



New Species of Biting Midges in the *Dasyhelea atlantis-bermudae* Complex (Diptera: Ceratopogonidae)

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Abstract

We provide a review of biting midges in the *Dasyhelea atlantis-bermudae* complex in the *D. mutabilis* group in the United States and Caribbean region. We also describe and include photomicrographs of *D. atlantis* Wirth & Williams, *D. bermudae* W. & W., three new species from Florida and a 4th new species from Jamaica. A key to adults in the *D. atlantis-bermudae* complex is provided as well as the first records of *D. atlantis* from Mexico and a new USA record from Maryland.

Key words: Forcipomyiinae, new taxa, Nearctic, Neotropics

Introduction

Biting midges (Diptera: Ceratopogonidae) are a very diverse family of nematocerous flies that inhabit all continents except Antarctica and some oceanic islands and includes almost 6300 extant species assigned to 112 genera (Borkent & Dominiak 2020; Borkent *et al.* 2022). The ceratopogonid fauna of the United States and Canada includes just over 600 primarily Nearctic species. Several Neotropical species range north of Mexico in Arizona, California, New Mexico and Texas (Borkent & Grogan 2009; Borkent & Spinelli 2000). Several Neotropical and Caribbean species inhabit Florida and adjacent states (Wilkening *et al.* 1985; Grogan *et al.* 2010), and a few exotic species are now established in Florida as follows. Wirth & Spinelli (1992) documented the Australasian biting midge, *Forcipomyia* (*F.*) *swezeyana* Tokunaga & Murachi, in Florida from decaying *Philodendron* and banana (*Musa*) plants. Grogan & Hribar (2006) reported the Neotropical species, *F.* (*Phytohelea*) *bromelicola* (Lutz), in the Florida Keys that they reared from larvae and pupae collected from bromeliads. Grogan *et al.* (2013) recorded the Old World *F.* (*Lepidohelea*) *pulcherrima* Santos Abreu, in the USA from California, Florida and Hawaii. Grogan *et al.* (2017) reported the Afrotropical *F.* (*F.*) *biannulata* Ingram & Macfie that is now established in the USA in Florida, Georgia, Mississippi, and Hawaii.

Wirth & Williams (1957) reported 13 species of ceratopogonids on Bermuda in four genera, *Forcipomyia* Meigen, *Dasyhelea* Kieffer, *Culicoides* Latreille, and *Bezzia* Kieffer, including five new species that they described: *Forcipomyia* (*Lepidohelea*) *varipennis* Wirth & Williams, *Dasyhelea* *luteogrisea* W. & W., *D. atlantis* W. & W., *D. bermudae* W. & W., and *Bezzia atlantica* W. & W., which is now regarded as a junior synonym of *Bezzia nobilis* (Winnertz) (Borkent & Grogan 2009; Borkent & Dominiak 2020).

Some of the earliest records of Ceratopogonidae from Florida are those provided by Johnson & Coquillett (1895) and Johnson (1913). Wilkening *et al.* (1985) provided the first modern review of all genera and species of ceratopogonids that inhabit Florida, which included 211 species in 25 genera. They also included a list of counties that each species had been recorded from as well as a table of genera and their primary literature sources that contain county records from this state. Wilkening *et al.* recorded 15 species in the genus *Dasyhelea* Kieffer from Florida.

More recently, Grogan *et al.* (2010) presented new records of Ceratopogonidae from Florida, including the first USA records of two primarily Neotropical species: *Dasyhelea griseola* Wirth and *D. scissurae* Macfie.

Dasyhelea is a large genus, with over 600 described species worldwide (Borkent 2016, Borkent & Dominiak 2020, Borkent *et al.* 2022), an increase over the previously known extant and extinct 470 species (Borkent & Wirth 1997). Over the years, many species have been described from Florida or reported in the state after being described from material collected elsewhere (Coquillett 1902; Kieffer 1906; Johannsen 1943; Wirth 1952; 1974; Borkent & Forster 1986; Hribar & Grogan 2005; Grogan & Wieners 2006; Huerta & Grogan 2006).

Wirth & Williams (1957) provided brief descriptions of both sexes of *D. atlantis* and *D. bermudae*, however, they only illustrated the male genitalia of both species. Herein, we describe and provide color photographs of slide-mounted specimens of *D. atlantis* and *D. bermudae*, three new species from Florida and a 4th new species from Jamaica.

Materials and Methods

Recently collected specimens were cleared in phenol-ethanol, then dissected and mounted on microscope slides in a mixture of phenol-ethanol and Canada balsam by the methods described by Wirth & Marston (1968). Specimens were compared with slide-mounted specimens of several Nearctic and Neotropical species of *Dasyhelea* as well as descriptions and illustrations of these species. Holotypes, allotypes, and paratypes of three new species are deposited in the U. S. National Museum of Natural History, Smithsonian Institution, Museum Support Center, Suitland, Maryland (USNM); the holotype, allotype, and paratypes of *D. wilkeningi* are deposited in the Florida State Collection (FSCA); and, paratypes of 3 new species are deposited in the Canadian National Collection, Ottawa (CNCI); Museo de La Plata, Argentina (MLPA); and the Florida Keys Mosquito Control District, Marathon (FLKC).

Morphological terms of adults are from the chapter on Ceratopogonidae by Downes & Wirth (1981) in the Manual of Nearctic Diptera, except for modifications of certain wing veins and cells proposed by Szadziewski (1996); they were subsequently summarized in a table by Spinelli & Borkent (2004) and included in the chapter on Ceratopogonidae in the Manual of Central American Diptera (Borkent *et al.* 2009). Terminology for male genitalia follows Grogan *et al.* (2019).

Data of numerical values and ratios are presented as ranges of values, followed by means and sample sizes. Antennal ratios of females are the combined lengths of flagellomeres 9–13 divided by the combined lengths of 1–8; antennal ratios of males are the combined lengths of flagellomeres 10–13 divided by the combined lengths of 1–9; flagellum lengths are the combined lengths of all 13 flagellomeres of both sexes. Palpal ratios were obtained by dividing the lengths of palpal segment 3 by their greatest widths. Wing lengths were measured from the basal arculus to wing tips, and wing widths were measured at their broadest sections; costal ratios were obtained by measuring the distance from the basal arculus to the end of the costa, divided by wing lengths. Spermathecae lengths includes the necks if present, and their widths were measured at their widest sections. Lengths of aedeagi were measured from the base of their proximal sections to the apex of their distal-most sections; total aedeagal widths were measured across the bases of the lateral arms of the proximal portion; and tip width was measured across the sclerotized portion of the apex of the distal portion.

Systematics

Key to adults in the *Dasyhelea atlantis-bermudae* Complex (females of *D. garymulleni* sp. nov. are unknown)

1. Males 2
Females..... 7
2. Medial portion of aedeagus short (Figs. 11–12) semi-tubular, apex extending to or near apices of gonocoxites, tip concave with recurved apicolateral extensions; tergite 9 short, apex broadly rounded with very short apicolateral processes with a single large subapical seta; gonocoxal apodemes and paramere slightly asymmetrical, barely fused or separated with a lightly sclerotized triangular posterior process *D. bermudae* Wirth & Williams
Medial portion of aedeagus elongate (Figs. 4–5, 19–20, 27–28) tubular, apex extending to apices of gonocoxites. 3
3. Medial portion of aedeagus (Figs. 4–5) long, tubular, their apices extending to or near apices of their gonocoxites, tip broad,

- hollow, basal portion with moderately long recurved apicolateral extensions; tergite 9 elongate, extending beyond gonocoxites with rounded apex and moderately long stout apicolateral processes; sternite 9 moderately long, with convex apical margin; gonocoxal apodemes and paramere asymmetrical, divided *D. atlantis* Wirth & Williams
- Disto-medial portion of aedeagus tubular or semi-tubular, moderately long, apex extending to or near apices of gonocoxites, tip solid with recurved apex, basal portion without recurved apicolateral extensions; tergite 9 elongate; sternite 9 moderately long, with convex apical margin; gonocoxal apodemes and paramere asymmetrical 4
4. Aedeagus (**Figs. 27–28**) basal portion broad, distal portion slender with a deep or moderately deep apex; gonocoxites short, broad; gonostyli relatively short with a baso-ventral group of stout setae and a slightly hooked apex; gonocoxites massive, broad; gonostyli relatively short with a baso-ventral group of stout setae and a slightly hooked apex. *D. woodruffi* sp. nov. Aedeagus with at least basal portion slender 5
5. Aedeagus (**Figs. 19–20**) basal half-slender, distal half stout, tubular with thick walls and concave tip; apicolateral processes elongate, slender; gonocoxal apodemes and paramere fused, symmetrical with a short quadrate distal portion *D. danklinei* sp. nov. Aedeagus slender basally and distally 6
6. Wing with a very short costa (**Fig. 34**) (costal ratio 0.38–0.40); aedeagus slender (**Figs. 35–36**), vasiform, with a greatly elongated disto-medial process, the apical 1/3 is tapered distally with a slightly flared apex and greatly elongated apicolateral arms; aedeagus broad, length/width ratio 1.72–2.55 *D. wilkeningi* sp. nov. Wing with a longer costa (**Fig. 43**) (costal ratio 0.43); aedeagus elongate, very slender (**Fig. 44**), length/width ratio 1.69. *D. garymulleni* sp. nov.
7. Genital sclerotization (**Fig. 8**) distinct, distal portion ovoid with broad ovoidal lumen; basal portion broad with deep central excavation, lateral arms elongate with blunt apices; spermatheca globular, tapered distally with a short to moderately long slender neck (length 0.04–0.09 (0.05, n=18) mm); antenna (**Fig. 6**) with elongate flagellomeres 9–13 *D. atlantis* Wirth & Williams Genitalia and antenna not as above 8
8. Genital sclerotization (**Fig. 16**) ovoid with ellipsoid lumen; spermatheca large, broader than long, very heavily sclerotized, thick-walled with a short, nipple-like neck; antenna (**Fig. 13**) with shorter flagellomeres 9–13. *D. bermudae* Wirth & Williams Genital sclerotization not ovoid 9
9. Genital sclerotization indistinct; antennal flagellomeres (**Fig. 37**) 1–12 short, 13 more elongate; spermatheca (**Figs. 39–40**) slightly flattened with very thick exterior wall *D. wilkeningi* sp. nov. Genital sclerotization quadrate 10
10. Thorax (**Fig. 21**) dark brown with some paler sections; antennal flagellomeres (**Fig. 22**) dark brown, 13th with semi-pointed tip; genital sclerotization (**Fig. 24**) quadrate with pale medial portion and slender distal apices; spermatheca ovoid with narrow slender apex *D. danklinei* sp. nov. Thorax (**Fig. 30**) dark on basal section, lateral sections pale or golden; antennal flagellomeres (**Fig. 29**) medium brown, 13th with rounded apex; genital sclerotization (**Fig. 32**) very pale, quadrate with divergent baso-lateral apices; spermatheca slightly ovoid with broader apex. *D. woodruffi* sp. nov.

