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# Pine Bark Beetles in Arkansas

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Arkansas forests are home to two native species of pine trees, loblolly pine (*Pinus taeda* L.) and shortleaf pine (*Pinus echinata* Mill.). We also have five species of native bark beetles (Figure 1) that attack and kill those pine trees. The bark beetles found in Arkansas are the Southern Pine Beetle, three species of *Ips* Engraver Beetles and the Black Turpentine Beetle.


**Figure 1. An adult bark beetle in a pine stem.**

*Photo courtesy of W. H. Bennett, USDA Forest Service, Bugwood.org*

## Southern Pine Beetle Biology

Southern Pine Beetle (*Dendroctonus frontalis* Zimmermann) is the most well-known, and the most destructive, of Arkansas' native pine bark beetles (Figure 2). These insects attack pine trees that have been stressed, usually from drought or overcrowding, and can kill the attacked trees in two ways. First, the beetles construct galleries through the inner bark of the tree to lay eggs (Figure 3). After the eggs hatch, the beetle larvae cut galleries through the inner bark as they feed. If enough beetles attack the same tree, the galleries effectively girdle and eventually kill the tree.


**Figure 2. An adult bark beetle stuck in pine resin.**

*Photo courtesy of Erich G. Vallery, USDA Forest Service - SRS-4552, Bugwood.org*

Second, southern pine beetles (SPB) can introduce blue stain fungi (Figure 4) into the trees they attack. Blue stain fungi colonize the xylem (wood) and block the flow of water from the roots to the tree crown, which results in tree mortality. Even if the number of SPB adults and larvae infesting the tree is not sufficient to


**Figure 3. S-shaped galleries constructed by southern pine beetles.**

*Photo courtesy of Ronald F. Billings, Texas A&M Forest Service, Bugwood.org*

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**Figure 4. Blue stain fungi can be carried by several bark beetle species.**
*Photo courtesy of Ronald F. Billings, Texas A&M Forest Service, Bugwood.org*


**Figure 5. A "beetle spot" surrounded by a zone of yellowing trees that have been more recently infested.**
*Photo courtesy of Terry S. Price, Georgia Forestry Commission, Bugwood.org*

cause immediate mortality, one beetle can introduce blue stain fungi into the tree and start the process of tree mortality if the fungi become established. Any southern pine beetles that emerge from trees infected with blue stain fungi have the potential to spread the fungi to any tree they subsequently attack. Healthy pines can defend themselves from blue stain fungi infection by producing lesions to isolate and stop the spread of the fungi, but environmental stress impairs a tree's ability to produce lesions and defend itself.

SPB are 1/8-inch long and have cylindrical black or reddish-brown bodies. Multiple generations can occur throughout the year in Arkansas, so all four life stages (adult, egg, larva and pupa) may be found in the same tree. Infestation occurs when the females land on the bole of a tree and tunnel into the inner bark and create a winding "S"-shaped gallery where they mate and lay eggs. The females then exit the tree and move to another tree to start the process over. When the females successfully attack a tree, they release pheromones which attract both male and female SPB adults that also attack the tree. The eggs hatch and the larvae begin to feed on the inner bark. After a short time, the larvae pupate then emerge as adults which leave the tree and move to attack another tree. The SPB life cycle can range from 26 to 54 days.

Initial SPB attacks occur in the spring often on trees that have been damaged by lightning or harvesting machinery. If the trees in the stand are stressed from overcrowding or drought, the insects are more likely to successfully attack the tree and spread to adjacent trees. This cycle produces a group of infested trees called a beetle spot (Figure 5) which, under the right conditions, will continue expanding throughout the growing season. Beetles actively fly when air temperature reaches or exceeds 58°F (Moser and Dell 1979). All life stages of the SPB can overwinter and continue activity when the temperature warms in the spring. Trees attacked by SPB usually show fading of the entire crown. The visual symptoms of tree death start with the crown fading to yellow and then quickly to red, especially during hot weather. The red needles fall from the tree soon after changing color. Once the needles drop, the SPB have left the tree. Trees that still have yellow and red needles may still have SPB larvae and pupa under the bark. Close examination of an infested tree will show fine wood dust around the base of the tree, in bark crevices, and on spider webs and other plants adjacent to the infested tree (Figure 6). This dust is a result of


**Figure 6. Frass or fine dust in bark crevices.**
*Photo courtesy of Gerald J. Lenhard, Louisiana State University, Bugwood.org*

adult beetles entering trees to lay eggs and emerging afterwards. Additional dust is created when the larvae pupate and emerge as adults. This dust may be seen in trees with green needles and no other apparent evidence of SPB infestation. Observing the dust is critical during the control phase and will be discussed later.

