Four new species of *Piruna* Evans, 1955 from western Mexico (Lepidoptera: Hesperiidae: Heteropterinae)

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Abstract: Four new species of *Piruna* are described from Mexico, and notes on their morphology, distribution, phenology, biogeography and ecology are provided. *Piruna uruapana* **sp. nov.** is described from the Municipality of Uruapan, Michoacán, in the western Trans-Mexican Volcanic Belt (Eje Neovolcánico). *Piruna chinicuila* **sp. nov.** is described from the Municipality of Chinicuila, Michoacán, in the central subprovince of the Sierra Madre del Sur. *Piruna bailowitzi* **sp. nov.** is described from the northern Sierra Madre Occidental and its associated Sky Islands in Sonora and Chihuahua. *Piruna temascaltepeca* **sp. nov.** is described from near the town of Temascaltepec de González, Municipality of Temascaltepec, State of México, in the central Trans-Mexican Volcanic Belt. Three of these new species appear to be restricted to fire-maintained grassy openings in montane pine-oak forest.

Key words: Biogeography, butterfly, distribution, ecology, morphology, skipper.

Resumen: Se describen cuatro nuevas especies de *Piruna* de México, con notas sobre su morfología, distribución, fenología, biogeografía y ecología. Se describe *Piruna uruapana* **sp. nov.** del Municipio de Uruapan, Michoacán, en el Eje Neovolcánico occidental. Se describe *Piruna chinicuila* **sp. nov.** del Municipio de Chinicuila, Michoacán, en la subprovincia central de la Sierra Madre del Sur. Se describe *Piruna bailowitzi* **sp. nov.** del norte de la Sierra Madre Occidental y las Islas del Cielo asociadas en Sonora y Chihuahua. Se describe *Piruna temascaltepeca* **sp. nov.** de las cercanías del poblado de Temascaltepec de González, Municipio de Temascaltepec, Estado de México, en el Eje Neovolcánico central. Tres de estas nuevas especies parecen estar restringidas a las zonas abiertas de pastizales mantenidas por el fuego en bosque montañoso de pino-encino.

Palabras clave: Biogeografía, distribución, ecología, hespérido, mariposa, morfología.

INTRODUCTION

The hesperiid genus *Piruna* Evans, 1955 currently comprises nineteen species (Warren *et al*., 2017), all but one of which, the North American *P. pirus* (W. H. Edwards, 1878), occur in Mexico. *Piruna* are small skipper butterflies that mainly fly during the rainy season, and tend to have short annual flight periods (Warren & González-Cota, 1998). Nine of the nineteen currently recognized species have been described since 1970, and several undescribed species remain to be formally named. Biological and ecological notes on the genus were provided by Warren & González-Cota (1998), yet details of their life histories remain mostly unknown.

The current study was initiated by the senior author in July 1996, while identifying papered specimens of Hesperiidae collected by the late Luis Lamberto González-Cota and his associates in Michoacán, Mexico. Three male specimens of an unfamiliar *Piruna* were encountered among this material, which, due to their large size and unique ventral hindwing spotting pattern, clearly represented an undescribed species. These specimens were all collected in the Municipality of Uruapan, at three different localities, on three different years, but within two days of each other (Cerro de la Cruz, 24 August 1991; Planta Hidroeléctrica Zumpimito, 25 August 1992; Matanguaran, 24 August, 1994). In an effort to secure additional specimens, several trips were made to Cerro de la Cruz in late August and September, 1997, at which time the species proved to be extremely abundant. Study of this material has confirmed its status as an undescribed species, which, along with a similar species from the Municipality of Chinicuila, Michoacán, is formally named and described below.

During the same period of time, on 22 August 1997, Sanford A. Upson (of Bisbee, Arizona) happened upon a very distinctive but unfamiliar species of *Piruna* in the Sierra Huachinera of northeastern Sonora, Mexico, where one male and two female specimens were collected. Upson encountered an additional male at the same site on 19 August 1998, and James P. Brock (of Tucson, Arizona) encountered a male in Chihuahua a week earlier, on 12 August 1998, approximately 19 miles southwest of Colonia Juárez. This material was forwarded to the senior

author, and it was determined to represent an additional undescribed species, closely related to the undescribed species found in the Municipality of Uruapan, Michoacán. This species is formally named and described below.

A decade later, on 6 September 2007, the senior author, joined by Jorge Hernández (Toluca, Mexico) and John Kemner (Oaxaca, Mexico), encountered another very distinctive *Piruna* near Temascaltepec de González, State of México, Mexico. This skipper was immediately recognized as an undescribed species, sharing features of both of the undescribed species from Michoacán and Sonora. Subsequent study of this material has confirmed its status as an undescribed taxon, which is formally named and described below.

The four new species named herein are placed in *Piruna*, as they key to *Piruna* in Evans (1955), and share many wing and genitalic characters with other *Piruna* taxa named in recent decades, as detailed by Freeman (1970a,b, 1990, 1991), Miller & Miller (1972) and Warren & González-Cota (1998).

MATERIALS AND METHODS

In an effort to locate *Piruna* specimens relevant to this study, the senior author has reviewed collections of Lepidoptera containing Mexican Hesperiidae, as follows: American Museum of Natural History, New York (AMNH); Coleção Entomológica Padre Jesus Santiago Moure, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Brazil (DZUP); C. P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins (CSU), Instituto de Biología, Universidad Nacional Autónoma de México, Mexico City (IBUNAM); McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Gainesville (MGCL); Museo de Historia Natural de la Ciudad de México, Mexico City (MHNCM); Museo de Zoología, Departamento de Biología Evolutiva, Facultad de Ciencias, Universidad Nacional Autónoma de México, Mexico City (MZFC); Private collection of James P. Brock, Tucson, Arizona (JPB); Private collection of the De la Maza Family, Mexico City (MAZA); Private collection of the Turrent Family, Mexico City (CFT); Private collection of José de Jesús García-Díaz, Tehuacán, Puebla (CJG); Research material of Andrew D. Warren (ADW); The Natural History Museum, London (NHMUK).

Male and female genitalia were prepared for examination by soaking abdomens in a 10% potassium hydroxide solution for 12 hours before dissection under a Leica MZ 16 stereomicroscope with camera lucida attached. After dissection, genitalia were soaked in a weak acetic acid solution for 10 minutes to neutralize any remaining potassium hydroxide. After illustration, genitalia were placed in small plastic vials containing glycerin for permanent storage. Photos of adults were taken with a Canon EOS 70D camera and 100 mm macro lens. Images and plates were modified using Adobe Photoshop 2021 and Adobe Illustrator 2021. The distribution map was generated using QGIS 3.10 (Quantum Geographic Information System; QGIS Development Team, 2019). Terminology for genitalia follows Klots (1970).

RESULTS

Piruna uruapana A. Warren & Gott, **sp. nov.**
(Figs. 1A-N, 3A, 5, 9A, 10A, 11A, 12)

Description. MALE (Figs. 1A-J): mean forewing length = 13.3 mm (12.1-14.1 mm, n = 10, holotype = 13.8 mm); forewing apex rounded, termen evenly convex, no stigma or brand; hindwing slightly produced at apex, termen convex to CuA_1, then straight to tornus at 1A+2A, inner margin slightly convex. Dorsal forewing dark brown. Opaque whitish macules individually extremely variable, being well-developed in some specimens and essentially absent in others, distributed as follows: subapical in R_3-R_4 to R_5-M_1, circular to rectangular; macule in R_4-R_5 smaller (sometimes absent), slightly offset basad, though mostly overlapping macules in R_3-R_4 and R_5-M_1; postmedial in mid-M_3-CuA_1, circular to rectangular; mid-CuA_1-CuA_2, circular to rectangular, usually larger; basal part of CuA_1-CuA_2, circular to triangular (sometimes absent); finally, roughly circular at anterior portion of distal third of discal cell, situated above macule at base of CuA_1-CuA_2, small, sometimes absent; small, circular (minute on holotype) to linear, non-opaque streak in posterior part of CuA_2-1A+2A, at end of basal 1/3 of cell, absent on most individuals. The most boldly marked specimen (Fig. 1I-J) possesses a tiny additional apical spot in R_2-R_3, and a tiny spot in posterior portion of discal cell adjacent to anterior spot. Wing fringe brown with scattered grayish scales near tornus. Dorsal hindwing same ground color as forewing; small, circular to semi-rectangular whitish macules as follows, which may be reduced or nearly absent in darker individuals: M_1-M_3, bipartite; CuA_1-CuA_2, circular to oval, poorly-developed or absent in darkest individuals. Wing fringe brown with scattered grayish scales concentrated near tornus.

Ventral forewing with opaque macules repeated from dorsal surface, though generally not as well developed, dark brown, subtly grayish at base 1A-2A; scattered dark golden-brown overscaling along costa, densest near apex distad of apical macules, variably extending along distal margin to M_3 or CuA_1 and basad along wing veins. Wing fringe as on upper surface. Ventral hindwing dark brown with dense overscaling of dark golden-brown scales evenly distributed across wing except over macules. Whitish-beige macules as follows, individually variable in size: small, circular to elongate oval submarginal spots in Sc+R_1-Rs (usually smallest), Rs-M_1, anterior and posterior halves of M_1-M_3 (these subtly offset basad from rest of submarginal series), M_3-CuA_1 and CuA_1-CuA_2; postmedial, circular to triangular in anterior and posterior halves of M_1-M_3 just distad of discal cell end, and oval-shaped at mid-CuA_1-CuA_2 (absent on some individuals); circular spot at mid-discal cell; better-marked individuals with minute macule at mid-1A-2A adjacent to macule in CuA_2-2A; finally, very subtle beige linear streak at mid-1A-2A spanning distal 1/4 of cell; distal 1/4 of vein 2A with similar beige coloration. Wing fringe as on upper surface.

Dorsal head black with scattered brown, olivaceous and gray setiform scales; small patch of white scales dorsad of eye; labial palpus with mixture of black and olivaceous setiform scales on dorsum, mixed whitish and black setiform scales on venter, third segment porrect, black on dorsum and whitish-beige with brown and black on venter. Antennal shaft and club black on dorsum with ochreous at base of each segment, mostly ochreous-beige on venter with some black between segments; nudum ochreous, 9-10 segments. Dorsal thorax and tegulae brown with scattered olivaceous setiform scales, ventral thorax brown with dense gray setiform scales, continuing onto ventral edge of femur; fore-tibia with relatively short brownish epiphysis; mid- and hind-legs ochreous-brown on dorsum, whitish-beige on venter; mid-tibia with pair of spurs distad, outer spur about 2/3 length of inner; hind-tibia with two pairs of spurs, in each pair, outer spurs about 4/5 length of inner. Dorsal abdomen dark brown with scattered dark beige setiform scales on anterior half; lateral abdomen whitish-beige with longitudinal brownish stripe; ventral abdomen grayish-white with few scattered brownish scales and scattered beige-gray setiform scales on anterior half.

Male genitalia (Fig. 5), eleven specimens dissected: uncus bifurcate, arms wide apart, gradually narrows from anterior edge to caudal tips in dorsal view, caudal tips ventrally oriented, in lateral view uncus remains same width from caudal tip to 1/3 its length (length including median apophysis), curves ventrally to nearly contact caudal edge of gnathos before curving back towards caudal edge of tegumen; median apophysis narrow at commencement, constricted immediately then widens in dorsal view, anterior edge invaginated to form shallow v-shape in dorsal view; gnathos bifurcate, caudal tips square, blunt in lateral view, narrow with membranous integument connecting both sides of gnathos in ventral view; tegumen with concave fenestra, caudal edge open

Figure 1. Holotype (A-B) and paratypes (C-N) of *Piruna uruapana* **sp. nov.**, and holotype male (O-P) of *Piruna chinicuila* **sp. nov.** A-J) Males, K-N) females, all from the type locality: south side of Cerro de la Cruz, 1700-2300 m, Municipality of Uruapan, Michoacán, Mexico, 23 August 1997, collected by Andrew D. Warren. O-P) From Los Laureles, 1365 m, Municipality of Chinicuila, Michoacán, Mexico, 12 September 1999, collected by Luis Lamberto González-Cota. Scale bar = 1.0 cm.

and covered by median apophysis of uncus; saccus 1/3 – 1/2 length of phallus, angled dorsally from posterior edge to 1/3 length before slightly curving downward; valvae symmetric, 3/4 length of phallus; sacculus and harpe fused; harpe narrow, caudal tip expanded, dentate, angled towards body midline, longer than ampulla; ampulla completely separated, overlapping harpe, arching towards body midline with harpe; phallus long, narrow, remaining same width for caudal 2/3, widens briefly then remains same width to anterior edge, caudal tip on ventral surface, invaginated on dorsal side; ductus ejaculatoris arising from dorsal surface; vesica with single, dentate cornutus; transtilla sclerotized, smaller than juxta, triangular in lateral view, v-shaped in dorsal view with midpoint on anterior edge expanded anteriorly; juxta sclerotized, triangular, with posterior edge expanded at midpoint in ventral view; two elongate, elliptical, sclerotized plates present in anellus.

