Beetle Infestation

Subject(s): Science

Grade Level: 7th

Activity author: Annette Brennan, Lakes Middle School, Coeur d'Alene

Time Required: Two 50-minute class periods.

Lesson Objectives: Students will demonstrate knowledge of how insects invade trees and affect a forest over time.

Materials Needed: Large selection of tree bark with and without beetle patterns, large pieces of butcher paper, wide tip marker for each group, copies of handouts

Overview: Students should have an understanding of the life cycle of various beetle species. This is a tailgate lesson at the end of an insect unit. It will also serve as a lead off lesson on environmental issues, specifically the health of forests.

Procedure: Form cooperative groups of 3-4 students.

1. Have students create a list of the basic needs of a beetle. Review the lists with the class. Show students a picture of a mountain pine beetle, Western pine beetle, and a Douglas-fir beetle. Ask cooperative groups to write on a piece of paper what these beetles might have in common (hopefully the names of the beetles will lead students to guess that they are tree beetles). Ask students to share their ideas.
2. Once they have surmised that they are tree beetles, ask students to think back on the list of beetle needs. What might these beetles need from this list that makes them tree beetles? Create and then share a list of ideas on butcher paper.
3. If the groups have not come up with the idea of beetles using trees as a hatchery, propose the question, "Where would we find beetle hatcheries and why?" Once again let groups brainstorm then have them share their ideas.
4. Discuss the life cycle of these beetles. Share pictures of the larvae, pupae, adult, and eggs of each beetle.
5. Bring in the bark with and without beetle tracks. Ask students, "Thinking about what we have been talking about, make a hypothesis on what your group thinks caused these tracts on the bark?"
6. Discuss the following: -Are all the tracts identical? Why or why not? -What are the tracts doing to the tree?
-Did all the bark samples include tracts? Why or why not? -Would the health of the tree be in jeopardy? Why or why not? -Do you believe the bark without tracts could at some later point be found with tracts? Why or why not?
7. Pass out a copy of the *General Biology of Bark Beetles*. Ask each group to read the information.
8. Ask each group to share some information they learn from reading through the General Biology of Bark Beetles. Write these on the overhead.
9. Using General *Biology of Bark Beetles* ask groups to once again look at the tree bark samples and identify what type of beetle invaded the tree. On a large piece of butcher paper have each group create a table that shows the following information:
   -Type of beetle -Boring pattern -Type of tree it infects -Reproduction cycle
10. Have groups share their findings and compile it into a classroom chart. Discuss the following:
    -If we took a forest sampling (10 km2) of the forest and it contained x amount of tree (contact the local forest service). Have students figure out the time it would take to infest all the trees in the forest.
    -Then look at a large local forest and using the sampling above figure out how long it would take to infect all the trees in the forest.

Discussion:

1. Ask students how real they think this threat of beetles infecting a forest could be. Have students share answers. Then pass out the article from the Coeur d'Alene Press titled "Bugs Infest Forest" which was written in October 1998. Have students read the article then re-ask the same question.
2. Pass out a worksheet that asks more questions regarding the article. This will be homework. They also need to share what they have learned with their parents, so make sure one of the questions on the worksheet is a parent question.

GENERAL BIOLOGY OF BARK BEETLES

Bark beetles are particularly destructive pests with some rather remarkable living habits. They all belong to one family of beetles, Scolytidae, represented by some 600 species in the western United States. We are concerned primarily with only the more destructive species that kill trees.

As a group, the bark beetles have many interesting adaptations for their life under the bark of trees. One feature, which is distinctive to this family, is the habit the parent beetles have of boring tunnels under the bark for feeding and egg laying. Most other insects found under the bark ay the eggs on the outside of the small larvae bore in, or the female inserts the egg through the bark, constructs a tunnel and lay the eggs. This behavior provides a good identifying characteristic; namely, the bark beetle gallery patterns (figure 1). Bark beetles construct galleries in which there is a central tunnel made by the parent beetles where the eggs are deposited. These galleries in conjunction with different fungi, which stop resin flow, girdle and kill the tree. The fungus is introduced by adult beetles at the time of attack. Later, when the eggs hatch, the larvae make their own galleries which usually branch out at right angles to the main egg gallery. They feed within the inner bark (cambium-phloem layer) and etch the wood.

Bark beetles have four stages of development during their life (egg, larvae, pupa, and adult). All stages of the insect are found under the bark where they are protected from the weather. The small, white, shiny eggs are tucked into niches along the side of the egg tunnel. The larvae, which hatch from these eggs, are easy to recognize from their position and appearance. They are white, wrinkled, plump little grubs with distinct heads, but no legs and usually curved into a “C-shaped” posture. They are found in the galleries that diverge from the egg tunnel.