Pine trees have a natural mechanism to protect themselves from bark beetle attacks. They produce pitch, a sticky substance, which floods beetle galleries and drives the beetles out or encases them in crystallized resin (Figure 7). Often the pitch leaks out of the holes bored by beetles entering the tree and hardens into white or cream-colored globs called pitch tubes (Figure 8) that can look like popcorn kernels on the bole of the tree. Trees which are not stressed can oftentimes produce enough pitch flow to prevent successful bark beetle attacks. However, trees stressed by overcrowding or drought may produce little or no pitch, enabling a successful bark beetle attack.


**Figure 7. A pine bark beetle trapped in crystallized pine resin.**

*Photo courtesy of Ronald F. Billings, Texas A&M Forest Service, Bugwood.org*


**Figure 8. A pitch tube produced in response to a bark beetle attack.**

*Photo courtesy of Erich G. Vallery, USDA Forest Service - SRS-4552, Bugwood.org*

## *Ips* Beetle Biology

There are three species of *Ips* bark beetles native to Arkansas (Figure 9). They are (1) the six-spined engraver (*Ips calligraphus* Germar), (2) the five-spined engraver (*Ips grandicollis* Eichhoff) and (3) the four-spined engraver (*Ips avulsus* Eichhoff). They range in size from 1/8 inch for the small southern pine engraver to 1/5 inch for the six-spined engraver. The *Ips* beetles have a row of spines along each side of the posterior, hence the name six-spined, five-spined and four-spined. The three *Ips* beetles are


**Figure 9. An adult *Ips* engraver beetle.**

*Photo courtesy of Lacy L. Hyche, Auburn University, Bugwood.org*

all dark reddish-brown to black in color. The three different *Ips* beetles attack pine trees in differing locations on the tree. The four-spined engraver attacks the upper portion of the crown, limbs and can even attack fresh logging slash. The five-spined engraver usually attacks the lower crown and upper bole of the tree, while the six-spined engraver usually attacks the bole of the tree (Figure 10).

Male *Ips* beetles select injured or stressed trees first. As the males bore into the tree and feed, they release pheromones, chemical scents, that attract beetles of the same species to that tree. The male beetles excavate a mating chamber in the living cambium immediately under the bark. One to several female beetles enter the mating chamber, breed and excavate a gallery that is 4 to 7 inches long. They lay eggs along either side of the gallery. Together the female beetles create a gallery that is either “H” or “Y” shaped (Figure 11). The females then emerge and either re-attack the same tree in another location or move to another weakened or injured tree occupied by male beetles. If the *Ips* beetles attack in large enough numbers, they can overwhelm the tree’s defenses and cause tree mortality. Like the SPB, *Ips* beetles can also carry the blue stain fungi which will kill the tree if it becomes established.


**Figure 10. The five species of bark beetles native to Arkansas forests.**

*Artwork courtesy of Southern Forest Insect Work Conference, Bugwood.org*


**Figure 11. *Ips* beetles create galleries that are either "H" or "Y" shaped.**

*Photo courtesy of William M. Ciesla, Forest Health Management International, Bugwood.org*

Trees produce pitch as a natural response to an *Ips* beetle attack, and if the tree is healthy, it can successfully evict or immobilize small numbers of *Ips* beetles and prevent them from colonizing the tree.

Trees that are attacked by *Ips* beetles on the bole will also show pitch tubes (popcorn) that are white or cream colored similar to those produced by SPB (Figure 12). However, if the tree is stressed, it may not produce any pitch or a very small amount which will not prevent an attack.

Since some of the *Ips* beetles attack the crown of the pine tree, many times the needles on only one or a few limbs may fade to yellow and then to red, indicating an insect attack. However, like the SPB, if the larger *Ips* beetles attack the lower bole of the tree, then the entire crown may fade at the same time.


