PROC. ENTOMOL. SOC. WASH.
88(4), 1986, pp. 666–672

A DESCRIPTION OF THE LATE-INSTAR LARVA OF *XENOMYCETES LAVERSI* HATCH (COLEOPTERA: ENDOMYCHIDAE) WITH NOTES ON THE SPECIES' HOST AND DISTRIBUTION

PAUL J. JOHNSON

Department of Plant, Soil and Entomological Sciences, University of Idaho, Moscow, Idaho 83843.

Abstract.—The late-instar larva of *Xenomycetes laversi* Hatch is described for the first time. SEM illustrations are presented to show unusual mycangial setae. *Paxillus atrotomentosus* (Batsch ex. Fr.) Fries is apparently the sole fungal host for both adults and larvae of the beetle. New collection data are presented for the species' known range in Washington and Oregon (New State Record).

Xenomycetes laversi Hatch was originally described from two specimens labelled "Seattle, Wash" (Hatch, 1961). Since this description, few specimens of this beetle have appeared in collections and no reports of it have been published. Here, I describe the late instar larva, identify the apparent sole host fungus, and report additional collections from various localities in western Oregon and Washington.

Larvae of six genera of Endomychidae found in North America have been described or illustrated. Böving and Craighead (1931) illustrated and gave key characters for *Mycetaea hirta* Marsham, *Aphorista vittata* (Fabricius), *Stenotarsus hispidus* Herbst, *Endomychus coccineus* Linnaeus., *E. biguttatus* Say, *Lycoperdina ferruginea* LeConte, and *Rhymbus ulkei* Crotch. Peterson (1960) provided illustrations of and a family description based on *L. ferruginea* and *E. biguttatus.* Pakaluk (1984) presented a description of the larva of *L. ferruginea* along with extensive biological data.

The following description is based on specimens which were killed in 70% ethyl alcohol, and preserved in a 19:1 solution of 70% ethyl alcohol and glycerin. Specimen preparation for SEM began with decapitation and a soaking in warm 1 N NaOH for 10–15 minutes. Specimens were then rinsed and flushed with distilled water, fixed with a solution of 2% glutaraldehyde in 0.1 M sodium phosphate, buffered, and dehydrated in a graduated series of ethyl alcohol. Specimens were then critical point dried, attached to stubs with double-stick cellophane tape, ion-coated with gold-palladium, and examined with an ISI-60 scanning electron microscope at 30 kv.

Xenomycetes laversi Hatch

Late instar larva.—Length 7.0 mm, width 1.8 mm, turgid; onisciform, broadly fusiform in dorsal aspect; shallowly convex dorsally; flavotestaceous, coriaceous, with sparsely to moderately distributed, erect, basket-like mycangial setae (Figs. 1, 3), marginal bristles slightly longer than discal bristles; densely set with truncate

microscoli (Figs. 4–5); terga and nota plate-like. Nota and terga 1–8 with an unsclerotized ecdysial suture densely set with truncate microscoli. Pleural and ventral regions cream colored, verrucose, densely set with truncate microscoli. Spiracles annular-uniforous; thoracic spiracle on anterior portion of mesothorax; abdominal spiracles in pleural membrane on segments 1–8.

