Exotic and Native Bark Beetles
Coleoptera: Curculionidae

Photo: J.R. Baker & S.B. Bambara, North Carolina State University, Bugwood.org #UGA5159028
What are bark and ambrosia beetles?

- Bark and ambrosia beetles are in the weevil family
- Over 600 species in the United States
- Bark beetles bore between the wood and bark
- Ambrosia beetles carry a fungus and infect trees when they bore into them
- Most attack dying or already weakened trees

Bark and ambrosia beetles are in the beetle family Curculionidae. They were recently moved into this family after phylogenetic analysis. The ambrosia beetles are in the subfamily Scolytinae and Platypodinae, while bark beetles are strictly in the subfamily Scolytinae. Bark beetles are small beetles which will bore into trees and feed on the tree, while ambrosia beetles carry a fungus, infect the tree, and feed on the fungus. Most bark and ambrosia beetles are not pests and are important for the breakdown of forest habitats as they normally attacked stressed or weakened trees.
Why are they a problem?

- Only a few species attack live, healthy, trees
- Increase in temperature and water stress
- Bark beetles can have a major effect on:
  - The environment
  - Timber industry
  - Tree fruit industry
    - Citrus
    - Avocado

Most bark beetles native to a region are an important part of the ecosystem. They hasten the decomposition cycle by removing weakened or dying trees and rarely attack healthy trees. Native bark and ambrosia beetles can become a problem in areas artificially planted with trees for timber as a monoculture or have “break-out” years where the weather is conducive to massive populations which emerge concurrently. Some bark beetles are more aggressive and attack young, healthy, trees but this is normally only during population booms. The picture reflects what can happen when the right conditions for a break-out year are present. If a bark beetle or ambrosia beetle is introduced into a new area, the beetle may be attracted to healthy trees, causing a pest issue which requires control.

In the US there are two main ranges of bark beetle, one is the Northwest where the Mountain Pine Beetle (Dendroctonus ponderosae) is present and the other is the
Basic Identification

• Bark beetles are small! Requires magnification to see necessary identification characters
• Great diversity of characters in bark beetles
• All bark beetles have:
  • Elbowed antennae with a club at the end
  • A round head, sometimes hidden from above

Bark and ambrosia beetles are hard to identify because they are extremely small in size. A microscope is required to see the features needed for identification. Some have obvious characters, but many are very difficult to identify and have a great diversity of characters. Two characters which are universal across the subfamilies Scolytinae and Platypodinae are the elbowed antennae and rounded head. The head may or may not be visible from above. In the photos, you can see the Southern pine beetle which has a head visible from above, the camphor shoot beetle which has a very truncated abdomen, and the ips engraver beetle which has a hidden head not visible from above and a marginally angled abdomen with projections.
General Symptoms

- Entrance and exit holes
- Larval galleries under bark
- Frass tubes, boring dust, or sap

General symptoms of bark beetle attack are entrance and exit holes in the bark. Usually the tree will respond to bark beetle attack by producing resin. The resin dripping down the tree may be an indication of recent bark beetle attack. Healthy trees should be able to produce enough resin to entrap an adult bark beetle, but stressed trees will not have the required nutrients to produce the resin necessary to stop the bark beetles. Healthy trees can also be overpowered if the beetles mass-attack; the resin may be enough to kill some of the beetles but not all of them.

Other symptoms of bark beetles are frass tubes, frass being waste from the beetles, emerging from the bark, and tunnels or galleries underneath the bark where the beetles were feeding.
The Southern pine beetle, *Dendroctonus frontalis* is a serious pest in the Southern US. It carries the bluestain fungus and favors loblolly pines as a host and is aggressive enough to attack healthy trees in breakout years. Breakout years are cyclical and tend to happen every 6-12 years. Bluestain fungus stains the wood of the tree as it blocks the xylem and in combination with the stress of the beetle and other environmental conditions is usually fatal. Although the bluestain fungus may not affect the strength of harvested and processed wood, the stain remains after harvest and processing resulting in reduction of the value of the wood.
Southern Pine Beetle: Life Cycle