Dasyhelea atlantis Wirth and Williams

(Figs. 1–8)

Dasyhelea atlantis Wirth & Williams, 1957: 11 (Bermuda); Waugh & Wirth 1976: 245 (records from Florida and New York (Long Island); redescription; figs. female, male, pupa); Davies & Giglioli, 1979: 592 (records from Grand Cayman); Wilkening *et al.* 1985: 519 (record from Indian River Co., Florida); Borkent, 1991: 108 (records from the Galápagos Islands and Maine, USA; description, figs.); Borkent & Spinelli, 2000: 24 (in Catalog of New World species south of the USA; distribution); Borkent & Spinelli, 2007: 59 (in Neotropical Catalog; distribution); Borkent & Grogan, 2009: 11 (in Catalog of New World Biting Midges North of Mexico; distribution); Grogan *et al.* 2010: 21 (records from Florida Keys, Monroe Co.); Borkent & Dominiak 2020: 42 (in World Catalog).

Diagnosis. A medium to large species in the *D. atlantis-bermudae* complex distinguished from all other species in this complex by the following combination of characters. Male aedeagus elongate, tubular, the apex extending to or near apices of gonocoxites, basal portion with moderately long recurved apicolateral extensions; aedeagus length/width ratio 0.93–1.75 (1.27, n=18); wing length 0.70–0.91 (0.80, n=20) mm, width 0.25–0.29 (0.28, n=20) mm; costa moderately long, costal ratio 0.44–0.48 (0.46, n=20); gonocoxal apodemes and paramere asymmetrical, divided; tergite 9 elongate, extending beyond gonocoxites with rounded apex and moderately long, stout apicolateral processes; sternite 9 moderately long with convex apical margin. Female wing length 0.59–0.91 (0.68, n=21) mm, width 0.28–0.44 (0.32, n=19) mm; antenna with moderately elongate flagellomeres 9–13; sub-genital plate sub-circular with basolateral ear-like extensions, lumen cordiform usually with basal pointed extension, posterior excavation very deep; spermatheca large, length 0.04–0.09 (0.05, n=18) mm, subspherical with narrow slender neck.



FIGURES 1–8. *Dasyhelea atlantis*. Fig. 1. Head, male. Fig. 2. Thorax, male. Fig. 3. Wing, male. Figs. 4–5. Genitalia, male. Fig. 6. Head, female. Fig. 7. Wing, female. Fig. 8. Genitalia, female.

Redescription of Male. *Head* (Fig. 1): Dark brown. Eyes contiguous for a distance equal to the length of 2–4 ommatidia, with moderately dense, fine pubescence. Frontal sclerite elliptical with slender ventral projection. Antennal flagellum medium brown, all flagellomeres with surface reticulations; flagellomeres 3–11 partially or completely fused in some specimens, 10–13 elongate; antennal ratio 0.96 (0.90–1.03, n=17); total flagellum length 0.53 (0.49–0.56, n=17) mm. Palpus light brown; segment 3 moderately long, slender with capitate sensillae; palpal ratio 3.60–6.00 (5.91, n=19). *Thorax* (Fig. 2): Scutum brown; scutellum yellow with 6–7 large, 0–2 smaller antero-central setae. Femora, tibiae medium brown, femora slightly darker than tibiae; hind tibial comb with 6 spines, 4th or 5th longest; tarsomeres 1–4 light brown, tarsomeres 5 darker; claws small, equal-sized, straight with basal inner seta, apices bent, tips bifid; hind tarsal ratio 2.21 (2.05–2.31, n=20). *Wing* (Fig. 3) moderately slender, membrane slightly infuscated, covered with dense microtrichia, macrotrichia moderately dense on all veins except basal portion of medius and in all cells except proximal portion of cua_1 and anal cell; radius and proximal portion of medius brown; one narrow to moderately broad radial cell in some specimens, reduced to a suture in others; basal 1/3 of proximal portion of medius poorly developed, reduced to 9–10 small, circular beadlike sclerites; extreme basal section of vein M_1 poorly developed, weakly joined to basal portion of medius, not connected to M_2 ; anal lobe moderately developed; wing length 0.70–0.91 (0.80, n=20) mm, width 0.25–0.29 (0.28, n=20) mm; costa moderately short,

costal ratio 0.44–0.48 (0.46, n=20). Halter stem brown; knob white. *Abdomen*. Genitalia (Figs. 4–5). Tergites (Fig. 2) dark brown, sternites lighter brown. Tergite 9 broadest at base, anterior margin slightly extended on mid-portion, apex with numerous very long setae, tapering distally at level of basal point of paramere apodemes, apex broadly rounded, extending considerably beyond gonocoxites; apicolateral process stout with single apical seta. Aedeagus elongate, tubular, the apex extending to or near apices of gonocoxites, basal portion with moderately long recurved apicolateral extensions. Aedeagus length/width ratio 0.93–1.75 (1.27, n=18).

Redescription of Female. Similar to male but more massive with the following notable sexual differences. *Head* (Fig. 6). Antennal flagellomeres separate with poorly developed surface reticulations; 9–13 considerably longer than 2–8, 13 longest; flagellomeres with basal whorl of long sensillae chaeticae; antennal ratio 0.82–0.96 (0.89, n=24) mm; total flagellum length 0.33–0.50 (0.38, n=24) mm. Palpal segment 3 with 1–3 capitate sensillae; palpal ratio 3.45–5.00 (4.15, n=18). *Thorax*. Hind tarsal ratio 2.00–2.26 (2.19, n=22); claws gradually curved on distal 1/4, apices slightly recurved, tips entire. Wing (Fig. 7) broader than males, anal lobe more developed; length 0.59–0.91 (0.68, n=21) mm, width 0.28–0.44 (0.32, n=19) mm; costa moderately long, costal ratio 0.47–0.52 (0.50, n=21). *Abdomen* (Fig. 8). Genital sclerotization very distinctive, distal portion ovoid with a broad ovoidal lumen; basal portion broad basally, lateral arms elongate with blunt apices and a deep central excavation. Spermatheca globular, tapered distally with a short to moderately long slender neck; length 0.04–0.09 (0.05, n=18) mm, width 0.03–0.05 (0.04, n=12) mm.

Discussion. This species was subsequently recorded in the USA from Florida and New York by Waugh and Wirth (1976), from the Cayman Islands by Davies and Giglioli (1979), and the Galápagos Islands and Maine (USA) by Borkent (1991). We provide the first records from Mexico and an additional USA record from Maryland. Wirth and Williams (1957) gave female wing lengths of 0.75–0.80 mm from Bermuda, and Borkent (1991) listed female wing lengths of 0.65–0.82 mm from the Galápagos Islands. We recorded female wing lengths of 0.59–0.79 (0.72, n=20) mm.

Bionomics. Davies and Giglioli (1979) noted on Grand Cayman that *D. atlantis* was “exceedingly common, being found everywhere in light traps. Adults were found resting in tall grass and herbs in flooded pastures and on pneumatophores in mangrove areas. During 3 days when flooding was actually taking place the emergence rate went up to 373.0 per day. ... Thus *D. atlantis* is probably the most common ceratopogonid in Grand Cayman, breeding in habitat from fresh to brackish and flooded to almost dry. Flooding seems to stimulate emergence.”

Material Examined. BERMUDA, 17–23 June 1955, R. W. Williams, recovery cage Spittal Pond, 1 female (allotype, Type No. 62198; USNM), 2 males (paratypes; USNM); same data except 7–12 June 1955, recovery cage Wilkenson Pond, 1 female (paratype; FSCA), 1 male (paratype; USNM); same data except 4 July 1955, recovery cage Warrick Pond, 1 female (paratype; USNM); Camden, 23-VII-(19)68, Dr. I. Hughes, 1 male (USNM). CAYMAN ISLANDS, Grand Cayman, Dec. 1973, J. E. Davies, 3 males, 3 females (USNM). USA: FLORIDA, Indian River Co., “Vero Beach”, Ent. Res. Cntr., April 1960, light trap, 1 female. Miami-Dade Co., Pinecrest Chapman Field, 5–11-1-2016, H. Escobar, Suction Trap, 1 male, 1 female (FSCA). Monroe Co., Lower Sugarloaf Key, 8 August 2012, Run 3, 20:14–20:28, L. Hribar & C. Pruszyński, Truck Trap, 1 female; same data except 4 Sept. 2012, C. Pruszyński, Truck trap, 1 male; No Name Key, 2 Feb. 2009, D. DeMay, 1 female, 1 male; Vaca Key, 10 Sept. 2010, L. Hribar, BG Sentinel trap, 1 female; Upper Key Largo, 9/14 June 2014, K. E. Schnepf, Funnel Trap, 1 female; (all FSCA). MARYLAND, St. Marys Co., St. George, 14-VI-1970, 1 female (USNM). NEW YORK, Suffolk Co., Long Island, Orient, 25-V-1963, W. Wirth, salt marsh, 1 male (FSCA). MEXICO, Cancun, Quintana Roo, 1-III-(19)75, D. Pletsch, LT, 1 male (USNM).

