

LORANTHOMITOURA, A NEW GENUS OF EUMAEINI (LEPIDOPTERA: LYCAENIDAE: THECLINAE)

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ABSTRACT.—*Loranthomitoura*, new genus, is described for five North American hairstreak butterflies which utilize *Arceuthobium* as a larval host. These species were previously placed in the genus *Mitoura* with other taxa which utilize hosts in the Cupressaceae. Separation of *Loranthomitoura* from *Mitoura* is based primarily on characteristics of the immature stages, especially first instar chaetotaxy. Larval and adult features indicate that *Loranthomitoura* may have greater affinity with *Incisalia*.

KEY WORDS: *Arawacus*, *Atlides*, California, Callophryina, *Callophrys*, *Chlorostrymon*, Cupressaceae, *Cyanophrys*, Durango, *Erora*, *Eumaeus*, Fabaceae, *Fixsenia*, *Habrodais*, *Harkenclenus*, *Hemiargus*, *Hypaurotis*, immature stages, *Incisalia*, larvae, Leguminosae, *Loranthomitoura* n. gen., Mexico, *Ministrymon*, *Mitoura*, Nearctic, Neotropical, New Mexico, North America, *Sandia*, *Satyrium*, Sonora, *Strymon*, Theclini, Viscaceae, *Xamia*.

A new genus, *Loranthomitoura*, is proposed for members of the eumaeine subtribe Callophryina (Johnson, 1990) which utilize dwarf pine mistletoe, *Arceuthobium* (Viscaceae), as a larval host. These species were previously placed in the genus *Mitoura* along with other species whose larvae feed only on cedars (*Cupressus*, *Juniperus*, *Libocedrus*, *Thuja*) (Cupressaceae). *Loranthomitoura* is readily separable from *Mitoura* on the basis of details of larval and pupal morphology and larval biology. The name *Loranthomitoura* reflects both the host plant (*loranth* is Greek for mistletoe) and the superficial similarity of this taxon to *Mitoura*.

Substantial larval differences between the cedar-eating and mistletoe-eating *Mitoura* were initially apparent to us from a survey of the mature larvae of California lycaenids (Ballmer and Pratt, 1989). First instar and pupal morphology further support the separation of these groups. This decision is reinforced by the nature of morphological variation among immatures of 26 callophryine taxa representing: *Callophrys*, *Cyanophrys*, *Incisalia*, *Mitoura*, *Sandia*, and *Xamia* (sometimes considered subgenera of *Callophrys* (*sensu* Ziegler (1960) and Clench (1961)), and additional taxa in the eumaeine genera *Arawacus*, *Atlides*, *Chlorostrymon*, *Erora*, *Eumaeus*, *Fixsenia*, *Harkenclenus*, *Ministrymon*, *Satyrium*, and *Strymon*, as well as *Habrodais grunus* (Boisduval) and *Hypaurotis crysalus* (W. H. Edwards) in the tribe Theclini.

LORANTHOMITOURA, new genus

TYPE SPECIES: *Thecla spinetorum* Hewitson 1867.

The following species, heretofore placed in the genus (or subgenus) *Mitoura*, are transferred to *Loranthomitoura*: *Callophrys* (*Mitoura*) *estela* Clench 1981, *Callophrys* (*Mitoura*) *guatemalena* Clench 1981, *Thecla johnsoni* Skinner 1904, *Callophrys* (*Mitoura*) *millerorum* Clench 1981, and *Thecla*

spinetorum Hewitson 1867. Robbins (1990) has shown that *L. millerorum*-like specimens from New Mexico are in fact *L. spinetorum*, and considers *L. millerorum* a synonym of *L. spinetorum*.

Ziegler (1960) first proposed separation of the cedar-eating and mistletoe-eating *Mitoura* (as subgenera of *Callophrys*) on the basis of genitalic features. He declined to formally name the subgenus of mistletoe-eaters. Clench (1981) described new species of *Mitoura* which, together with *L. johnsoni* and *L. spinetorum*, he placed in an informal group designated "The Blue *Mitoura*". Although Clench (1981) included the blue-winged *C. (M.) dospassosi* Clench 1981 in this group, larval morphology and biology clearly indicate its greater affinity with other cedar-eating *Mitoura*. Johnson (1976, 1985) also recognized that the mistletoe-feeders constitute a natural group distinct from the cedar-eating *Mitoura*.

The placement of *L. estela* and *L. guatemalena* in *Loranthomitoura* is based primarily on adult morphology, as little is known of their larval morphology and biology. Both species occur in montane pine forest habitats where *Arceuthobium*, the presumed larval host for both, also occurs. An adult *L. guatemalena* has been reared from a larva associated with *Arceuthobium* from southern Mexico (Dave McCorkle, personal communication). Interestingly, this species bears some resemblance to pine elfins (*Incisalia*) in wing pattern and Clench (1981) believed that it may represent an ancestral form from which *Incisalia* arose.

DIAGNOSIS.—Adult characters of wing maculation are similar to those of *Mitoura* and *Xamia* (Fig. 9, 21-25); genitalic structure is also similar to that of *Mitoura*, differing most notably in the greater sclerotization and/or pigmentation and spiny setation of the cephaloventrad portion of the valvae (Johnson, 1976, 1985).

