe crabs (fig. 3). These are marine animals that often live in shallow coastal waters. Both the opisthosoma and prosoma are covered with thick hard shells. They have a long telson that is used to help the animal move and right itself if it is upside down. According to a recent study (Ballesteros and Sharma 2019), horseshoe crabs are arachnids and sister taxa (most closely related) to Ricinulei (hooded tickspiders).


Fig. 3

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Palpigradi: Microwhip scorpions (fig. 4). These animals are extremely small (less than 5 mm) and tend to live in wet soils in warm habitats. They are colorless. Their pedipalps are used for walking. They have a long taillike flagellum.

Thelyphonida: Whipscorpions, sometimes called vinegaroons (fig. 5). These animals are known to spray an acetic or octanoic acid from their thin whiplike tail as a defense. The first pair of legs is antenniform, and the pedipalps are heavily armored.


Fig. 4


Fig. 5

Pseudoscorpions: These are small animals (2–8 mm) and often overlooked (fig. 6a). They do not have a stinging tail but otherwise look like miniature scorpions. They produce silk from their chelicerae, and venom is produced in their modified clawlike pedipalps (although they are too small to be of any threat to humans). Some species are known to travel using a technique referred to as phoresy, where they cling onto a larger, usually flying, animal (fig. 6b).


Fig. 6a


Fig. 6b pseudoscorpion traveling using phoresy

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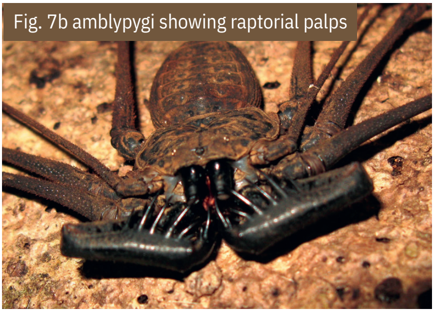
Amblypygi: Tailless whipscorpions, sometimes called whipspiders (fig. 7a). These are fierce-looking animals (although harmless to humans) with raptorial pedipalps (fig. 7b). The first pair of legs is extremely long, whiplike, and antenniform (used for sensory purposes). They do not produce silk or venom.

Fig. 7a

Fig. 7b amblypygi showing raptorial palps



Acari: This is a subclass and includes the mites and ticks. It is divided into two superorders: Acariformes or Actinotrichida, which tend to be herbivorous (fig. 8), and the Parasitiformes or Anactinotrichida, which includes many species that are considered parasites (fig. 9).

Fig. 8

Fig. 9

Opiliones: Harvestmen. These animals are sometimes referred to as "daddy-longlegs," which causes much confusion, as other animals are also commonly referred to by this name (fig. 10). Opiliones have fused body regions, so they often look like a football with legs. Oftentimes, they have very long thin legs, although there are some with shorter legs. Opiliones lack venom, but some can give off a noxious chemical defense. They are capable of eating solid pieces, unlike their spider cousins, which must liquefy their meal before ingesting it.

Fig. 10

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Ricinulei: Hooded tickspiders (fig. 11). These unique animals hide their face behind a cucullus or hoodlike structure, giving them an unusual appearance. They are eyeless. The third leg is modified in the males for sperm transfer, and the genital opening is located on the pedicel.

Solifugae: Windscorpions, sometimes also called "sun spiders" or "camel spiders" (fig. 12). These fast-running arachnids have large intimidating chelicerae. The long pedipalps cause many people to think, mistakenly, they are ten-legged. They are the subject of many urban legends that exaggerate their size, speed, and toxicity. (They have neither venom glands nor a venom-delivery method.)


Fig. 11


Fig. 12

Araneae: Spiders (fig. 13). So what makes a spider a spider? Like all arachnids, they have eight legs, pedipalps, and chelicerae. Unlike insects, they do not have antennae or wings. Unique to spiders are the spinnerets, used to produce silk. All spiders produce silk, and it has many uses. Some build elaborate capture webs with it, some use it as drag lines, and some make little silken retreats that are used for resting or molting. Silk can be used to wrap up prey, and it is used to cover the egg sacs. Spiders can produce up to seven different kinds of silks. Different silks have different uses.

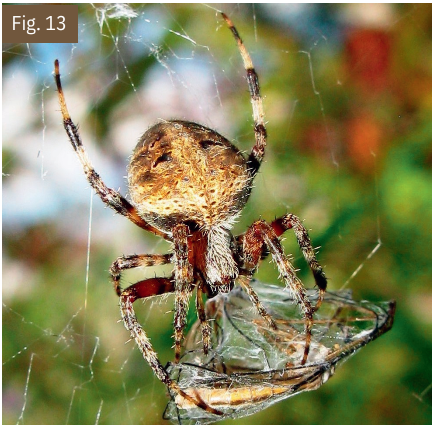
Fig. 13


Fig. 14

Spiders are separated into two suborders: Mesothelae and Opisthothelae. Mesothelae (fig. 14) are considered the most ancestral of the extant spiders. They have a clearly segmented abdomen, and the spinnerets are between the two pairs of book lungs. These spiders are found in Asia, and none is found in North America. They will not be covered in this guide. Opisthothelae have their spinnerets at the end of the opisthosoma. Opisthothelae is separated into two infraorders: the Mygalomorphae and the Araneomorphae. Mygalomorphs include some of the largest spiders and include such creatures as tarantulas. They also tend to be long-lived animals. Most live in burrows or cavities. Araneomorphs, sometimes called the true spiders, are most of the spiders we encounter on a day-to-day basis and include such animals as orbweavers, wolf spiders, and cobweb spiders. Araneomorphs can be divided into two groups; the entelegynes (those with more complex genitalia; the female having three external openings—not easily seen—and a sclerotized epigynum; the males with complex palp structures) and the haplogynes (those with more simple genitalia; the female having only one external opening, and the male palp with a simple bulb).

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HOW TO SEPARATE THE MYGALOMORPHAE FROM THE ARANEOMORPHAE

To determine if a spider is a Mygalomorphae or an Araneomorphae, look for the following combinations of traits:

Mygalomorphae: Their chelicerae are paraxial, or parallel to the central axis of the body (fig. 15a). When they attack, they raise up their prosoma (or cephalothorax) to unfold the fangs (fig. 15b) and strike downward onto the prey. They have two pairs of book lungs. They have eight eyes that are usually clustered together (fig. 15c). Their legs are usually robust.

