

COSMOCLOSTIS AGLAODESMA: DESCRIPTION OF THE LARVA AND PUPA (PTEROPHORIDAE: PTEROPHORINAE: PTEROPHORINI)

Additional key words: morphology, characters, immature stages, tribal placement, Australia

The genus *Cosmoclostis* Meyrick includes 12 species: 3 Australasian, 3 Afrotropical, and 6 Oriental in distribution (Fletcher 1947, Gielis 2003, Hao et al. 2004). Hostplants have been reported for 4 species (Hao et al. 2004, Matthews & Lott 2005) but the immature stages are poorly known. Fletcher (1932) illustrated and briefly described the larva and pupa of *C. pesseuta* Meyrick (as *C. premnicola* Fletcher). We describe and illustrate the pupa and a late instar larva of the type species, *C. aglaodesma* Meyrick, using setal nomenclature following Stehr (1987) and Heinrich (1916). Arenberger (1998) illustrates the adult and genitalia of this species.

Cosmoclostis aglaodesma occurs along the Pacific Rim of Australia. Meyrick's (1886) holotype is from Sydney, New South Wales. This species has also been collected in Toowong, Queensland (Arenberger 1998) and further north from Iron Range (see material examined). The larval host genus of these Iron Range specimens is *Gmelina* (Lamiaceae) but the species is not indicated on the label. Fletcher (1931) listed *G.*

arborea Roxb. as the host for *C. aglaodesma* from Assam, India, but according to Arenberger (1998), *C. aglaodesma* is restricted to Australia and these records are based on misdetermined specimens. *Gmelina arborea* is the host for *C. leucomochla* Fletcher in India (Nair 2001) and *C. gmelina* Hao, Li, & Wu in China (Hao et al. 2004). *Gmelina moluccana* Backer ex K. Heyne is the host for *C. lamprosema* Fletcher in the Solomon Islands (Arenberger 1998).

Material examined. Australia: Queensland: Iron Range 19 March 1964 I.B.F. Common & M.S. Upton, on *Gmelina* sp. (1 larva, 1 pupa) [Australian National Insect Collection]. Specimens identified by I.B.F. Common.

Larva. Figures 1a–c, 2a–d. Length 8 mm, maximum width 2.5 mm (excluding setae). Three forms of setae present: simple, with smooth shaft and pointed apex; spiculate with pointed or blunt apex; and scaliform. Dorsal and subdorsal setae reduced, minute and closely appressed to body. Lateral setae on prominent flange verrucae with dorsal-most setae radiating in a single plane forming conspicuous lateral fringe. Lateral setae short to long, longest setae 1.73 mm or 0.7× maximum body width.

