

Spiders

AN INTRODUCTION

Naturalists know that the world is full of interesting organisms. Yet for most people, naturalists included, a large portion of our lives is lived in human-altered, domesticated environments. We don't notice the enormous variety of life that is all around us. The lawn becomes an undifferentiated green carpet; the forest edge, a green wall. Even more invisible to us is the microworld. Down among the thatch of dead grass and leaves at the soil surface is a world teeming with bacteria and fungi that break down and recycle dead tissues, creating the basis for the living soil. The microscopic organisms feed a plethora of others. By kneeling down and parting the grass with our hands or a stick, we get a glimpse into this microcosmos. Peering closely, we will likely observe one of its most active inhabitants: spiders. Spiders are ubiquitous in soil-surface communities. This abundance lives literally under our feet, yet we seldom notice.

As a biology teacher, and when presenting talks in my community, I am impressed that most people are unaware of the great variety of living organisms that share our world. They

seem genuinely surprised to learn that there are so many different kinds of wild animals, even in cities and towns. When leading field trips to local parks, I can usually find dozens of species of small creatures during a relatively short walk. Children particularly embrace these experiences and relish the act of discovery. Where I can, I pass out sweep nets and set the children loose into abandoned fields or meadows. Their enthusiasm and energy yield nets full of colorful and surprising tiny beasts. We dump the contents onto white sheets on the ground and gather around to inspect the catch. Of course, many insects fly out of the nets as soon as they are opened, and some of the spiders also make a mad dash to escape. The remaining animals often feign death, remaining motionless for a while. After a few moments, they too begin to move away toward the edge of the sheet. Having spread themselves out, the organisms' true complexity and colorful diversity become evident. It is not unusual to find a few dozen spiders, including many different species.

Armed with some simple skills, you can find spiders of many kinds, even in the most

mundane places. Some spiders have become regular occupants of our cities and parks. Some spiders inhabit buildings, but many more live outside. Venture outdoors and an abundance of spiders can be found in even a small residential yard. I recently compiled a list of all the types of spiders that I have found in our rural yard in central Ohio over the past 20 years. This list includes more than 160 different species of spiders representing 20 families—all this in one modest backyard acre!

NORTH AMERICAN SPIDER FAUNA

Worldwide, there are more than 42,000 spider species (Platnick 2012). The tropics host the greatest variety of spiders; nearly a quarter of the world's 110 families of spiders are found exclusively or primarily in the tropical realm. The focus of this book is the spiders of North America north of Mexico. No one knows exactly how many different types of spiders exist here, because relatively few scientists study spiders. Our knowledge of them is incomplete. At last count, a total of 3,807 species of spiders had been found in this region. Nearly the same number has been found in Europe, a substantially smaller geographic area. Judging from the continuing rate of discovery of new species in North America, it is reasonable to believe that the current list represents only a fraction of the true diversity. Why? Many of the species of spiders are small and inconspicuous. Other species are so similar that only a specialist using a microscope can distinguish them.

Within the region covered in this book, North America north of Mexico, the areas with the greatest diversity of spiders are along the southern boundary. Florida has many tropical and subtropical species. California and Texas are both large states with considerable topographic and climatic variety, thus it is not surprising that they host many spider species. Although many spiders have adapted to existence in the arid regions of the Southwest, humid habitats and forests typically harbor the

highest numbers of spiders. This guide provides information on most of the larger, more conspicuous, and common species of spiders found in North America north of Mexico. For some genera of spiders, many species look the same. In these cases, one species from the group is illustrated. Representatives of all 68 families of spiders found in the region studied here are included. Nearly half of the species in North America north of Mexico never grow to more than 3 mm (about an eighth of an inch) long. Many of these tiny spiders live near the soil surface, often in the loose layers of fallen leaves or under rocks, and are rarely observed. Others inhabit caves or crevices that are rarely visited. This guide is biased to include those larger spiders that a curious naturalist is likely to encounter. In total, 469 species representing 311 genera are included.