Larval characters for Callophryina are generally typical of the Eumaeini. First instar eumaeine setation (Fig. 1) is reduced,

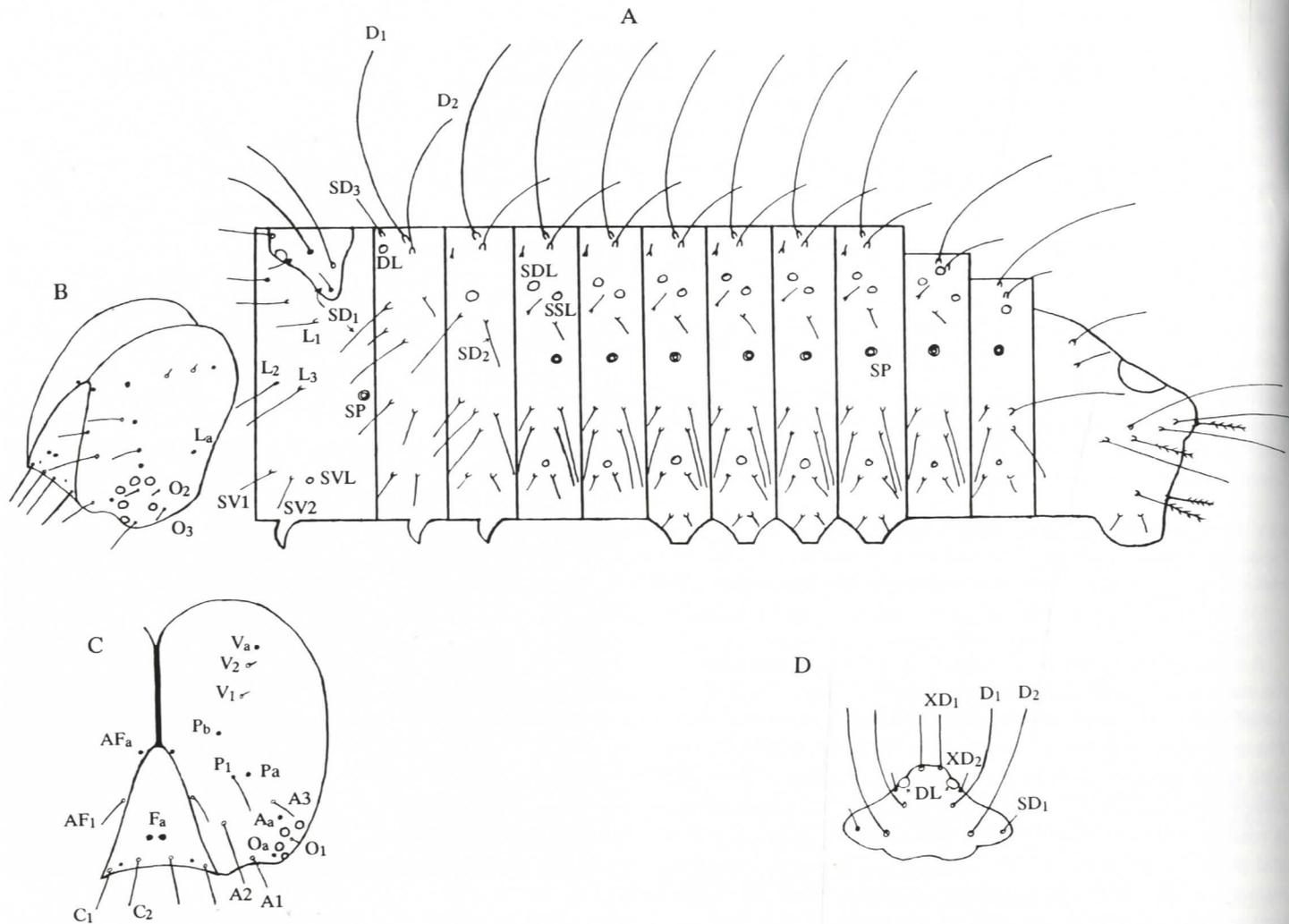


Fig. 1. Generalized chaetotaxy of first instar eumaeine larva. Diagrammatic lateral view of body (A), oblique frontolateral view of cranium (B), frontal view of cranium (C), and dorsal view of prothoracic shield (D). Legend: A1, A2, A3 = anterior (cranial) setae; Aa = anterior (cranial) puncture; AF1 = adfrontal seta; AFa = adfrontal puncture; C1, C2 = clypeal setae; D1, D2 = dorsal setae; DL = dorsal lenticle; Fa = frontal puncture; L1, L2, L3, L4 = lateral setae; La = lateral (cranial) puncture; O1, O2, O3 = ocellar setae; Oa = ocellar puncture; P1 = posterodorsal seta; Pa, Pb = posterodorsal (cranial) punctures; SD1, SD2, SD3 = subdorsal (cranial) seta; SDL = subdorsal lenticle; SP = spiracle; SSL = supraspiracular lenticle; SV1, SV2 = subventral setae; SVL = subventral lenticle; V1, V2 = vertical (cranial) setae; Va = vertical (cranial) puncture; XD1, XD2 = extra dorsal setae. Genal and subocellar setae and punctures not indicated.

compared to that found in many Old World hairstreak tribes (Ballmer, personal observations). Within the limits of taxa surveyed here, the Eumaeini may be defined by absence of cranial setae AF2, F1, F2, L, P2, and V3 and absence of lenticles associated with the lateral group of setae on the body (Figs. 1, 2 C, D, and 3 A, B, C, D). The Callophryina may be defined by the further absence of cranial seta A3, D1 setae posterior to A7, and D2 setae posterior to A6. The relatively complete setation of *Habrodais grunus*, a member of the primarily Old World tribe Theclini, is illustrated for comparison (Fig. 2 A). The setal pattern of *Strymon melinus* Hübner (typical of many eumaeines) is illustrated as an outgroup comparison (Fig. 2 B).