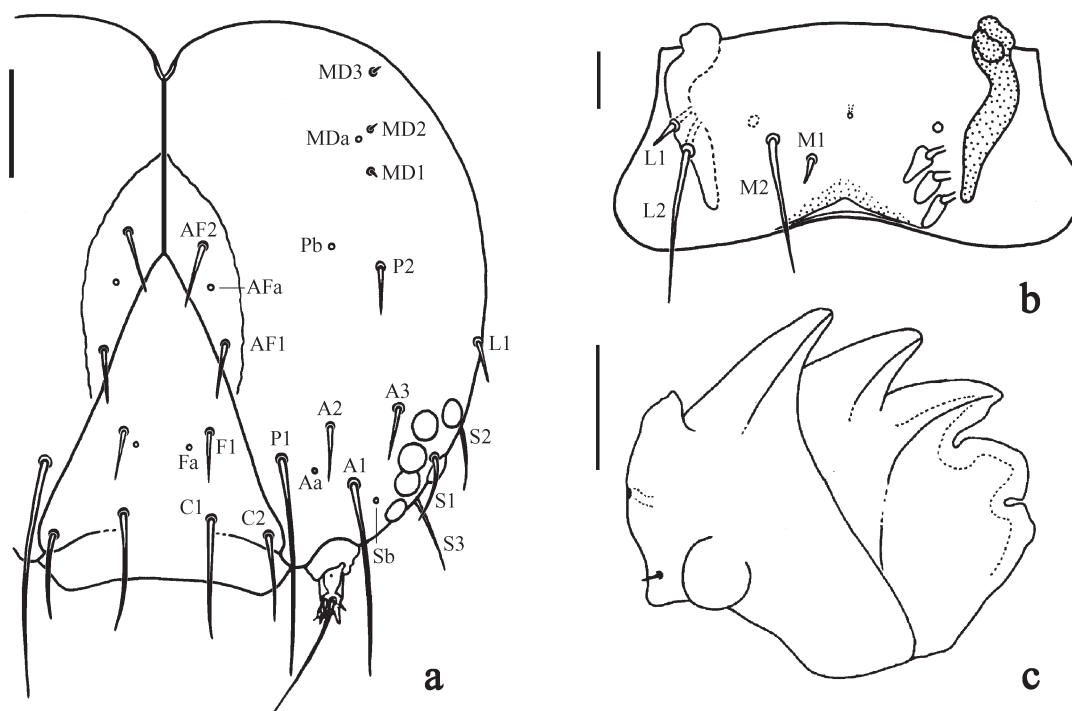


FIG. 1. Larval head of *Cosmoclostis aglaodesma*: **a**, Frontal view of cranium, scale line = 0.125 mm; **b**, Labrum, epipharyngeal surface on right, scale line = 0.035 mm; **c**, Right mandible, scale line = 0.040 mm.

