

## **ENVIRONMENTAL AND EVOLUTIONARY DETERMINANTS OF BARK BEETLE-FUNGUS SYMBIOSES**

Diana L. Six

Department of Ecosystem and Conservation Sciences, College of Forestry and Conservation, University of Montana, Missoula, MT 59812 USA.

[six@forestry.umt.edu](mailto:six@forestry.umt.edu)

Ectosymbioses among bark beetles (*Curculionidae: Scolytinae*) and fungi (primarily *Ophiostomatales*) are widespread. These associations range from mutualistic to commensal, and from facultative to obligate. Some are highly specific, with particular fungi associated only with one beetle species. Others are less so, with a single fungus associated with multiple beetle hosts. Mycangia, structures of the beetle integument that function in fungal transport, have evolved numerous times in the *Scolytinae*, indicating a high degree of importance of the fungi to at least some beetle species. However, the presence of mycangia alone may not be a perfect indicator of obligate associations, because several “non-mycangial” beetle species are also closely associated with specific fungi. Unfortunately, the processes that have shaped current day beetle-fungus associations remain only poorly understood. Because many beetle-fungus symbioses are multipartite, determining origins, and detecting which factors have been most critical in shaping present day assemblages, can be particularly difficult. No comprehensive study has been conducted comparing beetle and fungal phylogenies to look for evidence of cospeciation. However, the limited data available for a few groups within the *Scolytinae* indicate that strict cospeciation of beetles with fungal associates has not occurred, but rather, a combination of cospeciation and other events such as host switching have acted in combination to shape current assemblages. The degree of dependence of partners, mode of transmission (vertical vs. horizontal) of symbionts, effects of the abiotic environment, and interactions among symbionts and among symbionts and other members of the biotic community have likely played strong roles in determining composition, fidelity and longevity of partnerships between beetles and their fungal associates. In this chapter, I provide an overview of these associations, the evolutionary histories of both beetles and fungi, and discuss how both evolutionary history and the environment have likely acted together to shape these fascinating, complex symbioses.