A new species of *Dalla* Mabille, 1904, from Morelos, Mexico (Lepidoptera: Hesperiidae: Heteropterinae)

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Abstract: *Dalla amatlanensis* Warren, Gott & Legal, **sp. nov.**, is described and illustrated from seven male specimens from the State of Morelos, Mexico. Its apparent larval foodplant is *Chusquea circinata* Soderstrom & Calderón, based on the observation of an ovipositing female. Based on wing phenotype and male genital morphology, this new species appears to be closely related to *Dalla steinhauseri* Freeman, 1991, *D. bubobon* (Dyar, 1921), *D. freemani* Warren, 1997, and *D. austini* Warren & De la Maza, 2011, species endemic to Mexico and Guatemala.

Key words: Bambuseae, biodiversity, butterfly, *Chusquea circinata*, skipper

Resumen: Se describe *Dalla amatlanensis* Warren, Gott & Legal, **sp. nov.**, a partir de siete machos del Estado de Morelos, México. Aparentemente, su planta huésped es *Chusquea circinata* Soderstrom & Calderón, con la observación de una hembra ovipositando. Basado en el fenotipo de las alas y de su morfología genital, esta especie nueva parece más cercana a *Dalla steinhauseri* Freeman, 1991, *D. bubobon* (Dyar, 1921), *D. freemani* Warren, 1997, y *D. austini* Warren & De la Maza, 2011, especies endémicas a México y Guatemala.

Palabras clave: Bambuseae, biodiversidad, *Chusquea circinata*, hespérido, mariposa.

The butterfly fauna of the Mexican State of Morelos is one of the best known in the entire country, given its proximity to Mexico City, and the large number of faunistic studies that have been conducted there (Díaz-Francés, 1975; De la Maza, 1975; De la Maza, 1976; Medellín, 1985; De la Maza *et al.*, 1995a,b; Lara, 1999; Valencia, 1999; Vences, 2004; Luna-Reyes, 2007; Luna-Reyes *et al.*, 2008, 2010, 2012; Legal *et al.*, 2017; Rosas-Echeverría *et al.*, 2019). Thus, it was completely unexpected when the last author (L. Legal) happened upon an ovipositing female (Fig. 4) of what appeared to be an undescribed species of *Dalla* Mabille, 1904, on 31 July, 2015, just east of the town of Amatlán de Quetzalcóatl, in north-central Morelos. Legal and O. Dorado subsequently returned to the site on 7 August, 2015, and secured seven male specimens of this *Dalla*, which remain the only specimens known to us.

The skipper genus *Dalla* is extremely speciose, with about 63 species currently recognized (Mielke, 2005; Warren *et al.*, 2017; Cong *et al.*, 2019). While the genus is most diverse in the Andes mountains, there are several additional species endemic to Central America and Mexico, most of which have highly restricted geographical distributions, mainly between about 1500 m and 3000 m elevation in cloud forest habitats (Warren & De la Maza, 2011). In recent decades, new *Dalla* species have been described from Mexico, from Oaxaca (Freeman, 1991) and Chiapas (Warren & De la Maza, 2011), as well as from Guatemala (Warren, 1997), and new distributional information on other Mexican species has become available (Warren & González-Cota, 1996). After consulting all relevant literature on *Dalla*, as well as type specimens, it was clear that the *Dalla* from Amatlán de Quetzalcóatl represents a new species, described below.

MATERIALS AND METHODS

Genitalia were prepared for examination by soaking the removed abdomens in 10% potassium hydroxide solution for 12 hours before being dissected and illustrated under a Leica MZ 16 stereomicroscope with a camera lucida attachment. Dissections were soaked in a weak acetic acid solution for 10 minutes to neutralize remaining potassium hydroxide, and genitalia were placed in glycerin vials for permanent storage. Images and plates were modified using GNU Image Manipulation Program (GIMP) 2.10.14 (Kimball *et al.*, 2019).

