

A new *Floritettix* (Orthoptera, Acrididae, Melanoplinae) from the Bombing Range Ridge, Florida, U.S.A.

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Abstract

Floritettix are endemic to the North American Coastal Plain. Here I describe a new species, *Floritettix phlox* sp. nov., from the Bombing Range Ridge in central Florida. This species appears to be restricted to the heavily burned scrub habitat on this small ridge. This species is described based on morphological and biogeographical evidence.

Keywords

Biodiversity, fire, grasshopper, islands, Lake Wales Ridge, sand ridges

Introduction

In 2015, while conducting field surveys at Avon Park Air Force Range with John Barone, Reed Noss, and Steve Orzell, I collected a *Floritettix* Otte, 2014 that upon later microscopic examination did not fit the described species in a recently published revision of Otte (2014). More specimens were acquired during subsequent field expeditions to Florida and specifically Avon Park Air Force Range. Comparisons of these specimens with other *Floritettix* indicate that this is a new species that may be endemic to the scrub community of the Bombing Range Ridge. If so, then this would represent the first animal known to be endemic to the ridge.

Floritettix is one of the five acridid genera endemic to the southeastern United States (along with *Aptenopedes* Scudder, 1878, *Eotettix* Scudder, 1897, *Floridacris* Otte, 2014, and *Gymnoscirtetes* Scudder, 1897) and is Floridian in distribution, meaning that it is endemic to Florida and the southern portions of the adjacent states of Alabama and Georgia (Hill 2018). Otte (2014) established *Floritettix* with 13 species (six new; seven formerly *Aptenopedes*). Specimens from the Bombing Range Ridge were not examined in that study as access to the ridge has been limited since 1941, after the establishment of Avon Park Air Force Range. Most of the ridge itself occurs on the training range, where Air Force personnel gain experience firing aircraft mounted explosive ordinances, which results in frequent fires (Orzell and Bridges 2006). However, not all

Floritettix are inhabitants of scrub environments. For example, a cursory examination of Otte's (2014) maps indicate that *Floritettix hubbelli* (Hebard, 1936) have broad distributions that span much of peninsular Florida. My own sampling indicates that it typically inhabits moister flatwoods adjacent to the scrub environments and hyperseasonal prairies across south Florida.

Floritettix is differentiated by characters associated with the male genitalia. These morphological characters have been long used for species delineations in the Melanoplinae and have been further supported by molecular evidence (Hubbell 1932, Otte 2014, Hill 2015, Woller 2017, Huang et al. 2020). Here I provide the first key to the genus and a description of the new species.

Materials and methods

All but one of the specimens used in this study were collected by staff of the Mississippi Entomological Museum (MEM) and are deposited there. A single specimen was found in the insect collection at the Archbold Biological Station (ABS). Comparisons are made with *Floritettix nigropicta* and *F. hubbelli*, two species that occur in close geographical proximity to the new species. Habitus and internal genitalia photographs were taken with a Leica Z16 stereoscope equipped with a Leica DFC420 camera and imaged at different stages during dissection. Images were automontaged with the Leica Application Suite. Measurements, made with a reticle mounted inside a Leica MZ12.5 stereomicroscope, were taken as follows:

Body length—Dorsally from the fastigium vertices to the distal end of the genicular lobe of caudal femur in a parallel plane with the abdomen.

Pronotum length—Dorsally, along the median carina.

Cercus length—Laterally, maximum possible measurement of the left cercus.

Cercus basal width—Laterally, along the point of attachment from the dorsal to ventral margin.

Mid cercus width—Laterally, at the mid-length of the left cercus.

Cercus apex width—Laterally, along the distal end.