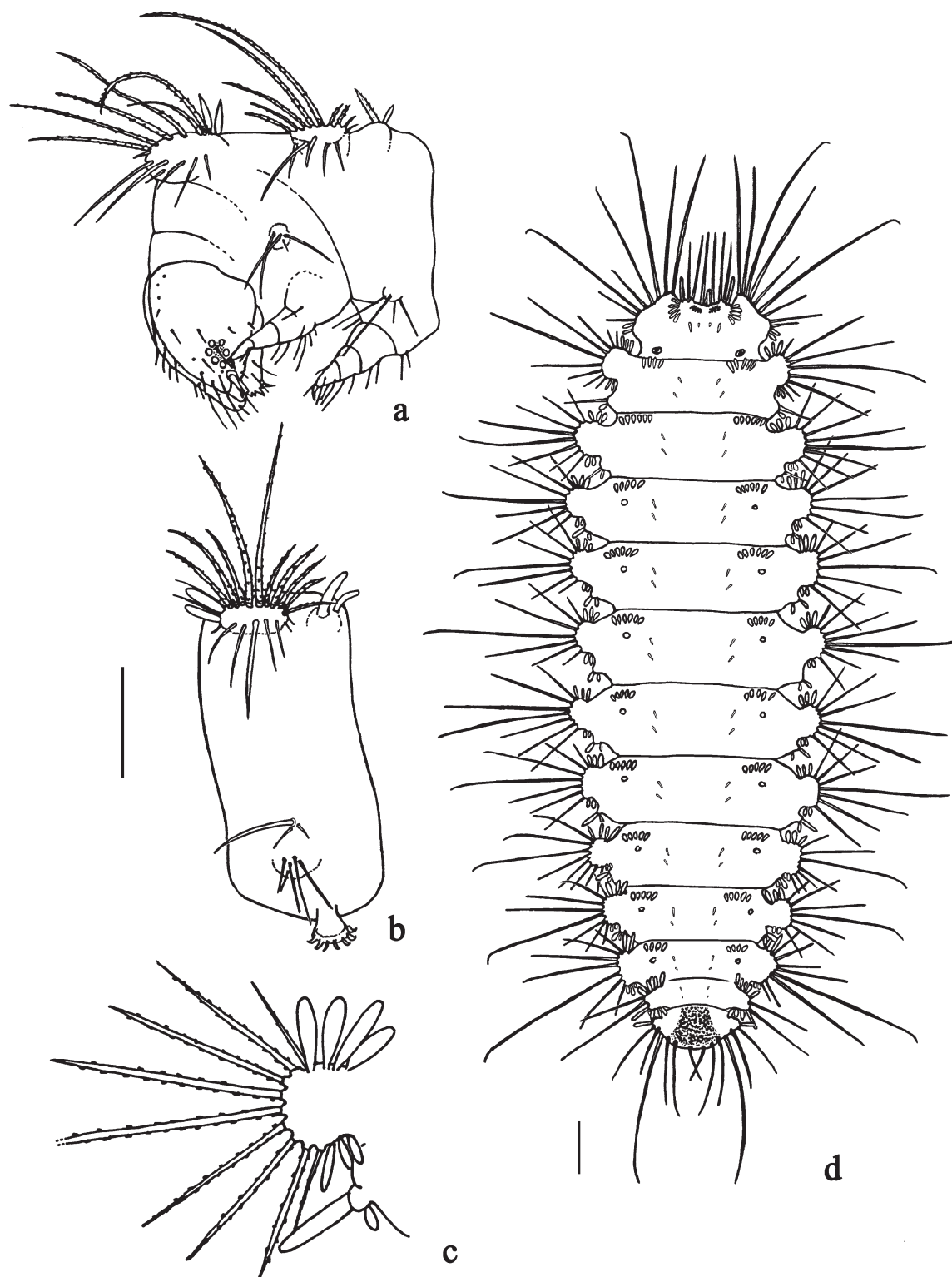


FIG. 2. *Cosmoclostis aglaodesma* larva: **a**, lateral view of head, prothorax, and mesothorax; **b**, lateral view of segment A3, scale line = 0.5 mm; **c**, morphological detail of lateral setae on abdomen, dorsal view; **d**, larva, dorsal view, scale line = 1.0 mm.

Head. Hypognathous. Anterior aspect round. Width 0.74 mm. Adfrontal sclerite not reaching anteclypeus. Pore AFa present. Lateral adfrontal suture length about 1.3× clypeal width, just exceeding 1.5× epicranial suture length. Setae AF1, AF2, F1, A2, A3, P2, L1, S1, and S2 about 0.25× clypeal width. Seta C1 about 0.5× clypeal width; C2 and S3 just less than 0.5× clypeal width. Length of setae P1 and A1 just less than 1× clypeal width, P1 slightly longer than A1. Seta P2 and pore Pb laterad of AF2. Seta P1 unusually distant from P2, more ventrally placed than in other pterophorid genera, about midway between F1 and A1. Pore Aa between P1 and A1. Seta A2 dorsad of pore Aa. Labrum with 4 setae; length of M2 and L2 about 0.25× clypeal width, that of M1 and L1 less than 0.2× M2 or L2. Labrum distally flared, without conspicuous notch, ventral margin slightly concave. Three epipharyngeal setae present. Mandible 6-toothed; ventral tooth distinctly basad of adjacent tooth and not arising from the same ridge (ventral tooth apex about midway between condyle and apex of adjacent tooth). Mandible width slightly greater than length; distal seta replaced by pore, proximal seta close to condyle, length about 0.3× condyle diameter.

Thorax. Dorsum of prothorax with setae XD1, XD2, SD1, and SD2 approximate and transversally aligned as anteriorly projecting fringe along anterior margin. Seta XD1 and XD2 similar in length, about 0.72 mm. Length of seta SD1 slightly less than that of XD2, SD2 about 0.3× XD2. A smooth scaliform secondary seta present between midline and XD1, length just less than SD2. With diffuse lightly sclerotized patch posteriad of XD setae. With cluster of 5 minute scaliform setae posteriad of SD2; setae directed laterad, closely appressed to body. Setae D1 and D2 minute and obscure, D1 less than 0.03 mm; D2 about 0.6 mm, laterad and slightly posteriad of D1, directed anteriorly, appressed to body. Lateral verruca oblong, projecting anteriorly of central anterior margin. Distal margin of verruca with 9 short to long spiculate setae flanked by 3–5 short to minute scaliform setae anteriorly and 2 minute scaliform setae posteriad. Ventral surface of verruca with 8–10 additional minute to medium length setae projecting ventrad. Prothoracic spiracle on T1 dorsum laterad near posterior segment margin, round, not exerted, peritreme light. Subventral verruca small, round, scarcely elevated, with 3 short simple setae and 1 or 2 minute setae.