Figure 1. Adult of *Dalla amatlanensis* **sp. nov.** Scale bar 5 mm. A) Dorsal and B) Ventral view of *D. amatlanensis* holotype, complete data in text.

RESULTS AND DISCUSSION

Dalla amatlanensis Warren, Gott & Legal, **sp. nov.** (Figs. 1-4)

Description. MALE (Figs. 1-3): forewing length 10.4-10.7 mm (n = 7); forewing apex fairly pointed, termen evenly convex though nearly straight between CuA_2 and 1A+2A, no stigma or brand; hindwing slightly produced at apex, termen convex to CuA_1, then concave to tornus at 1A+2A, inner margin straight. Dorsal forewing brown, scattered pale golden setiform scales sparsely distributed over most of wing (best seen in Fig. 3), densest on basal half of wing, especially along costa, inner margin and CuA_2-1A+2A. Opaque pale ochreous macules as follows: subapical in R_3-R_4 to R_5-M_1, quadrate, completely overlapping, forming a nearly straight line perpendicular to costa; postmedial in mid-M_3-CuA_1, larger, roughly quadrate; mid-CuA_1-CuA_2 (slightly extending into CuA_2-2A), larger, roughly quadrate; basal part of CuA_1-CuA_2 (slightly extending into CuA_2-2A), smaller, nearly triangular; finally, roughly quadrate spanning width of discal cell at proximal section of distal fourth of cell, situated between two macules in CuA_1-CuA_2, intermediate in size between them. Wing fringe brown with scattered grayish scales, concentrated near tornus. Dorsal hindwing same ground color as forewing; prominent overscaling of mixed dark brown and semi-irridescent olive setiform scales over basal 2/3 of wing, most prominent in basal half of discal cell and along inner margin to tornus (best seen in Fig. 3). Pale ochreous, semi-opaque macules as follows: M_1-M_3, large, semi-rectangular, continuous across M_2 with longest part in M_1-M_2, occupying distal end of discal cell and basal half of cells M_1 and M_2; CuA_1-CuA_2 (slightly extending into CuA_2-2A), centered just past mid-cell, smaller, roughly two thirds size of macule in M_1-M_3, roughly oval; finally, smaller rounded macule in discal cell just proximad of midpoint. Wing fringe with mixed brown and grayish scales; grayish scales concentrated near tornus. Ventral forewing with macules repeated from dorsal surface, each outlined with a narrow rim of golden scales. Somewhat paler scales present below macules in CuA_2-1A+2A; ground color dark brown, with dense, golden-brown overscaling concentrated along costa (caudad to M_1) and apex (to about M_3), and sparsely distributed in adjacent cells; base of discal cell and cells CuA_2 and 1A+2A shiny grayish; narrow line along termen slightly darker than ground color; wing fringe brown. Ventral hindwing with semi-opaque macules repeated from dorsal surface, though macule in CuA_1-CuA_2 broadened to extend across all of CuA_2-2A; additional pale ochreous (not semi-opaque) macule in Sc+R_1-Rs, large, roughly oval, borders somewhat blurred; holotype with rounded, small, pale ochreous macules in Rs-M_1, M_1-M_2, M_2-M_3, M_3-CuA_1, CuA_1-CuA_2 and CuA_2-2A (increasing in size from M_3-CuA_1); these macules are variably developed on paratypes, tending towards absent on some (as on live male in Fig. 3B); narrow line along termen slightly darker than ground color; wing fringe brown, paler brown distad. Dorsal head black with scattered dark brown, tan, and olive setiform scales, paler below eyes; labial palpus with mix of brown and pale golden setiform scales dorsally, paler laterally and ventrally, inner surface dark brown; third segment dark brown, porrect, extending slightly beyond distal scales of second segment. Antennal shaft and club black on dorsum with golden at base of each segment, mostly pale golden on venter with some black between segments; nudum tan proximad to brown distad, 12 segments. Dorsal thorax black with semi-iridescent, olive, setiform scales, ventral thorax with pale golden setiform scales, continuing onto ventral edge of femur; fore-tibia not spined, brownish epiphysis relatively short, not extending to distal end of tibia; mid-tibia with longitudinal row of 6 spines on inner surface, pair of spurs distad, outer spur about 2/3 length of inner; hind-tibia without spines, two pairs of spurs, in each pair, outer spurs about 4/5 length of inner; tarsus with three longitudinal rows of short spines. Dorsal abdomen dark brown, with long, semi-iridescent olive and pale golden setiform scales, somewhat paler caudad; ventral abdomen paler, with beige and yellowish setiform scales.

