SOME BORING INSECTS FROM THE ROOTS OF HAPLOPAPPUS TENUISECTUS, GUTIERREZIA MICROCEPHALA, G. SAROTHRAE, AND G. SEROTINA IN SOUTHERN ARIZONA

by

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A Thesis Submitted to the Faculty of the

DEPARTMENT OF ENTOMOLOGY

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

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STATEMENT BY AUTHOR

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ACKNOWLEDGMENTS

My best thanks are due to Dr. Floyd Werner for his guidance and encouragement throughout this project, for his interest in the student and dedication to the science of entomology, and simply, for the pleasure of working under his direction. I am also grateful to Dr. William Nutting and Dr. Brian Spears for their help in answering my many questions.

The task of digging weedy shrubs from concrete-like desert floor under the hot summer sun was not a pleasant one. I would like to express my appreciation to Carl Olson for his help also.

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ABSTRACT

In southern Arizona, adults and larvae of *Xeranobium* Fall (Coleoptera: Anobiidae) and larvae of *Sonia filiana* Busck (Lepidoptera: Olethreutidae) were removed from the roots of *Haplopappus tenuisectus* (Greene) Blake (Compositae). Larvae of *Eucosma ridingsana* Robinson (Lepidoptera: Olethreutidae) were removed from the roots of *Gutierrezia microcephala* (DC.) A. Gray, *G. sarothrae* (Pursh) Britt. & Rusby, and *G. serotina* Greene (Compositae). Caterpillars of the family Tineidae (Lepidoptera) were taken from the roots of *H. tenuisectus* and *Gutierrezia* spp. Larvae of all species, except the tineid moth, were reared to adults on an artificial diet. The larvae are described and comments on recognition characters are included. *Macrocentrus pallisteri* DeGant (Hymenoptera: Braconidae) was reared from *Sonia filiana* and *Eucosma ridingsana*.

INTRODUCTION

Of the Compositae, *Haplopappus tenuisectus* (Greene) Blake, *Gutierrezia microcephala* (DC.) A. Gray, *G. sarothrae* (Pursh) Britt. & Rusby, and *G. serotina* Greene are invaders of disturbed areas and depleted range lands and are distributed mostly in the southwestern U.S. and northern and central Mexico. *G. sarothrae* is found throughout the western U.S. to southern Canada and *G. serotina* seems to be confined mostly to the Tucson, Arizona area. These woody composites, known as burroweed (*H. tenuisectus*) and snakeweed (*Gutierrezia* spp.), are unpalatable to livestock and out-compete the native range land grasses in heavily grazed areas, to the extent that they constitute the majority of the vegetational cover over vast areas.

In a search for injurious insects affecting these range weeds in southern Arizona, I encountered anobiid beetles and olethreutid and tineid moths. Three adults and a number of larvae of anobiid beetles were removed from the roots and root crowns and two adults were taken from the foliage of *Haplopappus tenuisectus*. The beetles belong to the genus *Xeranobium* Fall. Larvae of olethreutid moths, which are abundant and cause considerable damage to the plant, were found burrowing in the roots and root crowns of *H. tenuisectus* and *Gutierrezia* spp. The larvae from burroweed and snakeweed appeared identical but the rearing of individuals taken from their root tunnels yielded two species in different genera. *Sonia filiana* Busck was reared only from the roots of *H. tenuisectus* and *Eucosma ridingsana* Robinson from the roots of the three species of *Gutierrezia*. Numerous larvae of a tineid moth were found inhabiting abandoned root tunnels, mostly in old, heavily damaged plants, of both *H. tenuisectus* and *Gutierrezia* spp. These larvae have not been reared to adults.

MATERIALS AND METHODS

Burroweed and snakeweed shrubs were dug from the ground, usually with the main roots still intact to a depth of 15-20 cm, by using a 5-lb. mattock. The larvae removed from their root tunnels were either preserved in a larval fixative (KAAD) (Peterson, 1948) or placed in 1-oz. plastic cups containing an artificial diet (Shorey and Hale, 1965) for rearing. Six adults of *Xeranobium*, twenty-five of *Sonia filiana*, and ten of *Eucosma ridingsana* were reared.

Presumably full grown larvae were used for measurements and descriptions. The epipharynx, maxillae and labium, and antennae of *Xeranobium* were cleared in KOH solution and mounted in glycerin on microscope slides. For the moths, the epipharynx, integument, and hindgut cuticle were cleared in KOH solution and mounted in glycerin or Hoyer's medium on microscope slides. The density of the spinules on the integument was determined with the aid of an ocular grid. The spinules of the hindgut cuticle are best observed with phase-contrast lighting. Scanning electron microscope material was prepared from larvae preserved in 95% ethyl alcohol, by dehydrating the desired parts in anhydrous ether for about three hours then rapidly drying them under a hot lamp to help prevent wrinkling.

Xeranobium FALL (COLEOPTERA: ANOBIIDAE)

Discussion

Although the biology and larvae of many of the Anobiidae are known, there have been no studies of the immature stages of *Xeranobium*. Böving (1927) and Parkin (1933) have treated several larval Anobiidae in detail and I have chosen to base the description of *Xeranobium* larvae on the characters used by Parkin, to permit comparison.

About 40 larvae were taken from burroweed roots and either kept for rearing or preserved. About 10 larvae were examined for description and illustration. White (1971), in his revision of the genus, provides one key for the separation of 23 species of males and another for nine species of definitely known females. Out of the eleven adults reared or collected, only three are males and can be determined to species. Two of these are *X. laticeps* Fall and one is *X. oregonum* Hatch. The females do not fit any description closely enough for a reliable identification, but it appears that several species are present.

Description

The description is based on presumably full grown larvae.

General (Figure 1)

Larva C-shaped, evenly curved, up to 13 mm long, and clothed with long, fine, golden setae, longer and denser on hypopleural folds and not obscuring the surface. Color, including the head capsule, near white. Thorax swollen to 1.26 times the width of the abdomen. Abdominal segments 1-6 uniform in diameter, terminal segments slightly wider. Asperities present on the metathorax and abdominal segments 1-7.

