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Three new grasshopper species in the Florida *Melanoplus* Puer group (Orthoptera: Acrididae: Melanoplinae)

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Abstract

Three new grasshopper species in the *Melanoplus* Puer Group *sensu lato* (Orthoptera: Acrididae: Melanoplinae) are described from Florida, United States, bringing the total number of described species in the group to 27 while the number of species in the Puer Group *sensu stricto* is increased to nine. **1)** *M. amphora* **sp. nov.** Woller, Kelly, and Orfinger is described from a relatively small region of southeastern Florida across four counties: Okeechobee, Brevard, Indian, and St. Lucie, with the latter three being along the east coast; **2)** *M. spiracor* **sp. nov.** Woller and Kelly is described from a small region of southwestern Florida across three counties: Hillsborough, Manatee, and Sarasota, all of which are along the west coast; and **3)**, *M. ferrarius* **sp. nov.** Woller, Kelly, and Orfinger is described from a single location in southeastern Florida within Martin County: Jonathan Dickinson State Park, which is along the east coast. Taxonomic placement of these species is justified based on distinct morphology, primarily of the internal genitalia (especially the shape of the aedeagus), which are sufficiently divergent from conspecifics and consistently unique enough across their known geographic ranges to be considered new species. Comparisons with some geographically close congeneric species in the Puer Group are also provided.

Key words: Genitalia, Aedeagus, Scrub

Introduction

Florida scrub (hereafter scrub) is a xeric ecosystem and one of the southeastern United States' most ancient, with an estimated age of 20 million years, suggesting that it has persisted for almost as long as a portion of Florida's landmass has been exposed (Webb, 1990). A highly pyrogenic ecosystem, scrub is characterized by low-growing, semi-sclerophyllous vegetation, especially oaks and ericaceous shrubs, sometimes with a sparse pine overstory (Deyrup, 1989; Myers, 1990), and is generally restricted to ridges and hills, isolated from the lower-lying surrounding habitat. This isolation might explain the high proportion of scrub endemics (40–60% of all known scrub species) (Deyrup, 1989), which are adapted to severe drought associated with sandy soil, extreme scarcity of soil nutrients, and periodic, high-intensity fires (White, 1970; Myers 1990). Examples of endemics include the Florida scrub-jay (*Aphelocoma coerulescens* Bartram, 1791, a federally designated threatened species), over 24 species of plants, and numerous arthropods (Deyrup, 1989, 1990; Mushinsky & McCoy, 1995). As a further example of the extraordinary endemism in the scrub ecosystem, a study by Deyrup & Carrel (2012) examined residents of one of the largest, most well-studied ridges, Lake Wales Ridge, and found 91 species endemic to that ridge alone, many of which were beetles.

One particular group of Florida arthropod endemics stands out because it presents some of the clearest evidence of the relative isolation of various xeric ecosystems, especially scrub, largely within peninsular Florida (Deyrup, 1996). This group of tiny, flightless (brachypterous) grasshoppers is known as the *Melanoplus* Puer Group *sensu lato* and currently includes 24 species that are restricted to the southeastern states, with the majority found in peninsular Florida (Table 1). *Melanoplus* Stål, 1873 (Orthoptera: Acrididae: Melanoplinae) is the most specious grasshopper genus in the world with more than 300 species that are mainly distributed throughout North America (Cigliano *et al.*, 2025). Based on similar morphology and geographic distribution, the Puer Group *sensu lato* was erected in

1916 (Rehn & Hebard) and has since undergone several taxonomic changes. These include the further splitting of the group into six historical *sensu stricto* groups (Table 1) based largely on morphology with some emphasis on geography, as well as the addition of several new species over time (Hubbell, 1932; Strohecker, 1960; Deyrup, 1996; Lamb & Justice, 2005; Otte, 2012 ("2011"); Hubbell, unpublished notes). Much like Darwin's famed finches and their unique beaks (Darwin, 1872; Lamichhaney et al., 2015), this grasshopper group is also predominantly separated into species by distinct morphological characters; in this case, the male genitalia, especially the shape of the aedeagus, which has historically been the primary character used to define Puer Group species (Hubbell, 1932; Strohecker, 1960; Deyrup, 1996; Squitier et al., 1998; Otte, 2012 ("2011")).

TABLE 1. List of the 27 current species (24 previous + 3 new) in the Puer Group *sensu lato* grouped by the six historical *sensu stricto* (*s.s.*) subgroups and in alpha-order by specific name within each of those groups. Synthesized from Hubbell, 1932; Strohecker, 1960; Deyrup, 1996; Lamb & Justice, 2005; Otte, 2012 ("2011"); and Hubbell, unpublished notes.

Species	Historical *sensu stricto* Subgroup	# of Species Within *s.s.* Group	Known Species Distribution by State
M. apalachicolae Hubbell, 1932	Forcipatus Group	1	Florida
M. forcipatus Hubbell, 1932	Forcipatus Group	2	Florida
M. gurneyi Strohecker, 1960	Forcipatus Group	3	Florida
M. indicifer Hubbell, 1933	Forcipatus Group	4	Florida
M. nanciae Deyrup, 1997	Forcipatus Group	5	Florida
M. ordwayae Deyrup, 1997	Forcipatus Group	6	Florida
M. adelogyrus Hubbell, 1932	Puer Group	1	Florida
M. amphora **sp. nov.**	Puer Group	2	Florida
M. bonita Otte, 2012 ("2011")	Puer Group	3	Florida
M. ferrarius **sp. nov.**	Puer Group	4	Florida
M. kissimmee Otte, 2012 ("2011")	Puer Group	5	Florida
M. peninsularis Hubbell, 1932	Puer Group	6	Florida
M. puer (Scudder, 1878)	Puer Group	7	Florida
M. seminole Hubbell, 1932	Puer Group	8	Florida
M. spiracor **sp. nov.**	Puer Group	9	Florida
M. pygmaeus Davis, 1915	Rotundipennis Group	1	Alabama, Florida
M. rotundipennis (Scudder, 1878)	Rotundipennis Group	2	Florida, Georgia
M. withlacoocheensis Squitier, Deyrup, & Capinera, 1998	Rotundipennis Group	3	Florida
M. mirus Rehn & Hebard, 1916	Scapularis Group	1	North Carolina, South Carolina
M. scapularis Rehn & Hebard, 1916	Scapularis Group	2	Florida, Georgia
M. stegocercus Rehn & Hebard, 1916	Scapularis Group	3	Georgia
M. tumidicercus Hubbell, 1932	Scapularis Group	4	Georgia
M. foxi Hebard, 1923	Strumosus Group	1	Georgia
M. strumosus Morse, 1904	Strumosus Group	2	Alabama, Florida, Georgia, North Carolina, South Carolina
M. childsi Otte, 2012 ("2011")	Tequestae Group	1	Florida
M. sebringi Otte, 2012 ("2011")	Tequestae Group	2	Florida
M. tequestae Hubbell, 1932	Tequestae Group	3	Florida

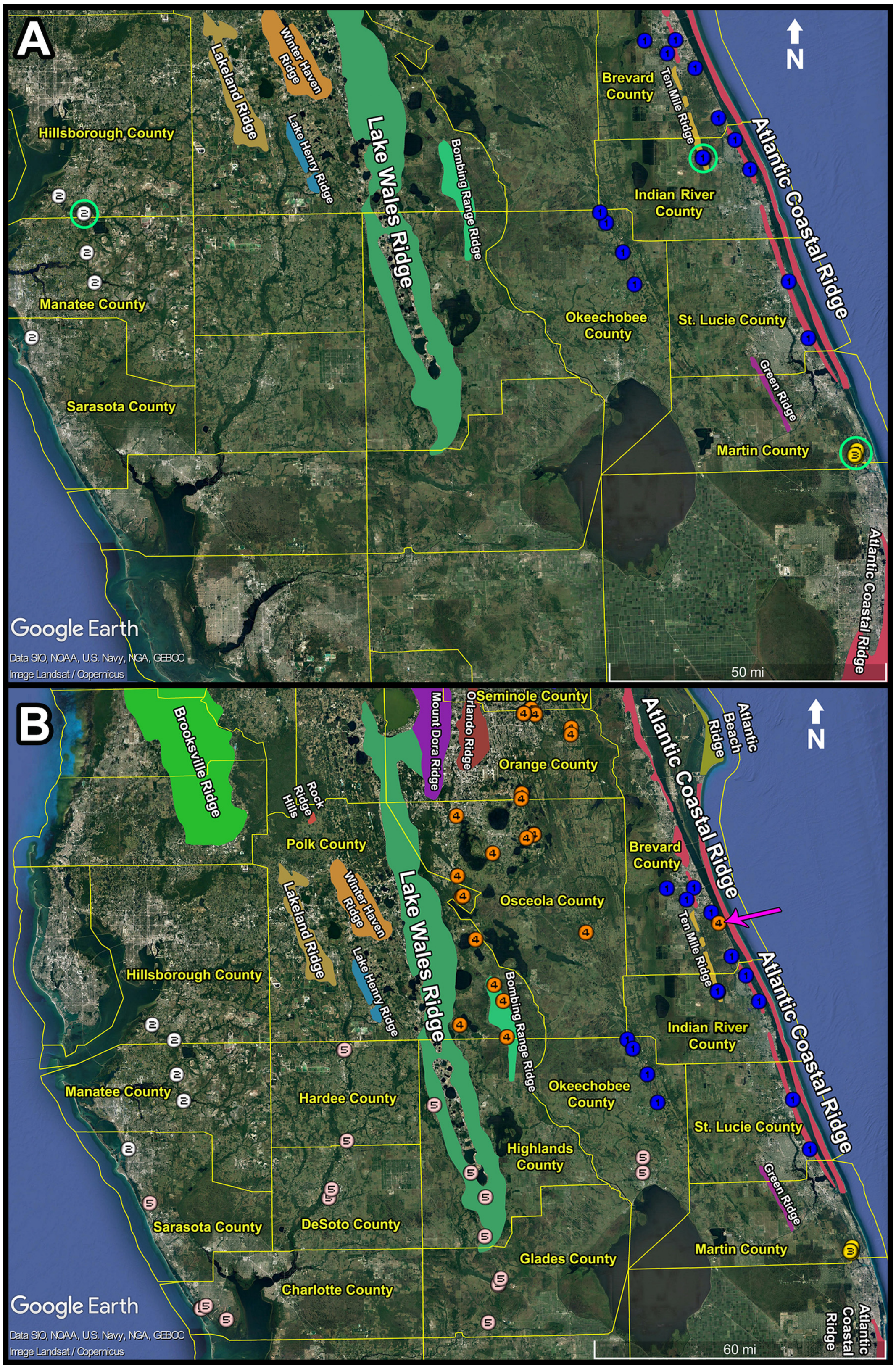

FIGURE 1. Known geographic distributions in Florida, U.S.A. of: **A.** all three new species: blue #1 dots are *Melanoplus amphora* **sp. nov.**, white #2 dots are *M. spiracor* **sp. nov.**, and yellow #3 dots are *M. ferrarius* **sp. nov.**; type specimen locations are circled in green; **B.** same as map A, but with the addition of the two most geographically close species in the Puer Group *sensu stricto* (Table 1), *M. kissimmee* Otte, 2012 ("2011"), which is represented by orange #4 dots and *M. seminole* Hubbell, 1932, which is represented by pink #5 dots. The pink arrow on the east coast points to the only known overlapping geographic location of any of these five species: a single locality for *M. kissimmee* surrounded by *M. amphora* localities.

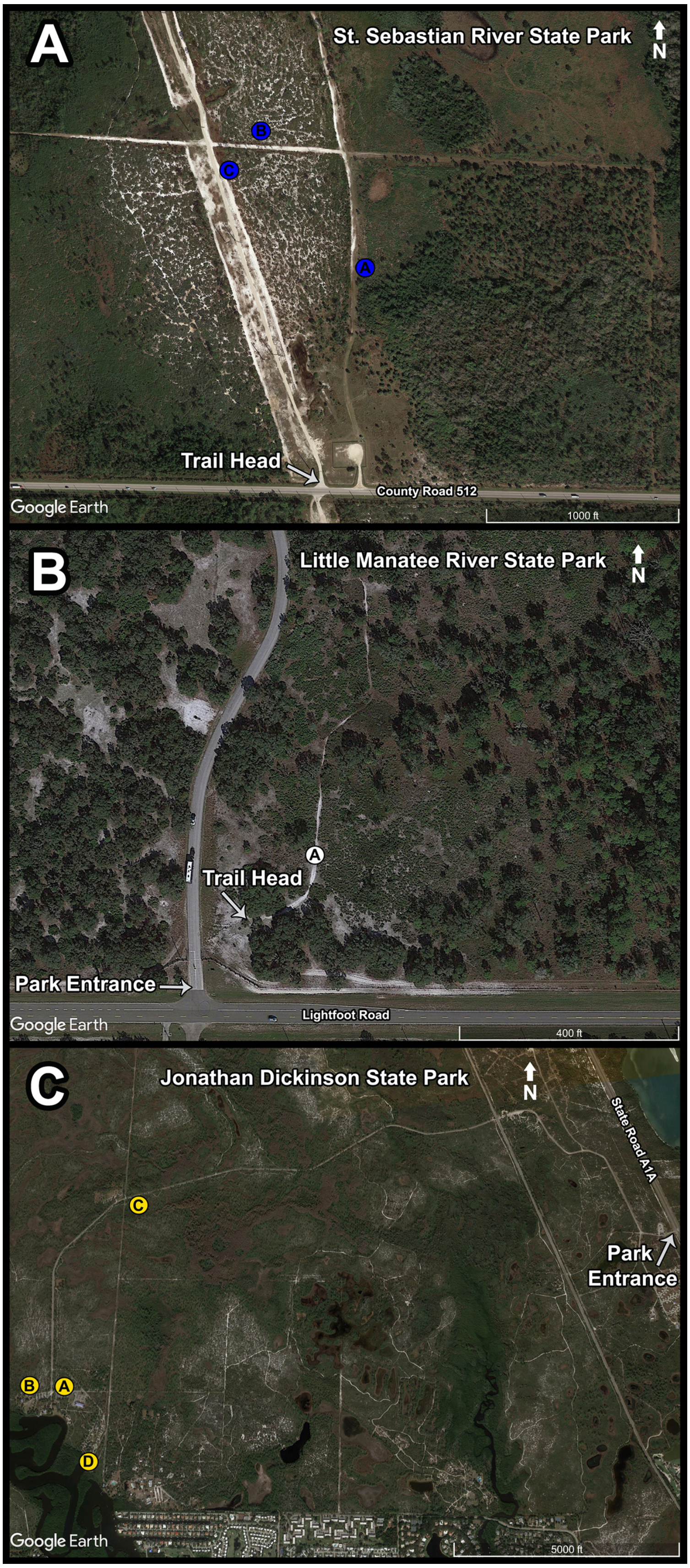

FIGURE 2. Type specimen locations of: **A.** *Melanoplus amphora* **sp. nov.** at St. Sebastian River State Park (note that A, B, and C were unique collecting subsites, but all specimens were grouped together); **B.** *M. spiracor* **sp. nov.** at Little Manatee River State Park, only known site is A; **C.** *M. ferrarius* **sp. nov.** at Jonathan Dickinson State Park, specific type specimen location is subsite C, with specimens also found at subsites A, B, and D.

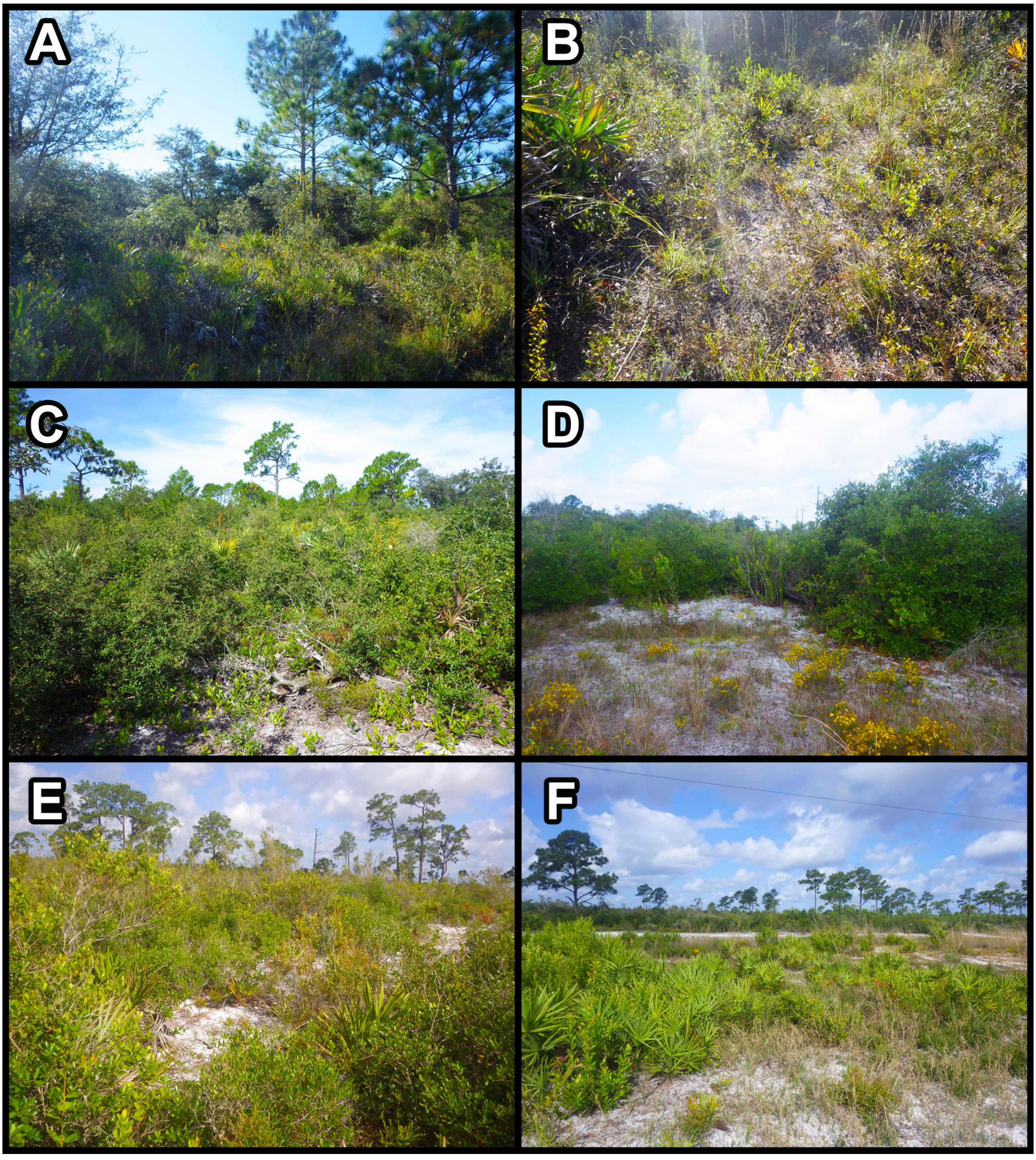

FIGURE 3. Habitats of *Melanoplus amphora* **sp. nov.** (see Table 2 for specific locality information): **A&B.** in general vicinity of Fort Drum; **C.** Malabar Scrub Sanctuary; **D–F.** St. Sebastian River Preserve State Park (also type specimen location), subsites A–C (see Fig. 2).

