Aphids & Their Relatives

O & T Guide [O-#01]

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Aphids are familiar, soft-bodied, pear-shaped insects with tremendous reproductive potential. As sap feeders, they can cause plants to wilt or seedlings to die; their excess fluid waste, called honeydew, attracts a variety of hungry flies, ants, wasps, bees and even rodents. Some species cause growth distortion or galls on their hosts, while others are vectors of certain plant pathogens. As a group, they demonstrate such a variety of host preferences and survival strategies that no generalized account can describe them adequately. Only a few common species affecting ornamentals are discussed below.

Scientifically: The insects in this fact sheet are all members of the Order Hemiptera, Suborder Sternorrhyncha. This classification may be quite different from that found in older entomology texts, yet it reflects recent revisions in certain insect orders and newer and accepted views on relationships among members of the order. The suborder name aptly describes the location of the mouthparts for aphids and their relatives---on the underside of the head and projecting between the bases of the first pair of legs, a feature that would require high power magnification to see clearly. All of the aphids described below belong to the family Aphididae with the exception of *Adelges*, the Cooley spruce gall aphid, which is a member of the Adelgidae (pine and spruce aphid family).

Metamorphosis: Simple
Mouth Parts: Piercing-sucking
Pest Stages: Nymphs, adults

Wingless adult green peach aphid, *Myzus persicae*. Note the cornicles on the abdomen. Photo: Whitney Cranshaw, Colorado State University, www.forestryimages.org

Life Cycle: Over the course of a year, different species of aphids can have life cycles ranging from simple to elaborate. An example of a simple life cycle is described here:

For most species found on woody ornamentals, the egg is the overwintering stage. Laid in small clutches on the bark of their perennial host, these eggs hatch in spring, producing female nymphs that mature usually within a couple of weeks.

These female adults reproduce parthenogenetically, that is, without males and mating. They also give birth to living young (called vivipary), producing one to many female offspring daily for an average 30-day adult life span. The first few generations usually consist of wingless individuals (all female) but eventually, crowding occurs and winged aphids (also female) are produced. In many species, these winged forms migrate to a different host species where reproduction involving parthenogenesis and live birth continues. As fall approaches, winged aphids are produced; these migrate back to the original perennial host, where they produce a single generation of both male and female aphids. After mating, overwintering eggs are produced and the parent aphids die. With short life cycles, all female populations and live births extend over a 30-day adult life time, tremendous populations of aphids build up very quickly on host plants.

Description of Life Stages:

Egg: Eggs are retained for internal development in parthenogenetic females. For those species overwintering on the bark of perennial hosts, eggs are minute, nearly spherical and usually dark gray or black. Some species scatter their eggs while others lay them in lines or small clusters.

Nymphs: Nymphs have globose to pear-shaped bodies with 3 pairs of thoracic legs, relatively long, thread-like antennae, small, paired compound eyes and a pair of tubular projections (cornicles) on the rear of the abdomen. Most are slow-moving, spending most of their time feeding. Some species are bare while others are covered by a fine dust or filaments of white wax produced by glands in their integument. Nymphs are various colors, depending upon species and sometimes hosts. Most are wingless; external wing buds may be visible in larger, older nymphs.

Adult: Most are wingless, looking like larger versions of nymphs; adults can reproduce, however. Parthenogenetic females give live birth to at least several nymphs daily for about 30 days in some species. Winged adults have two pairs of usually colorless wings; their hind wings are slightly smaller and shorter than their forewings. Aphids are usually green, yellow, black, brown, red, or pink, but may be almost any color, depending upon species and sometimes host plant. Veins on the leading edge of the forewing may be enlarged and black. Mouthparts are often absent on the last fall generation of aphids that will mate and lay overwintering eggs.

Habitat and Hosts: With over 1,000 described species in America north of Mexico, aphids exhibit a variety of habits, habitats and hosts. Indeed, nearly every species of ornamental grown in New Mexico nurseries, greenhouses, or anywhere outdoors will have at least one aphid or aphid relative that will use it for a host. Some aphids (e.g. Russian wheat aphid) are known from parthenogenetic populations of females only; presumably, these continue to feed over the winter in protected areas (roots?) of their hosts. Some common aphid species in greenhouses can continue parthenogenetic reproduction all year long, aided by warmer temperatures, availability of well-fertilized, succulent hosts and artificial lighting. Many other common aphid species overwinter as eggs on the bark of woody perennials but spend their summers on other species or herbaceous hosts.

Some species of aphids use very few species of hosts year-round; giant willow aphids (*Tuberolachnus salignus*) use only willow, rose aphids (*Macrosiphum rosae*) use various roses, ivy aphid (*Aphis hederae*) only English ivy, and conifer

Rose aphids, *Macrosiphum rosae*, on a rose bud. Overwintering eggs for rose aphids, *Macrosiphum rosae*,, also on rose.
Photos: Whitney Cranshaw, Colorado State University, www.forestryimages.org

Rose aphids, *Macrosiphum rosae*, on a rose bud. Overwintering eggs for rose aphids, *Macrosiphum rosae*,, also on rose.
Photos: Whitney Cranshaw, Colorado State University, www.forestryimages.org

bark aphids (*Cinara* spp.) are associated only with various pines, firs, spruce, etc. Other aphids have rather strange host affiliations; the introduced (from Europe) bright orange oleander aphid, *Aphis nerii*, is a common but apparently non-damaging pest of oleander, but it also does well on milkweed. Quite a few species of aphids or close relatives of aphids use very different hosts for overwintering and the summer. The curly leaf aphids (*Prociphilus* spp.) on ash foliage in the summer use roots of fir during the winter. Woolly apple aphid (*Eriosoma lanigerum*) causes woody galls on twigs, branches and roots of apple, hawthorn, mountain ash and pyracantha; it may overwinter as nymphs or adults on the roots of plants in the rose family or possibly as eggs on American elm if it is present.
Melon or cotton aphid (*Aphis gossypii*) and green peach aphid (*Myzus persicae*) have extensive host ranges, covering dozens of species in dozens of plant families. These latter two are probably the most common and persistent pests of plants grown in greenhouses.

Giant conifer aphids, *Cinara* sp.on pine twig. Note the ants tending these aphids.
Photo: E. Bradford Walker, Vermont Department of Forests, Parks and Recreation, www.forestryimages.org

Among the gall-making aphids and their relatives are: *Colopha ulmicola*, producing a cockscomb gall on elm foliage, *Pemphigus populitransversus*, producing a leaf petiole gall on poplar and cottonwood and the vagabond aphid, *Pemphigus vagabundus*, that produces a bunchy-leaf gall on foliage of poplar and cottonwood. Conifers also may be affected by these

pests; Cooley spruce gall aphids, *Adelges cooleyi*, create galls on spruce that resemble multi-chambered cones.

Damage: Aphids damage their hosts directly by removing sap, sometimes causing hosts to wilt. Salivary enzymes (proteins) injected into hosts during feeding can clog the vascular systems of some plants or injure surrounding tissue, causing yellowing spots, distorted growth or even necrosis (tissue death). Severely damaged foliage may fall from the plant, making it unsightly or unsaleable. Lost

Oleander aphid, *Aphis nerii*, with predatory coccinellid larvae. Photo: Anne W. Gideon, , www.forestryimages.org

Ash leaf-curl aphid, *Meliarhizophagus fraxinifolii*, on the underside of an ash leaf. Photo: Lacy L. Hyche, Auburn University, www.forestryimages.org

foliage may allow parts of the plant, including buds, flowers or fruit, to sunburn. Lost foliage results in loss of photosynthetic machinery for the plant; perennials may not be able to compensate for the loss of sugars that should be stored, especially late in the growing season.

Woolly apple aphid, *Eriosoma lanigerum*, on an apple twig. Their white waxy filaments have been partially removed to expose the aphids. Photo: Joseph Berger, , www.forestryimages.org

Alternatively, plants may expend additional energy to produce a new flush of foliage. Some species of aphids are well known vectors (carriers) of certain plant viruses. Often carried on the insect's mouthparts, the viruses are spread by winged aphids landing on plants and probing them with their feeding stylets. Aphids consume large quantities of plant sap, a rather dilute source of nutrients. Thus, they excrete tremendous amounts of liquid sugary wastes, called honeydew. Honeydew can leave a shiny residue on plants as well as make them sticky to the touch. Honeydew can be an attractive food source to a variety of insects such as ants, bees, wasps and flies. In high humidity conditions, it can also serve as a substrate for the growth of sooty mold fungi that blacken foliage, often causing the foliage to fall off affected plants.

IPM Notes: Aphids are hosts for a variety of predatory insects and spiders including minute pirate bugs, predatory stink bugs, damsel bugs, smaller assassin bugs, big eyed bugs, syrphid flies, many species of lady beetles and others. They are also targets for several genera of small parasitic wasps in the families Aphelinidae and Braconidae. Given enough time, these beneficial insects often can significantly reduce aphid populations on plants; however, host plants may incur significant damage in the meantime.

For small numbers of plants or where homeowners desire to use less hazardous means of control, strong streams of water can be sprayed as needed on infested plants to provide acceptable control. The aphids are so disturbed when they are knocked off their hosts that they are unable to find the plants again or settle to feed.

Insecticidal soap solutions may be used similarly. Horticultural oils formulated for use on green vegetation can kill aphids on contact; dormant oils applied to leafless trees and shrubs during the winter will often asphyxiate overwintering eggs of aphids as well as other pests on branches or trunks.

A variety of general use insecticides are available to homeowners for use on popular ornamentals. These same materials and a few restricted use products are available to licensed applicators. While many of these materials are contact insecticides, some are systemic; that is, the active ingredient may be absorbed by the plant and/or translocated in various plant tissues where it can be ingested by aphids as they feed on plant sap.

