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Natural Enemies of Bark Beetles in the United States: Potential for Biological Control

Robert E. Stevens

Rocky Mountain Forest and Range Experiment Station
Forest Service, U.S. Department of Agriculture
Fort Collins, Colorado 80526

Bark beetles (Scolytidae) are among the most destructive forest pests in the United States. Although there are more than 70 genera in the family, the genus *Dendroctonus* includes most of the economically important species. This discussion primarily deals with *Dendroctonus* beetles, with a short note on the smaller European elm bark beetle, *Scolytus multistriatus* (Marsham), which is the principal vector in the United States of the Dutch elm disease. The *Dendroctonus* species are mainly forest pests, while Dutch elm disease is primarily an urban problem.

The genus *Dendroctonus* includes some 13 species, among them the southern pine beetle, *D. frontalis* Zimmermann; the mountain pine beetle, *D. ponderosae* Hopkins; the western pine beetle, *D. brevicomis* LeConte; the spruce beetle, *D. rufipennis* (Kirby); and the Douglas-fir beetle, *D. pseudotsugae* Hopkins (Furniss and Carolin, 1977). These are the major pests, and the species on which most work with natural enemies has been done.

All of these bark beetles have similar life cycles. The adults bore into the area of the inner bark or phloem, mate there and lay eggs in galleries. The larvae and pupae develop within the tree; only during the adult dispersal phase of the life cycle are the beetles outside the confines of the bark.

The beetles do not kill the trees directly but introduce into successfully attacked trees various fungi of the genera *Ceratocystis* and *Europhium*, which interfere with the water and nutrient conduction systems of the tree. These fungi, along with the girdling of the tree by the beetles, cause rapid death of a successfully attacked tree.

In standing trees, *Dendroctonus* beetles commonly colonize the lower and middle parts of the boles, while the upper part is more or less concurrently occupied by other groups, especially by beetles of