

A New Species of *Sierola* Parasitic on Moth Larvae in Western Australia (Hymenoptera: Bethyridae)

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ABSTRACT. *Sierola ellingtoni* n. sp. is described from specimens recovered from *Gossypium hirsutum* Linnaeus infested with rough bollworm [*Earias huegliana* Gaede] and pink bollworm [*Pectinophora gossypiella* (Saunders)]. The new species is endemic to Western Australia and is under laboratory rearing in California for biocontrol of pink bollworm. *Sierola ellingtoni* is compared with other species of *Sierola* known from Australia and Hawai'i.

The pink bollworm (PBW), *Pectinophora gossypiella* (Saunders), is a gelechiid moth endemic to Western Australia and adventive to major cotton growing regions of the world (Gordh *et al.* in prep.). Globally, pink bollworm is one of the most serious pests of domesticated cotton. Research directed by Joe Ellington (New Mexico State University) has emphasized IPM against pink bollworm in the southwestern USA and Egypt. In conjunction with Ellington's project, exploration by James Altman in Western Australia for natural enemies of PBW has revealed a new species of *Sierola* which attacks PBW. This parasitic wasp has been exported to the University of California at Riverside where, under laboratory conditions, the bethyrid readily attacks PBW. This paper describes that species and makes a name available in anticipation of field release and biological studies.

SIEROLA Cameron, 1881

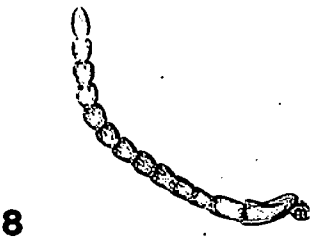
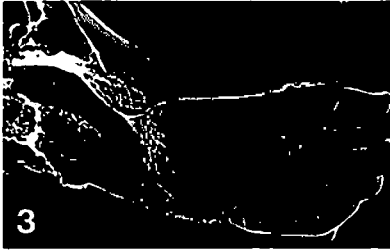
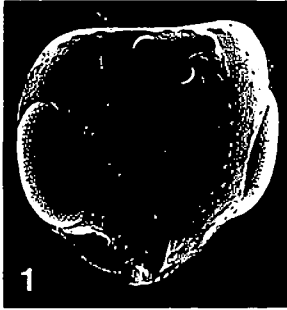
Type-species: *Sierola testaceipes* Cameron. Monotypic.

Sierola does not contain an extensive list of synonyms. *Sierola* species are typically black, shining and 1.5–3.5 mm long. The head is prognathous and the clypeus displays a median longitudinal carina (Figs. 1, 2, 10, 11); Hawaiian species sometimes display other clypeal modifications. *Sierola* antennae are relatively short, with 13 segments in both sexes (Figs. 8, 17). The forewing (Fig. 9) contains 5 closed cells including: costal cell, marginal cell, median cell, submedian cell and areolet. The mesonotum displays parapsidal sutures but notauli are absent.

Sierola ellingtoni, n. sp. (Figs. 1–18)

Female. 2.45 mm long (Holotype). Body uniformly black. Antenna yellow with apical and penultimate segments dusky. Mandible black with teeth reddish. Coxae dusky, nearly black; trochanters yellow; femora predominantly dusky; tibiae, tarsomeres yellow; tarsal claws black. Wings hyaline; forewing veins slightly dusky; prostigma and stigma darker than venation and bisected by hyaline stripe.

Head in dorsal (frontal) aspect (Fig. 1) as long and wide, surface with uniformly fine, reticulate microsculpture and moderate vestiture of shallow, setigerous punctations; setae along vertexal margin procurved, longer than other setae on head; vertexal margin rounded, not acute or carinate. Ocellar triangle obtuse with a broad, shallow depression anterior of median ocellus; lateral ocellus less than 1 diameter from vertex margin. Median, longitudinal carina acute on frontoclypeus. Head in lateral aspect (Fig. 2) about 1.7 x wider than tall. Clypeal carina sharply defined, broadly arched. Scrobal impression extending to margin of compound eye, dorsal margin broadly rounded; impression with a minute pore (? Anterior Tentorial Pit; Fig. 2). Compound eye with sparse vestiture of minute setae. Rounded vertex-margin continuing weakly toward posteroventral margin of compound eye and flanked by long, pale, procurved setae. Mandibles symmetrical, each with 4 teeth (Figs. 3, 4), uppermost tooth broadly rounded, remaining teeth more conical, ventral tooth longest; lateral surface of mandible coarsely sculptured (Fig. 4); sculpture on medial surface less apparent (Fig. 3).



