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A new species of *Megachile* (*Litomegachile*) from Cuba, the Antilles (Hymenoptera: Megachilidae)

Cory S. Sheffield[1] & Julio A. Genaro[2]

Abstract. A new species of leafcutter bee, ***Megachile* (*Litomegachile*) *droegei*** Sheffield & Genaro, new species, is described from Guantanamo Bay, Cuba. *Megachile droegei* is one of 12 species in this New World subgenus, and is part of the *M. brevis* species group (with *M. brevis* Say, *M. onobrychidis* Cockerell, and *M. pseudobrevis* Mitchell). This is the first record of the subgenus *Litomegachile* from the Antilles. A diagnosis for distinguishing this species from other species of *Litomegachile*, and full descriptions of the female and male with illustrations are provided. In addition, the male of *M. pankus* Bzdyk is described, and *M. cleomis* Cockerell is recognized as a valid species (new status) based on 1.45% divergence in COI (cytochrome c oxidase, subunit 1) from *M. texana* Cresson, and eastern (*M. texana*) /western (*M. cleomis*) distributions. Based on morphological data and COI sequence data, four distinct species groups are recognized within *Litomegachile*. Putative synapomorphies that support the monophyly of these groups are also discussed.

INTRODUCTION

Megachile Latreille *sensu lato* (Megachilidae) is one of the most common and diverse genera of bees (Mitchell, 1980; Michener *et al*., 1994; Baker & Engel, 2006; Michener, 2007; Gonzalez, 2008). Currently, 57 extant subgenera are recognized globally (Engel & Baker, 2006; Michener, 2007), most requiring revision (Gonzalez & Griswold, 2007); 31 subgenera are found in the Western Hemisphere (Raw, 2006), though Durante & Abrahamovich (2006) recognized *Chaetochile* Mitchell as a distinct monotypic subgenus separate from *Dasymegachile* Mitchell. In North America, 13 subgenera are indigenous, but species belonging to three additional subgenera have been introduced (Cane, 2003; Michener, 2007; Sheffield *et al*., 2010, 2011), these also occurring in Cuba (Genaro, 2008).

[1] Royal Saskatchewan Museum, 2340 Albert Street, Regina, Saskatchewan, Canada S4P 2V7 (Cory.Sheffield@gov.sk.ca).
[2] Florida State Collection of Arthropods, 1911 SW 34th Street, Gainesville, Florida, USA 32608-1268 (polimita@hotmail.com).

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Hurd (in Krombein *et al*., 1979) listed 134 species of *Megachile* in America north of Mexico, including *Chalicodoma* Lepeletier de Saint Fargeau (subgenus *Chelostomoides* Robertson in North America). Only a handful of additional species have been described since; five additional species were tallied by Michener *et al*. (1994), Genaro (2003) described a new species from the Cayman Islands, Gonzalez & Griswold (2007) described a new species occurring in Mexico and Guatemala, Bzdyk (2012) described a new species from Mexico, and most recently, Sheffield (2013) described a new species from Texas, USA. However, taxonomic knowledge of the genus *Megachile* in North America still remains incomplete as almost a third of the species have not had the sexes associated, primarily within the subgenus *Megachiloides* Mitchell (Sheffield & Westby, 2007).

The subgenus *Litomegachile* Mitchell is monophyletic, though its relationships with other subgenera remain unresolved (Gonzalez, 2008). This subgenus contains some of the most common species in America north of Mexico (Mitchell, 1962; Michener, 2007). *Litomegachile* was revised by Mitchell (1935) who recognized five species, three of which (*i.e*., *M. brevis* Say, *M. mendica* Cresson, *M. texana* Cresson) were treated as polytypic species. Michener (2007) included seven species, while Sheffield *et al*. (2011) and Bzdyk (2012) raised several of the previously known forms to species level, the former study integrating mitochondrial DNA sequences with morphological data. In that study, *M. onobrychidis* Cockerell, traditionally considered a subspecies of *M. brevis*, differed from the latter species by 5.47% COI (cytochrome c oxidase, subunit 1) sequence divergence, and was most similar to *M. pseudobrevis* Mitchell (which was also considered a subspecies of *M. brevis*) (Sheffield *et al*., 2011). The geographic distribution of these two species is allopatric; *M. onobrychidis* is primarily a western species, occurring into southern British Columbia (Sheffield *et al*., 2011) and apparently as far south as western Mexico (Bzdyk, 2012), while *M. pseudobrevis* occurs in the southeastern United States, including Florida (Mitchell, 1935; Bzdyk, 2012). Bzdyk (2012) recognized ten species in her recent revision of *Litomegachile*, including a new species, *M. pankus* Bzdyk, known only from the female, and only from Mexico.

Here we describe a new species of *Litomegachile*, *Megachile droegei* n. sp. from Cuba, as well as the previously unknown male of *M. pankus*. *Megachile droegei* is one of seven native species of *Megachile* presently known from Cuba (Genaro, 2008), further contributing to the high (*ca*. 50%) endemism of the island's insect fauna (Genaro & Tejuca, 2001).

MATERIAL AND METHODS

Representatives of all species of the subgenus *Litomegachile* were collected throughout North America or borrowed from other institutions as part of Bee-BOL, an ongoing campaign to DNA barcode all bee species of the world (Packer *et al*., 2009). This included specimens collected in Cuba, specifically the Guantánamo Bay area, in 2010–2011 (Fig. 1). DNA was sequenced for the short 5′ barcode region of the mitochondrial-encoded COI gene. The sequenced samples were taken from specimens collected mostly within the last 15 years. Specimens were processed at the Biodiversity Institute of Ontario, University of Guelph, Canada. DNA extraction, amplification and sequencing used the standard protocols described for bees in Sheffield *et al*. (2009). Universal primers for amplifying the COI barcode sequence for insects were used (variants LepF1 and LepR1). No amplification of *Wolbachia* (or other obviously non-target DNA) was detected. Collection data, sequencing results, and GenBank ac-