The pupae, or next stage, are white and naked and one can see the adult features forming, such as the eyes, legs, antennae, and wings.

The adult beetles are stout and cylindrical and have hard wing covers and membranous flying wings which fold away neatly below the wing covers when not in use. The adult beetle is usually light yellow in color when firest formed, changing to reddish-brown or black when mature.

The mating habits of bark beetles differ by species and are primarily responsible for the distinctive gallery patterns. Many members of the bark beetle family are polygamous-that is, one male beetle has a harem of two or more females. Each female constructs her own egg tunnel starting from a central chamber under the bark. This results in a forked or radiating pattern of egg tunnels as exemplified by beetles of the genus Ips. It appears that the beetles mate frequently, so a common feature in the polygamous-type gallery system is that the egg tunnels are clean. These open runways allow free and easy access to all branches of the gallery. Apparently the male beetle does most of the work in cleaning the tunnels.

The other mating arrangement is where there is only one female associated with each male. The monogamous beetles pair off and remain together in the egg tunnel while the female deposits her eggs. Since there is no need to keep the tunnels open, the monogamous beetles usually allow them to fill up with boring dust. The Dendroctonus beetles are well known for this habit. Most beetles of this genus found in the Rocky Mountain area have relatively straight egg tunnels oriented with the axis of the tree and vary in length up to 36 inches with individual larval galleries orient perpendicular along the sides. Some of the smaller monogamous beetles maintain clean galleries.

Although bark beetles derive important advantages from feeding and breeding under the bark of trees, they face one important hazard in this mode of living. They are often in imminent danger of being drowned in their galleries by tree pitch. In fact, the beetles must kill the host tree or at least a portion of it to stop this pitching before they can establish a brood.

The effect of pitch on the beetles influences their choice of a host tree. Research indicated that the beetles are more tolerant of the pitch from their natural host trees than they re of the pitch from other species of trees. But, even in their natural hosts, large volumes of pitch can drown or drive the beetle from the gallery. The beetles mix the pitch with boring dust and push it out of the entrance hole. This forms what is called “pitch tubes” on the outside of the bark. This reddish mass is a tube with a hole through it leading into the inner bark of the trees.

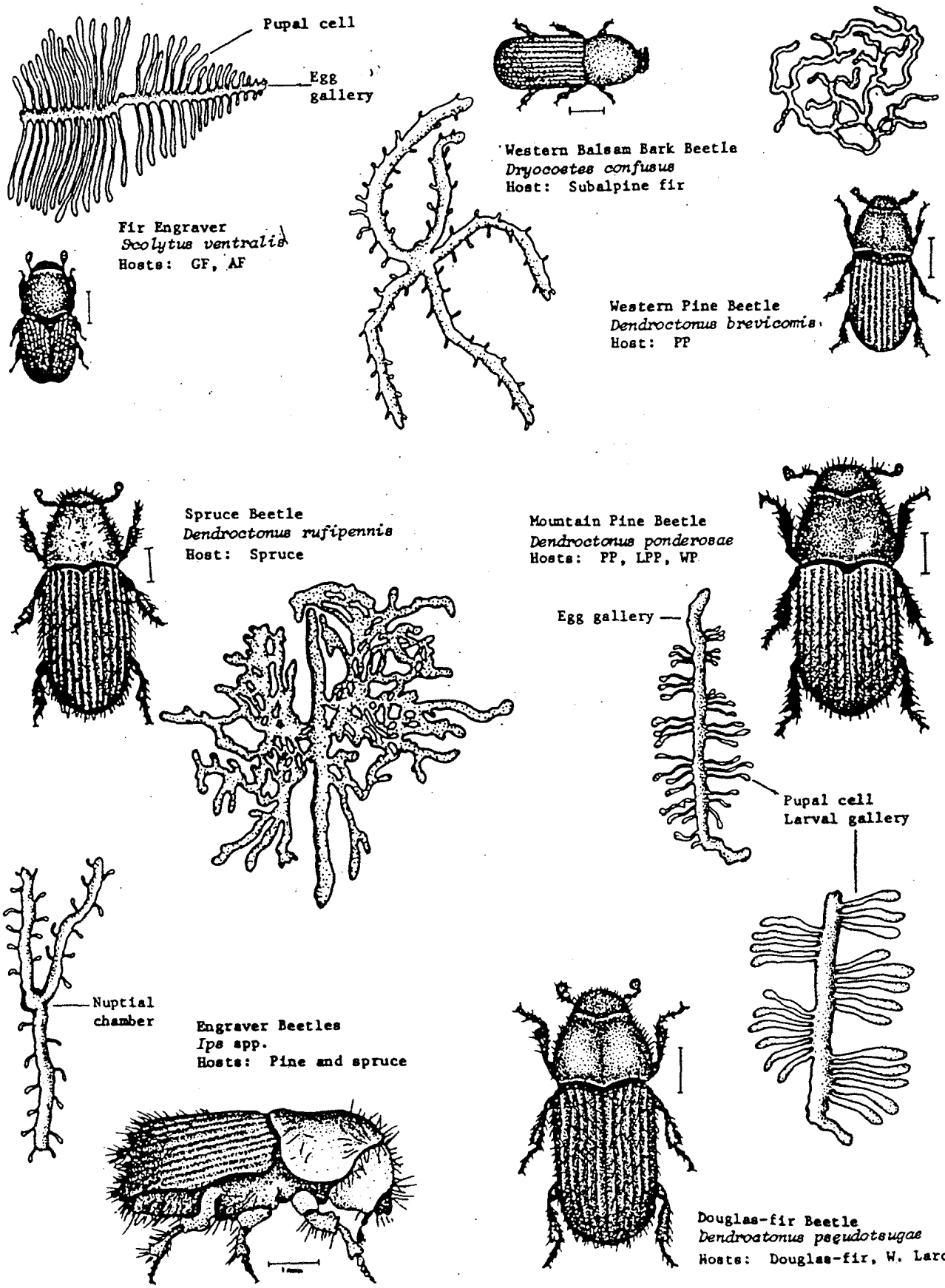
Bark beetles produce powerful attractants. These attractants are complex chemicals excreted in the hindgut of feeding beetles. They are carried by the frass and evaporate into the air as the frass is pushed out. These attractants are emitted after the beetles feed for a while and this directs more beetles to the tree. In this manner, large numbers of beetles congregate at a central point and kill additional trees with overwhelming mass attacks.

