GEORGIA FORESTRY
COMMISSION

Forest Health Guide for Georgia

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Introduction

This manual was prepared as a resource guide for foresters. The material included will help them make decisions about the health of the resource they manage.

Georgia is a state adorned with forests that cover more than 24 million acres of privately and commercially owned lands. The wood products derived from the forests and the recreational opportunities the forests provide are vital to the State's economy.

Many species of insects and fungi weaken and kill trees each year in the State. The damage doesn't stop with the tree. Pests such as powderpost beetles, termites, carpenter bees, old house borers and wood decay fungi destroy wood products. Natural elements such as tornadoes, ice and fire destroy forests and cause concern to the forest owner.

In addition to damages caused by insects, diseases, and other natural forces, things people do often damage trees and forests. Georgia currently loses about 19,000 acres of forests every year to urban sprawl.

When homes, apartments, shopping centers or office complexes are under construction, trees remaining on the site may be subjected to many abuses. More common causes of tree damage and mortality around construction sites are destruction of roots by trenching, mechanical bruising and wounding, soil compaction over the roots by heavy equipment and grade changes resulting in exposed roots or excess fill dirt. Protecting shade trees can add value and aesthetics to building sites as well as provide shade and cooling.

Chemicals emitted from mills and plants can damage trees. Georgia has well over 500 manufacturing facilities that produce toxic substances some of which are harmful to trees.

Increased demand for wood products from the forests of Georgia challenges all citizens to practice wise forestry and to be good stewards of the trees and the products they provide. Protection of wood in use reduces the demands on the forests and at the same time demonstrates a holistic concept of sustainability of the forests.

Georgia has two shipping ports that rank among the nations largest. State and federal entomologists are always on the lookout for introduced insect and disease pests entering the State. The European/Asian gypsy moth, sirex woodwasp, emerald ash borer, and the Asian longhorned beetle are major insect pests that threaten the State's hardwood forests. Federal and state programs aimed at the detection and eradication of new pests must continue if the forests are to be protected for future generations of people.

Pesticide recommendations listed in the Appendix are subject to change and most states have restrictions on the use of certain pesticides. Trade names of the pesticides are used in this publication strictly for the purpose of providing information. Mention of a trade name does not constitute a guarantee or warranty of the product by the Georgia Forestry Commission over other products not mentioned. Always read the label and follow directions as stated and keep all pesticides stored and locked out of the reach of children and pets.

The section on Hazards of the Forest was included to remind foresters and others of the many perils that should be avoided while working in the forests. Information contained in this guide is also available on the internet in a printable format at www.GaTrees.org.

Forest Entomology Section

Insects make up over 90% of all existing animal species. Over 1 million species have been identified. Not all forest insects are harmful. Many are beneficial predators and parasites that feed on the harmful species.

There are insect groups that are specialized to attack every part of a tree. Insects can attack flowers, seeds, roots, stems and foliage and others even transmit disease to living trees.

The insects discussed in this manual are some of the most common species encountered by foresters. Some are capable of causing measurable economic losses and others are considered minor pests. The southern pine beetle is an example of a forest insect that causes astronomical losses. Since 1972, the southern pine beetle alone has killed enough trees in Georgia that if placed end to end would reach to the moon eight times.

Subterranean termites in 2002 cost Georgians an estimated $121,610,170 in treatment costs and in repairs.

Outbreaks of forest insects are often discovered during aerial surveys conducted in a systematic manner by state and federal forestry agencies. Foresters working in the field often discover many of the smaller occurrences of forest insects. Both methods of detection are very important in quantifying and qualifying forest damage. Once an infestation has been discovered it can be evaluated for its economic impact if any to the forest. Control recommendations can then be tailored to deal with the problem.

The Georgia Forestry Commission employs persons who trap and/or look for evidence of various non-native insects which could have catastrophic impacts on Georgia's forest resources. These monitoring efforts are done in conjunction with the U.S.D.A. Forest Service and the Animal and Plant Inspection Service (APHIS). These non-native insects include Gypsy Moth, Emerald Ash Borer, Asian Longhorned beetle, Sirex Woodwasp, Redbay Ambrosia Beetle, and the Hemlock Woolly Adelgid. Today's global economy and the staggering volume of cargo shipped into Georgia, along with the migration of tens of thousands of U.S. citizens moving to the Peach State make the inadvertent introduction of these pests a very real threat.

Control of forest insects may include salvage removal of affected trees or an application of a pesticide. Pesticides may be used for prevention of an insect infestation or as a remedial control option. Most of the insecticides used in forestry today are considered to be short-lived in the environment or are host specific such as the biological *Bacillus thuringiensis* (Bt). The recent EPA registration of verbenone to control the southern pine beetle is an indication that foresters want to minimize the impact they have on the environment.

Bark Beetles and Weevils

Ambrosia Beetles
(Coleoptera: Scolytidae, Platypodidae)

There are many species of ambrosia beetles in the families Scolytidae and Platypodidae. Only a few are considered to be note worthy in the South. Some will breed in living trees but most prefer dying or recently cut trees, logs, and pulpwood. The principal ambrosia beetle that infests southern pines is *Platypus flavicornis* (**Figure 1**). This species will infest weakened, dying, or freshly cut pines and unseasoned pine lumber. It bores into the sapwood and heartwood of logs or lumber and makes hundreds of pin-size holes; each stained with fungal growth. The fungus is generally referred to as ambrosia and serves as food for the larvae and adults. The wood is not eaten. All species of ambrosia beetles require wood with moisture content of at least 48 percent.

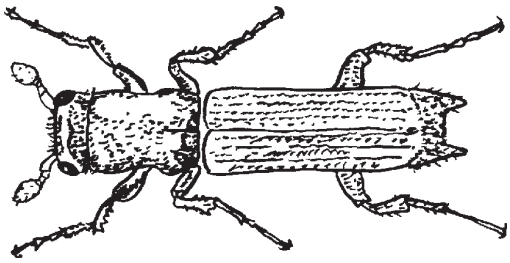


Figure 1

P. flavicornis is a common insect that is attracted to pines recently attacked by bark beetles. Piles of whitish boring dust (**frass**) around a tree's base indicate an ambrosia beetle infestation (**Figure 2**). The pinholes created by ambrosia beetles can degrade log and lumber values (**Figure 3**). Prompt utilization of dead and dying trees and rapid drying of lumber can reduce losses from this ambrosia beetle. Decked logs can be protected from attack by installation of water-misting systems.

Figure 2

Figure 3

Other species of *Platypus* ambrosia beetles breed in hardwoods, particularly oaks, poplar, beech, hickory, pecan, elm, sweetgum, and magnolia.

Adult ambrosia beetles sometimes attack erected log houses, particularly when the logs are rewetted or are freshly finished with stains that contain alcoholic solvents that attract these beetles. Offspring rarely survive from such attacks.

Another ambrosia beetle common in the South is the Columbian timber beetle *Corthylus columbianus* (**Figure 4**). Unlike *P. flavicornis* this beetle attacks healthy and weakened trees. Species preferred are yellow poplar, sycamore, maple, oak, elm and beech. Trees weakened by flooding are also attacked. This beetle degrades lumber by its boring and its introduction of a fungus that stains the wood. Silvicultural practices that promote tree vigor and the rapid utilization of damaged trees are essential in managing the Columbian timber beetle.

Figure 4 - Pupae and callow adult

The black twig borer, *Xylosandrus compactus*, has established itself as a major twig-infesting insect in the South. It will infest a broad range of tree species including dogwood, holly, magnolia, sweetgum and oak. The adult beetles measure about 1/15 of an inch in length. Recently transplanted trees are most susceptible. Infested twigs should be pruned and destroyed as soon as possible.

The Asian ambrosia beetle, *X. crassiusculus*, has become established throughout much of the South. This beetle attacks a wide range of hosts including magnolia, sweetgum, cherry, persimmon, pecan and oak. Long strands of **frass** are often seen sticking out from infested trees (**Figure 5**).

There is no practical chemical control for *X. crassiusculus* and *X. compactus*. Infested plants or plant parts should be cut and burned.

Figure 5

Pine Bark Beetles
(Coleoptera: *Dendroctonus* species)

The genus *Dendroctonus* contains the most damaging pine bark beetles in North America. The name *Dendroctonus* is Latin for "tree killer." The southern species are listed from top to bottom in **Figure 6** - *Ips avulsus, Ips grandicollis, Ips calligraphus, Dendroctonus frontalis,* and *Dendroctonus terebrans*. The pine engraver, *I. pini* (not pictured), occurs in the northern tip of Georgia. It breeds in all species of pine and spruce throughout its range in North America.

Figure 6

The **southern pine beetle** is the most destructive pine bark beetle in the South. Randomly flying females locate susceptible trees, which are called focus trees. Focus trees then become the source of an attracting pheromone called **frontalin** that attracts other flying beetles. As the focus trees become less attractive due to the male pheromone **verbenone**, incoming beetles begin to attack neighboring trees. This switching mechanism causes the spot to grow. As long as emerging beetles from old-killed trees are synchronized with the production of pheromones in recently infested trees, spots will continue to grow. However, if this synchrony becomes interrupted, spots will cease to grow.

The SPB attacks all species of southern yellow pines including eastern white pine. It is particularly destructive in overmature and overcrowded stands. Outbreaks are cyclic and are usually preceded by drought or flooding. In non-outbreak years individual spots are often associated with lightning and man caused disturbances.

Trees are killed when thousands of adult beetles bore underneath the bark to feed and lay eggs. The female beetles construct winding S-shaped galleries in the **cambium** while feeding and laying eggs (**Figure 7**). Adult beetles carry blue stain fungi and these fungi once introduced into trees will proliferate into the sapwood stopping water movement within the tree. This causes the needles to dry more rapidly. Blue stain can also interfere with southern pine beetle development (**Figure 8 - Note the larval galleries terminating at the blue stain border**).

Figure 7

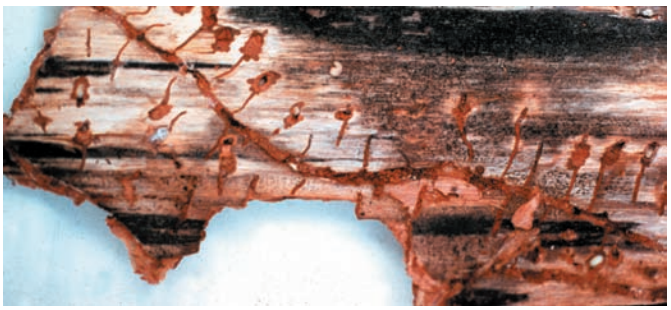


Figure 8

Figure 9

The usual signs of attack on the outside of trees will be pitch tubes (in bark crevices when formed) (**Figure 9**). Other secondary insects such as the southern pine sawyer **(Figure 10)** and ambrosia beetles will leave their marks behind **(Figure 2)**. Needles will turn pale to yellow green, then red, and then brown. The time

Figure 10 - Pine sawyer egg pit

required for the needles to fade depends on many factors. Trees attacked during the summer will begin to fade in about two weeks or less, whereas, those attacked in early spring or late fall may not fade for several weeks to months or green needles may shed before they fade in color.

Several broods are produced per year. Approximately 30-40 days are required for the completion of one brood during the warmer months. During winter all stages (eggs, larvae, pupae, and adults) can be found in trees.

The removal of all infested trees by salvage is the best means of controlling southern pine beetle spots. Another method of control is cut-and-leave. This method involves felling infested trees along with a buffer of uninfested trees and leaving them in the forest. Cut-and-leave disrupts spot growth by interfering with pheromone synchrony. Cut-and-leave should only be considered when salvage removal is prohibited and only during the summer months.

Figure 11

Chemical control is used on a very limited basis and is recommended only for spots having fewer than 20 trees. Pile and burn is effective for small spots and for pre-commercial sized trees.

There are two new tactics for controlling southern pine beetles. Phero Tech Inc. has registered a beetle-produced inhibitor, **verbenone** for use in disrupting spot growth. One tactic uses the **verbenone**-only and the second includes **verbenone**-plus-felling.

Southern pine beetle populations can be monitored effectively by deploying pheromone traps in the spring. Traps are baited with the chemical attractant **frontalin** and gum turpentine (**Figure 11**). When southern pine beetle catches outnumber those of the predator clerid beetle *Thanasimus dubius*, southern pine beetle

Figure 12 - Adult clerid beetle

populations are often predicted to increase. The larger the ratio of southern pine beetles to clerids the greater the likelihood of southern pine beetle population growth (**Figure 12**).

Aerial detection of southern pine beetle spots is the most effective means of locating spots for salvage. State forestry agencies across the South conduct annual southern pine beetle surveys in order to detect and record spot size and location. Data gathered from the aerial surveys are compiled into a south wide report every 5-6 years. This information is used for regionwide planning and assessment of beetle trends and impacts on timber supply (**see page 137 in Appendix**).

Isolated southern pine beetle outbreaks in the Coastal Plain of Georgia historically have been associated with dense, old-growth loblolly and shortleaf pines and less frequently, old-growth slash and longleaf pines on poorly drained sites or in association with flooding. These outbreaks, although local, build rapidly and result in catastrophic losses. Historical information documents the absence of detectable southern pine beetle from many of the Coastal Plain counties in Georgia. However, the current trend to favor loblolly over other less susceptible species in these counties is providing desired habitats for southern pine beetle expansion. Further, with the advent of intensive plantation forestry, the practice of pushing loblolly pine to the limit by increasing stand densities and investing in herbaceous control and fertilization increases the economic losses in the event of a southern pine beetle attack. The spatial rearrangement and enumeration of loblolly pine and the displacement of slash pine in the Coastal Plain may ultimately result in more frequent southern pine beetle outbreaks with greater intensities.

Land managers in the Coastal Plain should consider integrated pest management (IPM) practices aimed at preventing southern pine beetle attacks, especially on marginal sites. These are (1) planting less susceptible species such as slash and/or longleaf pine, (2) reducing planting densities, (3) ripping or subsoiling where appropriate prior to planting, (4) minimizing root deformations at planting, (5) controlling understory competition with prescribe fire and/or herbicides, and (6) accurately timing thinnings to avoid density-related mortality.

Southern pine beetle outbreaks in the Piedmont and Mountain regions of the state are usually preceded by droughts. Piedmont outbreaks occur at 6-10 year intervals and those in the mountains every 12 years. However, many changes in forest structure are occurring in and around urban communities in the state particularly in the Atlanta area and vicinity. Georgia loses about 19,000 acres of forests every year to urban sprawl. The fragmentation of the forest and increased land values has resulted in fewer acres of contiguous pine forests. People are reluctant to invest in forestry when land is valued more for commercial development. Southern pine beetle outbreaks will certainly be impacted by the declining acreage of pine forests.

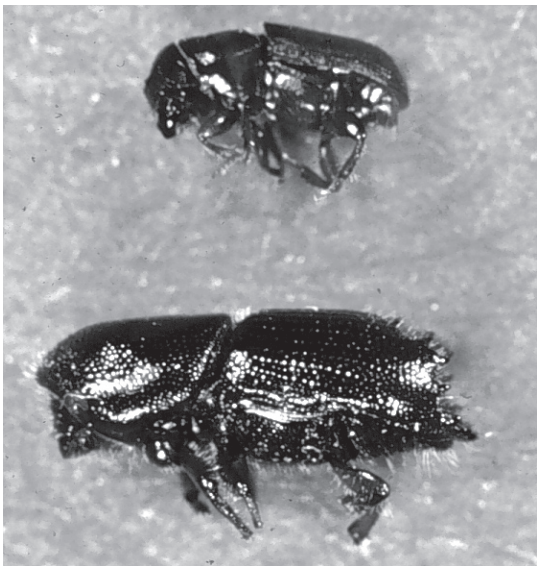


Figure 13 - Ips-bottom, southern pine beetle-top

***Ips* beetles** can be distinguished from southern pine beetles by the scooped out shape of their rear ends (**Figure 13**). *I. avulsus* completes its life cycle in about 20 days and may produce ten or more generations per year. *I. grandicollis* and *I.*

Figure 14 - Ips boring dust

calligraphus develop over a 20-30 day period producing six or more generations per year. Trees attacked by *Ips* beetles don't always produce pitch tubes (**Figure 14**). When they are produced they occur more often on the bark flakes and not in bark crevices (**Figure 15**).

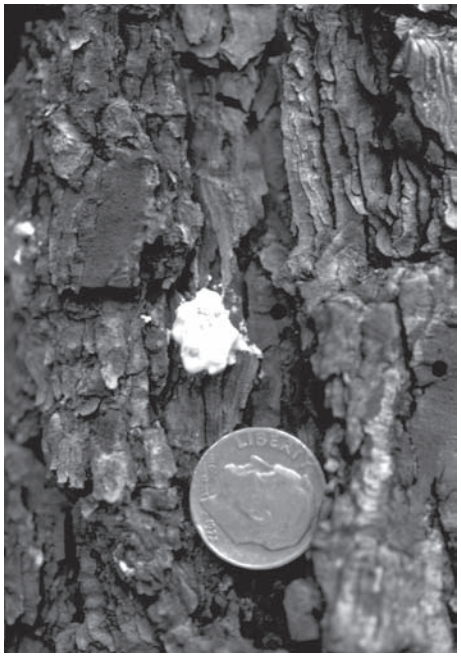


Figure 15

The small southern pine engraver *I. avulsus,* prefers the upper portions of trees and is often found in logging slash. The five-spined engraver *I. grandicollis,* is found more often above mid-bole and will attack logging slash. The six-spined engraver *I. calligraphus,* is the most aggressive and is found most often in the bottom ½ of trees but during outbreaks can be found in 4" diameter tops. Ips beetles often infest pine stands infected with annosum root rot disease.

Maintaining tree vigor and salvaging storm damaged trees can minimize damage from Ips beetles.

Ips spots are difficult to salvage because they are usually small and scattered making them uneconomical for salvage. *Ips* outbreaks usually subside after the first season and require no treatment. Exceptions would be places such as yards, golf courses, parks and arboretums.

The **black turpentine beetle** *Dendroctonus terebrans* prefers trees damaged by logging and landscaping equipment, naval stores operations and lightning. Outbreaks are also preceded by droughts. During droughts infestations often begin in sawtimber-sized trees in low-lying areas. Attacks are confined to the lower bole and are seldom found more than ten feet off the ground (**Figure 16**). Pitch tubes are about the size of a quarter and occur in the bark crevices.

Figure 16

Trees damaged during skidding and road building should be treated with a recommended insecticide or removed along with harvest trees. The black turpentine beetle is strongly attracted to the odor of resin that emanates from wounds. **Naval stores** producers must use insecticides to protect crop trees.

Figure 17

The southern pine coneworm, *Dioryctria amatella*, produces a pitch tube very similar to the black turpentine beetle but only occurs in conjunction with fusiform rust cankers (**Figure 17**).

Trees attacked by the black turpentine beetle can be treated effectively with an approved insecticide because it only infests the lower six feet of trunk.

"Frequently Asked Questions About Pine Bark Beetles"

How do I know if my trees are currently infested with bark beetles?

Trees that still harbor beetles will be characterized by green to yellow needles, tight fitting bark (hard to remove from the tree when struck by a hatchet or ax) and soft gummy pitch tubes. There are exceptions to these and homeowners should seek the advice of a forester to be sure trees are still infested.

What are my options for controlling an "active infestation" of Ips and southern pine beetles?

Removal of infested trees is the surest way to get rid of **Ips** and **southern pine beetles**. Other options include complete saturation of the entire tree trunk with a recommended insecticide. Trees can be sprayed standing or after being cut and sectioned on the ground. The entire bark area must be sprayed to the point of runoff. Spraying standing trees in urban areas is not generally recommended due to the possibility of pesticide contamination to nearby bird feeders and baths, swimming pools etc.

Another option is to fell trees and chip them on site and spread the chips for mulch. Infested trees should never be cut and stored on site for firewood unless the wood is covered with a plastic or vinyl tarp and sealed along the edges. From April to October infested firewood should be covered for at least 35 days to insure the death of the beetles.

During the cooler months from October to March, infested firewood should remain covered until after dogwoods have bloomed in the spring. **Remember**, **Ips** and **southern pine beetles** can complete a life cycle within 22-30 days respectively and control efforts must be done within this time frame.

What are my options for controlling black turpentine beetle infestations?

The **black turpentine beetle** is the only pine bark beetle that is confined to the lower six to ten feet of tree trunk. Except in extreme situations, the beetles do not mass attack trees as do the **Ips** and **southern pine beetles**. Rather, they tend to build up over a period of weeks thus allowing time for control by homeowners and landowners. Spraying the lower ten feet of trunk with a recommended insecticide can effectively control **black turpentine beetles**.

Do I need to remove trees that are already dead? (Those with brown needles or no needles.)

Dead trees from which bark beetles have emerged may harbor beneficial insects such as the checkered beetle. If dead trees are no threat to property, humans, or pets, they can be left standing to provide homes for checkered beetles and cavity nesting birds. Be sure dead trees are away from property lines, powerlines, houses, cars and children's play areas. Stay away from dead trees on windy days as they often lose branches and upper trunk sections from the swaying.

Can I protect my healthy trees with an insecticide before pine beetles get them?

Healthy trees that are near an **Ips** or **southern pine beetle** infestation can be protected if the entire trunk area (bottom to top) is treated with a recommended insecticide. This requires expensive equipment capable of thrusting the insecticide up to tree top level. In urban areas where bird baths and feeders, swimming pools, cars and people are often present, spraying standing trees is not a good idea. Although it's effective in preventing bark beetle attacks, it is often impractical.

Many tree companies offer to spray standing pines up to a height of about ten feet. This is only effective against the **black turpentine beetle** and will not provide protection against Ips and southern pine beetles. Also, many tree companies advertise the injection of systemic chemicals to control or prevent bark beetles. Although the Environmental Protection Agency (EPA) has allowed the registration of systemic insecticides for control of pine bark beetles, research has yet to prove the effectiveness of these compounds. Stay with the proven methods even though they may be more costly and labor intensive.

Will chips from recently ground pine trees attract pine beetles to my yard?

Yes and no! The **black turpentine beetle** is justly named because it is highly attracted to the odor of fresh pine tree resin. Sometimes green pine chips may heighten the possibility of a black turpentine beetle attack and to a lesser extent attacks from the other bark beetles. To be safe, pine chips should be used only in and around hardwood areas.

Must I have the stumps ground when I remove an infested tree?

Black turpentine beetles like the smell of fresh pine resin and a green stump is a prime target for them. Stump grinding is preferred when green pines are cut. If not, the stumps should be sprayed with a recommended insecticide unless there are no more pines left in the yard.

Does pruning attract pine bark beetles?

It is best to prune pine trees when pine beetles are inactive. Pruning trees between November and February is preferred to spring and summer pruning. If pruning can't be postponed, the pruning wounds should be coated with a tree wound dressing to reduce the possibility of a bark beetle attack.

Climbing spurs used by many tree surgeons and arborists when pruning can attract pine beetles. If pine beetles are on the rampage it is best to delay any pruning until the outbreak subsides. This would apply to powerline pruning as well.

What should I do if my neighbor has trees infested with pine bark beetles?

It is always a good practice to be aware of bark beetle activity or tree lightning strikes in your neighborhood or area. Pine bark beetles can devastate neighborhoods or woodlands and do not respect property lines. Quick action to rid an area of beetles is a must. Be sure your neighbors are aware of the situation.

What are my responsibilities toward my neighbors if I have an active bark beetle infestation on my property?

Once you have been educated to the potential hazard of your infestation spreading to nearby properties, you may be liable for negligence by failing to remove the beetle hazard(s). Neighbors need to work together to solve a community problem.

Are there any federal and state tax relief options for homeowners and timber owners plagued by pine bark beetles?

Yes! The IRS recognizes the **southern pine beetle** as a casualty agent. This means homeowners can minimize losses provided they document and report the losses in an appropriate manner approved by the IRS. Generally, homeowners can have the property appraised with and without the trees (those killed by beetles). The depreciation in property value due to missing trees is the amount of the casualty allowed by the IRS. Timber growers may qualify for an involuntary conversion. Under this rule, landowners who salvage killed trees may be able to reinvest the income into "like-kind" property within 3 years and postpone taxes.

Homeowners and timber owners need to refer to IRS publication 547, Casualties, Disasters and Thefts. This publication is available free of charge by calling 1-800-TAX-FORM.

What type of assistance does the Georgia Forestry Commission provide to homeowners in dealing with pine bark beetles?

The Georgia Forestry Commission provides technical assistance to any homeowner/landowner or neighborhood association upon request. During community wide or statewide beetle outbreaks, a GFC representative can provide a program to citizens about how to recognize and control pine bark beetles. It can also publicize and coordinate community wide suppression activities by training various tree companies, arborists and timber harvesters on proper control procedures. As a state agency the GFC does not remove trees nor provide financial assistance to citizens for tree removal. Contact the Georgia Forestry Commission by calling your local county office or 1-800-GA TREES or go online at www.gatrees.org.

Pine Weevils

(*Hylobius pales, Pachylobius picivorus, Pissodes strobi, P. nemorensis, Graphognathus leucoloma***)**

Weevils that damage pines can be classified as seedling debarking weevils, terminal weevils and root collar weevils. Damage from weevils can be severe when certain forestry practices favor their development.

Figure 18 - Pitch-eating weevil

Debarking Weevils

Weevils that debark pine seedlings are the **pales,** *H. pales*, and **pitch-eating,** *P. picivorus*. These weevils damage seedlings by chewing bark from the stem above and below the ground (**Figure 18**). Seedlings are often girdled. Damage can be prevented or reduced when conditions favoring their development are avoided. Debarking weevils are attracted to recently logged areas with pine stumps.

Adult weevils deposit eggs in roots of freshly cut pine stumps or buried slash. The larvae hatch in a few days and begin feeding beneath the bark. Upon emergence the new adults will seek out seedlings to feed on. The newly emerging weevils and older adults attack seedlings planted on or adjacent to these cut over areas. The following guidelines will help reduce weevil damage:

- Delay planting one year on cutover pine sites if harvest cannot be completed before July.
- If planting cannot be delayed the seedlings should be dipped in an approved insecticide or top sprayed in the nursery before lifting.
- Delay cuttings/thinnings that are adjacent to recently planted pines until the seedlings are 3-4 years old.
- Planted seedlings can be sprayed in the field with an approved insecticide if weevils begin to appear.

Terminal Feeding Weevils

Terminal weevils in the genus *Pissodes* are very similar in appearance and habits. The adults are 3/16”-5/16” in length depending on the species and vary in color from reddish brown to dark brown. The front wings (**elytra**) are marked with patches of white scales. Two common species that occur in Georgia are the white pine weevil (*P. strobi*) and the deodar weevil (eastern pine weevil), *P. nemorensis* (**Figures 19 & 20**).

Figure 19 - White pine weevil

Figure 20 - Deodar weevil

The white pine weevil attacks the terminals of white pine. Adult weevils and larvae do damage while feeding. The adults emerge in the spring and lay eggs in feeding pits they chew on the terminals. Upon hatching the larvae tunnel in the **cambium** often killing stems. When a terminal is killed it is replaced by an adjacent branch, which results in a crooked or forked stem (**Figure 21**).

Figure 21

The following management recommendations have been developed to reduce losses from the white pine weevil:

- Plant seedlings on soils where the hardpan is three or more feet from the surface. Avoid J and L rooting of seedlings.
- Regenerate white pine in mixture with hardwoods.
- Use insecticides in Christmas tree plantings.

The deodar weevil is active all winter and lays eggs in the fall and winter in small puncture holes chewed in the bark. The larvae have feeding habits similar to white pine weevil larvae in that stems are often girdled. Unlike the white pine weevil, the deodar weevil remains inactive during the summer in the ground litter.

Deodar cedar is the preferred host, but loblolly, slash, shortleaf, and longleaf pines are attacked. This weevil is often found breeding in pines that have been attacked by pine bark beetles and those infected with pitch canker. The wood chip cocoons made by the larvae are readily visible underneath the bark of infested trees (**Figure 22**).

Figure 22

No controls are necessary for the deodar weevil in forest stands.

Figure 23

Root Collar Weevils

The southern pine root collar weevil *Hylobius aliradicis* occasionally damages the roots of seedling and sapling sized loblolly and slash pines. Damage appears to be worse during droughts and on stressed trees and those with shallow roots. The larvae bore extensively in the root collar area of trees. Pupation occurs in wood chip cocoons (**Figure 23**).

Root Debarking Weevils

(Coleoptera: *Graphognathus leucoloma, G. minor, and G. peregrinus***)**

Whitefringed beetles are native to South America and were introduced into Florida in 1936. Since that time they have been found in nine states including Georgia. Three species have been described in the United States. *G. leucoloma* is represented by 5 races: *dubious, pilosis, imitator, striatus* and *fecundis*.

Whitefringed beetles are serious pests of cotton, peanuts, okra, velvetbeans, soybeans, and sweet potatoes. The larvae and adults have been observed feeding on more than 380 species of plants. The larvae debark the taproots, whereas, the adults feed on other plant parts above ground.

During the 1980s with the advent of the Conservation Reserve Program (**CRP**), the whitefringed beetle became a pest of pine seedlings. The adults are dark gray with a whitish band along the outer wing margins (**Figure 24**). The larvae readily attack the taproots of 1-2 year old seedlings. The bark is removed all along the main taproot and the seedling dies. (**Figure 25**) Abandoned soybean and peanut fields may harbor residual populations of whitefringed beetles for several years.

Larvae are typical weevil-like with no apparent identifying marks. Larvae spend the winter in the soil. Adults appear in May through August. Eggs are deposited at or near ground line on vegetation. Developing larvae feed in the soil and emerge as adults the following spring. During the warmer months larvae are found in the root zone of the seedlings but in the winter they migrate downward as much as 18 inches. Fields that have lain idle for 3-4 years usually do not harbor large populations of whitefringed beetles.

Cultural practices such as scalping help reduce weevil damage by displacing and exposing the larvae in the soil. However, herbicide use increases weevil feeding on pine seedlings because native plants that serve as food for the larvae have been killed by the herbicides.

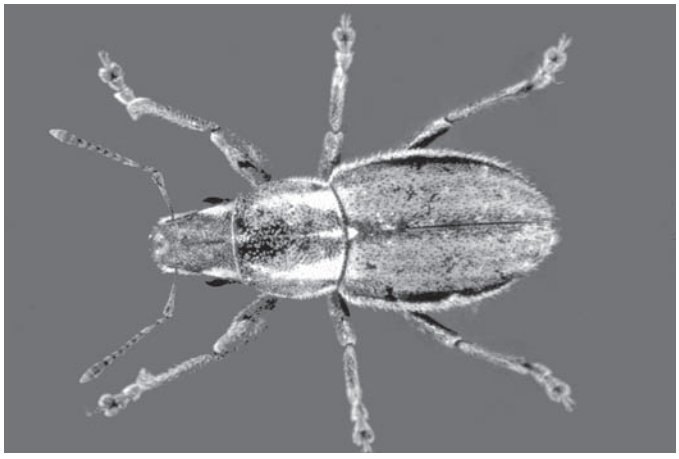


Figure 24

Figure 25

Wood-Infesting Insects

Insects That Do Not Eat Wood But Use It for Nesting

Carpenter ants, carpenter bees, and many solitary wasps and bees are common in log houses and other wooden structures. These insects are primarily a nuisance, and are not likely to cause serious damage quickly. Carpenter ants nest in stumps or tree cavities outside the home and enter homes to find sugar or organic matter as food. Ant workers, 1/4 to 1/2 inch long and reddish brown to black, do not eat wood, but excavate shallow nests with smooth (as if sanded) walls, preferably in moist, decaying wood (**Figure 26A and 26B**).

Figure 26A - Carpenter Ants

Preferred nesting sites are readily available inside between wall studs, around windows and doors, and in **heartwood** log centers in many houses. The nests cause only minor damage unless large colonies are present for several years. If the main nest of the ants is outside, it must be located and treated for satisfactory control. Reducing moisture traps for decay prevention also reduces favorable nest sites for ants.

Figure 26B - Carpenter ant galleries

Adult **carpenter bees** resemble bumble bees. Both have yellow hair over most of their black bodies, but the carpenter bee differs by having a hairless abdomen (**Figure 27**). The adult female bee bores a 3/8- to 1/2-inch round hole into wood, makes a right angle turn, and tunnels along the grain of the wood (**Figure 28**). Wood is not ingested, but discarded out the entrance hole. The tunnel is partitioned into cells, each containing a ball of pollen and nectar and egg. The offspring feed on this food until mature, and then all emerge through the hole made by the parent female. Young adults over winter until April or May, feed on nectar, mate, and often reuse the tunnel where they were reared to lay eggs. Reused tunnels may be several

Figure 27 - Carpenter bee

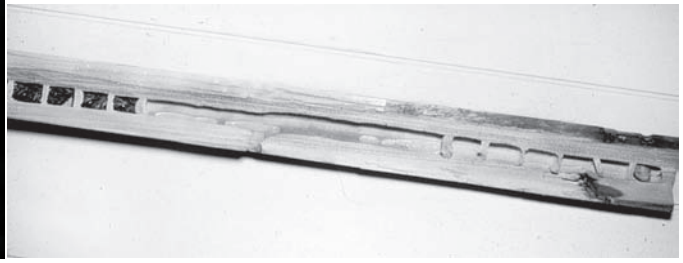


Figure 28

feet long. Repeated tunneling may weaken individual timbers or ruin moldings and trim work (**Figure 29**).

Solitary wasps and bees place food and eggs in beetle exit holes in log walls and seal the hole with a "wall" of dirt (**Figure 30**). The offspring bores a small hole in the wall of dirt to come out, often causing powdered dirt to accumulate beneath the hole. This is sometimes mistaken for a beetle infestation. These insects do not harm wood; caulking beetle holes to prevent decay eliminates them.

Injecting recommended insecticides into nests and tunnels will control carpenter bees. Dust formulations often work best. Don't seal treated bee holes until the bees are allowed to move freely over the insecticide. The holes can be plugged in the fall with a wooden dowel or silicon sealer. Preventing nesting by bees in logs is very difficult, even pressure-treated wood is sometimes attacked. Painting frequently attacked timber will sometimes discourage bees. Substituting pine facia boards with white oak worked for one homeowner in eliminating carpenter bee boring.

Figure 29 - Carpenter bees readily attack brick and eaves molding

Figure 30

Insects That Attack Weakened or Damaged Trees and Freshly Cut Logs

Insects that attack and bore into living trees or freshly cut logs are generally referred to as wood borers. The greatest number of wood borers are in the insect orders Lepidoptera (moths) and Coleoptera (beetles). Solomon in *Guide to Insect Borers in North American Broadleaf Trees and Shrubs* describes some 300 species of wood borers.

Softwood species are most often used for log homes, and include pine, spruce, fir, hemlock, northern white cedar, western redcedar, and cypress. In warm weather, freshly cut logs of all softwoods are frequently attacked within a few days after tree felling by beetles commonly called buprestids and cerambycids. The larvae of buprestids and cerambycids are called flat-headed borers, and round-headed borers (**Figure 31A, 31B, & 31C)**). These beetles do not infest logs that have been debarked; therefore, rapid utilization of felled logs is essential to prevent attacks from round and flat headed borers. Logs that are decked for several weeks often sustain heavy attacks from cerambycids and buprestids. Oftentimes these beetles will emerge from the logs after they have been erected in a house. Homeowners are often distressed initially when they see the beetles emerging from the logs in their house but they will not re-infest the logs and therefore no control is necessary.

Figure 31A - Buprestid adult

Figure 31B - Cerambycid adult

Some common roundheaded wood borers frequently encountered are the southern pine sawyer, *Monochamus titillator*, locust borer *Megacyllene robiniae*, cottonwood borer, *Plectroperda scalator*, red oak borer, *Enaphalodes rufulus*, white oak borer, *Goes tigrinus*, and the roundheaded appletree borer, *Saperda candida (***Figures 32-35***)*. Some common flatheaded wood borers are flatheaded appletree borer, *Chrysobothris femorata*, and species in the genus *Chalcophora;* the large flatheaded heartwood borer, *C. virginiensis*, and two related species *C. liberta* and *C. georgiana*.

