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Ambrosia Beetle

A Menace to the Forest Industry

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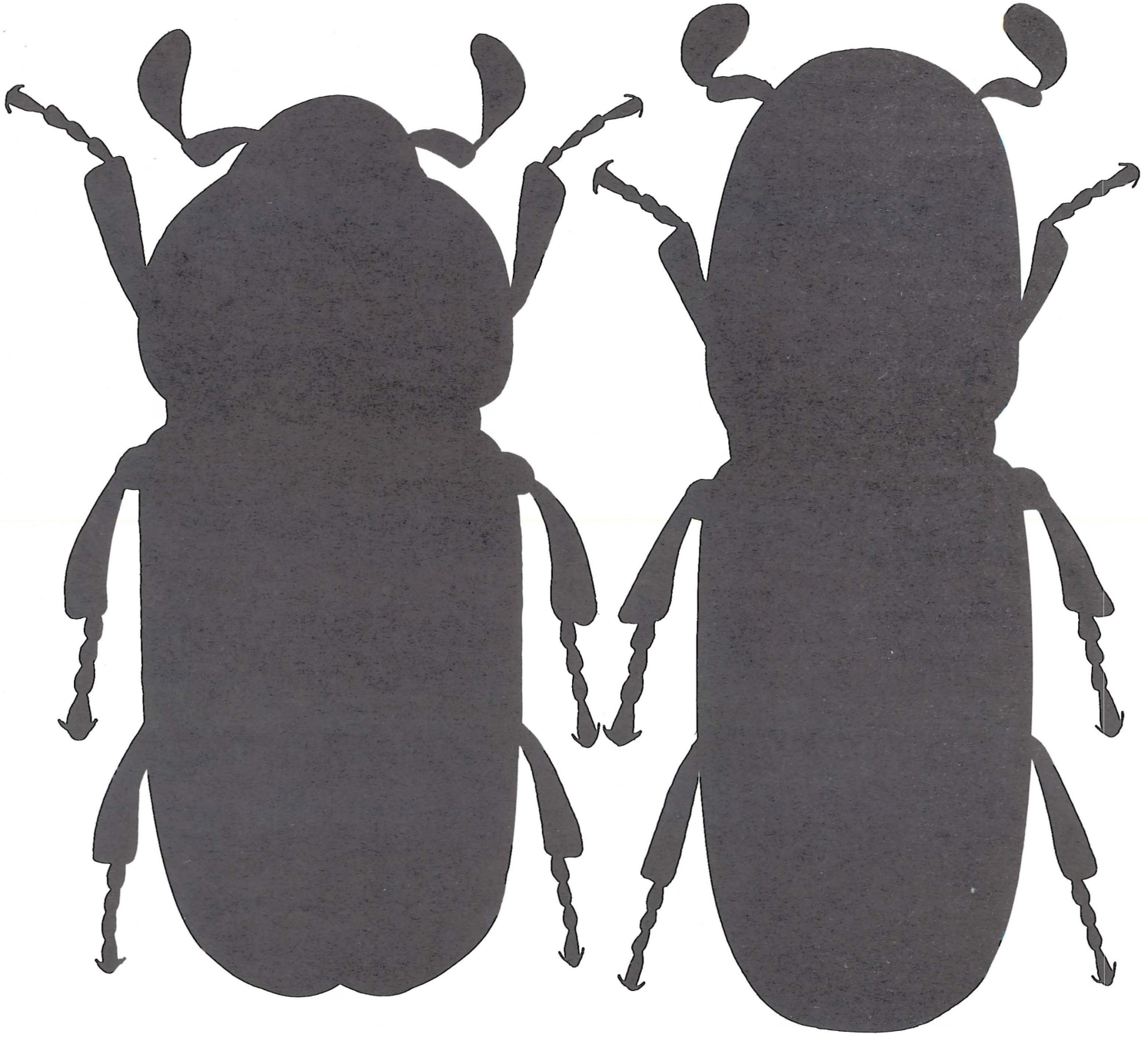

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Ambrosia beetles are a serious menace to commercial timber-producing areas. Their infestations result in degraded lumber and various hidden costs, both in the processing of infested material and in the rejection of export-bound products. In British Columbia, in 1975-76, the loss because of ambrosia beetle damage was estimated by Western Forest Products Laboratory, Vancouver, B.C. to be $7 million.

