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Geographic distribution of *Eurhopalothrix floridana* (Hymenoptera: Formicidae)

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ABSTRACT

Eurhopalothrix floridana, a slow-moving, cryptic leaf-litter ant, is the only species in the *Basiceros* genus-group (formerly Tribe Basicerotini) found in the continental US. Before 2007, this species was reported solely from Florida. Researchers, however, questioned whether this species was native to Florida or if it was an exotic of undetermined geographic origin. Recent records of *E. floridana* from natural areas in Cuba (two sites), Dominican Republic (nine sites), and Isla de Mona, Puerto Rico (one site) suggest that *E. floridana* is probably native to the Greater Antilles. Here, we report new records of *E. floridana* from Florida and Georgia and consider evidence concerning whether this species is native or exotic to Florida. We compiled 121 earlier Florida site records of *E. floridana,* primarily in nature preserves, ranging from Key West (24.6°N) to Three Rivers State Park and Fort Clinch State Park (both 30.7°N). In 2012, we collected *E. floridana* at one site in Georgia: Crooked River State Park (30.8°N), the first record of this species in the state. In 2018–2022, we collected ants through leaf-litter extraction at 461 disturbed sites in Florida and southernmost Georgia (24.6°N–31.0°N), mostly under slash pine and oak trees growing by roadsides and parking lots. We found *E. floridana* in 69 of 229 leaf-litter extractions north of 28.5°N (including one record from Georgia: Saint Marys, 30.7°N), but in none of the 232 leaf-litter extractions south of 28.5°N. Co-occurrence analyses suggest that non-native ant species may be excluding *E. floridana* from disturbed sites in South Florida. The recent appearance of widespread *E. floridana* populations in north-central Florida is currently the strongest evidence that this species is not native to Florida. Genetic analyses are needed to evaluate more conclusively the status of *E. floridana* in Florida, Georgia, and the Greater Antilles.

Key words: *Basiceros* genus-group, biological invasion, exotic species, native range

INTRODUCTION

Eurhopalothrix floridana Brown and Kempf is a slow-moving, cryptic leaf-litter ant originally described from Florida. Phylogenetic analyses place *Eurhopalothrix* in the *Basiceros* genus-group (formerly Tribe Basicerotini), along with five other genera: *Basiceros, Octostruma*, *Protalaridris*, *Rhopalothrix*, and *Talaridris* (Brown and Kempf 1960; Ward et al. 2015). Little is known of the biology of ants in these genera. *Eurhopalothrix floridana* is the only member of this genus-group found in the continental US. Until recently, *E. floridana* was known solely from Florida, though researchers questioned whether this species was native to Florida or if it was an exotic species whose origin had not yet been determined. Here, we compiled records of *E. floridana* and consider evidence concerning whether *E. floridana* is native or exotic to Florida.

There are currently 54 recognized species of extant *Eurhopalothrix* found in both the Neotropics and Paleotropics (Antwiki 2022). The name *Eurhopalothrix* comes from the Greek for "true club hair," referring to the club-shaped hairs characteristic of the genus (Fig. 1). Brown and Kempf (1960) described *E. floridana* based on a single worker that Henry S. Dybas collected in 1955 in leaf-litter sample from Highlands Hammock, Highlands County in Central Florida. Deyrup and Trager (1986) reported the first additional records *E. floridana,* from five sites in Florida, but wrote, "specimens have also been collected in Tamaulipas, Mexico (W.L. Brown,

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personal communication).” From “many thousands” of leaf-litter extractions, Deyrup et al. (1997) mapped the known distribution of *E. floridana* “based on about 130 collections from over 70 sites,” ranging from Key West (24.6°N) in the south to Three Rivers State Park and Fort Clinch State Park (both 30.7°N) in the north. Deyrup et al. (1997) collected “hundreds of samples from the western panhandle, without finding any *E. floridana*.”

Despite naming the species *floridana*, Brown and Kempf (1960) wrote “It is possible that *E. floridana* represents a recently introduced tramp originating farther south in the American tropics, although nothing like it has yet been found anywhere else.” Deyrup et al. (1988) treated *E. floridana* “as native even though its relationships and habits makes an exotic origin plausible.” However, Deyrup (1991) wrote, “*E. floridana* is almost certainly exotic in Florida. *E. floridana* occurs in Mexico (W.L. Brown 1985, pers. comm.) and other members of the genus are neotropical.”

