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The North American bees of the genus *Ptilothrix* Cresson, 1878 (Hymenoptera, Apidae, Emphorini), with the description of two new species

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Abstract

Ptilothrix Cresson is a genus of New World bees with an amphitropical distribution. Like other genera in the tribe Emphorini, *Ptilothrix* have narrow pollen preferences. These solitary ground-nesting bees exhibit a remarkable nesting behavior in which females carry water from ponds to facilitate the excavation of the hard soil where they nest. With 16 described species, there are few taxonomic studies and, before this work, a lack of taxonomic treatments for the species in North America. Thus, in this study we revised and recognized four species for the region: *Ptilothrix bombiformis* Cresson, *Ptilothrix sumichrasti* Cresson, *Ptilothrix chiricahua* Florez-Gomez & Danforth, **sp. nov.** and *Ptilothrix zacateca* Florez-Gomez & Danforth, **sp. nov.** We describe and illustrate males and females of the two new species. We also present diagnoses for the four species, a key to identify them, and a map of their geographic distributions.

Keywords

Anthophila, Apoidea, Chiricahua, Mexico, taxonomy

Introduction

The genus *Ptilothrix* Cresson, 1878 is a group of bees restricted to the Western hemisphere with an amphitropical distribution. In North America the genus is found from Ontario, Canada to Oaxaca, Mexico and in South America it occurs from northern

Brazil to northern Patagonia, Argentina (Michener 2007; Roig-Alsina 2007; Sharkey et al. 2020). Like many members in Emphorini, species in this genus are pollen specialists that are associated with plants in the families Malvaceae, Cactaceae, Convolvulaceae, Zygophyllaceae and Onagraceae (Cazier and Linsley 1974; Rust 1980; Hazeldine 1997; Tellería 2003; Sipes and Tepedino 2005). *Ptilothrix* species are solitary bees that nest in aggregations in flat or slightly sloping areas of hardpacked sandy soil that is softened with water they collect by alighting on nearby bodies of water (Linsley et al. 1956; Martins et al. 1996; Michener 2007).

Within Emphorini, *Ptilothrix* is phylogenetically related to *Diadasina* and *Melitomella* (Roig-Alsina and Michener 1993; Freitas et al. 2020), both South American genera. Morphologically, the genus can be distinguished from the other genera in the tribe by the lack of arolia, elongated first flagellomere, tongue not surpassing the forecoxae, upper margin of the clypeus surpassing the lower margin of the antennal sockets, and widely spaced tibial scopal hairs with straight branches (Roig-Alsina 1998; Michener 2007; Roig-Alsina 2007).

The genus currently includes 16 described species (Ascher and Pickering 2020), 14 of which are in South America. Taxonomic studies are scarce, the only previous revision is by Roig–Alsina (2007) for the *albidohirta* group, which comprises three species that are known for Bolivia and Argentina. In North America there are three reported species: *P. bombiformis* Cresson, *P. sumichrasti* Cresson and one undescribed species that has been identified in bee surveys as *P.* nr. *sumichrasti* (Michener 2007; Minckley and Radke 2021). Herein we describe this species and one new species from Mexico, we also present diagnosis of the North American species, an identification key to recognize males and females, and a map of their geographic distribution.

Methods

We examined specimens deposited in the following collections: Cornell University Insect Collection (**CUIC**), American Museum of Natural History (**AMNH**), Snow Entomological Museum, University of Kansas (**SEM**), USDA–ARS Pollinating Insects Research Unit, Utah State University (**BBSL**), Central Texas Melittological Institute (**CTMI**), Texas A&M University (**TAMU**), Minckley collection at the University of Rochester (**MCUR**), Illinois Natural History Survey Insect Collection (**INHS**), Entomology Research Museum at UC Riverside (**UCRC**) and Colección Nacional de Insectos, Departamento de Zoología, Instituto de Biología UNAM, Mexico (**CNIN**). Additionally, we examined the lectotypes of *P. sumichrasti* and *P. bombiformis* obtained on loan from the Academy of Natural Sciences of Drexel University (**ANSP**). Designated holotypes and paratypes were deposited at CUIC, AMNH, SEM, CTMI and BBSL.

The morphological terminology used in this study follows that proposed by Michener (2007). Abbreviations in the descriptions and key are T, S, and MOD for metasomal terga, metasomal sterna and median ocellar diameter, respectively. We made the descriptions based on holotype and paratype specimens, measurements were made using a Zeiss Stemi SV11 microscope and are expressed in millimeters (mm).

Additionally, we dissected male genitalia, seventh and eighth sterna (S7 and S8), these structures were cleared using a 10% NaOH solution and stored in glycerin. We took habitus images with a Cannon EOS 6D and a 65 mm macro lens. To stack single photographs we used a Stackshot 3× Cognisys device and Zerene stack software. Photographs of other structures were taken using a Zeiss Stemi SV6 microscope with an Axiocam 105 color camera.

Finally, the known distribution obtained from the specimen labels of the four species were mapped using QGIS software and topographic layers downloaded from EarthEnv. For *Ptilothrix bombiformis*, we additionally included data from the Global Biodiversity Information Facility (**GBIF**).

Results

Genus *Ptilothrix* Smith, 1853

***Ptilothrix chiricahua* sp. nov.**
https://zoobank.org/96871ED3-1B4A-48BD-8714-00BC4B91D5B9
Figs 1, 2A, B, 3A, B, 4B, 5

Diagnosis. Body size of females from 8.6–12 mm, males 9–10.8 mm. This species is distinguished by the polished and shiny ocellocular area, with few scattered punctures close to the eye margin in both sexes. Morphologically similar to *P. sumichrasti*, but males differ by the yellowish pubescence on T7, and the shape of S7, S8 and the genital capsule (Figs 2A, B, 3A, B). As in *P. sumichrasti*, this species is characterized by the relatively short first flagellomere (when compared with other *Ptilothrix*), length no more than twice its apical width; fulvous pubescence on pronotum, scutum, scutellum, pale yellowish to white in some specimens, and whitish on the mesepisternum and propodeum. Metasoma with apical bands of yellowish appressed hairs on T1–T4. Anterior area of T3–T5 with black, short appressed hairs.

