True Powderpost Beetles

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Scientific names of pests—*Lyctus brunneus* (Stephens), *L. costatus* Blackman, *L. discedens* Blackburn, *L. parallelocollis* Blackburn, *Minthea rugicollis* (Walker) [Coleoptera: Lyctidae (in Australia family Bostrichidae, subfamily Lyctinae)]

Scientific names of hosts—*Eucalyptus amygdalina, E. cloeziana, E. delegatensi, E. dunnii, E. globulus, E. nitens, E. obliqua, E. ovata, E. regnans, E. saligna, E. viminalis, Corymbia calophylla, C. citriodora,* and *C. maculata*. These species are listed because they are not resistant to lyctid infestation due to the diameter of their xylem vessels. Numerous hardwood species could be susceptible to attack. Other species of interest are resistant because xylem vessels are too small to allow insertion of the female's ovipositor (Erskine 1965).

Distribution—*Lyctus brunneus*: cosmopolitan; *L. costatus*: South Australia and Tasmania; *L. discedens*: Queensland and New South Wales; *L. parallelocollis*: Queensland, New South Wales and South Australia; *Minthea rugicollis*: Queensland and South Australia.

Summary of natural history and biology of the pest—Three families of beetles, Lyctidae, Bostrichidae, and Anobiidae, are often collectively referred to as powderpost beetles because their larvae reduce wood to a mass of powdery or pelleted frass (Ebeling 1975). There is no general agreement among specialists as to exactly which beetles should be classified as "powderpost beetles" or even whether the term should be used (Moore 1979). However, to distinguish the Lyctidae from the others, the Lyctidae are known as true powderpost beetles in the United States (Ebeling 1975).

The Lyctidae make their presence known by numerous small [<3 mm (<0.12 in.) diameter] exit holes on the surface of wood (Peters and others 1998). They attack sapwood of dead hardwood trees almost exclusively, especially dried and cured lumber (Peters and others 1996). Several generations can re-infest the same piece of wood until it is riddled with exit holes and only the outer shell remains (Brimblecombe 1947, Ebeling 1975, Peters and others 1996). Beneath the surface of the infested wood are galleries or tunnels filled with frass (a mixture of fecal material and wood fragments), usually following the grain of the wood (Ebeling 1975, Moore 1979, Anonymous 1986).

Most parts of the world are inhabited by both indigenous and introduced, well-established species of lyctids. In the United States, lyctids are second only to termites in their destructiveness to wood and wood products (Ebeling 1975). They confine their attacks to large-pored hardwoods. Powderpost beetles may be found in hardwood flooring, hardwood timbers, plywood, and wood articles such as crating and furniture. The damage the beetles cause consists of reducing sound wood to fine powder. This damage is usually not evident until the emergence holes of the adults are observed (Moore 1979, Anonymous 1986). Lyctids are generally brought into buildings in wood that contains their eggs or larvae, but once an infestation is established, it can continue unabated in hardwood lumber, cabinetry, and furnishings within the structure (Ebeling 1975).

The chief source of food for powderpost beetles is starch; they also digest whatever sugar and protein may be present. They do not digest cell walls, for the larvae cannot digest cellulose, hemicellulose, lignin, or pentosans; these components of wood pass through the alimentary canal undigested. Lyctids will not oviposit in sapwood with a starch content of less than 3% (Ebeling 1975). Adult females will bite the surface of wood to test for starch content before ovipositing (Moore 1979, Ito 1982, Peters and others 1996, 1998). Development time is reduced the greater the concentration of starch. Lyctids can live in wood with a water content between 8% and 32%. Because the water content of green wood is commonly 50% or more, attack by powderpost beetles is generally confined to partially or wholly seasoned wood. The greatest lyctid beetle activity is found in wood with a moisture content ranging from 10% to 20% (Ebeling 1975).

Lyctids are small beetles ranging from 2 to 7.5 mm (0.08 to 0.3 in.) in length. They are reddish, various shades of brown, or black; have a prominent head not covered by the prothorax; have short, 11-segmented antennae, each with a 2-segmented terminal club; and have tibiae with distinct spurs (Ebeling 1975, Moore 1979, Anonymous 1986, Peters and others 1996, 1998). Adult lyctids mate soon after they emerge from infested wood. Females have a long, flexible ovipositor that they insert deeply into the pores of hardwoods, laying one or more eggs/pore (Ebeling 1975). The vessels or pores in which the eggs are deposited are exposed when the wood is cut, or may be opened by the beetle herself when sampling for starch content.