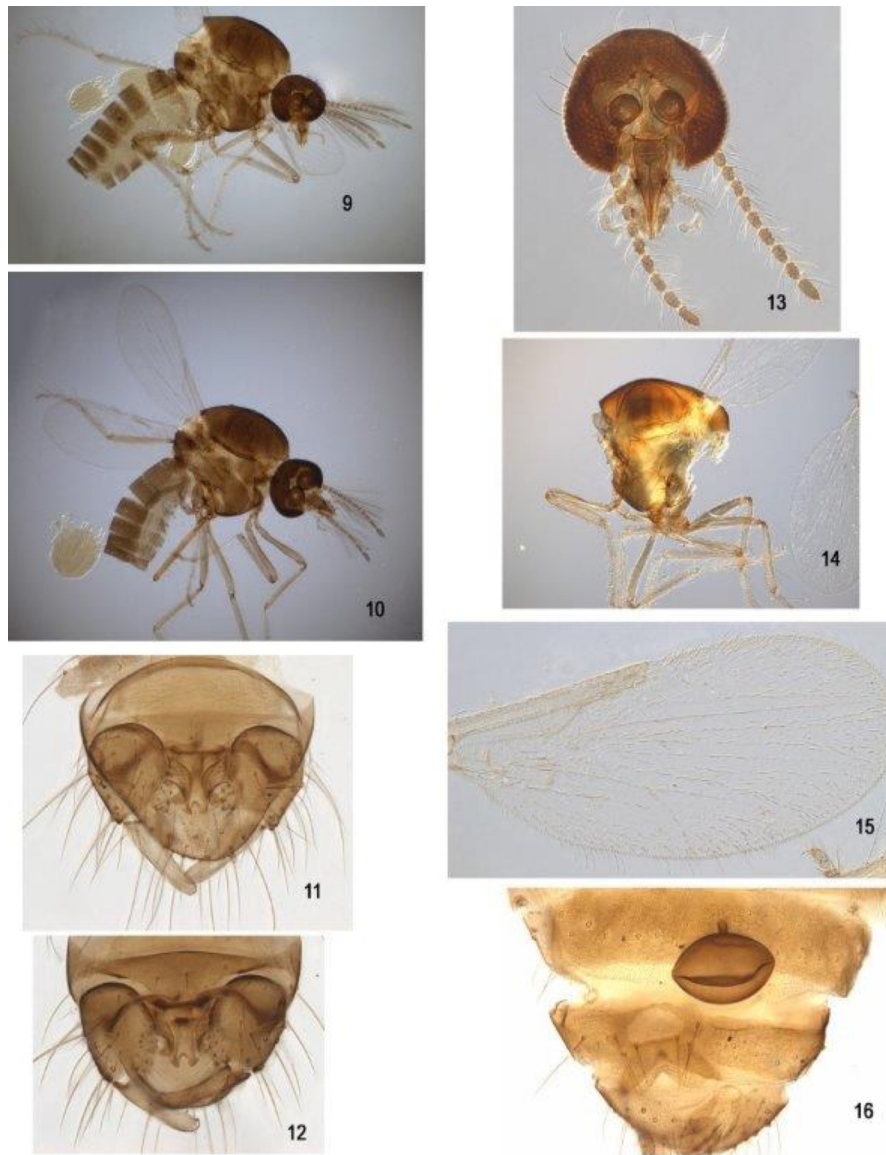
***Dasyhelea bermudae* Wirth and Williams**

(Figs. 9–16)

Dasyhelea bermudae Wirth & Williams, 1957: 11 (Bermuda); Wirth 1965: 126 (in Nearctic catalog north of Mexico); Borkent & Spinelli, 2000: 24 (in New World catalog south of the USA; distribution); Borkent & Spinelli, 2007: 60 (in Neotropical catalog; distribution); Grogan *et al.* 2016: 34 (Guadeloupe record); Borkent & Dominiak 2020: 43 (in World Catalog).

Diagnosis. A small species of the *D. atlantis-bermudae* complex distinguished from other species in this complex by the following combination of characters. Males small, wing length 0.67–0.72 (0.69, n=5) mm; disto-median portion of aedeagus tubular, moderately short, apex extending to or near apices of gonocoxites, tip concave with recurved

apicolateral extensions; tergite 9 short, apex broadly rounded with very short apicolateral processes which bear a single large subapical seta; gonocoxal apodemes and paramere slightly asymmetrical, barely fused or separated with a lightly sclerotized triangular posterior process. Females small, wing length 0.63–0.69 (0.66, n=3) mm; subgenital plate ovoid with ellipsoid lumen; spermatheca large, globular, dark brown, heavily sclerotized, with thick walls, and a short nipple-like neck.



FIGURES 9–18. *Dasyhelea bermudae*. Figs. 9–10. Lateral view, male. Figs. 11–12. Genitalia, male. Fig. 13. Head, female. Fig. 14. Thorax, female. Fig. 15. Wing, female. Fig. 16. Genitalia, female.

Redescription of Male. *Head* (Figs. 9–10): Dark brown. Eyes contiguous for the length of 3–4 ommatidia, with moderately dense, fine pubescence. Frontal sclerite elliptical with very slender ventral projection. Antennal flagellum medium brown, all flagellomeres with well-developed surface reticulations; flagellomeres separate, 5–10 partially or completely fused in some specimens; flagellomere 2 globular, 3–5 rhomboid, 7–9 broadly vasiform, 10–12 elongate vasiform, 13 with slightly tapered apex, flagellomere 11 or 13 longest; flagellomeres 1–12 with subbasal whorl of sensilla chaetica, those on 2–12 elongated and composed the moderately dense plume that extends beyond flagellomere 12; antennal ratio 0.81–0.93 (\bar{x} =0.87, n=5); total flagellum length 0.44–0.48 (0.46 mm, n=5). Palpus 5-segmented, light brown; segment 3 slender with 0–1 long, subbasal capitate sensilla; palpal ratio 3.17–4.00 (3.63, n=5). *Thorax* (Figs. 9–10): Scutum dark brown; scutellum yellow except lateral margins brownish with 6–7 large setae, 0–2 smaller anterocentral setae; lateral, ventral sclerites medium dark brown. Femora, tibiae medium brown, femora slightly darker than tibiae; tarsi with tarsomeres 1–4 light brown, tarsomeres 5 darker; claws small,

equal-sized, straight with basal inner seta, apices bent, tips bifid; hind tibial comb with 6 spines, 4–5 longest; hind tarsal ratio 1.94–2.12 (2.04, n=5). Wing (Fig. 10) moderately broad, membrane slightly infuscated, covered with dense macrotrichia, macrotrichia moderately dense on all veins except basal portion of medius and in all cells except proximal portion of CuA_1 and anal cell; radius, proximal portion of medius brown; one narrow to moderately broad radial cell in some specimens, reduced to a suture in others; basal 1/3 of proximal portion of medius poorly developed, reduced to 9–10 small, circular beadlike sclerites; extreme basal section of vein M_1 poorly developed, weakly joined to basal portion of medius, not connected to M_2 ; anal lobe moderately developed; costa short, costal ratio 0.42–0.47 (0.45, n=5); wing length 0.67–0.72 (0.69, n=5) mm, width 0.26–0.27 (0.27, n=3) mm. Halter stem brown; knob pale (the basal half of the knob is pale in one specimen), distal half whitish (appearing black under compound microscope). *Abdomen*. Tergites medium dark brown, sternite lighter brown. Genitalia (Figs. 11–12). Tergite 9 broadest at base, anterior margin nearly straight, surface with scattered very long setae, tapering distally at level of basal point of paramere apodemes, apex broadly rounded, extending considerably beyond gonocoxites; apicolateral process stout with single apical seta; cercus apparently reduced to very low mound on inner base of apicolateral process with 2–5 short setae; sternite 9 narrower basally than tergite 9, tapering gradually distally on proximal 2/3, tapering more abruptly on distal 1/3, apex curved, extending just below or to base of aedeagus. Gonocoxite short, stout, 1.3–1.4 X longer than broad, ventrolateral surface with scattered sparse long setae, mesoventral setae with more numerous shorter setae; gonostylus 0.90–0.95 length of gonocoxite, broadest at base, proximal 2/3 covered with short fine setae, tapering slightly distally at proximal 1/3, slightly curved, apex moderately broad, rounded with small to well-developed apicoventral “beak.” Gonocoxal apodemes and paramere slightly asymmetrical, separated or barely fused; basal apodemes heavily sclerotized, proximal 1/5 more or less quadrate in shape, set at 60° angle with junction of distal 4/5 stem, distal stem recurved at midlength nearly 90°, apices slightly tapered, tips slightly offset, with broad lightly sclerotized more or less triangular posterior sclerite that is difficult to see in some specimens. Aedeagus complex, composed of two sections; proximal sclerite heavily sclerotized, in shape of transverse bar with short basal arms, lateral arms mostly moderately sclerotized, tilted at 30° mesally, tapering very slightly distally with slender, heavily sclerotized apex that is recurved laterally 90°; distal portion lightly sclerotized, tubular, basal half triangular, apical half straight, parallel-sided, apex more heavily sclerotized, deeply concave medially with small flared, recurved apicolateral processes.

Redescription of Female. Similar to male with the following notable sexual differences. *Head* (Fig.13): Antennal flagellomeres separate, with poorly developed surface reticulations; flagellomeres 9–13 slightly longer than 2–8, 13 longest; flagellomeres with basal whorl of moderately long sensilla chaetica; antennal ratio 0.85–0.88 (0.86, n=3); total flagellum length 0.365–0.383 (0.379, n=3) mm. Palpal segment 3 with 2–3 capitate sensillae; palpal ratio 3.00–3.60 (3.29, n=3). *Thorax* (Fig. 14): Hind tarsal ratio 1.97–2.16 (2.08, n=3); claws more gradually curved, apices very slender, tips entire. Wing (Fig. 15) broader than male; anal lobe slightly better developed; wing length 0.63–0.69 (0.66, n=3) mm, width 0.28–0.32 (\bar{x} =0.30, n=3) mm; costal ratio 0.45–0.46 (0.46, n=3). *Abdomen* (Fig.16): Genital sclerotization with distal portion ovoid with broad ovoidal lumen; proximal portion broad basally, basal arms tapering gradually distally, bent at midlength. Spermatheca globular to slightly ovoid, very heavily sclerotized with thick walls, 0.97–1.24 X broader than long (two are slightly deformed, one is tilted); length 0.064–0.071 (0.067, n=3) mm, width 0.066–0.082 (0.072, n=3) mm; neck short, stout, straight, nipple-like in shape.

