Bark Beetles They're Back!!

Are Your Trees at Risk?

Many species of bark beetles are causing widespread tree mortality throughout the Intermountain West. Although sometimes viewed by humans as catastrophic, outbreaks of native forest insects are natural events. Native insects and the plants they use for food and reproduction have evolved together. Unlike some introduced pests, native insects kill individual trees but do not threaten the existence of an entire plant species. Native insect outbreaks are only a problem when they conflict with values that humans have for an area (i.e., recreation, wildlife habitat, scenic beauty, wood production or property values). A tree in the wilderness is not subject to the same human values as a tree in your backyard.


FADING TREES ATTACKED BY BARK BEETLES

Bark beetle populations have been increasing in forested areas of the western U.S. The primary reason for this increase is the combination of large areas with susceptible stand conditions (mature trees in dense stands) and trees stressed by drought. High levels of forest insect activity will likely continue if current conditions do not improve.

The bark beetles causing widespread mortality in the forests of the Intermountain West are all native. The principal species include: mountain pine beetle, spruce beetle, Douglas-fir beetle, fir engraver beetle, western balsam bark beetle, and pinyon ips.

Forest Health Protection

HOW CAN SOMETHING SO SMALL KILL SOMETHING SO BIG?

Individual beetles of these species are not much larger than a piece of cooked rice. Not only are they small, brown, and hard to see, but much of the time their activity is scattered and barely noticeable.

In low numbers (latent populations) these insects survive on newly dead, dying or stressed trees created by wind, snow, lightning, other biotic organisms, or by human activity. Occasionally, small pockets of standing trees may be killed but over the landscape these patches are often unnoticed.

However, beetle population levels can increase when sufficient food is available, allowing large numbers of these small beetles (outbreak populations) to attack large healthy trees *en mass*. Often many trees are killed over the landscape with results likened to that of wildfire. In recent years, more trees have been killed by bark beetles than by fire!

In the battle between trees and tree-killing beetles the two principle interacting factors are tree vigor and beetle numbers. When beetle populations are low, healthy trees often produce enough resinous pitch to drown and flush out the beetles that attempt to enter (pitchout). When trees are stressed they may be unable to produce sufficient amounts of defensive pitch. Yet, when beetle populations are high, even a healthy tree may not be able to produce enough pitch to ward off hundreds of simultaneous attacks (a mass attack). In addition, many beetles carry fungi that further damage the tree's defense system.


DOUGLAS-FIR MORTALITY (OUTBREAK)


A 'PITCHOUT'


A DOUGLAS-FIR BEETLE

The USDA Forest Health Protection offices in Ogden, UT and Boise, ID, in cooperation with the Caribou-Targhee and the Bridger-Teton National Forests have created this publication to educate the public regarding the principle tree-killing bark beetles in the Intermountain West. With this knowledge, you can make informed decisions concerning protection of your private property and provide meaningful input about proposed actions on public lands.

Representatives from the cooperating agencies are available to assist you with additional information. Please see page 12 for a list of contacts and additional information sources.

Does this affect you? Look inside

Are Your Trees at Risk to Bark Beetles? What Should You Do?

STEP 1: IDENTIFY YOUR TREES

The first step in determining whether or not your tree is susceptible to insect attack is to know what species of tree you have. The following lists are the principal evergreen species found in the Intermountain West.

PINES (NATIVE):

Most pines have more than one needle attached to the tree together in a 'bundle.' The number of needles per bundle is often important in determining the pine species.

PINYON (COLORADO AND SINGLELEAF)

Colorado pinyon, found mainly in Utah have two, 1-2" long needles per bundle. Singleleaf pinyon, found mainly in Nevada, have one sharp, rounded needle per bundle, >1" long. Cones are not spiny.

Natural Range: Colorado pinyon in UT; Singleleaf pinyon in NV, western edge of UT, scattered spots in southern ID.


COLORADO PINYON

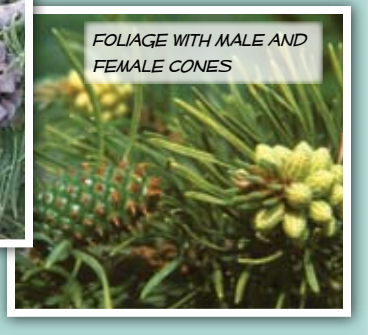

SINGLELEAF PINYON

LODGEPOLE

Needles are two per bundle, 1-3" long. The small ¾-2" long cones have very short stalks and stay attached to the tree for many years. Cones feel prickly.

Natural Range: ID, MT, WY, northern UT, spots along the Sierra Nevada Range in NV.


CLOSED AND OPEN CONES


FOLIAGE WITH MALE AND FEMALE CONES

PONDEROSA (AND JEFFREY)

Ponderosa needles are 2-3 to a bundle, ranging from 3-10" in length. Cones are 2-6" long and prickled. Jeffrey pine (3-needles) is found along the Sierra Nevada's, overlapping with ponderosa pine's broad range. Jeffrey generally has larger, stouter cones (5-9") with incurved spines (pokey ponderosa; gentle Jeffrey).

Natural Range: ID, MT, UT, spots in eastern NV and the Sierra Nevadas, isolated spots in WY.


OPEN PONDEROSA CONES


CLOSED PONDEROSA CONES AND LONG NEEDLES

5-NEEDLED (E.G. LIMBER, WHITE BARK, AND WESTERN WHITE PINES)

Several pine species with 5-needle bundles are native to the Intermountain West, but Limber is the more commonly planted species around homes. Needle length ranges from 1.5-4". Cones vary.