The incubation period for lyctid eggs can range from 1 to 3 weeks. Young larvae usually tunnel with the grain of the wood, but later take an irregular course, sometimes intersecting the tunnels of other larvae. The tunnels are packed with a fine, powder-like, boring dust. Larvae do not penetrate to the wood surface but, like termites, leave a thin, unbroken surface layer. Mature larvae bore to a point near the surface of the wood and build a pupal chamber. The pupal period lasts from 12 days to a month. After metamorphosis, adults chew their way to the surface, open an exit hole 2 to 3 mm (0.08 to 0.12 in.) in diameter, and push some of the fine dust out of the hole when emerging. Small piles of the dust are common near new emergence holes. Although the larva confines its burrowing to sapwood, if the adult has no other way of emerging it can bore its way through heartwood. Adults conceal themselves in cracks and holes in the wood during the day, become active at night, fly readily, and are positively phototrophic (Ebeling 1975, Moore 1979, Peters and others 1996, 1998).

The life cycle, from egg-laying to emergence of adults, ordinarily requires 9 to 12 months but under conditions in Australia may be as little as 3 to 4 months. Under exceptionally favorable conditions of high temperature and high starch content of wood, that period may be reduced to only 6 or 7 months. Outdoors, the larvae grow chiefly during spring and summer, but in heated rooms they can develop continuously. Under adverse conditions of temperature and nutrition, the life cycle may be prolonged to as much as 4 years. There can be a great difference in the length of the life cycles of different species. For example the average for *Trogoxylon parallelopipedum* (Melsheimer) is 3 to 4 months, compared with 9 to 12 months for *Lyctus planicollis* LeConte (Ebeling 1975).

Specific information relating to risk elements

A. Likelihood of introduction

1. Pest with host-commodity at origin potential:
   Logs—*High* (RC) (Applicable risk criteria, from Ch. 1: a, b, c, d, e, f, g, h)
   Chips—*High* (RC) (Applicable risk criteria, from Ch. 1: a, b, c, d, e, f, g, h)

   A majority of the commercial eucalypt species could supply harborage for all stages of powderpost beetles. The likelihood of powderpost beetles ovipositing in freshly cut logs is not great. However, as the outer sapwood dries in log decks, either in the forest, at ports, or in chipping mills, the likelihood of adults finding the wood suitable for oviposition increases. Chips, even though they average only 30 to 40 mm (1.2 to 1.6 in.) square by 10 mm (0.4 in.) thick (Gadgil and others 1996), are drier, have a plethora of open pores, and ample starch to support larval development. Lyctid eggs and early instar larvae would likely survive the chipping process.

2. Entry potential:
   Logs—*High* (RC) (Applicable risk criteria, from Ch. 1: a, b, c, d)
   Chips—*High* (RC) (Applicable risk criteria, from Ch. 1: a, b, c, d)

   Powderpost beetles could survive quite well during transit. In log decks, adults could easily be concealed between the logs or within cracks and crevices of the log surface. Eggs and early instar larvae could survive in the sapwood and would be nearly impossible to detect. Normal transit time from the bush to the port and transit to the United States would normally not exceed one month so that powderpost beetles would still be in the larval stage of the first generation. Adults are unlikely to complete development and emerge before logs are off-loaded at the port of entry unless the logs have been held for a long time before shipment. Therefore, the characteristic emergence holes and powdery frass would not be present to aid in identification of infested logs. The presence of eggs or larvae would easily go undetected in shipments of chips, although there is, as yet, no evidence in the literature that lyctids could complete their life cycle in wood chips. The greatest risk of introducing powderpost beetles would result from logs (or chips) that are shipped from plantations or ports in Australia with these species present, and then remain in storage at the import site for extended periods of time. Waste lumber at lumberyards or sawmills has been reported to be commonly infested with *Lyctus* beetles (Froggatt 1926a).

3. Colonization potential: *High* (RC) (Applicable risk criteria from Ch. 1: a, b, c, d, e)

   Powderpost beetles are generally polyphagous. The presence of an acceptable host is not the critical factor, because these powderpost beetles can infest numerous tree species and wood in service. The factors limiting host acceptability are moisture content, starch content in the sapwood, and pore size. If logs or chips arriving at a port are not immediately utilized or are left in a refuse pile, powderpost beetles can reinfest the parent material or disperse to find other suitable materials. For example, infestations that become established in lumber storage facilities are very difficult to eradicate because of the ready supply of seasoned, susceptible wood. The adults are strong fliers and are attracted to lights. They could easily become established in solid wood products, such as hardwood pallets, that would be in the vicinity of ports of entry. Once established, these beetles could infest dead wood in exotic trees grown as ornamentals (Bockerhoff and Bain 2000). Colonization potential is great at all ports, regardless of the climate.