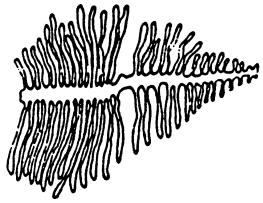
Table 1 illustrates the characteristics of the most common Dendroctonus beetles in Region 1.

Table 1. Identification of Dendroctonus beetles.

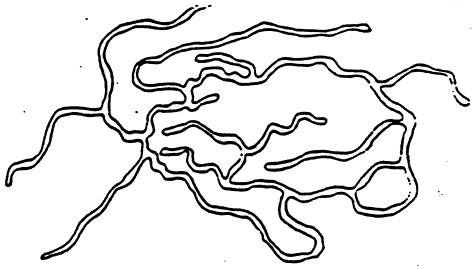
Host tree	Name of insect	Size of adult	Color of adult	Insect life cycle	Time of attacking new trees	Location in tree	Characteristics of susceptible stands
Pondersosa pine	Mountain pine beetle Dendroctonus ponderosae	1/5”-1/4”	Black	1 year	July thru August	Trunk of trees up to 6” diameter	Second-growth stands with BA above 120; old-growth trees with high risk rating and poor sites.
Ponderosa pine	Western pine beetle D. brevicomis	1/8”-1-5”	Black	1-2 generations per year	Spring to fall with some overlap between flights	Trunk of tree	Normally found in trees weakened by drought, lightning, fires, etc. Under epidemic condition can be found in unmanaged stands.
Lodgepole pine	Mountain pine beetle D. ponderosae	1/5”-1/4”	Black	1 year	Late July and early August	Trunk of trees up to 5” diameter	Old-growth stands with trees above 10” d.b.h. in the lower elevation zone for LPP.
White pine spp.	Mountain pine beetle D. ponderosae	1/5”-1/4”	Black	1 year	Late July and August	Trunk of trees	Larger d.b.h. trees of western white, limber, & white bark pine.
Engelmannn spruce	Spruce beetle D. rufipennis	1/4”	Dark reddish brown to black	Generally 2 yrs., but may be 1 or 3 due to elevation & temperatur e	June and July	Trunk of tree up to 6” diameter & undersides of windthrown trees & large slash.	Infestations start in logging slash, windthrown & damaged trees. Aggressive beetle populations will attack stands with 100 BA or more, site index 80 or more & average stand diameter of 16” or more.
Douglas-fir	Douglas-fir beetle D. pseudotsugae	1/5”	Reddish to dark brown to black	1 year	Early spring, extending into summer	Attacks of beetles found in lower 10’ of tree.	Mature & over mature stands & trees weakened by drought, fires, storm damage, etc. Slash & felled trees in early spring may create epicenters.
All pine	Red turpentine beetle D. valens	1/4”-3/8”	Reddish	1-2 per year	Mid-summer	Attacks of beetle found in lower 10’ of tree	Generally fond at base of trees infested with other bark beetles & in stumps in a logging operation.