Natural Range: various throughout Intermountain West.


LIMBER PINE NEEDLES AND CONES

PINES (EXOTIC):

SCOTCH AND AUSTRIAN PINES

These European pines have 2-needles per bundle, 1.5-3" and 3-6" longs, respectively. Scotch cones are smaller (1.5-2" long) than Austrian cones (2-3"). Cones of both species are not spiny (vs. ponderosa). Scotch pine is noted for the strong orange coloration of the bark.

Natural Range: As exotic species there is no native range but they can be found planted throughout the Intermountain West.


SCOTCH PINE

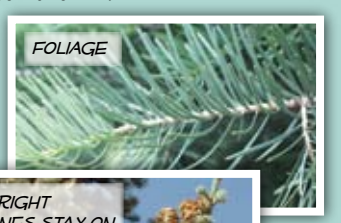
FIRS (NATIVE):

Firs and spruce have only one needle (no 'bundles') but the shape of that needle can differ by tree species.

WHITE FIR

The 2-3" long, single, flat needles narrow to a stalk at their base and have rounded tips (vs. sharp spruce or notched grand fir). The needles tend to curve upward, leaving few needles below the stem. The greenish purple or yellow cones (3-5"), found in the upper branches, point up and are not dropped. Rather, they fall apart on the tree (vs. Douglas-fir cones that drop off).

Natural Range: UT, eastern NV, southeast corner of ID.



DOUGLAS-FIR

Although not a true fir species, Douglas-fir is similar to other firs in having short (~1"), single, flat needles. Needles have rounded tips like white and subalpine fir, and are narrow at their base like white fir. However, the 3" long cones hang down. The cone scales have a distinct shape resembling the tail and back legs of a mouse.

Natural Range: ID, MT, WY, UT, and scattered spots in NV.

SUBALPINE FIR

The short (1-1.5"), single, flat needles also have rounded tips but are thick at their base (vs. white fir). The dark purple cones (2.25-4" long) are borne upright on the upper branches and are not dropped.

Natural Range: ID, western MT, western WY, UT, spots in northern NV.

GRAND FIR

The single, flat needles of grand fir are 1.25-2 inches long and distinguished by having a notched end. Needles tend to grow out to the sides giving the branchlets a flattened appearance. Cones are also 2-4" long, green-brown in color, and extend upward.

Natural Range: northern half of ID, northwest edge of MT.

SPRUCES (NATIVE):

ENGELMANN AND BLUE SPRUCE

Single needles are square and sharp, leaving 'bumps' on the small twigs when they fall off. Blue spruce needles tend to be stiffer and sharper than Engelmann needles. Cones hang down, measuring 1-2.5" in length for Engelmann and 2.5-4" for blue. In the wild, blue spruce prefers moist stream edges.

Natural Range: Engelmann spruce in ID, MT, WY, UT, and NV; blue spruce in UT and WY.

References:
- Kuhns, Michael. 1998. A guide to the trees of Utah and the Intermountain West. Utah State University Press, Logan, UT
- National Audubon Society. 1996. Field Guide to North American Trees. A. A. Knopf, NY
- Watts, Tom. 1985. Rocky Mountain Tree Finder. Nature Study Guild, Rochester, NY

STEP 2:
DETERMINE YOUR TREES' SUSCEPTIBILITY

The susceptibility of an individual tree is often described differently than the susceptibility of a stand of trees. When there is a group of trees (a stand), a tree may be killed yet the overall stand may look and function much as before. In an urban setting, however, an individual tree may be of high importance for aesthetic or other values.

A THINNED STAND WITH A DIVERSITY OF TREE AGES

A DENSE STAND WITH TREES COMPETING FOR RESOURCES

INDIVIDUAL TREE SUSCEPTIBILITY

Trees that are stressed are less able to produce the pitch used to counter bark beetle attacks. Damage to the bark, needles, or root system can occur through human activity (construction, paving, excavating, etc.) or by natural causes (drought, wind, lightning, other insect or disease agents, etc.). The more stressed the tree is the more susceptible it may be. Poor crown condition is often an indication of stress.

CROWN DIFFERENCES BETWEEN A HEALTHY (LEFT) AND STRESSED (RIGHT) TREE

Susceptible trees are not always attacked by bark beetles, especially if beetle numbers are low. Conversely, it is possible that when beetle populations are high, even healthy trees may be attacked.

STAND SUSCEPTIBILITY

Dense stands are more susceptible than open stands where trees do not have to compete with each other for limited water, light, and nutrients. Stands with a higher diversity of tree ages and tree species are also less susceptible. Some tree cover will likely remain if a bark beetle outbreak does remove the most susceptible trees.

Stands that have trees stressed by drought, defoliation, disease, or other damage are especially susceptible to bark beetle attacks.

SPECIFIC TREE SUSCEPTIBILITIES

Tree-killing bark beetles often have a preference for specific tree species. In some cases, a beetle species will attack only one tree type. In other cases the beetle may be able to use a number of similar tree species.

Lodgepole, ponderosa, '5-needled' pines, and other introduced and native pines: All native and introduced pines, except for Jeffrey pine, are susceptible to the mountain pine beetle. **Jeffrey pine** is susceptible to the Jeffrey pine beetle which is very similar to the mountain pine beetle. The most susceptible pine trees are older than 80 years; greater than 8 inches in diameter at breast height; weakened by drought, disease or damage (e.g. lightning or windthrow); or located near existing beetle-infested trees. Recently dead or downed pines are rarely infested by mountain pine beetle. However, there are other beetles that will use this material and can cause small clusters of tree mortality if conditions are right (especially *Ips* species).

