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Changes in Wood Processing and Use Have Influenced the Likelihood of Beetle Infestations in Seasoned Wood

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SUMMARY

Fewer houses are being built with crawl spaces and more houses have central heating and air-conditioning, so the number of anobiid beetle infestations should decline. The likelihood of lyctid infestations in domestic hardwoods has been decreased by improved processing and marketing, but increased imports of tropical hardwoods likely will increase the frequency of infestations. More imports of unseasoned hardwood crates, pallets, and dunnage also may increase the probability of bostrichid infestations. Incidence of infestations by old house borers probably will change little. Trends in wood use suggest the present nationwide incidence of wood-destroying beetle infestations in structures ranks: anobiids, lyctids, old house borers, and bostrichids. Rankings of anobiids and lyctids, however, probably will be reversed in the near future. Lyctids already create the greatest replacement expense.

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INTRODUCTION

Many beetle species in the families Anobiidae, Lyctidae, Bostrichidae, and Cerambycidae infest seasoned wood during processing or use. Beetles of each family, however, usually need wood of different types or in different conditions to successfully infest it. Depending upon the type of beetle involved and how the wood is stored, processed, finished, or used, infestations may occur during processing, manufacturing, and marketing, or years after wood is in use. Also, because infested wood is sometimes used for finished products, infestations often occur where adult beetles would not be present to start them or where temperature, moisture, and other factors are not favorable.

For each beetle family I discuss how changes in wood processing and manufacturing technology and in supply and demand have affected the likelihood of beetle infestations and needs for prevention or control.

ANOBIIDAE

Conditions Influencing Infestations

Many anobiid species attack seasoned hardwood and softwood. In the south, *Xyletinus peltatus* (Harris) is the most common beetle that infests wood in use (Williams and Smythe 1978). Outbuildings and improperly stored lumber are occasionally infested, but most infestations begin when adult beetles fly to exposed wood in crawl spaces beneath houses. In crawl spaces beetles find moderate temperatures and high relative humidities, conditions that favor infestation. During mid-April through September—when adult *X. peltatus* beetles are emerging, mating, laying eggs, and small larvae are establishing themselves in wood—ambient temperatures in crawl spaces on the Mississippi Gulf Coast usually are 23-29°C and relative humidities are 70-90 percent. So, emergence and infestation are synchronized with favorable conditions (Williams and Waldrop 1978).

The likelihood of an anobiid infestation depends primarily on whether unfinished wood is exposed in a damp environment such as a crawl space. Among crawl spaces, the likelihood and particularly the severity of infestations are influenced by species, density, and moisture of wood, and by reconstituted products such as plywood. Wood moisture in crawl spaces varies with local climates, annual rainfall, surface water drainage, soil moisture, ventilation, and use of heating, air-conditioning, soil covers, and insulating materials with vapor barriers.

Changes Influencing Infestations

Construction Type.—In 11 southern States, the number of single-family dwellings with crawl spaces was about 700,000 less in 1970 than in 1960 because more houses with crawl spaces were demolished than were built (table 1). In 1970, however, there were about 590,000 more houses with basements and about 3,000,000 more with slabs.

In houses with slab or full basement construction, infestations of Anobiidae are rare because unfinished, untreated wood is not exposed for beetles to attack. So, about 47 percent of all houses essentially are "immune" to anobiid beetle attacks (table 1). The number of crawl spaces declined in all States but North and South Carolina. Apparently, many new houses with crawl spaces are still being built in these two States and also in Arkansas, Georgia, and Tennessee (table 1). Construction in coastal areas

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of most States where high humidity favors anobiids probably parallels that observed in Mississippi; though many new houses are being built, most are on slabs.

Many new houses are being built with so-called log-kit construction. Houses built from these kits have a conventional crawl space with presawn, unseasoned southern pine logs for the walls above it. Although logs may receive momentary dip-treatments before use, unfinished, untreated wood will later be exposed by shrinking and cracking as the logs dry. Until treatments giving effective long-term protection are devised, such houses seem very susceptible to infestations of anobiids and other beetles or to decay.

