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TREATMENTS, TRADE AND LONG-HORNED WOODBORERS (CERAMBYCIDAE)

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The beetle family Cerambycidae, commonly called the long-horned woodborers because of the characteristically long antennae of adults of many of the included species, or round headed wood borers as a consequence of the shape of the larval head capsule, are a large family. More than 20,000 species have been described globally and more than 1100 species included in over 290 genera are known to occur in North America. There are 156 species included in 145 genera known to occur in Canada. At least two of these species, the Asian long-horned beetle, *Anoplophora glabripennis* (ALB), and the brown spruce long-horned beetle (BSLB), *Tetropium fuscum*, are recent introductions to Canada. Both species are of regulatory significance and are currently under eradication.

The Cerambycidae play an important role in nutrient recycling in forest ecosystems. Most species attack dead or dying trees. Their larval galleries penetrate the bark and wood opening it up to other decay organisms, thereby hastening the breakdown of the wood. They can be serious pests in timber and wood products when wood is cut from trees under attack by larvae, or when decked logs are attacked in the forest or mill yards. A number of species are recognized as quarantine pests in international trade. In addition to the damage that the larvae cause during feeding, the family is also important as vectors of other pathogenic organisms.

Over the past few decades considerable attention has been paid to the global movement of Cerambycidae with wood and wood products. In 1999, the brown spruce long-horned beetle was discovered to have established in Point Pleasant Park, in Halifax, NS. Evidence was subsequently found that the introduction had occurred more than a decade before its discovery. While considered a secondary pest in its native European range, in Halifax it was attacking and killing living red spruce. The location of the primary infestation adjacent to a container port suggests that the introduction occurred in association with infested wood packaging arriving at the port.

The Asian longhorned beetle was discovered in northwest Toronto and adjacent areas of Vaughn in 2003. More than 550 infested trees were discovered in a primarily industrial area. To date eradication efforts have resulted in the removal and destruction of more

than 25,000 trees and in 2006 no new infestations were discovered. At least two species of *Anoplophora* have been transported globally in association with wood packaging and established in areas well beyond their native range. Since 1996, infestations of ALB have been discovered in New York (1996), Chicago (1998) and New Jersey (2002) in the United States, in Braunau Austria (2001), in Gien (2003) and Ste-Anne sur-Brivet (2004) in France and in Neukirchen, Germany (2004); while the citrus long-horned beetle, *Anoplophora chinensis*, has established in Milano, Italy (2000) and has been the subject of eradication efforts in Tukwilla WA (2001) in the United States.

Global movements of Cerambycidae with trade have been detected more frequently in recent decades but they are by no means a recent phenomenon. Long-horned woodborers native to Australia have established in many regions of the world where eucalyptus has been planted as a forest resource or as an ornamental. *Phoracantha semipunctata* was first detected attacking eucalyptus in New Zealand in 1870 and has since been discovered in southern Africa (South Africa in 1908), South America (Argentina in 1917, Peru in 1967and Chile in 1980), northern Africa (e.g. Egypt in 1950), the Mediterranean region (Cyprus in 1945, Italy in 1971and Spain in 1980) and in California in the United States in 1984. Again, infested wood packaging is suspected as the primary pathway for these introductions.

The importance of the wood packaging pathway in the transport of long-horned woodborers has been demonstrated by regulatory surveys. Between 1997 and 2000, Canada's regulatory agency, the Canadian Food Inspection Agency, examined the frequency of interceptions of wood-borer families associated with wood packaging. Almost half of all the interceptions associated with wood packaging were Cerambycidae.

