

Beneficial Insects, Spiders, and Other Mini-Creatures in Your Garden

Who They Are and How to Get Them to Stay

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Most of the insects, spiders, and other mini-creatures that pass through or live in your garden or home landscape are beneficial—or do little to no harm to you or your plants. Only a handful of garden-inhabiting species are harmful to your plants; unfortunately, these give the majority of the mini-creatures found in gardens a bad name. An ecologically-healthy garden or landscape has a diverse fauna of insects, spiders, mites, centipedes, and harvestmen—each with a unique, and usually beneficial, role in keeping your backyard habitat healthy and functioning efficiently.

Harmful insects are represented by the few plant-eaters (such as mites, aphids, and tent caterpillars) that congregate and feed, or occur in large numbers (thrips). Most plant-eating insects and mites occur at low densities and cause minimal damage, so they can often be tolerated in the garden. For example, the caterpillars of many moth and butterfly species usually occur at low densities, and their feeding damage is usually negligible (except for that of mature larvae of some large moths, like hawk moths). These low-impact herbivores not only improve landscape diversity, but serve a valuable role in the garden as sustenance for carnivorous insects that will be needed when infestations of high-impact plant feeders occur.

So who are the “good guys” that provide free pest control for the home garden? A veritable squadron of “natural enemies” is available in Pacific Northwest garden landscapes, or present in nearby refuges (riparian areas in parks, along creeks, and the like). This native complex of natural enemies of pests, insects, and mites, occupies all natural and undisturbed habitats. The trick is to get this helpful fauna to visit your back yard (and stay), and set up defense lines against the troublesome herbivores. Strategies to encourage beneficial insects, spiders, and mites to visit and stay in your garden landscape, are discussed at the end of this manual.

First, it is important to be able to identify insect, spider, and mite allies, and to recognize who your insect friends are, in order to gauge how the “war” against pests is going in your garden. Beneficial

arthropods (insects, mites, spiders, centipedes, and harvestmen) that help maintain a garden with few or no outbreaks of damaging plant pests, are either predators or parasitoids. Predatory insects and spiders hunt, attack, kill, and consume insect and mite prey, usually smaller than themselves. They are the equivalent of big cats in the jungle, and range in size from microscopic predatory mites to praying mantids that are 3 to 4 inches long. Parasitoids are usually very small parasitic insects that develop inside the bodies of pest insects, eventually killing them. Table 1 summarizes the groups of predatory and parasitic arthropods described in this publication, along with the prey or pest species they attack and kill. Another group of beneficial insects are those that visit flowers for nectar and provide pollination services. Populations of many native pollinators, including bees and butterflies, are declining, and well-managed home garden landscapes will likely play an increasingly important role in providing habitat and resources for these charismatic beneficial insects.

Predators

There are about 25 families of insects that contain predatory species, and virtually all of the more than 100 families of spiders are predatory. Other arachnids like harvestmen (daddy-long-legs) and mites also contain many families which are predatory. The family groups of predators most likely to be found in Pacific Northwest gardens are summarized below.

Praying Mantids

Praying Mantids are among the largest (1 to 4 inches long) and most recognizable garden predators—and they’re not fussy about what they catch and eat. They are “sit and wait” predators that pounce on any insect that comes too close, including beneficial insects, like bees and butterflies (Figures 1 and 2). The most common species in the Pacific Northwest is the European mantid (*Mantis religiosa*). Praying mantids are most often seen in the garden from mid-summer to mid-autumn. After laying a number of white, hard-foam egg cases (which overwinter attached to branches and trunks), mantids are typically killed off

Table 1. Summary of Predatory and Parasitic Arthropod Groups

Natural Enemy	Prey or Pest Targeted
Praying mantid	Flies, wasps, bees, caterpillars, moths, and butterflies.
Predatory bugs (true bugs, including damsel bugs, big-eyed bugs, minute pirate bugs, mirid bugs, stink bugs, assassin bugs, ambush bugs, etc.)	Mites, aphids, leafhoppers, thrips, caterpillars, mealybugs, beetles, scale insects, and insect eggs.
Predatory beetles (ground beetles, lady beetles, rove beetles, soldier beetles, etc.)	Mites, aphids, leafhoppers, mealybugs, thrips, insect eggs and small larvae, scale insects, and whiteflies.
Earwigs	Aphids, mites, thrips, leafhoppers, centipedes, millipedes, caterpillars, insect eggs, and whiteflies.
Lacewings and snakeflies	Mites, aphids, leafhoppers, whiteflies, thrips, mealybugs, caterpillars, insect eggs, and scale insects.
Predatory flies (hover flies, robber flies, bee flies, dance flies, long-legged flies, predatory midges)	Mites, aphids, scale insects, thrips, caterpillars, beetle larvae, flies, wasps, grasshoppers, and bees.
Predatory thrips	Thrips, mites, aphids, scale insects, and small caterpillars.
Ants	Aphids, mites, thrips, leafhoppers, centipedes, millipedes, caterpillars, insect eggs, and whiteflies.
Stinging wasps (paper wasps, yellowjackets, hornets)	Caterpillars, spiders, mantids, and beetles.
Predatory mites	Mites, scale insects, insect eggs, and nematodes.
Spiders (orb-weaver, crab, jumping, etc.)	Aphids, mites, caterpillars, flies, wasps, beetles, wasps, bees, grasshoppers, leafhoppers, whiteflies, thrips, mealybugs, moths, and butterflies.
Harvestmen (daddy-long-legs)	Small larvae, beetles, mites, aphids, earthworms, slugs, and spiders.
Centipedes	Spiders, cockroaches, beetles, caterpillars, earthworms, pill bugs, and earwigs.
Parasitic wasps (chalcids, encyrtids, braconids, ichneumonids, etc.)	Aphids, mealybugs, caterpillars, true bugs, beetles, grasshoppers, leafhoppers, spiders, whiteflies, and insect eggs.
Parasitic flies (tachinids, bee flies)	Aphids, mealybugs, caterpillars, true bugs, beetles, grasshoppers, leafhoppers, spiders, wasps, bees, whiteflies, and insect eggs.



