



UI Extension Forestry Information Series II

Insects & Diseases No. 26

Everything you have always wanted to know about bark beetles, but were afraid to ask.

Yvonne C. Barkley

It has been estimated that 90% of insect-caused tree mortality in the United States is due to bark and ambrosia beetles, making them the most destructive insects in western conifer forests.

What are bark beetles?



Adult Douglas-fir beetle
(*Dendroctonus pseudotsugae*)

Photo by Jerald E. Dewey,
USDA Forest Service,
Bugwood.org

Bark beetles are small insects (about 1/4" in length) and get their name from where they live and breed, under the bark and wood of trees and shrubs. Collectively known as "scolytids", there are over 100 species of bark and ambrosia beetles known to Idaho, and all but 16 species attack conifers. Most

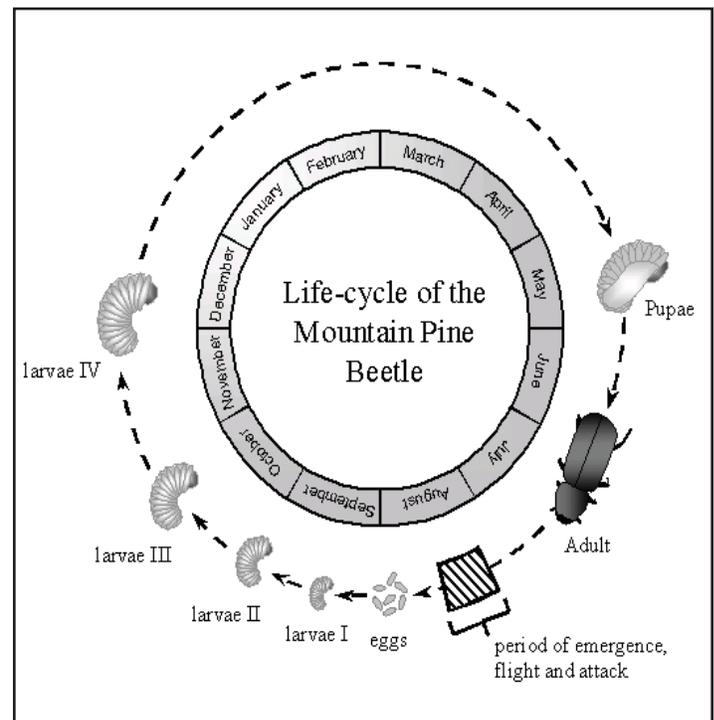
scolytids do little real harm, but the few that do are capable of infesting and killing large tracts of susceptible conifers, such as those in over-stocked, stressed or damaged stands.

Though there are differences between species, such as preferred tree hosts, number of generations per year and dates each species matures and flies, bark beetles share similar life cycles.

There are four stages of development during the life of a bark beetle: egg, larva, pupa and adult. Some species complete their entire life-cycle in one year, while others need two.

In general:

- Adult bark beetles emerge each spring from their hosts and fly off seeking new trees.
- Once found, they bore into the tree and excavate egg galleries under the bark, where they will spend the rest of their life-cycle.
- Adults lay small, white eggs along the sides of galleries.
- Eggs hatch into larvae, which are small, white grubs with distinct heads and no legs.
- Pupae develop from these larvae and live in small chambers, usually at the end of feeding galleries, where they overwinter as either pupae or adults.



It takes more than one bark beetle to kill a tree. Bark beetles prefer weakened host trees, but stressful environmental conditions, such as drought, can allow populations to build up rapidly even in healthy trees.

Bark beetles are host specific and each species only infests one or a few closely related species of plants. Each species of bark beetle also constructs uniquely-shaped galleries, with no two species having the exact same pattern.

- *Monogamous species* of bark beetles (one male, one female) construct linear galleries with the female initiating the gallery.
- *Polygamous species* of bark beetles (one male, several females) construct radiate galleries and the males initiate the galleries, beginning with a nuptial chamber. These chambers accommodate several females that gather here to mate with the resident lone male. Once mated, each female occupies their own branch of the gallery.