Description. Male. Total length 9.16 mm (paratypes 9–10.8 mm, n=10). ***Head.*** Integument black, except mandible brown with middle area lighter brown; apex yellowish in some paratypes. Mandible with rounded apical margin. Pubescence whitish on labrum, clypeus, around antennal sockets, frons and gena, becoming pale yellowish on vertex, whitish in some paratypes. Labrum rectangular, disc densely punctate, margin raised and impunctate. Clypeus protuberant in lateral view, with punctures densely distributed, separated by a distance less than a puncture diameter. Punctation of lower paraocular area, supraclypeal area and frons punctation as in clypeus. Inner ocular margins subparallel. Ocellocular area polished, with few scattered punctures and short pilosity closer to the eye margin, distance 0.52 mm. Antennae dark brown, scape 0.68 mm long, first flagellomere longer than broad, 1.7 times longer than its apical width. Head length 2.6 mm. Head width 3.2 mm. Gena width 0.62 mm. Lower interocular distance 1.8 mm. Upper interocular distance 2 mm. Lower interocular distance 0.8 mm. Antennocular distance 0.28 mm. MOD 0.228 mm.

***Mesosoma*.** Integument black. Pubescence fulvous on the pronotum, scutum, scutellum and metanotum; becoming whitish towards the propodeum, mesepisternum and metepisternum; some paratypes with pubescence entirely whitish. Propodeal triangle with short appressed, whitish hairs. Scutum with homogeneously distributed punctures separated by a distance up to a puncture diameter. Mesepisternal disc with punctures densely distributed, separated by a distance up to a puncture diameter, interspaces shiny. Hypoepimeral area with close punctures on the upper area, impunctate and polished towards the scrobal groove. Tegula translucent brownish. Tuft of yellow pubescence at base of wings, membrane of wings subhyaline, venation brown. Length of forewing 8 mm. Intertegular distance 2.6 mm. Scutum length 2.35 mm. ***Legs*.** Integument dark brown, except tarsi reddish brown, with whitish pubescence. Hind coxa and femur enlarged. Hind basitarsus slightly curved, 5 times the length of the second tarsomere. Posterior tibial spurs slightly hooked at the apex.

***Metasoma*.** Tergal integument black, sterna brown. T1 and T2 covered with whitish erect pilosity and posterior margin with a band of yellowish appressed hairs. T3–T6 with appressed short, dark hairs, margin with bands of yellowish pilosity. T7 covered with yellowish pubescence, apical margin with two pointed projections forming a medial U–shaped notch. Sternal pubescence erect, yellowish. S6 with a median tuft of hairs. Metasomal pubescence whitish in some paratypes. S7 and S8 as in Fig. 2A, B. Gonobase rounded, middle area of gonostylus slightly broadened (Fig. 3A, B).

Female. Total length 10.62 mm (8.6–12 mm n=10). ***Head*.** Integument color as in males. Maxillary palpus 6–segmented, segments 1–4 with short setae on the outer margin. Mandible with rounded apical margin. Pubescence color as in males, but hairs shorter. Labrum densely punctate, apex subtriangular with margin raised, impunctate. Inner ocular margins nearly parallel. Clypeus as in male, interspaces between punctures up to a puncture diameter. Punctation in paraocular area as in males. Ocellocular area polished and with few scattered punctures and short pilosity closer to the eye margin, distance 0.56 mm. Antennae dark brown, scape 0.71 mm long, first flagellomere 1.8 times longer than its apical width (Fig. 4B). Head length 2.7 mm. Head width 3.45 mm. Gena width 0.44 mm. Lower interocular distance 2.02 mm. Upper interocular distance 2.2 mm. Interocular distance 0.98 mm. Antennocular distance 0.3 mm. MOD 0.25 mm. ***Mesosoma*.** Color, punctures and pubescence color as in males, but hairs shorter. Wings and tegula as in males. Length of forewing 8.5 mm. Intertegular distance 2.66 mm. Scutum length 2.56 mm. ***Legs*.** Integument and pubescence color as in male. Hind tibia with whitish scopa, apical margin with a tuft of white pubescence, inner surface rugose and with short and appressed hairs. Scopa on hind basitarsus whitish on the outer surface and brownish on the inner surface. ***Metasoma*.** Integument as in male. T1–T4 pubescence as in male. T5 with black, short and appressed hairs on the anterior area, prepygidial fimbria yellowish with brown hairs intercalated, entirely brown in some paratypes. Pygidial fimbria dark brown. Pygidial plate with rounded apex.

Material examined. ***Holotype*.** United States of America • ♂; New Mexico; Hidalgo Co.1 mi. S Rodeo; 23 Aug. 2002; B.N. Danforth leg.; on *Kallstroemia*; CUIC.

***Paratypes*.** Mexico – **Sonora** • 1 ♀; Rancho San Bernardino. 28 km E Agua Prieta, Ciénaga; 27 Jul. 2000; K. Toal leg.; MCUR 1519 • 1 ♀; same data as for preceding;

Figure 1. *Ptilothrix chiricahua* sp. nov. **A** male holotype habitus, lateral view **B** male holotype habitus; frontal view **C** male holotype dorsal view **D** male holotype metasoma **E** female paratype habitus, lateral view **F** female paratype habitus, frontal view **G** female paratype dorsal view **H** female paratype metasoma.

22 Jun. 2000; MCUR 1874 • 1 ♂; 30 km E Agua Prieta; 31°19'08"N, 109°15'04"W; 12 Aug 2001; A. Romero leg., MCUR SBV043745.

United States of America – **Arizona** • 1 ♂; Cochise Co. 10 mi SW Apache; 31.571°N, 109.26°W; 27 Aug. 2014; B.N. Danforth leg.; CUIC • 5 ♀, 4♂; Cochise