Antenna curved to be confluent with lateral margin of head, slightly longer than length of head; multiporous plate sensilla (rhinaria, tyloids) on flagellar segments 2–11 (Fig. 8). Head in ventral aspect with surface uniformly reticulate and moderate vestiture of setae; postgenal bridge complete with median longitudinal carina acute near margin of mouth, becoming evanescent posteriad. Maxillary palpus with 5 segments; labial palpus with 3 segments.

Mesosoma in dorsal aspect (Fig. 5) rather broad; pronotum slightly longer than mesoscutum, with abundant long, white setae; surface non-punctate with minute, elongate sculpture; posterior margin sinuate (Fig. 7). Mesoscutum with moderate vestiture of long, white setae along posterior half and minute, reticulate sculpture; parapsidal sutures narrow, well defined, complete (Figs. 5, 7). Scutellum (Fig. 6) with a few white setae, sculpture nearly evanescent; scutellar pits minute, not connected by a transverse sulcus, seemingly connected by scutoscutellar suture; axillary region with large, circular fovea proximad and less apparent, elongate, slit-like fovea distad (Fig. 6). Metanotum with setae, sculpture in meson, pits in lateron (Fig. 6).

Propodeum (Figs. 5, 7) lacking anteromedian triangular elevation but area weakly polished; dorsal surface reticulate but lacking median longitudinal carina; transverse carina evanescent, incomplete, marking junction of dorsal and posterior propodeal surfaces; dorsal and lateral surfaces separated by well-defined carina, lateral surface moderately reticulate (Fig. 7); posterior surface transversely reticulate. Propodeal spiracle forming an obliquely oriented slit along anterolateral margin of dorsal surface (Figs. 5, 6).

Mesopleuron finely reticulate, moderately setose, robust and bearing a semicircular upper fovea immediately ventrad of tegula and narrow sulcus projecting posteriad (Fig. 7). Forewing flat or nearly planar, extending to apex of metasoma; prostigma and stigma separated by hyaline area (Fig. 9); costal cell very narrow; submarginal cell evanescent.

Petiole coarsely sculptured. Metasomal terga smooth, polished; apical 4 terga with sparse vestiture of pale setae; apical stema with similar vestiture of setae. Stema 1–4 smooth, polished with transverse row of pale, long setae along posterior margin of each sternum; apical sternum with moderate vestiture of pale, long setae.

Male. 2.2 mm long (allotype). Similar to female in coloration and habitus. Differing in following details: Antenna yellow with apical segment dusky. Mandible predominantly yellowish, condyle and base black, teeth reddish. Coxae yellowish, decidedly more pale than female coxae; fore femur yellowish with anterior margin dusky; middle and hind femora dusky; remaining leg segments yellow.

Head in dorsal aspect (Fig. 10) with ocelli slightly larger than female ocelli. Head in lateral aspect (Fig. 11) with sculpture pattern slightly more bold along posteroventral surface. Antenna (Fig. 17) as female in relative length of segments, position of multiporous plate sensilla. Mandible sculpture and chaetotactic pattern as shown (Figs. 12, 13).

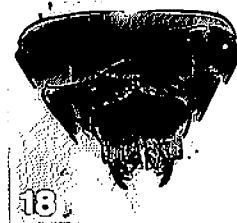
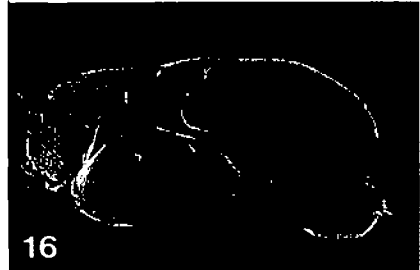
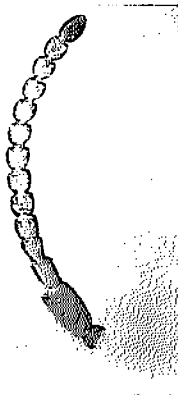
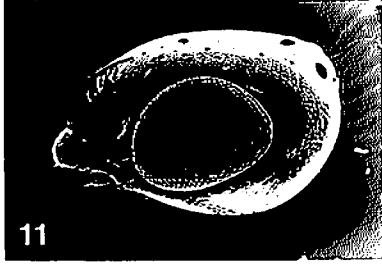
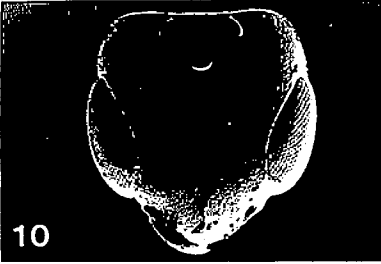
Propodeal spiracle aperture larger than female aperture (Fig. 15). Mesopleuron upper fovea less semicircular shaped with broader sulcus projecting to posterior margin (Fig. 16). Subgenital sclerite with apical margin transverse; paramere with lateral surface sclerotized, setose and medial surface membranous; cuspis with numerous sensoria on apicolateral surface; digitus with medial surface sclerotized and numerous long setae (Fig. 18).