4. Spread potential: *High* (RC) (Applicable risk criteria, from Ch. 1: b, c, d, e, g)

   Powderpost beetles do not fly great distances. However, infested wood, moved by humans in commerce, would spread these insects at a much faster rate than their natural spread. Also, once established at the receiving seaport or inland destinations, powderpost beetles can go undetected when they infest new material and because of their cryptic habits, populations can be large before the first evidence of their activities (emergence holes and piles of characteristic powdery frass) is apparent. Before an infestation is noticed, additional wood or trees could become infested and distributed within the continental United States or its territories and possessions. Furthermore, Australian powderpost beetles could be misdiagnosed or confused with native species.

B. Consequences of introduction

5. Economic damage potential: *High* (VC) (Applicable risk criteria, from Ch. 1: a, c, d, e)

Powderpost beetles can attack most hardwood species that are not protected by a wood surface treatment, such as varnish or wax. Their damage to wood in houses can be severe but is usually restricted to hardwood elements, such as those found in flooring, cabinetry, and furniture. Once they are in a structure, spread of powderpost beetles to other parts of the structure can be rapid, and the economic impact can be quite high. The economic losses due to damage by powderpost beetles in the United States are second only to those of subterranean termites. Control methods for infestations of powderpost beetles in structures are currently available and rely on fumigation of the entire structure with methyl bromide. Soon this fumigant will be phased out of production and use. The only available substitute, sulfuryl fluoride, is much more expensive and requires very high dosages to kill the egg stage.

6. Environmental damage potential: *Low* (MC) (Applicable risk criterion from Ch. 1: none)

Powderpost beetles would not likely cause large outbreaks nor do they affect live trees. They would breed in dead wood in live trees or in wood in use. Introduced powderpost beetles could displace some native species of wood-boring beetles.

7. Social and political considerations: *Moderate* (RC) (Applicable risk criterion from Ch. 1: c)

Powderpost beetles do not cause aesthetic damage in forests. Damage to hardwood components in structures or finished hardwood products destined for export would cause the consumer the greatest concern, adding to concerns about other powderpost beetle species worldwide. Control methods for powderpost beetles are available but can be expensive. Fumigant gases stop infestations but provide no residual protection. Furthermore, one of the fumigant gases (methyl bromide) is being phased out of use due to concerns over adverse effects to environmental quality through depletion of the ozone layer.

C. Pest risk potential:
Logs—*High* (Likelihood of introduction = *High*; Consequences of introduction = *High*)
Chips—*High* (Likelihood of introduction = *High*; Consequences of introduction = *High*)

As the eggs and larvae of true powderpost beetles would likely survive the chipping process and could survive transit, the pest risk potential for chips remains "*High.*"

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Reviewers' comments—"Powderpost beetles...are seldom an industry problem in Tasmania until the logs reach the sawmills where logs often will be stockpiled for periods of time. *Lyctus brunneus* survives in cambial layer tissue left on boards and beams after sawing and so is a common problem in newly constructed buildings.... Powderpost beetles are usually only a problem for air-dried boards or 'back-yard' constructions. My overall view is that there is low danger of attack if logs are debarked at landing and not stacked for long periods of time before processing. Holding under sprinklers again solves that problem. In Tasmania we have *L. brunneus* (Stephens); *L. costatus* Blackburn, and *Trogoxylon ypsilon* (Lesne), the latter attacking *Acacia dealbata*. *L. brunneus* is a very common species attacking drying hardwood timber. Debarking prevents some field attack. *L. brunneus* is usually a pest of timber in construction, attacking cambial layer. Could attack debarked hardwood logs if left on wharf for weeks and logs dry out. If held under sprinklers not a problem. The other species are not a problem from Tasmania. I very much doubt survival in woodchips for any of these species." (Bashford)