The economic importance of these beetles is closely related to man's forestry practices. Dry land sorting and storing of enormous amounts of wood creates conditions that can be ideal for brood production, increasing the danger of damage as well as producing a larger population of beetles which will become next year's pests.

The most effective way to prevent damage from occurring is by hot-logging (rapid utilization) and fast processing, methods that deny the beetles' wood supplies suitable for breeding.

WHY THE CONCERN

Restriction on the use of waterways for storage and transport of logs has resulted in many companies changing over to dry land operations. The advantages to dry sorting and storing are faster handling capabilities, reduction of loss through sinking and escapement and lessened water pollution. Because large volumes of logs that previously were mostly submerged are now piled on dry land, much more surface area is exposed to beetle attack. If nothing is done to restrict this, the beetle population will grow larger and losses will increase. The advantages of dry land operations will be partly lost because of increased insect damage.

The damage from ambrosia beetles shows up as numerous darkly stained holes and tunnel patterns in logs kept on dry land and in the upper portions of logs in booms, which cause degrade in lumber and plywood and restrict the use of materials for overseas export. All commercially important timber species in British Columbia are subject to attack by ambrosia beetles. The beetle tunnels are confined to the sapwood of most conifers, but in western hemlock and amabilis fir they appear throughout the entire log.

Knowledge of the behavior of these insects and the ability to recognize problem situations are important to the forester. The beetle hazard should be considered carefully and dry land operations planned and managed to minimize the effect the beetles have upon the value and quality of wood products. Protective action becomes increasingly advantageous with rising market prices.

DETECTION OF AMBROSIA BEETLE PROBLEMS

The first evidence of ambrosia beetle attack is usually seen on the bark surfaces of logs or on edges of green lumber, where small piles of white boring dust appear.

Once boring dust is seen on the log surface, most of the damage has already been done and there is a good chance that new brood will develop. It is, therefore, important to avoid these situations, rather than react to them. The hazard of future damage from one species can be assessed by sampling the beetle population in the forest edges around logging slash and log storage areas during fall or winter (Chapman 1974).

The number of dust piles indicates the severity of attack. The boring dust can even be seen on the ground below the logs or on the surface of the water among logs in booms. By removal of the bark and counting the number of entrance holes on the exposed wood, the density of attack can be determined more accurately. A very heavy attack can have in excess of 250 holes per 0.1 m^2 on the log surface.

number of holes per 0.1 m^2	attack rating
less than 15	low
between 15 and 50	medium
more than 50	heavy

Wood around beetle tunnels turns grey to black, a stain caused by the ambrosia fungus, which is carried into the log by the beetles. The dark stained tunnels show prominently in lumber and plywood veneer cut from infested logs and contribute greatly to the degrading effect of the beetle damage.

Just before the ambrosia beetle flight starts in early spring, small brown dust piles are often found on the log surfaces. These should not be mistaken for evidence of ambrosia beetle attack. If this dust remains brown, it is caused by small bark beetles that tunnel only in the bark and do not penetrate the wood.

WHAT TO DO ABOUT THE PROBLEM?

Because the damage has already been done when boring dust is evident, the treatment should be based on the principle of denying beetles access to susceptible wood. Ambrosia beetles initiate attacks from mid-April to October in southwestern British Columbia. Logs cut between early fall and February of the following year and left exposed from April to June are very susceptible to damage from one kind of ambrosia beetle, Trypodendron. Logs from trees felled after February and on into late summer are likely to be attacked by a second kind, Gnathotrichus.