Singleleaf and Colorado pinyons: Although several bark beetles can utilize pinyon pine, the landscape level mortality noted in recent years has been caused by pinyon ips. Trees stressed by drought, defoliation, pruning, or other damage are highly susceptible, especially if the trees are stressed in the spring or early summer. Drought is the principle instigator of outbreaks.

Engelmann and blue spruce: Engelmann is the preferred host tree species for spruce beetle with blue spruce occasionally attacked and successfully infested. Engelmann spruce trees over 16 inches in diameter are most susceptible to spruce beetle; trees less than 5 inches in diameter are seldom attacked. Freshly killed or damaged trees (e.g. from windthrow or avalanches) are preferred habitat. In this material beetles may be able to build a large population that can overcome the defenses of healthy host trees.

Douglas-fir: Douglas-fir trees can be killed by the Douglas-fir beetle. The most susceptible trees are larger than 14 inches in diameter; older than 120 years; growing in dense stands; weakened by drought, root disease, or defoliation; or are located near existing beetle-infested trees. The Douglas-fir beetle will readily use recently downed or damaged material and has shown a strong preference for fire-scorched trees.

White fir: The principle bark beetle in white fir is the fir engraver beetle. Large diameter trees weakened by drought, defoliation, or other stressors are most susceptible. Root disease is often associated with white fir and serves as a weakening agent. In some cases, only parts of trees are killed (especially tops).

Grand fir: Stressed trees over 5 inches in diameter are particularly susceptible to fir engraver. Odors emitted from stressed trees appear to be the principal attraction for attack. Overcrowding, disease, defoliation, and drought often cause stress. In grand fir forests, pure, dense stands are most susceptible. Because fir engraver may only kill a portion of the tree, a tree may sustain attacks over several years before tree mortality occurs.

Subalpine fir: Subalpine fir trees are also susceptible to the fir engraver beetle. However, western balsam bark beetle is the more common bark beetle in subalpine fir, and prefers highly stressed trees, especially those infected with root disease or weakened by drought. Windthrow events can also cause western balsam bark beetle outbreaks. Often a complex of factors including root disease, drought and bark beetles together cause widespread or pockets of subalpine fir mortality.

STEP 3:
DETERMINE IF YOUR TREES HAVE BEEN ATTACKED

Many symptoms of bark beetle attack are similar regardless of the tree or beetle species involved. However, some are more prevalent with certain bark beetles than others. Some of the most common signs are described below.

MOUNTAIN (AND JEFFREY) PINE BEETLES

HOSTS: Most native and introduced pine species, except Jeffrey pine which is attacked by the very similar Jeffrey pine beetle. Pinyon pines are not commonly attacked.


PITCH TUBES

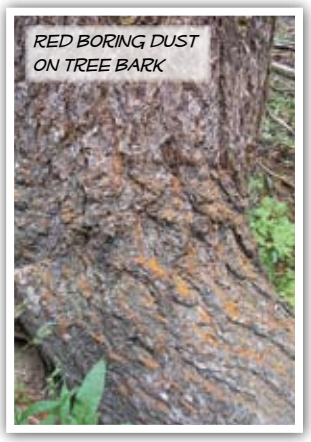
Pine trees infested with mountain pine beetle (or Jeffrey pine beetle) become next year's infection source, so it is important to identify freshly attacked trees. Signs of beetle infestation are pitch tubes or small holes and boring dust. Most beetle-attacked trees will have pitch tubes scattered over the bole of the tree. These popcorn-shaped masses of pitch and boring dust may be brown, pink, yellow or white. If the tree is extremely water stressed and cannot produce pitch, only small holes and boring dust are visible. Removing a section of the bark should show tunnels created by beetles in their reproduction (see page 8) if the attacks were successful. Downed host trees are rarely attacked by mountain pine beetle but may be attacked by another bark beetle group called 'ips'. The ips do not typically kill healthy live trees. Gallery patterns of all ips species are similar (see pinyon ips on page 9) and differ from that of mountain pine beetle.

DOUGLAS-FIR BEETLE

HOSTS: Douglas-fir.

Trees that have been infested will generally remain green until the following spring, so you must look for "clues" other than dead foliage. These trees become next spring's infection source, so it is important to identify them. Fresh-down trees and fire scorched trees are highly susceptible.

The most reliable external sign that your tree has been attacked is the presence of boring dust (reddish-brown sawdust) in bark crevices or around the base of the tree from April to August. Boring dust is created when the insects bore through the bark of the tree. Multiple pitch streams about 20 feet up on the tree bole may also be an indicator. However, not all pitching means bark beetles are present. Removing a section of the bark may show tunnels created by beetles in their reproduction process (see page 8). Unfortunately, sometimes the tunnels are made at heights on the tree that are beyond your reach.


RED BORING DUST ON TREE BARK

SPRUCE BEETLE

HOSTS: Principally Engelmann spruce although blue spruce may be occasionally attacked.

Signs of attack are boring dust (see photo under Douglas-fir beetle) in bark crevices or around the base of the tree from mid-May to July. Pitch tubes may accumulate around the insect boring holes. Also, look for pieces of bark around the base of the tree. Woodpeckers will often flake off pieces of this thin barked tree in order to feed on the beetles and their larvae. Removing a section of the bark should show tunnels created by beetles in their reproduction process (see page 8) if the attacks were successful.