FEMALE (Figs. 1K-N, 3A): mean forewing length = 14.6 mm (13.9-15.1 mm, n = 10); forewing and hindwing shape as on male, wings somewhat more rounded. Dorsal color and spotting pattern as on male; size of spots individually variable, as on male. Ventral forewing as on male. Ventral hindwing pattern elements as on male and individually variable; dark golden-brown overscaling denser. Head, thorax and abdomen as on male except no epiphysis on fore-tibia; brown longitudinal lateral stripe on abdomen broader, very prominent (Fig. 3A).

Female genitalia (Figs. 9A, 10A), five specimens dissected: papillae anales large, rectangularly shaped in lateral view, with many long setae; apophyses posterior narrow, long, reaching anterior edge of lamella antevaginalis; lamella postvaginalis reduced to small sclerotized plate, posterior edge invaginated medially to form two rounded halves meeting at midline, anterior edge straight; antrum narrow, long, constricted near mid-length with both sides of constriction nearly equal in width, five grooves perpendicular to midline; lamella antevaginalis reduced, sclerotized on left and right sides with membranous integument connecting sides medially; apophyses anterior reduced; ductus seminalis arising near midpoint between anterior edge of antrum and posterior edge of corpus bursae; cervix bursae rectangular, not clearly distinguished from ductus bursae; corpus bursae elongated, with many small, pointed signa; appendix bursae large, elongate.

Specimens examined. Holotype male with the following labels: white, printed: / MEXICO: MICHOACÁN: Mpio. / Uruapan: Cerro de la Cruz, / S side, 1700-2300m, vic. / 19°26'54.6"N, 102°02'41.7"W / 23-VIII-1997 / Andrew D. Warren /; red, printed: / HOLOTYPE / *Piruna uruapana* / A. Warren & Gott /. One hundred twenty-four male and twenty female paratypes same data as holotype. Additional paratypes from the same locality, as follows: 24-VIII-1991, L. L. González-Cota (1 male); 16-VIII-1996, L. L. González-Cota & M. Martínez (26 males); 22-VIII-1996, L. L. González-Cota & M. Martínez (24 males, 3 females); 29-VIII-1996, Andrew D. Warren (18 males, 12 females); 20-IX-1996 L. L. González-Cota & M. Martínez (2 males, 1 female); 23-IX-1996, L. L. González-Cota & M. Martínez (1 female). Additional paratypes from elsewhere in the Municipality of Uruapan, Michoacán, as follows: Planta Hidroeléctrica Zumpimito, 1490m, vic. 19°21'25"N, 102°04'15"W, 25-VIII-1992, L. L. González-Cota (1 male); Matanguaran, 1524m, 19°20'20.9"N, 102°05'48.1"W, 24-VIII-1994, L. L. González-Cota (1 male). The holotype and various paratypes will be deposited at the Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, Mexico City (MZFC).

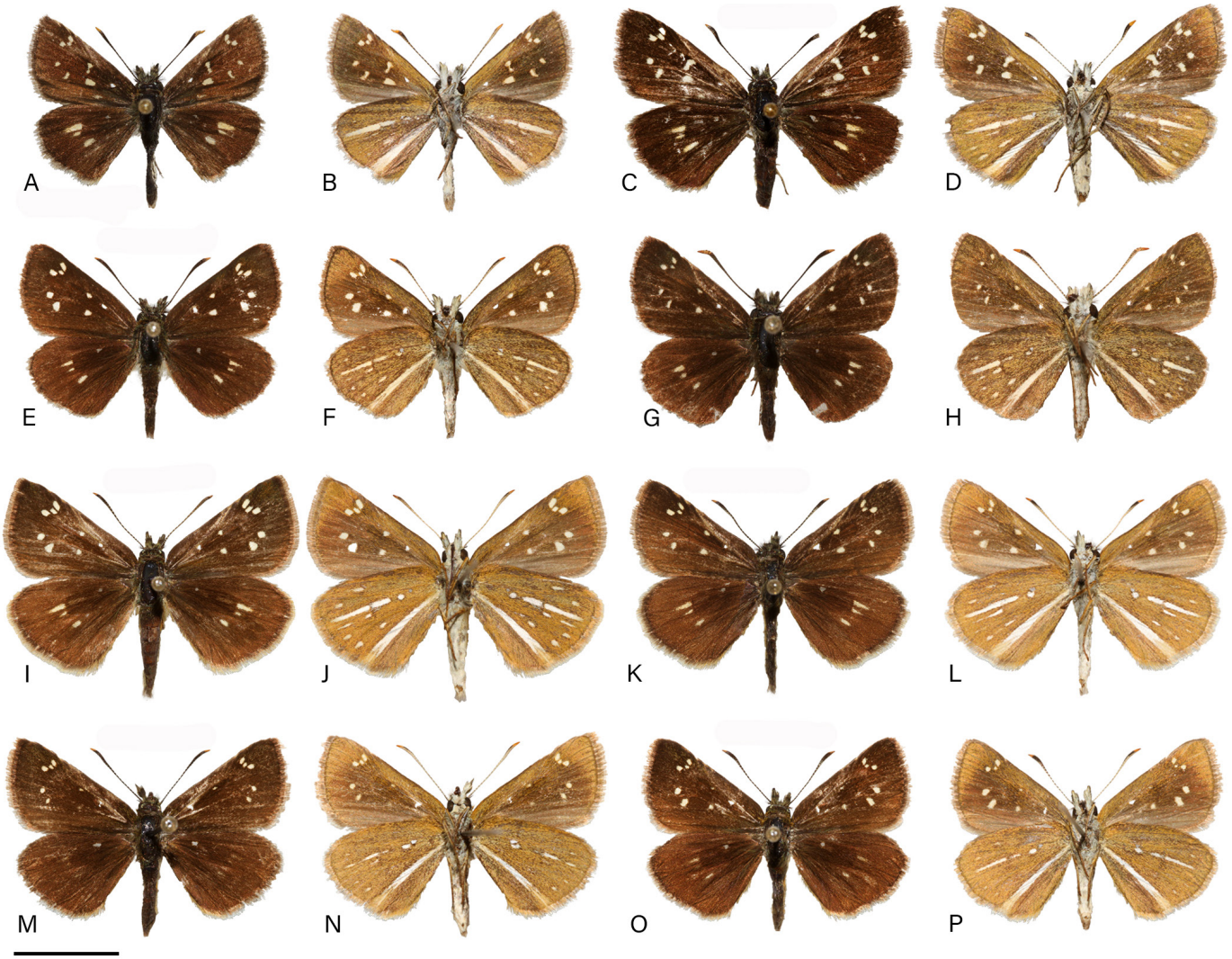

Figure 2. Holotype male (A-B) and paratype female (C-D) of *Piruna bailowitzi* **sp. nov.**, and holotype male (E-F), paratype male (G-H), and paratype females (I-P) of *Piruna temascaltepeca* **sp. nov.** A-D) From the type locality: east of Rancho Covadonga, 2135 m, Sierra Huachinera, Municipality of Huachinera, Sonora, Mexico, 19 August 1998 (A-B) and 22 August 1997 (C-D), collected by Sanford A. Upson. E-P) From the type locality: road from Temascaltepec de González to Zacazonapan, 3.0 road miles NW jct. Hwy. 134, 0.4 road miles SW jct. road to Valle del Bravo, 1981 m, Municipality of Temascaltepec, State of México, Mexico, 6 September 2007, collected by Andrew D. Warren. Scale bar = 1.0 cm.

Additional paratypes will be deposited at the McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Gainesville (MGCL), and the C. P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins (CSU).

Type locality. Cerro de la Cruz is situated at the northern edge of the city of Uruapan, Michoacán, Mexico. This steep mountain is covered in dense pine-oak forest, with scattered open, grassy areas, apparently created by fires resulting from lightning strikes (Fig. 11A). Additional information about Cerro de la Cruz was provided by Warren (2009) in the description of *Atrytonopsis llorentei* A. Warren, 2009, a species that flies with *P. uruapana* **sp. nov.** and likely shares the same larval foodplant.

Etymology. *Piruna uruapana* **sp. nov.** is named after the town closest to its type locality, Uruapan, in the Municipality of Uruapan, Michoacán, Mexico.

Distribution and phenology. To date, *P. uruapana* **sp. nov.** is known only from sites immediately adjacent to Uruapan, in the Municipality of Uruapan, Michoacán, Mexico, at elevations between 1490-2300 m (Fig. 12). Despite intensive surveys for Hesperiidae at similar habitats in many surrounding municipalities in Michoacán, *P. uruapana* **sp. nov.** has not been detected elsewhere (Salinas-Gutiérrez *et al*., 2015). However, *P. uruapana* **sp. nov.** could be more widely distributed than our current records suggest, in similar habitats, perhaps even in Jalisco. Adults have been encountered from mid-August to mid-September, which corresponds with the middle of the of the local rainy season, when afternoon rains generally occur on a daily basis.

Biogeography. *Piruna uruapana* **sp. nov.** appears to be endemic to the western portion of the Trans-Mexican Volcanic Belt (Eje Neovolcánico), a region known for a high degree of endemism in its flora and fauna (Luna-Vega *et al*., 2007).

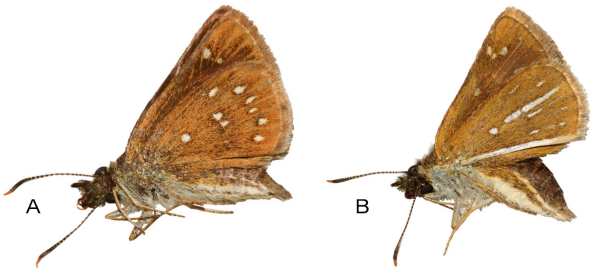

Figure 3. Left lateral views of female paratypes of *Piruna uruapana* **sp. nov.** and *Piruna temascaltepeca* **sp. nov.** from their type localities, showing prominent lateral abdominal bands. A) collected 23 August 1997, B) collected 6 September 2007, by Andrew D. Warren.

Figure 4. Live female of *Piruna bailowitzi* **sp. nov.**, showing prominent lateral abdominal band, from Los Pilares, Route 16, km. 300, 1305 m, Municipality of Yécora, Sonora, Mexico, 8 August 2018, photo by Michael Bearce.

Ecology. Adults of *P. uruapana* **sp. nov.** were encountered from 1700 m to 2300 m elevation on Cerro de la Cruz, mainly in open areas dominated by a tall (usually 0.5-2.0 m tall), unidentified grass, which is likely the larval foodplant. Individuals were mainly encountered flying among the tall grass and at the flowers of a small *Salvia* L. (Lamiaceae). No adults were encountered at damp ground. As noted by Warren (2009), the open, grassy areas on Cerro de la Cruz appear to have been created by fires resulting from lightning strikes, as suggested by the abundant, charred tree trunks in these areas (Fig. 11A). It seems probable that *P. uruapana* **sp. nov.** is dependent on fires to create and maintain suitable grass-dominated habitats in the otherwise dense pine-oak forest.

Diagnosis and discussion. *Piruna uruapana* **sp. nov.** is immediately recognized by its large size (it is the largest known *Piruna* species), dark ochreous-brown ventral ground color, unique ventral hindwing spotting pattern (Figs. 1A-N), and the ochreous-brown lateral stripe on the abdomen (Fig. 3A). Its overall coloration and spotting pattern is most similar to *P. sina* H. Freeman, 1970 and *P. mullinsi* H. Freeman, 1991 (see Warren *et al.* (2017) for detailed images of these taxa, including the holotypes), but those taxa are considerably smaller, lack the lateral abdominal stripe prominent on *P. uruapana* **sp. nov.**, and differ in details of wing pattern. Compared to *P. sina*, the ventral hindwing macules on *P. uruapana* **sp. nov.** are whiter and better developed, generally lacking the ventral hindwing spot in 1A-2A which is prominent on *P. sina*. Additionally, the dorsal and ventral forewing spot at the base of CuA_2-2A which is well-developed and prominent on *P. sina* is poorly developed or usually absent on *P. uruapana* **sp. nov.** *Piruna mullinsi* is even less similar to *P. uruapana* **sp. nov.**, given its very poorly-developed ventral hindwing macules, often appearing smudged, and like *P. sina*, its well-developed dorsal and ventral forewing spot at the base of CuA_2-2A; *P. mullinsi* also has extensive ochreous dorsal overscaling which is absent on *P. uruapana* **sp. nov.** No other species of *Piruna*, other than the one described immediately below, are likely to be confused with *P. uruapana* **sp. nov.** Genitalic attributes of *P. uruapana* **sp. nov.** are elucidated in the diagnosis of the following species.