Central Heating and Air-conditioning.—In the 11 States, the percentage of occupied structures with central heating increased from 13.5 percent in 1960 to 31.4 percent in 1970, ranging from about 21 percent in Mississippi to 43 percent in North Carolina. For these years the percentage of occupied structures with central air-conditioning increased 14.2 percent, houses with room units increased 18 percent, and those with no air-conditioning declined from 81.7 percent in 1960 to 49.7 percent in 1970 (table 2). Central cooling and heating systems are being installed in most new homes constructed today, and room units and central systems also are being installed in older homes. Central cooling or heating reduces the humidity in a house, so the wood moisture content is reduced below the critical level for infestation by *X. peltatus* beetles. Therefore, most infestations should be confined to crawl spaces or at least limited in their severity above the first floor.

With many heating and cooling systems, insulation is now being added between floor joists in many crawl spaces, where improper placement of vapor barriers could cause high wood moisture, which favors anobiid infestations. Detection and treatment of such infestations would be difficult and expensive. But if one installs soil covers when adding insulation, moisture problems can be avoided (Amburgey 1978).

Type of Wood Used.—Of all houses in the 11 States by 1970, about 69 percent were built before 1959 and about 27 percent (4.3 million) before 1940 (table 3). Limited construction of houses on slabs before 1940 and existence of only 1.2 million houses with basements by 1960 suggests most of

Table 1.—*Number of single-family dwellings in each of 11 southern States in 1970; number with basement, slab, or crawl space; percentage change from 1960 for each foundation type; and percentage of each type in 1970*

State	Total dwellings		Basements		Slab		Crawl space	
	No.	Change (%)	No.	Change (%)	No.	Change (%)	No.	Change (%)
Alabama	1,114,845	15.2	160,677	59.8	272,630	95.2	681,538	− 6.7
Arkansas	672,967	14.7	52,260	69.6	143,807	132.6	476,900	− 3.6
Florida	2,490,838	41.0	82,237	164.3	1,606,803	92.3	801,798	−13.5
Georgia	1,466,687	25.4	304,813	71.9	359,802	106.9	802,072	− 2.0
Louisiana	1,146,105	17.1	34,701	63.6	421,044	143.2	690,360	−13.6
Mississippi	697,271	10.9	35,103	88.3	152,969	157.4	509,199	− 8.2
North Carolina	1,619,548	22.4	387,055	40.4	313,579	103.8	918,914	+ 2.9
Oklahoma	937,815	15.0	102,872	16.2	316,661	91.0	518,282	− 8.3
South Carolina	804,858	18.6	88,438	57.6	148,561	74.5	567,859	+ 5.7
Tennessee	1,297,000	19.6	368,753	33.7	329,316	54.2	598,931	− 5.2
Texas	3,809,086	20.8	131,486	62.8	1,769,854	121.7	1,907,746	−19.1
Totals and Means	16,057,020	22.0	1,748,395	33.8	5,835,026	106.5	8,473,599	− 7.7

Table 2.—*Use of room or central air-conditioning in occupied single-family dwellings in 1960 and 1970 in 11 southern States*

State	No. occupied dwellings		Method of cooling[1]					
			Central air		Room unit(s)		No air	
	1960	1970	1960	1970	1960	1970	1960	1970
Alabama	884,116	1,114,791	2.6	15.2	14.1	33.8	83.3	51.0
Arkansas	523,442	672,970	2.1	14.9	11.8	31.6	86.1	53.5
Florida	1,550,414	2,490,777	2.8	23.3	15.4	37.1	81.8	39.6
Georgia	1,070,325	1,466,625	1.7	15.4	10.6	27.6	87.7	57.0
Louisiana	892,344	1,145,973	3.0	20.2	20.1	38.6	76.9	41.2
Mississippi	568,070	697,210	1.7	13.5	14.0	34.0	84.3	52.5
North Carolina	1,204,715	1,619,279	1.1	8.9	7.7	23.8	91.2	67.3
Oklahoma	734,593	937,827	3.5	18.9	26.2	39.7	70.3	41.4
South Carolina	603,551	804,817	1.4	11.0	10.7	29.1	87.9	59.9
Tennessee	1,003,301	1,296,928	2.0	12.2	18.5	40.3	79.5	47.5
Texas	2,778,116	3,808,916	5.1	27.8	25.3	36.4	69.6	35.8
Means			2.4	16.6	15.8	33.8	81.7	49.7

[1] Number of dwellings with each type expressed as a percent of total dwellings occupied in 1960 and 1970.