Segments T2–T3 with D setae obscure, minute; D2 posteriad of D1, both directed anteriorly, appressed to body. Primary seta SD1 apparently absent, with verruca remnant of 4–6 minute secondary scaliform setae along anterior margin dorsad of L verruca. Fan of about 9 short to long spiculate setae present on flange type L verruca; setae projecting laterad in single plane, about 3 minute scaliform setae anteriorly on verruca and 2 posteriad. About 5 minute to medium length simple setae on ventral surface of L verruca. A small tubercle present at lateral margin posteriad of main L (L1+L2) verruca with central short, articulated spiculate seta (L3) and minute secondary scaliform seta posteriad on tubercle. Subventral verruca as on T1.

Abdomen. Segments A1–A8 with D1 and D2 as on T2–T3. Primary seta SD1 absent. A transverse row of 4–6 scaliform secondary setae along anterior margin anteriorly of spiracle. Spiracles inconspicuous, round, peritremes light. Main lateral verruca as on T2–T3. Tubercle posteriad of main L verruca with 2 secondary setae; apical seta short (about 0.24 mm), scaliform; not spiculate or articulated at base as on T2–T3. Seta posteriad on tubercle minute, scaliform. Tubercle and associated setae absent on A8. Seta L3 of medium length, up to 0.38 mm, simple, central on small verruca with 2–3 minute setae; longitudinally aligned with SV verruca on T2–T3. Subventral verruca small, round, with 3–5 short to minute simple setae. Prolegs on A3–A6 with length about 2× width; 7–8 crochets arranged in mesopenellipse. Prolegs placed very close to meson, distance between right and left proleg less than proleg diameter. Seta V1 minute, solitary on all segments, mesad at proleg base on A3–A6.

Segment A9 with setae D1 and D2 as on A8 but shorter. Lateral verruca smaller, with only 2 spiculate setae (L1 & L2) and 5–6 scaliform setae anteriorly, 3–4 posteriad. Longest of 2 spiculate setae (L2, posteriad) 0.48 mm. One short simple seta on ventral surface of verruca. Seta L3 absent. Subventral verruca with 3 minute to short setae, verruca positioned more laterad than SV verruca of A8. Anal

plate (A10) with D1 setae apparently absent. Minute, thin simple seta, possibly D2, positioned just anteriorly of fringe setae on caudal margin. Dorsum of anal plate with moderately sclerotized longitudinal band on central third from anterior margin to caudal margin, flared toward caudal margin to include bases of 3 dorsal-most caudal setae. Caudal margin rounded, with 7 short to long spiculate setae; 2 most anterior setae arising from lateral tubercle. Two minute scaliform setae anteriorly on lateral tubercle. Ventral rim of anal plate with about 9 minute to short simple setae. Anal proleg with 9 crochets in transverse arc. About 6 short to minute setae projecting posteriad from posterior side of proleg.

Pupa. Figure 3a–c. Length 9 mm, maximum width 3 mm (includes verruca bases but not setae). Primary and secondary setae present, minute to medium in length. Longest setae, SD1 and SD2 on T1, and L setae on lateral verruca of abdomen, reaching 0.6 mm or 0.2× maximum body width. Primary D setae minute, appressed, blunt-tipped or scaliform, remaining primary and secondary setae simple or minutely spiculate. Dorsum with localized hyaline scobinations present. Head and thorax with prominent flanges bearing marginal setal fringe. Lateral verruca prominent plate-like flanges on abdominal segments. Dorsal aspect with wings hidden by flanges and setae. Thoracic appendages without secondary setae.

Head. Dorsum with vertex distinguishable as triangular sclerite medially of antennal bases. Front produced as prominent bilobed flange. Dorsum of front without setae, lateral margin of each flange lobe bearing fringe of 10–11 minute to short setae; primary setae AF1 and AF2 distinguishable from adjacent secondary setae as being longer, more distinctly spiculate, and by having articulated bases. Ventral surface of front smooth, without secondary setae. Seta F1 simple, about 0.24 mm, projecting laterad near anterior extent of gena. Frontoclypeal suture indistinct. One minute, thin, clypeal seta (C2) present, length about 0.5× F1, directed posteriad. Pilifers distinct, separated by labial palpus at meson. Genal seta slightly longer than C2. Suture between gena and smooth eye barely discernible. Junction of smooth and sculptured eye also obscure. Sculptured eye with two minute setae present, lengths similar to genal seta. Maxilla with base just exceeding 0.5× T2 leg length, reaching A3; mid section partly concealed by T1 leg, distal tip exposed between T2 leg tips, even or just exceeding T2 leg apex. Antenna extending along T2 leg to point midway between T1 and T2 leg tips, not exceeding forewing. Antenna without setae except for 3 short secondary setae along flange at base. Setae and flange visible in both dorsal and ventral aspects.