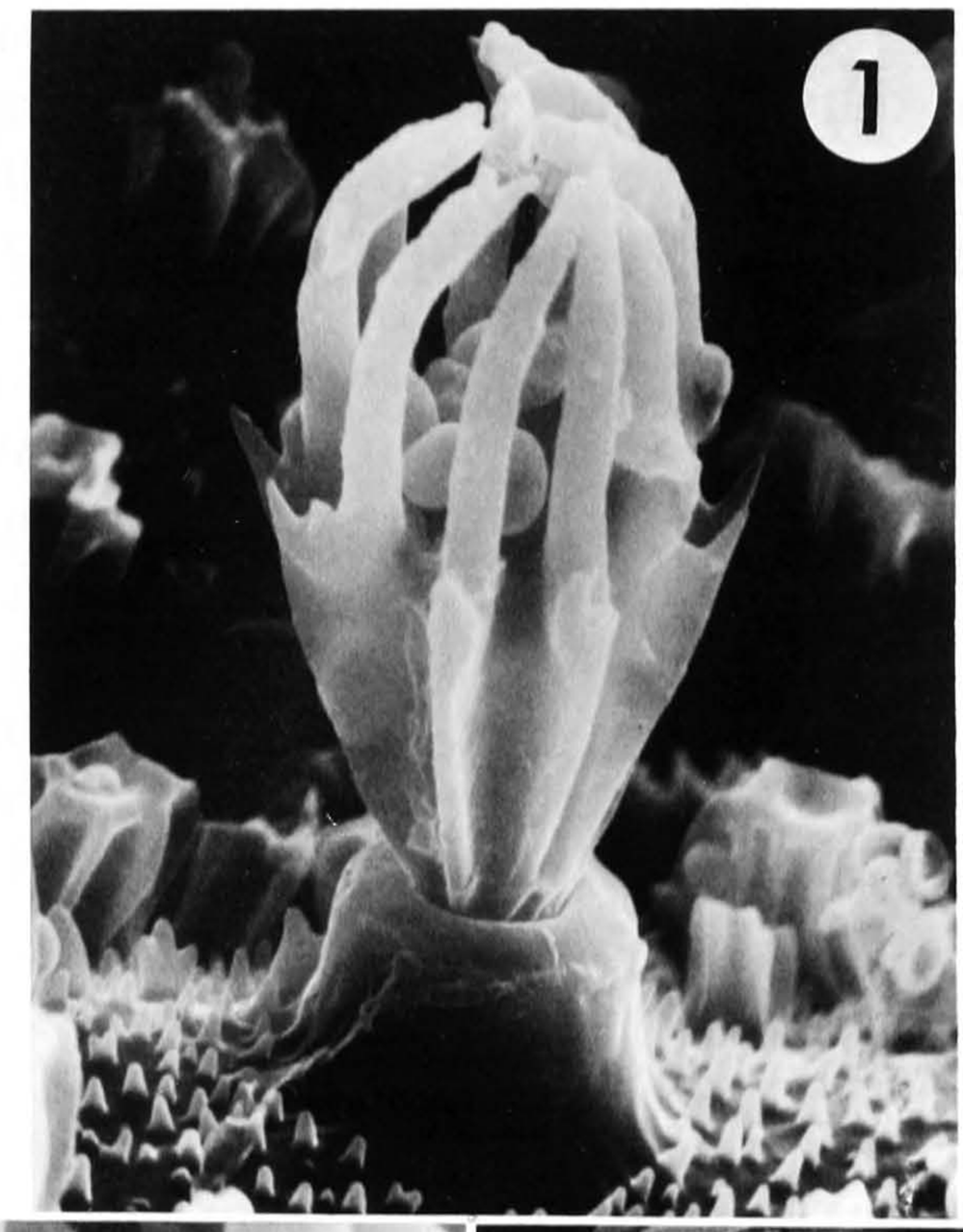
Head: 0.33× as long as wide, 0.5× as wide as pronotum, moderately well sclerotized; prognathus, slightly angled ventrally. Stemmata 3 each side, forming a nearly equilateral triangle. Ecdysial suture with frontal arms broadly U-shaped, epicranial stem absent. Antennae 3-segmented (Fig. 6), cylindrical; lateral sensorium trumpet-shaped, narrowing apically, slightly longer than segment 3. Mandibles (Fig. 7) slightly longer than wide; apically bifid, inner tooth with mesal preapical swelling; incisor lobe thin, blade-like mesally; prostheca flattened, membranous; molar lobe glabrous, developed as large, well sclerotized, serrate ridge. Labrum quadrate, slightly wider than long; anterior margin broadly shallowly emarginate. Epipharynx simple with medial, longitudinal asetose band; lateral portions with large acuminate setae directed medially, setae becoming minute laterally; anteriorly with setae forming whorled patches on disc. Labial and maxillary structures as in Fig. 8. Labial palps 2-segmented, set upon bulbous conjunctival membrane, apical segment short, cone-shaped. Maxillary palps short, 3-segmented; basal and second segments subequal in length and width; penultimate short, ring-like; apical segment 2× longer than penultimate segment, broadly cone-shaped. Malae moderately sclerotized, lobate with a single large chitinous dentation medio-apically with 2–3 stout setae, an additional 7 of these setae extending basally on dorsal surface. Stipites not divided. Cardines triangular, weakly differentiated from stipites.