Table 3.—*Age distribution in 1970 of single-family dwellings in 11 southern States*

State	Total No. dwellings in 1970	Percent of total dwellings in each age group			
		0-10 years	11-20 years	21-30 years	31 +years
Alabama	1,114,845	29.6	23.0	16.8	30.6
Arkansas	672,967	29.5	19.0	18.4	33.1
Florida	2,490,838	41.2	31.5	12.4	14.9
Georgia	1,466,687	34.2	22.5	14.7	28.6
Louisiana	1,146,105	28.3	24.6	18.8	28.3
Mississippi	697,271	29.4	20.2	17.6	32.8
North Carolina	1,619,548	30.8	22.0	15.6	31.6
Oklahoma	937,815	26.2	20.9	15.4	37.5
South Carolina	804,858	31.5	22.7	15.8	30.0
Tennessee	1,297,000	30.1	22.4	16.2	31.3
Texas	3,809,086	30.5	27.4	18.2	23.9
Total and Means	16,057,020	31.2	24.9	16.2	27.0

the 4.3 million houses, now 40 or more years old, have crawl spaces. Thus, about half of the crawl-space houses existing in 1970 were constructed with very dense lumber from large mature trees and should not be severely damaged by anobiid beetles (Williams and Smythe 1978, Williams and Barnes 1979). Most of the remaining crawl spaces, particularly those constructed between 1940 and 1959, contain fast grown southern pine with much springwood, the main food of *X. peltatus* in pine (Williams 1977). Such houses are most likely to be severely infested.

Housing surveys by Phelps (1966, 1971) and unpublished observations from house inspections made by Williams and Smythe suggest that wood and wood products other than southern pine often are present in recent crawl-space construction. For example, western conifers are often used for wall studs and sometimes for floor joists. Also, reconstituted wood products, particularly plywood, are often used for sheathing and subflooring. Apparently, *X. peltatus* beetles cannot successfully infest southern pine or Douglas-fir plywood that contains synthetic resin glues (Williams and Mauldin 1974).[1] Also, in limited tests,[2] western conifers were not infested by *X. peltatus*; significantly, this beetle's distribution does not include states where western conifers grow (Simeone 1962).

Outlook for Prevention and Control

If trends continue for foundation construction, wood products consumption, and central cooling and heating systems usage, then the number of anobiid beetle infestations should decline. This trend and the limited capabilities of these beetles for causing damage suggest expensive preventive measures are not warranted. Infestations are usually confined to softwood floor joists and subflooring where remedial control can be achieved after infestations are detected and usually before replacement of damaged wood is needed (Williams and Smythe 1978, Williams and Barnes 1979). But uncontrolled infestations may become inaccessible in walls and exposed damage (exit holes) may occur within living areas when houses have severe moisture problems (Williams 1973).

[1] Williams, Lonnie H., and Joe K. Mauldin. Unpublished data from study No. FS-SO-2205-11.367 (on file For. Sci. Lab., Gulfport, Miss.)

[2] Williams, Lonnie H. Unpublished test data (on file For. Sci. Lab., Gulfport, Miss.).

Because infestations are inaccessible and because the only approved insecticide giving residual control (0.5 percent lindane water emulsion registered in about 26 states) cannot be used indoors, expensive tent fumigations are done. To provide inexpensive controls appropriate for anobiid beetle damage capabilities, safe, residual insecticides for application in living areas and control by wood moisture reduction need evaluation.

LYCTIDAE

Conditions Influencing Infestations

Lyctid beetles only attack hardwoods that have at least 3 percent starch and pores large enough for the insertion of eggs. As wood ages after tree felling, it loses starch by respiration and becomes less susceptible. Any finish such as paint or varnish that fills wood pores will prevent egg-laying. Lyctid beetles therefore are primarily found where unfinished hardwoods are manufactured or distributed, or in hardwood products that have been in use or storage for less than 5 years (Bletchly 1960, Gerberg 1957). Most lyctid infestations are introduced within structures by the use of infested products. The likelihood of infestation varies with supply sources and species of hardwoods and with use of preventive procedures during manufacturing. These procedures include a sterilization step in kiln schedules to kill larvae in incoming stock, inspection for infestations, first-in/first-out stock rotation, good woodyard cleanliness including frequent chipping or burning of scraps, and using softwood (coniferous) stickers and pallets (LaFage and Williams 1979).