Male genitalia (Fig. 2 A-J): Tegumen in dorsal view (Fig. 2B) short, broad, with cephalad edge rounded, caudal edge concave following curve of cephalad edge; in lateral view (Fig. 2A) anterior edge rounded, angled slightly downward; uncus in dorsal view (Fig. 2B) short, broad, bifurcate with arms fused entire length, narrows to point caudally, rounded cephalad edge with two dense setal tufts covering left and right sides of junction with tegumen; in lateral view (Fig. 2A) narrow, becoming broader anteriorly from narrow, slightly upward projecting caudal tip; gnathos (Fig. 2A, C) shorter than uncus, broad caudal end blunt, slightly narrower than cephalad edge near junction with tegumen; vinculum (Fig. 2A) broad medially, narrowing towards saccus and tegumen; saccus (Fig. 2D) short, caudal edge with two flat, rounded projections in ventral view; valvae (Fig. 2E-G) symmetrical, long and narrow, harpe curved dorsad with tip finely dentate, appearing blunt in dorsal view (Fig. 2E), and extending beyond, not overlapping caudal edge of ampulla; interior caudal edge of ampulla finely dentate; aedeagus (Fig. 2H-J) longer than valvae, caudal end divided into narrow dorsal tip and blunt, rounded ventral tip; vesica with single, sclerotized, dentate cornutus; phallobase absent; juxta-transtilla (Fig. 2H-J) well developed, sclerotized, dorso-caudad edge and ventro-cephalad edge blunt, squared.

FEMALE. No specimens known in collections. Ventral wing patterns (Fig. 4, live individual) as on male; ventral hindwing ground color appears slightly darker and pale ventral hindwing spots perhaps whiter than in male.

Dalla amatlanensis **sp. nov.** is placed in the genus *Dalla*, as it keys in Evans' (1955) classification system to H.6.17b or H.6.17 (18), indicating a close relationship with *Dalla bubobon* (Dyar, 1921).

Specimens examined. Holotype male with the following labels: white, printed: / MEXICO: MORELOS: Mpio. / Tepoztlán: "La Puerta", Cyn. / 1 km E of Amatlán de Quetzalcóatl / 1675-1707m, vic. / 18°58'29.51"N 99°01'39.61"W / 7-VIII-2015 / Luc Legal & O. Dorado /; red, printed: / HOLOTYPE / *Dalla amatlanensis* / A. Warren, Gott & Legal /. Six male paratypes with same data as holotype. Two of the paratypes were dissected and contain the following labels: white, printed and hand printed: / Riley J. Gott / Genitalia / Dissection No. / RG0318 /; white, printed and hand printed: / Riley J. Gott / Genitalia / Dissection No. / RG0319 /. The holotype is deposited at the Museo de Zoología "Alfonso L. Herrera", Departamento de Biología Evolutiva, Facultad de Ciencias, Universidad Nacional Autónoma de México, Mexico City.