Figure 1. The praying mantid (*Mantis religiosa*) (*Mantidae*).



Figure 2. Mantids are not fussy about what they eat and will consume other beneficial insects, like this monarch butterfly.

by the first frosts of autumn. They kill and consume a good number of pests like caterpillars and flies, but their contribution to garden pest control is usually less than their larger-than-life image.

Predatory Bugs

Although “bug” is often used to describe just about any insect, its correct use is reserved for the “true bugs,” an enormous group of both herbivorous and carnivorous insects that are characterized by having a syringe-like beak. Stink bugs, damsel bugs, big-eyed bugs, assassin bugs, ambush bugs, plant bugs, and minute pirate bugs may all be found in Pacific Northwest gardens feeding on plant pests like leafhoppers, scale insects, thrips, aphids, psyllids, whiteflies, mites, and small caterpillars. Predatory true bugs are all generalist feeders and may eat some beneficial insects, but their positive impact on garden pests far outweighs this negative aspect.

Stink Bugs. Stink bugs have a shield-shaped body and range in size from $\frac{1}{4}$ to 1 inch long. They usually discharge a disagreeable odor when handled. Although plant-feeding stink bugs are more common, a number of species of predatory stink bugs may be found in gardens including the cryptically colored rough stink bug (Figure 3). Like many predatory bugs, the rough stink bug may feed occasionally on plants, but does not cause noticeable damage or injury. Until recently, the Pacific Northwest was fortunate in not having any stink bug species capable of causing serious damage to plants or crops. Unfortunately, the invasion of the marmorated Asian stink bug (*Halyamorphha halys*), which is very similar in appearance to the rough stink bug, has changed this. Identification should be sought for any stink bug found in the garden before encouraging its persistence.

Damsel Bugs. Damsel bugs are slender insects up to a $\frac{1}{2}$ inch long with an elongated head, long antennae, and enlarged front legs for grasping prey. They are mostly yellowish, gray, or dull brown (Figure 4). Nymphs look like small adults but are wingless. Adult damsel bugs overwinter in ground cover, debris, and other protected sites. They emerge from hibernation in April or May and begin laying eggs soon after. Numerous overlapping generations occur during the spring and fall. Both adults and nymphs feed on many soft-bodied insects and mites, including aphids, leafhoppers, small caterpillars, thrips, and spider mites.

Big-eyed Bugs. Big-eyed bugs are oval, somewhat flattened, and $\frac{1}{10}$ to $\frac{1}{5}$ inch long. They have a wide head, prominent, bulging eyes, and short antennae with an enlarged tip. They are usually gray-brown to



Figure 3. Adult rough stink bug (*Brochymena affinis*) (*Pentatomidae*).



Figure 4. An adult damsel bug (*Nabis* sp.) (*Nabidae*).

blackish (Figure 5). Big-eyed bugs walk with a distinctive “waggle” and emit an unpleasant odor when handled. Eggs are laid near potential prey and hatch into nymphs that resemble small, wingless adults. Under summer conditions, big-eyed bugs go through five nymphal development stages (from egg to adult) in approximately 30 to 40 days. Two to three generations of big-eyed bugs occur each year between April and September, and adults will overwinter in leaf litter or under bark. Both adults and nymphs are predatory and prey on a wide variety of insects and mites that are smaller than themselves. Nymphs may consume up to 1600 spider mites during their development, and adults feed on 80 to 100 mites per day. They also feed on eggs and small larvae of cutworm moths and other caterpillar pests, as well as all stages of leafhoppers, thrips, and mites. While they are predatory in nature, they can survive on nectar and honeydew when prey is scarce.



Figure 5. An adult big-eyed bug (*Geocoris* sp.) (*Miridae*).



Figure 6. The adult assassin bug (*Rhynocoris ventralis*) (*Reduviidae*).



Figure 7. An egg raft of the assassin bug.

Assassin Bug. The assassin bug is larger than other predatory bugs (2/5 to 4/5 inches long), and has a long, narrow head with round, beady eyes, and an extended, three-segmented, needle-like beak (Figure 6). The front legs are enlarged for grasping prey. It can range in color from black, brown, or red. Its eggs are reddish-brown, bottle-shaped, and laid in a batch (or “raft”) of 10 to 25 or more (Figure 7).

The eggs are coated with a sticky substance for protection. Nymphs are slow to develop and early instars are often ant-like; however they do resemble small versions of adults.

Assassin bugs are long-lived predators (often living more than one season) and consume large numbers of small insects and mites during their lifetime. Population densities of assassin bugs are usually low, but they provide useful, consistent, and long-term feeding on leafhoppers, beetles and caterpillars in gardens.

Ambush Bugs. Ambush bugs are closely related to assassin bugs but are smaller (1/2 inch long) and specialize in preying on insects that are visiting flowers (Figure 8). They hide within the flower and kill unsuspecting wasps, flies, bees, and butterflies. However, immature ambush bugs live on other parts of the plant and contribute more to the garden pest control effort by eating small, soft bodied insects and mites (Figure 9). Batches of eggs held together by hardened froth can be found on twigs or fences in the fall and winter (Figure 10).



Figure 8. The adult ambush bug (*Phymata* sp.) (*Phymatidae*).



Figure 9. An ambush bug nymph.



Figure 10. The egg mass of the ambush bug. Note the hardened froth that holds the mass together.



Figure 11. An adult predatory mirid (*Deraeocoris brevis*) (Miridae).