Araneomorphae: The chelicerae are diaxial, or at an angle to the central axis of the body (fig. 16a). When they attack, the fangs are used in a pinching motion. They usually have only one pair of book lungs. If they have two pairs of book lungs, they also possess a cribellum (a specialized plate that produces cribellate silk). Most have eight eyes, but some have six, four, two, or none. There are many different eye configurations, but often they are in two rows across the front of the prosoma (fig. 16b).

Fig. 15a

Fig. 15b

Fig. 15c

Fig. 16a

Fig. 16b

Fig. 15a ventral view of *Myrmekiaphila foliata* showing paraxial chelicerae

Fig. 15b *Sphodros* sp. with fangs unfolded

Fig. 15c eye cluster of *Antrodiaetus unicolor*

Fig. 16a ventral view of *Elaver excepta* showing diaxial chelicerae

Fig. 16b eyes in two rows across front of prosoma of *Elaver excepta*

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SPIDER ANATOMY

Some basic terminology:

Dorsal is the top side, and *ventral* is the underside. *Anterior* means "toward the front," while *posterior* means "toward the rear." *Lateral* means "to the side"; *median* means "toward the middle." *Proximal* is close to the body core, and *distal* is away from the body.

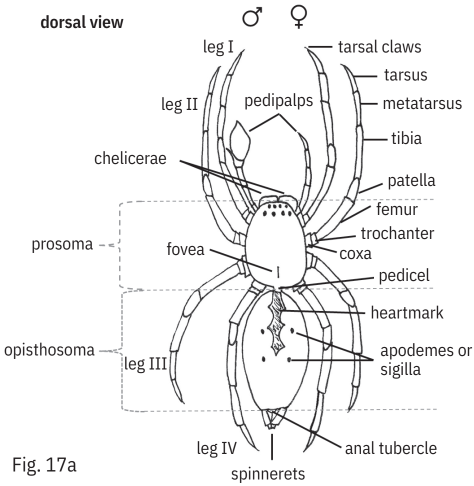


Fig. 17a

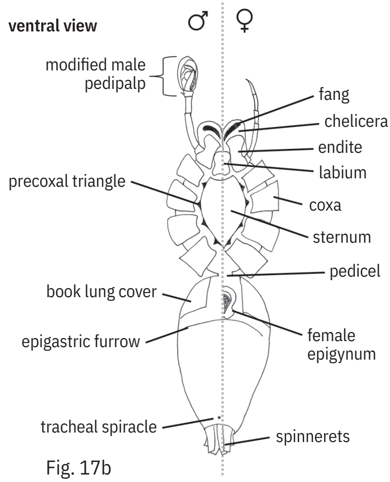
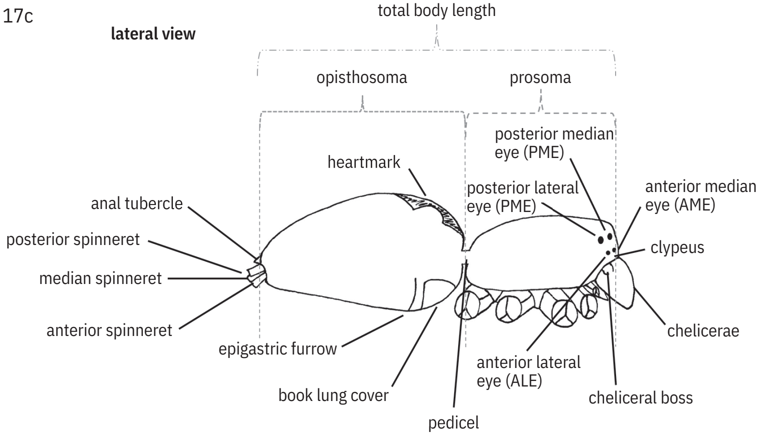


Fig. 17b

Fig. 17c



To learn how to identify spiders, one must also have an understanding of the basic anatomy (fig. 17a–c). Spiders have two main body regions or tagmata: the *opisthosoma* (some people refer to this as the abdomen) and the *prosoma* (some people call this the cephalothorax, or head). These two tagmata are connected by a narrow structure called a *pedicel*. The spinnerets are on the opisthosoma, and the mouthparts and legs are on the prosoma. (This is one mistake many make about spiders, as many "spiders" are depicted with their legs coming from the opisthosoma.)

Spiders have four pairs of walking legs. These are numbered starting near the front of the spider and using Roman numerals: first is leg I, then leg II, leg III, and leg IV. The legs are made up of the coxa at the base, the trochanter, femur, patella, tibia, metatarsus, tarsus, and tarsal

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claws. Spiders also have a pair of *pedipalps*; these often look like small walking legs and are near the chelicerae. Pedipalps have fewer segments (lacking the metatarsi) than the walking legs and are used for food manipulation and chemosensory purposes. Mature male spiders have modified pedipalps (additional structures that often make them look like they are wearing boxing gloves) for sperm transfer. At the base of the pedipalps are the *endites*; some spiders have endites that are lined with tiny teeth, forming what is called a *serrula*.

At the front of the spider is a pair of *chelicerae*; the fangs are attached to these at the distal end. The fangs are usually held folded into a furrow in the chelicerae, which is sometimes lined with teeth. The actual mouth of the spider is beneath the chelicerae. Spiders liquefy their food before consuming it. At the entrance to the mouth are rows of hairs that filter any solid particles out of the food being ingested. The area above the chelicerae but below the eyes is referred to as the *clypeus*.

On the top of the prosoma is often a visible mark called a *fovea*. This is where the muscles for the stomach attach. The ventral side of the prosoma has the sternum. Here you can also see the *coxae*, which are the base segments for the legs. The opisthosoma often has a visible *heartmark* on the dorsal surface. This is directly over where the heart of the spider is, and in some species, you can easily watch the heart beating. The dorsal opisthosoma may be smooth, or there may be visible depressions called *sigilia*; these are points where muscles attach. The *spinnerets* are usually located at the posterior end of the spider, and their number and placement are also useful in spider identification. In some spiders the anterior spinnerets are a modified plate, called a cribellum (and those spiders are referred to as cribellate). The ventral opisthosoma has a crease running transversely across it called the *epigastric furrow*. Mature females will have their *epigynum* or *gonopore* located just anterior to this. A pair of *book lungs* is anterior of the epigastric furrow (usually but not always one pair). The covers of the book lungs are sometimes colored or textured. Most spiders also have a *tracheal spiracle* (or more than one in some cases). This is usually located near the spinnerets. Its placement and number can also be helpful in identification.

