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BRUEELIA (PHTHIRAPTERA: ISCHNOCERA: PHILOPTERIDAE) OF NORTH AMERICAN NINE-PRIMARIED OSCINES (AVES: PASSERIFORMES: PASSERIDA) WITH DESCRIPTIONS OF NINE NEW SPECIES

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KEY WORDS

Brueelia
Philopteridae
Cardinalidae
Fringillidae
Icteridae
North America
New Species

ABSTRACT

Nine new species of chewing lice in the genus *Brueelia* Kéler, 1936, are described from North American hosts. They are *Brueelia thorini* n. sp. from *Haemorhous mexicanus frontalis* (Say, 1822) and *Haemorhous mexicanus potosinus* Griscom, 1928; *Brueelia straseviciusi* n. sp. from *Haemorhous purpureus* (Gmelin, 1789); *Brueelia mattsonae* n. sp. from *Coccothraustes vespertinus brooksi* (Grinnell, 1917); *Brueelia novemstriata* n. sp. from *Icterus wagleri wagleri* Sclater, 1857, and *I. parisorum* Bonaparte, 1838; *Brueelia benkmani* n. sp. from *Pheucticus melanocephalus* (Swainson, 1827); *Brueelia arizonae* n. sp. from *Passerina caerulea* (Linnaeus, 1758); *Brueelia hellstromi* n. sp. from *Piranga ludoviciana* (Wilson, 1811); *Brueelia dolorosa* n. sp. from *Spinus pinus pinus* (Wilson, 1810); and *Brueelia melancholica* n. sp. from *Spinus tristis* (Linnaeus, 1758). *Brueelia limbata* (Burmeister, 1838) is redescribed and illustrated from North American material. A key for these North American species is provided.

The "9-primaried oscines" is a large radiation within Passeriformes united by both molecular and morphological characters (Klicka et al., 2000; Yuri and Mindell, 2002; Hall, 2005; Barker et al., 2012, 2015). The group spans many of the more common passeriform families across the world, including Cardinalidae, Emberizidae, Fringillidae, Icteridae, Parulidae, Passerellidae, and Thraupidae. In total, this assemblage is estimated to contain about 20% of all perching birds (Yuri and Mindell, 2002). Although many of these birds are likely to host lice from the *Brueelia* complex, relatively few *Brueelia*-complex lice are known from this large avian radiation. To date, 98 *Brueelia*-complex louse species are known from 9-primaried oscines, including from the following families: Calcariidae (2 spp.), Cardinalidae (3 spp.), Emberizidae (5 spp.), Fringillidae (22 spp.), Icteridae (37 spp.), Parulidae (2 spp.), Passerellidae (6 spp.), and Thraupidae (19 spp.) (Gustafsson and Bush, 2017; Mey, 2017). Here we described or redescribe the following species of *Brueelia* from 9-primaried oscines in North America: *Brueelia hellstromi* n. sp. (Figs. 1–7), *Brueelia benkmani* n. sp. (Figs. 8–14), *Brueelia arizonae* n. sp. (Figs. 15–21), *Brueelia limbata* (Burmeister, 1838) (Figs. 22–28), *Brueelia mattsonae* n. sp. (Figs. 29–35), *Brueelia thorini* n. sp. (Figs. 36–42), *Brueelia straseviciusi* n. sp. (Figs. 43–49), *Brueelia melancholica* n. sp. (Figs. 50–56), *Brueelia dolorosa* n. sp. (Figs. 57–63), and *Brueelia novemstriata* n. sp. (Figs. 64–70).

MATERIALS AND METHODS

Slide-mounted specimens are deposited at the Natural History Museum, London, United Kingdom (NHML), Price Institute for Parasite Research, University of Utah, Salt Lake City, Utah (PIPeR), or University of Minnesota, St. Paul, Minnesota (UMSP). All studied material was mounted in Canada balsam on microscopy slides. Specimens were examined and measured with a Nikon Eclipse E600 microscope (Nikon Precision Inc., Belmont, California) fitted with an Olympus DP25 camera (Olympus Corp., Center Valley, Pennsylvania) and digital measuring software (ImageJ 1.48v, Wayne Rasband). Illustrations were drawn by hand, using a drawing tube. Line drawings were scanned, collated, and edited in GIMP (www.gimp.org). Thin gray lines in illustrations denote approximate extent of areas of dark pigmentation; note that these areas exhibit some intraspecific variation.

All measurements are given in millimeters, as ranges (mean value, when n $\geq$ 10). Abbreviations used are the following: AW =

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abdominal width (at segment V); HL = head length (at midline); HW = head width (at temples); PRW = prothorax width; PTW = pterothorax width; and TL = total length (at midline). Morphological terms and abbreviations thereof follow Gustafsson and Bush (2017) and include *aps = accessory postspiracular setae; ps = pleural setae; ss = sutural setae; tps = tergal posterior setae; vms = vulval marginal setae; vos = vulval oblique setae*; *vss = vulval submarginal setae*. Host taxonomy follows Clements et al. (2018).

SYSTEMATICS

Phthiraptera Haeckel, 1896
Ischnocera Kellogg, 1896
Philopteridae Burmeister, 1838
Brueelia complex *sensu* Gustafsson and Bush, 2017
Brueelia Kéler, 1936
Philopterus Nitzsch, 1818: 288 (*in partim*); *Nirmus* Nitzsch, 1818: 291 (*in partim*); *Degeeriella* Neumann, 1906: 60 (*in partim*); *Painjunirmus* Ansari, 1947: 285; *Allobrueelia* Eichler, 1951: 36 (*in partim*); *Nigronirmus* Złotorzycka, 1964: 248; *Spironirmus* Złotorzycka, 1964: 261; *Serinirmus* Soler Cruz et al., 1987: 244; *Plesionirmus* Mey, 2017: 144; *Neosittiella* Mey, 2017: 149.

Type species: Brueelia rossittensis Kéler, 1936: 257 [= *Brueelia brachythorax* (Giebel, 1874: 134)] ex *Bombycilla garrulus garrulus* (Linnaeus, 1758), by original designation.

Remarks

All 3 new species of *Brueelia* from hosts in the Cardinalidae share the following characters: male tergopleurite VI without *aps*; male abdominal segment III without *ps*; proximal mesosome broadly elongated; gonopore prominent, elongated; parameres elongated. This combination of characters is also shared with some *Brueelia* from hosts in the Passerellidae (D. R. Gustafsson and S. E. Bush, unpubl. data), which may be the closest relatives of the *Brueelia* of the Cardinalidae. The *Brueelia* of North American finches are also morphologically similar to *Brueelia* of Old World finches, with which they also share distinctive pigmentation patterns.

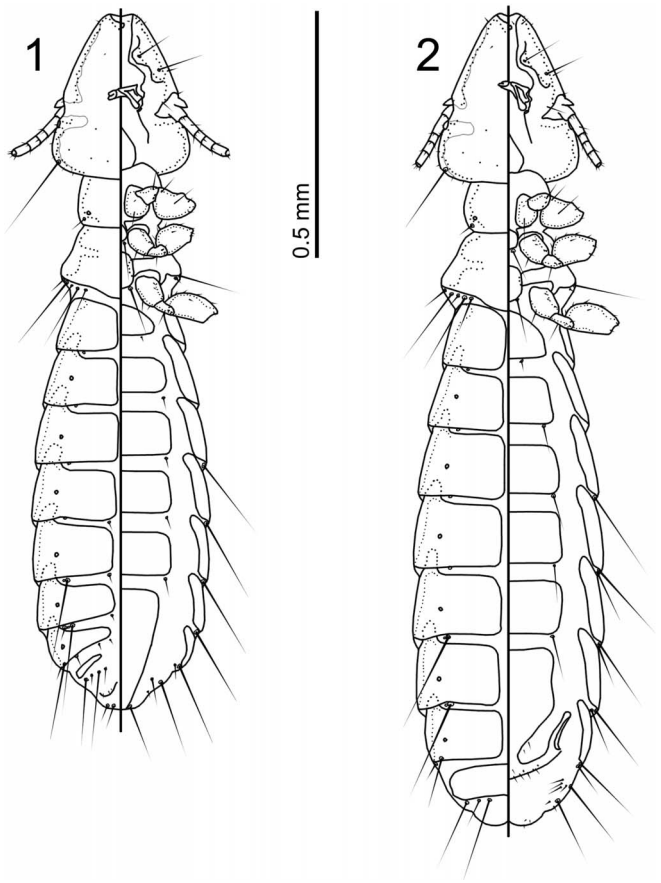
DESCRIPTIONS

Brueelia hellstromi Gustafsson and Bush, n. sp.

(Figs. 1–7)

Description both sexes: Head convex dome-shaped (Fig. 3), lateral margins of preantennal head convex, frons rounded to concave. Marginal carina moderate, inner margin slightly undulating, median section deeply displaced and widened. Ventral anterior plate roughly square-shaped, pale and hard to see in many specimens. Head chaetotaxy and pigmentation pattern as in Figure 3. Preantennal nodi wide, bulging slightly in posterior end. Pre- and postocular nodi large. Marginal temporal carina broad and irregular along lateral margins of head, thinner and more regular along posterior margin of head. Gular plate lanceolate. Thoracic and abdominal segments and pigmentation patterns as in Figures 1 and 2.

Male: Thoracic and abdominal chaetotaxy as in Figure 1; *ss* present on tergopleurite V, *tps* present on tergopleurite VIII but absent from tergopleurite VII, *aps* present on tergopleurite VII.



Figures 1, 2. *Brueelia hellstromi* n. sp. ex *Piranga ludoviciana* (Wilson, 1811). (**1**) Male habitus, dorsal and ventral view. (**2**) Female habitus, dorsal and ventral view.

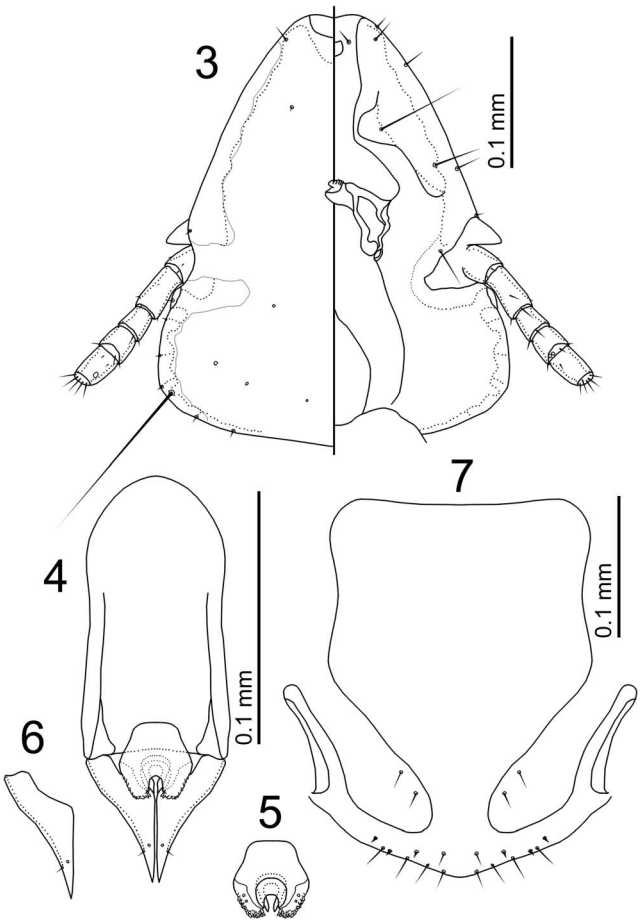
Basal apodeme broad, widening slightly distally (Fig. 4). Proximal mesosome broadly trapezoidal, lateral margins slightly concave (Fig. 5), anterior margin rounded in some specimens. Mesosomal lobes slender, rounded; rugose area covers most of lateral margin of distal mesosome; 2 *pmes* sensilla on each side lateral to gonopore. Gonopore thickly crescent-shaped, distal margin deeply concave. Penile arms short, not reaching distal margin of mesosome. Parameres stout, elongated, *pst1–2* as in Figure 6. Measurements (n = 5): TL = 1.30–1.39; HL = 0.32–0.34; HW = 0.26–0.27; PRW = 0.15–0.18; PTW = 0.23–0.25; AW = 0.31–0.37.