Discussion. Both sexes of *D. bermudae* are slightly smaller than those of *D. atlantis*, however, males of both species have slightly longer average wing lengths than their conspecific females, but their wings are narrower than females. Costal ratios of female *D. bermudae* are slightly lower (0.45–0.46) than females of *D. atlantis* (0.47–0.51), but no apparent differences in female antennal and hind tarsal ratios were noted in measured specimens. Females of *D. atlantis* apparently have a wider range of palpal ratios (3.45–5.00, n=10) than *D. bermudae* (3.00–3.60, n=3), but this may be partially due to the small sample size of the latter species. However, their female genital sclerotizations and spermathecae are very different, and we consider these two characters are best for identifying females of both species.

Bionomics. Wirth & Williams (1957) described *D. bermudae* from specimens collected in recovery cages during June and July 1955 from seven localities that were plotted on a map of the Bermuda Islands in Williams (1956). He also provided details on 15 microhabitats of several other species of Ceratopogonidae on Bermuda. Seven of these sites yielded 51 males and 75 females (the type series) of *D. bermudae* from South Shore Marsh on Pampas Farm (type locality), drainage ditches at Devonshire, Paget, South and Warwick Marshes, and from Seymour, Trott’s, and Warwick Ponds (Williams 1957).

Material Examined. BERMUDA, 21–27 June 1955, R. W. Williams, Pampas Farms recovery cage II, 1 female (allotype, USNM), 1 male (paratype); same data except 28 June 1955, recovery cage Paget Marsh, 2 males (paratypes); same data except July 1955, recovery cage Warrick Marsh, 1 female, 1 male (paratypes); Camden, 20-VII-1968, Dr. I. Hughes, 20-VII-(19)68, 1 female, (labeled by W. Wirth as *D. atlantis*, an obvious lapsis) (USNM). Guadeloupe, Basse Terre, NE Pigeon (16.1440N, 61.74977W) 8-V-2012, R. H. Turnbow, BL trap, 1 male (FSCA).

***Dasyhelea danklinei* sp. nov.**

(Figs. 17–24)

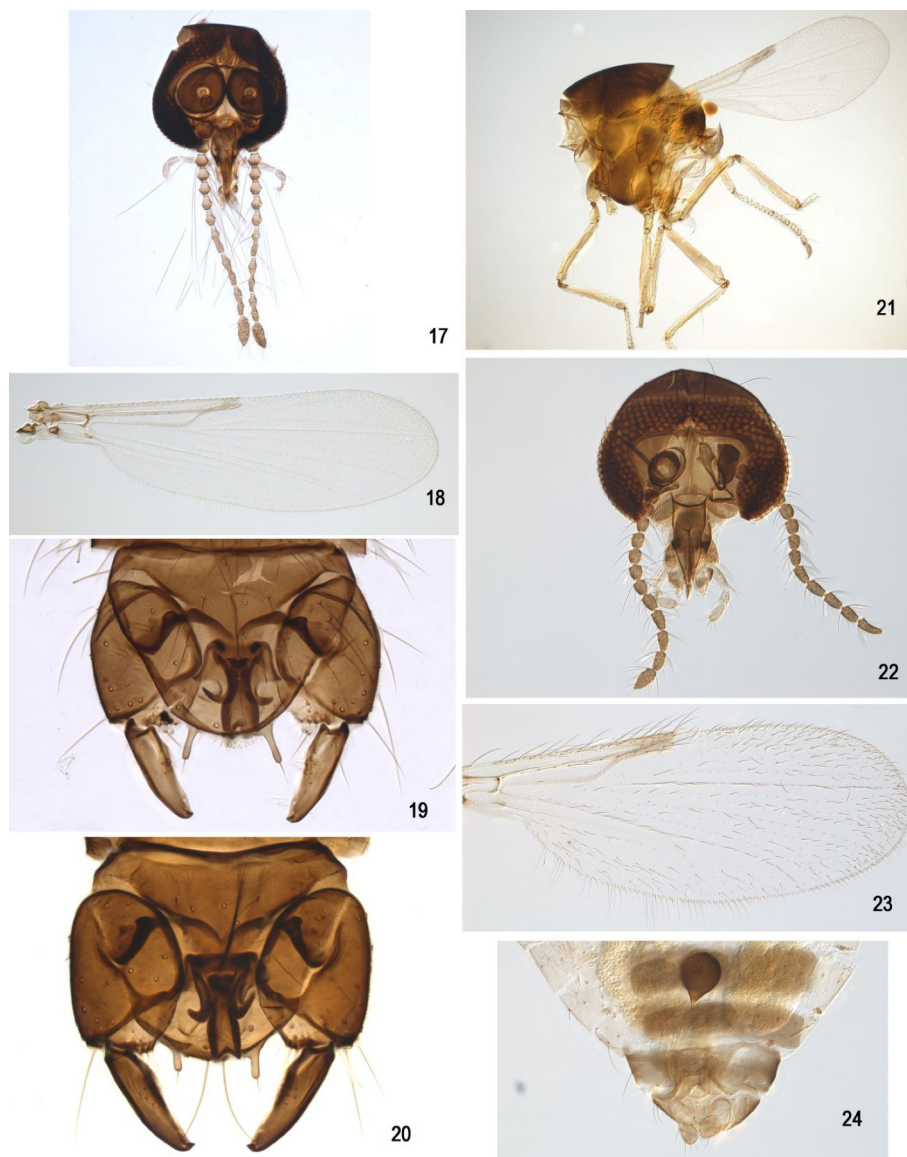
Dasyhelea mutabilis Coquillett; Grogan *et al.* 2010: 23 (female; Florida, St. Lucie Co.).

Diagnosis. A medium-size, dark brown species resembling *D. bermudae*, but differing from it and other species in the *D. atlantis-bermudae* complex by the following combination of characters: size (male wing length 0.67–0.81 mm; female wing length 0.55–0.77 mm). Male aedeagus with tubular, thick-walled distal portion with curved concave apex and elongate slender apicolateral processes; gonocoxal apodemes and paramere fused, symmetrical with a short quadrate distal portion; palpal segment 3 elongate, slender (palpal ratio 3.60–4.44). Female with quadrate genital sclerotization with a broad lumen and slender, elongate basal arms; spermatheca large (length including neck 0.07–0.08 (0.07, n=10) mm), globular, the distal portion abruptly tapered, conical with a very short narrow neck.

Male. Head (Fig. 17): Dark brown. Eyes contiguous for length of 3 ommatidia, with dense long inter-ommatidial pubescence. Frontal sclerite elongate elliptical, shape typical of other species in the *D. mutabilis* group. Antennal flagellum with separate flagellomeres with well-developed surface reticulations; flagellomeres 5–8 or 6–8 partially or completely fused in some specimens; flagellomeres 10–13 considerably longer than 2–9; 2–3 somewhat globular, 4–9 vasiform; plume of sensilla chaetica moderately dense, extending beyond flagellomere 12; total flagellum length 0.44–0.49 (0.46, n=20) mm; antennal ratio 0.80–0.91 (\bar{x} =0.87, n=20). Palpus light brown, 5-segmented; segment 3 elongate, slender with 1–3 long, hyaline capitate sensillae; palpal ratio 3.60–4.44 (3.97, n=19). **Thorax:** Dark brown; scutellum yellowish, lateral margins brownish with 6 large, 1–2 smaller apico-central setae. Femora medium to dark brown, tibiae light brown, tarsi pale except tarsomeres 5 brown; hind tibial comb with 6 spines, 4–5 longest; hind tarsal ratio 2.00–2.39 (2.15, n=19); claws equal-sized, nearly straight, moderately long with inner basal seta, apices bent with bifid tips. Wing (Fig. 18) membrane hyaline, with dense very fine microtrichia, macrotrichia moderately dense in all cells (most numerous in r_3), wing margin and on all veins except proximal portion of M; radial cells obliterated, or a poorly developed narrow 2nd cell present, or reduced to a suture in some specimens; base of M_2 not connected to M_1 ; anal lobe poorly developed; wing length 0.67–0.81 (0.71, n=19) mm, width 0.22–0.27 (0.24, n=17) mm; costal ratio 0.42–0.46 (\bar{x} =0.44, n=19). Halter stem brownish, knob pale or whitish (appearing black in most specimens). **Abdomen:** Dark brown; pleura golden. Genitalia. (Fig. 19–20). Tergite 9 broad proximally, tapering gradually distally to broad round apex, apicolateral process elongate, slender with single large apical seta; cercus very short, located at medial base of apicolateral process with 2–3 apical setae; sternite 9 produced posteriorly, extending onto base of aedeagus, covered with dense fine setae, apex truncate. Gonocoxite stout, about 1.5X longer than broad, extending just below or past apex of tergite 9, ventral surface with sparse very long setae, distomesal region with dense shorter setae; gonostylus 0.80–0.85 length of gonocoxite, broad proximally, tapering slightly distally to hooked apex, tip sharply pointed, with subbasomesal patch of 5–7 short setae on tubercles. Gonocoxal apodemes and paramere fused, symmetrical, heavily sclerotized; basal apodeme with proximal portion broad quadrate, distal portion with basal quadrate to rounded anterior projection, nearly straight except curved at apex and fused to opposite apodeme and forms a short truncate, quadrate posterior process. Aedeagus heavily sclerotized, composed of two sections; proximal portion with broad base and lateral arms that extend to about mid-length of distal portion, apical section recurved about 120° distal portion stout, tubular, thick walled, narrowest basally, becoming gradually broader distally, apex concave; aedeagus total length 0.06–0.07 (0.07, n=8) mm; width 0.04–0.05 (0.05, n=8) mm; length/width ratio 1.31–1.65 (1.49, n=8); width of apex 0.017–0.020 (0.018, n=8) mm.

