

# Scientific Note: Discovery of apparent wing coupling structures in *Calpodus ethlius* (Stoll, 1782) (Hesperiidae: Hesperinae: Calpodini) from Jamaica, West Indies

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**Abstract:** Photographs from Jamaica of *Calpodus ethlius* (Stoll, 1782), at rest on a leaf, were forwarded to the first author, who noticed a pair of dark, ovate structures extended laterally toward the anterior part of the dorsal hindwing. During microscopic examination of these structures, which we term ‘black bars’ and which are located at the base of the dorsal hindwing in pinned specimens, we observed features that appeared to be similar to a frenulum. Examination of the ventral forewing determined that there was also a retinaculum-like structure near the base of that wing. These structures are uniquely placed on each wing when compared to the location of the frenulum and retinaculum found in other Lepidoptera.

**Key Words:** black bar, bristles, forewing vein A3, ovate structure, pad and brush scales, wing coupling.

*Calpodus ethlius* (Stoll, 1782) occurs from the southeastern United States (with strays especially to the northeast), through Mexico and Central America to as far south as northern Argentina (Scudder, 1889; Warren *et al.*, 2017) and northern Chile, and in the Caribbean and the Galápagos Islands (Ecuador) (Onore & Meilke, 1988). The types of *Calpodus ethlius* are missing, but Scudder (1872) designated Suriname as the type locality. *Calpodus* is a monotypic genus in the subfamily Hesperinae, currently placed in the tribe Calpodini A. Clark, 1948.

This insect is well known, the larval stages being frequent pests of ornamental Canna lilies and cultivated Arrowroot in the Caribbean (Cockerell, 1892; Jones, 1951; Alam, 1987), and related Cannaceae and Marantaceae, as well as species of *Heliconia* (Strelitziaceae). The larvae can easily be reared in captivity and are frequently the subjects of physiological experiments (Locke, 1960), and detailed dissections in educational facilities (Ruppert *et al.*, 2004). Yet, in the 238 years since *Calpodus* was first described and extensively studied in the wild, as caged adults, or in the laboratory, the presence of an apparent wing coupling device in both the male and female appear to have gone unnoticed.

In Jamaica, *Calpodus* are found at elevations from sea-level to at least 856 m and are most active between mid- to late morning, exhibiting direct, rapid flight. The female is also crepuscular, ovipositing from late afternoon until dusk. Whether landing on flowers to feed or settling on food plant leaves to oviposit, both sexes spend a brief moment hovering before landing on the selected plant (Turner & Turland, 2017). When nectaring (Fig. 1) and when at rest (Fig. 2) the preferred posture is with wings firmly closed above the stout body, but not



Fig. 1. *Calpodus ethlius*; nectaring posture.

infrequently while perched the wings will be partially opened with the hindwings held close to the forewings (Fig. 3). Only rarely while the insect is sunning are the wings aligned almost horizontally.

In December 2019 the first author received a photograph of a female *Calpodus ethlius* perched, with wings partially open, taken by the second author in Mandeville, Jamaica. The insect was photographed in scrub on a golf course at 18.034° N, 77.518° W, at an altitude of 619 m, on 1 December 2019 between 16:20 and 16:25, about an hour before sunset which occurred at 17:34. The setting sun was approximately 30° above the horizon; the air temperature was 26°C with 5/8<sup>th</sup> cloud cover and no wind, with the insect opening its wings toward the sun.



Fig. 2. *Calpododes ethlius*; preferred resting posture.



Fig. 3. *Calpododes ethlius*; alternate resting posture.

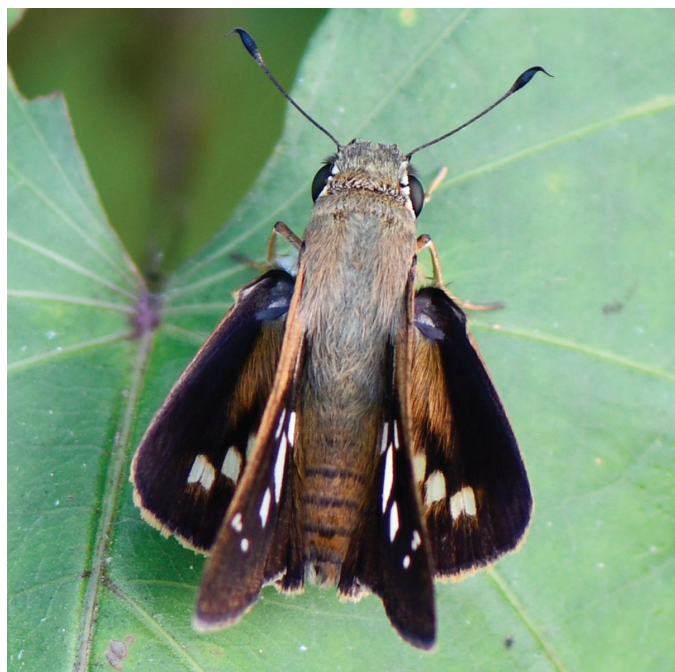


Fig. 4. *Calpododes ethlius*; ovate structures at base of each wing (© Vaughan A. Turland).