The specialized setation of lycaenid first instar larvae requires further studies in order to accurately determine homologies, especially for some setae on the prothorax and terminal segments. Setal nomenclature used here largely follows that of Wright (1983) and Downey and Allyn (1984), which in turn are based on that of Hinton (1946). But, whereas Wright (1983) and Downey

and Allyn (1984) respectively found four pairs of primary setae on the prothoracic shield of *Lycaena epixanthe* (Boisduval and LeConte) and *Hemiargus ceraunus antibubastus* (Hübner), there are five pairs in *Loranthomitoura* and most other Eumaeini. The fifth pair of setae on the shield is interpreted here as XD2. Both Wright (1983) and Downey and Allyn (1984) applied the designation XD2 to a different seta, interpreted here as SD1 (see Ballmer and Pratt, 1989).

ADULTS: Wings dorsally brownish (*L. johnsoni*) or steel blue (all other known species); males with scent patch associated with forewing discal cell. Hind wings with a prominent tail at vein Cu_2 and a short tail-like dentation at vein Cu_1 (Fig. 26). Wings ventrally some shade of brown (ranging from yellow-brown to blackish brown) with distinct, whitish postmedian line edged basally with black or darker brown (Fig. 17).

LARVAE: *First instar* (Fig. 3 C): Cranial chaetotaxy - A1, A2, AF1, O1, O2, O3, P1, V1, V2 present (A3, AF2, F1, F2, L, P2, and V3 absent); puncture Va variably anterior or posterior to seta V2. Body chaetotaxy - T1: five pairs of setae on the shield, three 'fringe setae'

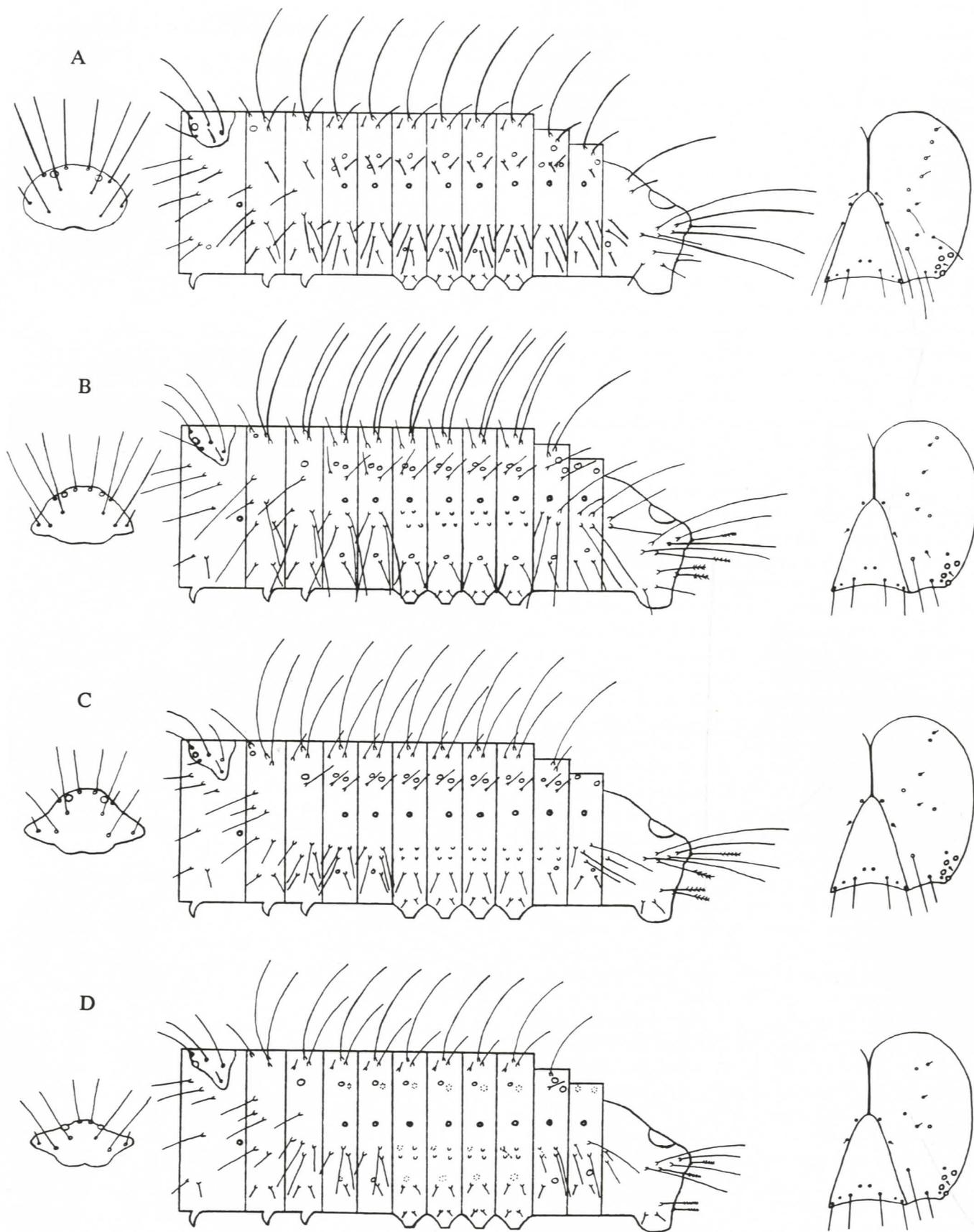


Fig. 2. Chaetotaxy of *Habrodais grunus* (A), *Strymon melinus* (B), *Cyanophrys miserabilis* (C), and composite of *Callophrys* and *Incisalia* spp. (D); dorsal view of prothoracic shield (left), lateral view of body (center), frontal view of head (right). Lateral setae on A3-6 indicated by positions of chalazae; structures indicated by broken lines are variably present or absent. Genal and subocellar setae and punctures not indicated.