Results

Key to male *Floritettix*

- 1 Sheath produced over the dorsal valves of the aedeagus as large, fleshy lobes that are as long as wide and are quadrate in lateral view (Figs 1C–J, 2A–D)..... 3
- 1' Sheath not produced over dorsal valves of the aedeagus as large fleshy lobes but instead the two present as narrow, keel-like projections that are longer than wide and arched in lateral view (Fig. 1A, B)..... 2
- 2 Dorsal valves with minimal sheathing; distal ends bilobate with the ventral lobe longer than the dorsal one; ventral valves projecting beyond the end of the dorsal valves with acute apices (Figs 1A, 7C–G); rami long and narrow; lateral bands on the pronotum yellowish (Fig. 7J); found widely over the western-half of peninsular Florida..... *F. hubbelli* (Hebard, 1936)
- 2' Dorsal valves narrow, with moderate sheathing, not appearing bilobed and extending beyond the length of the ventral valves (Fig. 1B); rami shorter and broad; known only from Manatee County on the west coast of Florida..... *F. ocilla* Otte, 2014
- 3 Sheath quadrate in lateral view with length and height nearly equal (Fig. 1C–E)..... 4
- 3' Sheath oblong or ovate in lateral view with length greater than height (Figs 1F–J, 2A–D)..... 6
- 4 Body grayish green with lateral and dorsal thoracic sulci strikingly black colored (sometimes lost in pinned specimens) (Fig. 6J); apices of ventral valves broad basally, apically acute (Figs 1C, 6C–G); found on the Lake Wales Ridge in Central Florida..... *F. nigropicta* (Hebard, 1936)
- 4' Body green, sulci not strikingly black (Figs 3, 5J); apices of ventral valves different..... 5
- 5 Apices of ventral valves semifalciform (Fig. 1E); lateral striping on the pronotum orange and black; subgenital plate and pallium gray to grayish pink; found in Marion, Orange, or Putnam Counties in northeast Florida..... *F. holotamico* Otte, 2014
- 5' Apices of ventral valves broadly rounded (Fig. 1D); lateral striping on the pronotum white subgenital plate and pallium pink found in Highlands or Polk County in central Florida..... *F. phlox* sp. nov.
- 6 In lateral view, sheath of the aedeagus ovoid (Fig. 1F–J)..... 7
- 6' In lateral view, sheath of aedeagus oblong (Fig. 2A–D)..... 11
- 7 In lateral view, sheath of the aedeagus deeply ovoid (Fig. 1F–G)..... 8
- 7' In lateral view, sheath of the aedeagus broadly ovoid (Fig. 1H–J)..... 9
- 8 In dorsal view, the sheath of the aedeagus is constricted near their midpoint (Fig. 1F); apices of ventral valves acute (Fig. 1F); from Brevard or Indian River Counties in east central Florida..... *F. floridana* Otte, 2014
- 8' In dorsal view, the sheath of the aedeagus is not constricted near their midpoint (Fig. 1G); apices of ventral valves blunt (Fig. 1G); from central Florida..... *F. aptera* (Scudder, 1897)
- 9 In dorsal view, the sheath of the aedeagus is wider than long (Fig. 1H); ventral valves narrow; from Orange and Polk Counties in central Florida..... *F. hadjoi* Otte, 2014
- 9' In dorsal view, the sheath of the aedeagus is longer than wide (Figs 1I–J)..... 10
- 10 In ventral view, ventral valves more evenly triangular (Fig. 1I); from the west coast of Florida from Hillsborough County south to Lee County..... *F. calusa* Otte, 2014
- 10' In ventral view, ventral valves more obtusely triangular (Fig. 1J); from the northern third of Florida into south Georgia..... *F. borealis* (Hebard, 1936)
- 11 Ventral valves not decurved (Fig. 2A, B)..... 12
- 11' Ventral valves decurved (Fig. 2C, D)..... 13

- 12 In lateral view, the sheath is very shallowly oblong; ventral valves abruptly taper to a point (Fig. 2D); from southeast Florida..... *F. coquinae* (Hebard, 1936)
- 12' In lateral view, the sheath is oblong; ventral valves shorter and obtusely triangular (Fig. 2A); from Osceola and Seminole Counties in east central Florida..... *F. osceola* Otte, 2014
- 13 Sheath more evenly rounded apically, not constricted medially (Fig. 2B); found on the Atlantic Coast of Florida in Duval, Flagler, and Volusia Counties, east of the St. Johns River..... *F. simplex* (Hebard, 1936)
- 13' Sheath more acute apically, constricted medially (Fig. 2D); found in northeast Florida in Flagler, Nassau, Putnam, St. Johns, and Volusia Counties..... *F. saturiba* (Hebard, 1936)

Taxonomy

Family Acrididae MacLeay, 1821

Subfamily Melanoplinae Scudder, 1897

Genus *Floritettix* Otte, 2014Type species.—*Floritettix aptera*.*Floritettix phlox* sp. nov.<https://zoobank.org/27893934-AA54-4081-9C26-75AE9C07BD1C>

Figs 1D, 3, 4A–C, 5A–J

Material examined.—**Holotype:** USA • ♂; FLA, Highlands Co., Avon Park Air Force Range; 27.5788°N, -81.2516°W; 16 June 2015; J. G. Hill, J. Barone, R. Noss, S. Orzell leg; low oak scrub, Bombing Range Ridge; MEM. **Other specimens examined:** USA • 1♂; Florida: Polk Co., Avon Park Bombing Range; 24 September 1991; M.E. Deyrup leg.; ABS • 2♂, 1♀; Avon Park AFB; 27.6481°N, -81.2747°W; 20 June 2019; J.G. Hill, B.S. Dunaway leg; low oak scrub, Alpha Range; MEM • 1♂; same data except; 27.6481°N, -81.2736°W; J.G. Hill leg.; low oak scrub, Alpha Range; MEM • 4♂; Avon Park AFB; 27.6744°N, -81.2861°W; 5 October 2021; M.J. Thorn leg.; scrubby flatwoods/low oak scrub; MEM • 1♂; same data except; J.G. Hill leg.; MEM • 3♂, 2♀; same data except; 27.6729°N, -81.2874°W; 5 October 2021; M.J. Thorn leg.; scrubby flatwoods and low oak scrub; MEM • 2♀; same data except; J.G. Hill leg.; MEM • 4♂, 1♀; 27.6836°N, -81.2897°W; 5 October 2021; J.G. Hill leg.; MEM.

Diagnosis.—Differing from other *Floritettix* in the shape of the male genitalia, which has the sheath produced over the dorsal valves as two large adjacent, rounded-subquadrate lobes with a decided concavity caudad, ventral valves that slightly curve dorsally with broadly rounded apices, and a distinct geographic distribution (Figs 1D, 5C–J). Can be separated from *F. nigropicta* based on the green coloration of the body (grayish in *F. nigropicta*), the lack of black-colored body sutures, and the shape of the male genitalia that are rounded ventral valve apices and more rounded to subquadrate dorsal valve/sheath complex (Figs 1D, 6C–J), and *Floritettix holotamico* by the color of the dorsal lateral pronotal stripe (white in *F. phlox*, orange in *F. holotamico*) and the shape of apices of the ventral valves (round in *F. phlox* and falcate in *F. holotamico*). *Floritettix hubbelli* occurs in the hyperseasonal Florida dry prairies that surround the Bombing Range Ridge. *Floritettix phlox* can be distinguished from *F. hubbelli* by the coloration of the post ocular and dorsal stripes (yellow in *F. hubbelli* and white with a pink border in *F. phlox*) and the very different shapes of the internal male genitalia (Figs 1A, D, 6C–G, 7C–G).