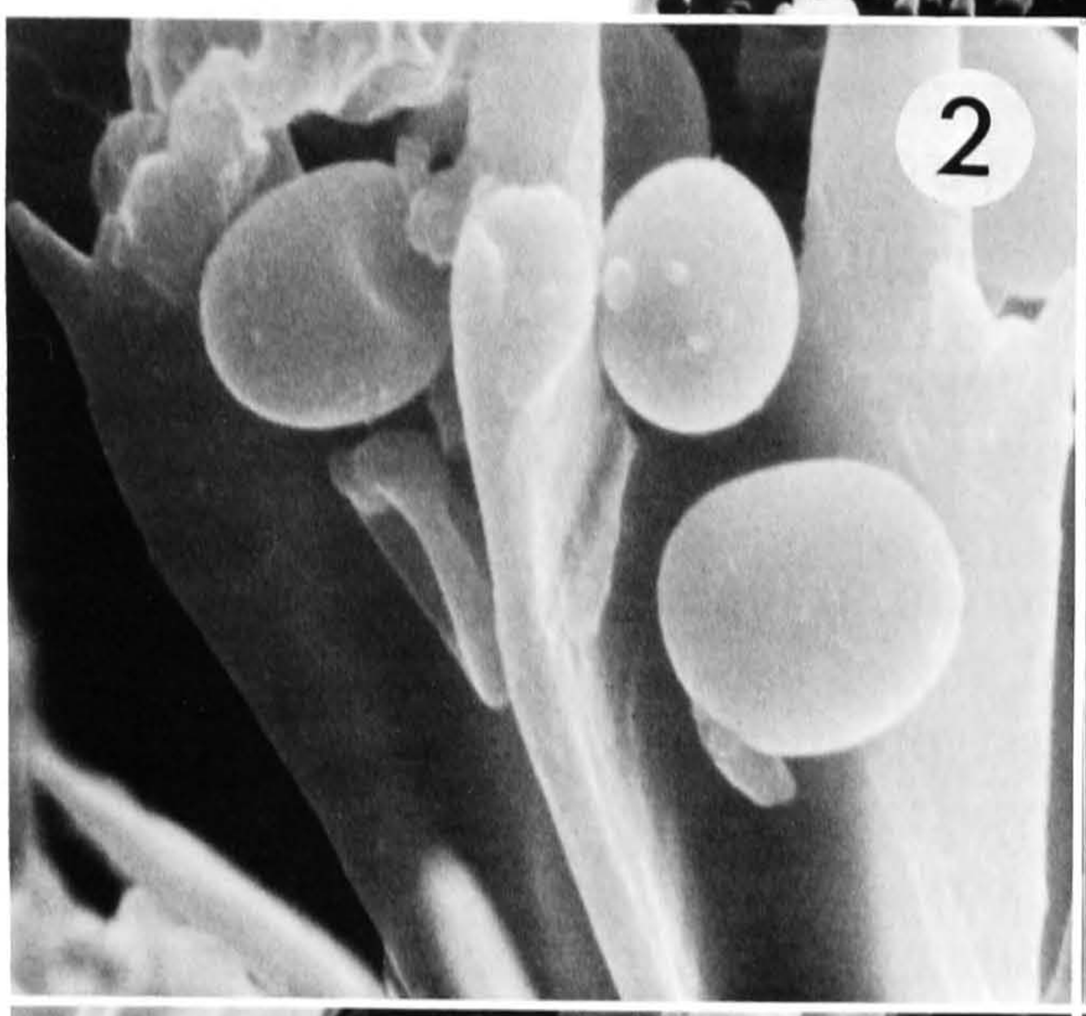
Thorax: Pronotum 2× length of mesonotum, rounded trapezoidal, narrowing anteriorly in dorsal aspect; anterior lateral angles broadly rounded. Mesonotum and metanotum subequal in length, progressively slightly wider, metanotum 1.2× width of pronotum. Legs of polyphagan type, sparsely set with long, acuminate hairs distad of coxa, without microscoli; coxa conical, slightly projecting; trochanter short triangular; femur fusiform; tibia 0.5× as long as femur, subcylindrical; tarsungulus large, 0.5× length of tibia.