Head

Head capsule perpendicular to the longitudinal axis of the body, broadest at 2/3 the distance below the vertex, truncated at the epistome, with sides evenly rounded, and covered with fine, long, golden setae which become shorter at the vertex. Epicranial sulcus branching at 2/3 the distance below the vertex. Epistome darkly pigmented except in a median area about the width of the labrum, with setae along the base of the clypeus, and with a tuft of longer, fine setae above the mesal to each antenna. Ocelli absent. Antennae minute, bearing one lightly sclerotized conical appendix and two darker basiconical processes that have two minute setae near the base. Labrum emarginate, narrower than the clypeus, and fringed with fine setae. Epipharynx (Figure 2) covered on apical 1/3 with long, curved, blunt setae directed mesad; those in the remaining 2/3 becoming

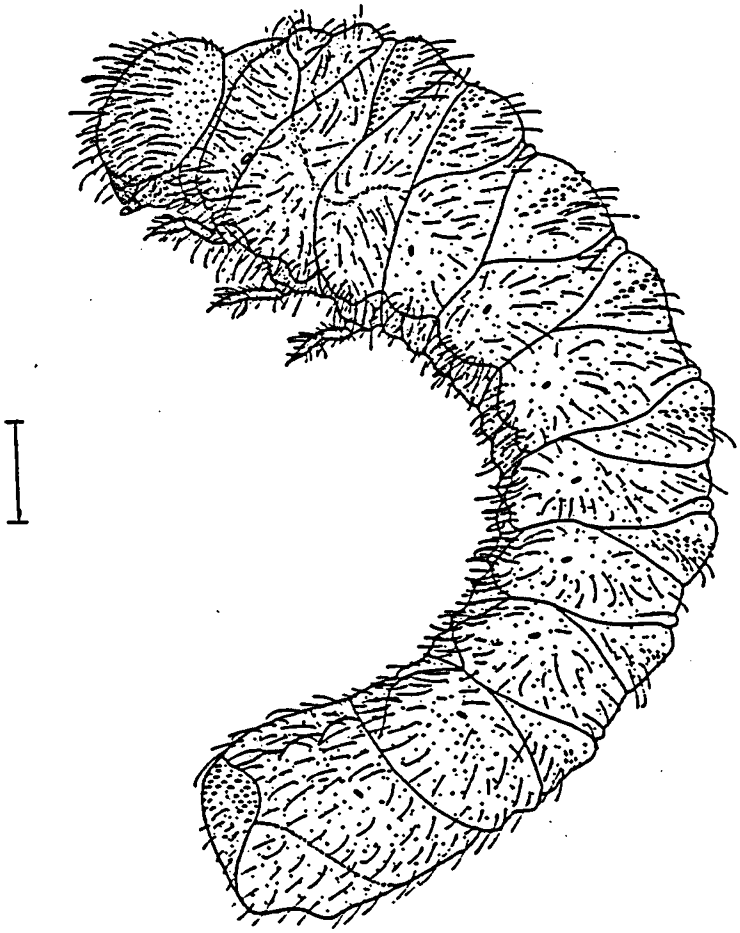

Figure 1. Xeranobium Fall, larva. -- (line = 1.0 mm)

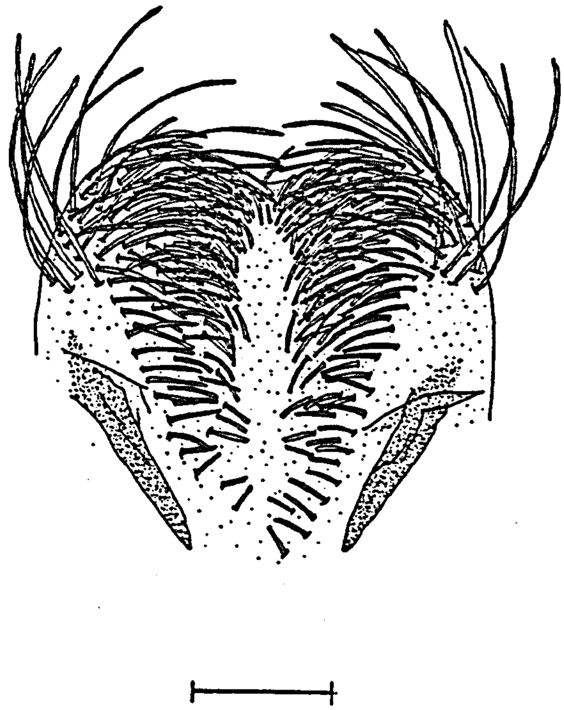

Figure 2. Xeranobium Fall, epipharynx. -- (line = 0.1 mm)

a row on each side of the midline, several deep, and fewer and shorter until only a few anteriorly pointed setae are present between the tips of the tormae. Midline naked. Tormae darkly sclerotized. Mandibles large, dark brown to black, stout, with two teeth on the lower leading edge (anterior margin), and two groups of setae; the anterior group of about five set in a large, deep, central pit, and the posterior group of many slightly longer and finer setae between the anterior group and the posterior margin, in a vertical column. Anterior margin above the teeth smooth, nearly straight, and with a slight bulge before rounding off above. Labial palpi 2-segmented, lightly sclerotized, and with no setae (Figure 3). Mentum mostly membranous, rounded trapezoidal, with a band of fine setae, and the basal margin lightly sclerotized. Submentum membranous, with a transverse band of fine setae about its apex, second segment with only two or three very small setae apically. Galea with stout, inward curving, sharp-pointed setae and with the lower 2/3 of the outer edge forming a heavily sclerotized, comma-shaped support. Lacinia shorter than, and about as wide as the galea and densely margined with long, straight, stout setae. Stipes straight-sided, slightly longer than the cardo, the basal 2/3 with many fine appressed setae and the apical 1/3 with longer erect setae that reach to the tip of the palpus. Stipital rods darkly sclerotized, Y-shaped, and with one branch extending into

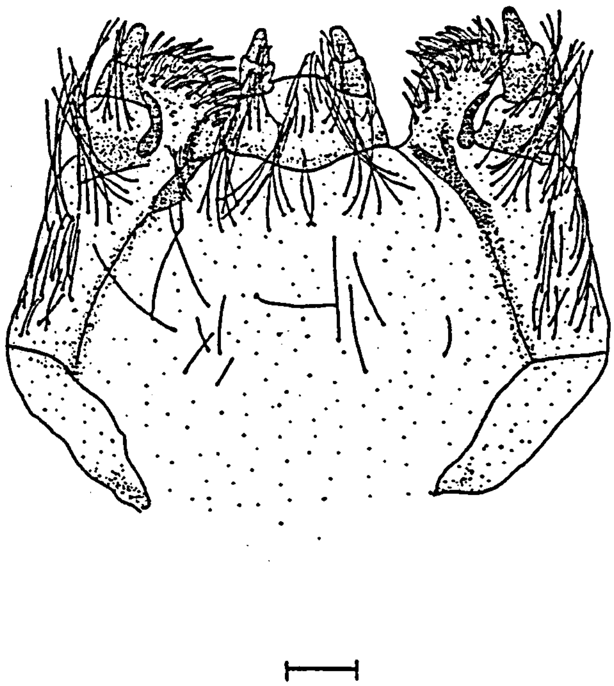

Figure 3. Xeranobium Fall, ventral view of the maxillae and labium. -- (line = 0.1 mm)

the base of the galea. Cardo elongate, about 4 times as long as wide, lightly sclerotized at its base, and naked.