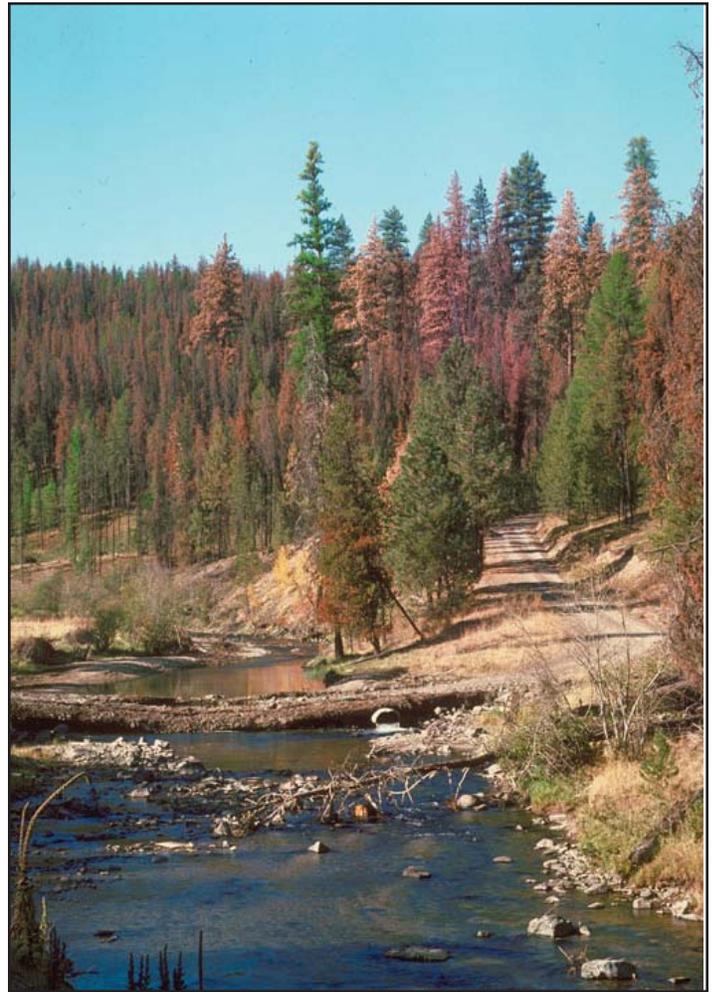
Bark beetles communicate with each other both chemically and sonically. Some species of bark beetles produce chemical compounds called pheromones that are used to communicate with other beetles of the same species.

- *Aggregation pheromones* cause both larvae and beetles to congregate together. Larvae aggregate in a common chamber in order to complete their life-cycle in live trees without killing the host. Adult beetles aggregate on a host tree and attack en masse, overwhelming a huge tree's defenses by attacking together.
- *Anti-aggregation pheromones* cause beetles to *not* congregate, causing them to fly past occupied hosts to neighboring trees and lessening the competition among beetles in an occupied tree for food and space.

Some species of bark beetles communicate with each other by rubbing body parts together to make sounds. Males in the genus *Dendroctonus* emit sounds to let others know a particular female is "taken", while sounds between male and female pairs provide recognition. Larvae make sounds by their chewing, allowing them to avoid each other and thereby lessen competition.

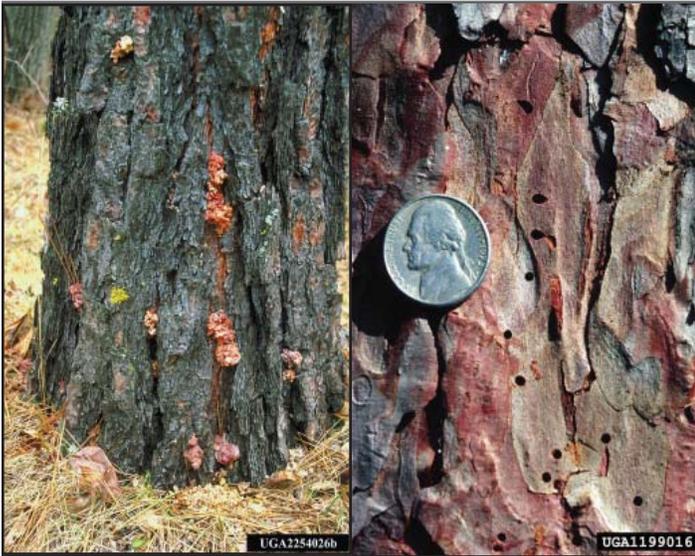
How do you know if your trees have bark beetles?