WOODPECKER FEEDING

PINYON IPS

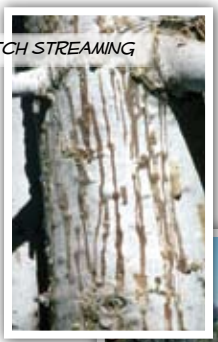
HOSTS: Singleleaf pinyon, common pinyon, other pinyon species, and occasionally other pines.

Pinyon ips attack all species of pinyon and occasionally other types of pines if they occur around the pinyon trees. Crown fading is often the first noticeable sign of attack. Small pitch tubes and boring dust may be present but are not easily noticed on bushy trees. Attacks can occur from early spring through late summer since this bark beetle can have several generations in a year. Woodborers also will quickly infest dead or dying trees, but can be differentiated by their larger size and a lack of distinct 'ips' gallery pattern (see page 9).

FIR ENGRAVER

HOSTS: White fir, grand fir, and occasionally subalpine fir.

Fir trees are often attacked in groups with attacked trees usually 5 inches in diameter or greater. Trees generally turn yellow-red within 3-6 months. Evidence of attack before trees fade is often hard to detect; entrance holes are without pitch tubes and in the Intermountain West pitch streamers are rare. Boring dust in bark crevices and color fading are most noticeable. This beetle may attack only strips or portions of the tree which will not cause mortality of the entire tree. These partial attacks may result in dead branches or tree tops. If your tree is fading and you think it might be caused by fir engraver beetle, check for the distinct gallery pattern the beetle creates under the bark (see page 9).


PITCH STREAMING


TOP KILL AND TREE MORTALITY CAUSED BY FIR ENGRAVER

WESTERN BALSAM BARK BEETLE

HOSTS: Subalpine fir.

External evidence of successful attacks by western balsam bark beetle can be hard to detect. Entrance holes and boring dust may be visible in late summer. Pitch flow may be found, especially when attacks have not been successful. Successfully attacked trees turn yellowish-red within a year and can stay bright red for several years after death.

STEP 4: HOW TO TREAT TREES THAT HAVE BEEN ATTACKED

Once bark beetles have attacked a tree around more than half of its circumference, there is generally nothing you can do to save it. There are no chemical insecticides registered or recommended for killing bark beetles under the bark of infested trees. While some trees do survive bark beetle attack, the vast majority are killed once infested.

To kill the beetles, cut down the infested trees and debark or burn all material greater than 4 inches in diameter. Burying trees is another option. Bucking and splitting infested trees for firewood may kill some beetles if done in the summer and if the wood is located where it can dry out quickly. However, if firewood is stacked or placed in the shade before it dries, most of the beetles will survive.

If infested trees or slash are not treated, removed, or burned, adult insects will emerge the following spring and attack standing trees nearby. Pinyon ips (and other ips) may emerge in as little as 35 days to repeat another reproductive cycle (2-4 cycles per year). In the case of spruce beetle, adult beetles will also emerge during the second spring.

By the time trees have red-brown needles, most bark beetles have left the tree; however, spruce beetles can emerge from trees with practically no needles. Other beetles and larvae may be observed, but they are of little concern in causing further tree mortality. Most are beneficial wood decomposers – not tree killers. The tree may be cut down for firewood or left standing for wildlife habitat (see below). The tree should be removed, however, if it has the potential to endanger persons or property.

DEAD TREES ARE "HOME" TO MANY FOREST CREATURES

If enhancing wildlife habitat interests you, consider keeping dead trees on your forested lands. Standing dead trees in a forest are called "snags" and many species of wildlife depend on snags for their survival.

Owls, hawks, and eagles use snags to perch and to support their nests. Cavity nesters such as woodpeckers, mountain bluebirds, and chickadees nest in the snag cavities.

Chipmunks, squirrels, and other mammals use snags as homes. Bats use areas under loose bark for roosting. Fungi, mosses, and lichens commonly grow in the decaying wood of a snag.

Insects chew through the decaying wood, creating tunnels and chambers. Moths and ladybird beetles, and many species of reptiles and amphibians, hide under the bark of snags.

With so many animals and plants living on and in a dead tree, other animals frequently come there to feed. For example, many species of woodpeckers depend on snags to provide insect larvae for food.

If a tree on your private land does not have the potential to endanger persons or property, please consider leaving it standing for our animal friends!

STEP 5: HOW TO PREVENT BARK BEETLE ATTACKS

There are several things you can do to protect your trees from bark beetles. Preventing attack is key because you cannot do anything to save a tree once it has been successfully attacked.

1. Remove all trees that currently contain beetles as described in Step 4.
2. Always clean up any recently blown down trees or fresh slash over 4 inches in diameter. Beetles are more attracted to and reproduce better in large diameter slash material.

3. Avoid tree damage such as knocking off bark, or compacting/excavating soil near trees. Injured trees attract bark beetles.
4. Thin out dense stands of trees, leaving the healthiest, most vigorous ones. Contact your state forester (see page 12) for details on proper thinning methods. Trees that have less competition for water, light, and nutrients more effectively repel bark beetle attacks. Thinning can also hamper the bark beetle pheromone communication system that facilitate mass attacks.

5. Increase age and species diversity to enhance stand resistance to bark beetle attacks and reduce the effects of tree mortality when attacks occur.
6. Use commercially produced beetle pheromones to inhibit attraction to an individual tree or a stand. Presently, this method is only available for deterring mountain pine beetle and Douglas-fir beetle under some situations.
7. Use insecticides to protect unattacked trees. Carbaryl spray applied as a preventative treatment is effective for most bark beetles, but is not registered for use against fir engraver or western balsam bark beetle.