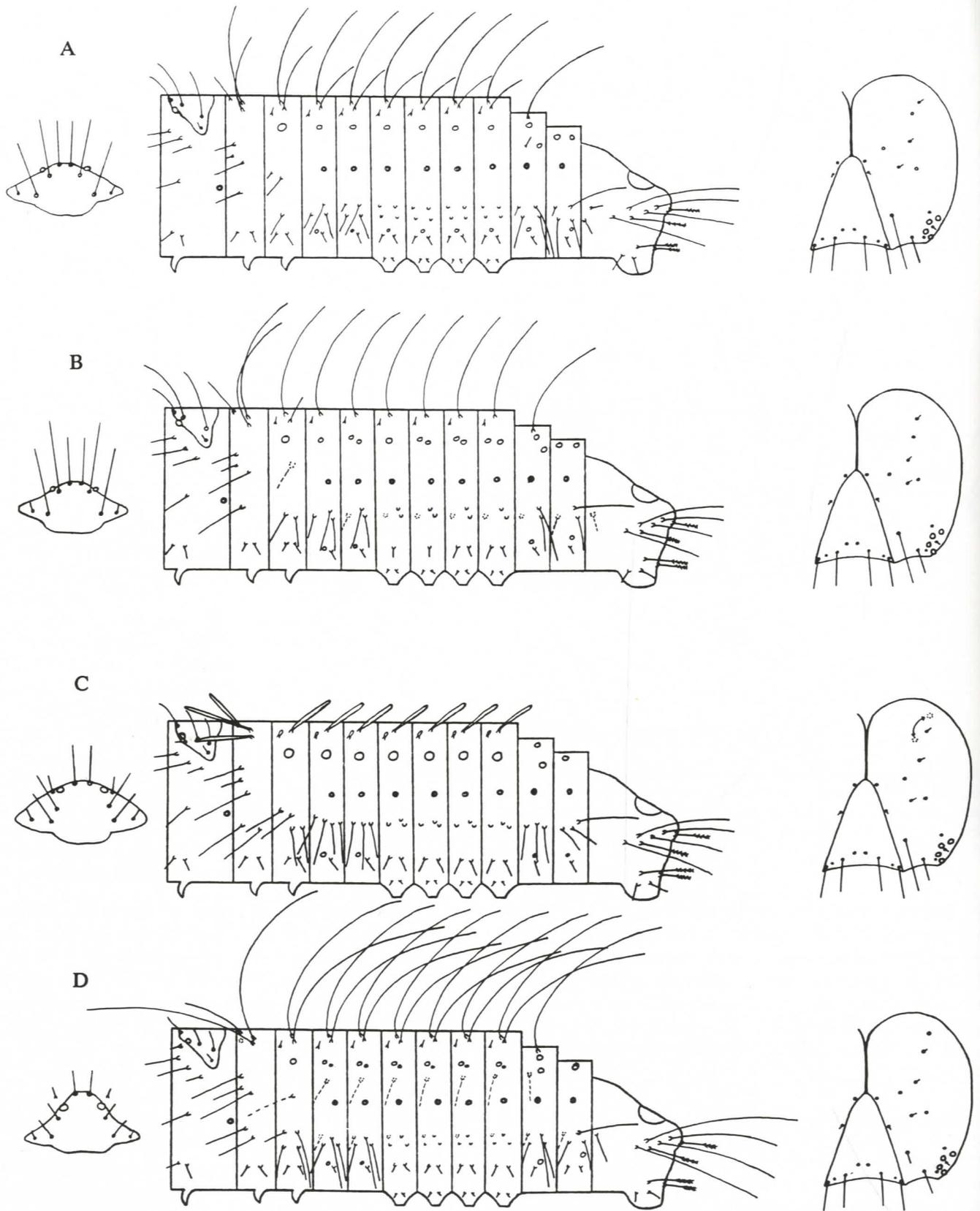


Fig. 3. Chaetotaxy of *Xamia xami* (A), *Sandia mcfarlandi* (B), *Loranthomitoura* (*L. johnsoni* and *L. spinetorum*) (C), and composite of *Mitoura* spp. (D); dorsal view of prothoracic shield (left), lateral view of body (center), frontal view of head (right). Lateral setae on A3-6 indicated by positions of chalazae; structures indicated by broken lines are variably present or absent. Genal and subcellular setae and punctures not indicated.