Figure 31C - Buprestid larva - flat-headed borer

Figure 32 - Southern pine sawyer

Figure 33 - Locust borer

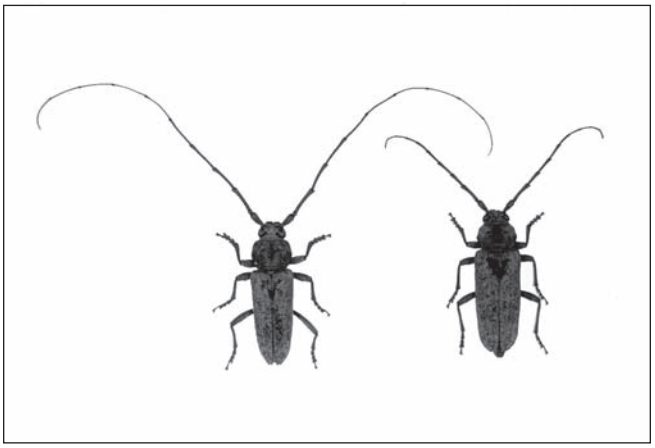


Figure 34 - Red oak borers, male (left) and female (right)

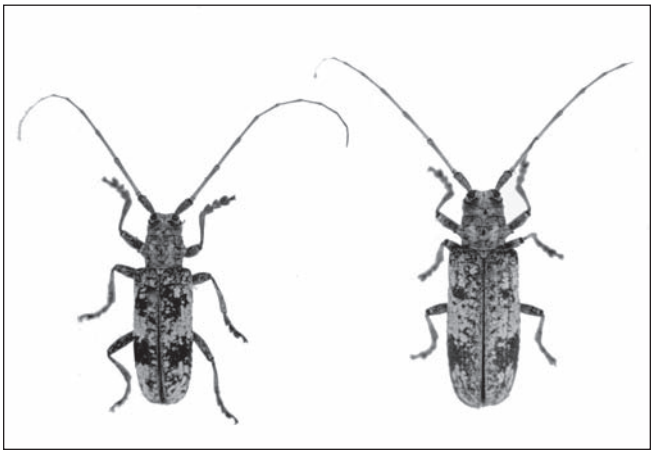


Figure 35 - White oak borers, male (left) and female (right)

Beetles That Attack Dry, Debarked Wood
(Lumber, poles, woodwork and manufactured products)

Adults of a round-headed borer, commonly called the old house borer *Hylotrupes bajulus*, are strong fliers and are attracted to odors from recently processed softwoods (**Figure 36**). They infest only pine, spruce, or fir when wood moisture content ranges from 30% to 10%. Old house borers do not resemble adult buprestids, but the 1/4 to 3/8-inch oval exit holes, powder in tunnels, and chewing sounds of larvae are very similar and often confused.

Figure 36 - Adult old house borer

Adults emerge during June and July in most locations. Eggs are laid in small cracks on wood surfaces during June through possibly September. In the South a minimum of 2 to 3 years is required from egg laying until adults emerge. Infestations in houses less than 2 years old mean the logs/lumber were infested before construction.

Logs infested before treatment may remain infested when non-penetrating chemical treatments allow larvae to survive in untreated log centers. These larvae emerge as adult beetles that chew holes without ingesting treated wood. These beetles may survive to lay eggs in untreated wood exposed in exit holes or in cracks as partially seasoned logs continue to dry. Unless a deeply penetrating treatment has been used, insecticides must be applied to exterior walls either before or with the scheduled water-repellent preservative treatment required for prevention of decay fungi.

Insecticide surface treatments will not kill larvae deep in wood and are not recommended for interior surfaces; finishes further limit effectiveness. Injection treatments into exit holes may be effective for limited infestations inside homes.

Heavy, widespread infestations may need to be fumigated (**Figure 37**). Fumigants provide no residual protection, do not penetrate "wet" logs very well, and often fail to control beetles in log houses. But fumigation may give immediate control and is accepted by financial institutions when houses are being sold.

Old house borer and buprestid larvae tend to concentrate in exterior log surfaces where moisture is high. Beetle exit holes and tunnels rarely cause structural damage, but moisture that accumulates in them promotes the growth of decay fungi. Therefore, money spent for fumigation could be more effectively spent for water repellent preservative plus insecticide treatments of exterior log surfaces and for other measures needed for long-term protection.

Figure 37 - Fumigating a log home

The most important group of insects that attack wood in use other than termites are three closely related families of beetles (Lyctidae or true powderpost beetles, Bostrichidae or false powderpost beetles and Anobiidae the deathwatch beetles). They are all generally referred to as powderpost beetles. The larvae can reduce wood to a mass of powdery or pelleted frass. The damage caused by these 3 families can be

Table 1: Characteristics of some common wood-infesting insects. (From Levy, 1975)

Insect	Shape & Size of Hole	Wood Type	Age of Wood Found In	Type of Frass in Tunnels	Reinfests Structural Timber
Ambrosia beetles	Round 1/32-1/8” o O	Soft & Hard	Green Logs	None present	No
Anobiid beetles	Round 1/16-1/8” o O	Soft & Hard	New & Old Wood	Fine powder and pellets, loosely packed	Yes
Bostrichid beetles	Round 3/32-9/32” o O	Soft, Hard & Bamboo	New Wood	Fine to coarse powder, tightly packed	Rarely
Carpenter bee	Round 3/8-1/2” O	Soft & Hard	New & Old Wood	None	Yes
Flat-headed borer	Oval 1/8-1/2” 0 O	Soft & Hard	New Wood	Sawdust-like, tightly packed	No
Lyctid beetles	Round 1/32-1/16” o O	Hard	New & Old Wood	Fine, flour-like, loosely packed	Yes
Old house borer	Oval 1/4-3/8” 0 O	Soft	New & Old Wood	Fine powder & tiny pellets, tightly packed	Yes
Round-headed borer	Round-oval 1/8-3/8” o O	Soft & Hard	New Wood	Coarse to fibrous, mostly absent	No
Wood wasps	Round 1/16-1/4” o O	Soft	New Wood	Coarse, tightly packed	No

identified by the type frass produced as well as types of wood infested (**Table 1**).

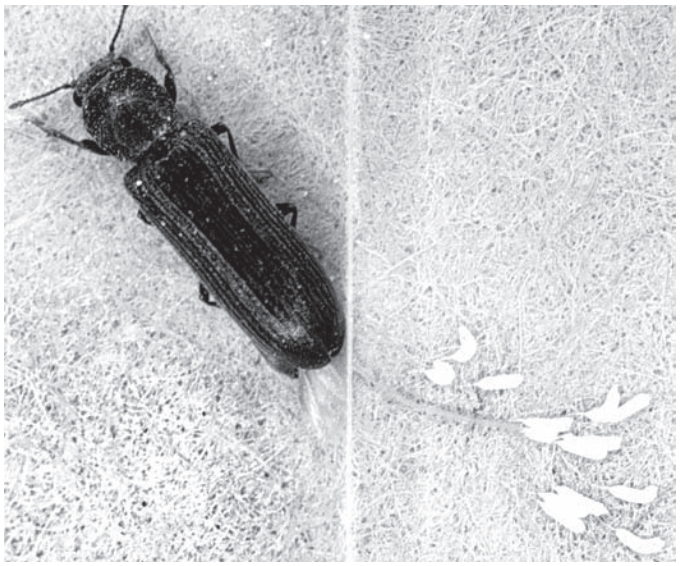


Figure 38

Lyctid powderpost beetles are the true powderpost beetles and only attack hardwoods with large pores with 3% or more starch content. The pores or vessels in the wood must be large enough for the female beetle to insert the ovipositor to lay eggs. Softwoods (conifers) do not have pores and usually have low starch contents and are not attacked by lyctids. Ash, hickory, maple and oak are preferred wood species with large diameter pores. Lyctids prefer wood with moisture content from 10 to 20%. These beetles usually re-infest wood and may severely damage sapwood portions of oak or walnut logs sometimes used for log homes. Recently processed hardwood molding, picture framing, flooring, implement handles and furniture are often infested. The southern Lyctus beetle, *Lyctus planicollis* is found throughout the United States and is the common species found in the south (**Figure 38**). Lyctids rarely infest wood older than five years. Most lyctid infestations in houses usually result from infested wood being placed in the home at the time of construction or remodeling, particularly hardwood flooring.

Anobiid beetles naturally occur throughout the South and may attack untreated wood in exterior logs or exposed wood in crawl spaces (**Figure 39**). About 260 species of anobiids occur in the United States. Wood must have moisture contents above 13% (but preferably below 20%). Pine and yellow poplar are often attacked, but many other hardwoods also are susceptible. Cedar and western softwoods are not attacked by the most common anobiid species in the south. The furniture beetle, *Anobium punctatum*, attacks only well-seasoned wood that has not been sandpapered, painted or varnished. The female requires a rough side in order to lay eggs. The eastern deathwatch beetle, *Hemicoelus carinatus*, has been recorded from ash, basswood, maple, beech and elm and in sills, joists, beams and flooring. Attacks by this beetle may be confused with that of a lyctid beetle but its emergence holes will be a little larger and the frass is somewhat coarser (see Table 1). Anobiid infestations in recently processed logs are limited to occasional minor ones by species that only infest bark (these need no control).

Figure 39

Anobiid or lyctid infested wood from old buildings is sometimes reused for bookcases, paneling, flooring, or picture framing. If round 1/8-inch diameter holes and powder-filled tunnels are in such wood, it should be discarded or possibly fumigated or kiln-dried before use. Piles of fresh looking powder on or beneath wood suggest live larvae are present.

Powder of anobiids feels gritty and lyctids like talcum powder. Anobiid adults may emerge from infested wood placed in centrally heated or air conditioned spaces, but wood moisture will be too low for survival of small larvae thus reducing the possibility of reinfestation by emerging adults. This is not true for lyctids. Lyctids will often reinfest the wood for many years. To kill lyctids before using infested wood, move wood from 60 to 80ºF temperatures and store at OºF or below for at least 48 hours for 1-inch-thick wood.

Bostrichids (false powderpost beetles) differ from the lyctids and anobiids in that they bore into wood to lay eggs instead of ovipositing in surface cracks or pores. The most common bostrichid in the eastern United States is the redshouldered shothole borer, *Xylobiops basilaris*. It prefers to breed in hickory, persimmon, pecan, and elm.

Infestations of powderpost beetles are often discovered when frass appears on wood surfaces. One should not panic at this stage. Powderpost beetles work slowly often requiring many years for the damage to be severe. If hardwood flooring is infested one should try to determine whether or not the infestation is widespread or just limited to a few boards. Oftentimes replacing a few boards will solve the problem. If the infestation is widespread, the flooring finish can be removed and the boards treated with borates. Since anobiid infestations often occur in pine joists, sills, rafters and subflooring they can often be treated easily with borates. Borates will not penetrate wood surfaces that have been painted or sealed with varnish or acrylic. Such wood surfaces must be sanded before an effective treatment with borates can begin.

The two borate formulations that are currently available for use are Bora-Care® and Tim-Bor®. Bora-Care® is recommended for well-seasoned wood and Tim-Bor® for green logs and lumber.

Subterranean Termites

Subterranean termites are by far the most destructive insects that attack wood in use. Ninety-five percent of all termite damage in the United States can be attributed to the eastern subterranean termite, *Reticulitermes flavipes,* (**Figure 40**). Infestations may occur in poles, woodwork of buildings, and occasionally in living trees, shrubbery and other plants. In recent years the Formosan termite, *Coptotermes formosanus,* has threatened North America (**Figure 41**). This termite was first reported from a shipyard warehouse in Houston, TX in 1965. Since then it has been reported from several southern and Gulf Coast states.

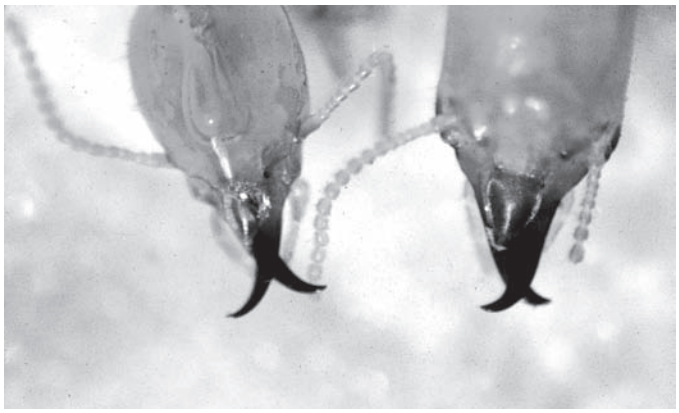


Figure 40 - Heads of termite soldiers; Formosan- left, eastern subterranean-right

Figure 41 - Formosan termite soldiers

small, white, wingless, soft-bodied insects that do the work in the colony. The soldiers are similar but have greatly enlarged heads and powerful mandibles. Their function is to protect the colony. The winged reproductive caste is the one most commonly seen. These are brown to black in color with 4 large fragile wings. They look like flying ants but all 4 wings are the same size while the front wings of the ants are larger than the hind wings (**Figure 42**). Winged adults swarm or emerge from older colonies in spring and occasionally in the late summer. These winged adults mate soon after swarming and search for a place to establish a new colony. Termite swarms are often the first indication of an infestation.

Although the swarm poses little or no immediate danger to the structure, it gives warning of termites in close vicinity. Earthen shelter tubes constructed over surfaces of foundation walls and directly con-

Termites are commonly known as wood lice or white ants. They look somewhat like ants but do not have the constricted "waist". Three different forms or "castes" of termites are usually present in a colony. The most numerous caste is the worker. These are

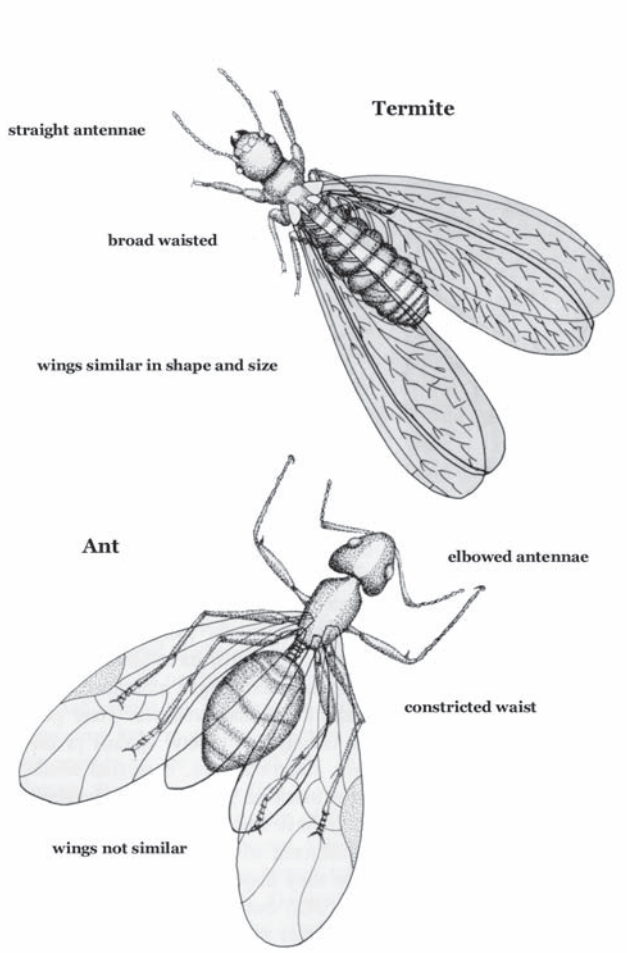


Figure 42

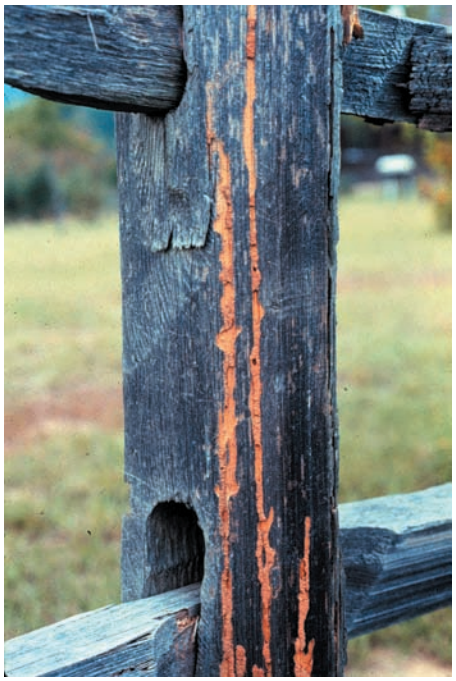


Figure 43 - Termite mud tubes on fence post

necting the soil and the structure are signs of termite infestation. These tubes are between one-fourth and one-half inch or more wide (**Figure 43**). If the tunnels or tubes are in use, the insides will be moist and there may be white workers present. If the tubes are not in use and have been abandoned, they will be dry and crumble easily.

Without the external evidence of winged termites or visible shelter tubes, it is more difficult to determine whether or not termites are present in a building. The first place that should be checked is wood that is near or rests on the ground. Weather boarding, wood supports, basement window frames, door casings, sills, etc. can be checked for soundness by being tapped with a hammer and probed with a screwdriver or ice pick. If hollow wood is found, and it is the result of a termite infestation, the soft portions of the wood will be eaten leaving the hard sections. Also, accumulations of a wood type paste and excrement are often present.

Preventative measures to protect a building against subterranean termites are best when done during the construction. Since termites are present in their natural habitats, all stumps, roots, fallen trees and other wood debris should be removed from the building site prior to beginning construction. All scraps of lumber should be removed and not buried beneath porches, terraces, carports, around foundations, etc. There is less likelihood of the building being infested when no wood is left on or buried in the soil.

The basic principal of preventing and controlling an infestation of termites is the insulation of woodwork from the ground. To accomplish this special care is needed in design and construction near or below grade level so termites do not have an easy and convenient way to reach the wood. The addition of termite shields may give some degree of protection, however, experience has shown that good shield construction and installation are rare. Protection of woodwork in construction may be supplemented by the use of chemicals as soil poisons. Treating the soil with an effective insecticide before and during construction is the best means of assuring a complete chemical barrier below and around a structure. At this time crawl spaces and basements are exposed for thorough treatment before the concrete slab or floor is poured, foundation walls are not capped, and there is no need to drill and dig special trenches.

Lumber should be stacked above ground with all supports chemically treated to prevent infestation by termites. Termites often infest trees recently attacked by pine bark beetles.

The Formosan termite does not have to maintain a contact between the wood and the ground, therefore, soil treatment with an insecticide is not always effective against this pest. Colonies have been observed in living and dead trees, on boats and ships and in floating drydocks. Fumigation is often required to control infestations of Formosan termites.

Defoliating Insects

Hardwood Defoliators

Many species of insects feed on the foliage of hardwood trees. Some are host specific and others are considered general feeders. Outbreaks can be quite extensive and may last for several years. The extent of defoliation and the time of year the defoliation occurs determine the severity of effects on trees.

Defoliation that occurs just as the leaves are expanding in the spring can deplete nutrition reserves needed for tree growth. Since leaves are the food factories for the tree, their removal early in the season delays the manufacture of new food. However, defoliation occurring in mid to late summer is not as damaging to a tree's health as defoliation occurring in the spring. Some defoliators reach outbreak proportions periodically with outbreaks lasting 2-10 years.

Following are brief descriptions of some common hardwood defoliators in Georgia:

Oakworms in the genus *Anisota*, are common throughout Georgia and do considerable damage in forest and landscape trees. Common species are the orangestriped, pinkstriped and spiny oakworms (**Figures 44 and 45)**. Defoliation is widespread throughout the hosts' range.

Figure 44 - Orange striped oakworm

Figure 45 - Spiny oakworm

Figure 46

The orangestriped oakworm feeds on various oaks and sometimes birch and hickory. Mature caterpillars are just over 1 ½ inches long, black with eight longitudinal orange-yellow stripes. They also have two black spines on the second thoracic segment and smaller spines on each succeeding segment.

The greenstriped mapleworm, *Dryocampa rubicunda*, prefers maples but will feed on boxelder and oaks where they grow intermingled with maples. Full-grown caterpillars are about 1.5 inches long, pale yellow-green with cherry-red heads (**Figure 46**).

The buck moth, *Hemileuca maia,* feeds primarily on oaks. Full-grown caterpillars are about 2.5 inches long, brownish black and covered with small, yellowish dots; head is deep reddish brown (**Figure 47**).

Figure 47

The fall webworm, *Hyphantria cunea*, is a very common defoliator of pecan, sourwood, and persimmon. The caterpillars construct ugly nests of silk around the leaves they feed on **(Figure 48)**. The caterpillars can be removed by hand on small trees, but larger orchard trees need to be sprayed using high-pressure equipment.

The oak skeletonizer, *Bucculatrix ainsliella,* feeds on oaks and chestnuts. Full-grown larvae are about .19 inch, pale yellow green with tan heads. Leaves are skeletonized by the larvae (**Figures 49 & 50**). Outbreaks are widespread over the range of chestnut oak. Based on GFC aerial surveys the oak skeletonizer was responsible for extensive defoliation of chestnut oak over a 300,000-acre area in North Georgia from 1986 to 1999 (**Figure 51**). Adult moths become active in May. They lay eggs on the undersides of leaves. Upon hatching, the larvae enter the leaves and begin to skeletonize them. During the winter, the white, ridged cocoons can be found on the bark of trees and on the undersides of leaves lying on the ground. Trees appear to recover well from many years of defoliation, however, they are probably made more susceptible to *Hypoxylon* canker. There may be two generations per year.

Figure 48

Figure 49 - Oak skeletonizer larva

Figure 50 - Skeletonized leaf

The cherry scallop shell moth, *Hydria prunivorata*, feeds on black cherry. Full-grown caterpillars are about .8 inch, blackish above with 4 yellow lines. Outbreaks can be extensive over much of the range of black cherry **(Cover Photo)**.

Figure 51 - Chestnut oak defoliation

The forest tent caterpillar, *Malacosoma disstria*, feeds on water tupelo, sweetgum, blackgum, birch, elm, maple, oak and flowering fruit trees. Full-grown caterpillars are about 1.6 inches long, light blue heads; body is blackish with whitish hairs; each segment is marked dorsally with a white keyhole-shaped spot (**Figure 52**). The adult moths are buff colored with two darker bands on the forewings. Caterpillars are present in early spring and upon maturity construct cocoons from folded leaves. The adults emerge in late summer and lay eggs in brown masses that encircle twigs. Eastern tent caterpillar egg masses do not encircle the twigs. The caterpillars make silken tents in host trees. In the 1980's an outbreak occurred in southeast Georgia that involved several hundred acres of water tupelo. Most of the infestation was confined to a large swamp and was eventually controlled by high water. As the caterpillars striped the foliage they would crawl down the trunks in search of more foliage and or soil in which to pupate. However, they were trapped by the flooding waters and had no place to go. The outbreak soon subsided. On small trees caterpillars can be hand picked and destroyed. Bt can be sprayed to control young larvae. Older larvae can be controlled with a residual insecticide. There is one generation per year.

Figure 52

Figure 53

Eastern tent caterpillar, *Malacosoma americanum*, feeds on cherry, apple, and plum. Full-grown caterpillars are about 1.6 inches long; coloration varies but in general they have black heads, bodies marked with a mid-dorsal white stripe down the length of the back and yellow lateral stripes between each pair of which occurs a blue dot (**Figure 53**). The adult moths are light brown with two diagonal white stripes across the forewings. Silken tents usually occur in tree forks. The larvae lay trails of silk from the communal tent to wherever they are feeding. Long trails of larvae can be seen migrating along the silken path between the tent and leaves.

Eggs are laid in masses on twigs (**Figure 54**). Egg masses can be pruned from twigs during the dormant season and destroyed. Caterpillars can be handpicked from the communal tents. Bt should be used on flowering trees to control young caterpillars. Bt is not harmful to pollinating bees.

Figure 54

Catalpa sphinx, *Ceratomia catalpae,* feeds on catalpa. Full-grown caterpillars are about 3 inches; black horn near the end; body marked with black and yellow (**Figure 55**).

The walnut caterpillar**,** *Datana integerrina,* feeds on walnut, butternut, pecan and hickory. Full-grown caterpillars are about 2 inches; black body with yellowish stripes covered with long, white to gray hairs (**Figure 56**). Younger larvae are reddish brown with longitudinal yellowish stripes. The adult moths lay eggs on the undersides of leaves beginning in May or June. Trees can be completely defoliated during outbreaks. Defoliations of two or more years can result in tree death. The pupae overwinter in the soil and there is one generation per year.

Figure 55

Variable oakleaf caterpillar, *Heterocampa manteo,* feeds on oaks, birch, elm, apple and other hardwoods. Full-grown caterpillars are about 1.5 inches long with variable coloration. They are greenish with white and yellow stripes. The head has a purplish brown band on each side (**Figure 57**). Adults emerge in May and larvae are present from July to fall. The young larvae skeletonize leaves by feeding on the undersides. Older larvae consume entire leaves except for the veins. Severe defoliation can occur in outbreak years. The insect overwinters in the soil as a prepupa. There is only one generation per year.

Figure 56

Figure 57

The gypsy moth, *Lymantria dispar*, feeds on most hardwood species preferring oaks (**Figure 58**). Full-grown caterpillars are from 1.5-2 inches long and have a series of blue and red dots along the back (**Figure 59**). The gypsy moth is a serious spring defoliator of forest and shade trees. The destructive stage is the caterpillar, which feeds on several hundred species of trees and shrubs. This moth was brought to the United States in 1869 and has become established in at least 12 northeastern states. Long distance spread of the gypsy moth occurs when unsuspecting people move egg masses, caterpillars or pupae from infested areas (**Figure 60**).

The Georgia Forestry Commission (GFC), in co-operation with USDA Forest Service, has eradicated

Figure 58 - Adult gypsy moths, male-left, female-right

Figure 59

Figure 60 - Female gypsy moths and egg masses

three infestations of the gypsy moth since 1991. The GFC in cooperation with the USDA APHIS conducts a comprehensive trapping program every year to detect the presence of the moth in the state (**See Figure 177**).

The locust leafminer, *Odontota dorsalis*, causes extensive defoliation every year throughout the range of black locust. The adult beetles feed on newly expanding leaves in the spring by skeletonizing the undersides of the leaves and chewing small holes in them. Eggs are then deposited on the undersides of the leaves. The larvae hatch and begin to mine the leaves. Outbreaks are spectacular, but trees are seldom killed (**Figure 61**).

Figure 61 - Life stages of locust leaf miner

Figure 62 - Sweetgum defoliation

A sweetgum defoliator, *Paectes abrostaloides*, was recorded as defoliating sweetgum across the South in 1977. Specimens collected from Georgia were sent to the Smithsonian Institution where they were identified as the same species occurring in other southern states. The outbreak lasted one season and there hasn't been any activity reported since (**Figure 62**).

The larger elm leaf beetle, *Monocesta coryli*, causes widespread defoliation of native elm species throughout the South. Other trees attacked are river birch, pecan, hawthorn and Asian elms. Adults are about 7/16 inch in length, dull-yellowish brown head with large greenish patches at the tip of each **elytra**. Mature larvae are about the same length as the adults and are of a metallic reddish-brown color (**Figure 63**). The larvae overwinter in the soil. The adults emerge in May at which time eggs are laid on the undersurfaces of the leaves. Upon hatching the larvae feed together between the veins of leaves. The larvae skeletonize the leaves. There is one generation per year.

Figure 63

The elm leaf beetle, *Pyrrhalta luteola*, is about ¼ inch long and yellowish to dull green, with a black stripe on the edges of the elytra, with three dark dots behind the head. Mature larvae are about 7/16 inch long and are yellowish with two lines of black dots along the back (**Figure 64**). Unlike the larger elm leaf beetle, this beetle overwinters as an adult in protected places such as attics. In May the adults emerge and lay eggs in May to June. The larvae feed on the undersides of leaves and pupate at the base of trees. There are two generations per year.

Figure 64

The Japanese beetle, *Popillia japonica*, is a very destructive foreign pest that entered the United States over 80 years ago. By 1972 the beetle had been reported in 22 states east of the Mississippi River. Since then it has continued to spread into Wisconsin, Oregon and California. Adult beetles feed on the foliage and fruits of several hundred species of fruit trees, ornamental trees, shrubs, vines, and field and vegetable crops. Adults leave behind skeletonized leaves and large holes in leaves. The grubs live in the soil, feeding on the roots of plants and grasses and often destroying turf in lawns, parks, golf courses and pastures. The beetle is about ½ inch long with a shiny, metallic-green body

and bronze outer wings (**Figure 65**). Control of the insect is best achieved by targeting the adults and grubs.

Figure 65

The yellow-poplar leaf-mining weevil, *Odontopus calceatus*, periodically causes partial defoliation of yellow poplar throughout the State (**Figure 66**). Affected trees really look "sick" but in time appear to recover well. However, weevil damage to transplanted trees and other landscape trees can reduce their aesthetic value. Adult weevils damage the leaves by feeding on the undersides near the midrib and the females damage leaves by chewing oviposition pits in the midrib. Larvae feed together between leaf surfaces causing the leaves to turn brown and die. Damaged leaves may stay on the tree until fall or they may drop prematurely. The adult weevils become active in early spring and egg laying occurs between March and May. Eggs hatch from 4-14 days. The larvae can be found from April to June. New adults emerge in May and feed on the foliage until mid-June. At this time the adults migrate from trees to ground duff and stay there until the following spring.

Figure 66 - O. calceatus damage

The spring cankerworm (SC), *Paleacrita vernata*, and fall cankerworm (FC), *Alsophila pometaria*, are often confused. They feed on elm, ash, hickory, birch, beech, apple, maple and oak. Adult females of both species are wingless gray moths. They are about 7/16 inch long. The males have tan wings. Mature larvae are ¾ inch long and vary in color from green to reddish brown to black, with one or more stripes of white, green or black **(Figure 67)**. The SC has two pairs of prolegs while the FC has three pairs. The FC emerges from the soil as an adult moth in the fall. Mating takes place, the eggs are laid and the adults die. The eggs hatch from April to May at about the time the host buds are opening. SC pupae in the soil do not emerge as adults until early spring. Both species' eggs hatch at about the same time. There is one generation per year. Outbreaks of both species often last for several years before declining.

Figure 67 - Fall cankerworm, dark phase

Conifer Defoliators

Pine sawflies are a unique group of defoliating insects. Eleven species are described here and most are generally distributed throughout the south wherever the preferred hosts grow. The larvae consume the needles and feeding preferences are peculiar to each species. Most all sawfly species feed on old and current year foliage at some point in their development. Some species have one generation per year with defoliation occurring in the spring and others produce three or more generations with defoliation occurring into the fall and winter. Fall and winter defoliations have greater impacts on trees and it is for this reason that sawflies having multiple generations are considered more devastating.

Sawfly adults resemble large house flies but are actually broad-waisted wasps. The females are equipped with an ovipositor that is serrated which enables them to saw little slits in the needles where eggs are laid; thus the name sawflies. It's important for foresters to recognize sawflies and the damage they do (**Figures 68-78**).

Defoliation by sawflies is sporadic, occurring in localized or region wide outbreaks lasting one to several years. Growth losses the year following a severe defoliation (>75%) can average over 50 percent and mortality increases due to secondary invasions by bark beetles and pine sawyers.

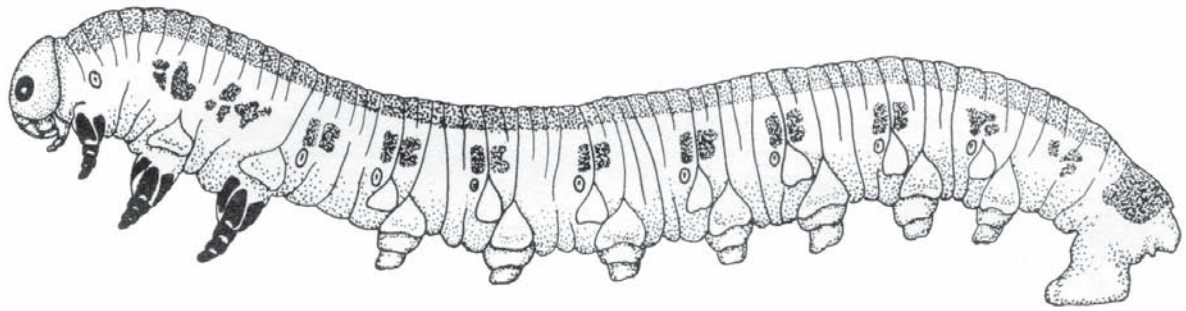
The redheaded pine sawfly is the most widely distributed species in the south and is usually the species responsible for regionwide outbreaks covering several states. It is capable of producing three or more generations per year in the south (**Figures A & 75**).

Although most of the southern conifers are adaptable to a wide range of conditions it is always advisable to match the tree species to sites favoring that species. The management suggestions that may reduce the severity of sawflies are:

- ❏ Consider herbicides to reduce hardwood competition.
- ❏ Avoid planting on wet or droughty soils.
- ❏ Avoid sites below an index of 65.
- ❏ Monitor plantations frequently for sawfly damage. Most infestations begin on the edges of stands or are localized in a portion of the stand. Control with insecticides is most effective at this stage.