Changes Influencing Infestations

Although a reference (USDA 1941) on the prevention and control of lyctids in military operations suggests these beetles once caused serious problems for domestic hardwood consumers, this is no longer true. Now most domestic hardwoods are kiln dried, a process which, if properly done, kills all insects within wood. Kiln-dried wood often is dipped in water-repellent sealers that close pores and prevent egg-laying. Susceptible domestic woods such as ash, white oak, pecan, and walnut have become so valuable that they are used primarily as veneers. Drying and gluing of veneers also helps prevent attack to

woods that otherwise might be susceptible. On the whole, improved processing and transportation technology has minimized lyctid beetle damage in domestic hardwoods.

Domestic hardwood production has declined and millwork, molding, plywood, and veneer are no longer listed as major uses of domestic hardwoods.[3] For example, production of domestic hardwood plywood and veneer declined 50 percent from 1950 to 1974 (Phelps 1975). To obtain plentiful supplies of raw hardwoods, U.S. manufacturers now rely on imports from Africa, Asia, Latin America, and Southeast Asia. From 1950 to 1974, imported hardwood lumber trade increased by about 67 percent and imports of hardwood plywood and veneer increased about 30-fold (Phelps 1975, Stone and Dickerhoof 1977). In 1976, the United States imported, mostly from southeast Asia, about 594,560 m^2 of hardwood plywood, veneer, and hardboard valued at cost of about $440 million. About 1,368,800 m^3 of solid hardwood products such as lumber, flooring, and moldings, valued at about $129.6 million were imported, with more than half from Asia and the rest mostly from Latin America.[4]

As in England and Germany where lyctid infestations frequently result from the importation of tropical hardwoods (Bletchly 1960, Cymorek 1977), concomitant increases in lyctid infestations and damage will probably result from the increasing volume and variety of hardwood imported into the United States. Included among the lyctid-susceptible woods commonly being imported are the light-colored, low-density woods with high starch content such as banak (*Virola* spp.), meranti or lauan (*Shorea* spp.), and obeche (*Tripoxylon scleroxylon* K. Schum.). Such woods are now used for millwork, molding, picture frames, paneling, plywood core stock, or specialty products such as shoe heels, and may contain lyctid infestations (fig. 1, 2, 3). Imported hardwoods are particularly vulnerable to lyctid attacks because adult beetles are present during most of the year in the tropics. Also, untreated, un-

[3] Grefrath, B. C. (n.d.) The use of benzene hexachloride in the southern hardwood lumber industry. Natl. Manuf. Prod. Assn., Washington, D.C.

[4] Potter, P. M. 1978. Personal correspondence to J. P. LaFage, La. State Univ., Baton Rouge, La. Imported Hardwood Prod. Assn. Rep on imported hardwood statistics for 1976.