Mirids. Mirids (“plant bugs”) are small, ¼ inch long, and black or brown in color. They are similar to big-eyed bugs, but without bulging eyes. Some species of mirids are omnivorous, feeding on plants as well as insects, but they rarely cause significant plant damage. Like big-eyed bugs, they are long-lived and spend their time hunting for mites, thrips, insect eggs, leafhoppers, and small caterpillars on leaves, buds, and flowers. The most common beneficial mirid found in eastern Washington is *Deraeocoris brevis* (Figure 11). This shiny black bug has pale markings on an oval body that is 1/10 to 1/5 inches long, and approximately 1/12 inch wide.

Deraeocoris overwinters as an adult in protected places such as under bark or in leaf litter. The adults emerge from hibernation in March and April and initially feed on the nectar of willow catkins and other early spring flowers. They seek out prey and begin to lay eggs in late April or May. The first generation of nymphs appear two to three weeks later and will continue to develop through five stages in approximately 25 days (at 70°F). A female mirid can lay up to 250 eggs during her lifetime.

Nymphs have dull, red eyes and are a whitish-gray color with long gray hairs on the thorax and abdomen—dark patches on the thorax and abdomen give it a spotted appearance. A cottony secretion covers most of its body. (Figure 12).

Deraeocoris adults and nymphs are voracious predators—adults can consume 10 to 20 aphids or mites a day; while nymphs can eat 400 mite eggs per day.

Minute Pirate Bugs. Minute pirate bugs are common predators in gardens and contribute significantly to the control of spider mites, rust mites, aphids, leafhoppers, mealybugs, and thrips. They are 1/12 to 1/5 inch long, oval-shaped, and black or purplish in color, with white markings on the forewings that extend beyond the tip of the



Figure 12. The nymph of a predatory mirid.

body (Figure 13). Minute pirate bugs overwinter as adults in leaf litter or under bark and usually emerge from hibernation in March-April. Females lay an average of 130 eggs during their lifetime and several generations are produced during spring and summer. The tiny (1/100 inch) eggs are embedded in plant tissue with the egg’s “lid” exposed, through which the nymph emerges (Figure 14).

Newly hatched nymphs are transparent with a slight yellow tinge (Figure 14), turning yellow-orange to brown with maturity (Figure 15). They are fast-moving, wingless, and teardrop-shaped. The development period from egg to adult, through five nymphal stages, takes a minimum of 20 days.

Minute pirate bugs are efficient at locating prey and are voracious feeders—adults and immature nymphs can consume 30 to 40 spider mites or aphids per day. When prey is not available, minute pirate bugs are able to survive on nectar, pollen, and plant juices. They aggregate in areas of high prey density and increase their numbers more rapidly when there is an abundance of prey.



Figure 13. Adult minute pirate bug (*Orius tristicolor*) (*Anthocoridae*).



Figure 14. Eggs and early instar nymph of minute pirate bug.



Figure 15. Mature nymph of minute pirate bug checking out its next meal, a caterpillar.

Predatory Beetles

Beetles are the most diverse and numerous group of insects worldwide. This group includes some very important garden predators, such as ground beetles, and the very familiar lady beetle.

Ground Beetles. Ground beetles (carabids), as their name suggests, are ground-dwelling and live in soil and detritus. Some species prey on cutworms, ants, maggots, earthworms, slugs, and other beetles. Carabids are largely nocturnal and are rarely seen, but large populations can exist in gardens and provide valuable pest control services. There are many species of ground beetles ranging in size from 1/8 to 1 inch long, and most are a shiny, dark color with prominent eyes and thread-like antennae (Figure 16).

Rove Beetles. Rove beetles are common in most gardens, but are rarely seen because of their secretive and nocturnal behavior. However, if you turn over a rock or log, especially near a compost pile,



Figure 16. An adult ground beetle (*Carabidae*).



Figure 17. Adult rove beetle (*Staphylinidae*).

you will frequently find these fast-moving beetles. They are odd-looking, shiny brown or black beetles, 1/4 to 1 inch long, with elongated bodies and short wings (Figure 17). Rove beetles have long sharp mandibles that close sideways across the front of the head, and larger species are capable of inflicting a bite if roughly handled. They look fierce because of the scorpion-like way they hold the tip of the abdomen, but most are only dangerous to the insects on which they prey. Adults and larvae feed on a wide range of insects that are smaller than themselves, especially fly maggots, ant larvae, mites, and many other soft-bodied arthropods.

Lady Beetles. Lady beetles are revered for their splash of color, and are a favorite with gardeners and children alike. After butterflies, they are probably the best-loved insects of all. They are often featured in human cultures as symbols of good luck and religion—they are certainly a good sign in the garden, indicating a healthy environment. Lady beetles are industrious predators and are extremely important to the natural suppression of aphids, leafhoppers, mites, thrips, scale insects, mealybugs, and insect eggs. Gardeners should encourage all lady beetles to colonize and reside in their gardens. Attracting and conserving lady beetles is more effective and sustainable than introducing purchased lady beetles to the garden. Purchased insects tend to rapidly leave the garden after release.

There are about 90 species of lady beetles in the Pacific Northwest, but only a dozen species are likely to turn up in the garden. The five species most likely to be seen in Washington gardens include the transverse, convergent, seven-spot, multi-colored, and mite-eating lady beetles.

Transverse Lady Beetles. Transverse lady beetles (*Coccinella transversoguttata*) are native to North America, but appear to be declining in numbers



Figure 18. An adult transverse lady beetle (*Coccinella transversoguttata*) (Coccinellidae).

(Marshall 2006). The transverse lady beetle has a round shape and is approximately 1/4 inch long. Its wing covers (elytra) are orange-red with distinct, narrow transverse black markings (Figure 18). The body and pronotum (the area between the head and wing cases) are black with small white or yellow patches.