Thorax. Pronotum constricted at midline, with prominent rounded flange laterad bearing marginal fringe of 14–16 minute to short setae. Secondary fringe setae reaching 0.38 mm in length. Primary setae SD1 and SD2 most posterior of fringe setae, up to 0.55 mm in length, more spiculate than preceding setae, bases articulated. Setae D1 and D2 minute, less than 0.12 mm long, scaliform, directed anteriorly, appressed. Seta D2 posterolaterad of D1. Prothoracic spiracle embedded in T2 margin, not elevated, peritreme light. Fore leg with coxa/trochanter exposed as sclerite between maxilla base and tibia/tarsal sclerite. Fore leg apex reaching A4 posterior margin.

Dorsum of mesothorax relatively flat, without dorsal ridges or keel. Setae D1 and D2 minute (0.14 mm long), scaliform to blunt-tipped, appressed. Seta D1 directed anteriorly, D2 posteriad of D1, directed laterad. Numerous hyaline scobinations present near D setae. Primary SD setae absent. Lateral margin with bilobed flange. Anterior lobe small, with arc of about 6 minute blunt-tipped secondary setae at margin, continued anteriorly by transverse row of about 4 setal bumps or scobinations, posteriad by about 5 microscopic scaliform setae. Posterior flange lobe broadly rounded, with marginal fringe of up to 14 minute blunt-tipped secondary setae. Forewing and mid leg apex reaching A5 posterior margin.

Metathorax with D setae as on T2 but closer to anterior margin. Hyaline scobinations present. Subdorsal setae absent. Lateral flange broadly rounded, not subdivided; with marginal fringe of 18–19 minute to short setae. Hindwing not visible in dorsal aspect, reaching A2 posterior margin in lateral aspect. Hind leg concealed beneath T2