Figure A - Redheaded pine sawfly larvae on Longleaf

Spotted Loblolly Pine Sawfly Neodiprion taedae taedae

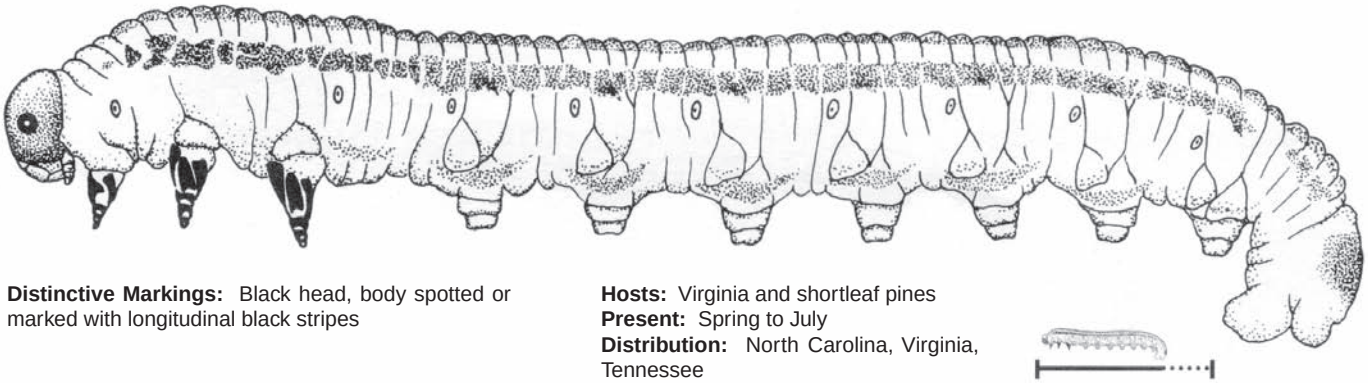


Distinctive Markings: Greenish-white, red-brown head, a dull gray-green stripe on each side of body, a row of black spots just above the midline, two black blotches on top of tenth body segment

Hosts: Loblolly and shortleaf
Present: Spring to July
Distribution: North Carolina, Eastern Virginia, (scattered in southeast)

Figure 68

Virginia Pine Sawfly Neodiprion pratti pratti

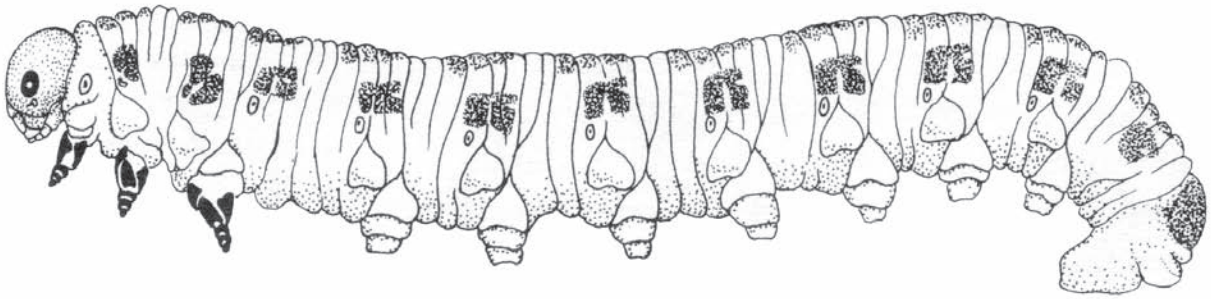


Distinctive Markings: Black head, body spotted or marked with longitudinal black stripes

Hosts: Virginia and shortleaf pines
Present: Spring to July
Distribution: North Carolina, Virginia, Tennessee

Figure 69

White Pine Sawfly Neodiprion pinetum

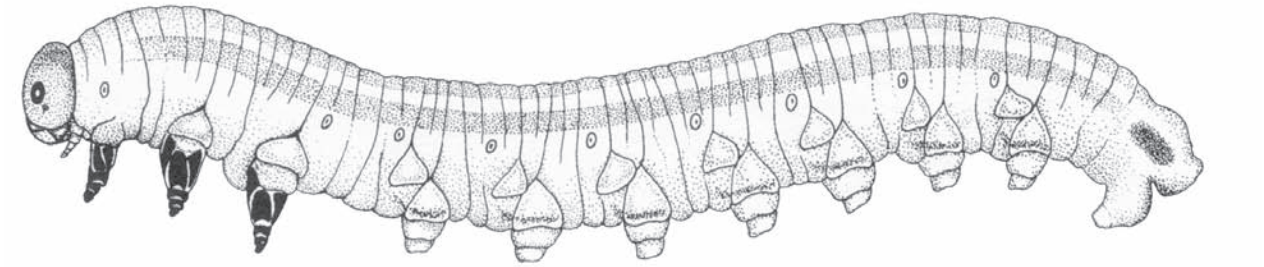


Distinctive Markings: Pale yellow with 4 rows of black spots extending from head to a black spot at tail end of body, black head

Hosts: Eastern white pine
Present: Spring to July
Distribution: Eastern North America

Figure 70

Slash Pine Sawfly Neodiprion merkeli

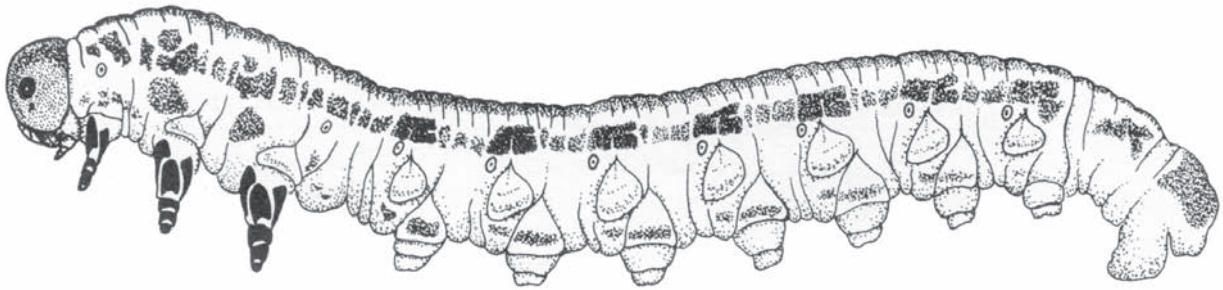


Distinctive Markings: Reddish above the eyes and sooty black below the eyes, brown stripes and two widely separated black semi-oval spots near tail end

Hosts: Slash pine
Present: Spring to December
Distribution: Georgia, Florida, and Mississippi

Figure 71

Hetrick's Sawfly Neodiprion hetricki

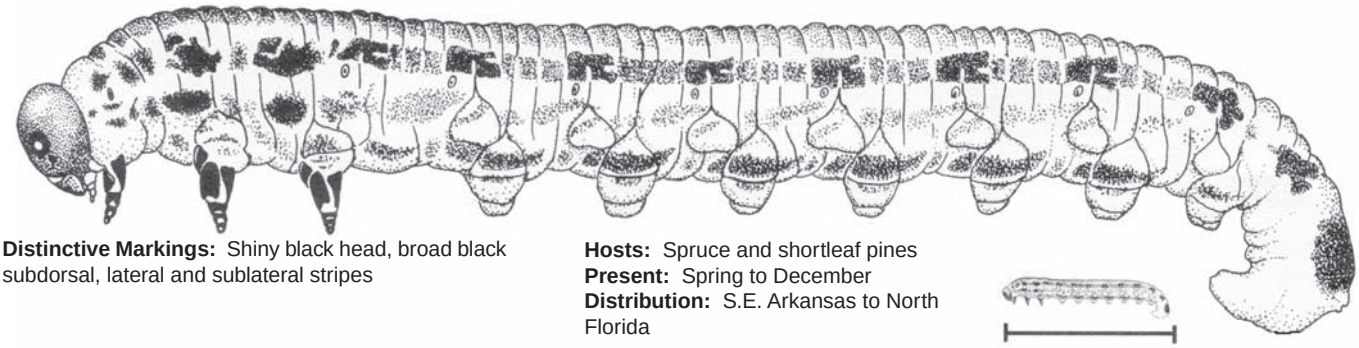


Distinctive Markings: Black head and black subdorsal and lateral stripes, (Florida specimen are pale green with faintstripes,, head is pale amber and bears a yellow triangular spot with a large pentagonal marking

Hosts: Observed feeding on loblolly, pond, and longleaf
Present: April to July
Distribution: Virginia, Florida, South Carolina, Georgia

Figure 72

Warren's Sawfly Neodiprion warreni

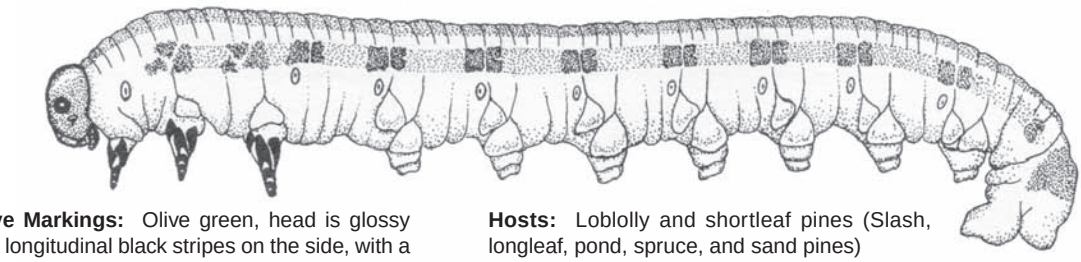


Distinctive Markings: Shiny black head, broad black subdorsal, lateral and sublateral stripes

Hosts: Spruce and shortleaf pines
Present: Spring to December
Distribution: S.E. Arkansas to North Florida

Figure 73

Blackheaded Pine Sawfly Neodiprion excitans

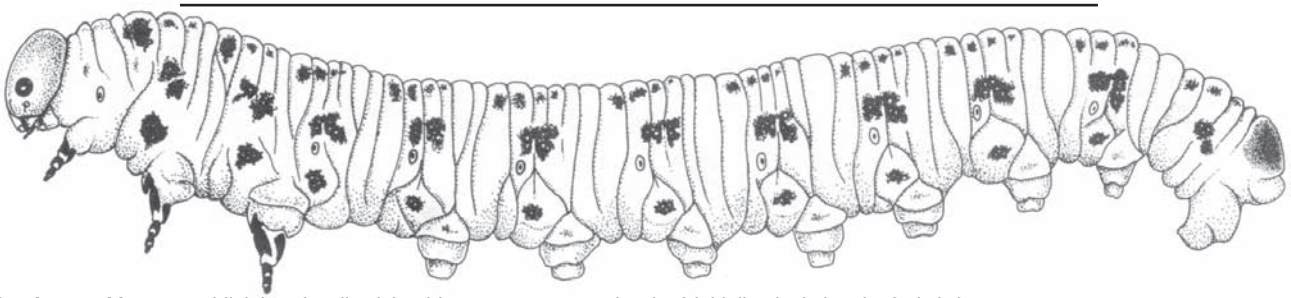


Distinctive Markings: Olive green, head is glossy black, two longitudinal black stripes on the side, with a row of black spots on each side and a large black spot on the last body segment

Hosts: Loblolly and shortleaf pines (Slash, longleaf, pond, spruce, and sand pines)
Present: Spring to December
Distribution: Virginia to Florida and west to Arkansas and Texas (probably southwide)

Figure 74

Red-Headed Pine Sawfly *Neodiprion lecontei*

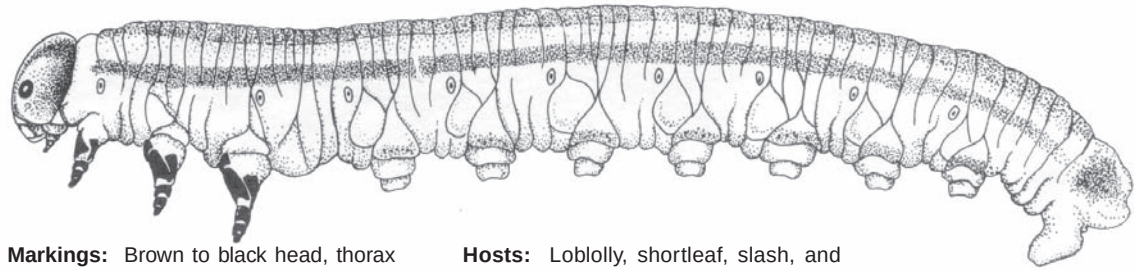


Distinctive Markings: Reddish head, yellowish-white body with six rows of black spots

Hosts: Shortleaf, loblolly, slash, longleaf, pitch (eastern white pine, deodar cedar)
Present: Spring to December (probably year-round in South Florida)
Distribution: Eastern United States

Figure 75

Abbott's Sawfly *Neodiprion abbottii*

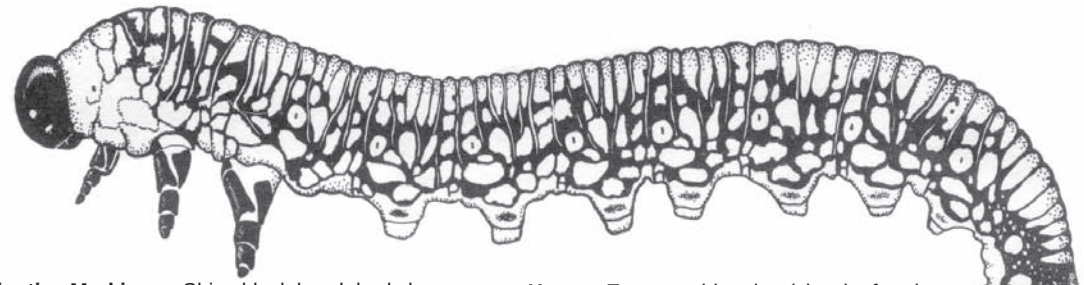


Distinctive Markings: Brown to black head, thorax and abdomen pale green, four dark green to black lateral stripes

Hosts: Loblolly, shortleaf, slash, and longleaf
Present: Spring to December
Distribution: Wisconsin to Florida

Figure 76

Introduced Pine Sawfly Diprion similis

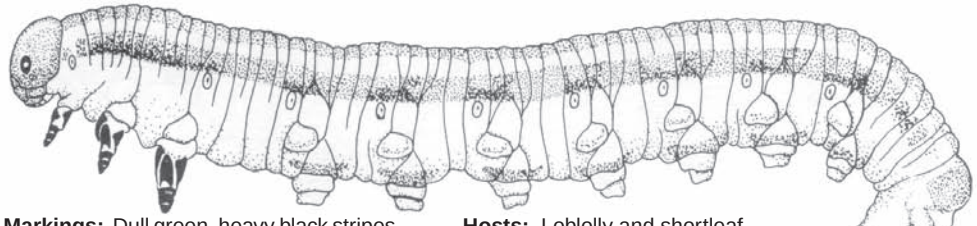


Distinctive Markings: Shiny black head, body has a double black strip bordered by yellow along the back; sides are dark and mottled with numerous rounded yellow and white spots

Hosts: Eastern white pine (shortleaf and Virginia pines)
Present: Spring to first freeze
Distribution: North Carolina, Virginia, Tennessee

Figure 77

Loblolly Pine Sawfly Neodiprion taedae



Distinctive Markings: Dull green, heavy black stripes along each side and often two lighter stripes below the heavier ones

Hosts: Loblolly and shortleaf
Present: Spring to July
Distribution: Arkansas, Louisiana, S.E. Texas, Mississippi, South Carolina, (Probably southwide)

Figure 78

The pine webworm, *Tetralopha robustella*, can cause extensive defoliation in young pine stands in certain years. Heavy defoliation tends to coincide with droughts. This insect primarily attacks one and two year old seedlings. When larger trees are attacked injury is usually not severe. Most Georgia pines are attacked.

Adult moths have a wingspread of 7/8 to one inch: hind wings and body are smoky gray; front wings have tufts of raised scales. Caterpillars are approximately 3/4 inch in length at maturity; tan to gray with two darker longitudinal stripes along each side. The pupae are ½ inch in length, robust and reddish.

Winter and spring are passed as pupae in the soil. In late June the adults emerge, mate and the females deposit the eggs on the needles. Weather is an important factor and greatly influences egg incubation. Cool temperatures may prolong the incubation period. The larvae hatch in August and feed on the needles. After feeding the larvae drop to the ground and pupate in an oval shaped cell. In Georgia there may be two generations per year.

The larvae feed on the needles constructing masses of frass bound together with silk on the seedlings. These masses of excrement are usually 3 to 5 inches long surrounding the twigs and enclosing the basal portions of the needles (**Figure 79**). No control is necessary.

Figure 79

Pine colaspis beetle, *Colaspis pini* (**Figure 80A**), infestations appear to be more severe on pines growing along edges of grasslands and trees in isolated groups such as yard trees or trees growing in fields in clumps. In light infestations usually the edges of the year old needles on smaller trees are fed upon (**Figure 80B**). During heavy infestations all needles may be attacked and the tree defoliated. Cypress, spruce and most southern pines are fed upon.

Figure 80A

The adult beetles are about 3/16 inch long; rusty yellow or brown with greenish iridescence (**Figure 80A**). Full-grown larvae are about ¼ inch long, yellowish-white in color. The adults emerge in the summer and lay eggs in the soil. Upon hatching the larvae feed upon roots of various grasses and other vegetation. Pupation takes place in the spring and shortly after; adults begin feeding on the needles. There is only one generation per year.

Figure 80B

Figure 81 - Adult pine chafer beetle

The pine colaspis beetle is not considered an important forest insect. Heaviest feeding occurs between May and June, therefore, insecticides should be used at this time if yard trees are to be protected.

The pine chafer beetle, *Anomala oblivia*, periodically erupts into local severe outbreaks. Attacked trees have a scorched appearance. Adult beetles chew small notches in current year needles just above the sheath (**Figure 81**). Needles will often bend or break at the notched area. Although infestations can be quite spectacular little damage is done. The larvae feed on the roots of various plants including grasses.

Figure 82

The evergreen bagworm, *Thyri-dopteryx ephemerae-formis*, is common on junipers, arborvitae, bald cypress and other conifers. The adult females are wingless and stay confined to the bag for life. The males do fly and will locate females in the fall and mate with them. Each female may lay from 800-1000 eggs. The eggs overwinter in the female's bag hatching in late April to early May. Upon hatching each larva constructs a small bag made from silk, portions of leaves and twigs. The bag is carried by the larva everywhere it goes. As the larva increases in size the bag is enlarged. Fully-grown bags may reach two inches or more (**Figure 82**).

The front end of each larva is exposed from the bag and this enables it to feed and crawl. The larva holds itself in the bag by a pair of prolegs attached to the tail end of its body. When disturbed or threatened the larva will quickly pull itself into the bag. The bag protects the larva from predators and insecticides. When the larva matures it attaches the bag to a twig, seals it and pupates. There is only one generation per year.

The larvae consume entire needles leaving only the sheath behind. The bags can be picked by hand and destroyed or trees can be sprayed with an insecticide just after the larvae appear.

Gall Insects

Galls are abnormal vegetative growths on trees that result from the feeding and egg laying activities of various insects and mites. Chemical secretions from the adults while laying eggs as well as the saliva from the feeding larvae cause the plant to react abnormally.

The more common gall producers on trees are aphids, beetles, jumping plant lice, midges, mites and wasps. Each species causes a swelling of plant tissue that is characteristic on specific plant parts such as the stem, twig, leaf or petiole. Most often the gall is more readily identified than the gall producer. It is convenient to identify galls and their producers simply by noting where the gall is located and also the shape of the gall. **Table two** lists some of the more common trees that are frequently attacked by gall producers along with a description and location of the gall.

Generally galls are not life threatening to trees. Oftentimes the most drastic effects are premature leaf fall and dieback of several smaller branches.

On small trees galls should be pruned and destroyed. Leaf and twig litter that is on the ground around the base of the tree should be raked and disposed of. A few of the common species are shown in (**Figures 83-85**).

Figure84 - Wool sower galls on white oak

Figure 83 - Cynipid oak galls

Figure 85 - Leaf galls on black cherry

Table 2: Some common galls and their plant hosts.

Tree	Location	Gall Description	Occurrence	Name/Organism
Ash	leaf	reddish-brown bullet shaped	summer	ash bullet gall/midge
	midrib	swollen ¼”-1/2”	summer	ash midrib gall/midge
Beech	leaf	white/buff velvety pile	summer	Erineum gall/mite
Birch	seed	swollen infertile	spring	birch seed midge
Boxelder	bud	½”-1” swollen	spring	boxelder bud gall/midge
	leaf	nearly spherical, 1/10” diameter	spring-summer	boxelder leaf gall/midge
Cherry, Black	twig	irregular black swellings	year-round	back knot/fungus
	bud/shoot	irregular red or yellow	spring	wild cherry bud gall/midge
Chestnut	bud	swollen bud or petiole	spring	chestnut bud gall/wasp
Dogwood	twigs	club-shaped swellings	summer	dogwood club gall/midge
	stem	irregular ½”-1”	summer	dogwood stem gall/midge
Hackberry	petiole	kidney-shaped	summer	hackberry petiole gall/ plant lice
	leaf	Large nipple-like	summer	hackberry nipple gall/ plant lice
Hickory	leaf	cylindrical, green slanting	summer	hickory tube gall/midge
	twig/leaf stem	new galls-green, old galls black	spring-summer	hickory gall/phylloxeran
Locust, Black	leaflets	folded	early summer	locust midge
	twig/stem	fusiform swellings	summer	locust twig gall/midge
Locust, Honey	leaflets	folded or marginal leaf rolls	early summer	honey locust gall/midge
Maple	leaf	sac-like	summer	maple bladder gall/mite
Oak	leaf	various shapes	summer-fall	oak apple galls/wasp
	bud	urn-shaped	spring-summer	leafy oak gall/wasp
Pine	new shoots	spindle shaped	spring-summer	pine gall sawfly
	twigs/stems	globular resin masses	spring-summer	southern pitch midge
Poplar	petiole	globose ridged	summer	ribbed petiole gall/moth
	leaf, stem, petiole	oval with transverse openings	summer	poplar leaf stem gall/aphid
Willow	branch/stem	globose galls	summer	willow borer/beetle
	bud/leaf	various shapes	spring-summer	various names midge/sawfly

Pine Tip Moths

There are three species of pine tip moths occurring in Georgia: the Nantucket pine tip moth, *Ryacionia frustrana* **(Figure 86)**, the pitch pine tip moth, *R. rigidana*, and the subtropical pine tip moth, *R. subtropica***.**

The Nantucket pine tip moth is the most widely distributed species and causes the most damage to recently planted pines. All native pines up to about 15 feet in height are attacked. Eastern white pine is considered resistant. Slash and longleaf pines may be infested under certain conditions but are generally considered resistant. Loblolly and shortleaf are the favored hosts. Severe and repeated attacks often result in stunted, bushy, and deformed trees (**Figure 87**).

The adult Nantucket pine tip moth is about 1/4" in length with irregular brick red and coppery patches on the forewings. The wingspan is about 1/2". The pitch pine moth range overlaps with the Nantucket pine tip moth and positive field identification is difficult. However, they have similar habits. The larvae of both species are small, yellowish to brownish and are approximately 1/8" in length.

Adult pine tip moths of the over wintering generation emerge in early spring. Depending on weather conditions, spring emergence may occur as early as January in South Georgia or as late as April in North Georgia. Egg laying begins soon after adult emergence. The temperature greatly influences the incubation period. After the larvae hatch they begin to feed on new shoots near the base of the needles or the base of the buds. A protective web is spun over their bodies while they feed. Eventually this web becomes covered with pitch and is the characteristic sign of tip moth infestations (**Figure 88**). When the larvae have completed their development, a cocoon is spun in the hollowed out shoot tip and pupation occurs within. Winter is passed as pupae within the injured tips. Two to five generations occur per year in Georgia.

The subtropical pine tip moth occurs in South Georgia on slash pine. Damage is usually of no significance in forest plantings but control may be justified in newly established tree improvement orchards.

Control of the Nantucket pine tip moth in Christmas tree plantations and in newly established seed orchard plantings is best achieved by deploying pheromone-baited traps to determine moth emergence. Timing insecticide applications coincides with egg laying and larval hatching. **Table 3** lists the site number, location and optimal spray periods for 70 weather stations located throughout Georgia.

Figure 86 - Adult Nantucket pine tip moth

Figure 87

Figure 88

Table 3: Site number, location and optimal spray period predictions for 70 weather stations located throughout Georgia. (Fettig et. al., 2000)

Site No.	Location	Spray Period 1	Spray Period 2	Spray Period 3	Spray Period 4
1	Albany	March 17-22	May 21-25	July 10-14	Aug 19-23
2	Alma	- a	-	-	-
3	Alpharetta	April 21-25	June 30- July 4	Aug 24-28	
4	Americus	March 22-26	May 26-30	July 15-19	Aug 29-Sept 2
5	Appling	April 11-15	June 20-24	Aug 9-13	
6	Ashburn	March 27-31	May 26-30	July 15-19	Aug 29-Sept 2
7	Athens	April 16-20	June 20-24	Aug 4-8	
8	Atlanta	April 16-20	June 15-19	Aug 4-8	
9	Augusta	April 1-5	May 31-June 4	July 20-24	Sept 3-7
10	Bainbridge	March 12-16	May 21-25	July 10-14	Aug 19-23
11	Blairsville	-	-	-	-
12	Brunswick	-	-	-	-
13	Byron	April 1-5	June 5-9	July 25-29	Sept 8-12
14	Calhoun	April 16-20	June 25-29	Aug 14-18	
15	Camilla	-	-	-	-
16	Carrollton	April 16-20	June 20-24	Aug 14-18	
17	Cartersville	April 16-20	June 20-24	Aug 9-13	
18	Cedartown	April 16-20	June 20-24	Aug 9-13	
19	Claxton	March 22-26	May 26-30	July 20-24	Aug 29-Sept 2
20	Clayton	April 26-30	July 5-9	Sept 8-12	
21	Colquitt	March 12-16	May 16-20	July 10-14	Aug 19-23
22	Columbus	March 17-31	May 26-30	July 15-19	Aug 29-Sept 2
23	Commerce	April 16-20	June 25-29	Aug 14-18	
24	Cordele	March 17-21	May 21-25	July 10-14	Aug 19-23
25	Cornelia	April 21-25	June 30-July 4	Aug 29-Sept 2	
26	Covington	April 11-15	July 15-19	Aug 4-8	
27	Cuthbert	March 17-21	May 21-25	July 10-14	Aug 19-23
28	Dalton	April 21-25	June 25-29	Aug 14-18	
29	Douglas	March 17-21	May 21-25	July 15-19	Aug 24-28
30	Dublin	March 22-26	May 26-30	July 15-19	Aug 29-Sept 2
31	Eastman	March 22-26	May 26-30	July 15-19	Aug 29-Sept 2
32	Elberton	April 11-15	June 20-24	Aug 14-18	
33	Experiment	April 16-20	June 20-24	Aug 9-13	
34	Fargo	March 12-16	May 16-20	July 10-14	Aug 19-23
35	Fitzgerald	March 17-21	May 21-25	July 10-14	Aug 19-23
36	Folkston	-	-	-	-
37	Forsyth	April 1-5	June 5-9	July 25-29	Sept 13-17
38	Gainesville	April 21-25	June 25-29	Aug 14-18	
39	Helen	April 21-25	July 5-9	Aug 29-Sept 2	
40	Homerville	March 12-16	May 16-20	July 10-14	Aug 24-28
41	Jasper	April 21-25	June 30-July 4	Aug 24-28	
42	LaFayette	April 21-25	June 25-29	Aug 19-23	
43	Louisville	March 22-26	May 26-30	July 15-19	Aug 29-Sept 2
44	Lumpkin	March 22-26	May 26-30	July 20-24	Sept 3-7
45	Macon	March 27-31	May 26-30	July 15-19	Aug 29-Sept 2
46	Midville	March 27-31	May 31-June 4	July 20-24	Sept 3-7
47	Milledgeville	April 6-10	June 5-9	July 25-29	Sept 13-17
48	Millen	March 17-21	May 26-30	July 15-19	Aug 24-28

Table 3 continued:

Site No.	Location	Spray Period 1	Spray Period 2	Spray Period 3	Spray Period 4
49	Monticello	April 6-10	June 5-9	July 25-29	Sept 13-17
50	Moultrie	-	-	-	-
51	Nahunta	March 7-11	May 16-20	July 10-14	Aug 24-28
52	Newnan	April 11-15	June 15-19	Aug 4-8	
53	Quitman	-	-	-	-
54	Rome	April 16-20	June 20-24	Aug 9-13	
55	Sandersville	April 1-5	June 5-9	July 25-29	Sept 8-12
56	Sapelo Island	March 17-21	May 21-25	July 10-14	Aug 24-28
57	Savannah	March 17-21	May 21-25	July 10-14	Aug 19-23
58	Siloam	April 6-10	June 5-9	July 30-Aug 3	Sept 13-17
59	Surrency	March 12-16	May 21-25	July 10-14	Aug 29-Sept 2
60	Swainsboro	March 22-26	May 26-30	July 15-19	Aug 24-28
61	Talbotton	March 27-31	May 31-June 4	July 25-29	Sept 8-12
62	Thomaston	March 27-31	May 31-June 4	July 25-29	Sept 8-12
63	Thomasville	-	-	-	-
64	Tifton	March 17-21	May 21-25	July 10-14	Aug 24-28
65	Warrenton	April 6-10	June 509	July 25-29	Sept 8-12
66	Washington	April 16-20	June 20-24	Aug 9-13	
67	Waycross	-	-	-	-
68	Waynesboro	April 1-5	May 31-June4	July 25-29	Seppt 8-12
69	West Point	April 1-5	June 5-9	July 25-29	Sept 8-12
70	Winder	April 16-20	June 20-24	Aug 14-18	

"- a" refers to spray periods that are not applicable to spray timing because models have not been developed for populations with 2 or 5 annual generations.

Twig Girdlers, Twig Pruners, and Dogwood and Peachtree Borers

The twigs and branches of hardwood trees are often attacked by various longhorned wood boring beetles and clearwing moths. Two common beetle species are the twig girdler, *Oncideres cingulata,* and the twig pruner, *Elaphidionoides villosus* (**Figure 89 & 90**). Both species attack oaks, hickories, pecan and many other species of hardwoods. Damage is often severe in pecan and other fruit tree orchards.

Figure 89 - Twig girdler

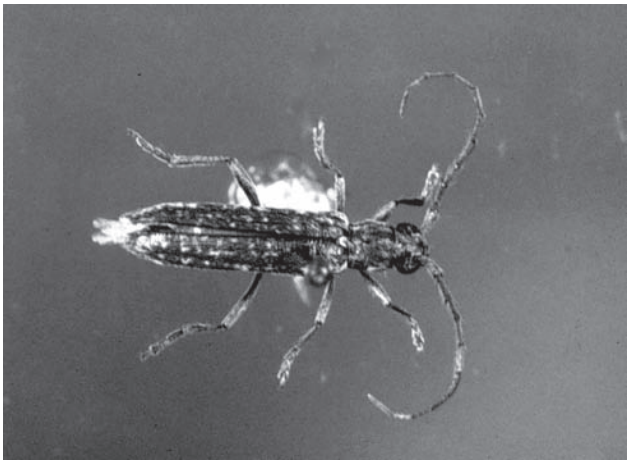


Figure 90 - Twig pruner

The twig girdler beetle chews around the outside of the twig until it is almost severed (**Figure 89**). Eventually these twigs will break and fall to the ground or may bend at the girdle and swing in the tree. The twig pruner's girdle is made from within the branch or twig by the grub and there is no visible outside girdle (**Figure 91**). In both situations, however, the result is the same. Both twigs and branches are girdled.

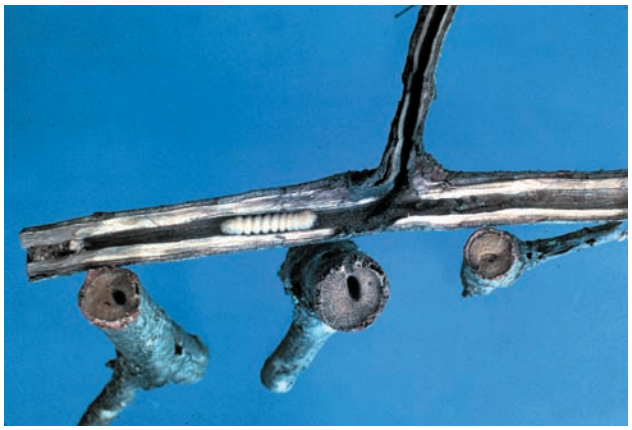


Figure 91

The larvae of both species spend the winter in the girdled twig. A good method of control is to collect the twigs and branches that fall to the ground and burn them. Those hanging in the tree should be collected and burned as well. This should begin soon after the damage is noticed and continued through the winter months.

The dogwood twig borer, *Oberea tripunctata*, is a beetle that breeds in dogwood, sourwood, elm and various fruit trees. The adults appear in the spring and the females lay eggs in the smaller twigs of the tree. The larvae bore down the center of the twigs feeding towards the trunk (**Figure 92**). Infested twigs will often break. Local infestations can become severe on trees. Infested twigs should be pruned and destroyed.

Figure 92

The dogwood borer, *Synanthedon scitula*, is a clearwing moth that resembles a wasp (**Figure 93**). It is blue-black in color with two yellow abdominal bands. Adult emergence begins about the time dogwood flower petals fall and continues until September. Eggs are laid in damaged bark areas or in crotch areas of branches. Signs of borer infestation will be sloughing of bark, dieback and adventitious growth. Coarse brown frass is often pushed from the larval galleries and can be seen on the outside of the bark. The dogwood borer attacks numerous other hosts including pecan, oak, hickory, flowering cherry, willow, birch, and apple. Black knot fungus galls on Prunus spp. are also attacked. Populations of the dogwood borer can be monitored with pheromone traps.

Figure 93

The peachtree borer, *Synanthedon exitiosa*, is a clear winged moth that attacks several species of fruit and ornamental trees (**Figure 94**). The females lay eggs in bark crevices and scar tissue near the ground. The larvae upon hatching bore into the tree just above the ground line. Trees can be killed or severely weakened by the girdling action of the larvae. Trees skinned by lawn mowers or string trimmers are highly susceptible. Signs of attack are sap mixed with boring dust at the tree's base.

Figure 94

The lesser peachtree borer, *Synanthedon pictipes*, is very similar in appearance to the peachtree borer, however, it attacks trees at many points along the trunk or larger branches. Therefore, any borer attacks occurring above the tree's base will be that of the lesser peachtree borer.

Sucking Insects/True Bugs

Aphids and Adelgids

Aphids and adelgids are grouped in the insect suborder Homoptera and are closely related species. Many species of aphids are common throughout the forest but the damage done is not considered a forest threat. Aphids appear to favor drought conditions. Pine seedlings growing on dry sites sustain a higher level of aphid attack than trees growing on good to marginal sites. However, damage is considered secondary to drought and control is best achieved by natural means. Chemical control of aphids in forest plantings is not necessary. A black **sooty mold** develops on trees as a result of aphid secretions (**Figure 95**). These fungi help entomologists diagnose the occurrence of aphids and other sucking insects.

Figure 95

Figure 96

Adult aphids are small, 1/32 to 1/4 inch, soft-bodied, pear-shaped insects varying in color from red, yellow, green, blue, brown, gray, or black (**Figure 96**). Adults may be winged or wingless. Most species have a pair of tube-like cornicles arising from the top of the 5th or 6th abdominal segment. Legs and antennae are well developed. Nymphs resemble the adults but lack wings and are smaller. Eggs are usually black and rather large considering the small size of the adult.

Figure 97

Many aphids have a complex life cycle. Most species spend the winter in the egg stage. The eggs hatch in the spring into wingless females. These females reproduce parthenogenetically (without males) and give birth to living young. Several generations may be produced in this fashion, with the first generation or two consisting of wingless individuals and winged individuals appearing later. When the winged individuals appear they usually migrate to a different host plant and reproduction continues. Later in the season the aphids will migrate back to the original plant host where a generation of both males and females is produced. The males and females mate and these females lay the eggs that overwinter.

Aphids suck plant juices from foliage and bark of young twigs and stems. Needles will turn yellow and may curl and become deformed. Aphids also excrete large quantities of honeydew that may drop from the trees onto cars and other objects below. Honeydew is simply the sap that is sucked in through the beak and only partially digested and excreted. This honeydew is sweet and sticky and often forms on the branches, foliage and twigs upon which sooty molds grow. Ants commonly feed on these sweet excretions. Certain species of ants are often seen scraping the outer bark over which aphid secretions have formed. The bark has a unique appearance (**Figure 97**).

Common Aphid Species on Conifers

The white pine aphid, *Cinara strobi*, is a common pest occurring on white pines. Young trees, recently transplanted trees or individual branches on large trees may be killed. The body is shiny dark brown with a white stripe extending down the middle of the back, and white powdery spots on the sides (**Figure 98**). In the fall, winged females lay eggs. The shiny black eggs are laid end to end in a straight line with an average of about 6 per needle. Hatching occurs in the spring and the wingless females produce living young. Later in the season winged females are produced which migrate and also produce living young. In the fall, winged males and females mate and lay the eggs that overwinter.

The pine bark aphid, *Cinara atlantica*, congregates in large masses on the branches of southern pines (**Not Pictured**). Sap is sucked from the phloem of branches and twigs. It occurs statewide and is a nuisance during the Christmas season when brought in homes via Christmas trees. Many homeowners think this aphid is a tick and to the casual observer may appear as such.

Figure 98

Adelgids

These insects are often confused with aphids. They are related to woolly aphids and phylloxerans but occur exclusively on conifers. Adelgids feed on foliage, twigs, limbs and trunks. Galls are produced on some hosts and can be used to identify the species of adelgid **(Figure 99)**. Their life cycle is very complicated and is confounded by sexual and asexual reproduction as well as alternate hosts.

Figure 99 - Balsam woolly adelgid damage

Some adelgids resemble aphids and others are quite unique. Identification is confirmed by the host plant and the production of a white secretion that may be powdery, filamentous or ribbon-like (**Figure 100**).

Adelgids insert their long, hairlike, mouthparts through the bark into the phloem and begin sucking sap. Soon their bodies are covered with the white excretions. Twigs become swollen and gouty from the feeding. Tree trunks become covered with the white excretions and appear as snow. Some common species are the pine bark adelgid, *Pineus strobi,* a pest of white pine (**Figure 101**) and the hemlock woolly adelgid (HWA), *Adelges tsugae,* a pest of Eastern and Carolina hemlock (**Figure 102**). The HWA has spread throughout the native hemlock range in Georgia. The hemlock woolly adelgid use their sucking mouthpart to remove sap from the new growth of the tree. This causes a gradual decline of tree health, and tree mortality occurs after 5 or more years of repeated attacks.

Figure 100

Figure 101

Figure 102 - Woolly material produced by HWA

Predator insects, specific to HWA are being reared and released in the hopes of minimizing the impact of this insect. Currently, four species of predators have been identified by researchers from the HWA's native range. Releases of these insects have occurred since 2004 in carefully selected hemlock stands on Federal and State owned lands.