Females lay yellowish-orange, elongated eggs in upright batches. Eggs hatch into alligator-shaped larva that are purple-blue with orange markings. Larvae molt through four instars before pupating, and the entire lifecycle, from egg to adult, takes approximately 3 to 4 weeks during the summer. Both larvae and adults are voracious feeders—adults may consume up to 100 aphids or mites a day depending on the temperature. When prey is scarce, adults can survive on nectar, honeydew, and pollen (but will not reproduce).

Convergent Lady Beetles. Convergent lady beetles (*Hippodamia convergens*) are a native species and are common in gardens. They are also available commercially and can be purchased from garden centers and introduced into the garden. However, these lady beetles frequently disperse away from the site of introduction.

The adult is approximately 1/4 inch long and more oval-shaped than round (Figure 19). The wing covers range in color from orange to red and typically have 12 to 13 black spots. However, the number of spots is variable, and some individuals have none. The pronotum is black with two converging white stripes and white edges. The small head is nearly covered by the front of the thorax.

Females will lay 200 to 500 eggs during their lifetime, which hatch in 5 to 7 days. The alligator-shaped larva is dark gray to blackish-blue with two small, indistinct orange spots on the pronotum and four larger spots on the back (Figure 20). The pupa is orange and black and is often attached to the upper



Figure 19. An overwintering aggregation of convergent lady beetles (*Hippodamia convergens*) (Coccinellidae).



Figure 20. Larva of the convergent lady beetle.



Figure 21. The pupa of the convergent lady beetle.

surface of a leaf (Figure 21). The insect's development through larval and pupal stages takes 3 to 6 weeks, depending on available food and temperature. There can be one to two generations a season, but the largest populations occur during spring.

Convergent lady beetles tend to disappear when the weather becomes hot, especially in eastern Washington. Field evidence suggests that populations migrate to cooler, high-elevation areas in summer and aestivate (go into summer dormancy).

Congregations of millions of inactive convergent lady beetles may be found during July and August in the Blue Mountains of northeastern Oregon and southeastern Washington. Most of these beetles overwinter in the mountains before migrating back to the valley areas in spring (Figure 19).

Asian Lady Beetles. The exotic, multicolored Asian lady beetle (*Harmonia axyridis*) is considered to be

primarily a forest-dweller, but it is frequently seen in home landscapes, and is often the most common lady beetle species present. There is concern that this species is displacing native lady beetles in some areas of the United States (Marshall 2006).

Adults are distinctly oval and convex, and approximately 1/4 inch long. They vary greatly in color and pattern, but most commonly, they are orange to red with many spots or no spots at all. Some individuals are black with several large orange spots. The first section between the head and thorax is straw-yellow with up to five black spots; or it may have lateral spots usually joined to form two curved lines, an M-shaped mark, or a solid trapezoid (Figure 22).

Unmated females overwinter in large congregations, often in buildings or caves. Mating occurs in spring and eggs hatch in 5 to 7 days. Asian lady beetle larvae are elongate, somewhat flattened, and adorned with strong round nodules (tubercles) and spines. The mature larva is strikingly colored, black to dark bluish-gray, with a prominent bright yellow-orange patch on the sides of abdominal segments 1 to 5.

In summer, the larval stage is completed in 12 to 14 days and the pupal stage requires an additional 5 to 6 days. In cool conditions development may take up to 36 days.

Adults may live for 2 to 3 years and are voracious predators, feeding on aphids, scale insects, insect eggs, small caterpillars, spider mites, and leafhoppers. In late summer and fall, populations may increase to high levels, and can be seen swarming on fences and walls. To date, populations in the Pacific Northwest have not reached the extraordinary levels seen in some areas of the eastern U.S., where the insects often enter houses and need to be controlled. While some home invasions have occurred in the Seattle and Portland areas, it's been relatively small-scale compared to the eastern U.S.



Figure 22. Adult multicolored Asian lady beetle (*Harmonia axyridis*) (Coccinellidae).



Figure 23. The adult seven-spotted lady beetle (*Coccinella septempunctata*) (Coccinellidae).

Seven-Spotted Lady Beetle. The seven-spotted lady beetle (*Coccinella septempunctata*) is another exotic species, and is a relative newcomer to the Pacific Northwest, having been unknown in the region before 2000 (Marshall 2006). This lady beetle is large (approximately 3/8 inch long) compared to other lady beetles, with a white or pale spot on either side of the first section between the head and thorax (Figure 23). The body is oval and domed. The black spot pattern is usually configured with one spot near the head, four spots across the mid-section, and two near the back, on orange or red wing cases.

Adults overwinter in protected sites, and throughout the spring and into early summer, females may lay from 200 to more than 1,000 eggs. The eggs are usually deposited near prey, in small clusters of 10 to 50, in protected sites on plant leaves and stems. Larvae are alligator-like, dark gray with orange spots on body segments 1 and 4. They grow from 1/25 inch to 3/8 inch long in 10 to 30 days, depending on the food supply of aphids. The pupal stage lasts from 3 to 12 days depending on temperature. Adults are most abundant in mid- to late-summer and live for weeks or months, depending on the availability of prey and time of year. One to two generations of seven-spotted lady beetle occur before the adults enter hibernation.

Mite-Eating Lady Beetle. The mite-eating lady beetle, *Stethorus picipes*, is a native species commonly found in the garden; however, the introduced species, *S. punctillum*, may also turn up. Both species are voracious spider mite feeders (consuming 50 to 75 mites per day), and are very useful for good biological control of spider mites. One or two in the garden are usually sufficient to control an early-season mite “hot spot,” preventing it from spreading into a larger outbreak.

Mite-eating lady beetles are the size of a pin-head (1/25 to 1/16 inch), shiny black in color, oval,



Figure 24. The adult mite-eating lady beetle (*Stethorus picipes*) (Coccinellidae).