Deyrup et al. (1997) considered arguments for and against *E. floridana* being native to Florida. Deyrup et al. (1997) presented three lines of evidence in support of native status in Florida: a very early first record in the state (an 1887 museum specimen from Key West), no association with highly disturbed habitats, and broad habitat preferences that could have allowed it to migrate overland from Mexico to Florida during warmer periods in the past. In support of non-native status, Deyrup et al.’s (1997) wrote: “expanding ranges are typical of exotic species; *E. floridana* is now easily obtained in Alachua and Putnam counties where Van Pelt (1958) sampled extensively for dacetine ants without finding *E. floridana*.” In addition, Deyrup et al. (1997) pointed out that *E. floridana* was reported from Mexico, but was unknown from the West Indies, the source of most naturally dispersing tropical ant species in Florida. Deyrup et al. (1997) concluded that *E. floridana “*is probably introduced into Florida, but [we] would like to see better documentation of the species in Mexico.”

Deyrup et al. (2000) classified *E. floridana* as a “dubious native” in Florida, writing: that it “probably occurs in Mexico, but records need to be confirmed... If the distribution of this species turns out to be Florida and southern Mexico, without populations in northern Mexico, it would be difficult to claim that it is native to Florida.” Nonetheless, Deyrup (2003) did not include *E. floridana* among Florida ants considered non-native. To date, the presence of *E. floridana* in Mexico has never been confirmed (Longino 2013). It now appears likely that Brown’s record of *E. floridana* from Mexico was based on misidentification of some other *Eurhopalothrix* species. Seven *Eurhopalothrix* species, including four newly described by Longino (2013), are currently known from Mexico: *Eurhopalothrix clypeata* Brown and Kempf, *Eurhopalothrix gravis* (Mann), *Eurhopalothrix hunhau* Longino, *Eurhopalothrix pilulifera* Brown and Kempf, and *Eurhopalothrix sepultura* Longino, *Eurhopalothrix xibalba* Longino, and *Eurhopalothrix zipacna* Longino (Longino and Branstetter 2018).

Baroni Urbani and de Andrade (2007) reported the first records of *E. floridana* from the West Indies, collected in 2000 at two sites in Cuba. In addition, Longino (2013) reported specimens of *E. floridana* from Isla de Mona (Puerto Rico) and Barahona, Dominican Republic. Subsequently, Lubertazzi (2019) reported additional *E. floridana* records from the Dominican Republic. With this new information, Deyrup (2016) now concluded that *E. floridana* “might be a West Indian species that was introduced to Florida or arrived on its own.”

Here, we report additional records of *E. floridana* and evaluate further evidence concerning whether *E. floridana* may be native or exotic to Florida.

METHODS

Using published and unpublished records, we documented the known range of *Eurhopalothrix floridana.* We obtained unpublished site records from museum specimens in the collections of Archbold Biological Station (ABS), the Florida State Collection of Arthropods (FSCA), the Museum of Comparative Zoology (MCZ; mczbase.mcz.harvard.edu), and the Field Museum (collections-zoology.fieldmuseum.org). In addition, we used published data (Booher et al. 2023) supplemented by on-line databases with collection information on specimens by antweb.org and idigbio.org, and photographs posted on bugguide.net and iNaturalist.org.

In 2018–2022, the first author (JKW) extracted

ants from leaf-litter samples collected at 461 sites in Florida and southernmost Georgia (24.6°N–31.0°N; Fig. 3). In an effort to map the spread of non-native ants, JKW collected almost exclusively at highly disturbed, weedy sites, primarily along the sides of roads and parking lots, and in vacant lots, because non-native ant species tend to be more common in such habitats. Even in parks, JKW collected in more disturbed areas, usually around the parking areas. At each site, JKW scooped up leaf litter with a ladle from several places and sifted it using a Davis sifter, putting 1–2 liters of sifted material in a zip-lock bag. Ants were extracted from the sifted material over the course of several days by placing the material on top of the Davis sifter screen, and letting the ants drop down through the screen, much like a Berlese funnel. We previously used data from the 2018–2021 extractions in documenting the distributions of other ant species, including *Anochetus mayri* (Wetterer et al. 2018), *Syllophopsis sechellensis* (Wetterer 2020a), *Odontomachus ruginodis* (Wetterer 2020b), and *Syllophopsis subcoeca* (Wetterer and Sharaf 2021).

Using co-occurrence data for ants that extracted from litter samples collected in disturbed and undisturbed natural areas of Florida and southern Georgia between 1980–2000 (Booher et al. 2023), we examined the relation between the proportion of non-native ant species and the presence of *E. floridana* in leaf litter samples from northern Florida (>28.5°N; 21 of 291 extractions with *E. floridana*) and southern Florida (<28.5°N; 20 of 396 extractions with *E. floridana*) in JMP statistical software using one-way ANOVAs.

We created maps (Figs. 2–3) using carto.com.

RESULTS

In total, we compiled records of *Eurhopalothrix floridana* from 203 sites (Fig. 2) in Florida (189 sites), Georgia (two sites), and on three islands of the Greater Antilles: Cuba (two sites; Baroni Urbani and de Andrade 2007), Mona (one site; Longino 2013), and Dominican Republic (nine sites, some tightly clustered; Longino 2013, Lubertazzi 2019; mczbase.mcz.harvard.edu).