Idaho is home to many species of bark beetles and it is not uncommon to see different species of bark beetles attacking a tree at the same time. Easily recognized symptoms are useful for discovering if your trees have bark beetles.



Trees dying from bark beetle attacks can often be identified from afar by their fading crowns, which turn from green to yellow to reddish-brown. Symptoms can occur as soon as one month after an attack to more than two years later, depending on the temperature, moisture conditions, species and number of beetles in the tree.

*Photo by Dave Powell, USDA Forest Service (retired),
Bugwood.org*



A close inspection of a tree's trunk will show either small globules of resin (pitch tubes), small pin holes through the bark or reddish boring dust in bark crevices and around the base of the tree.

*Photo (left) by Bob Oakes, USDA Forest Service, Bugwood.org.
Photo (right) by Steven Katovich, USDA Forest Service, Bugwood.org.*



When the bark is removed from an infested tree, two types of galleries are revealed: (left) egg galleries, which are constructed by adult beetles and are rather uniform in width; and (right) larval galleries, which branch off from the egg galleries and increase in size as the young larvae grow.

*Photo (left) by Brytten Steed, USDA Forest Service, Bugwood.org.
Photo (right) by Scott Tunnock, USDA Forest Service, Bugwood.org.*

Five common conifers of Idaho. Bark beetles are very host tree specific. You can often identify the species of bark beetle your trees have by knowing the tree species.



Firs are friendly.
Needles are single, soft and flattened; buds are rounded and sticky.

Photo courtesy of Native Plants PNW.com.



Pines are in packets.
Needles are in bundles of 1-5 and enclosed at the base by a sheath.

Photo by Chris Evans, University of Illinois, Bugwood.org.



Spruces are spiky.
Needles are single and sharply pointed; can be 4-angled or flattened.

Photo by Joseph OBrien, USDA Forest Service, Bugwood.org.



Douglas-fir is not a fir.
Needles are soft and single; buds are pointed and *not* sticky.

Photo courtesy of Iowa State University Forestry Extension.edu.



Larch have soft needles arranged in tufts.

Also called tamarack, this tree is a deciduous conifer.

Photo by Chris Schnepf, University of Idaho, Bugwood.org.

Bark beetles common to Idaho.

Here are the most common species of bark beetles found in Idaho, arranged by their preferred host tree(s).



Western pine beetle gallery

Photo by Ladd Livingston, Idaho Department of Lands (Retired), Bugwood.org.

PREFERRED HOST: PINES

Western pine beetle – *Dendroctonus brevicomis*

Preferred tree host: ponderosa pine (*Pinus ponderosa*); this species of bark beetle has yet to be found east of the Continental Divide. Trees damaged mechanically, by lightning or by fire are often targets, as are diseased trees. Woodpeckers can often be found flaking away the outer bark of infested hosts to feed

on the larvae during the winter, giving the trunk of infested trees an orange-yellow color. This can act as a type of early warning system and help managers identify effected trees that may still have green foliage.

Life cycle: Two to four generations per year depending on the length of the growing season. Inactive during the winter months, western pine beetle activity increase as temperatures rise each spring. The first sign of attack is the production of pitch tubes on newly attacked ponderosa pines. Beetles mate and eggs are deposited along the margins of serpentine galleries that often cross themselves. Galleries are packed with frass once eggs are deposited. Larvae feed briefly in the inner bark on the phloem layer and, after a short period, turn out into the bark of the host tree, where they continue to feed within the outer bark. The primary overwintering stage appears to be the larval stage. Pupation occurs in the bark and, once temperatures warm in the spring, adults emerge and fly to infest new hosts.

The unique combination of long, crisscrossed, serpentine galleries and larval feeding in the

bark of host trees (instead of the phloem) are key characteristics of this species, making them easy to identify. Another unique feature of the western pine beetle is that it is often found in “mixed broods,” where several different species of bark beetles attack the same host simultaneously or within the same season. Some species will concentrate their activities in separate portions of the same host tree; in other cases, galleries of different species of bark beetles have been found immediately adjacent to each other.