Figure 25. Mite-eating lady beetle egg.



Figure 26. Larva of mite-eating lady beetle.

convex, and covered with sparse, fine, yellowish-to-white hairs (Figure 24).

Non-reproductive adults overwinter in protected habitats, such as in ground debris or under bark. Adults emerge from hibernation in March and April, and begin to seek out spider mite colonies—which they are able to do extraordinarily well. Once the



Figure 27. Pupa of mite-eating lady beetle.



Figure 28. The adult scymnus beetle (*Coccinellidae*) can often be mistaken for a mite-eating lady beetle.



Figure 29. Larva of scymnus beetle.

food source is located, females feed rapidly (exterminating small colonies of mites) and lay approximately 15 eggs per day. The eggs are white and laid singly, usually on the underside of leaves near the primary vein, and adhere tightly to the leaf (Figure 25). A newly hatched larva is gray to black, and has many long-branched hairs and black patches (Figure 26). The larvae grow from 1/25 to 1/16 inch



Figure 30. European earwig (*Forficula auricularia*) (*Dermaptera*).

long, becoming reddish as they mature, just prior to pupation. Larvae develop through four instars, pupating after 12 days. Pupae are black and flattened, somewhat pointed on the posterior end, with the entire body covered with yellow hairs (Figure 27). The development from egg to adult takes approximately 3 weeks, and 3 to 4 generations are produced during the spring and summer months. Adults live for 4 to 8 weeks during summer and thrive at temperatures between 68°F and 95°F.

Scymnus Beetles. A number of *Scymnus* beetles (*Scymnus* spp.) are found in Washington, and all are predators of rust and spider mites, as well as leafhoppers and mealybugs. Adult scymnus beetles are slightly larger than the mite-eating lady beetle and have similar coloring, making it easy to mistake one species for the other (Figure 28). However, scymnus larvae are very different. The scymnus beetle larvae have white or pale colored, long, thick, cottony filaments adorning the body (Figure 29). They look a little like mealybugs and can be mistaken for that pest.

Earwigs

Earwigs are so named because of their alleged behavior of frequenting people's ears! This may have occurred 500 years ago, when people slept on the damp ground (where earwigs live), but the ear of a twenty-first century human is unlikely to be the dark, damp place an earwig would call home today. The introduced European earwig (*Forficula auricularia*; Figure 30) is found in most gardens, and is an omnivore that eats small insects (especially aphids and small caterpillars) as well as flower petals and leaves. The earwig is about 1/2 inch in length and is nocturnal. At moderate population levels, the earwig probably does far more good than bad in most gardens.

Lacewings

Adult lacewings are delicate, slender-bodied creatures (1/2 to 1 inch long) that appear to fly weakly, with



Figure 31. The adult golden eye lacewing (*Chrysopa oculata*) (*Chrysopidae*).



Figure 32. Green lacewing eggs are laid singly, each on a long, hair-like stalk.



Figure 33. Larva of a green lacewing.

lacy, netted wings (Figure 31). There are two types: green lacewings (most frequently seen in gardens) and brown lacewings. Brown lacewings are generally smaller (1/4 to 1/2 inch long) and active earlier and later in the season than green lacewings.

Green lacewings lay their eggs singly, each on a long, hair-like stalk, presumably to keep the egg away from substrate-based predators (Figure 32). Although adults of some lacewings are predatory, it is the lacewing larvae that provide most of the pest control in the garden.

Lacewing larvae, like lady beetle larvae, resemble little alligators, but differ by having enlarged sickle-

shaped mouthparts that extend forward from the head (Figure 33). These mouthparts puncture prey and suck out bodily fluids. A garden abundant with lacewings is almost certain to have a well-balanced habitat, since these predators thrive best in undisturbed, pesticide-free environments.

Snakeflies

Snakeflies are similar to lacewings but have an extended “neck” and a long, tapering head, which resembles a snake’s head (Figure 34). They are about 3/4 inch long and are commonly seen in gardens and in trees. Snakeflies are voracious predators, and feed on a variety of small soft bodied insects and mites. Larvae are also predatory and can be found living under tree bark or on the ground in decaying matter.

Predatory Flies

Most people do not consider flies to be beneficial insects, but a surprising number of these two-winged insects provide good pest control in the garden.

Hover Flies. Hover flies do not look like a typical fly, instead they resemble wasps, with their yellow-or orange-and-black-banded abdomens (Figure 35). They also mimic the behavior of stinging wasps and bees, which presumably confers survival benefits to the stingless hover fly. Such is the cleverness of their deception that agricultural fields have been sprayed



Figure 34. Adult snakefly (*Agulla* sp.) (*Rhapidiidae*).



Figure 35. The adult hover fly (*Sphaerophoria* sp.) (*Syrphidae*).



Figure 36. The larva of a hover fly is legless and can be green, gray, or yellow.



Figure 37. Larvae of hover flies feeding on aphids.

with pesticides because of the presence of “wasps!” Before beating a hasty retreat from that “wasp” in your garden, observe it a little closer—is it hovering? Most wasps do not spend time hovering, but hover flies excel in this behavior. Hover flies frequently visit flowers and feed on nectar and pollen (belying their other common name of flower flies), and are important pollinators.

Adults and larvae can range in size from 1/4 to 1/2 inch long. The larvae can be green, gray, or yellow and are legless (Figure 36). They develop for 1 to 2 weeks, feeding voraciously on aphids, thrips, mites, and other small insects. If you find a legless maggot within a colony of aphids, it will be a hover fly larva enjoying a meal (Figure 37).

Robber Flies. Robber flies are large (1/2 to 1 inch long), aggressive predators that capture prey while in flight. They have prominent eyes, long legs, and a tapered slender abdomen (Figure 38). They catch and consume many kinds of insects including flies, wasps, grasshoppers, leafhoppers, beetles, and butterflies. Robber fly larvae live in the soil and feed on small insects.