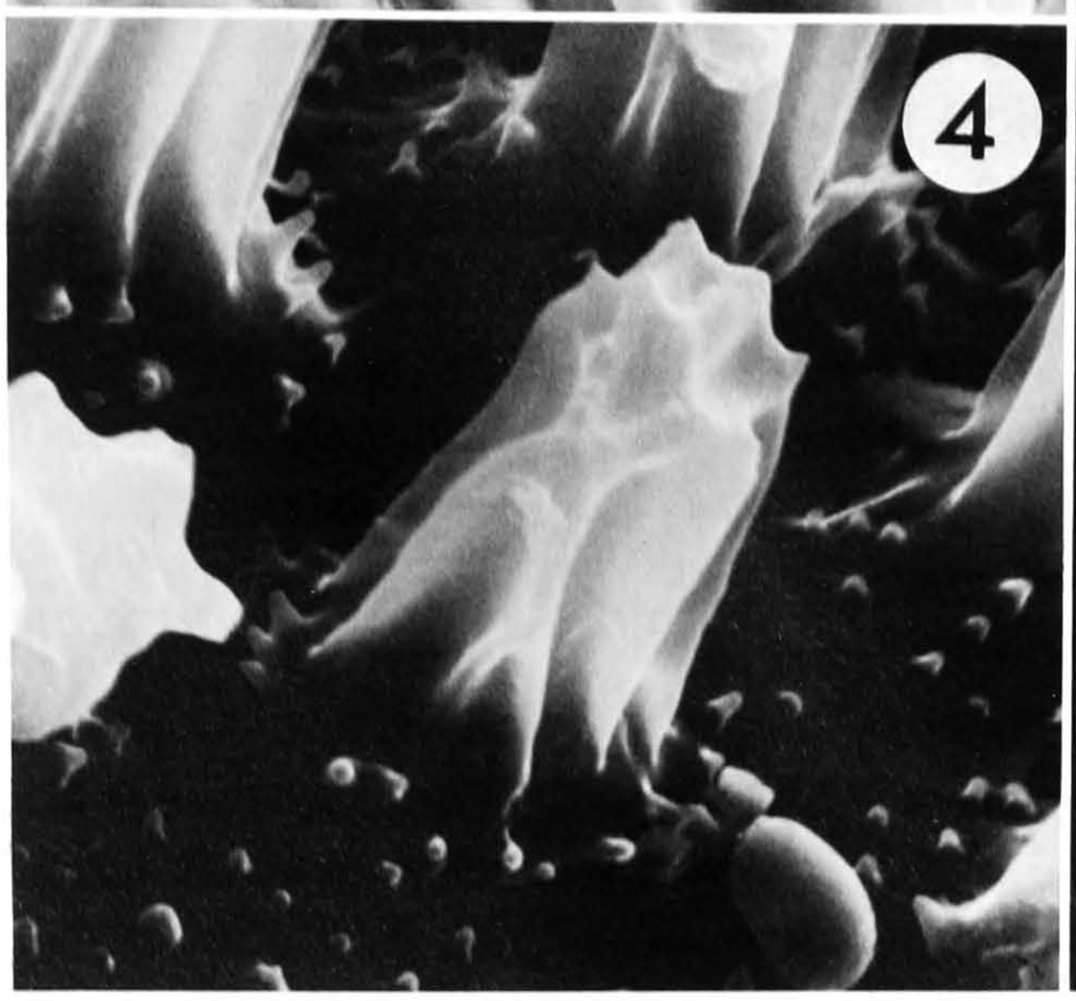
Abdomen: Terga similar to and subequal in width with metanotum to segment 5, then gradually, progressively decreasing in width to segment 9; segment 9 0.5× as wide as segment 1, and 1.5× as long as segment 8, posterior margin evenly rounded; abdominal segment 10 obsolescent. Lateral margins of tergites broadly rounded, slightly oblique posteriorly. Anal region soft, extrusable; anal tube short, fleshy, unmodified, not forming a true pygopod.