The purpose of this current work is to describe three new species for the Puer Group *sensu lato*, *M. amphora* **sp. nov.**, *M. spiracor* **sp. nov.**, and *M. ferrarius* **sp. nov.**, bringing the total number of species to 27 (Table 1). The three will also be added to the historical subgroup known as the Puer Group *sensu stricto,* which previously included six species and will now include nine (Table 1). To date, this subgroup has been collected throughout central-southern peninsular Florida and all species share strongly similar external morphology overall, as well as cerci that are highly similar among species of the subgroup, but are sufficiently different collectively from all other Puer Group *sensu* *lato* species. Despite this, each species in the Puer Group *sensu stricto* can be considered unique based largely on the internal genitalia of the males (especially the shape of the aedeagus), which are consistently unique across their known geographic ranges. This same situation applies to the three new species (Figs. 1–17).

Materials and Methods

Descriptive Taxonomy: All descriptions followed the synthesis of *Melanoplus* genitalia terminology found in Woller & Song (2017). Species separations are primarily predicated on the differences among male anatomy (particularly the internal genitalia) and relative geographic locations. Descriptions are primarily based on adult specimens with occasional use of nymphs.

Dissections and Measurements: Male genitalia were dissected from adult specimens (rehydrated by being dipped briefly into boiling water) and removed from the body using standard procedures (Hubbell, 1932) and the assistance of an AmScope dissecting microscope. After taking photos, the intact dry genitalia were put into 0.65 ml vials containing a 10% KOH solution and placed into a boiling water bath for up to a half hour to clear away obstructing tissues. The specimens were then removed and further dissected as necessary for examination and imaging by fully separating the epiphallus from the ectophallus and endophallus. After these photographs were taken, the ectophallus and endophallus were next separated for one to two specimens of each species to write detailed anatomical descriptions. All genitalia were then preserved in glycerin in genital vials pinned beneath the respective specimen. Anatomical measurements were made by adding an ocular micrometer to the microscope and then converting to millimeters. For each species, measurements included at least 10 adult specimens for each sex, with specimens chosen from across all known locations and across all available body sizes. Note that the "body length" measurement in the descriptions includes the tip of the head to the tip of the abdomen.

Specimen Collections: Specimens collected by DAW were with permits: Florida Department of Environmental Protection, Division of Recreation and Parks: for 2012/2013: #10031210 and 2014/2015: #05281410. All other specimens were borrowed from the following collections in the U.S.A. (alpha order by first letter): Archbold Biological Station (ABS), Venus, Florida, Florida State Collection of Arthropods (FSCA), Gainesville, Florida, North Carolina State University Insect Collection (NCSUIC), Raleigh, NC, Texas A&M University Insect Collection (TAMUIC), College Station, Texas, University of Central Florida Arthropod Collection (UCFC), Orlando, Florida, and University of Michigan Museum of Zoology Insect Division (UMMZI), Ann Arbor, Michigan.

Maps: The maps (Figs. 1 and 2) were created with the web-based application Earth Point (Clark, 2025), a tool for converting Microsoft Excel files (file format containing the Puer Group *sensu lato* locality data) into Google Earth-enabled KML files. The resulting KML was combined with county boundaries in KML form for Florida, downloaded from Google's Fusion Tables site (https://fusiontables.google.com), and then combined with a KMZ file of Florida's ridges and hills, from the Florida Department of Environmental Protection. Text was added to the maps using Adobe Photoshop CS6 Extended.

Photography: Photographs of habitats (Figs. 3 and 4) were taken with a Pentax WG-3 GPS camera. Photographs of live specimens (Fig. 5) were taken in the lab using scrubby oaks (*Quercus* spp.) found in each habitat and photographed using a Canon EOS 6D DSLR camera with a 100mm lens. The curated specimen images in Figures 6–15, 16A, C, E, G, and 17A, C, E, G, I were taken in the United States Department of Agriculture (USDA)-Animal and Plant Health Inspection Service (APHIS)-Plant Protection and Quarantine (PPQ)-Science & Technology (S&T)-Insect Management and Molecular Diagnostics Laboratory (Phoenix, Arizona, U.S.A.) using a Macroscopic Solutions Macropod Pro imaging system equipped with a Canon EOS 6D DSLR camera and 65mm/100mm lenses to take multiple images (JPEG) at different focal lengths. The images in Figures 16B, D, F, H and 17B, D, F, H, J were taken in the Texas A&M University Song Lab using a Visionary Digital imaging system equipped with a Canon EOS 6D DSLR camera and a 65mm lens/2x magnifier to take multiple images (RAW, converted to TIFF) at different focal lengths. Image files from both camera systems were stacked into a single composite image using the latest version of Zerene Stacker, and then Adobe Photoshop CS6 Extended was used to add a scale bar and adjust light levels, background coloration, and sharpness as needed, as well as arrange the composite figures.

Type Material: Primary type material (holotypes and allotypes) are deposited in the University of Central Florida Collection of Arthropods (UCFC), Orlando, FL, U.S.A. while paratypes collected by DAW are distributed among UCFC, TAMUIC, the Mississippi State University Mississippi Entomological Museum (MEM), and DAW's private collection. The other paratypes were loans and sent back accordingly (Table 2).

TABLE 2. Type specimen localities and label information for the three new *Melanoplus* species, with holotypes and allotypes noted explicitly and all other specimens to be considered paratypes. Coordinates are provided in WGS84 decimal degrees. All specimens collected by DAW were georeferenced using a Pentax WG-3 GPS camera. All specimens not collected by DAW were georeferenced using a combination of historic field notes and best guesses based on specimen label clues and personal knowledge of the regions using Google Earth and Google Maps. For localities only known from the name of a town/city, the center of the location was used for georeferencing. Specimens (very few) without sufficient locality information to make a best-guess are noted as such. Locality information format has been standardized across specimens, and missing information and current location names have been updated when possible. Unique identifiers for specimens have also been included, with the prefix containing the abbreviation for each collection as follows (in order of table appearance): UMMZI = University of Michigan Museum of Zoology Insect Division, MEM = Museum of Entomology at Mississippi State University, DAW = Derek A. Woller's personal collection, UCFC = University of Central Florida Collection of Arthropods, TAMU ENTO = Texas A&M University Insect Collection, TAMU-IGC = TAMU Insect Genomic Collection, ABS = Archbold Biological Station, FSCA = Florida State Collection of Arthropods, and NCSU_ENTO = North Carolina State University Insect Collection. Total number of specimens/species: *M. amphora* **sp. nov.** = 53, *M. spiracor* **sp. nov.** = 99, and *M. ferrarius* **sp. nov.** = 38.

					Totals and Unique Identifiers (if available)					
Species	**County**	**Specific Locality**	**Coordinates**	**Total #**	**M**	**F**	**N**	**Copulating**	**Unique Collecting Data**	**Holotype + Allotype**
M. amphora **sp. nov.**	Brevard	1.75 mi. S. Melbourne on U.S. Hwy 1	28.057808, -80.590238	4	**2:** UMMZI-00050237, UMMZI-00050234	**1:** UMMZI-00050235	**1:** UMMZI-00050238	N/A	9-VIII-1938, coll. T.H. Hubbell & J.J. Friauf, Field #104	N/A
M. amphora **sp. nov.**	Brevard	5 mi. W. Melbourne	28.078674, -80.727476	1	**1:** UMMZI-00050233	N/A	N/A	N/A	24-V-1931, coll. T.H. Hubbell, Field #1, atypical E. phase	N/A
M. amphora **sp. nov.**	Brevard	Malabar Scrub Sanctuary, along sides of various trails, but primarily at coordinates	28.004746, -80.581205	1	**1:** MEM 455042	N/A	N/A	N/A	15-VIII-2014, coll. D.A. Woller, B. Silverman, & S.L. Kelly, Field #PG151-1-A, somewhat overgrown classic scrub	N/A
M. amphora **sp. nov.**	Brevard	Melbourne	28.078906, -80.636833	2	**1:** UMMZI-00050231	N/A	**1:** UMMZI-00050232	N/A	24-V-1931, coll. T.H. Hubbell, Field #1, atypical E. phase	N/A

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TABLE 2. (Continued)

					Totals and Unique Identifiers (if available)					
Species	County	Specific Locality	Coordinates	Total #	M	F	N	Copulating	Unique Collecting Data	Holotype + Allotype
M. amphora **sp. nov.**	Brevard	Micco	27.874097, -80.517353	10	**1:** UMMZI-00050243	**3:** UMMZI-00050244, UMMZI-00050245, UMMZI-00050246	**6:** UMMZI-00050247, UMMZI-00050248, UMMZI-00050249, UMMZI-00050250, UMMZI-00050251, UMMZI-00050252	N/A	24-V-1931, coll. T.H. Hubbell , Field #2, atypical E. phase	N/A
M. amphora **sp. nov.**	Brevard	St. Sebastian River Preserve State Park, along Scrub Jay Link Trail, trailhead just N. of Fellsmere Rd./CR 512	**A:** 27.770833, -80.565000; **B:** 27.772778, -80.566667; **C:** 27.772222, -80.567222	15	**7:** DAW-200-1-A/B/C-1, UCFC 0 577 308, UCFC 0 577 309, TAMU-ENTO X1539428, TAMU-IGC-1528, TAMU-IGC, MEM 455043	**6:** DAW-200-1-A/B/C-2, UCFC 0 577 310, UCFC 0 577 311, TAMU-ENTO X1539564, TAMU-IGC, MEM 455044	**2:** DAW-200-1-A/B/C-3, MEM 455045	N/A	16-V-2015, coll. D.A. Woller, S.L. Kelly, & A.B. Orfinger, Field #PG200-1-A/B/C, mix of overgrown and classic scrub, didn't separate A, B, or C specimens	includes holotype (M): UCFC 0 577 309 and allotype (F): UCFC 0 577 311
M. amphora **sp. nov.**	Indian River	3.2 mi. S. Sebastian	27.739107, -80.429602	1	**1:** UMMZI-00050254	N/A	N/A	N/A	24-V-1931, coll. T.H. Hubbell , Field #1, atypical E. phase, tag: genitalia figured	N/A

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TABLE 2. (Continued)

					Totals and Unique Identifiers (if available)					
Species	**County**	**Specific Locality**	**Coordinates**	**Total #**	**M**	**F**	**N**	**Copulating**	**Unique Collecting Data**	**Holotype + Allotype**
M. amphora **sp. nov.**	Indian River	Sebastian	27.816415, -80.470608	1	**1:** UMMZI-00050253	N/A	N/A	N/A	24-V-1931, coll. T.H. Hubbell , Field #1, atypical E. phase	N/A
M. amphora **sp. nov.**	Martin	unknown	N/A	1	**1:** FSCA 00033489	N/A	N/A	N/A	17-IV-1962, coll. unknown	N/A
M. amphora **sp. nov.**	Okeechobee	23 mi. N. Okeechobee near Olney (*ghost town)	27.609469, -80.853869	1	**1:** UMMZI-00050279	N/A	N/A	N/A	24-V-1931, coll. T.H. Hubbell, Field #2	N/A
M. amphora **sp. nov.**	Okeechobee	Olney (*ghost town)	27.636846, -80.871379	3	**1:** UMMZI-00050266	**1:** UMMZI-00050278	**1:** UMMZI-00050265	N/A	24-V-1931, coll. T.H. Hubbell, Field #2, atypical E. phase	N/A
M. amphora **sp. nov.**	Okeechobee	County Road 68, 2 mi. E. U.S. 441, along road	27.449354, -80.775826	1	**1:** ABS	N/A	N/A	N/A	27-VIII-1992, coll. M. Deyrup, scrub ridge	N/A
M. amphora **sp. nov.**	Okeechobee	in general vicinity of Fort Drum, on W. side of U.S. 441/15, not too far N. of Fort Drum General Store	27.532674, -80.807697	9	**3:** DAW-183-1-A-1, DAW-183-1-A-2, UCFC 0 577 312	**1:** DAW-183-1-A-3	**5:** DAW-183-1-A-4, DAW-183-1-A-5, UCFC 0 577 313, TAMU-ENTO X0354172, MEM 455046	N/A	18-X-2014, coll. D.A. Woller & S.L. Kelly, Field #PG183-1-A, dense and overgrown scrubby patch in mostly-urban area	N/A
M. amphora **sp. nov.**	St. Lucie	Fort Pierce	27.446706, -80.325606	2	**2:** UMMZI-00050255, UMMZI-00050256	N/A	N/A	N/A	5-VII-1935, coll. I.J. Cantrall, Field #66	N/A

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TABLE 2. (Continued)

Species	County	Specific Locality	Coordinates	Total #	Totals and Unique Identifiers (if available) M	F	N	Copulating	Unique Collecting Data	Holotype + Allotype
M. amphora **sp. nov.**	St. Lucie	Savannas Preserve State Park	27.298852, -80.272981	1	**1:** DAW-0000001	N/A	N/A	N/A	8-VI-2002, coll. T.L. Lamb & T.C. Justice	N/A
M. spiracor **sp. nov.**	Hillsborough	Little Manatee River State Park, 5 miles S. of Sun City, on both sides of trail slightly NE of park entrance off of Lightfoot Rd.	27.658500, -82.374083	23	**11:** DAW-121-1-A-1, DAW-121-1-A-2, UCFC 0 577 314, UCFC 0 577 315, UCFC 0 577 316, UCFC-OR1276 (in TAMU-IGC), TAMUIGC, TAMU-ENTO X1537799, TAMU-ENTO X1537515, MEM 455047, MEM 455048	**10:** DAW-121-1-A-3, DAW-121-1-A-4, DAW-121-1-A-5, DAW-121-1-A-6, DAW-121-1-A-7, UCFC 0 577 317, UCFC 0 577 318, TAMU-ENTO X1537359, TAMU-IGC, MEM 455049	**2:** DAW-121-1-A-8, UCFC 0 577 319	N/A	27-III-2013, coll. D.A. Woller & S.L. Kelly, Field #PG121-1-A, unusual habitat - resembles pine flatwoods with more oaks than pines, following up on a Hubbell lead	includes holotype (M): UCFC 0 577 316 and allotype (F): UCFC 0 577 318

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TABLE 2. (Continued)

Species	County	Specific Locality	Coordinates	Total #	Totals and Unique Identifiers (if available) M	F	N	Copulating	Unique Collecting Data	Holotype + Allotype
M. spiracor **sp. nov.**	Hillsborough	Little Manatee River State Park, 5 miles S. of Sun City, on both sides of trail slightly NE of park entrance off of Lightfoot Rd.	27.658500, -82.374083	12	**4:** DAW-121-2-A-1, DAW-121-2-A-2, DAW-121-2-A-3, UCFC 0 577 320	**4:** DAW-121-2-A-4, UCFC 0 577 321, TAMU-ENTO X1538305, MEM 455050	N/A	**2:** DAW-121-2-A-5, MEM 455051	17-VI-2013, coll. D.A. Woller, R. Mariño-Pérez, G. Alava, & Integrative Bio. Class, Field #PG121-2-A, unusual habitat - resembles pine flatwoods with more oaks than pines	N/A
M. spiracor **sp. nov.**	Hillsborough	Little Manatee River, US Hwy 41	27.704525, -82.446943	7	**2:** UMMZI-00050165, UMMZI-00050168	**3:** UMMZI-00050166, UMMZI-00050167, UMMZI-00050169	**2:** UMMZI-00050170, UMMZI-00050171	N/A	15-VIII-1938, coll. T.H. Hubbell & J.J. Friauf, Field #133	N/A
				1	N/A	**1:** UMMZI-00050157	N/A	N/A	15-VIII-1938, coll. T.H. Hubbell & J.J. Friauf, Field #134	N/A
				5	**2:** UMMZI-00050160, UMMZI-00050161	**1:** UMMZI-00050162	**2:** UMMZI-00050163, UMMZI-00050164	N/A	18-VIII-1938, coll. T.H. Hubbell & J.J. Friauf, Field #129	N/A
				2	N/A	N/A	**2:** UMMZI-00050158, UMMZI-00050159	N/A	14-15-VIII-1938, coll. T.H. Hubbell & J.J. Friauf, Field #129	N/A

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TABLE 2. (Continued)