1. Host selection
2. Aggregation
3. Colonization
4. Reemergence/Emergence
5. Dispersal
6. Overwintering

1. Host Selection:
   - Adult females emerge and look for susceptible trees. Once females find a host tree, they let off pheromones to attract other beetles to the tree, called secondary attractants. Only females search for host trees and are called “pioneer females” if they are not drawn in by other secondary attractants.
   - We are not completely sure how pioneer females choose a host tree. Some researchers have proposed the tree release volatiles in the air that signal for plant cell degradation, which is why bark beetles normally attack weakened trees. Another theory is that SPB land on any vertical trees and
only a few individuals, the tree may be able to push out adults with resin (picture). Mass attack can happen within 3-5 days after the pioneer female lands.

3. Colonization
   • Once the resin flow ends, the mating will begin. Females are monogamous and lay eggs approximately 1-3 days after mass attack. Eggs hatch 2-9 days later, and begin feeding in the cambium, and then the inner bark. Fourth instar larvae bore into the outer, dead bark to form a pupal cell and develops into an adult.

4. Emergence
   • Once they lay eggs 1-3 days after mass attack, females and males will re-emerge and find another host or attack a different part of the same tree.
   • After the lifecycle is complete, new adults will emerge from the tree and begin infecting new trees.

5. Dispersal
   • Beetles emerging in the spring and fall have more fat content than those that emerge in the winter or summer. The stored fat serves as an energy reserve, allowing the SPB females to disperse farther.
   • Temperature plays a large role in dispersal; if it is cold females would be more inclined to attack the same tree they emerged from or trees hat are very close-by.

6. Overwintering
   • Overwintering is a process like hibernation where the beetle is inactive. Population growth greatly slows during the winter.
From aerial view change in the color of the crown of the tree can be used to identify the infestation spot. The crown of trees will change from green to yellow to red to brown and eventually die as the infestation progresses. Visible from ground level many resin tubes will appear on the trunk of the from the tree trying to fend off the attack. The effect of the infestation can also be seen inside of the trunk of the tree as the wood discolors due to infection by bluestain fungus. As for the SPB itself, it will have a head visible from above, unlike some other bark beetles, but remember these beetles are quite small.
Look alike: *Ips* engraver beetles

- Overall less aggressive than Southern Pine Beetle, *Dendroctonus frontalis*
- Carries bluestain fungus
- 3 common *Ips* species in Florida, all have large teeth on posterior portion of the abdomen
- *Ips* spp. have the head hidden from above

A common look alike are *Ips* engraver beetles. *Ips* spp. are usually less aggressive and destructive than the SPB but carry the same bluestain fungus. It is common to find SPB with *Ips* spp. and the black turpentine beetle in the same tree, but SPB is the most aggressive.

In Florida the Southern Pine Beetle can be distinguished by the genus *Ips* by the presence of large teeth on the posterior portion of the abdomen of the *Ips* spp. SPB will have a round posterior. However, the large teeth present on the abdomen of *Ips* spp. is only present in male specimens.

The head is also a distinguishing feature as the *Ips* spp. may have a head hidden from above while the SPB does not.
Another look-a-like to SPB is the black turpentine beetle. The SPB and BTB are different in size with the BTB being much larger in size and darker in color. In the past, the black turpentine beetle has been a major pest in wounded pines and or pines treated with herbicide. In the 1950’s, the population of the black turpentine beetle were so high, they damaged significant amounts of timber and contributed to the turpentine farm financial collapse. (Featured Creatures BTB). BTB is usually only a pest in areas that were recently damaged either by logging, climactic stress, fire, or storm damage.
Survey and Detection for SPB, *Ips*, and BTB

- Look for orange boring dust and pitch tubes
- Pitch tubes near the base of the tree may indicate BTB
  - Look for active infestations
- Foliage discoloration – especially the crown
- Remove some bark and look for the presence of galleries
  - SPB will produce S-shaped galleries

It is common to find SPB, *Ips* and BTB in the same tree. They often will colonize slightly different areas at different times to partition resources. SPB is normally the most aggressive and finds a new area and eventually the others will follow.