**Figure 12. A pitch tube created by an *Ips* beetle.**

*Photo courtesy of G. Keith Douce, University of Georgia, Bugwood.org*

*Ips* beetles are more likely to attack a single tree or only a few trees in a stand. This results in a scattered pattern of symptoms in trees, which is distinctly different from the spots created by a SPB infestation. This may make salvage or treatment less economical or less necessary than with a SPB attack. Although less severe than SPB in most cases, *Ips* beetles are always present such that a few trees can be attacked and die every year. The SPB populations are more cyclical, going from levels of boom to bust over a 10 plus year period.

## Black Turpentine Beetle Biology

Black Turpentine Beetle (*Dendroctonus terebrans* (Olivier)) is the largest of the pine bark beetles in Arkansas. They are approximately 1/5 to 3/8 inch long and black in color. Unlike other pine bark beetles, the black turpentine beetle (BTB) attacks scattered trees as a single insect or in very low numbers. They usually attack trees that have been stressed by a lightning strike, previous timber harvest damage, yard work damage, age or some type of environmental factor. Attacks by the BTB can kill trees over a period of months or years, though trees often survive the attacks. The BTB attacks a pine tree and spends a considerable time inside that tree. The beetles kick out frass and wood dust while occupying the tree (Figure 13). This causes the pitch tubes to be reddish or pinkish colored (Figure 14), making them easier to distinguish from the pitch tubes of the other bark beetles. The BTB is typically found in the lower 8 feet of the tree, most commonly in the lower 2 feet. Their feeding and egg laying activities differ from that of the *Ips* or SPB. BTB produce large round galleries in the inner bark (Figure 15) instead of linear galleries. BTB larvae feed in groups rather than as solitaire larva like *Ips* larvae and SPB larvae.


**Figure 13. Frass and wood dust created by black turpentine beetles.**

*Photo courtesy of Lacy L. Hyche, Auburn University, Bugwood.org*


**Figure 14. A pitch tube resulting from a black turpentine beetle attack.**

*Photo courtesy of Herbert A. 'Joe' Pase III, Texas A&M Forest Service, Bugwood.org*


**Figure 15. Galleries produced by black turpentine beetles.**

*Photo courtesy of Ronald F. Billings, Texas A&M Forest Service, Bugwood.org*

## Bark Beetle Control Methods

Control methods for bark beetles depend upon the type of beetle attacking the tree, so knowing what type of bark beetles are infesting your tree is therefore critical.

### Southern Pine Beetle

SPB attacks cause the most serious concern, and without proper control, the spots could result in hundreds of acres of forest being lost. Overstocked or older pine stands are the most susceptible to attack, especially during drought years. After a SPB attack becomes established, the bark beetle population