Bee Flies. Bee flies are, as their name suggests, bee-like with large, fuzzy bodies and a wingspan range from 1/4 to 3/4 inch (Figure 39). Despite their



Figure 38. Adult robber fly (Asilidae).



Figure 39. Adult bee fly (*Anastoechus* sp.) (Bombyliidae).

spear-like mouthparts, they are pollen feeders and are harmless to people. Their larvae, however, are predators or parasitoids of a wide variety of mostly soil-dwelling insects in the immature stages of development, including grasshoppers, beetles, wasps, and bees.

Predatory Midges. Predatory midges are tiny (less than 1/8 inch long), mosquito-like flies. The larvae of a few species prey on mites and aphids. The predatory gall midge (*Feltiella acarisuga*, Figure 40), specializes in feeding on spider mites, while *Aphidoletes aphidimyza* attacks aphids. Predatory midge larvae are similar to those of hover flies, but are much smaller, and like hover fly larvae, they live among colonies of their prey.

Long Legged Flies. Long legged flies, as their name suggests, are graced with long legs (Figure 41). These flies are 1/4 to 1/2 inch long, metallic-green to blue, and are common in most gardens, favoring moist areas. They prey on small, soft-bodied insects like aphids, thrips, young caterpillars, and mites. There is little known about the larvae, but they are also likely to be predators or scavengers in detritus and soil.



Figure 40. Larva of the predatory gall midge (*Feltiella acarisuga*) (*Cecidomyiidae*).



Figure 42. Adult dance fly (*Platypalpus* sp.) (*Hybotidae*).



Figure 41. Adult long legged fly (*Condylostylus* sp.) (*Dolichopodidae*).



Figure 43. Predatory thrips (*Aleoalothripidae*).

Dance Flies. Dance flies are similar in appearance and size to long legged flies, but they have shorter legs and usually a humped thorax (Figure 42). They are predators of aphids, flies, thrips, and other small, soft-bodied insects. Common in gardens, dance flies are often seen “dancing” in mating swarms—thus its common name.

Predatory Thrips

The majority of thrips found in gardens are plant feeders and only occasionally cause significant damage beyond leaf speckling. The most common species found is the western flower thrips, which feeds on a wide host-range including insect and mite eggs, making it a true omnivore. Other garden thrips species are true predators, feeding only on mites, aphids, small caterpillars, and other thrips. Most of the predatory thrips in the Pacific Northwest are about 1/16 inch long, dark colored and banded in white, or are red-orange (Figure 43). Closer observation with a hand-lens will show that the forelegs of these thrips are enlarged for handling prey.



Figure 44. Worker ant (*Formicidae*).

Ants

Every home garden has ants, and, like spiders, these creatures engender fear and loathing in some people. Ants indoors are clearly a problem, but outdoors, they have an important place in the garden’s ecology. Many species play an important role as pest control or scavengers (Figure 44). Other species prefer to collect sweet substances, like honeydew, produced



Figure 45. The European paper wasp (*Polistes dominula*) (Vespidae), an introduced species, can be identified by its mostly orange antennae.



Figure 46. A western yellowjacket (*Vespula pennsylvanica*) (Vespidae).

by some pest insects like aphids. These ants “protect” honeydew-producers from their natural enemies and therefore disrupt biological control. Fortunately, in the Pacific Northwest, predatory ant species tend to outnumber honeydew-collectors, so ants are generally good for the home garden.

Stinging Wasps

Stinging wasps include the familiar paper wasps, yellowjackets, and hornets; and, despite their fearsome reputation, most provide valuable pest control services.

Paper Wasps. Native paper wasps live in small groups of 6 to 20 in papery nests that hang from stalks under house eaves or from branches in bushes and trees. These wasps search plants for caterpillars, beetle larvae, and other suitable prey, which are chewed, then fed to the larvae in the nest. Unless the nest is in a high-traffic area like a doorway, paper wasps usually do not sting people—if you leave them alone, they will leave you alone. However, the



Figure 47. Hunting wasp (*Sphecidae*) carrying caterpillar prey.

non-native European paper wasp (*Polistes dominula*) (Figure 45) is an aggressive species, which has recently spread to the Pacific Northwest. It should be discouraged from living in the garden and nests should be removed. The European paper wasp is recognizable by its mostly orange antennae—the only paper wasp with antenna of this color.

Yellowjackets. Yellowjackets (Figure 46) are also very aggressive (especially in late summer and fall) and do more harm than good in the garden. The foraging activities of yellowjackets are dominated by scavenging rather than predation, thus their potential for danger in the garden or backyard outranks any pest control benefits. The nests of yellowjackets are located below ground or in the walls of a structure, and may contain hundreds of wasps. The presence of a nest is a clear and present threat to people and pets, and professional help with their removal should be sought.

Hunting Wasps

Hunting wasps are solitary insects and rarely sting. There are many species of these wasps, and each specializes in the type of insect it preys upon. Some hunting wasps prey only on spiders, while other species feed on grasshoppers, and still others will prey on caterpillars (Figure 47). Live, paralyzed prey is taken back to a nest (usually made of mud) and stored. The female hunting wasp will lay an egg on the paralyzed prey, which provides food for the developing larva. Hunting wasps range in size from 1/2 to 1 1/2 inches long and while they appear quite fearsome, they are a definite asset to pest control in the home garden.

Predatory Mites

Predatory mites are among the unseen, and invariably, the unsung heroes of the home garden. A



Figure 48. Western predatory mite (*Galendromus occidentalis*) (*Phytoseiidae*) with an egg (oval egg on lower left) and a spider mite egg (round egg on upper right).

typical garden in the Pacific Northwest, which has not been treated with pesticides, will have dozens of species of predatory mites living on leaves, in trees, or on the ground. They prey mainly on plant-feeding pest mites, but also consume insect eggs and thrips. Because of their tiny size (1/50 inch long), a hand-lens or microscope is usually needed to have a good look at these creatures. Most mites move rapidly and may be seen by the naked eye as fast moving “dots” on the undersides of leaves.