Thorax

Each segment with a pair of 5-segmented legs clothed with long, fine setae and ending in a single claw. Pleural folds bulging between the sulci and meso- and metathorax divided approximately in half by a sinuate, longitudinal depression. Prothorax with narrow, elliptical mesothoracic spiracles at the posterior margin, in the pleural fold, and with one notal fold. Mesothorax with one notal fold. Metathorax with a large prenotal fold bearing asperities on its anterior face, in 3 rows dorsally and scattered below.

Abdomen

Segments 1-7 with broad prenotal folds bearing asperities in 2 or 3 rows dorsally, scattered below, and segments 1-6 with narrow postnotal folds. Asperities on segments 1-5 in broader bands than those on segments 6 and 7. Segment 8 cylindrical, without folds. Terminal segment with a crescent of asperities laterally.

Results

All spiracles vary markedly in the number, size, and positioning of accessory chambers extending from their margin, even including the two spiracles on one segment.

In general, these projections are on the anterior margin of the mesothoracic spiracles and on the posterior margin of all 8 abdominal pairs.

Xeranobium larvae differ significantly from the anobiid larvae (Xestobium rufovillosum, Anobium punctatum, Ernobius mollis, Ptilinus pectinicornis, Priobium castaneum, Ochina ptinoides, Hedobia imperialis, and Sitodrepa panicea) described by Parkin by the heavily setose epipharynx and the bidentate mandible containing a large central pit.

The maxilla, antenna, and length of the full grown larva also can be used as separating characters but are not so obvious. The cardo is rectangular-elongate in Xeranobium, while either of a quadrate or a triangular outline in the above species, and Xeranobium larvae seem to be the only ones with a heavily sclerotized, comma-shaped structure along the outer edge of the galea. Xeranobium has two basiconical processes on each antenna, as opposed to one in the anobiids described by Parkin. The largest Xeranobium larvae are about 13 mm long, corresponding in size with that of the adults.

The larvae of Xeranobium are slow in developing and may take well over a year to complete their life cycle in nature.

SONIA FILIANA BUSCK AND EUCOSMA RIDINGSANA ROBINSON (LEPIDOPTERA: OLETHREUTIDAE)

Discussion

Immature Olethreutidae are very similar in appearance and most are exceedingly difficult to separate at the generic and specific levels. *Sonia filiana* and *Eucosma ridingsana* are no exception. MacKay (1959) gives larval descriptions for about 185 species of olethreutids and includes a statement, based on three larvae, that *Eucosma ridingsana*, "except for the crotchets 'in situ' being much more ovoid on these specimens than on those examined of (*Eucosma*) *mobilensis* Heinr., no appreciable differences noted between the larvae of this species and those of *mobilensis* Heinr." No further description or illustration is known. *Sonia filiana* is undescribed in the larval stage. In this work I describe the larva of each and note characters that can be used to separate the two.

In the search for characters that can be used to distinguish *S. filiana* from *E. ridingsana* I examined structures such as the epipharynx, the spinules of the integument, and the cuticle of the hindgut, in addition to those commonly used for larval Lepidoptera, such as setal patterns of the head and body, mouthparts, proleg crochet arrangement and type, and body proportions.

For the setae of the head and body I am following Hinton's (1946) system of nomenclature. About 40 larvae of each species were examined or used for measurements, descriptions, illustrations, and photographs. All measurements were made from preserved larvae and are based on n=10 for each species.

The width of the head capsule is measured from the dorsal view and the height from the frontal view, from vertex to postgena. The ocellar arch is the connecting line drawn through the middle of each ocellus. For the comparison of the width of the mesothorax against that of the abdomen I chose the first abdominal segment as representative of the abdomen and the dorsal aspect for measurement, to avoid discrepancies caused by the curling of the body and contraction of the coxae from the effects of the larval preservative. The third abdominal segment, in dorsal view, was arbitrarily chosen for comparing the distances separating the D1 setae from the D2 setae. The dorsum of the mesothorax was used for determining the density of the spinules on the integument.

Description of *Sonia filiana* Busck

General

Length of largest larva 25 mm. Body white with head capsule yellow. Mesothorax swollen to 1.15 times width of first abdominal segment, s.d. 0.05. Abdominal segments 1-7 of uniform diameter, caudal segments tapering. Spiracles elliptical, mesothoracic pair largest and pair on 8th abdominal segment larger than and dorsal to those on abdominal segments 1-7. Pinacula of body color. Thorax and abdomen covered with minute spinules, approximately 12,000/mm^2 (Figure 4).

Head

Head capsule prognathous, 1.33 times as wide as high, s.d. 0.05. Ocelli III, IV, and V in a straight, vertical line with ocellus I posterior and slightly ventral to ocellus II, and ocellus VI between ocelli IV and V and posterior to ocellus I. 01 between ocelli II and III and usually just inside of ocellar arch. 02 closer to ocellus I than to ocellus VI and 03 ventral to and equidistant from ocelli V and VI. A2 approximately equidistant from A1 and A3. L1 closer to A3 than A3 is to A2. C1 and C2 at posterior clypeal margin. AF1 posterior to F1. P1 posterior to and laterad of AF2, and P2 posterior to and laterad of P1. V1 and V2 equidistant from epicranial sulcus, with V3

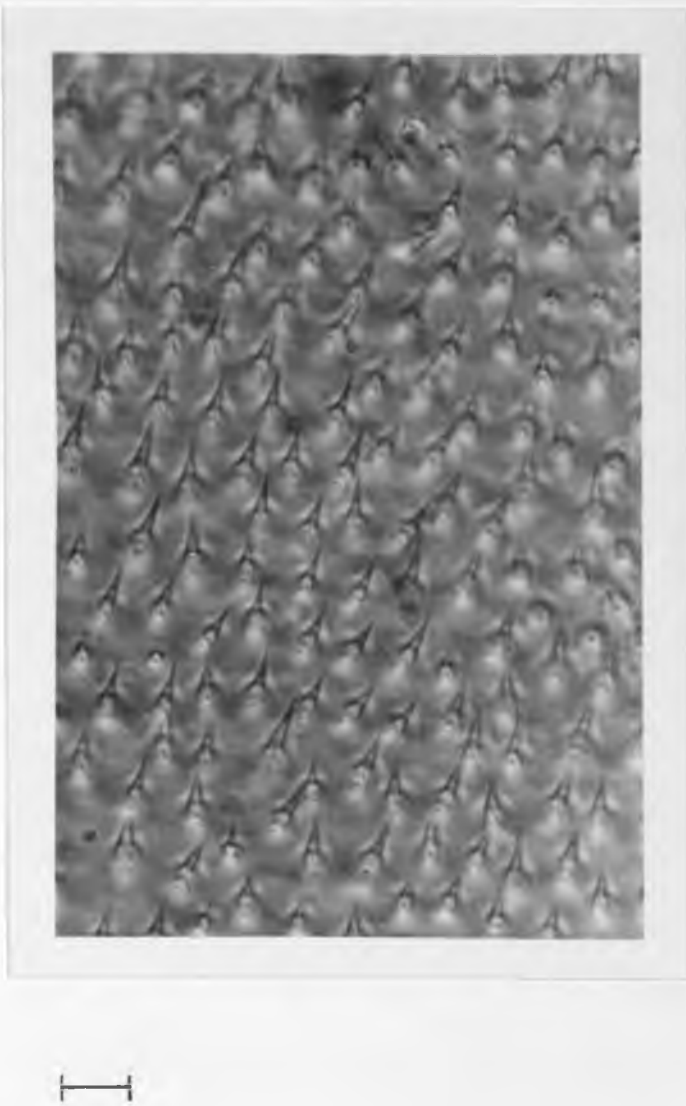

Figure 4. Sonia filiana Busck, photomicrograph of integument spinules on the dorsum of the mesothorax. -- (line = 0.01 mm)