All information given has been provided under the assumption that you will have an intact specimen that is not deformed in any way. Deformities can happen. Figure 18a shows a *Dolomedes vittatus* that either hatched with a deformity or suffered some great injury, causing it to have fewer eyes than usual. Injuries can happen, too; loss of legs is common for spiders. Figure 18b shows a *Schizocosa* species (family Lycosidae) with only five legs, and all three missing legs were on the same side. This did not seem to slow her down at all. These spiders seem to fare quite well in their natural environment, but these differences can sometimes make identification tricky if the trait that has been injured or is missing is diagnostic.

Fig. 18a *Dolomedes vittatus* missing eyes

Fig. 18b *Schizocosa* sp. missing three legs on left side

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In the scientific literature, spiders are measured from the front of the prosoma to the end of the opisthosoma. This is referred to as the *total body length*. This is recorded in millimeters (metric is used for scientific literature) but can easily be converted to inches if you remember that 25.4 mm equals 1 in. A ruler marked in inches and millimeters is provided on page 612 to assist you with this.

There can be many variations in the markings of spiders (fig. 19). Marginal bands or stripes will be on the very edge, usually of the prosoma. Median bands or stripes run longitudinally down the middle. Submarginal bands are in the area between the median and marginal bands. An anterior band on the opisthosoma runs transversely across the anterior edge. If a band or stripe is referred to as broken, it is discontinuous, like a dashed line. Paired spots are usually on either side of the medial line. Chevron markings are usually on the opisthosoma. Leg banding creates rings on the legs, whereas leg striping runs longitudinally. These markings can be darker than the background coloration of the spider, or they can be lighter.

One useful trait that may be used to help narrow down the family-level identification is the eye configuration or eye placement. Most spiders have eight eyes, some have six, some have four, a few have two, and some are eyeless. Eyes are often in two rows and are referred to by their placement. The anterior eyes are toward the front of the spider, while the posterior eyes are toward the rear of the head. The median eyes are toward the midline, and the lateral eyes are toward the edge. As such, we end up with the anterior median eyes, the anterior lateral eyes, the posterior median eyes, and the posterior lateral eyes (fig. 20). The posterior and anterior eye rows can be straight or curved. If they are curved so the lateral eyes are closer to the anterior than the median eyes, this is referred to as *procurved*. Conversely, if they are curved so the lateral eyes are closer to the posterior than the median eyes, this is referred to as *recurved*.

Lastly, we should address coloration. Some species can come in several different color forms. In addition, some spiders' coloration can be affected by prey consumption, spiders' coloration will often vary immediately before and after molting, and some spiders are able to shift their color based on their environment. Therefore, coloration may not always be the most useful trait when trying to identify spiders (fig. 21).

How can you look at the ventral side of a spider? Looking at the anatomy and reading the descriptions of many species, you will see that you need to look not only at the dorsal surface of the spider but also at the ventral surface. This can be fairly easy with

Fig. 19

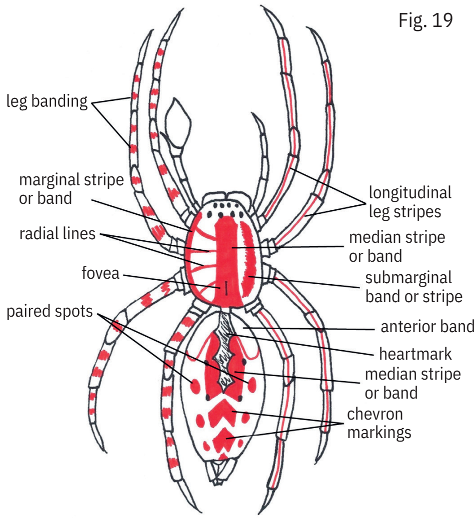

Fig. 20

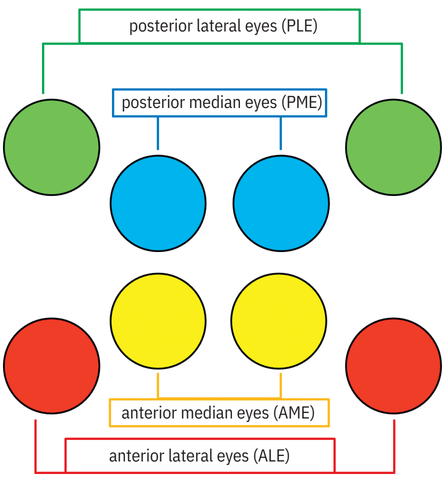

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Fig. 21a *Pholcus* that is pink from consuming ladybugs

Fig. 21b *Parasteatoda tepidariorum* with green prey causing color shift

Fig. 21c *Parasteatoda tepidariorum* with an overall green coloration from prey consumption

Fig. 21d the same *Parasteatoda tepidariorum* in the previous photo a few days later

some of the web-building spiders, which sit suspended within their web, but tricky with ground-dwelling spiders. If you are able to catch the spider, there are a couple of ways to get a good view of the ventral side.

First, spiders can be temporarily anesthetized using carbon dioxide (CO_2). A bicycle tire inflator (fig. 22) or keyboard duster that uses CO_2 can be used. Catch the spider in a container that has a lid. Carefully fill the container with CO_2 and place the lid on. (Since you can hurt or kill a spider if you fill the container with CO_2 too rapidly, you will want to try this without a spider in the container the first time.) After a few moments, the spider will become motionless. At this point, you can turn the spider out of the container to obtain a ventral view. Be careful moving spiders, as they are very delicate. Be warned, not all spiders will give you any indication that they are waking up, so place the spider where it will not fall or cause harm; it may be a little disoriented upon waking. Also, do not place the spider in your hand, as it can be startling when it awakens.