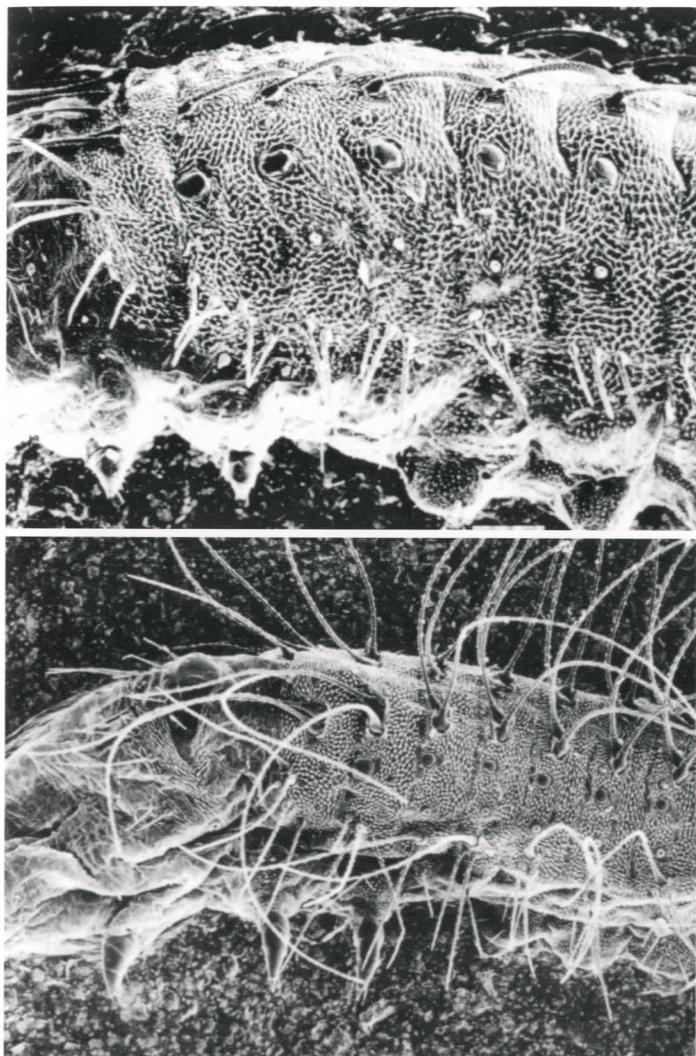


Fig. 4. SEM of first instar *L. spinetorum*; dorsolateral view of T2-A4 (scale bar = 0.1mm).

Fig. 5. SEM of first instar *M. loki*; dorsolateral view of T1-A5 (scale bar = 0.1mm).

anterolateral to the shield, one L seta anterior to the spiracle, and two SV setae; T2: D1, D2, SD1, SD3, L1, L2, L3, L4, SV1, SV2 present and SD2, SDL absent; T3: similar to T2, but SDL present and D1, SD1 absent; A1, A2: similar to T3, but L group variable (2-3 setae), SV1 absent, and SVL present; A3-A6: similar to A1 and A2, but SV1 present and SVL absent; A7 and A8: similar to A1 and A2, but D2 and SD3 absent.

Last instar: cranial pigmentation yellow-brown; body ground color yellow-brown to maroon, with dorsolateral chevron markings; body shape sub-cylindric (not especially onisciform); setae relatively short and sparse; prothoracic shield broadly 't' shaped, with clavate 'sensory' setae; body profile somewhat angulate, with rounded dorsal prominences on T2, T3, A1, and A6 (Fig. 15).

PUPAE: similar in shape to most Eumaeini, i.e. compact and obtect; dark brown; with scattered, short, erect setae (Fig. 16); dendritic setae confined to the region around the A6 spiracle; cremastral hooks present; silk girdle present or absent.

REMARKS.— First instar *Loranthomitoura* are unique among the taxa examined in lacking all D1 setae on T3-A6 and in the relatively short, broad, clavate structure of all D and SD3 setae

on T2-A6. The interpretation of the identity of the dorsal setae is based on their orientation (directed caudad) and distribution (absent on A7), which is consistent with the orientation and distribution of D2 setae in other Callophryina. [An alternative interpretation (suggested by David M. Wright), based on the position of these setae with respect to the micro-dorsal setae (not figured) is that they are D1 setae.] *Sandia mcfarlandi* (Fig. 3 B) also has reduced dorsal setae; but in this species D2 is lost (usually) on A1-A6, while remaining D and SD setae are normally tapered (not clavate).

The presence of five pairs of setae on the first instar *Loranthomitoura* prothoracic shield probably represents the ancestral condition among callophryines, as this configuration is widespread among theclines (Ballmer, personal observations). However, among other callophryine first instars examined, only *Cyanophrys miserabilis* (Clench) has five pairs of setae on the shield. Seta XD2 is typically absent in *Callophrys*, *Incisalia*, *Sandia*, and *Xamia*; however, this seta was found on one side of the shield in about a third of *Incisalia mossii* (H. Edwards) larvae examined. In *Mitoura* XD2 is present but located anterior to the shield.

First instar cranial chaetotaxy of *Loranthomitoura* is very similar to most other Callophryina, but differs from *Mitoura* in the length of seta A2. In *Mitoura* A2 is about half as long as A1 (Fig. 3D), whereas in *Loranthomitoura* and other eumaeines it is approximately twice as long as A1 (Fig. 2B, C, D; 3A, B, C). Puncture Va is variably anterior or posterior to seta V2 in *Loranthomitoura* (Fig. 3C); it is consistently posterior to V2 in *Mitoura* (Fig. 3D) and most eumaeines, but consistently anterior to V2 in other callophryines (Fig. 2C, D; 3A, B).

Last instar larvae of *Loranthomitoura* and *Mitoura* (to an even greater extent) are more cylindrical than onisciform. This is probably an adaptation to crypsis on relatively cylindrical host plant parts (stems with tiny, scale-like or dehiscent leaves). Other callophryine larvae are more markedly onisciform. *Loranthomitoura* larvae also have a variably angulate (saw-toothed) dorsal profile with paired conical dorsal prominences most pronounced on T2, T3, A1, and A6 (Fig. 15). Similar dorsal prominences are a variable trait on larvae of other Callophryina, but when present occur on A1-6 and are not more pronounced on T2, T3, A1, and A6 (Fig. 6, 8, 10, 12, 18, 20). Dorsal prominences on T2-A6 are also present in *M. dospassosi* but not in other *Mitoura* species.