THE ROLE OF SPIDERS IN NATURE

As small or intermediate-sized predators in the food web, spiders are pivotal to the normal function of both natural and human-modified habitats. One study concluded that spiders accounted for more than half of the predator biomass in the forest floor community. Most spiders are considered generalist predators because they will capture and consume a variety of different kinds of prey. Some spiders are specialists that feed on only one type of prey. Because of their small size, the remarkable abundance of spiders is the key to their importance. Density estimates of spiders range from hundreds to millions of spiders per acre. Of course, these are mostly tiny spiders. Despite their bad reputation with the general public, spiders are mostly beneficial to humans. Scientific studies have established that spiders play an important role by eating insects in natural environments as well as in agricultural croplands. Although spiders cannot completely control explosive pest outbreaks, their presence probably dampens fluctuations in pest insect populations in farm fields and orchards.

Each natural environment has its own community of small animals, including many kinds of spiders. Consider the tiny spaces under the leaf litter of a deciduous forest: here you will find an abundance of tiny sheet-weaving and hunting spiders that prey on the resident mites and springtails. These spiders themselves will become food for larger spiders, ants, beetles, and perhaps wasps that also forage among the fallen leaves. On first glance, deserts seem to be inhospitable places. A closer look reveals that life abounds. In the dry brush of a desert wash in Arizona, sweeping with a net captures large numbers of small spiders searching for their insect prey. Up close, these are sometimes marvelously colored and beautiful animals, such as jumping spiders, but we overlook them in favor of the larger lizards and birds that also forage in this habitat. At night this same desert comes alive with both spider and scorpion predators.

Under the canopy of a soybean field in the Midwest live both sedentary cobweb weavers and active hunting lynx and jumping spiders. Near the ground are the tiny webs of numerous sheet-weaving species. Running on the soil surface are a variety of wolf spiders—small, medium, and large. Each of these is both predator and prey. They feed on small insects but may also eat spiders smaller than they are. In turn, they fall prey to large predatory spiders and insects, such as wasps and praying mantises.

Among the reedy growth at the edge of a freshwater pond can be found numerous horizontal orb webs of longjawed orbweavers waiting for emerging mosquitoes. Perhaps a fishing spider clings to a twig of emergent vegetation, patiently waiting for an unwary minnow, tadpole, or aquatic insect nymph to stray within reach. Along the muddy shore, small pirate wolf spiders stalk their insect prey. For each of these situations, the most numerous and important small predators in the ecosystem may be the spiders. They are inconspicuous but crucial components in every terrestrial environment. Tiny species, often living near the soil surface, are usually the most diverse residents. Pick

any spot and the first small predator that you encounter will probably be a spider.

SPIDERS IN BUILDINGS

A few spiders are closely associated with human-created habitats. These spiders can tolerate dry conditions indoors and may become locally abundant. Most of the spiders in buildings reside in relatively undisturbed or dark areas under furniture, in corners, closets, basements, cellars, garages, and warehouses. Outbuildings (such as barns and sheds) sometimes support large numbers of spiders. Spiders in buildings provide a service by capturing and devouring insect pests. Most will live out their lives without ever encountering their human landlords.

SPIDER LIFE HISTORIES

The lives of most spiders are relatively short. The majority of species live less than a year. The seasonal timing of reproduction in spiders usually conforms to one of a few basic patterns. One pattern, characteristic of large orbweavers, begins with emergence from the egg case in the spring. The young spiders grow throughout the summer and mature in the autumn. Egg cases are laid at this time, before the first hard frosts in the North, and the adults usually die before winter (see egg cases in color plates). The population continues through the winter as eggs or tiny juveniles in egg cases destined to emerge in spring. In a second common pattern, maturity is achieved in the spring, eggs are produced in late spring or early summer, and growth extends through the autumn. Individuals spend the winter as adults or subadults. Subadult spiders are one molt away from maturity. In the first appropriate weather of early spring, spiders become active, the subadults molt into adults, and courtship and mating occurs. Other spiders actually mature and reproduce during the winter months. This pattern is common among dwarf sheet weavers that live close to

the ground. Even in the North, where winter is cold, courtship may happen under the insulating cover of snow near the soil surface. Some multigenerational populations of spiders, particularly in warmer climates, can mature at any season and adults are found year-round.

Courtship and Mating

Some of the most fascinating aspects of spider behavior are their courtship and mating. Soon after a male spider molts into his mature form, he prepares for mating in a behavior called “charging the palps.” The palps (short for pedipalps) are small leglike appendages at the front of the spider’s head (see Fig. 7). In adult male spiders the last segment (the tarsus) of the palps is modified into a receptacle for the transfer of his sperm. Charging the palps entails spinning a small web, sometimes a single silk line, and depositing the seminal fluid containing sperm as a droplet onto this sperm web. The male then repositions himself and draws the droplet up into one of his palps and then the other.