Piruna chinicuila A. Warren & Gott, **sp. nov.**
(Figs. 1O-P, 6, 12)

Description. MALE (Figs. 1O-P): forewing length = 13.0 mm (n = 1); forewing apex rounded, termen evenly convex, no stigma or brand; hindwing slightly produced at apex, termen convex to CuA_1, then straight to tornus at 1A+2A, inner margin slightly convex. Dorsal forewing dark brown. Opaque whitish macules as follows: subapical in R_3-R_4 to R_5-M_1, rectangular; macule in R_4-R_5 smaller, slightly offset basad, though mostly overlapping macules in R_3-R_4 and R_5-M_1; postmedial in mid-M_3-CuA_1, rectangular; mid-CuA_1-CuA_2, rectangular, larger; basal part of CuA_1-CuA_2, semi-triangular; finally, circular, small, at anterior portion of distal third of discal cell, situated above macule at base of CuA_1-CuA_2; small, linear, non-opaque streak in posterior part of CuA_2-1A+2A, at end of basal 1/3 of cell. Wing fringe brown with scattered grayish scales near tornus. Dorsal hindwing same ground color as forewing; small, circular, whitish macules as follows: M_1-M_3, bipartite; CuA_1-CuA_2, slightly larger. Wing fringe brown with scattered grayish scales concentrated near tornus.

Ventral forewing with opaque macules repeated from dorsal surface, dark brown, subtly grayish at base 1A-2A; scattered dark golden-brown overscaling sparsely along costa, densest near apex distad of apical macules, extending along distal margin to M_3, and basad along wing veins, very pronounced from R_3 through CuA_1. Additional white macules as follows: subapical in M_1-M_2, just distad of distal end of macule in R_5-M_1, minute; posterior half of 1A-2A, small, circular, centered below macule in mid-CuA_1-CuA_2. Wing fringe as on upper surface. Ventral hindwing dark brown with dense overscaling of dark golden-brown scales evenly distributed across wing except over macules. Whitish-beige macules as follows: small, circular to elongate oval submarginal spots in Sc+R_1-Rs (smallest), Rs-M_1, anterior and posterior halves of M_1-M_3 (posterior macule subtly offset basad from rest of submarginal series), M_3-CuA_1 and CuA_1-CuA_2; postmedial, circular, in anterior and posterior halves of M_1-M_3 just distad of discal cell end, and oval-shaped at mid-CuA_1-CuA_2; circular spot at mid-discal cell; finally, very subtle beige linear streak at mid-1A-2A spanning distal 1/4 of cell; distal 1/4 of vein 2A with similar beige coloration. Wing fringe as on upper surface.

Dorsal head black with scattered brown, olivaceous and gray setiform scales; few whitish scales dorsad of eye; labial palpus with mixture of brown and olivaceous setiform scales on dorsum, mixed whitish and brown setiform scales on venter, third segment porrect, black on dorsum and venter. Right antenna missing. Base of left antennal shaft black on dorsum with ochreous-beige at base of each segment, ochreous-beige on venter with black between segments; remaining left antennal shaft and club missing. Dorsal thorax and tegulae brown with scattered olivaceous setiform scales, ventral thorax brown

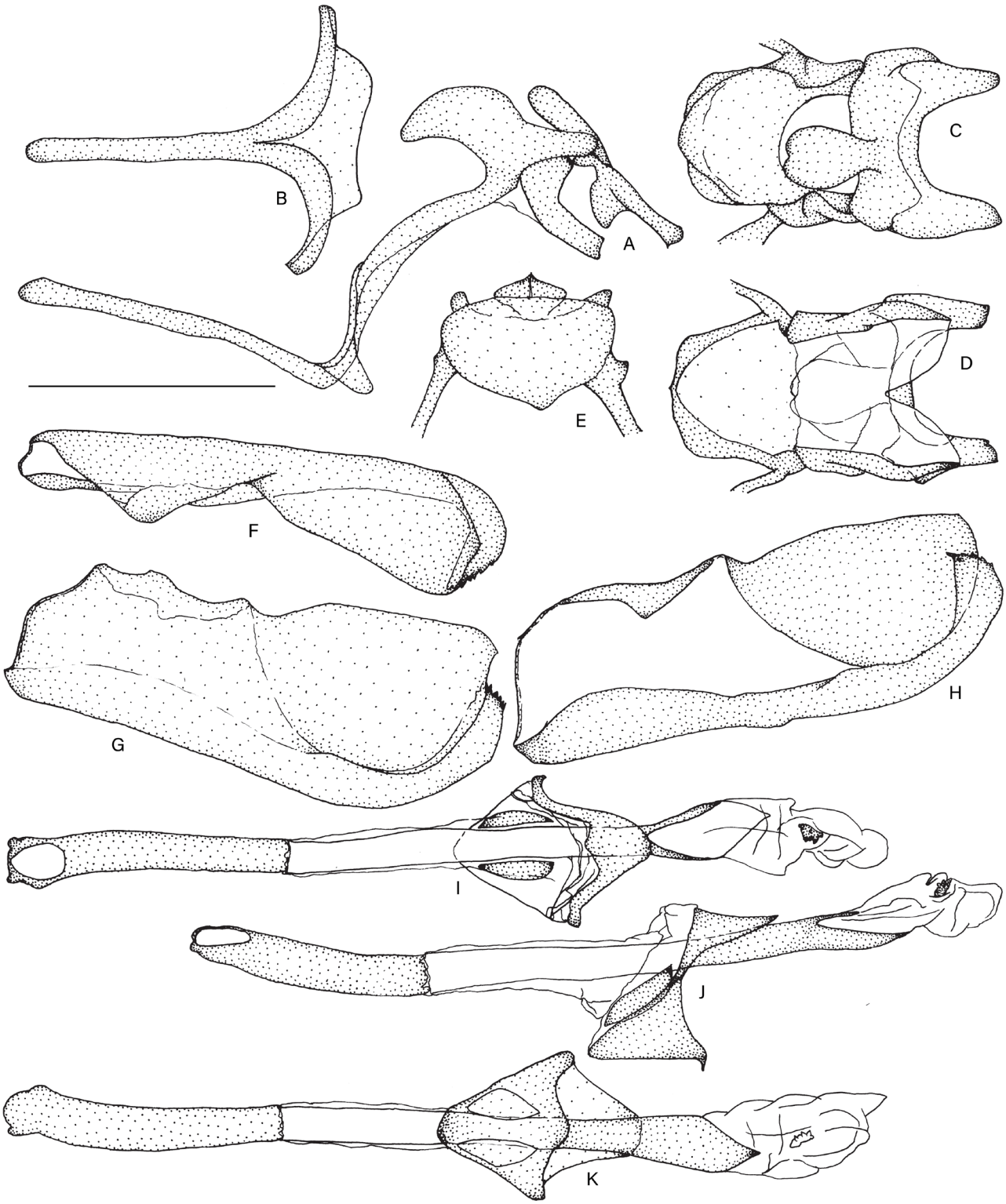

Figure 5. Male genitalia of *Piruna uruapana* **sp. nov.** paratype from the south side of Cerro de la Cruz, 1700-2300 m, Municipality of Uruapan, Michoacán, Mexico, 24 August 1991, collected by Lamberto González-Cota; Andrew D. Warren dissection number ADW 95-87. A) Left-lateral view of uncus, gnathos, tegumen, and saccus; B) ventral view of saccus; C) dorsal view of uncus and tegumen; D) ventral view of uncus, gnathos, and tegumen; E) anterior view of uncus and gnathos; F) dorsal view of right valve; G) exterior lateral view of left valve; H) interior lateral view of right valve; I) dorsal; J) ventral; K) left-lateral view of aedeagus, juxta, transtilla, and everted vesica. Scale bar = 1.0 mm.

with dense gray and brown setiform scales, continuing onto ventral edge of femur; left prothoracic and right mesothoracic legs detached and stored in a gelatin capsule pinned below specimen, remaining legs missing; fore-tibia with relatively short whitish-beige epiphysis; mid-leg ochreous-brown on dorsum, whitish-beige on venter; mid-tibia with pair of spurs distad, outer spur about 2/3 length of inner. Dorsal abdomen dark brown with scattered dark beige setiform scales on anterior half; lateral abdomen whitish-beige with longitudinal brownish stripe; ventral abdomen grayish-white with few scattered brownish scales and scattered beige-gray setiform scales on anterior half.

Male genitalia (Fig. 6): uncus bifurcate, arms wide apart at posterior

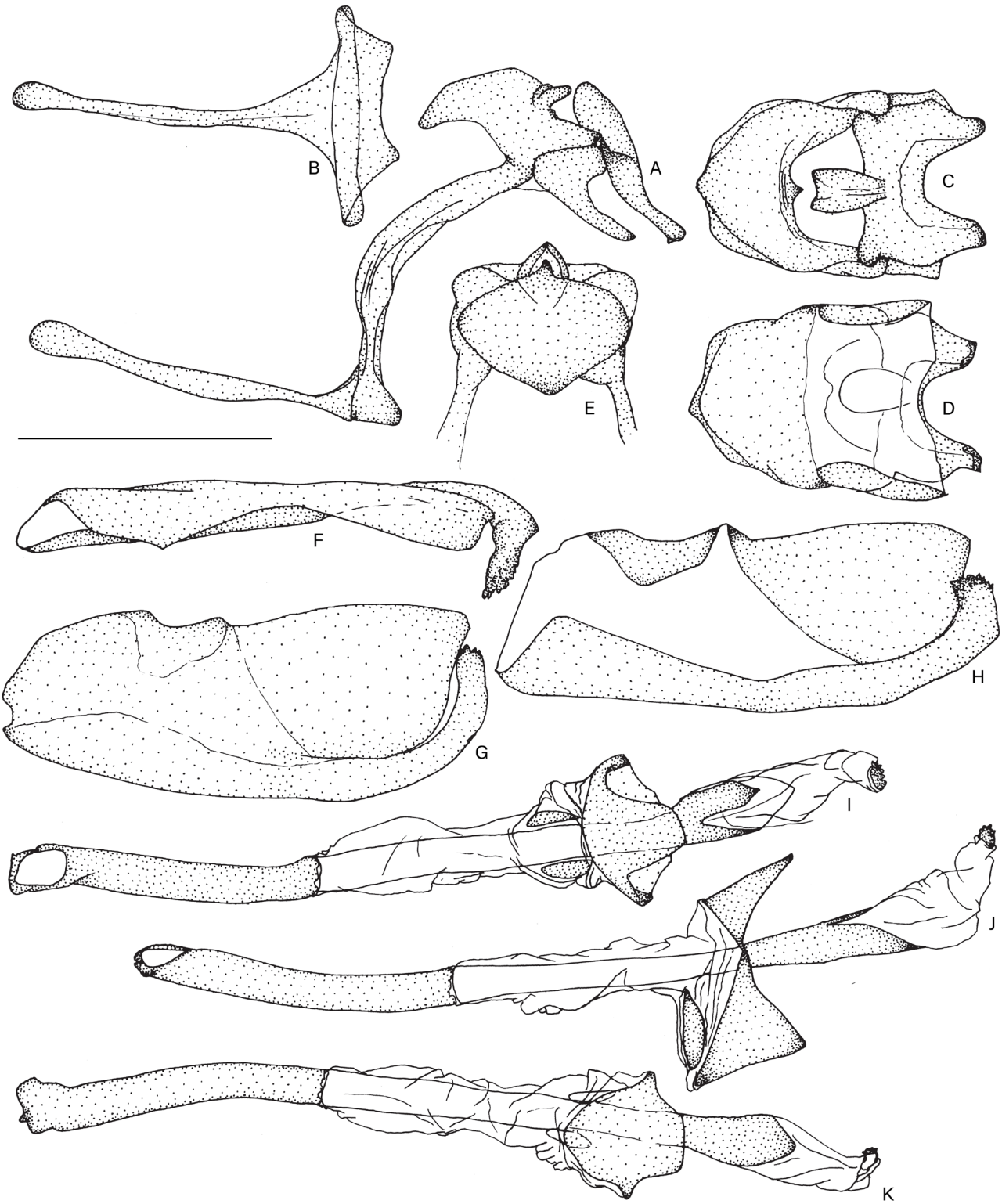

Figure 6. Male genitalia of *Piruna chinicuila* **sp. nov.** holotype from Los Laureles, 1365 m, Municipality of Chinicuila, Michoacán, Mexico, 12 September 1999, collected by Luis Lamberto González-Cota; Riley J. Gott dissection number RG0422. A) Left-lateral view of uncus, gnathos, tegumen, and saccus; B) ventral view of saccus; C) dorsal view of uncus and tegumen; D) ventral view of uncus, gnathos, and tegumen; E) anterior view of uncus and gnathos; F) dorsal view of right valve; G) exterior lateral view of left valve; H) interior lateral view of right valve; I) dorsal; J) ventral; K) left-lateral view of aedeagus, juxta, transtilla, and everted vesica. Scale bar = 1.0 mm.