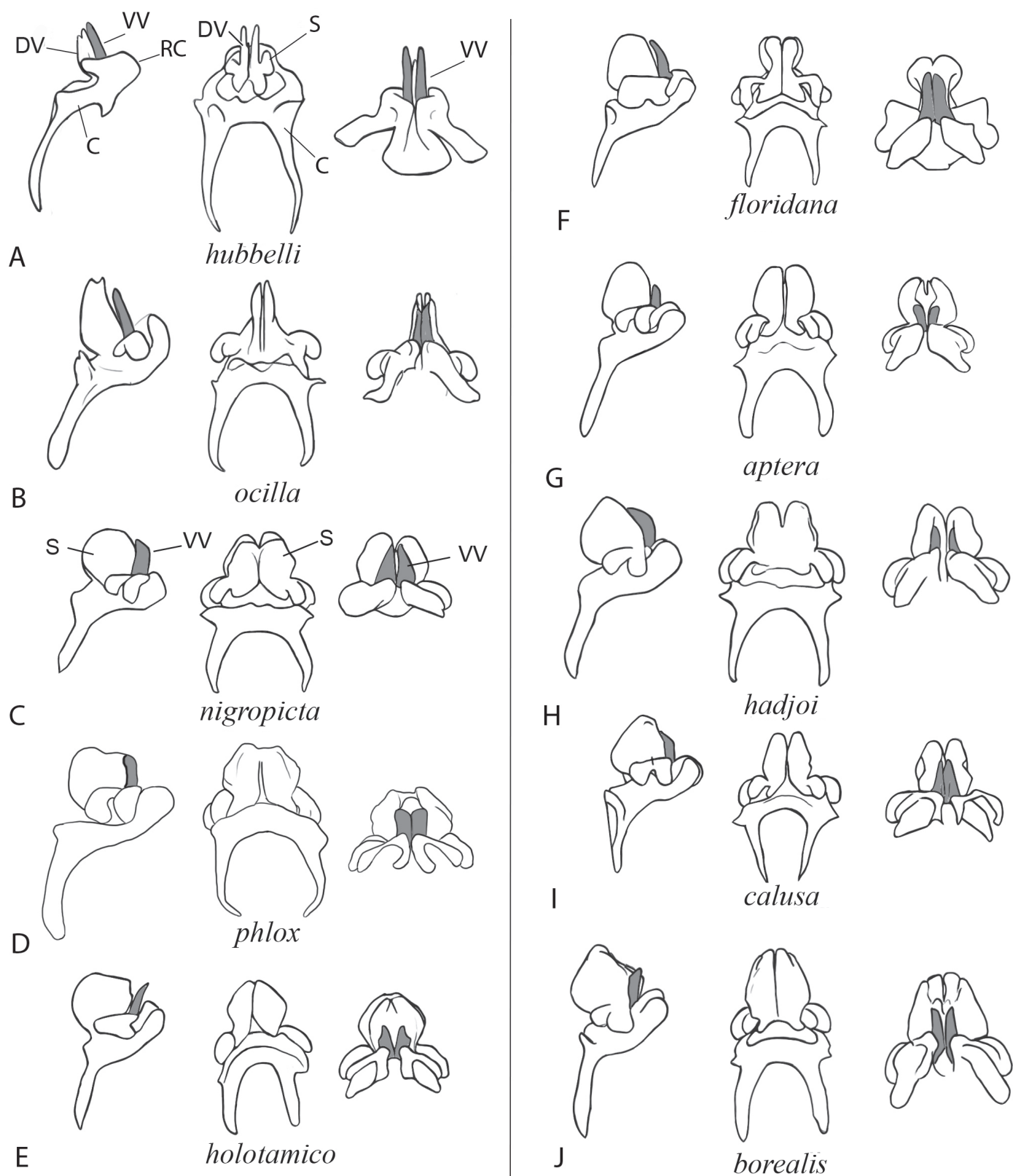


Fig. 1. Partial illustrations of male genitalia of *Floritettix* species showing the cingulum, rami, sheath of aedeagus, and distal portion of dorsal and ventral valves in lateral, dorsal, and ventral (left to right) views; C-cingulum, RC-rami of cingulum, S-sheath of aedeagus, DV-dorsal valves, VV-ventral valves (gray). A. *F. hubbelli*; B. *F. ocilla*; C. *F. nigropicta*; D. *F. phlox* sp. nov.; E. *F. holotamico*; F. *F. floridana*; G. *F. aptera*; H. *F. hadjoi*; I. *F. calusa*; J. *F. borealis*.