Species	County	Specific Locality	Coordinates	Total #	Totals and Unique Identifiers (if available) M	F	N	Copulating	Unique Collecting Data	Holotype + Allotype
M. spiracor **sp. nov.**	Manatee	County Road 675 at radio tower	27.556977, -82.366835	4	**2:** ABS	N/A	N/A	**1:** ABS	25-X-1991, coll. M. Deyrup, sandhill habitat	N/A
M. spiracor **sp. nov.**	Manatee	Lake Manatee SP	27.479409, -82.344763	2	**2:** ABS	N/A	N/A	N/A	26-X-1991, coll. M. Deyrup, scrubby flatwoods	N/A
				1	**1:** ABS	N/A	N/A	N/A	26-X-1991, coll. M. Deyrup, sand pine scrub, genitalia on point	N/A
				1	**1:** DAW-0000002	N/A	N/A	N/A	10-III-2002, coll. T.L. Lamb & T.C. Justice	N/A
M. spiracor **sp. nov.**	Manatee	Manatee	can not find	2	**1:** UMMZI-00050228	**1:** UMMZI-00050227	N/A	N/A	14-XII-1924, coll. F.W. Walker, Paratype	N/A
				1	N/A	**1:** UMMZI-00050218	N/A	N/A	2-I-1925, coll. T.H. Hubbell, Field #15, Paratype	N/A
				1	N/A	**1:** UMMZI-00050222	N/A	N/A	18-VIII-1925, coll. T.H. Hubbell, Field #23, Paratype	N/A
				2	N/A	**2:** UMMZI-00050219, UMMZI-00050220	N/A	N/A	18-VIII-1925, coll. T.H. Hubbell, Field #25, Paratype	N/A
				1	N/A	N/A	**1:** UMMZI-00050225	N/A	19-VIII-1925, coll. T.H. Hubbell, Field #28, Paratype	N/A

......*continued on the next page*

TABLE 2. (Continued)

					Totals and Unique Identifiers (if available)					
Species	**County**	**Specific Locality**	**Coordinates**	**Total #**	**M**	**F**	**N**	**Copulating**	**Unique Collecting Data**	**Holotype + Allotype**
				21	**12:** FSCA 00033490, UMMZI synoptic, UMMZI-00050202, UMMZI-00050203, UMMZI-00050204, UMMZI-00050205, UMMZI-00050206, UMMZI-00050208, UMMZI-00050209, UMMZI-00050210, UMMZI-00050211, UMMZI-00050212	**8:** FSCA 00033491, UMMZI synoptic, UMMZI-00050207, UMMZI-00050213, UMMZI-00050214, UMMZI-00050215, UMMZI-00050216, UMMZI-00050217	**1:** UMMZI-00050226	N/A	22-VIII-1925, coll. T.H. Hubbell, Field #36, Paratype	N/A
				2	N/A	**1:** UMMZI-00050221	**1:** UMMZI-00050224	N/A	22-VIII-1925, coll. T.H. Hubbell, Field #37, Paratype	N/A

......*continued on the next page*

TABLE 2. (Continued)

Species	County	Specific Locality	Coordinates	Total #	Totals and Unique Identifiers (if available) M	F	N	Copulating	Unique Collecting Data	Holotype + Allotype
				1	**1:** NCSU_ ENT 00244699	N/A	N/A	N/A	22-VIII-1925, coll. T.H. Hubbell, Field #96	N/A
M. spiracor **sp. nov.**	Manatee	unknown	N/A	7	**4:** FSCA 00033492, FSCA 00033493, FSCA 00033494, FSCA 00033495	**1:** FSCA 00033496	**2:** FSCA 00033497, FSCA 00033498	N/A	28-IV-1955, coll. H.A. Denmark	N/A
M. spiracor **sp. nov.**	Sarasota	Sarasota	27.339392, -82.530265	1	N/A	**1:** FSCA 00033499	N/A	N/A	13-II-1911, coll. W.S.B.	N/A
				1	**1:** UMMZI-00050192	N/A	N/A	N/A	17-II-1911, coll. W.S.B.	N/A
				1	N/A	**1:** TAMU-ENTO X0366546	N/A	N/A	18-II-1911, coll. W.S.B.	N/A
M. ferrarius **sp. nov.**	Martin	Jonathan Dickinson State Park, across from a parking lot and SE of Park Rd./SE Jonathan Dickinson Way	26.992974, -80.144831	6	**2:** DAW201-1-A-1, TAMU-ENTO X1538584	**3:** DAW201-1-A-2, TAMU-ENTO X1539248, MEM 455052	**1:** MEM 455053	N/A	16-V-2015, coll. D.A. Woller, S.L. Kelly, & A.B. Orfinger, Field #PG201-1-A, pine flatwoods (possibly *Pinus elliottii* var. *densa*)	N/A

......*continued on the next page*

TABLE 2. (Continued)

Species	County	Specific Locality	Coordinates	Total #	Totals and Unique Identifiers (if available) M	F	N	Copulating	Unique Collecting Data	Holotype + Allotype
M. ferrarius **sp. nov.**	Martin	Jonathan Dickinson State Park, not far from parking lot along Kitching Creek Nature Trail	26.993056, -80.147222	19	**7:** DAW-201-1-B-1, DAW-201-1-B-2, DAW-201-1-B-3, UCFC 0 577 322, MEM 455054, TAMU-IGC-1529, TAMU-IGC	**8:** DAW-201-1-B-4, DAW-201-1-B-5, UCFC 0 577 323, UCFC 0 577 324, TAMU-ENTO X1538333, TAMU-IGC, MEM 455055, MEM 455056	**4:** DAW-201-1-B-6, DAW-201-1-B-7, UCFC 0 577 325, MEM 455057	N/A	16-V-2015, coll. D.A. Woller, S.L. Kelly, & A.B. Orfinger, Field #PG201-1-B, pine flatwoods (possibly *Pinus elliottii* var. *densa*)	N/A
M. ferrarius **sp. nov.**	Martin	Jonathan Dickinson State Park, just SE of Park Rd. and an unnamed road	27.005278, -80.140278	9	**4:** DAW-201-1-C-1, UCFC 0 577 326, UCFC 0 577 327, MEM 455058	**5:** DAW-201-1-C-2, DAW-201-1-C-3, UCFC 0 577 328, UCFC 0 577 329, TAMU-ENTO X1538577	N/A	N/A	16-V-2015, coll. D.A. Woller, S.L. Kelly, & A.B. Orfinger, Field #PG201-1-C, pine flatwoods (possibly *Pinus elliottii* var. *densa*)	includes holotype (M): UCFC 0 577 327 and allotype (F): UCFC 0 577 329
M. ferrarius **sp. nov.**	Martin	Jonathan Dickinson State Park, far SW edge of park, in scrubby area just N of boat ramp	26.988461, -80.142645	3	**3:** UCFC-OR1238 (in TAMU-IGC), DAW-0000003, MEM 455059	N/A	N/A	N/A	31-VIII-2001, coll. T.C. Justice, overgrown scrubby area	N/A
				1	**1:** TAMU-ENTO X1537870	N/A	N/A	N/A	18-V-2001, coll. T.C. Justice, overgrown scrubby area	N/A

Results

Taxonomic reviews and descriptions

Class: Insecta

Order: Orthoptera

Suborder: Caelifera

Superfamily: Acridoidea MacLeay, 1821

Family: Acrididae MacLeay, 1821

Subfamily: Melanoplinae Scudder, 1897

Tribe: Melanoplini Scudder, 1897

Genus: *Melanoplus* Stål, 1873

General Description

Each of the three new species described here strongly resemble other species in the Puer Group *sensu lato*, especially those in the Puer Group *sensu stricto*, to which they are hypothesized to be the most closely related based on general appearance, relative size, and geography. For these reasons, I am currently placing these three new species into the Puer Group *sensu stricto*.

Melanoplus amphora sp. nov. Woller, Kelly, and Orfinger

(Figs. 1, 2A, 3, 5A & B, 6–8)

General Description

A full list of unique anatomical components that separate this species from the other two new ones described here are found in Table 3. However, the primary character that separates this species from all other congeneric species is the shape of the ventral valves of aedeagus (see Fig. 15 for a comparison of all three new species), which, in dorsal view, resemble the shape of a classic vase (the origin of its name, see Etymology section), a sideways fish (as drawn by a child), or an open-top hourglass, while, in lateral view, they resemble the curving-upwards tips of classic elf shoes. Described from 53 specimens total (adult male holotype, adult female allotype, and 51 paratypes): 25 males, 12 females, and 16 nymphs.

Detailed Description

Note that the descriptions for each body region below are for adults of both sexes unless otherwise noted.

General Body Coloration (Figs. 5A & B, 6): Males light brown-yellowish (medium to light brown in females), often with some lateral black striping and scattered splashes of black (less-so in females), although darker or mottled variations exist; in males, integument of pronotum's dorsum, tegmina, and anterior abdominal areas tend to be slightly darker.

Head, Pronotum, and Thorax (Figs. 5A & B, 6): Antennae filiform and composed of 22 segments. Fastigium not overly pronounced, eyes very prominent and of variable coloration: yellow, red, brown, or a combination of these. Median carina obvious and raised slightly, intersected by three obvious sulci, one within the prozona's posterior portion and the other two continuing on from the lateral sulci that delimit the meso/metazona. Prosternal process subconical and prominent, often extending ventrally enough to be in line with the sternum. An often-faint, thin black stripe emerges from just behind the midpoint of the eye and crosses onto the lateral sides of the pronotum where it darkens greatly and initially doubles in width, almost reaching the anteroventral edge, and then immediately narrows again diagonally, ending at approximately the same width it began and usually at the posterior edge of the mesozona, although with occasional bleed-over into dorsolateral region of the metazona. When viewed in isolation, the pronotal stripe roughly resembles a right-angled trapezoid (the right angle being the anterodorsal corner of the prozona). This black stripe (now more abstract and less stripe-like) emerges again at its full width on the pleurites just beyond the pronotum, passes behind the tegmen, and extends onto the abdomen. In females, the overall striping is less common and less obvious in general, particularly behind the eye (when present, most obvious on the pronotum).

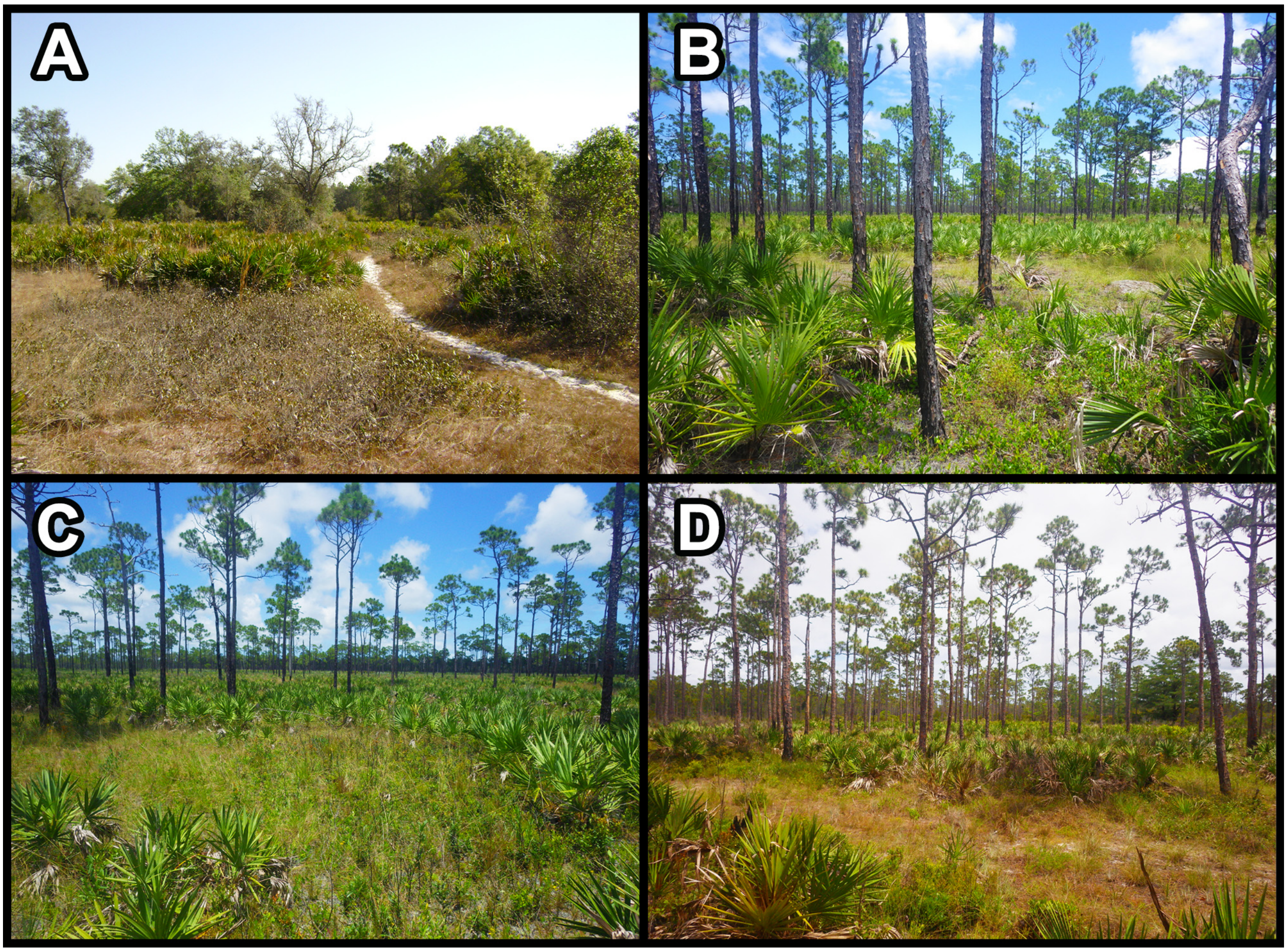

FIGURE 4. Habitats (see Table 2 for specific locality information) of: **A.** *Melanoplus spiracor* **sp. nov.** in Little Manatee River State Park (type specimen location); **B–D.** *M. ferrarius* **sp. nov.** in Jonathan Dickinson State Park, subsites A–C (C is the type specimen location).

Abdomen, Tegmina, Legs (Figs. 5A & B, 6): Both sides of abdomen's anterior regions with the black stripe-like pattern that began on the thorax and head, typically ending at the posterior edge of tergite 2, with occasional black splashes beyond, mostly on tergites 3 and 4, and mostly on the anterior or posterior edges. In females, this pattern is less common and less obvious overall. Tegmina appear narrow, being moderately compressed dorsoventrally and reaching at least the end of tergite 1 or the first quarter of tergite 2 (common in most males and females); covered in dense, raised reticulations. Fore and midfemora (most common) with occasional black splotches, mainly on dorsal side; hind femora quite variable, with assorted black splotches on dorsal side (almost always fewer in size and number compared to midfemora) and/or sometimes along the medial area (if present, most common in males and usually more homogenous than splotchy). In females, outer ventral edge of hind femora often reddish, sometimes bleeding upwards onto the medial area. Hind tibiae ventral coloration most often yellowish in males, matching rest of leg, but also occasionally muted purple, which can be faint (most common) or strong (quite rare); in females, yellowish-brown, sometimes with a hint of muted purple.

Terminalia:

Male, external (Fig. 7A & B): Furculae short and rounded strongly at apices. Supra-anal plate triangular to subtriangular with rounded apex and shallow, median groove that extends apically for approximately 1/3 to 1/2 the total length. Cerci shape approximately twice as wide at the base and tapering gently upwards towards a rounded apex, often nearly reaching the apex of the supra-anal plate or, more rarely, reaching it or extending slightly beyond. Subgenital plate semi-conical with a rounded apex in posterior view; pallium embedded slightly beneath inner edge.

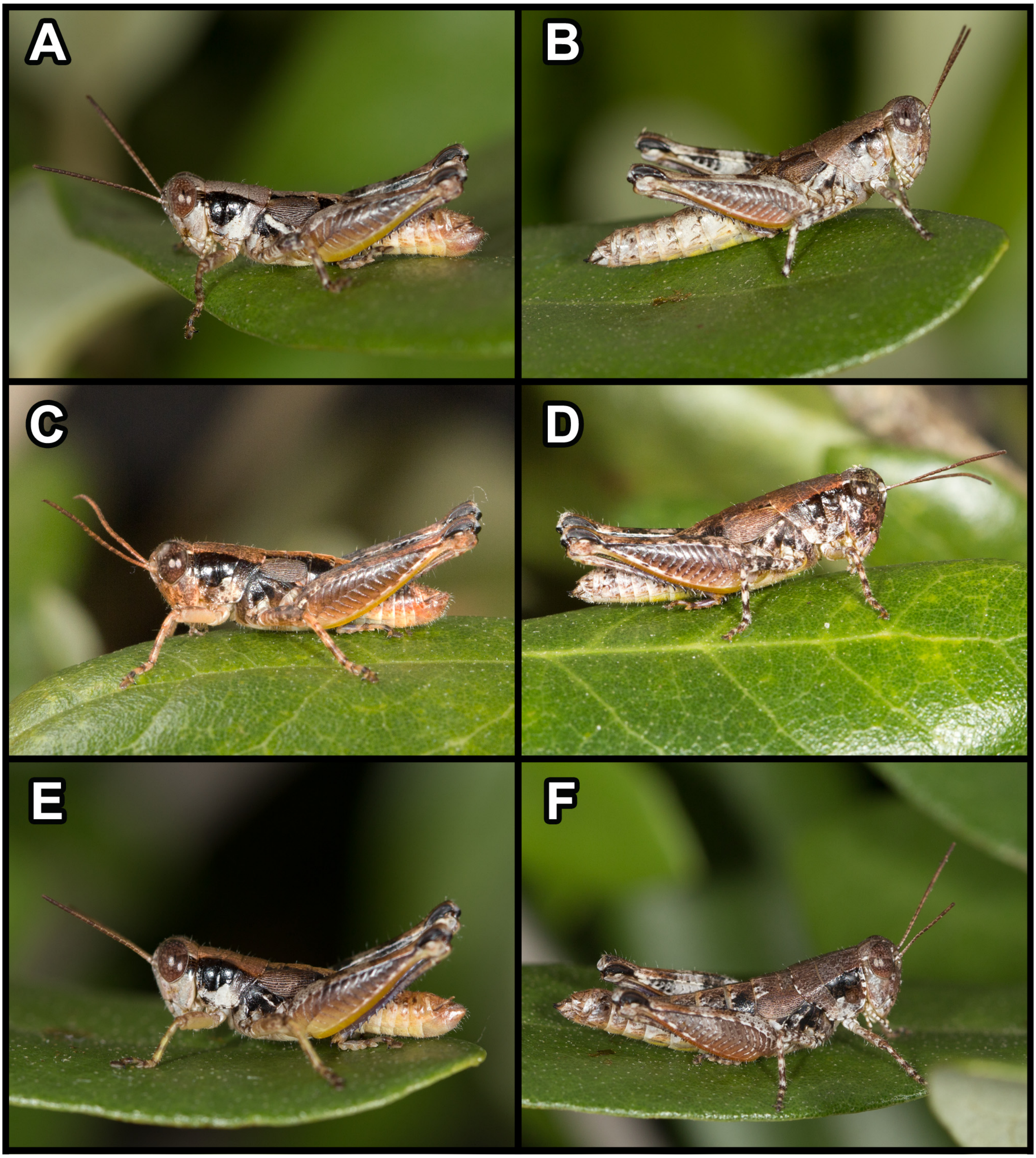

FIGURE 5. Live specimens of: **A.** *Melanoplus amphora* **sp. nov.**, male; **B.** *M. amphora* **sp. nov.**, female; **C.** *M. spiracor* **sp. nov.**, male; **D.** *M. spiracor* **sp. nov.**, female; **E.** *M. ferrarius* **sp. nov.**, male; **F.** *M. ferrarius* **sp. nov.**, female.