Female: Thoracic and abdominal chaetotaxy as in Figure 2. Lateral margins of anterior subgenital plate parallel or concave (Fig. 7), with broad connection to cross-piece. Vulval margin convergent to blunt median point (Fig. 7), with 3–5 short, slender *vms* and 3–4 short, thorn-like *vss* on each side; 3–4 short, slender *vos* on each side of subgenital plate; distal 1 *vos* median to *vss*. Measurements (n = 31 except TL where n = 28 and HL where n = 29): TL = 1.51–1.71 (1.61); HL = 0.34–0.37 (0.35); HW = 0.26–0.30 (0.28); PRW = 0.17–0.19 (0.18); PTW = 0.25–0.29 (0.27); AW = 0.36–0.44 (0.40).

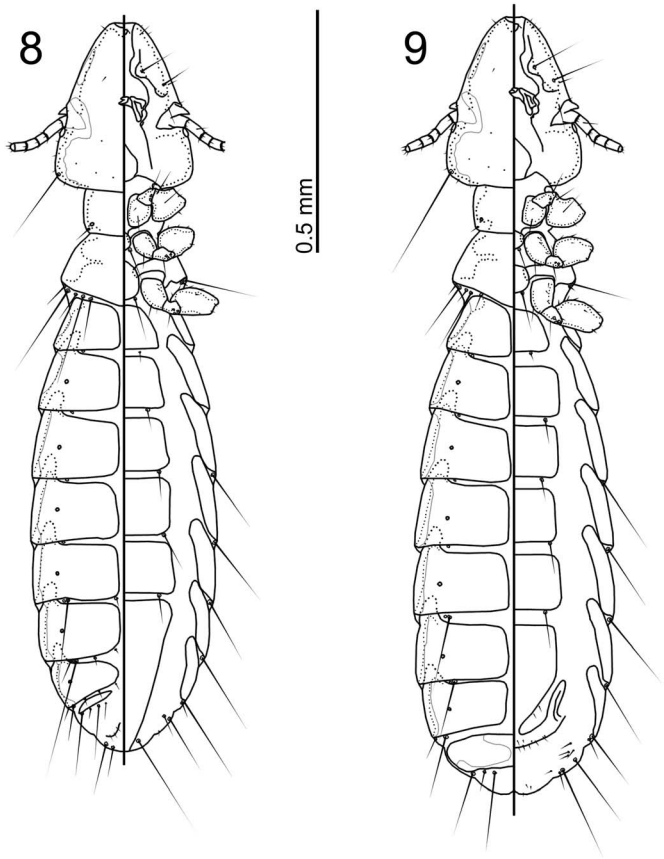
Taxonomic summary

Type host: Piranga ludoviciana (Wilson, 1811), western tanager (Cardinalidae).

Type locality: Dugway, Tooele County, Utah.



Figures 3–7. *Brueelia hellstromi* n. sp. ex *Piranga ludoviciana* (Wilson, 1811). (**3**) Male head, dorsal and ventral view. (**4**) Male genitalia, dorsal view. (**5**) Male mesosome, ventral view. (**6**) Male paramere, dorsal view. (**7**) Female subgenital plate and vulval margin, ventral view. (Figs. 4–6 share lower left scale bar.)



Figures 8, 9. *Brueelia benkmani* n. sp. ex *Pheucticus melanocephalus* (Swainson, 1827). (**8**) Male habitus, dorsal and ventral view. (**9**) Female habitus, dorsal and ventral view.

Type material: Holotype ♂, Dugway, [Tooele County] Utah, Summer 1958, E and E [Branch] (NHML). Paratypes 1♀, same data as holotype (NHML); 2♂, 2♀, same data as holotype (PIPeR); 2♀, Dugway, Tooele County, Utah, 1 June 1971, E. and E. Branch, D.P.G., 71-0-0033 (PIPeR); 2♂, 5♀, North Skull Valley, Tooele County, Utah, 10 June 1964, E. and E. Branch, EE5334 (PIPeR); 4♀, Little Granite Mountain, Dugway, Tooele County, Utah, 10 June 1970, EE-700-88 (PIPeR); 20♀, same locality, 12 June 1970, EE-700-94 (PIPeR).

ZooBank registration: urn:lsid:zoobank.org:act:5928C996-2571-4BB2-811E-A9BDB0D20645.

Etymology: Brueelia hellstromi is named after Magnus Hellström, station master of Ottenby Bird Observatory, in recognition of his long work with bird banding in Sweden, and for welcoming D.G. to collect louse specimens at Ottenby several times between 2007 and 2014. Without the assistance of Hellström and his staff, much less would be known about the Swedish louse fauna.

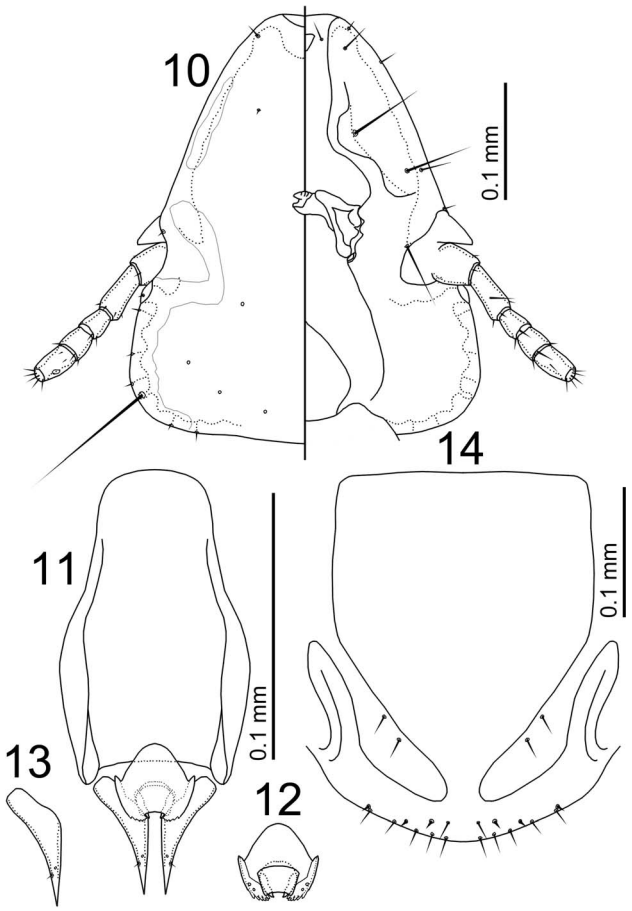
Remarks

Brueelia hellstromi is most similar to *Brueelia benkmani* n. sp. with which it shares the following characters: *aps* absent on male tergopleurites V–VI (Figs. 1, 8), *ps* absent on male abdominal segment III (Figs. 1, 8), and proximal mesosome broad and mesosomal lobes very narrow (Figs. 5, 12). These 2 species can be separated by the following characters: *ss* present on male tergopleurite V in *B. hellstromi* (Fig. 1) but absent in *B. benkmani* (Fig. 8), *tps* absent on male tergopleurite VII in *B. hellstromi* (Fig. 1) but present in *B. benkmani* (Fig. 8), proximal mesosome rounded trapezoidal in *B. hellstromi* (Fig. 5) but semi-oval in *B. benkmani* (Fig. 12), gonopore of different shape in the 2 species (Figs. 5, 12), and female abdominal segments V–VII with 2 *ps* on each side in *B. hellstromi* (Fig. 2) but with 1 *ps* on each side in *B. benkmani* (Fig. 9). Female vulval chaetotaxy overlaps between these 2 species, but the shape of subgenital plate and the vulval margin are distinctive (Figs. 7, 14).

Brueelia benkmani **Gustafsson and Bush, n. sp.**

(Figs. 8–14)

Description both sexes: Head rounded trapezoidal (Fig. 10), lateral margins of preantennal area convex, frons flattened to slightly concave. Marginal carina moderate, median margin slightly undulating, median section moderately displaced and much widened. Ventral anterior plate roughly triangular. Head chaetotaxy and pigmentation pattern as in Figure 10. Preantennal nodi wide, bulging. Preocular nodi large, postocular nodi moderate. Marginal temporal carina wide, undulating. Gular



Figures 10–14. *Brueelia benkmani* n. sp. ex *Pheucticus melanocephalus* (Swainson, 1827). (**10**) Male head, dorsal and ventral view. (**11**) Male genitalia, dorsal view. (**12**) Male mesosome, ventral view. (**13**) Male paramere, dorsal view. (**14**) Female subgenital plate and vulval margin, ventral view. (Figs. 11–13 share lower left scale bar.)

plate broadly lanceolate. Thoracic and abdominal segments and pigmentation patterns as in Figures 8 and 9.

Male: Thoracic and abdominal chaetotaxy as in Figure 8; *ss* absent on tergopleurite V; *aps* present on tergopleurite VII; *tps* present on tergopleurites VII–VIII. Basal apodeme broad, narrowing anteriorly (Fig. 11). Proximal mesosome elongated, parabolic (Fig. 12). Mesosomal lobes slender, long; rugose area limited to distal and median margins; 2 *pmes* sensilla on each side lateral to gonopore. Gonopore rectangular, broad and long, proximal margin slightly convex, distal margin slightly concave. Penile arms short, not reaching distal margin of mesosome. Parameres slender, elongated; *pst1–2* as in Figure 13. Measurements (n = 2): TL = 1.49–1.50; HL = 0.35; HW = 0.28; PRW = 0.16–0.18; PTW = 0.26–0.27; AW = 0.38–0.39.

Female: Thoracic and abdominal chaetotaxy as in Figure 9. Lateral margins of anterior subgenital plate roughly parallel (Fig. 14), with narrow connection to cross-piece. Vulval margin gently rounded (Fig, 14), with 4–5 short, slender *vms* and 2–3 short, thorn-like *vss* on each side; 3–5 short, slender *vos* on each side of subgenital plate; distal 1 *vos* median to *vss*. Measurements (n = 3): TL = 1.59–1.65; HL = 0.36–0.37; HW = 0.28–0.29; PRW = 0.17–0.19; PTW = 0.25–0.28; AW = 0.39–0.41.

Taxonomic summary

Type host: Pheucticus melanocephalus (Swainson, 1827), black-headed grosbeak.

Type locality: Cane Springs, Cedar Mountains, vicinity of Dugway, Tooele County, Utah.

Type material: Holotype ♂, Cane Springs, Cedar Mountains, vicinity of Dugway, Tooele County, Utah, 27 August 1953, R.D. Porter, 178-B-405 (NHML). Paratypes 2♀, same data as holotype (NHML); 1♂, 1♀, same locality, 26 August 1953, R.D. Porter, 189-B-402 (NHML); 1♀, Las Vacas, Coahuila, Mexico, 15 July 1958, C.A. Ely, CAE-664 (PIPeR).

ZooBank registration: urn:lsid:zoobank.org:act:E342C750-EE45-4D60-AEA7-065424C01491.

Etymology: Specific name is in honor of Craig Benkman (University of Wyoming), in recognition of the decades he has spent researching the evolutionary ecology of avian foraging behavior.

Remarks

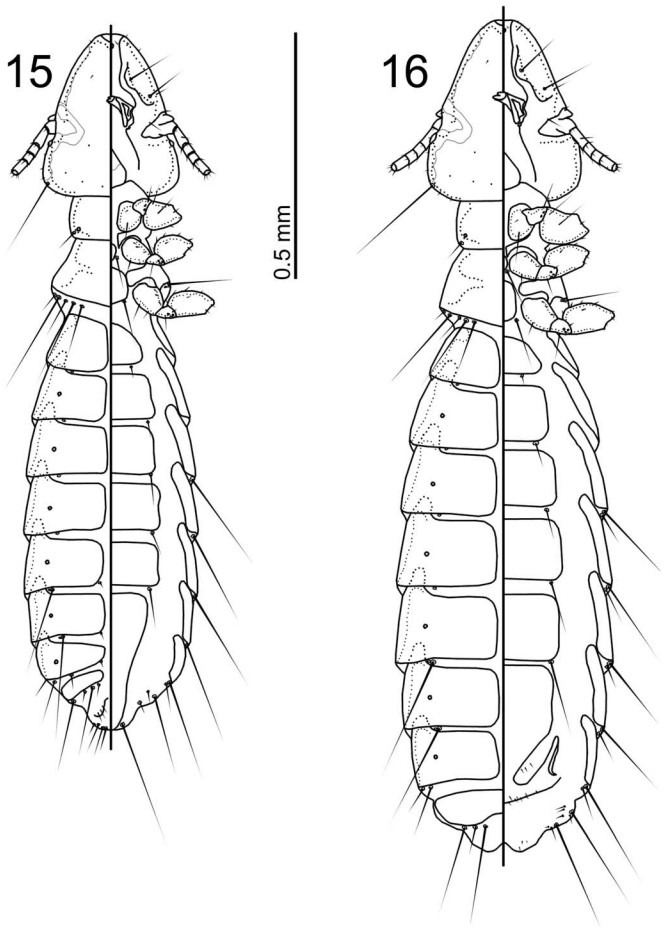
Brueelia benkmani is most similar to *Brueelia hellstromi* with which it shares the following characters: *aps* absent on male tergopleurites V–VI (Figs. 1, 8); *ps* absent on male abdominal segment III (Figs. 1, 8); proximal mesosome broad and mesosomal lobes very narrow (Figs. 5, 12). These 2 species can be separated by the following characters: *ss* absent on male tergopleurite V in *B. benkmani* (Fig. 8) but present in *B. hellstromi* (Fig. 1), *tps* present on male tergopleurite VII in *B. benkmani* (Fig. 8) but absent in *B. hellstromi* (Fig. 1), proximal mesosome rounded trapezoidal in *B. hellstromi* (Fig. 5) but semi-oval in *B. benkmani* (Fig. 12), gonopore of different shape in the 2 species (Figs. 5, 12), female abdominal segments V–VII with 2 *ps* on each side in *B. hellstromi* (Fig. 2) but with 1 *ps* on each side in *B. benkmani* (Fig. 9). Female vulval chaetotaxy overlaps between these 2 species, but the shape of subgenital plate and the vulval margin are distinctive (Figs. 7, 14).

