A REVIEW OF MYCOPHAGY IN THE EUCINETOIDEA (COLEOPTERA), WITH NOTES ON AN ASSOCIATION OF THE EUCINETID BEETLE, *EUCINETUS OVIFORMIS*, WITH A CONIOPHORACEAE FUNGUS (BASIDIOMYCETES: APHYLLOPHORALES)

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Abstract. – Published records of hosts and microhabitats of species of the eucinetoid families Clambidae and Eucinetidae (Coleoptera) are reviewed. *Eucinetus oviformis* LeConte is reported breeding on the fungus Coniophora olivacea (Pers.) Karst. in mountainous western North Carolina. This represents the second known association of a eucinetid beetle with a basidiomycete host.

The superfamily Eucinetoidea was proposed by Crowson (1960) to include the families Clambidae, Eucinetidae, and Scirtidae (= Helodidae). Little is known about the hosts and habitats of eucinetoids. Larval scirtids are aquatic, except for the probable larva of *Veronatus*, found by Crowson (1981: 456) in damp humusrich soil in New Zealand; no scirtids are known to be associated with fungi. The Clambidae and Eucinetidae, however, are considered principally mycophagous (Benick, 1952; Crowson, 1981, 1984), although there are relatively few published host records. The purpose of this paper is to provide a brief summary of published accounts of the hosts and microhabitats of Clambidae and Eucinetidae, and to record the association of a eucinetid beetle with a wood-rotting fungus in the southern Appalachians.

REVIEW OF MYCOPHAGY IN EUCINETIDAE AND CLAMBIDAE

Among the seven species of *Eucinetus* occurring in North America, most host data are for *E. morio* LeConte. This species was first associated with slime mold (Myxomycetes) fruiting bodies by Weiss and West (1921) who found adults with a *Trichia* sp. (Trichiales, Trichiaceae) in New Jersey. Lawrence and Newton (1980) have recorded this species in eastern North America from *Arcyria pomiformis* (Leers) Rostafinski (Trichiales, Trichiaceae); *Fuligo septica* (L.) Wiggers (Physarales, Physaraceae); *Stemonitis axifera* (Bulliard) Macbride, *S. splendens* Rostafinski and *Stemonitis* sp. (Stemonitales, Stemonitaceae); and *Tubifera* sp. (Liceales, Reticulariaceae). One of us (QDW) has also collected adults and larvae of *E. morio* from fruiting bodies of *Stemonitis* sp. in North Carolina (Macon Co.) and Ohio (Franklin Co.).

Bruns (1984) recently discovered adults of *Eucinetus punctulatus* chewing on immature fruiting bodies of *Paragyrodon sphaerosporus* (Peck) Sing. (Agaricales, Bolitaceae) in several localities in Minnesota. Its larvae were found on the fresh

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pores and gills of *P. sphaerosporus* and *Paxillus involutus* (Batsch. ex Fr.) Fr. (Agaricales, Paxillaceae), probably feeding on the hymenium and spores. Bruns' observations were the first firm association of a eucinetid beetle with a basidiomycete host. An association of another North American eucinetid with a wood-rotting basidiomycete is given below.

Large numbers of adults of the European *Eucinetus meridionalis* Castelnau have been observed, along with larvae and pupae, in unidentified fungal growths under bark of logs and stumps (Perris, 1851), and larvae have been found feeding on fungus under bark of pitch pine (Gardner, 1969). Adults of *E. haemorrhoidalis* Germar, another common European species, have been recorded by Klausnitzer (1971, 1975) from a variety of habitats, including decaying plant remains, under bark, rotting stumps, and logs (especially *Pinus* and *Quercus*), fungus-infested roots of *Euphorbia* and grasses (Gramineae), *Polyporus* sp. (Basidiomycetes, Aphyllophorales, Polyporaceae) on *Betula*, and under stones.