VARIATION: Females display some variation in the intensity of infuscation on legs and antenna, and sculpture pattern on the head. Female body-length ranges from 2.40–2.80 mm; male body length ranges from 2.12–2.25 mm. Males also vary somewhat in coloration on the antenna and legs, and the sculpture pattern on the head.

MATERIAL EXAMINED: Described from lab-reared specimens at UC Riverside. The type-series was propagated from pupae collected near Broome, Western Australia on 3 June 1993 "Beagle Bay" and 6 June 1993 "Nita Downs" (WA—homestead 19°08'S; 121°42'E). Many of the specimens were received from the Univ. Calif. Riverside in damaged condition, presumably in transit through the mail.

HOLOTYPE: Intact, card-mounted female propagated from pupae taken at Nita

Figs. 1–9. *Sierola ellingtoni*, females. 1, head, frontal aspect. 2, head, lateral aspect. 3, right mandible, medial aspect. 4, left mandible, lateral aspect. 5, mesosoma, dorsal aspect. 6, scutellum. 7, mesosoma, lateral aspect. 8, antenna. 9, forewing.



Downs on 6 June 1993 by James Altman. The presumed host was *Pectinophora gossypiella* or *Earias huegeliana* Gaede on *Gossypium hirsutum* Linnaeus.

ALLOTYPE: Intact, card-mounted male collected at the same time and place as the holotype.

PARATYPES: Ten females and 8 males, all card-mounted. Numerous appendages from damaged specimens placed on microscope slides and deposited in University of Queensland Insect Collection (UQIC).

Holotype and allotype deposited in the Queensland Museum. One female and 1 male paratype each in the UC Riverside Entomological Collection, and Australian National Insect Collection, Canberra. Remainder of type-series deposited in UQIC.

Etymology. The species name is a patronymic for Joe Ellington in recognition of his sustained and dedicated efforts in the control of cotton pests.

Discussion. This bethylid was collected from plant material infested with *P. gossypiella* and *Earias huegeliana* (identified as *E. huegeli* Rogenhofer). The field host was not determined, but I suspect that the host was not *P. gossypiella*. In the laboratory at Univ. Calif. Riverside, *S. ellingtoni* readily attacks PBW and has been propagated through many generations on this host (E.B. White, pers. comm.) My experience has been that many species of Bethylinae will attack unusual host species in the laboratory when provided larval hosts which are exposed, in confined space and under conditions of no-choice.

Three species of *Sierola* have previously been reported from Australia. *Sierola antipode* Ashmead (1900) was described from material taken at Sydney, New South Wales. Females of *S. antipode* are considerably smaller (1.5–1.8 mm), the coxae and femora are dark brownish-piceous and the head twice as long as wide; *S. antipode* is described as lacking parapsidal "furrows" which, if correct, would also separate the species.

Sierola leeuwinensis Turner (1915) was described based on a female taken at Yallingup, S.W. Australia during December. Females of *S. leeuwinensis* are considerably larger (3 mm) than *S. ellingtoni*. The head of *S. leeuwinensis* is very large, flat, twice as long as broad and the propodeum displays a weakly developed median longitudinal carina.

Sierola websteri Ashmead (1900) was described from a female taken somewhere in New South Wales. The species remains unknown, aside from the comments of Kieffer (1908, 1914). Apparently the antennae of *S. websteri* are black, except segments 2–5.

Fullaway (1920) provides a key to most of the species of *Sierola* known from Hawai'i. The new species keys to *S. striate* Fullaway, a species known only from the holotype taken on O'ahu during 1912. *Sierola ellingtoni* differs from *S. striate* in coloration of the legs (not brown), head length (not 1.5 x longer than wide) and scutellum sculpture (not smooth).