Brueelia arizonae **Gustafsson and Bush, n. sp.**

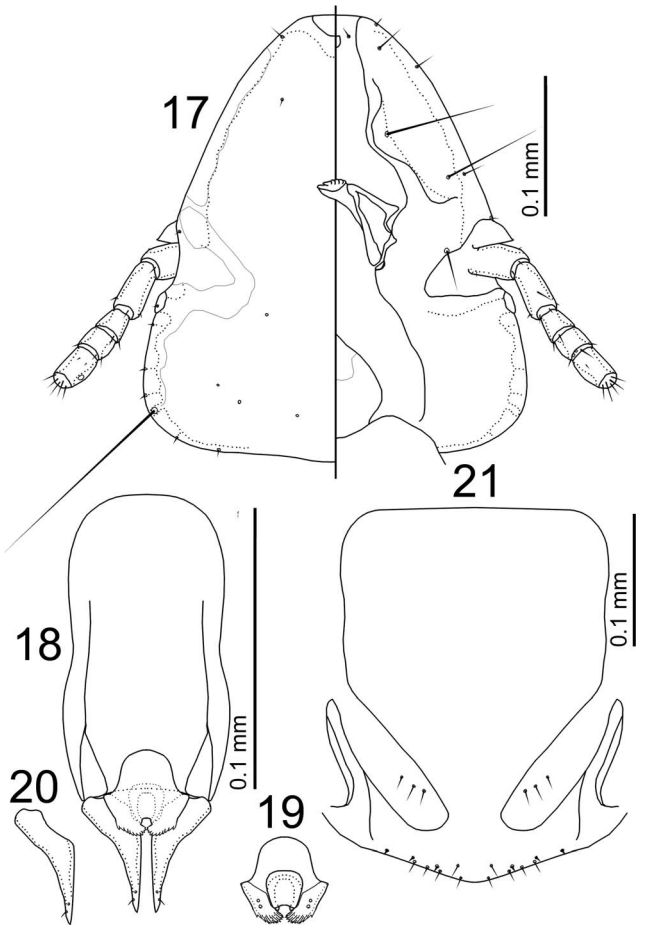
(Figs. 15–21)

Description both sexes: Head flat dome-shaped (Fig. 17), lateral margins of preantennal area convex, frons slightly flattened. Marginal carina moderate, median margin slightly undulated, median section deeply displaced and widened. Ventral anterior plate small, roughly quadratic. Head chaetotaxy and pigmentation pattern as in Figure 17. Preantennal nodi slender, bulging slightly posteriorly. Pre- and postocular nodi small. Marginal temporal carina moderate, irregular in anterior end. Gular plate broadly lanceolate. Thoracic and abdominal segments and pigmentation patterns as in Figures 15 and 16.

Male: Thoracic and abdominal chaetotaxy as in Figure 15; *ss* absent on tergopleurite V; *aps* and *tps* absent on tergopleurites VI–VII. Basal apodeme broad, slightly constricted at mid-length (Fig. 18). Proximal mesosome broad, elongated, rounded (Fig. 19). Mesosomal lobes broad, extensively fringed, and rugose in distal ends, 2 *pmes* sensilla on each side postero-lateral to gonopore. Gonopore elongated, rounded trapezoidal. Penile arms short, not reaching distal margin of mesosome. Parameres slender, elongated, *pst1–2* as in Fig. 20. Measurements (n = 1): TL = 1.37; HL = 0.33; HW = 0.26; PRW = 0.17; PTW = 0.25; AW = 0.36.



Figures 15, 16. *Brueelia arizonae* n. sp. ex *Passerina caerulea* (Linnaeus, 1758). (**15**) Male habitus, dorsal and ventral view. (**16**) Female habitus, dorsal and ventral view.



Figures 17–21. *Brueelia arizonae* n. sp. ex *Passerina caerulea* (Linnaeus, 1758). (**17**) Male head, dorsal and ventral view. (**18**) Male genitalia, dorsal view. (**19**) Male mesosome, ventral view. (**20**) Male paramere, dorsal view. (**21**) Female subgenital plate and vulval margin, ventral view. (Figs. 18–20 share lower left scale bar.)

Female: Thoracic and abdominal chaetotaxy as in Figure 16. Lateral margins of anterior subgenital plate more or less parallel (Fig. 21), with broad connection to cross-piece. Vulval margin convergent to blunt median point (Fig. 21), with 3–4 short, slender *vms* and 3 short, thorn-like *vss* on each side; 3–4 short, slender *vos* on each side of subgenital plate; distal 1 *vos* median to *vss*. Measurements (n = 3): TL =1.63–1.73; HL = 0.36–0.37; HW = 0.30; PRW = 0.19–0.20; PTW = 0.28–0.29; AW = 0.41–0.45.

Taxonomic summary

Type host: Passerina caerulea (Linnaeus, 1758), blue grosbeak.

Type locality: Tucson, Arizona.

Type material: Holotype ♂, Tucson, Arizona, 18 May 1940, A.R. Phillips (NHML). Paratypes 3♀, same data as holotype (NHML).

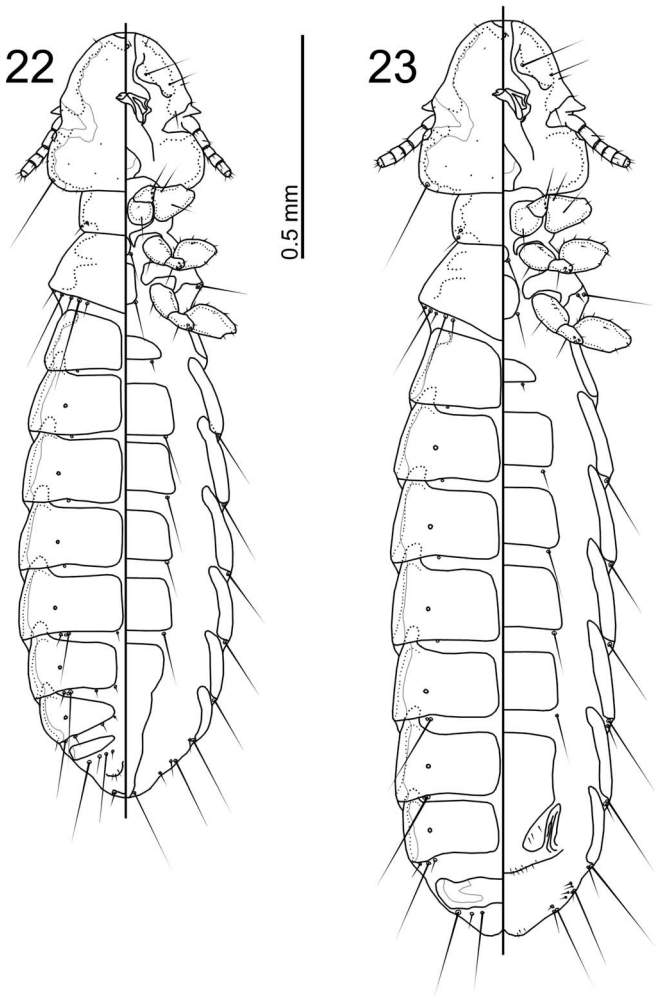
ZooBank registration: urn:lsid:zoobank.org:act:4BAC1FB7-9513-45BE-A1F8-C40CCFB0A13F.

Etymology: Specific name derived from the type locality.

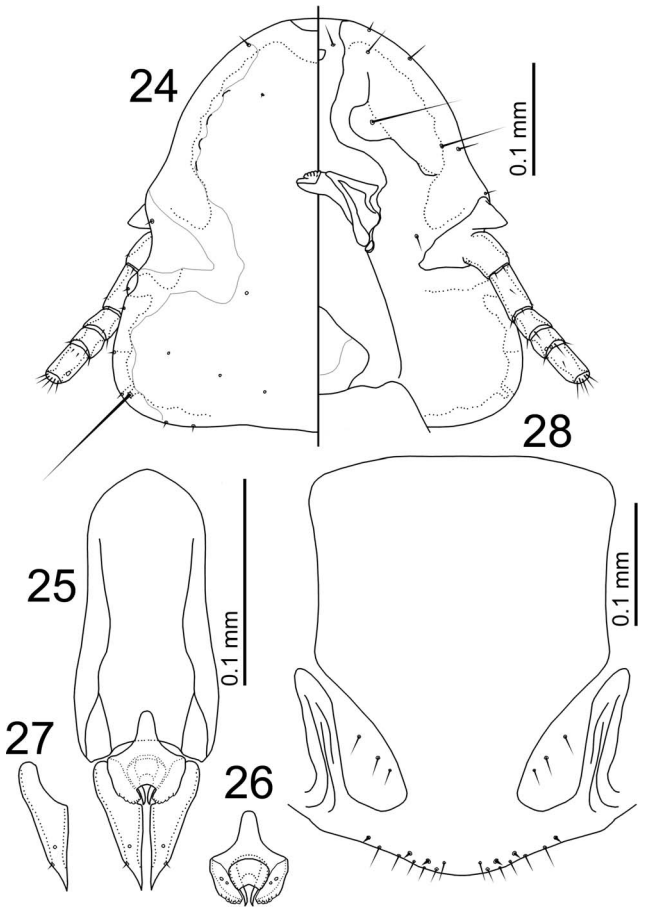
Remarks

Brueelia arizonae is most similar to *B. hellstromi* with which it shares the following characters: *aps* absent on male tergopleurites V–VI (Figs. 1, 15), *tps* absent on male tergopleurite VII (Figs. 1, 15), and proximal mesosome broad (Figs. 5, 19). These 2 species can be separated by the following characters: *ss* present on male tergopleurite V in *B. hellstromi* (Fig. 1) but absent in *B. arizonae* (Fig. 15), *aps* absent on male tergopleurite VII in *B. arizonae* (Fig. 15) but present in *B. hellstromi* (Fig. 1), proximal mesosome rounded trapezoidal in *B. hellstromi* (Fig. 5) but rounded in *B. arizonae* (Fig. 19), and female abdominal segment IV with 2 *ps* on each side in *B. arizonae* (Fig. 16) but with 1 *ps* on each side in *B. hellstromi* (Fig. 2). Vulval chaetotaxy overlapping between these 2 species, but females can be separated by head shape (Figs. 2, 16).

Brueelia arizonae is also similar to *B. benkmani* with which it shares the following characters: *aps* absent on male tergopleurites V–VI (Figs. 8, 15), *ss* absent on male tergopleurite V (Figs. 8, 15), and proximal mesosome broad and rounded (Figs. 12, 19). These 2 species can be separated by the following characters: *aps* absent on male tergopleurite VII in *B. arizonae* (Fig. 15) but present in *B. benkmani* (Fig. 8), *tps* absent on male tergopleurite VII in *B. arizonae* (Fig. 15) but present in *B. benkmani* (Fig. 8), gonopore longer than wide in *B. arizonae* (Fig. 19) but wider than long in *B. benkmani* (Fig. 12), female abdominal segments IV–VII with 2 *ps* on each side in *B. arizonae* (Fig. 16) but with 1 *ps* on each side in



Figures 22, 23. *Brueelia limbata* (Burmeister, 1838) ex *Loxia curvirostra stricklandi* Ridgway, 1885. (**22**) Male habitus, dorsal and ventral view. (**23**) Female habitus, dorsal and ventral view.