These fall or winter cut logs can usually be removed from the forest and utilized well before spring attacks by Trypodendron beetles. Weather conditions often prevent the removal of logs felled in late fall and early winter before the spring beetle attack. This situation should be avoided as much as possible because these logs lose value and, if they are transported to the dry land storage areas during the flying period, they contribute to the beetle population there. Degrade losses can be avoided by scheduling the felling of stands for pulp wood if logs cannot be removed from the woods before the spring flight. These logs, however, should not be transported to dry land storage areas before the new brood of Trypodendron beetles has emerged to overwinter, because this can enlarge the beetle population around log storage areas.

Hot-logging is very important because it reduces the hazard of insect damage. In addition, fast processing of wood that has been attacked will prevent further brood development and destroy beetles before they can emerge to attack other logs.

Gnathotrichus beetles overwinter inside the wood in all stages of development and continue their activities as soon as the wood has sufficiently warmed up. They move along with the logs in which they have established themselves; therefore, stockpiling of these logs should be avoided. The habit of overwintering in logs and stumps makes Gnathotrichus populations vulnerable to slash burning, which has probably helped to keep field populations low. Prolonged dry land storage of logs infested with Gnathotrichus brood can cause a larger problem the following season. It is therefore recommended that the storage inventory be reduced as much as possible before early spring.

During the spring and summer flight period, total protection of logs has been achieved by water misting (Richmond and Nijholt 1972). The constraints of this system are that large amounts of water are required over a period of about four months. The equipment and maintenance costs are, however, relatively low (Nijholt 1978).

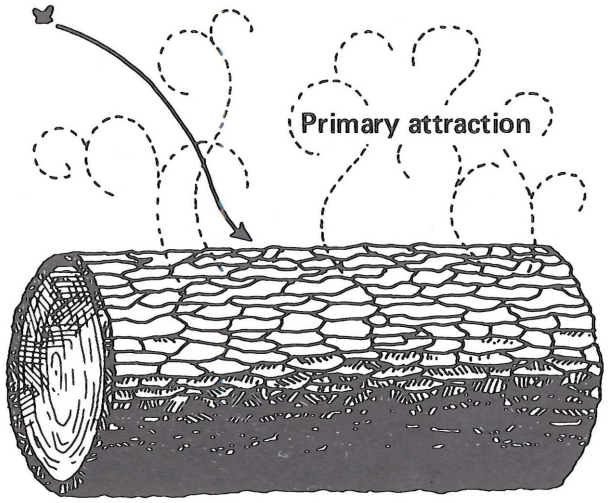
Traplogs, logs deliberately left to be infested and utilized before the brood has completed development, have been used to divert beetles from valuable wood. However, the impact of this technique on the total beetle population has not been quantitatively assessed. The use of natural products, including pheromones, as attractants or repellents to manipulate the insect population is at a promising stage. Kiln drying green lumber has been suggested as a method of killing ambrosia beetles that may be present.

LIFE HISTORY OF AMBROSIA BEETLES

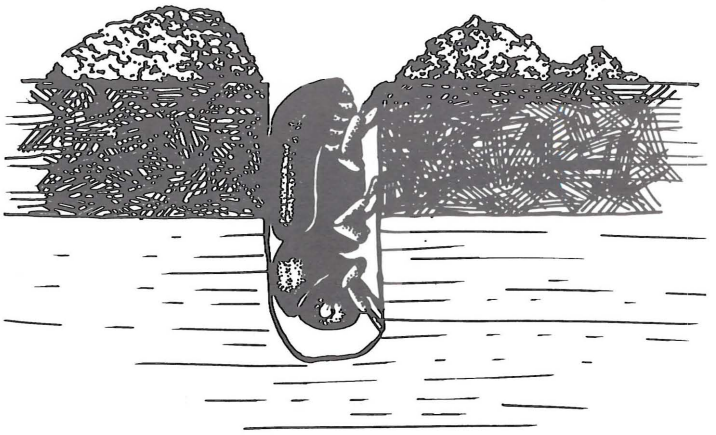
There are several species of ambrosia beetles. In British Columbia, we are mainly concerned about Trypodendron lineatum (Oliv.), Gnathotrichus sulcatus (Le Conte) and Gnathotrichus retusus (Le Conte). Two species less frequently found in British Columbia are Platypus wilsoni Swaine and Xyleborus saxeseni (Ratz.)(Prebble and Graham 1957).