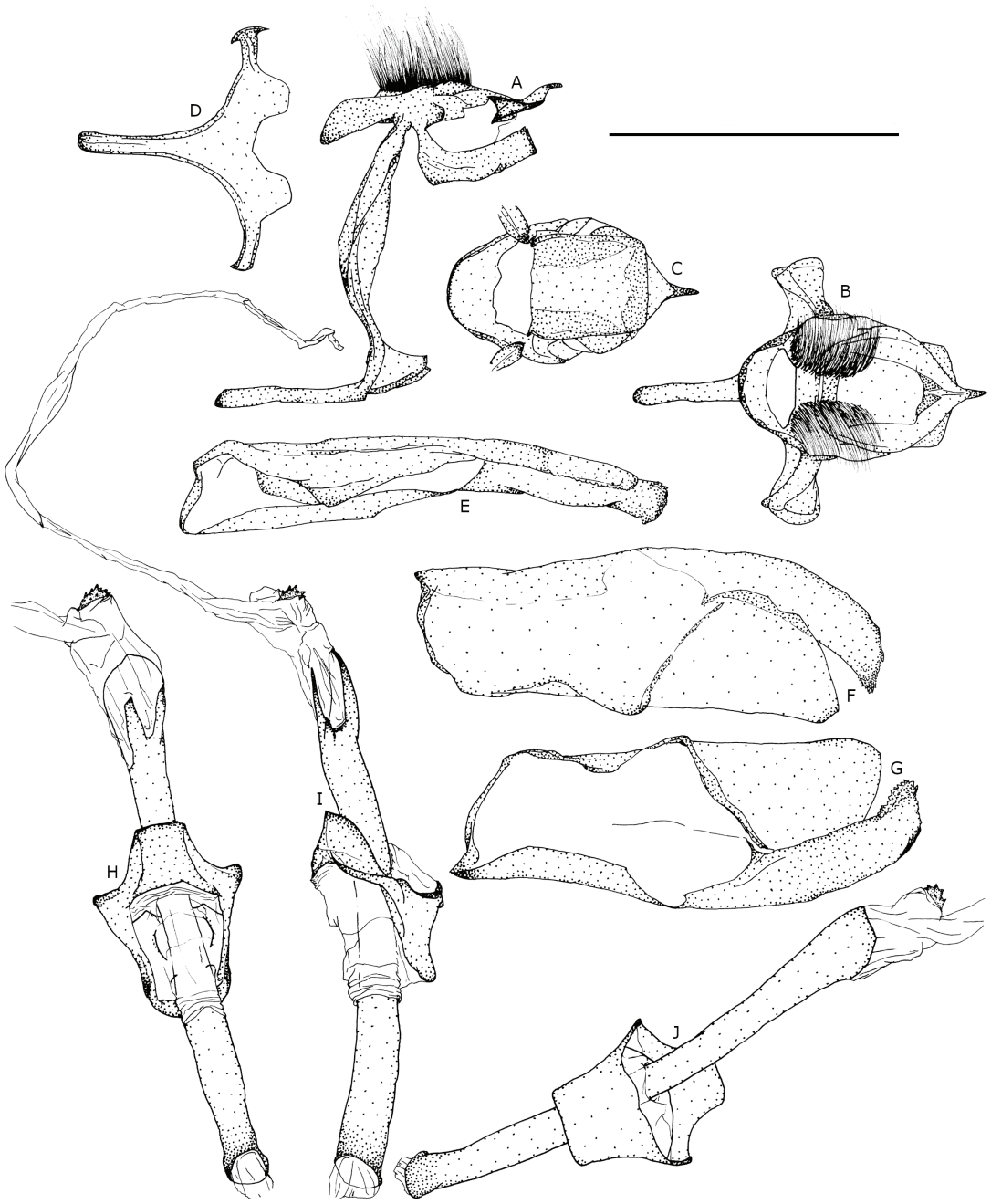

Figure 2. Male genitalia of *Dalla amatlanensis* **sp. nov.** paratype, from Morelos, Mexico; Riley J. Gott Genitalia Dissection No. RG0318, complete data in text. Scale bar 1 mm. A) Left lateral view of uncus, gnathos, tegumen, and saccus; B) Dorsal view of uncus and tegumen; C) Ventral view of gnathos and tegumen; D) Ventral view of saccus; E) Dorsal view of right valve; F) Exterior lateral view of right valve; G) Interior lateral view of right valve; H) Dorsal view of aedeagus, juxta, and transtilla; I) Lateral view of aedeagus, juxta, transtilla, and everted vesica; J) Ventral view of aedeagus, juxta, and transtilla.