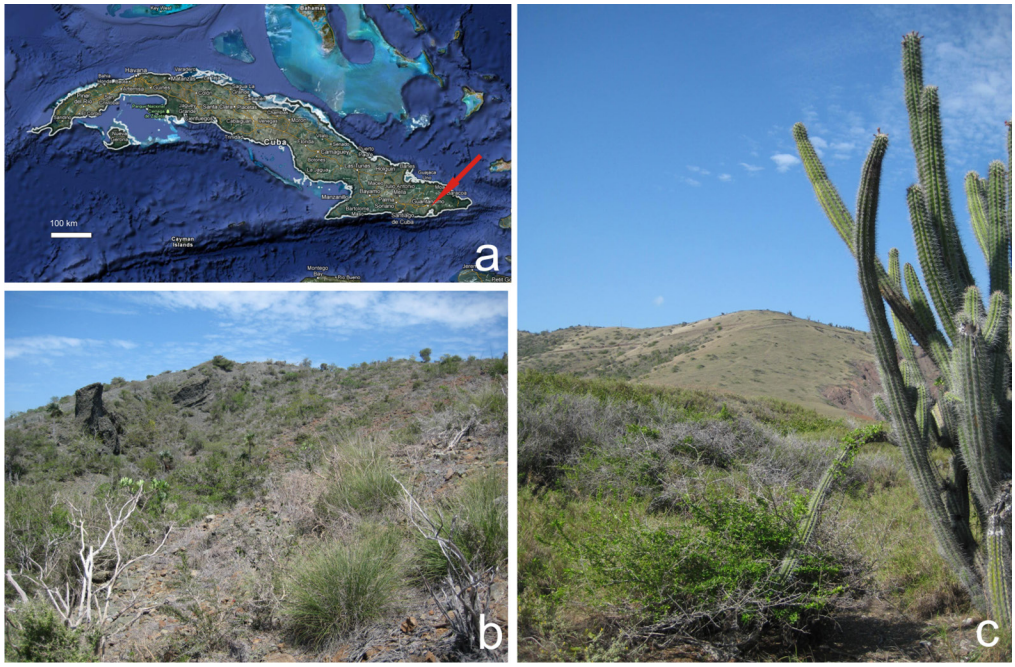

Figure 1. Cuba. **a.** Map of the island of Cuba (Google Earth); red arrow showing Guantánamo Bay area. **b, c.** Habitat views of the type locality for *Megachile* (*Litomegachile*) *droegei*, new species (photographs courtesy Sam Droege).

cession numbers for specimens used in this study are available through the Barcode of Life Database (BOLD, http://www.boldsystems.org). The strength of cohesion at varied taxonomic levels was quantified using the 'Nearest-Neighbour module'on BOLD; this module examines the strength of association among lineages at each level in the taxonomic hierarchy based on COI sequence similarity. The key level of analysis in this study, that examining the strength of association among conspecific individuals, involved identification of the closest COI sequence match for each individual belonging to a species represented by more than one individual in the database.

Photomicrography was undertaken with a Canon EOS 5D Mark II digital camera with an MP-E 65 mm 1:2.8 1-5× macro lens. Measurements were made with an ocular micrometer on a Nikon SMZ1000 stereomicroscope. Head length was measured from the lower margin of the clypeus to vertex in facial view. The following abbreviations are used in the descriptions: F, flagellomere; S, metasomal sternum; T, metasomal tergum; MOD, median ocellar diameter; i, interspace; pd, puncture diameter. Morphological terminology generally follows Mitchell (1980) and Michener (2007).

SYSTEMATICS

Genus *Megachile* Latreille
Subgenus *Litomegachile* Mitchell

Megachile (*Litomegachile*) Mitchell, 1934: 301, 308. Type species: *Megachile brevis* Say, 1837, by original designation.

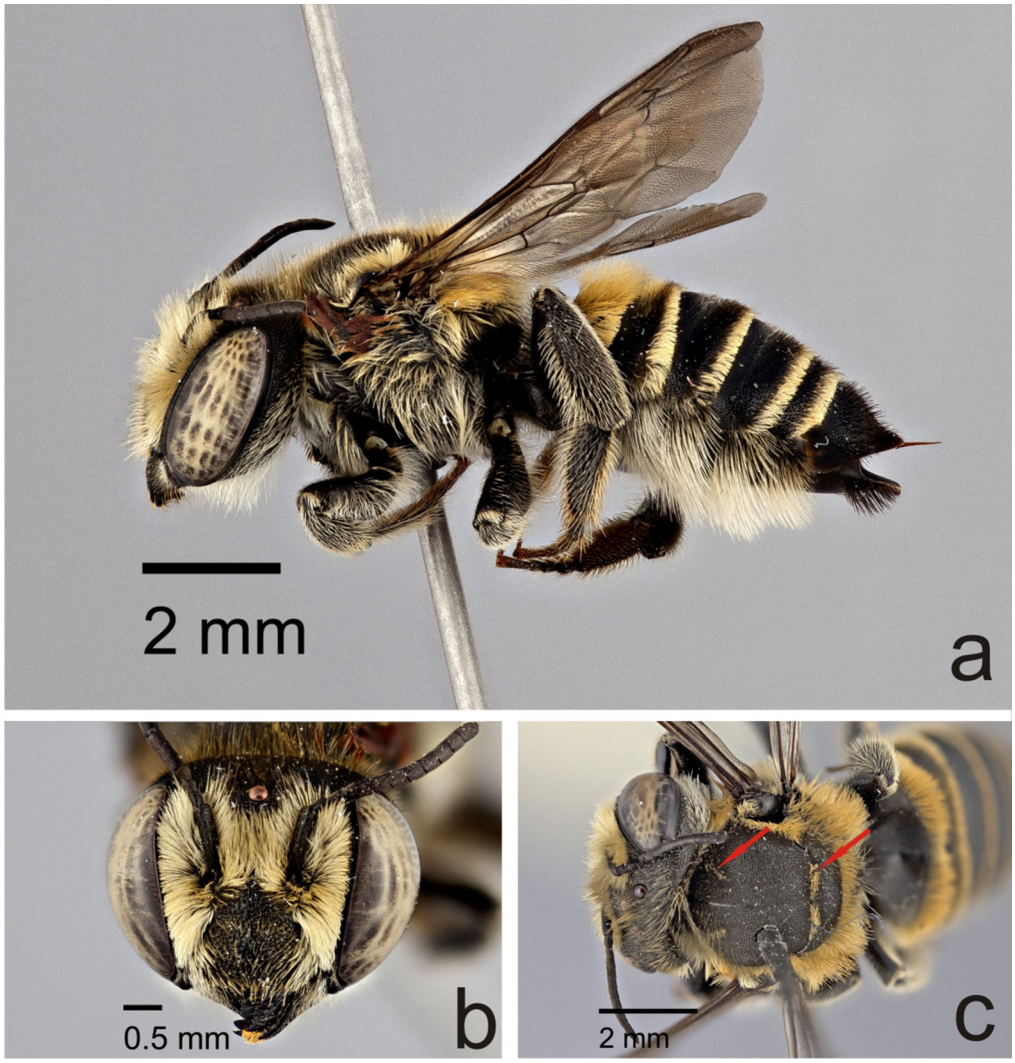

Figure 2. *Megachile* (*Litomegachile*) *droegei*, new species, female. **a.** Lateral. **b.** Face. **c.** Mesoscutum and mesoscutellum; anterior arrow shows lines of thin, yellow pubescence; posterior arrow shows tomentum at suture.