Figures 24–28. *Brueelia limbata* (Burmeister, 1838) ex *Loxia curvirostra stricklandi* Ridgway, 1885. (**24**) Male head, dorsal and ventral view. (**25**) Male genitalia, dorsal view. (**26**) Male mesosome, ventral view. (**27**) Male paramere, dorsal view. (**28**) Female subgenital plate and vulval margin, ventral view. (Figs. 25–27 share lower left scale bar.)

B. benkmani (Fig. 9). Vulval chaetotaxy overlaps between these 2 species, but females can be separated by head shape and the shape of the subgenital plate.

***Brueelia limbata* (Burmeister, 1838)**

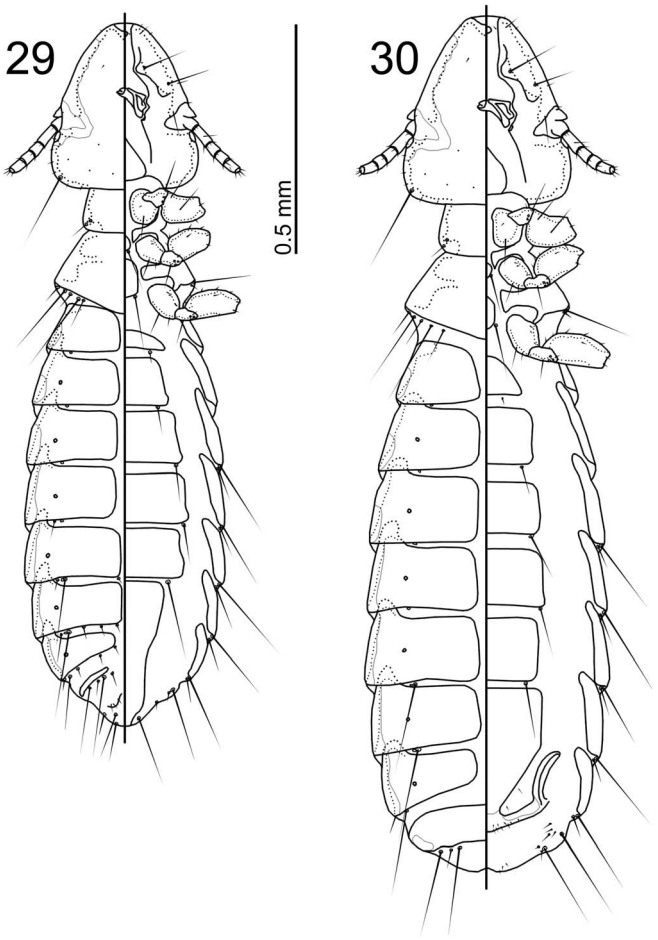
(Figs. 22–28)

(*Nirmus limbatus* Burmeister, 1838: 429)
(*Degeeriella limbata* Nitzsch in Burmeister, 1838; Harrison, 1916: 116)
(*Brueelia limbata* (Burmeister), 1838; Hopkins and Clay, 1952: 57)
(*Nigronirmus limbatus* (Burmeister); Lakshminarayana, 1968: 98)

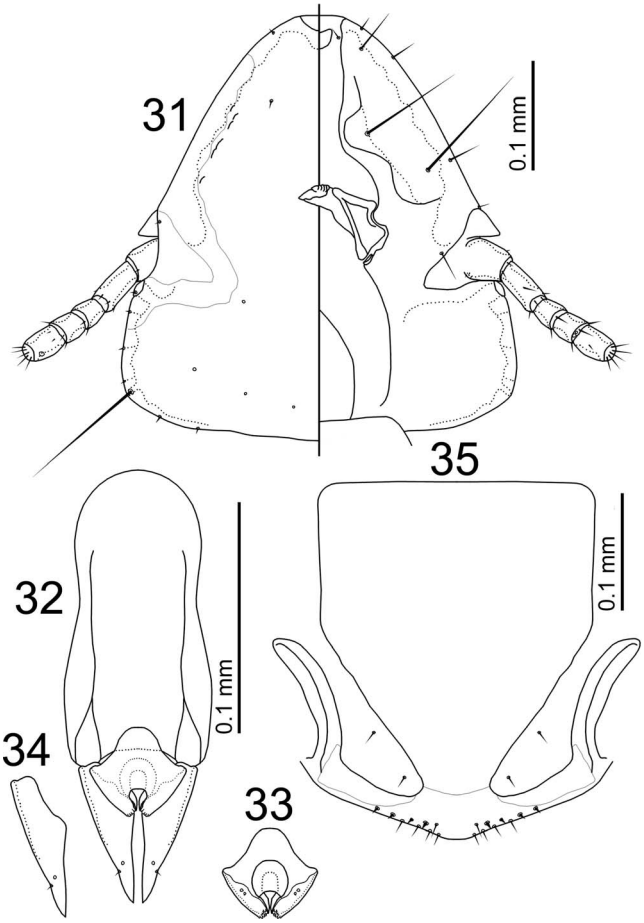
Description both sexes: Head broadly flat dome-shaped (Fig. 24), lateral margins of preantennal area highly convex, frons rounded to slightly flattened. Marginal carina wide, median margin undulated, median section moderately displaced and widened. Ventral anterior plate small, roughly triangular. Head chaetotaxy and pigmentation pattern as in Figure 24. Preantennal nodi very large, bulging. Pre- and postocular nodi large. Marginal temporal carina wide, irregular. Gular plate triangular. Thoracic and abdominal segments and pigmentation patterns as in Figures 22 and 23.

Male: Thoracic and abdominal chaetotaxy as in Figure 22; *ss* absent on tergopleurite V; *aps* present on tergopleurite VI, absent on tergopleurite V; *ps* present on abdominal segment III. Basal apodeme long and slender (Fig. 25), narrowing anteriorly. Proximal mesosome elongated, narrowly rounded (Fig. 26). Mesosomal lobes slender, rugose area restricted to distal and median margins, 2 *pmes* sensilla on each side lateral to gonopore. Gonopore large, arched. Penile arms long, reaching beyond distal margin of mesosome. Parameres elongated, stout, *pst1–2* as in Figure 27. Measurements (n = 1): TL = 1.72; HL = 0.36; HW = 0.34; PRW = 0.20; PTW = 0.34; AW = 0.47.

Female: Thoracic and abdominal chaetotaxy as in Figure 23; *ps* present on abdominal segment III. Lateral margins of anterior subgenital plate roughly parallel to concave (Fig. 28), with very broad connection to cross-piece. Vulval margin gently rounded, in some specimens bulging slightly medianly as in Figure 28, with 5–6 short, slender *vms* and 3 short, thorn-like *vss* on each side; 4–5 short, slender *vos* on each side of subgenital plate; distal 1 *vos* median to *vss*. Measurements (n = 2): TL = 2.06–2.08; HL = 0.39; HW = 0.37–0.38; PRW = 0.23; PTW = 0.38–0.39; AW = 0.51–0.52.



Figures 29, 30. *Brueelia mattsonae* n. sp. ex *Coccothraustes vespertinus* (Cooper, 1825). (**29**) Male habitus, dorsal and ventral view. (**30**) Female habitus, dorsal and ventral view.



Figures 31–35. *Brueelia mattsonae* n. sp. ex *Coccothraustes vespertinus* (Cooper, 1825). (**31**) Male head, dorsal and ventral view. (**32**) Male genitalia, dorsal view. (**33**) Male mesosome, ventral view. (**34**) Male paramere, dorsal view. (**35**) Female subgenital plate and vulval margin, ventral view. (Figs. 32–34 share lower left scale bar.)

Taxonomic summary

Type host: Loxia curvirostra curvirostra Linnaeus, 1758, red crossbill.

Type locality: None given, likely Germany.

Other hosts: Loxia curvirostra japonica Ridgway, 1884. *Loxia curvirostra stricklandi* Ridgway, 1885.

Material examined (non-types): 1♂, 2♀, Santa Rita Mountains, Arizona, 12 September 1939 (NHML).

Remarks

Examined material from Arizona does not differ substantially in any aspect from European material from the type host subspecies we have examined.

Brueelia mattsonae **Gustafsson and Bush, n. sp.**

(Figs. 29–35)

Description both sexes: Head rounded broadly flat dome-shaped (Fig. 31), lateral margins of preantennal area convex, frons flattened to slightly concave. Marginal carina broad, median margin undulating, median section deeply displaced but not widened. Ventral anterior plate large, roughly triangular with concave anterior margin. Head chaetotaxy and pigmentation pattern as in Figure 31. Preantennal nodi wide, bulging. Preocular nodi large, postocular nodi moderate. Marginal temporal carina wide along lateral margins of head, narrower along posterior margin. Gular plate lanceolate. Thoracic and abdominal segments and pigmentation patterns as in Figures 29 and 30.

Male: Thoracic and abdominal chaetotaxy as in Figure 29; *ss* absent on tergopleurite V; *aps* present on tergopleurites V–VII; *ps* absent on abdominal segment III. Basal apodeme slender, constricted at mid-length (Fig. 32). Proximal mesosome short, rounded, rather narrow (Fig. 33). Mesosomal lobes wide proximally but lateral margins highly convergent distally, rugose area restricted to median margin, 2 *pmes* sensilla on each side poster-lateral to gonopore. Gonopore about as long as wide, rounded, with shallowly concave posterior margin. Penile arms short, not reaching distal margin of mesosome. Parameres stout, elongated, *pst1–2* as in Figure 34. Measurements (n = 4): TL = 1.52–1.69; HL = 0.36–0.39; HW = 0.32–0.34; PRW = 0.19–0.21; PTW = 0.31–0.33; AW = 0.42–0.45.

Female: Thoracic and abdominal chaetotaxy as in Figure 30; *ps* present on abdominal segment III. Lateral margins of anterior subgenital plate parallel or slightly convergent (Fig. 35), with

broad connection to cross-piece. Vulval margin convergent to flattened median point (Fig. 35), with 3–4 short, slender *vms* and 3–4 short, torn-like *vss* on each side; 2–4 short, slender *vos* on each side of subgenital plate; distal 1 *vos* median to *vss*. Measurements (n = 4): TL = 1.84–2.08; HL = 0.40–0.44; HW = 0.36–0.39; PRW = 0.22–0.24; PTW = 0.35–0.39; AW = 0.50–0.57.

Taxonomic summary

Type host: Coccothraustes vespertinus brooksi (Grinnell, 1917), evening grosbeak.

Type locality: Government Creek, Tooele County, Utah.

Type material: Holotype ♂, Government Creek, Tooele County, Utah, 15 March 1965, E. and E. Branch, EE-HV74 (NHML). Paratypes 1♀, same data as holotype (NHML); 1♂, 1♀, same data as holotype (PIPeR); 2♂, 2♀, Vernon, British Columbia [Canada], 10 February 1947, 1948-229 (NHML).

ZooBank registration: urn:lsid:zoobank.org:act:73E8598C-5DCE-4DD0-890F-1C148C397FB5.

Etymology: Brueelia mattsonae is named in honor of Gittan Mattson (Falun, Sweden), in recognition of her long work with bird banding and bird surveys in Sweden, and the assistance, hospitality, and good companionship she has shown during D.G.'s collecting expeditions in Sweden.

Remarks

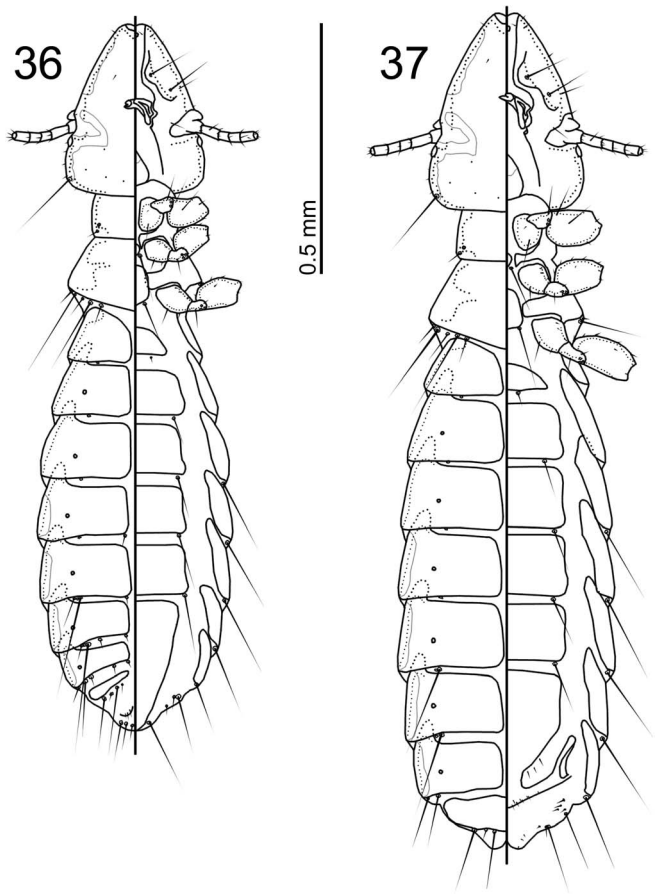
Brueelia mattsonae is most similar to *Brueelia juno* (Giebel, 1874), and the chaetotaxy of these 2 species is identical. These 2 species can be separated by the following characters: preantennal area longer, wider, and with more convex lateral margins in *B. mattsonae* (Fig. 31) than in *B. juno* (this difference is more noticeable in females than in males); proximal mesosome broad and short in *B. mattsonae* (Fig. 33) but more elongated and slender in *B. juno* and more similar to that of *B. limbata* (Fig. 36); gonopore about as long as wide and with shallowly concave posterior margin in *B. mattsonae* (Fig. 33) but clearly wider than long and with deeply concave posterior margin in *B. juno;* rugose area of mesosomal lobes restricted to median margin in *B. mattsonae* (Fig. 33) but more extensive, in some specimens reaching the distal *pmes* in *B. juno*.