Urban hemlocks can be temporarily protected with a systemic insecticide (imidacloprid) applied to the root system. More treatment information can be found at www.gatrees.org/ForestManagement/HemlockWoollyAdelgid.cfm.

Cicadas belong to the insect sub-order Homoptera. Generally, cicadas are called either annual or periodical. The annual cicadas are present each year and their shells can be seen attached to the trunks of trees (**Figure 103**). The periodical cicadas emerge in mass either on a 13 or 17-year cycle (**Figure 104**). Three species with 13-year cycles and three species with 17-year cycles represent the genus *Magicicada*. Generally, the 17-year broods are northern and the 13-year broods are southern. The last 13-year brood emerged in Georgia in 1998 and the 17-year brood in 2004.

Figure 103

Figure 104

Female cicadas damage trees by ovipositing on twigs and smaller branches. Eggs are laid in Y shaped pits in living twigs (**Figure 105**). Each pit may contain up to 20 eggs. A female may lay up to 600 eggs. After a month or so, the eggs hatch and the newly emerged nymphs drop to the ground from the twigs, burrow underground, locate a suitable rootlet for feeding and begin their long 13 or 17-year development. The nymphs pierce and suck juices from roots.

At the end of the 13- or 17-year cycle the brood emerges between May and June thus completing the cycle.

The annual cicadas better known as “dog day” cicadas belong to the genus *Tibicen* and are found throughout the U.S. in late summer to early fall every year although their life cycle requires 4-5 years for development. Twigs and branches can be severely damaged by cicadas but trees appear to recover.

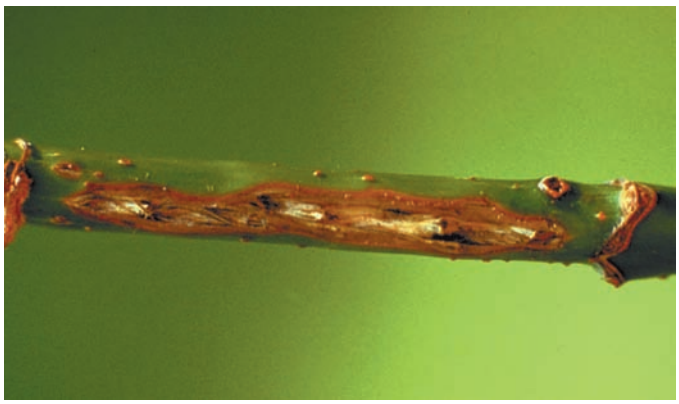


Figure 105

Lace bugs are unique in appearance by possessing a hood-like extension of the **pronotum** that covers the head (**Figure 106**). The wings are reticulated giving the bugs a lace-like appearance. The sycamore lace bug is a very common pest of the sycamore tree and has been recorded feeding on mulberry, ash and hickory.

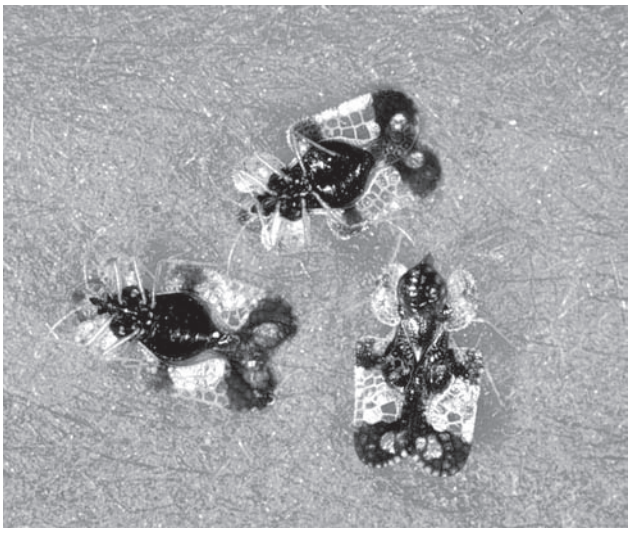


Figure 106

Both adults and **nymphs** cause damage by extracting juices from the undersides of leaves. The feeding causes small, white, bleached areas on the upper leaf surfaces. Heavily infested leaves will turn brown and drop from the tree. The Sycamore lace bug is shown in **Figure 107**.

Drought conditions favor sycamore bug activity and heavy leaf fall. The eggs are laid on the under sides of leaves in early spring. Within 2-3 weeks, they hatch into nymphs that feed for about 6 weeks. Lace bugs overwinter as adults in protected places. The sycamore lace bug produces two or more generations per year in Georgia.

Under forest conditions control of lace bugs is not warranted. However, shade trees are often heavily infested and may require an insecticide spray to prevent injury and dieback.

Figure 107

The **false chinch bug,** *Nysius raphanus* (**Figure 108**), resembles the chinch bug *Blissus leucopterus*, and is often mistaken for it except for its shorter, slender body . Normally the false chinch bug is a pest of potatoes, beets, cabbage, cotton, corn and sorghums. Recently, the bugs have been found feeding on first-year containerized longleaf pine seedlings. Damage appears to be worse in arid fields and where a total broadcast of herbicides was used. Insecticides are effective in killing the false chinch bug, but due to their migration habits, a recently sprayed field can be re-infested within days following the insecticide application.

The bugs normally increase during early spring and summer, principally on weeds. During droughts or in fields where herbicides have been used, weeds are either absent or less succulent and the bugs migrate to other hosts such as pine. Damage is done by their piercing-sucking mouthparts. They remove sap from the needles causing the needles to wilt and die.

The adults are small, averaging about 3 mm in length. Both adults and nymphs overwinter among plant remnants and become active in early spring. Eggs are laid in the soil and on plants low to the ground and hatch in about four days. The nymphs feed for about three weeks before transforming to adults. In Georgia there are at least 4 generations per year with a fifth likely.

Figure 108

Little is known about the effects the false chinch bug will have on containerized longleaf pine seedlings. Heavy seedling mortality has occurred in Georgia throughout the Coastal Plain. Damage appears to be heaviest in fields where herbicides were broadly applied as opposed to band applications.

Harrowing of fields before planting is likely to kill many over wintering adults and nymphs, but it may not be practical because of the migration habits of the bugs particularly during droughts. Others are likely to fly and crawl from adjoining fields after the pines have been planted. This is particularly true when drought has desiccated weeds and other host crops.

Insecticides are effective but may not be warranted when rainfall has been normal and there is an abundance of succulent weeds nearby.

Seed bugs are very injurious to pine seed in seed production orchards. First year conelets often abort due to seed bug feeding. Cones that don't abort either shrivel or produce low yields of sound seeds.

The shieldedbacked pine seed bug, *Tetyra bipunctata*, is sometimes hard to spot since it hides very quickly if disturbed (**Figure 109**). It has the typical stink bug appearance and varies from light brown to reddish-brown in color. The leaffooted pine seed bug, *Leptoglossus corculus* has leaf-like hind tibiae that easily identify it (**Figure 110**).

Figure 109

Figure 110

Scale insects can be injurious to pines in seed orchards and a nuisance in Christmas tree plantations. This group of insects is very large; containing minute and highly specialized individuals. Different species attack different parts of the host, branches and twigs being frequently infested.

Development of scale insects varies somewhat with different species. In most cases development is rather complex. The first nymphal instars (crawlers) have legs, antennae, and are fairly active. After the first molt the females lose their legs and antennae and become immobile and sessile. A waxy covering is then secreted over their body. This covering may be in the form of powder, plates or drops of resin. The females remain under the covering where they lay eggs and give birth to living young (viviparously). The eggs are never laid in the open. The males develop much like the females having several scale-like nymphal instars; the last **instar** is often called a pupa. There may be one to six generations per year varying with species and geographical location.

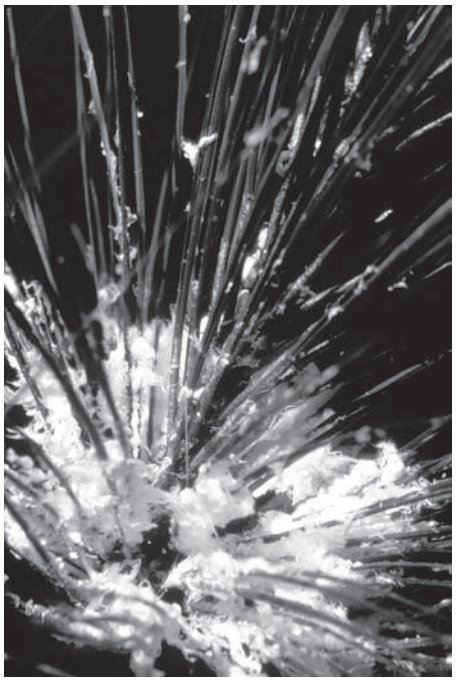


Figure 111

Scale insects extract sap from plant parts thus causing devitalization and death of the infested parts. Some scales produce galls. The woolly pine scale, *Psuedophilippia quaintancii*, produces a white, cottony, waxy secretion that accumulates on the needles (**Figure 111**). During heavy infestations trees appear to be covered in snow. Scales feed on needles and twigs causing yellowing, stunted growth, dieback, and heavy sooty mold. The cottony maple scale, *Pulvinaria innumerabilis*, feeds on maples, honey locust and other hardwoods.

Other common species of soft scales are the pine tortoise scale, *Toumeyella parcivicornis and the* oak lecanium scale, *Parthenolecanium quercifex*, and the pine needle scale *Chionaspis pinifoliae* (**Figures 112-114**). Examples of armored scales are the pine twig gall scale, *Matsucoccus gallicolus*. The pine mealybug, *Oracella acuta* is a scale affecting loblolly pine.

Figure 112 - Pine tortoise scale

Figure 113 - Oak lecanium scale

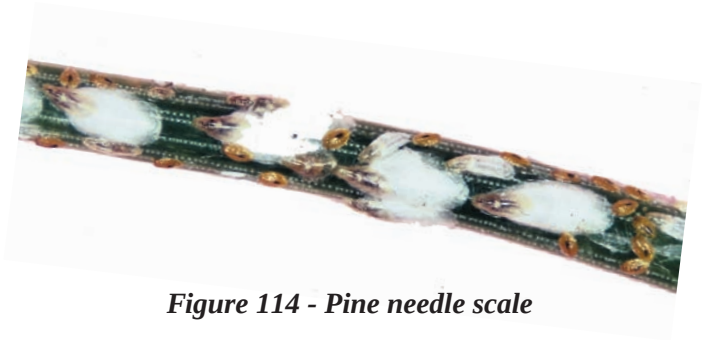


Figure 114 - Pine needle scale

Forest Pathology Section

Forest pathology is the science that deals with the study of forest tree diseases. Organisms that can cause tree disease are fungi, bacteria, viruses, mycoplasmalike organisms (MLO's), parasitic plants and nematodes. The fungi are probably the most important group to forest pathology. Many fungi require a weakened host yet others are perfectly capable of infecting healthy plants. Extensive deviations from the normal such as drought, flooding, freezing, defoliation and transplanting shock often predispose trees to disease.

The economic and environmental impacts that diseases have caused are illustrated best by the devastation wrought by Dutch elm disease and chestnut blight. Both diseases were introduced into North America in the early to mid 1900s. Since then, most of the American chestnut and elm trees have been killed. Georgia currently faces the threat of sudden oak death caused by the fungus *Phytophthora ramorum (see page 109)*.

As the U.S. expands its trade with foreign countries the threat of new diseases being introduced into American forests becomes more imminent.

Annosum Root Disease

Annosum root disease *Heterobasidion annosum,* can be a serious problem of pines in plantations that have been thinned one or more times. Loblolly, slash and white pines are affected most but shortleaf and longleaf are sometimes infected.

The fungus that causes annosum root rot reportedly enters pine stands when its airborne spores land on freshly cut stump surfaces. The spores progress downward into the roots and then spread to adjacent healthy trees through root contacts in the soil. Field evaluations conducted by the Georgia Forestry Commission tend to support the notion that stands are infected well before they are thinned. Thinning would then create dead stumps in which the fungus would proliferate from and then spread into nearby standing trees.

Roots wounded during the plowing of firebreaks or road building as well as insect feeding may create wounds for infection. Infected trees begin to show symptoms 3-5 years following thinning. Crowns will thin, turn light green to yellow and have shortened needles that may be tufted at the branch ends. These symptoms are very noticeable when sick trees are compared to healthy trees. Crown symptoms are more pronounced in loblolly than in slash pine. The fungus can rot the roots so bad that some trees may fall over on their own or do so during moderate to heavy winds. Wind-thrown trees in a pine plantation may indicate root rot.

Figure 115 - White stringy decay

The roots of wind-thrown trees can be examined for resin soaking (an early infection symptom), or for white stringy decay (an advanced infection symptom) (**Figure 115**). These symptoms along with wind-throw are usually positive signs that root rot is present. Isolated ips and black turpentine beetle attacks appearing 3-5 years after a thinning often indicate the presence of annosum.

Occasionally the fungus will develop fruiting bodies of conks at the base of living and dead trees or stumps (**Figure 116**). These conks are hard to see because they are frequently formed below the litter layer around the tree or stump base and are most prevalent during the cool wet winter months.

Annosum root disease is found throughout Georgia on most forested sites, however, the most hazardous sites for the disease are characterized by deep sandy sites along the fall line of the state. It is best to consult with a soil scientist or forester for a more detailed description of a particular site. Following is a broad classification of sites for possible root rot occurrence:

High Hazard - Sandy or sandy loam soils with at least 65% sand in the upper 12 or more inches above a clay layer and with no high seasonal water table.

Intermediate Hazard - Silt and silt loam soils 12 or more inches deep.

Low Hazard - Poorly drained clay and clay loam soils or those with high water tables.

Figure 116 - Annosum root rot conks

Managing Established Stands

If plantations are severely infected with annosum (>50%), they should be clearcut and regenerated. Usually by this time infection centers are scattered throughout the stand and future thinnings will necessitate removing too many trees thus leaving the stand understocked.

When regenerating high hazard sites a wider spacing should be used. This will delay the first thinning and ultimately reduce the total number of thinnings made during the rotation. Low hazard sites require no special planting treatments.

One recommendation for preventing annosum infection is to treat stumps with borax during the first thinning (**Figure 117**). The borax presumably prevents fungus spores from gaining entrance into the stump. The unavailability of labor usually prevents the use of borax. An alternative recommendation would be to thin only in the summer at which time disease spread appears to be minimized.

Figure 117 - Stump treatment

Loblolly Pine Decline (LPD)

Figure 118

A phenomenon known as Loblolly Pine *(Pinus taeda)* Decline is now used to describe drastic decreases in tree health, growth rates, and ongoing mortality in stands. Stands suffering from LPD are characterized by thinning and yellowing crowns, reduced radial growth, deterioration of fine feeder root systems, and increased mortality rates on an ongoing basis beginning in stands as young as 29 years of age. This problem occurs in the upper coastal plain and lower piedmont regions of Georgia, and seems to be most widespread in the west central portion south and south of Columbus. The LPD problem has been recognized by resource managers since the early 1960's and although scientists have studied the problem for several decades, the best indication is that a variety of environmental, insect, and pathogen agents are likely working collectively to cause this decline/mortality complex that is impacting such a widespread region.

The most common initial symptoms above ground are very thin crowns that only have needles tufted on the branch ends and may be yellowish in appearance (**Figure 118**). The symptoms closely resembled those associated with littleleaf disease caused by *Phytophthora cinnamomi*. This pathogen is described else where in this guide, but is most commonly associated with Shortleaf Pine *(Pinus echinata)* on specific types of sites. This pathogen, along with another common root pathogen *(Leptographium spp.)*; have been consistently found on sites suffering from LPD in east central Alabama (Hess, N.J. et al., 2002).

It is unclear the exact roles root pathogens play in the LPD complex, but they are likely a contributing factor. Hess's study found a high correlation between feeder root decline and LPD so root mortality is considered to be at least one of the factors involved. Other factors can also cause damage to root systems including drought, wind, insects, equipment and fire.

Many of the stands are older (sawtimber), and found on upland sites that suffer drought periodically. Almost all of the sites had a previous farming history and widespread topsoil losses occurred throughout most of this region. Both of these factors likely play a role in stressing stands and predisposing them to decimating factors such as LPD.

Loblolly Pine is not considered to be long-lived tree and although 150+ year old trees are known and not rare under ideal conditions, this is the exception rather than rule. Growth rates on heavily eroded, upland sites in this region of the state decline rapidly after age 40 and older stands are generally considered to be lower vigor and more prone to all types of decimating agents. For this reason, sites that have a known history of LPD should be evaluated for regenerating to Longleaf Pine *(Pinus palustris)* if this is a suitable species for the specific site. Longleaf is a much longer lived species that is less prone to drought and adapted to sandy sites. Furthermore, pine bark beetles have traditionally been a problem throughout the central region of Georgia, and Longleaf has a natural resistance to these insects.

Research is ongoing with LPD, and perhaps we will eventually understand the entire complex of agents that cause this decline/mortality issue. Each site that suffers from LPD may differ but some of the factors that may be involved are: poor site quality, limited top soil and nutrient availability, drought, root insects and pathogens, bark beetles, storm or fire damage, species not properly matched to site, and stand density and age. For land managers, however, there are no clear management strategies for Loblolly to avoid the Decline or correct the problem once it is recognized. Stands that must be clearcut prematurely due to LPD should be carefully evaluated by a professional forester, and species selection and silvicultural activities should be considered before reforesting the site.

Littleleaf Disease

Around 1936 trees having yellow-green foliage and unusually short needles characterized many of the shortleaf pine stands that had seeded in on abandoned farmlands in the Piedmont regions of Georgia. The trees were best described as having littleleaf symptoms; hence the name littleleaf disease. Many of the stands were 20 to 30 years old. Further investigations associated the syndrome with soil series such as Wilkes, Mecklenburg, Tatum, Orange, and Vance. The sites were severely eroded due to previous agricultural activities and subsequent abandonment. The topsoil was almost completely eroded away. On such sites, tree roots were weakened by heavy clay subsoil with poor internal drainage.

Research then and more recently has identified at least two soil-borne fungi associated with littleleaf; *Phytophthora cinnamomi*, and species of *Pythium*. These fungi kill the root tips of stressed trees. As more and more feeder roots are killed, essential element uptake by the tree is reduced even though adequate elements may be present. As trees weaken the symptoms become more pronounced (**Figure 119**). Trees eventually die from littleleaf.

Figure 119

The disease is most prevalent in stands 30-50 years old. The fungi associated with littleleaf are widely distributed in the soils of the southeastern United States.

There is no cure for littleleaf disease but there are several recommendations that foresters can follow to minimize losses. Trees under 20 years of age or 3-4 inches in diameter rarely show littleleaf symptoms. Infected trees can live as long as 5 to 6 years after initial symptoms appear but some trees may die in as little as one year. This is particularly true during extended droughts or when bark beetles have attacked trees.

The amount of littleleaf in a stand dictates the management of that stand. The following guidelines should help foresters and landowners better manage their littleleaf stands:

- If up to 10 percent of the trees in the stand have symptoms, all diseased trees should be removed by ten-year intervals.

- If 10-25 % of the trees in the stand have symptoms, remove all diseased trees at six-year intervals.

- If 25-50% of the trees in the stand have symptoms, clearcut and regenerate with Virginia pine or hardwoods. This is particularly true for stands being managed for pulpwood. Loblolly pine is about one-third as susceptible as shortleaf and may be considered as an option on littleleaf sites. It does, however, sustain severe damage on many sites within the range of littleleaf disease. Rotations for loblolly on high hazard sites should be shortened to 30 or 40 years.

- Soil amendments with a 5-10-5 commercial fertilizer and ammonium sulfate can prevent symptoms from developing and will benefit trees in the early stage of the disease but are only practical for speci- men or historic trees.

Foliage and Shoot Diseases

Diseases that attack the needles, twigs and leaves of forest and shade trees with the exception of a few, do very little harm but nursery or Christmas trees can be damaged so that they lose commercial value.

Brown-spot needle blight, *Mycosphaerella dearnessii*, causes a serious needle disease of pine. Longleaf pine seedlings can be seriously damaged. Severe needle blight on young seedlings can increase the length of time it takes longleaf pine to grow out of the grass stage. The disease affects both planted and natural seedlings in the field. Infected needles in the early stages are irregularly yellow to brown spotted, with green tissue in between the spots (**Figure 120**). Needles are eventually killed by the girdling action of the fungus.

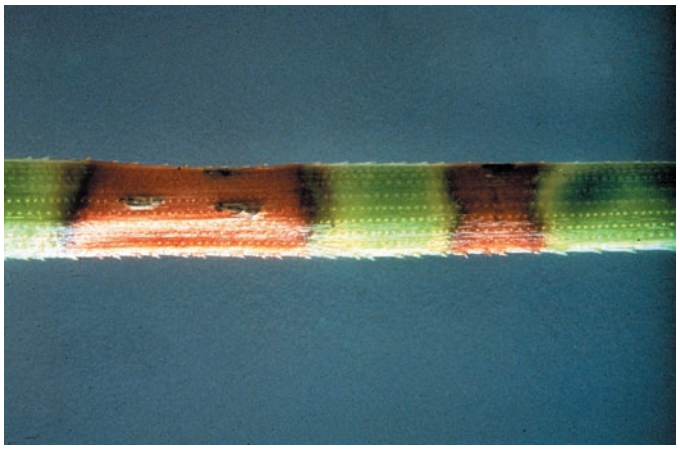


Figure 120

Brown spot can be controlled in nurseries by spraying with an approved fungicide. Prescribed burning is recommended for control of the disease in plantations. Burns should be made only when the disease is causing damage and weather conditions are favorable for burning. Fire should not be introduced until the second winter then controlled burns can be done at three-year intervals until trees begin to elongate out of the grass stage. First year seedlings are very susceptible to fire. Kais et al. demonstrated the value of dipping seedlings in a benomyl/kaolin slurry to shorten the length of the grass stage (**Figure 121**).

Leaf blister of oaks is perhaps the most conspicuous leaf disease of the pointed leaf oaks such as scarlet and southern red. Certain of the entire leaf oaks are also attacked. The disease is more prevalent during wet springs. Infected leaves will have blister-like eruptions (**Figure 122**). Premature leaf fall is common while the leaves are only partially dead. The fungus over- winters on twigs and dead leaves. Raking up and burning the infected leaves as they fall will destroy over wintering spores thus reducing the source of inoculum for next year. Applications of an approved fungicide can be made in the spring just as the buds are swelling.

Figure 121 - Benomyl treated right

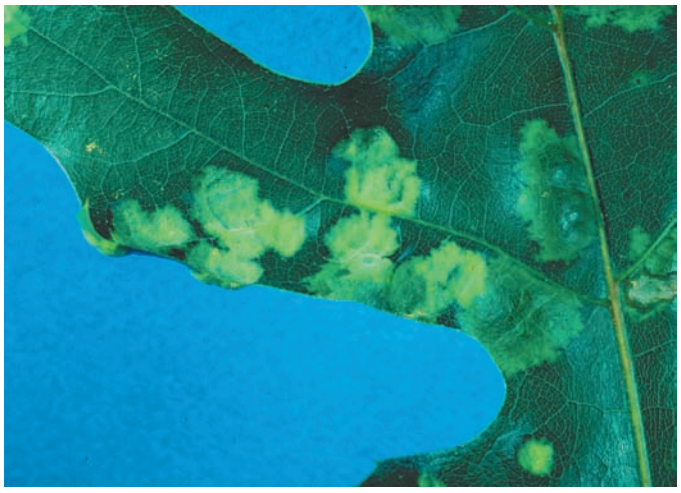


Figure 122

Dogwood anthracnose caused by the fungus *Discula destructiva,* was discovered in Georgia in 1987. The disease was cultured from dogwoods growing on the Chattahoochee National Forest in northwest Georgia. The disease has been found in 38 Georgia counties **(Table 4).** Initial symptoms are small, purple-rimmed spots and large blotches on the leaves (**Figure 123**). Dieback of small twigs occurs initially with larger branches dying later. The dieback usually progresses from the bottom to the top of infected trees. Death of the tree may occur in one to three years. Susceptible trees appear to be those growing on droughty, shallow soils, low in organic material and those that are in a general decline. Affected branches can be pruned. Yard trees should be watered, mulched and fertilized periodically to increase their vigor. Trees should not be dug from the wild and transplanted in yards. This may introduce the fungus into ornamental plantings. Disease free nursery stock should be used.

Figure 123

Table 4: Georgia counties infected with dogwood anthracnose as of 2001

County	County	County	County
Banks	Bartow	Catoosa	Chattooga
Cherokee	Clarke	Cobb	Dade
Dawson	Dekalb	Fannin	Fayette
Floyd	Forsyth	Franklin	Fulton
Gilmer	Gordon	Gwinnett	Habersham
Hall	Haralson	Hart	Henry
Jackson	Lumpkin	Madison	Murray
Pickens	Polk	Rabun	Stephens
Towns	Union	Walker	Walton
White	Whitfield		

Anthracnose of sycamore and certain oak species is caused by *Apiognomonia veneta*. Infection occurs in the spring when spores erupt from infected twigs and fallen leaves. The spores germinate and grow into the newly expanding leaves and down into the petiole and twigs. Twigs are often girdled and killed. Secondary buds are formed below the girdled areas of the twig causing a noticeable angle from the parent twig. This ziz-zag appearance is characteristic of recurring heavy anthracnose infections. The disease is favored by cool, moist springs. Control is not recommended in forest stands but applying a fungicide as the buds are expanding can protect shade trees. A second application about two weeks later is suggested if cool wet weather occurs following the initial application. Raking leaves to remove inoculum is not effective since most infections initiate from previously infected tissues on the tree. Pruning infected twigs is recommended.

Needle cast refers to the shedding of needles of pines due to various species of fungi (*Lophodermium*, *Hypoderma*). The fungi responsible for this casting produce black spots of different shapes on the older needles (**Figure 124A**). Affected needles turn brown and are shed. New tufts of green needles will be present on the branch ends (**Figure 124B**). Needle cast shows up in the spring and fall, and tends to show up more in years with lots of rainfall. Longleaf pines will naturally shed their older needles during dry years and this shedding should not be confused with needle cast. Needle cast very seldom causes permanent damage to trees, therefore, negating the use of fungicides. For fungicidal control of needle cast in Christmas tree plantations, refer to the Disease Control Section on page 138.

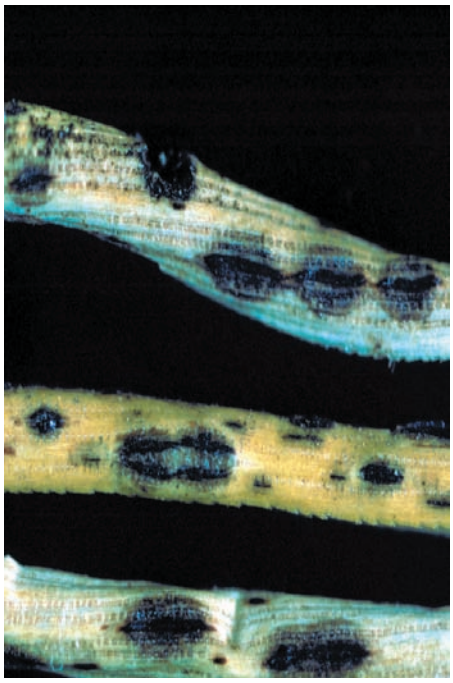


Figure 124A

Figure 124B

Diplodia Tip Blight

This tip blight is caused by the fungus, *Sphaeropsis sapinea*. The host range includes 33 species of pine but the disease is most frequently encountered on Austrian pine and is commonly seen on ponderosa, red, scots and mugo pines. It has also been reported to affect some species of Abies, Araucaria, Cedrus, Chamaecyparis, Cuppressus, Larix, Picea, Pseudotsuga, Thuja and possibly other conifers. In the southern hemisphere, plantings of loblolly, Monterey and slash pines are often infected. *S. sapinea* should be considered likely to colonize any pine and any other conifers that grow under unfavorable environmental conditions and among diseased, highly susceptible Austrian pine.

This disease has been reported in the southeastern United States in slash pine seedlings and seed orchards from Florida and Georgia. It is commonly isolated from slash and loblolly pines and is recognized as causing tip and shoot dieback in association with pitch canker (**Figure 125**).

The fungus overwinters in pine shoots, bark, cones or litter and infects growing shoots in the spring. Spores are released during wet weather from spring through fall. Trees that are stressed because of poor sites, drought, or insect activity are very susceptible. In trees that are relatively free from stress, the fungus kills only current-season buds and shoots and second year cones. Fresh wounds, e.g., those created by insects, hail or pruning, on older branches and stems also are infection courts. Fully elongated needles and shoots and bark on the previous year's shoots apparently are not susceptible to infection. However, the fungus has been found to persist on or in asymptomatic needles, cones and stems and it can proliferate to cause disease in stems subjected to water stress.

Greenhouse inoculation tests conducted on slash and loblolly pines resulted in the killing of new shoots. The first test was conducted with stem-wounded inoculations using 20 seedlings of six-month-old slash and loblolly pines. Stem lesions developed in both species within two weeks of inoculations, but seedlings continued to grow and thrive. The second test was conducted using one-year-old loblolly seedlings. Inoculations were made in the new shoots using agar plugs. Shoots began to die after one week and after two weeks a necrotic lesion was visible around the shoots and extended through the lower area from the inoculation point.

Figure 125

The most conspicuous symptom is stunting and browning of new shoots and needles, usually beginning in the lower crown. Successive attacks result in dieback of branches and tops, but progression to tree death is rare. Damage is often associated with climatic and site conditions. Tip blight sometimes displays a "shepherd's crook" conformation making it indistinguishable from low-temperature injury due to late spring frosts.

Epidemics have been attributed to excessive nitrogen from atmospheric sources in the Netherlands and from paper mill wastes spread in plantations in Wisconsin. It is feasible to associate tip blight in pine plantations located near chicken houses due to the atmospheric release of ammonia from the bird droppings.

Powdery Mildews, Sooty Molds

Powdery mildews are represented by seven genera. They occur on many species of plants and can cause economic losses on roses and certain other crops. Forest trees and shrubs are often attacked but no control is necessary. Crape myrtle and elm are two common species of trees often attacked by powdery mildews. Fungus growth covers the leaf surface giving the typical powdery appearance (**Figure 126**). Individual landscape trees infected with powdery mildews can be successfully treated with fungicides to improve their appearance but are not necessary for tree survival. Fungi that cause powdery mildew on outside plants spend the winter as spores on infected plant parts or on fallen leaves. When spring comes, these spores are released into the air where they are transported back to the plant to begin the cycle again.

Figure 126

Raking the fallen leaves and removing them from around the plant can achieve some level of control.

Sooty molds like powdery mildews are superficial on leaf and other plant surfaces and cause little damage to trees. They grow in concert with the sweet honeydew caused by scales and aphids. Controlling the insects indirectly eliminates the sooty mold.

Wilt Diseases

Wilt diseases affect trees' ability to transport water and other materials. This results in moisture stress that leads to wilting. Although water may be plentiful, the vessels that carry it within the tree are clogged up by the action of the disease causing organisms. Wilt diseases can be introduced into trees by insects or by spores gaining entrance through wounds or root grafts. Once infected, a tree may die gradually or suddenly depending on the nature of the disease and the vigor of the tree before infection. A common wilt affecting elm trees in Georgia is Dutch elm disease.

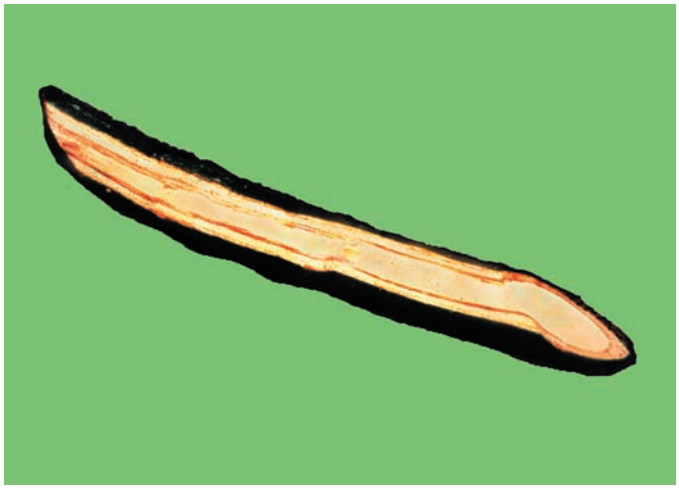


Figure 127

The fungus that causes **Dutch elm disease** (DED), *Ophiostoma ulmi*, was introduced into the United States many years ago. It was first identified in Atlanta, Georgia in 1967. This disease affects all native elm species. The earliest symptoms are wilting, curling and yellowing of leaves on one or more branches, followed by leaf fall and death of the branches. Trees of all ages can be affected. Trees may die within a few weeks of the onset of symptoms or may die a limb at a time over a period of a year or more. The springwood of the last annual ring of an infected tree shows in cross section as a dark brown ring or as a series of dark dots (**Figure 127**). The only sure way of identification of the disease is by culturing the fungus in the lab from wood samples taken from infected trees.

DED is transmitted to healthy trees by two species of bark beetles: the smaller European elm bark beetle, *Scolytus multistriatus*, and the native elm bark beetle, *Hylurgopinus rufipes* (**Figure 128**). Both beetles breed in dead and dying elms. Upon emergence from infected trees, the adult beetles will seek out a healthy tree and begin to nibble in the crotches of twigs, thereby, inoculating the tree with the fungus.

Figure 128 - European elm bark beetle

Native elm species that are infected usually cannot be saved when more than 5 percent of the branches are dying. Pruning out the dying branches followed by the use of a systemic fungicide are the best methods of controlling the disease in trees having 5 percent or less branch wilting. Removing dead or dying trees can protect healthy elms. This eliminates potential breeding sites for the beetles that carry the fungus. Trenching can prevent transmission of the disease through common root systems.

Uninfested trees can be sprayed with an insecticide to prevent the beetles from feeding but the chemical registered for this purpose is a restricted pesticide and can be applied only by a licensed pest control person.

Some of the Asian and European elms are moderately resistant to the disease and should be favored over the native species.

Elm yellows (formerly known as elm phloem necrosis) is caused by a micoplasmalike organism (MLO) and is often confused with Dutch elm disease. With elm yellows all of the branches are affected at once. Infected phloem tissues turn a tan or brown color and when placed in a vial for a few minutes will produce a wintergreen odor. The disease is transmitted by the white-banded leafhopper. Some success in suppressing elm yellows has been achieved by the use of tetracycline antibiotics injected into trees and trenching to prevent the spread through root grafts.

Three other wilt diseases that should be mentioned are **mimosa wilt**, *Fusarium oxysporum*, **persimmon wilt,** *Acromonium diospyri*, and **oak wilt**, *Ceratocystis fagacearum*.

Mimosa wilt is common throughout the range of mimosa and is a very serious disease. A few wilt resistant mimosa selections have been propagated to a limited extent.

Persimmon wilt has devastated persimmon trees in ten states from Tennessee and North Carolina, south to the Gulf, and west to Texas. The disease enters healthy trees via wounds. Diseased trees should be removed and destroyed to prevent the disease from spreading. Insects that may spread the disease to healthy trees often attack drought stricken trees.

Oak wilt has not been positively identified in Georgia, but it is present in South Carolina, North Carolina, Tennessee, Virginia, Kentucky and Texas. Species of the red oak group are the most susceptible. It probably occurs in Georgia but just hasn't been detected.

Rust Diseases

Fusiform Rust

Fusiform rust, *Cronarium quercuum f sp. fusiforme*, is the most damaging disease of slash and loblolly pines throughout the southeastern United States. This disease causes stem and branch cankers (galls) to form on infected trees (**Figure 129**). The majority of infections occur prior to age 5. In early spring active galls produce yellow-orange spores (**aeciospores**) that are windblown to young, tender oak leaves. Water, willow and laurel oaks are the species most affected.