Cotton aphid, *Aphis gossypii*, wingless adults, nymphs and one winged adult. Photo: Mississippi State University Archives, Mississippi State University, www.forestryimages.org

Gall on the base of a cottonwood leaf produced by a cottonwood gall aphid, *Pemphigus populitransversus*. Photo: Herbert A. "Joe" Pase III, Texas Forest Service, www.forestryimages.org

Cooley spruce gall aphid, *Adelges cooleyi*, damage on a spruce twig. The brown cone-like structures are the dried, mature galls produced by feeding of these aphids. Earlier in spring, these galls housed developing colonies of Cooley spruce gall aphids. Photo: John A. Weidhass, Virginia Polytechnic Institute and State University, www.forestryimages.org

Cooley spruce gall aphid, *Adelges cooleyi*, feeding externally on needles of its alternate host, Douglas fir. Photo: Petr Kapitola, Forestry and Game Management Research Institute - Czechia, www.forestryimages.org

Bagworms

O & T Guide [O-#02]

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True to their common name, bagworms are caterpillars that feed and develop in individual silken bags camouflaged with dried bits of host foliage and frass (body waste).

Scientifically: Bagworms are member of the insect order Lepidoptera, family Psychidae. The bagworm described here is *Thyridopteryx ephemeraeformis*.

Metamorphosis: Complete
Mouth Parts: Chewing (larvae)
Damaging Stage: Larva

Typical Life Cycle: Eggs overwinter in the female's old bag which is firmly attached to the host plant → Larvae hatch in spring and soon disperse by crawling or being blown on wind currents. As they begin to feed on foliage they create individual silken bags that cover their abdomens. These are enlarged as the larvae grow. By late summer or fall, the mature larva attaches its bag to a twig of its host and molts to the pupa stage. → The male pupa matures by late fall and emerges as a winged adult moth. The female pupa also matures by late fall, only the sexually mature adult female that emerges is wingless, legless and still resembles a caterpillar in appearance. Flying at night, the male bagworms find and mate with female bagworms. Afterward the female returns to her old bag, laying her eggs in her old pupa case. The eggs remain in the bag until spring. One generation occurs annually.

Description of Life Stages:

Egg: Eggs are minute, white, and spherical to slightly elongated. When dissected from the old silk bag, they are often interspersed with an off-white, fluffy but fibrous material produced by the female.

Mature bagworm, *Thyridopteryx ephemeraeformis*. Note the dry, dead conifer needles incorporated into the bag of this individual. Compare with the photo of the bagworm collected from a broadleaf host. Photo: Eric R. Day, Virginia Polytechnic Institute and State University, www.forestryimages.org

Larvae: Normally, only the mottled grayish black and brown head, true legs and part of the thorax are exposed during feeding while the rest of the insect's body is covered by the bag. When threatened, the larva draws the camouflaged bag over its body and head.

Using silk glands (modified salivary glands) located near the chewing mouthparts, the larva covers its amber-colored abdomen with a bag of silk to which it attaches bits of dried, chewed host plant and frass; the bag is enlarged as the caterpillar grows and molts.

Bagworms have broad host ranges that include not only broadleaf shrubs and trees but also common ornamental conifers. Bags collected from different host plants may look very different due to the foliage bits involved.

The mature larva secures its bag to a host twig with a band of tough silk. After withdrawing inside the bag, the larva seals the opening and molts into a pupa.

By fall, bags of mature bagworms can be nearly two inches long for females and about 1.75 inches long for males.

Pupa: The pupa is a dark brown to black transitional stage about ¾ inch long. It does not feed and generally is incapable of moving. In the pupa, some larval tissues are lost while others are remodeled; new adult tissues are formed, also. The male pupa is tapered on the end, while the female pupa is rounded. The pupal stage for both sexes is completed by early fall when adults emerge.

Adult: The female adult bagworm is wingless, off-white to yellow, and caterpillar-like, with no or very tiny, useless legs. Most are 1-1.5 inches long but are rarely seen since they remain inside or close to their bags. The male is a "hairy," brownish-black moth with two pairs of yellowish-brown wings sparsely covered in black scales; most males are about an inch long with a wingspan of 1.25-1.5 inches. Males also are rarely seen since they are nocturnal. Males die shortly after mating; females die after ovipositing.

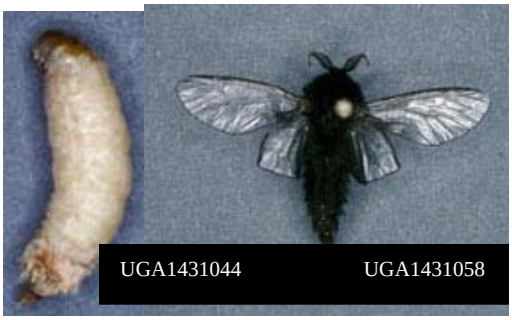
Habitat and Hosts: Bagworms feed on a variety of woody perennials, including evergreen conifers and deciduous broadleaf trees and shrubs. Bagworms are not native to New Mexico but have been introduced here multiple times over the last century on infested nursery stock.

Damage: Young larvae skeletonize host foliage while more mature larvae consume all but the larger veins on broadleaf plants. Since the larvae are so well camouflaged, defoliation during the growing season is easily overlooked. Affected plants may have noticeably fewer leaves by fall. While bagworms on evergreens may remain camouflaged throughout the winter, bags on broadleaf hosts will be easier to see when leaves fall. Even then the bags may be overlooked since they resemble dried foliage adhering to twigs.

IPM Notes: If possible, hand-pick the overwintering bags before foliage reappears in the spring since the bags are filled with eggs. Dispose of these bags in a trash bag that will not allow the larvae to hatch and escape back to host foliage; do not just drop the bags on the ground or throw them somewhere else in the landscape. To control young active bagworms, apply a foliar insecticide. Bacterial insecticides will be more effective on very young larvae. Once the bagworm is stationary and pupation has occurred, chemical control is ineffective.

This bagworm is the same species as that feeding on conifer (above), but this one is feeding on a broadleaf host (sweet gum). Note the bits of foliage incorporated into the bag. Photo: Lacy L. Hyche, Auburn University, www.forestryimages.org

This bagworm caterpillar is exposed after its debris-covered, silk-lined bag was cut open. At most, only the head and thorax would be visible; the abdomen is totally covered by the bag. Photo: Lacy L. Hyche, Auburn University, www.forestryimages.org



Adult bagworms. The female adult (left) bagworm pupated but remains larviform in appearance. After mating and laying eggs inside her old bag, the female dies. The male (right) has bushy antennae and two pairs of wings sparsely covered with black scales that often wear off before the male dies. Both photos: Lacy L. Hyche, Auburn University, www.forestryimages.org

By the fall, the female bagworm lays her white eggs in the pupa case she vacated inside her bag. These eggs resume development the following spring. Photo: Lacy L. Hyche, Auburn University, www.forestryimages.org

Bark Beetles

O & T Guide [O-#03]

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Although New Mexico bark beetle adults are small, rarely exceeding 1/3 inch in length, they are very capable of killing even the largest host trees with a mass assault, girdling them or inoculating them with certain lethal pathogens. Some species routinely attack the trunks and major limbs of their host trees, other bark beetle species mine the twigs of their hosts, pruning and weakening trees and facilitating the attack of other tree pests. While many devastating species of bark beetles are associated with New Mexico conifers, other species favor broadleaf trees and can be equally damaging.

Scientifically: Bark beetles belong to the insect order Coleoptera and the family Scolytidae.

Metamorphosis: Complete
Mouth Parts: Chewing (larvae and adults)
Pest Stages: Larvae and adults.

Typical Life Cycle: Adult bark beetles are strong fliers and are highly receptive to scents produced by damaged or stressed host trees as well as communication pheromones produced by other members of their species. The first beetles to attack a potential host tree may be repelled or killed by resins in the bark if that portion of the tree is still relatively healthy. If the tree is too weak to "pitch out" the beetles, infestation proceeds and even more bark mining beetles are attracted to infest the host. In extreme cases where bark beetle populations are exceedingly high, the defenses of even healthy, live host trees can be overwhelmed.

In monogamous species such as the Douglas fir beetle, *Dendroctonus pseudotsugae*, the female bores the initial gallery into the host tree, releases pheromones attractive to her species and accepts one male as her mate.

Adult "engraver beetle" in the genus *Ips*. The head is on the left; note the "scooped out" area rimmed by short spines on the rear of the beetle, a common feature for members of this genus. Photo: USDA Forest Service Archives, USDA Forest Service, www.forestryimages.org

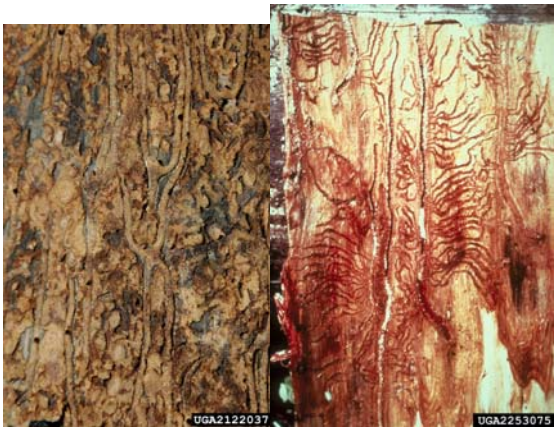
In polygamous species such as the pinyon bark beetle, *Ips confusus*, the male bores a short nuptial chamber into the host's bark, releases pheromones attractive to his species and mates with 2-3 females. Each female bores her own egg gallery through the live bark at angles to the nuptial chamber.

Many, if not all, bark beetle species transport spores of tree fungi that further weaken the host, clogging its vascular system and sometimes killing it before the bark beetles do. Tree fungi transported by conifer-infesting bark beetles in New Mexico are called either "blue stain" or "brown stain" fungi for the colors that streak and down grade the wood

after it is infested. The smaller European bark beetle, *Scolytus multistriatus,* transports the fungus responsible for Dutch elm disease, a lethal pathogen for American elm. Although the beetle has been confirmed in New Mexico elms, the disease has not (yet).