Ambrosia beetles are wood boring insects that provide for their own nutrition in the form of "ambrosia" fungi. In spring, when their overwintering site has warmed up sufficiently and the air temperature is above 16°C(60°F), they emerge and fly. In flight, they respond to odors from susceptible logs or similar host material. After landing on the bark surface, they search for a place to make an entrance

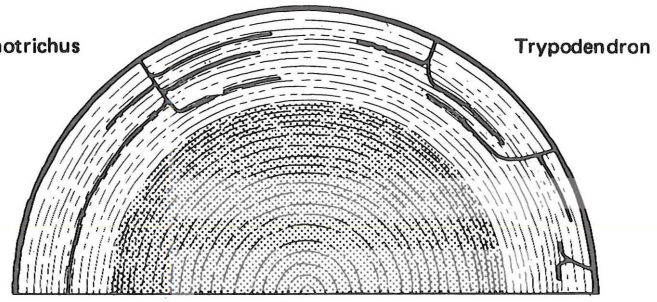
AMBROSIA BEETLE ACTIVITIES DURING PERIOD OF ATTACK AND BROOD DEVELOPMENT



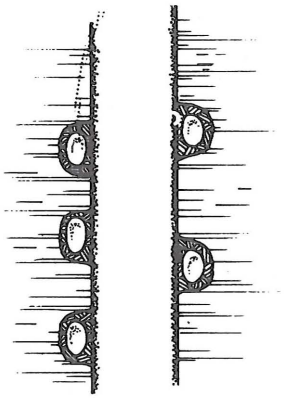
1 Beetles attracted by odor of susceptible log.



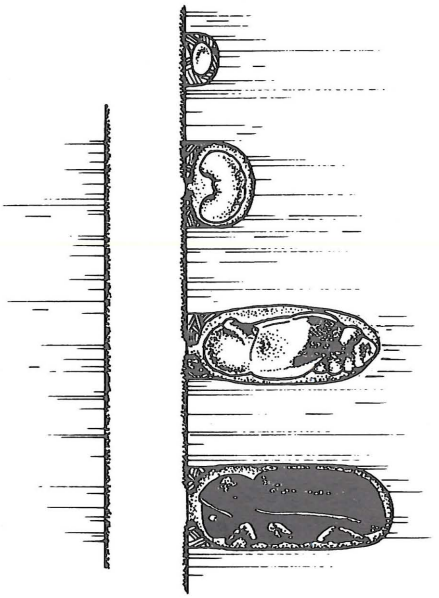
2 Trypodendron female starting tunnel through the bark and into the sapwood.



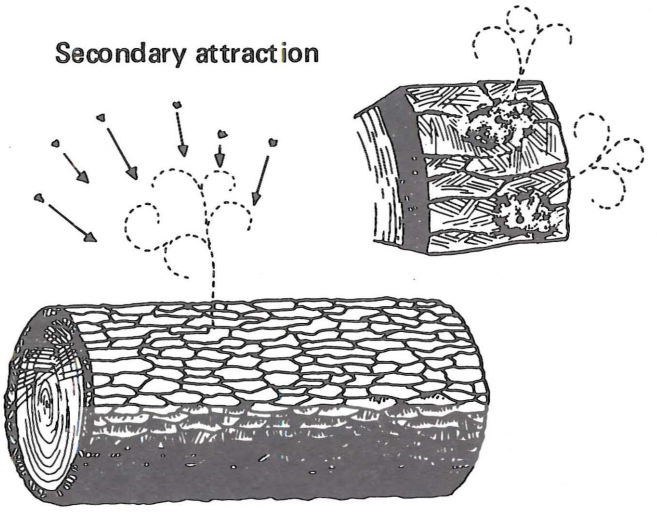
5 Tunnel patterns of ambrosia beetles. Brood galleries often concentric with annual rings.