Body setae of mature *Loranthomitoura* larvae are reduced in both density and length, resulting in a macroscopically nearly glabrous and somewhat shiny appearance (Fig. 15). Larvae of other callophryines generally appear velvety or spinose due to longer and/or more numerous setae (Fig. 6, 8, 10, 12, 18, 20). Dendritic setae (see Ballmer and Pratt, 1989, 1992), when present in callophryines, are confined to the margin of the honey gland on A7. These setae are present in *Loranthomitoura*, *Callophrys*, *Incisalia*, *Sandia*, and *Xamia*, but are absent in *Cyanophrys* and all *Mitoura* except *M. dospassosi*.

'Sensory' (SD1) setae (see Ballmer and Pratt, 1989) on the prothoracic shield of mature *Loranthomitoura* larvae are gradually enlarged apically and have short lateral spicules. In *Mitoura* these setae are similarly gradually enlarged apically, but have more prominent lateral spicules. In other Callophryina the

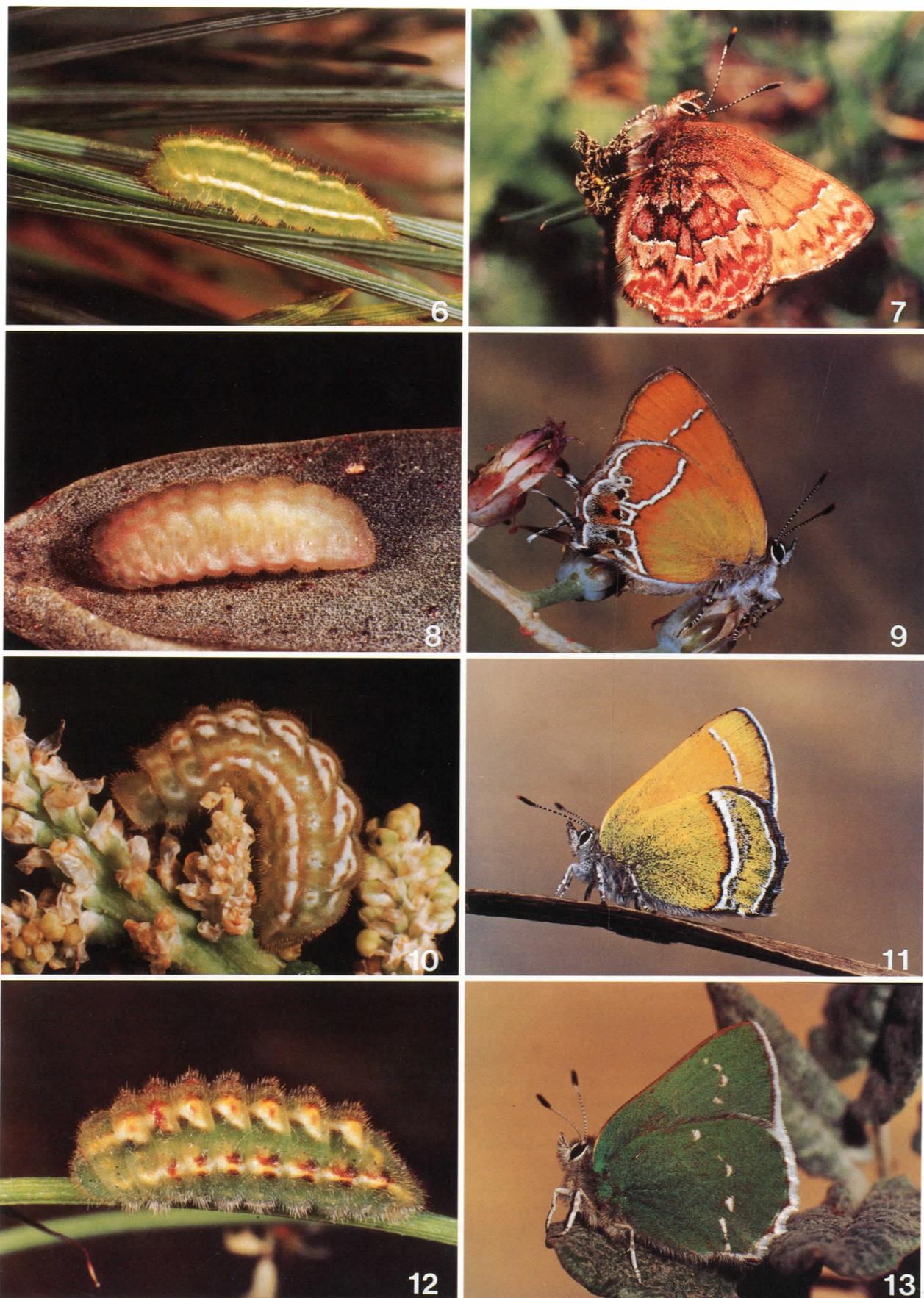


Fig. 6-13. Adults and immatures of various Callophryina.— *Incisalia eryphon*: 6) last instar (CA: San Bernardino Co.: 3 mi W Onyx Summit, elev. 8000'); 7) adult (CA: San Bernardino Co., Wildhorse Mdw., elev. 8200'). *Xamia xami*: 8-9) last instar and adult (AZ: Pima Co., Santa Catalina Mts.). *Sandia mcfarlandi*: 10-11) last instar and adult (NM: Dona Ana Co., Organ Mts). *Callophrys dumetorum*: 12-13) last instar and adult (CA: San Mateo Co., San Bruno Mt.).