Fig. 5. Magnified view of ovate structures (© Vaughan A. Turland).

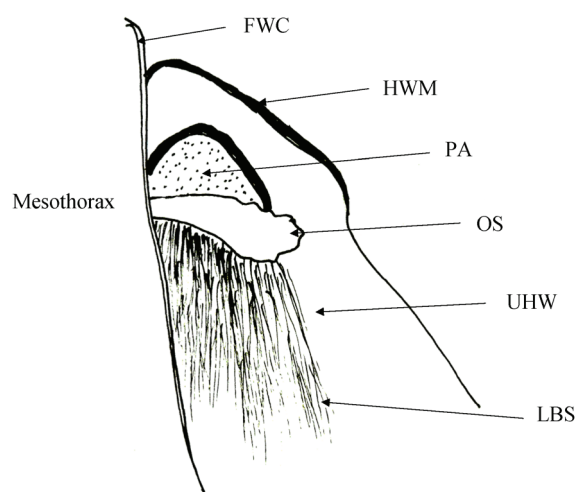


Fig. 6. Details of ovate structures, right side, as viewed in Figure 5. FWC: Forewing costa; HWM: Hindwing margin; PA: Pale area; OS: Ovate structure; UHW: Upper hindwing; LBS: Long brown setae.

No rain fell that day. The photographs were taken using a Nikon D850 camera with a Micro Nikkor AF-S 105 mm lens, at F/4, 1/60 sec. The specimen was not collected.

It was immediately apparent from examination of photographs that a pair of dark, ovate structures extended laterally on the upper face of the hindwing near their respective bases on each side of the thorax (Figs. 4, 5). The base of each ovate structure is not visible in the photographs but appears to be close to the area where the hindwing attaches to the mesothorax (Fig. 6). Examination of the base of the dorsal hindwing of a pinned specimen using a stereomicroscope at 20X magnification revealed that the structure visible in living *C. ethlius* is a short, black, stemmed, structure with a scalloped margin, referred to here as a ‘black bar’. Each black bar is fused to the wing, as shown in the photograph of the right hindwing of *Calpododes ethlius* from Texas provided by Bryan Reynolds (Fig. 7). For detailed examination of the wing veins and black bar, wings were removed from pinned specimens and floated in a dilute solution of sodium hydroxide for 72 hours. Examination of the prepared dorsal hindwing at 40X magnification revealed that the black bar consists of a narrower stemmed base expanding



Fig. 7. *Calpododes ethlius*; position of black bar on hindwing (© Bryan E. Reynolds).

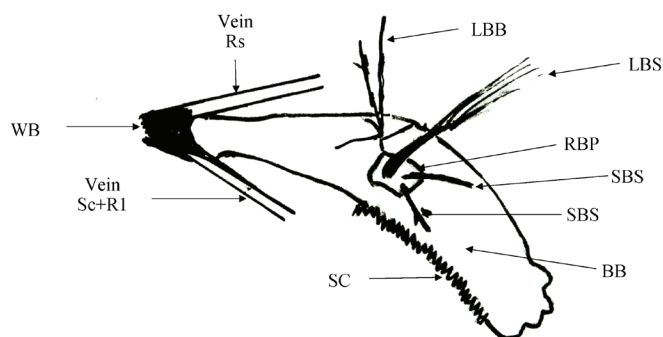


Fig. 8. Details of black bar on right dorsal hindwing. WB: Wing base; SC: Scales; BB: Black bar; SBS: Short black spines; RBP: Rhomboidal base plate; LBS: Long black spines, with additional cluster of long twisted brown scales; LBB: Long brown branching spines.

into a slightly raised elongated club-shaped structure with an irregular distal margin. The base of black bar begins at the point where veins Sc+R1 and Rs join at the base of the hindwing. At the point where the stem of the black bar expands is a flat, but darker rhomboidal-shaped plate and from this emanate three black bristles; two shorter and more distal, and one much longer which arises basally on this plate. This longer bristle is also accompanied by a cluster of longer, stiff, twisted, pale brown scales. In addition, there are long, branched brown scales originating near the base of the longest bristle, whose function is uncertain. This compound structure illustrated in Fig. 8 is present in both sexes.