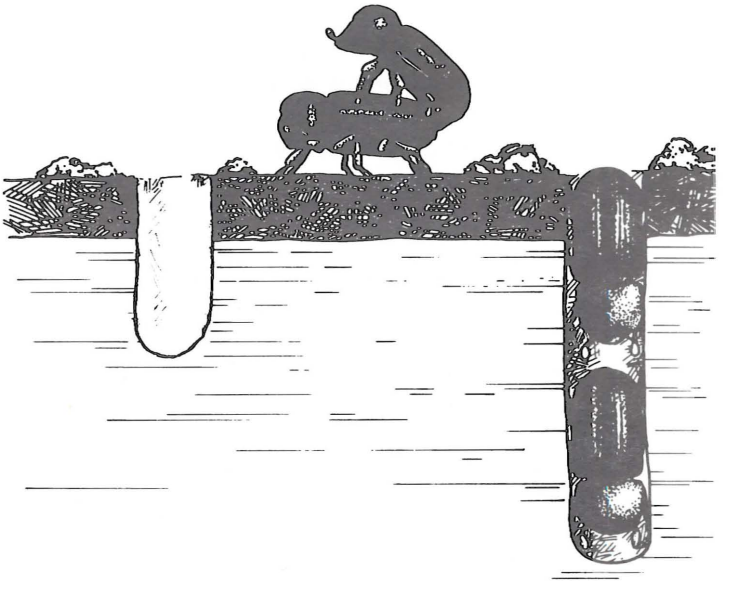
6 Female makes shallow niches on opposing sides of the tunnel wall, deposits eggs and covers them with fine boring dust. Gallery wall covered with fungal layer that is the essential food for both beetles and their developing brood.



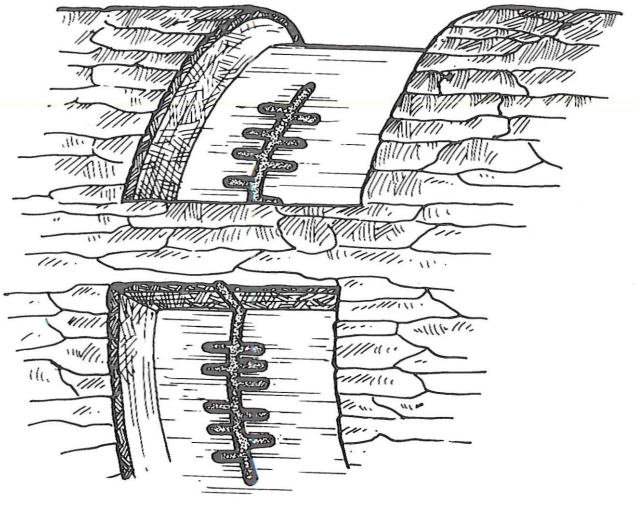
7 Egg, larva, pupa and young adult in gallery. Larvae enlarge niches as they grow.



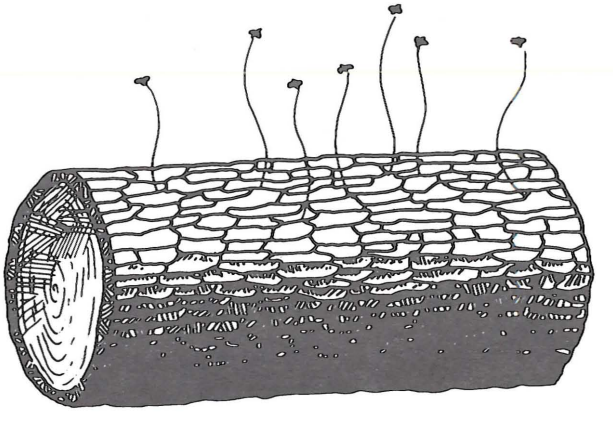
3 Substance produced by the beetle (pheromone) attracts many other beetles.