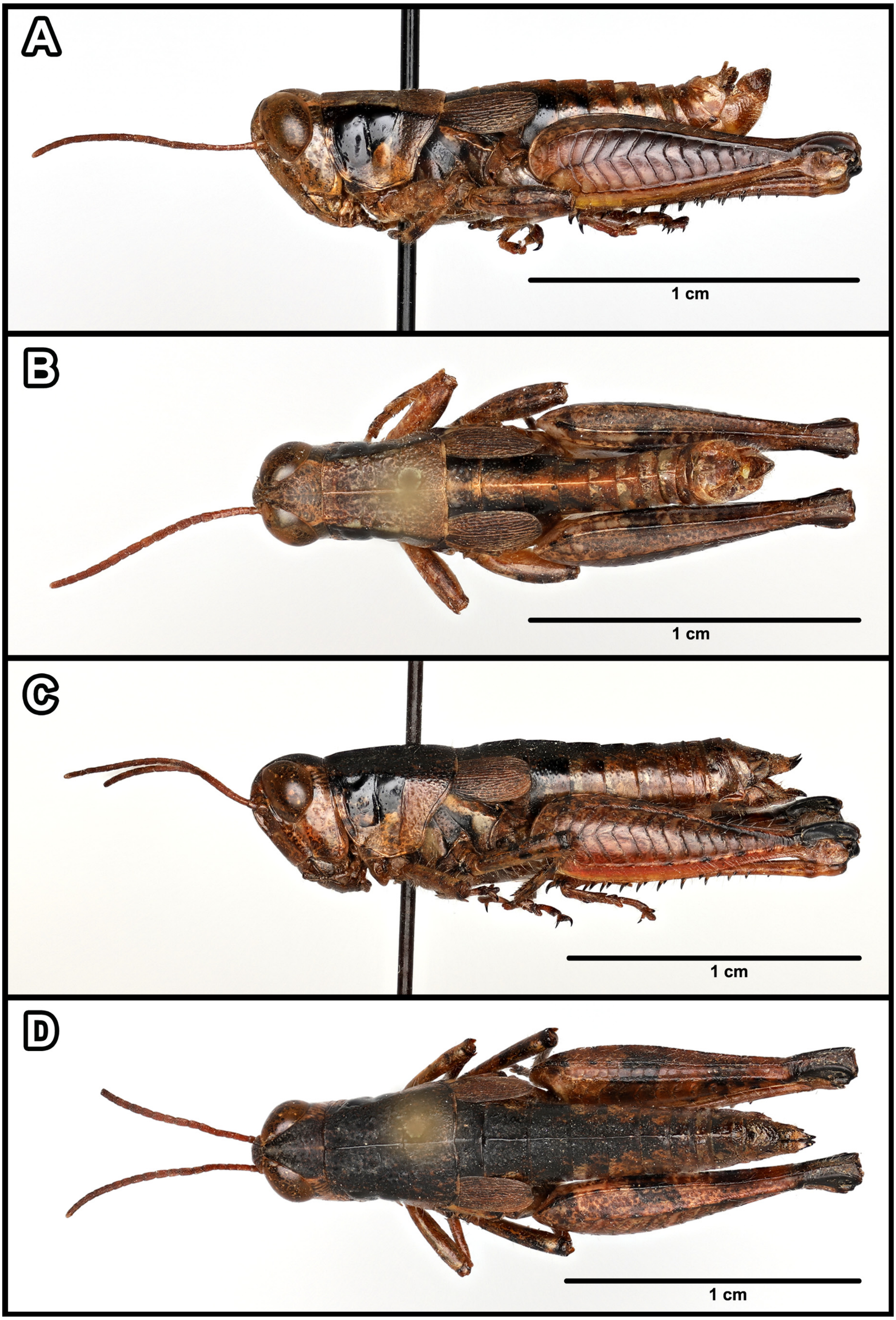

FIGURE 6. *Melanoplus amphora* **sp. nov.**: holotype male: **A.** Habitus, left lateral view; **B.** Habitus, dorsal view; allotype female: **C.** Habitus, left lateral view; **D.** Habitus, dorsal view.

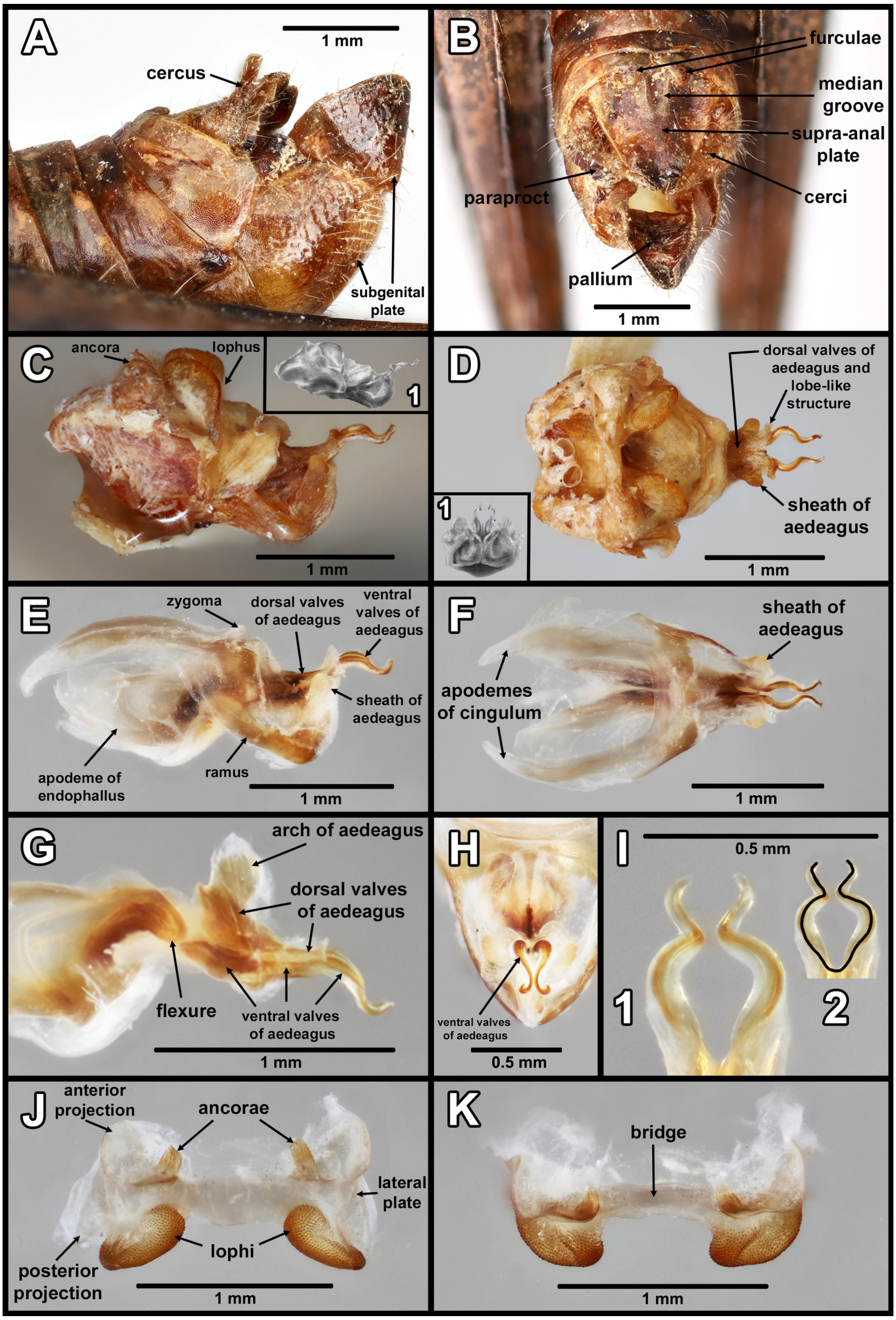

FIGURE 7. *Melanoplus amphora* **sp. nov.** male: external genitalia (with internal genitalia removed) (holotype): **A.** left lateral; **B.** dorsal; internal genitalia, phallic complex (UMMZI-00050254): **C.** left lateral: **1)** Drawing from Hubbell, 1932 (see note below); **D.** dorsal: **1)** same as C-1; internal genitalia (KOH-cleared): **E.** phallic complex, left lateral (holotype); **F.** phallic complex, dorsal (holotype); **G.** endophallus, left lateral (DAW-200-1-A/B/C-1); **H.** ventral valves of aedeagus, posterior view (holotype); **I.** ventral valves of aedeagus, dorsal view (DAW-200-1-A/B/C-1): **1)** average shape; **2)** overlaid drawing to visually explain the etymology of the specific name, *amphora*, which is Latin for vase; **J.** epiphallus, dorsal view, posterior downwards (holotype); **K.** epiphallus, anterior view, dorsal downwards (holotype). **C-1** and **D-1** are drawings of UMMZI-00050254 from Figure 28 in Hubbell, 1932, the caption of which reads: "*Melanoplus puer seminole* Hubbell, atypical eastern phase. Lateral and caudal views of concealed genital structures of male—near Sebastian, Indian River Co., Florida."

Male, internal phallic complex (Fig. 7C–K): Overall, typical for a melanopline, particularly Puer Group *sensu lato* species, with the unique characters described below for the epiphallus, ectophallus, and endophallus, many of which are shared by *M. spiracor* **sp. nov.** and *M. ferrarius* **sp. nov.**, with the sheath of aedeagus and ventral valves of aedeagus being the two most unique structures for each of the three species (Fig. 15, Table 3):

Epiphallus (Fig. 7C, D, J, K): Ancorae subtriangular, relatively elongate, bent slightly ventrally, and curving slightly inwards; lophi prominent, subrectangular, fairly narrow (laterally compressed), and covered in raised microstructures; anterior projections generally rounded with no defined shape; posterior projections, in dorsal view, either obscured by the lophi or slightly extending beyond posterior edges of lophi.

Ectophallus (Fig. 7C–F): Apodemes of cingulum elongate and zygoma shelf-like, meaning both resemble all other Puer Group species. Rami prominent, extending posteriorly at about a 45° angle and curving inwards slightly, with final 1/3rd bent at a 90° angle that curves slightly upwards toward the ventral valves of aedeagus, terminating at approximately the midpoint of the valves, and tapering to a rounded apex; when viewed laterally, the ramus resembles an upside-down scythe. Sheath of aedeagus taking the form of two halves that do not meet, each consisting of an apical lobe that arises from the apical, "scythe blade" region of the rami, which extend dorsally at a 45° angle, and usually terminates just beyond the dorsum of the ventral valves of aedeagus. These lobes are relatively large, oblong in shape, and laterally compressed moderately, with apices more bulbous and marginally expanded; covered in raised microstructures.

Endophallus (Fig. 7G–I)): Apodemes of endophallus large and rounded like all other Puer Group species; arch of aedeagus well-developed. Dorsal valves of aedeagus do not meet flexures, are about 1/2 the length of ventral valves, with basal ½ more robust, and fused and fairly flat for entire length except final ¼, which has a y-shaped cleft, each half terminating in a lobe-like structure (covered in raised microstructures) just beyond the sheath of aedeagus that curves slightly around its corresponding ventral valve and flares upwards fairly strongly (when viewed posteriorly, shape resembles an eyebrow, see Fig. 7H). Ventral valves of aedeagus meet flexures, are twice as long as the dorsal valves, with basal third more robust, and the remaining 2/3 forming a unique rigid pattern. When viewed dorsally (with valve apices oriented north, see Fig. 7I-1), the general pattern is as follows: the valves initially bow outwards (obviously to strongly, but not known to go beyond the midpoint of the apices of the lobes of sheath of aedeagus) just beyond the lobe-like structures of the dorsal valves, and then gently inwards again, usually almost meeting at the start of the final 1/4th, then curve outwards almost as much as before, with the apices bending inwards again at an almost 45° angle, but retaining more distance between; overall, the dorsal shape resembles several objects, such as a classic vase (Fig. 7I-2), a sideways fish (as drawn by a child), or an open-top hourglass. When viewed laterally (Fig. 7G), the first curve of the ventral valves rises gently a little way above the dorsal valves, with the next curve then plunging to be in line with the lower lobes of the sheath of aedeagus, and, finally, with the apices rising to be in line with the first curve; overall, the two valves are fairly parallel and line up well in lateral view, with the shape resembling a wave of fixed height but mixed wavelengths. When viewed posteriorly, the apices of the ventral valves resemble the curving-upwards tips of classic elf shoes.

Female, external (Fig. 8A & B): Supra-anal plate subtriangular; cerci relatively small and subconical, not extending beyond posterior edges of paraprocts; subgenital plate similar in appearance to abdominal sternites. In lateral view, dorsal valves of ovipositor curved deeply upwards while ventral valves of ovipositor moderately curved downwards with small tooth at anteroventral edge, thus resembling a shallow claw.

Male measurements (in mm) (n = 23, including holotype): Body length 9.57–13.43 (average 12.13 ± 0.80); pronotum length 2.29–3.14 (average 2.86 ± 0.22); pronotum width 2.14–2.57 (average 2.32 ± 0.16); tegmina length 1.57–2.43 (average 2.11 ± 7.63); and hind femur length 6.71–8.29 (average 7.63 ± 0.42).

Female measurements (in mm) (n = 11, including allotype): Body length 14.71–19.86 (average 17.02 ± 1.36); pronotum length 3.43–4.14 (average 3.77 ± 0.27); pronotum width 2.86–4.00 (average 3.59 ± 0.34); tegmina length 2.14–3.29 (average 2.69 ± 0.38); and hind femur length 9.00–10.43 (average 9.73 ± 0.47).

Geographic Distribution (Fig. 1): This species is currently only known from a relatively small region of southeastern Florida across four counties: Okeechobee, Brevard, Indian, and St. Lucie, with the latter three being along the east coast. Ten Mile Ridge is located within this region while the Atlantic Coastal Ridge runs through it, and specimens have been collected from both, which suggests a possible historical ridge connection that needs further exploration. Of the other Puer Group *sensu stricto* species, only *Melanoplus kissimmee* Otte, 2012 ("2011") (Table 1) overlaps, with a single known location found 4.28 km (2.66 miles) from the closest known one for *M. amphora* **sp. nov.** (Fig. 1B) and relatively far from all other known locations of *M. kissimmee*, which are more towards south-central Florida. Of the other Puer Group *sensu lato* species, only *M. indicifer* Hubbell, 1933 (Table 1) has been collected in some of the same locations, suggesting similar habitat preferences.

Known Habitat (Fig. 3): Mainly collected from classic scrub habitat with minimal trees (dominantly pines, slash (*Pinus elliottii* Engelm.) and longleaf (*Pinus palustris* Mill.)), plenty of scrubby oaks (*Quercus* spp.), occasional gopher apple (*Licania michauxii* Prance) patches, scattered saw palmetto (*Serenoa repens* (Bartram)), *Smilax* spp. vines, and even scrub rosemary (*Ceratiola ericoides* Michx.) now and then. Florida scrub jays (*Aphelocoma coerulescens* (Bosc, 1795)) are also present at some sites and, more commonly, gopher tortoises (*Gopherus polyphemus* (Daudin, 1802)). Some encountered habitats were remnants of classic scrub and quite overgrown. All specimens collected by DAW and colleagues (Table 2) were in scrubby oaks and/or gopher apple.

Etymology: *M. amphora* **sp. nov.** is named after the Latin word for "vase" because its ventral valves of aedeagus in dorsal view strongly resemble a classic vase shape (Fig. 7I).

Holotype: Male (Fig. 6A & B). U.S.A.: FL: Brevard Co.: St. Sebastian River Preserve State Park, along Scrub Jay Link Trail, trailhead just N. of Fellsmere Rd./CR 512, [A: 27.770833,-80.565000], [B: 27.772778,-80.566667], [C: 27.772222,-80.567222] (Figs. 2A, 3D–F), 16-V-2015, coll. D.A. Woller, S.L. Kelly, & A.B. Orfinger, Field #PG200-1-A/B/C, mix of overgrown and classic scrub, did not separate A, B, or C specimens. Deposited in the UCFC, specimen with the unique identifier UCFC 0 577 309. Measurements (mm): Body length 12.71; pronotum length 3.14; pronotum width 2.57; tegmina length 2.43; and hind femur length 8.29.

Allotype: Female (Fig. 6C & D). Same locality info as holotype (Figs. 2A, 3D–F). Deposited in the UCFC with the unique identifier UCFC 0 577 311. Measurements (mm): Body length 16.14; pronotum length 3.71; pronotum width 3.29; tegmina length 2.14; and hind femur length 9.57.

Additional Type Material: 51 paratypes: 24 males, 11 females, 16 nymphs. See Table 2 for locality details and other information.

Melanoplus spiracor **sp. nov. Woller and Kelly**

(Figs. 1, 2B, 4A, 5C & D, 9–11)

General Description

A full list of unique anatomical components that separate this species from the other two new ones described here are found in Table 3. However, the primary character that separates this species from all other congeneric species is the shape of its ventral valves of aedeagus (see Fig. 15 for a comparison of all three new species), which, in dorsal view, resemble the shape of a triangle with a rounded base or a Hershey's Kiss chocolate, while, in lateral view, they resemble a mesmerizing, spiraling version of the classic artistic heart shape (the origin of its name, see Etymology section). Described from 99 specimens total (adult male holotype, adult female allotype, and 97 paratypes): 44 males, 36 females, 13 nymphs, and 6 copulating pairs.