Figure 129

The fungus goes through three additional spore stages on the oak leaves. The fourth and final stage results in **basidiospores** being formed. The basidiospores are windblown to new pine needles and/or succulent green bark areas of young trees thus completing the disease life cycle.

The amount of infection in planted and natural pine stands varies considerably across the South. Factors such as individual tree resistance, site characteristics and rust virulence all interact to influence infection levels.

When regenerating sites to pine, land managers must take steps to deal with fusiform rust. Below are some practices that will help minimize rust problems and protect economic investments.

Artificial Regeneration

Use rust resistant seedlings (improved) that are available from state and privately owned nurseries. These seedlings are the result of many years of valuable research that hopefully will result in increased seedling resistance to the disease. Further protection from rust is provided by timed applications of a fungicide to seedlings in the nursery. Rare cases have been documented due to equipment breakdowns, where seedlings are not sprayed while in the nursery bed. Seedlings that become infected with rust while in the nursery will oftentimes develop galls at or near the ground during the first growing season. Landowners should realize this and be sure to question the nursery from which they are buying seedlings from to confirm they have been treated with an appropriate fungicide.

In high hazard regions, increase planting densities to allow for anticipated losses. This will, of course, increase the number of thinnings required throughout the life of the stand.

Consider site preparation techniques that reduce oak trees unless they conflict with other management objectives (prescribed burning, herbicides, and intensive mechanical preparation). Use seed from a resistant source. Seed should be treated with an approved bird and rodent repellent.

Natural Regeneration

If seed tree or shelterwood methods are used, be sure to select disease-free seed trees.

Managing Established Stands

Evaluate plantations at age 3-5 to determine degree of rust infection. Plantations that are showing 50% or more infections should be seriously considered for clearcutting. If the decision is made not to clearcut, a sanitation cut should be planned as soon as it is economical.

After age five, it is usually uneconomical to clearcut and start over. However, rotation ages will need to be adjusted in order to maximize on the establishment costs.

In older stands with less than 50% stem infections, remove as many stem-cankered trees as possible with each thinning. Try to maintain a basal area of 75-85-sq. ft. per acre or at least 200 trees per acre. When thinning plantations, be sure to consider annosum root rot.

Eastern Gall Rust

(*Cronartium quercuum f.sp. virginianae* and *echinatae*)

Eastern gall rust attacks many **hard pines**, particularly Virginia, spruce, sand and shortleaf pines. Infections produce globose galls on main stems and branches. In spring the galls become covered with large blisters that rupture and release spores in the form of a pale, orange-colored powder (**Figure 130**).

The rust fungus must pass through a stage of growth on the leaves of various oak species before it can reinfect pines. The life cycle is very similar to that of fusiform rust. Weather and available hosts species greatly influence the extent of infection. Trees are seldom killed. Disfigured and malformed trees may result from infection.

Unlike fusiform galls, eastern gall rust galls seldom spread from branch to stem and usually remain localized at the point of infection. Shade and yard trees may be protected by pruning infected branches. Under forest conditions stems with galls should be removed during thinnings.

Figure 130

Red Cedar Rusts

Eastern red cedar is host to species of *Gymnosporangium* rusts that infect the foliage, twigs and branches. The red cedars in Georgia are affected by both needle and twig rusts. These rusts while causing some concern on the part of the landowners are not of economic importance on the cedars.

During wet weather in the spring, the gall rusts produce bright orange gelatinous finger-like masses of spores (**Figure 131A**). The twig and branch rusts produce tongue-like spore masses on the branch swellings (**Figure 131B**).

Figure 131A

Red cedar should not be planted near apple orchards as apple, hawthorn and crabapple are alternate hosts to the rusts and some species may be severely defoliated. No chemical control is recommended for cedar rust under forest conditions. The homeowner may wish to prevent or reduce infections on crabapple, hawthorn or apple trees by spraying with recommended fungicides.

Figure 131B

Pine Needle Rusts

The foliage of the two and three needle hard pines in Georgia are subject to several needle rusts in the genus Coleosporium. Most of these pathogenic fungi have herbaceous alternate hosts. The alternate hosts are generally golden rod and aster.

The most noticeable symptoms of needle rusts are the bright orange aeciospores on the pine needles in the spring when weather conditions are favorable for the development of the disease (**Figure 132**) The entire tree may have a yellow to orange appearance. Often heavily infected needles are shed giving the tree a thin looking crown. Young trees may be heavily defoliated and growth stunted, but older trees are seldom damaged.

No chemical controls are recommended for this disease either under forest or shade tree conditions. Elimination of the alternate host in the vicinity of the pines should reduce the incidence of infection.

Figure 132

Southern Cone Rust

Southern cone rust, *Cronartium strobilinum*, attacks seed-bearing slash and longleaf pines in the South. The disease is usually not considered serious under forest conditions, but may periodically become severe in localized areas. Damage could become an economic consideration in seed orchards and seed production areas. The disease has various species of oak as the alternate host.

New conelets are infected in winter from spores produced on the leaves of the evergreen oaks, i.e., live oak and low growing runner oaks. The disease becomes evident on the new conelet shortly after pollination. The infected conelet increases in size very rapidly so that by April or early May it is several times larger than uninfected cones. A reddish color is also generally observed. In late spring, the diseased cones become orange-yellow in color due to the abundant spores produced by the fruiting body of the fungus (**Figure 133**). The diseased cones usually abort and fall to the ground.

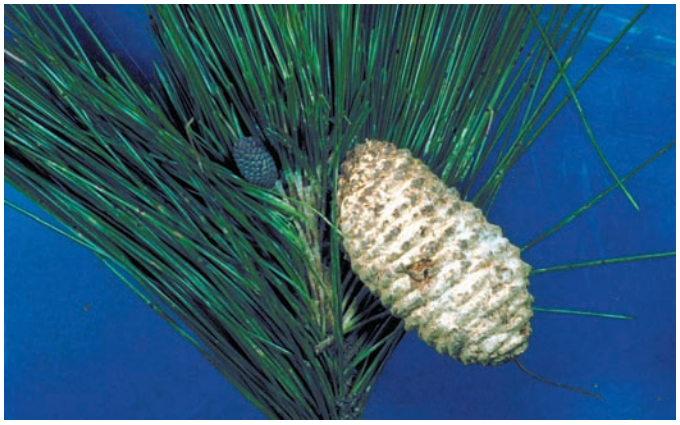


Figure 133

Past surveys have shown losses up to 20% of slash pine cones in an average year. The incidence of rust on cones will depend upon air temperatures and moisture at the time of spore production on the oak leaves.

For best control, slash and longleaf pine seed orchards should be established in areas with the lowest number of evergreen oaks. Chemical control should be directed mainly to seed orchards. Losses can be reduced by spraying with fungicides; however, spraying should start as soon as the female flowers emerge and continue on a five-day schedule until pollination has ceased. This schedule would ordinarily require five or six sprayings per season.

Hardwood Cankers

Hypoxylon Canker

Hypoxylon canker is common throughout the South on oaks and other hardwoods where it normally occurs on stressed hosts. The canker is caused by one or more species of fungi in the genus *Hypoxylon*. Found in the outer bark areas of living and healthy trees, the fungi are normally of little consequence. However, *Hypoxylon* can severely injure or kill trees weakened by factors such as drought, root disease, mechanical injury, logging or construction activities. These agents of stress enable the fungus to move into the xylem and produce cankers on the branches and trunk. Apparently, the fungus is activated by reduced moisture in the xylem and bark. Once this low moisture threshold is reached, the fungi quickly spread. Especially in droughty areas, *Hypoxylon* fungi are often associated with tree death. Other fungi found in weakened trees may also play a role.

In recent years more oaks have been dying across the South. In many cases, the affected trees are victims of oak decline, a complex of environmental stress, site factors, and living agents, of which *Hypoxylon* canker is a major contributor.

Trees infected with *Hypoxylon* often develop severe injuries on the branches or trunk. They may also exhibit crown dieback. Large patches of bark of infected trees often slough off along the trunk and major branches revealing the fungus fruiting bodies (**Figure 134**). In spring or early summer, powdery greenish to brown or gray masses of the spores (conidia) are produced on the surface of crusty, fungal tissue patches (**stromata**). These stromata are the most obvious signs of *Hypoxylon* canker. They vary from less than ¼ inch to 3 feet long or more, running along the stem and main branches. In the summer or fall, these stromata thicken, harden, and turn silver or bluish-gray to brown or to black depending on the *Hypoxylon* species. Small slightly raised dots may be found on the surface of these masses. These are the tops of small chambers where a second type of spore (**ascospore**) is produced.

How do trees become infected? - The most abundant species of *Hypoxylon*, *H. atropunctatum*, infects trees when they are seedlings. This fungus develops within the inner, living bark. As the tree grows, the fungus continues to grow but does not enter the sapwood. Insect defoliation or drought, or other weather extremes exert stress on trees that may activate the fungus. Once fruiting bodies develop the disease spreads from tree to tree via airborne spores.

Figure 134

Hazard rating stands and trees- many species of oak (and to a lesser hickory) throughout the South are hosts to *Hypoxylon* canker. Trees growing on clay, sandy, rocky or other poor soils are highly susceptible to this disease, particularly during extended drought. Some of the most commonly affected oak species are post, southern red, white, water, and chestnut oak and blackjack. Nevertheless, all oak species are vulnerable under conditions favorable to the development of the fungi. Any condition that reduces vigor can predispose trees to *Hypoxylon* canker. Site and species factors also influence susceptibility.

When put together these factors could show whether *Hypoxylon* canker may be likely to present problems in a given stand. Some of the more important factors to consider are:

- ❏ Tree species-Oaks as a group are more susceptible.
- ❏ Site-The disease is more common on droughty soils.
- ❏ Site Changes-These could include flooding, erosion, etc.
- ❏ Tree Age-All ages, except seedlings, are susceptible, but older trees are more so.
- ❏ Tree Injury-Logging injury, root injury, soil compaction caused by construction activities, lightning strikes, insect defoliation, and spring frost are all examples of stress factors that can cause *Hypoxylon* canker to flourish.
- ❏ Tree Exposure-Forest trees are sometimes suddenly exposed to intense sunlight or site changes. In response, trees often undergo physiological changes. The result may be lower vigor and subsequent *Hypoxylon* canker-caused decline and death.

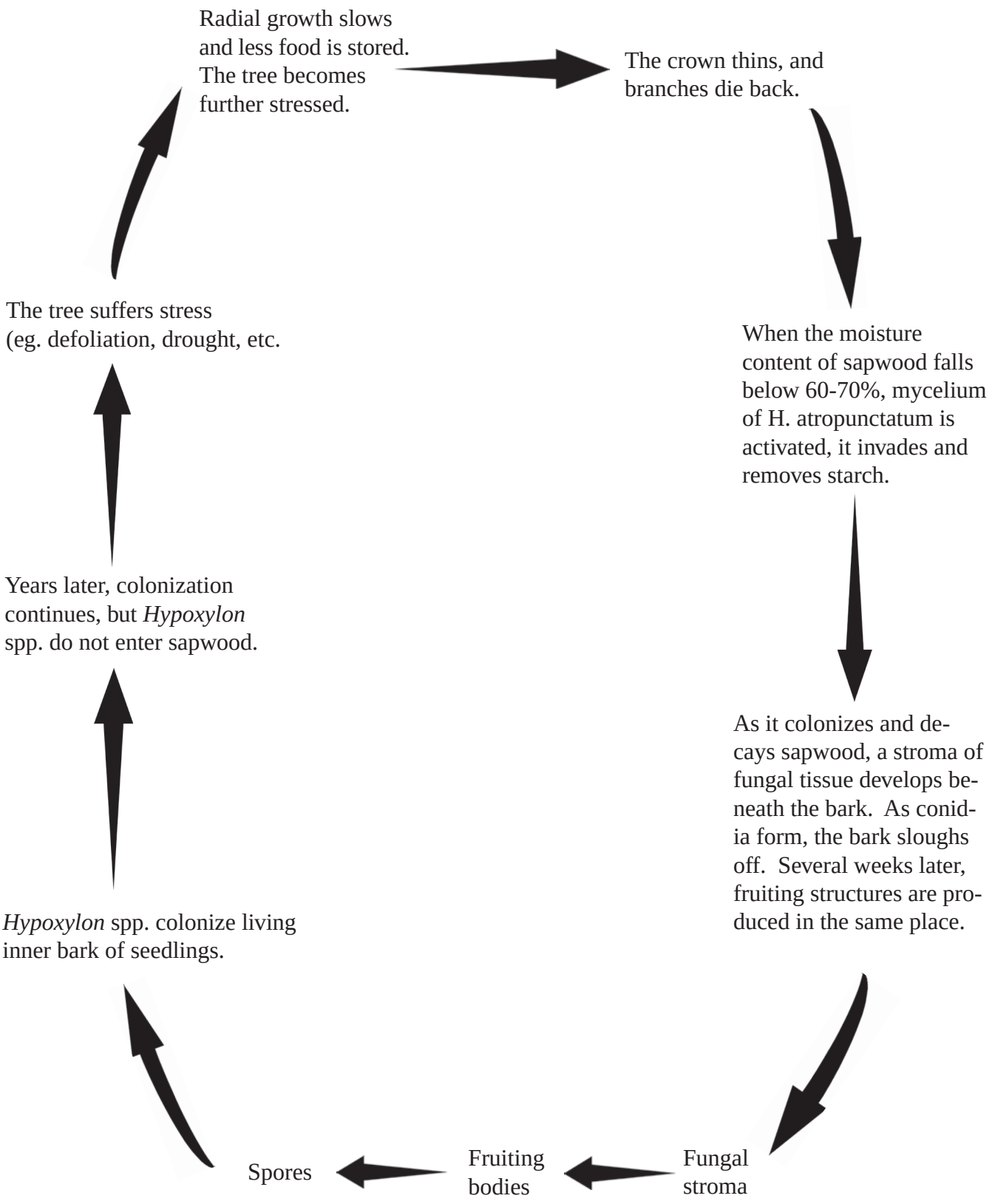
What to do in forested areas? In forested areas, the key is prevention. Forest management practices such as thinning are very beneficial and increase tree vigor. However, improperly applied practices can actually worsen *Hypoxylon* infection through injury, exposure, and site changes. Basically, any forestry practice that increases stand vigor is encouraged. Conversely, any practice that stresses trees must be evaluated very carefully. Often, you must consider whether active stand management is likely to increase or decrease damage from *Hypoxylon* canker. It is advisable to delay stand disturbances during drought.

When *Hypoxylon* canker is present in a forested stand evaluate it from the aspect of tree species and number of trees affected. If practical, salvage infected trees before they die. Proceed carefully, because the stress of logging may aggravate stand stresses. If removal of infected trees may result in an understocked stand, consider a final harvest cut. Then regenerate with species that are immune or resistant to *Hypoxylon* canker. An option for large forests is to set aside infected timber stands for other objectives such as wildlife.

What to do in urban areas? - The key to *Hypoxylon* canker-free trees is prevention. Prevent injury to trees during construction (**Figure 135**). Avoid herbicide injury and minimize site changes. These steps will help maintain tree vigor. Fertilization, watering during droughts, and mulching will help ward off losses to *Hypoxylon* canker. For high-value trees, consider lightning protection. When planting trees be sure to select the appropriate species, the proper site and use good planting techniques. Trees showing fruiting structures of *Hypoxylon* will not survive, regardless of treatment. Carefully prune branches that have a local infection to help slow the advance of the fungus.

Figure 135

Life Cycle of *H. atropunctatum*



Hispidus Canker Decay of Hardwoods

Hispidus canker, *Inonotus hispidus,* is abundant across the southeastern United States. Willow, oak, ash, and hickory are species most often infected. Although the disease is more noticeable on large, old growth trees, it is also common of slow growing young trees. Hispidus cankers are usually several feet long with irregular partly callused margins (**Figure 136**). The dark, soft, **applanate, sporophores** are found at the top of the canker. In the fall the conks fall to the ground where they may be found for several months following. Decay is often quite extensive within the tree. There is no known cure or control of this disease. Since dead branch stubs serve as entry points for the fungus, trees should be properly pruned. Infected trees can be removed during timber stand improvement cuttings under forest management conditions, however, trees with cankers are often used by wildlife. There is little the homeowner can do except fertilizing every 3-5 years and watering affected trees during droughts. Severely decayed trees are susceptible to windsnap and should be removed if in danger of falling on people and/or property.

Figure 136

Nectria Canker

Many species of hardwoods are subject to *Nectria* canker. The most common hosts in the South are red and sugar maples, red and white oaks, apples and black locust. Infections often occur through branch stubs or wounding such as pruning. *Nectria* cankers are targetlike in appearance because the canker grows at the same rate as the callused growth (**Figure 137**). Affected forest trees are of low merchantable value. Yard trees should not be pruned during wet weather since infection is highest at this time. Severely cankered trees are prone to windsnap and might need to be removed.

The Nectria canker fungus overwinters as small red, lemon-shaped fruiting bodies at the edge of the canker. In the spring, spores are produced that are blown or splashed to branch stubs or other wounds. Spore dissemination occurs in wet weather, primarily in the summer and fall, and it is for this reason pruning should be done during dry periods. Cankers occurring on branches can be controlled by pruning. Trunk cankers can be treated surgically by removing the bark down to the cambium at least one inch beyond the edge all around the canker. Homeowners should seek the advise of a professional arborist or forester before attempting this surgical procedure.

Figure 137

Black Knot of Prunus

The fungus, *Dibotryon morbosum*, causes black knot of cherry and plum. The fungus causes irregular shaped, ugly knots (**Figure 138**). The great majority of infections occur on green shoots, however, older branches can be infected if the bark has been damaged. A major source of infection for ornamental cherries and plums are the native wild cherries that grow along fencerows. Eliminating wild cherries will help reduce the source of inoculum. Diseased branches should be pruned and destroyed. Otherwise, the disease will continue to spread within the tree.

Chemical control can be achieved if trees are sprayed when the buds begin to swell and the temperatures reach 55º or higher. Several applications may be necessary to protect the new growth from disease inoculum.

Figure 138

Bacterial Gummosis

Gummosis is caused by bacteria (*Pseudomonas syringae*) and is common on various fruit and nut trees as well as flowering cherry. The classic sign of gummosis is oozing of gum (**Figure 139**). Oozing occurs during the fall, winter or early spring. The bacteria gain entrance into the tree around wounds such as those caused by lawnmowers, string trimmers, or pruning. There is no control for stem infections but branches infected with gummosis can be pruned.

Figure 139

Cytospora Canker

Several related fungi in the genus *Cytospora* cause this plant disease. *C. chrysosperma* causes cankers on hardwoods and *C. kunzei* causes cankers on conifers. Maples, poplars, and willows are hardwood species most often infected, while blue and Norway spruces are the most susceptible conifers. The fungi produce sunken lesions on trunks and branches (**Figure 140**). In the spring, black fungal spores develop in the bark and curly orange spore chains form. These spores are wind blown or splashed by rain to uninfected trees where they grow on injured or wounded bark tissue. Bark that has been damaged by sunscald, cold, pruning or other means is especially susceptible to infection. Wet mild springs are conducive for infection. Pruning should be done in dry weather to reduce the incidence of infection. There is no control for the disease other than pruning infected branches. Experienced professionals can cut out individual cankers occurring on the trunk but this practice is not advisable for homeowners.

Figure 140

Bot Canker

Bot canker is caused by *Botryosphaeria dothidea*. This fungus is opportunistic in that it generally requires a weakened or damaged host. It is usually associated with plants stressed by drought, heat, freezing or defoliation and those damaged by hail and pruning. It is associated with more than 100 genera of plants. The disease is common on apple, dogwood, elm, oak, persimmon, redbud, willow, sycamore, hickory, holly, Leyland cypress and sweetgum.

Figure 141

Lesions vary in size and number depending on the host and its condition at the time of infection. They are often surrounded by callus tissue (**Figure 141**). Diseased twigs usually die but larger branches may have several cankers without dying. If the cankers are numerous and they encircle the branch then death will result. Bot canker can be confused with gummosis on peach trees.

Things that can be done to manage bot canker are:

- ❏ Prune affected branches before bud break and destroy.
- ❏ Water plants to prevent drought stress.
- ❏ Avoid wounding plants with lawnmowers and weed trimmers.
- ❏ Pruning can cause infections of bot canker. Avoid pruning on cool wet days when disease spores are plentiful.

Chestnut Blight

The American chestnut was one of the most valuable trees in the entire eastern hardwood forests until the chestnut blight, *Cryphonectria parasitica*, was introduced around 1900. By 1940 the disease had ravaged chestnut trees throughout North America. Efforts to eradicate the disease have failed miserably and all that remains of a once majestic forest of chestnuts are stump sprouts that eventually die before producing chestnuts.

The chestnut blight fungus also infects post and live oak, red maple and shagbark hickory. Damage on post oak can be extensive but is usually insignificant on the other tree species mentioned. Infection occurs through wounds caused by hail, insects, birds, squirrels and rubbing of branches caused by wind. When these wounded areas become inoculated with spores the disease progresses rapidly girdling and killing branches (**Figure 142**). Chestnut trees can be girdled and killed in a period from 1-10 years.

Figure 142

Current research efforts to control chestnut blight involve backcrossing hybrids of American and Asiatic chestnuts to the American chestnut and the use of **hypovirulent** strains of the fungus to stricken the virulent strains. Both offer some promise in bringing back the American chestnut.

Conifer Cankers

Pitch Canker

Figure 143

The pitch canker fungus, *Fusarium subglutinans*, can infect most of the southern pines but more damage is done to slash, shortleaf and Virginia pines. It gains entrance into trees through wounds and insect feeding sites made by pine tip moths, the deodar weevil and beetles in the genus *Pityophthorus*. After the fungus gains entrance into the tree, the tips of terminal and lateral branches are often girdled and killed (**Figure 143**). Upon close examination of the dead shoots, the wood will be pitch soaked beneath the bark (**Figure 144**). The fungus also causes trunk cankers. Plantations adjacent to chicken houses are often infected with the pitch canker fungus. The fungus apparently likes the high concentrations of ammonia that's absorbed by pine needles and shoots. High concentrations of ammonia can cause excessive shoot growth which are easily wounded and provide points of entry for the fungus. The disease has not been a serious problem to pine plantations in Georgia; however, pitch canker outbreaks have occurred in slash pine plantations in the late 1970's and again in 2004-05.

Figure 144

Several management options are available for managing the disease in slash pine plantations:

- ❏ Infected trees should be removed during thinnings.
- ❏ When regenerating stands, consider using the seed tree method because native seed sources may be more disease resistant than nursery seedlings from a particular seed source.
- ❏ Regulate stocking densities to avoid over crowding and individual tree stress.

Management guidelines for seed orchards:

- ❏ Avoid damage to trees from shakers, boom trucks and other equipment. Inform personnel on the proper handling of equipment and the importance of not wounding trees.
- ❏ Rogued trees should be sold or burned and not left as breeding sites for weevils and beetles.

Management guidelines for Christmas tree plantations:

- ❏ Sell or remove all infected trees as soon as possible.
- ❏ Pruning provides ideal wound sites for pitch canker to invade. In areas where pitch canker is prevalent, favor eastern red cedar over Virginia and white pines since these two species are susceptible to the fungus.
- ❏ Over fertilization may enhance pitch canker infections.

Wood Decay

Decay in Living Trees and Wood Rot of Lumber

There are many species of fungi that can cause decay in living trees. Of primary importance to the timber producer and the homeowner, are the various types of heart decay (rot) within the living tree. Heart decay may take place in any tree that has been exposed to infection as a result of injury, broken branches, fire scars, or cultural measures such as improper pruning. Some decay fungi are active only in the butt, while others are capable of causing decay throughout the length of the bole and larger branches.

Figure 145

The decay fungi reproduce by means of fruiting bodies (conks) that develop on old branch stubs, wounds, or cracks in the bark caused by windshake, heat or cold. These fruiting bodies are **applanate**, hoof-shaped, or bracket-like, and may vary greatly in size, color and texture (**Figure 145**). The spores of the fungus are produced by these fruiting bodies. Wind, water, animals and insects may all take part in the movement of these spores to a wound, in a healthy tree, where infection may subsequently take place. Several years of growth by the decay organisms are required before new conks are formed. The prevention of wounds caused by fire or mechanical causes is the most effective measure in maintaining a healthy tree. Timber management procedures should stress the removal of diseased trees and proper logging practices to minimize mechanical injury and promote strong, vigorous growth. Homeowners should avoid wounding shade trees. Trees with heart decay are very prone to breakage as a result of wind or ice.

Another wood decay fungus that is associated with standing living trees is red ring decay also known as red heart rot which is caused by the fungus, *Phellinus pini*. Red ring decay infections occur through dead branch stubs. It produces white pockets of decay in the **heartwood** of living conifers. Incidence is greater in trees above age 65. The endangered red-cockaded woodpecker selects older trees that have been infected with the fungus in which to construct nest and roost cavities. Cavities have been found in longleaf, loblolly, shortleaf, pitch, slash, pond, and Virginia pines. Studies done in the South found that cavity trees ranged in age from 62-149 years.

Wood decay is often described as white or brown rot. Organisms causing white rot break down both the **lignin** and **cellulose** causing the wood to lose its color and appear whiter than normal. Brown rot fungi feed on the cellulose in wood that is a component of the cell wall leaving the brown lignin constituent in the cell wall. This causes the wood to crack across the grain to form brown cubical pieces. Wood affected by white rot does not crack across the grain as in brown rot.

Wood decay fungi require moisture for survival and growth. This is the reason most decay fungi will not grow in dry wood. However, the fungus *Poria incrassata* is capable of rotting wood by developing root-like structures called **rhizomorphs**. These rhizomorphs can conduct water over 25 feet from a moisture source to the wood. Wood that has a moisture content above 20% will be susceptible to wood decay organisms. Stumps left around house foundations are often sources of wood decay in structures. Rhizomorphs will spread from the stump or soil to sound wood bringing with them the necessary moisture for the fungus to decay wood in use. This type of decay is often referred to as dry rot but in reality wood kept dry will never rot.

Infestations of *Poria* can begin in dirt filled porches, damp crawl spaces and basements where wood is in contact with the soil or moist concrete or damp bricks. Initially, yellowish **mycelial** fans grow over the surfaces of joists and sub-floors or wood in unexposed areas (**Figure 146**). The root-like rhizomorphs may be seen on foundation walls, framing, sub-flooring and other surfaces. The rhizomorphs are dirty white when young but turn brown to black as they age.

Wood infested with *Poria* eventually dries and shrinks. This causes cracking and/or depressed areas in painted woodwork that may be the only evidence of a *Poria* infestation.

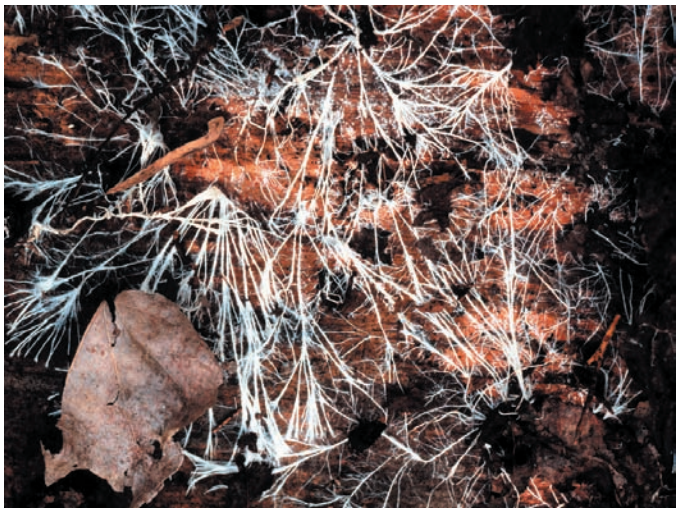


Figure 146

Keeping wood dry will prevent it from decaying. Untreated wood should not be in direct contact with the soil or concrete as it will absorb moisture and be subject to wood decay and termites. Decay fungi grow best at temperatures between 70 and 90 degrees F and wood moisture content above 20%.

Certain wood species naturally resist attack by decay organisms. Examples of species with natural decay resistance include redwood, cedars, walnut, Osage orange, white oak, and black locust. At a minimum these species can have a service life in excess of 10 years. Most of the historic log structures in the South were constructed of the durable, decay resistant heartwood of relatively large, slow-grown trees, whereas most modern log homes are constructed of logs from small diameter, fast-grown trees consisting of sapwood that is susceptible to decay fungi.

Wood in use that is subjected to continual wetting or that is in contact with the ground should be pressure treated. Pressure treated wood is very resistant to attacks by decay fungi and insects. The pressure treating process is done by commercial facilities where the wood is placed in large cylinders and the preservative chemicals are forced deep inside the wood using high pressure. Chromated copper arsenate (CCA) has been the primary wood preservative for many years.

Wood that has been pressure treated with CCA can last for 30-40 years. All CCA treated wood will have a stamp indicating the level of preservative treatment (ie- below or above ground use). In recent years consumers have become concerned about the presence of arsenic in CCA treated wood thus forcing the industry to develop alternative chemicals.

Effective December 31, 2003, the use of CCA treated wood was restricted to industrial applications and not residential. Some exceptions are roundstock products such as poles, building posts and piles. There are some exceptions where sawn lumber can be treated with CCA. A few of these examples are wood used in highway construction, utility pole crossarms, wood used in salt water habitats and wood used as permanent foundations.

Some alternatives to CCA treated wood are:

- ❍ Alkaline copper quat (ACQ)
- ❍ Copper azole
- ❍ Acid Copper Chromate (ACC)
- ❍ Copper dimethyldithio carbamate (CDDC)

Other chemicals used to protect wood are known as water repellents (WR) and water repellent preservatives (WRP). These products are penetrating wood finishes that enable wood to repel water thus inhibiting the growth of decay fungi. A WRP is simply a WR that has been enhanced with a fungicide, which inhibits the growth of mildews and decay fungi.

Landscape timbers are specialty products that are sold for use in flower gardens and other landscaped areas. These timbers are by-products left over from the manufacture of plywood. Although they are sometimes advertised as being treated for decay, they have not been pressure treated. They have been dipped or soaked in a wood preservative. Their life expectancy ranges from 5-7 years.

General precautions should be adhered to when using pressure treated wood:

- ❏ Do not use treated wood in places where the preservative may come in contact with food including animal feed.
- ❏ Do not use treated wood for cutting boards or countertops.
- ❏ Do not use pressure treated wood where it may come into contact with drinking water.
- ❏ Avoid frequent or prolonged inhalation of sawdust from treated wood. A dust mask and goggles should be worn when working with treated wood.
- ❏ Avoid prolonged skin contact with treated wood.

Another treatment method for wood involves the use of borates. Borate treated wood is a less toxic method of treating wood. The product Timbor® is a water diffusible borate that moves through the water in unseasoned (green) wood from areas of high concentration on the surface to one of lower concentration within the wood. Penetration is best when wood moisture content is high. Bora-Care® is a borate product that is specially formulated for use in treating seasoned (dry) wood. Both products are derived from the natural element boron (borax). Full-scale use of borates as wood preservatives in the U.S. has been limited because they are water-soluble and will leach from wood when it is re-wetted.

Wood can be pressure treated with borates and is being promoted widely on the Caribbean market. Protecting wood from termites is a challenge in areas where the water table is near the surface of the soil. Chemicals applied to the soil in such areas are soon leached away from the structure. Borate-pressure treated wood provides protection from decay and termites and eliminates the need for termite protection by soil treatments.

Molds and **stain fungi** are often mistaken for decay. These fungi may discolor wood by producing spores that grow on the surface of wood. The presence of molds and stains on wood should not be alarming but they are signs that conditions are favorable for decay fungi. Oftentimes people will store potatoes in crawl spaces underneath the house. Fungi that grow on the potatoes will often **sporulate** on the surface of floor joists. If molds and stains do appear preventive steps should be taken to increase air circulation in crawl spaces and basements. The presence of mold or stain fungi should be a warning sign that conditions may be developing for a potential wood decay problem.

Leafy Mistletoes

The leafy mistletoes are in the genus *Phoradendron*. They are popular around Christmas due to folk tales that attribute them with mystical powers. Most are parasitic on hardwoods. Leafy mistletoes have **chlorophyll** and can manufacture their own food, however, they use various hosts to extract water and minerals. Leafy mistletoes are spread to other areas of the tree when their sticky seeds drop to branches below. Also, birds and other tree dwelling animals can spread the seeds. The seeds germinate on the branch and penetrate the branch by their root-like structures called **haustoria**. Branches usually swell around these points of attachment. The haustoria can grow through the branch sending up more leafy tufts of new growth several feet away from the original plant. They appear as green streaks or specks in the wood. Trees heavily infested with mistletoe fail to thrive and can be seriously damaged or killed (**Figure 147**). The most effective way to get rid of mistletoe is to prune off infested branches. Since the haustoria may extend three feet down the branch, care should be taken to prune off the branch at least three feet below the mistletoe plant. Another less popular method is to cut the individual plants away from the branch and then wrap several feet of the branch in a black plastic to retard the sprouting of new plants from the imbedded haustoria.

Figure 147

The plant growth regulator ethephon [(2-chloroethyl) phosphonic acid], is registered for control of leafy mistletoe. It can be applied to individual bunches of mistletoe in the fall after leaf fall or in early spring before leaf out. For best results, ethephon should be applied when the daytime temperature is above 65°F and there is no forecast of rain for the next 24 hours. More than one application may be needed to effectively control mistletoe.

Slime Flux or Wetwood

Slime flux or wetwood is a condition in trees that is characterized by the bleeding of sap through a wound in the bark (**Figure 148**). Fluxing may occur in the spring and/or fall and is generally confined to trees larger than 12 inches in diameter. Some type of wound caused by mechanical means; wood split by freezing or wind injury usually precedes slime flux. Oaks, elms and maples are the species most often affected by slime flux but certain softwoods are susceptible .

Figure 148

The fluxing or oozing of sap is a result of bacterial activity at the wound site, which may be deep within the tree. As the bacteria grow pressure is produced and has to be released to the outside. When this happens, fluxing is evident on the outside of the tree. The sap may be clear and alcoholic in odor or viscid and odorous and variously colored.

Slime flux cannot be cured. Debate still exists among tree experts as to the treatment methods used for slime flux. Most experts feel the disease is not life threatening and therefore make no recommendations to control it. The other school of thought is to install drainage pipes just below the point of fluxing to relieve internal pressures within the tree. The pipes allow for the collection of the sap into pans so it can be discarded. Otherwise the sap will ooze down the tree and become an attractant for yellowjackets and other wasps.

One-half inch diameter copper pipes should be installed below the fluxing area to a depth of two to four inches. The pipe should be slanted upward with a driving fit. The pipe should be long enough to extend 6-8 inches from the tree (**Figure 149**).

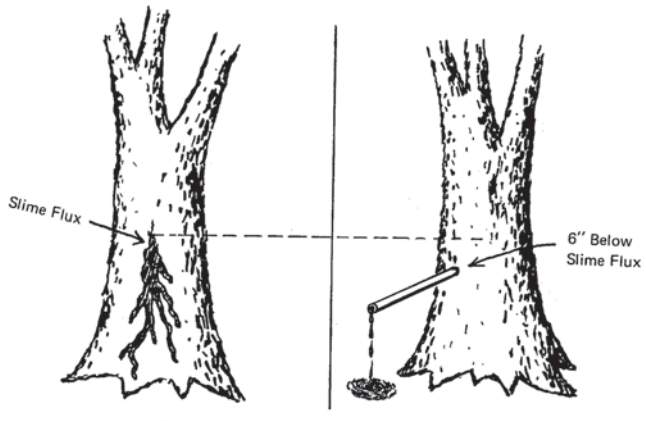


Figure 149

Fluxing usually diminishes after several years with or without drainage pipes and shade tree owners should regard slime flux as a non-life-threatening event.

Miscellaneous

Herbicide Injury

Herbicide injury to trees often occurs along highway, railroad and utility rights-of-way. Damaged foliage may take the appearance of twisting, stunting, curling, witches broom, or blighting depending upon the herbicide type, herbicide concentration, and tree species involved (**Figure 150**). Small trees or very susceptible species may be killed by relatively small amounts, while larger trees or more resistant species may show only temporary effects from the chemical. In urban areas, care should be exercised in the application of herbicides to lawn areas for the control of weeds.