Female. Similar to male with the following notable sexual differences. **Head** (Fig. 22): Antennal flagellum with separate flagellomeres, 9–12 longer than 2–8, 13 longest; flagellomeres with basal whorl of moderately long sensilla chaetica; reticulations moderately developed on flagellomeres 9–13, 2–8 without reticulations; flagellomeres 2–4 slightly globular, 5–12 vasiform; antennal ratio 0.85–0.99 (0.91, n=10); total flagellum length 0.35–0.38 (0.36,

n=10) mm. Palpal segment 3 with 3–5 capitate sensilla more broadly distributed on mesal surface; palpal ratio 2.67–3.80 (3.29, n=21). *Thorax*: Scutellum more diffused with brown in some specimens. Hind tarsal ratio 2.10–2.38 (2.24, n=10); claws more gradually curved, apices very slender, tips entire. Wing (Fig. 23) broader, anal lobe well developed; wing length 0.59–0.70 (0.64, n=10) mm, width 0.27–0.33 (0.28, n=10) mm; costal ratio 0.43–0.47 (0.44, n=10). *Abdomen*: Subgenital plate (Fig. 24) main body quadrate with broad lumen and more lightly sclerotized anterolateral arms that taper abruptly distally; basal arms slender, elongate, curved. Spermatheca (Fig. 24) ovoid, extreme distal portion abruptly tapered, conical, with very short narrow neck, length including neck 0.07–0.08 (\bar{x} =0.07, n=10) mm, width 0.54–0.66 (0.59, n=15) mm.



FIGURES 17–24. *Dasyhelea danklinei*. Fig. 17. Head, male. Fig. 18. Wing, male. Figs. 19–20. Genitalia, male. Fig. 21. Thorax, female. Fig. 22. Head, female. Fig. 23. Wing, female. Fig. 24. Genitalia, female.

Type Material. Holotype male, allotype female, paratypes 8 females and 6 males, FLORIDA, Highlands Co., Lake Placid, Archbold Biological Station, Sept. 1990, W. W. Wirth, at UV light (USCA); other paratypes, 24 males, 20 females: same data as holotype except 13–19 April 1989, light trap, 3 females, same data except Lake Annie, S. Side, Sept. 1990, Malaise trap, 3 females, 4 males, same data except Lake Annie 89W6, 13–19 April 1989, 3 females; same data except Price Tract, 1-IV-1990, Malaise trap, 2 males, same data except IX-1990, 2 males; same data except Animal pens, 1-IV-1991, malaise trap, 2 females; same data except 15-IX-1990, at *Polygonella* flowers, 4 females, 5 males; same data except Sept. 1990, at UV light, 1 male; same data except 8-IV-1991, palmetto

flowers, 4 males; same data except Buck Island Ranch, Sept. 1990, at UV light, 1 male, same data except IV-1991, 1 male, same data except 6-IV-1991, 1 female; same data except 3-IV-1992, emergence trap, 1 male. Alachua Co., Gainesville, Oak Crest, 8-VIII-1986, W. Wirth, UVLT, 1 female, same data except Chantilly Acres, VII-1967, F. S. Blanton, light trap, 1 male, same data except IX-1967, 1 male. Baker Co., Pitcher plant bog on Rt. 127 3 km S of Rt. 125, 6-V-2014, W. L. Grogan, Jr., Sweep net, 1 female, same data except Pitcher plant bog on Rt. 127 3 km S of Rt. 125, 6-V-2014, 1 female (FSCA). Collier Co., Immokalee, Suction Trap, 7/14-VIII-2014, 2 males, same data except 27-XI/4-XII-2014, 1 male, same data except 30-X/6-XI-2014, 1 male, 1 female, same data except 4 females, same data except 4/11-IX-2014, 5 females; same data except 25-IX/2-X-2014, 1 female; same data except 6-13-XI-2014, same data except 4-11-XII-2014, 5 males, same data except 28-VIII/4-IX-2014, 2 males (FSCA). Hardee Co., Ona, July 1970, E. Irons, 1 male. Highlands Co., Archbold Bio Sta, 13-19 Apr. 1970, W. W. Wirth, light trap, 1 male; same data except 8.IV.90, palmetto flow, 1 male, same data except 15-IX-1990, 1 male. Indian River Co., Vero Beach, Fla., March 1959, 1 male, same data except Aug. 1959, 1 male, same data except I 1960, 1 male, same data except May 1960. Miami Dade Co. Miami, 28 Sept. 1960, P. E. Briggs, 1 male; same data except Miami-Dade Co., Pinecrest Chapman Field, 9/17-XII-2014, H. Escobar, 26' Tall Suction Trap, 1 male; Florida, Dade Co., Orchid Jungle, May-June 1969, R. M. Baronowski, B. L. Trap, 1 male; same data except Miami-Dade Co., Pinecrest Chapman Field, 9/17-XII-2014, H. Escobar, 26' Tall Suction Trap, 1 male; same data except 3-8-VII-2015, H. Escobar, Suction Trap, 1 female (FSCA). Kendall, Fla, Dade Co., 6-VII-(19)77, W. W. Wirth, LT, 1 female; Miami, Fla., 17 May 1965, J. C. Buff, light trap, 1 male (USNM). Monroe Co., Everglades Nat. Park, Flamingo, Mar. 1969, B. L. Trap, F. S. Blanton, 3 males. St. Johns Co., Crescent Beach, July 1961, 1 male. St. Lucie Co., 10-VIII-1986, R. L. Escher, 1 female. Okeechobee Co., 36 km N of Okeechobee, 27.559215 N, 80.823552 W, 15-1/10-11-2018. K. E. Schnepf. Barrier pitfall trap, 1 female (FSCA). Polk Co., Winter Haven, DPI, Citrus Arboretum, P. Sieburth, Suction Trap, 11/18-IX-2014, 1 female, same data except 23-30-X-2014, 1 male, same data except 6-13, XI-2014, 1 male, same data except 13-20-XI-2014, 1 female, same data except 20-27-XI-2014, 1 female, same data except 27-XI/4-XII-2014, 1 male, same data except 4-11-VI-2015, 1 female, same data except 17-28-IX-2015, 1 male, same data except 17-28-XII-2015, 1 female, same data except 4-11-II-2016, 1 female (FSCA). Union Co., Dry streambed E of Rt. 121, 1 km S of Sapp, 12 May 2015, W. L. Grogan, Jr., Sweep net, 3 males, 2 females (FSCA).

Bionomics. This new species is widely distributed throughout peninsular Florida as the type series includes specimens from just south of the Florida-Georgia line in Baker County to the southern-most region of Miami-Dade and Monroe counties. We have no records from the Florida panhandle; however, it likely inhabits that region and at least the southern portions of Georgia and Alabama and possibly other nearby southeastern states.

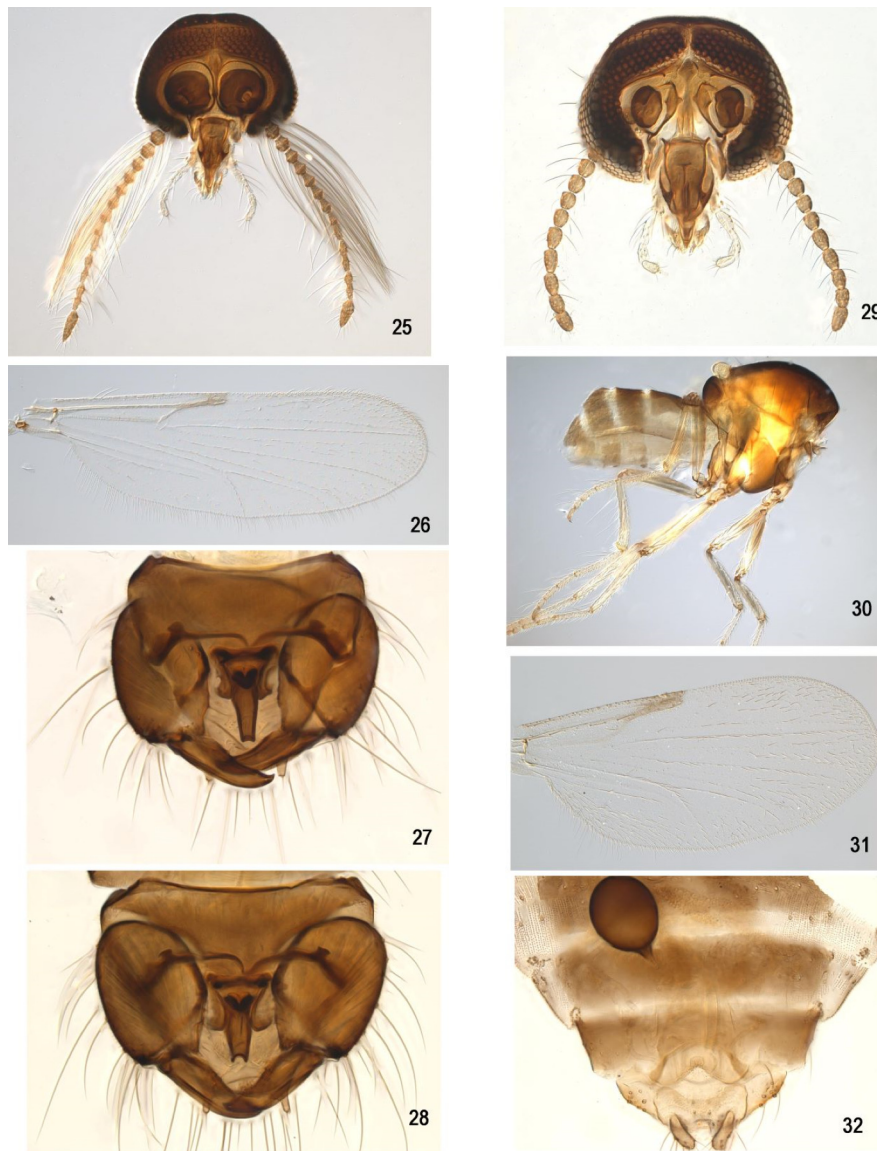
Etymology. We dedicate this new species to our colleague, Dan Kline, who has published numerous articles on *Culicoides* biting midges and mosquitos, including controlling populations of these pestiferous flies.