posterior to and laterad of V2. Epipharynx with 3 pairs of flat setae and with area containing epipharyngeal spinules terminating between bases of labral tormae in a broad 'V' (Figure 5). Mandible 5-toothed with the two upper teeth blunt and shorter than the lower 3; inner surface cupped and bearing grooves arising from between teeth. Labial palpi about 1/2 length of spinneret; basal segment cylindrical, diameter about 2/3 width of spinneret; apical seta about 1/2 length of a palpus.

Thorax (Figure 6)

Prothorax. Pronotal plate faintly yellow-pigmented. L-group trisetose with bases of setae forming a straight line and L2 dorsal to L3. MXD1 posterior and ventral to D1 and minute.

Mesothorax. D1 and D2 normally on same pinaculum, SD1 and SD2 anterior and ventral to D1 and D2 and usually on separate pinacule. MD1, MSD1, and MSD2 minute. L1 dorsal and posterior to L2 and both on same pinaculum. L3 posterior to and about equidistant from SD setae and L1, L2. MV1, MV2, and MV3 minute. MV3 pinaculum larger than that of either MV1 or MV2.

Metathorax. Setal arrangement same as on mesothorax but SD1 and SD2 not usually on separate pinacula.

Legs well developed, 5-segmented, and with a single, simple tarsal claw.

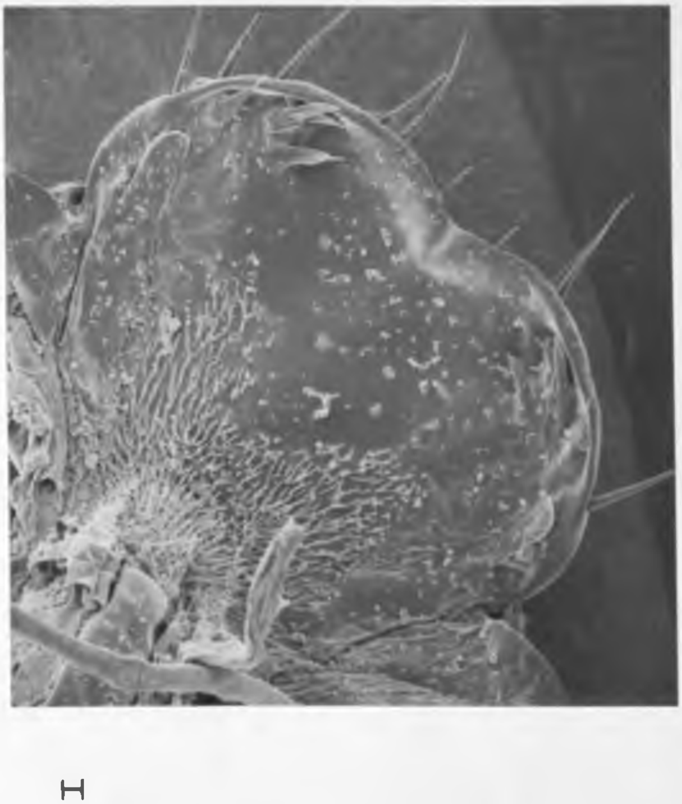

Figure 5. Sonia filiana Busck, scanning electron micrograph of the epipharynx. -- (line = 10.0 microns)