Figure 150

Volatile fumes from herbicides may damage or kill many species of ornamental plants. Herbicides applied to lawn areas several times during the growing season or in amounts greater than that specified on the label may be taken up in the roots of ornamental plants and trees causing injury or death. Many of these chemicals can also be absorbed through the bark of the tree. Label precautions should always be carefully observed.

Herbicide damage often causes concern to homeowners as it distorts leaves and causes necrotic areas in the tissues. Damage usually occurs where weed killers have been applied to lawns and trees are injured by drift. Drift from herbicides may injure trees as much as a mile away. Other trees are injured when the herbicide is applied directly to poison ivy or kudzu climbing up the stem. In the latter case some trees may be killed outright. Herbicides should never be applied when the wind is over 5 miles per hour and never directly to a tree that is not to be killed.

Herbicide drift to planted pine stands is quite common in agricultural areas, particularly where cotton is being defoliated. Damage can be direct or can act as a precursor to insect damage. Pines weakened from cotton defoliants are often attacked by pine bark beetles. Another insect that appears to be attracted to pines affected by certain herbicides is the southern pine coneworm, *Dioryctria amatella*. Certain herbicides can increase resin production and resin flow in pines, which in turn attracts the coneworm. One documented case of herbicide induced coneworm infestation occurred when a ten-year-old loblolly pine plantation was accidentally contaminated by cotton defoliant. Approximately 30% of the trees were affected. Coneworm attacks had occurred at several branch stem junctions causing the branches to break away from the stems (**Figure 151**). Only the upper branches had been affected.

Figure 151

Common Urban Tree Problems

Urban shrubs and trees are left in a development or planted to beautify the surroundings of which they are a part. The plants must have a healthy vigorous appearance to be attractive. For these conditions to exist, the various plants must be suitable to the site characteristics. A shade loving tree or shrub would not be planted in full sunlight, nor would a plant requiring full or partial sun be planted in deep shade. The plant must be suited to the temperature extremes that normally can be expected to occur from year to year. The moisture and nutrients required by the various plants must be within reasonable limits to that offered by the site and to the amount of available growing space in which the tree or shrub will be planted.

When homes, apartments, shopping centers or office complexes are under construction, trees and shrubs remaining on the site may be subjected to many abuses. The common causes of tree mortality on construction sites are mechanical wounding of trees and root loss caused by trenching, grading, and excessive filling within the tree's root zone (**Figure 152**).

Figure 152

Extensive grade changes and cuts within the drip line not only destroy roots but may upset the water balance. Affected trees may die with symptoms similar to that of drought even though weather conditions are normal. Excessive cuts or earth removal several hundred feet away may so drastically alter the water table that site conditions become too wet or too dry and the tree is lost. It would probably be best to clear the area around major construction sites and replant with two to three inch caliper trees of acceptable species after the site is completed and final grading is accomplished.

Some tree species will die when suddenly released from all surrounding vegetation as in a closed stand. Dogwood trees suddenly released in this fashion often decline in health and eventually die.

Figure 153

Any effort to save trees around a proposed construction site should begin prior to actual construction. The trees that are to be left standing should be selected and marked. All phases of construction should be kept in mind during this selection phase. It would be rather futile to attempt to save a tree where a large cut is required immediately next to it or where excessive grade changes are required. The contractor should be given explicit instructions as to procedures and care to be taken to prevent injury. Boardwalks may be constructed under the drip line to prevent excessive soil compaction and heavy machinery should not be allowed within this area. No large piles of dirt or debris should be piled around the trunk or within the drip line. Trees to be left should be prominently marked with tape, ribbon or other means that do not damage or wound the bark (**Figure 153).**

If excessive soil is removed from around the tree a temporary wall should be immediately constructed and backfilled and water should be applied to drench the soil. Roots are very sensitive to air and dry out quickly, which results in the death of part or all of them. It is best to install the final retaining wall whenever possible. In all cases, soil disturbance by removal, addition, or compaction should be kept to a minimum. As little as three inches of additional soil (heavy clay) placed over the root area may be sufficient to reduce the aeration of the soil and cause the death of a tree. Tree wells, properly constructed, may allow a fine specimen tree to survive and grace the site for many years. However, the amount of time and effort to properly construct a tree well is seldom expended. If a tree well is to be constructed, proper methods as shown in various texts on tree care should be closely followed (**Figure 154**).

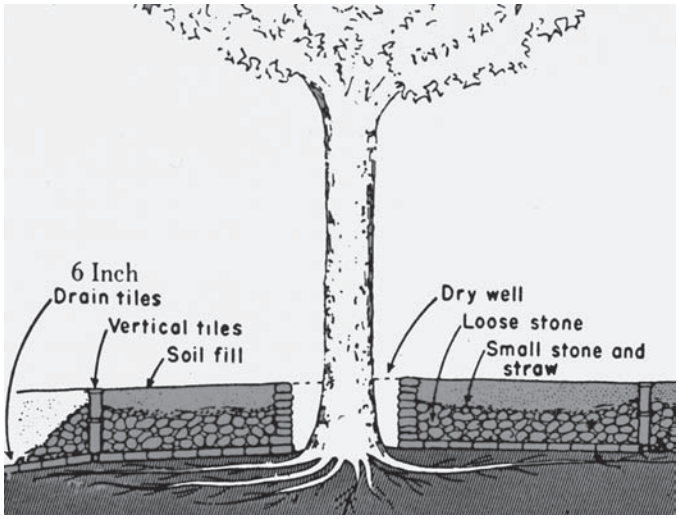


Figure 154

Figure 155

The root system of a tree needs the proper amount of air and water in order to maintain satisfactory growth. Trees growing near streets, driveways, sidewalks, or in parking lots can be described as growing in an asphalt jungle. We do everything possible to keep our trees from getting adequate amounts of air and water to the root system (**Figure 155**). Yet we seem surprised if the tree appears sickly. Trees with limited root space should be periodically watered during droughts, aerated or vertically mulched and fertilized.

It is not uncommon in new urban developments to find large hardwood trees with butt scars caused by previous fires or other types of injury. These wounds are often unsightly but there is little one can do to correct the damage. However, the wound should be cleaned out to sound wood by removing the decayed wood to facilitate wound closure (**Figure 156**). If the owner wants the cavity filled it should be done with a pliable asphalt material that will not harden and will give when the tree is swayed by the wind. Never fill cavities with a rigid material that may separate from the wood, creating a moist chamber ideal for additional decay development.

Figure 156

After high winds, heavy snow or ice storms, many limbs are broken from trees. These broken branches need to be removed for safety and aesthetic purposes. When removing such damage, the trees should be climbed with ropes and never with spurs. Spur wounds on pine trees are attractive to bark beetles and those on hardwoods may be suitable for entrance of heart rot fungi.

Lightning often strikes urban trees. Trees most likely to be struck include oak, pine, poplar, and maple. Lightning that spirals down the tree is more likely to kill the tree than a single streak (**Figure 157**). Lightning struck trees are often infested with ambrosia beetles and other wood boring insects within days of the strike. Oftentimes if insects are kept out of lightning struck trees, the trees have a good chance of surviving.

Figure 157

Lightning scars should have the loose bark and splinters removed and the edges smoothed. As most lightning struck trees are tall, wounds will usually have to be treated by a competent tree climber. Television and radio antennas should never be installed in trees since they often attract lightning.

Homeowners ordinarily do not consider fertilizing their shade trees; however, trees have nutritional requirements for growth and health. A tree may be fertilized by applying a granular fertilizer into predrilled holes in the soil or with liquid fertilizers using hydraulic injectors or as foliar sprays. The most frequently used and easiest method is broadcasting a granular fertilizer on top of the soil. Broadcasting is not recommended when trees are located on slopes where runoff can occur or where heavy sod (grass) is present. These situations would warrant drilling holes in the soil as shown in **figure 158**. Start four feet from the tree base, punch or bore holes about two feet apart in concentric circles out to the drip line. The holes should be about two inches in diameter and 6 to 12 inches deep. The amount of fertilizer to be placed in each hole will depend on the size and age of the tree. Homeowners should have the soil tested by their county extension agent before applying a fertilizer. A soil analysis will provide specific recommendations to follow.

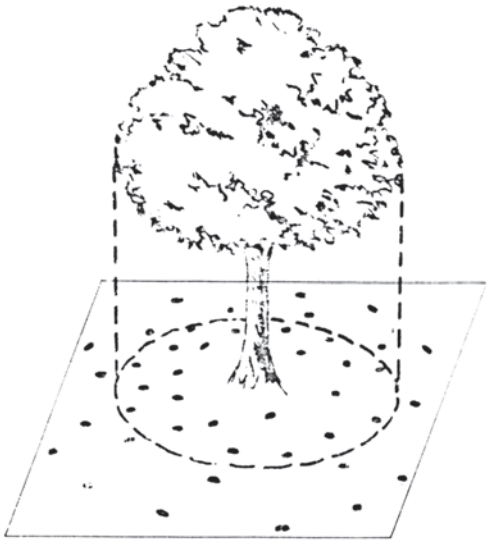


Figure 158

It is necessary to inspect trees regularly to keep them beautiful and in good growing condition. They occasionally need to be pruned. Pruning will improve the appearance, guard its health and make it stronger. If pruning is done when the need arises, it can easily correct defects that, if delayed, would require major surgery. Pruning should remove (1) dead or dying branches; (2) branches that grow toward the center of the tree; (3) branches that rub each other; (4) V-crotches on young trees, (5) more than one leader; and (6) nuisance growth, such as branches that interfere with wires, streetlights, create traffic hazards, cut off cooling breezes or interfere with mowing. Care should be taken when branches are removed. Small branches up to 2 inches in diameter can be easily removed by sawing. Branches more than 2 inches in diameter should have an undercut to prevent bark stripping below the cut. Stubs should not be left on the tree trunk. The pruning cut should be made just beyond the collar ridge to promote maximum wound closure (**Figure 159**).

Figure 159

Pruning may be done at any time of the year, but for faster wound closure, it is recommended late winter or early spring. Pines should be pruned in winter if possible to prevent pine bark beetles. For safety sake, dead or broken branches should be removed before they fall and injure someone.

Arborists in recent years have been told by professionals in forest research not to use wound dressings any longer when pruning trees. Although research indicates wound dressings do very little to prevent wood decay from pruning wounds, indications are they can discourage attacks by elm bark beetles, southern pine bark beetles and insects that transmit the oak wilt fungus. Wound dressings may prevent infection from diseases like pitch canker. They have also been recommended to protect wounded roots from soil contact. Severed roots should be trimmed to remove splintered wood and then treated with an asphalt base wound dressing. Homeowners should check with their local forestry expert before pruning to see if a wound dressing is warranted.

Another common type of injury in urban areas is that caused by air pollution. Densely populated areas are more subject to pollution damage because of industrial complexes and the concentration of automobiles. Four common types of air pollutants are; sulfur dioxide, fluoride, chlorine and oxidants. Sulfur dioxide forms as a result of burning coal and fluorides by the manufacture of brick, pottery, steel and phosphate fertilizers. Ozone is a naturally occurring oxidant present in the upper atmosphere. Ozone is the major ingredient in urban smog and may be formed as a result of hydrocarbons and other materials contained in auto exhausts. Air pollutants may cause damage in very low concentrations to the foliage (**Figure 160A & 160B**).

Figure 160A - Chlorine damage to loblolly pine

Figure 160B - Ozone damage on maple

Oftentimes homeowners desire to plant large caliper trees. Field grown trees require a root ball proportional to the size of the tree based upon caliper diameter (measured in inches at the ground line). The rule of thumb is for every one inch of tree diameter, the root ball should measure 1 foot across at the top of the ground (hence a 2” tree would require a 24” root ball, and a 4” tree would require a 48” root ball). Although larger trees can be successfully planted, the failure rate can be very high. Balled trees should be planted to the original depth. Too often, landscape companies will elevate the ball several inches above ground and then apply a 12” or greater mulch layer (**Figure 161**). This is not a wise practice and should be avoided. The mulch layer should be no more than 3 to 4 inches deep. When it is necessary to elevate the ball above the ground a few inches, the ball should be covered with soil and then the 3-4 inch layer of mulch. The planting hole should be about twice the size of the ball to cradle the roots properly. The cord or wire tied at the top of the ball should be removed before the tree is planted. Surprisingly, this is an often-overlooked problem in urban plantings. Some balled trees are cradled in wire baskets. These baskets should be removed prior to planting. Native tree species should be favored over exotic species when practical.

The same insects and diseases that attack forest trees attack shade trees. Some insects and diseases most likely to be found on shade trees are southern pine beetle, black turpentine beetle, Ips engraver beetles, eastern tent caterpillar, mimosa webworm, bagworm, fusiform rust, annosus root rot, needle cast, spot anthracnose of dogwood and Dutch elm disease.

Figure 161

Animal Damage

Animals that are damaging to trees or forestry are beaver, deer, rabbit, certain burrowing rodents, and seed-eating birds.

Figure 162

Beavers are beneficial to water conservation and wildlife habitat development, but some timber producers can suffer substantial timber losses when timber stands are flooded (**Figure 162**). Based on a Georgia Forestry Commission beaver damage survey in 1975, the total damage to pine and hardwood was estimated at $45 million statewide. The area of damage increased by 128 percent between 1967 and 1975. Over 287,000 acres were inundated in 1975.

Trapping is an effective method in reducing beaver in local areas, but it must be kept up over a long period for complete control.

Deer damage young pine stands by feeding on the terminals of recently planted pine seedlings. Damage to pine seedlings appears to be heaviest in February and March where natural browse has been damaged by frost.

Christmas trees and young trees in seed orchards are often damaged when antlered bucks use them for scraping posts.

Figure 163

Animal repellents provide short-term control but are not economical for large areas. Seed orchard trees can be wrapped with various materials such as heavy Kraft paper or burlap.

Cotton rats and **meadow voles**, periodically damage young pine stands by gnawing at the base of trees (**Figure 163**). Frequent mowing between rows of trees can reduce damage from cotton rats and so can prescribed fire by reducing cover. **Pine voles** damage young pines by feeding underground and stripping the lateral roots.

Rabbits damage seedlings by gnawing or biting them off at various heights. There are two signs in the field that will help foresters determine whether the seedlings were damaged by deer or rabbits:

- ❏ Deer clip the seedlings straight across and leave a ragged edge; rabbits clip them off at an angle (**Figure 164**).
- ❏ Droppings will usually be present. Rabbit pellets are usually deposited at the base or near the base of damaged seedlings. Deer droppings are deposited at random throughout the area. It is not uncommon to find droppings from both animals in the same area. Rabbit droppings are round, whereas deer droppings are oval.

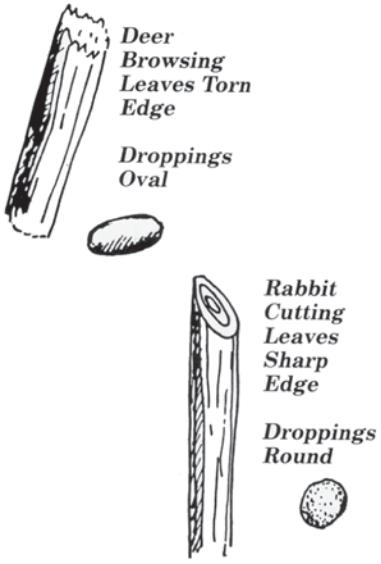


Figure 164

Figure 165

Squirrels are not considered serious pests of forest trees, however, when mast production has been affected by drought or other phenomenon, trees in forests, cities, and yards can be seriously damaged. Shade trees can be completely stripped of their bark on most of the branches (**Figure 165**). Branches damaged by squirrels are often infected with fungi that cause further dieback in the tree. Pines damaged by squirrels are often infested with Ips beetles. Isolated trees can be banded with metal flashing to prevent squirrels from climbing in them. Banding cannot adequately protect trees growing next to buildings and other structures. Trapping squirrels in live traps and transporting them to other areas has not proven effective either. In time, natural forces tend to reduce squirrel overpopulation.

Several species of scratching birds can consume enough pine seed to render artificially seeded areas worthless. Pine seed should be treated with a repellent before they are sown or broadcast.

Table 5 lists some of the more common methods of controlling/preventing animal pests. Be sure to check with the Georgia Department of Natural Resources before applying any control to an animal population. Game laws change periodically depending on animal population trends.

Table 5: Control/Prevention Recommendations for Animal Pests

Pest	Control/Prevention Options
Beaver	Steel Traps/Install drainage devices
Birds	Use treated seed
Deer	Fencing/Control hunting
Rabbits	Mow to reduce cover
Cotton Rats	Mow or burn to reduce cover

Storm Damage

Storms of various types and intensities do considerable damage to forest stands. Based on best estimates during the last three decades, over 51 million board feet and 1.6 million cords of pine and hardwood were destroyed following 30 reported storms in Georgia.

Tornadoes occur more frequently than ice storms but do not cover as large an area. Georgia Forestry Commission records indicate that 24 tornadoes did an estimated $7 million of damage that averaged over $291,666 per occurrence (1973-1994). However, four major ice storms occurring during the same period did over $26 million of damage or $6.5 million per occurrence.

Numerous other tornadoes and ice accumulations occurred but did only light damage and were not recorded. As the records indicate, tornadoes occur more frequently during April and May and ice storms are more common during January and February.

Figure 166

Hailstorms are usually associated with severe thunderstorms and occur more frequently during spring and summer. Most hailstorms do very little noticeable damage to forests, but occasionally will cause serious defoliation and branch damage. A hailstorm in 1985 damaged about 400 acres of pine and hardwood in northeast Georgia. The damage was so severe that wood sawyers (*Monochamus* spp.) and Ips beetles infested the stand that promulgated a clearcut (**Figure 166).**

Land managers can reduce the impacts of high winds and ice by regulating stand densities. Pine plantations in areas likely to be hit by ice should not be thinned more than one-third of the total basal area at a time. Shortleaf and Virginia pines are more resistant to ice than loblolly. Loblolly should be maintained at denser stockings than shortleaf and Virginia pines.

Pine stands that have been damaged by winds, hail or ice should be evaluated as soon as possible. Damaged trees should be salvaged to prevent pine bark beetles (see pine bark beetles).

Stem breakage and windthrow are severe effects of wind damage that may occur depending upon the windspeed and duration of wind. Other factors contributing to wind damage are stand age and structure, species characteristics, heart decay, fusiform rust and root disease. Trees weakened by decay or cankers are more likely to snap and those infected with annosum root rot are more likely to be windthrown.

Tree species vary in their ability to withstand strong winds. Wind resistance is often determined by several factors: depth and mass of the root system, live crown ratio, wood strength and amount of rainfall. Pine trees often have deep-rooted tap roots provided they have been planted properly and the roots have not encountered any hard objects such as rock, heavy clay or hardpan.

Hardwoods in general have shallower taproot systems than pines and it is for this reason, pines are more likely to snap from strong winds and hardwoods are more prone to uprooting. Rainfall also increases the likelihood of trees being uprooted. Once the soil has become saturated with moisture, roots are easily dislodged by strong gusts of wind or sustained winds associated with hurricanes and tornadoes. The size and

shape of the crown is critical in determining the amount of wind resistance. Trees with large, dense crowns catch more wind and are more likely to blow over. The amount of breakage depends a lot on the strength of the wood and that varies among tree species.

Table 6 compares the relative resistance of selected trees to hurricane related damage.

Table 6: Resistance of selected tree species to hurricane related damage in descending order of resistance. (Source: United States Department of Agriculture, Forest Service, Southern Region, Management Bulletin R8-MB 63).

Breakage	Uprooting	Salt	Deterioration by insect and decay
live oak	live oak	live oak	live oak
palm	palm	palm	palm
baldcypress	baldcypress	slash pine	sweetgum
pondcypress	pondcypress	longleaf pine	water oak
sweetgum	tupelo-gum	pondcypress	sycamore
tupelo-gum	redcedar	loblolly pine	baldcypress
mimosa	sweetgum	redcedar	pondcypress
dogwood	sycamore	tupelo-gum	southern red oak
magnolia	longleaf pine	baldcypress	magnolia
sweetbay	mimosa	sweetgum	tupelo-gum
southern red oak	southern red oak	water	sweetbay
water oak	magnolia	sycamore	hickory
sycamore	slash pine	sweetbay	pecan
longleaf pine	loblolly pine	southern red oak	redcedar
slash pine	sweetbay	hickory	red maple
loblolly pine	water oak	mimosa	mimosa
redcedar	red maple	pecan	dogwood
hickory	dogwood	magnolia	longleaf pine
red maple	hickory	red maple	slash pine
pecan	pecan	dogwood	loblolly pine

Drought and Flooding

Drought is a meteorological term that means a lack of rain or precipitation over a prolonged period of time. Oftentimes foresters refer to the effects of drought as water stress. Water comprises 85 to 90% of the green weight of trees. When water is limited the equilibrium within the tree is disturbed. Trees under stress from lack of water have a reduced growth rate, a reduction in stem and shoot elongation and leaf expansion. Oftentimes re-hydration aggravates the damage caused by the drought.

Hypoxylon canker provides a good example of how drought stress can precipitate a fatal reaction in oaks and other hardwoods. When the moisture content of sapwood of oaks and other hardwoods falls below 60-70%, the *Hypoxylon* fungus living in the inner bark is activated to invade, removing **starch** and other nutrients from the tree. As it colonizes and decays **sapwood**, a **stroma** of fungal tissue develops beneath the bark eventually causing the bark to slough-off **(Figure 134)**.

Symptoms of drought in hardwoods are wilting of foliage, leaf curling and bending, marginal browning and shedding. In conifers, drought is often expressed as needle yellowing and tip browning and needle shedding.

Yard and specimen trees should be drip watered 2-3 times a week during droughts to prevent root loss. Trees need an extra one to three inches of water per week when there is little or no rainfall. Drip irrigation or a soaker hose is sufficient for effective watering. The ground should be watered out to the **dripline** of the tree. A two to four inch layer of mulch over the root system will help to conserve moisture. Pine straw, wood chips, cone mulch, pine bark or other materials can be used.

Flooding can cause the air filled pores in the soil to become filled with water. This creates an anaerobic condition from which roots cannot obtain oxygen. Generally soils have 10-30% of the volume composed of air-filled spaces but the percentage decreases as water content increases. Excess soil moisture can cause a "physiological drought" by interfering with water uptake in oxygen-deprived roots. Prolonged flooding during the growing season produces a major stress.

Insects and diseases play a major role in determining the survival of water-damaged trees. Insect borers, such as the bronze birch borer, *Agrilus anxius,* ambrosia beetles, *Platypus* spp. and bark beetles such as *Ips* spp., and the hickory bark beetle, *Scolytus quadrispinous*, often attack flooded trees.

Flooded trees are prone to be infected with root pathogens such as *Phytopthora* and *Pythium* spp. These fungi are known as water mold fungi that are suited for waterlogged soil conditions. Plant roots stressed by reduced oxygen in waterlogged soils exude more amino acids and ethanol that attract disease spores to root surfaces. Branches and main trunks of trees submerged in floodwaters or those injured by floating debris are prime targets for canker fungi such as *Cytospora*, *Botryosphaeria* and *Nectria*.

Salvage is often hindered by waterlogged soils. Foresters need to have a salvage plan in place and be ready to remove all dead and dying trees as soon as possible. It is not uncommon for trees damaged by flooding to die slowly over a period of 2-4 years. Therefore, trees exhibiting **chlorotic** crowns, numerous cones, crown dieback and leaf fall should be removed along with the insect infested trees.

Table 7 lists some common tree species and their relative susceptibility to flooding in the Lower Mississippi Valley and Missouri River Divisions. The tree species listed are common throughout the South and their relative susceptibility shouldn't change from location to location.

Foresters developing forest management plans should consider the relative tolerance of trees to flooding and/or drought to tailor recommendations for certain sites. Only tolerant species should be recommended for planting in areas prone to flooding.

Table 7: Relative tolerance of trees to flooding during the growing season.
(Cited from **Flooding and Its Effect on Trees** by the USDA Forest Service, State and Private Forestry, Northeastern Area, 1993).

Species	Common Name	VT[1]	T[a]	ST*	I[o]
Acer rubrum	Red maple		X		
Alnus rugosa	Hazel alder			X	
Betula nigra	River birch			X	
Carya illinoensis	Pecan	X	X		
Carya ovata	Shagbark hickory				X
Carya tomentosa	Mockernut hickory				X
Celtis laevigata	Sugarberry		X		
Celtis occidentalis	Hackberry		X		
Cornus florida	Flowering dogwood				X
Diospyros virginiana	Persimmon		X		
Fraxinus americana	White ash		X		
Fraxinus pennsylvanica	Green ash	X	X		
Liquidambar styraciflua	Sweetgum		X		
Morus rubra	Red mulberry				X
Nyssa aquatica	Water tupelo	X			
Nyssa sylvatica	Blackgum			X	
Pinus echinata	Shortleaf pine				X
Pinus taeda	Loblolly pine				X
Platanus occidentalis	Sycamore		X	X	
Populus deltoides	Eastern cottonwood		X		
Prunus serotina	Black cherry				X
Quercus alba	White oak			X	
Quercus falcata	Southern red oak			X	
Quercus lyrata	Overcup oak	X			
Quercus marilandica	Blackjack oak				X
Quercus nigra	Water oak			X	
Quercus phellos	Willow oak			X	
Quercus rubra	Northern red oak				X
Quercus shumardii	Shumard oak				X
Quercus stellata	Post oak				X
Quercus velutina	Black oak				X
Salix nigra	Black willow	X			
Sassafras albidum	Sassafras				X
Taxodium distichum	Baldcypress	X			
Ulmus alata	Winged elm			X	
Ulmus americana	American elm			X	

[1] **Very tolerant**: able to survive deep, prolonged flooding for more than a year.
[a] **Tolerant**: able to survive deep flooding for one growing season, with significant mortality occurring if flooding is repeated the following year.
* **Somewhat Tolerant**: able to survive flooding or saturated soils for 30 consecutive days during the growing season.
[o] **Intolerant**: unable to survive more than a few days without major mortality.

Wildfire and Prescribed Fire

A wildfire is a fire that is started by accident or malice intent that can result in significant forest damage. Conversely, a prescribed fire is a well-planned controlled fire that accomplishes a desired goal. Georgia averages nearly 9,000 wildfires per year with incendiary and debris burning leading all causes.

Wildfires occur as a direct result from extended drought, and these burns can consume all of the litter layer and the humus layer of soil. The upper layer will normally contain fine, feeder roots of the tree which are directly killed, and trees can be stressed from this damage and consequent reduction in water absorption capability of the tree. Deeply burned soils can expose the main lateral roots indicating the severity of the damage.

Fires that linger for extended periods of time at their base can severely damage the cambium layer and the food and water conductive tissue of the tree (**Figure 167A**). Trees that burn completely around the circumference are effectively "girdled" (**Figure 167B**).

Figure 167A

Figure 167B

Crown consumption is more damaging than merely scorch, growing season fires tend to cause more insect problems and consequent mortality, Basal damage (caused by smoldering fires) can also cause high mortality (even if stem char doesn't indicate this), younger stands that made it through the first 3 months tend to survive. Older stands with moderate to severe damage will suffer additional mortality the second growing season (possibly due to insects), and lastly ongoing drought can make the problem worse and conversely, plentiful rainfall following the fire can help minimize losses.

Not all wildfires are bad for forest health. In fact, many wildfires prove to be beneficial. Assessing the affects of wildfire on standing trees is often done by examining the amount of crown scorch, bark charring and damage to feeder roots. These collectively can indicate fire intensity (**Figure 167C**). Also the age of the stand and tree species will affect the relative susceptibility

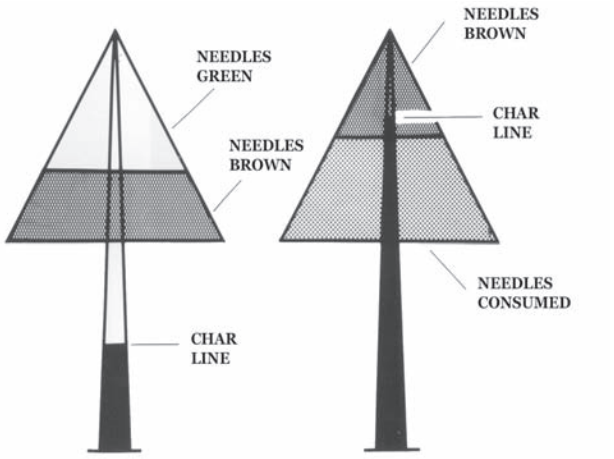


Figure 167C - Fire damage to pine. Tree on left will probably live. Tree on right will probably die and be infested by Ips.

Figure 167D

to fire. Longleaf pine can withstand fire as early as age two. Conversely, loblolly and slash pines rarely survive a fire before age 6. Dormant season fires are usually less damaging than growing season fires because the buds have hardened off making them less susceptible to heat (up to a point).

A forest stand damaged by wildfire should be evaluated as soon as possible. Pine bark beetles are often attracted to fire damaged trees and can move very rapidly throughout the stand (**Figure 167D**) . Hardwoods damaged by fire are often infested with ambrosia beetles and wood borers.

An interesting beetle that is often found attacking the charred bark of southern pines is the bostrichid beetle *Rhyzopertha dominica*. This insect is probably native to India and will feed on all kinds of stored grains and a wide variety of foods, chiefly cereals. When it attacks the bark of burned pines it produces a reddish-brown, powdery boring dust that resembles that of *Ips* species (**Figure 167E**). The beetle does not harm trees and therefore, no control is necessary. It feeds only in the outer bark and does not enter the cambium. Timber managers need to be familiar with this insect because it is often confused with *Ips* beetles. It would be unfortunate to salvage trees infested with this beetle when it is unnecessary.

Prescribed fires are vital to maintaining the health of coniferous forests in the South. Fire is an effective tool in killing undesirable hardwood species that compete for soil nutrients and water. Fire releases nutrients that are bound in leaf litter and woody debris on the forest floor. Regardless of the reason for doing a prescribed fire it must be carefully planned under predetermined conditions of fuels, weather and topography.

Figure 167E

Cogongrass

Cogongrass, *Imperata cylindrica (L.)*, is considered the seventh worst weed in the world and listed as a federal noxious weed by USDA Animal and Plant Health Inspection Service – Plant Protection and Quarantine. Cogongrass was first introduced into the United States near Grand Bay, Alabama in 1911 via seed packing material in shipping containers from Japan. Since its introduction, it has become widespread throughout Alabama, Mississippi, and Florida and is moving into Georgia and South Carolina. This grass suppresses and eliminates natural vegetation thereby significantly reducing tree & plant regeneration, wildlife habitat, forage, and ecological diversity.

Cogongrass infestations are being found primarily in south Georgia but is capable of growing throughout the state. It grows in numerous soil types with the exception of saturated soils and is highly adaptable from full sunlight to shade. Cogongrass invades forests, pastures, old fields, roadsides, utility rights-of-ways, and ditches. The grass spreads through both rhizomes and seed production. Forming dense mats, it is extremely flammable creating hazardous prescribed burning and wildfire conditions. Cogongrass is difficult to eradicate once it has become established due to the tremendous root system that must be completely eliminated.

The first step in eradicating cogongrass is educating individuals how to identify the grass. The most recognizable feature of cogongrass is the fluffy white seed heads that are produced in the spring (March-June) immediately following grass "green-up" (**Figure 167F**). Cogongrass is the only warm season grass that produces cotton-like seeds in the spring (**Figure 167G**). When not in the flowering stage, inspection of the roots is the most identifiable feature (**Figure 167H**).

Figure 167F

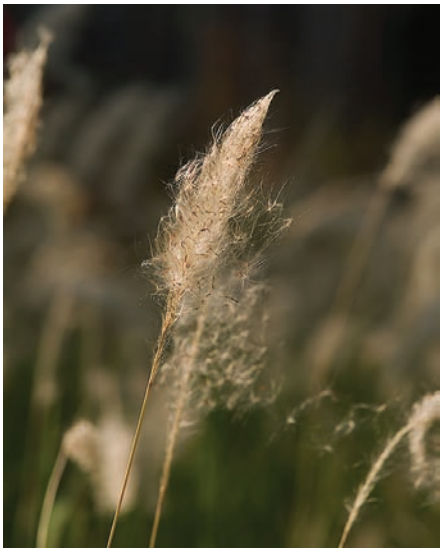


Figure 167G

Figure 167H

Figure 167I

Figure 167J

Cogongrass has sharp pointed, scaly rhizomes (**Figures 167I**) with a very dense root system (**Figures 167J**). It will usually grow in a circular-shaped pattern. Although not a sole identification feature, the grass also has an off-centered midrib on long leaf blades - 1-5 feet (**Figure 167K**).

Figure 167K

The Georgia Forestry Commission (GFC) is taking a proactive approach at eradicating cogongrass in Georgia, and formed the Cogongrass Task Force in 2004. A diverse group of government and private agencies and groups have joined forces within this Task Force into a collective effort to detect and eradicate this plant form our State. Anyone suspecting they have seen cogongrass should contact their local Georgia Forestry Commission office. A GFC representative will inspect the site. If confirmed to be cogongrass, a chemical eradication program will be initiated at no expense to the landowner. In the meantime, avoid mowing or disking through or near a known or suspected cogongrass spot since this could move seed or root fragments to other areas.

Join the cogongrass eradication team in Georgia and be a part of protecting our state's forest and wildlife habitat. Report a potential cogongrass sighting at http://www.gatrees.org/ForestManagement/CogongrassReport.cfm or call 1-800-GA-TREES.

Laurel Wilt Disease Associated With Redbay Ambrosia Beetle

Laurel wilt, a new disease of redbay (*Persea borbonia*) and other plant species in the family Lauraceae, is causing widespread mortality in the coastal regions of South Carolina, Georgia, and Florida. The disease is caused by a fungus (Raffaelea species) that is introduced into trees by an exotic insect, the redbay ambrosia beetle (*Xyleborus glabratus*) (**Figure 167L**). The redbay ambrosia beetle is native to Asia and is the 12th new species of ambrosia beetle introduced into the U.S. since 1970.

Figure 167L

Although of minor commercial timber value, redbay trees provide fruit for song birds, turkey, and quail, deer and black bear browse on the foliage and fruits. Additionally, the larvae of the Palamedes swallowtail butterfly require redbay leaves for development.

The redbay ambrosia beetle was discovered in Savannah's Port Wentworth area in spring 2002; however, it is likely to have been established in the area prior to 2002 when the three adult specimens were trapped at the port. The beetle likely entered the country in solid wood packing material with cargo that was imported at Port Wentworth. Redbay trees began dying in Georgia and South Carolina near the Savannah area in 2003 (**Figure 167M**). By early 2005, officials with the Georgia Forestry Commission (GFC), South Carolina Forestry Commission (SCFC), and USDA Forest Service began to suspect the newly discovered ambrosia beetle was associated with this mortality. Subsequent research since 2005 has found that the mortality is caused by a pathogenic fungus that is carried by the redbay ambrosia beetle. The fungus is believed to be transmitted to healthy redbay trees when they are attacked by the beetle, resulting in a wilt disease. The disease has also been discovered in individual plants of the federally endangered pondberry (*Lindera melissifolia*), the threatened pondspice (*Litsea aestivalis*), sassafras (*Sassafras albidum*), and avocado (*Persea americana*).

Figure 167M

Many native ambrosia beetles (40 plus species) occur in the United States and primarily target stressed or dying trees. In general, ambrosia beetles carry specific fungi that are introduced into the trees as they tunnel into the wood, and are fed upon by the developing insects. In the case of the redbay ambrosia beetle, one of the associated fungi also acts a pathogen as it spreads through the tree's vascular system, causing the trees to wilt and die (**Figure 167N**). This associated fungus is in the same class of fungi as those that cause Dutch elm disease and blue stain in pines.

Figure 167N

All of Georgia's coastal counties now have confirmed laurel wilt and the disease is moving northward in South Carolina, southward in Florida, and inland at an alarming rate. Officials estimate that natural spread is about 20 miles per year, but movement of infested firewood, wood chips and logs may be a major factor in spreading the disease into new locations not contiguous with main area of infestation. Landowners, loggers, and others are asked to leave dead redbay trees in the woods and not salvage them for logs, chips or firewood. It is likely that long distance spread via wood movement has occurred already, and the public is asked to cooperate with this voluntary request by state and federal agencies.