Damage: At most times, western pine beetle is found in low numbers, with beetles attacking stressed, damaged or weakened ponderosa pines. Populations can deramatically increase during periods of drought, with over-stocked stands being especially vulnerable to attack. All size classes of ponderosa pines are susceptible to mortality from western pine beetle, and outbreaks can last for several years and effect widespread areas.

Management: The most economical and efficient means of management is to maintain trees and stands in a healthy condition. Overall susceptibility can be reduced by decreasing stocking levels and increasing stand diversity. Regular monitoring and prompt removal of infested trees can reduce overall impacts, especially during droughty years.



Mountain pine beetle gallery

Photo by Leslie Chong, Simon Fraser University, Bugwood.org.

Mountain pine beetle - *Dendroctonus ponderosae*

Preferred tree host(s): pines (*Pinus* spp.) and Norway spruce (*Picea abies*). During large outbreaks, Engelmann (*Picea engelmannii*) and blue spruce (*Picea pungens*) have also been attacked and successfully colonized.

The mountain pine beetle is the most aggressive, persistent and destructive bark beetle in the western United States and Canada. Outbreaks

usually develop in mature to over-mature forests.

Life cycle: One generation per year. Mountain pine beetles overwinter as larvae and adults. In most lodgepole and ponderosa pine stands, larvae pupate at the end of their feeding galleries in late spring.

Adults emerge and attack new hosts from about early July through August, depending on elevation and temperature. Egg galleries are more or less straight and vertical and may be up to 30-inches long. Eggs are laid along each side of the gallery in individual niches, with both niches and egg galleries tightly packed with frass. Larvae feed until freezing temperatures trigger dormancy.

Prolonged periods of temperatures below -30° F can cause significant mortality and lead to a reduction of, or end, an outbreak.

Damage: Mountain pine beetles cause obvious pitch tubes at the attack site as well as leaving noticeable amounts of boring dust in bark crevices and around the base of attacked trees. Infested trees fade from yellow-green to red-brown within a year.

Management: Thin overstocked forests, remove over-mature and stressed trees. Individual trees can be protected by using verbenone, which is an anti-aggregation pheromone.



Red turpentine beetle gallery

Photo by Ladd Livingston, Idaho Department of Lands (Retired), Bugwood.org.

Red turpentine beetle - *Dendroctonus valens*

Preferred tree host(s): pines (*Pinus* spp.) and some spruces (*Picea* spp.) A common pest of forest, shade and park trees that have been stressed by drought or fire.

Red turpentine beetles are extremely attracted to the smell of resin, which is stronger in stressed and dying trees than in vigorous individuals. If growing conditions improve, trees may survive an attack; if not, trees often die from a

combination of other beetles, fungi and other factors. Trees can be re-infested for several years and it may

take several years for these re-infestations to kill a tree.

Life cycle: One or two-year life-cycle. Red turpentine beetles emerge and attack in the spring to early summer. Adults emerge from recently cut stumps and dying trees and/or exposed roots and attack new host trees. Eggs hatch during the summer in one- to three-weeks.

Whereas most other bark beetle larvae maintain separate feeding tunnels, red turpentine beetle larvae congregate and feed gregariously – a unique feature of this species. As they feed, larvae tunnel away from the adult gallery and make an irregular, fan-shaped gallery. Beetles overwinter as larvae, new adults or parent adults.

Damage: Red turpentine beetles infest the bases of standing trees as well as freshly cut stumps. Light-pink to reddish-brown pitch tubes are evident around the base of the tree, as is white granular material on the ground. Red turpentine beetle pitch tubes may be as large as two-inches in diameter, much larger than those of other pine infesting bark beetles.

Management: The most effective way to prevent red turpentine beetle attacks is to maintain tree vigor and avoid practices that damage trees during harvests. Fresh stumps, slow-dying and fire-scorched trees, exposed roots of live trees and trees with compacted soil around them should be removed from the site.



Pine engraver beetle gallery

Photo by Texas A&M Forest Service, Bugwood.org.