"The pest risk assessments for these two groups of insects (true powderpost beetles and false powderpost beetles) are well written and thorough. However, I question whether either powderpost beetles or false powderpost beetles could successfully complete development in chips. As discussed, chips average only 30 to 40 mm square by 10 mm thick and are not likely to be selected by adult females for oviposition. Is there any evidence that eggs or young larvae that survive the chipping process can complete their life cycle within chips? (It is hard to imagine that a beetle ranging in size up to 20 mm would be able to complete development in a 30 to 40 mm chip.) If larvae are unable to complete development in chips, then the likelihood of their introduction and establishment in the U.S. from chips would be nil. Unless there is strong evidence that powderpost beetle larvae can mature and emerge as adults equally well from eucalypt chips as from logs, I suggest the risk for entry potential (for emerging adults, not larvae) for powderpost beetles in chips be reduced to moderate or low (rather than high) for both groups of beetles. If such evidence exists, it should be cited in the assessment document. The entry potential on logs should retain a 'high' rating. You state 'If logs or chips arriving at a port are not immediately utilized or are left in a refuse pile, powderpost beetles can reinfest the parent material'; is this true for chips?" (Billings)

"You state that given favourable conditions, life cycles can be reduced from 12 to 6 to 7 months. Experience in Australia is that given a hot climate/heated surroundings in houses etc., this can be reduced to 3 to 4 months." (Collett)

"Is there evidence in the literature that they (powderpost beetles) would develop completely in chipped material?" (Seybold)

In referring to the statement in the IPRA "...infested wood, moved by humans in commerce, would spread these insects at a much faster rate than their natural spread." The reviewer states "This is why many species currently have cosmopolitan distributions." (Seybold)

"I believe that you have done an excellent job in summarizing the risk potential of these insects arriving in the U.S. in *Eucalyptus* spp. logs and chips. I have taught the biology of these beetles for over 30 years and you had some information that was new for me. I concur with all of your conclusions! As with Monterey pine logs imported from New Zealand, importing *Eucalyptus* logs and chips from Australia would be another open pathway for pests to enter North America. We already have too many powderpost beetle species introduced to the U.S.! Thank you for the opportunity to make comments on these assessments." (David Wood)

"My participation in previous pest risk assessments was based on my experience with bark and ambrosia beetles (Scolytidae & Platypodidae). Although I have collected and observed powderpost beetles in Australia, New Guinea, and South America, I do not consider myself a specialist on powderpost beetles. I have, however, seen rather considerable and extensive plantings of non-native eucalypt trees on the Pacific Coast in the USA, in Mexico, and Central and South America where those trees were almost free of insect and disease problems. The importation of unprocessed eucalypt logs and chips will almost certainly have serious impact on existing plantings on our Pacific Coast, including southern Nevada, most of Arizona, and other southern areas. Most powderpost beetles are much more difficult to detect and can remain in the wood much longer than is possible for scolytids and platypodids, hence the potential for introduction of pest species is much greater. We cannot afford to lower the barriers on eucalypt materials as was done for Oregon and Washington a couple of decades ago that resulted in the introduction of more than a dozen pest species of oaks and conifers that are now here to stay. Some are now becoming significant pests here. I am unequivocally opposed to the importation of unprocessed logs or chips of any tree species into this country. In the long run it will be far less expensive to grow them here." (Stephen Wood)

Response to comments—The concerns expressed by Seybold, David Wood, and Stephen Wood are the main reason for conducting the pest risk assessment. This IPRA does not address prevention or remediation; however, the comments made by Bashford can be used by whoever develops guidelines for prevention and remediation. Although there is doubt of survival or continued development in chips, this has yet to be proven or disproven.

There is no evidence in the literature that powderpost beetles will develop completely in chipped material. All we have is one empirical observation, so stated in the text. This would be a good research project, both in the laboratory and by sampling chips arriving in Japan.

The shorter time frame of the life cycle pointed out by Collett is indicated in the revised text.

In response to concerns expressed by Billings, lyctids could be transported in chips as (1) adult hitchhikers, (2) eggs or larvae from logs that were later chipped, and (3) as eggs or larvae that started in chips, not logs. To the team's knowledge, there is no experimental or empirical evidence of lyctids selecting chips for ovipositing, eggs or larvae surviving the chipping process (although we strongly suspect they would), oviposition in chips (we strongly suspect they would do this), or larvae completing their development in chips. It cannot be assumed that beetle larvae would be restricted to a single chip to complete its life cycle. The chip piles at the originating port and receiving port; as well as during transit, are packed together and could allow larvae to move among the chips as if they were one piece of wood. Because we have no knowledge of the potential for lyctids to successfully inhabit chips and survive transport, the team chose to err on the conservative side and maintain the pest risk potential at "high."