Sierola one of the largest genera of bethylids with more than 200 nominal species. Notably, nearly all of the species are found in the Hawaiian Islands or other oceanic islands (Gordh & Moczar 1990). I speculate that *Sierola* probably originated in Asia, invaded the Hawaiian Islands within the past few million years and radiated rapidly. A few species have been described from the Marquesas (Fullaway 1920), California (Evans 1978), China (Fullaway 1920), and Australia (Ashmead 1900, Turner 1915). Undescribed species of *Sierola* have been reported on Norfolk and Lord Howe Islands (Dodd 1924,

Figs. 10–18. *Sierola ellingtoni*, males. 10, head, frontal aspect. 11, head, lateral aspect. 12, left mandible, ventromedial aspect. 13, left mandible, ventral aspect. 14, mesosoma, dorsal aspect. 15, scutellum. 16, mesosoma, lateral aspect. 17, antenna. 18, genitalia.

Hawkins 1942). Personal collecting and study of Australian collections leads me to conclude that *Sierola* is moderately common along coastal Australia, a conclusion consistent with the collection of *S. ellingtoni* near Broome.

The host associations and ecology of *Sierola* are poorly understood, despite the large number of species known from the Hawaiian Islands and the profusion of entomologists working in the Islands. Nearly all host records suggest that *Sierola* species attack larval Lepidoptera (Gordh & Moczar 1990; Tachikawa 1985). One account of *Sierola* attacking cecidomyiid fly larvae (Ashmead 1901) must be verified. Brief biological accounts have been provided by Swezey (1915) and Bridwell (1919). Williams (1931) observed that most *Sierola* species are forest inhabitants. This apparent habitat preference in Hawaii suggests that species of *Sierola* may display poor potential for control of field-crop pests such as Lepidoptera in cotton. However, the habitat and climate neighboring Broome, W.A. is substantially different from Hawai'i. Thus, *S. ellingtoni* may show some promise as a biocontrol agent of PBW in arid environments.

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LITERATURE CITED

- Ashmead, W.H. 1900. Notes on some New Zealand and Australian parasitic Hymenoptera, with descriptions of new genera and new species. *Proc. Linn. Soc. N.S.W.* 1900 (3): 327-60.
- Ashmead, W.H. 1901. Hymenoptera Parasitica. *Fauna Hawaiiensis* 1: 227-364.
- Bridwell, J.C. 1919. Some notes on Hawaiian and other Bethyilidae (Hymenoptera) with descriptions of new species. *Proc. Hawaii. Entomol. Soc.* 4 (1): 21-38.
- Dodd, A.P. 1924. Chalcidoidea and Proctotrupeoidea from Lord Howe and Norfolk Islands, with descriptions of new genera and species. *Trans. R. Soc. S. Aust.* 48: 162-86.
- Evans, H.E. 1978. The Bethyilidae of America North of Mexico. *Mem. Am. Entomol. Inst.* 27, 1-332, 159 figs.
- Fullaway, D.T. 1920. New species of *Sierola* with explanatory notes. *B.P. Bishop Mus. Polynes. Ethnogr. Nat. Hist. Occas. Pap.* 7 (7): 57-159, 1 pl.
- Gordh, G. & L. Moczar 1990. A catalog of the world Bethyilidae (Hymenoptera: Aculeata). *Mem. Am. Entomol. Inst.* 46, 364 p.
- Hawkins, C.N. 1942. The insects of Norfolk Island, including a preliminary report on a recent collection. *Ann. Mag. Nat. Hist.* (11) 9: 865-902.
- Kleffer, J.J. 1908. Bethyilidae. *Genera Insectorum* 76: 1-50, 3 pls.
- Kleffer, J.J. 1914. Bethyilinae. *Das Tierreich* 41: 228-595, figs. 112-205. R. Friedlander und Sohn, Berlin.
- Swezey, O.H. 1915. A preliminary list of the hymenopterous parasites of Lepidoptera in Hawaii. *Proc. Hawaii. Entomol. Soc.* 3 (2): 99-107.
- Tachikawa, T. 1985. On the bethylid wasps II. *For. Pests* 34 (9): 161-69, figs.
- Turner, R.E. 1915. Descriptions of new fossorial wasps from Australia. *Proc. Zool. Soc. Lond.* 1915: 41-69, 1 pl.
- Williams, F.X. 1931. *Handbook of the insects and other invertebrates of Hawaiian sugarcane fields*. Hawaiian Sugar Planters' Association Experiment Station, Honolulu. 395 p.