Type locality. The type locality, a path locally known as "La Puerta," is the canyon 1 km east of the town of Amatlán de Quetzalcóatl, Municipality of Tepoztlán, in the State of Morelos. This pathway, which begins at 1600 m and ends around 1950 m, leads to San José de los Laureles, and is regularly used by the Chalma pilgrims (Chalmeros) on their procession to Chalma (State of México). The area where *D. amatlanensis* **sp. nov.** has been found in the canyon is the "bamboo zone," beginning around 1675 m and extending up to 1850 m, which is the coolest and most humid part of the canyon. The bamboo is the suspected larval foodplant, *Chusquea circinata* Soderstrom & Calderón. A few noteworthy butterfly species found in this zone include *Cecropterus* (*Thorybes*) *cincta* Plötz, 1882, *Stallingsia smithi* (Druce, 1896) (Hesperiidae), *Parides alopius* (Godman & Salvin, 1890), (Papilionidae), and *Cyllopsis diazi* Miller, 1974 (Nymphalidae). The surrounding area is semi-disturbed temperate oak forest, comprising *Lysiloma acapulcense* (Kunth) Bentham, *Inga vera* (L.) Britton, *Lonchocarpus argyrotrichus* Harms, *Urera caracasana* (Jacquin) Gaudichaud-Beaupré ex Grisebach, and various species of *Quercus* Linné, *Erythrina* Linné, *Ficus* Linné, and *Annona* Linné.

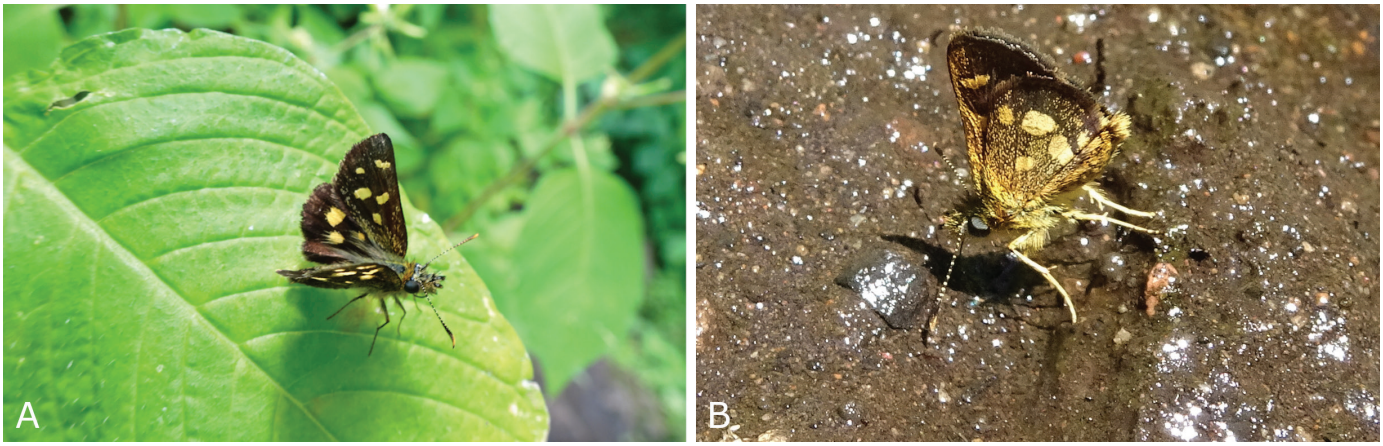

Figure 3. Live males of *Dalla amatlanensis* **sp. nov.** at type locality. A) Perching on leaf 13 August 2017, L. Legal. B) At mud, 7 August 2015, L. Legal & O. Dorado.