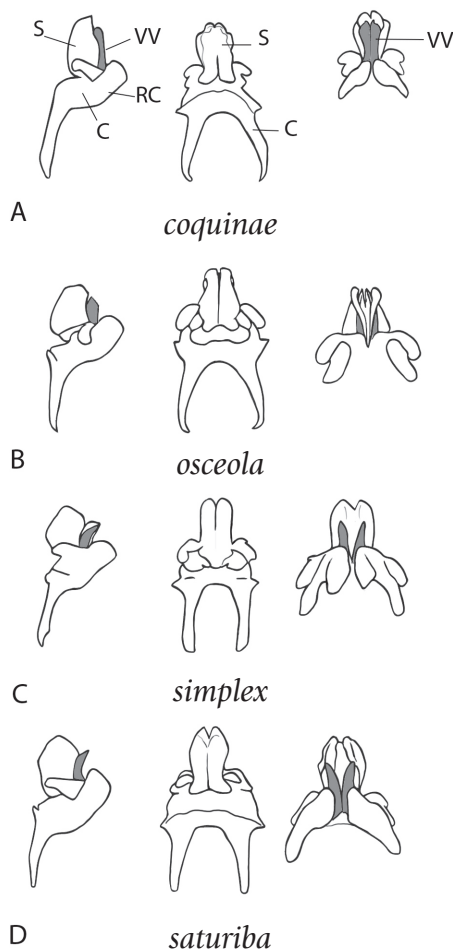


Fig. 2. Partial illustrations of male genitalia of *Floritettix* species showing the cingulum, rami, sheath of aedeagus, and distal portion of dorsal and ventral valves in lateral, dorsal, and ventral (left to right) views; C-cingulum, RC-rami of cingulum, S-sheath of aedeagus, VV-ventral valves (gray). A. *F. coquinae*; B. *F. osceola*; C. *F. simplex*; D. *F. saturiba*.

Male measurements.—(in mm; $n = 14$) Body length 16.6–19.6 (mean = 18.1); pronotum length 3.3–3.7 (mean = 3.5); hind femur length 8.6–9.8 (mean = 9.1); cerci length 0.6–1.0 (mean = 0.8); basal width of cercus 0.3–0.5 (mean = 0.5); mid-cercal width 0.2–0.3 (mean = 0.2); cerci apex width 0.1 (mean = 0.3).

Female measurements.—(in mm; $n = 3$) Body length 21.4–24.0 (mean = 22.5); pronotum length 4.4–5.1 (mean = 4.7); hind femur 10.5–12.2 (mean = 11.5).

Description.—External morphology.—Body of medium size (Figs 4A–C, 5J). Head moderately large in proportion to the body (especially in females), having the face strongly oblique, fastigium broad in dorsal view and produced anterior to the eyes; eyes large and prominent, elongate-oval. Antennae filiform and slender, with joints somewhat flattened. Pronotum with dense shallow punctures throughout, distinctly widening from apex to base, female widening only on the metazona. Median carina low, cut only by the principal sulcus; lateral carinae absent; prozona over twice as long as the metazona; with a feebly rounded front margin, metazona with hind margin sub-truncate or broadly emarginate; lateral lobes sub-vertical, nearly twice as long as deep, narrowing ventrally, tegmina vestigial, reduced to minute inconspicuous scales. Tympanum large; prosternal spine cylindrical and slender with a blunt apex, hind femora slender; slightly surpassing the abdomen in the male and reaching the base of the ovipositor in the females. Abdomen compressed and carinate; male supra-anal plate short, triangular with lateral margins weakly convergent, with its margins rounded and reflexed and with a short basal median groove. Cercus simple, triangular about twice as long as broad, tapering to an acute apex (Fig. 3A, B). Furcula are a pair of minute divergent lobes, slightly longer than wide. Sub-genital plate short, not tuberculate, with a narrow chitinous ring that is slightly thicker in the medially, tapering laterally. Pallium a large fleshy rounded flap that rests over the base of the male genitalia.

Phallic structures.—Sheath produced over the dorsal valves as two large proximo-lateral processes as in other species in the genus, but more specifically as two large adjacent, rounded-sub-quadrangle lobes with a decided concavity caudad, the ventral pair

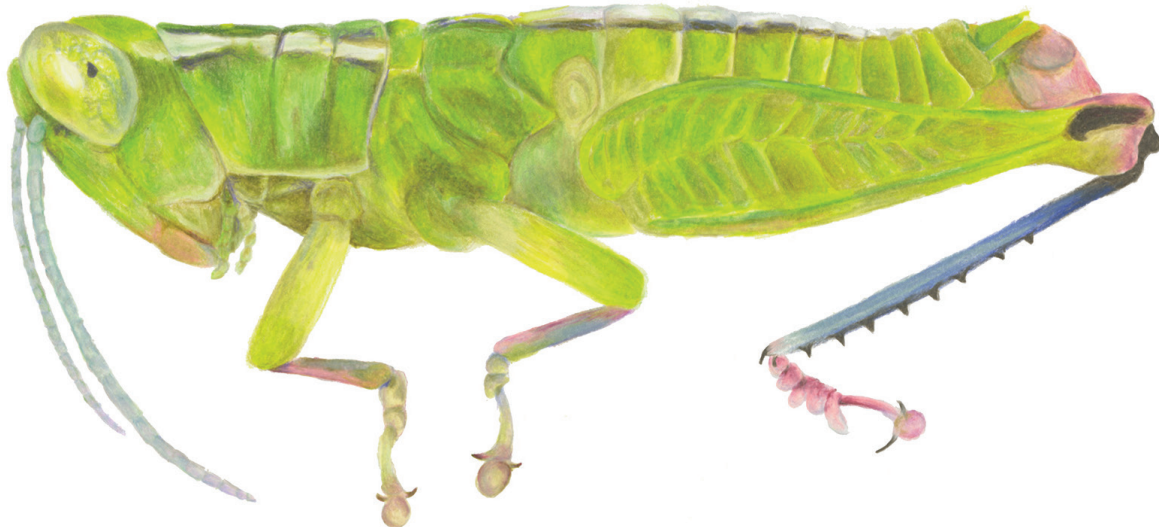


Fig. 3. Male *Floritettix phlox* sp. nov. Illustrated by Ashley Rude Baker.