Introduced by bark beetles, blue stain fungus has been growing in the vascular system of this Douglas fir tree. Photo: Sandy Kegley, USDA Forest Service, www.forestryimages.org

As the female bark beetle chews her gallery, depositing eggs at intervals on either side, the male usually accompanies her, clearing the gallery behind her and pushing the boring dust out the entry hole, evidence of bark beetle infestation. After hatching, each larva bores its own tunnel through the phloem; together these radiate outward at near right angles to the female's egg gallery, creating a feather-like or lacey pattern on the inner bark. Multiple egg and larval galleries produced by mass attacks on host trees can quickly intersect all of the vascular tissue in the live bark, eliminating movement of photosynthates downward from the foliage as well as movement of water and nutrients upward from the roots. Larval tunneling further spreads the vascular fungi introduced into the host by the adult bark beetles. As the larvae molt, feed and continue tunneling away from the egg gallery, the mines become larger and frass filled. Mature larvae pupate at the ends of their tunnels. Upon emerging as adults, the beetles may remain under the host bark for some time, even the remainder of the winter, before chewing an emergence hole through the bark or exiting via a crack in the bark.



(Left) Larval galleries of the pinyon bark beetle, *Ips confusus*. Photo: William M. Ciesla, Forest Health Management International, www.forestryimages.org. (Right) Larval galleries of the Douglas fir bark beetle, *Dendroctonus pseudotsugae*. Photo: Mark McGregor, USDA Forest Service, www.forestryimages.org

Patterns formed under the bark by the adults and boring larvae generally are characteristic of each bark beetle species affecting that host. Dying and dead host trees often are infested by other wood boring, scavenging insects including metallic wood boring beetles, long horned beetles and others.

Some bark beetle species have only one generation annually, especially at higher elevations. Others may complete two to four generations per year. Reproductive activity usually is minimal in the winter.

Description of Life Stages:

Egg: off-white, oval, and tiny, eggs are found only in the female's egg gallery in the live bark of the host tree.

Larvae: Larvae are legless, white, multi-segmented, ¼ inch long or less at maturity, C-shaped, with yellowish-brown head capsule and chewing jaws.

Pupa: Generally found near the end of each larval gallery, each pupa resembles an off-

white, quiescent, non-feeding "mummy" of the adult it will become. At maturity, pupae are dark brown to black.

Larvae of Douglas fir bark beetle, *Dendroctonus pseudotsugae*. The legless, C-shaped, wrinkled white larvae are slightly larger than rice grains at maturity. They mine the live bark of host trees. Photo: Malcolm Furniss, , www.forestryimages.org

Adult: After emerging from the pupa, the young adult beetle may remain temporarily inactive under the bark of the host or it may leave the host tree by chewing a hole through the bark or emerging through a crack in the bark. Adults are cylindrical beetles with short, knobbed antennae and heads not easily visible from above; most are dark brown or black.

Side view of a smaller European elm bark beetle, *Scolytus multistriatus*. The head is on the left; note the "scooped out" area on the underside of the abdomen. Photo: Pest and Diseases Image Library, , www.forestryimages.org

Some of the tiniest twig beetles are about 1/10 inch long. Most common New Mexico bark beetles are about ¼ inch long, but none exceed 1/3 inch. Viewed from the side, adult *Dendroctonus*, *Phloeosinus* and *Hylesinus* have smoothly rounded wing covers and abdomens. Viewed from the side, the abdomens of *Scolytus* are "scooped out" from below while the wing covers of *Ips* are "scooped out" from above.

Adult "cedar" bark beetle, *Phloesinus* sp., a common pest of native junipers. Photo: E. Richard Hoebeke, Cornell University, www.forestryimages.org

Habitat and Hosts: Host preferences by different bark beetle species are fairly specific; some attack only pines while others are restricted to spruce, fir, Douglas fir or other host conifers. Some *Scolytus* species attack distressed fruit or shade trees. *Scolytus multistriatus*, the smaller European elm bark beetle, focuses on elm. While it damages and can kill Siberian elms and related species, it and its associated hitchhiking pathogen, Dutch elm disease, are a lethal combination for American elm. Together these two pests have eliminated most stands of American elm across the northern states of the U.S. The banded elm bark beetle, *Scolytus schevyrewi*, is an Asiatic species accidentally introduced into the U.S. possibly in the 1980s or 1990s; it

was confirmed in Clovis from specimens collected from dying elms in 1998. It also is known to occur in other New Mexico counties. *Tomicus piniperda*, an exotic and highly destructive pine beetle from Western Europe, invaded the U.S. in the 1980s but is not yet known to occur in New Mexico.

Adult *Hylesinus* sp., an ash twig borer; actual size is about 1/5 inch long. Photo: Daniel Adam, Office National des Forêts - France, www.forestryimages.org

Of the twig-boring bark beetles, several are common in New Mexico. Several species of *Phloeosinus* are known as "cypress bark beetles" because their primary hosts are species of *Cupressus* (Arizona cypress), *Juniperus* (various species of juniper) and similar cedar-like conifers. They reproduce in the trunk and larger branches of the host, sometimes killing injured and weakened trees. At least two species of *Phloeosinus* may be vectors of the cypress-killing fungus *Coryneum cardinale*. Newly emerged adults also mine and kill twigs, often making ornamental trees unsightly.

Ash twig beetles, *Hylesinus* spp., have been attacking twigs of most ash cultivars in New Mexico since at least the 1980s. Adults bore into the leaf buds or leaf scars on twigs, killing the twig from the entry point to the terminal. Successive infestations by these beetles create dramatic and cumulative losses in tree canopy as well as buildup of unsightly dead wood. This insect and the lilac borer, a wood-boring caterpillar, have severely decimated ash tree stands in Northern New Mexico, a situation that continues to spread in the state.

Damage: Typical symptoms of bark beetle activity in a coniferous forest include "fading foliage" that may be faded green, yellowish, red or eventually brown, accumulations of reddish brown frass and bark bits, hardened, yellowish pitch tubes on the trunk and BB-sized emergence holes. Sometimes a single tree in a stand is affected; at other times, a cluster of adjacent trees of the same species will have symptoms of bark beetle infestation. Not all symptoms may be present, obvious or long lasting on a tree. Occasionally, infested trees will show extensive woodpecker damage. Dead bark may loosen or be pried off the tree to reveal the galleries or various stages of the insects themselves.

Relatively few bark beetles and their developing progeny in a tree can girdle and kill the host. Sometimes pest pressure is so extreme that the defenses of even healthy host trees are overwhelmed by attacking bark beetles and the tree is killed before showing obvious symptoms of distress.

IPM Notes: The health and pest infestation levels of New Mexico's forests impact survival of many landscape conifers, particularly when urban and suburban trees are planted near the same species growing in the wild. Despite the best efforts of landscapers and homeowners, many trees, particularly conifers, are not planted on the best sites, nor are they adequately maintained, setting the stage for bark beetle infestation. In addition, wind damage, physical injuries and soil compaction make trees attractive to bark beetles. This is especially true for trees affected by construction or location of trees along roadways and parking areas. While not fool-proof, the best defense against bark beetles begins with maintenance of a healthy, actively growing, non-stressed tree.

Recent transplants and trees stressed for whatever reason can be protected from bark beetles with topical applications of labeled insecticides. These treatments should be

applied at least to the trunk and major limbs of each tree according to label specifications and prior to the first flights of bark beetles in early spring. While some systemic insecticides are labeled for bark beetle control, these products may not be translocated adequately in the tree to kill bark beetles and their larvae. Also, beetle damage to live bark may be more extensive than first estimated. Live bark damaged by bark beetle tunneling will not "heal" or resume functioning even if the pests are killed. No pesticide is currently labeled for control of tree-killing fungi carried by many bark beetles.

Corrective pruning or tree removal should be done in the winter when bark beetle flight activity is minimal. Promptly dispose of pruned branches or limbs, foliage and bark away from live, healthy trees. Logging slash as well as fresh mulch made from recently cut trees may be highly attractive to flying bark beetles until these materials dry and are weathered. Never stack firewood near or beneath valued landscape trees, whether they are conifers or broadleaf species. Instead, locate firewood piles in parts of the yard receiving the most hours of daily sunlight. Keep the stacks relatively low and loose. Cover each stack with colorless landscape plastic, anchoring all edges securely with soil. Allow the covered firewood to bake in the sun over the summer, venting and drying it prior to use in the fireplace or wood stove.

A variety of beneficial insects and nematodes are natural enemies of bark beetles and their immature stages, suppressing populations of these pests. However, wind storms, fire and drought can stress large numbers of trees in an area; in these situations, bark beetles can reproduce and disperse much more efficiently than any or all of their natural enemies together.

Boxelder Bugs

O & T Guide [O-#04]

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These exceedingly common and widely distributed black and red bugs are more annoying to homeowners than they are destructive pests.

Scientifically: Boxelder bugs are members of the insect order Hemiptera, family Rhopalidae.

Metamorphosis: Simple
Mouth Parts: piercing-sucking
Pest Stages: nymphs, adults

Typical Life Cycle: Eggs of spring or first generation bugs are laid in irregular masses of 10-25 on clusters of dropped host seed. Second or late summer generation eggs are laid on host foliage or developing seed. → five stages of Nymphs can be found in the same habitats as the adults---in the soil litter around host plants, on those plants or resting in large congregations on various surfaces → Adults are winged but fly infrequently. Most stay close to their host plants, mingling with the various ages of nymphs. Two generations occur annually.

Description of Life Stages:

Egg: Eggs are oval, dark or rusty red, and about 1/10 inch long.

Nymphs: The immatures are smaller, wingless versions of the adult. The abdomen and bulging compound eyes are dull brick red. Legs, head, thorax and developing external wing pads are dark gray with fine red line highlights. Wing pads first become visible on 3rd instar nymphs and are largest (but still non-functional) on mature 5th instars.

Adult: Most of the bug's head, thorax and forewings are rusty-brown edged with brick red; the bulbous compound eyes are dark red with the antennae, legs and ends of the wings black. Adults are about ½ inch long; their bodies appear flat on top with a prominent triangle between the bases of the forewings, as is typical of many adult Hemiptera.

Boxelder bug adult, *Boisea trivittata*, about ½ inch long. This eastern species is found in New Mexico, along with a Western species that seems generally less troublesome. Photo: Clemson University - USDA Cooperative Extension Slide Series, , www.forestryimages.org

Habitat and Hosts: Boxelder bugs overwinter as nymphs or adults in protected areas including leafy mulch around boxelder and other trees, in homes or other structures. Active by late spring, they feed on a variety of herbaceous and woody plants, recently dead insects and even each other. While sap of boxelder foliage, flowers and seed is preferred, boxelder bugs will accept some maples and even ash when boxelder is not available. Second generation nymphs prefer

the sap of developing boxelder seeds but also may feed on various fruits such as apples.