Etymology. This species is named for its only known locality of occurrence, near Amatlán de Quetzalcóatl, Morelos, Mexico. Amatlán de Quetzalcóatl is an important historical site in Mexico, being the apparent birthplace of Cē Ācatl Tōpīltzin Quetzalcóatl, who was the Lord of the Toltecs and their major city Tōllān during the 10th century, and was considered a living god by his followers. He prohibited human sacrifices, and in their place, released birds and butterflies from the tops of temples (Zamora, 2007).

Distribution and phenology. To date, *Dalla amatlanensis* **sp. nov.** is known only from the type locality; adults were observed by Legal on 31 July 2015 (one female, Fig. 4), 7 August 2015 (type series and Fig. 3B), 13 August 2017 (5-6 males seen, including Fig. 3A), and 28 July 2019 (1 male seen). Visits to the site by Legal on 7 July 2019, as well as multiple times and years in September, October and November, failed to result in records of adults, suggesting that *D. amatlanensis* flies in a single annual brood from the end of July to mid-August, corresponding with the first half of the local rainy season.

Diagnosis and discussion. As noted above, this new species is placed in *Dalla* as it keys to *Dalla bubobon* in Evans' (1955) classification system. Despite this, *Dalla amatlanensis* **sp. nov.** is remarkably distinct, and is likely to be confused only with *D. steinhauseri* Freeman, 1991, *D. austini* Warren & De la Maza, 2011, *D. freemani* Warren, 1997, and *D. bubobon*. In overall size, *D. amatlanensis* is the smallest of the similar species, with a wing length of only about 10.4-10.7 mm; *D. austini* is the largest with a wing length of 14.6-16.4 mm, while *D. freemani* (12.7 mm) and *D. steinhauseri* (around 14.0 mm) are intermediate in size. The dorsal and ventral forewing pattern of *D. amatlanensis* is most similar to that of *D. steinhauseri*, although the spots on the mid- and basal parts of CuA_1-CuA_2 don't extend into CuA_2-2A on *D. steinhauseri* as they do on *D. amatlanensis*, and the forewing spot in Mc-CuA_1 is closer to the spot in CuA_1-CuA_2 on *D. steinhauseri* than it is on *D. amatlanensis*. The dorsal hindwing pattern of *D. amatlanensis* is most like that of *D. freemani*, though the spots are larger and paler in color; they are similar in size and color to the spots on *D. steinhauseri*, but that species lacks the discal spot just proximad of the midpoint that is prominent on *D. amatlanensis*. The ventral hindwing of *D. amatlanensis* is unique among similar species in having the spots in CuA_1-CuA_2 and CuA_2-2A conjoined; they are separately formed spots on all the other species. Forewing apical spots appear somewhat variable in size and position in all of these *Dalla* species and are not considered diagnostic, although the macule in R_5-M_1 tends to be offset distad to a greater extent in *D. amatlanensis* and *D. bubobon* than in the other species.