Detailed Description

Note that the descriptions for each body region below are for adults of both sexes unless otherwise noted.

General Body Coloration (Figs. 5C & D, 9): Males light brown-yellowish (medium to light brown in females), often with some lateral black striping and scattered splashes of black (less-so in females), although darker or mottled variations exist; in males, integument of pronotum's dorsum, tegmina, and anterior abdominal areas tend to be slightly darker.

Head, Pronotum, and Thorax (Figs. 5C & D, 9): Antennae filiform and composed of 22 segments. Fastigium not overly pronounced, eyes very prominent and of variable coloration: usually yellow, red, brown, or a combination of these. Median carina obvious and raised slightly, intersected by three obvious sulci, one within the prozona's posterior portion and the other two continuing on from the lateral sulci that delimit the meso/metazona. Prosternal process subconical and prominent, often extending ventrally enough to be in line with the sternum. This stripe then often continues on through the metazona, although at the same width or, more narrowly, along the dorsolateral edge, and crosses over onto the pleurites, either fully or partially (splotches), and then onto the abdomen after passing behind the tegmina. An often-faint, thin black stripe emerges from just behind the midpoint of the eye and crosses onto the lateral sides of the pronotum where it darkens greatly and initially doubles in width, almost reaching the anteroventral edge, and then immediately narrows again diagonally, ending at approximately the same width it began and usually at the posterior edge of the mesozona, although occasional bleeding-over into dorsolateral region of the metazona or, more rarely, at same full width across metazona. When viewed in isolation, the pronotal stripe roughly resembles a right-angled trapezoid (the right angle being the anterodorsal corner of the prozona). This black stripe (now more abstract and less stripe-like) emerges again at its full width on the pleurites just beyond the pronotum, passes behind the tegmen, and extends onto the abdomen. In females, the overall striping is less common and less obvious in general, particularly behind the eye (when present, most obvious on the pronotum).

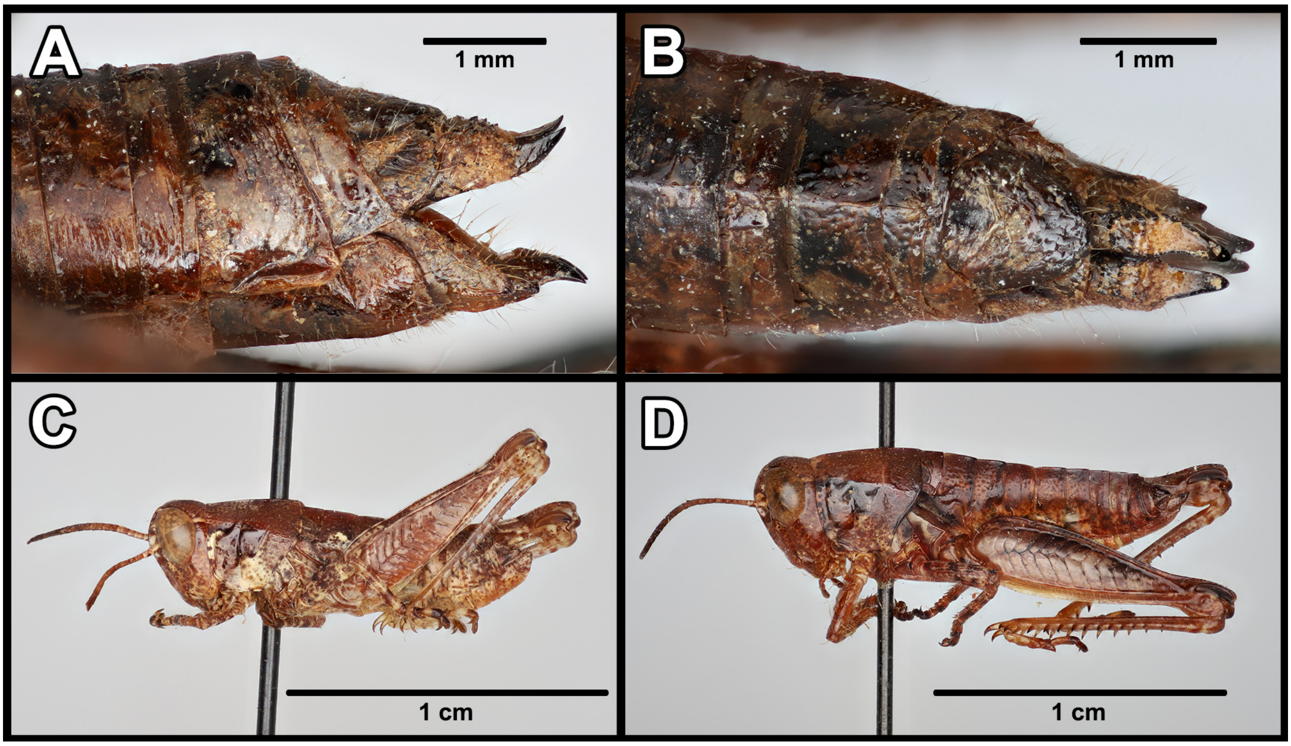

FIGURE 8. *Melanoplus amphora* **sp. nov.** female external genitalia (allotype): **A.** left lateral; **B.** dorsal; nymphs: **C.** male, possibly 4th instar (UMMZI-00050248); **D.** female, possibly 5th instar (UMMZI-00050252).

Abdomen, Tegmina, Legs (Figs. 5C & D, 9): Both sides of abdomen's anterior regions with the black stripe-like pattern that began on the thorax and head, typically ending at the posterior edge of tergite 2, with occasional black splashes beyond, mostly on tergites 3 and 4, and mostly on the anterior or posterior edges. In females, this pattern is less common and less obvious overall. Tegmina appear narrow, being moderately compressed dorsoventrally, and most often reaching at least the first quarter of tergite 2; covered in dense, raised reticulations. Fore and midfemora (most common) with occasional black splotches, mainly on dorsal side; hind femora quite variable, with assorted black splotches on dorsal side (almost always fewer in size and number compared to midfemora) and/or, rarely, along the medial area. In females, outer ventral edge of hind femora often a vivid yellow or, more rarely, reddish. Hind tibiae ventral coloration most often yellowish in males, matching rest of leg, but also occasionally muted purple, which can be faint (most common) or strong (quite rare); in females, yellowish-brown, sometimes with a hint of muted purple.

Terminalia:

Male, external (Fig. 10A &B): Furculae short and rounded strongly at apices. Supra-anal plate triangular to subtriangular with rounded apex and shallow, median groove that extends apically for approximately 1/3 to 1/2 the total length. Cerci shape approximately twice as wide at the base and tapering gently upwards towards a rounded apex, often coming short of reaching the apex of the supra-anal plate. Subgenital plate, semi-conical with a rounded apex in posterior view; pallium embedded slightly beneath inner edge.

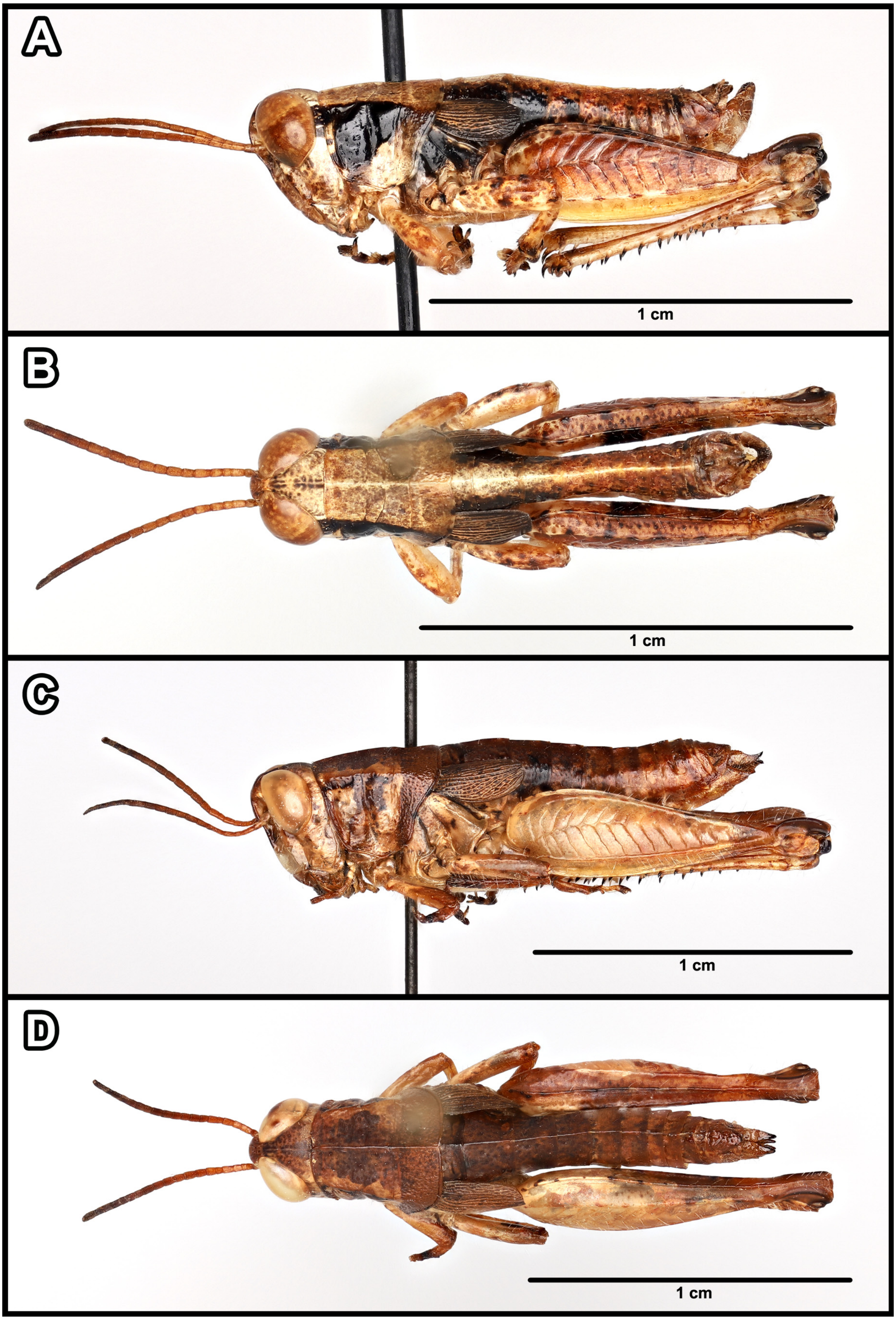

FIGURE 9. *Melanoplus spiracor* **sp. nov.**: holotype male: **A.** Habitus, left lateral view; **B.** Habitus, dorsal view; allotype female: **C.** Habitus, left lateral view; **D.** Habitus, dorsal view.

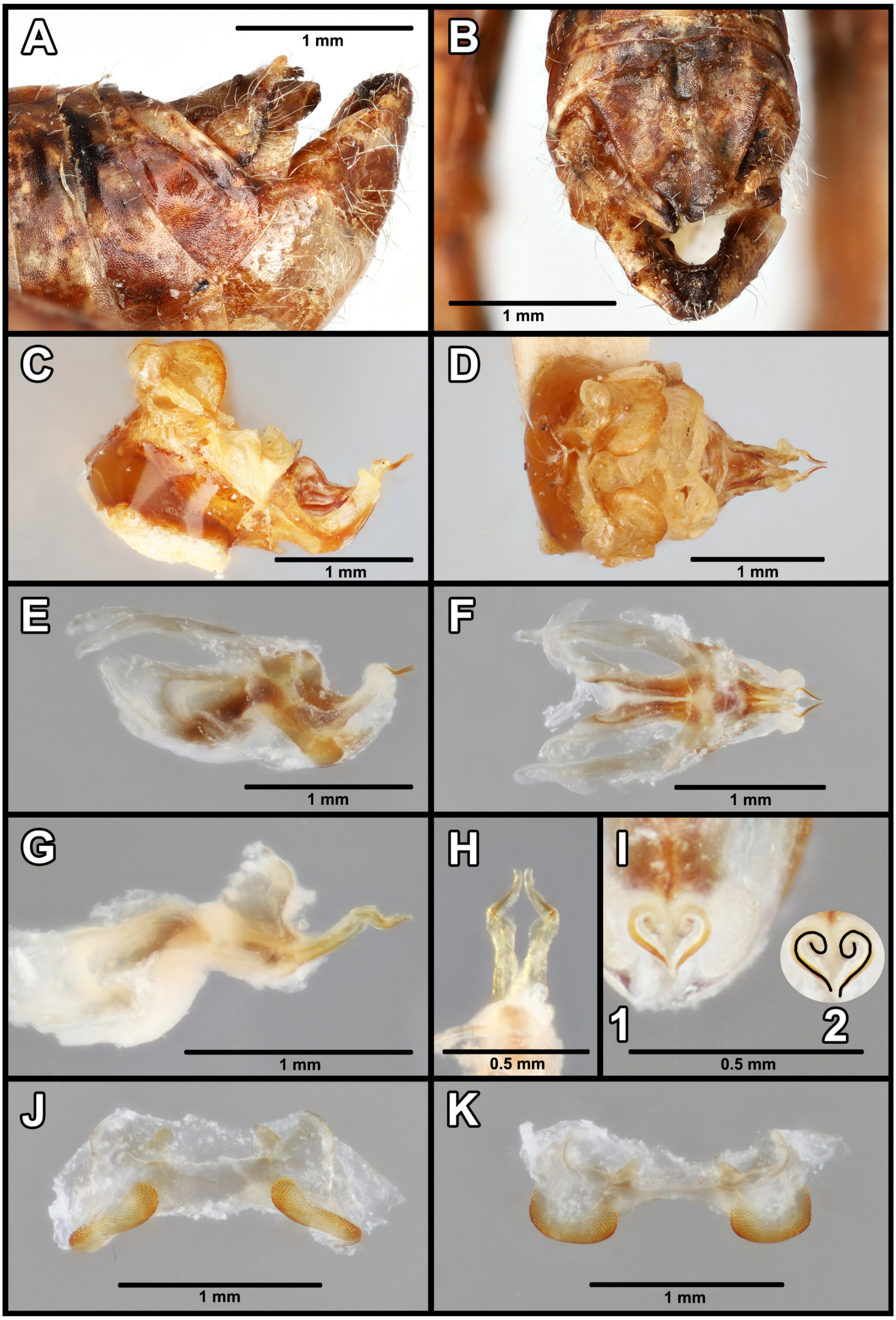

FIGURE 10. *Melanoplus spiracor* **sp. nov.** male: external genitalia (with internal genitalia removed) (holotype): **A.** left lateral; **B.** dorsal; internal genitalia, phallic complex (UMMZI-00050228): **C.** left lateral; **D.** dorsal; internal genitalia (KOH-cleared): **E.** phallic complex, left lateral (holotype); **F.** phallic complex, dorsal (holotype); **G.** endophallus, left lateral (UMMZI-00050161); **H.** ventral valves of aedeagus, dorsal view (UMMZI-00050161); **I.** ventral valves of aedeagus, posterior view (holotype): **1)** average shape; **2)** overlaid drawing to visually explain the etymology of the specific name, *spiracor*, which is a combination of the Latin words for "coil" (spira) and "heart" (cor) since the shape resembles a mesmerizing spiraling classic heart; **J.** epiphallus, dorsal view, posterior downwards (holotype); **K.** epiphallus, anterior view, dorsal downwards (holotype). *(see Fig. 7 for the names and locations of anatomical components).*

Male, internal phallic complex (Fig. 10C–K): Overall, typical for a melanopline, particularly Puer Group *sensu lato* species, with the unique characters described below for the epiphallus, ectophallus, and endophallus, many of which are shared by *M. amphora* **sp. nov.** and *M. ferrarius* **sp. nov.**, with the sheath of aedeagus and ventral valves of aedeagus being the two most unique structures for each of the three species (Fig. 15, Table 3):

TABLE 3. Average comparisons of anatomical components of interest between the three new *Melanoplus* species. *Indicates the components of two species are similar.

Sex	Body Region	Component(s)	***M. amphora* sp. nov** (53 specimens)	***M. spiracor* sp. nov** (99 specimens)	***M. ferrarius* sp. nov.** (38 specimens)
Male	**External**	**average body length and other measured components**	larger* (all components very similar in length to *M. ferrarius* **sp. nov.**); average body length 12.13 ± 0.80 mm	smaller; average body length 10.88 ± 1.0 mm	larger* (all components very similar in length to *M. amphora* **sp. nov**.); average body length 12.13 ± 0.76 mm
		general body coloration	often light brown-yellowish*	often light brown-yellowish*	often light to medium brown
		lateral pronotal stripe	often stops at posterior edge of mesozona*	often stops at posterior edge of mesozona*	often extends beyond mesozona
		tegmina	does not extend as far onto abdomen	often extends farther onto abdomen*	often extends farther onto abdomen*
		hind femora medial area	sometimes with black coloration*	rarely with black coloration	sometimes with black coloration*
		hind tibiae ventral coloration	usually yellow, sometimes faintly lavender*	usually yellow, sometimes faintly lavender*	usually lavender, sometimes yellow
		cerci	sometimes extend to apex of supra-anal plate or beyond*	not known to extend to apex of supra-anal plate or beyond	sometimes extend to apex of supra-anal plate or beyond*
	Internal	**lobes of sheath of aedeagus size**	medium	small	large
		dorsal valves of aedeagus length	long*	short	long*
		dorsal valves of aedeagus apices	flare upwards fairly strongly	often ephemeral and very difficult to see	obvious and blunt
		ventral valves of aedeagus length	long	short	medium
		ventral valves of aedeagus corkscrew	not present	present, tight	present, stretched-out
		ventral valves of aedeagus shape (dorsal view)	classic vase, sideways fish (as drawn by a child), or open-top hourglass	triangle with rounded base or Hershey's Kiss chocolate	forceps commonly used by the village blacksmith/dentist to extract teeth in the 17th and 18th centuries

.....*continued on the next page*

TABLE 3. (Continued)

Sex	Body Region	Component(s)	*M. amphora* sp. nov (53 specimens)	*M. spiracor* sp. nov (99 specimens)	*M. ferrarius* sp. nov. (38 specimens)
		ventral valves of aedeagus shape (posterior view)	curving-upwards tips of classic elf shoes	mesmerizing, spiraling version of the classic artistic heart shape	(same as dorsal view above)
Female	**External**	**average body length**	larger*; average body length 17.02 ± 1.36 mm	smaller; average body length 15.04 ± 1.66 mm	larger*; average body length 16.95 ± 1.67 mm
		hind femora medial area	sometimes with black coloration	rarely with black coloration	often with black coloration
		hind femora outer ventral edge coloration	often reddish*	often vivid yellow, rarely reddish	often reddish*
		hind tibia ventral coloration	usually yellowish-brown, sometimes with hint of muted purple*	usually yellowish-brown, sometimes with a hint of lavender	usually yellowish-brown, sometimes with hint of muted purple*

Epiphallus (Fig. 10J & K): Ancorae subtriangular, relatively elongate, bent slightly ventrally, and curving slightly inwards; lophi prominent, subrectangular, fairly narrow (laterally compressed), and covered in raised microstructures; anterior projections generally rounded with no defined shape; posterior projections, in dorsal view, either obscured by the lophi or slightly extending beyond posterior edges of lophi.