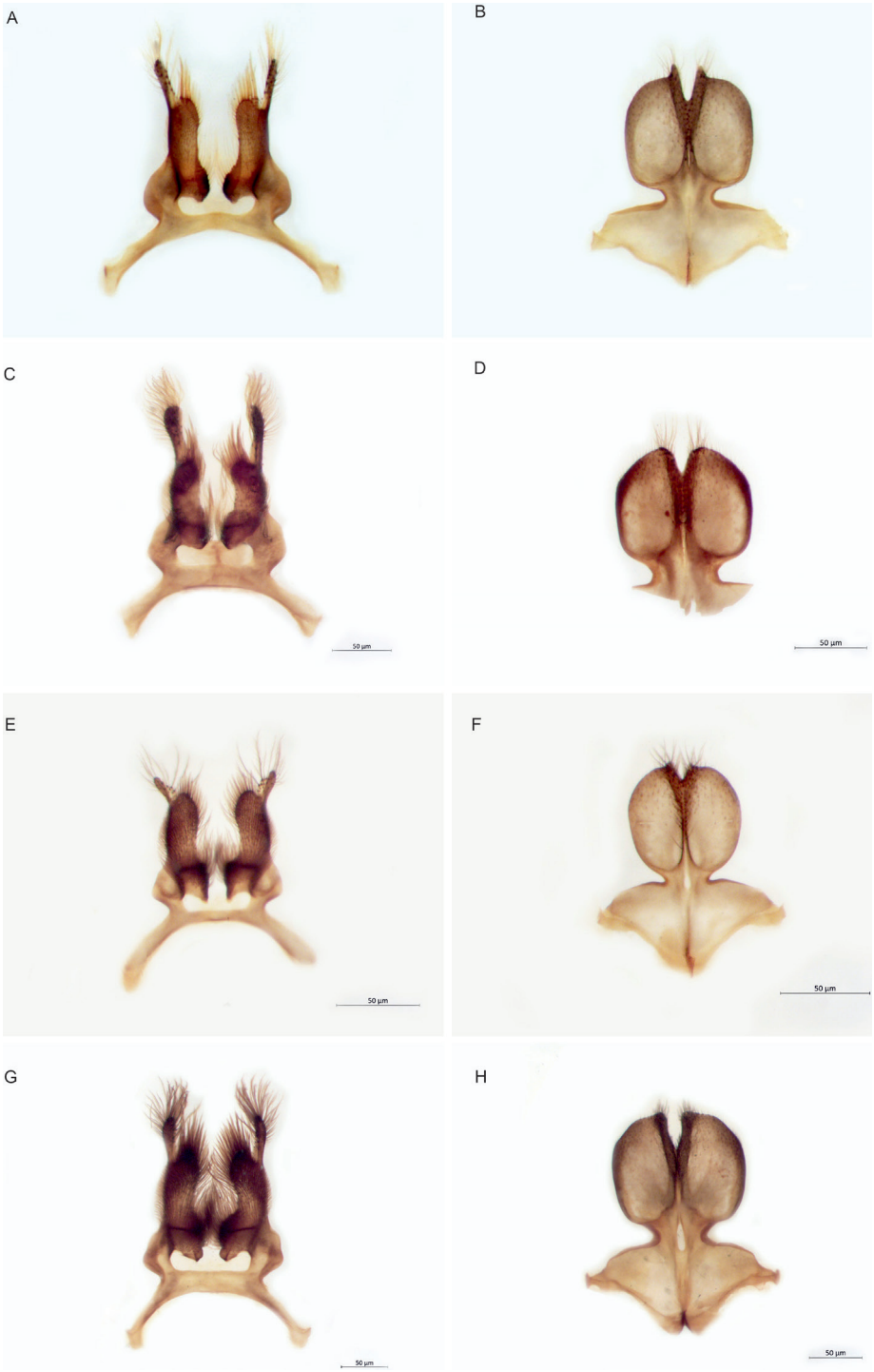

Figure 2. A *Ptilothrix chiricahua* sp. nov. male S7 **B** *Ptilothrix chiricahua* sp. nov. male S8 **C** *Ptilothrix zacateca* sp. nov. male S7 **D** *Ptilothrix zacateca* sp. nov. male S8 **E** *Ptilothrix sumichrasti* male S7 **F** *Ptilothrix sumichrasti* male S8 **G** *Ptilothrix bombiformis* male S7 **H** *Ptilothrix bombiformis* male S8.

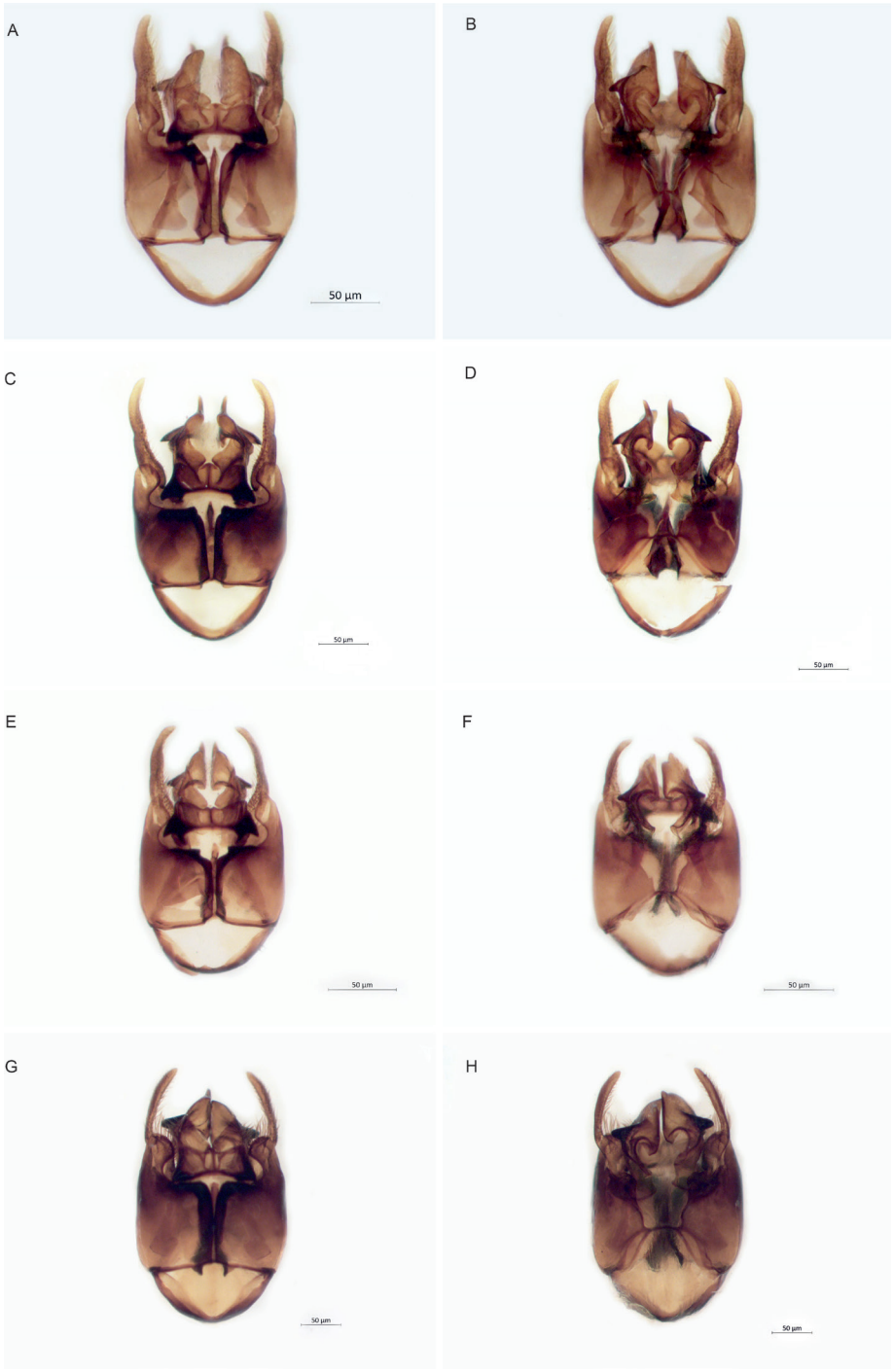

Figure 3. A, B *Ptilothrix chiricahua* sp. nov. male genital capsule **A** dorsal view **B** ventral view **C, D** *Ptilothrix zacateca* sp. nov. male genital capsule **C** dorsal view **D** ventral view **E, F** *Ptilothrix sumichrasti* male genital capsule **E** dorsal view **F** ventral view **G, H** *Ptilothrix bombiformis* male genital capsule **G** dorsa view **F** ventral view.