4 Mating takes place near the tunnel entrance, male assists female by cleaning out tunnel.



8 A completed gallery with dark staining in the surrounding wood.



9 Young Trypodendron adults emerge from log and fly to hibernation sites. Gnathotrichus broods overwinter inside galleries.

Drawings by J.C. Wiens.

hole, usually at the bottom of a bark crevice. They chew into the bark and enter the sapwood, where they construct brood galleries in the springwood between two concentric annual rings. In most conifers, the beetles confine themselves to the sapwood; in western hemlock and amabilis fir, they may tunnel through the whole log.

Immediately after the beetles enter the wood, they produce a potent chemical attractant (pheromone) that draws many more beetles from the flying population toward the same host. Mating usually takes place on the bark surface near the entrance hole. The beetles generally stay in pairs, one doing the excavating and its companion assisting in keeping the gallery free from boring dust and excrement. As soon as the gallery has been extended laterally between the two annual rings, niches are made in the tunnel walls in which the eggs are laid. Eggs are packed into place with fine gnawing dust. One female can produce 20-50 eggs.

Each species of ambrosia beetle has its own specific fungus. The fungal spores are carried in specialized pockets, called mycangia, by the Trypodendron female and the Gnathotrichus male. Spores are deposited on the tunnel walls as the beetles construct their galleries. The fungus grows immediately in the galleries and niches and is the sole food source of the beetles and their offspring. This ambrosia fungus needs intensive care and an optimum environment in which to grow. The beetles constantly crop the fungus and keep the galleries clean and open. They are superb fungus farmers.

TRYPODENDRON

Eggs hatch 8-10 days after being laid. Larvae, which develop in the niches, enlarging them, parallel to the grain, feed on the fungus growing on the inside of the enlarged niche. Fecal matter is excreted through a small hole in the plug of boring dust that separates the niche from the main gallery. This is dutifully disposed of by the parent beetles. Because of the fungus diet, the color of the feces is greyish. Therefore, when the color of the dust pile at the entrance hole turns greyish, the infestation is well advanced.

Development of the larvae takes 3 to 6 weeks. After a short pupal stage (8-10 days), the mature larvae develop into young adults, which are fully grown and developed in 6-10 weeks after egg deposition. Parent beetles emerge and may fly to hibernation or may attack and establish another brood if circumstances are right. All newly formed adults, when they emerge, fly to the nearest hibernation site. There, hidden under the outer bark of trees or in the litter on the forest floor, they can endure severe winter conditions in a state of virtual immobility. Only one generation is produced during the year.

Flight activity varies in intensity and duration throughout spring and summer, as influenced by weather conditions. In the coastal regions, two major flights occur. In the first, beetles fly in search of new host material from the middle of April to June. The second flight, in August, consists mainly of new brood flying to the nearest forest margins in which to hibernate. Some times "parent" beetles may attack once more.

GNATHOTRICHUS

Gnathotrichus broods develop in a similar way to those of Trypodendron. The major difference is that all developmental stages of Gnathotrichus can be found overwintering inside the logs in their brood galleries. Galleries of Gnathotrichus are slightly narrower than those of Trypodendron. Each gallery system can have as many as six brood galleries leading from the main gallery. Gallery construction and

Biologically, ambrosia beetles play an important role within the forest community. In contrast to beetles that kill trees, they commonly infest windthrown and dying trees of all commercially important species within their geographic range. The overall result of their activities in the trees, in addition to a new brood, is that they open up the wood with their numerous galleries, leaving it exposed to further deteriorating agents, such as wood rotting fungi. Ambrosia beetles do not distinguish between naturally dying trees and those felled by man. Well-organized wood handling procedures will improve our competitive edge against these beetles without interfering with their role in nature.

brood development continue until low temperature immobilizes their activity. The larvae also feed on their specific fungus as do the young adults before they emerge. Flight activity of this species is also dependent upon weather. The main flight period is in the April-May interval, but extends to the end of October.