Ectophallus (Fig. 10C–F): Apodemes of cingulum elongate and zygoma shelf-like, meaning both resemble all other Puer Group species. Rami prominent, extending posteriorly at about a 45° angle and curving inwards slightly, with final 1/3rd bent at a 90° angle that curves slightly upwards and usually running parallel to the ventral valves of aedeagus, terminating at approximately the midpoint of the valves or beyond, and tapering to a fairly sharp apex; when viewed laterally, the ramus resembles an upside-down scythe. Sheath of aedeagus taking the form of two halves that do not meet, each consisting of an apical lobe that arises from the apical, "scythe blade" region of the rami, which extends dorsally at a 45° angle, and usually terminates slightly beyond the dorsum of the ventral valves. These lobes are oblong in shape, laterally compressed strongly, and with the rounded apices enlarged to some degree and flared outwards strongly; covered in raised microstructures.

Endophallus (Fig. 10G–I): Apodemes of endophallus large and rounded like all other Puer Group species; arch of aedeagus well-developed. Dorsal valves of aedeagus do not meet flexures, are about 1/3 the length of ventral valves, with basal ½ more robust, and fused and fairly flat for almost entire length except for final ¼ (often ephemeral and very difficult to see), which has a y-shaped cleft, each half terminating bluntly near the apices of the lobes of the sheath of aedeagus. Ventral valves of aedeagus meet flexures, are thrice as long as the dorsal valves, with basal third more robust, and the remaining 2/3 forming a unique rigid pattern. When viewed dorsally (with valve apices oriented north, see Fig. 10H), the general pattern is as follows: each valve undergoes a single, tight corkscrew (right valve spirals counterclockwise, left valve spirals clockwise) that then immediately bends strongly outwards, either just beneath the lobes of the sheath of aedeagus or just beyond them; if the former condition, observing the telltale corkscrews can be difficult without KOH-clearing and can still be difficult even then without moving aside the lobes, but the effect can be seen well in posterior view (Fig. 10I-1) or in dried, pre-KOH-cleared specimens (Fig. 10D). The final 1/4th of each valve (the only portion often seen clearly in specimens due to the afore-mentioned lobe-obscurement) curves gently inwards until their apices are almost touching, usually for a relatively short distance; overall, the dorsal shape resembles either a triangle with a rounded base or a Hershey's Kiss chocolate. When viewed laterally, the corkscrews (obscured by lobes or not) are essentially invisible (dry specimens being a possible exception) and the valves (just beyond the corkscrew) look like they curve downwards about 45° to about the midpoint of the lobes of the sheath of aedeagus, after which they bend almost 90° and extend posteriorly for a short distance; overall, the two valves are fairly parallel and line up well in lateral view. When viewed posteriorly, the apices of the ventral valves resemble a mesmerizing, spiraling version of the classic artistic heart shape (Fig. 10I-2).

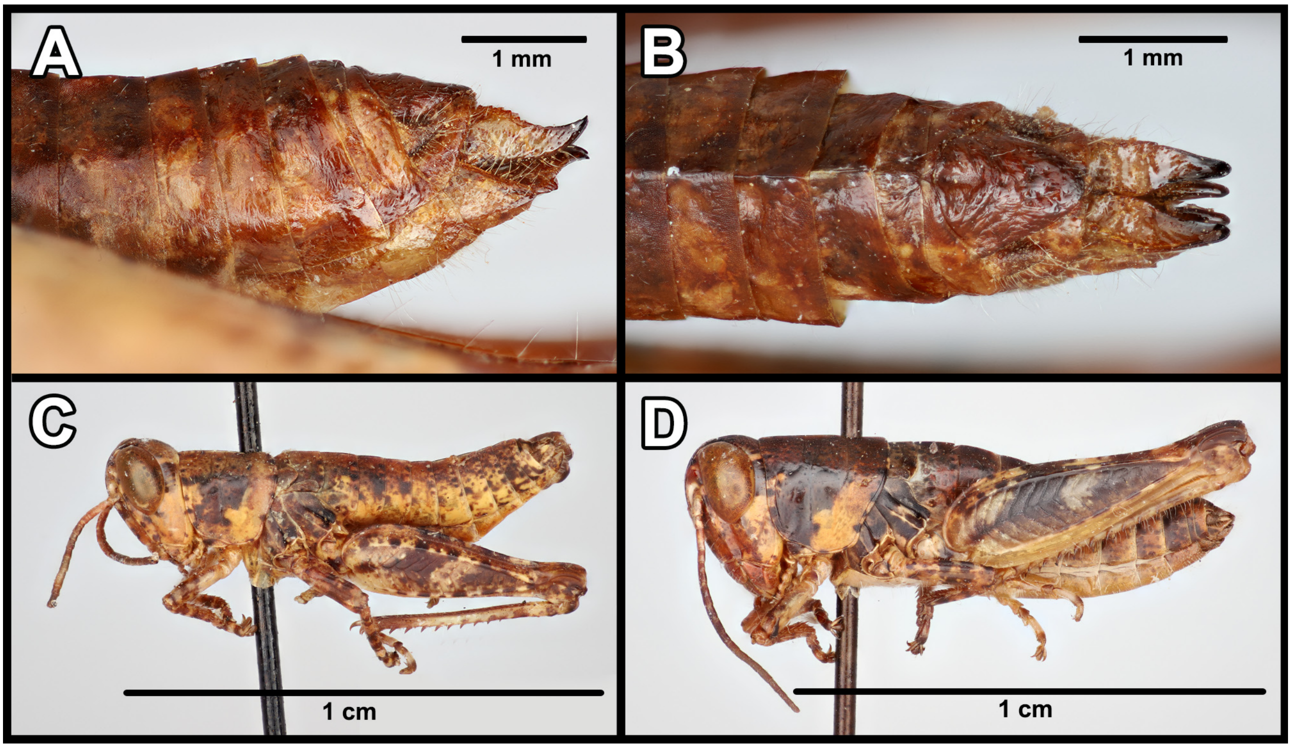

FIGURE 11. *Melanoplus spiracor* **sp. nov.** female external genitalia (allotype): **A.** left lateral; **B.** dorsal; nymphs: **C.** male, possibly 3rd instar (FSCA 00033497); **D.** female, possibly 4th instar (UMMZI-00050170).

Female, external (Fig. 11A & B): Supra-anal plate subtriangular; cerci relatively small and subconical, not extending beyond posterior edges of paraprocts; subgenital plate similar in appearance to abdominal sternites. In lateral view, dorsal valves of ovipositor curved deeply upwards while ventral valves of ovipositor moderately curved downwards with small tooth at anteroventral edge, thus resembling a shallow claw.

Male measurements (in mm) (n = 11, including holotype): Body length 9.29–12.86 (average 10.88 ± 1.03); pronotum length 2.43–2.86 (average 2.62 ± 0.11); pronotum width 1.86–2.14 (average 1.99 ± 0.10); tegmina length 1.71–2.71 (average 2.06 ± 0.26); and hind femur length 6.43–7.43 (average 7.10 ± 0.31).

Female measurements (in mm) (n = 11, including allotype): Body length 11.86–17.86 (average 15.04 ± 1.66); pronotum length 2.86–3.86 (average 3.44 ± 0.278); pronotum width 2.71–3.57 (average 3.16 ± 0.31); tegmina length 1.71–3.00 (average 2.44 ± 0.38); and hind femur length 7.57–9.71 (average 8.91 ± 0.61).

Geographic Distribution (Fig. 1): This species is currently only known from a small region of southwestern Florida across three counties: Hillsborough, Manatee, and Sarasota, all of which are along the west coast. The nearest ridge of note is Lakeland Ridge, which is ~48.28 km (30 miles) northeast of the most eastward location for this species. No other Puer Group *sensu lato* or Puer Group *sensu stricto* species are yet known to overlap with this species. The closest one is *M. seminole* Hubbell, 1932, which is to the south and east (Fig. 1B), and strongly resembles this new species, especially the internal genitalia (Fig. 16, Table 4).

Known Habitat (Fig. 4A): Collected from sandhills habitat as well as sparse pine flatwoods habitat containing a mix of oaks (*Quercus* spp.), both overgrown and scrubby, and interspersed with swaths of saw palmetto (*S. repens*). All specimens collected by DAW and colleagues (Table 2) were in scrubby oaks.

Etymology: *M. spiracor* **sp. nov.** is named after a combination of the Latin words for "coil" (spira) and "heart" (cor) because its ventral valves of aedeagus in posterior view strongly resemble a mesmerizing, spiraling version of the classic artistic heart shape (Fig. 10I).

Holotype: Male (Fig. 9A & B). U.S.A.: FL: Brevard Co.: Hillsborough Co., Little Manatee River State Park, 5 miles S. of Sun City, on both sides of trail slightly NE of park entrance off of Lightfoot Rd., [27.658500,-82.374083]

(Figs. 2B, 4A), 27-III-2013, coll. D.A. Woller & S.L. Kelly, Field #PG121-1-A, unusual habitat - resembles pine flatwoods with more oaks than pines, following up on a Hubbell lead. Deposited in the UCFC with the unique identifier UCFC 0 577 316. Measurements (mm): Body length 10.00; pronotum length 2.43; pronotum width 2.00; tegmina length 1.71; and hind femur length 6.57.

Allotype: Female (Fig. 9C & D). Same locality info as holotype (Figs. 2B, 4A). Deposited in the UCFC with the unique identifier UCFC 0 577 318. Measurements (mm): Body length 13.71; pronotum length 3.29; pronotum width 2.71; tegmina length 2.29; and hind femur length 8.71.

Additional Type Material: 97 paratypes: 43 males, 35 females, 13 nymphs, 3 copulating pairs. See Table 2 for locality details and other information.

TABLE 4. Average comparisons of the key components of male internal genitalia of two species that are in close geographic proximity (Fig. 1B) and strongly resemble each other otherwise: *Melanoplus spiracor* **sp. nov.** and *M. seminole* Hubbell, 1932 (Table 1 and see Fig. 16 for visual comparisons).

Component(s)	***M. spiracor* sp. nov**	***M. seminole* (Hubbell, 1932)**
ventral valves of aedeagus length	longer	shorter
ventral valves of aedeagus bow out (dorsal view)	once	twice
ventral valves of aedeagus (lateral view)	curve downwards about 45° (just beyond the corkscrew)	extend straight out (more or less)
ventral valves of aedeagus corkscrew	tight and near base of apical 2/3	stretched-out along entire apical 2/3, but tighter basally

Melanoplus ferrarius sp. nov. Woller, Kelly, and Orfinger

(Figs. 1, 2C, 4B–D, 5E & F, 12–14)

General Description

A full list of unique anatomical components that separate this species from the other two new ones described here are found in Table 3. However, the primary character that separates this species from both the other new species and other congeneric species is the shape of its ventral valves of aedeagus (see Fig. 15 for a comparison of all three new species), which, in dorsal and lateral views, resembles the forceps used by village blacksmiths to extract teeth in the 17th and 18th centuries since blacksmiths were also commonly dentists (the origin of its name, see Etymology section). Described from 38 specimens total (adult male holotype, adult female allotype, and 36 paratypes): 17 males, 16 females, and 5 nymphs.

Detailed Description

Note that the descriptions for each body region below are for adults of both sexes unless otherwise noted.

General Body Coloration (Figs. 5E & F, 12): Males usually light to medium brown (medium to light brown in females) with some occasional yellow mixed in, usually on legs, and often with some lateral black striping and scattered splashes of black (less-so in females), although darker variations exist; in males, integument of pronotum's dorsum, tegmina, and anterior abdominal areas slightly darker occasionally.

Head, Pronotum, and Thorax (Figs. 5E & F, 12): Antennae filiform and composed of 22 segments. Fastigium not overly pronounced, eyes very prominent and of variable coloration: usually yellow, red, brown, or a combination of these. Median carina obvious and raised slightly, intersected by three obvious sulci, one within the prozona's posterior portion and the other two continuing on from the lateral sulci that delimit the meso/metazona. Prosternal process subconical and prominent, often extending ventrally enough to be in line with the sternum. An often-faint, thin black stripe emerges from just behind the midpoint of the eye and crosses onto the lateral sides of the pronotum where it darkens greatly and initially doubles (at least) in width, sometimes reaching the anteroventral edge, and then immediately narrows again diagonally, typically ending at approximately the same width it began. This stripe then often continues on through the metazona, although at the same width or, more narrowly, along the dorsolateral edge, and crosses over onto the pleurites, either fully or partially (splotches), and then onto the abdomen after passing behind the tegmina. In females, the overall striping is less common and less obvious in general, particularly behind the eye, but, when present, most obvious on the pronotum and often ending at the posterior edge of the mesozona. When viewed in isolation, the female's pronotal stripe roughly resembles a right-angled trapezoid (the right angle being the anterodorsal corner of the prozona). This black stripe (now more abstract and less stripe-like) emerges again at its full width on the pleurites just beyond the pronotum, passes behind the tegmen, and extends onto the abdomen.

Abdomen, Tegmina, Legs (Figs. 5E & F, 12): Both sides of abdomen's anterior regions with the black stripe-like pattern that began on the thorax and head, typically ending at the posterior edge of tergite 2, with occasional black splashes beyond, mostly on tergites 3 and 4, and mostly on the anterior or posterior edges. In females, this pattern is less common and less obvious overall. Tegmina appear narrow, being moderately compressed dorsoventrally, and most often reaching at least the first quarter of tergite 2; covered in dense, raised reticulations. Fore and midfemora (most common) with occasional black splotches, mainly on dorsal side; hind femora quite variable, with assorted black splotches on dorsal side (almost always fewer in size and number compared to midfemora) and/or sometimes along the medial area (if present, usually more homogenous than splotchy). In females, outer ventral edge of hind femora often reddish, rarely bleeding upwards onto the medial area. Hind tibiae ventral coloration most often muted purple, but occasionally yellow.

Terminalia:

Male, external (Fig. 13 A & B): Furculae short and rounded strongly at apices. Supra-anal plate triangular to subtriangular with rounded apex and shallow, median groove that extends apically for approximately 1/3 to 1/2 the total length. Cerci shape approximately twice as wide at the base and tapering gently upwards towards a rounded apex, often nearly reaching the apex of the supra-anal plate or, more rarely, reaching it or even extending slightly beyond. Subgenital plate, semi-conical with a rounded apex in posterior view; pallium embedded slightly beneath inner edge.

Male, internal phallic complex (Fig. 13C–K): Overall, typical for a melanopline, particularly Puer Group *sensu lato* species, with the unique characters described below for the epiphallus, ectophallus, and endophallus, many of which are shared by *M. amphora* **sp. nov.** and *M. spiracor* **sp. nov.**, with the sheath of aedeagus and ventral valves of aedeagus being the two most unique structures for each of the three species (Fig. 15, Table 3):

Epiphallus (Fig. 13J & K): Ancorae subtriangular, relatively elongate, bent slightly ventrally, and curving slightly inwards; lophi prominent, subrectangular, fairly narrow (laterally compressed), and covered in raised microstructures; anterior projections generally rounded with no defined shape; posterior projections, in dorsal view, either obscured by the lophi or slightly extending beyond posterior edges of lophi.

Ectophallus (Fig. 13C–F): Apodemes of cingulum elongate and zygoma shelf-like, meaning both resemble all other Puer Group species. Rami prominent, extending posteriorly at about a 45° angle and curving inwards slightly, with final 1/3rd bent at a 90° angle that curves slightly upwards and usually running parallel to the ventral valves of aedeagus, terminating at approximately the midpoint of the valves, and tapering to a fairly sharp apex; when viewed laterally, the ramus resembles an upside-down scythe. Sheath of aedeagus taking the form of two halves that do not meet, each consisting of an apical lobe that arises from the apical, "scythe blade" region of the rami, which extend dorsally at a 45° angle, and usually terminates with a third of its length above the dorsum of the ventral valves of aedeagus. These lobes are obvious and robust, oblong in shape, and laterally compressed moderately, with apices more bulbous and occasionally appearing to almost touch in dorsal view; covered in raised microstructures.