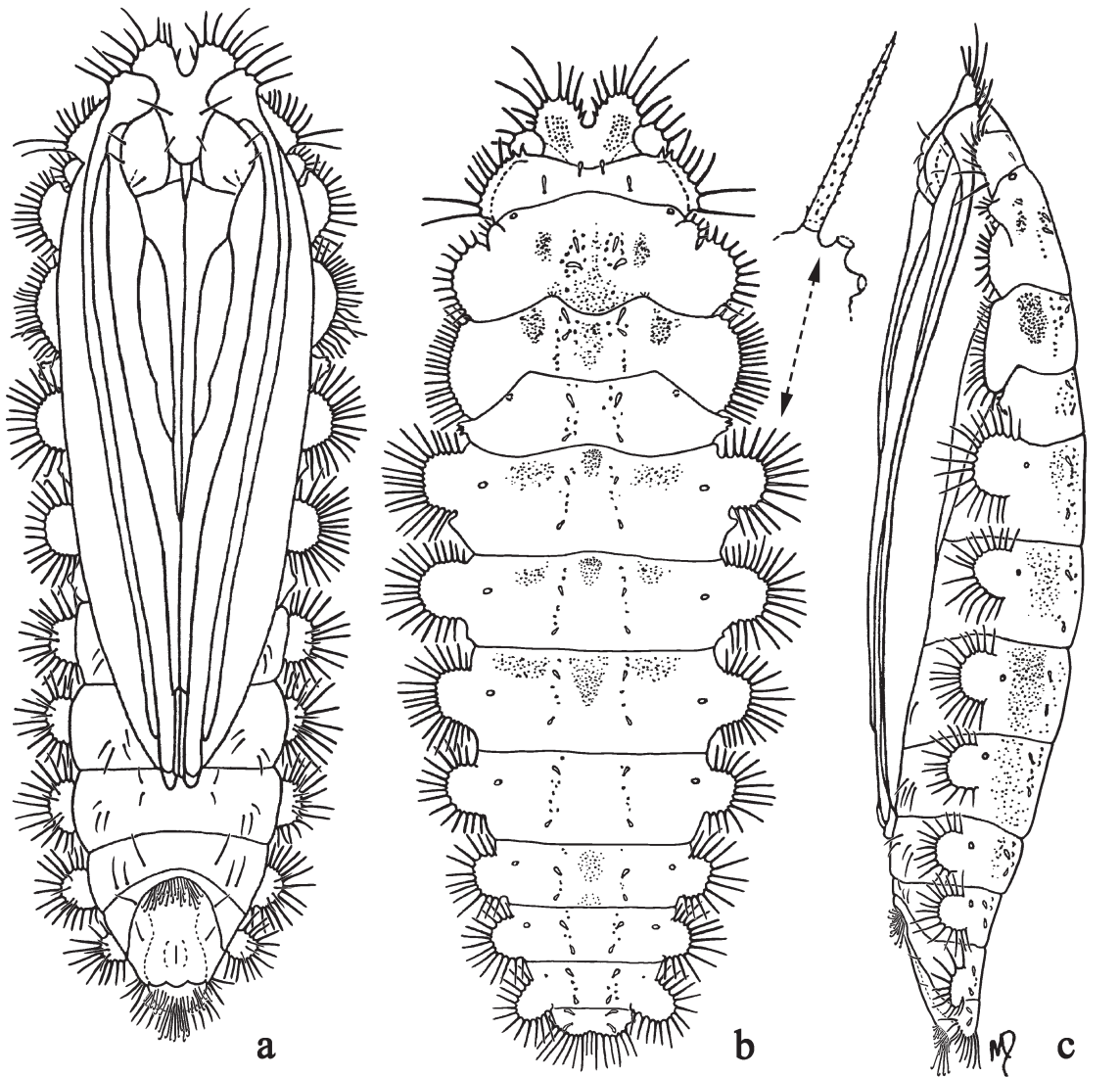


FIG. 3. *Cosmoclostis aglaodesma* pupa: **a**, ventral view; **b**, dorsal view with enlargement showing structural detail of a spiculate lateral seta; **c**, lateral view, scale line = 1.0 mm.

leg, exposed tips just exceeding T2 leg and apex of maxilla.

Abdomen. Segments A1–A8 with D setae generally as on T1–T2 but spaced apart at about 0.3× and 0.6× from anterior margin, seta D2 directed posteriad instead of laterad. Scobinations associated with D setae arranged in longitudinal row. Subdorsal setae apparently absent. Spiracle on A1 non-functional, visible beneath cuticle at anterolateral margin (concealed by hindwing in most pterophorid genera). Spiracles functional on A2–A7, peritremes light, elevated just above surface on A2. Spiracular scar remnant present on A8. Lateral flange verruca present on A2–A8 but absent on A1. Flange verrucae conspicuous, plate or paddle-like, projecting from side of each segment, size gradually decreasing on posterior segments. Fan of up to 20 minute to short setae present along verruca margins. Longest setae just exceeding verruca diameter. Setae minutely spiculate. Segments A4–A8 with 3–5 minute simple setae on ventral surface of verruca. Small tubercle bearing series of about 3 small bumps or scobinations present on A1–A2, bump single on A3. Tubercle apical on A1, posteriad of L verruca on A2–A3. Venter of segments A4–A7

with cluster of 2–3 minute, simple setae in L3 position (absent on A8); setae directed posteriad on A4–A6, anteriad on A7. Segments A5–A6 with 2 minute, simple SV setae, A7 with 1 SV seta; SV setae erect on A5–A6, directed anteriad on A7. Segment A8 with 1 SV seta near A8/A9 margin

Segment A9 with setae D1 and D2 approximate, minute, with few adjacent hyaline scobinations. Posterior margin of A9 terminal in dorsal aspect, with middorsal indentation; 8 short, minutely spiculate setae (each side) forming caudal fringe. Dorsum of segment A10 reduced to small narrow rim, subterminal, beneath overriding A9 posterior margin. Venter of A9/10 fused. One minute SV seta present on A9. Anterior and posterior hooked hamuli present. Anterior hamuli patch dense, longest hamuli laterally placed. Posterior hamuli with central tuft of about 12 longer (0.36 mm) hamuli flanked by dense patch of shorter hamuli.