Megachile* (*Litomegachile*) *droegei Sheffield & Genaro, new species
ZooBank: urn:lsid:zoobank.org:act:1EA1AB80-D000-491B-B872-3D8001739123
(Figs. 2, 3a, 4–5)

DIAGNOSIS: *Megachile droegei* can be distinguished from other members of the subgenus *Litomegachile* by the yellowish pubescence on most of the body in both sexes (Figs. 2, 4), including the distinct yellowish tomentose area at the junction of the mesoscutum and mesoscutellum (Figs. 2c, 4c), and the basal concavity of T1 dull, with fine, appressed yellow pubescence (Fig. 3a). All other *Litomegachile* have whitish pubescence, and the surface of the basal concavity of T1 relatively shiny with long, sparse erect pubescence (Fig. 3b). The female of *M. droegei* can be further distinguished from

Figure 3. Basal concavity of T1 of female. **a.** *Megachile* (*Litomegachile*) *droegei*, new species, with a dull surface and fine, appressed yellow pubescence. **b.** *M.* (*L.*) *mendica* Cresson, with the surface of the concavity relatively shiny with long, sparse erect pubescence.

other members of the subgenus *Litomegachile* by the combination of the following characters: mandible without angulation between the 3rd and 4th (inner) teeth, and the scopa with black hairs on S6 (Fig. 2a). It is most similar to *M. pseudobrevis*, *M. onobrychidis*,

and *M. brevis*; females of these species have mostly whitish pubescence and lack, or have scarcely visible tomentum at the junction of the mesoscutum and mesoscutellum; *M. brevis* has mostly pale scopal hairs on S6. Males of *M. droegei* can be further distinguished from other members of the *brevis*-group by having T6 without pale tomentum. They are most similar to *M. onobrychidis* which lacks the thin appressed pubescence and the dull surface of the basal concavity of T1.

DESCRIPTION: ♀: Length: 9.4–10.8 mm. Forewing length: 6.6–7.5 mm. Head width 3.9–4.2 mm; head length 3.0–3.2 mm (Fig. 2b). Intertegular distance 2.6–2.8 mm; distance between outer margins of tegulae 3.5–3.8 mm.

Color. Integument black, except antennal flagellum, tegula and tibial spurs dark brown, apical edges of S2–S5 thinly hyaline (<MOD); wings subhyaline, veins dark brown to black.

Structure. Compound eyes convergent below (Fig. 2b); lateral ocelli slightly nearer edge of vertex than to compound eye (3.5:4); mandible distinctly 4-dentate, with an incomplete cutting edge between the 2nd and 3rd teeth, complete cutting edge between 3rd and 4th teeth; clypeal margin smooth, entire; gena narrower than compound eye in profile (3:5). F1 as long as broad, subequal in length to pedicel and F2, individually, F2 quadrate, F3–F9 longer than broad (5:4), apical flagellomere more elongate, almost twice as long as broad. T2 and T3 with postgradular grooves deep, grooves on T4 and T5 shallower but distinct, basal depressions carinate, apical margins of T2–T5 depressed laterally, very slightly so medially, T6 concave in profile (Fig. 2a).

Surface sculpture. Face with punctures fine and close, rather shallow on gena, deeper but rather fine and very close on vertex medially, more irregularly sized but still close on vertex laterally, quite coarse on clypeus, close laterally, more distinct medially and on supraclypeal area, with apical edge of clypeus shiny and impunctate. Mesoscutum with punctures deep, but rather fine and uniformly close, finer and close over most of mesoscutellum and pleura above, becoming rather coarse and slightly separated on pleura below, with distinct shiny interspaces; tegula finely and closely punctate throughout; propodeum with shallow, fine punctures with i=0.5-1pd; triangle dull, smooth and impunctate. Metasoma with punctures fine, minute and very close on T2, larger but still close (i<1pd) on T3–T5, becoming somewhat more sparse (i=1pd) basal to depression, fine and densely crowded on T6, becoming finely subrugose apically; basal sterna with punctures coarse and close, becoming slightly more separated on apical sterna, quite sparse on S6.

Pubescence. Mostly yellow on body; hairs dark, short and sparse on vertex laterally, sparse and somewhat yellowish-brown over most of clypeus and supraclypeal area, becoming dense and entirely yellow on face around bases of antennae; mesoscutum sparsely pubescent, with short erect dark hairs visible in anterior half, long, dense and yellow at periphery, becoming somewhat paler on mesosoma ventrally, distinctly tomentose at mesoscutal-mesoscutellar suture, with two thin rows of posteriorly converging hairs on anterior half of mesoscutum (Fig. 2c). T3–T5 with dark, erect hairs basal to pale apical fasciae; T6 entire dark pubescent; T1 with very thin, subappressed plumose hairs on anterior surface. S2–S5 with scopa pale yellow to white, black apicolaterally on S5, black on S6 (Fig. 2a).

♂: Length: 8.0–9.1 mm. Forewing length: 6.0–6.4 mm. Head width 3.5–3.8 mm; head length 2.6–2.8 mm (Fig. 4b). Intertegular distance 2.4–2.7 mm; distance between outer margins of tegulae 3.2–3.5 mm.