Brueelia thorini **Gustafsson and Bush, n. sp.**

(Figs. 36–42)

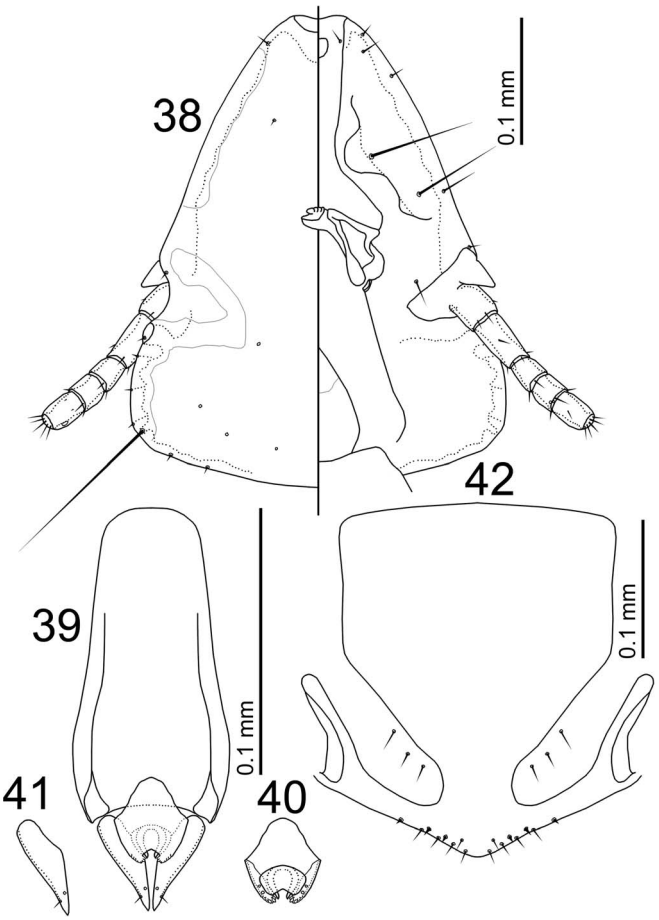
Description both sexes: Head convex dome-shaped (Fig. 38), lateral margins of preantennal area more or less straight or only slightly convex, frons flattened to slightly concave. Marginal carina slender, median margin slightly undulating, median section deeply displaced and widened. Ventral anterior rounded but pale and hard to see in many specimens. Head chaetotaxy and pigmentation pattern as in Figure 38. Preantennal nodi moderate, not bulging. Preocular nod much larger than postocular nodi. Marginal temporal carina wider and more irregular along lateral margins of head than along posterior margin of head. Gular plate lanceolate. Thoracic and abdominal segments and pigmentation patterns as in Figures 36 and 37.

Male: Thoracic and abdominal chaetotaxy as in Figure 36; *ss* present on tergopleurite V; *aps* present on tergopleurite VI; *ps* absent on abdominal segment III. Basal apodeme short, slender, widening distally (Fig. 39). Proximal mesosome elongated, rounded broad (Fig. 40). Mesosomal lobes narrow, rugose area restricted to near distal and median margins, 2 *pmes* sensilla on each side postero-lateral to gonopore. Gonopore large, wider than long, arched. Penile arms short, not reaching distal margin of mesosome. Parameres short, only slightly elongated distally, moderate in width, *pst1–2* as in Figure 41. Measurements ex *Haemorhous mexicanus frontalis* (n = 5): TL = 1.46–1.61; HL = 0.33–0.37; HW = 0.28–0.29; PRW = 0.16–0.18; PTW = 0.27–0.29; AW = 0.36–0.40. Measurements ex *H. m. potosinus* (n = 6 except TL where n = 5): TL = 1.40–1.53; HL = 0.34–0.36; HW = 0.26–0.28; PRW = 0.16–0.17; PTW = 0.25–0.27; AW = 0.35–0.39.



Figures 36, 37. *Brueelia thorini* n. sp. ex *Hemorhous mexicanus* (Müller, 1776). (**36**) Male habitus, dorsal and ventral view. (**37**) Female habitus, dorsal and ventral view.

Female: Thoracic and abdominal chaetotaxy as in Figure 37; *ps* absent on abdominal segment III. Lateral margins of anterior subgenital plate roughly parallel to slightly concave (Fig. 42), with broad connection to cross-piece. Vulval margin convergent to rounded median point (Fig. 42), with 3–4 short, slender *vms* and 3–4 short, thorn-like *vss* on each side; 3–4 short, slender *vos* on each side of subgenital plate; distal 1 *vos* median to *vss*. Measurements ex *Haemorhous mexicanus frontalis* (n = 11 except AW where n = 10): TL = 1.57–1.91; HL = 0.36–0.41; HW = 0.30–0.34; PRW = 0.18–0.21; PTW = 0.30–0.33; AW = 0.40–0.47. Measurements ex *H. m. potosinus* (n = 13 except TL where n = 12): TL = 1.47–1.72 (1.60); HL = 0.36–0.40 (0.38); HW = 0.28–0.31 (0.30); PRW = 0.17–0.20 (0.18); PTW = 0.27–0.31 (0.29); AW = 0.37–0.44 (0.40).



Figures 38–42. *Brueelia thorini* n. sp. ex *Hemorhous mexicanus* (Müller, 1776). (**38**) Male head, dorsal and ventral view. (**39**) Male genitalia, dorsal view. (**40**) Male mesosome, ventral view. (**41**) Male paramere, dorsal view. (**42**) Female subgenital plate and vulval margin, ventral view. (Figs. 39–41 share lower left scale bar.)

Taxonomic summary

Type host: Haemorhous mexicanus potosinus Griscom, 1928, house finch.

Type locality: Las Vacas, Coahuila, Mexico.

Other host: Haemorhous mexicanus frontalis (Say, 1822).

Type material: Holotype ♂**,** Las Vacas, Coahuila, Mexico, 8 August 1958, C. A. Ely, CAE-772 (NHML). Paratypes 1♂, same data as holotype (PIPeR); 1♀, same locality, 2 August 1958, C.A. Ely, CAE-748 (PIPeR); 2♂, 6♀, same data, CAE-749 (PIPeR); 1♂, same locality, 13 July 1958, C. A. Ely, CAE-649 (PIPeR); 2♂, 7♀, 40 miles North of Saltilla, Coahuila, Mexico, 30 December 1957, C.A. Ely, CAE-426 (PIPeR); 3♂, 6♀, Callao, Juab County, Utah, 20 November 1963, University of Utah (PIPeR); 3♂, 2♀, Wig Mountain, Dugway Proving Grounds, Tooele County, Utah, 19 Feb. 1963, E. and E. Branch, University of Utah, 31-B3B (PIPeR); 1♀, Government Creek, Dugway Proving Grounds, Tooele County, Utah, 7 December 1962, CM-530 (PIPeR); 4♀, Dugway Proving Grounds, Tooele County, Utah, 27 February 1969, E. and E. [Branch] (PIPeR).

Additional material examined (non-types): Ex *Haemorhous mexicanus frontalis* [as *Carpodacus mexicanus frontalis*]: 12♂, 21♀, California, March 1939, R. Meinertzhagen, 12993–94 (NHML); 7♂, 9♀, same data except 13050–51 (NHML).

ZooBank registration: urn:lsid:zoobank.org:act:E3AFA3E6-3075-4310-88DF-8232040F9E24.

Etymology: Brueelia thorini is named in honor of Mats Thorin (Ralången Bird Observatory, Sweden) in recognition of his long work with bird banding in Sweden, and his great assistance and hospitality during DG's louse collections in Aneby.

Remarks

Brueelia thorini is most similar to *Brueelia mongolica* Mey, 1982, with which it shares the following characters: head narrow and pointed anteriorly (Fig. 38), proximal mesosome elongated and anterior margin gently rounded (Fig. 40), *ss* present on male tergopleurite V (Fig. 36); *aps* present on male tergopleurite VI (Fig. 36), *ps* absent on male abdominal segment III. These 2 species can be separated by the following characters: head longer and wider anteriorly in *B. mongolica* than in *B. thorini* (Fig. 38), proximal mesosome broad in *B. thorini* (Fig. 40) but slender in *B. mongolica,* gonopore wider than long in *B. thorini* (Fig. 40) but about as wide as long in *B. mongolica*. *Brueelia thorini* and *Brueelia mongolica* also differ widely in pigmentation patterns, with *B. thorini* being more uniformly pale brown and *B. mongolica* being translucent with dark lateral margins of the head, gular plate, proepimera, metepisterna, lateral margins of tergopleurites, and sternal and subgenital plates.

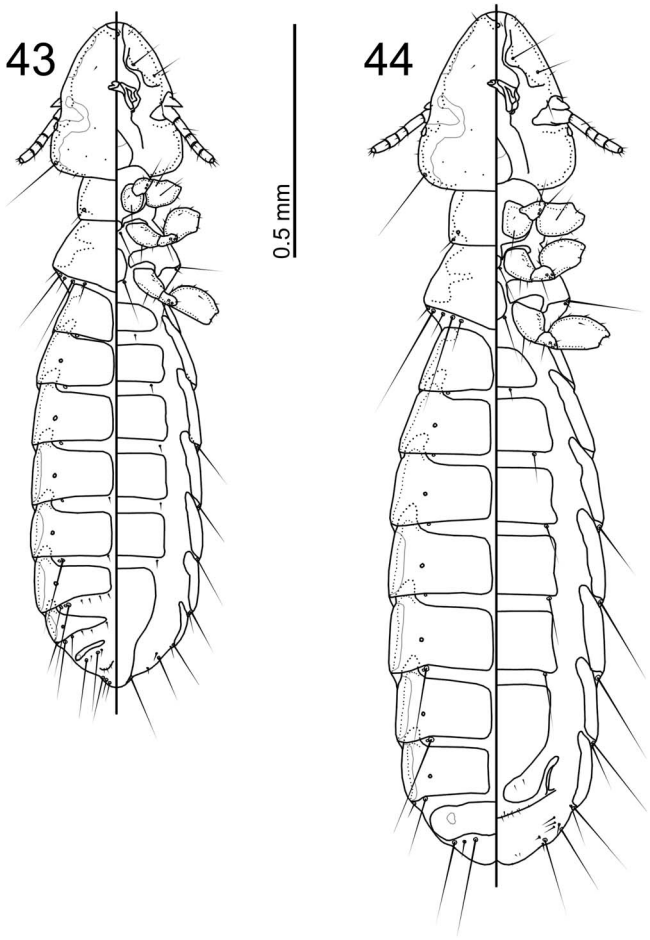
Many specimens from Mexico in the type series have small abdominal setae (*ss, tps, aps*) that were dissolved or broken off during mounting. Thus, the chaetotaxy illustrated in Figures 36–37 is based mainly on material from California and Utah. All illustrated setae are found in at least some specimens from the Mexican material, however.

Brueelia straseviciusi Gustafsson and Bush, n. sp.