Endophallus (Fig. 13G–I): apodemes of endophallus large and rounded like all other Puer Group species; arch of aedeagus well-developed. Dorsal valves of aedeagus do not meet flexures, are about 1/2 the length of ventral valves, with basal ½ more robust, and fused and fairly flat for almost entire length except for final ¼, which has a y-shaped cleft, each half terminating obviously and bluntly near the apices of the lobes of the sheath of aedeagus. Ventral valves of aedeagus meet flexures, are twice as long as the dorsal valves, with basal third more robust, and the remaining 2/3 forming a unique rigid pattern. When viewed dorsally (with valve apices oriented north, Fig. 13I-1), the general pattern is as follows: although quite difficult to see, each valve essentially resembles a stretched-out corkscrew that rotates at least one full 360° revolution (right valve spirals clockwise, left valve spirals counterclockwise); high magnification and steady eyes are often required, with the effect often easier to see on dried, pre-KOH-cleared specimens (Fig. 13C & D). With this in mind, the valves begin simultaneously bowing outwards (obviously to strongly, but not known to go beyond the midpoint of the apices of the lobes of sheath of aedeagus) just prior to the apices of the lobes of the sheath of aedeagus, and then gently inwards again, usually almost meeting at the start of the final 1/4th, then curving gently outwards or pointing posteriorly and terminating that way; final 1/4th resembling curved hooks and typically crossing (or looking as if they are about to), both right over left and the inverse; overall, the dorsal shape strongly resembles the forceps used by historical village blacksmiths for tooth extraction or, perhaps, a pair of garden shears with overly long, bowed handles. When viewed laterally (Fig. 13G), the corkscrew effect is essentially invisible and the valves simply look like they curve downwards about 45° to about the midpoint of the lobes of the sheath of aedeagus, after which they bend almost 90° and extend posteriorly for a short distance, with the apices usually curved slightly ventrally; overall, the two valves are poorly parallel and both valves can often be seen to some degree up in lateral view. When viewed posteriorly, the ventral valves look the same as they do in dorsal view.

Female, external (Fig. 14 A & B): Supra-anal plate subtriangular; cerci relatively small and subconical, not extending beyond posterior edges of paraprocts; subgenital plate similar in appearance to abdominal sternites. In lateral view, dorsal valves of ovipositor curved deeply upwards while ventral valves of ovipositor moderately curved downwards with small tooth at anteroventral edge, thus resembling a shallow claw.

Male measurements (in mm) (n = 14, including holotype): Body length 10.14–13.14 (average 12.13 ± 0.76); pronotum length 2.43–3.14 (average 2.92 ± 0.18); pronotum width 2.14–2.57 (average 2.31 ± 0.14); tegmina length 1.86–2.43 (average 2.19 ± 0.19); and hind femur length 7.29–8.86 (average 7.85 ± 0.49).

Female measurements (in mm) (n = 16, including allotype): Body length 14.00–20.14 (average 16.95 ± 1.67); pronotum length 3.29–4.00 (average 3.71 ± 0.17); pronotum width 3.00–3.71 (average 3.50 ± 0.19); tegmina length 1.86–3.43 (average 2.71 ± 0.40); and hind femur length 8.43–10.43 (average 9.66 ± 0.54).

Geographic Distribution (Fig. 1): This species is currently only known from a single location in southeastern Florida within Martin County: Jonathan Dickinson State Park, which is along the east coast between the middle and southern sections of the Atlantic Coastal Ridge. Within the park, this species has been collected so far from four subsites (Fig. 2C). Of the other Puer Group *sensu lato* species, only *M. indicifer* Hubbell, 1933 (Table 1) has been collected in the same location, suggesting similar habitat preferences. No other Puer Group *sensu stricto* species are yet known to overlap with this species, with *M. amphora* **sp. nov.** being the closest to the north (Fig. 1A). Despite this, *M. kissimmee* (Table 1) strongly resembles this new species at first glance, particularly the internal genitalia, but there are differences (Fig. 17, Table 5).

TABLE 5. Average comparisons of the key components of male internal genitalia of two species that strongly resemble each other at first glance, but have so far not been collected in geographic proximity to each other (Fig. 1B): *Melanoplus ferrarius* **sp. nov.** and *M. kissimmee* Otte, 2012 ("2011") (Table 1 and see Fig. 17 for visual comparisons).

Component(s)	***M. ferrarius* sp. nov**	***M. kissimmee* Otte, 2012 ("2011")**
lobes of sheath of aedeagus size and shape	larger, apices more bulbous	smaller, apices less bulbous
lobes of sheath of aedeagus length (lateral view)	longer, extend beyond dorsum of ventral valves of aedeagus	shorter, do not extend beyond dorsum of ventral valves of aedeagus
ventral valves of aedeagus bow out (dorsal view)	more narrowly (usually)	more broadly (usually)
ventral valves of aedeagus (lateral view)	curve downwards about 45°	extend straight out (more or less)
ventral valves of aedeagus corkscrew	more obvious	less obvious
ventral valves of aedeagus apices	often crossing or about to, resembling pair of garden shears	not crossing, but occasionally starting to slightly overlap

Known Habitat (Fig. 4B–D): Collected from classic pine flatwoods, most likely south Florida slash pine (*P. elliottii* var. *densa*) in fairly dense understory of scrubby oaks (*Quercus* spp.) and wiregrass (*Aristida stricta* Michx.), but with some open swaths and scattered gopher apple (*L. michauxii*) patches. All specimens collected by DAW and colleagues (Table 2) were in the latter.

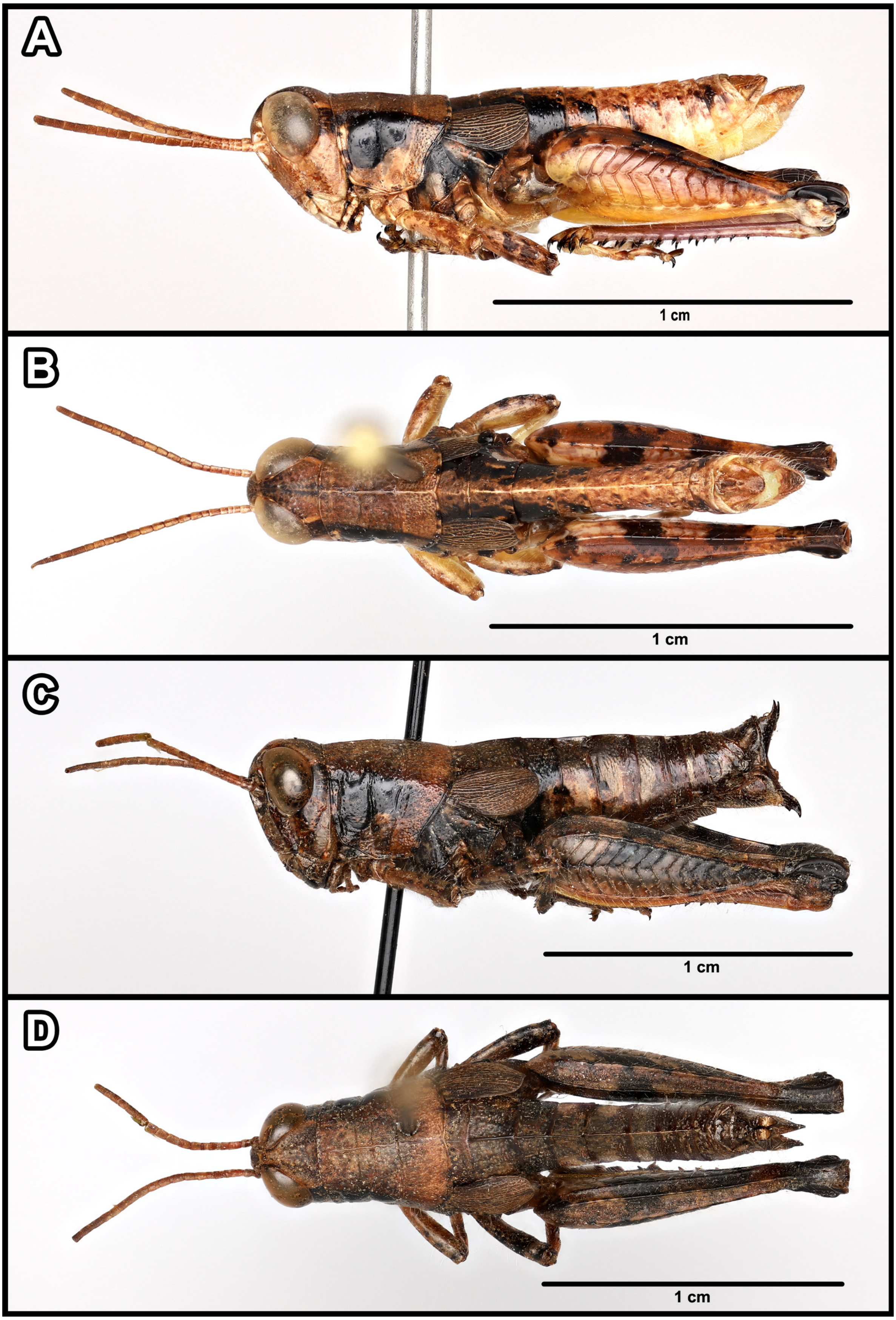

FIGURE 12. *Melanoplus ferrarius* **sp. nov.**: holotype male: **A.** Habitus, left lateral view; **B.** Habitus, dorsal view; allotype female: **C.** Habitus, left lateral view; **D.** Habitus, dorsal view.

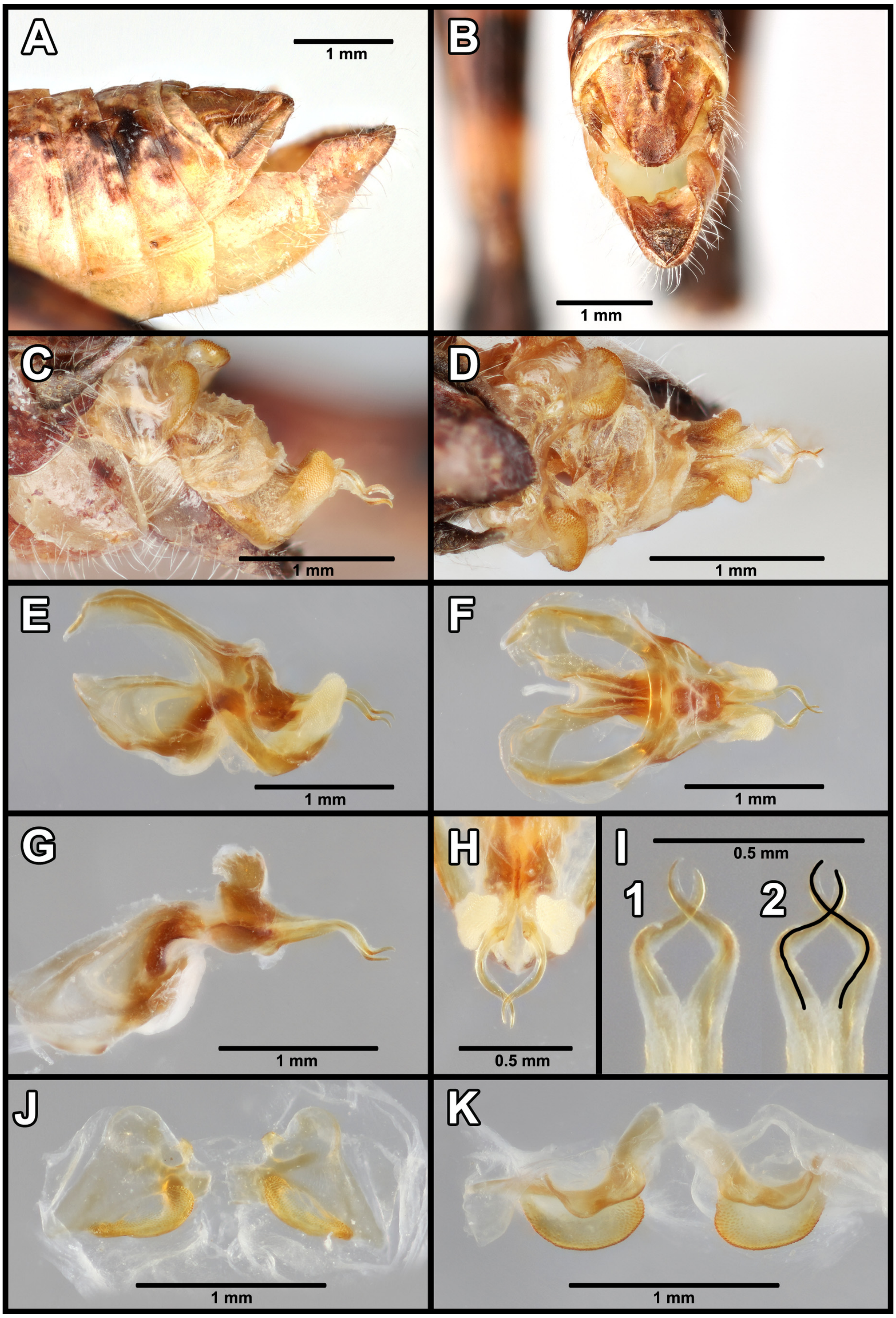

FIGURE 13. *Melanoplus ferrarius* **sp. nov.** male: external genitalia (with internal genitalia removed) (holotype): **A.** left lateral; **B.** dorsal; internal genitalia, phallic complex (DAW-0000003): **C.** left lateral; **D.** dorsal; internal genitalia (KOH-cleared): **E.** phallic complex, left lateral (holotype); **F.** phallic complex, dorsal (holotype); **G.** endophallus, left lateral (DAW-201-1-C-1); **H.** ventral valves of aedeagus, posterior view (holotype); **I.** ventral valves of aedeagus, dorsal view (DAW-201-1-C-1): **1)** average shape; **2)** overlaid drawing to visually explain the etymology of the specific name, *ferrarius*, which is Latin for "blacksmith" since the shape resembles the forceps used by village blacksmiths to extract teeth in the 17th and 18th centuries since blacksmiths were also commonly dentists; **J.** epiphallus, dorsal view, posterior downwards (*bridge broken at center) (holotype); **K.** epiphallus, anterior view, dorsal downwards (*bridge broken at center) (holotype). *(see Fig. 7 for the names and locations of anatomical components)*

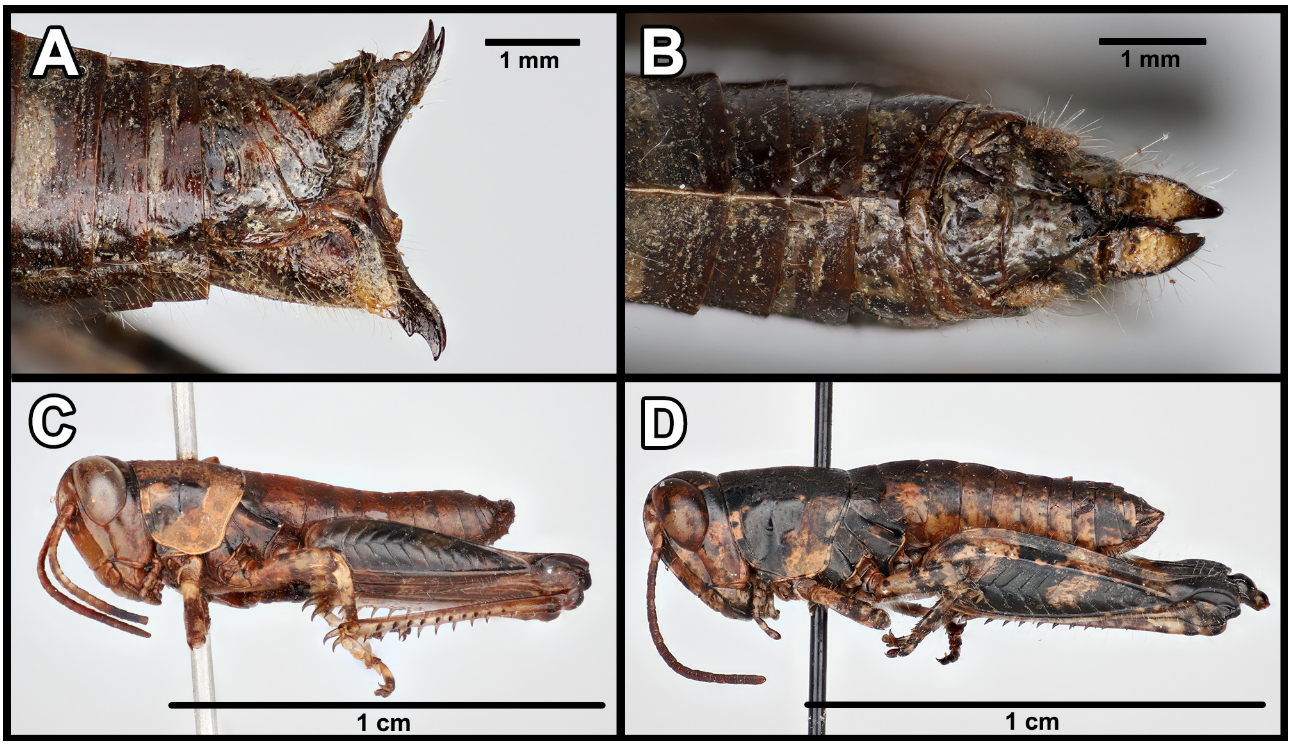

FIGURE 14. *Melanoplus ferrarius* **sp. nov.** female external genitalia (allotype): **A.** left lateral; **B.** dorsal; nymphs: **C.** male, possibly 4th instar (MEM 455057); **D.** female, possibly 4th instar (UCFC 0 577 325).