Most male spiders live a relatively brief period as adults. It has been estimated that the average lifespan of an adult male orbweaver is only about one week, and they spend this time searching for females. In some species adult males may not eat during this period. For many spiders the males use special odors called pheromones to locate the females. Chemical cues may be present in the silk web, or draglines, of females. For example, some wolf spider males find the females by following her silk draglines. When a male encounters a female, he usually begins to court her immediately. This courting may involve a combination of plucking the web, vibrating or waving his palps and legs to provide a visual signal, or producing soft sounds by stridulation (rubbing two body parts together). Some spiders will tap the surface of the substrate (leaf, ground) with their legs or their body to produce the courtship sounds. This vibratory signal is usually transmitted to the female through the substrate. Some species of diurnal (day-active) spiders—in particular,



FIGURE 1. A pair of filmy dome spiders (*Neriene radiata*) mating. The male is above with the embolus of his palp inserted and the hematodocha is inflated, as sperm is pumped into the female’s gonopore (photo by author).

the members of the jumping spider family—use brightly colored body parts in visual courtship displays. It is important to remember that male spiders run the risk of being confused with prey, attacked, and eaten by the (usually larger) female. Elaborate courtship behavior may make this less likely.

If the female accepts the male, the two will mate. In some species the male has specific structures that permit him to grasp the female, or her jaws, during mating. In some crab spiders the male spins a few thin silk lines over the female as a mating veil. The male then reaches out to the female and inserts a syringe-like structure called the embolus (part of the palp) into her reproductive opening and pumps in the seminal fluid. In some spiders thin-walled sacs in the palps, called the hematodochae, inflate and assist in insertion and insemination (Fig. 1). Female spiders have bilaterally symmetrical reproductive structures, so after the first mating, the male may change sides and inseminate the other side. In some spiders the male will pause to recharge his palps between matings. The entire process may last a few moments, or sometimes it may extend for hours. The female stores the seminal fluid, containing the sperm, in special internal structures called spermathecae. When the female



FIGURE 2. Female spiders with their egg cases: (upper) *Misumessus oblongus*; (lower) *Pirata minuta* (photos by author).

lays eggs, she adds sperm from the spermathecae to fertilize them.

After mating, the pair usually separates relatively quickly. Typically the males provide little parental care. Females continue to feed, adding yolk to the eggs. The abdomen swells noticeably in such gravid females. At the appropriate time the female spins a special platform of silk upon which she deposits the eggs. The eggs are fertilized as they pass out through the oviduct. She then covers the eggs with a series of layers of soft silk padding and a tough outer covering, and finally she attaches this egg case in a suitable location. The shape and color of the egg case is often distinctive (Fig. 2). A few are so characteristic that the species that made them can be identified from the egg case alone. Some spiders leave the eggs to hatch, and the young emerge on their own. The female may remain with the egg case, guarding it until she dies. A few spider females carry the egg case with them until the young emerge. For exam-

ple, wolf spiders carry the egg case attached to the spinnerets (Fig. 2, lower); the nursery web spiders and cellar spiders carry the egg sac with their jaws. For spiders that lay eggs in the late autumn, the eggs are capable of surviving the freezing weather and emerge in the spring.

Growth and Development

When the young emerge from their eggs, they remain within the silken egg sac and continue to develop. Spiders grow by shedding their “skins” (called an exoskeleton). Each shedding of the exoskeleton is called a molt. Depending on species and sex, spiders can molt about five to ten times before reaching adulthood. Each developmental stage between successive molts is referred to as an instar. The young spiders, called spiderlings, undergo their first molt within the silken egg sac and then emerge as second-instar spiderlings. The spiderlings often remain together in a tight cluster for some hours before dispersing. In many spiders the young disperse by an aerial flight called ballooning. Ballooning is not powered flight; rather, it is passive, relying on a breeze more like the flying of a kite. The tiny spiderlings produce strands or loops of silk by walking back and forth near the tip of a grass blade, branch, or other exposed structure. Sometimes the spider pulls out a small amount of silk and points its abdomen skyward, the gentle breeze pulling out more and more silk until the spider is lifted into the air.