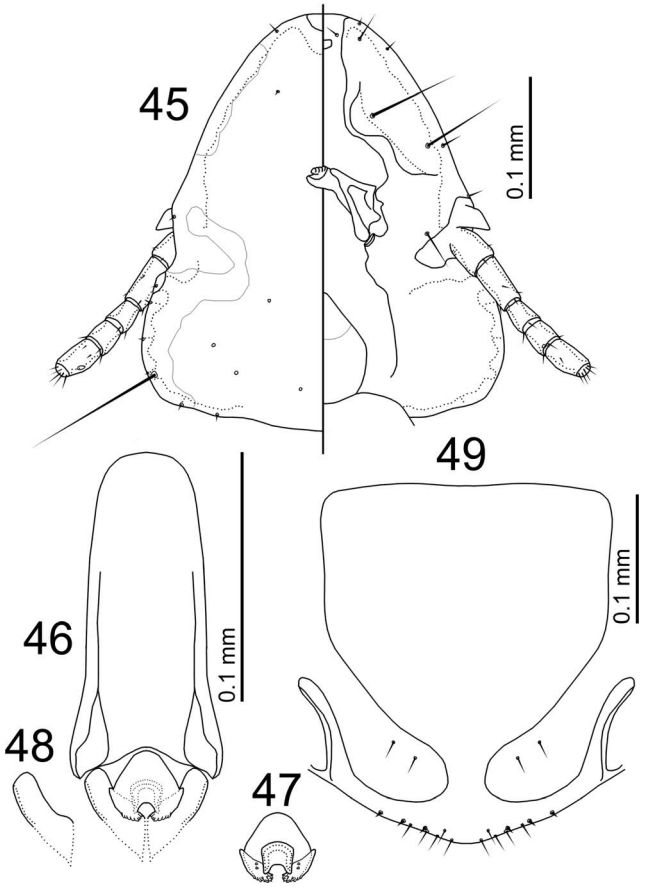
(Figs. 43–49)

Description both sexes: Head broadly convex dome-shaped (Fig. 45), lateral margins of preantennal area convex, frons rounded. Marginal carina slender, median margin only slightly undulating, median section deeply displaced and widened. Ventral anterior plate small. Head chaetotaxy and pigmentation pattern as in Figure 45. Preantennal nodi moderate. Preocular nodi much larger than postocular nodi. Marginal temporal carina slender, irregular. Gular plate lanceolate. Thoracic and abdominal segments and pigmentation patterns as in Figures 43 and 44.

Male: Thoracic and abdominal chaetotaxy as in Figure 43; *ss* present on tergopleurite V; *aps* absent on tergopleurite VI; *ps* absent on abdominal segment III. Basal apodeme short, slender, widening distally (Fig. 46). Proximal mesosome elongated, broadly rounded (Fig. 47). Mesosomal lobes wide, short, rugose area restricted to distal and median margins, 2 *pmes* sensilla on each side lateral to gonopore. Gonopore about as wide as long, anterior margin convex, posterior margin concave. Penile arms short, not reaching distal margin of mesosome. Parameres partially everted in single examined male, and cannot be illustrated completely (Fig. 48). Measurements (n = 1): TL = 1.41; HL = 0.34; HW = 0.28; PRW = 0.17; PTW = 0.26; AW = 0.37.



Figures 43, 44. *Brueelia straseviciusi* n. sp. ex *Hemorhous purpureus* (Gmelin, 1789). (**43**) Male habitus, dorsal and ventral view. (**44**) Female habitus, dorsal and ventral view.



Figures 45–49. *Brueelia straseviciusi* n. sp. ex *Hemorhous purpureus* (Gmelin, 1789). (**45**) Male head, dorsal and ventral view. (**46**) Male genitalia, dorsal view (parameres in examined male were everted and thus the structure is tentatively illustrated with dotted lines). (**47**) Male mesosome, ventral view. (**48**) Male paramere, dorsal view. (**49**) Female subgenital plate and vulval margin, ventral view. (Figs. 46–48 share lower left scale bar.)

Female: Thoracic and abdominal chaetotaxy as in Figure 44; *ps* absent on abdominal segment III. Lateral margins of anterior subgenital plate roughly parallel (Fig. 49), with narrow connection to cross-piece. Vulval margin convergent to blunt median point (Fig. 49), with 3–4 short, slender *vms* and 3–4 short, thorn-like *vss* on each side; 2–4 short, slender *vos* on each side of subgenital plate; distal 1 *vos* median to *vss*. Measurements (n = 7 except TL and AW where n = 6): TL = 1.70–1.85; HL = 0.36–0.38; HW = 0.30–0.33; PRW = 0.20–0.21; PTW = 0.30–0.35; AW = 0.43–0.48.

Taxonomic summary

Type host: Haemorhous purpureus (Gmelin, 1789), purple finch.

Type locality: Liebre Mountains, Los Angeles County, California.

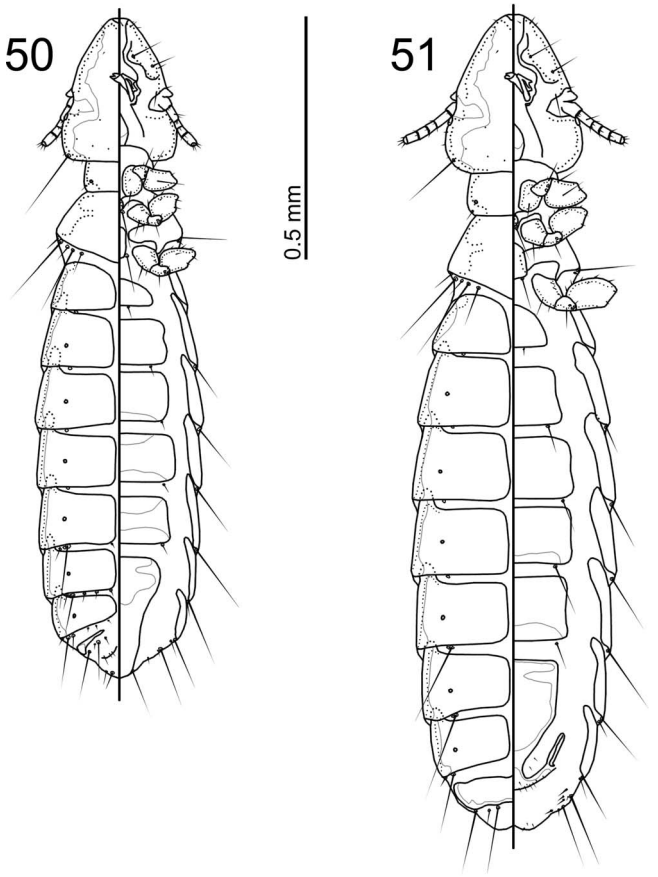
Type material: Holotype ♂, Liebre Mountains, Los Angeles County, California, 27 December 1986, M. A. Marin [as M.M.A.], 29 (NHML). Paratypes 2♀, same data as holotype (NHML); 6♀, Elm Fork of Trinity River, University of Dallas, Dallas, Texas, 13 December 1959, W. Pulich, WP8 (PIPeR).

ZooBank registration: urn:lsid:zoobank.org:act:C0AAFAD5-2EBA-4352-947E-0F6DA0DFFCF8.

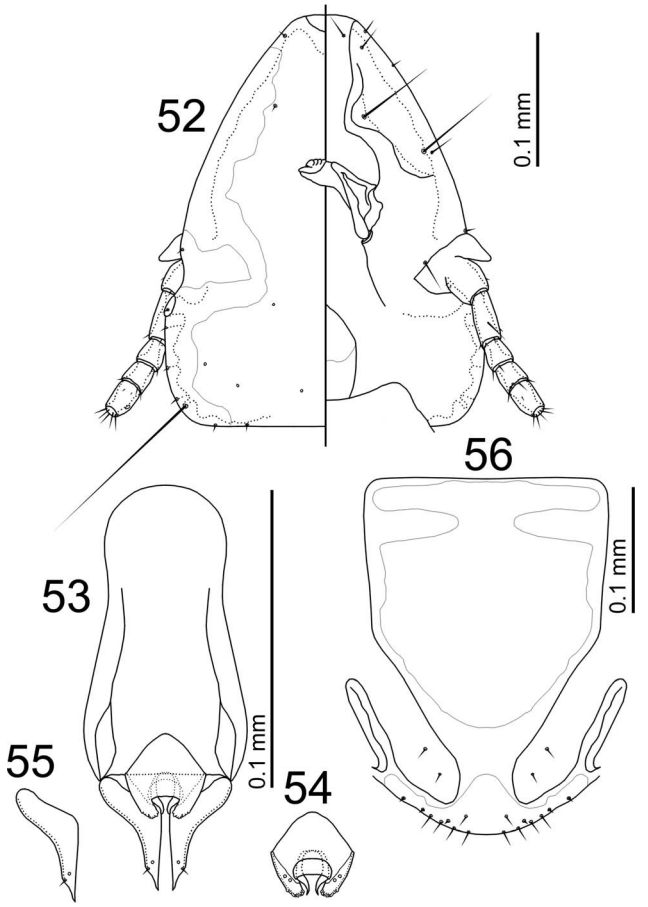
Etymology: Named in honor of Darius Strasevicius (Umedeltats Bird Observatory, Umeå, Sweden) in recognition of his long commitment to bird banding and bird studies in northern Sweden, and his assistance during D.G.'s field work.

Remarks

Brueelia straseviciusi is similar to *B. thorini* and *B. mongolica* Mey, 1982, in the abdominal chaetotaxy, and these 3 species are the only *Brueelia* on fringillid hosts to have *ss* on male tergopleurite V but no *ps* on abdominal segment III in either sex. As in *B. thorini,* the pigmentation on *B. straseviciusi* is nearly a uniform pale brown, unlike the contrast-rich translucent and brown pigmentation patterns of most *Brueelia* on fringillid hosts. *Brueelia straseviciusi* can be separated from both *B. thorini* and *B. mongolica* on the following characters: *aps* absent on male tergopleurite VI in *B. straseviciusi* (Fig. 43) but present in *B. thorini* (Fig. 36) and *B. mongolica,* preantennal head short and widely rounded in *B. straseviciusi* (Fig. 45) but longer and narrowly pointed in *B. thorini* (Fig. 38) and *B. mongolica*.



Figures 50, 51. *Brueelia melancholica* n. sp. ex *Spinus tristis* (Linneaus, 1758). (**50**) Male habitus, dorsal and ventral view. (**51**) Female habitus, dorsal and ventral view.



Figures 52–56. *Brueelia melancholica* n. sp. ex *Spinus tristis* (Linneaus, 1758). (**52**) Male head, dorsal and ventral view. (**53**) Male genitalia, dorsal view. (**54**) Male mesosome, ventral view. (**55**) Male paramere, dorsal view. (**56**) Female subgenital plate and vulval margin, ventral view. (Figs. 53–54 share lower left scale bar.)

Brueelia melancholica **Gustafsson and Bush, n. sp.**

(Figs. 50–56)

Description both sexes: Head flat dome-shaped (Fig. 52), lateral margins of preantennal area clearly convex, frons flattened to slightly concave. Marginal carina moderate, median margin slightly undulating, median section deeply displaced and widened. Ventral anterior plate not visible. Head chaetotaxy and pigmentation pattern as in Figure 52. Preantennal nodi moderate, bulging slightly. Preocular nodi larger than postocular nodi. Marginal temporal carina moderate, very irregular. Gular plate lanceolate. Thoracic and abdominal segments and pigmentation patterns as in Figures 50 and 51.

Male: Thoracic and abdominal chaetotaxy as in Figure 50; *ss* absent on tergopleurite V; *aps* present on tergopleurite VI, *ps* present on abdominal segment III. Basal apodeme short, constricted at mid-length, narrower anteriorly than posteriorly (Fig. 53). Proximal mesosome broadly rounded (Fig. 54). Mesosomal lobes slender, rugose area restricted to distal and median margins, 2 *pmes* sensilla on each side postero-lateral to gonopore. Gonopore wider than long, arched. Penile arms long reaching to distal margin of mesosome. Parameres slender, elongated, *pst1–2* as in Figure 55. Measurements (n = 5 except AW where n = 4): TL = 1.31–1.37; HL = 0.29–0.31; HW = 0.23–0.24; PRW = 0.14–0.16; PTW = 0.23–0.26; AW = 0.29–0.33.

Female: Thoracic and abdominal chaetotaxy as in Figure 51; *ps* present on abdominal segment III. Subgenital plate as in Figure 56, with moderate connection to cross-piece; pigmentation as in Figure 56. Vulval margin gently rounded (Fig. 56), with 2–4 short, slender *vms* and 2–3 short, thorn-like *vss* on each side; 3–4 short, slender *vos* on each side of subgenital plate; distal 1 *vos* median to *vss*. Measurements (n = 9 except AW where n = 8): TL = 1.55–1.70; HL = 0.31–0.35; HW = 0.26–0.28; PRW = 0.16–0.17; PTW = 0.25–0.28; AW = 0.34–0.41.

Taxonomic summary

Type host: Spinus tristis (Linnaeus, 1758), American goldfinch.