Fig. 22

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Fig. 23a spi-pot with the sections separated

Fig. 23b spi-pot with the sections together

Fig. 23c ventral view of a spider in the spi-pot

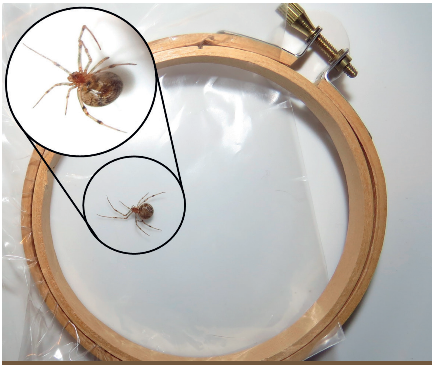

Fig. 24 spider being held in plastic bag in an embroidery hoop

Second, if you cannot (or don't want to) anesthetize the spider, you can use a spi-pot (fig. 23). Spi-pots are described in the Collins field guide *Spiders of Britain and Northern Europe* (Roberts 1995) and can be made in different sizes to accommodate spiders of different sizes. Lots of online tutorials show how to make them. Remember, spiders are delicate, so you will need to be careful not to hurt the spider when placing it in your spi-pot. Do not keep the spider in the cup for a long time, just long enough to take a closer look or snap a couple photos.

Third, you can trap the spider into a clear sandwich bag and, using an embroidery hoop (fig. 24), hold the spider immobilized while you look at the ventral side.

WHERE DO SPIDERS LIVE?

Since spiders are highly diverse, they can live in just about any terrestrial ecosystem. Species specialize in many different habitats. There are even spiders that are well adapted to living in our homes and are considered synanthropic (from the Greek for "together" and "man"). There is also a diversity of hunting strategies and life histories. So you can find spiders under rocks, on trees, in large webs, running on the ground, hiding in tall grasses, hunting on the surface of water, hiding in the leaf litter, even inhabiting your home.

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OBSERVING SPIDERS

Observing spiders in the wild can be difficult but also rewarding. Spiders occupy many different habitats and can be observed almost anywhere. The key is finding them. One of the things to remember is that all spiders produce silk, and that finding their silk can help you track down the spiders.

Techniques for Finding and Collecting Spiders

First and foremost, one needs to be aware of local laws and restrictions on collecting spiders and altering the habitat. Please be aware of local laws and restrictions before trying to collect any animals from the wild. You must also be aware of any threatened or endangered species in your area, so you can be sure that your actions will not harm them in any way. In general, if you do not own the land from which you will be collecting, you would at least need to get permission from the landowner before attempting to collect any animals.

VISUAL SEARCHING

Web-based spiders can be found by following the silk. Webs built for prey capture are highlighted well on foggy mornings, making them great times to hunt for spiders. If you can see the web, careful examination will often lead you to the spider. If the spider is not out in the open on their web, remember to look at the edges, in the vegetation, or on the structure to which the web is attached. Funnel-weaving spiders often hide in the back of their funnel retreat and will rush down at the slightest disturbance. Some of these spiders can be coaxed into the open with a tuning fork or sonic toothbrush (fig. 25), as the vibrations mimic prey. Spiders also like to hide under things. Rolling logs is a good way to find spiders, but please always try to leave things as you found them; replace the log into its original position when you are done searching. Walls, fences, bridges, and cellars are other great places to look for spiders. It is important when searching to take care not to harm the environment or the plants and other animals within it.

Fig. 25a sonic toothbrush luring Agelenidae from its retreat

Fig. 25b sonic toothbrush luring *Amaurobius* sp. from its retreat

SWEEP NETTING

This technique is great for grassy habitats. A canvas or mesh net is swept through the vegetation several times (fig. 26). Be sure to avoid areas with thorny plants, as these will tear or snag your net. Also, if you have plant allergies (for example, to poison ivy), you should avoid sweeping those plants, as the oils and residues from the plants can transfer to your net. Oftentimes, a sheet is laid flat on the ground, and the contents of the net are placed onto it for examination. Many creatures

Fig. 26a sweep netting

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Fig. 26b sorting the sweep net sample

Fig. 27 vegetation beating

will make a quick dash to get away, so be prepared to capture as soon as the contents of the net are emptied. Some spiders will play dead (the scientific term is *thanatosis*), so look carefully through the debris from the net for those critters. This technique should be done only in dry conditions, as moisture will make the insects/spiders stick to the debris and can easily cause injury or death.

VEGETATION BEATING

This method is used mainly in areas of woody plants. A sheet or tarp (or even an open umbrella) is placed or held below the branches of vegetation. Then the branches are struck with a pole or branch, or they are grasped and vigorously shaken, dislodging spiders that are within that structure and causing them to drop onto the sheet beneath (fig. 27). This is often easier to do with more than one person, as the dislodged spiders will often run frantically off the sheet. It can be helpful to have one person who is prepared to capture those spiders while another shakes or beats the vegetation. Also, watch for spiders suspended on a line of silk. They will often quickly retreat to the branch on their silk line when the shaking stops. Once again, this technique is best done in dry conditions. If the vegetation is wet, the spiders will stick to the moisture and can be hurt or killed.

SNIFFING FOR SPIDERS

Sniffing for spiders does not use odors or the sense of smell but is a technique for observing spiders at night. Many spiders are more active during the night. This technique requires the use of a bright flashlight or headlamp and is best done during dry weather conditions (as condensation and raindrops will create reflections similar to the eyes of a spider). Many spider eyes have a reflective tapetum, which will reflect the light from a flashlight. The key to this method is the angle of the light. One way to obtain a good angle is to hold the flashlight or place your headlamp below your nose (which is where the name “sniffing” came from). If you sweep the light back and forth across grassy areas, you will see twinkling greenish-blue reflections that likely belong to spiders. Other animals’ eyes also have these reflective properties. (Think about wildlife eyes you have seen highlighted by car headlights.)