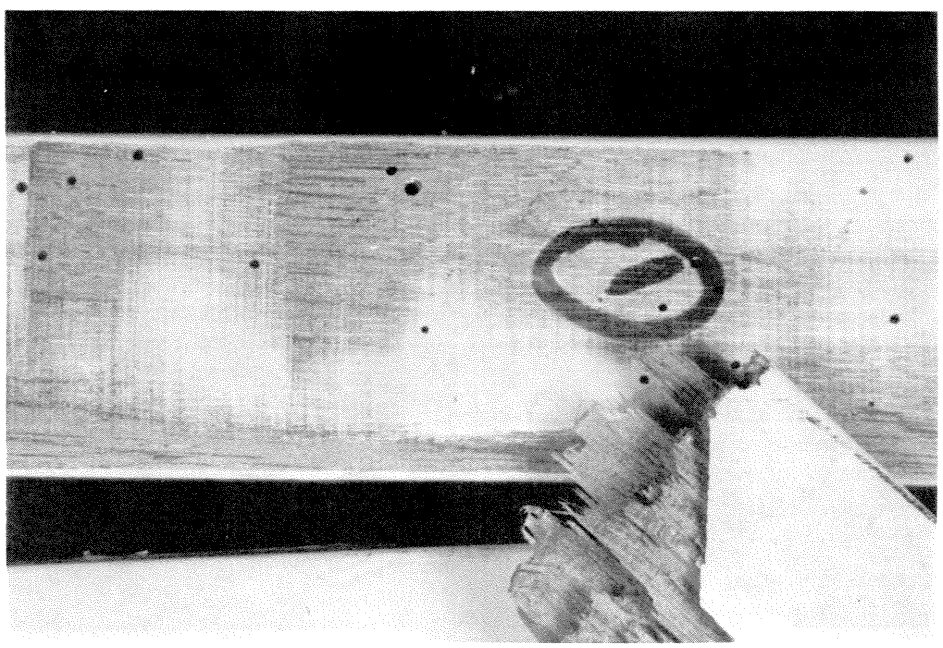

Figure 1.—*Door facings of banak heavily infested by* L. brunneus.

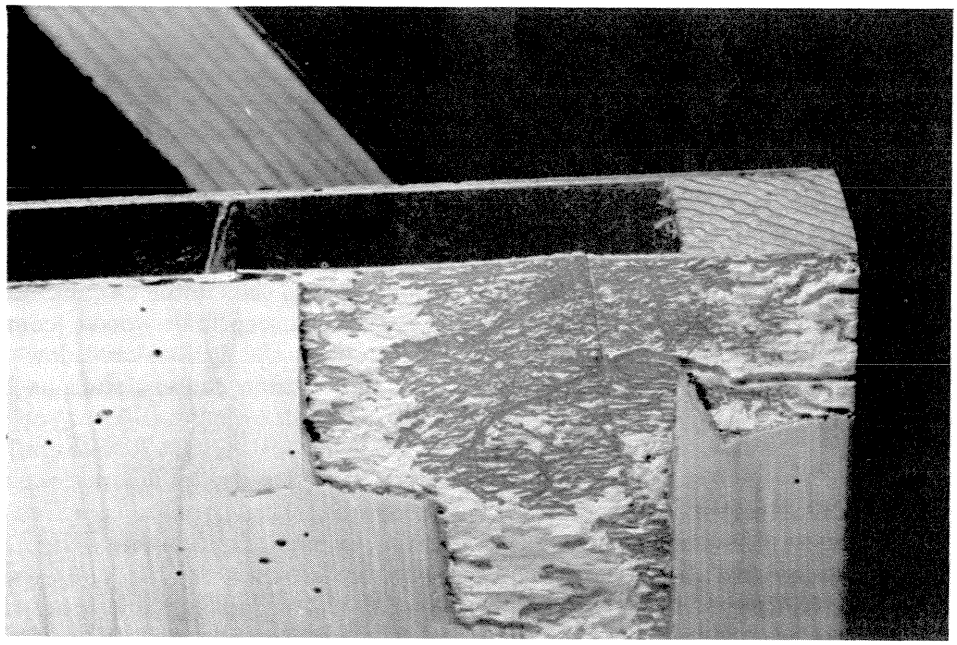

Figure 2.—*A three-ply parana pine door panel imported from Brazil with extensive damage by* L. brunneus *beetles in the unidentified hardwood inner core.*