tips, gradually widening anteriorly in dorsal view, posterior tips ventrally oriented, uncus wider at tip, narrows slightly to constriction near 1/3 its length (length including median apophysis) before widening to connection with tegumen in lateral view; median apophysis narrow posteriorly, gradually widening to square anterior edge with shallow v shape in dorsal view; gnathos bifurcate, narrow, caudal tips bluntly pointed in lateral view, with membranous integument connecting both sides in ventral view; tegumen with fenestra wider at posterior edge, gradually narrowing to anterior edge, anterior edge with single posterior projecting point in dorsal view; saccus 1/3 – 1/2 length of phallus, curving dorsally, constricted at 1/4 length from anterior edge then

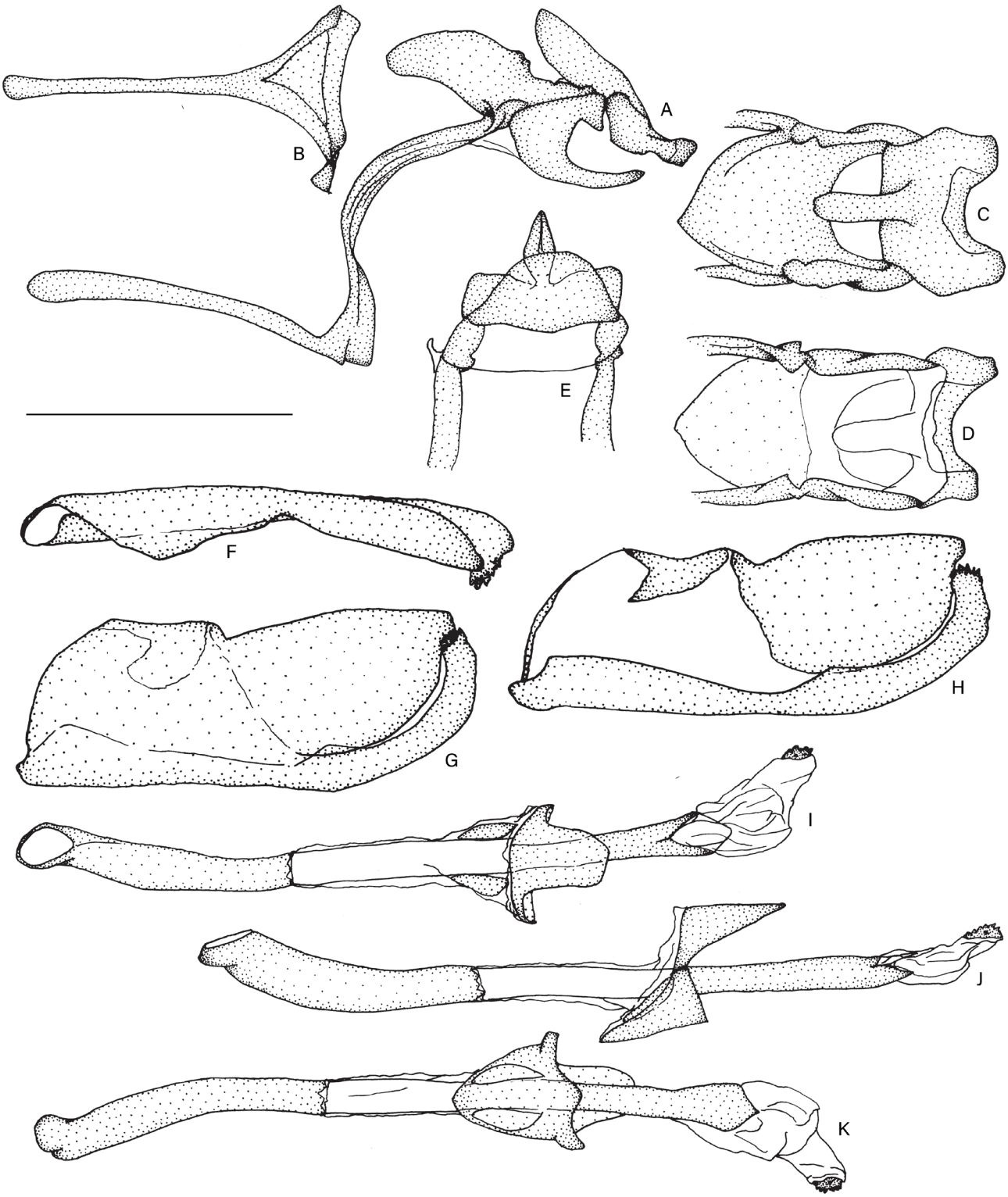

Figure 7. Male genitalia of *Piruna bailowitzi* **sp. nov.** paratype from east of Rancho Covadonga, 2135 m, Sierra Huachinera, Municipality of Huachinera, Sonora, Mexico, 22 August 1997, collected by Sanford A. Upson; Riley J. Gott dissection number RG0411. A) Left-lateral view of uncus, gnathos, tegumen, and saccus; B) ventral view of saccus; C) dorsal view of uncus and tegumen; D) ventral view of uncus, gnathos, and tegumen; E) anterior view of uncus and gnathos; F) dorsal view of right valve; G) exterior lateral view of left valve; H) interior lateral view of right valve; I) dorsal; J) ventral; K) left-lateral view of aedeagus, juxta, transtilla, and everted vesica. Scale bar = 1.0 mm.

widens back to same thickness before becoming constricted 1/4 length from posterior edge then widening to vinculum in lateral view; valvae symmetric, 3/4 length of phallus; sacculus and harpe fused, widest at anterior edge, narrowing to half its width at widest point near mid-length; harpe narrow, caudal tip expanded, dentate, angled towards body midline further than ampulla, longer than ampulla; ampulla completely separated for entire length, not overlapping harpe, slightly angled towards body midline with harpe; phallus long, narrow, anterior 1/3 thicker than posterior 2/3, caudal edge with tip on dorsal and ventral surfaces, lateral edges invaginated; ductus ejaculatoris arising from dorsal surface; vesica with single, dentate cornutus; transtilla sclerotized, smaller than

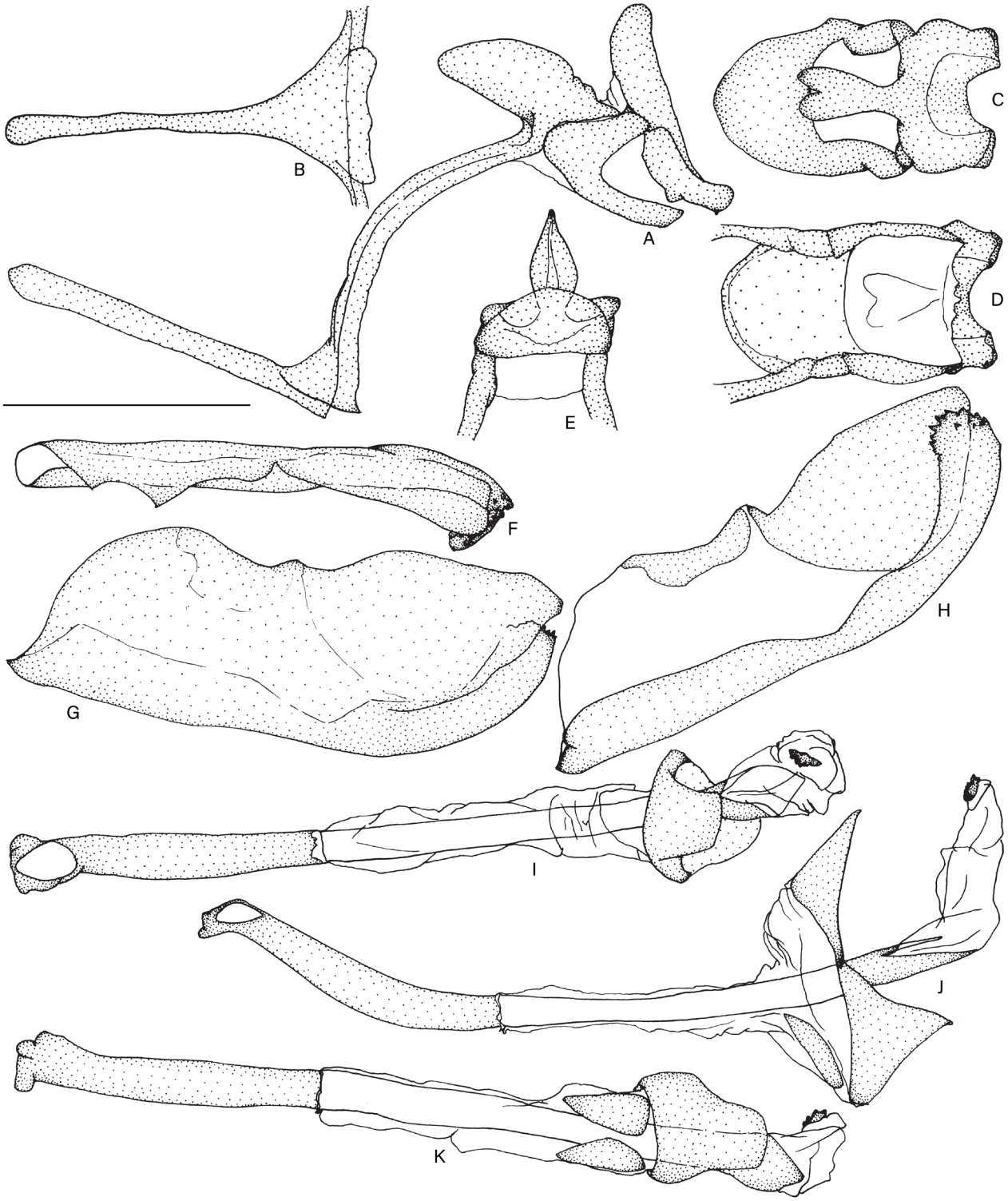

Figure 8. Male genitalia of *Piruna temascaltepeca* **sp. nov.** paratype from the road from Temascaltepec de González to Zacazonapan, 3.0 road miles NW jct. Hwy. 134, 0.4 road miles SW jct. road to Valle del Bravo, 1981 m, Municipality of Temascaltepec, State of México, Mexico, 6 September 2007, collected by Andrew D. Warren; Riley J. Gott dissection number RG0413. A) Left-lateral view of uncus, gnathos, tegumen, and saccus; B) ventral view of saccus; C) dorsal view of uncus and tegumen; D) ventral view of uncus, gnathos, and tegumen; E) anterior view of uncus and gnathos; F) dorsal view of right valve; G) exterior lateral view of left valve; H) interior lateral view of right valve; I) dorsal; J) ventral; K) left-lateral view of aedeagus, juxta, transtilla, and everted vesica. Scale bar = 1.0 mm.

juxta, triangular in lateral view, posterior edge expanded in dorsal view; juxta sclerotized, triangular in lateral view, irregularly shaped in ventral view; two elongate, elliptical, sclerotized plates present in anellus.

FEMALE: Unknown.