One of the earliest visible symptoms for these beetles is the presence of orange boring dust and white pitch tubes on the tree. A SPB will produce pitch tubes from the ground up to 60 feet, while BTB commonly form pitch tubes close to the ground. If the pitch tubes are dried and do not contain sawdust, it is likely that these were cause from an old infestation, not an active one.

Foliage discoloration is another visible sign of beetle infestation. The crown is a key area to focus on when examining a foliage discoloration. It will turn from green to
Prevention

Control measures are limited so prevention is key. Loblolly pines are especially vulnerable. Planting more resistant species such as the longleaf pine and slash pine can help reduce the risk of SPB infestation. Including multiple species of trees in a stand can also help prevent attacks.

Limiting stump height and removing dead and damaged trees will help reduce the amount of susceptible trees that will be attractive to SPB.

Maintaining healthy trees is critical for the trees ability to produce resin to fend off attacks. It is when plants are stressed and cannot produce enough resin to find off attackers that trees become susceptible. Often, trees are flooded for years which makes them stressed and more susceptible to attack.
Control option are very limited

- Remove infected trees and a buffer strip 50-100 ft around infected area
- Infected trees can be processed
  - Should not be moved out of local area
- Insecticides can be used if tree removal is not an option
  - But not recommended
- If BTB is present, tree removal is not recommended

There are limited control measures for an on-going infestation, removing infected trees and immediately processing them is the recommended form of control because of this limitation. In addition to the infected area a buffer strip of 50-100 feet outside the affected area should also be eliminated in order to remove any recently infected trees that have not yet begun showing symptoms.

Generally trees can still be salvaged if removed during an ongoing infestation. The milling process will eliminate the SPB in removed trees, however, if the tree is unsalvageable and not processed the bark must be destroyed, buried or composted to help control the spread of SPB.

Insecticides can be used if tree removal is not an option, but this not recommended.
The Oak Ambrosia Beetle, *Platypus quercivorus*, belongs to the wood boring ambrosia beetle Family Platypodidae (CABI, 2015). Platypodidae is a very diverse family with over 1,000 species distributed primarily throughout the tropics (Atkinson, 2000). Only seven species, all belonging to the genus *Platypus*, are found in the United States of which four occur in Florida (Atkinson, 2000).

Oak Ambrosia Beetle was first described from specimens in Taiwan in 1925 (Davest et al., 2010). This beetle is part of an ambrosia beetle-fungus complex, serving as a vector of Japanese Oak Wilt, *Raffaelea quercivorua*, a fungal disease that is devastating several species of oaks in Japan (Kubono & Ito, 2002). This fungus is in the same genus as Laurel Wilt, *Raffaelea lauricola*, and many other plant diseases.
This host map created by USDA-APHIS-PPQ-CPHST in the 2011 Exotic Wood Borer and Bark Beetle National Survey Manual illustrates the known host range of Oak Ambrosia Beetle distribution based on the density of host acreage in different counties (11). Note the higher relative host density along the Atlantic seaboard and southeastern US. It is also possible that new host plants might be discovered if the OAB is introduced to a new region.

USDA-APHIS-PPQ-CPHST and NCSU cooperators are working to revise the NCSU/APHIS Plant Pest Forecast System, a tool which will be able to combine available distribution and survey data for the purpose of predicting the potential distribution of pests and diseases in new areas.
Oak Ambrosia Beetle infestations can be identified by the presence of white boring dust and frass on the ground or surrounding foliage at the base of a tree or fallen logs (Davis et al., 2010). Minute entrance and exit holes in the bark may also be indicative of beetles (Davis et al., 2010). However, other beetles can produce similar damage. Therefore, identification of this pest cannot be guaranteed unless a specimen is observed under the microscope.