The most important group of predatory mites, known as phytoseiids, are extensively used in bio-control programs against spider mites in agriculture (Flint and Dreistadt 1998) (Figure 48). Phytoseiids are excellent predators of a range of plant-feeding mites, and a healthy home garden population of phytoseiids will go a long way to ensure that spider mites are not a pest problem on plants. If pest mites are regularly causing plant damage, it’s likely that there are few phytoseiids living in your garden. Predatory mites may be purchased from biological control suppliers, but it is best to attract and conserve locally adapted populations by restricting pesticide use. Plants with leaves that have hairs, chambers, or pits on the underside are often favored by predatory mites because they provide shelter.

Spiders

Spiders generally evoke negative emotions in people, but you should truly be grateful for their presence in your garden. The pest control service that spiders provide is enormous and greatly under-appreciated. There are more than 800 species of spiders in Washington State, and the average pesticide-free garden is likely to be home to 20 to 25 species.

Spiders occupy a range of habitat niches with correspondingly different behaviors and prey preferences.



Figure 49. An orb weaver spider (*Araneidae*).



Figure 50. A jumping spider (*Salticidae*).

There are three main groups of spiders: those that spin and sit in webs to catch their prey; those that are very active, foraging for prey, and often running it down; and those that sit still and “ambush” prey when it comes too close. Garden web builders are perhaps the least threatening to people because they are fixed in a location and not likely to surprise anybody (except for the unfortunate winged insects that get caught in the web). Most often seen in late summer and autumn, orb-weaving or “garden” spiders (Figure 49), spin their prominent, and sometimes large, webs in bushes and on buildings, fences, and the like, catching and feeding on any winged insect that gets trapped.

Hunting spiders patrol backyards constantly searching for prey. Some species specialize on ground-living prey, others roam over plants and trees, while others prefer to hunt on structures like fences and buildings. Jumping spiders (salticids) are small to medium-sized spiders (1/4 to 1/2 inch long) that jump and pounce on their prey. They are commonly found in Pacific Northwest gardens. All hunting spiders devour a great number of insects every day (Figure 50).



Figure 51. Crab spider (*Thomisidae*) welcoming prey.



Figure 52. Harvestman or daddy-long-legs (*Sclerosomatidae*).

Ambush spiders are masters of disguise, quietly waiting for prey to come to them. Crab spiders (1/4 to 1/2 inch long) often wait in blooming flowers for insects seeking nectar or pollen (Figure 51). Some sit on leaves waiting for an insect to land. Invariably, crab spiders are identically colored to their background, and some can even change color to match the background they are residing on.

By spending a little time watching spiders in your garden, your negative feelings towards them may just become positive!

Harvestmen

Closely related to spiders, harvestmen (known as daddy-long-legs) are common in gardens (Figure 52). While the insect's body may only measure 1/4 inch, its legs may stretch from 1 to 1½ inches long. The story that harvestmen are the most venomous animals in the world is a myth—they contain no venom and they are unable to puncture human skin. Most species are omnivores feeding on small insects and mites, as well as plants, fungi, and dead organisms. Although they don't control pests as well as spiders and mites, they do play a small role in pest control in gardens.



Figure 53. The stone centipede (*Lithobiidae*) is common in the Pacific Northwest and will bite if handled.

Centipedes

All centipedes (Figure 53) are predators of small insects and spiders that live in the ground or on the soil surface. They require a humid environment for survival and are vulnerable to desiccation. They are often found living under pots that are watered frequently. Stone centipedes (*Lithobiomorpha*) are commonly found in Pacific Northwest gardens, and can range in size from 1/2 to 2 inches long, with 15 pairs of legs. Be careful with stone centipedes, they will bite if handled!

Parasitoids

Parasitoids are natural enemies of pests and kill by devouring their prey from the inside out. Parasitoids develop within their pest host, and are parasitic only in their immature stages—killing their host just prior to maturity. In contrast to predators, where each individual kills many prey, each immature parasitoid kills only one host during its development. Most parasitoids are wasps or flies that do not sting people. These insects are often barely visible, and are very diverse in their appearance, biology, and hosts that they prey upon. Parasitoids play a vital role in the garden because they provide significant control of a number of pests, including aphids, scale insects, leafhoppers, mealybugs, and caterpillars.

Chalcid Wasps

Chalcids are very small (1/50 to 1/16 inch), dark-colored parasitic wasps, often metallic blue or green, with complex sculpturing on the body. There are hundreds of species in the Pacific Northwest, and most feed on the eggs and larval stages of moths, flies, grasshoppers, beetles, and other wasps (Figure 54).

Encyrtid Wasps

Encyrtids (Figure 55) are a group of very small (1/50 to 1/16 inch) parasitoids that are used in agriculture for the biological control of scale insects and mealybugs.



Figure 54. A parasitic wasp (Chalcididae).



Figure 55. Encyrtid wasp (*Metaphycus sp.*) (Encyrtidae).

Other species of encyrtids attack beetles, flies, caterpillars, grasshoppers, true bugs, and other wasps. With more than 300 species of encyrtid wasps found in the United States, every garden likely harbors some populations of these ubiquitous pest control agents.

Ichneumonid and Braconid Wasps

This group of familiar parasitic wasps comprises a number of species that target caterpillars. Adults usually measure from 1/2 to 1 1/2 inches long, are slender and long-legged, with the abdomen longer than the head and thorax combined (Figures 56 and 57). Many have a long ovipositor, which is a needle-like structure at the end of the female abdomen used for inserting eggs into the host insect.