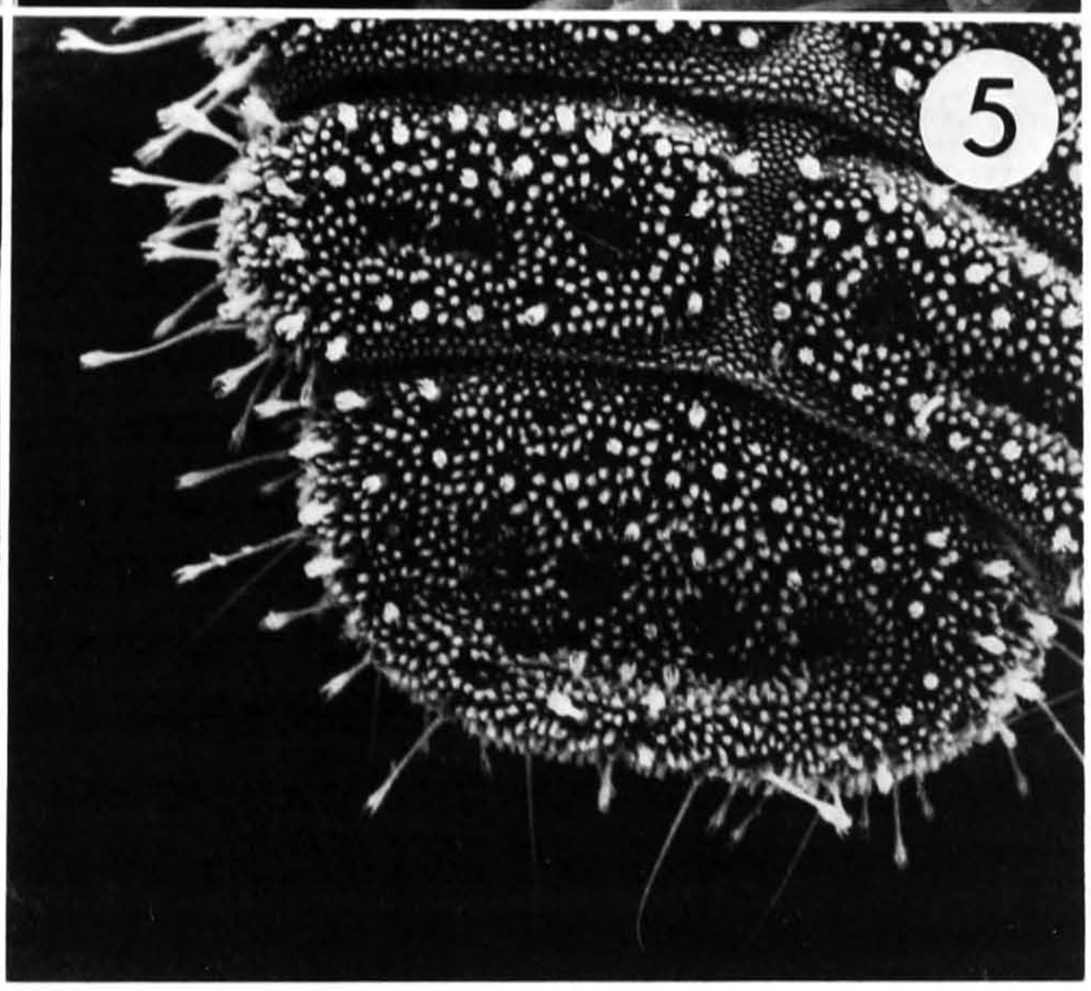
Remarks.—With regard to the North American endomychid fauna, *X. laversi* larvae can only be confused with *Aphorista, Mycetaea,* and possibly *Endomychus* (see previous references). Discrimination of *X. laversi* from *Endomychus* and *Aphorista* is readily made by the lateral tergal projections and longer 2nd antennal segment of the latter genera; and from *Mycetaea* by its more deeply excavated incisor lobe of the mandible.

Mycangial setae (Figs. 1, 3) have apparently not been described in the larvae of Endomychidae or related families, although the phylogenetically related Coccinellidae often possess a variety of interestingly formed defensive spines. I have examined the larva of *Aphorista laeta* LeConte which possesses basket-like my-