Chemical Treatments

PHEROMONES

- **MCH for Douglas-fir beetle:** MCH (one-methy-cyclo-hex-3-one) is a chemical used by Douglas-fir beetle to communicate (a 'pheromone'). This pheromone tells the beetle that the tree is already fully occupied and they should look elsewhere for a tree to lay their eggs in. The chemical has been commercially synthesized and is available in small bubble caps that are easily stapled to tree boles just prior to beetle flight in mid-May. Application rates should be 30-40 bubble caps per acre for area protection or 2-4 caps per tree for individual tree protection. The cap slowly releases the pheromone and is generally effective for one season if properly applied. Current cost per cap is under $2. See 'Using MCH to Protect Tees and Stands from Douglas-fir beetle Infestation' at http://www.fs.fed.us/r1-r4/spf/fhp/publications/MCH_brochure/MCH_online.pdf for more information.

- **VERBENONE for mountain pine beetle:** Verbenone (4,6,6-trimethylbicyclo[3.1.1]-hept-3-en-2-one) is considered the principal pheromone used by mountain pine beetle to tell other beetles that the tree is fully occupied and to move on. As with MCH, this chemical has been commercially synthesized, however the cost is closer to $8 a pouch. Recommended dosage is 40 pouches per acre (area protection) or 2+ pouches per tree for individual tree protection; applied around mid-June. Verbenone pouches have shown mixed results in repelling mountain pine beetle attacks. In some previously treated sites where population pressures were high, the verbenone applications have had only limited success. Research studies in Idaho and Montana are currently being conducted to determine if population densities affect the performance of verbenone treatments. It is also critical that currently infested trees be removed from the area before the pouches are deployed or efficacy is greatly reduced. Generally, use of verbenone is limited to areas where insecticide application (see section below on Carbaryl) is not feasible.

- CONTACT YOUR STATE FOREST HEALTH SPECIALIST (see page 12) for assistance to determine if these treatments will be effective and if financial assistance is available to help defray your costs.

INSECTICIDES

- **Carbaryl for mountain pine beetle, Jeffrey pine beetle, spruce beetle, Douglas-fir beetle, and pinyon ips:** Application of this insecticide prior to beetle flight will protect pines, spruces, and Douglas-fir from the beetles described in this pamphlet. However, carbaryl is not approved for use against fir engraver or western balsam bark beetle on true firs. Due to the cost and the need for special equipment, this treatment is generally used only on individual, high value trees, and is generally applied by certified applicators. All tree bole surfaces must be completely soaked up to a height where the tree is too small in diameter to be useful habitat. While labeled as being an annual treatment, research has shown that the effectiveness generally lasts 18-24+ months. Contact your state's forest health specialist (see page 12) to determine if this is an appropriate treatment for your trees. Contact your state's agriculture department (see page 12), division of pesticides, for assistance finding qualified applicators.

- **Other insecticides for bark beetles:** Other insecticides such as pyrethroids are registered for use against some bark beetles. Research has shown some success with pyrethroids but they do not last as long or work as effectively as Carbaryl.

- **Systemic treatments** applied to the soil around the tree or inserted into holes drilled in the tree have not been shown to be effective although new injection systems and insecticides are currently being tested.

- **PESTICIDE PRECAUTIONS**
  Pesticides used improperly can be injurious to humans, animals, and plants. Follow directions and read all precautions on the label. Consult your local county agriculture agent or State extension agent about restrictions and registered uses of particular pesticides.

What is a Bark Beetle?


FEEDING LARVAE GIRDLING TREE

Bark beetles are small (<1/4"), hard bodied beetles that bore through the protective bark of a tree to lay their eggs in the moist, living tissues. These beetles and the larvae they produce feed on this living tissue, cutting off the tree's ability to transport water and nutrients. The shape of the tunnels created by adult beetles and their larvae as they feed are unique for each species of beetle. The principle gallery is created by the female who lays eggs along the gallery walls (egg gallery). The eggs hatch and the larva create 'larval galleries' that tend to increase in width as the larva increases in size. (Also see the beetle-specific information on page 5.)

Mountain (and Jeffrey) Pine Beetles


MOUNTAIN PINE BEETLE

Mountain pine beetle is a native to forests of western North America and attacks all species of pine except Jeffrey pine; Jeffrey pine is attacked by the similar Jeffrey pine beetle. Periodic outbreaks of these beetles, especially of mountain pine beetle, can result in the loss of millions of trees.

During low population levels, attacks are primarily on trees under stress from injury, poor site conditions, overcrowding, root disease, or old age. As the beetle populations increase, attacks may involve most trees 8 inches in diameter or greater in the outbreak area, regardless of their apparent health.

Adults are brown to black in color and about 3/16 inch long with a rounded back end. The larvae are yellowish white, legless grubs with dark heads, found within tunnels under the bark.

Successfully attacked trees normally do not show red, faded foliage until 8 to 10 months after attacked. However, drought stress will cause some trees to start "fading" as early as 4 to 5 months after attack.


MOUNTAIN PINE BEETLE GALLERIES

Mountain pine beetle adults leave the dead, yellow- to red-needled trees and attack green trees from July through September with the majority flying in mid to late July.

The female mountain pine and Jeffrey pine beetles create straight, vertical (with grain of wood) egg galleries that can extend up to 3 feet in length or more. At the bottom of this gallery where the attack was initiated is a distinctive J-shaped crook. Eggs are laid alternately along the walls of the egg gallery.

