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SUMMARY
BEETLE TRANSMISSION OF STAIN

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The underlying cause of many problems for wood quality, wood preservation and wood protection are invasive bark and ambrosia beetles making their home in trees and wood products. In many cases these beetles are associated with staining and or pathogenic fungi that can compromises or even kill a tree, and damages the wood. In this paper, I discuss aspects of how these beetles are capable of causing such harm, the implications for our ecology and industry and why I think the problem will worsen.

Example of beetles and their economic impact

Not all approximately 400 species of bark and ambrosia beetles in Canada are currently of economic importance, but the money values of the damage of only a few examples reveal the scale of the problem.

A) Large wood borers: *Cerambycidae* and *Buprestidae*
e.g. Asian longhorn beetle, Brown spruce longhorn beetle
Damage in interior of British Columbia: $340 million/ year

B) Bark beetles: *Scolytidae*
e.g. Mountain pine beetle (MPB), Douglas-fir beetle
Damage due to the MPB in British Columbia: $1 billion / year

C) Ambrosia beetles: *Scolytidae*
e.g. Striped ambrosia beetle
Damage > $100 million on British Columbia's coast

Threats and problems

A beetle's window of opportunity to attack a standing tree or wood products is framed by the environmental conditions, the status of the host as well as the various aspects of its biology, e.g. its association with fungi and its behaviour. These parameters are under human influence and their alteration can lead to increased pest and disease problems, which, in turn impact the requirements for wood protection and preservation.

The window of attack opportunity can be altered significantly when either a foreign beetle or a foreign host is introduced. The cryptic habit of bark and ambrosia beetles promote concealed and protected transportation, which may cover great distances when movement occurs internationally in infested dunnage or in other wood products. For example Lee Humble (Pacific Forestry Centre, Victoria, B.C.) found 16 different beetles species in a single Norway spruce bolt that was imported into Canada as packaging material (Humble 2001). Such movement provides the opportunity for introductions. Consequences of such introductions include hybridization with native species and rapid evolution of the exotic insect or fungal genotypes. In this case the non-native organism is subject to novel or episodic selection, in which sudden exposure to new biotic and abiotic factors may cause promote rapid evolution. A classic example for rapid evolution of a pathogenic beetle-associated fungus is the Dutch Elm disease, *Ophiostoma ulmi* (Brazier 2001).

Some ambrosia beetles are primary attackers of healthy, living trees, but in recent years species, which normally attack fallen or dead trees, have been observed attacking living trees, either as exotics or even in their native geographic ranges. We hypothesize that the underlying factors for an increased prevalence of attack by secondary ambrosia beetles on living trees are induced by climate changes. For example with an increase in temperature the beetles may be able to fly earlier. Early flight, prior to budflush, could allow angiosperm-infesting ambrosia beetles to attack their hosts long before the trees begin to photosynthesize. Prior to budflush their metabolic capabilities to withstand attack through induced resistance would be at best weak. The temporal window of opportunity for ambrosia beetles to attack living host trees successfully may thus expand in the early spring if climatic warming is occurring. The beetles could then penetrate the bark, start a gallery system, and establish fungal cultures while the tree is still dormant and unable to resist. Such a mechanism could also hold true for other tree species and we may, in the near future face many more unexpected forest pests (Kühnholz et al. in press).

Solutions and approaches

The beetles and their associated fungi are well adapted to exploit tree tissue. Because they adapt faster than we are able to respond, it is likely that these organisms will always 'outsmart' us, and the prevention of increased future damage should have priority over treatment. The emphasis should be on the development of enhanced protection and improved diagnostic tools. International quarantine standards for insects and fungi should be implemented as soon as possible, and internationally coordinated for effective mitigation. Only research on the biological interactions with the host, in concert with interdisciplinary collaborations will enable a fair and accurate socio-economic impact assessment. Finally, we should protect, test and improve our current natural resources and create an environment for the forest industry to change.

Literature

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