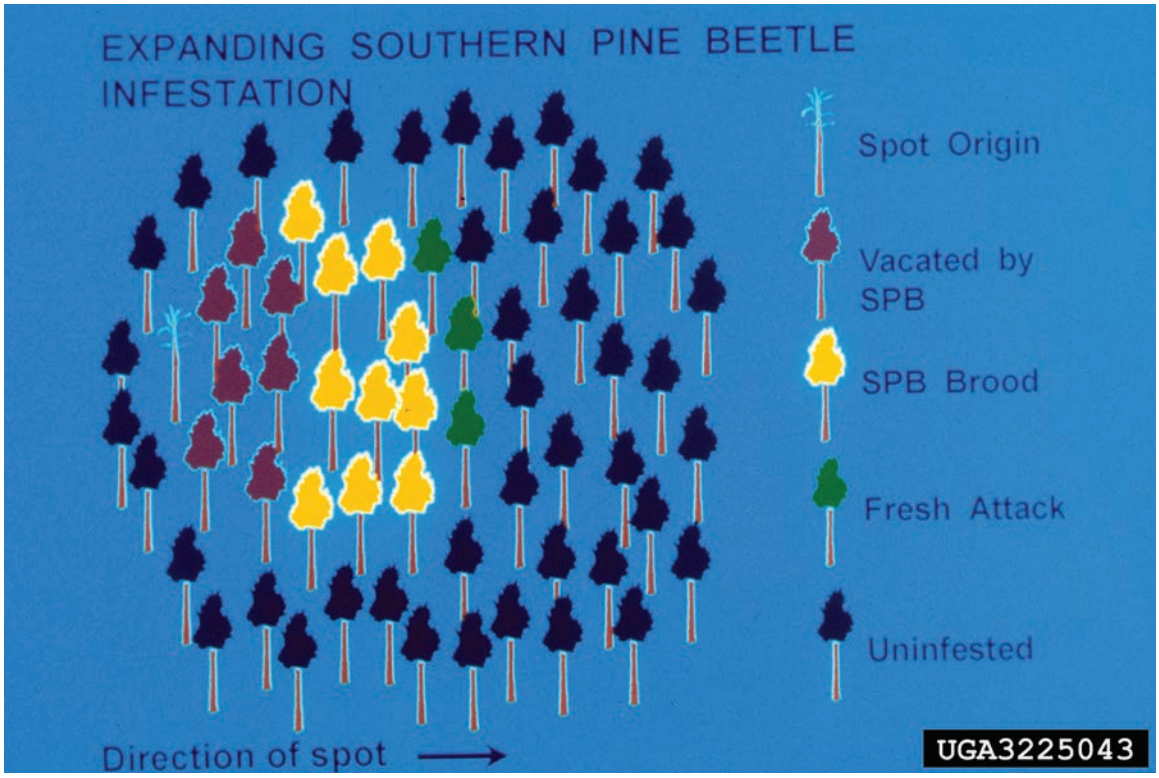


**Figure 16. Progression of a southern pine beetle attack. This one is spreading from left to right.**

*Image courtesy of Ronald F. Billings, Texas A&M Forest Service, Bugwood.org*

increases dramatically and insects move rapidly from one tree to the next. These "spots" often begin spreading in a specific direction due to several factors including wind direction (pheromones from attacking SPB attract additional SPB), tree density and pine species (Figure 16). During severe infestation years, cutting trees well ahead of the moving SPB infestation is the only way to stop the spread of SPB to surrounding trees and even to adjacent property owners. Below we will discuss the two most widely used harvest methods and mention previously used methods that are no longer recommended.

### *Salvage*

A salvage operation, one in which trees are cut and removed, is the preferred method of treating an active SPB spot. A salvage operation can provide income to the landowner which can help offset some of the losses from SPB-killed trees. To be successful, the salvage operation should be conducted in a specific order.

First, examine the bark and base of trees near the edge of the SPB spot for the symptoms of SPB infestation discussed earlier. Finding the infested trees is critical to stopping the spread of the SPB infestation. Second, immediately prior to harvesting, a buffer of uninfested pine trees at least one tree length past the last infested tree must be cut. For example, if the infested trees are 50 feet tall, then the buffer strip must extend at least 50 feet past the last infested tree. Third, the uninfested buffer trees must be harvested immediately by the salvage logging crew (Figure 17). All trees in the buffer must be felled back toward the center of the SPB spot or dragged back to the center after felling to assure that any remaining infested trees will not introduce SPB into the uninfested region beyond the buffer strip. After felling the buffer strip, the logger should cut the remaining trees


**Figure 17. Spread of this beetle spot has been halted by the buffer strip. Salvage logging will begin soon.**

*Photo courtesy of Ronald F. Billings, Texas A&M Forest Service, Bugwood.org.*

that are infested with SPB, again felling or dragging the trees toward the center of the spot. All infested trees with needles (green, yellow or red) should be harvested. Pine trees which have lost their needles should be left. The SPB have already left these trees; however, insects that prey on SPB are usually still developing in them. Leaving these needleless, dead trees will help build a population of predators which will in turn help reduce the overall SPB population in the area. Take care during the salvage operation to avoid damage to healthy trees that will be left standing. Injured trees often attract additional bark beetles.

The salvaged trees should be immediately loaded onto a truck and hauled to the mill. If the trees cannot be hauled that day, they should be left in the center of the spot until the next day when they can be hauled away. If left overnight next to healthy pine trees, the SPB can leave the cut logs and attack the healthy trees thus continuing the spread of the spot. It is very important that the buffer trees be identified and marked immediately before harvest. SPB can move from one tree to another in less than a day when infestations are severe. Marking a buffer strip too far in advance of the harvest can provide an opportunity for the beetles to move through and beyond the buffer strip before the salvage harvest occurs.

### *Cut and Leave*

In some cases the SPB spot can't be salvaged in a timely manner. This may be due to a logger shortage, small spot size, remote location or some other reason. If this is the case, the alternative approach is to cut the infested trees as well as the buffer strip as discussed previously but leave the cut trees on the site. As mentioned before, all buffer trees must be felled or moved to the center of the spot. The remaining infested trees with needles should also be felled or pulled to the center of the spot. Trees with no needles should remain standing. In most cases the cut and leave operation will disrupt the beetle activity and disperse the population so that the beetle spot will not continue to spread. If logging crews become available, the cut trees can be hauled for salvage to generate some revenue to the landowner, however this is not necessary.