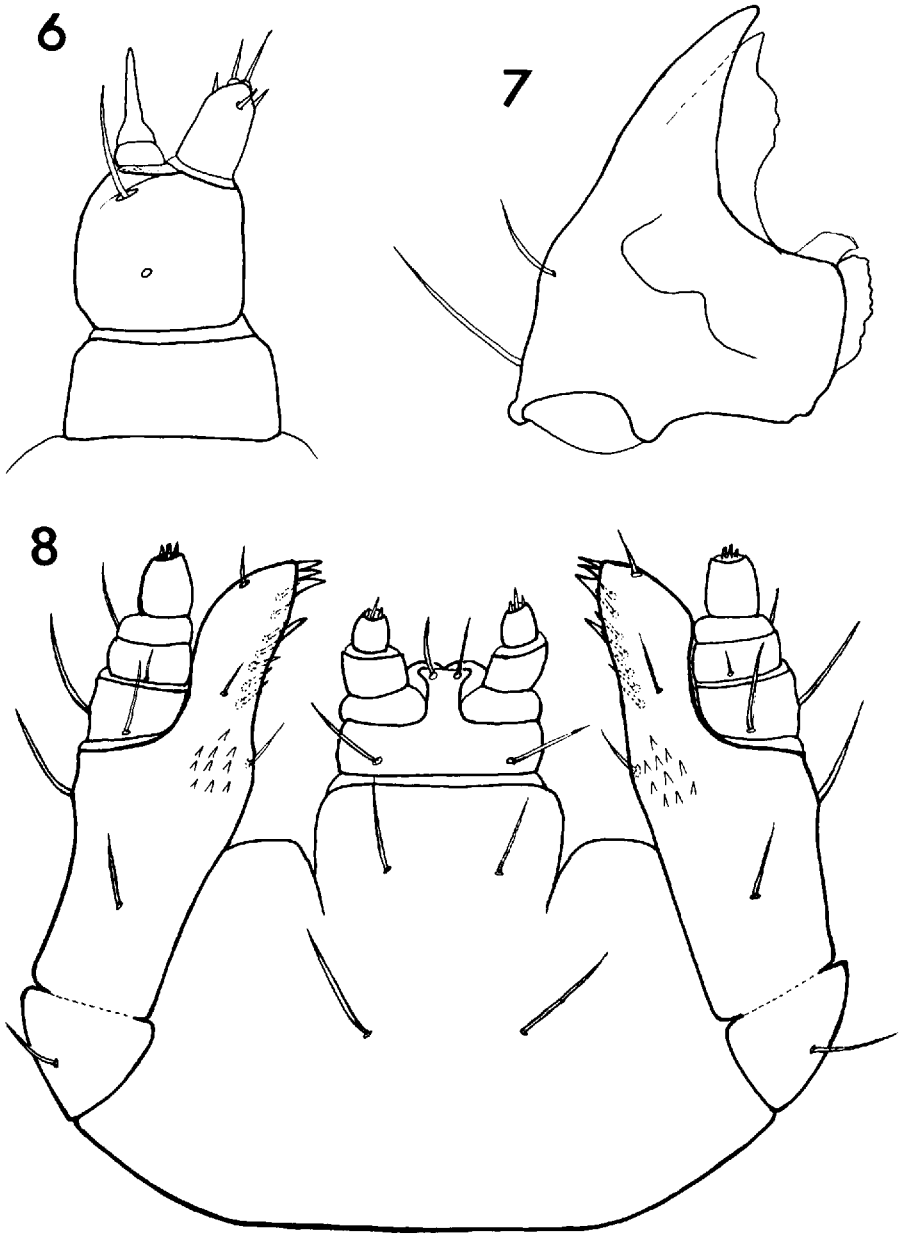








Figs. 1–5. *Xenomycetes laversi* Hatch, late-instar larva. 1, Mycangial seta from disc of abdominal tergite, ca. 2000×. 2, Host fungus spores on mycangial setae, ca. 3000×. 3, Mycangial setae and microscoli on lateral-tergal region of abdominal tergite 7, ca. 1500×. 4, Tergal microscolus, ca. 2500×. 5, Dorsal posterior of larva, ca. 100×.



Figs. 6–8. *Xenomycetes laversi* Hatch, late-instar larva. 6, Antenna. 7, Mandible. 8, Labium and maxillae, ventral aspect.

cangial setae very similar to those found on *Xenomycetes.* Close examination of the illustrations of endomychid larvae by Peterson (1960), and Böving and Craighead (1931), suggest that similar setal formation may occur in *Aphorista vittata, Mycetaea hirta, Endomychus coccineus,* and *E. biguttatus.* These mycangial setae, as can be seen in Figs. 1–2, are evidently useful for the active transport of spores

of the host fungus, thus possibly permitting *X. laversi* larvae to act as distribution agents of the fungus.

Rawlins (1984) illustrates and briefly discusses cuticular modifications on the mycetophagous larva of *Epizeuxis lubricalis* (Geyer) (Lepidoptera: Noctuidae: Herminiinae) which closely resemble the truncate microscoli of *Xenomycetes* (Fig. 4). These structures were interpreted by Rawlins to be hydrophobic, useful for the prevention of integumental wetting and direct contact with host tissues and particles including pathogenic fungal spores. Rawlins also considered setal modifications to assist in the prevention of contact with detrital particles and rotted fungal tissues. These functions could also be important for *X. laversi* larvae, although SEM examination showed the occasional presence of fungal spores lodged between microscoli.

Xenomycetes laversi appears to be restricted to *Paxillus atrotomentosus* (Batsch ex Fr.) Fries (Basidiomycetina: Agaricales: Paxillaceae) in the classification by Singer (1975). All collections of the larvae, and most specimens of adults have been from sporocarps or mycelia of this fungus during the late summer to early winter months. In all situations, the fungus has been associated with the rotted wood of Douglas-fir (*Pseudotsuga menziesii* (Mirbel) Franco), western hemlock (*Tsuga heterophylla* (Raf.) Sarg., or mountain hemlock (*Tsuga mertensiana* (Bong.) Carr), in the form of stumps, logs, and limbs. *Paxillus atrotomentosus* is a saprobe of well-rotted conifer wood, especially *Pseudotsuga* and *Tsuga* (J. M. Trappe, pers. comm.), and is typically found in these woods at the late brown-rot stage of decay in which the wood has been delignified and forms elongate blocks. Singer (1975) lists *Pinus banksiana* Lamb. as a host for *P. atrotomentosus,* but this tree is not found in the known range of *X. laversi.* Miller (1978) indicates that this fungus is widespread and will fruit during both autumn and spring.