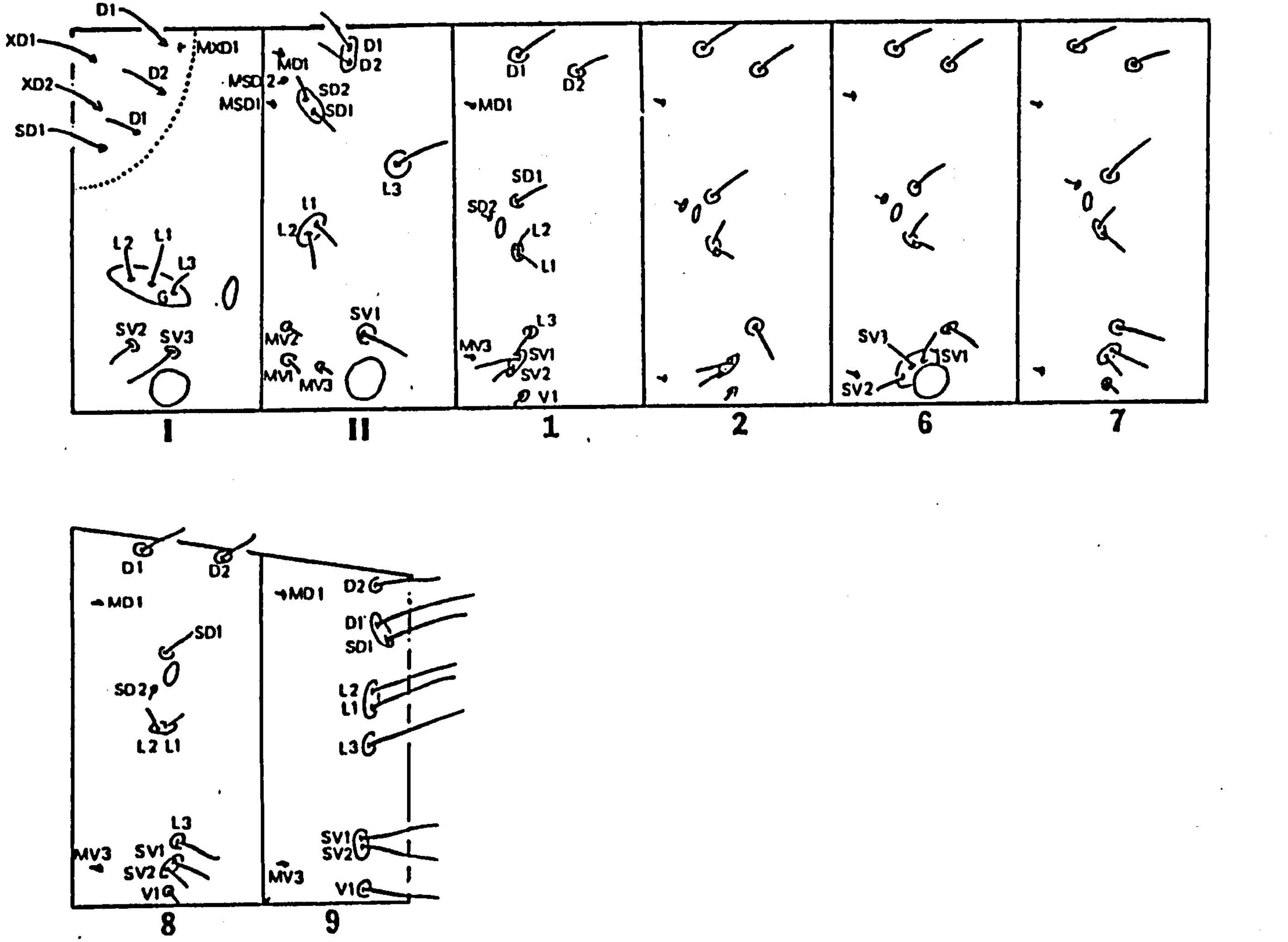

Figure 6. Sonia filiana Busck and Eucosma ridingsana Robinson, chaetotaxy of the pro- and mesothorax and abdominal segments 1, 2, 6, 7, 8, and 9.

Abdomen (Figure 6)

On segments 1-7 D1 dorsal to D2; D2 setae separated by 1.55 times distance separating D1 setae, s.d. 0.15; SD2 minute and on separate pinaculum from SD1; SD1 dorsal and posterior to spiracle, SD2 just dorsal and anterior to spiracle; L1 and L2 on same pinaculum and dorso-ventral to spiracle; L1 ventral and posterior to L2; L3 closer to SV-group than to L1, L2. SV-group bisetose on segments 1, 2, 7, 8, and 9 and trisetose on segments 3-6. V1 mesad to abdominal prolegs on segments 3-6. MV1 and MV3 minute. On segment 8, D2 posterior to D1, SD1 anterior and dorsal to spiracle, SD2 anterior to and at level of ventral margin of spiracle, and L1 and L2 on same pinaculum and ventral to spiracle with L1 directly posterior to L2. Setae of 9th segment in a straight, vertical line, with D2 on its own pinaculum, D1 and SD1 on same pinaculum with SD1 posterior and ventral to D1, L1 and L2 on same pinaculum, and L3 on its own pinaculum. Caudal segment broad, trapezoidal in dorsal view. Prolegs well developed on segments 3-6, with crochets unevenly uniordinal and arranged in a broad ellipse. Anal proleg crochets transverse, uniordinal, and usually 16 in number, s.d. 2.86.

Description of Eucosma ridingsana Robinson

General

Length of largest larva 25 mm. Body white with head capsule yellow. Mesothorax swollen to 1.14 times width of first abdominal segment, s.d. 0.06. Abdominal segments 1-7 of uniform diameter, caudal segments tapering. Spiracles elliptical, mesothoracic pair largest and pair on 8th abdominal segment larger than and dorsal to those on abdominal segments 1-7. Pinacula of body color. Thorax and abdomen covered with minute spinules, approximately 4,800/mm^2 (Figure 7).

Head

Head capsule prognathous, 1.41 times as wide as high, s.d. 0.07. Ocelli III, IV, and V in a straight, vertical line with ocellus I posterior and slightly ventral to ocellus II, and ocellus VI between ocelli IV and V and posterior to ocellus I. O1 between and in line with ocelli II and III. O2 closer to ocellus I than to ocellus VI, and O3 ventral to and equidistant from ocelli V and VI. A2 approximately equidistant from A1 and A3. L1 closer to A3 than A3 is to A2. C1 and C2 above clypeal margin. AF1 posterior to F1. P1 posterior to and laterad of AF2, and P2 posterior to and laterad of P1. V1 and V2 equidistant from epicranial sulcus and V3 posterior to and laterad of V2. Epipharynx

Figure 7. *Eucosma ridingsana* Robinson, photomicrograph of integument spinules on the dorsum of the mesothorax. -- (line = 0.01 mm)

with 3 pairs of flat setae and with area containing epipharyngeal spinules terminating between bases of labral tormae in a convex arch (Figure 8). Mandible 5-toothed with the 2 upper teeth blunt and shorter than the lower 3; inner surface cupped and bearing grooves arising from between teeth. Labial palpi about 1/2 length of spinneret; basal segment cylindrical, diameter about 2/3 width of spinneret; apical seta about 1/2 length of a palpus.

Thorax (Figure 6)

Prothorax. Pronotal plate faintly yellow-pigmented. L-group trisetose with bases of setae forming a straight line and with L2 dorsal to L3. MXD1 posterior and ventral to D1 and minute.

Meso- and Metathorax. D1 and D2 on separate pinacula. SD1 and SD2 on same or separate pinacula and anterior and ventral to D1, D2. MD1, MSD1, and MSD2 minute. L1 dorsal and posterior to L2 and on same pinaculum. L3 posterior to and about equidistant from SD-group and L1, L2. MV1, MV2, and MV3 minute. MV3 pinaculum larger than that of either MV1 or MV2.

Legs well developed, 5-segmented, and with a single, simple tarsal claw.

Abdomen (Figure 6)

On segments 1-7 D1 dorsal to D2; D2 setae separated by 1.35 times distance separating D1 setae, s.d. 0.11; SD2

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Figure 8. Eucosma ridingsana Robinson, scanning electron micrograph of the epipharynx. -- (line = 10.0 microns)

minute and on separate pinaculum from SD1; SD1 dorsal and posterior to spiracle, SD2 just dorsal and anterior to spiracle; L1 and L2 on same pinaculum and posterior and ventral to spiracle, with L1 ventral and posterior to L2; L3 closer to SV-group than to L1, L2. SV-group bisetose on segments 1, 2, 7, 8, and 9 and trisetose on segments 3-6. MD1 and MV3 minute. On segment 8 D2 posterior to D1, SD1 anterior and dorsal to spiracle, SD2 anterior to and at level of ventral margin of spiracle, and L1 and L2 on same pinaculum and ventral to spiracle, with L1 directly posterior to L2. Setae of 9th segment in a straight, vertical line; D2 on its own pinaculum; D1 and SD1 on same pinaculum, with SD1 posterior and ventral to D1; L1 and L2 on same pinaculum; L3 on its own pinaculum. Caudal segment broad, trapezoidal in dorsal view. Prolegs well developed on segments 3-6, with crochets unevenly uniordinal and arranged in a broad ellipse. Anal proleg crochets transverse, uniordinal, and usually 12 in number, s.d. 1.44.