Since Oak Ambrosia Beetle vectors Japanese Oak Wilt, routine scouting for signs and symptoms of wilt will benefit management plans. Rust-colored, crumpled leaves, premature defoliation, and stem dieback are typical wilt symptoms (CABI, 2015). When logs are felled, fungal hyphae can be seen in beetle galleries and the wood may appear dark and necrotic (Davis et al., 2010). As with many other insect species, Oak
Oak Ambrosia poses a potential threat to several endangered plant species that are protected in various states, for example, the American Chestnut (*Castanea dentata*) and Willow Oak (*Quercus phellos*) (Davis et al., 2005).
The Oak Ambrosia Beetle is a polyphagous forest pest which feeds on multiple species of plant hosts.

At present, the Oak Ambrosia Beetle’s true host range is limited to the family Fagaceae (Davis et al., 2005). This family contains beeches, oaks, and their relatives. Oak Ambrosia Beetle was first recorded on *Quercus* species in southern Kyushu, Japan in the 1930’s (Sone & Ide, 1998). The genus *Quercus* contains the oaks, a very common group of native trees found naturally (and ornamentally) throughout every state in the US. At least 28 *Quercus* species present in the continental US may potentially serve as hosts of the Oak Ambrosia Beetle should it be introduced to North America (Davis et al., 2005).
eastern US, comprising nearly 31% of all hardwood production (Smith et al., 2009). Oak forests account for approximately 69% of forested land in the US, comprising roughly 622 million acres (3). Oak trees are part of a lucrative hardwood industry and provide various ecosystem services such as habitat and food for wildlife, recreation, soil stability etc. In addition, once OAB invades a new region it is unknown which hosts will be suitable for development.

Major hosts of the Oak Ambrosia Beetle from the genus *Quercus* include (USDA-APHIS, 2011):

- **Japanese Evergreen Oak, *Q. acuta***
- **Sawtooth Oak, *Q. acutissima***
- **Ichii-gashi, *Q. gilva***
- **Japanese White Oak, *Q. glauca***
- **Mongolian Oak, *Q. mongolica***
- **Ubame Oak, *Q. phillyraeoides***
- **Urazirogashi, *Q. salicina***
- **Konara Oak, *Q. serrata***
• Tsukabanegashi, *Q. sessilifolia*

Minor hosts include (USDA-APHIS, 2011):
• Japanese Chinkapin, *Castanopsis cuspidata*
• Sudajii, *C. sieboldii*
• Japanese Tanbark Oak, *Lithocarpus edulis*
• Japanese-Oak, *L. glaber*
• Japanese White Oak, *Quercus myrsinaefolia*
• Japanese cedar, *Cryptomeria japonica*
Identification of the Oak Ambrosia Beetle relies primarily on adult morphology although trained taxonomists may readily identify late instar larvae (Davis et al., 2010). Since the other life stages (eggs, larvae, and pupae) occur within the wood tissue they are not typically used for identification.

Adults are rust-colored or reddish brown and measure about 4.5mm in length (USDA-APHIS, 2011). The venter is a golden brown color, females being slightly lighter than males, with long yellow hairs sparsely distributed (USDA-APHIS, 2011). The head is flattened at the front and usually darker than the rest of the body (USDA-APHIS, 2011). Elytra, the hardened forewings which cover the beetle’s abdomen, have distinct, finely punctured striae and several pointed “teeth” at the posterior margin (USDA-APHIS, 2011). The striae are thin lines made of tiny holes running parallel to...
This life cycle features images of the Redbay Ambrosia Beetle, *Xyleborus glabratus*, a representative of the bark and ambrosia beetle family Scolytidae. Redbay Ambrosia Beetle is similar in appearance and biology to Oak Ambrosia Beetle, and is a vector of Laurel Wilt Disease, *Raffaelea lauricola*, a relative of Japanese Oak Wilt, *R. quercivora*.

New adult Oak Ambrosia Beetles emerge and disperse in late June throughout early fall (Davis et al., 2005). Adult males initiate attacks on suitable Fagaceous hosts and a combination of plant volatiles, aggregation pheromone, and male sounds attract both sexes triggering a massive attack (3, 10). Like other Platypodids, the Oak Ambrosia Beetle is a monogamous species, adult pairs create one gallery system and fulfill their life cycle within the host.
oviposition galleries along with fungi (*Raffaelea quercivora*) that was stored in the female’s mycangia (3, USDA-APHIS, 2011). This fungi is cultivated as a food source for the larvae and adults (12). Eggs hatch within one week depending on moisture conditions within the wood (Davis et al., 2005).