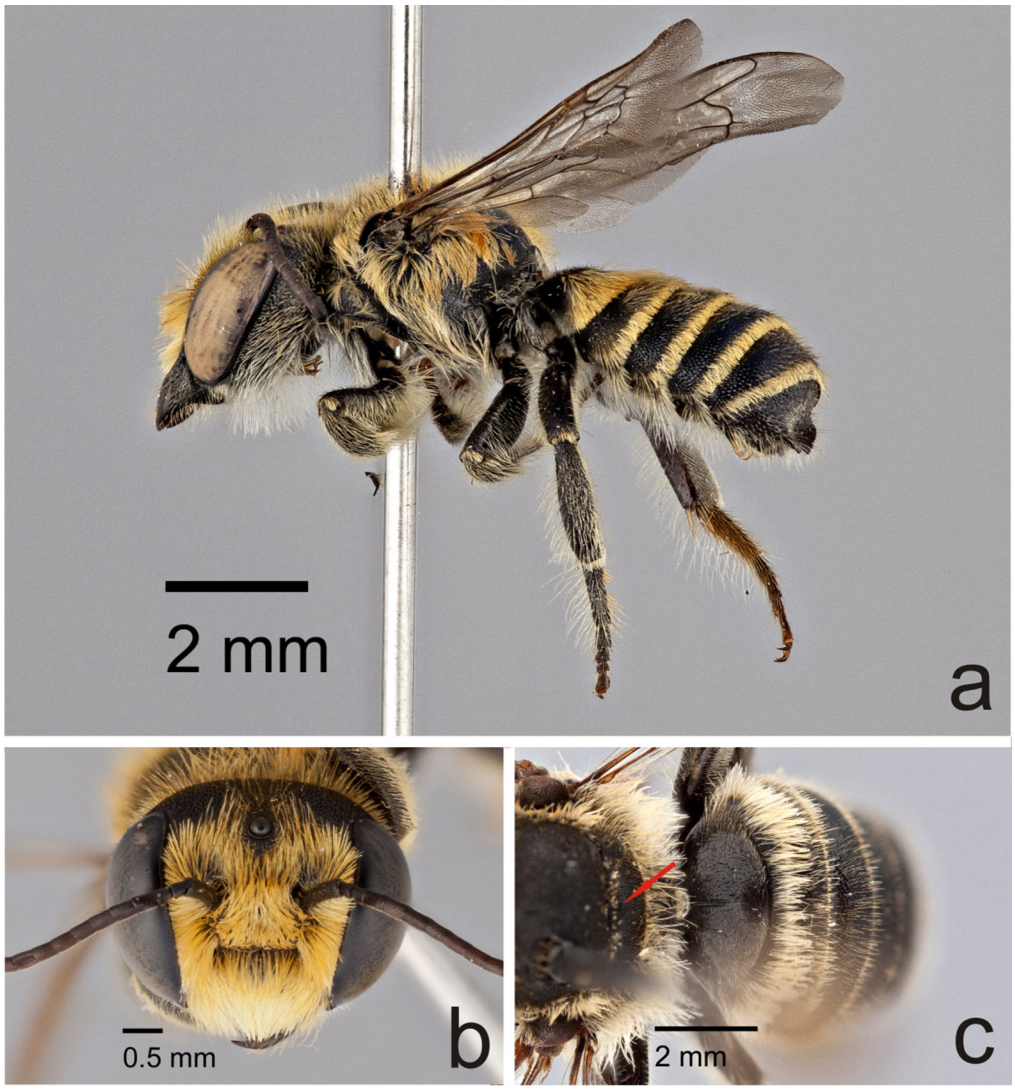

Figure 4. *Megachile* (*Litomegachile*) *droegei*, new species, male. **a.** Lateral. **b.** Face. **c.** Mesoscutum and mesoscutellum; arrow shows tomentum at suture.

Color. Integument black, flagellum reddish-brown beneath, tegula and apical tarsomere dark brown, spurs dark yellowish-brown, apical edge of S2–S5 hyaline (1 MOD); wings subhyaline, veins dark brown to black.

Structure. Compound eyes convergent below (Fig. 4b); lateral ocelli as near to compound eye as to edge of vertex; mandible 3-dentate, lower process of mandible slender, acute, subbasal in position; clypeal margin shiny and impunctate, broadly and shallowly emarginated medially; gena narrower than compound eye (3:5). F1 as long as broad, subequal in length to pedicel, slightly shorter than F2, F2 quadrate, F3–F8 longer than broad (5:4), apical segments more so (3:2), apical flagellomere more elongate, almost twice as long as broad. Front coxal spine short, distinct, longer than

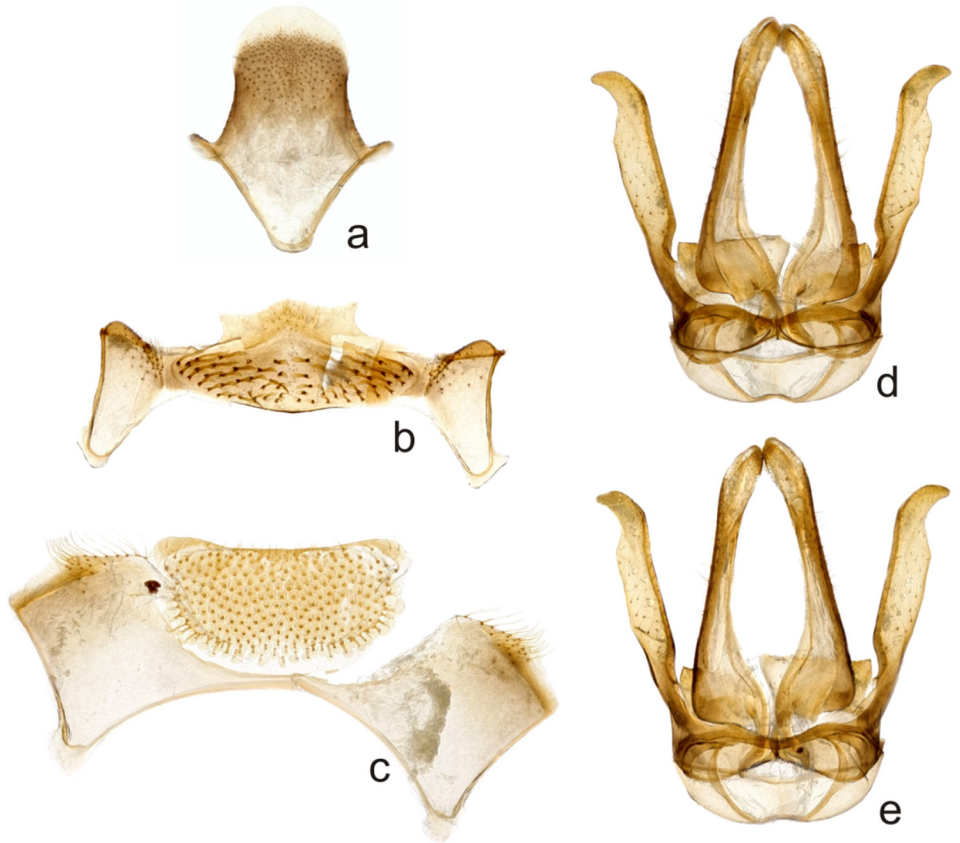

Figure 5. Hidden sterna and genitalia of *Megachile* (*Litomegachile*) *droegei*, new species, male. **a.** Sternum 8 (S8). **b.** Sternum 6 (S6). **c.** Sternum 5 (S5). **d.** Genitalia, dorsal. **e.** Genitalia, ventral.

broad, subacute. T2 and T3 with deep postgradular grooves, grooves shallower but distinct on T4 and T5, basal depressions subcarinate; apical margins of T2–T5 slightly depressed laterally, very slightly so medially; T6 vertical in position, preapical carina conspicuous with rather deep, semicircular median emargination, finely and irregularly denticulate on each side, median carinate teeth of apical margin of segment rounded, equidistant to each other as to small lateral acute teeth; T7 visible, subtriangular, much broader than long, pointed medially. S4 with apical margin slightly emarginate medially; S5 with pregradular area very thin medially, postgradular area broadly rounded to subtruncate basally, apical rim laterally produced (Fig. 5c); S6 with apical lobe produced medially, with lateral edges acutely angulate, postgradular setal patch contiguous (Fig. 5b); S8 with lateral edges subparallel medially, evenly rounded apically (Fig. 5a). Genitalia with gonocoxite not protuberant at base, constricted above it; gonostylus unmodified, evenly rounded and slightly outcurved apically (Figs. 5d, 5e).