Larvae collected to date are apparently late instar. No earlier instar larvae or pupae have been reared or collected. Larvae have always been found with adults, some of the latter being teneral in late summer. Larvae and adults were observed grazing upon the basidia and mycelia. Occasionally, larvae have been found within tunnels in the cortex of the cap, but it is not known whether these tunnels were actually formed by the *X. laversi* larvae. Competition for food appears to be limited; few Collembola, Diptera larvae, or other mycetophagous Coleoptera have been observed on this fungus.

The known localities for *X. laversi* are within the low to mid-elevation hemlock forests of western Oregon and Washington. All of the localities are dominated by seral Douglas-fir or the closely related climax species of western and mountain hemlock. In addition to the type locality, the following records have been collated for this species (map, Fig. 9): WASHINGTON: Clallam County, Boulder Lake, Olympic Nat. Park, 21-VII-1953, M. C. Lane (1 adult, OSU); Skamania County, 10 mi. W Troutlake (Klickitat Co.), 3300 ft., 25-IX-1983, *Paxillus atrotomentosus*—caps & mycelia/buried mtn. hemlock wood, P. J. Johnson (4 larvae, 10 adults, PJJ). OREGON (NEW STATE RECORD): Benton County, Mary's Peak, 6-VI-1970, G. L. Peters (1 adult, GLP); 2500 ft., 9-II-1981, in pit trap near rotted Doug-fir log, P. J. Johnson (1 adult, PJJ); 1600 ft., Woods Creek road, 20-IX-1980, *Paxillus atrotomentosus*—cespitose caps on rotted Doug-fir stump, P. J. Johnson (3 larvae, 34 adults, PJJ); MacDonald State Forest, 4 mi. NW Corvallis, Sulfur Springs road, 6-III-1973, G. L. Peters (2 adults, GLP); 1-III-1978, under