Fig. 4. Photos of live *Floritettix phlox* sp. nov. and the plant communities where specimens were collected. A. Lateral view of a live male; B. Dorsal view of a live male; C. Lateral view of live female; D. Low oak scrub at the type locality; E. Scrubby flatwoods; F. Scrubby Flatwoods.

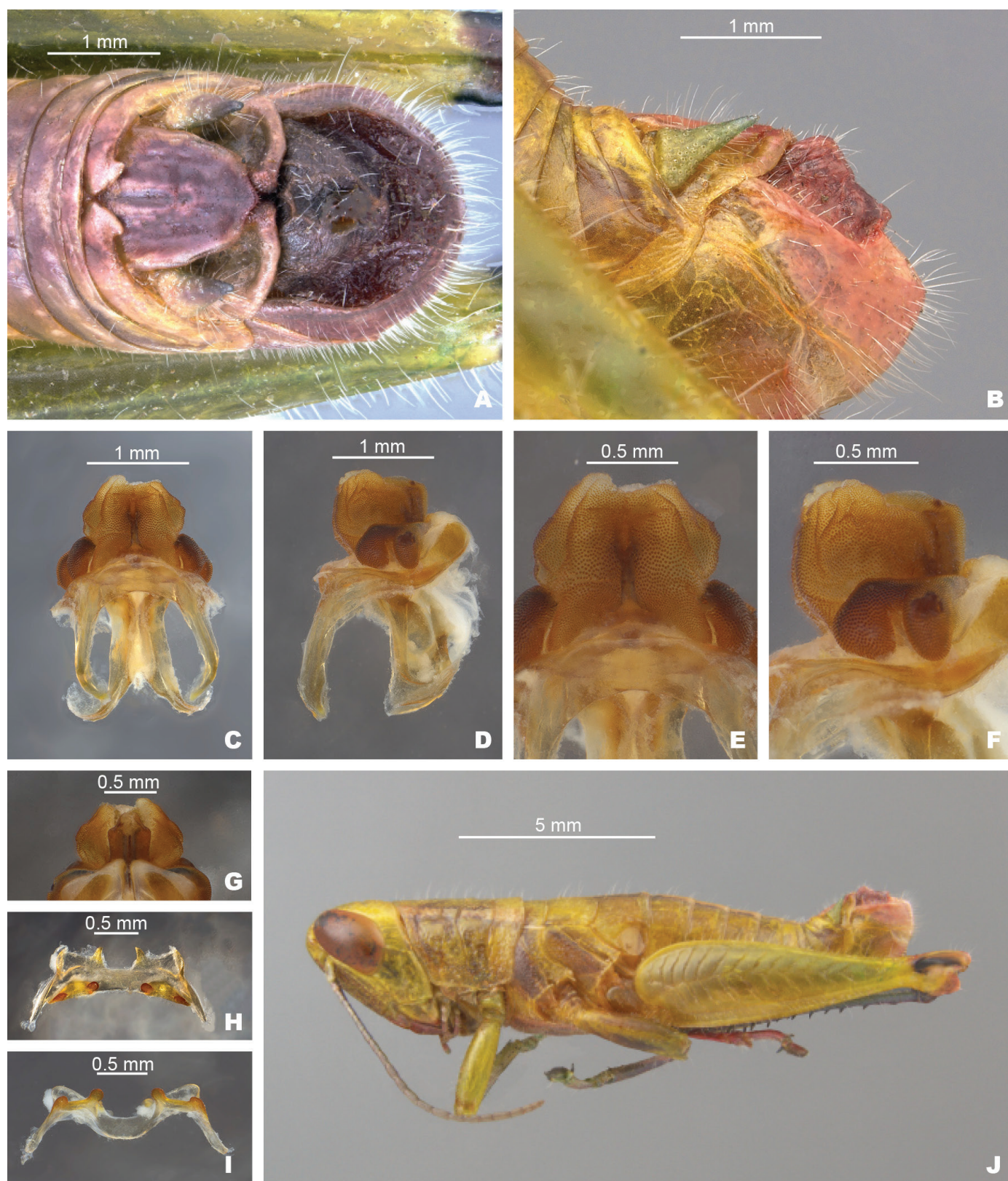


Fig. 5. *Floritettix phlox* A. Dorsal view of terminalia; B. Lateral view of terminalia; C. Dorsal view of phallic complex; D. Lateral view of phallic complex; E. Dorsal view of aedeagus; F. Lateral view of aedeagus; G. Caudal view of the aedeagus; H. Dorsal view of epiphallus; I. Caudal view of epiphallus; J. Habitus.