The male genitalia of *D. amatlanensis* most closely resembles that of *D. bubobon*, as illustrated by Warren and González-Cota (1996), but it also shares similarities with *D. austini, D. steinhauseri,* and *D. freemani*. *Dalla bubobon* has a long uncus that is broad at the tegumen and narrows caudally with tip slightly angled downward, while the uncus is similarly long and posteriorly angled downward, but is narrow in *D. austini*, *D. freemani,* and *D. steinhauseri*. The uncus is short, broad, and slightly angles upward at the narrowed caudal tip in *D. amatlanensis*. From the dorsal view, the uncus and tegumen of *D. amatlanensis* resembles *D. bubobon* with the cephalad edge of the uncus being broad, narrowing abruptly towards caudal edge, and connecting to a short, hollowed-out tegumen with dense dorsal setal tufts, which differs from the long, narrow uncus of *D. steinhauseri, D. austini,* and *D. freemani* that gradually broaden anteriorly towards the tegumen. *Dalla bubobon, D. steinhauseri, D. freemani,* and *D. austini* have a long narrow gnathos that gradually tapers caudally to a rounded point, while the gnathos of *D. amatlanensis* is short, broad, and is nearly as wide at the caudal edge as it is at its junction with the tegumen. Although the illustration of *D. steinhauseri* by Freeman (1991) does not show a long, narrow gnathos, Warren & González-Cota (1996) discuss this difference as an artifact of dissection technique. The cephalad end of the saccus in *D. amatlanensis* is short, but is not angled dorsally as in *D. bubobon*, while *D. steinhauseri, D. austini,* and *D. freemani* it is longer and curved dorsally. The caudal edge of the saccus in *D. amatlanensis* has two flat, rounded, hump-like projections that are not present in *D. bubobon, D. steinhauseri*, *D. freemani,* or *D. austini.* The valvae are long and narrow in all five species, but the harpe does not overlap the ampulla in *D. amatlanensis* and *D. austini*, as it does in *D. steinhauseri, D. bubobon,* and *D. freemani. Dalla amatlanensis*, *D. austini,* and *D. bubobon* lack

Figure 4. Adult female of *Dalla amatlanensis* **sp. nov.** ovipositing on *Chusquea circinata*, 31 July 2015 at type locality, photograph by L. Legal.

a phallobase, while the phallobase is present in *D. steinhauseri* and *D. freemani,* although reduced. Both *D. amatlanensis* and *D. bubobon* have similarly shaped, strongly sclerotized juxta-transtilla that differ from the irregular shape of that in *D. steinhauseri,* and the broad, square-shaped structure in *D. freemani,* and *D. austini*. *Dalla amatlanensis*, *D. bubobon, D. steinhauseri,* and *D. austini* have a single, heavily sclerotized cornutus on the vesica. A combination of the following genitalic characters clearly separates *D. amatlanensis* from the other *Dalla* species mentioned previously: caudal edge of gnathos nearly as broad as cephalad edge, uncus short, broad anteriorly, and caudal tip slightly angles upward, saccus short with cephalad edge slightly down turned and caudal edge with two prominent flat, rounded projections.

As noted above, the butterfly fauna of Morelos has been intensively studied, in particular the fauna of the Tepoztlán area, which is only about 6 km west of Amatlán de Quetzalcóatl. Thus, the discovery of *Dalla amatlanensis* was completely unexpected, and begs the question of how widely distributed the species might be. Known dates of occurrence suggest that adults fly in a very narrow window from late July to mid- or late August, perhaps partly explaining why this species has gone undetected until now. Its apparent larval foodplant, based on the ovipositing female observed on 31 July 2015 (Fig. 4), is *Chusquea circinata*. At this point we have no reason to believe that other larval foodplants are utilized, although this possibility cannot yet be ruled out.

According to Ruiz-Sanchez *et al.* (2019), *Chusquea circinata* is widely distributed in western Mexico, from Sinaloa to Chiapas and Guatemala, thus the distribution of *D. amatlanensis* could be more widespread than currently known. Careful searches in other areas where this bamboo occurs, during July and August, might turn up additional populations in Morelos, Guerrero, or other adjacent states. Species related to *D. amatlanensis*, namely *D. steinhauseri*, *D. bubobon*, *D. freemani* and *D. austini*, are all rare in collections, and each is known from just one to a few localities. Thus, it is unknown whether any of these species fly in sympatry, or if they replace each other geographically. Further fieldwork in Mexico and Guatemala is needed to elucidate the actual distributions of all five of these *Dalla* species. With the description of *D. amatlanensis*, four *Dalla* species are now known from Morelos, joining the other species that are known from the southwestern part of the state: *D. bubobon* (only a single Morelos record is known), *D. dividuum* (Dyar, 1913) and *D. faula* (Godman, 1900).

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