Ballooning usually occurs when there are gentle rising air currents, often early on a sunny morning. Catching their silk threads, the currents loft the tiny spiders skyward. Often the “flight” is short, but on occasion small spiders, even adults, can be carried high into the atmosphere during ballooning. Such long-distance dispersal is responsible for colonization of vacant territory with a fresh population of spiders. It represents a gentle “rain” of spiders that can occur almost anywhere. A number of scientific studies have shown that the first arrivals in an area after a catastrophe such as a flood,

volcanic eruption, ash flow, landslide, or fire are usually spiders (Crawford, Sugg, and Edwards 1995).

Spiderlings search for suitable environments particular to their species. For web builders, the physical characteristics of the vegetation or other substrate are often critical to the choice of an appropriate place to build a web. For burrowing spiders, it may be the soil texture or moisture. After establishment, young spiders forage for food to grow. Growth in all arthropods, including spiders, involves a series of molts. Each molt is the process of replacing the exoskeleton with a fresh, slightly larger one. In spiders this size, increase is initially accomplished by movement of body fluids between body compartments. The process begins internally with the dissolution of the inner layers of the old exoskeleton, freeing it from the body. The spider then forces body fluids into the front part of the body (cephalothorax) until it splits at the front edge, then around the sides. This pressure forces the soft vulnerable spider through this opening, and as its body is lifted out of the old exoskeleton, it pulls out its legs and palps last. All of this is usually accomplished with the spider hanging suspended on a silk line.

In some large spiders, such as tarantulas, the molt begins with the spider resting on its back rather than hanging from a thread. As the new exoskeleton hardens, the spider maintains blood pressure in the cephalothorax and legs to stretch them into a slightly larger size than previously. The abdomen has a flexible covering, and it is this area that appears shrunken during the transfer of fluid to the expanded cephalothorax and legs. Just after molting, the body proportions are a bit unusual, with the abdomen being small. A few meals will solve this discrepancy, and the spider's proportions are quickly restored.

SPIDER SILK

A key feature of spiders is their ability to spin silk. The silk of spiders is produced by glands

in the abdomen and secreted from special fingerlike appendages at the end of the abdomen called spinnerets. Each spinneret has many microscopic spigots through which the silk is secreted. The silk itself is composed almost entirely of protein. This protein is in a liquid form within the body of the spider, but as it is pulled out, the molecular structure of the silk is rearranged and the silk becomes a solid yet elastic fiber. The spider does not eject the silk; rather, it must be pulled out either by attaching a silk line then moving the spinneret itself, tugging the silk out with a leg, or moving the body away from where the silk is attached. In addition to these fibrous proteins, some spiders make liquid adhesive glue that may be added to the silk as it is produced.

Spider silk has remarkable properties. It is exceptional both in strength and elasticity, and there is more than one type of silk, each of which has its own properties and specific uses (Hayashi, Shipley, and Lewis 1999). One of the most basic uses of silk by spiders is the production of a single line of silk dragline that is played out wherever the spider walks. The spider may catch itself in mid-fall or it may use the line to climb back up to where it fell. For many web-building spiders, which drop from their web when disturbed, the dragline often serves this purpose. Before moving on to a new location, it is not uncommon for the spider to produce a sort of anchor of silk. This is a tiny patch of adhesive silk that serves to fix the silk line. Another common use of silk is to spin a cocoon or silk-lined retreat. All spiders employ silk in constructing their egg case. Perhaps the most important use of silk for many spiders, however, is to produce the capture snare or web. Spiders' webs are distinctive of the species, and the characteristics of webs are useful for identification.

Some spiders have an unusual silk-spinning organ called a cribellum. The spiders that possess a cribellum produce a distinctive type of silk. The cribellum has hundreds of tiny spigots, each producing an impossibly thin strand of silk. Combined, these fibers become a fluffy

tangle that is produced around a pair of relatively thick, straight silk lines. This is accomplished with the aid of a special comb of spines on the hind legs that are used to manipulate the cribellar silk as it is produced. This special comb is called the calamistrum. The silk from the cribellum, referred to as cribellate silk, has unique properties. It is adhesive without glue. The large number of strands are drawn out and teased into irregular yarnlike fibers. The abundance of microscopic lines adhere to any irregular surface, even one that appears quite smooth to us, such as the shiny wing covers of a beetle. Because each fiber is composed of a teased fluff of lines, the webs of cribellate spiders look different. Sometimes “hackled” or “hackle-banded” is used to describe this sort of line. The lines look thicker or more reflective, sometimes in webs with simple thin lines combined with thicker cribellate sections. Under certain lighting conditions, the cribellate silk may even appear bluish.