Discussion. Grogan *et al.* (2010) tentatively identified the female paratype from St. Lucie Co, Florida as *D. mutabilis* (Coquillett) and noted that it was slightly smaller (wing length 0.66 mm) than Waugh & Wirth (1976) provided for that species (0.72-0.83 mm). However, Borkent (1991) recorded wing lengths of 0.58-0.91 mm for nine females of *D. mutabilis* from the Galápagos Islands. This suggests that females of *D. mutabilis* vary greatly in size; however, they differ from females of this new species in having much longer antennal flagellomeres, a circular genital sclerotization, and a small spherical spermatheca with a very short, narrow neck (Waugh & Wirth 1976; Borkent 1991).

***Dasyhelea woodruffi* sp. nov.**

(Figs. 25-32)

Diagnosis. A medium size dark brown species most closely resembling *D. danklinei* sp. nov. but differing from that and other species in the *D. atlantis-bermudae* complex by the following combination of characters: Male wing length 0.71-0.86 mm; aedeagus with a stout, tubular, thick-walled distal portion that gradually tapers distally with a moderately deep, curved apex; gonocoxites massive, broad; gonostyli relatively short with a basal ventral group of stout setae and a slightly hooked apex. Female wing length 0.66-0.74 mm; sternite 9 with a poorly developed ventral plate with numerous tiny, thin surface setae; and a large (length 0.09-0.10 mm, (n=3), ovoid spermatheca with a moderately long tapered neck.



FIGURES 25–32. *Dasyhelea woodruffi*. Fig. 25. Head, male. Fig. 26. Wing, male. Figs. 27–28. Genitalia, male. Fig. 29. Head, female. Fig. 30. Thorax, female. Fig. 31. Wing, female. Fig. 32. Genitalia, female.

Males. *Head* (Fig. 25). Dark brown. Eyes contiguous or very narrowly separated. Antennal flagellum with flagellomeres 2–9 rhomboid, 10–13 elongate, 13 broader than 10–12; 2–9 with single whorl of long sensillae chaetica that comprise the dense plume; 10–12 with 2 rows of shorter setae; 13 with numerous very slender hyaline setae; antennal ratio 0.78–0.92 (0.85, n=13; flagellum length 0.43–0.51 (0.47 mm, n=13). Frontal sclerite broadly rhomboidal with a very slender ventral extension. Clypeus elongate, tapering distally with a slender pointed tip; with 4–5 pairs of slender setae. Palpus pale brown, elongate, apex extending beyond tip of proboscis; segment 3 slender, longer than 4–5 combined, with 2–3 capitate sensillae on inner surface of basal 1/3; palpal ratio 2.83–4.40 (3.71, n=14). *Thorax*. Scutum dark brown; scutellum yellow except lateral margins light brown with 6 large and 3–4 smaller setae. Wing (Fig. 26) moderately slender, membrane hyaline with moderately dense macrotrichiae; anterior veins light brown, posterior veins paler; 2nd radial cell very short or absent in some specimens; apices of costa, radius perpendicular with wing margin; fork of CuA₁ at level of base of 2nd radial cell; anal lobe moderately developed; wing length 0.71–0.85 (0.78 mm, n=14), width 0.24–0.35 (0.28 mm, n=13); costal ratio 0.44–0.47 (0.45 mm, n=14). *Abdomen*. Dark brown on dorsum and distal ventral segments. Genitalia (Figs. 27–28) Tergite 9 moderately broad basally, tapering slightly distally to broad, rounded apex that extends to or just beyond apices of gonocoxites; apicolateral processes on raised humps, moderately long to more elongate and slender with a single long apical seta.

Sternite 9 base broadly curved; posteromedian portion with elongate distal section, tapering slightly distally to a rounded apex that extends onto the basal section of the aedeagus. Gonocoxite very stout, elongate, extending near or just beyond apex of the aedeagus, the inner apical margin with dense elongate setae on raised round bases; gonostylus much shorter and slender than the gonocoxite, its base is moderately broad, gradually tapering and slightly curved distally with pointed beak-like apex. Gonocoxal apodemes symmetrical with curved bases and quadrate anterior extensions at curved sections, distal sections gradually tapering distally, apices curved 90° anteriorly and joined on extreme tip just below the base of the aedeagus; paramere absent. Aedeagus (Figs. 27–28) basal section with straight lightly sclerotized section that attaches to more heavily sclerotized lateral extensions that are bent laterally underneath medial lobes of gonocoxites; they are joined to stout “lateral flanges” as described by Borkent (1991: 108) as in *D. atlantis*. These lateral flanges are broad basally, curved 120° with slender very sharply pointed apices; distal portion of aedeagus is semi-connected with basal section by slender, pointed extensions; the basal section is composed of two bulbous portions that are lightly pigmented and connected to two other black bulbous portions that are apparently fused together and to the main body of the aedeagus; this distal section is broadest at just above levels of the curved lateral extension; the lateral walls are heavily sclerotized on the distal portion of the aedeagus and gradually taper to the bifid apex.

Females. Similar to males with the following notable sexual differences. *Head* (Fig. 29). Dark brown. Eyes as in males. Antennal flagellum with flagellomeres 2–4 rhomboid, 5–8 slightly longer, 9–13 elongate, 13 longest; 2–12 with basal whorl of long, stout setae, 13 with sparse clear slender setae, without basal whorl of long, stout setae; antennal ratio 0.85–0.90 (0.88, n=5); flagellum length 0.34–0.38 (0.35 mm, n=5). Frontal sclerite similar to males but with a longer ventral extension. Clypeus similar to males. Palpus elongate, pale brown, similar to males; segment 3 similar to males but with more numerous capitate sensillae on entire length; palpal ratio 2.67–2.83 (2.70, n=5). *Thorax.* Scutum and scutellum as in males. Wing (Fig. 31) similar to males but shorter and broader; wing length 0.66–0.74 (0.66 mm, n=5), width 0.30–0.32 (0.31 mm, n=5); costal ratio 0.46–0.48 (0.47 mm, n=5). *Abdomen.* Similar to males in coloration, but much broader. Subgenital plate (Fig. 32) with a truncate moderately broad, light brown anterior portion that is connected to a slightly more heavily sclerotized, curved medial section. The distal-most section is more lightly sclerotized; the posteriorly indented portion is covered with tiny dark, pointed spicules that are most dense on the posterior-most section. A single large elongate ovoid spermatheca (Fig. 32) with thick dark black walls and an apparently tapered, slender neck. Spermatheca length 0.09–0.10 mm (n=3), width 0.06–0.07 mm (n=3).

Type Material. Holotype male, allotype female, paratypes 4 males, 3 females, JAMAICA, Clarendon Parish, Milk River Bath, 19 Nov. 1968, R. E. Woodruff, blacklight trap (USNM). Other paratypes, 15 males, 1 female: JAMAICA, Trelawny Parish, 1.9 mi. N. of Burnt Hill, 16-V-1968, R. E. Woodruff, 4 males. St. Catherine Parish, Caymans Estate, 17 Nov. 1968, S. A. Apeji, blacklight trap, 8 males, 1 female (USNM & FSCA). Montego Bay, March 1963, J. B. Davies, wind trap, 1 male (FSCA).

Etymology. We dedicate this new species to our recently deceased colleague, Robert (Bob) Woodruff, who worked at the Florida Department of Agriculture & Consumer Services, Gainesville, Florida from 1958 to 1988. Bob collected over 50% of the type series of this new species in Jamaica during May and November 1968. He has five previous ceratopogonid patronyms: *Atrichopogon* (*Psilokempia*) *woodruffi* Spinelli, Marino & Huerta 2015: 58 (Dominican Republic); *Bezzia* (*Bezzia*) *woodruffi* Spinelli & Wirth 1989: 120 (Jamaica); *Brachypogon* (*Brachypogon*) *woodruffi* Spinelli & Grogan 1998: 72 (Dominican Republic); *Culicoides woodruffi* Spinelli & Huerta 2015: 133 (Mexico); and *Forcipomyia* (*Lasiohelea*) *woodruffi* Szadziewski & Grogan 1998: 272 (fossil; Dominican amber).

***Dasyhelea wilkeningi* sp. nov.**

(Figs. 33–40)

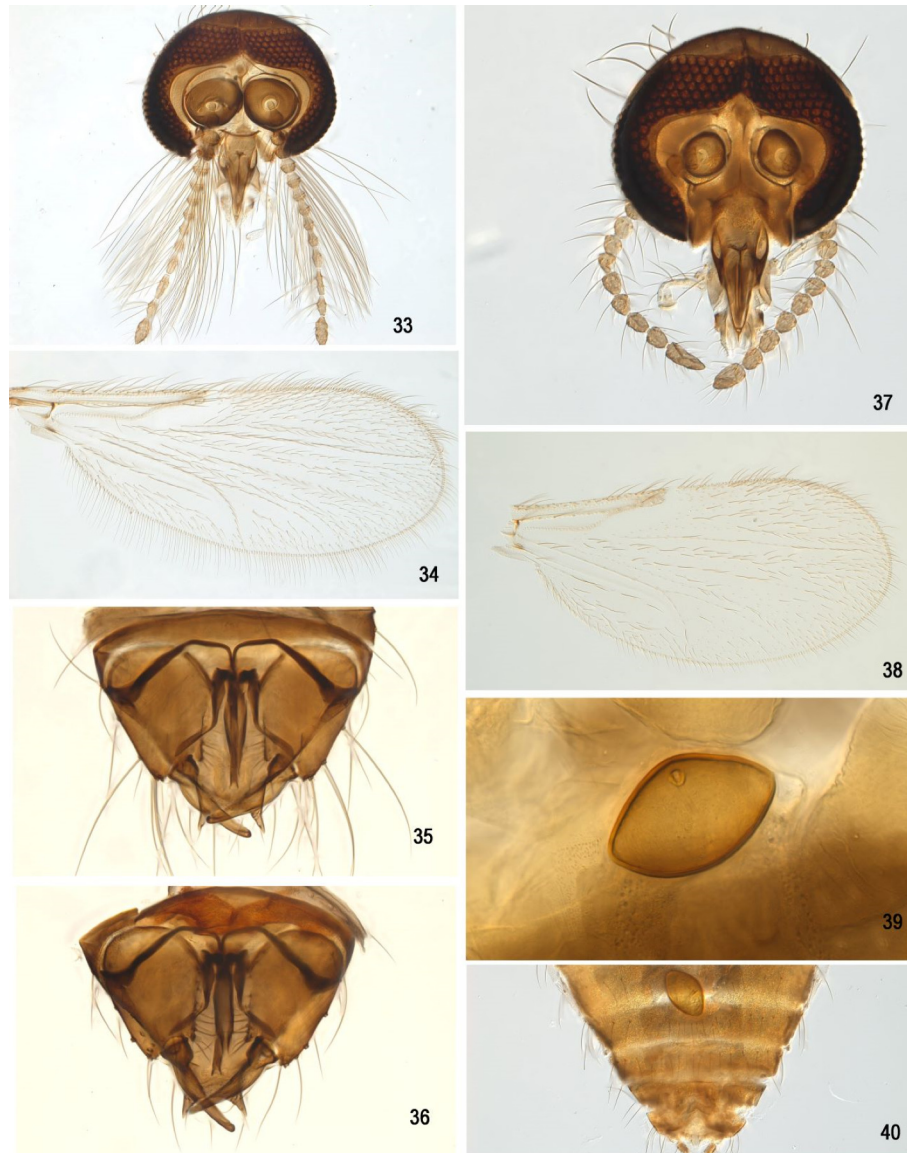
Diagnosis. A very small species that differs from other species in the *D. atlantis-bermudae* complex by the following combination of characters: male aedeagi with a slender, vasiform, greatly elongate disto-medial process, the apical 1/3 is tapered distally with a slightly flared apex and greatly elongated apicolateral arms; gonocoxal apodemes and paramere fused at mid-lengths, forming a long extension that extends to or beyond the apex of the aedeagus; wing short (length 0.57–0.67 mm), with a short costa (costal ratio 0.38–0.40); and a very small antennal ratio (0.62–0.76).