Figure 4. Ocellocular area and antenna of **A** female lectotype of *Ptilothrix sumichrasti* **B** female paratype of *Ptilothrix chiricahua* sp. nov. **C** female paratype of *Ptilothrix zacateca* sp. nov.

Co. Portal 6 mi E; 31.876°N, 109.058°W; 31 Jul. 2010; B.N. Danforth leg.; CUIC • 2 ♀, 1 ♂; Cochise Co. Portal vicinity; 31°52.55'N, 109°03.46'W; 26 Jul. 2008; B.N. Danforth leg.; CUIC • 2 ♀; Cochise Co. Portal 6 mi E.; 31.876°N, 109.058°W; 29 Aug. 2010; J.L. Neff leg.; on *Kallstroemia grandiflora*; CTMI 34537 to 34538 • 2 ♂; same data as for preceding; CTMI 34539 to 34540 • 1 ♂; Cochise Co. Portal Rd. 1.4 mi. N. rd 80; 31.880°N, 109.036°W; 25 Jul. 2006; J. L. Neff leg.; on *Kallstroemia grandiflora*; CTMI 31553 • 1 ♀; Cochise Co. Douglas 16 mi N; 31°28.10'N, 109°15.12'W; alt. 1250 m; 22 Jul. 2000. J. L. Neff leg.; on *Kallstroemia grandiflora*; CTMI 11971 • 1 ♀; Pima Co. Silver Bell, 5 mi E; 32.383°N, 111.417°W; 12 Aug. 1974; J. L. Neff leg.; on *Kallstroemia grandiflora*; CTMI 97071 • 2 ♂; same data as for preceding; 7–12 Aug. 1973; CTMI 102430 to 102431 • 1 ♂; same data as for preceding; 28 Sep. 1974; CTMI 65420 • 1 ♂; Pima Co. Rillito; 34.208°N, 111.150°W; 17 Jul 1974; J. L. Neff leg.; on *Kallstroemia grandiflora*; CTMI 65570 • 1 ♀; Pima Co. Silver Bell Bajada IBP Desert Scrub Site; J. L. Neff leg.; on *Kallstroemia grandiflora*; CTMI 97073. – **New Mexico** • 8 ♀, 3 ♂; same data as for holotype • 1 ♀; Hidalgo Co. 0.5 mi N Rodeo; 19 Sep. 2001; Danforth & Magnacca leg.; CUIC • 6 ♀, 3 ♂; Hidalgo Co. 7 mi N Rodeo; 31.933487°N, 109.024734°W; 27 Jul.2018; B.N. Danforth leg.; on *Kallstroemia*; CUIC • 7 ♀, 1 ♂; Hidalgo Co. Rodeo; 22 Sep. 1999; Danforth & Magnacca leg.; on *Kallstroemia*; CUIC • 2 ♀; Hidalgo Co. Rodeo 20 mi. N. San Simón Ciénaga; 12 Sep. 1999; Danforth & Magnacca leg.; CUIC • 9 ♀, 1♂; Hidalgo

Co. Rodeo 4 mi N.; 18 Sep. 1999; Danforth & Magnacca leg.; on *Kallstroemia*; CUIC • 1 ♀; Hidalgo Co. Rodeo 2 mi N; 15 Jul. 1974; JM Linsley leg.; on *Kallstroemia grandiflora*; INHS 375568 • 1 ♂; same data as for preceding; INHS 375569.

Other material. Mexico – **Sonora** • 1 ♀; 30 km E Agua Prieta; 31°30'00"N, 109°28'00"W; 1 Aug 2001; E. Serrano leg., MCUR SBV069744 • 1 ♀; same data as for preceding; MCUR SBV069979 • 1 ♀; same data as for preceding; MCUR SBV070114 • 1 ♀; same data as for preceding; MCUR SBV070141 • 1 ♀; same data as for preceding; 1–15 Aug. 2001; R.L. Minckley leg.; MCUR SBV079342 • 1 ♀; same data as for preceding; MCUR SBV079339 • 1 ♀; same data as for preceding; MCUR SBV079331 • 1 ♀; Rancho San Bernardino. 28 km E Agua Prieta, Ciénaga; 27 Jul. 2000; K Toal leg.; MCUR 1329 • 1 ♀; same data as for preceding; 10 Jul. 2000; MCUR 232 • 1 ♀; same data as for preceding; MCUR 2555 • 1 ♀; same data as for preceding; MCUR 226 • 1 ♀; same data as for preceding; MCUR 182.

United States of America – **Arizona** • 1 ♂; Portal. Cochise Co.; 7 May 1977; R Brooks leg.; on *Kallstroemia*; SEM 1304613 • 1 ♂; Pima, San Luis Wash; 31.63227°N, 111.429°W; alt. 1038 m; 19 Aug. 2016; T.L. Griswold leg.; BBSL 1035487 • 1 ♂; same data as for preceding; BBSL 1035497 • 3 ♂; same data as for preceding; BBSL 1035575 to 1035577 • 1 ♀; same data as for preceding; BBSL 1035579 • 1 ♀; same data as for preceding; BBSL 1035496 • 1 ♂; same data as for preceding; on *Kallstroemia grandiflora*; BBSL 1035010 • 1 ♀; Pima, Brown Canyon; 31.75558°N, 111.525°W; alt. 1131 m; 21 Aug. 2016; T.L. Griswold leg.; BBSL 1035607 • 1 ♀; same data as for preceding; BBSL 1035609 • 1 ♂; Pima; Tequila Tank, 0.67 air km ESE; 31.632°N, 111.444°W; alt. 1062 m; 19 Aug. 2016; T.L. Griswold leg.; BBSL 1035465 • 1 ♀; Cochise; Portal, 3.7 mi N; 31.959°N, 109.151°W; alt. 1412 m; 21 Aug. 2002; T.L. Griswold leg.; BBSL 689511 • 1 ♀; same data as for preceding; BBSL 689526 • 1 ♀; same data as for preceding; BBSL 689530 – **New Mexico** • 1 ♂; Hidalgo Co. 3 mi N Rodeo; 12 Aug.1978; R. Brooks leg.; on *Kallstroemia*; SEM 1304615 • 1 ♂; Hidalgo, Jct. Stateline & Hwy 80; 31.87985°N, 109.004°W; alt. 1250 m; 20 Aug. 2002; T.L. Griswold leg.; on *Kallstroemia* sp.; BBSL 689267 • 1 ♂; same data as for preceding; BBSL 689295 • 1 ♂; same data as for preceding; BBSL 689301 • 1 ♀; same data as for preceding; BBSL 689297 • 1 ♂; Hidalgo, Animas; 31.9292°N, 108.806°W; alt. 1352 m; 18 Aug. 2002; T.L. Griswold leg.; BBSL 690364 • 1 ♀; same data as for preceding; 31 Aug. 2002; BBSL 689365 • 1 ♀; same data as for preceding; BBSL 689368 – **Texas** • 2 ♀; Jeff Davis Co. TNC Davis Mountains Preserve McIvor Center vicinity; 8 Jul.- 27 Aug. 2022; J.A. Hanson, D. Heffern leg.; TAMU.