Douglas-fir Beetle

This beetle is a native to forests of western North America and only attacks Douglas-fir trees. Outbreaks typically occur in areas of wind-thrown trees or trees damaged by fire or spruce budworm defoliation. The Douglas-fir beetle generally does not cause widespread mortality like mountain pine beetle. Groups of trees ranging from a few to several hundred trees may be killed. Although large outbreaks sometimes occur due to drought stress and dense stand conditions.


DOUGLAS-FIR BEETLE

The Douglas-fir beetle prefers large trees, but will attack trees as small as 6 inches in diameter. Depending on weather and elevation, attacks occur from late April through August, with peak flights occurring from early June to early July.

While physiologically dead within a few weeks, trees typically do not show yellow-green ("fading") or red foliage until 10 months or more after being attacked. With trees that are drought stressed, "fading" may occur by the fall following the attack (4 to 5 months).


DOUGLAS-FIR BEETLE GALLERIES

Adult beetles are brown to black in color and about 3/16-inch long. The larvae are whitish, legless grubs with brown heads found within tunnels under the bark. Eggs are laid in groups on alternative sides of the female's gallery, creating a unique pattern. The female's gallery may be 8x10 inches long starting at the bottom with a small angled 'J'.

Spruce Beetle

This beetle is a native to forests of western North America and attacks all species of spruce, although Engelmann is preferred; blue spruce is seldom attacked. Outbreaks typically begin in areas of wind-thrown trees, then move into standing trees. In landscapes dominated by Engelmann spruce, extensive mortality can occur.

Adult beetles are ¼ inch long, brown to black in color with reddish-brown or black wing covers. The larvae are yellowish white, legless grubs found within tunnels under the bark.

Unlike the previous two bark beetles, spruce beetle can have a one- or two-year life cycle. Infested trees usually do not "fade" (turn yellow-green or reddish) until one or sometimes two years after attack.


SPRUCE BEETLE

The spruce beetle egg galleries average 3-12 inches in length with a slight crook at the start. Eggs are laid alternately along the gallery with larva feeding gregariously outward in all directions.


SPRUCE BEETLE GALLERY

PINYON IPS

Most native bark beetles in the 'ips' group are not very aggressive tree killers. Rather they tend to rely on recently dead, damaged or stressed trees for food and reproduction. Pinyon ips, a native ips, is no exception. However, their host trees are often found in areas prone to water and heat stress (droughts) which makes them susceptible to attack. During drought periods, pinyon ips is able to overcome the weakened defenses of trees, affecting broad landscapes. Because this beetle can have two or more generations in a year it is able to spread quite rapidly when conditions are favorable.

PINYON IPS

Attacks begin early in the spring, and attacks can continue through early fall.

TYPICAL IPS GALLERY

Pinyon ips are about 1/5 inch long, and have a spiny back end typical of all "ips' species (versus a rounded back end). Gallery patterns of most ips are similar; often a Y or H shape, with a larger 'mating' gallery from which the separate egg galleries radiate. Larva and beetles overwinter under the bark, consuming large patches of inner bark and lacking specific galleries. Wood borers (see side panel) are quick to infest attacked trees after pinyon ips have attacked.

FIR ENGRAVER

Also a native bark beetle, this species attacks true firs. It does not attack Douglas-fir which is not a true fir.

Measuring only about 1/8 inch, these small, shiny, black beetles are distinguished by having a truncated, spineless, back end. The gallery pattern is also unusual in that the egg

FIR ENGRAVER

FIR ENGRAVER GALLERY

gallery runs across the grain of the wood (horizontally) for 4 to 12 inches with the larval galleries extending up and down with the wood grain. Shortly after attack, a fungus that travels with the beetle starts to stain the area a yellow-brown color.

The larva overwinter under the bark with the adult beetles emerging around June, and dispersing from June through September. Most populations have a one-year life cycle, occasionally two years at higher elevations. Larva and pupae are similar to those of other bark beetles.

WESTERN BALSAM BARK BEETLE

Only about 1/8th to 1/6th of an inch long, a magnifying glass may be needed to see the distinctive hairy patch (toupee) on the head of this beetle. The gallery pattern is star shaped, and often accompanied by a lesion caused by fungi that assist in killing the tree.

WESTERN BALSAM BARK BEETLE

The beetle is the most conspicuous agent in a complex that is responsible for killing large numbers of subalpine fir throughout the Intermountain West. Other agents in the complex include root disease and balsam woolly adelgid.

In addition to drought, windthrow has been known to initiate large scale outbreaks of this insect.

WESTERN BALSAM BARK BEETLE GALLERY

Western balsam bark beetle normally needs two years to develop. However, a one year life cycle is possible under the right weather conditions. Two peak flights of this beetle occur in late June/ early July and again in late July / early August.

OTHER AGENTS . . .

THAT CAUSE DAMAGE SIMILAR TO THAT OF BARK BEETLES

Other insects or animals can cause damage to trees that may resemble bark beetle activity. We have listed a few of these to help you discern between bark beetles and activity from other agents.

OTHER WOOD DAMAGING AGENTS:

Because bark beetles have often left the tree by the time you see red needles, your inspection of a dead tree may find insects that were not directly responsible for the tree's death. Many of these insects live under the bark of dead and dying trees and are important in recycling the nutrients back into the ground.

A BARK BEETLE (LEFT) AND WOOD BORER (RIGHT)

Most often confused with bark beetles are the metallic and longhorn **WOOD BORERS**. Wood borers are much larger than bark beetles. These borers feed on the phloem just as bark beetles do; however, their galleries lack a distinct shape. While developing, the larva may drill large oval or round holes into the wood. Their life cycle may take from one to over 10 years to complete.