SPIDER BEHAVIOR

Spiders are good at waiting. Many spiders will stop moving when they notice a potential predator, such as an observant human. A stationary spider is often difficult to see, unless the coloration contrasts with the background. Most spiders choose to rest in places where their colors match the background, rendering them camouflaged. When we search for spiders, we most often notice them if they are exposed in a web or because they are moving. If you stay still and watch a motionless spider long enough, it may resume its normal behavior. The common behaviors of spiders that we are likely to observe are related to finding food or searching for and courting a mate. To understand what we are seeing, it is important to think in terms of the spider’s world.

SPIDER SENSES

To understand spider behavior, we must try to perceive the world as spiders do, through their

very different senses. This is indeed challenging because humans primarily use sight and sound, while spiders are first and foremost creatures of touch. Spiders sense subtle vibration, typically substrate-borne vibration. What does this mean? Spiders are covered with exquisitely sensitive sensory organs that are adapted to reception of vibratory clues about their environment. The place where the spider is standing, or hanging, is the substrate. The spider notices tiny vibrations felt through sensors in and on its eight legs and sometimes the palps. If the substrate is solid—such as a leaf, branch, rock, or the ground—the vibrations are very subtle. Spiders have been shown to sense the faint signals of walking insects many inches away and can even estimate the distance and direction of potential prey (Barth 2002). Webs are a sort of extension of the spider’s body. Vibrations are transmitted efficiently to the legs through the thin taut strands of the web lending web-building spiders remarkable sensitivity to disturbance of the web. These spiders can even distinguish what sort of prey has entered the web, merely by the pattern of vibrations. Thus spiders use their legs to “hear” the world they are standing on. By extension, the webs of spiders expand their sensory capabilities out into the environment.

Spiders also sense air movement with their hairs. The most sensitive hairs are the trichobothria, fine microscopic hairs borne in pits and attached to a flexible membrane of the exoskeleton. These trichobothria can feel air movement so well that they are sometimes referred to as sensors of touch-at-a-distance. Spiders can detect the approach of potential prey, or a dangerous predator, well before it comes in contact with them. This sense is limited, however, and sound waves are perceived only to the extent that they jiggle the trichobothria. There is modest evidence that they can also sense airborne chemical compounds—that is, essentially smell—with the hair receptors or tiny pit organs of the legs and palps. The clearest demonstration of odor reception is the perception of sexual perfumes called pheromones. Some

spiders have been shown to respond to the sexual pheromones of others of their species from distances as great as 1 meter. This distance, for a spider, would be roughly equivalent to a city block in human terms. Spiders' chemoreceptors are also sensitive to direct contact, a sense similar to taste.

Although useful, sight is only an important sense for some spiders. They do have eyes, typically eight, but the eyes of most spiders are small, and their vision is adapted to sense pattern and movement. For many types of spiders, vision is used to detect the threatening approach of a potential predator. The presence of many eyes, each with a different visual field, ensures that spiders can detect movement from almost any direction. They often do have eyes in the back of their heads! It truly is difficult to sneak up on a spider without it noticing our approach. The activity patterns of spiders are influenced by the light cycle of day and night. Most spiders are active primarily at night. Like many nocturnal animals, nocturnally active spiders possess a reflective layer, the tapetum, at the back of their eyes. This has the function of reflecting the low light of the moon or stars at night back through the sensory retina, thus amplifying its signal and increasing its sensitivity in the dark. Wolf spiders are famous for having large eyes that enable night vision.

The structures of the spiders' eyes reveal much. The front lens of the eyes is a part of the exoskeleton and fused in place. Among the eight eyes, the most interesting differences are between the anterior median eyes (AME), or principal eyes, and the other eyes. Spiders can shift their gaze by moving the retina within the head well behind the lens. Thus the AME are the only ones that can search the visual field without the spider moving its body, making them a little like human eyes. This fact is dramatically illustrated by the jumping spiders, which have unusually large and acute AME. For them, the long tubular internal structure acts much like a miniature telephoto lens. Closely watching the extraordinary eyes of jumping spiders scanning their environment, one can

actually see a pattern of shadow shift within the eye tube. Of course, the jumping spiders are also famous for moving their bodies to face any object of interest, be it a potential prey, mate, or even a human observer. This habit of returning the human gaze with their own binocular visage is one of the features of jumping spiders that provide their appeal to many human watchers.