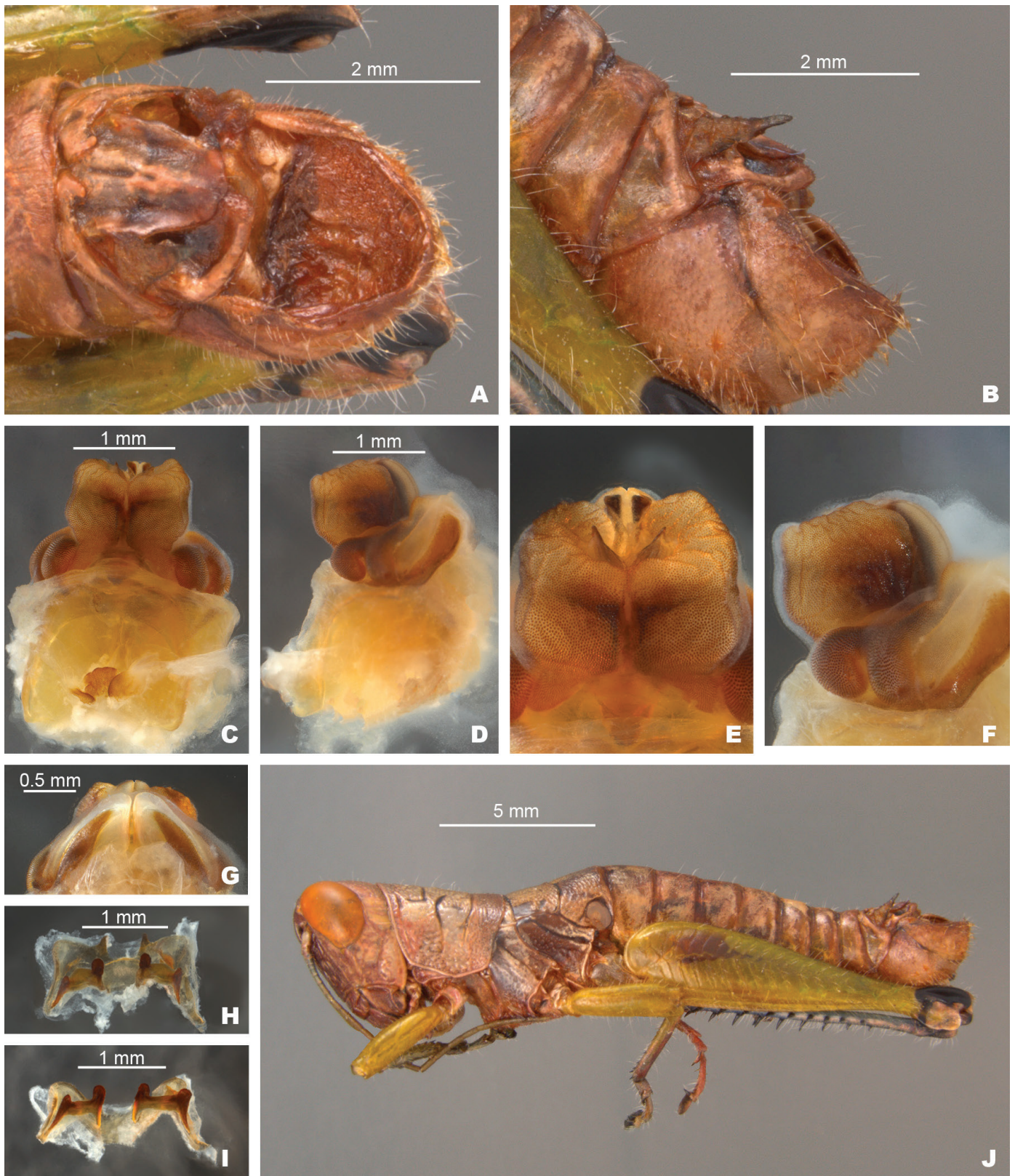


Fig. 6. *Floritettix nigropicta* A. Dorsal view of terminalia; B. lateral view of terminalia; C. Dorsal view of phallic complex; D. Lateral view of phallic complex; E. Dorsal view of aedeagus; F. Lateral view of aedeagus; G. Caudal view of the aedeagus; H. Dorsal view of epiphallus; I. Caudal view of epiphallus; J. Habitus.