Because of their association with the pine wood nematode, *Bursaphelenchus xylophilus*, species in the genus *Monochamus* are some of the most important long-horned woodborers in international trade. Eight species of *Monochamus* are present in the coniferous forests of Canada. Following emergence from wood, adults move to and feed on the foliage and bark of twigs, to acquire food resources to develop their eggs. Following mating and maturation feeding, females move to the trunks of recent dead or dying trees and chew an oviposition pit in the bark and lay eggs into the underlying phloem. Early instar larvae feed on the phloem before entering the wood to feed. Later instar larvae feed primarily in the sapwood and may penetrate into the outer heartwood (see http://warehouse.pfc.forestry.ca/pfc/3095.pdf). During their development, later instar larvae may return to the bark-phloem interface and feed on the phloem. At maturity, the larvae return to the outer sapwood and cut a pupation chamber. The chamber is plugged with characteristic excelsior-like wood shavings. In the early late spring through early summer the larvae transform to pupae, and subsequently to adults. The adults then chew through the remaining sapwood and bark to emerge, leaving a characteristic round exit hole. In southern regions the life cycle is completed in one year while in more northern areas it can take up to two years to complete.

While high levels of attack by *Monochamus* can reduce the value of wood products cut from infested logs, the primary international phytosanitary concern is related to the woodborers importance as vectors of pinewood nematode (PWN), *B.xylophilus*, the causal agent of pine wilt disease in Japan and China. PWN has a short and complex life cycle. Following introduction into a tree during maturation feeding (primary transmission) or oviposition (secondary transmission) the nematode rapidly spreads through resin canal system of the tree, feeding on the thin-walled cells lining resin canals. When living plant cells are no longer present, the nematodes feed on fungal hyphae growing in the wood. The nematodes become inactive as the weather cools in fall, and overwinter in live or dead trees. In the spring, nematode larvae migrate to the pupation chambers of *Monochamus* and moult to a specialized larval type (dauer larvae) that enter the tracheae of newly eclosed *Monochamus* adults. Once the *Monochamus* adult emerges, tens of thousands of dauer larvae can be present in the tracheae. As the adult beetle feeds on the foliage or lays eggs under the bark, the dauer larvae leave the beetle and enter the tree through the wounds. The dauer larvae migrate to resin canals, moult immediately to adults, mate and lay eggs. The life cycle of PWN is the most rapid of any known plant parasitic nematode. Juvenile nematodes moult once in the egg, the second instar emerges from egg, feeds, and moults twice to the adult. Under optimal conditions the life cycle can be completed in about 4 days. Once a tree has been colonized, the PWN rapidly disperses throughout the stem and branches and can even be found in the roots.

Following the discovery of PWN in green lumber, the European Union implemented phytosanitary restrictions on green lumber imports from Canada. As a consequence of these restrictions, green wood exports to the EU from Canada in 1992 were eliminated as a consequence of the regulation and wood exports to the EU drastically reduced.

The presence of woodborers and other organisms including PWN has led to the adoption of phytosanitary treatments to eliminate these pests from wood packaging. In 2002, the International Standard on Phytosanitary Measures No. 15 (Guidelines for regulating wood packaging material in international trade) was adopted by the FAO. The following treatments are currently accepted as effective when conditions identified in Annex 1 of the amended measure[1] are met: methyl-bromide fumigation to the schedule noted in Annex 1 or heat treatment to a minimum temperature of 56°C for 30 min at the core. The standard also staes that “Kiln-drying (KD), chemical pressure impregnation (CPI), or other treatments may be considered HT treatments to the extent that these meet the HT specifications. For example, CPI may meet the HT specification through the use of steam, hot water, or dry heat.” Thus any kiln dried lumber that has attained a minimum core temperature of 56°C for a minimum of 30 minutes can be considered HT. At the present time, no chemical wood preservation techniques have been accepted as phytosanitary treatments under the International Plant Protection Convention. A new international standard is currently being developed that identifies the standards to evaluate any new phytosanitary treatments.

[1] https://www.ippc.int/servlet/BinaryDownloaderServlet/133703_ISPM15_2002_with_Ann.pdf?filename=1152091663986_ISPM_15_2002_with_Annex1_2006_E.pdf&refID=133703