There are no proven management strategies for preventing the development of laurel wilt disease. Early sanitation of newly infested trees and limiting movement of infested wood may help slow the spread. Field trials evaluating the effectiveness of certain pesticides are being conducted in Florida and Georgia. Formal ground surveys are being conducted by the SCFC and the GFC to develop baseline infestation information. More information about this problem is available at: http://www.fs.fed.us/r8/foresthealth/.

Sirex Woodwasp

A non-native woodwasp, *Sirex noctilio,* was detected in New York (NY) in 2005 and likely entered a port via solid wood packing material in cargo. This insect is native to Europe and Asia, but has now been introduced into every continent, and has the potential to kill many species of pines including several of our native species.

This is a large insect (1 – 1½ inches in length) that is a strong flyer capable of traveling almost 50 miles in one season, and now covers a good portion of NY and has migrated into Pennsylvania and Canada (**Figure 167O**). Trapping surveys are taking place in several southeastern states, including Georgia, but no Sirex noctilio has been detected to date.

Sirex woodwasp create egg niches and lay eggs in trees, and also inject a symbiotic fungus and toxic mucus into the tree. The larvae feed upon the fungus, but the mucus spreads within the water conductive tissue of the tree and clogs this pathway. Their larvae tunnel through the wood as the feed upon the fungus (not the wood), and these large holes can disrupt the water conductive tissue also.

We have several species of native woodwasps in the southeastern U.S., but these species do not kill the host trees. In other parts of the world, it has been observed that weakened, stressed stands (such as overstocked plantations) have been more vulnerable to *Sirex noctilio* than thinned, vigorous, healthy stands.

Figure 167O

Exotic Pests

Georgia, along with all of the southern states, is vulnerable to exotic insects, diseases, and plants. Dutch elm disease was found in Atlanta, Georgia in 1967 and since then has virtually destroyed the American elm and other native elm species in the State. The chestnut blight introduced from Europe has devastated the American chestnut in the Southern Appalachian Mountains. Three separate introductions of the gypsy moth have appeared in Georgia since 1991. Privet, an exotic plant from Asia, now occurs in all of Georgia's 159 counties (**Figure 176**).

Figure 176

The GFC in cooperation with various federal agencies maintains a vigil for introduced pests. Each year the GFC places gypsy moth detection traps along roadsides and in recreational areas (**Figure 177**). The GFC began trapping for gypsy moths in 1973 but it was not until 1986 when a memorandum of understanding was signed between the GFC and the Georgia Department of Agriculture that the GFC began receiving federal dollars to do the trapping. Since that time the GFC and the U. S. Department of Agriculture have systematically grided the state each year in attempts to find any artificial introductions of the pest.

Figure 177

To date, the GFC and the USDA Forest Service have eradicated three infestations in three northern counties. In 1991 egg masses of the gypsy moth were found on a river birch tree on the banks of Duke's Creek in White, County. That find led to the additional discovery of egg masses some two miles away. Ultimately, over 5,250 acres were aerially treated with *Bacillus thuringiensis var kurstaki* (Bt) in 1991 and 1,937 acres in 1992. The infestation was successfully eradicated in 1993.

The second infestation was discovered in Fannin County in 1994 and 1,254 acres were treated in 1995 and 800 acres in 1996 with Bt. Again the treatments were successful in eradicating the moth. Based on interviews with residents, the White and Fannin County infestations were associated with people relocating from Pennsylvania to Georgia.

The third infestation was found in Rockdale County in 1994 in a small rock yard. Apparently egg masses were moved into the state via field rock from Pennsylvania. The infestation was monitored for three years by mass trapping, but eventually two acres were treated in 1998 with Dimilin. Again the treatment was successful with complete eradication.

Figure 178A

Currently, the GFC is concerned about four new exotic pests that threaten the State. These are the Asian longhorned **beetle** (*Anoplophora glabripennis)*, emerald ash borer **(***Agrilus planipennis)*, sudden oak death fungus **(***Phytophthora ramorum)*, and hemlock woolly adelgid (pg. 51). The GFC in cooperation with the U.S. Forest Service, USDA APHIS, Georgia Department of Agriculture and the University of Georgia Cooperative Extension Service, is conducting surveys across the State for these pests.

The Asian longhorned beetle has been found in New York and Illinois and eradication efforts in Illinois have been successful (**Figure 178A**). The beetle has killed thousands of maples and other hardwoods since being introduced some 12 years ago. It more than likely came into the U.S. in shipping material known as solid wood packing material (SWPM) that originated in Asia. The GFC has identified over 100 warehouses in Georgia that have been receiving SWPM from Asian markets. The number increases each year. To date, after four years of intensive survey efforts at these warehouses, the GFC has not found any suspect Asian longhorned beetles.

Figure 178B

The emerald ash borer is another exotic beetle from Asia that kills ash trees (**Figure 178B**). So far it has been found in southeastern Michigan, northern Ohio and Indiana. A small infestation was eradicated in Virginia near the Washington DC area in 2004. Spread has been through the movement of infested nursery trees. Based on surveys conducted in 2003 by the GFC, most of the ash trees sold in Georgia originate from local or southern nurseries thus reducing the risk of having the insect in Georgia.

A newly identified foreign pathogen threatens Georgia's oak woodlands. It is called sudden oak death. The fungus that causes the disease has existed in Europe for many years and was probably introduced into California in the early 1990's. Tens of thousands of coast live oak, tanoak and California black oak trees have been killed. This disease could have severe economic and environmental impacts if it reaches Georgia. In March of 2004, plants from a California nursery were identified as being infected with the fungus. Georgia nurseries had been receiving thousands of potentially infected plants from that nursery since January of 2002. In October of 2004 it was learned that two nurseries in Oregon had been shipping plants into Georgia that could have been infected with the fungus. The fungus causes leaf spots on many different species of plants (**Figure 179A**). These plants serve as sources of inoculum that infect trees. On the oak, the disease causes cankers underneath the bark that are characterized by dark zone lines (**Figure 179B**). Several Georgia nurseries have been identified as having received infected plants, but all have been checked and certified as free from the fungus.

Figure 179A

Figure 179B

Bark Lice

Bark lice or psocids are in the insect order Psocoptera. These insects do not damage trees. They form sheets of silk on the bark of main stems and branches and feed on fungi and lichens underneath the sheets of silk (**Figure 180**). Oak trees appear to be affected more than other hardwoods. Bark lice or psocids resemble aphids. Psocids appear to be more prevalent in the southern coastal plain of Georgia. Outbreaks are sporadic and local in nature that subside without chemical control.

Figure 180

Boxelder Bug

The boxelder bug, *Boisea trivittatus*, prefers to feed on boxelder but will feed on ash and maple. The adults are about 7/16 inch long; black with 3 longitudinal red stripes on the **thorax** and red margins on the basal half of the wings. The abdomen is bright red under the wings (**Figure 181**). The bugs feed primarily on the seed bearing trees by sucking sap from the leaves. Damage to the tree is considered minor but the bugs are a source of annoyance to homeowners. They congregate in large numbers in or on the outside of houses and other buildings in autumn looking for places to hibernate. They appear to be attracted to bright sunny surfaces. Thousands may literally cover the sides of buildings. Female boxelder trees should be replaced with males or the non-seed bearing ones. The bugs can be treated with an insecticide as they congregate on buildings.

Figure 181

Hazards of the Forest

Professional foresters, as well as everyday citizens, are often confronted with hazards while working or recreating in the forest. This section discusses venomous insects, spiders, ticks, snakes, poisonous plants, abandoned water wells, downed fences, stump holes, lightning, hazardous roots and dead standing trees or snags. No occupation is free of hazards or obstacles. Good safety precautions concerning these hazards are the first steps in avoiding a serious mishap.

A Guide to Biting and Stinging Insects and Other Arthropods

Introduction

Insects, scorpions, spiders and ticks are members of a group of animals known as arthropods. Several species can sting or bite, transmit disease organisms, cause serious allergic reactions and are considered harmful to humans.

Bees, wasps and hornets can also be the cause of injury without stinging. When accidentally disturbed or encountered, these insects can create so much excitement that people often panic and become careless while trying to escape. Individuals have been known to jump from ladders and scaffolding, abandon running machinery (bulldozers, tractors, chainsaws, etc.), throw tools and even loose control of their automobiles. The injuries sustained while trying to avoid a sting can be severe to fatal.

This section describes those harmful arthropods that are encountered during everyday activities. Information about their habits has been provided and should be helpful to people who work and recreate outdoors.

The medically important arthropods are found in all sorts of unexpected places. Utility workers, tree surgeons, painters and others may find themselves high above the ground when wasps appear. Children are likely to be stung or bitten while playing outside in yards, parks or school grounds. Servicemen and repairmen who crawl under buildings often encounter spiders and scorpions. Campers and hikers may find themselves far away from medical assistance when danger strikes.

Avoidance is a key step in preventing bites and stings. This section has been prepared to familiarize you with the most common, medically important arthropods and where they live. Be alert and keep a watchful eye and remember most arthropods are beneficial and only attack when threatened. Always consult with your physician or health care professional for the most up-to-date treatments of bites and stings.

Allergic Reactions

Venom and saliva of arthropods can cause allergic reactions in humans. The severity of reactions varies and depends on the nature of the venom/saliva and the individual's sensitivity to it. Most allergic reactions to stings and bites are brought about by the body's own immune system. Antibodies are produced to attack the intruding allergen. The antibody most closely associated with allergies is immunoglobulin E (IgE). We all possess IgE antibodies as part of our immune systems; however, some individuals appear to produce larger quantities. When these IgE antibodies collide with the allergens, chemical substances are released one of which, is histamine. Histamine can cause a number of reactions in humans. These reactions may affect the circulatory, respiratory and other body systems. The reactions vary in severity depending on the amount of histamine released. Persons whose immune systems are producing large quantities of IgE antibodies will exhibit more intense allergic reactions and are considered to be hypersensitive. Until first exposed to an allergen, the body has not developed any allergen-specific IgE antibodies; therefore, the first exposure to a venom is usually not life threatening. After the body has been exposed to a particular allergen, it becomes sensitized to it and future stings may result in similar reactions or even more severe reactions. The venom of honey bees and certain wasps contains histamine. Therefore, when histamine is injected directly into the body, reactions can occur immediately and are not antibody mediated as described above. **Honey bee stings and those of some wasps (social and solitary) contain histamine.**

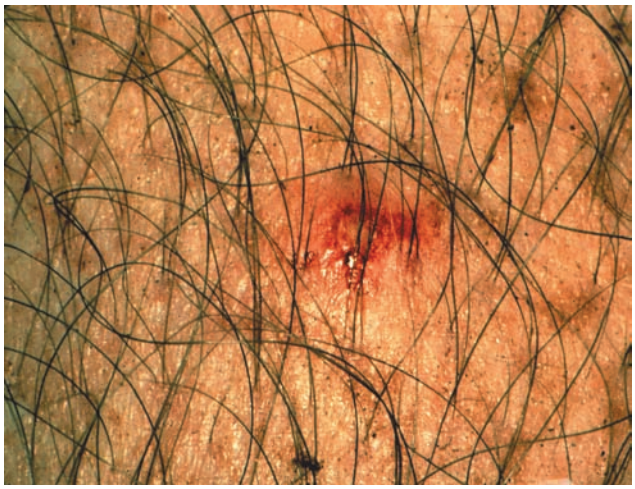


Figure 182

Fortunately only a small percentage of the human population is hypersensitive. The typical response to a single sting is intense pain and burning for 10-15 minutes. A weal often forms soon after the sting (**Figure 182**). Some local swelling around the sting site may occur. Generally, after a day or so only an itchy spot remains at the sting site.

Non-hypersensitive individuals receiving many stings often experience the same symptoms as with a single sting except the pain and swelling are more intense and last for longer periods. These reactions are referred to as **large local reactions** but are not considered life threatening and require no medical attention (**Figure 183**).

The reactions of medical concern are referred to as systemic or generalized reactions. Systemic reactions can be classified as cutaneous, vascular, or respiratory.

Figure 183

Cutaneous reactions involve only the skin and consist of rashes, itchiness, swellings, hives and general reddening.

Vascular reactions may lead to dizziness, fainting and unconsciousness.

Respiratory reactions consist of swellings and/or massive buildups of fluids in the respiratory system. This causes difficulty in breathing, sneezing, tightness in the throat and chest or frothing from the mouth. Respiratory reactions are terrifying to the victim because he or she perceives they are suffocating.

Other reactions often involve the gastrointestinal tract and result in nausea, vomiting, diarrhea, headache, chills or fever, weakness and a feeling of impending fear. Reactions involving the vascular and respiratory systems are of major medical concern. The inability to obtain air or a very low or absent blood pressure means oxygen deprivation is occurring to the brain that may result in possible death. Reactions, which cause congestion in the heart, brain or lungs, are anaphylactic in nature and are very serious.

Hypersensitive persons can be desensitized by receiving injections of venom preparations from the arthropod species to which they are allergic. The injections are gradually increased in strength until the patient can tolerate a few stings without having an allergic reaction. This procedure is known as immunotherapy and is done by a physician (allergist).

Immunotherapy is a complicated and lengthy procedure and the patient will require numerous injections. The entire program must be completed as prescribed by the physician. Recent studies indicate venom immunotherapy is highly effective in reducing the reoccurrence of a systemic reaction and is recommended for hypersensitive people. However, people who have undergone immunotherapy should continue to avoid stings and be aware that they may be one of the unfortunate few who may react to a sting at some later date. Insect sting kits are available by prescription and come highly recommended for those who are hypersensitive to stings even following immunotherapy. These kits contain a pre-measured dose of epinephrine that can temporarily halt the onset of severe systemic reactions. Sting kits do not replace expert medical care but should be carried by hypersensitive individuals and those who work in remote places far away from emergency medical aid (**Figure 184**).

Figure 184

The Social Wasps and Bees
(Order Hymenoptera)

The social Hymenoptera includes the fire ants, honey bees, bumble bees, paper wasps, yellowjackets and hornets. These insects are social in that they live in colonies in which individuals perform certain functions. The individuals of a colony are of three types-queens, workers and males. The queens and workers are **females that possess stingers**, which are capable of delivering a painful, venomous jab. The stinger is a modified egg laying tube that is used for defense and for paralyzing prey during food gathering. **Some colonies may contain several hundred stinging members. This increases the likelihood of multiple stings when a nest is disturbed.** Hymenoptera venom is protein-based except in the fire ants, which is composed of potent alkaloids.

Figure 185

The paper wasps, yellowjackets and hornets construct their nests out of materials that consist of wood or leaves that have been chewed and worked into a papery substance. These nests can be found in many places and are frequently encountered by people and pets. Nests are abandoned before winter and only the queens survive the winter. In the spring she emerges from hiding to start a new nest and colony.

The **yellowjackets** are medium sized wasps marked with black and yellow bands or stripes that build nests below or above the ground (**Figure 185**). Subterranean nests are often built in rotten stumps, under landscape timbers and firewood piles, and in the sides of terraces, gullies or ditches. Above ground nests occur in barns between stacks of baled hay or straw, under porches, in block voids and wall voids of buildings (**Figure 186**). The eastern and southern yellowjackets are two common species found in the South. Both species are very aggressive when nesting sites are approached and intruders are often stung repeatedly before they can retreat. People are often stung by yellowjackets while mowing grass, walking behind tractors that are plowing or excavating dirt or walking through wooded and brushy areas. Nests located in wall voids may threaten people inside the home when individual yellowjackets enter a room through openings around electrical outlets.

The **bald-faced hornet** (aerial yellowjacket), is not a true hornet. It's an aerial nesting yellowjacket that prefers to build nests in trees, bushes and shrubs (**Figure 187**). The bald-faced hornet is marked with a white face and is considerably larger than the other yellowjackets. The nest is very similar in size and shape to a yellowjacket's nest and it can pose a serious threat to people when built close to the ground.

Figure 186

Figure 187

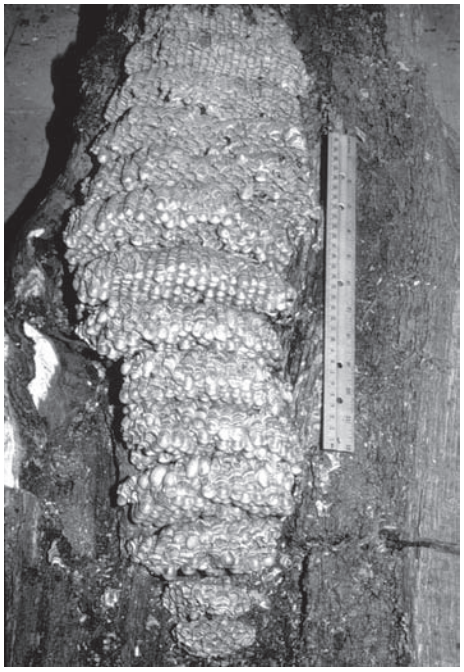


Figure 188

The **European hornet** is the only true hornet in North America. It was unknowingly brought to the U.S. around 1850 from Europe and prefers to build its nests in tree cavities, chimneys, wall voids and hollow porch posts (**Figure 188**). This hornet is attracted to lights at night and is often a nuisance to people who like to sit on the porch and "chew the fat". It is a relatively large wasp and is reddish brown with lighter markings around the head and abdomen. It is reluctant to sting when encountered away from the nest. However, do not swat at the one buzzing your head, you may provoke a sting. The nests are large and may be protected by several hundred stinging wasps.

The **guinea wasp** is often confused with the yellow-jacket because of similar black and yellow markings (**Figure 189**). It is probably encountered more than any other paper wasp. It will nest under mailboxes, propane tank tops, above doorways, under decks and porches; on playground equipment and in shrubbery and brush piles. The nest is usually small (<20 wasps) and is attached by a single pedicel.

Figure 189

The **red wasp** is found more often along river and creek banks in trees and bushes. However, large nests are common around barns and other out buildings. One nest containing over 500 wasps was removed from an idle chimney. This wasp is larger than the guinea wasp and is reddish brown in color (**Figure 190**). The nest is usually larger than the guinea wasp's.

The **bumble bees** and **honeybees** are easily recognized. The bumble bees are represented by several species; some large and others only slightly larger than the honey bee (**Figure 191**). Bumble bees nest underground

Figure 190

Figure 191

in pastures, orchards, yards and parks; under clumps of matted straw or grass and in abandoned bird houses and animal burrows. Most bumble bees are covered with black and yellow hairs over much of the body. They are often confused with the not-so-hairy carpenter bee. Bumble bees are very aggressive and may often pursue an intruder for hundreds of feet. People who mow large fields, pastures or orchards are often stung by bumble bees. Otherwise, most stings occur around flowers while bees are feeding.

Honeybees naturally nest in trees with cavities, but when such sites are limited, they will choose attics or walls in houses and other buildings. Rarely they will build a hive in the open air attached to a tree branch (**Figure 192**). A honeybee stings only once. The stinger has inverted barbs down the sides and when it's thrust into the skin, the barbs catch the skin. As the bee attempts to fly away, the stinger is pulled from the body along with the venom sac (**Figure 193**). The **Africanized honeybee** is sure to spread throughout the southeastern U. S. over the next 10 years. The venom of this bee is not any more treacherous than that of our familiar honeybees; however, the African bee is very aggressive and attacks with a vengeance.

Figure 192

Figure 193

Fire ants have become a major nuisance throughout much of the South. The red and black imported fire ants were introduced into the United States from South America (Brazil and Uruguay). The southern fire ant is a native species. Their mounds are common in pastures, lawns, parks, golf courses and along roadsides (**Figure 194**). Stings from the red imported fire ant always cause intense burning and produce necrotic pustules that itch for days (**Figure 195**). Fire ants can be distinguished from most other ants by having two nodes on the pedicel. The venom contains a potent alkaloid and only a trace of protein.

Figure 194

Figure 195

Solitary Wasps and Bees
(Order Hymenoptera)

This group includes those bees and wasps that do not have a social structure and are only occasionally encountered by people. Among the more common ones are the velvet ants, sweat bees, spider wasps, cicada killers, mud daubers, and carpenter bees.

The **velvet ants** are wasps and not ants. In the southeastern U.S. they are called "cow killers." The females are wingless and scurry along the ground alone in search of prey. They can inflict painful, repeated stings. They are brightly colored and have a velvety texture. A common species throughout the south is red and black (**Figure 196**). Female velvet ants like to roam in open places where the ground cover is sparse. Males can fly and are often a nuisance to golfers around greens. Remember that males can't sting. Velvet ants are predacious on spiders and other insects and are very beneficial, discounting of course, their painful sting. Wearing shoes when outdoors and being careful where you sit can help prevent stings from velvet ants. Sitting on the ground is really a poor practice for a number of reasons (chiggers, ticks, velvet ants, fire ants, spiders, and scorpions ad infinitum).

Figure 196

Carpenter bees look like bumble bees except their abdomens are smooth and void of hair (**Figure 197**). The females can sting but rarely do. Carpenter bees nest in seasoned wood and can be damaging to log homes and other wood in use (**Figure 198**). The males have a white marking on the face and often buzz people into intimidation, but we now know those male insects can't sting, so why get upset? Carpenter bees visit flowers often and blend with bumble bees quite effectively.

Figure 197

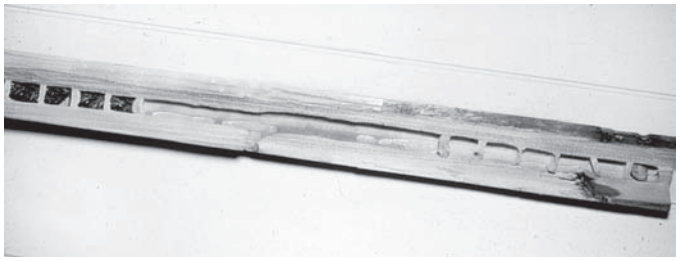


Figure 198

Treatment of Hymenoptera Stings

Warning: If stung, remove all rings and bracelets immediately. Arms and hands may swell twice their normal size in a matter of minutes. If you are known to be hypersensitive, wear a medical alert bracelet in the event you are stung and lose consciousness.

Local Reactions:

- ❑ A honey bee stinger should be scraped off with a knife blade, credit card, or long fingernail. If the stinger is lifted with fingers or forceps, the venom sac, which is attached, could get mashed, forcing more venom into the victim.
- ❑ Wasps and other bees do not leave stingers in the skin. There is no need to try and scrape for stingers.
- ❑ Wash the sting site with soap and water or disinfect the site with an antiseptic to prevent infection. Elevate the affected limb to about heart level.
- ❑ Several topical creams or ointments are available that contain benadryl which will relieve itching and reduce local swelling. If these are not available, **wet table salt** placed immediately on the sting site will lessen the swelling and pain (**Figure 199**). None of these remedies will prevent a systemic reaction in hypersensitive persons.

Figure 199

- ❑ Be aware of systemic reactions developing within 10-30 minutes.

Systemic Reactions:

- ❑ Use an insect sting kit if available. Follow the directions provided in the kit. Transport the victim to the nearest physician or urgent care center. **One study indicated that 70% of all deaths related to Hymenoptera stings were from respiratory failure caused by massive secretions and/or swelling resulting in blocked airways.**
- ❑ If a sting kit is not available, place an ice pack on the sting site and transport the victim to the nearest medical facility. Remember, most systemic reactions occur within 10-30 minutes. **One study indicated that 58% die in less than 1 hour and that one-half of the deaths from Hymenoptera stings occur in victims over 50 years of age.**
- ❑ A sting kit is not a substitute for a physician. Even after the administration of epinephrine, a victim may experience a second phase of anaphylaxis hours after the initial reaction. **Always see a physician and make sure family members know how to use the sting kit.**

Avoiding Stings and Other Injuries

- ❑ Wear dull colored clothing when outdoors. Brightly colored clothing attracts certain Hymenoptera. **Remember** flowers are brightly colored and many bees and wasps feed on the nectar and pollen of flowers.
- ❑ Wear long sleeves and long legged pants outdoors where practical. Sweat bees can sting and are attracted to sweaty skin.
- ❑ Do not wear sweet smelling cologne or perfume when outdoors. Sweet odors attract bees and wasps.
- ❑ Before you smell the roses make sure a bee hasn't beat you to them. Flowers that are big and showy can harbor a bee deep inside.
- ❑ Don't swat at flying bugs. If you hear a buzzing sound around the head, stay calm and retreat slowly.
- ❑ If you encounter a nest, don't panic and don't forget where you are. Tree surgeons have let go of ropes high above the ground and painters have jumped from scaffolding.

Spiders

All spiders are considered venomous, but most species do not cause serious reactions in people. The **black widow** and **brown recluse** are exceptions. The brown recluse is easily recognized by a violin or fiddle-shaped mark on the top of its body (**Figure 200**). Three other species of spiders frequently found in the forests are the golden silk spider, garden spider, and spiny-bellied spider (**Figures 201-203**).

Figure 200

Figure 201 - Golden Silk Spider

Brown recluses are shy spiders that prefer quite, undisturbed places. People are often bitten while cleaning out closets, basements, or other storage areas. Shoes and clothing in storage are often infested.

Reactions to brown recluse venom may be mild to very severe. The venom is classified as a necrotoxin. The bitten area becomes painful and swollen

Figure 202 - Garden Spider

Figure 203 - Spiny-Bellied Spider

in a short period. Blisters often form on the skin around the bite site (**Figure 204**). The next day the skin at the bite begins to turn purple. During the next week or more the skin turns black as the cells die (**Figure 205**). Later the blackened area sloughs off leaving a depression in the skin (**Figure 206**). The depression slowly fills with scar tissue (**Figure 207**). Many times the bite site has to be repaired by a surgeon to promote healing otherwise an unsightly scar often remains. Brown recluse spiders can become a nuisance in untidy areas at home or on the job. Closets, basements, and other storage areas should be periodically cleaned and straightened to discourage spiders from taking up residence there. Work gloves, shoes, boots, and coveralls should be sealed in plastic bags when not in use to inhibit the invasion of spiders.

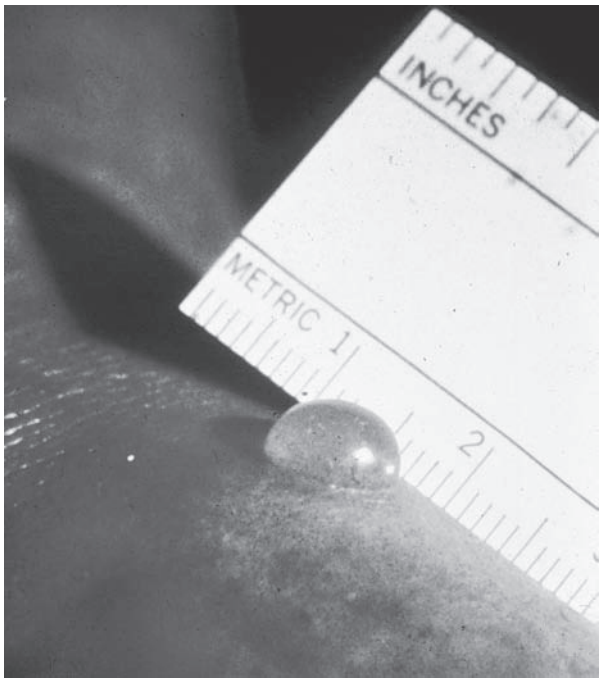


Figure 204

Figure 205

Figure 206

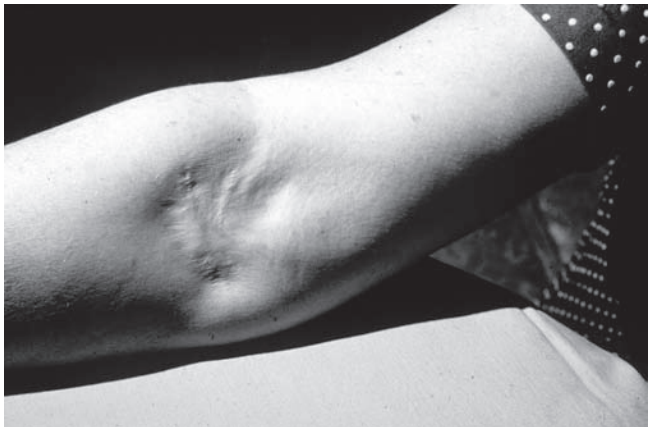


Figure 207

The **black widow** is considered an extremely poisonous species. The mature female is easily identified by a red hourglass mark on the underside of the abdomen (**Figure 208**). Younger females will be variously marked with white and red on the upper abdomen (**Figure 209**).

Figure 208

Outdoors, black widows build their webs close to the ground under houses, stones, wood, tin, in tall weeds and grasses, in water meter boxes, around playground equipment, and many other unlikely places. Indoors, the spiders often are found in attics, basements, and under cabinets.

Figure 209

Reactions to a black widow bite are unique and usually follow a similar pattern among all victims. The venom is classed as a neurotoxin. The bite itself is very seldom felt but immediate pain soon follows. Victims suffer with severe muscular pain, stiffening of abdominal muscles, weakness, tremor, sweating, and salivation. Convulsions may occur in small children. Death is rare but does occur more frequently in children and older persons. In one study, large, muscular adult men seemed to be affected the most. Local treatment of the bite site is usually not effective. The victim should get immediate medical attention. Try to capture the spider so physicians can make a positive identification. This will aid in treatment.

Rubbish piles, old boards, and tin should be removed from around buildings. Grass and weeds should be mowed frequently. Children's play areas should be inspected weekly during the warm months for spiders. It is not uncommon to find black widows under sandboxes, around playhouses, benches and tables, and various types of homemade and commercial playground equipment.

The golden silk spider is chiefly a Coastal Plains spider. It inhabits dense bottomland woods and can number many hundreds per acre. The bite is painful but severe reactions are not reported.

The spiny-bellied spiders are probably the most commonly encountered spiders in the forests. Their webs can be obnoxious when they get entangled in the hair and face area. Their bite is nothing to fear, however.

The arboreal orb weavers (not pictured) are common in forests too. They often suspend silk threads across wide areas such as roads and fireline breaks. An orb web is then spun in the center of the silk strand in the evening hours and then removed before daylight. The strand of silk remains attached between two objects during the day and then again in late evening the spider crawls out and reconstructs the orb web in hopes of catching a night flying prey. During the day, these spiders hide in folded leaves in trees.

Scorpions

Scorpions are nocturnal and are rarely seen by people unless they invade the home. Scorpions often invade houses built in wooded areas. The little southern devil scorpion is a common species throughout the South (**Figure 210**). It is not a dangerous species but it can be very annoying by invading attics, closets, cabinets, and vacation cabins and utility buildings. Reports are common of scorpions falling from ceilings at night onto beds with sleeping people.

Figure 210

Scorpions can be discouraged from taking up residence inside homes and rental cabins by keeping the yards and areas adjacent to the buildings clear of wood piles and other debris. Most stings from scorpions usually occur when people walk barefoot through the house at night or working outside without gloves.

Stings from scorpions in the southeastern U.S. are not life threatening and usually require no medical attention, unless the victim happens to be sensitive to the venom.

Ticks

Ticks are important vectors of organisms causing disease in humans. Some common southeastern species are lone star tick, American dog tick, brown dog tick and blacklegged tick. Among the diseases that are transmitted by ticks, Rocky Mountain spotted fever (RMSF), Lyme disease (LD) and ehrlichiosis are the most noted. Symptoms of RMSF include fever, headache and rash. The rash usually develops a few days after infection, around the wrist, ankles and on the back. Initial symptoms feign those of the common flu and many victims often delay going to a physician. A bacteria-like organism called a rickettsia causes RMSF. Not all ticks are infected with the organism but it only takes one infected tick bite to contract it.

Lyme disease is caused by a spirochete and is characterized by a distinctive skin lesion in about 65% of the cases. The skin lesion is called erythema migrans (EM) and appears from 3 days to 1 month after the bite (**Figure 211**). Victims usually suffer with headaches, fever, arthritic-like pain and a stiff neck. Several tick species in the South can transmit RMSF and LD, but the blacklegged tick is most often associated with LD (**Figure 212**).

Figure 211

Figure 212 - Female - left, male - right

A group of biology students from Mercer University in Macon, Georgia have been screening lone star ticks captured from 6 middle Georgia counties for the presence of the causative agents of Lyme Disease and human ehrlichiosis. So far, 17% of the lone star tick population has been infected with *Borrelia burgdorferi*, the causative agent of Lyme disease and 3% with the causative agent of ehrlichiosis.

Human monocytic ehrlichiosis (HME), and human granulocytic ehrlichiosis (HGE) are transmitted by ticks. Both types cause fever, headache, chills, sweating, muscle aches, nausea and vomiting. Antibiotic therapy is effective if started early in the course of infection. The lone star tick is suspected of being the primary vector in the southeastern U.S.

Persons working in tick-infested areas should always use a repellent on the outer clothing or at least inspect themselves frequently for ticks. Children should be examined regularly all over after coming in from outside areas. They need to be examined in the scalp and groin areas in particular.

Immature ticks are called larvae or “seed ticks” and have only six legs while adults have eight. Both stages are capable of transmitting disease organisms.

Ticks should be removed with tweezers or forceps. If parts of the mouth are left in the skin, local irritation can persist for weeks. The mouth is anchored in with barbs and cemented saliva. It is not an easy job to remove an imbedded tick. Unattached ticks can be lifted with adhesive tape. **If a tick(s) is found on your body or a family member's and you feel it has been attached for 6 or more hours, you need to be wary if any flu-like symptoms or rashes appear over the next few days. If so, call your physician and get an examination. Ticks are more likely to vector a disease organism after being attached for 6 or more hours (some experts argue 24 hours, but hey, don't take a chance). So quick detection and removal is very wise. Children often lose their appetites and are irritable if infected, so be a nosy parent and ask questions and always think tick in the active season.**

A vaccine has been developed against Lyme disease. LYMErix is a noninfectious vaccine that has been developed by SmithKline Beecham. Persons who habitually encounter ticks should discuss LYMErix with their physician.

Stinging Caterpillars

Some common stinging caterpillars are the saddleback, tussock moth, puss moth, hag moth, Io moth, Isa moth and spiny oak slug (**Figures 213-219**). All feed on the leaves of various trees and shrubs between March and September and are capable of causing severe reactions in certain people.

The caterpillars are equipped with stinging spines located over their bodies. Each spine is connected to a poison gland that injects venom when touched. Children should be taught not to handle caterpillars unless they are recognized as harmless species. Wearing long-sleeved shirts and long pants will prevent many brushes with these caterpillars while pruning trees and shrubbery or just taking a stroll through the woods.