Cut and leave is usually successful in stopping the spread of SPB spots, especially smaller spots. Applying some type of control treatment is critical to stop the spread of the SPB and to prevent further tree mortality. Untreated SPB spots can continue to expand any time air temperatures exceed 58°F. Spots can grow to consume hundreds of acres, especially during warm months.

### *Outdated Treatments*

Previously used approaches to control SPB included (1) cut-and-spray insecticide treatments and (2) cut-pile-and-burn treatments. Neither of these two treatments proved to be any more effective at stopping the spread of SPB than the two currently recommended practices.

## *Ips* Beetle Control

Because *Ips* beetles seldom create large spots of dead trees, the treatment for these attacks is different than that of SPB. Usually *Ips* infestations occur on single trees or small groups of trees scattered throughout a pine stand (Figure 18). This makes the use of buffers around infected trees unnecessary in most instances. If enough trees are infested within a stand, then a salvage of infested trees can be economically viable. However, if there is extreme drought or some other severe stressors predisposing the trees to attack, then logging damage to residual trees can cause the *Ips* beetle infestation to spread. These salvage operations should be conducted in the late fall or winter when the insects are not active. During the late fall and winter, reduced sap flow in pines makes trees damaged during the harvesting operation less attractive to *Ips* beetles. Because the two smaller *Ips* beetles infest the tops and limbs, care should be taken during salvage operations to make sure tops and limbs that remain are not left next to healthy trees. Leaving them next to healthy trees can give the *Ips* beetles an opportunity to move from the infected top into the adjacent healthy trees.


**Figure 18. *Ips* often kill scattered trees or scattered branches within a tree.**

*Photo courtesy of Ronald F. Billings, Texas A&M Forest Service, Bugwood.org*

### Black Turpentine Beetle Control

BTB usually attack the lower 8 feet of the tree bole. They are less likely to spread to more than one or two trees, so a labeled insecticide such as permethrin can be applied to healthy trees to prevent BTB infestations if there are infested trees nearby. Labeled insecticides also can be applied to infested trees to reduce the spread to nearby healthy trees. The labeled insecticides require wetting the entire bark surface (usually the lower 8 feet) with the labeled rate of insecticide. Although these insecticides can be successful in preventing or treating active infestations in urban trees, they are usually not used in commercial forest stands because finding and treating infested trees is cost prohibitive when applied on a large scale.

These same insecticides are labeled for SPB and *Ips*. However, applying these chemicals to the attack zones and to the entire trunk or crown of a tree is difficult and the cost can also be prohibitive.

## Forest Management for Bark Beetle Prevention

Maintenance of forest health has great potential to minimize loss to bark beetle attacks. The most important step one can take is to prevent overcrowding in your forest. Overcrowding creates stress for a forest by stretching resources such as water, light and nutrients too thinly. Thinning your forest reduces the likelihood of a bark beetle attack and reduces the likelihood of the beetles spreading beyond the initial spot. Overcrowded stands are more likely to be attacked by bark beetles, and the attacks are likely to be more severe. Thinning the stand to control the stocking level, or trees per acre, is the best tool to maintain forest health and reduce the risk of bark beetle damage. However, care should be taken during the thinning to minimize damage to the residual crop trees as these damaged trees can attract bark beetles. Talk to your consulting forester to determine the density (stocking level) appropriate for your pine stand and plan your thinning. At times cost-share programs funded through the USDA may provide funding to help forest landowners thin pine stands to reduce the risk of bark beetle attacks. Contact your Arkansas Forestry Commission county forester or your Cooperative Extension Service county agent for more information about cost-share programs.

## Conclusions

Bark beetles can severely affect the health of your forest. A well-managed forest is a healthy forest that is better able to resist attacks by pests and diseases. For more information on managing your forest, see these fact sheets from the Arkansas Cooperative Extension Service at www.uaex.edu and talk to your Arkansas Forestry Commission county forester:

- Improve Your Pine Stand by Thinning, FSA5001
- Managing Loblolly Pine Stands . . . from A to Z, FSA5023

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