Results

An accurate separation of *S. filiana* and *E. riding-sana* cannot be based on the positioning of the cephalic and thoracic setae because of variation found in these characters. On the head, the distance between AF1 and AF2 and the location of P1 and P2 may be different in each individual examined. O1 on *S. filiana* was inside the ocellar arch on six specimens and directly in the line of the arch on three. On one caterpillar the seta was well outside of the arch on one side but directly in line on the other. O1 on E. ridingsana was normally directly in the line of the arch, that is, four larvae with O1 in the same position on both sides of the head and four with only one side in this position, while the others were evenly divided between being outside or inside the ocellar arch. The positions of A1, A2, A3, and L1 in relation to each other are also unstable. The distance separating L1 from A3 varies considerably from larva to larva.

On the meso- and metathorax the D- and SD-groups are unstable as far as being on the same or separate pinacula. In S. filiana, the D-group, on both segments, is on the same pinaculum in eight larvae but on separate pinacula in two, while the SD-group of the mesothorax is on the same pinaculum in three larvae but separate in seven. On the metathorax the SD-group is evenly divided between five individuals having them on the same pinaculum and five with them on separate pinacula. In E. ridingsana, the D-group of the meso- and metathorax is always on separate pinacula, but the SD-group, of both segments, is divided between five with the SD setae on the same and five with them on separate pinacula.

The epipharynx normally contains three pairs of epipharyngeal setae, which are similar in shape and location in both S. filiana and E. ridingsana, but in two of the seven S. filiana specimens that I examined an additional pair of setae lies immediately adjacent to and dorsal of the middle pair, thus giving the appearance of four pairs of epipharyngeal setae, which is very unusual in the Microlepidoptera. All E. ridingsana specimens bore three pairs of epipharyngeal setae.

The significance of pyloric armature as a taxonomic character in Lepidoptera larvae was explored by Byers and Bond (1971). Definite trends at the superfamily level were found, as well as some evidence for their value as characters at the specific level in some Noctuidae. I found the spinules of the pyloric chamber, the pyloric valve, and the posterior zone of the pylorus to be similar in size, shape, and arrangement in S. filiana and E. ridingsana.

Of all the characters that I examined only those of the epipharynx and the integument are definite and constant enough to be used in distinguishing S. filiana from E. ridingsana. The pattern in which the epipharyngeal spinules terminate between the bases of the labral tormae was constant for all individuals examined, six of S. filiana and six of E. ridingsana. The density of the spinules on the integument also was stable in three specimens of S. filiana and three of E. ridingsana. In an area of 0.0025 mm^2 a mean of 30 spinules, s.d. 3.9, are found on

S. filiana and a mean of 11.8 spinules, s.d. 1.6, are found on *E. ridingsana*. This small area was used for counting because of the large number and small size of the spinules.

Because structures such as the spinules of the epipharynx and integument require a seemingly excessive amount of time and patience for preparation, they are little used in classification of larval Microlepidoptera. But they do appear to be useful. A meaningful comparison of *S. filiana* and *E. ridingsana* with related species cannot be made because of the wide range of variation they show in the characters usually used in classification.

S. filiana and *E. ridingsana* are abundant and cause considerable damage to the roots and root crowns of their host plants. They can be found throughout the year in all stages of development.

Parasitoids

Both *S. filiana* and *E. ridingsana* are parasitized in the immature stage by *Macrocentrus pallisteri* DeGant (Hymenoptera: Braconidae), an internal parasite. The caterpillars are not killed until they are about full grown, at which time they are completely consumed except for the integument and head capsule. The parasite then spins a cocoon inside its host's root tunnel in preparation for pupation. The adult wasp that emerges leaves the root through the exit hole cut by the caterpillar. Twelve adults were reared and one young larva (presumably _M._ _pallisteri_) was dissected from its host.

LEP.-I (LEPIDOPTERA: TINEIDAE)

Discussion

The family Tineidae includes some important economic pests, such as the clothes moths *Tineola bisselliella* (Hummel) and *Tinea pellionella* (L.), but life histories of the majority of the family are unknown. In general, the caterpillars feed on various dry or decaying plant or animal material, fungi, or scavenge. The tineid caterpillars I removed from burroweed and snakeweed roots were associated with living plants that had been heavily damaged by root borers. The root tunnels were usually much larger in diameter than the body of the caterpillars and contained much frass, fecal material (probably from the tineid), and occasionally fungus. In dissections of the caterpillar's midgut I found some material, shavings bearing marks from the mandibles, closely resembling that contained in the midguts of true root borers (Olethreutidae). Usually, many larvae per plant occur within abandoned root tunnels, but they can also be found in cracks between two adjoining major roots and on the outer surface of the root crown and larger roots. It seems that these larvae are scavengers, feeding on decaying wood, frass, and possibly fungus. The caterpillars are present throughout the year in all stages of development.

About 25 individuals were examined for measurement and description. For the setae of the head and body I am following Hinton's (1946) system of nomenclature. Measurements of head and body widths and distances separating the D1 setae and D2 setae were made from the dorsal view. I chose the first abdominal segment as representative of the abdomen in comparing the width of the mesothorax against that of the abdomen and the third abdominal segment for comparing the distances separating the D1 setae and D2 setae. All measurements were made from preserved larvae and are based on n=10.

Description

General

Head yellow-brown, maximum width 1.6 mm. Body long, slender, integument transparent. Largest larva 33 mm long, abdomen 2.2 mm wide. Mesothorax swollen to 1.16 times width of abdomen, s.d. 0.04. Abdominal segments cylindrical, of uniform diameter, with spiracles and setae on narrow, slightly raised bands appearing as rings, and caudal segments tapering slightly. Spiracles of abdominal segments 1-7 small, round, just ventral to middle of side. Spiracles of mesothorax and 8th abdominal segment large, elliptical; pair on abdomen larger, dorsal to middle of side. Pinacula of body color, and rough texture. Integument with spinules that are larger on thorax than on abdomen.

Head

Prognathous. Front extending about 2/3 distance to vertical triangle (Figure 9). Adfrontals narrow, extending about 3/4 distance to vertical triangle. Ocelli absent. One pigmented eyespot present ventral and just posterior to antennal insertion. O3 ventral to eyespot. O2 posterior and slightly dorsal to eyespot. O1 dorsal to antenna and anterior to O3. A1 farther from A2 than A2 is from A3. A3 approximately equidistant from A2 and L1. SO1 anterior and ventral to O3. SO1, O3, and O2 in a straight line. SO3 ventral to SO1 and posterior to O2. SO2 dorsal and posterior to SO3. G1 dorsal and posterior to SO2. C1 on clypeus at anterolateral margin and C2 at posterior margin (Figure 9). F1 posterior and lateral to C2. AF1 and F1 adjacent with AF1 lateral and posterior to F1. AF2 distant from AF1, near top of front. P1 just anterior to AF2 (laterad of AFa) and same distance from meson as C1. P2 posterior to and just laterad of P1. P2, V1, V2, and V3 in a straight line with V3 farther from meson than P2. V1 close to P2 and V2 about 2 times as far from V1 as from V3. Labrum truncate. Epipharynx bearing 3 pairs of flat setae, lateral pair