So how good is spider vision? The answer depends on the type of spider. Some spiders can barely form a simple image, using their vision mostly to avoid predators. A few cave spiders are blind. Others, most famously the jumping spiders, are primarily visual creatures. Their eyes are both large and acute. Jumping spiders, and perhaps others, are also capable of sensing color. Color vision ability is employed by female jumping spiders to watch the bright and colorful courtship displays of males.

SPIDER INTELLIGENCE

For most invertebrates, including spiders, much of their behavior is based on preprogrammed behavioral patterns that we call instinct. Nevertheless, it is clear that many spiders learn about their environment and this information is incorporated into decisions they make. They can be trained to respond to particular stimuli for a positive reward and will ignore stimuli associated with a negative or unpleasant experience. Spiders also learn spatial position information: they can orient themselves and return to familiar locations such as their web, retreat, or burrow.

Some spiders exhibit flexible behavior, which can be modified to suit subtly different situations. Typically these spiders are considered more intelligent. Examples include jumping spiders that employ spatial memory and planning in their stalking of prey at a distance (Tarsitano and Jackson 1997). They use an approach path that is out of view of the prey until the last possible moment before they pounce. They even alter their tactics for different prey. By contrast, the web-building spiders'



FIGURE 3. (Left) *Clubiona riparia*, folded-leaf retreat; the spider folds the leaf twice, using silk to fasten the edges (photo by Joseph Warfel). (Right) *Phidippus audax* and cocoon (photo by author).

behavioral program seems less flexible, yet their ability to adapt the detailed web-building protocol to local conditions is remarkable. Their reaction to disturbance at the web varies depending on the signal. Sometimes it is the struggling of a potentially suitable prey organism that will elicit an attack. Other times it is the approach of a potential threat, such as a hunting wasp. In this instance the spider will quickly drop from the web or vibrate it violently. For an adult female spider, it might be the arrival of a potential suitor. Each of these situations provides a complex suite of stimuli that must be received, interpreted, and acted upon, often quickly.

SPIDER MOVEMENT

Spiders have excellent climbing ability. They can move through almost any habitat. Equipped with specialized tufts of hair or claws on the tips of their legs, spiders can scale the smoothest surfaces with ease. The spiders' silk dragline is left behind as a continuous record of their journey. On occasion I've been able to follow the silk trail and find the spider, hunting for its next meal. If a wandering spider finds itself at the end of the trail—for example, the tip of a branch—it can just lower itself down on a silk line until it finds a new place to continue

searching. A number of spiders are fast runners. They exploit this ability to dash away to the nearest cover and then remain motionless until the threat moves on. Many spiders habitually walk, or even run, on the water's surface. These spiders are usually not immersed and floating; rather, they exploit a waxy water-repellant covering their lightweight bodies, allowing them to stay dry and to remain on top of the water surface. Watching a large spider on the water, you may notice that the legs are resting in shallow dimples, caused by the spider's weight pushing down and the water's surface tension pushing back up.

SPIDER RETREATS

Second only to their patience, spiders possess remarkable hiding ability. Some hide in plain sight, possessing bodies that are camouflaged against the background where they choose to rest, combined with their habit of remaining still. Other spiders squeeze into such tiny spaces as cracks in the soil or the bark on trunks of trees, gaps in the gravel, or debris at ground level. Many spiders spin silken cocoons or retreats where they spend their inactive period, usually the day (Fig. 3, right). The retreat may be a simple thin cocoon under a leaf or branch

or under the eaves of a building. Others build elaborate camouflaged spaces that are covered with bits of local environmental debris such as dead leaves, soil, flakes of lichen, even body parts of prey they have recently eaten. Some sac spiders are famous for folding over large blades of grass and sewing them into strong, resilient, waterproof chambers (Fig. 3, left). Web-building spiders often build small silk retreats near their hunting webs.

HOW SPIDERS HUNT

Spiders capture their prey either by grasping it with their front legs or biting their prey. Some spiders have such strong jaws that they can hold the prey as they inject venom. Others make a quick bite then back off and wait for the venom to take effect. After the prey is paralyzed, the spider moves in to feed. A third approach is to wrap the prey in silk to immobilize it, and then bite. Such spiders approach a potential prey item, turn so that their spinnerets are pointing at the target, then use their legs to rapidly draw out silk from the spinnerets and toss it onto the prey, a wrapping attack. For some spiders that use a wrapping attack on a surface—such as a rock, the trunk of a tree, or the ground—the spider moves around the prey and its action produces a sort of wall or tent of silk over the victim.