Type locality: Carlos Avery, Minnesota.

Type material: Holotype ♂, Carlos Avery, Minnesota, 18 January 1957, J. R. Beer, 66-223 (UMSP). Paratypes 4♂, 9♀, same data as holotype (UMSP).

ZooBank registration: urn:lsid:zoobank.org:act:BC442887-2C5B-453D-B0D2-7F53266165AE.

Etymology: Specific name derived from Greek "*melancholia*" for "sadness," referring to the darkly pigmented lateral margins of the head.

Remarks

Brueelia melancholica is most similar to *Brueelia breueri* Balát, 1955, with which it shares the following characters: *ss* absent from male tergopleurite V (Fig. 50), *ps* present on abdominal segment III of both sexes (Figs. 50–51), *aps* present on male tergopleurite VI (Fig. 50), pigmentation of sternal plates restricted to anterior and posterior margins in both sexes (Figs. 50–51), darkly pigmented area of female subgenital plate with deep lateral constriction near anterior end (Fig. 56). These 2 species can be separated by the following characters: proximal mesosome broad and rounded in *B. melancholica* (Fig. 54) but slender and square-shaped in *B. breueri,* gonopore wider than long in *B. melancholica* (Fig. 54) but about as wide as long in *B. breueri,* postantennal head much wider than preantennal head in *B. breueri* but widest point of preantennal head almost as wide as postantennal head in *B. melancholica* (Fig. 52), male subgenital plate with dark pigmentation distally in *B. breueri* but with pale pigmentation distally in *B. melancholica* (Fig. 50), abdominal segment VII of both sexes with 2 *ps* on each side in *B. melancholica* (Figs. 50–51) but with 1 *ps* on each side in *B. breueri,* pigmentation patterns of the female subgenital plate differ between these 2 species but females may be best separated on head shape and abdominal chaetotaxy.

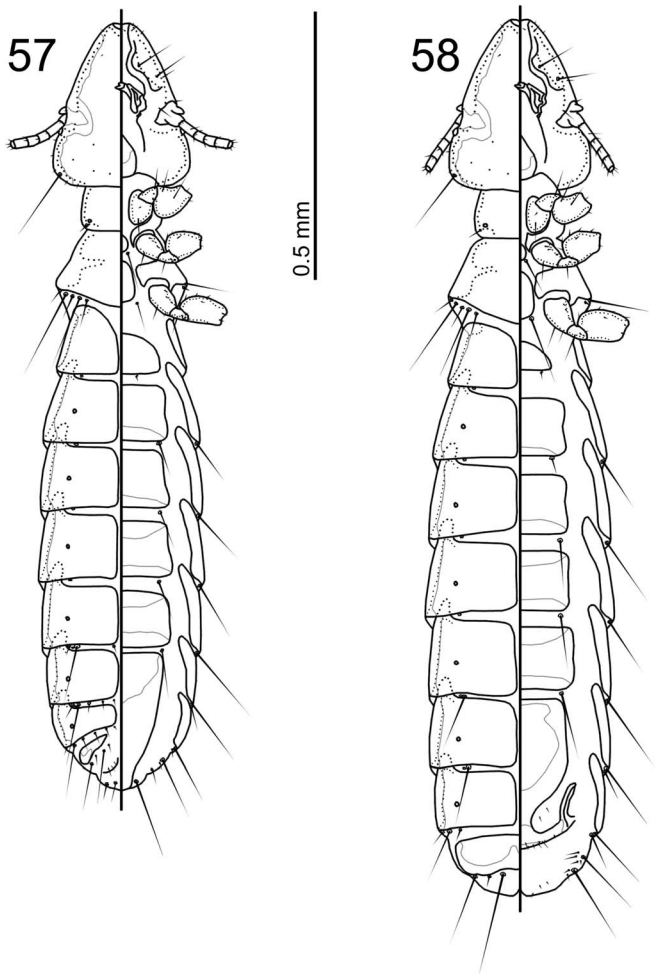
Brueelia dolorosa **Gustafsson and Bush, n. sp.**

(Figs. 57–63)

Description both sexes: Head flat dome-shaped (Fig. 59), lateral margins of preantennal area slightly convex, frons flattened to slightly concave. Marginal carina slender, median margin slightly undulating, median section moderately displaced and widened. Ventral anterior plate not visible. Head chaetotaxy and pigmentation pattern as in Figure 59. Preantennal nodi slender, not bulging. Preocular nodi larger than postocular nodi. Marginal temporal carina moderate, irregular. Gular plate lanceolate. Thoracic and abdominal segments and pigmentation patterns as in Figures 57 and 58.

Male: Thoracic and abdominal chaetotaxy as in Figure 57; *ss* absent on tergopleurite V; *aps* present on tergopleurite VI; *ps* present on abdominal segment III. Anterior margin of basal plate obscured in all examined males, and illustrated approximately (Fig. 60). Proximal mesosome shaped as in Fig. 61. Mesosomal lobes slender, rugose area restricted to distal and median margins, 2 *pmes* sensilla on each side lateral to gonopore. Gonopore about as wide as long, broadly crescent-shaped. Penile arms long, reaching beyond distal margin of mesosome. Parameres stout, elongated, *pst1–2* as in Figure 62. Measurements (n = 2): TL = 1.41–1.43; HL = 0.31; HW = 0.25–0.26; PRW = 0.16; PTW = 0.25–0.26; AW = 0.31.

Female: Thoracic and abdominal chaetotaxy as in Figure 58; *ps* present on abdominal segment III. Lateral margins of anterior subgenital plate roughly parallel (Fig. 63), with broad connection to cross-piece; pigmentation as in Fig. 63. Vulval margin gently rounded (Fig. 63), with 3–4 short, slender *vms* and 3–5 short, thorn-like *vss* on each side; 3–4 short, slender *vos* on each side of subgenital plate; distal 1 *vos* median to *vss*. Measurements (n = 7): TL = 1.61–1.83; HL = 0.32–0.36; HW = 0.26–030; PRW = 0.17–0.19; PTW = 0.27–0.30; AW = 0.35–0.40.



Figures 57, 58. *Brueelia dolorosa* n. sp. ex *Spinus pinus pinus* (Wilson, 1810). (**57**) Male habitus, dorsal and ventral view. (**58**) Female habitus, dorsal and ventral view.

Taxonomic summary

Type host: Spinus pinus pinus (Wilson, 1810), pine siskin.

Type locality: Zoo, California.

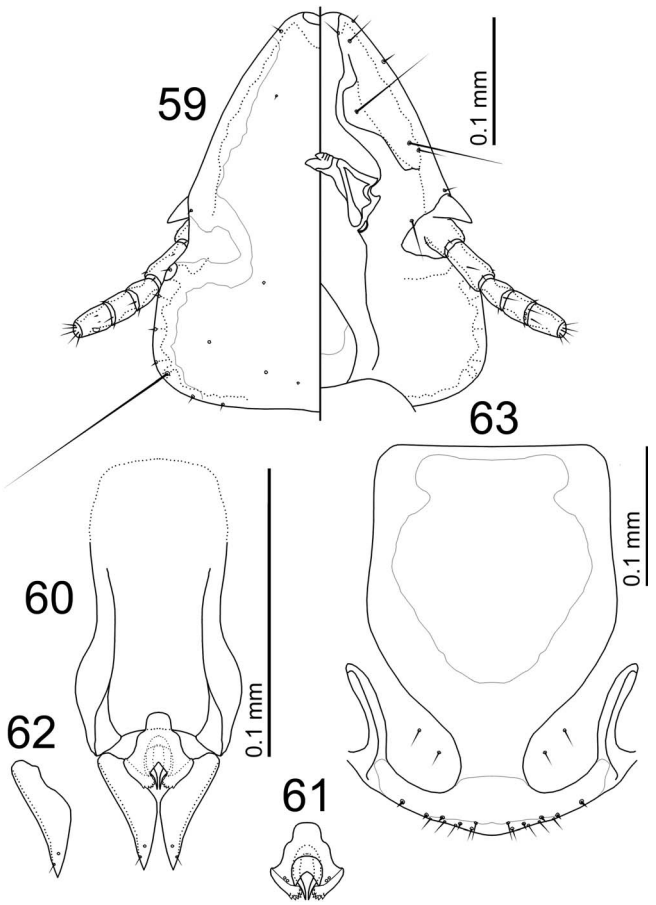
Type material: Holotype ♂, Zoo, California, February 1937, R. Meinertzhagen, 8307 (NHML) [marked with black dot on slide). Paratypes: 1♂, 7♀, same data as holotype (NHML).

ZooBank registration: urn:lsid:zoobank.org:act:55313C31-313C-42B6-9E4F-3C2881FC199B.

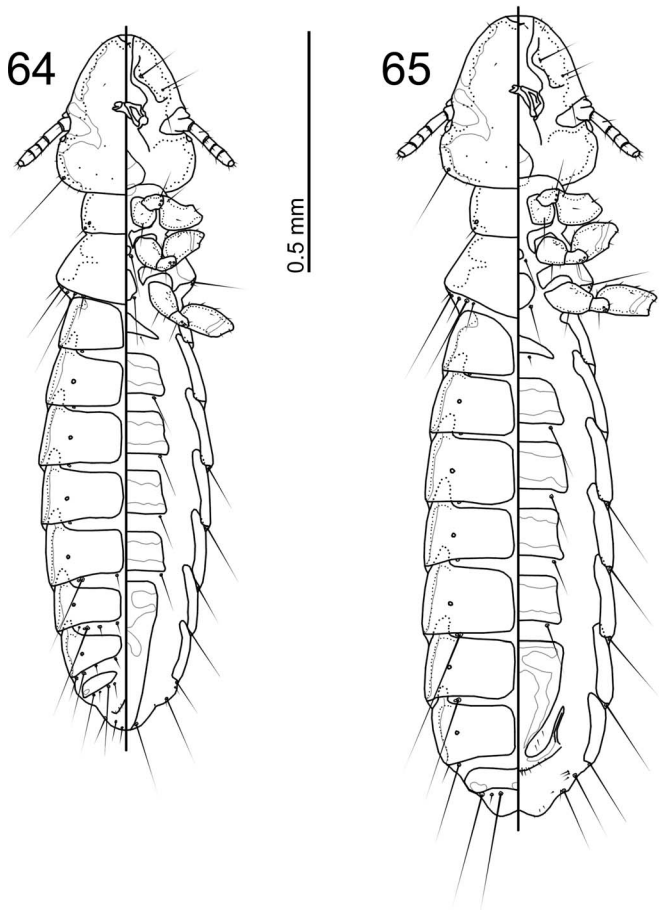
Etymology: Specific name derived from Latin "*dolorosus*" for "sorrowful," referring to the darkly pigmented areas of the head.

Remarks

Brueelia dolorosa is most similar to *Brueelia chrysomystris* (Blagoveshtchensky, 1940), with which it shares the following characters: *ss* absent on male tergopleurite V (Fig. 57), *ps* present on abdominal segment III in both sexes (Figs. 57–58), proximal mesosome slender (Fig. 61); gonopore about as broad as long with deeply concave posterior margin (Fig. 61); pigmentation of



Figures 59–63. *Brueelia dolorosa* n. sp. ex *Spinus pinus pinus* (Wilson, 1810). (**59**) Male head, dorsal and ventral view. (**60**) Male genitalia, dorsal view (obscured areas of examined specimens tentatively illustrated with dotted line). (**61**) Male mesosome, ventral view. (**62**) Male paramere, dorsal view. (**63**) Female subgenital plate and vulval margin, ventral view. (Figs. 60 and 61 share lower left scale bar.)



Figures 64, 65. *Brueelia novemstriata* n. sp. ex *Icterus wagleri wagleri* Sclater, 1858. (**64**) Male habitus, dorsal and ventral view. (**65**) Female habitus, dorsal and ventral view.

sternal plates restricted to anterior and posterior margins in both sexes (Figs. 57–58); darkly pigmented area of female subgenital plate with shallow lateral constriction near anterior end (Fig. 63). These 2 species can be separated by the following characters: *aps* present on male tergopleurite VI in *B. dolorosa* (Fig. 57) but absent in *B. chrysomystris,* more than 1 *tps* on male tergopleurites VII–VIII in *B. dolorosa* (Fig. 57) but only 1 *tps* on each side in *B. chrysomystris,* proximal mesosome square-shaped with near-parallel lateral margins in *B. dolorosa* (Fig. 61) but rounded and gently divergent in *B. chrysomystris,* parameres more slender in *B. chrysomystris* than in *B. dolorosa* (Fig. 62).