Comments. *P. chiricahua* is associated to mixed Chihuahuan desert grassland habitats of Southern Arizona, New Mexico, Western Texas and Northern Mexico (Fig. 5). This species has been mainly collected on flowers of *Kallstroemia grandiflora* in the late summer/fall and, based on examination of scopal loads, appears to be a pollen specialist on *K. grandiflora*. Butler (1967) and Michener (2007) also reported that this species has been collected in cotton flowers (Malvaceae).

Etymology. This species is named in honor to the Chiricahua Apache people whose historical homeland encompasses the area where this bee now occurs.

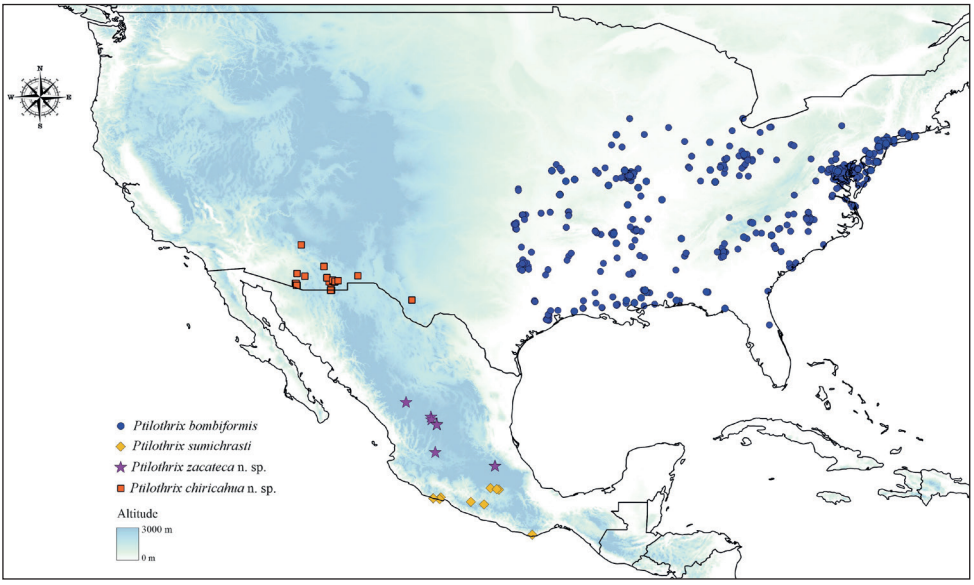

Figure 5. Distribution map of the North American species of the genus *Ptilothrix*: *Ptilothrix chiricahua* sp. nov., *Ptilothrix zacateca* sp. nov., *Ptilothrix sumichrasti* and *Ptilothrix bombiformis*.

***Ptilothrix zacateca* sp. nov.**
https://zoobank.org/9A25784C-75A2-4BD3-978B-C9B17B25F1CD
Figs 2C, D, 3C, D, 4C, 5, 6

Diagnosis. Female body size from 11.3–12.7 mm, male 10.5–13 mm. This species can be recognized by the overall whitish to pale yellowish pubescence, except for that on the female basitarsi, which is dark yellowish to pale brown. Differing from *P. sumichrasti* and *P. chiricahua* by the longer first flagellomere (length at least twice its apical width), presence of erect, overall longer pubescence, especially on the anterior areas of T2 and T3, more robust body and slightly larger size. Both sexes with tergal hair bands on T1–T4 in females, T1–T6 in males.

Description. Male. Total length 12.34 mm (paratypes 10.5–13 mm, n=7). ***Head.*** Integument black, except brown middle area of the mandible, mandibular apex yellowish in some paratypes. Uniformly whitish pubescence covering all of the head except ocellocular area where hairs are sparser. Mandible with rounded apical margin. Maxillary palpus 6–segmented. Labrum rectangular, disc densely punctate, margin raised and impunctate. Clypeus slightly protuberant in lateral view, with coarse punctation. Inner ocular margins subparallel. Frons, paraocular area and vertex with close punctures, separated by a distance up to a puncture diameter. Ocellocular integument micro–sculptured and with punctures towards the eye margin, small area around the lateral ocellus polished and shiny, distance 0.63 mm. Antennae black, scape 0.8 mm,

first flagellomere 2.5 times longer than its apical width. Head length 3.25 mm. Head width 3.85 mm. Gena width 0.8 mm. Lower interocular distance 2.45 mm. Upper interocular distance 2.5 mm. Interocular distance 1.03 mm. Antennocular distance 0.41 mm. MOD 0.25 mm

Mesosoma. Integument black. Overall pubescence whitish on pronotum, scutum, scutellum, mesepisternum, metepisternum and propodeum; pale yellowish on the scutum of some specimens. Scutum with close punctures regularly distributed, separated by less than a puncture diameter with shiny interspaces. Scutellar punctures even more closely spaced than those of the scutum. Disc of mesepisternum punctured as in scutum, deep punctures and very close one to each other, imbricate interspaces between punctures. Hypoepimeral area deeply and densely punctate, micro–sculptured towards the scrobal groove. Propodeal triangle with whitish short pubescence, middle line glabrous. Tegulae translucent brown. White tuft of hairs at the base of wings, membrane of wings slightly infuscate, venation brownish. Length of forewing 10.83 mm. Intertegular distance 3.25 mm. Scutum length 3.0 mm. ***Legs.*** Integument black to dark brown, except tarsi reddish brown. Pubescence whitish overall. Hind coxa and femur enlarged. Hind basitarsus slightly curved, 6 times the length of the second tarsomere. Hind tibial spurs dark brown, slightly hooked at the apex.