Damage: For boxelder, maple and ash, feeding damage by boxelder bugs is negligible. Toxins in boxelder bug saliva (and that of other fruit-feeding bugs) create "cat-facing" injuries on developing fruit; in these cases, the place where the feeding stylets punctured the skin is sunken and surrounding flesh is puckered, discolored and hardened. The biggest objection to boxelder bugs is their sheer numbers. They congregate on windows, porches and sides of homes on cool, sunny days in fall and spring.

IPM Notes: Removal of female boxelder trees and elimination of spring leaf litter may discourage or at least delay a seasonal buildup of these insects. Homeowners should realize that the bugs will wander several hundred feet away from even their preferred hosts. Foliar insecticide treatments may reduce numbers of boxelder bugs temporarily.
Aggregations of bugs may disperse when sprayed with insecticidal soap solutions. Reducing the amount of plant cover and increasing air flow and light, particularly near walls or other areas where the bugs hide, can be helpful. Western boxelder bug, *Boisea rubrolineata*, is a widely distributed western species that is not nearly as annoying a pest as the eastern species *trivittata.* The goldenrain tree bug, *Jadera haematoloma*, is a substantially black bug highlighted on the thorax with red; it resembles the boxelder bug in color and size and has many of the same annoying habits. Its preferred host is the goldenrain tree, a popular introduced ornamental.

Western boxelder bug adult, *Boisea rubrolineata*, about ½ inch long. This species is also found in parts of New Mexico, especially along higher elevation waterways where host trees are available. Photo: Whitney Cranshaw, Colorado State University, www.forestryimages.org

Aggregation of nymphs and adult boxelder bugs, *Boisea trivittata*. Photo: James B. Hanson, USDA Forest Service, www.forestryimages.org

Elm Leaf Beetles

O & T Guide [O-#05]

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Cooperative Extension Service • College of Agriculture and Home Economics • October 2006

Elm leaf beetles chew holes in elm foliage and skeletonize the leaves as larvae. While making their host trees unsightly, stressed and susceptible to other elm pests, adult elm leaf beetles also can be objectionable household pests in the winter.

Scientifically: Elm leaf beetles belong to the insect order Coleoptera, family Chrysomelidae.

Metamorphosis: Complete
Mouth Parts: Chewing (larvae, adults)
Pest Stages: Adults, larvae.

Typical Life Cycle: Eggs are laid in small irregular clusters or lines along the midribs of leaves on the lower parts of the tree by early summer→ Larvae hatch after 10-14 days and begin skeletonizing host foliage. These molt three times before maturing and crawling down the tree trunk to find a place to pupate.→Pupae can be found in the uppermost layer of loose soil and plant debris surrounding the host tree; occasionally these will lodge in bark crevices especially in crotches of limbs. → Adults emerge in 10-15 days, disperse, mate and begin a new generation. Adults produced in late fall may feed briefly on foliage but soon change physiologically, usually leaving the host tree and entering buildings or other winter shelters. They turn dark olive green, becoming more sluggish and failing to reproduce (called "reproductive diapause"). Overwintering adults emerge in spring and return to their elm hosts now with new foliage. They resume feeding and get more active, gradually turning from olive green to yellowish tan with black stripes and dots.

The adult elm leaf beetle is about ¼ inch long with yellowish-tan and black striped wing covers. Photo: Clemson University – USDA Cooperative Extension Slide Series, , www.forestryimages.org

Females may produce 600-800 eggs each in their lifetimes, laying them in clusters or lines of up to 25 eggs. One to at least three generations occur annually in New Mexico. Tree damage is cumulative over the growing season; large pest populations

Overwintering elm leaf beetles are quiescent, non-reproductive and typically dark gray-green to almost black in color. Photo: Whitney Cranshaw, Colorado State University, www.forestryimages.org

may damage foliage faster than the tree can replace it, depleting stored food reserves within the tree.

Description of Life Stages:

Egg: tiny, pale yellow and lemon-shaped. Female beetles lay them on the undersides of host leaves in loose clutches or lines of up to 25 irregularly placed eggs.

Larvae: Larvae are slow-moving, black and alligator shaped. The body is obviously segmented with three pairs of short legs visible**.** Mature larvae are about 3/8 inch long, mostly black with yellow stripes, and are found on host foliage.

Pupa: Golden pupae about 1/4 inch long. The actual pupa resembles a quiescent "mummy" of the adult beetle, rounded on the back and fairly flat on the underside.

Adult: A ¼ inch long, yellowish tan, somewhat flattened beetle with their wing covers edged in black. Most have two tiny black dots on the bases of the wing covers and up to three tiny black dots between the head and wing covers. The threadlike antennae are about ¼ of the body length.

Overwintering adults are the same size as above but are dark olive green and sluggish.

Habitat and Hosts: The elm leaf beetle occurs throughout the United States. All species and varieties of elm are attacked by this pest. In some years damage can be so severe that affected trees are brown by mid-summer. Although overwintering adults are lethargic and do not feed on anything, homeowners find them objectionable because of their musty odor and sheer numbers.

Damage: Adults chew small holes in the leaves. Larvae feed on the undersides of leaves, leaving behind only a skeleton of dried vascular tissue. Damaged leaves turn brown by mid-summer and often drop off the tree early. With severe infestations, a tree may not be able to grow new foliage faster than the beetles damage it. Severely stressed trees may show twig and limb die back, becoming susceptible to other elm pests such as banded elm bark beetle. In extreme cases, the entire tree can die.

IPM Notes: Treatment of infested trees with contact insecticides should be timed to kill young first-generation larvae; repeat treatments may be required for subsequent generations. Bacterial insecticides (*Bacillus thuringiensis tenebrionis* or the 'San Diego' strain of Bt) formulations may be an effective spray treatment for young pest larvae. In recent years, certain systemic insecticide treatments have been valuable in some areas with large beetle populations. Soil-applied formulations of these systemic insecticides apparently last longer than foliar applications of the same active ingredient. Injectable systemic insecticide treatments also have been used with some success on this pest. In recent years, a minute wasp parasitic on elm leaf

beetle eggs was released in south central New Mexico. Observations continue on its overwintering success and dispersal.

In extreme cases, removal of elm trees may be less expensive and provide more relief from these pests than treatments.

Elm leaf beetle larvae skeletonize the foliage of their hosts, often causing the leaves to turn brown by late summer. Photo: James Solomon, USDA Forest Service, www.forestryimages.org

Egg mass of an elm leaf beetle. Photo: John A. Weidhass, Virginia Polytechnic Institute and State University, www.forestryimages.org

Larva of an elm leaf beetle. Larvae typically skeletonize the foliage of their host. At maturity they are about 3/8 inch long. Photo: Clemson University - USDA Cooperative Extension Slide Series, , www.forestryimages.org

At maturity, elm leaf beetle larvae crawl down the trunk of their host or drop from the foliage where they form golden yellow pupae in the soil litter. Photo: James Solomon, USDA Forest Service, www.forestryimages.org

Fall Webworms and Tent Caterpillars

O & T Guide [O-#06]

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Caterpillars of both of these defoliators make somewhat similar looking, large, communal silk tents on the limbs of their tree or shrub hosts. Fall webworms are most prominent in the fall on a variety of broadleaf shade, fruit and nut trees while tent caterpillars are active only in spring on mostly native broadleaf trees and shrubs.

Scientifically: Fall webworm, *Hyphantria cunea*, is a member of the insect order Lepidoptera, family Arctiidae. Tent caterpillars, *Malacosoma* spp., are members of the insect order Lepidoptera, family Lasiocampidae.

Metamorphosis: Complete in both
Mouth Parts: Chewing (larvae)
Pest Stage: Larvae

Typical Life Cycle---Fall Webworm---One to four generations per year depending upon location and elevation; populations are largest in the fall. Eggs laid in dense, flat masses on the undersides of host foliage hatch in about a week. Young larvae immediately begin to spin a communal silken web. Larvae feed and molt for about six weeks, continually enlarging their protective webs, sometimes to a point of covering 2-3 feet at the end of an infested branch. Larvae are gregarious until the last molt, after which they feed singly. Fully grown larvae leave the web and pupate in soil litter, below soil level or in crevices around buildings, fence posts, rock walls, etc. During the growing season, development is continuous; the last generation in the fall overwinters in the pupa stage. The

Adult female fall armyworm. Adults fly and mate and females lay eggs at night. Note the egg mass visible at the rear of this female. Photo: H C Ellis, University of Georgia, www.forestryimages.org

Female Western tent caterpillar moth with her egg mass. Photo: Jerald E. Dewey, USDA Forest Service, www.forestryimages.org

first adults for next year begin to emerge in late spring or early summer, although emergence from overwintering pupae may continue over the summer.

Description of Life Stages---Fall Webworm:

Egg: Minute, pale green and laid in tight, flat masses of 100+ eggs on undersides of host foliage. Females dust their egg masses with scales from their bodies.

Larvae: Larvae are hairy with distinct but small dark spots on the back of each segment. Both black- and red-headed races occur, sometimes in the same location. Caterpillar color is also variable with the black-headed race tending to be yellowish or pale green with light-colored hairs. The red-headed form is usually darker with reddish brown hairs. Mature caterpillars are 1-1¼ inches long.

Pupa: The brown, lozenge-shaped pupa is about 5/8 inch long and enclosed in a thin, felt-like cocoon concealed in trash, ground litter, cracks and crevices or in the soil.

Fall webworm larvae embedded in a communal web located on the ends of a host tree's branches. Photo: G. Keith Douce, University of Georgia, www.forestryimages.org

The egg mass of the fall webworm. Photo: H.C. Ellis, Univ. Georgia, www.forestryimages.org

(Left) The communal web has been cut open, exposing a group of young fall webworm larvae. Photo: G. Keith Douce, University of Georgia, www.forestryimages.org . (Right) Mature larvae of fall webworm have longer and denser white hairs covering their bodies. Photo: Lacy L. Hyche, Auburn University, www.forestryimages.org

The shed larval skin has been cut open to reveal the pupa of the fall webworm. Photo: Lacy L. Hyche, Auburn University, www.forestryimages.org

Adult: Adults are about 5/8 inch long with white wings and body; some may have scattered, minute black dots. Their bodies are about ½ to ¾ inch long. At rest, they hold their wings swept back at angles to the body, like fighter jets. Adults are nocturnal.