GALLERY PATTERNS OF IMPORTANT BARK BEETLES IN THE NORTHERN REGION

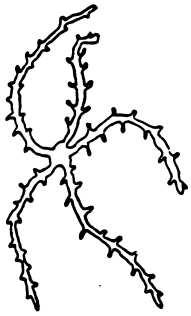




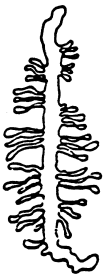
Fir engraver



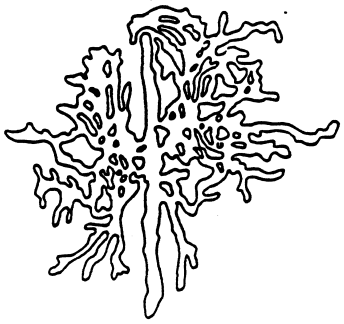
Western pine beetle



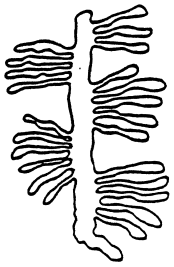
Western balsam bark beetle



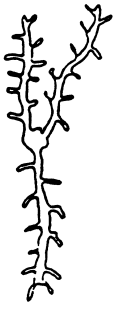
Mountain pine beetle



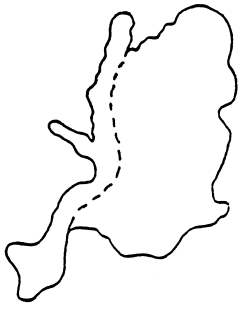
Spruce beetle



Douglas-fir beetle



Pine engraver



Red turpentine beetle

Bugs infest Forest

No threat to city trees

By MATT BROADHURST
Staff writer
Coeur d'Alene Press, October 1998

COEUR D'ALENE – Nearly 75,000 acres of the Idaho Panhandle National Forest are infested with deadly beetles and another 200,000 acres could be, according to Forest Service officials.

However, the outbreak of Douglas fir bark beetles and Western pine beetles appear to be limited to the forest. Karen Hinson, Urban Forestry coordinator for Coeur d'Alene, said the insects find their way into the city, but don't stay because they are attracted to dead, dying and stressed trees that are not common in residential areas.

"That's the reason why we cleaned the (1996) Ice Storm debris off Tubbs Hill," Hinson said.

Still, she encouraged homeowners to keep an eye on their trees to catch any potential problems before it's too late.

Sandy Kegley, Forest Service entomologist, said the beetle attack it the largest recorded since the 1950s. A team of specialists from the USFS is currently assessing the severity of the outbreak and what actions should be taken.

Kegley said the winters of 1996 and 1997 brought a lot of damage to the forest. The beetles flocked to the dad and dying trees and bean reproduction in healthy trees nearby. The firs sustained additional stress during the hot, dry summer, which made them even more susceptible, Kegley said.

The red-needled trees east of Hayden Lake, which look to be a part of the fall foliage, are actually part of a two- to four-year outbreak, she said.

"We are finding that for every red-needled tree that exists," Kegley said, "there are about 5 to 10 green trees that were attacked this year."

Recently attacked trees will have a small pile of sawdust at the trunk, which is caused by the beetles boring into the tree.

Art Zack, a forest ecologist, said the outbreak is a sign the ecosystem is out of balance.

What we are seeing is a result of there being almost twice the amount of Douglas fir trees in our forests than what was there historically," he said. "There used to be a better mix of other species like white pine, Ponderosa pine and larch; all species that are more resistant to many insects and diseases and a better match for the climate and growing conditions of north Idaho."

Zack attributes the population explosion of Douglas firs on the suppression of wildfires, white pine blister rust and past logging that removed resistant species. Information from the Interior Columbia Basin Scientific Assessment shows this problem is prevalent in may areas throughout the Columbia River Basin.

Dave Wright, forest supervisor for the IPNF, said his staff will develop recommendations by the end of the week. The team is giving emphasis to the implications involving adjacent private lands, the future effects on wildfires, the protection of recreation facilities and opportunities for ecosystem enhancement.

"If this were the old days, our recommendation would probably be to remove all the beetle-attacked trees we could reach," Wright said. "But these aren't the old days and we have a lot of other components of the ecosystem to consider before we do anything."