We have examined early instar larvae of *C. leucomochla* from Kerala State, India. They were

generally very similar to those of *C. aglaodesma* and shared certain characters such as: head seta P1 ventrad of A2, body with prominent L verrucae, elevated D and SD tubercles absent, D and SD setae closely appressed to the body, and prolegs very close together. Larvae of *C. leucomochla* differ from *C. aglaodesma* in having distinguishable primary SD setae, primary D setae surrounded by radiating secondary setae, and in lacking flattened scaliform secondary setae. The pupa of *C. leucomochla* is unknown.

Based on the illustration and description (Fletcher 1932), the larva of *C. pesseuta* is similar to those of *C. aglaodesma* and *C. leucomochla* in having prominent lateral verrucae bearing setae much longer than the D and SD setae. Differences include the presence of apically bifurcate setae and distinctly enlarged, exerted T1 and A8 spiracles in *C. pesseuta*. The pupa of *C. pesseuta* is similar to that of *C. aglaodesma* in having prominent adfrontal protuberances and lateral setae on verrucae. The pupa of *C. pesseuta* differs from *C. aglaodesma* in having longitudinal rows of secondary setae on the wings, dorsum with numerous minute to short secondary setae, and slightly exerted spiracles.

The genus *Cosmoclostis* has been placed in tribe Oxyptilini based on adult wing morphology, with the genera *Trichoptilus* Walsingham and *Megalorhipida* Amsel suggested as close relatives (Arenberger 1998, 2002). Gielis (2000, 2003) includes *Cosmoclostis* in the tribe Pterophorini based on his earlier revisionary study (1993) of the superfamily Pterophoroidea using adult characters. Characters of the larvae and pupae of *Cosmoclostis aglaodesma* support Gielis' tribal placement of the genus. In the larva, some of these characters include the presence of the adfrontal pore (AFa), labrum without a distinct notch and with setae M3 and L3 absent, and a 6-toothed mandible bearing only one seta. The adfrontal pore is present in Pterophorini and Oidaematophorini, as well as Agdistinae, Ochyroticinae, and 2 genera presently included in Platyptiliini. Pore AFa is lost in Oxyptilini, Exelastini, at least 13 genera of Platyptiliini, and Deuterocopinae (Matthews, unpublished data). A distinct labral notch, typically with a secondary median fissure is seen in the Oxyptilini, Exelastini, Platyptiliini, and Agdistinae, whereas a shallow rounded notch or a slight convex distal margin is present in tribes Pterophorini and Oidaematophorini. Six setae are present on the labrum of Pterophoridae except in the Pterophorini and Oidaematophorini where M3 and L3 are lost in the final instar. The pterophorid mandible usually has five teeth. A sixth tooth is present along the ventral margin in *Agdistis*, and in certain genera and species groups of Pterophorini and Oidaematophorini.

A sixth tooth has not been found in Platyptiliini, Exelastini, or Oxyptilini. In the genus *Trichoptilus* (Oxyptilini) the mandible is reduced to 4 or 3 teeth, the smaller, most dorsal, tooth/teeth lost. The distal seta of the mandible is shorter than the proximal seta in most genera but it is extremely short or replaced by a pore in Pterophorini and Oidaematophorini. In *Agdistis*, 1 minute seta is found, with no second seta or pore evident.