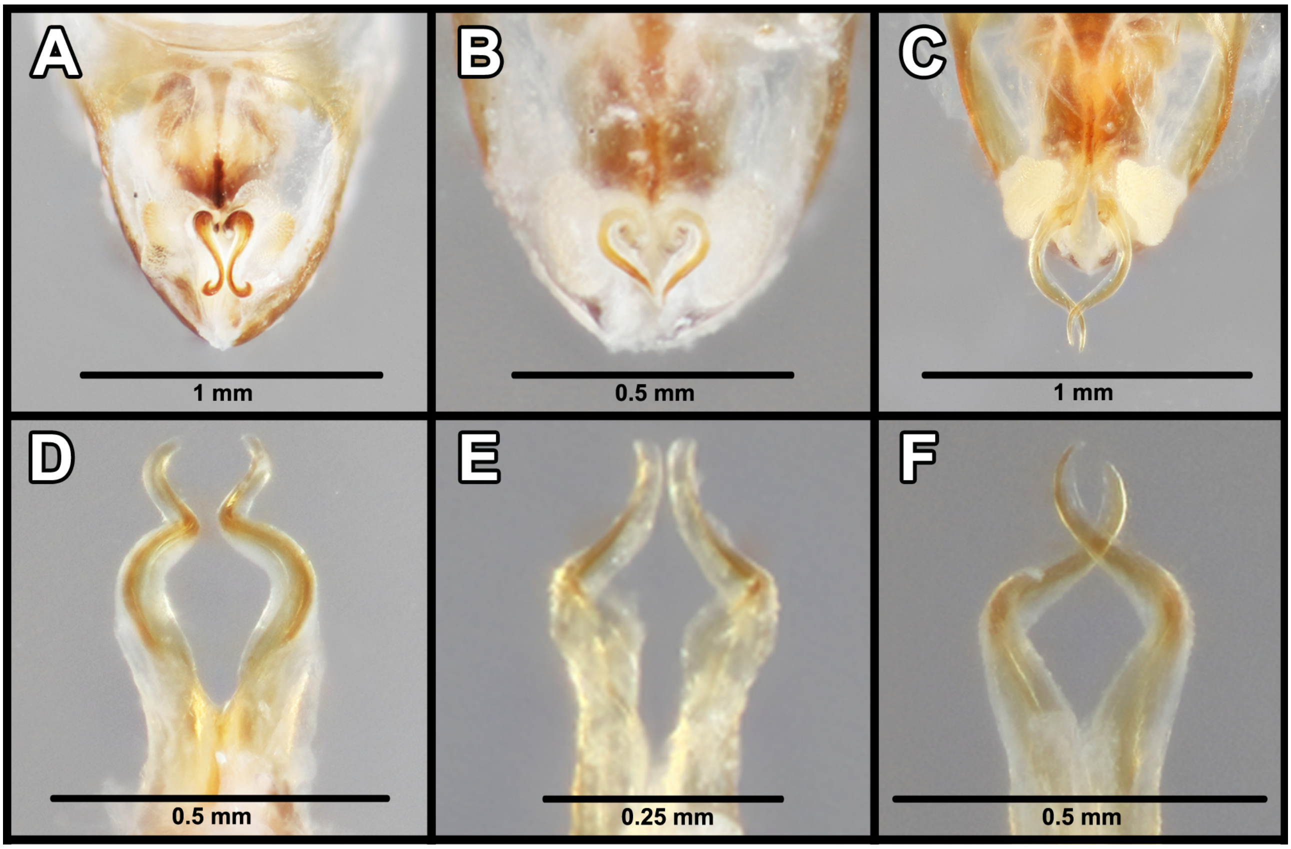

FIGURE 15. Comparison of the ventral valves of aedeagus of all three new species in: posterior view: **A.** *Melanoplus amphora* **sp. nov.**; **B.** *M. spiracor* **sp. nov.**; **C.** *M. ferrarius* **sp. nov.**; dorsal view: **D, E, and F** in the same species order as posterior view. *(see Fig. 7 for the names and locations of anatomical components)*

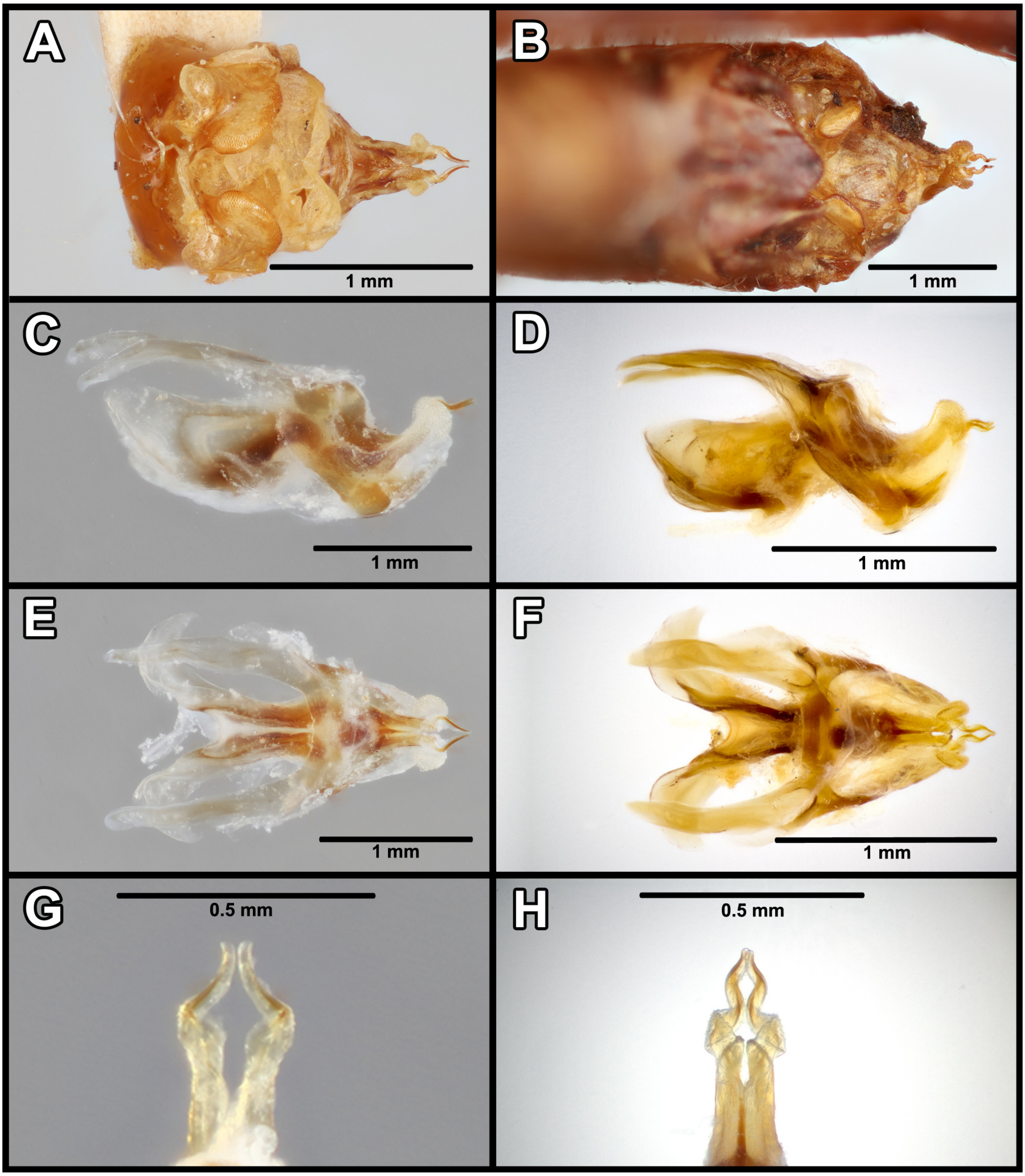

FIGURE 16. Comparison of male internal genitalia of *Melanoplus spiracor* **sp. nov.** (**A**, **C**, **E**, **G**) vs. *M. seminole* Hubbell, 1932 (**B**, **D**, **F**, **H**) (see Table 4 for average comparisons of the key components*)*, which are in close geographic proximity (Fig. 1B) and strongly resemble each other otherwise: **A and B.** uncleared phallic complex, dorsal view (B = UMMZI-00050173); **C and D.** KOH-cleared phallic complex with epiphallus removed, left lateral view; **E and F.** same as C and D, but dorsal view; **G and H.** KOH-cleared ventral valves of aedeagus, dorsal view. (**D, F, H** = FL: Highlands Co., Venus, 19-IV-1958, Det. H.F. Strohecker (FSCA, no unique identifier yet)). *(see Fig. 7 for the names and locations of anatomical components)*

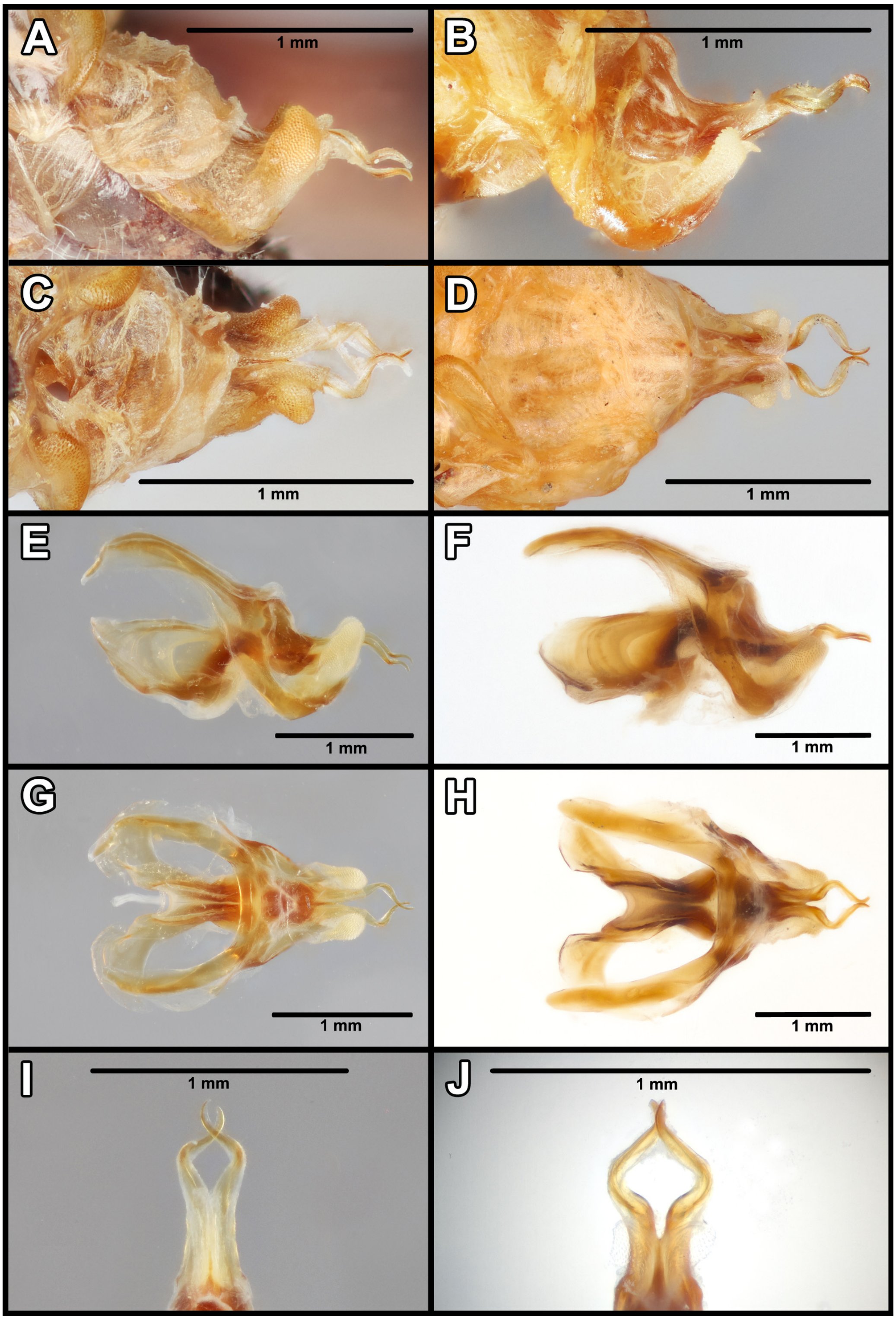

FIGURE 17. Comparison of male internal genitalia of *Melanoplus ferrarius* **sp. nov.** (**A**, **C**, **E**, **G**, **I**) vs. *M. kissimmee* Otte, 2012 ("2011") (**B**, **D**, **F**, **H**, **J**) (see Table 5 for average comparisons of the key components*)*, which strongly resemble each other at first glance, but have so far not been collected in geographic proximity to each other (Fig. 1B): **A and B.** uncleared phallic complex, lateral view; **C and D.** same as A and B, but dorsal view; **E and F.** KOH-cleared phallic complex with epiphallus removed, left lateral view; **G and H.** same as E and F, but dorsal view; **I and J.** KOH-cleared ventral valves of aedeagus, dorsal view. (**B & D** = FL: Brevard Co., 10 mi. N. Sebastian River, 24-V-1931, coll. T.H. Hubbell, Field # 2, atypical eastern phase, Det. T.H. Hubbell, 1931 (NCSU, no unique identifier yet); **F, H, J** = FL: Osceola Co., Kissimmee, 9–10-IX-1917, coll. Rehn & Hebard, Paratype, in cypress bay, Det. Otte, 1994 (Academy of Natural Sciences of Drexel University or ANSP, no unique identifier yet)). *(see Fig. 7 for the names and locations of anatomical components)*

Etymology: *M. ferrarius* **sp. nov.** is named after the Latin word for "blacksmith" because its ventral valves of aedeagus in both dorsal and posterior view strongly resemble the forceps used by village blacksmiths to extract teeth in the 17th and 18th centuries since blacksmiths were also commonly dentists (Fig. 13I-2). Note that "forceps" was briefly considered for the specific name since the aedeagal shape obviously resembles the tool itself, but we decided this might be confusing since "forceps" are sometimes used as a synonym for grasshopper cerci, plus we think the chosen name sounds more interesting.

Holotype: Male (Fig. 12A and B). U.S.A.: FL: Martin Co., Jonathan Dickinson State Park, just SE of Park Rd. and an unnamed road, [27.005278,-80.140278] (Figs. 2C, 4B–D), 16-V-2015, coll. D.A. Woller, S.L. Kelly, & A.B. Orfinger, Field #PG201-1-C, pine flatwoods (possibly *Pinus elliottii* var. *densa*) Deposited in the UCFC with the unique identifier UCFC 0 577 327. Measurements (mm): Body length 12.71; pronotum length 2.86; pronotum width 2.14; tegmina length 1.86; and hind femur length 7.29.

Allotype: Female (Fig. 12C & D). Same locality info as holotype (Figs. 2C, 4B–D). Deposited in the UCFC with the unique identifier UCFC 0 577 329. Measurements (mm): Body length 15.14; pronotum length 3.57; pronotum width 3.29; tegmina length 2.43; and hind femur length 8.71.

Additional Type Material: 36 paratypes: 16 males, 15 females, 5 nymphs. See Table 2 for locality details and other information.

Discussion

In terms of geographic proximity among the now-nine members of the Puer Group *sensu stricto* (Table 1), the only known ranges of species to overlap are *M. kissimmee* and *M. amphora* **sp. nov.** (Fig. 1B), although only by a single disjunct locality for the former, with the two locations being 4.28 km (2.66 miles) apart. Meanwhile, although *M. seminole* specimens have been collected relatively close to the known locations of *M. spiracor* **sp. nov.** (Fig. 1B), they are not yet known to overlap. Finally, *M. ferrarius* **sp. nov.** does not currently overlap with any other subgroup species (Fig. 1) and is the second-most southeastern subgroup species after *M. peninsularis* Hubbell, 1932 (not included in Fig. 1). Although *M. ferrarius* **sp. nov.** is, so far, only known from Jonathan Dickinson State Park, it has been collected across four subsites within the park (Fig. 2C).

Despite the geographic proximity of two of these three new species and the relative morphological similarities among the Puer Group *sensu stricto*, I want to reiterate that the internal genitalia of these three new species (Figs. 7, 10, 13, 15–17), especially the shape of the aedeagus, are sufficiently divergent enough from conspecifics and consistently unique enough across their known geographic ranges to be considered new species. Morphological divergence of male genitalia has long been considered rapid versus non-genitalic structures (Eberhard, 1985; Eberhard, 1996; Hosken & Stockley, 2004; Eberhard, 2009; Eberhard, 2010a; Eberhard, 2010b; Song & Bucheli, 2010; Rowe & Arnqvist, 2011; Simmons, 2014), and the Puer Group *sensu lato's* highly divergent and unique internal genitalia provide strong evidence for the idea that sexual selection has been a driver of speciation in this group.

Moreover, given the relatively young geological age of the Florida peninsula and the fact that all of the Puer Group *sensu lato's* species are flightless, it is highly probable that the speciation within this group has occurred rapidly, particularly within the Puer Group *sensu stricto* given how similar they all resemble each other externally. For these reasons, the Puer Group *sensu lato* and its several subgroups are an incredible resource for investigating evolutionary questions, especially those related to sexual selection. Unfortunately, many scrub endemics may be threatened or endangered by habitat destruction and fragmentation (Deyrup, 1990; Turner et al., 2006; Weekley et al., 2008), which is ongoing. Thankfully, all known Puer Group *sensu lato* species, including the three new ones described here, have been collected from one or more protected sites, primarily state parks, but even these sites do not always utilize best practices for maintaining scrub habitats, which are highly pyrogenic (Deyrup, 1989; Myers, 1990). Still, based on numerous collecting trips and personal observations, these species seem to be quite hearty and adaptable to shifting habitats to some degree, which provides some optimism for continued perseverance. I have little doubt that even more Puer Group *sensu lato* species are waiting to be described in the southeastern U.S. given their cryptic nature, so you are encouraged to join the search. Just make sure you bring a powerful microscope to closely examine this fascinating group's male genitalia!

On a final note, I am going to provide an illustrative example of the situation described above that spans many decades that I think you will find interesting. Hubbell (1932) revised the Puer Group using a revolutionary idea at the time, which was separating species based on male genitalia characters, mainly internal ones. In that publication, he observed that some Puer Group species seemed to have "phases" based on geography, but was not prepared to recognize them as new species or even subspecies. One of these was what he called an "atypical eastern phase" of *M. puer seminole* (which he still considered a subspecies at the time) and he even drew the internal male genitalia of one of several specimens he collected in Figure 28 of his publication (Fig. 7C-1 & D-1). When I first began working with the Puer Group, I was intrigued by this drawing because it did not seem to resemble *M. seminole* at all, at least to my novice eyes. During my time with the group, I have gathered (and field-collected) as many curated specimens as I possibly could and had the good fortune of borrowing the very specimen Hubbell drew in Figure 28: UMMZI-00050254.

Examining the internal genitalia of this UMMZI specimen closely and comparing it with all the other Puer Group species males simultaneously is what enabled the detection of a consistent geographic pattern in the internal genitalia, especially the shape of the aedeagus. This led me and my colleagues (Kelly and Orfinger) to go hunting for more specimens in new places based on locality clues left behind by Hubbell and his colleagues, which, in turn, led to us erecting *M. amphora* **sp. nov**. Obviously, Hubbell was on the right track in identifying this new species with his geographic "phases" concept, but he lacked some key items we used, mainly access to far more male specimens from multiple insect collections and the field, in addition to better technology in the form of more powerful microscopes and focal-stacking macrophotography systems.

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