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Typical Life Cycle---Tent Caterpillar:

One generation occurs each spring in tent caterpillars; these are among our earliest defoliators of the growing season. Eggs hatch shortly after bud break in the spring with the young larvae from several egg masses working together to create a densely woven, silk tent in the crotches of various trees and shrubs. As caterpillars grow, the tent is enlarged. Most of the caterpillars feed at night, returning to the tent to rest or molt during the day. Larger caterpillars disperse throughout

the host plant to complete feeding. When fully grown (usually mid-June), larvae disperse from the host tree or shrub, find sheltered places to attach themselves and spin white to ivory cocoons on tree trunks, rocks, houses, buildings and the like. After pupating for approximately 7-10 days, adult moths emerge. After mating, females lay 100 to 350 eggs in a froth-covered band around small twigs or branches of host trees. The eggs mature in three weeks but do not hatch until the following spring.

Tent caterpillar-Egg: Black or dark brown eggs are laid on host twigs in distinct blobs or bands, depending on species. The eggs are covered with a somewhat shiny, varnish-like material produced by the female.

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Larvae: Mature caterpillars can be nearly two inches long and are "slightly hairy," with bluish-brown heads, various tints of brown all over the body and powder blue marks along the sides of the caterpillar. Several races of caterpillars are recognized with slight variations in appearance for each.

Pupa: Their brown, lozenge-shaped pupae are encased in a white silk cocoon that is securely attached to the substrate in a protected location usually away from the host tree.

Adult: Adult tent caterpillar moths are relatively thick-bodied, brown to reddish-brown insects about ¾ to one inch long; their brown wings are marked with slightly paler wavy lines. At rest, these moths also hold their wings swept back at angles to the body like fighter jets. Adults are active at night.

Habitat and Hosts:

Fall Webworm can attack over 100 species of deciduous trees and shrubs including cottonwood, mountain-ash, pecan, elm, willow, chokecherry, and assorted fruit and nut trees. These caterpillars build their communal silken webs over the ends of branches rather than the crotches of branches. This web is usually filled with caterpillars seeking refuge, partially eaten foliage and frass. Remains of these nests may persist harmlessly into the winter.

Tent Caterpillars are cyclic pests with usually moderate host ranges that favor native species of deciduous trees and shrubs such as aspen, mountain mahogany and currants. They are more common pests in the higher elevations and northern parts of New Mexico.

Damage: Adults of both species are night-flying and harmless. Caterpillars of both species are defoliators; the youngest may skeletonize leaves while larger caterpillars consume entire leaves. Severe defoliation in the spring by tent caterpillars may severely deplete stored food reserves for affected host plants since the plants must expend at least equal resources to refoliate before they can again store energy. Defoliation in the fall by fall webworm occurs mostly after energy reserves have been restocked for the season and loss of foliage to frost is imminent. Since the same hosts may not be attacked the following year, healthy trees and shrubs generally can recover quickly. Host damage can be more serious if the same tree or shrub is heavily defoliated several years in a row.

For both defoliators, people often consider the large silk tents unsightly and the caterpillars as life threatening to the host trees and shrubs. As noted above, the cost to host energy reserves is probably greater for tent caterpillar infestations than fall webworms given hosts of approximately equal size and health levels. Mature caterpillars of both species can be annoying and unsightly as they disperse to find pupation sites; at times, crawling larvae can be so numerous as to make busy roadways slick and smelly with their run-over carcasses.

IPM Notes: Both species have numerous natural enemies that keep their populations in check. Birds, small mammals, insect predators, spiders and tiny parasitoid wasps attack the eggs and immature stages of both species. A naturally occurring virus may

decimate caterpillar populations in some years; if humidity is unusually high, the fungus *Entomophthora* may also kill many caterpillars of both species. If the communal silk webs can be safely reached from the ground, pruning individual infested branches may be one possible means of control if the plant's appearance is not destroyed by this method. Insecticidal control may be warranted if the infestation of either pest is heavy or the webs are high in the trees and difficult or impossible to reach. *Bacillus thuringiensis* ("Bt") sprays can be used for either pest. Best results are usually obtained with Bt or with conventional topical insecticides when the tents are first noticed and the larvae of either species are still small. While the entire tree need not be sprayed, the webs and surrounding foliage should be thoroughly covered. Tearing open webs can help spray droplets contact the caterpillars.

Western tent caterpillar colony defoliating a host plant in the spring. Photo: William M. Ciesla, Forest Health Management International, www.forestryimages.org

A mature western tent caterpillar. Photo: Jerald E. Dewey, USDA Forest Service, www.forestryimages.org

Pupae of the Western tent caterpillar. Photo: USDA Forest Service - Rocky Mountain Region Archives, USDA Forest Service, www.forestryimages.org

Scale Insects & Their Relatives

O & T Guide [O-#07]

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For most of their lives, scale insects look like anything other than insects. Some are fairly flat while others are raised and wart-like; some are well camouflaged on their hosts while others are extremely obvious. Mealybugs are covered with dusty or mealy filaments of wax secreted by glands in their integument. The life cycles of some scales and their relatives are complex, others are fairly simple and a few are still poorly known. Damage potential varies considerably by species.

Scientifically: According to a recent taxonomic reorganization, these insects belong to the Order Hemiptera, Superfamily Coccoidea.

Metamorphosis: Simple
Mouth Parts: Piercing-sucking
Pest Stages: Crawlers, nymphs, female adults of some species

Life Cycle: Egg (may be retained in some species that give live birth)→series of Nymphs of which only the first may be mobile (the "crawler")→Adult. Females are immobile in some species but mobile in others; males, if known, usually have one pair of wings. Most are very small and very weak fliers, remaining close to their host plant.

Soft scales (Family Coccidae) include the wax and tortoise scales among others. Females in this group are elongate-oval and generally about 1/8 inch long, occasionally more, depending upon species. They are usually convex but sometimes flattened with a hard, smooth integument or a covering of soft wax. Legs are usually present and the antennae may either be missing or much reduced. Males may be winged or wingless. Brown soft scale, *Coccus hesperidium*, is usually the most common soft scale pest of greenhouse and interior landscape plants in New Mexico. *Parthenolecanium corni*, the European fruit lecanium, and its relatives are reddish-brown to black, crusty and hemispherical with a diameter about the size of a pencil eraser; it attacks twigs on a variety of fruit, nut and shade trees. Cottony maple scale, *Pulvinaria innumerabilis*, is a fairly large (about ¼ inch long) reddish-brown scale whose eggs are laid on maple twigs in a large, cottony mass that protrudes from the end of the scale.

With over 300 species known in the U.S., the family of **armored scales** (Diaspididae) is the largest family of scales, containing some very important pest species. Females are very small and soft-bodied and are concealed under a scale covering that is usually free from the body of the insect underneath. The scale covering is formed by a combination of wax secreted by the insect plus old cast skins and excretions. Female armored scales lack eyes and legs and the antennae are absent or much reduced. Depending upon species, these scales may be circular or elongate, smooth or rough, and colored variously. Male scales usually have covers that are smaller and more elongated than those of females. Adult male armored scales are winged (only one pair of wings) and have well-developed legs and antennae. Reproduction may be with two sexes or parthenogenetic (i.e. females lay their eggs without fertilization from males). Some

species lay eggs under their scales. Others give birth to live young. The first instar young, or crawlers, are active insects that may crawl some distance before they find a suitable site to settle and begin feeding. Crawlers may also be dispersed on the wind or even the feet of birds landing on infested plants. Once the crawlers have settled and inserted their long stylets into the host, they start to lose many of their insect attributes with succeeding molts. Females remain in one spot for the rest of their lives; males emerge, fly around their host looking for females and die soon after mating.

- San Jose scale, *Quadraspidiotus perniciosus*, probably an import from Asia in the late 1800s, is an important pest of orchard and shade trees, as well as numerous shrubs. It is minute and volcano-shaped; females give live birth to crawlers.

- Oystershell scale, *Lepidosaphes ulmi*, is brown and shaped and textured like its namesake. Infesting many varieties of orchard and shade trees, it can be lethal to aspens in New Mexico. Females lay their overwintering eggs under their scales.

- Euonymus scale, *Unaspis euonymi*, attacks and often kills its host in New Mexico. These scales are easily overlooked initially; the actual scales are tan and minute but the fluted waxy extensions produced by the females eventually give them away.

- Pine needle scale, *Chionaspis pinifoliae*, is an elongated, waxy white scale often found on pine foliage and sometimes other conifers. Although common on some pines in some areas, these usually are heavily parasitized and are minor pests of pine needles.

Kermid or Gall-like Scales (Kermesidae) are most commonly seen on twigs or leaves of oak in New Mexico. Females in this small and poorly known family are rounded, often with hard or tough scale covers and resemble small galls.

Dactylopid Scales or Cochineal Insects (Dactylopidae) are pests of *Opuntia* cacti, especially the pad types. Scale colonies are covered by a dense mat of sticky white wax. The actual scales are minute, dark purplish red insects that are broadly oval in form and distinctly segmented.

Pinyon Needle Scales (Margarodidae) are common pests of New Mexico pinyon, both in forests and cultivated settings. Affected plants may have rather thin foliage clumped near the ends of twigs. Closer examination of the tree, especially in the fall, reveals numerous tiny black “beans” adhering loosely to the needles. In late winter, yellowish, mobile females emerge from these “beans” and begin crawling down the branches and trunk towards the bases of their host plants. They are soon joined by gnat-like winged males of the species that have emerged from some of the other “beans.” After mating, the females lay their eggs into masses of filamentous waxy material that they also produce around the bases of host trees. The crawlers soon hatch and begin the return trip up the host tree where they settle to feed for the rest of their nymphal lives on the new growth needles. One generation occurs annually.