IDENTIFICATION

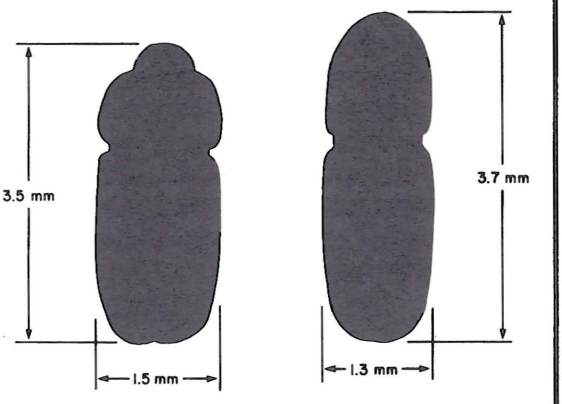
Trypodendron overwinters in the forest litter and under bark of trees in forest margins; Gnathotrichus remains in the brood galleries in the wood to overwinter; the attacking population, therefore, originates from different sources. The ability to determine which kind of ambrosia beetle is present in the greatest numbers will aid in deciding the appropriate action.

The damage caused by each genus can be distinguished by the

1) diameter of the holes. A 1.5-mm diam. (No. 53 wire twist) drill fits the holes made by Trypodendron easily but is too large for holes made by either species of Gnathotrichus, and

2) shape of boring dust particles. Those of Trypodendron are variable, with ragged edges. Those of Gnathotrichus are mostly C-shaped. A hand lens may be needed to observe these characteristics clearly.

The beetles themselves can be distinguished by size, color and shape.



Trypodendron

Adults are brown to black, with lighter bands on smooth wing covers.

Gnathotrichus

Adults are dark reddish-brown, with smooth shiny wing covers.

Some differing aspects of behavior

	TRYPODENDRON	GNATHOTRICHUS
Susceptible log age	Fall and winter felled	From 1-2 weeks after felling on
Attacking and fungus carrying sex	Female	Male
Overwintering stage	Adult	All stages
Overwintering habitat	In litter on the forest floor or in tree bark in shady places, usually in forest margins	In the brood galleries in the logs
Time of attack	Early spring, with second attack July-August	Spring to end of October.

RECOMMENDATIONS:

At the logging site:

1. Avoid having susceptible logs available to beetle attack.
2. Remove and utilize logs from the forest as soon as possible after felling. Hot-logging.
3. Avoid leaving fall and winter cut logs in the woods through the following spring beetle-flight period.
4. If susceptible logs have to be left in the woods during the attack period, leave pulpwood rather than peelers and those logs yielding a high percentage of clear lumber.
5. Do not transport attacked logs to dry land storage facilities during spring and summer as that will increase the resident beetle population at the storage area.
6. Low grade logs can be used as trap-logs to help reduce the population.

At dry land sorting and storage areas:

1. Avoid conditions that result in a beetle population increase.
2. Reduce spring and summer inventories in millyards and log storage facilities.
3. Avoid storage of fall and winter felled logs.
4. Do not store freshly attacked material to prevent new brood from emerging and overwintering in the nearby forest edges.
5. Water misting can completely protect log decks from attacks in dry land operations.
6. Dispose of debris. It can be breeding ground for beetles.

RECOMMENDED READING:

Chapman, J.A. 1974. Ambrosia beetle. Guidelines to population estimates near dry land long-storage areas and damage hazard assessment. Can. For. Serv., Pac. For. Res. Cent. Inf. Rep. BC-X-103.

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