Larvae are legless, creamy-white with a sclerotized, amber head capsule, and range from 2 to 6mm (0.08 to 0.24in) at maturity (CABI, 2015). Larvae undergo five instars, feeding on the cultivated fungus growing throughout the gallery system (USDA-APHIS, 2011). Larvae may overwinter in the larval gallery during the last instar. (Davis et al., 2005). Those that do not overwinter pupate in vertical chambers where the adult will stay until its cuticle sclerotizes (USDA-APHIS, 2011).

Pupation usually occurs in May and genders can be distinguished at this time (Davis et al., 2005). Pupae are white, slightly larger than the adults, and formed in 1cm-long (0.39in) pupal chambers that branch off from the larval gallery (Davis et al., 2005).

New adults emerge from their pupae and can remain in their parental host galleries until the following spring or leave in search for a new host (Davis et al., 2005).
The UF/IFAS faculty is responsible for reporting diseases, insects, weeds, nematodes, or any other invasive species to the Florida Department Agriculture and Consumer Services, Division of Plant Industry (FDACS, DPI). Reporting this information is essential to protect Florida agriculture, communities and natural areas.

Local county extension agents can assist in identifying plant pest or assist in submitting a pest sample to the correct department or agency for identification. Attached is a link to find the closest extension agent near you.
If a diseased plant needs identification, the link to the UF/IFAS Plant Diagnostic Center run by Dr. Carrie Harmon is attached to assist in reporting and identifying the correct pest.

The diagnosticians and identifiers in each area will also provide management strategies for the pest identified to help eliminate the damage caused on the plants. If an invasive pest is found, they will send it FDACS, DPI for further testing.
Reporting
Distance Diagnostic and Identification System

• Digital Diagnostic Collaboration
  – Extension agents
  – Laboratories
  – Clinics
  – Specialists
• https://ddis.ifas.ufl.edu/

The DDIS system connects the UF/IFAS faculty mentioned before to provide quick and accurate identification throughout Florida. This reporting collaboration tool enhances screening, early detection, monitoring, pest mapping, and rapid communication to protect agriculture. The site provides training, media of pest, equipment, and diagnostic labs in Florida.
Reporting
FDACS: Division of Plant Industry

• FDACS, DPI Responsibility
  o Announcing detection or establishment of new invasive species.
  o Reporting is a legal obligation under Florida Statute 581.091.

• Submission Form

Florida Department of Agriculture and Consumer Services: Division of Plant Industry is a regulatory agency that detects, intercepts, and controls Florida’s native and commercially grown plants. Announcing the establishment of new invasive species can affect Florida’s agricultural producers and trade of agricultural products.

FDACS, DPI provides online submission forms to fill out and send into the agency for proper identification. Additionally, DPI provides useful videos of how to properly handle the specimens before shipping them for identification.
FDACS, DPI Contact

• Dr. Leroy Whilby, Bureau Chief-Entomology, Nematology and Plant Pathology
  – 352-395-4661
  – Leroy.whilby@freshfromflorida.com

• Dr. Paul Skelley, Assistant Chief-Entomology, Nematology and Plant Pathology
  – 352-395-4678
  – Paul.skelley@freshfromflorida.com

• Division of Plant Industry Hotline
  • 1-888-397-1517
  • DPIHelpline@FDACS.gov

The DPI contacts provided will assist in determining the next steps if the pest found is of regulatory concern. Additionally, FDACS, DPI has a hotline with both a phone number and email for questions and concerns.
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Collaborating Agencies

- U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS)
- Cooperative Agricultural Pest Survey Program (CAPS)
- Florida Department of Agriculture and Consumer Services (FDACS)
- National Plant Diagnostic Network (NPDN)
- Sentinel Plant Network (SPN)
- Protect U.S.
- University of Florida Institute of Food and Agricultural Sciences (UF-IFAS)
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