Specimens examined. Holotype male with the following labels: white, printed: / MEXICO: / MICHOACÁN: / Mpio. Chinicuila: / Los Laureles, 1365m / 18°41’30.3”N / 103°22’55.1”W / 12 IX 1999 / L. L. González-Cota /; white, printed and handprinted: Riley J. Gott / Genitalia / Dissection No. / RG0422 /; red, printed: / HOLOTYPE / *Piruna chinicuila* / A. Warren & Gott /. The

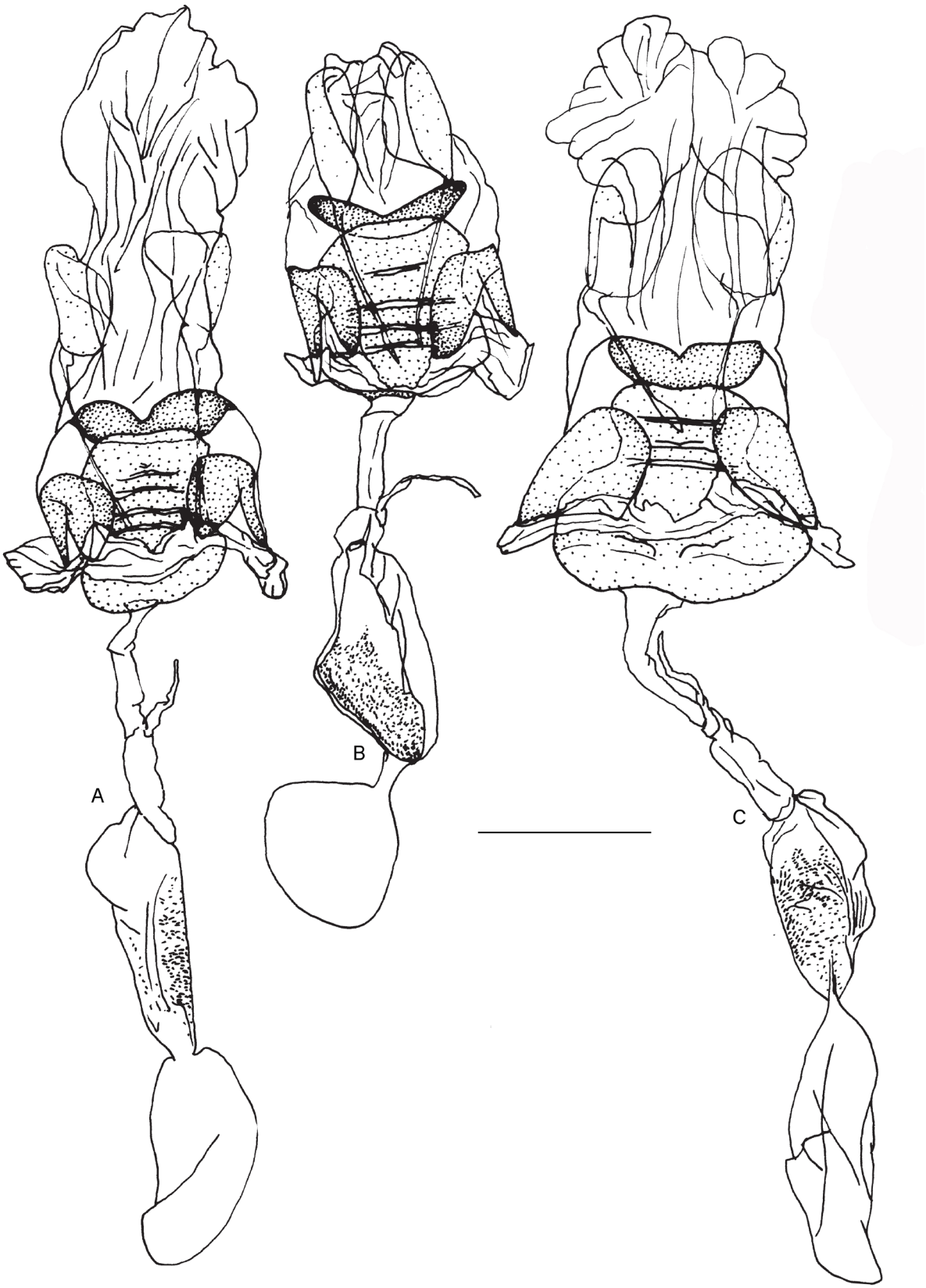

Figure 9. Ventral views of genitalia of female *Piruna* paratypes: A) *Piruna uruapana* **sp. nov.**, B) *P. bailowitzi* **sp. nov.**, and C) *P. temascaltepeca* **sp. nov.** A) From the south side of Cerro de la Cruz, 1700-2300 m, Municipality of Uruapan, Michoacán, Mexico, 29 August 1997, collected by Andrew D. Warren. Riley J. Gott dissection number RG0433. B) From east of Rancho Covadonga, 2135 m, Sierra Huachinera, Municipality of Huachinera, Sonora, Mexico, 22 August 1997, collected by Sanford A. Upson; Andrew D. Warren dissection number ADW 97-129. C) From the road from Temascaltepec de González to Zacazonapan, 3.0 road miles NW jct. Hwy. 134, 0.4 road miles SW jct. road to Valle del Bravo, 1981 m, Municipality of Temascaltepec, State of México, Mexico, 6 September 2007, collected by Andrew D. Warren; Riley J. Gott dissection number RG0421. Scale bar = 1.0 mm.

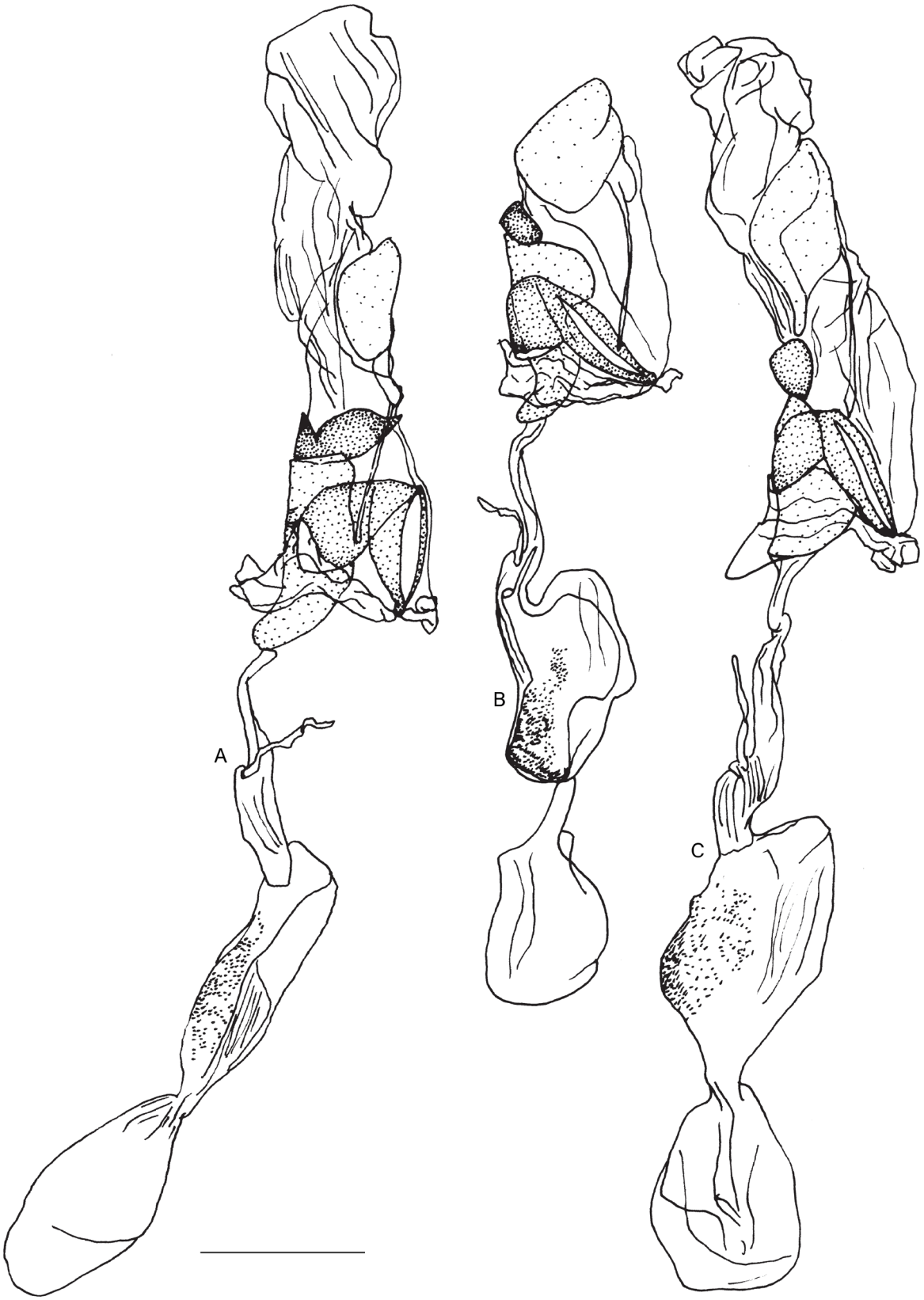

Figure 10. Right-lateral views of genitalia of female *Piruna* paratypes: A) *Piruna uruapana* **sp. nov.**, B) *P. bailowitzi* **sp. nov.**, and C) *P. temascaltepeca* **sp. nov.** A) From the south side of Cerro de la Cruz, 1700-2300 m, Municipality of Uruapan, Michoacán, Mexico, 29 August 1997, collected by Andrew D. Warren. Riley J. Gott dissection number RG0433. B) From east of Rancho Covadonga, 2135 m, Sierra Huachinera, Municipality of Huachinera, Sonora, Mexico, 22 August 1997, collected by Sanford A. Upson; Andrew D. Warren dissection number ADW 97-129. C) From the road from Temascaltepec de González to Zacazonapan, 3.0 road miles NW jct. Hwy. 134, 0.4 road miles SW jct. road to Valle del Bravo, 1981 m, Municipality of Temascaltepec, State of México, Mexico, 6 September 2007, collected by Andrew D. Warren; Riley J. Gott dissection number RG0421. Scale bar = 1.0 mm.

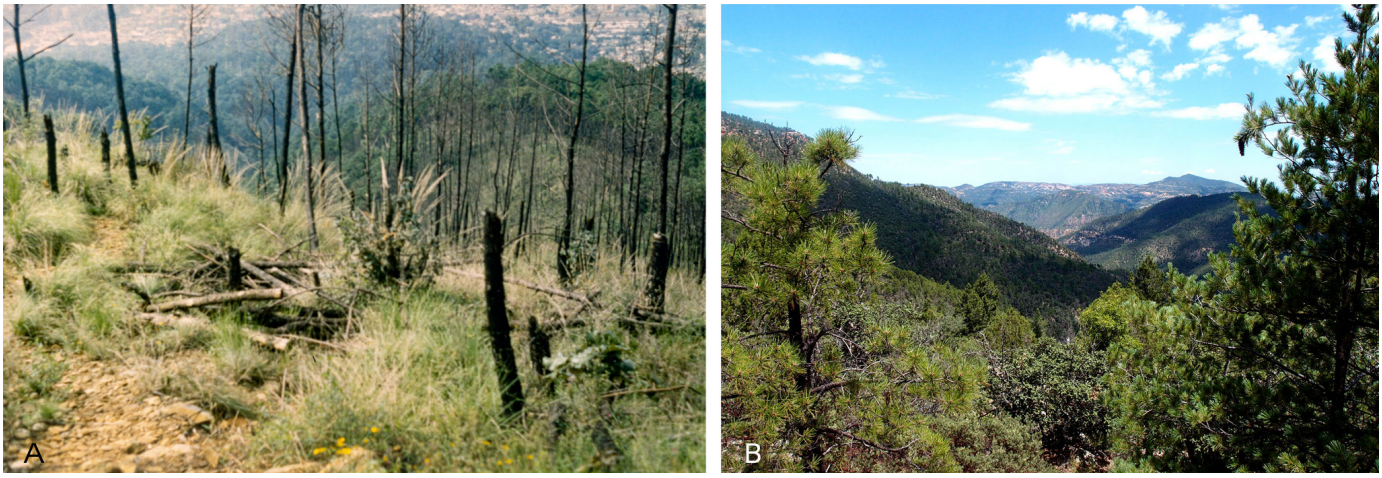

Figure 11. *Piruna* habitats. A) Type locality of *P. uruapana* **sp. nov.**, south side of Cerro de la Cruz, 2050 m, Municipality of Uruapan, Michoacán, Mexico, 23 July 1996, photo by Andrew D. Warren. B) Habitat of *P. bailowitzi* **sp. nov.**, vic. Rancho El Tigre, 2300m, Sierra El Tigre, Municipality of Nacozari de García, Sonora, Mexico, 11 August 2015, photo by Ana Lilia Reina-G.