Females very small (wing length 0.44–0.67 mm) with a short costa (costal ratio 0.37–0.42); their abdomens are covered with dense long setae that are often lost during clearing and slide-mounting; they have a large golden colored spermatheca shaped like a pincushion with very thick walls and a short to elongate dorsal neck.

Male. *Head* (Fig. 33): Dark brown. Eyes contiguous for the distance of the length of 6 ommatidia, with short dense inter-ommatidial pubescence. Frontal sclerite elliptical as typical for other species in the *D. mutabilis* group, but with heavily sclerotized distolateral margins and a slender ventral process that extends between medial margins of antennal pedicels. Antennal flagellum medium light brown, flagellomeres with well-developed surface reticulations; flagellomeres 1–4, 10–13 separate, 5–9 partially or completely fused; flagellomere 2 globular, somewhat flattened, 3–4 rhomboidal, 5–9 vasiform, 10–13 elongate, much longer than 2–9, 13 longest; flagellomeres 1–12 with subbasal whorl of sensilla chaetica, these greatly elongate on flagellomeres 2–10, comprising the moderately dense plume that extends beyond flagellomere 12; antennal ratio 0.62–0.76 (0.67, n=10); total flagellum length 0.357–0.417 (0.390, n=10) mm. Palpus pale brown; segment 3 slender, apparently with a single baso-mesal capitate sensilla; palpal ratio 4.00. *Thorax*: Scutum dark brown, humeral areas and lateral margins yellowish; scutellum yellow, extreme margins brownish, with 6 large setae, 2 smaller anterocentral setae; postscutellum medium dark brown; lateral, ventral sclerites golden brown. Femora medium brown; tibiae light brown; tarsomeres 1–4 pale, 5 light brown; claws equal-sized, nearly straight, each talon with inner basal seta and small inner tooth at 1/3 length, apices bent, tips bifid; hind tibial comb with 8 spines, 5–6 longest. Wing (Fig. 34) moderately broad, hyaline, with numerous short, fine macrotrichia; macrotrichia moderately dense on veins and membrane except on proximal portion of medius, cells r_3 , m_1 , distal portion of anal cell, dense on wing margin and anterior margin of r_3 ; radial cells obsolete; basal portion of medius poorly developed, reduced to about 35 lightly sclerotized very small circular bead-like sclerites; M_1 separate from basal portion of medius, not connected to M_2 ; anal lobe poorly developed; costa short, costal ratio 0.38–0.40 (\bar{x} = 0.39, n=10); wing length 0.57–0.67 (0.61, n=10) mm, width 0.230.26 (0.24, n=10) mm. Halter stem brown, knob pale on extreme base, remainder appearing black, but likely whitish in life. *Abdomen*: Dark brown. Genitalia as in Figs. 35–36. Tergite 9 very broad at base, tapering progressively distally to rounded apex with an attached extended proctiger bearing apicolateral processes that are stout, conical, closely approximated, apices slightly divergent with single subapical seta; cerci poorly developed, apparently reduced to 2–3 very small raised tubercles on inner bases of apicolateral process, each bearing single short seta; sternite 9 short at base with narrow posterior extension that reaches base or onto proximal portion of aedeagus. Gonocoxite stout, 1.2–1.4X longer than broad, ventral and lateral surface with very long setae that are longest on distal half of lateral margin and apex, mesal surface with moderately dense shorter setae; gonostylus about 0.8 length of gonocoxite, proximal 1/4 broadest section, then tapering abruptly for short distance before expanding slightly at mid portion, distal 1/3 tapering slightly distally to rounded simple apex bearing pair of short subapical setae. Gonocoxal apodemes and paramere symmetrical, slender, heavily sclerotized, fused at mid-length, forming a long extension that extends to or beyond apex of aedeagus; basal apodeme broadest on extreme base, tapering gradually distally, bent 30° at distal 1/3, apex curved 90°, fused with opposite apodeme; distomedian portion elongate, slender, extending to distal 2/3 of median portion of aedeagus. Aedeagus complex, composed of two sections; proximal portion a heavily sclerotized basal sclerite that is divided at midlength with a small basolateral tooth like projection, basal sclerite attached to more lightly sclerotized very long lateral arms, proximal section of lateral arm expanded, tapered on distal 1/4, bent 60° at midlength, distal half very slender basally, expanded on apical 3/4, scalpel-shaped with pointed tip with a very slender basal lobe that is partially detached and curved distally; distomedian portion moderately sclerotized, greatly elongate, vasiform, proximal 2/3 expanded, distal 1/3 tapered, slender with a flared tip.

Female. Similar to males with the following notable sexual differences. *Head* (Fig. 37): dark brown. Eyes contiguous by the width of 2–4 ommatidia, with short dense inter-ommatidial pubescence as in males. Frontal sclerite elliptical, similar to males with a slender ventral extension that extends midway between bases of eyes. Antennal flagellum lighter brown, with relatively short flagellomeres 2–4 broader than long, 5–8 vasiform, becoming progressively longer, 9–12 more vasiform, 13 longest, more elongate; antennal ratio 0.73–0.82 (0.79, n=10); flagellum length 0.27–0.35 (0.31, n=10) mm. Clypeus with 4–6 pairs of long sub-marginal setae. Palpus (Fig. 37) light brown, segment 3 moderately long with 1–3 mesal, capitate sensillae; palpal ratio 2.17–3.80 (3.03, n=10). *Thorax*. Scutum yellowish to brown, with 2 large marginal and 3–4 large central setae. Femora light brown, tibiae usually paler, hind tibia palest; tarsomeres 1–4 pale, 5 light brown; hind tibial comb with 7 spines, 5–6 longest; hind tarsal ratio 1.88–2.10 (2.00, n=10). Wing (Fig. 38) moderately broad; membrane hyaline with dense long macrotrichia; radial cells obsolete, or, present as a single short suture; apices of costa, radius at a slightly oblique

angle; fork of CuA₁ at level of or just anterior of apex of costa-radius; wing length 0.44–0.67 (0.56, n=10) mm; costal ratio 0.37–0.42 (0.41, n=9). Halter stem brown, knob white (appearing black in slide-mounted specimens). *Abdomen*. Dark brown, with sparse long setae. Sub-genital plate (Fig. 40) obscure in some specimens, anterior portion lightly sclerotized, semicircular; posterior portion more heavily sclerotized, narrowly attached to anterior portion, basal arms broad with a V-shaped notch; spermatheca (Fig. 39) large, length 0.020–0.027 (0.24 mm, n=9), round, golden colored, shaped like a pin-cushion with very thick walls, and a short or elongate dorsal neck.



FIGURES 33–40. *Dasyhelea wilkeningi*. Fig. 33. Head, male. Fig. 34. Wing, male. Figs. 35–36. Genitalia, male. Fig. 37. Head, female. Fig. 38. Wing, female. Fig. 39. Spermatheca. Fig. 40. Genitalia, female.