Spiders feed exclusively on liquid material. Once the prey has been immobilized, the spider regurgitates digestive fluids into the prey. The enzymes in this fluid liquefy the internal contents of the prey. The spider then sucks the liquid back out, digestive secretions and digested prey materials together. They may repeat this cycle of spitting-and-sucking for a few minutes to an hour or more. Some spiders use the teeth on their jaws, along with the moveable fangs to crush and manipulate their prey as the feeding progresses. Spiders that eat this way leave only a small pellet of indigestible material. Others do not crush the prey and feed only from small holes produced by the fangs; for these spiders the prey remains in a hollow,

but still recognizable, empty husk after the spider has finished its meal.

SPIDERS AS PREDATORS

Web-builders

The most familiar predatory strategy of spiders is to build a silk snare. Just over half (54 percent) of North American spider species use a web to capture their prey. The webs of spiders come in a great variety of types. Some are complex, with many functional components. Others can be as simple as a series of trip lines emanating from a retreat where the spider hides.

Ambushers

Many spiders dispense with building a web and employ a sit-and-wait ambush strategy. Remaining absolutely still, the spider is not noticed until it is too late. Of course this works best in a spot where prey may likely be found. Spiders can afford to use this time-consuming method because they expend little energy while waiting. One group of crab spiders, the flower spiders, are sit-and-wait hunters that take advantage of the attractiveness of flowers. They wait at flowers for the arrival of pollinators and often capture them. Flower spiders rest with their front four legs outstretched. These legs are well armored with heavy spines that assist in grasping the prey until it can be bitten. The venom acts quickly and as soon as the prey has been subdued, the legs release and the meal is held by the fangs alone.

Burrowers

Some spiders dig burrows as a retreat. Burrows often provide protection from predators and a favorable cool and moist microclimate. For some, the burrow is merely a retreat. These spiders leave the burrow and wander in search of food, usually under the cover of darkness. Other burrowing spiders remain in the burrow, or near its entrance. If danger threatens, they

can quickly disappear into the burrow. If potential prey happen by, a quick lunge is sufficient for capture. Several families of spiders build trapdoors to cover the burrow entrance, which can be closed when the spider is not hunting. The door serves to hide the burrow and protect the spider from predators.

Stalkers

Some spiders stalk their prey, a bit like a cat. These species move through the vegetation, or over the ground, periodically stopping to sense potential prey. They may feel the vibrations made by the prey as they walk by, or the spider may actually see the prey moving. The best-known visually hunting spiders are the jumping spiders. These diurnal spiders approach stealthily to within range, then pounce. Another group of stalking diurnal hunters are the active and agile lynx spiders. They run and jump over the vegetation with long thin legs. When they notice prey, they leap on it using their spiny legs as a capture basket.

Among the stalkers, the nursery web spiders are known for their relatively large size and their preference for humid or aquatic habitats. Several species of this group feed at the water's edge and from the water surface. They submerge below the surface to capture prey or to elude potential predators with some difficulty, because spiders are buoyant and will float to the surface if they release their grasp. They typically crawl below the water surface by holding onto aquatic vegetation. A number of other spiders are commonly found hunting at the water surface, including the long-legged water spider of Arizona and several species of pirate wolf spiders.

Wandering Hunters

The wandering hunters include spiders that typically hunt in vegetation, usually at night. These spiders move quickly, sometimes running, along the branches and leaves. They capture prey by running up onto them. The pale

ghost spiders, sac spiders, and prowling spiders feed in this way. These families share an adaptive behavior that supports their relatively active running lifestyle. They actually feed on plant nectar and other sugary secretions, both from the flowers and special nectar glands on the other parts of plants. This sugary solution provides them with the caloric energy to power their constant motion. In the Southern states, another group, the huntsman spiders, also forage in a similar way over the surface of plants, rocks, or the walls of buildings.