Surface sculpture. Face with punctures fine and close, rather shallow on gena, deeper and rather fine and close on vertex medially, more irregular sized but still close on vertex laterally, quite coarse but close on clypeus, becoming finer and closer in apical half, fine and close on supraclypeal area, apical edge of clypeus shiny and impunctate. Mesoscutum with punctures deep, rather fine and uniformly close, finer and close over most of mesoscutellum and on pleura above, becoming rather coarse

and slightly separated on pleura below, with distinct shiny interspaces; tegula finely and closely punctate throughout; propodeum with shallow, fine punctures with i=0.5–1pd; triangle dull, smooth and impunctate. Metasoma with punctures fine over most of surface, minute and very close on T2, larger but still close (i<1pd) on T3, larger and more elongate on T4–T5 with shiny i≤1pd, fine and densely crowded on T6; S1–S2 with punctures coarse and well-spaced (i=1–2pd), becoming more sparse (i=3–4pd) on S3–S4.

Pubescence. Mostly pale yellow on body; dense and entirely yellow on face below level of median ocellus; mesoscutum sparsely pale pubescent, especially in posterior half, becoming long, dense and yellow at periphery, somewhat paler on mesosoma ventrally, thick subappressed pubescence at mesoscutal-mesoscutellar suture (Fig. 4c). T3–T5 with some dark, erect hairs basal to pale apical fasciae, T6 with sparse, erect dark hairs and very thin, scarcely visible pale tomentum; T1 with very thin, subappressed plumose hairs on anterior surface.

Holotype: ♀ (Fig. 2), CUBA: Guantánamo Bay, 19.9521N 75.0916W, 8-9 May 2010 (S Brady) [USGS-DRO 169904 // BeeBOL, CCDB-12076 C12, BEECF701-11 [DNA barcode accession #s:] [deposited in the Smithsonian Institution, National Museum of Natural History, Washington, DC].

Allotype: ♂, CUBA: GTMO [Guantánamo], 19.9291N 75.1162W, 9 Nov 2010 (SW Droege) [USGS-DRO 192513; DNA barcode accession #s: CCDB-12076 D07, BEECF708-11] [deposited in the Smithsonian Institution, National Museum of Natural History, Washington, DC].

Paratypes: 1♀, CUBA: GTMO [Guantánamo], 19.9053N 75.1637W, 10 Nov 2010 (S Brady) [USGS-DRO 192844; DNA barcode accession #s: CCDB-12076 D03, BEECF704-11]; 1♀, CUBA: Guantánamo Bay, 19.9156N 75.1475W, 12 Jun 2011 (SW Droege) [USGS-DRO 289154]; 1♀, CUBA: Guantánamo Bay, 19.99172N 75.1016W, 11 Jun 2011 (SW Droege) [USGS-DRO 289194]; 1♂, CUBA: Guantánamo Bay, 19.8922N 75.1692W, 10 Jun 2011 (SW Droege) [USGS-DRO 216462] [deposited in the Smithsonian Institution, National Museum of Natural History, Washington, DC].

2♀♀, CUBA: Guantánamo Bay, 19.9521N 75.0916W, 8-9 May 2010 (S Brady) [USGS-DRO 169923, DNA barcode accession #s: CCDB-12076 D01, BEECF702-11], [USGS-DRO 169912, DNA barcode accession #s: CCDB-12076 D02, BEECF703-11]; 1♂, CUBA, GTMO [Guantánamo], 19.9291N 75.1162W, 9 Nov 2010 (SW Droege) [USGS-DRO 192476, DNA barcode accession #s: CCDB-12076 D05, BEECF706-11] [deposited in the American Museum of Natural History, New York, NY].

1♀, CUBA: Guantánamo Bay, 19.9521N 75.0916W, 8-9 May 2010 (S Brady) [USGS-DRO 169913; DNA barcode accession #s: CCDB-12076 D04, BEECF705-11]; 1♂, CUBA: Guantánamo Bay, 19.923N 75.1027W, 9 Jun 2011 (SW Droege) [USGS-DRO 288745] [deposited in the USDA Bee Biology and Systematics Lab, Logan, UT].

1♀, CUBA: Guantánamo Bay, 19.9183N 75.162W, 12 Jun 2011 (SW Droege) [USGS-DRO 288803]; 1♂, CUBA: GTMO [Guantánamo], 19.9291N 75.1162W, 9 Nov 2010 (SW Droege) [USGS-DRO 192467, DNA barcode accession #s: CCDB-12076 D06, BEECF707-11] [deposited in the Royal Saskatchewan Museum, Regina, SK, Canada].

Distribution: *Megachile droegei* is known only from the Guantánamo Bay area of Cuba (Fig. 1). Specimen data available at http://dx.doi.org/10.5886/5fgt2a9k.

Comments: The species is bi-voltine/multi-voltine as it has been collected in May/June and November.

Etymology: It is our pleasure to name this species after Sam Droege, United States Geological Survey, for his outstanding efforts to promote and disseminate knowledge of bees.