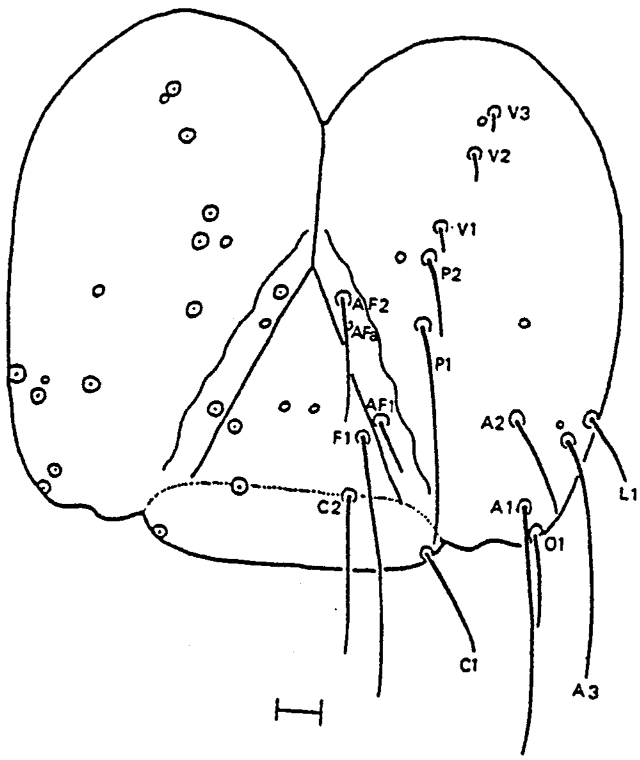

Figure 9. Lep.-1, dorsal view of the head capsule. -- (line = 0.1 mm)

longest. Epipharyngeal surface spinulose with spinules bordering a naked, median, U-shaped area with opening of "U" posterior. Spinules towards apex of epipharynx and at margins of "U" longer than others. There is a cone-shaped structure in middle of spinulose area posterior to epipharyngeal setae. Mandible 2-toothed, triangular in outline. Spinneret about 2.3 times length of labial palpus. Labial palpus about 1.6 times length of apical seta, its basal segment about as wide as spinneret.

Thorax (Figure 10)

<u>Prothorax</u>. Pronotal plate very faintly yellow-pigmented with a darker pigmented line extending from between D1 and D2 to meson at posterior edge of plate. XD1, D1, and D2 on dorsal 1/2 of pronotal plate and XD2, SD1, and SD2 on ventral 1/2. MXD1 minute, posterior to and between D1 and D2. L-group trisetose. SV-group bisetose with SV2 directly anterior to SV1. MV1, MV2, and MV3 anterior to coxa and minute.

<u>Meso- and Metathorax</u>. D1 dorsal to and on same pinaculum as D2. SD2 dorsal to and on same pinaculum as SD1. L1 and L2 on same pinaculum with L2 anterior and ventral to L1. L3 posterior and dorsal to L1 and L2, on separate pinaculum. SV-group bisetose with SV2 directly anterior to SV1. MD1 and MSD setae about 3 times as large as surrounding integument spinules. MD1 near anterior

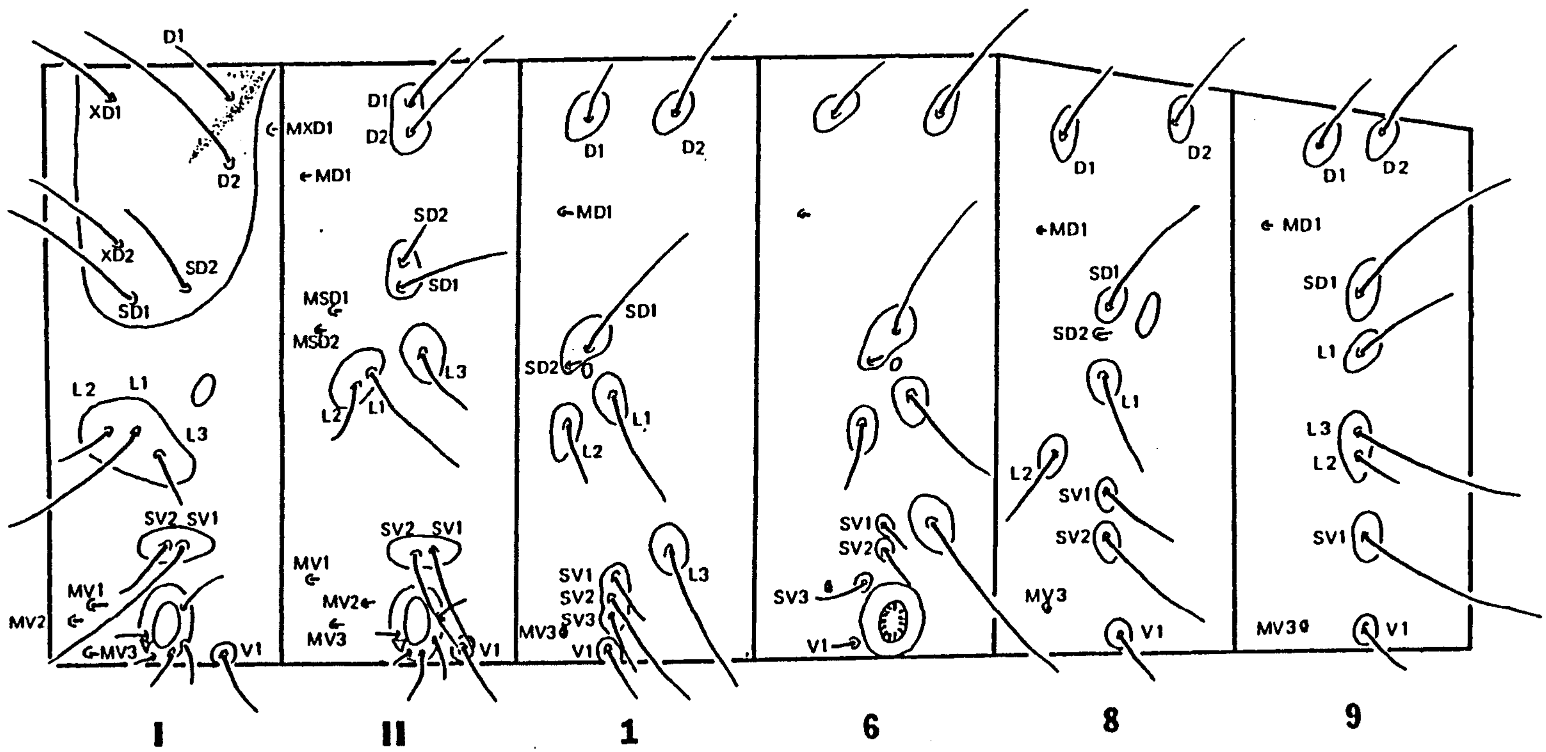

Figure 10. Lep.-1, chaetotaxy of the pro- and mesothorax and abdominal segments 1, 6, 8, and 9.

margin and between D- and SD-groups. MSD setae anterior to and between SD- and L-groups. MV1, MV2, and MV3 anterior to coxa and minute.