Metasoma. Overall integument black, margin of sterna subhyaline. T1–T4 with dense, whitish erect pubescence, posterior margin with band of white hairs. T5–T6 with dense and erect black pubescence on the anterior area, margin with a band of whitish dense pubescence. T7 covered with black pubescence, margin with two pointed projections forming a middle notch. Sterna with dense, whitish, erect pubescence. S6 with a median tuft of hairs. S7 and S8 as in Fig. 2C, D. Gonobase rounded, gonostylus filiform (Fig. 3C, D).

Female. Total length 12.67 mm (11.3–12.7 mm n=8). ***Head.*** Integument color as in male, pubescence as in male, but less abundant. Mandible color and shape as in males. Labrum densely punctate, with subtriangular, raised, impunctate apex. Clypeus with coarse punctures separated by a distance up to twice a puncture diameter. Punctation of paraocular area and frons as in males, puncture size smaller than those on clypeus. Inner ocular margins nearly parallel. Integument of ocellocular area as in males, distance 0.76 mm. Antennae black, scape 0.93 mm long, first flagellomere 2.3 times longer than its apical width (Fig. 4C). Head length 3.48 mm. Head width 4.49 mm. Gena width 0.83 mm. Lower interocular distance 2.81 mm. Upper interocular distance 2.85 mm. Interocular distance 1.22 mm. Antennocular distance 0.47 mm. MOD 0.30 mm. ***Mesosoma.*** Color, punctures and pubescence as in males, but pubescence shorter. Wing color and tegula as in male. Wings and tegula as in males. Length of forewing 10.62 mm. Intertegular distance 3.75 mm. Scutum length 3.37 mm. ***Legs.*** Overall black integument except brown tarsi. Hind tibia with whitish scopa, apical margin with a tuft of white pubescence, inner surface rugose and with short, whitish and appressed hairs. Scopa on hind basitarsus entirely dark yellowish to pale brown. ***Metasoma.*** Integument as in male. T1– T2 with erect whitish hairs, posterior margin with bands of whitish pubescence. T3 and T4 with whitish erect pubescence on the anterior area

Figure 6. *Ptilothrix zacateca* sp. nov. **A** male holotype habitus, lateral view **B** male holotype habitus; frontal view **C** male holotype dorsal view **D** male holotype metasoma **E** female paratype habitus, lateral view **F** female paratype habitus, frontal view **G** female paratype dorsal view **H** female paratype metasoma.

shorter than those in T1–T2, and with bands of pubescence. Prepygidial fimbria brownish, with whitish hairs intercalated laterally. Pygidial plate with rounded apex. Sterna with erect long, whitish–yellowish pubescence on the disc, denser at the margins.

Material examined. ***Holotype.*** Mexico • ♂; Zacatecas; Guadalupe; 28 Jun. 1953; C. & P. Vaurie leg.; D. Rockefeller Mex exped.; AMNH

Paratypes. Mexico – **Durango** • 2 ♂**;** 14 mi N.E of Durango; alt. 1889 m; 17 Jun. 1956; H.A. Scullen leg.; BBSL – **Jalisco** • 1 ♀**;** Villa Guadalupe; 26 Jul. 1951; H. E. Evans leg.; SEM SM0803860 • 1 ♂; same data as for preceding; SEM SM0803859 – **Zacatecas** • 3 ♂**;** same data as for holotype • 6 ♀**;** Fresnillo; alt. 2133 m; 15 Aug. 1947; C.D. Michener leg.; D. Rockefeller Mex exped.; AMNH. – **Hidalgo** • 1 ♀**;** 3 mi Pachuca; Kansas University Mexico exped.; 24 Jun. 1953; on *Argemone*; UCRC 546145 • 1 ♂; same data as for preceding; UCRC 546145.

Comments. This species is endemic to Mexico. Records are from the mountain regions in the Sierra Madre Occidental from 1800–2000 m (Fig. 5). Its preferred host plants are unknown, although two specimens were collected on *Argemone* flowers, suggesting a possible association. But labels of most of observed material did not include information about related plants and specimens did not have pollen loads to facilitate these associations. It has been collected from June–August.

Etymology. This species is named in honor to the Zacatecos, the indigenous group that inhabited the state of Zacatecas, the area where the holotype was collected.

Ptilothrix sumichrasti Cresson, 1878

Figs 2E, F, 3E, F, 4A, 5, 7

Ptilothrix sumichrasti Cresson, E. T. (1878). (Lectotype: ANSP #f: Mexico).

Diagnosis. Body size of females from 10–10.6 mm, males 8.2–10 mm. This species is morphologically similar to *P. chiricahua* but is recognizable by the punctation pattern in the ocellocular area, which is micro–sculptured, with punctures towards the eye margin and a small area around the lateral ocellus polished and shiny in both sexes. Males are clearly distinguishable by the brown pubescence covering T7, in addition to the shape of S7, S8 and genital capsule (Figs 2E, F, 3E, F). This species shares with *P. chiricahua* the following characters: fulvous pubescence on pronotum, scutum, scutellum, whitish towards the mesepisternum and propodeum. Metasoma with apical bands of yellowish appressed hairs from T1–T4. Anterior area of T3–T5 with black, short appressed hairs. First flagellomere length less than twice its apical width, being shorter than the rest of species in the genus *Ptilothrix* (Fig. 4A).

Material examined. Mexico – **Guerrero** • 1 ♂; Iguala; CNIN 2887 – **Michoacán** • 1 ♀; La Mira, 4 km N Playa Azul; 2 Nov. 1987; T. Griswold leg.; BBSL 725135 • 1 ♂; Los Amates, 26 km N Playa Azul; 2 Nov. 1987; T. Griswold leg.; on *Ipomoea*; BBSL 725132 • 2 ♂; Caleta de Campos, 4 kmN Playa Azul; 3 Nov. 1987; T. Griswold leg.; BBSL 725133 to 725134 –**Oaxaca** • 1 ♂; 4 mi. N Pochutla. 11 Oct. 1975; J.L. Neff leg.; CTMI – **Puebla** • 6 ♀; Tilapa, Carr. Fed. Azúcar de Matamoros–Cuautla; 18°37.96'N, 98°34.96'W; 4 Sep.1998; T. Griswold leg.; BBSL 335125 to 335130.

Guatemala • 3 ♀; C.A; alt. 300 m; 10 Jan.1923; AMNH 262013 to 262015.