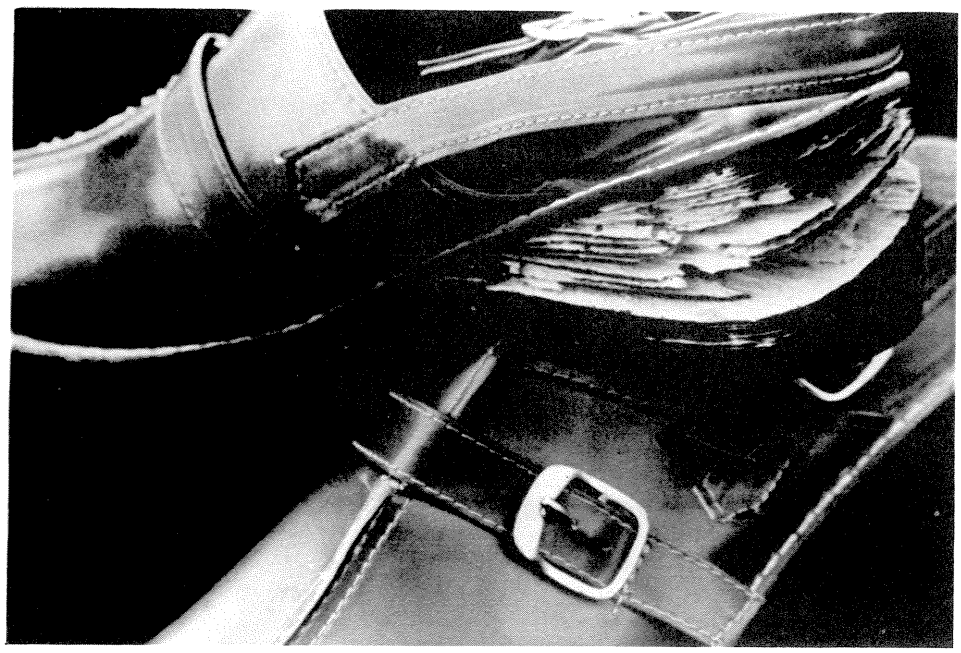

Figure 3.—*Shoes imported from Taiwan with extensive lyctid beetle damage in the wooden heel.*

finished, air-dried wood is sometimes stored for 6 months or more during transporting, processing, and marketing.

Quarantine inspections of hardwood imports at ports-of-entry do not necessarily insure that lyctid infestations will be detected and treated. Infestations of eggs and small larvae are not likely to be detected because no external damage shows. Also, because most tropical hardwood imports are semimanufactured and containerized, inspection is often limited to external surfaces of packaged lumber and bundles containing 200 veneer sheets or furniture squares. Most importantly, the main purpose of quarantine is to prevent entry of exotic pests, not to limit the distribution of pests already established or their damage. For example, though *Lyctus brunneus* (Stephens) is the species most frequently infesting tropical hardwood imports according to Bletchly (1960), Cymorek (1977), and my own records, infestations detected at ports are not treated by quarantine because this beetle is established in the United States.

Outlook for Prevention and Control

Because tropical hardwood imports may double by the year 2000 (USDA 1976), lyctid infestations, damage, and remedial control problems will increase unless quarantine requirements change for imports of hardwoods or unless hardwood importers and manufacturers use preventive treatments on raw imports and manufactured products. To prevent attack of domestic hardwoods and spreading of infestations when domestic and imported woods are stored together, preventive treatments would have to be applied to all susceptible domestic and foreign woods. Although the incidence of infestations may not seem to warrant the additional expense, widely applied prevention is important because remedial controls often are limited to replacement of high-valued products or tent fumigation. And combined costs of performing such controls, wood loss, and litigation over damage liability are very expensive.

Insuring that preventive treatments are properly applied to tropical hardwoods in foreign countries or that all hardwoods are treated would be expensive (and perhaps impossible) so a system of prevention for individual firms needs to be developed. The system would combine sterilization of wood by kiln-drying or microwave heating with inexpensive chemical treatments giving permanent protection of products made from sterilized wood. Because prevention would not always be done, safe, inexpensive remedial controls also are needed for use within structures.

BOSTRICHIDAE

Conditions Influencing Infestations

Most wood-infesting bostrichids also attack recently processed hardwoods with high starch content, but their attacks are not restricted to wood with large pores. Most native bostrichids lay eggs in bark on wood with a moisture content above 30 percent. Most infestations occur while hardwoods are being air-dried, and many are found in firewood. A few native species infest coniferous woods and their larvae occasionally survive in air-dried structural timbers. An exception is the leadcable borer (*Scobicia declivis* [LeConte]); females bore short tunnels for egg laying and infestations occur in lead sheathing of cables and dry wood such as wine casks (Ebeling and Rierson 1973, Fisher 1950). Tropical species within the genera *Heterobostrychus* and *Sinoxylon* also lay eggs in short tunnels bored into bare wood and are very destructive to recently processed hardwoods, particularly unseasoned crates and pallets (Bletchly 1967). Once the wood dries, however, reinfestation is rare.