Fig. 14-17. *Loranthomitoura spinetorum*: 14-17) first instar, last instar, pupa, and adult (CA: San Diego Co., Laguna Mts., Boiling Springs).

'sensory' setae range from tapered to slightly enlarged apically, with lateral spicules more-or-less intermediate in length between those of *Loranthomitoura* and *Mitoura*. In most other North American eumaeines the 'sensory' setae are tapered, filiform, or weakly enlarged apically and have less conspicuous lateral spicules.

RELATIONSHIPS

Both *Loranthomitoura* and *Mitoura* exhibit substantial divergence from other North American Callophryina in first instar morphology; however, they have diverged in very different directions. Thus, dorsal setae are reduced in length and number and are broadly clavate in *Loranthomitoura*, but a full complement (on T2-A6) is present in *Mitoura* where they are often exceptionally long and tapered. Preliminary studies based on allozyme analyses (Pratt, in prep.) indicate that *L. spinetorum* is more closely related to *Incisalia* than to *Mitoura*. Examination of the immature stages of *L. guatemalena*, which remain undescribed, would probably help to clarify the relationship of this taxon to other *Loranthomitoura* as well as to *Incisalia* and *Mitoura*.

Both *Mitoura* and *Loranthomitoura* first instars possess unique apomorphies within the Callophryina. In *Mitoura* the greatly reduced length of cranial seta A2 is unique among all eumaeines examined, while the migration of seta XD2 to a position anterior

to the prothoracic shield is unique among callophryines and rare among other eumaeines. However, the location of cranial puncture Va posterior to seta V2 in *Mitoura* is a plesiomorphic trait widespread among Eumaeini (and other theclines), whereas its location anterior to V2 in other callophryines is an apomorphy. The variable location of Va in *Loranthomitoura*, ranging from anterior to posterior to V2, hints that the progenitor of this genus could also be ancestral to other North American callophryine genera (or subgenera). The primary apomorphies distinguishing first instar *Loranthomitoura* from other Callophryina are the loss of D1 setae on T3-A6 and modification of remaining D1, D2, and SD3 setae to relatively short, stout, clavate structures. The absence of SD1 and SD2 on T3-A7 in *Loranthomitoura* (Fig. 3C) coincides with the situation in *Callophrys*, *Incisalia*, *Sandia*, and *Xamia* (Fig. 2D; 3A, B); these setae are present in *C. miserabilis* (Fig. 2C) and in some *Mitoura* species, but absent in others (Fig. 3D).

Apomorphies which distinguish mature *Loranthomitoura* larvae from other Callophryina chiefly relate to crypsis. Thus, the relatively cylindrical body shape, angulate dorsal profile, sparse setae, and disruptive color patterns (chiefly green-brown, yellow, red) aid in concealment on *Arceuthobium* hosts (Fig. 15).

Loranthomitoura is unusual with respect to the number of larval instars. Whereas most Eumaeini have four larval instars, *Loranthomitoura* (so far as known) have five and *Mitoura* usually have six or seven (Ballmer and Pratt, 1989). Mature larvae and



18



19



20



21



22



23



24



25

Fig. 18-25. Adults and immatures of various Callophryina.— *Cyanophrys miserabilis*: 18-19) last instar and adult (MEXICO: Sonora, 10 mi E Navajoa). *Mitoura gryneus sweatneri*: 20-21) last instar and adult (FL: Levy Co., Yankeetown). *Mitoura nelsoni muii*: 22) adult (CA: San Luis Obispo Co., Cuesta Ridge). *Mitoura thornei*: 23) adult (CA: San Diego Co., Otay Mt.). *Mitoura siva mansfieldi*: 24) adult (CA: San Luis Obispo Co., 50 mi E Santa Margarita). *Mitoura dospassosi*: 25) adult (MEXICO: Durango, vic. El Salto).

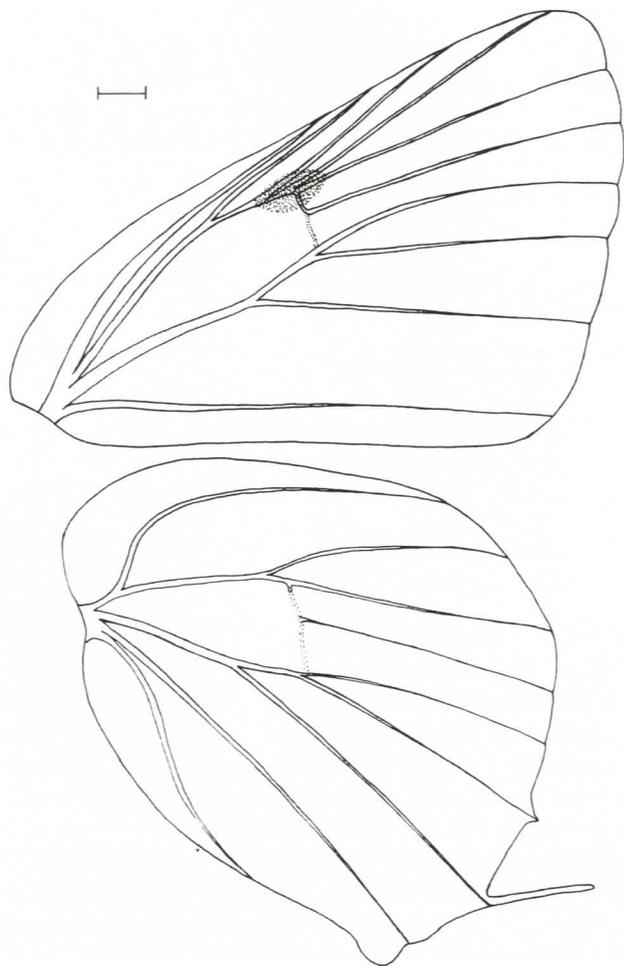


Fig. 26. Venation of *Loranthomitoura spinetorum* (scale bar = 1.0mm).