Legs well developed, 5-segmented, and with a single, simple tarsal claw.

Abdomen (Figure 10)

On segments 1-7 D2 setae separated by 1.19 times distance separating D1 setae, s.d. 0.07; SD1 and SD2 on same pinaculum with SD1 dorsal to spiracle and SD2 anterior to spiracle and minute; L1 and L2 on separate pinacula with L1 ventral and just posterior to spiracle and L2 anterior and ventral to L1; L3 posterior to L1 and closer to SV-group than to L1, L2. On segments 1, 2, and 7 SV1, SV2, SV3, and V1 in straight, vertical line. On segments 3-6 SV2 ventral to SV1; SV3 at base of proleg and anterior to SV2. On segments 1-9 MD1 ventral and just anterior to D1 and about 3 times as large as surrounding integument spinules; MV3 appearing as sensillum basiconicum. On segment 8 distance separating D1 setae greater than distance separating D2 setae; SD1 anterior to spiracle; SD2 anterior to and at ventral edge of spiracle and on separate pinaculum from SD1; L1 ventral to SD1, SD2; L2 anterior and ventral to L1 and closer to SV1 than to L1; SV2 ventral to SV1; V1 ventral and posterior to SV2. On segment 9 distance separating D1 setae greater than distance separating D2 setae; SD1, L1, L2, L3, SV1, and V1 in straight, vertical line; L3 between L1 and L2 and on same pinaculum as L2, all other setae on their own pinacula. Caudal segment broad, its posterior margin evenly rounded in dorsal view; distance separating D1 setae equal to distance separating D2 setae; D1 setae on same pinaculum; D2 setae and L1 setae on same pinaculum; SD1 on its own pinaculum. Prolegs well developed on segments 1-6 with uneven, uniordinal crochets arranged in transverse oval, narrowing mesally. Anal proleg crochets transverse, uniordinal.

Results

Larval Tineidae are separated from other Microlepidoptera larvae (Peterson, 1948) by having the L-group setae of the prothorax trisetose, close together, and separate from the cervical shield, crochets uniserial, uniordinal, and arranged in a circle, L1 and L2 on the abdomen remote, the D1 setae on the abdomen farther apart than the D2 setae, and the front extending more than half way to the vertical triangle. Illustrations and descriptions of immature tineid moths are given by Hinton (1956), 31 species mostly of economic importance, and Davis (1978), two scavenger species. All characters noted by Peterson hold true for these species, except for the distances separating the D1 setae and the D2 setae on the dorsum of the abdomen. For example, in _Lindera_ _tessellatella_ Blanchard (in Hinton, 1956) and Oinophila v-flava Haworth and Opogona omoscopa (Meyrick) (in Davis, 1978) the D1 setae are not farther apart than the D2 setae on abdominal segments 1-8. The D2 setae of Lep.-1 are slightly farther apart than the D1 setae on abdominal segments 1-7 but closer together on segments 9 and 10.

In the tineids treated by Peterson, Hinton, and Davis the adfrontals extend to the vertical triangle and are usually broad. This character is not noted in familial keys or description. In Lep.-1 the adfrontals extend only 3/4 of the distance to the vertical triangle and are narrow.

The adfrontals, positions of D1 and D2 setae on the abdomen, and the extreme length and narrow width of the body set Lep.-1 aside from the Tineidae, even though all other characters fit the family description. Because of the differences found in these characters, Lep.-1 cannot be worked through Peterson's key to larval Lepidoptera with assurance. Complications arise in the terminating couplet for the Tineidae and Heliodinidae, B 21 and B 21a. The front extends less than half way to the vertical triangle in the Heliodinidae and more than half way in the Tineidae. If a third part to the couplet, say B 21b, were added stating that the front extends more than half way to the vertical triangle, the adfrontals are narrow, ending 3/4 of the way to the vertical triangle; alpha (1) (D1) closer together than beta (2) (D2) on abdominal segments 1-7 and farther apart than beta (2) on segments 9 and 10; larva long, to 33 mm, and slender . . . Tineidae., a place would be provided for Lep.-1.

From consideration of all characters examined, Lep.-1 appears to be an unusual tineid. The principal features distinguishing it from the tineids discussed by Hinton and Davis are the truncate labrum, arrangement of spinules on the epipharyngeal surface, bidentate mandibles, and long, slender body. All species described by Hinton have an emarginate labrum, mandibles one or several toothed, and the median area of the epipharynx with spinules. In Opogona omoscopa and Oinophila v-flava the median area of the epipharynx is naked but closed posteriorly and in the shape of either a narrow ellipse or an oval, in comparison with the naked, median area in Lep.-1, U-shaped with the "U" opening posteriorly. Also, there is no mention of the MV3 setae on abdominal segments 1-9, in Hinton, Davis, or Peterson, appearing as a sensillum basiconicum, as it does in Lep.-1.

SUMMARY

On heavily grazed or otherwise depleted range lands in southern Arizona native grasses become dominated, and may be replaced by noxious woody Compoaitae. *Haplopappus tenuisectus* (Greene) Blake (burroweed) and *Gutierrezia microcephala* (DC.) A. Gray, *G. sarothrae* (Pursh) Britt. & Rusby, and *G. serotina* Greene (snakeweeds) are notorious as invaders of range lands. In a search for insects affecting the roots of these plants larvae and adults of anobiid beetles and larvae of olethreutid and tineid moths were encountered. The larvae were reared to adults for identification on an artificial diet. *Xeranobium* Fall (Coleoptera: Anobiidae) and *Sonia filiana* Busck (Lepidoptera: Olethreutidae) were reared from the roots of *Haplopappus tenuisectus* and *Eucosma ridingsana* Robinson (Lepidoptera: Olethreutidae) were reared from the roots of the three species of *Gutierrezia*. Rearing attempts for caterpillars belonging to the family Tineidae, found in both burroweed and snakeweed roots, were unsuccessful. *S. filiana* and *E. ridingsana* occur in large numbers and cause considerable damage to their host plants. The tineid is a scavenger feeding on decaying wood and frass in abandoned root tunnels of borers.

Xeranobium, *S*. *filiana*, *E*. *ridingsana*, and the tineid can be found throughout the year in all stages of development. *Marcocentrus pallisteri* DeGant (Hymenoptera: Braconidae) was reared from *S*. *filiana* and *E*. *ridingsana*.

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