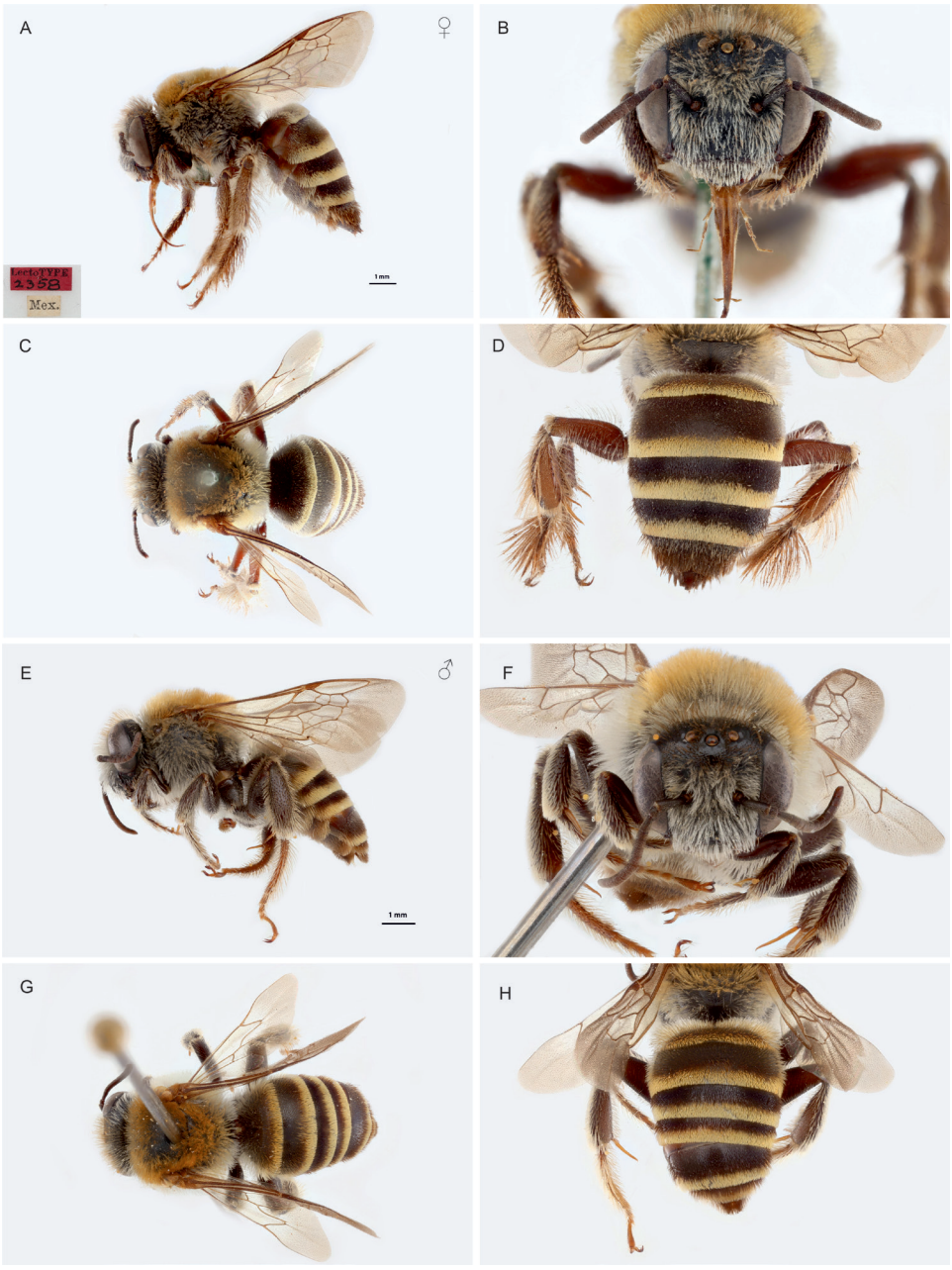

Figure 7. *Ptilothrix sumichrasti* **A** female lectotype habitus, lateral view **B** female lectotype habitus; frontal view **C** female lectotype, dorsal view **D** female lectotype habitus metasoma **E** male habitus, lateral view **F** male habitus, frontal view **G** male dorsal view **H** male metasoma.

Comments. Records of this species are from lowlands in Guatemala and Mexico in the Transmexican Volcanic Belt and the Balsas River Basin (Fig. 5), it is seemingly associated with flowers of *Ipomoea* and has been collected from October to January.

***Ptilothrix bombiformis* Cresson, 1878**
Figs 5, 6G, H, 7G, H, 8

Emphor bombiformis Cresson, 1878.
Emphor fuscojubatus Cockerell, 1913.
Ptilothrix bombiformis Cresson, (1878). (Lectotype: ANSP #f: Kansas, Snow).

Diagnosis. Large bees, female body size from 13.5–19 mm, males from 12.5–18.6 mm. This species is clearly recognizable by the white to pale yellow pubescence on the head and mesosoma, and entirely black metasoma, except T1 which has whitish pubescence on the lateral sides in some specimens. Differs from *P. sumichrasti*, *P. chiricahua* and *P. zacateca* by the absence of yellowish metasomal bands, darkened wings, entirely black scopa, and overall larger size. First flagellomere length twice its apical width, as in other *Ptilothrix* species except *P. sumichrasti* and *P. chiricahua*. Shape of male S7, S8 and genital capsule as shown in Figs 2G, H, 3G, H.