Examination of the base of the ventral forewing reveals the presence of vein 3A, as also found on the forewing in some other hesperiid genera including species of *Polygonus* Hübner, [1825], *Achylodes* Hübner, [1819], *Atalopedes* Scudder, 1872, *Asbolis* Mabille, 1904, and *Ephyriades* Hübner, [1819] (Alayo & Hernández, 1981). At the end of this vein in *C. ethlius* is a long, somewhat rectangular area of short, lighter brown scales between the bases of veins 2A and 3A. A pad with short scales, possibly hooks, is present between the end of vein 3A and the

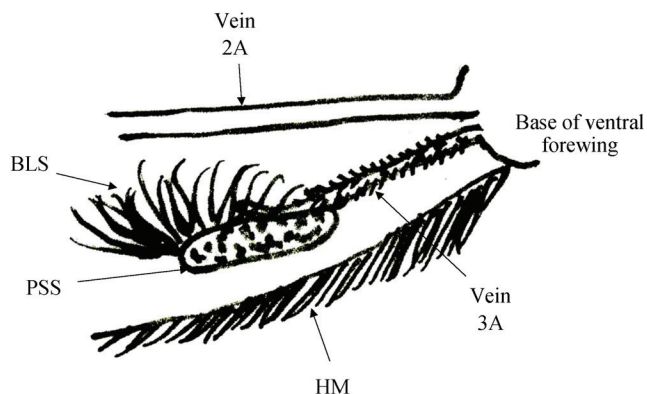


Fig. 9. Locations of pad and brush at end of vein 3A on ventral forewing. BLS: Brush with long scales; PSS: Pad with short scales; HM: Hind margin.

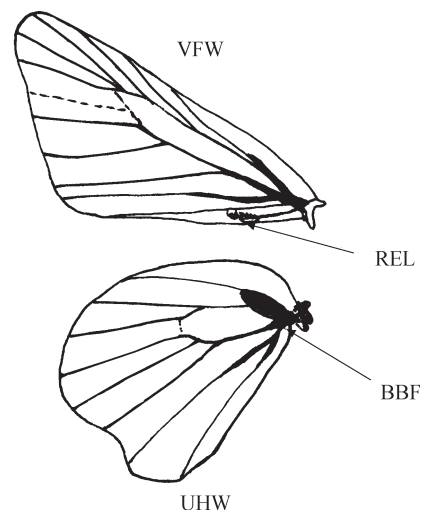


Fig. 10. Location of apparent wing coupling structures in *C. ethlius*. VFW: Right ventral forewing; REL: Retinaculum-like structure proximate to vein 3A; UHW: Upper hindwing; BBF: Black bar with frenulum-like structure.

wing margin. At the end of vein 3A there is a brush of longer curved setae (Fig. 9). The location of these novel structures on both hindwing and forewing are indicated in Figure 10.

Together, these bristles and scales look very much like a frenulum (Braun, 1924), as illustrated in Fig. 8, a frenulum being a stiff bristle or group of bristles that extend from the hindwing of some moths. The frenulum then interlocks with the retinaculum near the hind margin of the forewing. The function of these structures is to couple the forewings and hindwings together during flight (Braun, 1924, Gullan & Cranston, 2004). The wings of nearly all butterflies, however, are without a frenulum and retinaculum. The only previously known exception among Papilionoidea is found in the genus *Euschemon* Doubleday, 1846, which contains a single species *Euschemon rafflesia* (Macleay, 1826) (Euschemoniinae), the Regent Skipper, endemic to eastern Australia. (Fig. 11). In this species, however, it is only the male which possesses the frenulum and retinaculum (Braby, 2000). Of the four basic types of insect wing coupling, the arrangement observed in *C. ethlius* appears somewhat similar to the female frenate subtype (Chapman, 1998), but with the frenulum-like structure



**Fig. 11.** *Euschemon rafflesia* Macleay, Queensland, Australia (© Ross Kendall).

positioned not at the humeral lobe but close to the wing-base.

Forewings and hindwings of other Jamaican Hesperinae possessing a superficially similar black bar at the base of the dorsal hindwing were also examined under 40X magnification for similar structures. Investigation of *Panoquina lucas* (Fabricius, 1793) revealed that the black bar at the base of the dorsal hindwing is delta-shaped in the female and club-shaped in the male, with long posteriorly pointing golden-brown hair-like scales across the wing originating just distad of the bar, but no evidence was found of any additional structures like those described for *C. ethlius*. Other species inspected include *Panoquina panoquinoides* (Skinner, 1891), *Panoquina ocola* (Edwards, 1863), *Hylephila phyleus* (Drury, 1773), *Wallengrenia vesuria* (Plötz, 1882), and *Choranthus lilliae* Bell, 1931, all possessing black bars but without the novel structures observed in *C. ethlius*.

We suspect that the *Calpododes* photographed (Fig. 4) may have recently emerged and had made its maiden flight to a sunlit leaf and that the paler color of the black bar photographed may either reflect lighting conditions at the time, or possibly not enough time had elapsed since eclosion for the black bars to have fully darkened. How the bristles and accompanying elongated scales (Fig. 8) develop is presently unknown. Observations are needed to determine the origination and sequential development

of the black bars at the base of the dorsal hindwing not only in *Calpododes*, but in other species of Hesperidae, especially those currently classified in the tribe Calpodini.

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