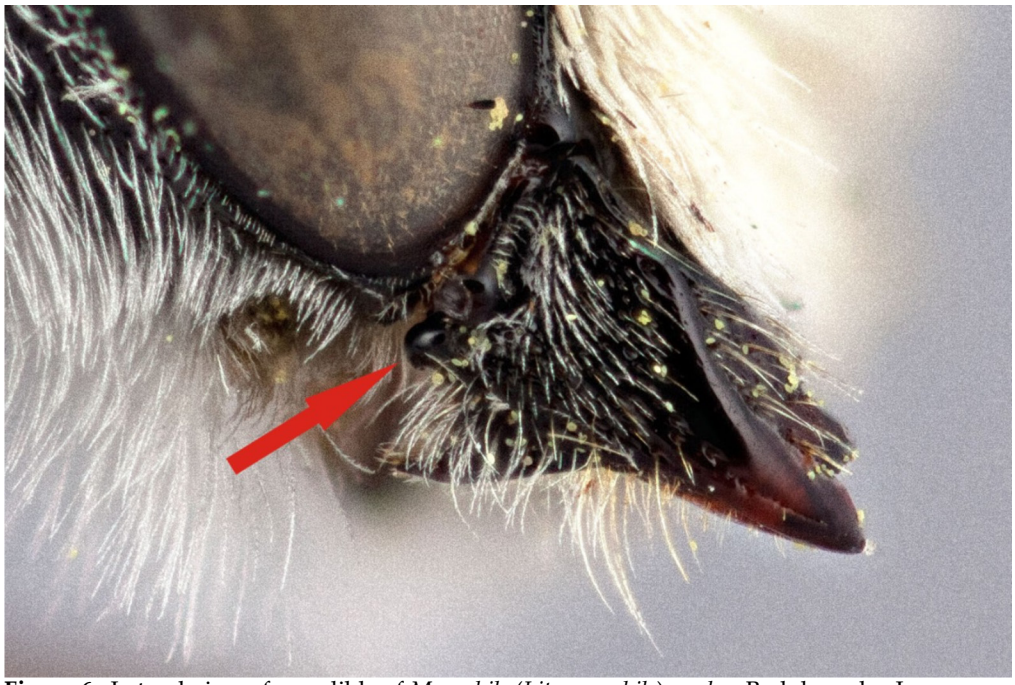

Figure 6. Lateral view of mandible of *Megachile* (*Litomegachile*) *pankus* Bzdyk, male. Lower process of mandible is submedian in position, and red arrow shows pronounced condyle, both characters diagnostic for males of this species.

Megachile (*Litomegachile*) *pankus* Bzdyk, 2012
(Figs. 6–8)

DIAGNOSIS: The female of *M. pankus* can be recognized by the combination of the mandible with angulation between the 3rd and 4th (inner) teeth, scopa of only S6 partially black, and T6 concave in profile, with erect hairs arising above the appressed black pubescence. It is most similar to *M. gentilis* Cresson, *M. snowi* Mitchell, and *M. mendica*, which share the mandibular structure. Females of *M. gentilis* have the scopal hairs of S6, and apically on S5 entirely black; females of *M. snowi* and *M. mendica* have T6 straight in profile and without erect hairs. The male of *M. pankus* is distinct in having the mandibular condyle very pronounced (Fig. 6), and can be recognized by the combination of T5 lacking apical fascia (Fig. 7c) and T2 thinly but completely fasciate. It is most similar to *M. gentilis*, *M. snowi*, and *M. mendica*. Males of *M. gentilis* and *M. snowi* have T5 fasciate apically; *M. mendica* have T2 with apical fascia restricted to the lateral edges.

DESCRIPTION: ♂: Length: 9.0 mm. Forewing length: 7.5 mm. Head width 3.5 mm; head length 2.5 mm (Fig. 7b). Intertegular distance 2.6 mm; distance between outer margins of tegulae 3.2 mm.

Color. Integument black, except for flagellum brown beneath, tegula and apical tarsomere dark brown, tibial spurs dark yellowish-brown, front femur reddish yellow below, apical edge of S2–S5 hyaline (1 MOD); wings subhyaline, with outer half including within marginal cell somewhat darkened along apical edge, veins dark brown to black.

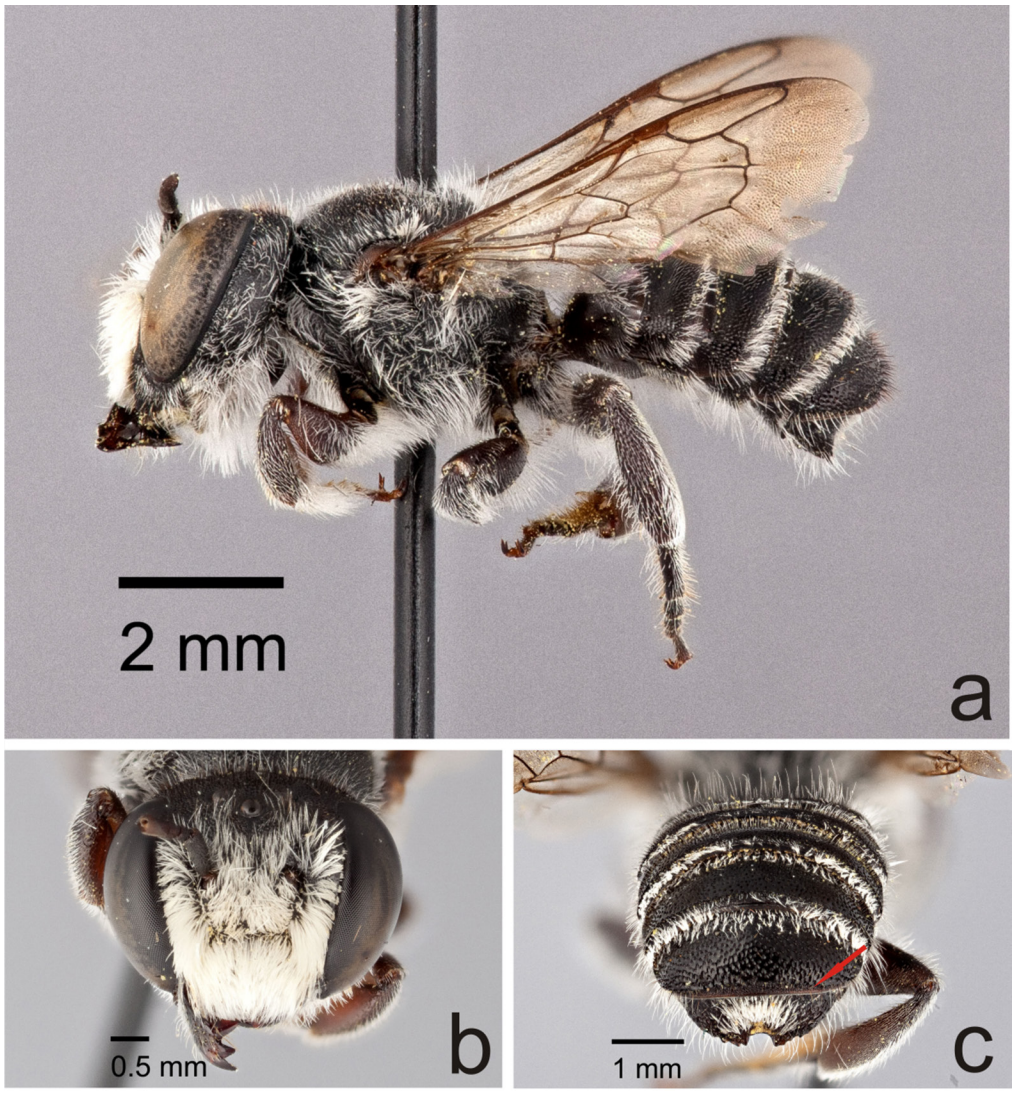

Figure 7. *Megachile* (*Litomegachile*) *pankus* Bzdyk, male. **a.** Lateral. **b.** Face. **c.** Dorsal view of apical terga, showing absence of an apical fascia on tergum 5 (T5).