Changes Influencing Infestations

The likelihood of native bostrichids damaging domestic hardwood products has been minimized by improved processing and transportation technology. Of all wood-infesting insects, however, bostrichids are most frequently intercepted by U.S. quarantine officials (Williams and La Fage 1979). The most commonly occurring species are *Heterobostrychus aequalis* (Waterhouse), *Sinoxylon anale* Lesne, and *S. conigerum* Gerstaker. Many infestations are in crating, pallets, and dunnage which are included with all types of import cargo. Because the volume of such cargo has increased greatly, some undetected bostrichid infestations are surely entering the country.

Outlook for Prevention and Control

The greatest danger may be introduction of a tropical species that can attack native hardwood trees, especially weakened ones. At least two

species, *Dinoderus minutus* Fabricius (Baker 1972) and *H. aequalis*, are established in the south (USDA 1967, Woodruff 1967). Since its discovery in 1967 at Fort Lauderdale, Florida, *H. aequalis* seems to be spreading rapidly. Specimens have been collected from throughout Florida, Georgia, and northward to North Carolina. [5]

Preventive measures taken for lyctid beetles would also prevent bostrichid infestations in manufactured products, but prevention of bostrichids entering with general cargo will depend on quarantine procedures.

CERAMBYCIDAE

Conditions Influencing Infestations

The old house borer (*Hylotrupes bajulus* L.) is the major cerambycid pest of seasoned wood. Although the old house borer was introduced into the United States before 1841 (St. George et al. 1957), its distribution remains largely confined to the Atlantic Coast States from Florida to Massachusetts. Temperature apparently is a limiting factor because adult flight is rare below 25°C and 30°C is optimum (Cymorek 1968). Other cerambycids occasionally occur in ash, pecan, and other recently seasoned furniture stock. *Arhopalus* spp. occasionally infest air-dried western conifer lumber. Of these minor pests, only *Smodicum cucujiforme* (Say) infests dry wood.

The old house borer mainly attacks southern pine, spruce, and Douglas-fir—woods usually used for structural frameworks. A high nitrogen level in wood favors infestations and old house borers prefer to attack freshly processed wood. Infestations are often introduced into structures when infested materials are used in construction.

Attacks in existing structures are influenced by the same factors that affect the Anobiidae. Because optimal temperatures (28-30°C) for old house borer mating, egg hatching, and feeding are higher than for anobiids and the minimum wood moisture requirement is lower (Becker 1942, Berry 1972, Durr 1956), severe infestations can occur in attics, especially when shade lowers the temperature and lack of adequate ventilation increases moisture.

Although this large beetle is potentially very damaging, damage is usually slight in an occupied house where central systems control temperature and humidity, if no other moisture problems exist (Moore 1978a). But initial infestations such as in exposed ceiling beams can cause extensive damage. Therefore, the public often desires the immediate control given by fumigation even though the structural damage likely to occur does not warrant the expense (Moore 1978b).

Changes Influencing Infestations

Fewer crawl spaces are being built, and many roof trusses are being prefabricated with wood treated with temporary water repellents. Such prefabrication minimizes the time that kiln-dried wood is exposed to egg-laying females during construction. So the number of infestations should decline, though the present increase in the inspection of attics by pest control firms may suggest an opposite trend.

Most softwood lumber is currently kiln-dried, but higher energy costs may lead to more air-drying of wood and thereby increase the likelihood of infestations. Also, increased use of insulation in attics and crawl spaces will make discovery and treatment of infestations more difficult (Moore 1978c).

Outlook for Prevention and Control

Because the old house borer has not greatly extended its range westward in more than 150 years since its introduction, it seems unlikely that the number of infestations will greatly increase. More thorough inspections within its present range may suggest so however.

Expense of preventing old house borers, other than by using kiln-dried wood in construction, should not be warranted (Moore 1978a,c). Pretreatment of log-kit construction, however, is an exception and should be done. Also, safe, inexpensive remedial controls need to be developed so expense of fumigating limited infestations can be avoided.

[5] Williams, Lonnie H. 1977. Personal correspondence with Dr. Phil Koehler, Extension Entomologist, Univ. Fla. (On file For. Sci. Lab., Gulfport, Miss.)

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Anobiid beetle infestations should decline because fewer houses are being built with crawl spaces and more houses have central heating and air-conditioning. Increased imports of tropical hardwoods may increase likelihood of lyctid infestations, and the incidence of attacks by old house borers should change little

Additional keywords: wood-destroying beetles, anobiid beetles, bostrichid beetles, lyctid beetles.

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