PITFALL TRAPPING

Pitfall trapping is a great way to capture ground-running spiders, and also a good technique to capture night-active spiders without having to be out at night, as the trap can be set during the day and left overnight before the contents are examined. For pitfall traps, a catch container is placed in the ground so the edge of the container is level with the ground’s surface (fig. 28). Some traps can have a funnel top, and you can also provide a roof over the trap to help prevent debris and rain from entering. If you are interested in just looking at the spiders caught, you can leave the trap dry. (Some people even put some moss or leaves in the bottom.) Most scientists using this collection method put in a few inches of chemical that kills and preserves the spiders until

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the contents are collected. (Propylene glycol is a good choice, as it is less toxic than other chemicals.) A couple drops of dish soap will help reduce the surface tension, so that the spiders will fall into, rather than sit on top of, the solution. If you are using any chemical solution, your trap should also be covered with a wire screen (chicken wire or hog wire) to help reduce the chances of larger wildlife disturbing your trap and accessing the chemicals. If you are dry trapping, you should check your traps daily and be aware that spiders and other predacious animals confined in the trap will readily eat one another. Traps with chemicals can be left for longer periods of time, but the specimens will degrade over time. Be prepared to have lots of specimens that will need to be transferred to 70 percent ethanol in a timely manner.

Fig. 28a digging the hole for a pitfall trap

Fig. 28b installing the outer container

Fig. 28c checking that the fit is snug and level with the ground surface

Fig. 28d installing the catch container

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Fig. 28e the outer roof structure of the pitfall trap

Fig. 28f putting the roof on the pitfall trap

Fig. 28g trap roof covered with chicken wire and ready to catch invertebrates

LEAF LITTER SAMPLING

Many spiders live, hide, and hunt in the leaf litter. One easy way to sample them is to scoop samples of leaf litter into a large bag or Berlese funnel (fig. 29a). Wear leather gloves when scooping up the leaf litter to help prevent anything in the litter from causing scratches or wounds. The bag of litter can be spread out on a sheet or tarp similar to that employed in the sweep-net method, or you can use a Berlese funnel. The leaf litter is placed in the top area of the funnel, which has a mesh at the bottom large enough for spiders to go through but fine enough to hold the litter. A catch container is placed below the funnel, and a light or heat source is placed at the top. The spiders will try to avoid the heat and work their way through the funnel and into the catch container. This

Fig. 29a Berlese funnel made from a flower pot

Fig. 29b *Pirata sedentarius* in the catch container soon after setting up Berlese funnel

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container can be filled with 70 percent ethanol to kill and preserve the spiders, or it can be left dry if you want to look at live specimens (but you will need to check this frequently). Within minutes of setting up the funnel, you may have spiders in the catch container like the young *Pirata sedentarius* shown in figure 29b; it was collected moments after setting up the funnel. Be careful not to place your light or heat source so close that it ignites your leaf litter. Leaf litter can be collected at any time of year. During winter, many spiders will be inactive, in a state called torpor, so bringing leaf litter samples inside to a warm area will enable you to watch as they "wake up."


Fig. 30a pootering

POOTERING SPIDERS

A device commonly called a "pooter," or an aspirator, can be used to suction up spiders into a tube or catch container (fig. 30a). There are lots of different designs. Pooters can be made from common household items, or they can be purchased from a variety of outlets. You can also purchase an attachable filter that will prevent you from inhaling things you would not want to introduce into your lungs. (The one shown was purchased from BioQuip fig. 30b.) Pooters are great for collecting small or extremely fast-running animals that could be harmed in the collection process.

Fig. 30b pooter from BioQuip with attached filter


Keeping Live Spiders Captive

People have mixed feelings about capturing and keeping wild spiders. In general, if the spider is not an endangered or threatened species, little harm to the overall population would be caused by keeping a solitary spider. Once again, you would need to check your local laws and ordinances to verify that you can collect spiders from a location legally. Additionally, you would need to know that you could provide a suitable habitat and food supply for the animal. Observing spiders in captivity is a great way to learn about these fascinating creatures. Salticidae (jumping spiders), Theraphosidae (tarantulas), and other spiders can be found in the pet trade and purchased from breeders, but please make sure you buy only from reputable sellers. A spider's behavior in captivity may be different from its natural, "wild" behavior, but keeping a spider gives a chance for some up-close observations that can be very educational. Many people have overcome their arachnophobic tendencies by learning about spiders and then keeping one as a pet. Be sure to research the species of spider you plan to acquire as a pet so you know you can provide an adequate home for it.

Any wild-collected and preserved spider should have two labels associated with it to be useful to the scientific community (fig. 31). The first label should list the location where the spider was originally collected and the collection date (if the spider was captive reared, you would also want to note that here), the sampling technique, and the collector's name. The second label should include the identification of the specimen and the person who identified it.

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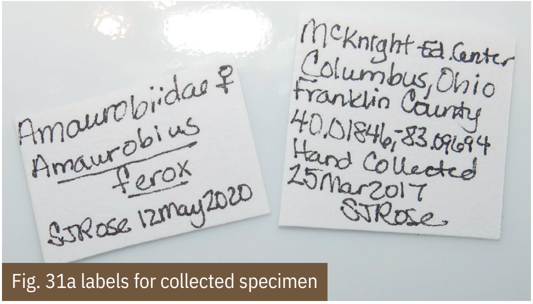
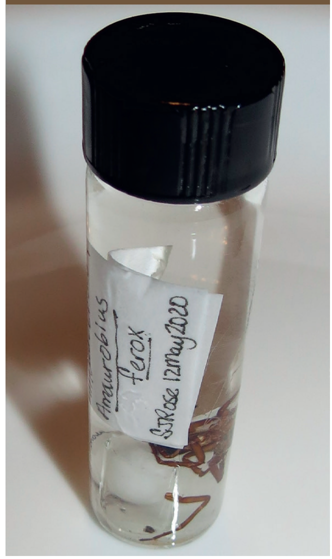


Fig. 31a labels for collected specimen

Fig. 31b labels in vial of 70% ethanol with specimen



The labels, usually written on linen in ink (that does not dissolve in ethanol) or pencil, should be placed in the vial with the specimen when it is preserved. It is also a good idea to keep a field notebook if you are collecting multiple animals. In this notebook, you can record the details of obtaining permission to collect as well as permit numbers, notes on the habitat and time of day the collection was made, and any other details about the time and conditions when the collection was made. These data can be extremely valuable for scientists in their research.