Pine engraver beetle - *Ips pini* & *I. emarginatus*

Preferred tree host(s): pines (*Pinus* spp.). Most pine engraver beetle problems are associated with disturbances that stress trees and create a lot of fallen debris (slash), such as windthrow and

ice breakage, drought in spring and early summer, thinning, logging, fires, road construction, housing developments or tops of trees being weakened or killed by other agents. *Ips* beetles prefer breeding in fresh slash, though living trees may be attacked during outbreaks.

Life cycle: A normal life cycle includes two generations per year; more in warmer parts of its range and in dry years. Polygamous adults winter beneath the duff on the forest floor as well as in slash piles.

Initial flights of adults infest fresh slash or winter-damaged trees and occur most often in late April to early May, but vary with weather conditions. The first brood of the year develops into adults after 40-45 days, after which they emerge and attack slash and standing trees.

Mid-year attacks are initiated by male beetles, who construct nuptial chambers beneath the bark of suitable hosts. Each male mates with several females, who then construct egg galleries that radiate out from the nuptial chamber. Most progeny of this second generation drop to the ground in the fall and overwinter in the litter. Unlike other species of bark beetles, egg galleries of *Ips* spp. are kept free of boring dust and frass.

Damage: Fading tops of large, standing trees or whole crowns of small trees can be indicators of infestation, as can accumulations of boring dust in bark crevices, at the base of trees and in slash.

Management: Remove stressed trees and thin stands to maintain vigor, particularly during droughty years. Because pine engraver beetles that overwinter as adults normally infest green slash in the spring, avoid creating slash from December to June, unless it can be treated (masticated or burned) prior to early spring beetle emergence.



**PREFERRED HOST:
FIRS & DOUGLAS-
FIR**

Fir engraver - *Scolytus ventralis*

Preferred tree host(s): grand fir (*Abies grandis*); occasionally subalpine (*A. lasiocarpa*), concolor (*A. concolor*) and silver tip (*A. magnifica*) fir and Douglas-fir (*Pseudotsuga menziesii*). Infests mature trees, especially during drought years, as well as downed trees.

Fir engraver gallery

Photo by Texas A&M Forest Service, Bugwood.org.

Life cycle: The fir engraver has one generation per year and overwinter as larvae. Adults fly from June to July, with flights to new hosts more intense in July. The fir engraver is monogamous and females initiate attacks on new host trees.

Damage: The fir engraver infests boles, large branches, slash and windthrown trees larger than four-inches in diameter.

Root disease infected trees, as well as those defoliated by Douglas-fir tussock moth or western spruce budworm are especially susceptible to attack. Trees may be killed outright or be repeatedly attacked over several years, leading to patches of dead bark. Fir engraver beetles may also attack the tops of trees, causing top-kill.

Management: Maintain good tree vigor, especially in ornamental settings. Limit root and lower stem damage during maintenance, construction or harvesting activities. There are both predators and parasitoids available that provide natural control of fir engraver beetles.



**PREFERRED HOST:
DOUGLAS-FIR**

**Douglas-fir beetle
- *Dendroctonus pseudotsugae***

Preferred tree host(s): live and downed Douglas-fir (*Pseudotsuga menziesii*) and downed larch (*Larix occidentalis*). Trees injured by fire, defoliation, windthrow or root disease are especially vulnerable to attack.

Douglas-fir beetle gallery

Photo by USDA Forest Service - Ogden, USDA Forest Service, Bugwood.org.

Life cycle: One generation per year. Adults fly in mid- to late-spring when temperatures reach $\geq 60^\circ$ F. Females construct

vertical egg galleries in the pith of new host trees. Eggs are laid in groups, alternating along opposite sides of the gallery and hatch in one- to three-weeks. Newly hatched larvae mine out at right angles from the egg gallery. While feeding, larvae often introduce

fungi, yeasts and other organisms that can lead to tree mortality.

Once mature, larvae construct a pupal chamber at the end of mines, where the transformation to adults is completed by late August to early September. Adults overwinter in host trees and need a chilling period before they become sexually mature and capable of flying the following spring.

Damage: Though not always easily visible, the first sign of attack is reddish-orange frass that accumulates in bark crevices. Pitch-tubes are usually not visible, but trees may have pitch streaming down the trunk from the top of the beetle-colonized area. Crowns start to turn yellow and then red-brown several months to a year after the initial attack.