Structure. Compound eyes convergent below (Fig. 7b); lateral ocelli as near to edge of vertex as to compound eye; mandible 3-dentate, lower process of mandible slender, acute, submedian in position with a pronounced condyle (Fig. 6); clypeal margin shiny and impunctate, broadly and shallowly emarginated medially; gena slightly narrower than compound eye (3.5:3). F1 about as long as broad, subequal in length to pedicel, and half as long as F2, F2 longer than broad (2:1), F3–F10 longer than broad (2:1.3), apical flagellomere more elongate, almost twice as long as broad. Front coxal spine short, distinct, quadrate to slightly longer than broad, subacute. T2 and T3 rather deeply grooved across base, grooves on T4 and T5 more shallow but distinct, basal depressions carinate; apical margins of T2–T5 depressed laterally, less so medially; T6 vertical in position, the carina quite conspicuous, with a rather deep, semicircular median emargination, finely and irregularly denticulate on each side in apical half, me-

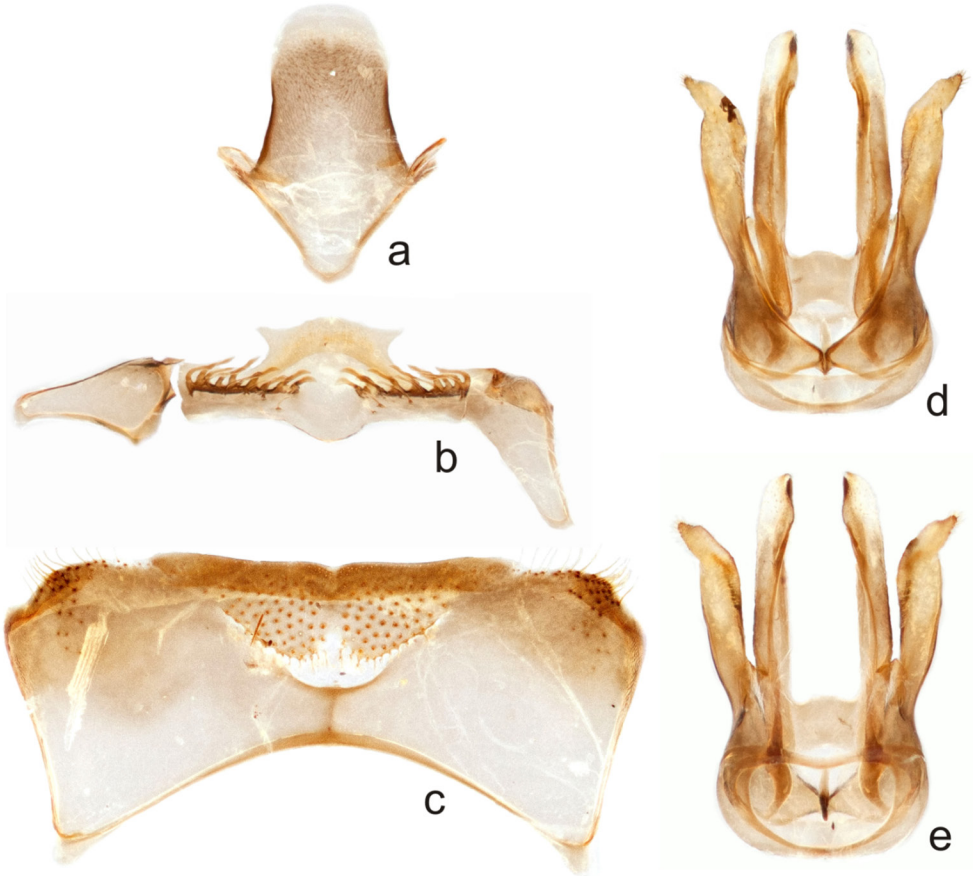

Figure 8. Hidden sterna and genitalia of *Megachile* (*Litomegachile*) *pankus* Bzdyk, male. **a.** Sternum 8 (S8). **b.** Sternum 6 (S6). **c.** Sternum 5 (S5). **d.** Genitalia, dorsal. **e.** Genitalia, ventral.

dian carinate teeth of apical margin of segment rounded to subtruncate, further apart from each other than distance to small lateral acute teeth; T7 hardly visible, apical margin rounded to subtruncate, with a small median triangular protuberance. S5 with pregradular area wide medially, about 1/3 medial length of plate, postgradular area subtriangular, narrowest basally and widest apically, with apical rim produced (Fig. 8c); S6 with apical lobe produced medially, with lateral edges angulate, postgradular setal patch widely divided medially (Fig. 8b); S8 with lateral edges converging in basal half, subparallel in apical half, evenly rounded apically (Fig. 8a). Genitalia with gonocoxite not protuberant at base, slightly narrowed above base; gonostylus unmodified (Figs. 8c, 8d).

Surface sculpture. Punctures fine and close on face, rather shallow on gena, deeper and rather fine and close on vertex medially, more irregular sized but still close on vertex laterally, quite coarse but close on clypeus, becoming finer and closer in apical half, fine and close on supraclypeal area, apical edge of clypeus shiny and impunctate. Mesoscutum with punctures deep, rather fine and uniformly close, finer and close over most of mesoscutellum and pleura; tegula finely and closely punctate throughout; propodeum with shallow, fine punctures with i=1–2pd; triangle dull, smooth and

impunctate. Metasoma with punctures fine, minute and very close on T2, larger but still close (i<1pd) on T3, larger and more sparse (i=1–2pd) on T4, elongate on T5 with shiny i≤1pd, fine and densely crowded on T6; S1 with punctures coarse and close (i<1pd), becoming more sparse (i=1–2pd) on S2 and S3, S4 with surface shiny with very sparse (i=3–4pd), coarse punctures.

Pubescence. Mostly white on body; dense and entirely white on face below level of median ocellus, short, sparse and entirely dark on vertex area; mesoscutum sparsely pale pubescent but faintly intermixed with shorty, erect dark hairs, especially in posterior half, becoming long, dense and entirely white at periphery, a few subappressed hairs at mesoscutal-mesoscutellar suture; terga mostly white pubescent, including basal tomentum on T2–T5, T3 and T4 with dark, erect hairs basal to white apical fasciae, fasciae complete on T1–T4, though thin medially, entirely lacking on T5 (Fig. 7c), T6 with abundant pale tomentum hiding most of surface.