Fig. 32 the shed exoskeletons of a *Dolomedes albineus* from when it emerges from the egg sac to adulthood

Fig. 33a immature *Bassaniana versicolor* missing two legs

Fig. 33b *Bassaniana versicolor* freshly molted with regenerated legs

Fig. 33c *Bassaniana versicolor* with regenerated legs

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Fig. 34a *Dolomedes albineus* exoskeleton stomach

Fig. 34b *Dolomedes albineus* exoskeleton stomach close-up

SPIDER LIFE HISTORY

Development and Growth

Spiders start their life as an egg laid by the female. Some mothers guard their egg sacs, others carry their egg sacs with them, and some build the egg sac and leave their offspring to fend for themselves. In some cases, the young emerge months after the mother has died. When the spiders emerge from the egg, they look like a spider, although they may not look exactly like the adult form of their species. They will then go through a series of molts, or *ecdysis* (shedding of the exoskeleton), to grow (fig. 32). All spiders molt, and many of them can regenerate lost limbs during this process. Legs, chelicerae, pedipalps, or spinnerets lost due to injury, predator attacks, or a previous bad molt can all be regenerated. Figure 33 shows a *Bassaniana versicolor* that was collected missing two legs. He molted into maturity and regenerated both legs. You can see that, when he was freshly molted and he tried to stretch the two new legs as much as possible, they were pale. Once his legs hardened, they had the same coloration as the other legs, although they were slightly shorter. In this case, as the spider is now a mature male, he will not molt again. If he were immature and able to molt again, we would likely not be able to tell that any of his legs had regenerated. One interesting fact about spiders is that ecdysis is not limited to the external cuticle we see on the spider. Figure 34 shows a few photos of the stomach and esophagus that were shed during the molting of a *Dolomedes albineus* fishing spider.

Fig. 34c *Dolomedes albineus* exoskeleton stomach

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How Spiders Disperse

Spiders are known to be one of the first colonizers of recently disturbed habitats, such as areas devastated by fire, flooding, or even human behaviors. For example, during a May 1884 expedition after the eruption of Krakatoa, which cleared the landscape of all animal life, the first (and only) living creature found was a spider on the south side of Rakata (Thornton 1997). How do spiders get to these habitats? They fly using a technique called ballooning (fig. 35). Spiders can balloon at any time of year, and some spiders can balloon at any life stage, but most often ballooning occurs when young spiders disperse from where they emerged. During the spring and fall/early winter, it is not uncommon to have mass ballooning events, where the landscape will be covered by the gossamer silk strands of thousands of spiders taking flight. The photo in figure 36 was taken on December 24, 2015, in central Ohio. You can see the gossamer silk covering the grassy areas of the park. To balloon, spiders usually climb up any structures that can provide them with height. They then stand on their tiptoes and start releasing silk. When enough silk has been released to catch the wind (or electromagnetic field), they take off. Often, they make many failed attempts to balloon and release the long strands of silk before takeoff.


Fig. 35a *Pardosa* sp. wolf spider ballooning

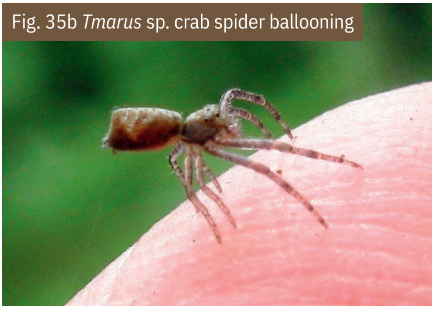
Fig. 35b *Tmarus* sp. crab spider ballooning


Fig. 35c *Philodromus* sp. ballooning


Fig. 35d *Steatoda grossa* ballooning


Fig. 36 field at a park in Central Ohio covered in gossamer silk

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Mating and Courtship

Spiders have some unique mating and courtship rituals (fig. 37). Since spiders are so diverse, there are many different strategies, but many of them include some way for the male to be sure the female is the correct species and receptive to mating (as the female can and will readily eat male suitors). A simple internet search will yield numerous videos demonstrating a vast variety of courtship displays. Many a male web-based spider plucks the strands of the female's web to announce his arrival. Male jumping spiders dance and sing in elaborate displays. Some wolf spiders purr and use percussion and stridulation to attract a mate. Although Australian peacock jumping spiders are not found in North America, videos of them are really fun to watch, as the males display their abdomens in their mating dances.

There is a myth that all spider females eat the male once copulation is complete. The notorious black widows have this reputation erroneously, as there are not many quantified cases where the male succumbs to the fangs of the female, especially if the female is in good condition (Johnson et al. 2011). In contrast, studies have shown that the male *Dolomedes tenebrosus* (dark fishing spider) spontaneously dies after mating and then is consumed by the female (Schwartz, Wagner, and Hebets 2014). Some male spiders are known to offer the female a "nuptial gift" of a snack prior to attempting to mate—in the hopes, one would assume, that she would be too busy eating her gift to consider eating the male.

Fig. 37a *Agelenopsis* sp. mating

Fig. 37b *Dolomedes albineus* (in captivity) mating

Fig. 37c *Tetragnatha elongata* mating

Fig. 37d *Tetragnatha elongata* mating showing the locked jaws

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Fig. 37e *Micrathena gracilis* mating

Fig. 37f *Phidippus audax* male courting female

Fig. 37g *Phrurolithus goodnighti* mating

Fig. 37h *Trachelas tranquillus* (in captivity) male courting female

Fig. 37i Lycosidae mating

Fig. 37j *Gea heptagon* male courting female

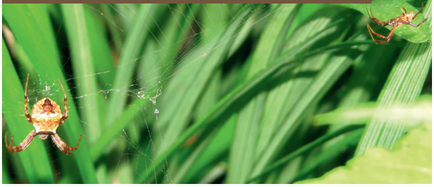

Fig. 37k *Neriene radiata* mating

One unique thing about spider mating is the method of sperm transfer. Male spiders have modified pedipalps, and upon maturing, they build a sperm web onto which they deposit their semen. The pedipalps are charged by dipping into the semen, collecting it. When copulation between spiders occurs, the embolus of the palp is inserted into the female's epigynum or gonopore, and the sperm is delivered to the female (fig. 38). This sperm can be stored by the female for months to years and used to create multiple egg sacs. A captive *Steatoda grossa* (false black widow) produced thirteen viable egg sacs over eighteen months from a single mating encounter (fig. 39). Egg sacs come in many different shapes and sizes. Some are carried by the females, some are guarded by the females, and some are left to fend for themselves (fig. 40).