Brueelia novemstriata **Gustafsson and Bush, n. sp.**

(Figs. 64–70)

Description both sexes: Head broadly flat dome-shaped (Fig. 66), lateral margins of preantennal head clearly convex, frons rounded. Marginal carina broad, undulating, median section deeply displaced and slightly widened. Ventral anterior plate small, crescent-shaped. Head chaetotaxy and pigmentation pattern as in Figure 66. Preantennal nodi large, bulging. Pre- and postocular nodi large. Marginal temporal carina wide, irregular. Gular plate broadly lanceolate. Thoracic and abdominal segments and pigmentation patterns as in Figures 64 and 65.

Male: Thoracic and abdominal chaetotaxy as in Figure 64; *ss* present on tergopleurites VI–VIII; *tps* present on tergopleurites VII–VIII; *psps* present on tergopleurites VI–VII; *aps* present on tergopleurite VII; *ps* present on abdominal segments IV–VIII. Pigmentation pattern on subgenital plate as in Figures 67 and 68. Basal apodeme short, stout (Fig. 69). Proximal mesosome elongated, narrowly flattened (Fig. 70). Mesosomal lobes wide, rounded, rugose area restricted to near medio-posterior corner, 2 *pmes* sensilla on each side lateral to gonopore. Gonopore wide, near-rectangular. Penile arms short, reaching to distal margin of mesosome. Parameres gently tapering, *pst1–2* as in Figure 71. Measurements ex *Icterus parisorum* (n = 6 except TL and AW where n = 5): TL = 1.40–1.58; HL = 0.31–0.34; HW = 0.28–0.31; PRW = 0.18–0.20; PTW = 0.27–0.30; AW = 0.34–0.40. Measurements ex *I. wagleri wagleri* (n = 3): TL = 1.30–1.40; HL = 0.31–0.33; HW = 0.28–0.29; PRW = 0.19; PTW = 0.27–0.28; AW = 0.33–0.34.

Female: Thoracic and abdominal chaetotaxy as in Figure 65; *psps* present on tergopleurites VI–VII; *ss, aps, tps* absent on all abdominal segments; *ps* present on abdominal segments IV–VIII. Subgenital plate as in Figure 72, with narrow connection to cross-piece. Pigmentation pattern as in Figure 72; most of plate

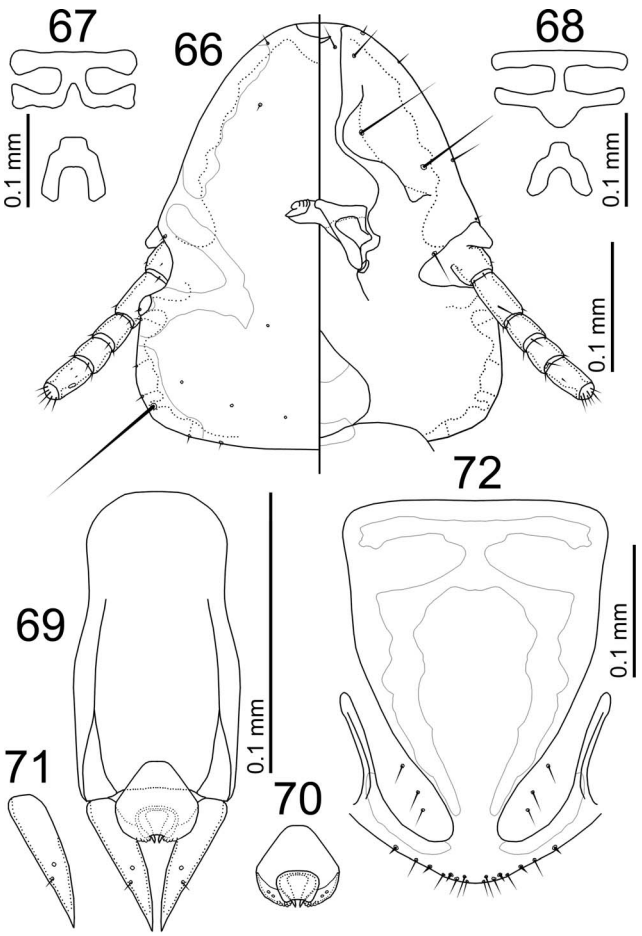


Figure 66–72. *Brueelia novemstriata* n. sp. ex *Icterus wagleri wagleri* Sclater, 1858. (**66**) Male head, dorsal and ventral view. (**67**) Pigmentation pattern of male subgenital plate in material from *I. wagleri wagleri*. (**68**) Pigmentation pattern of male subgenital plate in material from *I. parisorum*. (**69**) Male genitalia, dorsal view. (**70**) Male mesosome, ventral view. (**71**) Male paramere, dorsal view. (**72**) Female subgenital plate and vulval margin, ventral view. (Figs. 69–71 share lower left scale bar.)

translucent, with dark pigmentation only in narrow transversal cross-band in anterior end, narrowly connected to 2 subparallel bands that run posterior to reach cross-piece; only anterior margin of cross-piece with dark pigmentation. Vulval margin gently rounded (Fig. 72), with 4–5 short, slender *vms* and 2–3 short, thorn-like *vss* on each side; 3–4 short, slender *vos* on each side of subgenital plate; distal 1 *vos* median to *vss*. Measurements ex *Icterus parisorum* (n = 7 except AW where n = 6): TL = 1.55–1.77; HL = 0.31–0.39; HW = 0.31–0.34; PRW = 0.20–0.22; PTW = 0.29–0.33; AW = 0.38–0.43. Measurements ex *I. wagleri wagleri* (n = 4): TL = 1.57–1.69; HL = 0.34–0.36; HW = 0.31–0.33; PRW = 0.20–0.21; PTW = 0.31–0.35; AW = 0.38–0.41.

Taxonomic summary

Type host: Icterus wagleri wagleri Sclater, 1857, black-vented oriole.

Type locality: Las Vacas, Coahuila, Mexico.

Other hosts: Icterus parisorum Bonaparte, 1838, Scott's oriole.

Type material: Ex *Icterus wagleri:* Holotype ♂, Las Vacas, Coahuila, Mexico, 23 July 1958, C. A. Ely, CAE-704 (NHML). Paratypes 1♂, 1♀, same data as holotype (NHML); 2♂, 3♀, same locality, 24 July 1958, C. A. Ely, CAE-711 (PIPeR).

Additional material examined (non-types): Ex *Icterus parisorum*: 5♂, 5♀, Las Vacas, Coahuila, Mexico, 7 October 1958, C. A. Ely, CAE-886 (PIPeR); 2♂, 2♀, same data (NHML); 2♀, same locality, 29 July 1958, C. A. Ely, CAE-729 (PIPeR).

ZooBank registration: urn:lsid:zoobank.org:act:252ED614-B85B-4167-8C7E-6681EC915F2E.

Etymology: Specific name constructed from Latin "*novem*" for "nine" and "*striatus*" for "striated," referring to the 9 dark pigmented stripes of the sternites.

Remarks

Brueelia novemstriata belongs to the *ornatissima* species group (Cicchino and Castro, 1996) within *Brueelia* s. str. Other than *B. novemstriata*, only 2 of the species in this group lack *aps* and *tps* on male tergopleurite V: *Brueelia badia* Cicchino and Castro, 1996, and *Brueelia oxypyga* (Giebel, 1874).

Brueelia novemstriata can be separated from *B. badia* by the following characters: *ss* absent from male tergopleurite V in *B. novemstriata* (Fig. 64) but present in *B. badia, aps* present on male tergopleurite VII in *B. novemstriata* (Fig. 64) but absent in *B. badia, ss* absent on female tergopleurite VII in *B. novemstriata* (Fig. 65) but present in *B. badia,* dark pigmentation on sternal plates of both sexes laterally continuous in *B. badia* but separated into anterior and posterior bands in *B. novemstriata* (Figs. 64–65), dark pigmentation of submedian postantennal head follows temporal carina to near occiput in *B. badia* but not in *B. novemstriata* (Fig. 66), dark pigmentation pattern on subgenital plates more restricted in *B. novemstriata* (Figs. 67, 68, 72) than in *B. badia*; proximal mesosome narrow in *B. novemstriata* (Fig. 70) but broad in *B. badia*.

Brueelia novemstriata can be separated from *B. oxypyga* by the following characters: *ps* absent on female abdominal segment III in *B. novemstriata* (Fig. 65) but present in *B. oxypyga,* dark pigmentation of submedian postantennal head follows temporal carina to near occiput in *B. oxypyga* but not in *B. novemstriata* (Fig. 66), dark pigmentation present on median tergopleurites in *B. oxypyga* but not in *B. novemstriata* (Figs. 64, 65), dark pigmentation of cross-piece medianly interrupted in *B. novemstriata* (Fig. 72) but medianly continuous in *B. oxypyga*. Male of *B. oxypyga* unknown, and no comparison can be made.

No significant differences have been found between the material from the 2 host species, but material from *I. parisorum* is consistently slightly paler than material from *I. wagleri,* and in 2 males from *I. parisorum* the male subgenital plate has a different pattern of pigmentation (Fig. 68) from that of most material (Fig. 67). Host-specific differences in louse pigmentation may be associated with differences in host color; the plumage of *I. parisorum* is lighter than *I. wagleri* (Jaramillo and Burke, 1999). Louse color is often correlated with host color (Bush et al., 2010, 2019). The pigmentation of the male subgenital plate varies slightly between individuals and may not be a reliable species-level character. We presently consider all material from both hosts conspecific.

DISCUSSION

With the descriptions of the 9 species treated here, a total of 71 species of *Brueelia* are known from the 9-primaried oscines. There

are no morphological characters that bind the *Brueelia* from 9-primaried oscines together to the exclusion of *Brueelia* species from other hosts. This is reflected by the scattered distribution of *Brueelia* specimens from hosts in this group in the phylogeny of Bush et al. (2016). Moreover, at least some groups of *Brueelia* occur on multiple families of 9-primaried oscines. For instance, the species described here from cardinalid hosts are similar to some undescribed *Brueelia* species from passerellid hosts we have examined. This complex pattern of host associations, where morphologically similar lice are associated with birds in different families rather than other lice on confamilial hosts, is known in other groups within the *Brueelia* complex. For example, the *Brueelia* of nuthatches, goldcrests, and tits and chickadees are quite similar, despite being found on 3 host families (Gustafsson et al., 2018), and the *Brueelia clara* species group is known to infest starlings and the distantly related magpie shrike *Corvinella melanoleuca* (Jardine, 1831) (Gustafsson and Bush, 2015). As research on the *Brueelia* complex continues, it seems likely that additional cases of complex host associations will be discovered. Such discoveries may provide clues to the evolutionary and ecological history of their hosts.

Key to the *Brueelia* of North American Cardinalidae

1. Male tergopleurite VII with *accessory post-spiracular setae* (Fig. 1); female abdominal segment IV with 1 *pleural seta* on each side (Fig. 2) 2
— Male tergopleurite VII without *accessory post-spiracular setae* (Fig. 15); female abdominal segment IV with 2 *pleural setae* on each side (Fig. 16) ..... *Brueelia arizonae*
2. Male tergopleurite V with *sutural setae* (Fig. 1); proximal mesosome flattened (Fig. 5); female abdominal segments V–VII with 2 *pleural setae* on each side (Fig. 2) ..... *Brueelia hellstromi*
— Male tergopleurite V without *sutural setae* (Fig. 8); proximal mesosome rounded (Fig. 12); female abdominal segments V–VII with 1 *pleural setae* on each side (Fig. 9) ..... *Brueelia benkmani*

Key to the *Brueelia* of North American Fringillidae

1. Abdominal segment III with *pleural setae* in both sexes... 2
— Abdominal segment III without *pleural setae* in either sex 4
2. Head broadly rounded (Fig. 24) ..... *Brueelia limbata*
— Head narrow, somewhat pointed (Figs. 52, 59) 3
3. Proximal mesosome square-shaped (Fig. 61); pigmentation pattern of female subgenital plate as in Fig. 63 ..... *Brueelia dolorosa*
— Proximal mesosome rounded (Fig. 54); pigmentation pattern of female subgenital plate as in Fig. 56 ..... *Brueelia melancholica*
4. Male tergopleurite V with *sutural setae* (Fig. 36) 5
— Male tergopleurite V without *sutural setae* (Fig. 29) ..... *Brueelia mattsonae*
5. Male tergopleurite VI with *accessory post-spiracular setae* (Fig. 36); connection between female subgenital plate and cross-piece broad (Fig. 42) ..... *Brueelia thorini*
— Male tergopleurite VI without *accessory post-spiracular setae* (Fig. 43); connection between female subgenital plate and cross-piece narrow (Fig. 49) ..... *Brueelia straseviciusi*

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