Distribution: As discussed by Bzdyk (2012), *M. pankus* was known only from Mexico (Hidalgo, Pachuca; Sonora, Alamos; Sinaloa, Mazatlan; Sinaloa, 4 mi NW Choix; Sinaloa, 6 mi NW Choix). This is supported here; labels from one of the male specimens described here reads: MEXICO: Sonora, 30 km E Agua Prieta, 31°19′32″N 109°16′00″W, 7 Aug 2007, R.L. Minckley, ex. *Lepidium thurberi*, Pol 27 horse corral, AM SBV076514; DNA barcode accession #s: 04744G10-MEX, BBOFWM652-10. Additional specimens examined (with partial DNA barcodes) include: 1♀, USA: Arizona, Cochise Co., San Bernardino NWR, 31°20′16″N 109°15′44″W, 5 May 2001, A. Romero, ex. yellow bowl, R6T4, 011814; DNA barcode accession #s: 04744G06-AZ, BBOFWM648-10; 1♂, USA: New Mexico, Hidalgo Co., Hwy 80, 32.094, -108.968, 1367m, 15.viii.2007, J. Gibbs and C. Sheffield // *Megachile mendica snowi* Det. C. Sheffield; DNA barcode accession #s: 07-NM-2100, BEECC427-08.

Comments: *Megachile pankus* belongs to the *mendica* group, as supported by morphological and COI analysis. It is most similar to *M. mendica*, with 2.52% sequence divergence between the two species.

DISCUSSION

Litomegachile is one of the most commonly encountered subgenera of leafcutter bees in North America (Michener, 2007), and now its range extends to southernmost Cuba. However, its relationships to other subgenera of *Megachile* remain unclear. Michener (2007) noted the similar general appearance of *Litomegachile* to subgenera placed in what he calls Group 1, most notably *Eutricharaea* Thomson, an Old World subgenus that has been introduced into North America; these introduced species were treated taxonomically by Parker (1978), Mitchell (1980), and Sheffield *et al*. (2011). *Litomegachile* females differ from *Eutricharaea* in lacking bands of white hair (apical fascia) beneath the scopa, but Michener (2007) indicated that consistent differences between males were lacking. However, all of the species of *Eutricharaea* introduced into North America have the distinct lateral fovea on T2 (Parker, 1978; Sheffield *et al*., 2011), as do many others (Gonzalez *et al*., 2010). The present study and the recently published revision of *Litomegachile* (Bzdyk, 2012) now provide complete knowledge of species within the subgenus.

Based on morphological data and COI sequence data, *Litomegachile* can be divided into four distinct species groups; the *brevis*-group, the *coquilletti*-group, the *mendica*-group, and the *texana*-group (see Table 1). The *brevis*-group contains *M. brevis*, the most widespread member of the subgenus (Mitchell, 1935; Bzdyk, 2012) and one of

Table 1. Species groups for the *Megachile* subgenus *Litomegachile*, showing mean and maximum percent intra-specific variation, nearest neighbor (NN), and the percent distance to NN, based on COI sequences.

Species Group	Species Included	% Intra-Specific Variation		NN	% Distance to NN
		Mean	Maximum		
brevis	*M. brevis*	0.25	1.14	*M. pseudobrevis*	4.92
	M. droegei	0.2	0.46	*M. onobrychidis*	1.7
	M. onobrychidis	0.22	0.79	*M. pseudobrevis*	1.49
	M. pseudobrevis	0.08	0.16	*M. onobrychidis*	1.49
coquiletti	*M. coquiletti*	0.1	0.16	*M. lippiae*	4.71
mendica	*M. mendica*	0.0	0.0	*M. snowi*	1.19
	M. gentilis	0.33	0.5	*M. pankus*	2.55
	M. pankus	0	0	*M. mendica*	2.41
	M. snowi	0	0	*M. mendica*	1.19
texana	*M. texana*	0.08	0.32	*M. cleomis*	1.45
	M. lippiae	0.35	0.81	*M. texana*	2.65
	M. cleomis	0.18	0.32	*M. texana*	1.45

the most thoroughly studied leafcutter bees (Michener, 1953), *M. droegei*, *M. onobrychidis*, and *M. pseudobrevis*. Although *M. onobrychidis* and *M. pseudobrevis* have in the past been considered subspecies of *M. brevis*, these and *M. droegei* are separated from *M. brevis* by 4.92% divergence in COI, with less than 2% divergence internally (Table 1). Despite the internal genetic divergence within this species group (Table 1), the relationship to *M. brevis* is supported by shared morphological features, primarily the smaller size of all species, T6 being concave in the female in lateral view (Fig. 2a), and in the structure of S5 and S6 of the males; unlike other *Litomegachile*, the pregradular area of S5 is medially very thin, almost linear, the postgradular area is very large, occupying most of the medial surface (Fig. 5c), and the postgradular setal patch on S6 is not, or scarcely divided into lateral patches (Fig. 5b) [for comparison, see *M. pankus*, Fig. 8].

The *mendica*-group contains *M. mendica*, *M. gentilis*, *M. pankus*, and *M. snowi*; all females sharing the angulation on the mandible between the 3rd and 4th teeth. The males of *M. mendica* and *M. pankus* are unique among the subgenus in lacking apical fascia on tergum 5 (Fig. 6c).

The *coquilletti*-group is monotypic within *Litomegachile*, the most recognizable difference being the pale tarsomeres of the front legs in the male. On the mandible in some female specimens of *M. coquilletti* Cockerell, a very slight angulation may be visible between the 3rd and 4th teeth (Fig. 9), thus supporting that this species might form a larger group with the *mendica*-group to which it is closely related, though it appears molecularly distinct (and sharing COI similarity with *M. lippiae* Cockerell of the *texana*-group) (Table 1).

The *texana*-group contains *M. texana*, *M. lippiae*, and *M. cleomis* Cockerell, which is here recognized as a distinct species from *M. texana* based on 1.45% divergence in COI (Table 1), the distinction partitioning the "species" into distinct eastern (*M. texana*)

Figure 9. Mandible of *Megachile* (*Litomegachile*) *coquilletti* Cockerell. Red arrow shows slight angulation between the 3rd and 4th teeth.

and western (*M. cleomis*) haplotypes. A forthcoming phylogeny will detail the internal relationships within the subgenus, and those of *Litomegachile* to other subgenera of *Megachile*.

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