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Fig. 38 male *Steatoda grossa* with palp inserted


Fig. 39 *Steatoda grossa* making an egg sac


Fig. 40a *Bassaniana* sp. guarding egg sac with young emerging


Fig. 40b *Heteropoda ventoria* with egg sac


Fig. 40c *Parasteatoda tabulata* with egg sac


Fig. 40d *Trachelas tranquillus* egg sac


Fig. 40e *Pholcus manueli* with egg sac


Fig. 40f *Ero* sp. egg sac

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Fig. 40g *Tigrosa helluo* with egg sac

Fig. 40h *Uloborus glomsus* with egg sac

Fig. 40i *Neospintharus trigonum* with egg sac

Fig. 40j *Dolomedes albineus* with egg sac

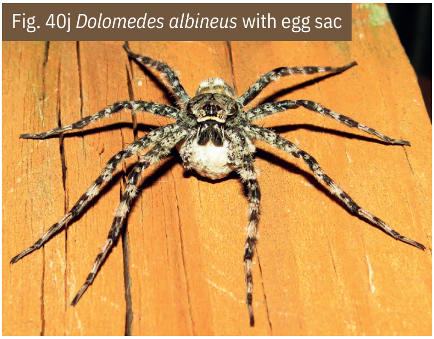

Fig. 40k *Euryopis* sp. egg sac

Fig. 40l *Cyclosa turbinata* with egg sac in trashline

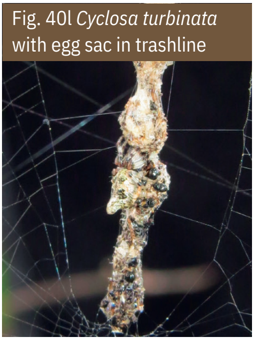

Fig. 40m *Mermessus tridentatus* egg sac

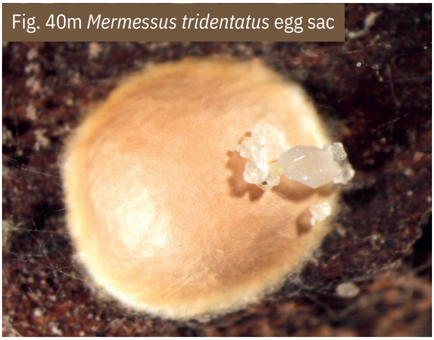

Fig. 40n *Mastophora hutchinsoni* egg sac

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Fig. 40o *Enoplognatha marmorata* with egg sac


Fig. 40p *Tetragnatha laboriosa* egg sac


Fig. 40q *Theridiosoma gemmosum* egg sac


Fig. 40r *Theridion* sp. guarding egg sac with young emerging


Fig. 40s *Rhomphaea fictilium* egg sac


Fig. 40t *Oxyopes scalaris* guarding egg sac with young emerging


Fig. 40u Gnaphosidae guarding egg sac

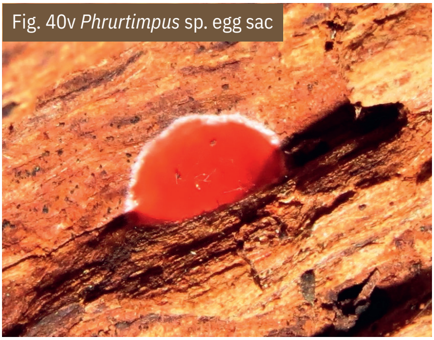
Fig. 40v *Phrurtimpus* sp. egg sac

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WHAT ARE THE BENEFITS OF HAVING SPIDERS AROUND?

Spiders often elicit strong responses in people. Some people love them; many people strongly dislike them. Whether you like them or not, there are lots of benefits to having spiders around.

Spiders are one of the top predators of the invertebrate world. There is only one documented "vegetarian" spider: *Bagheera kiplingi*, which is native to Central America. It has forgone the predatory lifestyle. The other spiders utilize prey for at least some of their food intake. The fact that spiders are predators is highly beneficial to humans. It has been calculated that the mass of insects that all spiders consume each year totals more than the mass of the entire human population (Nyffeler and Birkhofer 2017). Without spiders, we would be overrun with many insects that people don't like to have around (as they eat us, our food, or our homes). Figure 41 shows just a few examples of spiders with their invertebrate prey. Most spiders are generalist predators and can even act as our first line of defense against potentially invasive insects, as you can see in figure 42, which shows a *Neoscona* orbweaver feasting on a spotted lanternfly (*Lycorma delicatula*); in figure 43, which shows a *Phidippus audax* feeding on a brown marmorated stink bug (*Halyomorpha halys*); and in figure 44, which shows an *Araneus marmoreus* preying upon a German yellowjacket (*Vespula germanica*). All of the insects are non-native, and the spotted laternfly and brown marmorated stink bug are considered invasive species. Spiders are not usually considered of economic importance,


Fig. 41a *Euryopis* sp. with ant


Fig. 41b *Trachelas tranquillus* with Indianmeal moth

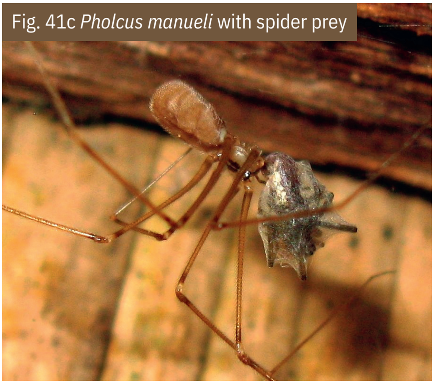
Fig. 41c *Pholcus manueli* with spider prey

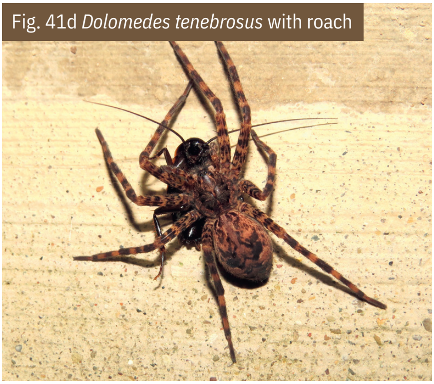
Fig. 41d *Dolomedes tenebrosus* with roach