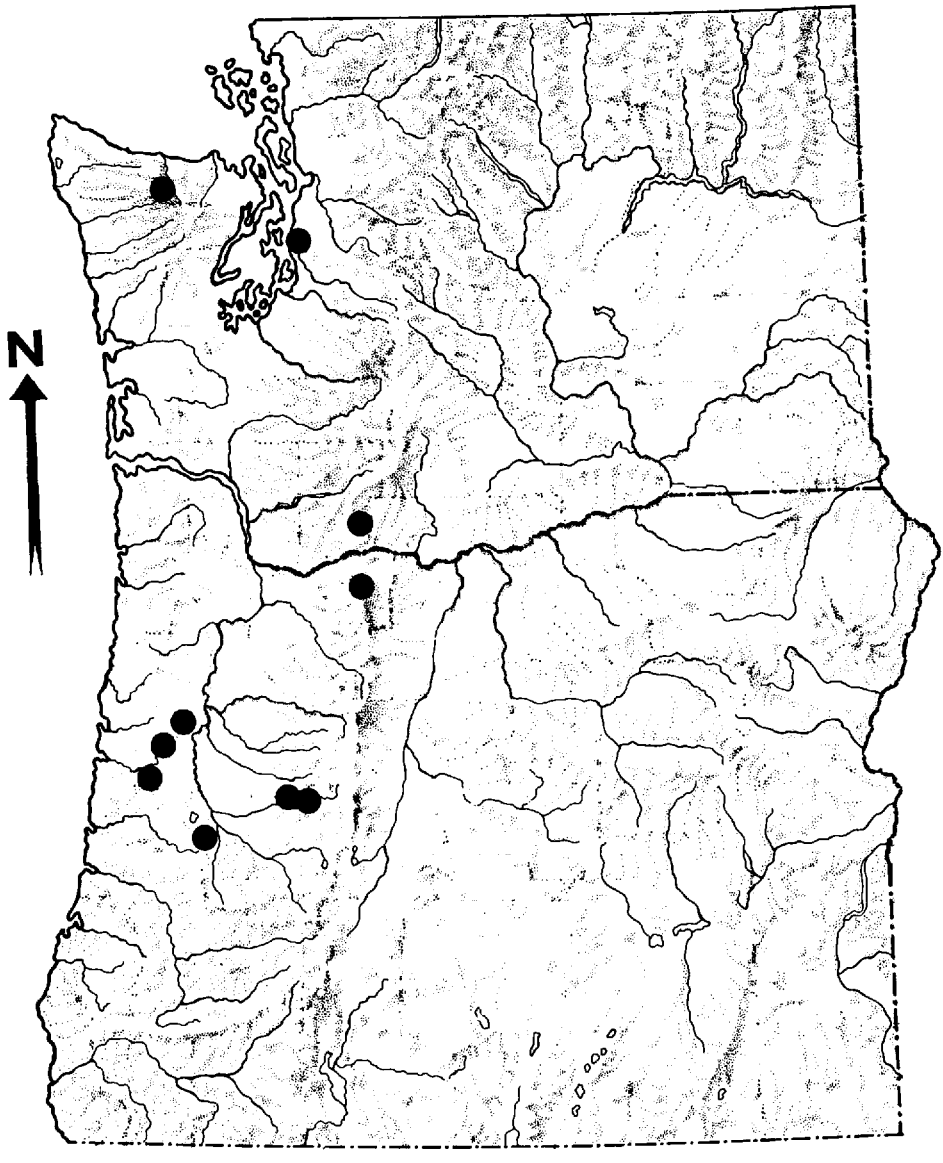


Fig. 9. Distribution of *Xenomycetes laversi* Hatch in Oregon and Washington; larva and adult records combined.

bark Doug. fir stump, P. J. Johnson (1 adult, PJJ); Oak Creek area, 22-III-1973, ex fungus on log, G. L. Peters (3 adults, GLP); 10-X-1978, ex under bark Doug-fir log (1 adult, GLP); Alsea Falls County Park, 7 mi. SW Alsea, XI-1979 (4 larvae, 7 adults, PJJ); 20-IX-1981, ex caps *P. atrotomentosus* (2 adults, PJJ); 10 mi. W Philomath, ex newt stomach, R. Friedburn (1 adult, OSU); Lane County, Spencer's Butte, Eugene, 13-X-1979, P. J. Johnson (4 larvae, 3 adults, PJJ); H. J. Andrews Exp. Forest, 6-VII-1979 (1 adult, OSU), 25-VII-1973 (1 adult, OSU), 10-VII-1972 (1 adult, OSU); Limberlost Campground, 5 mi. E. McKenzie Bridge, 3000

ft., 5-VII-1978, under bark rotted Doug-fir log, P. J. Johnson (1 adult, PJJ); Hood River County, Lost Lake, 2000 ft., 13-IX-1981, mycelia *P. atrotomentosus*/buried mtn. hemlock wood, P. J. Johnson (6 adults, PJJ). Collection abbreviations are: OSU (Oregon State University), GLP (G. L. Peters collection), PJJ (P. J. Johnson collection).

Larval specimens are located in the collections of the U.S. National Museum, Washington, D.C.; H. F. Strohecker, University of Miami, Coral Gables (collection now at Florida State Collection of Arthropods, Gainsville); J. F. Lawrence, CSIRO, Canberra; University of Idaho, Moscow; and my personal collection.

Acknowledgments

Appreciation is extended to G. L. Peters, Oregon State University, Corvallis, for collection data, J. D. Lattin for access to the Oregon State University collection; and to W. F. Barr and J. B. Johnson, University of Idaho, Moscow, and J. F. Lawrence, CSIRO, Canberra, for reading the manuscript and providing valuable suggestions.

This article is being published with permission of the director of the Idaho Agricultural Experiment Station as Research Paper no. 8672.

Literature Cited

Böving, A. G. and F. C. Craighead. 1931. An illustrated synopsis of the principal larval forms of the Order Coleoptera. Entomol. Am. 11: 1–351.

Hatch, M. H. 1961. Beetles of the Pacific Northwest, part III, Pselaphidae and Diversicornia I. Univ. Wash. Press, Seattle. 503 pp.

Miller, O. K., Jr. 1978. Mushrooms of North America. E. P. Dutton, New York. 368 pp.

Pakaluk, J. 1984. Natural history and evolution of *Lycoperdina ferruginea* (Coleoptera: Endomychidae) with descriptions of immature stages. Proc. Entomol. Soc. Wash. 86:312–325.

Peterson, A. 1960. Larvae of insects: An introduction to Nearctic species, part II, Coleoptera, Diptera, Neuroptera, Siphonaptera, Mecoptera, Trichoptera. 4th ed., Columbus, 416 pp.

Rawlins, J. E. 1984. Mycophagy in Lepidoptera. *In* Wheeler, Q. and Blackwell, M., eds., Fungus-insect relationships: Perspectives in ecology and evolution. Columbia Univ. Press, New York. 514 pp.

Singer, R. 1975. The Agaricales in modern taxonomy, 3rd ed. Strauss and Cramer, Leutershausen. 912 pp.