Pupal characters supporting the placement of *Cosmoclostis* in tribe Pterophorini, as opposed to Oxyptilini, include the exposed coxa/trochanter of the fore leg, the mid legs not joined at meson, and the lateral setae of the abdomen arising from verrucae. Mosher (1916) first used the key character "Femora of the prothoracic legs exposed" vs. not exposed to distinguish between *Pterophorus* Geoffroy and *Oxyptilus* Zeller, based on *Hellinsia* (*Pterophorus*) *paleaceus* (Zeller) [Oidaematophorini] and *Geina* (*Oxyptilus*) *tenuidactylus* (Fitch) [Oxyptilini]. Examination of pupae containing pharate adults shows that this sclerite covers the coxa (anterior) and trochanter (posterior), and that the femur lies directly beneath the fore leg tibia. Yano (1963) correctly used the term coxa in his key to subfamilies, distinguishing Pterophorinae from Agdistinae and Platyptiliinae by "Coxa of fore leg exposed" vs. "Coxa of fore leg not exposed" respectively. We find this character to be very consistent, the fore leg coxa/trochanter sclerite is present in all examined genera of Oidaematophorini and Pterophorini and absent in the other pterophorid tribes.

The mesothoracic legs, specifically the mid leg tibiae of Ochyroticinae, Oidaematophorini and Pterophorini, (including *Cosmoclostis aglaodesma*), do not meet at any point along the meson. In Platyptiliini, Exelastini, Oxyptilini and Deuterocopinae, the midlegs are joined posterior of the fore leg apex. In some species the mesothoracic legs are joined immediately posterior of the fore leg but are distally parted where the maxilla tip is exposed. In Agdistinae, the maxilla may be thinly exposed along its entire length but the mid leg tips are joined posterior of the maxilla apex.

Pupae with lateral setae on verrucae are found in certain genera and species groups of Oidaematophorini and Pterophorini, such as *Emmelina*, *Pterophorus*, *Oidaematophorus*, some *Adaina*, and some *Hellinsia*. Lateral tubercles may be present in other tribes or subfamilies but the primary setae are morphologically distinguishable from associated secondary setae on these tubercles. In the true verrucae of Oidaematophorini and Pterophorini, most of the secondary setae on the verrucae have distinguishable

“sockets” or are articulated, as are the primary D or SD setae.

While tribal placement of *Cosmoclostis* in Pterophorini can be supported, additional species need to be examined, to ascertain larval and pupal characters entirely unique to the genus *Cosmoclostis*. Continuing studies of larval and pupal structure will provide additional insight into the relationships between and within tribes and subfamilies of this group.

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ADDITIONAL RECORDS OF *CYCLARGUS AMMON* (LYCAENIDAE: LYCAENINAE) IN THE FLORIDA KEYS

Additional key words: *Caesalpinia*, colonization, Fabaceae, *Cyclargus thomasi bethunebakeri*, oviposition

Cyclargus ammon Lucas (Lycaenidae) is a small blue of the Bahamas, Cuba, and the Isle of Pines (Smith *et al.* 1994). Although historically reported from Florida, Calhoun *et al.* (2000) concluded with reasonable certainty that all such records actually represented those of the superficially similar *Cyclargus thomasi* Clench (Lycaenidae). In recent years, scattered anecdotal reports of *C. ammon* from south Florida continued to circulate but were not verified until 1997 and 1998 when several adults were photographed on Big Pine Key (Calhoun *et al.* 2000; Krizek 1998, 1999; Glassberg 1999). Since its initial discovery, regular additional sightings have persisted along with evidence of regular breeding colonies, indicating that the species has become firmly established. *C. ammon* has continued to increase in abundance and can now be found in many suitable habitat areas across Big Pine Key, but it has not

been documented off the large island. We have found it to be locally common near patches of pineland *Acacia pinetorum* F. J. Herm. (Fabaceae) in open pine rockland habitat within the boundaries of Key Deer National Wildlife Refuge as well as along disturbed roadside areas on nearby private lands harboring sweet acacia, *Acacia farnesiana* (L.) Willd. (Fabaceae).

In June 2002, the U. S. Fish and Wildlife Service contracted the McGuire Center for Lepidoptera and Biodiversity to conduct a comprehensive one-year status monitoring survey of the now state-endangered Miami blue, *Cyclargus thomasi bethunebakeri* (Comstock & Huntington) (Lycaenidae) throughout its historic range and to gather detailed biological and ecological information on the remaining Bahia Honda State Park population. Concurrently, surveys were undertaken for the presence of *C. ammon* adults or active colonies on