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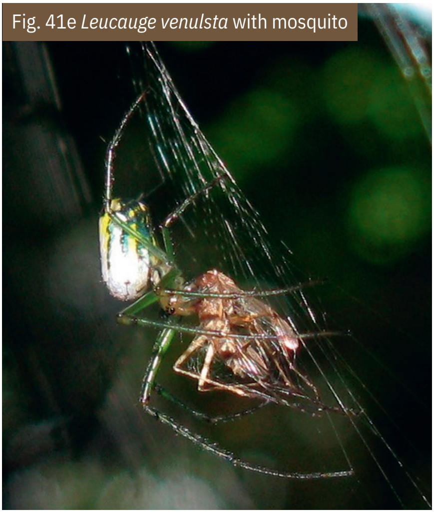

Fig. 41e *Leucauge venulsta* with mosquito

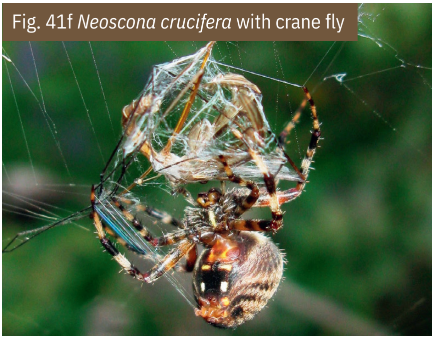

Fig. 41f *Neoscona crucifera* with crane fly

Fig. 41h *Leucauge venusta* with midge

Fig. 41g *Synema parvulum* with ant

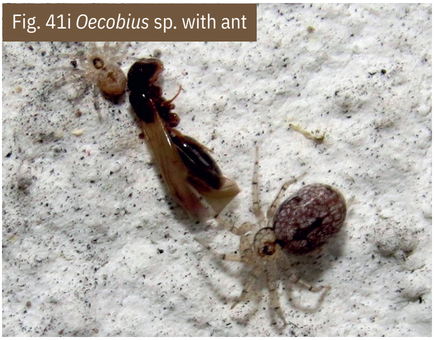

Fig. 41i *Oecobius* sp. with ant

Fig. 41j *Micrathena gracilis* with horsefly

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Fig. 41k *Theridion frondeum* with Opiliones

Fig. 41l *Neriene clathara* with fruit fly

Fig. 42 *Neoscona* sp. feeding on a spotted lanternfly (*Lycorma delicatula*)

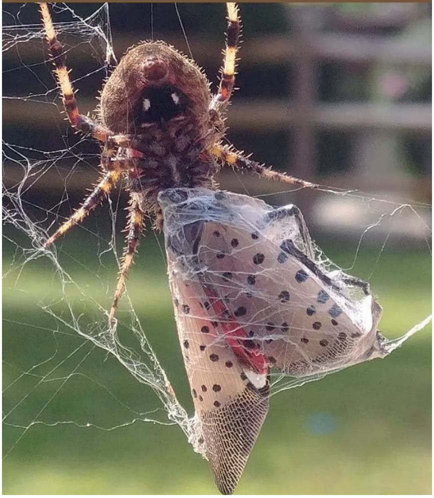

Fig. 43 *Phidippus audax* feeding on a brown marmorated stink bug (*Halyomorpha halys*)

Fig. 44 *Araneus marmoreus* with German yellowjacket (*Vespula germanica*)

Fig. 45 *Argiope aurantia* with a five-lined skink (*Plestiodon fasciatus*)

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but the role they play in pest control is extremely valuable. Every so often, you will find that spiders are able to capture and overpower vertebrates, too. Figure 45 shows an *Argiope aurantia* that has caught a five-lined skink (*Plestiodon fasciatus*).

Spiders also serve as prey to many animals, including but not limited to birds (fig. 46), lizards, snakes, small mammals, fish, insects, even other spiders. A study has even shown that baby birds that were fed spiders have greater brain development (Arnold et al. 2007), and many birds also utilize spider webs in nest building (fig. 47). Additionally,


Fig. 46 Grackle with spider prey


Fig. 47a Hummingbird and nest

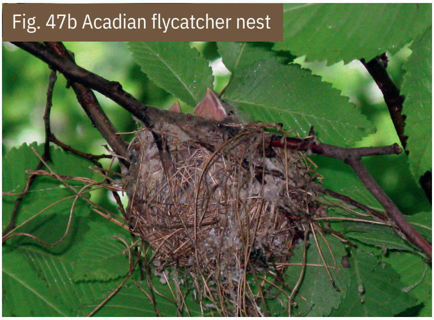
Fig. 47b Acadian flycatcher nest

hummingbirds have been observed picking prey insects out of a *Micrathena gracilis* web. The spider was not consumed in this case. It may be that the spines on the spider were a deterrent to it serving as a prey item for the hummingbird. To have birds, we need spiders.

Spiders are also hosts for a number of parasites and parasitoids. Quite a few insects will prey upon spiders in various life stages. There are wasps that specialize on spiders, paralyzing them for their larvae to feed upon (fig. 48). Some of these wasps remove the spider's legs before securing the body in a burrow with an egg laid on it (fig. 49). There are wasps that provide multiple spiders for each larva, and that pack mud tubes full of spiders (fig. 50). Small-headed flies are internal parasites that consume the spider from the inside until they are ready to pupate into flies (fig. 51). There are also wasps that lay their egg on a spider, and the larva will feed on the spider while it goes about its normal life (fig. 52). When the wasp is ready to pupate, it can use mind control to make the spider build an appropriate web for its cocoon. Then it will finish off the spider before pupating.


Fig. 48 Wasp with paralyzed spider


Fig. 49 Wasp with spider with legs removed

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Fig. 50 *Trypoxylon* wasp nest with paralyzed spiders

Fig. 51a *Philodromus* sp. harboring a smallheaded fly larva

Fig. 51b Smallheaded fly larva emerging from host *Philodromus* sp.

Fig. 51c Smallheaded fly larva emerging from host *Philodromus* sp.

Fig. 51d Smallheaded fly larva

Fig. 51e Smallheaded fly larva

(continued...)

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INDEX

This index includes the *scientific name* (in *italics*) and the common name (as approved by the American Arachnological Society) of each species in this book. Family scientific names are capitalized, and the guilds are capitalized and in **bold**. Page numbers are followed by figure numbers (in parenthesis and in *italics*) when referring to a photograph. The page numbers in **bold** highlight the main written account.

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