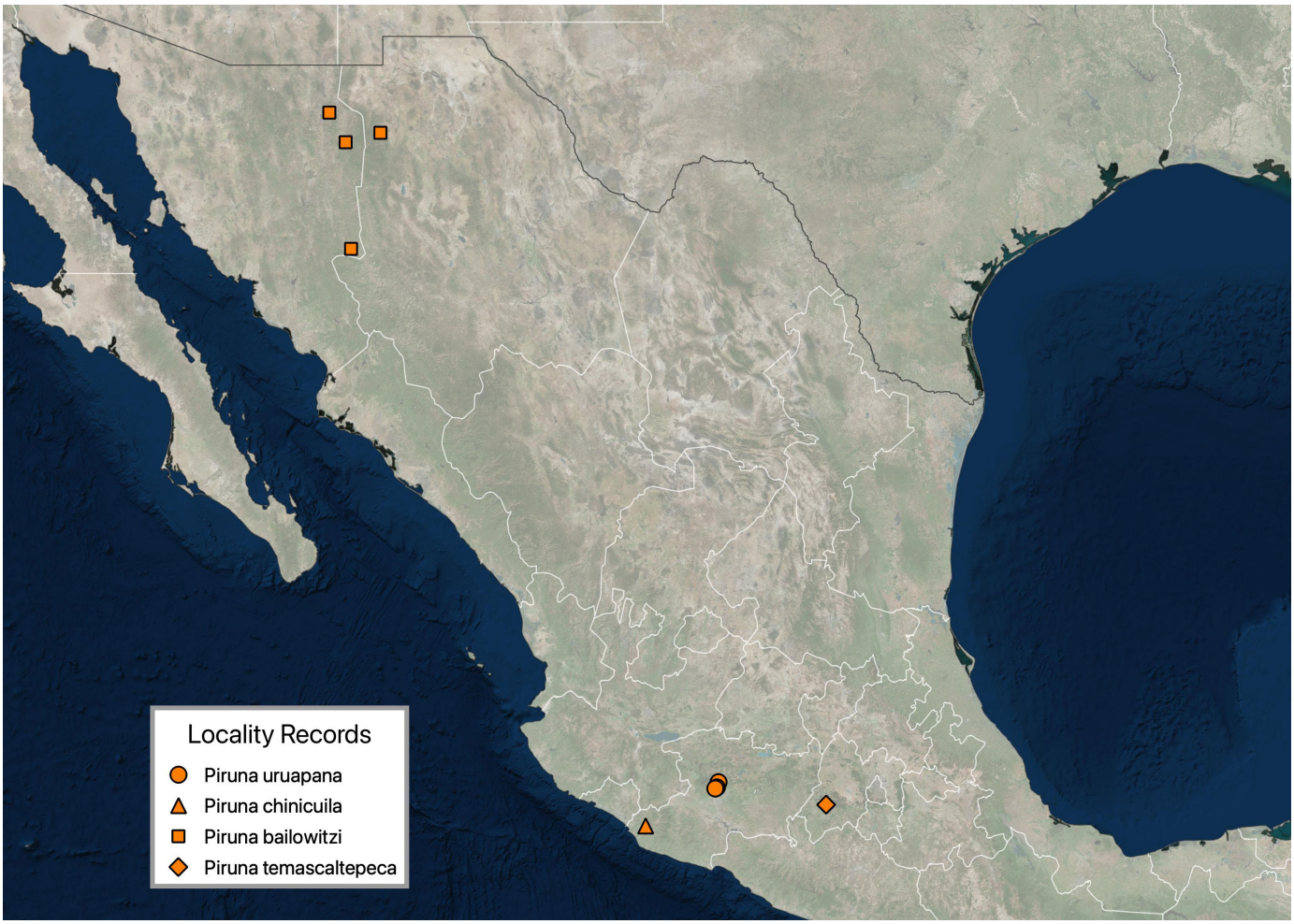

Figure 12. Distribution of *Piruna uruapana* **sp. nov.**, *P. chinicuila* **sp. nov.**, *P. bailowitzi* **sp. nov.**, and *P. temascaltepeca* **sp. nov.**

holotype will be deposited at the Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, Mexico City (MZFC).

Type locality. The glassine envelope the holotype specimen was preserved in listed the coordinates of Los Laureles, in the Municipality of Chinicuila, Michoacán, as 18°41'30.3"N, 103°22'55.1"W, at 1365 m elevation. The nearest community by the name of Los Laureles is located about 1.5 km to the northwest of this site, in the vicinity of 18°42'03.4"N, 103°23'28.9"W, at an elevation of 1544 m. The specific site where the holotype specimen was collected remains unknown, and the collector is deceased.

Etymology. *Piruna chinicuila* **sp. nov.** is named after the Municipality of Chinicuila, Michoacán, Mexico, where the holotype specimen was collected.

Distribution and phenology. To date, *P. chinicuila* **sp. nov.** is known only from its type locality (Fig. 12). Despite detailed surveys for Hesperiidae in many surrounding municipalities in southwestern Michoacán, *P. chinicuila* **sp. nov.** has not been detected elsewhere (Salinas-Gutiérrez *et al*., 2015). However, *P. chinicuila* **sp. nov.** could occur in habitats similar to that of the type locality elsewhere in Sierra Madre del Sur of Michoacán, Jalisco and/or Colima. The collection date in mid-September corresponds with the middle of the of the local rainy season.

Biogeography. *Piruna chinicuila* **sp. nov.** occurs in the central subprovince of Mexico's Sierra Madre del Sur (Morrone, 2017), a range known to host many endemic plant and animal species (Luna-Vega *et al*., 2016; Almazán-Núñez *et al*., 2018; Rocha-Méndez *et al*., 2019).

Ecology. Ecological information for *P. chinicuila* **sp. nov.** is lacking, although Google Earth imagery of the vicinity of the type locality indicates a woodland-grassland mosaic of habitats.

Diagnosis and discussion. *Piruna chinicuila* **sp. nov.** (Figs. 1O-P) is similar to the boldest-marked specimens of *P. uruapana* **sp. nov.** (*e.g*., Fig. 1I-J). The holotype of *P. chinicuila* **sp. nov.** differs from boldly marked *P. uruapana* **sp. nov.** individuals in details of the ventral forewing maculation, including the presence of a minute sub-apical spot in M_1-M_2, and in the presence of a small circular spot in the posterior portion of 1A-2A. None of the 235 specimens examined of *P. uruapana* **sp. nov.** possess these additional ventral forewing spots. In addition, the dark golden-brown scaling along the ventral forewing veins from R_3 through CuA_1 is more prominent on *P. chinicuila* **sp. nov.** than it is on any specimen of *P. uruapana* **sp. nov.** *Piruna chinicuila* **sp. nov.** wing markings differ from other similar species of *Piruna* as discussed under *P. uruapana* **sp. nov.**

Despite the subtle differences in wing markings, which in themselves would not strongly support species-level status for this unique specimen, the genitalia of the holotype of *P. chinicuila* **sp. nov.** (Fig. 6) differ from those of *P. uruapana* **sp. nov.** (Fig. 5; eleven males dissected) in many ways. In dorsal view, the uncus of *P. uruapana* **sp. nov.** (Fig. 5C) is wider and its bifurcate arms are separated by a greater distance than in *P. chinicuila* **sp. nov.** (Fig. 6C); in lateral view, the uncus of *P. uruapana* **sp. nov.** (Fig. 5A) curves near its midpoint to form a ventrally angled, triangular plate that nearly contacts the gnathos, while *P. chinicuila* **sp. nov.** (Fig. 6A) does not have such a plate; in anterior view, the median apophysis of the uncus is wider, more flattened in *P. uruapana* **sp. nov.** (Fig. 5E), while it is folded and more pointed in *P. chinicuila* **sp. nov.** (Fig. 6E); in dorsal view of the valvae, the harpe of *P. uruapana* **sp. nov.** (Fig. 5F) is broad, remaining near the ampulla its entire length, while the harpe is narrower and its posterior tip is widely separated from the ampulla in *P. chinicuila* **sp. nov.** (Fig. 6F); in ventral view, the juxta is triangular in *P. uruapana* **sp. nov.** (Fig. 5K), while it is essentially square in *P. chinicuila* **sp. nov.** (Fig. 6K). For these reasons, we are confident in the species-level status of *P. chinicuila* **sp. nov.**

Piruna bailowitzi A. Warren & Gott, **sp. nov.**
(Figs. 2A-D, 4, 7, 9B, 10B, 11B, 12)

Description. MALE (Figs. 2A-B): mean forewing length = 11.6 mm (11.3-12.2 mm, n = 3, holotype = 11.3 mm); forewing apex slightly produced, termen evenly convex, no stigma or brand; hindwing slightly produced at apex, termen convex to CuA_1, then straight to tornus at 1A+2A, inner margin straight. Dorsal forewing dark brown, few scattered grayish scales at base. Opaque whitish-beige macules as follows: subapical in R_3-R_4 to R_5-M_1, rectangular; macule in R_4-R_5 smaller, offset basad, mostly overlapping macule in R_3-R_4 and slightly overlapping macule in R_5-M_1; postmedial in mid-M_3-CuA_1, circular to semi-rectangular; mid-CuA_1-CuA_2, semi-rectangular; basal part of CuA_1-CuA_2, larger, semi-rectangular; finally, hour-glass shaped spanning distal third of discal cell, situated above distal end of macule at base of CuA_1-CuA_2; small, linear, non-opaque streak in posterior part of CuA_2-1A+2A, at end of basal 1/3 of cell; size of all macules individually variable. Wing fringe brown with scattered grayish scales, concentrated near tornus. Dorsal hindwing same ground color as forewing; whitish-beige macules as follows: M_1-M_3, bipartite, anterior macule large, elongate triangular, posterior macule semi-rectangular to linear; CuA_1-CuA_2, linear to oval shaped. Wing fringe brown with scattered grayish scales, concentrated near tornus.

Ventral forewing with macules repeated from dorsal surface except linear non-opaque streak in CuA_2-1A+2A absent, dark brown, grayish at base of 1A-2A; scattered olivaceous-brown overscaling along costa, near apex distad of apical macules, variably extending along distal margin to CuA_1 or CuA_2. Narrow line along termen somewhat darker than ground color; wing fringe as on upper surface. Ventral hindwing dark brown with dense overscaling of olivaceous-brown scales evenly distributed across wing except over macules and sparse in 2A-3A. Whitish-beige macules as follows, individually variable in size: minute, circular to elongate oval submarginal spots in Sc+R_1-Rs (absent on most individuals), Rs-M_1, posterior half of M_1-M_3, M_3-CuA_1 and CuA1-CuA2 (largest); postmedial, linear to oval in posterior part of M_1-M_3 just distad of discal cell end, and larger, at mid-CuA_1-CuA_2; long, linear streak in anterior part of M_1-M_3 from discal cell end to submargin, then continued basad in distal part of discal cell; circular to elongate oval spot at mid-discal cell; finally, broad linear metallic silver streak filling 1A-2A spanning length of wing, becoming whitish-beige near margin. Narrow line along termen from apex to 1A somewhat darker than ground color; wing fringe as on upper surface though mostly whitish-beige at 1A-2A adjacent to linear streak.

Dorsal head black with scattered black, olivaceous and gray setiform scales; small patch of whitish scales dorsad of eye; labial palpus with mixture of black and gray setiform scales on dorsum, whitish to pale beige with scattered black setiform scales on venter, third segment porrect, black on dorsum and whitish-beige on venter. Antennal shaft and club black on dorsum with gray at base of each segment, mostly whitish-beige on venter with black between segments; nudum ochreous, 8-9 segments. Dorsal thorax and tegulae black with scattered black and olivaceous setiform scales, ventral thorax brown with dense white setiform scales, continuing onto ventral edge of femur; fore-tibia with relatively short brownish epiphysis; mid- and hind-legs pale brownish on dorsum, whitish-beige on venter; mid-tibia with pair of spurs distad, outer spur about 2/3 length of inner; hind-tibia with two pairs of spurs, in each pair, outer spurs about 4/5 length of inner. Dorsal abdomen dark brown with scattered olivaceous setiform scales on anterior half; lateral abdomen whitish-beige with longitudinal brownish stripe; ventral abdomen whitish with few scattered brownish scales and scattered pale gray setiform scales on anterior half.