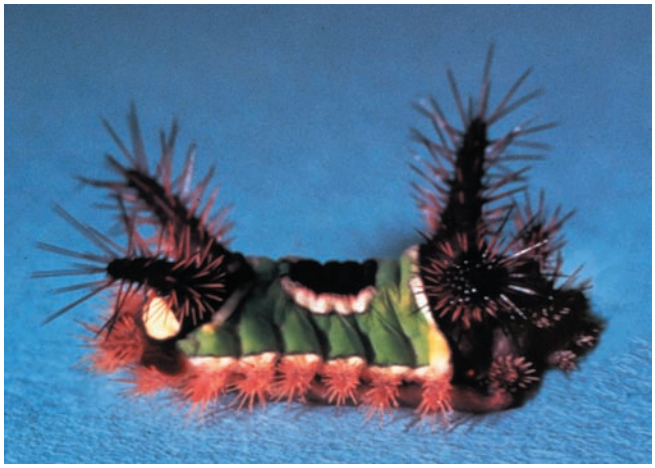


Figure 213 - Saddleback caterpillar

Figure 214 - Tussock moth caterpillar

Figure 215 - Puss caterpillar

Figure 216 - Hag moth caterpillar

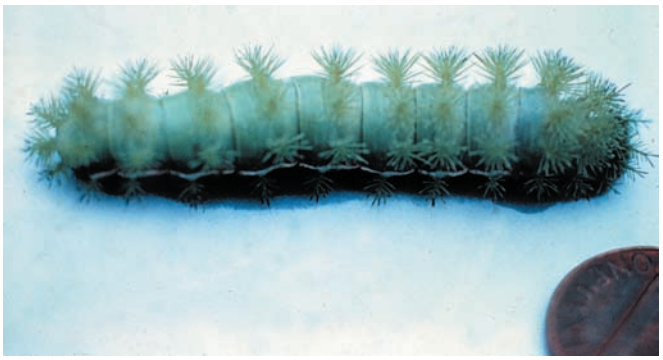


Figure 217 - Io moth caterpillar

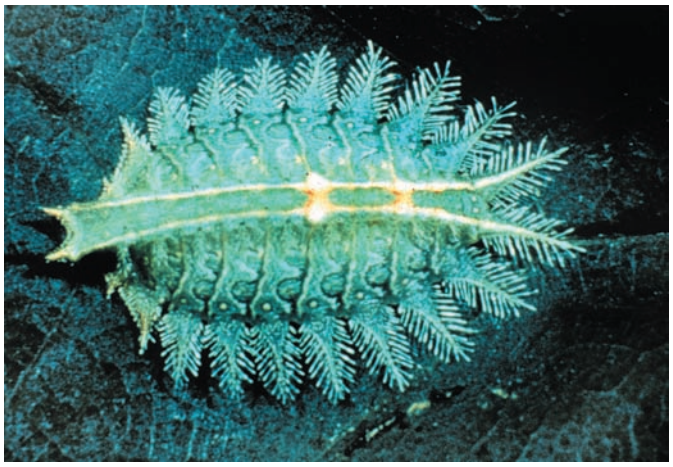


Figure 218 - Isa moth caterpillar

Figure 219 - Spiny oak slug caterpillar

Biting Flies and Gnats

Deer, stable, horse and black flies, no-see-ums and mosquitoes are some of the most obnoxious biting insects on earth. They are probably the reason many people stay indoors or away from woods and streams. Long-sleeved shirts and long pants are effective in reducing bites from these insects. Repellents are not very comfortable considering you have to apply them to the face and other exposed body areas. Reactions from fly bites vary from local to systemic. Systemic reactions are rare but are just as life threatening as those caused by stinging insects. The most common reactions are wheals, swelling, and itching. Various over the counter products can be used to relieve the itching and swelling from fly bites. If you are known to swell from fly bites, remove all rings and other tight fitting jewelry. Arms and hands can swell to frightening dimensions on rare occasions (**Figure 220**).

Figure 220

Chiggers

Chiggers or redbugs belong to a group of arthropods called mites. They are closely related to ticks. Chiggers are notorious pests of humans. The six-legged larva is the attacking stage and is barely visible to the unaided eye (**Figure 221**). Chiggers live outside in the moist humus layers of woods, meadows and grassy areas. Some areas are more "chigger" ridden than others. Out-of-bound areas of golf courses are ideal places for chiggers to live. Pine straw and other decaying woody materials provide rich environments for chigger development plus the occasional meal from a wandering golfer. Chiggers feed on many species of animals and like to bite humans around the waistband of underwear and any other place where the clothing fits tightly. Chiggers actually feed on lymphatic fluids and rarely consume blood.

Chiggers stay attached for only a short period and then drop off. Itching continues due to the irritation from the chigger's saliva. Itching can be relieved with most over-the-counter ointments. Warm soapy baths are effective in removing most chiggers. Infested clothing should be washed immediately to prevent chiggers from finding you or a family member to bite. Repellents containing DEET are very effective in keeping chiggers off of the body.

Figure 221

Snakes

There are several species of snakes dangerous to humans in the southern states that are frequently encountered. These are the copperheads, cottonmouths and rattlesnakes. These snakes are grouped as pit vipers; that is, snakes that have a heat sensitive hole or pit between the eye (with elliptical-shaped pupil) and nostril. The cottonmouth by far is the most aggressive of the pit vipers. Each species has distinct markings that enable easy identification (**Figures 222-227**).

People that work alone in remote wooded places should wear protective boots or leggings and be familiar with local medical protocols for treating snake bites.

Figure 222 - Copperhead

Figure 223 - Coral snake

Figure 224 - Timber rattlesnake

Figure 225 - Cottonmouth

Figure 226 - Pigmy rattlesnake

Figure 227 - Diamondback rattlesnake

Plants Causing Contact Dermatitis

Poison ivy, poison oak, and poison sumac are plants that can cause intense itching and dermatitis when contacted by sensitive persons (**Figure 228**). The poisonous ingredient of these plants is urushiol and it is found in the sap of bruised plant parts (roots, stems, flowers, fruit, leaves, and pollen). Contact may be direct or indirect such as touching an animal or item that came in contact with the plant. Droplets of sap can even be contacted from burning the plants. Persons should become familiar with the plants and learn to avoid them. If contact is accidentally made with one of the plants the area of the skin affected should be washed immediately with soapy water. An antihistamine cream or steroid cream may help relieve itching. However; a physician should be contacted for diagnosis and treatment. Over-the-counter products are now available that can be applied to the skin that will block the poison from entering the skin. Information about these products can be obtained from your local pharmacist.

Figure 228 - Poison Ivy

Miscellaneous Hazards

There are many hazards of the forest other than creepy, crawly things and poisonous plants. Awareness of these hazards will often suffice in preventing an accident. Common man made hazards are abandoned water wells that were left uncovered, and downed fencing (**Figure 229**). Natural hazards would be stump holes, exposed roots, dead trees, and snags. Old rubbish piles in the forest may indicate an abandoned house site and possibly an open well nearby. Stump holes roots and fencing can be avoided by watching where you step. Standing dead trees and snags are common hazards in the forest. They should be avoided particularly on days when the wind is gusting above 20 miles per hour.

Figure 229 - Abandoned, uncovered water well

Lightning strikes to trees are very common throughout the South. People should avoid going into the forest whenever thunderstorms are looming. However, if caught, one should not seek shelter under a lone tree.

Appendix

Southern Pine Beetle Historical Data for Georgia

Georgia's Most Destructive Forest Pest

36 year totals

 # Spots **134,103**

$ Loss **$254,295,101**

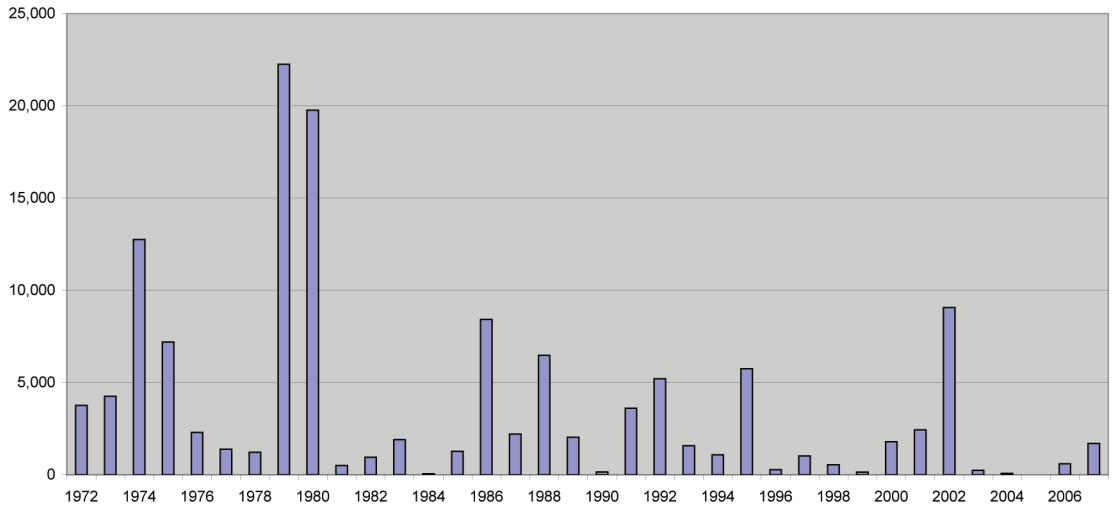
36 year averages:

 # Spots **3,725 per year**

$ Loss **$7,063,753 per year**

Year	Total Spots	$ loss
1972	3,766	$970,771
1973	4,263	$6,290,700
1974	12,752	$7,081,540
1975	7,201	$1,324,985
1976	2,300	$620,625
1977	1,388	$306,777
1978	1,221	$172,468
1979	22,254	$25,216,776
1980	19,765	$19,737,886
1981	507	$95,092
1982	955	$849,789
1983	1,906	$1,763,285
1984	61	$438,360
1985	1,278	$4,879,991
1986	8,426	$9,673,712
1987	2,215	$2,302,346
1988	6,485	$14,111,039
1989	2,043	$8,405,832
1990	157	$3,005,106
1991	3,606	$3,787,367
1992	5,210	$3,515,585
1993	1,583	$2,916,690
1994	1,084	$771,098
1995	5,750	$27,866,516
1996	279	$5,681,934
1997	1,023	$2,609,742
1998	549	$1,943,721
1999	147	$1,472,332
2000	1,798	$8,578,988
2001	2,438	$14,292,363
2002	9,070	$57,239,375
2003	239	$931,899
2004	79	$370,116
2005	0	$0
2006	601	$928,545
2007	1,704	$14,141,750

Number of Southern Pine Beetle Spots Detected by Year in Georgia



For more information on the southern pine beetle, visit: http://whizlab.isis.vt.edu/servlet/sf/spbicc/index.html

Based upon annual aerial surveys conducted by the Georgia Forestry Commission

Disease Control Guide

Host-Pest	Fungicide[1]	How to Apply	Physical Control
Arbovitae, Junipers, Cedar, Arizona Cypress Twig Blight (Phomopsis)	Dithane Mancozeb Fore	Apply when symptoms first appear around May. Repeat 3-4 times at weekly intervals.	Plant trees in areas with good circulation and full sun. The disease is most serious during wet weather or in shady, moist places. Water the soil and not the plant's foliage.
Crabapple Cedar Rusts	Mancozeb	Spray when flower buds start to open. Repeat 3-4 times and at 10-day intervals.	Prune out infected branches about one foot below any visible discoloration and destroy.
Fireblight	Agri-mycin Kocide	Spray before bud break in the spring. Repeat at 5-7 day intervals until end of bloom.	
Powdery mildew	Thalonil	Spray when disease first appears or as leaves start to expand. Repeat 1-2 times 10 days apart.	
Scab	Banner Maxx	Spray the new growth. If rainy, spray several times 10-14 days apart.	
Dogwood Fungus leaf spots Flower and leaf blight	Banner Maxx Mancozeb	Spray when flower bracts are fully expanded. Reapply 1 or more times at 2-week intervals.	
Elm Anthracnose Black leaf spot Other leaf spots and Blights	Banner Maxx Bayleton Mancozeb	Spray 2-3 times at 10-14 day intervals when leaves are fully -grown.	
Flowering Cherries Leaf spots	Banner Maxx Thalonil	The first application should begin when flower petals fall followed by 2 more applications at 2-week intervals	
Powdery mildew	Banner Maxx Benefit Thalonil	Follow Label	
Wild Cherries/Plums Black Knot Fungus	No control		Prune infected branches.
Holly Fungus leaf spots (tar spot)	Banner Maxx Mancozeb	Spray when new growth begins in the spring. Repeat in 2 weeks.	
twig dieback	Protect T/O	Follow Label	
Magnolia Leaf spots	See Holly	See Holly	See Holly

Disease Control Guide

Host-Pest	Fungicide[1]	How to Apply	Physical Control
Maples Anthracnose, leaf spots, Tar spot, leaf scab	Banner Maxx	Spray 3 times: just before buds open; when leaves are half grown; and when 10-14 days old.	Rake leaves in the fall and compost or burn.
Oaks-Hickories Anthracnose, leaf spot, Leaf blister, leaf scab	Banner Maxx Thalonil Strike	Spray 3 times just before buds open; when leaves are half grown; and when 10-14 days old.	Rake leaves in the fall and compost or burn.
Pines Needle diseases in Christmas trees	Mancozeb	Apply every 3-4 weeks. Start in mid April when new growth is ½"- 2" long. Spray every 3-4 weeks through July.	Prune the lowest whirl of branches so that shed needles will fall to the ground.
Brown spot needle Blight in nurseries		Apply at 10-12 day intervals from June to October.	Use prescribe fire in older stands to control brown spot.
Sycamore Anthracnose	Banner Maxx	Apply at bud break. Repeat 7-10 days later.	

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Host-Pest	Pesticide[1]	How to Apply	Non-Chemical
Arborvitae Bagworms	Diflubenzuron (Dimilin) Bt (*kurstaki*) Acephate (Orthene) Carbaryl (Sevin)	Bt should be used whenever possible to avoid killing natural enemies. Treat when larvae first hatch before bags are constructed.	Hand pick and destroy bags if practical.
Ash Ash borer	Bifenthrin (Onyx®)	Spray trunks and branches thoroughly in May, June, August and September.	Protect trunks from weed trimmers and lawnmowers.
Boxelder Boxelder bug	Carbaryl (Sevin)	Spray trunks and branches of infested trees in early summer. Treat bugs in fall as they congregate on buildings.	Plant non-seed bearing trees.
Cedar Bagworms	See arborvitae		
Cherry Eastern tent caterpillar	Bt (*kurstaki*) Malathion Acephate (Orthene) Carbaryl (Sevin)	Treat when webs first appear.	Webs and caterpillars can be destroyed by hand.
Chestnut Chestnut weevil	Carbaryl (Sevin)	Apply in sufficient amounts to cover tree. Apply 3-4 sprays at weekly intervals beginning when weevils emerge or about August	
Crabapple Aphids Mites Scales Eastern tent caterpillar	Acephate (Orthene) Acephate (Orthene) Carbaryl (Sevin) Horticultural soap Horticultural oil Malathion	Apply when aphids or mites are first noticed. Repeat if necessary. Apply oil as dormant spray Treat when webs are small.	Remove and destroy by hand. Prune egg masses from twigs during winter.
Dogwood Dogwood borer Scales 	Bifenthrin (Onyx®) Endosulfan (Thiodan) Malathion Carbaryl (Sevin) Horticultural soap Horticultural oil	Spray trunk and bases of lower branches in mid-May and repeat twice at 2 week intervals. Apply when crawlers are present. Use oil as dormant spray.	Avoid injury to trunks with weed trimmers and lawn mowers.
Elm Smaller elm leaf beetle Larger elm leaf beetle	Malathion	Treat when insects appear.	

Insect Control Guide

Host-Pest	Pesticide[1]	How to Apply	Non-Chemical
Elm (cont'd)			
Cankerworms	Carbaryl (Sevin) Bt (*kurstaki*)	Apply when worms are present	Remove webs and worms by hand.
Fall webworm	Malathion Bt(*kurstaki*)	Apply when webs are first noticed.	
Woolly aphid	Malathion	Treat when aphids appear.	
Hickory			
Hickory bark beetle	No chemical control	No chemical control	Cut and remove infested trees.
Twig girdler	No chemical control	No chemical control	Gather all severed twigs and destroy.
Holly			
Leaf miner	Dimethoate (Cygon) Acephate (Orthene)	Apply when miners begin to appear. Repeat spray in 21 days.	Mined leaves can be hand picked and destroyed in light infestations.
Juniper			
Bagworm	Bt (*kurstaki*) Carbaryl (Sevin) Acephate (Orthene)	Treat when bags are small	Pick bags by hand and destroy.
Webworm	Carbaryl (Sevin)	Treat when worms appear	Destroy webs by hand.
Locust			
Locust borer	Bifenthrin (Onyx®)	Spray trunks thoroughly in late August or early September.	
Magnolia			
Magnolia scale	Malathion Carbaryl (Sevin) Acephate (Orthene) Horticultural oil	Spray when crawlers are active. Apply in dormant season	
Maple			
Borers	Bifenthrin (Onyx®)	Treat infestations in May, June, and July.	
Scales	Carbaryl (Sevin)	Treat when crawlers are active.	
Aphids	Acephate (Orthene) Malathion	Treat when aphids are noticed.	
Mimosa			
Mimosa webworm	Bt(*kurstaki*) Acephate (Orthene) Carbaryl (Sevin)	Treat when worms appear.	Destroy webs and worms by hand.
Oak			
Scales	Carbaryl (Sevin) Horticultural oil	Treat when crawlers are active. Apply as dormant spray.	
Oakworms, webworms	Acephate (Orthene) Carbaryl (Sevin) Bt (*kurstaki*)	Treat when worms appear.	Pick worms by hand and destroy.
Galls	No chemical control		Prune twigs and destroy.

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Host-Pest	Pesticide[1]	How to Apply	Non-Chemical
Pine			
Aphids	Malathion	Treat when aphids appear.	
Tip moths	Asana XL Acephate (Orthene) Carbaryl (Sevin) Pounce 3.2 EC/25WP	Control is best achieved in Christmas trees when pheromone baited traps are used to determine moth emergence.	
Black turpentine beetle	Onyx®(Bifenthrin)	Spray trunks of trees to runoff to a height of 5 or 6 feet or to the highest pitch tube.	
Ips engravers and Southern pine beetles	Onyx®(Bifenthrin)	Infested trees should be removed. Healthy trees can be protected if the main trunk is sprayed from top to bottom.	Salvage all infested trees
Pales, Pitch-eating and Terminal weevils	Imidan 70WSB Pounce 3.2 EC	Spray stem of seedlings to runoff. Dip tops of seedlings down to and including the root collar.	
Scales	Malathion Acephate (Orthene)	Spray when crawlers are active during May, June and July.	
Sawflies	Malathion Carbaryl (Sevin) Acephate (Orthene)	Spray when larvae are first noticed.	
Sycamore			
Sycamore lace bug	Malathion Carbaryl (Sevin) Acephate (Orthene)	Damage is noticeable in mid to late June. Treat undersides of leaves when insects appear. Repeat every 10 days as needed.	
Tulip Poplar			
Tuliptree scale	Carbaryl (Sevin) Horticultural oil	Apply when crawlers are present in August Apply oil as a dormant spray.	
Poplar tentmaker	Acephate (Orthene)	Apply when larvae are present.	
Walnut			
Aphids	Malathion Dimethoate (Cygon)	Apply when aphids appear.	
Walnut caterpillar	Diazinon Carbaryl (Sevin)	Apply when larvae appear.	
White Pine			
White pine weevil	Diflubenzuron (Dimilin)	Spray when weevils first appear about mid-April.	Prune out and destroy infested terminals.
Willow			
Leaf beetles	Acephate (Orthene) Carbaryl (Sevin)	Apply when beetles appear.	
Tent caterpillars	Carbaryl (Sevin) Acephate (Orthene) Bt (*kurstaki*)	Treat when webs appear.	Destroy webs and worms by hand.

Applying Forest Health to Management Plans

Improving Forest Stewardship and Management Plans by Incorporating Forest Health Recommendations

Foresters sometime fail to consider forest health recommendations in their management plans. Forest health prescriptions can be involved and require a working knowledge of forest entomology and pathology. Hopefully this handbook will enable foresters to refer more often to forest pests in the plans they prepare for landowners.

Most of the insects and diseases encountered by foresters are insignificant to forest health and do not deserve scrutiny in a forest plan. However, some are capable of becoming pests due to unfavorable conditions such as droughts, floods, and cultural practices we impose upon them.

The following exercise of questions and information has been inserted to challenge the forester to make associations between their management or stewardship plans and potential pest problems. Some of the information is a repeat and can be found in the previous sections of this handbook. Hopefully this section will serve as a beginning point for foresters and other land managers to better inform the private landowner about issues that affect forest health.

Geography, Geology, and Soils

- ❏ Have I classified the soils on this tract?
- ❏ Should I consider slope, aspect and physiographic region?
- ❏ Have I considered past land uses?
- ❏ Is this tract prone to flooding?

Foresters have spent many years focusing on above ground attributes such as basal area, diameter and height. It's time we use our knowledge of soils and topography when assessing a particular tract of land.

Soil types, slope, aspect and physiographic region can be used to rate the relative risk of stands to many pests including damage from ice and wind.

Knowledge about past land uses can provide invaluable insight into potential pest problems. The white-fringed beetle grub is a common pest on pine in agricultural fields that once grew peanuts and soybeans. Recently the false chinch bug has become a problem on containerized and bareroot longleaf seedlings following herbicide applications.

Pasturelands converted to pine may present problems with white grubs. Scrub oak ridges provide food for adult white grub beetles and fields adjacent to these areas once converted to pine can sustain heavy root feeding from white grubs.

Fields that were used as dumping grounds for animal manure can cause serious yellowing in pine reproduction when the tree roots begin absorbing the high levels of nitrogen that have accumulated on top of the plow hard pan.

Land subject to flooding should be noted and dealt with accordingly.

Nantucket Pine Tip Moth

- ❏ Does the landowner know that loblolly pine is most susceptible to pine tip moths?
- ❏ Pine tip moths appear to increase in response to herbicide releases.
- ❏ Pine tip moths are more severe when loblolly pine is planted off-site.
- ❏ Has the landowner been informed on how to monitor pine tip moths with pheromone traps and when to apply the pesticide?

The Nantucket pine tip moth prefers loblolly pine to slash and longleaf. These moths appear to do more damage in the Coastal Plain and Lower Piedmont when loblolly pine is planted on deep sands and scrub oak ridges.

Also, there is speculation that when herbicides are used to control weeds and woody brush, the newly planted pine trees are more accessible to tip moth attacks.

If the landowner is regenerating a dry/sandy site, longleaf should be considered over loblolly pine.

Research indicates the potential for increased tip moth activity on seedlings with bent taproots. Stress the importance of planting the seedlings properly to minimize J and L rooting and the value of subsoiling in reducing the potential for root bending.

Applying insecticides can effectively control pine tip moths but each stand has to be monitored for moth emergence and the spray has to coincide with larval migration. Effectiveness of chemical control depends on many factors and at best is a gamble for most private landowners to undertake without the expert advice of an entomologist. In most cases tip moth damage can be reduced or eliminated by planting the least susceptible tree species.

Pine Reproduction Weevils

- ❏ When was the site harvested?
- ❏ When will the site be regenerated?
- ❏ How would I rate the quality of the harvesting operation?
- ❏ Have I examined natural pine reproduction on an adjacent site for weevil feeding?
- ❏ Have I determined whether any cutting will occur in nearby pine stands (within ½ mile) during the first year of the newly planted site?
- ❏ Does the landowner know the GFC upon request, at the time seedlings are ordered will spray his seedlings to protect them from weevils?

Pine reproduction weevils can do serious damage to young seedlings (1-2 years old) planted on recent cutover areas. Sites harvested before June can be planted the upcoming planting season without high risk to weevils.

Unwise logging can add to a potential weevil problem by providing breeding sites in partially buried, larger diameter tops and limbs. Sites with a minimum of pine logging debris will generally have less weevil damage.

Weevils feed on natural reproduction as well as planted seedlings. Examining nearby, natural pine reproduction for incidence of weevil feeding can aid in predicting how bad weevils could be on the proposed regenerated site. If the area to be regenerated is not a cutover site, it could still be infested with weevils from any logging activity nearby.

Larger diameter seedlings can withstand heavier weevil feeding than smaller ones. Be sure to advise the landowner to cull the smaller diameter seedlings. The GFC provides landowners with insecticide treated seedlings upon request for protection against weevils.

Pine Bark Beetles

- ❏ Have I considered stand age, basal area, tree species and site index?
- ❏ Have I looked for lightning strikes, logging damage, active spots?
- ❏ What is the stand's accessibility to logging/salvage?
- ❏ Have I evaluated the stand for vigor i.e. (radial growth in last five years, live crown ratios)?
- ❏ Have I identified side slopes, dry ridges or flood plains?
- ❏ Have I thought about the landscape ecology of the tract?
- ❏ Have I discussed the effects of drought on bark beetle activity?
- ❏ Have I discussed the pros and cons of harvesting or thinning pine stands in different seasons?
- ❏ Have I discussed the role of prescribed fire in relation to bark beetles?
- ❏ Have I discussed the role of root diseases in relation to pine bark beetles?

Pine bark beetles prefer varied habitats and conditions depending on species. All five species are highly attracted to lightning struck pines.

The large six-spined Ips thrives during droughts and temperatures above 90 degrees F. This species will attack young pine reproduction up to mature-sized trees and recently decked logs. Most infestations are limited to 2 acres or less and generally decline after October and may not reappear the following season.

The small four-spined Ips thrives during droughts and prefers the tops and limbs of standing mature trees and logging slash and the boles of sapling-sized trees.

The southern pine beetle will attack any-sized pine during its characteristic outbreaks that occur every 6-12 years. Stands with basal areas above 120-sq. ft. per acre are most susceptible. Loblolly, shortleaf, Virginia and sand pines are preferred to slash and longleaf. Over-mature slash and longleaf are attacked but usually when associated with loblolly pine. Trees growing on dry sites and those adjacent to lightning struck trees are more likely to be attacked than trees on good sites not impacted by lightning.

The black turpentine beetle prefers trees damaged around log loading decks, logging roads, and skid trails. Trees struck by lightning are highly favored by the black turpentine beetle.

All of the pine bark beetles orient their movements to forests containing pine. The distribution of trees (pine and hardwood), fields and open areas can greatly affect the pattern of bark beetle activity on any given tract of land. Tracts broken up by fields, fire lanes, roads and non-susceptible species are less likely to suffer severe damage from pine bark beetles.

When talking to landowners about pine bark beetles distinguish between risk and hazard. Risk refers to population levels and hazard to conditions favorable for beetles (high basal areas, old age, root disease, loblolly/shortleaf vs slash or longleaf). During bark beetle outbreaks, beetles are maximizing their distribution throughout the landscape of the pine forests.

When high levels of any species of beetle are present, the risk of damage is high, even in well-managed stands. Contrarily, during low population years lightning struck trees, which are highly susceptible, may not be attacked. The risk of lightning striking in any given stand of trees is hard to predict. However, stands with high pine basal areas present a greater hazard and ideal conditions for pine beetle development. Stands should not be thinned when bark beetle populations are high. Improperly timed thinnings can create severe beetle problems. Prescribed fire can reduce the hazard of a severe beetle infestation but does not reduce the risk.

Southern pine beetle and *Ips* infestations are often associated with pines infected with *Heterobasidion annosum* and *Leptographium spp*. *Heterobasidion annosum* causes a root and butt rot and can be prevented or minimized by treating freshly cut pine stumps with the borate compound, Sporax® during the first thinning. The stumps must be treated within a 12-hour period following cutting. *Leptographium* species have been associated with loblolly pine decline (LPD) and southern pine beetle attack. Slope and aspect can be used to hazard rate stands for LPD and southern pine beetle attack.

White Pine Weevil

- ❏ Consider a mixture of white pine and hardwood?
- ❏ Evaluate for shallow hardpan?

The white pine weevil can cause considerable damage to white pine reproduction. Damage appears to be reduced when a mixture of pine and hardwood is managed. A shallow hardpan favors white pine weevil.

White-fringed Beetles, White Grubs and False Chinch Bugs

- ❏ Is the landowner regenerating an old-field site that was previously occupied by soybeans, peanuts or cotton?
- ❏ Will herbicides be used to prepare the site?
- ❏ Have you considered tree spacing?
- ❏ Physiographic Region?

White-fringed beetle larvae can be very detrimental to recently planted pine seedlings. There are about seven distinct races of this beetle but a positive identification is not necessary since the damage they do is identical. The adult white-fringed beetle feeds on the foliage of over 500 different plant species. Abandoned soybean and peanut fields tend to harbor this insect. When pines are established on such sites the larvae will readily attack and feed on pine roots. The use of herbicides reduces native vegetation and therefore forces the larvae to feed on pine roots.

Another example of an agricultural pest becoming a forest pest is the false chinch bug. These insects are very common in and around cotton fields. When these sites are converted to containerized longleaf heavy damage can occur on the pine needles. The use of herbicides, particularly the broadcast method appears to accentuate the damage from this bug.

Gypsy Moth

- ❏ Consider the potential long-term risk of gypsy moth establishment in the area?
- ❏ Identify the most susceptible tree species to defoliation?

The gypsy moth is moving further south each year. Three introductions have been eradicated in Georgia since the late 1980's. The caterpillars prefer oak species and will avoid yellow poplar and most maples. The moths are spread to Georgia primarily by the movement of people and their infested items from the Northeast. The moth is more likely to establish north of Atlanta. Advise landowners/homeowners that stands can be managed for optimal resistance to gypsy moth if they are willing to favor certain tree species.

Annosum Root Disease

- ❏ Have I determined the soils for the tract?
- ❏ What is the depth of the sand?
- ❏ Is there any water mottling or clay within the top 12 inches of soil?
- ❏ Have I considered the age of the stand?
- ❏ Have I examined tree crowns for poor coloration and thinning?
- ❏ Have I considered prescribed fire?
- ❏ Have I determined when the stand was first and last thinned?

Annosum root disease is usually limited to well-drained sandy sites that are typical throughout the sandhill regions of the state. Root rot does not thrive in moist or wet soils. Water mottling and clay within 12 inches of the soil surface indicates a low hazard for root disease. The root rot organism is found on most forested sites throughout the state but the dry, sandy, sites are most susceptible.

Loblolly pine is slightly more susceptible than slash and longleaf but all three species can be severely damaged on high hazard sites. Root rot enters most stands following the first thinning. Disease spores land on fresh cut stump surfaces and spread to nearby healthy trees. Within 3-5 years following a thinning, affected trees will begin to turn a pale green and lose needles. Therefore, a landowner won't know if the disease has invaded the stand until 3-5 years following a thinning. The hazard needs to be established before the first thinning.

Since thinnings promote the spread of root rot, recommendations that reduce the frequency of thinnings will also lessen the severity of the disease. Initial stocking levels should be lowered to around 545 trees per acre (8 x 10). This will postpone the first thinning and delay the spread of root rot.

Prescribed burning helps reduce the amount of organic litter that provides sustenance for the disease. Sites that are at risk for severe root rot should be regularly burned and monitored for bark beetle activity. If beetle activity becomes an annual event, the stand should be clearcut before annual mortality exceeds annual growth.

Pitch Canker

- ❏ Have I considered chicken houses?
- ❏ Have I considered tree species?
- ❏ Have I considered the use of fertilizer?
- ❏ Have I considered the weather?
- ❏ Have I considered cotton fields and the use of defoliants?

Wind and certain insects can spread the pitch canker-causing organism. Pine tip moths and weevils are likely candidates. The insects either act as wounding agents and/or vectors. Pitch canker appears to be cyclic with dry weather patterns. Pine plantations near chicken houses can become infected due to the presence of ammonia that is produced from the guano. Similarly, stands that have been fertilized or over sprayed with herbicides experience pitch canker flare-ups. Although the disease rarely kills trees, the terminal dieback that occurs can reduce product value and attract bark beetles. Advise landowners that damage may be incurred when pine stands are established near chicken houses and also following fertilization.

Hypoxylon Canker

- ❏ Determine site aspect and soil quality?
- ❏ Identify the oak species most susceptible?
- ❏ Did I notice signs of previous hypoxylon damage?

Drought, flooding, logging, sanitation and/or firewood cuttings, and lightning often trigger Hypoxylon canker exacerbations. Damage from hypoxylon can be devastating on dry sites. These would characteristically be the shallow, rocky side slopes and ridges in North Georgia and the sandy soils of the Coastal Plain. The oak species most susceptible to hypoxylon are: chestnut, water, blackjack, white and post. The more resistant species should be recommended as leave trees if possible. Stand disturbances should be minimized during logging.

Fusiform Rust

- ❏ Is the proposed planting site surrounded by an abundance of oak species?
- ❏ What physiographic region is in question?
- ❏ What type of weather is predicted for the planting season?

Fusiform rust is the most common disease affecting the southern pines. There are probably hundreds of strains of the disease. Rates of infection vary tremendously throughout the south. Even trees that have been bred for resistance are often heavily infected by the more virulent strains. Land managers often feel embarrassed when the so-called resistant trees they planted were hit hard by this fungus. The explanation is simple. Even the best of trees can succumb to fusiform rust under optimum conditions of host virulence, temperature, and humidity. Fusiform rust sporulates in the early spring. If weather conditions are cool and wet during spore production then infection can be severe. On the other hand if the weather is hot and dry during sporulation the disease infection rate plummets. In general, genetically improved seedlings are more resistant to fusiform rust and should be used in areas where the disease has historically been a problem. Oak species serve as alternate hosts for fusiform rust and their abundance in an area may indicate a risk for pine infection.

Glossary

Aeciospore-The yellowish-powdery spore stage of fusiform rust. The aeciospores are formed on the pine host and appear in early spring.

Alternate host- refers to the rust fungi; where two or more hosts are required for the rust fungus to complete its life cycle.

Applanate-Flat shaped.

Ascospore-A fungal spore borne in a sac like structure called an ascus.

Bacillus thuringiensis (Bt)- A bacterium that when ingested, is toxic to insects, in particular, caterpillars.

Basidiospore-The spore stage of fusiform rust that infects the pine host. This stage is developed on the oak leaf.

Cambium-The living layer of cells under the bark of trees that divides to form the xylem and phloem.

Cellulose- The principal chemical constituent of the cell wall of higher plants.

Chlorophyll-The green coloring substance of leaves and plants.

Chlorosis-The yellowing of green leaves due to lack of chlorophyll.

Chlorotic-Yellowish-green foliage.

Chromated copper arsenate (CCA)-A wood preservative that has fungicidal and insecticidal activity.

Conk-Fruiting body of a wood destroying fungus.

Copper napthenate-A wood preservative used to control fungal decay and insect attack. Usually applied as a 1%-2% solution in petroleum solvents.

Creosote-A wood preservative that is relatively insoluble in water. Also known as coal tar.

CRP- The CRP is a cost-share program aimed at converting highly erodible agricultural lands into stable croplands. Pine trees are an accepted cover crop and thousands of acres of farmland have been converted to pines in the south.

Dripline-The area beneath the outermost branch tips of a tree.

Dry rot-The brown rot caused by *Poria incrassata*.

Elytra-The hard front wings of the beetles.

Frass-Feeding debris left behind by wood boring insects.

Frontalin-One of the many pheromones produced by the southern pine beetle. It is the primary aggregation pheromone.

Haustoria-Specialized structure of a fungus or mistletoe that enables it to enter a host cell.

Heartwood-The darker inner core of a woody stem or log.

Hypovirulent-In this text refers to a strain of chestnut blight disease that is characterized by having a double-stranded ribonucleic acid (RNA).

Inoculum-Any part of a pathogen such as a spore or mycelium.

Instar-The stage of an insect between molts.

Lignin-Along with cellulose a principal cell wall constituent.

Mold-Fungal growth that stains or discolors wood.

Mycelium-Pertains to a fungal structure that grows vegetatively and can infect host tissue.

Naval Stores-Refers to the gum naval stores industry in which gum from slash and longleaf pine trees is collected and distilled into various products.

Nymph-The immature stage of an insect that resembles the adult.

Pentachlorophenol-A wood preservative used to control fungal decay, termites or lyctid beetles.

Pheromone-A chemical substance released by an insect that causes another individual of the same species to react.

Pronotum-The region of an insect's body immediately behind the head.

Rhizomorph-A specialized form of mycelium consisting of several strands twisted together to form a rootlike structure.

Sapwood-The outer portion of a woody stem or log that is different from heartwood by its lighter color. Sapwood is the portion preferred by wood boring insects and most decay fungi.

Spore-The reproductive structure in fungi that functions similar to a seed in flowering plants.

Sporophore-A spore-producing or spore-supporting structure.

Sporulate-To produce spores.

Stain fungi-Fungi that discolor wood such as blue stain. These fungi are often carried by certain insects from one tree to the next.

Starch- The major food substance in wood that wood boring insects feed on.

Stroma-A mass of mycelium on which sporophores originate.

Sunscald-Damage to plants resulting from direct sun. Usually more prevalent with thinned-bark species.

Thorax- The region of an insect body where the wings and legs are attached.

Verbenone-A pheromone produced predominantly by male southern pine beetles which functions as a switching mechanism or helps balance the sex ratio of attacking beetles.

Zinc napthenate-A wood preservative for above ground use to control fungal decay.

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