LONGHORN WOOD BORER

METALLIC WOOD BORER

AMBROSIA BEETLES are very small, creating multiple pin holes in wood where they cultivate a fungi (ambrosia) that they feed on.

WOOD WASP larva make large holes in dead wood similar to wood borers but the larva do not feed in the phloem.

Even woodpeckers (**SAPSUCKERS**) can make holes in the bark that may look like a bark beetle entrance/exit hole.

DEFOLIATING INSECTS:

Other insects and diseases can cause damage to the needles of trees by either consuming the needles or causing the trees to drop their needles. The 'defoliating' agents can cause trees to die if they remove most of the needles over a several year period. Most conspicuous are several moth larvae that eat foliage, especially the western spruce budworm and the Douglas-fir tussock moth.

WESTERN SPRUCE BUDWORM

HOSTS: Douglas-fir, all true firs, spruce, and larch.

Western spruce budworm is a small moth. In the caterpillar stage, it feeds on the needles of trees. Populations of this defoliating insect periodically rise to outbreak levels.

The weather naturally regulates this insect's population. During recent years, drought conditions have left trees severely water stressed and susceptible to insect infestations. Budworms grow more vigorously in stressed trees. If drought conditions continue, budworm populations can increase dramatically where there is an abundance of susceptible tree species. Forested stands, which are densely stocked with predominantly Douglas-fir or subalpine fir and are multi-storied, are at high risk to infestation.

Tree damage is caused by the budworm caterpillars (larvae) feeding on needles in the early spring through summer. Larvae primarily consume current-year foliage, but can move to older needles in extreme cases. Infested trees will appear to have a red luster when observed from a distance. Upon closer inspection, branch tips will be bare or covered with nests of silk webbing and dead needles. Several years of continued defoliation will reduce tree growth and development, and sometimes cause death. In addition, budworm defoliation stresses the trees and makes them more susceptible to bark beetle attack.

WESTERN SPRUCE BUDWORM ADULT AND PUPAL CASE

FEEDING LARVAE

Western spruce budworm populations can be reduced with insecticides. If you feel spraying is needed, contact your local State Forester (see page 12) for treatment recommendations. You may also contact a licensed, professional pesticide applicator. Promoting non-host species such as aspen or pines will reduce overall stand susceptibility.

TREE CROWN DAMAGE FROM FEEDING LARVAE

DOUGLAS-FIR TUSSOCK MOTH

HOSTS: Douglas-fir, all true firs, and spruce.

Feeding damage and light webbing from Douglas-fir tussock moth is similar to that of western spruce budworm, but the larva, egg masses, and cocoons are distinctly different. Most identifiable are the oldest larva which have four dense patches of yellowish brown hair (tussocks) and two hair 'horns' at the back and two at the front. Younger larva lack these long 'horn' tufts but will have the four tussocks. The youngest larva are a plain gray with long hairs. The adult male is a non-descript brown moth. The female does not have wings and is usually found near her cocoon.

In the fall, females lay egg masses in a gelatinous substance and attached to foliage, twigs, trunks, under limbs, or other objects near the tree. These eggs hatch in the spring when the buds on their host trees start to open. The early larva feed on this new foliage, often stringing a loose webbing from branch to branch. In late July-early August the larvae pupate and the new moths emerge about two weeks later to mate and start the process over.

DOUGLAS-FIR TUSSOCK MOTH DAMAGE TO TWIGS AND OVER LANDSCAPE

The most visible defoliation occurs in the later larval stages in July. Mature, dense stands with trees of different ages, especially in dry sites, are most often affected. High population levels (outbreaks) can last for 2-3 years; long enough to kill entire stands of host trees. Top kill and some tree mortality can occur in only one year of heavy defoliation. Non-fatal defoliation or continual low-level defoliation can also cause decreased growth and vigor, often making the trees more susceptible to bark beetle attacks (e.g. Douglas-fir beetle, spruce beetle, and fir engraver).

DOUGLAS-FIR TUSSOCK MOTH MALE AND FEMALE; EARLY STAGE LARVA; LATE STAGE LARVA WITH "TUSSOCKS"

Challenges of a Bark Beetle Outbreak – What are Land Managers Doing?

Federal and State Land Managers

Effective management of bark beetle populations is a difficult challenge. Federal and State land managers know a great deal regarding characteristics that make stands susceptible to bark beetles and defoliators. Unfortunately, having this knowledge does not mean that they are able to prevent outbreaks.

The most effective way of dealing with bark beetle outbreaks over large, forested areas is through preventative vegetation management practices. Treating vast areas such as entire National Forests with chemicals to reduce bark beetle populations is not practical or feasible.

Land management planning is a required process for all Federal and State administered lands. Public involvement is a required – and encouraged – part of Federal planning efforts. During the Federal planning process, some areas are excluded from vegetation management (i.e. wilderness areas, roadless areas). Within these areas, treatments to manage an insect outbreak are often not available.

Where vegetation management activities are permitted, Federal and State land managers can reduce insect-related tree mortality. Examples of management activities that can reduce forest susceptibility to insect damage include:

- Remove some of the trees in dense stands through thinning to improve tree vigor and reduce susceptibility to bark beetles.
- Promote a diversity of tree species, which also reduces stand susceptibility to bark beetles.
- Promote a diversity of age classes (not always recommended for defoliators).
- Remove small pockets of bark beetle infested trees when they first appear in an area. This can be an effective way of suppressing populations. This method may not be effective in eliminating all beetles in an area if infested trees remain in susceptible sites.