Tachinid Flies

Tachinid flies resemble large house flies and are the most important group of parasitic flies. Their usual target prey are caterpillars. Tachinids range from 1/4 to 1/2 inch long, and are usually dark, robust, and hairy, with stout bristles at the tip of their abdomen



Figure 56. Ichneumonid wasp (*Trogus sp.*) (Ichneumonidae).



Figure 57. Braconid wasp (Braconidae).



Figure 58. Tachinid fly (Tachinidae).

(Figure 58). Eggs are laid on their hosts or on the plants that their hosts are living on. Young larvae bore their way into their caterpillar hosts and feed on internal organs until the host dies and the larva reemerges to pupate.

Pollinators

Many of the predators and parasitoids described above also play a secondary beneficial role in the garden—they help in flower pollination. As adults,

hover flies, predatory bugs, lady beetles, lacewings, predatory wasps, predatory flies, and many others will feed on nectar or pollen. Similarly, adult parasitoids, like tachinid flies and parasitic wasps, fuel themselves by feeding on sugary nectar. In the process of feeding, all of these pest-regulating insects also provide pollination services.

Non-carnivorous insects also play a role in flower pollination. The most important group of pollinators is, of course, the bees—both the introduced honey bee and the hundreds of native bee species that are found in the Pacific Northwest. Native bees are receiving renewed interest at a time when the introduced honey bees battle adversity and decline. Gardens stocked with bee-attractive flowering plants can play an important role in encouraging and conserving native bee species.

Butterflies are a group of pollinators with immense appeal, so much so, that some gardeners design and cultivate “butterfly gardens.” These gardens contain flowers and caterpillar host-plants aimed at attracting and retaining some of the 160 or more butterfly species found in the Pacific Northwest (James and Nunnallee 2011). The only butterfly caterpillar that causes plant damage is that of the cabbage white butterfly (*Pieris rapae*), which, as its name suggests, feeds on cabbages and related crucifers.

The geographic location of a garden or landscape will determine the species that are attracted to it. Inland gardens located east of the Cascades, generally have a wider variety of butterfly species visiting. In many eastern Washington gardens, growing the native chokecherry or ornamental green ash, along with butterfly-attracting flowering plants like coneflower, columbine, asters, and blazing star, virtually assures the residence of the largest butterfly in western North America—the two-tailed tiger swallowtail



Figure 59. A two-tailed tiger swallowtail Butterfly (*Papilio multicaudata*) feeding on columbine in an eastern Washington garden.

(*Papilio multicaudata*) (Figure 59). Coastal gardeners have a good chance of seeing the closely related western tiger swallowtail (*Papilio rutulus*), if they provide maples, willows, or cottonwoods for the caterpillars; and lilac, columbine, phlox, and the like, for the adult butterflies to feed on.

Strategies for Attracting and Keeping Beneficial Insects in Your Backyard

The single greatest impediment to attracting and maintaining a good population of beneficial insects and other arthropods in your backyard, is the regular use of synthetic, broad-spectrum pesticides. Infrequent use of certain narrow-spectrum pesticides is more compatible with some beneficial insects, but, generally, the fewer chemical inputs there are, the greater and more diverse the beneficial insect community will be. Some native bees and butterflies are extremely sensitive to pesticides, whether broad- or narrow-spectrum. Extensive lawns are also non-conducive to attracting and retaining a diversity of beneficial insects, mites, and spiders, so it's best to minimize lawn areas and maximize shrub and bush plantings.

Populations of all the beneficial insects described in this publication reside naturally in riparian (river- or creek-side) and other natural areas near many backyards. Natural dispersion from these refuges ensures that some beneficial insects will visit backyards, but they will not stay unless food, hosts, and shelter resources are available in the back yards. Native plants have closer affinities with native insects, and therefore provide most of these resources. Current research at Washington State University is identifying the plant species and communities that provide optimal resources for beneficial insects and other arthropods (<http://www.wavineyardbeautywithbenefits.com/>).

Generally though, providing some elements of a native habitat in and around backyards, will improve the abundance and diversity of natural enemies of pests and pollinators. A garden with a good diversity of local, native flora will soon attract a good diversity of local, beneficial arthropods. Native flora also provide natural overwintering sites for many beneficial insects, and it is useful to leave at least a small area of native vegetation undisturbed during fall and winter.

Some species of beneficial insects (lady beetles, lacewings, predatory mites) are available for purchase from commercial suppliers. However, the benefits from introducing these beneficial insects to your garden are usually limited and short-lived. Upon release, commercially obtained lady beetles and lacewings of-

ten disperse and rapidly leave your backyard, despite the presence of prey and suitable nectar resources. Purchased insects generally originate from non-local populations and may not be well-adapted to the conditions of the Pacific Northwest.

Generally, it is more effective and sustainable to create a garden habitat that will be colonized naturally. Food resources like sugar or yeast sprays are also commercially available and claim to encourage beneficial insect residence in backyards. However, if there is already a diversity of flowering plants available, these supplemental sprays are unlikely to significantly enhance populations. Beneficial insect attractants based on volatiles (usually methyl salicylate) produced by plants when attacked by pest insects, do have potential for attracting and retaining beneficial insects in the garden. These volatiles mimic the “distress signals” emitted by plants, and are therefore a reliable guide for predators and parasitoids searching for food or hosts (<http://www.agbio-inc.com/predalure.html>).

By being a good host to beneficial insects, spiders, and mites, your diversified, native plant-based garden should rarely experience plant pest outbreaks. As a fully-functioning ecosystem, with a diverse and balanced biological community, it will be as attractive, as it is practical.

Further Reading

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All photos are courtesy of David G. James, unless otherwise noted.

Use pesticides with care. Apply them only to plants, animals, or sites as listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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