Material examined. United States of America – **Alabama** • 1 ♂; Morgan; 34.6059°N, 86.9833°W; alt 178 m; Aug.1944; GE Bohart leg.; BBSL 511531 • 2 ♀; Houston, Cowarts; 31.2°N, 85.3047°W, 1 Aug. 1916; AMNH 00260371 to 00260372. – **Arkansas** • 1 ♂; Monroe, Cotton Plant, 5.4 mi SWbS; 34.9327°N, 91.2726°W; alt. 54 m; 21 Jul. 2015; P.L. Stephenson leg.; BBSL 1027862 • 1 ♂; same data as for preceding; BBSL 1027868 • 1 ♀; Prairie Des Arc, 6.8 mi SE, Cache River NWR; 34.9231°N, 91.3959°W; alt. 50 m; 24 Jun. 2015; P.L. Stephenson leg.; BBSL 1027864 • 1 ♂; same data as for preceding; BBSL 1027863 • 1 ♂; Monroe, Brinkley, 7.6 mi SW; 34.8521°N, 91.3242°W; alt. 49 m.; 16 Jul. 2015; PL Stephenson leg.; BBSL 1027865 • 1 ♂; same data as for preceding; BBSL 1027867 • 1 ♂; St. Charles, 4.4 mi SWbS; White River NWR. 55 m. 34.3117, –91.1213. 24–VII–2015. P.L. Stephenson; BBSL 102786. – **Illinois** • 13 ♂; Calhoun, Two Rivers NWR, HQ TI3S-RIW-S. 16; 38.94888°N, 90.5889°W; 2 Jul. 2012; B Loges leg.; AMNH 00260559 to 00260571 – **Indiana** • 1 ♀; Ripley, Friendship; 38.9703°N, 85.1477°W, alt. 194 m; on *Hibiscus syriacus*; 29 Jul. 1950; LW Chandler leg.; BBSL 511562 – **Iowa** • 2 ♂; Louisa, Port Louisa NWR (HSB6) Rush Lake Rd.; 41.22°N, 91.12°W; 3 Jul. 2012; J Young; AMNH 00260557 to 00260558 – **Kansas** • 1 ♂; Crawford Pittsburg, 404 West Jefferson Street; 37.40049°N, 94.7119°W; alt. 286 m; on *Hibiscus syriacus*; 14 Jun. 2010; BBSL 1046881 • 1 ♀; same data as for preceding; 15 Jul. 2003; BBSL 1046887 • 2 ♂; same data as for preceding; 15 Jul. 2003; BBSL 1046885 to 1046886 • 2 ♂; Crawford, Pittsburg; 37.41092°N, 94.6993°W; alt. 283 m; on *Hibiscus* sp.; 20 Jul. 2003; BBSL 1046882 to 1046883 • 2 ♀; Douglas, Lawrence, Mary's Lake; 38.9284°N, 95.2171°W; alt. 253 m; 8 Aug. 1996; B Alexander leg.; BBSL 207987 to 207988 – **Kentucky** • 1 ♂; Franklin, Frankfort, Lakeview Park; 38.21638°N, 84.8303°W; alt. 231 m; 25 Jul. 1999; DM Gordon leg.; on *Helianthus* sp.; BBSL 1047096 • 2 ♀ ; same data as for preceding; on *Ipomoea* sp.; 16–19 Jul. 2000; BBSL 1047109 to 1047110 • 7 ♂; same data as for preceding; BBSL 1047097 to 1047106 • 2 ♀ ; Franklin. Frankfort, 504 Piaute Trail; 38.2149°N, 84.8362°W; alt. 227 m; 1 Jun 1999; DM Gordon leg.; BBSL 1047111 to 1047112 – **Louisiana** • 2 ♀; Saint Tammany, Abita Creek Preserve; 30.517°N, 89.967°W; 07 Aug. 2002; D Prowell leg.; on *Hibiscus aculeatus*; BBSL 664704

Figure 8. *Ptilothrix bombiformis* **A** female lectotype habitus, lateral view **B** female lectotype habitus; frontal view **C** female lectotype, dorsal view **D** female lectotype habitus metasoma **E** male habitus, lateral view **F** male habitus, frontal view **G** male dorsal view **H** male metasoma.

to 664705 • 2 ♂; same data as for preceding; BBSL 664706 to 664707 – **Mississippi** • 1 ♀; Pearl River, Poplarville; 30.84°N, 89.5342°W; alt. 102 m; 18 Aug.1998; B Sampson leg.; on *Hibiscus cannabinus*; BBSL 511533 – **Virginia** • 1 ♀; Warren; 39.006°N, 78.071°W; alt. 159 m; 03 Aug. 2014; E Bodnar; BBSL 1096111.

Comments. This species is the most widely distributed in North America, its geographical range from Ontario, Canada (Sharkey et al. 2020) to South Texas and Florida (Fig. 5). It is mainly associated to flowers of *Hibiscus*, although occasionally visits species of *Ipomoea*. It is active mid– to late summer.

Key to North American species of *Ptilothrix*

1 Metasoma with bands of yellowish or whitish pubescence from T1–T4; wings infuscate or subhyaline; female hind tibia with white or yellow scopa, yellow or brownish on basitarsus..... **2**

– Metasoma pubescence entirely black, without bands, T1 sometimes with yellow pubescence on lateral areas; wings darkened, female hind tibia and basitarsus with entirely black scopa..... ***Ptilothrix bombiformis***

2 First flagellomere up to two times longer than its apical width (Fig. 4A, B); T3 with appressed, short black pubescence on the anterior area, posterior margin with bands of yellow or white pubescence; body size of females from 8.6–12 mm, males 8.2–10.8 mm..... **3**

– First flagellomere more than two times longer than its apical width (Fig. 4C); T3 with erect pubescence on the anterior area, posterior margin with bands of white pubescence; body size of females from 11.3–12.7 mm, males 10.5–13 mm..... ***Ptilothrix zacateca* sp. nov.**

3 Ocellocular area predominantly impunctate, polished and shiny (Fig. 4B); male T7 covered with yellowish pubescence; male S7 and S8 as in Fig. 2A, B .... ***Ptilothrix chiricahua* sp. nov.**

– Ocellocular area micro–sculptured, with scattered punctures and a small polished area around the lateral ocellus (Fig. 4A); male T7 covered with brown pubescence; male S7 and S8 as in Fig. 2E, F ..... ***Ptilothrix sumichrasti***

Discussion

The genus *Ptilothrix* is a species–rich group, especially in South America (Roig–Alsina 1998), however the precise number of species is hard to assess because no taxonomic revisions exist and there are a considerable number of new species and synonymies. In this study we added two new, previously undescribed species to the four total known from North America. We found that characters in the male genitalia, S7 and S8, integument punctation and metasomal pubescence are useful to distinguish North American species.

Ptilothrix bombiformis is the most widely distributed species in North America and one of the most commonly collected, it is associated to the genus *Hibiscus* (Malvaceae), although occasionally can visit flowers of *Ipomoea* (Convolvulaceae) (Rust 1980; Sharkey et al. 2020). *Ptilothrix chiricahua*, is also abundant in collections and is associated with flowers of *Kallstroemia grandiflora* (Zygophyllaceae) and cotton (*Gossypium* spp., Malvaceae) (Butler 1967; Cazier and Linsley 1974). Collection efforts focusing

on these species have benefited from the fact that their preferred pollen sources are known, facilitating their observation and study. In contrast, *Ptilothrix sumichrasti* and *Ptilothrix zacateca* are rare species that have been associated with the genus *Ipomoea*. Only one study, done by Linsley et al. (1956), has described biological aspects of *P. sumichrasti*. This work was conducted in Fresnillo, Zacatecas, Mexico. Based on our analysis of the geographic distributions of Mexican *Ptilothrix*, *P. sumichrasti* does not occur in this area. We suspect that the observations by Linsley et al. were of *P. zacateca* sp. nov, but we were not able to locate voucher specimens from this study to confirm their identity. If this study actually was on the biology of *P. zacateca*, then this species has an association with *Ipomoea longifolia* Benth. and *Ipomoea pringlei* A. Gray. From the examined specimens, we could not get information about floral hosts for this species, and the few labels of *P. sumichrasti* indicated a relationship with the genus *Ipomoea*. This finding highlights the importance of including floral associations in specimen labels, in order to facilitate future collections and further study of host–plant use in this lineage of pollen specialist bees, especially in Mexico and Guatemala, where they are uncommon.

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