On the ground, too, there is a suite of wandering hunters. These include the familiar wolf spiders, ground spiders, wandering spiders, the antlike runners, as well as a number of smaller families. Most of the wolf spiders hunt on the ground or in low vegetation near the ground. They have excellent vision, and although many hunt during the day, more individuals can be found active at night. Their hunting strategy involves short movements alternating with periods of rest. It is while the spider is still that it detects the movement of potential prey. At night this detection is probably by sensing the vibrations caused by the prey moving over the substrate.

NAMES FOR SPIDERS

Scientists called taxonomists assign names to all organisms based on their biological relationship to one another. These names are recognized and applied worldwide, no matter what the language of the scientist. The names consist of seven parts or categories, which range from the broadest and most inclusive, to the narrowest and least inclusive; the categories are kingdom, phylum, class, order, family, genus, and species. Individual organisms that are members of the same species (and there are more than a million described species of organisms) are members of the same genus, the same family, the same order, and so on, and are the most closely related and can mate and reproduce. All members of the same genus are less closely related; all members of the same family even

less closely related and so on, up to members of the same kingdom. In the case of spiders, they are members of the kingdom Animalia, which includes all animals, from elephants to mosquitoes. Spiders are arthropods (members of the phylum Arthropoda), which are animals that possess exoskeletons and whose limbs and feet are jointed. This phylum also includes the insects and thereby contains more member species than any other phylum. The phylum Arthropoda contains several classes, one of which is Arachnida. Spiders are in this class, along with mites, ticks, scorpions, and harvestmen (called daddylonglegs by some)—all of which are arachnids. Among the arachnids are the “true spiders,” and these compose the order Araneae, the subject of this book.

Typically, in naming organisms, we could move from the category “order” to the final three categories—family, genus, and species—but to properly categorize spiders, we need two more groups within the order Araneae. One group consists of the suborders, of which there are two—the Mesothelae, an odd group of spiders with segmented abdomens, and all the rest of the spiders without segmentation, the Opisthothelae. All North American spiders fall into the Opisthothelae. Then the Opisthothelae are divided into two infraorders, Mygalomorphae and Araneomorphae. The mygalomorphs are mostly large burrowing spiders, such as the tarantulas. These spiders account for fewer than 4 percent of spiders in North America north of Mexico. The other 96 percent are members of the infraorder Araneomorphae.

The family name is what we use to refer to groups of spiders. For example, what are popularly called wolf spiders are in the family Lycosidae, also called lycosids. Likewise, people know jumping spiders, which are in the family Salticidae, or salticids. Crab spiders, in the family Thomisidae, are also known as thomisids. Some family groupings are controversial among scientists. There are differences of opinion based on which evidence for relationship is considered most important. For example, a

current controversy concerns the placement of certain genera in the Amaurobiidae or Agelenidae. Such disagreements are a normal part of systematics but can be frustrating or confusing to nonspecialists. Finally, all organisms, spiders included, have what is called a formal scientific binomial name, its genus and species. An example among spiders of a genus is *Phidippus*, which is one genus in the jumping spider family Salticidae. North of Mexico, the genus *Phidippus* contains 47 species, of which *audax* is one. *Phidippus audax* is the formal binomial name of an impressive jumping spider popularly known as the bold jumper. To summarize, the full scientific name of the bold jumper is described below:

phylum Arthropoda
 class Arachnida
 order Araneae
 suborder Opisthothelae
 infraorder Araneomorphae
 family Salticidae
 (jumping spiders)
 genus *Phidippus*
 species *audax*
 (bold jumper)

There are a few points to make about the use names. One is that the formal binomial name (genus, species) is always italicized, such as *Phidippus audax*. Second is that the genus name is capitalized, the species is not. Third, in formal scientific practice, the name of the scientist who named it and in what year is listed after the italicized name. The naming scientist is called the “author.” If the species has never been recategorized, and therefore its name has never been changed, the author’s name is not in parentheses, and it and the year of description follow the name of the species. If, however, a species has been recategorized, then the original author’s name and year of naming will appear in parentheses—for example, *Phidip-*

pus audax (Hentz, 1845), which was originally placed in the genus *Attus* by Nicolas Hentz back in 1845.

Finally, some common spiders have been given English names that can refer to just a single species or to an entire family. For example, a member of the single species *P. audax* is

known as the bold jumper. However, the entire family of Araneidae is known as the orbweavers. In cases where many families exhibit a shared distinctive behavior, such as the seven families that build somewhat similar circular webs, I identify them by that behavior collectively, the orb-shaped web group.