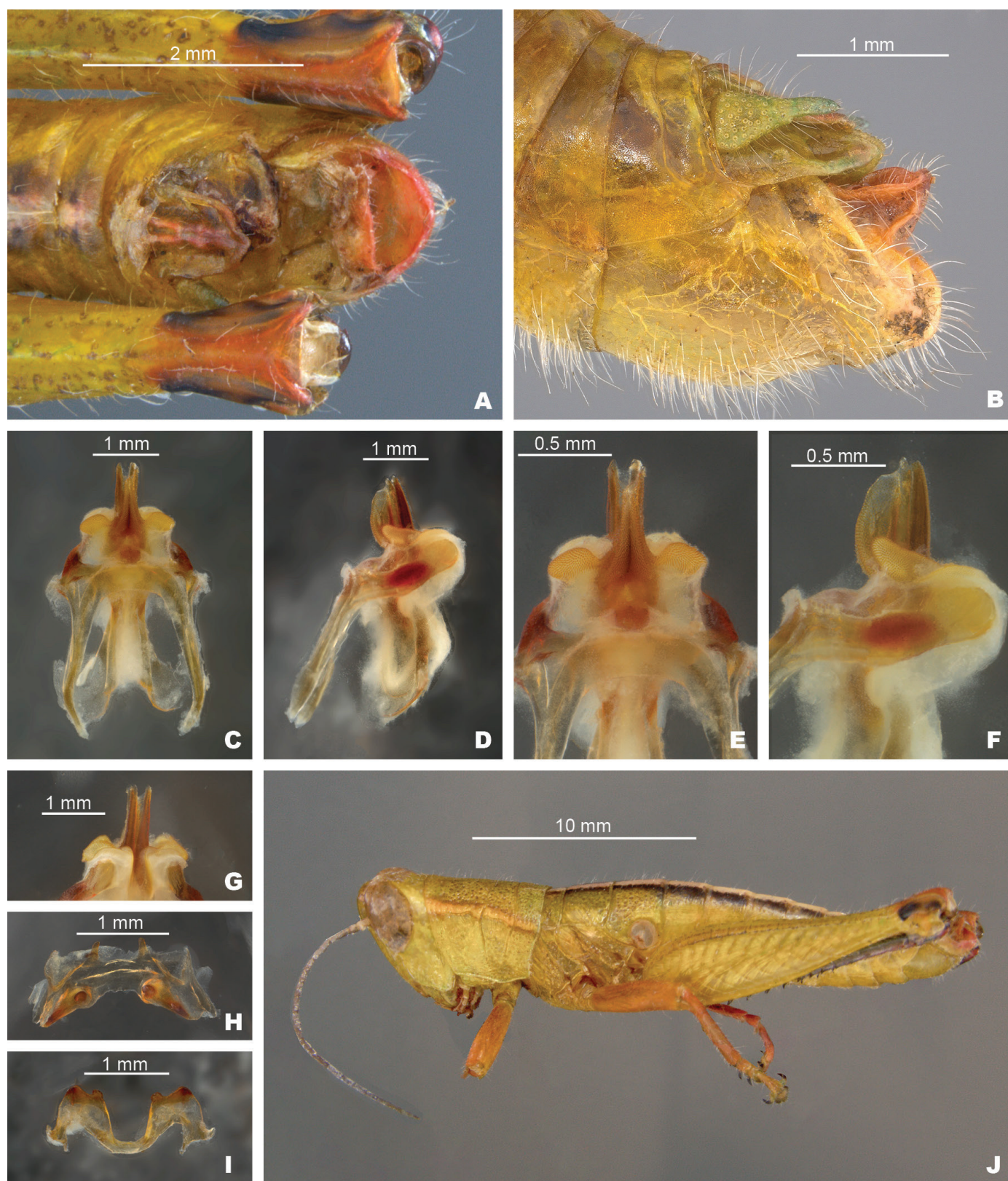


Fig. 7. *Floritettix hubbelli* A. Dorsal view of terminalia; B. Lateral view of terminalia; C. Dorsal view of phallic complex; D. Lateral view of phallic complex; E. Dorsal view of aedeagus; F. Lateral view of aedeagus; G. Caudal view of the aedeagus; H. Dorsal view of epiphallus; I. Caudal view of epiphallus; J. Habitus.

of parameres situated ventro-proximad; adjacent, directed distad and slightly curving dorsal to their broadly rounded apices. The epiphallus is of the typical melanoploid shape, with lophi, ancorae, and an undivided bridge. More precisely, epiphallus with a concave bridge, bilobed lophi, convexly curved lateral plates subrectangular in shape with an angular anterior lobe and a long, acute caudal tip; ancora closely set, triangular, taper to a point, and decurved ventrally.

Coloration.—Overall greenish in life can fade to yellow in specimens (Figs 3, 4A–C, 5J). Antenna light, white in life, turning darker in specimens. Antennal crescent complete. Head, thorax, and abdomen green. Males with a well-defined, white or pinkish-white post-ocular stripe that extends to the caudal edge of the metazona and a moderately broad white to pinkish-white stripe margined with a suffusion of black extending medio-longitudinally on the dorsum of the abdomen. Females typically lacking the post-ocular stripes and with only a faint indication of the abdominal stripe.

Mouthparts, supra-anal plate of male and the genicular area of the hind femora pinkish-brown, genicular arches of latter black. Female with mouthparts pinkish. Fore and middle tibia faintly glaucous blue, tarsi gray. Caudal tibia black basally then glaucous blue, caudal tarsi rich pink in males, females similar, but tibia can be purplish. (Figs 3, 4A–C, 5J)

Distribution.—*Floritettix phlox* is known only from the Bombing Range Ridge in Highlands and Polk Counties in Central Florida (Fig. 8).

Etymology.—“*phlox*” from the Greek word for flame, in reference to the frequent fires that occur on the Bombing Range Ridge that maintains the habitat for the species. Further, the terminalia and mandibular areas are pink like *Phlox* flowers.

Habitat.—*Floritettix phlox* appears to be restricted to the low oak scrub and scrubby flatwoods on the Bombing Range Ridge (Fig.