Mealybugs (Eriococcidae) are so named from the mealy or waxy white secretions that cover the bodies of these insects both as immatures and adults. Females of most species have elongate-oval, segmented bodies with functional legs. Some species lay eggs while others give birth to live young. The egg-producers cover their clutches in loose filaments of sticky white wax. Various life stages of mealybugs may be found on virtually any part of their host plants. Several important pest species are common in New Mexico including:

- citrus mealybug, *Planococcus citri*, and long-tailed mealybug, *Pseudococcus longispinus*, are both

significant pests of greenhouse and interiorscape plants.
- obscure mealybug, *Pseudococcus affinis,* is a widespread pest of both woody and herbaceous plants.

Descriptions of Life Stages:

Eggs: Eggs are usually minute, white, yellow, pink or pale orange for most species. Eggs are found under the female scale in armored scales or in waxy coverings exuded by females of other members of this diverse group of insects. Other species retain their eggs and give live birth to crawlers.

Nymphs: The first instar is called a "crawler" for most insects in this diverse group. Most crawlers are barely visible to the naked eye, segmented, with short antennae, small eyes and three pairs of legs. Their mouthparts are visible but are not used in the crawler stage. Upon settling down on an acceptable site on the host, the crawler inserts its filamentous feeding stylets into host leaves or stems and begins to feed on sap. Shortly afterward, it molts and begins to lose its insect attributes with successive molts. Immature mealybugs remain mobile for the duration of their lives; they also produce powdery or waxy filaments from glands in their integument. Male armored scales usually have smaller, narrower scale coverings than females of their species

Adult: Adult mealybugs look like larger versions of their nymphs, only they are able to reproduce. Any "tails" on the end of the abdomen or filaments on the sides of the body are likely to consist only of wax that is easily damaged; also, this wax will dissolve in alcohol if the insect is collected for identification, leaving the bare bodies of the insects. Similarly, the wax of cochineal insects will dissolve in alcohol, leaving only the dark red bodies of the females and nymphs. Of the scale insects, soft scales have their bodies firmly attached to their scales while armored scales have a generally loose attachment between the soft body and scale covering. Some of these insects are known from female-only populations. Where males are known, they often lack mouthparts and have only one pair of wings; males are minute and very poor fliers.

Habitat and Hosts: Scale insects and their relatives are well adapted to parasitize their host plants. Most are very well camouflaged; their small size, particularly as crawlers, permits them to squeeze into a variety of places on their hosts, many of which would not be readily visible, let alone accessible to topical pesticide treatments. Some, especially the mealybugs, can occur almost anywhere on the exterior of their hosts, including below-ground plant parts. The kermid scales are the least known biologically and taxonomically of all of the scale insects and relatives mentioned. Many species of soft and armored scales as well as mealybugs have extremely broad host ranges, despite their common names.

Damage: Many species of soft and armored scales produce large amounts of honeydew. Ants, bees, wasps and flies can be attracted to honeydew deposits. In humid conditions, honeydew becomes a substrate for growth of black, sooty mold on foliage. In addition to being unsightly, foliage covered by sooty mold often falls from the plant, diminishing food production by the plant and stressing it to produce regrowth. Usually feeding on the undersides of leaves, small twigs or branches, scale insects can cause yellowing of foliage, leaf drop and twig die-back. Sap loss causes some of these problems while salivary enzymes produced by these feeding pests contribute to tissue damage and growth irregularities. Some, such as San Jose scale, can infest developing fruit, causing irregular ripening and hardening the flesh under the skin. Armored scales feed mainly on perennial shrubs and trees. Large populations can encrust twigs or branches, severely weakening or killing their host plants. Many species of scale insects and their relatives are economically important pests of greenhouse and nursery crops, interiorscape plants, shrubs and a variety of native and imported tree species.

Kermid scales produce the often noticeable and objectionable pea-sized, woody galls on oak twigs. Progressive twig die-back is common with these infestations. Most species and details of their life cycles are poorly known.

Cochineal insects produce very obvious white, cottony colonies that detract from the appearance of their "prickly-pear cacti" host plants. Left alone, these pests weaken the pads, progressively killing the plant.

Pinyon needle scales also can progressively weaken their pinyon hosts to the point that the only needles on the branches are at the very ends and these are densely covered with the black "beans" of the developing pests. The late winter-early spring congregation of adult pinyon needle scales at the base of the plant or in crotches of limbs is unsightly. Large populations of these pests can kill pinyon trees unless treated; they also can stress their hosts, making them more susceptible to infestation by other pests, particularly bark beetles.

Mealybugs are extremely difficult pests to control. Easily transmitted to other hosts by physical contact and overcrowded growing conditions, the pests can be very difficult to find because of their invasive nature, secretive habits and camouflage. They can feed on almost any live part of the plant where the bark or external covering is thin enough to allow penetration of the mouthparts. Eggs may be hidden in the axils of leaves, crevices of branches, rough bark, surface roots or concealing plant parts. In addition they are covered with thick coats of protective wax which resists wetting.

IPM Notes: The insects presented in this fact sheet often are serious pests of various ornamental plants for different reasons.

Cochineal insects and their *Opuntia* cactus hosts are both native to New Mexico and the Southwest; despite their long relationship with each other, the insects can disfigure and kill their hosts, situations not acceptable for cacti used as landscape ornamentals. Kermid scales and oaks likewise are native to the Southwest. Although they rarely kill their hosts, kermid scales can damage the appearance of specimen landscape oak trees.

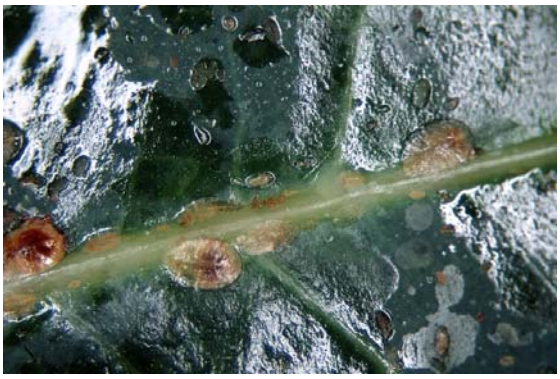
Environmental stresses and some growing practices may favor infestations and outbreaks of scale insects and their relatives. Scales can infest cuttings or recently received plant stock. Crawlers may move to uninfested hosts directly, particularly when plants are crowded. Alternatively, natural wind currents or greenhouse blowers can disperse crawlers from one growing area to another. Constant scouting of new and older plants is required, as is fast action to minimize damage.

Many species of damaging scale insects are not native to New Mexico or the U.S. and have arrived here without their natural enemies. Whether or not effective natural enemies could be identified in the homelands of these pests, safely imported by regulatory authorities and adequately established in this area to control these exotic pests is beyond the scope of this handout; in many cases, these projects are probably too costly to investigate or implement.

Where some biological control agents do help curb populations of various scale insects, certain insecticides or treatment frequencies may foster scale pest outbreaks because they eliminate the effective natural enemies better than they do the pests. Producers and plant managers should be aware of these risks and choose appropriate treatments wisely.

For many infestations of scale insects and their relatives, insecticides may work poorly because of poor timing or because the non-living coverings on the pests protect them from applied toxins. The timing issue is best addressed by scouting for crawlers, a susceptible and unprotected life stage. Use a sheet of white typing or copy paper and a small hand tool like a trowel, short tool handle, tree branch or similar object. Holding the paper under a potentially infested host branch, hit the branch sharply several times;

watch for small particles landing on the paper to start moving. These are likely to be the crawlers. Insecticide applications made when crawlers are active can significantly reduce pest populations and improve plant health; they can break the cycle of damage before a new generation infests host plants. Even better results may come from treatments with labeled systemic insecticides. These products can kill crawlers and young nymphs by ingestion, regardless of where the pests may be hiding and regardless of application methods that may result in less than complete and thorough coverage.



Brown soft scale, *Coccus hesperidum*, adults and nymphs. Photo: Whitney Cranshaw, Colorado State University, www.forestryimages.org

European fruit lecanium, *Parthenolecanium corni*, on oak. Photo: Haruta Ovidiu, University of Oradea, www.forestryimages.org

Cottony maple scale, *Pulvinaria innumerabilis*, on maple twig. Photo: Southern Forest Insect Work Conference Archives, Southern Forest Insect Work Conference, www.forestryimages.org

Close-up of San Jose scale, *Quadraspidiotus perniciosus*, on an apple. Photo: Biologische Bundesanstalt Archives, Germany, www.forestryimages.org

Close-up of oystershell scale, *Lepidosaphes ulmi*. Photo: USDA Forest Service - Rocky Mountain Region Archives, USDA Forest Service, www.forestryimages.org

Close-up of euonymus scale, *Unaspis euonymi*, on euonymus. Photo: Lisa Ames, UGA, www.forestryimages.org

Kermes scale, *Kermes* sp., on white oak. Photo: James Solomon, USDA Forest Service, www.forestryimages.org.

Close-up of the overwintering stage ("black bean") of pinyon needle scale, *Matsucoccus acalyptus*.

Cochineal scale or Dactylopid scale, *Dactylopus confusus*, on a pricklypear cactus pad. Photo: USDA Forest Service - Ogden Archives, USDA Forest Service, www.forestryimages.org

Pinyon needle scale, *Matsucoccus acalyptus*, on pinyon. Note the "black bean" stages on the older, brown foliage. Photo: Whitney Cranshaw, Colorado State University, www.forestryimages.org

Close-up of a long-tailed mealybug, *Pseudococcus longispinus*. Photo: David Cappaert, , www.forestryimages.org

Spider Mites

O & T Guide [O-#08]

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Cooperative Extension Service • College of Agriculture and Home Economics • October 2006

Spider mites are very common and often very numerous, nearly microscopic pests of orchard trees, field crops, nursery and landscape plants, especially in hot, dry weather.

Metamorphosis: None
Mouth Parts: Paired, piercing
Pest Stages: Larvae, nymphs, adults

Typical Life Cycle: Eggs hatch in 3-5 days during the highest summer temperatures. Females develop from fertilized eggs while males develop from unfertilized eggs. → Six-legged Larvae hatch and begin feeding, molting in about a week to the First 8-legged Nymph stage. Feeding continues for a week when it molts to the second 8-legged Nymph which continues feeding and developing for another week. →Adults have patterns of plates on their bodies that distinguish them from immatures; in most species, plate patterns distinguish the sexes, also. Development time from egg to egg may require about 3-4 weeks, more or less, depending upon temperature. Live host plants are always required for food. All life stages are likely to be found together.