Recent changes through the Healthy Forests Restoration Act of 2003 and the President's Healthy Forests Initiative, have given Federal land managers tools that will reduce delays and statutory barriers for projects which target improving forest health and reducing hazardous fuels. Federal land managers have used these tools to expedite projects aimed at reducing insect related mortality and thus decreasing hazardous fuels for wild fires.

Private Landowners

Each private landowner has different objectives for their property and trees. Each will have their own opinion about possible management techniques. Some will choose to do nothing; others will adopt aggressive bark beetle suppression strategies.

A neighbor who chooses not to remove beetle-infested trees will increase the probability that susceptible trees on adjacent property could be attacked. Obviously, these situations can become complicated. Tree removal options are not equally available to all landowners. Economics of the treatment may be a factor, especially for large properties. Site conditions, such as steep slopes, may make tree removal difficult.

Fortunately, using MCH caps for Douglas-fir beetle or Carbaryl insecticide for mountain pine beetle, Jeffrey pine beetle, spruce beetle, and pinyon ips, can be effective, preventative treatments for trees on your property; irregardless of what your neighbor chooses to do. However, treatments need to continue until the outbreak in your area collapses.

WHERE TO GO FOR HELP OR ADDITIONAL INFORMATION

ORGANIZATIONS

- For on-the-ground technical assistance with insect and forest management on private lands:
  - In Idaho, contact Jeff Fidgen, Idaho Department of Lands, (208) 666-8624, jfidgen@idl.idaho.gov, (http://www.idl.idaho.gov/Bureau/forasst.htm)
  - In Montana, contact Amy Kearney, Montana Department of Natural Resources, (406) 542-4283, (http://dnrc.mt.gov/forestry/assistance/pests/default.asp)
  - In Nevada, contact Gail Durham, Nevada Division of Forestry, (775) 684-2513 or 687-0431, gdurham@forestry.nv.gov, (http://agri.nv.gov/PLANT_Entomology_index.htm)
  - In North Dakota, contact Michael Kangas, North Dakota Forest Service, (701) 231-5936, Michael.Kangas@ndsu.nodak.edu
  - In Utah, contact Colleen Keyes, Department of Natural Resources Division of Forestry, Fire, and State Lands, (801) 538-5211, ColleenKeyes@utah.gov
  - In Wyoming, contact Les Koch, Wyoming State Forestry Division, (307) 777-5495, lkoch@state.wy.us

- For information on professional pesticide applicators and insecticide registration contact your local state Department of Agriculture, division of pesticide licensing. Web pages to assist you with the contacts are listed below:
  - Idaho: http://www.agri.idaho.gov (see noxious weed contacts)
  - Utah: http://ag.utah.gov/
  - Wyoming: http://wyagric.state.wy.us/techserv/tsindex.html
  - Montana: http://www.agr.state.mt.us/ (see pesticides, program contacts)
  - Nevada: http://agri.nv.gov/index_Plant2.htm or http://agri.nv.gov/PLANT_Chemistry_Index.htm
  - North Dakota: http://www.agdepartment.com/Programs/Plant/Pesticides.html (see laws and regulations for contacts)

- For general National Forest information, contact the National Forest directly
- For information on USDA FS Forest Health Protection for the Northern and Intermountain Region, visit http://www.fs.fed.us/r1-r4/spf/fhp/index.html
- Visit the FIREWISE™ program at www.firewise.org
- Additional pictures of the various trees and insects mentioned in this pamphlet can be found at www.bugwood.com

PUBLICATIONS

- A Field Guide to Diseases and Insect Pests of Northern & Central Rocky Mountain Conifers (http://www.fs.fed.us/r1-r4/spf/fhp/field_guide/index.htm)
- Forest Insect and Disease Management Guide (http://www.fs.fed.us/r1-r4/spf/fhp/mgt_guide/index.htm)
- Forest Insect and Disease Leaflets (FIDLs) are available for a variety of forest pests (http://www.na.fs.fed.us/spfo/pubs/fidl.htm)
- Using MCH to protect trees and stands from Douglas-fir beetle infestation (http://www.fs.fed.us/r1-r4/spf/fhp/publications/MCH_brochure/MCH_online.pdf)

THE ROLE OF FIRE

Dead trees with red needles, whether killed by bark beetles or other agents, are more flammable than live trees. However, once the needles are gone, the standing dead trees generally do not pose an increased risk of wildfire. As the trees eventually fall to the ground, increasing downed fuel loads have the potential to again increase fire severity.

Fire is a fundamental part of the natural ecosystem. The vegetation in the Intermountain West has evolved with fire and, in many cases, relies on fire to sustain its health and its presence on the landscape. However, fire around your home or other infrastructure is usually not desirable.

Research has shown that the most critical factors for a home surviving a wildfire are the construction of the home and the vegetation near the home.

FIREWISE™ is a multi-agency, nonprofit program devoted to helping people and their property survive a wildfire. The program encourages developing a "defensible space" around your home. Information on how to improve the survivability of your home from wildfire can be found on a variety of *FIREWISE*™ websites.

Some general recommendations are:

1. Roofs should be made of non-flammable material.
2. Enclose places where fire embers could accumulate such as soffits and underneath porches.
3. Thin out dense trees or shrubs.
4. Remove brush or dried grasses close to your home.
5. Landscape with fire resistant plants.
6. Do not place flammable material such as firewood or above ground propane tanks near your home.

Firefighter safety is a primary consideration in any fire incident. Creating a "defensible space" will increase the chance that firefighters can safely protect your home.

For more information regarding protecting your home from wildfire, visit the FIREWISE™ website (see box at left) or contact your local fire department.

34.08.400.09/06