Management: Thin dead, dying and windthrown trees as well as those severely damaged by fire or stand disturbances. Douglas-fir beetles preferentially attack burned trees, so removing fuels from beneath large-diameter Douglas-fir before prescribed burns can reduce tree scorch and decrease susceptibility to attack.

Individual trees can be protected by using the anti-aggregation pheromone **methylcyclohexanone (MCH)**, which disrupts beetle aggregation.



Spruce beetle gallery

Photo by Edward H. Holsten, USDA Forest Service, Bugwood.org.

PREFERRED HOST: SPRUCE

Spruce beetle - *Dendroctonus rufipennis*

Preferred tree host(s): Engelmann (*Picea engelmannii*) and Colorado blue (*P. pungens*) spruce; rarely lodgepole pine (*Pinus contorta*). Windthrown trees are especially susceptible to outbreaks.

Life cycle: The number of generations per year varies. In Idaho, a one-year cycle is more

common in lower elevations, with two-year cycles possible at higher or colder locations. Adults emerge

from trees May through July, with attack periods lasting as long as five- to six-weeks.

Female beetles bore through the bark of standing and downed trees, depositing eggs on either side of constructed egg galleries. Egg galleries vary from a few to 12-inches and are packed with frass. Larvae emerge and feed in phloem, developing into pupae during the summer. In areas with a one-year life cycle, beetles overwinter as adults.

In areas with a two-year life-cycle, beetles overwinter as larvae the first winter and as adults the second year. Some of these beetles will exit trees and colonize the bases where snow insulates them from extremely cold temperatures. A new cycle begins when adult beetles emerge and colonize new hosts in the spring/summer one or two years after the initial attack.

Damage: The earliest sign of infestation is the presence of fine, bark-colored frass in bark crevices and around the base of standing trees. Pitch tubes may or may not be evident. Tree crowns can remain green for up to a year after attack. Woodpeckers often remove the outer bark of infested trees to feast on larvae in winter.

Management: Manage stands for health and vigor. When treating infested stands, minimize stump heights, cut cull logs into short lengths and lop and scatter slash to maximize exposure to sunlight. Windthrown spruce can be removed either before they can be colonized by spruce beetles, or after beetle colonization, but before adults develop and exit.

Bark beetles and firewood.

People often introduce bark beetles into new areas of forests, home sites and/or urban areas by transporting firewood from one place to another. Bark beetle larvae, pupae and/or adults can overwinter in firewood and emerge in spring to infest local trees.

There are two methods you can use to prevent bark beetles from emerging in the spring and infesting local trees.



Remove all bark from infested trees while they are still green. Removing the bark uncovers beetle galleries and exposes larvae, pupae and/or adults to harsh temperatures, wind and predators - effectively killing the brood that would have been next year's problem. Though hard and tedious work, it is very effective.

Photo from www.aligningwithnature.com/2017/12/



Solarization. Create a solar oven by stacking infested wood in an area that gets full sun. Loosely wrap the pile with thick, clear plastic, with edges held in trenches with soil or with bricks or other heavy objects. Leave wood wrapped for six months to a year. The plastic barrier will prevent any able adults from flying, while the heat from the sun kills any remaining beetles.

Photo by of Tom DeGomez, University of Arizona.

Learn more.

For a more in-depth information about bark beetles common to Idaho here are two great references:

- Furniss, Malcolm M. and J. J. Johnson. 2002. **Field Guide to the Bark Beetles of Idaho and Adjacent Regions.** Idaho Forest, Wildlife and Range Experiment Station Bulletin 74, Moscow, ID. 125 pp. Order a copy from: <http://www.cals.uidaho.edu/edComm/detail.aspx?IDnum=94&category1=Forestry&category2=NULL>.
- Rocky Mountain Region, Forest Health Protection. 2010. **Field Guide to Diseases and Insects of the Rocky Mountain Region.** Gen. Tech. Rep. RMRS-GTR-241 Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 336 p. Available online at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5262952.pdf.

Special thanks to Dr. Steve Cook, Professor of Entomology, University of Idaho, for his review of this publication.