Male genitalia (Fig. 7), one specimen dissected: uncus shallowly bifurcate, arms thick, wide apart at posterior tips, gradually widening anteriorly in dorsal view, posterior tips bulbous, ventrally pointed in lateral view, uncus wide at tip, narrows slightly to constriction near 1/3 its length (length including median apophysis) before widening to connection with tegumen in lateral view; median apophysis narrow, same width in dorsal view, extending past fenestra, reaching caudal edge of tegumen, appearing spear-shaped, dorsally projected from anterior view; gnathos bifurcate, sharply pointed in lateral view, widely separated by membranous integument in ventral view; tegumen with fenestra appearing as a half circle with posterior edge open in dorsal view, anterior edge narrowing to an anterior projecting point in dorsal view; saccus 1/3 – 1/2 length of phallus, slightly curved ventrally in lateral view, gradually widening from posterior edge to anterior tip; valvae symmetric, 3/4 length of phallus; sacculus

and harpe fused, widest at anterior edge, narrows to constriction at midpoint, widens to 2/3 width at widest point, remains same width to posterior tip of harpe; harpe narrow, caudal tip expanded, dentate, slightly angled towards body midline, longer than ampulla; ampulla completely separated, overlaps harpe at posterior tip, slightly angled towards body midline with harpe; phallus long, narrow, remaining same width for caudal 2/3 then widens gradually to anterior edge, caudal tip on ventral surface, invaginated on dorsal side; ductus ejaculatoris arising from dorsal surface; vesica with single, dentate cornutus; transtilla sclerotized, approximately same size as juxta, triangular in lateral view, posterior edge expanded in dorsal view; juxta sclerotized, triangular in lateral and ventral views, with posterior edge expanded at midpoint in ventral view; two elongate, elliptical, sclerotized plates present in anellus.

FEMALE (Figs. 2C-D, 4): mean forewing length = 14.6 mm (14.3-14.9, n = 2); forewing and hindwing shape as on male, wings somewhat more rounded. Dorsal color and spotting pattern as on male; size of spots individually variable, as on male, spots subtly paler than on male. Ventral forewing as on male. Ventral hindwing pattern elements as on male and individually variable though subtly better-developed than on male; olivaceous-brown overscaling denser. Head, thorax and abdomen as on male except no epiphysis on fore-tibia; brown longitudinal lateral stripe on abdomen broader, very prominent (Fig. 4).

Female genitalia (Figs. 9B, 10B), one specimen dissected: papillae anales large, rectangularly shaped in lateral view, with many long setae; apophyses posterior narrow, long, reaching posterior edge of lamella antevaginalis, slightly widens near anterior tip before tapering to point; lamella postvaginalis reduced to small sclerotized plate, posterior edge angled to midpoint to form shallow v-shape, anterior edge curved; antrum nearly as long as wide, constricted near mid-length with both sides of constriction being of nearly equal width, four grooves perpendicular to the midline; lamella antevaginalis reduced, sclerotized on left and right sides with membranous integument connecting sides medially; apophyses anterior reduced; ductus seminalis arising closer to posterior edge of corpus bursae than anterior edge of antrum; cervix bursae bulbous; corpus bursae long, ovate, with many small, pointed signa; appendix bursae spherical.

Specimens examined. Holotype male with the following labels: white, printed: / MEXICO: SONORA: Mpio. / Huachinera: Sierra Huachinera / E of Rancho Covadonga, 2135m / vic. 30°06’51”N 108°54’13”W / 19-VIII-1998 / Sanford A. Upson /; red, printed: / HOLOTYPE / *Piruna bailowitzi* / A. Warren & Gott /. One male and two female paratypes from same locality as holotype, 22-VIII-1997, Sanford A. Upson. One male paratype from MEXICO: SONORA: Mpio. Nacozari de García: 27.2 km WNW Bavispe, Rancho El Tigre, 2300m, 30°34’57”N 109°11’54”W, 11-VIII-2015, T. Van Devender (JPB); one additional male paratype from MEXICO: CHIHUAHUA: 19 mi. SW of Colonia Juárez, 12-VIII-1998, James P. Brock (JPB). The holotype will be deposited at the Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, Mexico City.

Type locality. The area where the holotype and most paratypes of *P. bailowitzi* **sp. nov.** were encountered is on the west slope of the Sierra Huachinera in northeastern Sonora, Mexico, along the road that leads southwest into the Sierra from the town of Huachinera, at about 2135 m elevation, east of Rancho Covadonga. The habitat comprises relatively dense pine-oak forest, with abundant stands of *Ceanothus fendleri* A. Gray. In 1997, the area contained multiple small fire scars, most of them spanning just a few acres, that appeared to be the result of lightning strikes (J. Brock, pers. comm. 2020).

Etymology. *Piruna bailowitzi* **sp. nov.** is named in honor of Richard A. Bailowitz, an exceptional lepidopterist, in celebration of his countless contributions to our knowledge of the butterflies of Sonora, Mexico, and Arizona, USA.

Distribution and phenology. To date, *Piruna bailowitzi* **sp. nov.** is known from just four localities in northwestern Mexico (Fig. 12): two in northeastern Sonora, one in adjacent northwestern Chihuahua, and one from east-central Sonora along Route 16. The latter record is based on photographs of one live female individual, taken by Michael Bearce in the Municipality of Yécora at Los Pilares, Route 16, Km. 300, 1305m, 28°24’07”N 108°47’47”W, 8 August, 2018 (Fig. 4). This represents the southernmost known record for the species. The northernmost known locality for *P. bailowitzi* **sp. nov.** is in the Sierra El Tigre (Fig. 11B), at Rancho El Tigre, 2300 m (coordinates listed above). Adults have been encountered on 8 August (live female photo), 11 August (male from Rancho El Tigre), 12 August (male from Chihuahua), 19 August (holotype male), and 22 August (male and two females), indicating a single annual brood in August, possibly extending into September. This time corresponds with the middle of the local rainy season.

Biogeography. *Piruna bailowitzi* **sp. nov.** appears to be endemic to the far northern end of the Sierra Madre Occidental and the associated Sky Islands (Sierra El Tigre) of northeastern Sonora, Mexico. This area is known for a high degree of endemism in plant and animal taxa (Molina-Freaner & Van Devender, 2010; Van Devender *et al*., 2013).

Ecology. Little is known about *Piruna bailowitzi* **sp. nov.** Based on observations at the type locality by James P. Brock in 1997, forests in the area seem to be maintained naturally by small fires resulting from lightning strikes.

Diagnosis and discussion. *Piruna bailowitzi* **sp. nov.** is readily identified by its large size, dark dorsal ground color, metallic silver linear streaks on the ventral hindwing (Figs. 2A-D), and its ochreous brown lateral abdominal stripe (Fig. 4). The only superficially similar species of *Piruna*, other than the new species described below, is *P. roeveri* (L. Miller & J. Miller, 1972) (see Warren *et al.* (2017) for detailed images of *P. roeveri*, including the holotype), which shares a similar ventral hindwing pattern, but lacks the lateral abdominal stripe of *P. bailowitzi* **sp. nov.**, and the ventral hindwing linear streaks in M_1-M_3 and 1A-2A are not metallic silver as they are on *P. bailowitzi* **sp. nov.** In addition, *P. bailowitzi* **sp. nov.** is much larger than *P. roeveri*, lacks the extensive ochreous dorsal overscaling found on *P. roeveri*, has paler dorsal and ventral forewing spots than *P. roeveri*, and has a much darker ventral forewing ground color than *P. roeveri*. Male genitalia of *P. bailowitzi* **sp. nov.** (Fig. 7) differ from those of *P. roeveri* (pers. obs.) in having blunt tips to the uncus arms in dorsal view (sharply pointed in *P. roeveri*), narrow gnathos arms in ventral view (widened anteriorly in *P. roeveri*), and the nearly even width of the phallus (constricted near the midpoint on *P. roeveri*). Female genitalia of *P. bailowitzi* **sp. nov.** (9B, 10B) differ from those of *P. roeveri* (pers. obs.) most prominently by the posterior edge of the lamella postvaginalis in ventral view, being subtly angled to the midpoint to form a shallow v-shape (midpoint swollen posteriorly in *P. roeveri* to form a bulbous B-shape).

Piruna temascaltepeca A. Warren & Gott, **sp. nov.**
(Figs. 2E-P, 3B, 8, 9C, 10C, 12)

Description. MALE (Figs. 2E-H): mean forewing length = 11.8 mm (10-7-12.9 mm, n = 10, holotype = 12.2 mm); forewing apex rounded, termen evenly convex, no stigma or brand; hindwing slightly produced at apex, termen convex

to CuA_1, then straight to tornus at 1A+2A, inner margin slightly convex. Dorsal forewing dark brown. Opaque whitish macules as follows: subapical in R_3-R_4 to R_5-M_1, semi-rectangular; macule in R_4-R_5 smaller, offset basad, partly overlapping macule in R_3-R_4 and variably overlapping macule in R_5-M_1 (slightly overlapping in holotype); postmedial in mid-M_3-CuA_1, rectangular; mid-CuA_1-CuA_2, semi-rectangular; basal part of CuA_1-CuA_2, nearly triangular; finally, roughly circular at anterior portion of distal third of discal cell, situated above macule at base of CuA_1-CuA_2, small; size of all macules individually variable. Wing fringe brown with scattered grayish scales near tornus. Dorsal hindwing same ground color as forewing; whitish macules as follows, which may be reduced or absent in darker individuals: M_1-M_3, bipartite, both macules elongate triangular, posterior macule reduced or sometimes absent; CuA_1-CuA_2, oval to semi-rectangular, poorly-developed in darkest individuals. Wing fringe brown with scattered grayish scales concentrated near tornus.

Ventral forewing with macules repeated from dorsal surface, dark brown, grayish in 1A-2A; scattered dark golden-brown overscaling along costa, densest near apex distad of apical macules, variably extending along distal margin to M_3 or CuA_1. Narrow line along termen somewhat darker than ground color; wing fringe as on upper surface. Ventral hindwing dark brown with dense overscaling of dark golden-brown scales evenly distributed across wing except over macules. Beige macules as follows, individually variable in size: small, circular to elongate oval submarginal spots in Sc+R_1-Rs (very small or absent), Rs-M_1, posterior half of M_1-M_3, M_3-CuA_1 and CuA_1-CuA_2; postmedial, linear to oval in posterior part of M_1-M_3 just distad of discal cell end, and at mid-CuA_1-CuA_2; long, linear streak in anterior part of M_1-M_3 from discal cell end to submargin, then continued basad in distal part of discal cell; circular spot at mid-discal cell; finally, broad linear streak across anterior 2/3 of 1A-2A spanning length of wing, becoming diffused near margin. Narrow line along termen from apex to 1A somewhat darker than ground color; wing fringe as on upper surface though mostly pale gray at 1A-2A adjacent to linear streak.

Dorsal head black with scattered black, olivaceous and gray setiform scales; small patch of gray scales dorsad of eye; labial palpus with mixture of black and gray setiform scales on dorsum, whitish to pale beige with scattered black setiform scales on venter, third segment porrect, black on dorsum and whitish-beige on venter. Antennal shaft and club black on dorsum with gray at base of each segment, mostly whitish on venter with some black between segments; nudum ochreous, 8-9 segments. Dorsal thorax and tegulae black with scattered black and olivaceous setiform scales, ventral thorax brown with dense white setiform scales, continuing onto ventral edge of femur; fore-tibia with relatively short brownish epiphysis; mid- and hind-legs pale brownish on dorsum, whitish-beige on venter; mid-tibia with pair of spurs distad, outer spur about 2/3 length of inner; hind-tibia with two pairs of spurs, in each pair, outer spurs about 4/5 length of inner. Dorsal abdomen dark brown with scattered gray setiform scales on anterior half; lateral abdomen whitish-beige with longitudinal brownish stripe; ventral abdomen whitish with few scattered brownish scales and scattered gray setiform scales on anterior half, as on dorsal surface.