pupae of *Loranthomitoura* retain plesiomorphic features common to most other Callophryina. Presence of dendritic setae on the last instar larva distinguishes *Loranthomitoura* (and most other Callophryina examined) from *Mitoura* (except *M. dospassosi*) and *Cyanophrys*, which lack them. Similarly, the presence of cremastral hooks on the pupae of *Loranthomitoura* is a feature common to most Callophryina, but *Mitoura* and *Callophrys* lack them.

Host plant utilization in *Loranthomitoura* may provide additional insight regarding phylogenetic relationships with other Callophryina. One hypothesis holds that the mistletoe-eaters arose from cedar-eating *Mitoura* by virtue of repeated oviposition on or near the mistletoe parasite of a gymnosperm host plant (Chew and Robbins, 1984). Since *Arceuthobium* is primarily associated with pines and rarely attacks cedars, this hypothesis is more palatable if a pine-feeding *Incisalia* were substituted for *Mitoura*, which cannot utilize pines (Ballmer, personal observations). The same process could be invoked to account for the perhaps more likely scenario that gymnosperm-feeding Callophryina arose from a mistletoe-feeding ancestor. It is also notable that, although *Loranthomitoura* apparently uses only *Arceuthobium* in nature, larvae can be reared successfully on *Lotus scoparius* (Fabaceae), a plant which is generally accepted by *Callophrys*, *Incisalia*, and *Sandia*, but not by *Mitoura* (Pratt and Ballmer, 1991). Scott

(1985) hypothesized that the original butterfly ancestor used a host plant in the Fabaceae, because members of many butterfly groups, including some of the more primitive forms, use this plant family. Although the Callophryina are undoubtedly far removed from such a hypothetical ancestor, the acceptability of a fabaceous host to many constituent species may indicate that a more recent common ancestor either utilized such a host or had a relatively broad host range. Thus, one could interpret the ability of *Loranthomitoura* to utilize *L. scoparius* as a retained ancestral trait and the inability of *Mitoura* to use the same host as an apomorphic loss of dietary breadth.

The weight of evidence from the immatures (larval and pupal morphology and host specificity) indicates that *Loranthomitoura* and *Mitoura*, as defined here, are separate monophyletic groups which could not have an immediate common ancestor. A closer (perhaps sister group) relationship between *Loranthomitoura* and the pine-feeding *Incisalia* species remains an open question.

MATERIAL EXAMINED

Immatures of the following taxa were examined (F = first instar, L = last instar larva, P = pupa):

CALLOPHRYINA: *Loranthomitoura johnsoni* (Skinner) (F, L), *L. spinetorum* (Hewitson) (F, L, P), *Callophrys apama* (W. H. Edwards) (F, L), *C. dumetorum* (Boisduval) (F, L, P), *C. perplexa* Barnes & Benjamin (F, L, P), *Cyanophrys goodsoni* (Clench) (L), *C. longula* (Hewitson) (L), *C. miserabilis* (Clench) (F, L, P), *Incisalia augustinus* (Westwood) (F, L, P), *I. eryphon* (Boisduval) (F, L, P), *I. fotis* (Strecker) (F, L, P), *I. mossii* (H. Edwards) (F, L, P), *I. polia* Cook & Watson (F, L, P), *Mitoura dospassosi* (Clench) (F, L), *M. grynea grynea* (Hübner) (F, L, P), *M. g. castalis* (W. H. Edwards) (F, L, P), *M. g. sweadneri* F. H. Chermock (F, L, P), *M. hesseli* Rawson & Ziegler (F, L, P), *M. loki* (Skinner) (F, L, P), *M. nelsoni nelsoni* (Boisduval) (F, L, P), *M. n. muiri* (H. Edwards) (F, L, P), *M. siva siva* (W. H. Edwards) (F, L, P), *M. s. chalcosiva* (Clench) (F, L, P), *M. s. juniperaria*, (W. H. Edwards) (F, L, P), *M. s. mansfieldi* (F, L, P), *M. thornei* J. W. Brown (F, L, P), *Sandia mcfarlandi* (Ehrlich & Clench) (F, L, P), and *Xamia xami* (Reakirt) (F, L, P).

First and last instar larvae and pupae of the following additional taxa were examined:

EUMAEINI: *Arawacus jada* (Hewitson), *Atlides halesus* (Cramer), *Chlorostrymon simaethis sarita* (Skinner), *Erora quaderna* (Hewitson), *Eumaeus atala florida* Röber, *Fixsenia ontario* (W. H. Edwards), *Harkenclenus titus* (Fabricius), *Ministrymon leda* (W. H. Edwards), *Satyrium auretteorum* (Boisduval), *S. behrii* (W. H. Edwards), *S. californicum* (W. H. Edwards), *S. fuliginosum* (W. H. Edwards), *S. saepium* (Boisduval), *S. sylvinum* (Boisduval), *S. tetra* (W. H. Edwards), *Strymon columella* (Fabricius), and *S. melinus*.

THECLINI: *Habrodais grunus* (Boisduval) and *Hypaurotis crysalus* (W. H. Edwards).

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