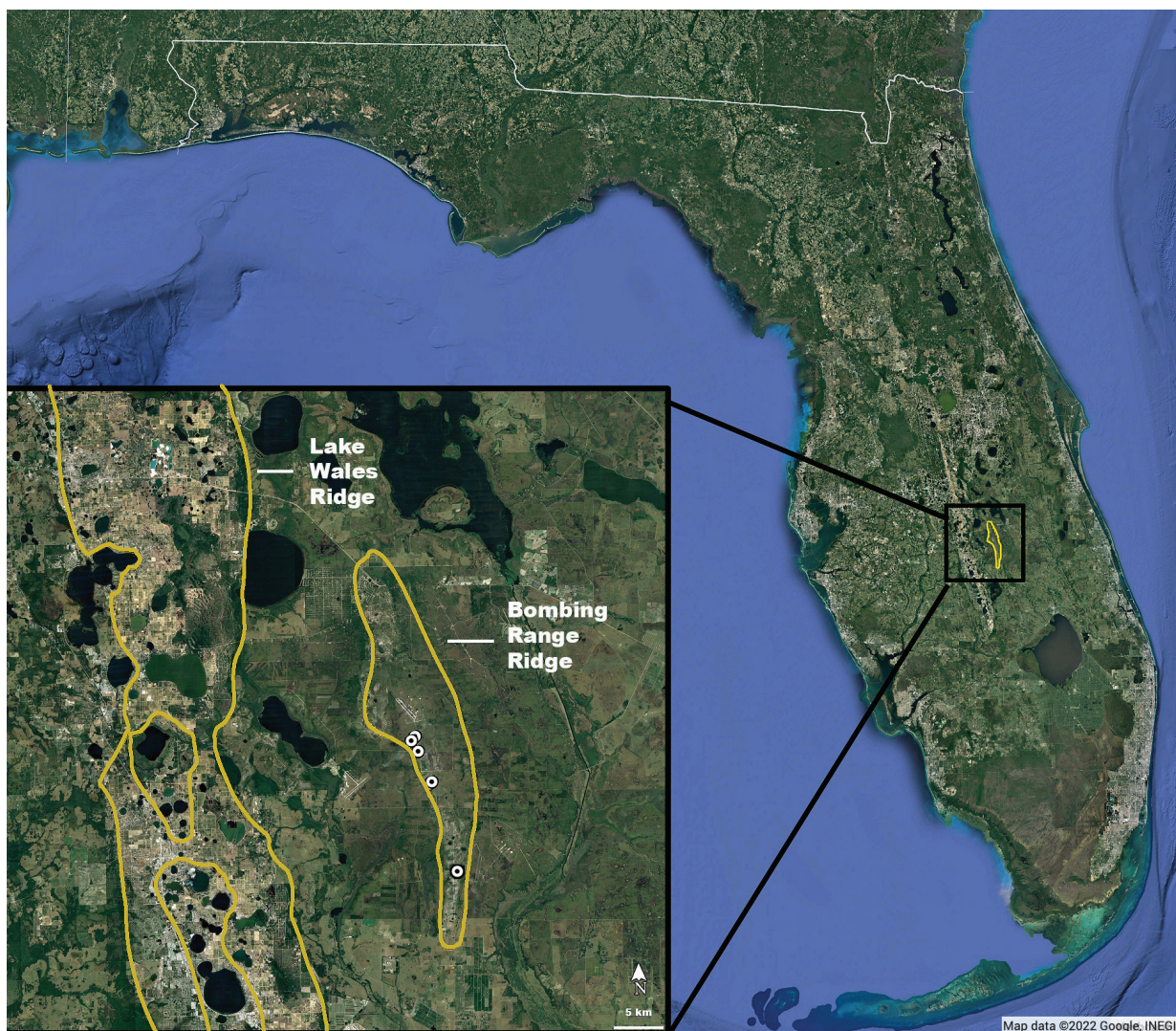


Fig. 8. Map of Florida showing the location of the Bombing Range Ridge with an inset showing the Bombing Range Ridge, the Lake Wales Ridge, and the collecting localities of *Floritettix phlox* sp.nov. Map data 2022 (C) Google.

3D–F). Searches in the adjacent Florida dry prairies yielded only specimens of *F. hubbelli*, and *F. nigropicta* seems to replace it on the adjacent Lake Wales Ridge. *Floritettix phlox* is typically found on scrubby oaks with which it blends in quite well with (Fig. 3B).

Discussion

The sand ridges of Florida have been long recognized areas of endemism (Deyrup 1990). These well-drained ridges and uplands are ancient islands that served as refuges during periods of higher sea level in the Miocene, Pliocene, and Pleistocene (McNeill 1957). During that time, the islands were areas of evolutionary divergence for populations separated by the sea but, due to their edaphic conditions, still function as islands after the water retreated from the surrounding lowlands. The resulting habitat islands support a xerophytic plant community called Florida scrub that is characterized by low, evergreen sclerophyllous oaks (*Quercus* ssp.), various shrubs, palmettos, sand pine (*Pinus clausa*), and numerous forb species with interspersed areas of bare sand. Florida scrub is a fire-maintained community, and in the absence of fire, the oaks grow dense and tall, often reducing grasshopper diversity and abundance (J. G. Hill unpublished data). The scrub on the Bombing Range Ridge is maintained by frequent fires resulting from explosives used in military training exercises as well as prescribed burns.

Studies on the speciation and biogeography of grasshoppers inhabiting the scrub communities of these sand ridges has focused on species belonging to the large genus *Melanoplus* Stål, 1873 (Hubbell 1932, Deyrup 1990, Woller 2017) and has largely ignored the five genera endemic to the North American Coastal Plain (Hill 2018). Otte (2014) shows only county-level distributions and is of limited use in determining fine-scale distributional patterns. However, based on museum records and my own field studies, it appears that *F. nigropicta* is endemic to the Lake Wales Ridge and *F. phlox* to the Bombing Range Ridge. The Bombing Range Ridge rises from the Osceola Plain, reaching elevations of 38.1–44.2 m.a.s.l., and is thought to be a relict marine sand bar. In places, it is separated by as little as 2 km from the much larger Lake Wales Ridge (Fig. 6), but the two do not share identical floras and faunas (Orzell 1993, Branch and Hokit 2000). The Arbuckle Creek lowlands flow between the two ridges likely provides a dispersal barrier for flightless scrub-inhabiting insects.

The discovery of *Floritettix phlox* demonstrates that there is still a need for biodiversity exploration in the scrub communities on the Florida peninsula. Furthermore, given that *Floritettix* is Floridian in distribution, phylogenetic and biogeographic studies would likely yield results as equally interesting or greater than that of *Melanoplus*. Indeed, I have begun gathering specimens of all the species in the genus in ethanol for population-level study.

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