Male genitalia (Fig. 8), five specimens dissected: uncus shallowly bifurcate, arms thick, wide apart at posterior tips, gradually widening anteriorly in dorsal view, posterior tips broad, ventrally pointed in lateral view, uncus nearly same width for entire length in lateral view, ventral point nearly reaching gnathos at 1/3 length from posterior tips in lateral view; median apophysis angled dorsally in lateral and anterior views, narrow, constricted near commencement, widens to anterior edge, anterior edge invaginated to form shallow v-shape in dorsal view, appearing spear-shaped in anterior view; gnathos bifurcate, bluntly pointed in lateral view, widely separated by membranous integument in ventral view; tegumen with fenestra appearing as a half circle with posterior edge open in dorsal view; saccus 1/3 – 1/2 length of phallus, straight, thick, remaining same width entire length in lateral view, widening posteriorly to vinculum in ventral view; valvae symmetric, 5/8 –3/4 length of phallus; sacculus and harpe fused, widest at anterior edge, narrows to constriction near midpoint, widens slightly, then constricts immediately until widening towards posterior tip of harpe; harpe broad at tip, dentate, angled slightly towards midline of body, same length as ampulla; ampulla overlaps harpe, angled towards body midline with harpe; phallus long, narrow, remaining same width for caudal 2/3, widens gradually to half of anterior 1/3, then narrows to anterior edge, anterior 1/3 curved dorsally, anterior tip bent ventrally, caudal tip on ventral surface, invaginated on dorsal side; ductus ejaculatoris arising from dorsal surface; vesica with single, dentate cornutus; transtilla sclerotized, approximately same size as juxta, triangular in lateral view, posterior edge expanded in dorsal view; juxta sclerotized, triangular in lateral view, posterior edge expanded in ventral view; two elongate, elliptical, sclerotized plates present in anellus.

FEMALE (Figs. 2I-P, 3B); mean forewing length = 12.8 mm (12.0-13.5 mm, n = 10); forewing and hindwing shape as on male, wings somewhat more rounded. Dorsal color and spotting pattern as on male; size of spots individually variable, as on male. Ventral forewing as on male. Ventral hindwing pattern elements generally as on male and individually variable; dark golden-brown overscaling denser, covering entire wing surface; pale macules metallic silver (not beige as on male), except beige at distal end of 1A-2A. Head, thorax and abdomen as on male except no epiphysis on fore-tibia; brown longitudinal lateral stripe on abdomen broader, very prominent (Fig. 3B).

Female genitalia (Fig. 9C, 10C), five specimens dissected: papillae anales large, rectangularly shaped in lateral view, with many long setae; apophyses posterior narrow, long, reaching posterior edge of lamella antevaginalis, widening near anteriorly to form spear-shaped tips; lamella postvaginalis reduced to small, sclerotized plate, posterior edge straight to midpoint, abruptly notched at midpoint, anterior edge curved; antrum long, constricted near mid-length with anterior side wider than posterior side, three grooves perpendicular to midline; lamella antevaginalis reduced, sclerotized on left and right sides with membranous integument connecting sides medially; apophyses anterior reduced; ductus seminalis arising near midpoint between anterior edge of antrum and posterior edge of corpus bursae; cervix bursae rectangular, not clearly distinguished from ductus bursae; corpus bursae ovate, with many small, pointed signa; appendix bursae large, elongate.

Specimens examined. Holotype male with the following labels: white, printed: / MEXICO: MÉXICO: Mpio. / Temascaltepec: camino / Temascaltepec-Zacazonapan / 3.0 rd. mi NW jct. Hwy. 134, / 0.4 rd. mi SW jct. camino a / Valle del Bravo, 1981m (6500') / 19°03'22.6"N 100°03'40.2"W / 6-IX-2007 / Andrew D. Warren /; red, printed: / HOLOTYPE / *Piruna temascaltepeca* / A. Warren & Gott /. Twenty-two male and twenty-nine female paratypes with same data as holotype. The holotype and various paratypes will be deposited at the Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, Mexico City (MZFC). Additional paratypes will be deposited at the McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Gainesville (MGCL), and the C. P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins (CSU).

Type locality. The site near Temascaltepec de González, State of México, Mexico, where the type series of *P. temascaltepeca* **sp. nov.** was collected is a gently sloping roadside habitat of about 15 acres comprised of open pine-oak forest with scattered open, grassy areas, which, based on the widespread presence of charred tree trunks, is apparently maintained by fires. Other species of grass-feeding Hesperiidae found flying in sympatry and synchrony with *P. temascaltepeca* **sp. nov.** include, among others, *Atrytonopsis llorentei*, *Lon melane vitellina* (Herrich-Schäffer, 1869), *Lon zabulon* (Boisduval & Le Conte, [1837]), and *Oarisma edwardsii* (W. Barnes, 1897).

Etymology. *Piruna temascaltepeca* **sp. nov.** is named after the town closest to its type locality, Temascaltepec de González, in the Municipality of Temascaltepec, State of México, Mexico.

Distribution and phenology. To date, *Piruna temascaltepeca* **sp. nov.** is known only from its type locality (Fig. 12). Systematic surveys of Hesperiidae elsewhere in the State of México (Hernández-Mejía *et al*., 2008) have failed to detect its presence, as have surveys for Hesperiidae in the neighboring states of Michoacán (Salinas-Gutiérrez *et al*., 2015) and Morelos (Legal *et al*., 2017). However, *P. temascaltepeca* **sp. nov.** likely occurs at additional sites in similar habitats. Based on the somewhat flight-worn condition of most of the type series, collected on 6 September 2007, *P. temascaltepeca* **sp. nov.** likely flies in a single annual flight from mid- or late-August to mid-September, depending on annual variation in

local conditions. This time corresponds with middle of the local rainy season, when afternoon rains generally occur daily.

Biogeography. Temascaltepec de González, the only known area supporting *P. temascaltepeca* **sp. nov.**, is situated on the southern slope of the central Trans-Mexican Volcanic Belt (Eje Neovolcánico), a region with many endemic animal and plant species (Luna-Vega *et al*., 2007).

Ecology. Adults of *P. temascaltepeca* **sp. nov.** were mainly encountered flying among a tall (generally 0.5-2.0 m tall), unidentified grass, which is likely the larval foodplant; this grass is very similar to, or may be the same species as the grass that appears to support *P. uruapana* **sp. nov.** in Michoacán. Most individuals of *P. temascaltepeca* **sp. nov.** were encountered flying among the tall grass, while some were found at the flowers of a small *Salvia* L. None were encountered at damp ground. As with the grassy sites that support *P. uruapana* **sp. nov.** in Michoacán, the open aspect of the type locality near Temascaltepec appears to be maintained by fires, either resulting from lightning strikes or man-made, as suggested by the abundant, charred tree trunks in the area. As with *P. uruapana* **sp. nov.**, it seems probable that *P. termascaltepeca* **sp. nov.** is dependent on fires to create and/or maintain suitable grass-dominated habitats in the otherwise normally dense pine-oak forest.

Diagnosis and discussion. *Piruna temascaltepeca* **sp. nov.** is immediately recognized by its large size, dark dorsal ground color, unique ventral hindwing pattern (Figs. 2E-P), and its lateral abdominal stripe (Fig. 3B), a feature shared only with *P. bailowitzi* **sp. nov.** (Fig. 4), *P. chinicuila* **sp. nov.** and *P. uruapana* **sp. nov.** (Fig. 3A). The ventral hindwing pattern is similar to *P. bailowitzi* **sp. nov.** (Figs. 2B, 2D) and *P. roeveri* (figured in detail by Warren *et al.* (2017)), but differs from both in many details. Unlike *P. bailowitzi* **sp. nov.** and *P. roeveri*, the ventral hindwing macules of *P. temascaltepeca* **sp. nov.** are sexually dimorphic in color, being beige on males and metallic silver on females. Compared to *P. bailowitzi* **sp. nov.**, *P. temascaltepeca* **sp. nov.** has narrower linear streaks in M_1-M_3 and 1A-2A, usually has better-developed submarginal and postmedian ventral hindwing spots, forewing semi-opaque macules are subtly paler, and lacks the distinctive hour-glass shaped spot in the forewing discal cell. Compared to *P. roeveri*, *P. temascaltepeca* **sp. nov.** is much larger with a darker dorsal coloration, lacks dorsal ochreous overscaling, has paler dorsal and ventral and forewing macules, has a much darker ventral forewing ground color, and possesses a well-developed lateral abdominal stripe, which is absent in *P. roeveri*.

Male and female genitalia of *P. temascaltepeca* **sp. nov.** differ from those of *P. roeveri* as indicated in the diagnosis for *P. bailowitzi* **sp. nov.** Male genitalia of *P. temascaltepeca* **sp. nov.** differ from those of *P. bailowitzi* **sp. nov.** as follows: the median apophysis of the uncus is narrow and anteriorly projected in *P. bailowitzi* **sp. nov.** (Figs. 7A, C), while it widens anteriorly and is dorsally projected, with a divided anterior tip, in *P. temascaltepeca* **sp. nov.** (Figs. 8A, C); in lateral view, the ventral surface of the uncus is smooth near its midpoint in *P. bailowitzi* **sp. nov.** (Fig. 7A), where there is a triangular shaped point nearly contacting the gnathos in *P. temascaltepeca* **sp. nov.** (Fig. 8A); in lateral view, the gnathos has a sharp posterior tip in *P. bailowitzi* **sp. nov.** (Fig. 7A), while it is blunt-tipped in *P. temascaltepeca* **sp. nov.** (Fig. 8A); in lateral view of the valvae, the harpe is narrow and clearly separated from the ampulla in *P. bailowitzi* **sp. nov.** (Fig. 7G), while it is wider, gradually widening to a broader posterior tip, and not clearly separated from the ampulla in *P. temascaltepeca* **sp. nov.** (Fig. 8G); in ventral view, the juxta gradually narrows to its anterior tip *P. bailowitzi* **sp. nov.** (Fig. 7K), while it is broadest at its anterior tip in *P. temascaltepeca* **sp. nov.** (Fig. 8K), gradually narrowing to a blunt posterior end.

Female genitalia of *P. bailowitzi* **sp. nov.** (Figs. 9B, 10B) differ from those of *P. temascaltepeca* **sp. nov.** (Figs. 9C, 10C) as follows: in ventral view, the caudal edge of the lamella postvaginalis forms a wide V-shape in *P. bailowitzi* **sp. nov.** (Figs. 9B), while it is flat until invaginating abruptly at the midline to form a shallow V-shaped notch in *P. temascaltepeca* **sp. nov.** (Figs. 9C); in ventral view, the antrum has four shallow, perpendicular grooves to the body midline, and is of nearly uniform width in *P. bailowitzi* **sp. nov.** (Figs. 9B), whereas it has three grooves and a narrower posterior end in *P. temascaltepeca* **sp. nov.** (Figs. 9C); the cervix bursae is short and bulbous in *P. bailowitzi* **sp. nov.** (Figs. 9B), while it is elongated and rectangular in *P. temascaltepeca* **sp. nov.** (Figs. 9C); the appendix bursae is roughly spherical in *P. bailowitzi* **sp. nov.** (Figs. 9B, 10B), while it is elongated in *P. temascaltepeca* **sp. nov.** (Figs. 9C, 10C).

DISCUSSION

Piruna uruapana **sp. nov.**, *P. chinicuila* **sp. nov.**, *P. bailowitzi* **sp. nov.**, and *P. temascaltepeca* **sp. nov.** appear to be very closely related to each other. Their large size, generally larger than other *Piruna* species, dark dorsal ground color lacking ochreous overscaling, and broad lateral abdominal bands set them apart from most other species in the genus. Wing patterns and male genitalia suggest that *P. uruapana* **sp. nov.** and *P. chinicuila* **sp. nov.** are each other's closest known relatives, while the same characters suggest a very close relationship between *P. bailowitzi* **sp. nov.**, and *P. temascaltepeca* **sp. nov.**

Ecologically, *P. uruapana* **sp. nov.**, *P. bailowitzi* **sp. nov.**, and *P. temascaltepeca* **sp. nov.** are similar in that they all exist in habitats that are apparently dependent on occasional fires to maintain grassy openings withing otherwise dense pine-oak forest, and all of them seem to fly in a single annual generation at the peak of the local rainy season. *Piruna uruapana* **sp. nov.** and *P. temascaltepeca* **sp. nov.** appear to utilize the same or a very similar species of grass as the larval foodplant. After the discovery of *P. uruapana* **sp. nov.** and *P. bailowitzi* **sp. nov.**, and noting their apparently close relationship, it was predicted that more species in this group would be discovered. Thus, when *P. chinicuila* **sp. nov.** was located among papered material, and when *P. temascaltepeca* **sp. nov.** was encountered in the field a decade later, the uniqueness of these taxa was not unexpected. Given the rather different overall wing morphologies of these four taxa, we suggest that additional species in this group

remain to be discovered during the peak of the Mexican rainy season, most likely fire-maintained grassy openings in pine-oak forest in the Sierra Madre Occidental of western Mexico and the Trans-Mexican Volcanic Belt of south-central Mexico.

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