Description of Life Stages:

Egg: spherical, barely visible to the naked eye but still about ½ the length of the female's body, white or various pale colors, depending on species

Immatures: Both nymph stages are 8-legged, resembling small scale adults. All three stages have two fused body regions that, together, are round in larvae to oval in nymphs. Most immatures are off-white to yellowish and are slow moving.

Adult: Adults are larger (to about 1.5mm long), oval, 8-legged and slow moving. Many species have 1-2 pairs of darker blotches on either side of the body. Plates on the adult's body indicate the maturity and sex of the individual. Adults and immatures spin fine silk, camouflaging the infestations and allowing dispersal. Adults of many species are off white; others are pale orange, yellow or greenish.

Two-spotted spider mite, *Tetranychus urticae*. Note the fine silk filaments that suspend the mite over its plant host. Photo: David Cappaert, , www.forestryimages.org

Habitat and Hosts: Some widely distributed species such as two-spotted spider mites, have hundreds of known

hosts, numerous generations annually and are active year long in greenhouses. Others, such as spruce spider mite, are more restricted in distribution and hosts, but still have several generations annually. Spruce spider mites are most damaging and most numerous on their conifer hosts in cooler weather of spring and fall.

Damage: Most spider mites feed on foliage or fruits of their hosts; their minute paired piercing mouth parts puncture individual plant cells, causing their death and discoloration. Damaged vegetation may appear dry, dull green, bronze or reddish. Distorted growth or loss of foliage, buds, flowers, fruit and even entire young plants is common. Spider mites usually can be found wherever plants are stressed or crowded, indoors or out.

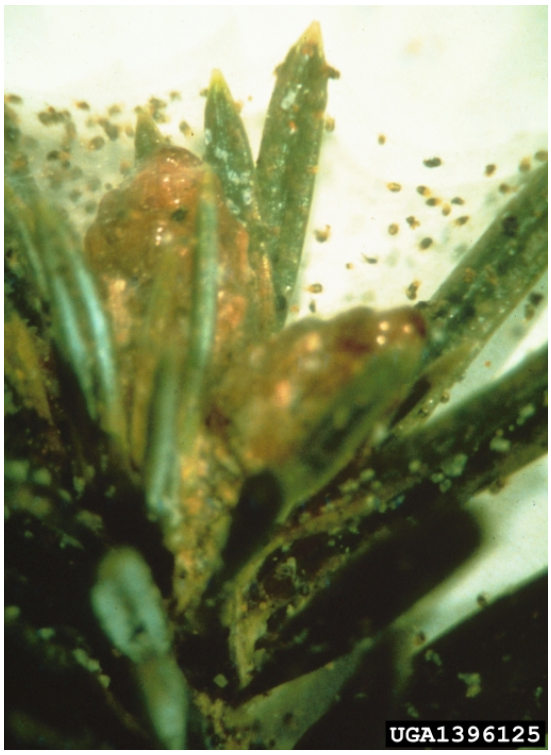
IPM Notes: Since they are quite small and often occur on the undersides of host foliage, magnification may be needed to confirm presence of spider mites, particularly in low level infestations. Under outbreak conditions, spider mites may mass on the upper parts of host plants where silk webbing may be especially visible. Handling infested plants can cause intense itching.

Spider mite populations are favored by hot, dry growing conditions and plants under stress. They are also favored by dust accumulations on foliage. Alternatively, spider mite populations are suppressed at least temporarily by rain or by forcefully washing foliage with water.

Because spider mites have such short generation times and are so prolific, insecticides (or acaricides) should be used infrequently and very judiciously to prevent development of pesticide resistance and resurgence. Insecticidal soap mixed with horticultural oil may be an effective control against mite eggs and newly hatched nymphs. Some of these materials are tolerated by the spider mites but are very hazardous to the tiny natural enemies of spider mites including other predatory mite species, lady beetles and their larvae, green lacewing larvae, and a variety of predatory bugs.

Dormant oils are sometimes used on fruit trees or deciduous shade trees in the winter to control overwintering stages of pests such as spider mites. These oils coat the eggs or free-living stages of these pests, killing by contact or asphyxiation.

Spider mite damage on a broadleaf host plant. Note the dry and “sanded” appearance of the foliage, evidence of individual plant cell deaths caused by spider mite feeding. Photo: Clemson University - USDA Cooperative Extension Slide Series, , www.forestryimages.org



Severe infestation of spruce spider mite, *Oligonychus ununguis*, on a spruce twig. Note the mites on the webbing. Photo: USDA Forest Service - Northeastern Area Archives, USDA Forest Service, www.forestryimages.org

Thrips

O & T Guide [O-#09]

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Cooperative Extension Service • College of Agriculture and Home Economics • October 2006

These minute, yellow to brown splinter-shaped insects kill individual cells in succulent plant tissue, causing it to brown and tear easily. They also dot infested foliage with their frass. Some species are known to be vectors of tomato spotted wilt virus and perhaps other viruses affecting some vegetables and ornamentals. Some thrips species are predatory on small insects and mites. (Note: "Thrips" is both singular and plural.)

Metamorphosis: Simple
Mouth Parts: Rasping-sucking for nymphs and adults
Pest Stages: Active nymphs and adults.

Scientifically: Thrips are members of the insect Order Thysanoptera. Among the most common and damaging species of pest thrips are *Thrips tabaci* (onion thrips) and *Frankliniella occidentalis* (Western flower thrips).

Typical Life Cycle: Egg→2 Nymphs feed on plant→2 quiescent Nymphs →Winged Adult. Females lay their eggs singly usually on or in the tissues of host foliage, flowers, fruit or stems. Eggs of several common pest species hatch in about 7 days. The first two nymph stages are passed in about two weeks while the second two require slightly less time. Egg to egg development time is about one month. Three to 10 generations may occur annually depending upon hosts, development conditions and altitude.

Some thrips, including some of the common pest species, are known to be predaceous and even cannibalistic.

Adults of the (left) onion thrips, *Thrips tabaci*, and (right) Western flower thrips, *Frankliniella occidentalis*. Photo: Alton N. Sparks, Jr., The University of Georgia, www.forestryimages.org

Description of Life Stages:

Egg: Minute, white, kidney shaped, partially inserted into host tissue by female
Nymphs: First two instars rasp on host foliage, sucking the sap from the wound. Third and fourth instars do not feed; two pairs of stubby external wing pads develop. All nymphal stages resemble miniature white to yellowish versions of the adults they will become. The common pest species all have 6 legs in each stage.

Immatures of some of the less commonly seen thrips, e.g. *Chirothrips falsus* in the heads of various species of range grasses, are legless and almost maggot-like.

Adult: very tiny insects with most 1/16 inch or less in length; colors of adults vary by species from yellow to brown and nearly black. Head rotated downward and flattened such that mouth parts face the rear and are located almost between the bases of the forelegs. Rasping-sucking mouth parts remain asymmetric in the adult stage with one functional and one non-functional mandible. The insect slashes at succulent plant tissue with the functional mandible and suck up the plant sap oozing from the wound. Adults with two pairs of strap-like wings fringed with hairs. Although thrips are weak fliers, the wings help get the insects into the air stream which can carry them quickly to new feeding sites many miles away. While nymphs are either lethargic or quiescent during development, adults of many species are quite active and will hop or fly away when disturbed.

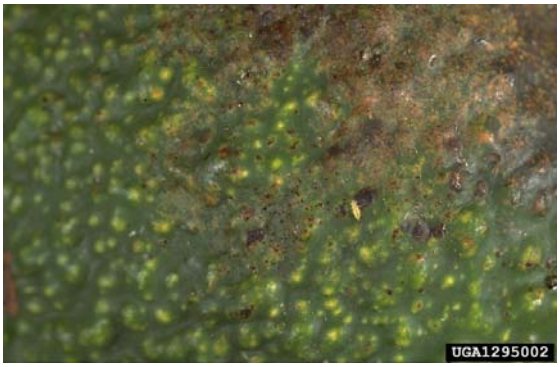
Habitat and Hosts: Many pest species of thrips have extremely broad host ranges. Onion thrips favor onion, beans and cabbage and can damage these plants severely. At times they can be the most numerous pest thrips on garden vegetables and flowers. Western flower thrips populations have soared in recent years on a variety of common forage, vegetable, field and nursery crops as well as garden vegetables and landscape ornamentals. At times, these thrips may be the most numerous pest species on these crops. Western flower thrips is known to transmit tomato spotted wilt virus to a variety of horticultural crops both in greenhouse and field situations as well as backyard gardens.

Damage: Thrips feed preferentially on succulent plant tissues. They may feed on fully expanded foliage, open flowers, and even pollen grains. Light colored flowers (white, yellow or other pale colors) are often preferred. They may also penetrate the bud scales surrounding developing foliage and flowers where they feed on and scar delicate leaf and flower tissues. Affected tissue dies, turns brown and tears easily, a situation especially noticeable on the edges of pastel-colored rose petals. Leaves that are attacked become bleached and dry. Skin of damaged fruit appears sanded and the underlying tissues may be off-flavored, hard and/or dry.

Cuban laurel thrips feeding on the foliage of *Ficus nitida* and *Ficus benjamina* produce spotting and thickened leaf curls on new growth, making it unsightly and often unmarketable if not detected early and controlled. More visible than the thrips themselves are the dark fecal pellets and whitened, desiccated material they leave behind after feeding.

IPM Notes: Thrips prefer a dry environment, so to help control them, mist or water plants regularly. Spraying infested plants with insecticidal soap every few days can be very effective for infested house plants. Various life stages of thrips are preyed upon by syrphid fly larvae, young or small predatory bugs, lacewing larvae and adults, and predaceous mites. A variety of contact and systemic insecticides have been used to control thrips on commercial crops and backyard garden plants. Due to their short generation time and high fecundity, thrips can rapidly develop resistance to these materials; some of these products are more toxic to the natural enemies of thrips than to the pests, hence the possibility of thrips

populations exploding or resurging following these treatments.