Known microhabitats of other North American and European species of Eucinetus also suggest a close association with fungi. The western North American E. infumatus LeConte has been collected under bark of Fraxinus, Cupressus, and Alnus (Lawrence and Newton, 1980), and Keen (1895) reported larvae, pupae, and adults under loose bark of decaying spruce (Picea). Adults, larvae, and pupae of this species have been collected under bark of a dead Sargent cypress (Cupressus sargenti Jeps.) in Mendacino Co., California (borrowed from U.S. National Museum), and from a "basidiomycete on Eucalyptus inner bark" in Contra Costa Co., California by J. K. Liebherr. It will be interesting to determine whether other eucinetids are also mycophagous, particularly those adults that exhibit remarkable sucking adaptations of their mouthparts, such as Jentozkus plaumanni Vit, Tohlezkus ponticus Vit, and Euscaphurus nikkon Vit (Vit, 1977). All three species have been collected in habitats where both slime mold plasmodia and fungal hyphae are potentially abundant. Specimens of T. ponticus have been taken from soil samples among roots of spruce (Picea), in decomposing spruce stumps, and in the wood of decaying alder (Alnus) and beech (Fagus).

While only a single species of Eucinetidae is known to be associated with slime molds (i.e. E. morio), it may not be coincidental that there is evidence that some Clambidae are also slime mold associates. Unidentified species of Neotropical Clambus have been collected from fruiting bodies of the slime molds Arcyria stipata (Schweinitz) A. Lister, Arcyria sp., Stemonitis axifera, and S. fusca Roth on Barro Colorado Island and at Cerro Campana, Panama (Lawrence and Newton, 1980). Clambus panamensis Endrody-Younga has also been collected (by QDW) from fruiting bodies of Stemonitis sp. on Barro Colorado Island and Cerro Campana, Panama (Endrody-Younga, 1981; Wheeler, 1983). Crowson and Crowson (1955) successfully reared larvae of Clambus minutus Sturm and Calyptomerus dubius Marsham on hyphae and spores of mold in culture, probably Mucor sp. (Zygomycetes, Mucorales: Mucoraceae). Clambus minutus was observed to occur commonly "on more or less water-logged sticks lying partly in or adjacent to streams in shady situations" and in flood debris. Crowson (1979) found Acalyptomerus asiaticus Crowson occurring commonly in haystacks and similar accumulations of decaying vegetation. Grigarick and Schuster (1961) discovered various types of spores in the gut contents of Loricaster rotundus Grigarick and Schuster, surmising that this species probably feeds on fungi, at least in part.

EUCINETUS OVIFORMIS/CONIOPHORACEAE ASSOCIATION

During recent field studies of mycophagous and slime mold feeding Coleoptera in the southern Appalachian Mountains of western North Carolina, K. J. and Q. D. Wheeler discovered several life stages of Eucinetus oviformis LeConte in association with a wood-rotting basidiomycete fungus. Adults, pupae, and larvae were collected from mycelia of Coniophora olivacea (Pers.) Karst. growing in a large patch on a standing stump in a mixed hardwood-coniferous forest in Macon County, about 2 miles northwest of Highlands on September 14, 1982 (Q. W. Lot #82117). This series of specimens includes 33 larvae (tentatively separable into three size classes, possibly corresponding with instars), two pupae, and five adults. Voucher specimens of all life stages and the host fungus are deposited in the Cornell University Insect Collections. Coniophora belongs to the family Coniophoraceae (Aphyllophorales) and includes brown wood-rotting species related to the familiar dry-rot fungi of the Stereaceae (Alexopoulos and Mims, 1979). Bruns' (1984) record of eucinetid-Agaricales associations aside, no Eucinetidae have previously been associated with the extensive wood-rotting mycoflora (Gilbertson, 1984).

CONCLUSIONS

The association of *Eucinetus oviformis* with *Coniophora* reported here and the recent association of *E. punctulatus* with fungi of the Boletaceae and Paxillaceae (Bruns, 1983) provide an unambiguous indication of eucinetid-basidiomycete associations. The *Eucinetus-Coniophora* association points to the need to survey small, inconspicuous wood-rotting fungi as well as taxa producing larger fruiting bodies. Associations of eucinetids with both slime molds and Basidiomycetes, and slime mold feeding in Clambidae may indicate by outgroup comparison (Watrous and Wheeler, 1981) that the common ancestor of these lineages was associated with slime molds. Unfortunately, our knowledge of the hosts of both families is too sparse and fragmentary to support or refute this hypothesis. Crowson (1981) regards coleopterous associations with Myxomycetes to be of considerable antiquity, and Eucinetidae to be among the most primitive of the polyphagan beetles (Crowson, 1955, 1960). Ultimate resolution of questions about ancestral feeding habits and evolution of modern ones will rest on learning more about extant relationships between eucinetoids and their fungal hosts.

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