Type Material. Holotype male, FLORIDA, Levy Co., Yankeetown, XI 1987, light trap with CO₂, coll: Alan Wilkening (FSCA); allotype female with same data except SW of Yankeetown, 15-X-2015, W. L. Grogan, Jr., Sweeping *Solidago* flowers nr. marsh (FSCA). Paratypes, 43 males, 25 females: 1 female with same data as allotype; 1 male, 1 female with same data except W of Yankeetown, 11-X-2014, Sweeping flowers in tidal marsh; 2 males, 1 female with same data except 27-X-2016, Sweeping vegetation near tidal marsh. Miami-Dade Co., Pinecrest Chapman Field, 17/23-XII-2014, H. Escobar, 26' Tall Suction Trap, 2 females; same data except 29-XII-2014/6-I-2014, 1 male; same data except 20/26-I-2015, 1 male; same data except 6/20-IV-2015, 3 males; same data except 20/27-IV-2015, 1 female; same data except 6/11-V-2015, 1 female; same data except 1–15-VI-2015, Suction Trap, 2 males; same data except 15–22-VI-2015, 1 female; same data except 29-VI/6-VII-2015, 2 males; same data except

13–20-VII-2015, 1 male; same data except 27-VII/3-VIII-2015, 1 female; same data except 17/24-VIII-2015, 1 male; same data except 8–14-IX-2015, 1 male; same data except 28-X/2-XI-2015, 2 males; same data except 30-X/7-XII-2015, 1 male; same data except 9/17-XII-2015, 1 male; same data except 15–21-XII-2015, 1 male, 1 female; same data except 28-XII-2015/5-I-2016, 3 males, 2 females; same data except 5–11-I-2016, 2 females; same data except 11–19-I-2016, 2 females; same data except 1–8-II-2016, 2 males, 1 female; same data except 8–15-II-2016, 1 male; same data except 22-II/1-III-2016, 4 males; same data except 1–7-III-2016, 1 male, 1 female; same data except 7–14-III-2016, 1 female; same data except 14–21-III-2016, 3 males; same data except 4–11-IV-2016, 1 female; same data except 5–11-VII-2016, 1 female; same data except 19–26-IX-2016, 1 female; same data except 21–28-XI-2016, 1 female; same data except 21–28-III-2016, 1 male; same data except 28-III/4-IV-2016, 1 male; same data except 19–27-XII-2016, 1 female; same data except 10–17-I-2017, 1 female; same data except 13–20-II-2017, 2 males, 1 female; same data except 20–27-II-2017, 1 male; same data except 27-III/3-IV-2017, 1 male; same data except 17-XII-2018/8-1-2019, 1 male, 1 female; same data except 14–21-I-2019, 1 male; same data except 2–8-I-2020, 1 female; same data except 23–29-I-2020, 1 male, 1 female; same data except 10–17-II-2021, 1 female; same data except 17–24-II-2021, 1 male. Collier Co., Immokalee, 23–30-XII-2020, Scott Croxton, Suction Trap, 1 male. Paratypes are deposited in the USNM; the Canadian National Collection, Ottawa (CNCI); Museo de La Plata, Argentina (MLPA); and, the Florida Keys Mosquito Control District, Marathon (FLKC).

Etymology. We dedicate this new species to Alan Wilkening, who collected the male holotype, in recognition of his collecting a variety of interesting Ceratopogonidae while a graduate student at the University of Florida during the 1980s.

Discussion. Males of this new species differ from most other congeners by their greatly elongate aedeagus and very long distally fused gonocoxal apodemes and paramere. Females differ from similar congeners by their unique large, golden colored, pincushion-shaped spermatheca with very thick walls.

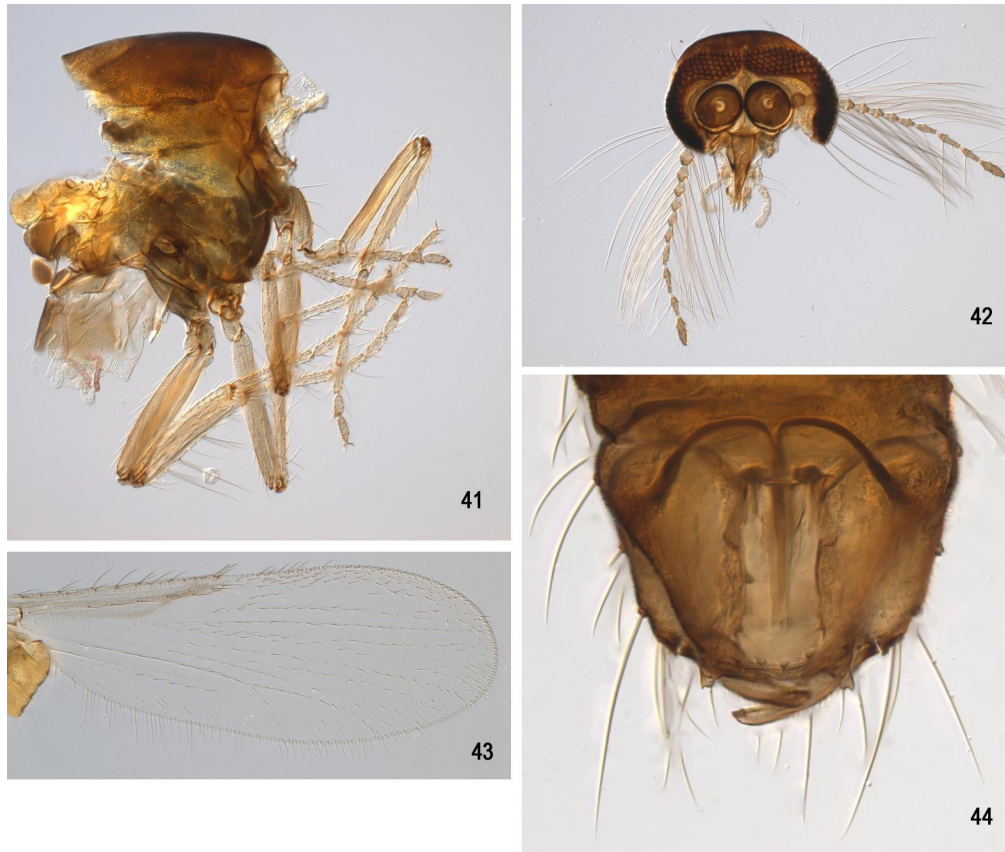
Dasyhelea garymulleni sp. nov.

(Figs. 41–44)

Diagnosis. A small species that is similar to males of *D. wilkeningi* sp. nov. As in that species, its aedeagus is also broadest on its basal 1/4, but it is more distally slender than in *D. wilkeningi*, and gradually tapers on its distal 3/4 with a shallow bifid tip; the gonocoxal apodemes and paramere are fused at mid-length and form a long extension that extends below the apex of the aedeagus; the wing is short (length 0.58 mm), very slender (width 0.21 mm), with a moderately short costa (costal ratio 0.43); and a small antennal ratio (0.69). Females unknown.

Male. *Head* (Fig. 42). Dark brown. Eyes narrowly separated, with very short dense inter-ommatidial pubescence. Frontal sclerite as in *D. wilkeningi* sp. nov. Antennal flagellum light brown, flagellomeres with surface reticulations; flagellomeres 1–4, 10–13 separate, 5–9 partially or completely fused; flagellomeres 1–12 with sub-basal whorl of sensilla chaetica that comprises the moderately dense plume which extends beyond flagellomere 12; antennal ratio 0.69; total flagellum length 0.41 mm. Palpus pale brown; segment 3 moderately slender, apparently with 2 baso-mesal capitate sensillae; palpal ratio 3.00. *Thorax* (Fig. 41). Scutum dark brown, humeral and lateral margins lighter brown; scutellum yellowish brown, extreme margins darker with 5 large setae, but lacking antero-central setae; post-scutellum medium dark brown; lateral, ventral sclerites golden brown. Femora medium brown; tibiae lighter brown, hind tibiae with row of 4–6 greatly elongate setae; tarsomeres 1–4 light brown, 5 darker brown; claws slightly unequal-sized, outer claws curved on distal 1/2 with pointed apices nearly straight, each talon with inner basal seta and base with small inner tooth, inner claws shorter, only slightly curved on distal 1/3 with blunt tips; hind tibial comb with 7 spines, 5–6 longest. *Wing* (Fig. 43) moderately broad on distal 1/3, membrane hyaline with sparse macrotrichiae on veins and membrane except on subapical half of anal cell; radial cells fused on distal section of costa; anal lobe poorly developed; costa moderately short, costal ratio 0.43; wing length 0.58 mm, width 0.21 mm. Halter stem brown, knob pale on base, distal portion dark brown. *Abdomen*: Dark brown on dorsal 1/2, paler on ventral 1/2. *Genitalia* (Fig. 44). Tergite 9 very broad at base, tapering slightly distally to rounded apex with an attached extended proctiger with apicolateral processes that are short, stout, conical, apices slightly divergent with a single subapical short seta; sternite 9 short at base with narrow posterior extension that reaches base or onto proximal portion of aedeagus. Gonocoxite stout, 1.2–1.4X longer than broad, ventral and lateral surfaces with very long setae that are longest on distal half of lateral margin and apex, mesal surface with moderately dense shorter

setae; gonostylus about 0.8 length of gonocoxite, proximal 1/4 broadest section, then tapering abruptly for short distance before expanding slightly at mid portion, distal 1/3 tapering slightly distally to rounded simple apex bearing a pair of short subapical setae. Gonocoxal apodemes and paramere symmetrical, slender, heavily sclerotized, fused at mid-length, forming a long extension that extends to or beyond apex of aedeagus; basal apodeme broadest on extreme base, tapering gradually distally, bent 30° at distal 1/3, apex curved 90°, fused with opposite apodeme; disto-median portion elongate, slender, extending to distal 2/3 of median portion of aedeagus. Aedeagus complex, composed of two sections; proximal portion with a heavily sclerotized basal sclerite that is divided at mid-length with a small basolateral tooth like projection, basal sclerite attached to more lightly sclerotized very long lateral arms, proximal section of lateral arm expanded, tapered on distal 1/4, bent 60° at mid-length, distal half very slender basally, expanded on apical 3/4, scalpel-shaped with pointed tip with a very slender basal lobe that is partially detached and curved distally; distal-medial portion moderately sclerotized, greatly elongate, vasiform, proximal 2/3 expanded, distal 1/3 tapered, slender with a flared tip.



FIGURES 41–44. *Dasyhelea garymulleni*, male Fig. 41. Thorax. Fig. 42. Head. Fig. 43. Wing. Fig. 44. Genitalia.

Female. Unknown.

Type Material. Holotype male, FLORIDA, Highlands Co., Lake Placid, Archbold Biological Station, 5-IV-(19)91, animal pens, W. W. Wirth, malaise trap (USNM).

Etymology. We dedicate this new species to our colleague, Gary Mullen, former professor of Entomology at Auburn University, Alabama. Gary was a mentor of nine graduate students at Auburn—Bonnie Buxton, Mary Beth Hayes, Nancy Hinkle, Larry Hribar, Steve Murphree, Shirley Luckhart, Whitney Qualls, Matt Aubuchon, and Nathan Burkett-Cadena.

Discussion

The holotype of this new species differs from males of *D. wilkeningi* **sp. nov.** in having a very slender aedeagus with a shallow bifid tip; the gonocoxal apodemes and paramere are fused at mid-length and extends below the apex of

the aedeagus; the hind tibiae have a row of 4–6 greatly elongate setae; and its wing is very slender (width 0.21 mm), with a longer costa (costal ratio 0.43).

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