Close-up of foliar damage done by greenhouse thrips, *Heliothrips haemorrhoidalis*. Photo: Martin Heffer, The Horticulture and Food Research Institute of New Zealand, www.forestryimages.org

The white marks this gladiolus flower result from feeding by gladiolus thrips, *Thrips simplex*. Photo: Whitney Cranshaw, Colorado State Univ., www.forestryimages.org

Thrips damage (*Frankliniella* sp.) can occur during cool weather on seedling plants like this cotton. Note the puckered, misshaped new growth. When temperatures rise, the thrips are at a disadvantage and the newest foliage will look more normal in size and shape. Photo: Ronald Smith, Auburn University, www.forestryimages.org

Damage by Cuban laurel thrips, *Gynaikothrips ficorum*, causes the foliage of several species of *Ficus* to curl and fold, creating microhabitats for these comparatively large thrips to feed and reproduce. The white eggs are shown here along with a yellow nymph. Photo: Whitney Cranshaw, Colorado State University, www.forestryimages.org

Wood Boring Beetles

O & T Guide [O-#10]

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Besides bark beetles (separate fact sheet), two other common families of beetles use woody plants to rear their offspring. The Buprestidae have one common name for the adult---metallic wood borer---and a second for the larvae---flat-headed wood borers. Similarly, adult Cerambycidae are generally known as long-horned beetles, while larvae are called round-headed wood borers. Some species in both families prefer conifers as hosts while others use only broadleaf trees. Many species attack live but usually stressed trees, while others prefer recently dead hosts.

Metamorphosis: Complete, both families
Mouth Parts: Chewing (larvae, adults)
Pest Stage: Larvae

Life Cycles and Descriptions of Hosts:

Adult metallic wood boring beetles are bullet-shaped, flat at the front of the head and sharply tapered at the ends of the wings and abdomen; most are slightly flattened, hard bodied beetles ranging in lengths from about ½ to 1 ¼ inch. At least part of the body, sometimes just the underside, is a metallic color; blue, green, black or coppery brown are common depending upon species. Adults are powerful flowers and many species are active by day. Adults sometimes frequent flowers where they feed on pollen. After mating, females find preferred hosts that may be stressed due to prior disease, insect infestation, lightning strikes, fire or physical damage. They lay their eggs singly in rough bark or after chewing a shallow hole into bark.

Adult *Chrysobothris femorata*, a metallic wood boring beetle (Buprestidae). Photo: James Solomon, USDA Forest Service, www.forestryimages.org

Larva of a buprestid beetle, a flat-headed wood borer, *Buprestis novemmaculata*. Photo: Pest and Diseases Image Library, , www.forestryimages.org

Larvae of many species mine the live bark of their hosts initially, especially where the bark is thin. Although called "flat-headed," it is the thoracic segments of the larva that are significantly broader and flatter than the insect's head. The abdominal segments are considerably narrower. The well-developed, sharp jaws of many species are black while the legless larval body is off-white. As the larvae molt into larger instars, they often bore deeper into sap and heart wood, creating oval burrows packed with excess sawdust and waste (frass). Mature larvae chew a slightly larger chamber near the bark when they are ready to pupate. The life cycle of smaller beetles may take only one year; multiple year life cycles are common, particularly when an infested tree is felled and used in construction. Affected trees may have loose bark where it has been mined by flat-headed wood borers. These insects and their oval tunnels are common in firewood. Adults emerging from firewood inside the home do not reinfest firewood, nor do they infest wooden furniture or construction wood. Most adults fly to windows where they soon die of desiccation.

Long-horned beetle adults vary in length from less than ½ inch to nearly 2 ½ inches. Most are elongate oval and slightly flattened with antennae ranging from roughly half the length of the body to greatly exceeding the length of the body. The smaller, brightly colored species are usually active by day and often can be found on flowers feeding on pollen. The duller or darker colored (i.e. brown, black or mottled gray) species are often nocturnal. Most species are strong fliers. Many adult beetles make a squeaking or hissing sound when picked up due to the forcible release of air from the abdominal spiracles (breathing ports). Long-horned beetles are attracted to distressed, dying or recently dead host shrubs or trees like adult metallic wood borers and may infest the same hosts simultaneously.

Adult spotted pine sawyer, *Monochamus clamator*, Family Cerambycidae. Photo: Whitney Cranshaw, Colorado State University, www.forestryimages.org

Mating pair of locust borers, *Megacyllene robiniae*, family Cerambycidae. Photo: Whitney Cranshaw, Colorado State University, www.forestryimages.org

Adult cottonwood borer, *Plectrodera scalator*, family Cerambycidae. Photo: Ronald F. Billings, Texas Forest Service, www.forestryimages.org

Exceptionally large example of a long-horned beetle larva or "round headed wood borer," likely a prionid. Note the cylindrical shape, row of spiracles and stout black mandibles on the head. Photo: Herbert A. "Joe" Pase III, Texas Forest Service, www.forestryimages.org

Eggs are laid singly in natural cracks in the host or in shallow pits chewed by the female. Larvae are cylindrical, white, segmented and legless or nearly so. While most mature at about one inch in length, some of the largest are nearly 3 inches long and at least ½ inch in diameter. Their head capsules are well defined but relatively small compared to the diameter of the larval body. The mandibles are stout and sharp and forward directed. These larvae create tunnels that are round in cross section; the tunnels are usually tightly packed with excess sawdust and wastes (frass) as long as the tree is intact. Mature larvae bore toward the bark of the host where they chew larger cells prior to pupation. While the smallest of these insects may mature in one year, many species have multiple year life cycles. Larvae of these beetles are also likely to occur in forest trees harvested for poles and vigas in home construction and in firewood. When installed in a home, their life cycles may be extended to 5-10 years due to cooler indoor temperatures. As with buprestids, adult long-horned beetles will emerge from firewood inside a home; they usually fly to a window where they soon die. Without meeting their biological needs to disperse and find fertile mates, these beetles are doomed.

Habitat and Hosts: Metallic wood-boring beetles and long-horned beetles vary in their host preferences. Some species target certain conifers while others prefer various deciduous trees or larger diameter shrubs. Damage is cumulative with trees in distress usually sustaining the most damage. Finding evidence of bark beetles, metallic wood-boring beetles and long-horned beetles in the same tree or piece of firewood is not unusual. When active in construction timbers, larvae in both buprestid and cerambycid beetles sometimes can be heard chewing at night; homeowners often find accumulations of dry "sawdust" wastes on floors or furniture underneath infested timbers. While some sawdust comes from activities of live beetle larvae, the rest may fall

simply because the timbers twist slightly as they air-dry, releasing sawdust from old or vacated larval tunnels.

Damage: Recently transplanted, stressed, dying or recently dead host trees are eagerly sought out by female metallic wood borers or long-horned beetles searching for mates and/or places to oviposit. Adults also will attack recently cut logs, slash or wind-damaged trees while a few may attack intact apparently healthy trees. Larvae feed in woody tissues with enough moisture and food value to sustain them. Exit holes made by the new adults are often diagnostic clues of a borer infestation. Depending on the specific site of attack, internal feeding in woody tissues can stunt a plant's growth, cause twig or limb die-back, kill the plant by interfering with water and nutrient transport, kill the plant by disrupting the production of new growth, or allow entrance of rot-causing organisms. Borers can also weaken the structure of a tree and increase its susceptibility to storm damage and disease. While common in firewood, none of these beetles infest or reinfest dry wood or firewood, regardless of whether it is unfinished or finished; this information is comforting to homeowners experiencing a flight of beetles coming out of their fireplace logs.

IPM Notes: Logically, maintenance of healthy trees is the best defense against wood boring beetles; however, this condition is difficult to achieve and maintain under New Mexico growing conditions, particularly in urban planting sites throughout the lifetime of the tree. Pruning out the dead wood may not result in an aesthetically pleasing tree. Merely correcting horticultural care problems may come too late to rescue the damaged tree. Also, realize that new growth on a damaged tree probably will come from adventitious buds, producing odd-looking clusters of branches that are oddly shaped and weakly attached to the tree limbs. These can make the tree more susceptible to storm damage and additional pest infestations. While some insecticides are labeled to control wood borers as adults land to lay eggs or as larvae hatch, none of these products, including systemics, can reach larger, older larvae deeper in the wood. Insecticides will not reverse the cumulative damage already done to the tree by these insects. Consider protecting recently transplanted trees from adult wood borers by making topical applications of registered insecticides to the bark at intervals and concentrations specified on the labels. Transplanted trees exposed to bright, hot sun may be protected from bark sunburn by applications of white latex paint diluted with water or a similar sort of "whitewash" product. While the whitewash treatment has no direct effect on wood boring pests, it may alleviate some environmental damage to trees that would make them more susceptibe to wood borers. Paper or plastic wraps applied to trunk bark may prevent irrigation or rain water from evaporating adequately, favoring the growth of microorganisms, providing harborage to potential pests and perhaps weakening the tree such that it becomes more attractive to wood borers. Avoid long-term use of guy wires, even those padded with sections of hose or soft tubing since they can girdle a tree, again making it susceptible to wood borers.

Pupa of a cottonwood borer, *Plectrodera scalator*, in its burrow inside a cottonwood root. Photo: James Solomon, USDA Forest Service, www.forestryimages.org

Neoclytus caprea, the banded ash borer, has naturally shorter antennae, although it also is a member of the family Cerambycidae. Larval tunnels in this picture are mostly packed with sawdust and frass. Photo: James Solomon, USDA Forest Service, www.forestryimages.org

Adult female twig girdler, *Oncideres cingulata*, family Cerambycidae. Note that the beetle's jaws are oriented at a 90 degree angle to the twig. In this position, the female can girdle a host twig by taking a bite and side-stepping her way repeatedly around and around the twig. Expect twig die-back from the terminal to this girdling damage. Photo: James Solomon, USDA Forest Service, www.forestryimages.org

(Left) *Moneilema armatum*, a long-horned beetle (Cerambycidae) that uses various cacti as hosts for food and larval development. (Right) Example of damage caused by a *Moneilema armatum* larva in a section of cholla cactus (*Opuntia* sp.). Both Photos: Whitney Cranshaw, Colorado State University, www.forestryimages.org