We compiled 120 Florida site records of *E. floridana* from other researchers (red in Figs. 2), based primarily on specimens in the collection of Archbold Biological Station (ABS), with additional records from the Florida State Collection of Arthropods (FSCA), in Deyrup et al. (1988), Ferster and Prusak (1994), Deyrup et al. (1997), King (2007), and Moreau et al. (2014), and on antweb.org and idigbio.org. One *E. floridana* record was based on photos posted on-line: Alachua Co., Paynes Prairie State Preserve (29.52769, -82.296758; S. Wang; 4-Apr-19; bugguide.net/node/view/1651472; inaturalist.org/observations/22310277).

In 2012, D. Booher collected *E. floridana* at one site in Georgia, the first *E. floridana* record from this state and the northernmost record for the species:

Camden Co.: Crooked River State Park (30.8421, -81.5436; 13-Oct-12)

In 2020, JKW collected *E. floridana* in leaf-litter extractions at one site in Georgia:

Camden Co.: Saint Marys; Osbourne Rd (30.7480, -81.5648; 4-Jul-20)

In 2019–2020, JKW collected *E. floridana* at 68 sites in 19 Florida counties (counties arranged from north to south; + = new county record; geo-coordinates and dates in parentheses):

Nassau Co.: Fernandina Beach; N 8th and Dade St (30.6758, -81.4579; 4-Jul-20); Fernandina Beach; SR-A1A (30.5644, -81.4527; 4-Jul-20)

+Duval Co.: Jacksonville; US-17 S of Clark Rd (30.4127, -81.6509; 13-May-20)

St Johns Co.: St Augustine; Palencia (30.0095, -81.3887; 22-Apr-20)
St Augustine; SR-207 (29.8805, -81.3280; 13-May-20); Elkton; Church Road (29.7839, -81.4717; 22-Apr-20); Elkton; CR-207 and CR-305 (29.782, -81.426; 21-Sept-19); Hastings; CR-204 (29.6587, -81.2894; 27-Mar-20)

Clay Co.: Kingsley Lake; SR-16 and SR-230 (29.9500, -82.0192; 2-May-20); Keystone Heights; by Electric Coop parking (29.7883, -82.0359; 2-May-20)

+Bradford Co.: Starke; SR-100 and CR-100A (29.9276, -82.1000; 2-May-20)

+Columbia Co.: High Springs; SE Sprite Loop (29.9197, -82.6086; 16-May-21)
Fort White; SW Bobcat Drive (29.8723, -82.6547; 10-Jul-20)

Putnam Co.: Boswick; by post office (29.7789,

-81.6411; 12-Jun-20); Florahome; by post office (29.7332, -81.8842; 2-May-20); Palatka; Palmetto Branch Rd (29.6893, -81.7437; 2-May-20); East Palatka; Cracker Swamp Rd (29.6669, -81.5393; 27-Mar-20); Palatka; Carter Rd (29.6648, -81.6875; 12-Jun-20); Palatka; Madison St and N 19th St (29.6521, -81.6486; 2-May-20,); Francis; SR-20 (29.6312, -81.7329; 1-Apr-20); San Mateo; by post office (29.6074, -81.5831; 12-Jun-20); Rodman; Rodman Dam Rd (29.5273, -81.7547; 1-Apr-20); Crescent City; N of Ewers Rd (29.4063, -81.5125; 1-Apr-20)

Alachua Co.: Paradise; FL 121 x FL 25 (29.7124, -82.3532; 7-May-21); Gainesville; NW 6th & NW 23rd (29.6749, -82.3305; 2-Apr-21); Gainesville; by FSCA (29.6337, -82.3717; 2-Apr-21); Gainesville; SE 15th St (29.6155, -82.3056; 7-May-21); Hawthorne; Little Orange Creek Park (29.5937, -82.0639; 10-Nov-19); Gainesville; I-95S rest area (29.5884, -82.3632; 2-Apr-21); Island Grove; 219th Ave (29.4534, -82.1085; 10-Nov-19)

+Gilchrist Co.: Trenton; by post office (29.6155, -82.7992; 25-Jun-20); Trenton; NW 2nd Ave (29.6155, -82.8199; 25-Jun-20); Lottieville; CR-341 (29.6125, -82.9066; 25-Jun-20); Trenton; behind Ameris Bank (29.6119, -82.8123; 25-Jun-20)

+Dixie Co.: Old Town; NE 81st Ave (29.6036, -82.9813; 25-Jun-20)

+Flagler Co.: Palm Coast; Linear Park (29.560, -81.194; 23-Dec-20); Palm Coast; Waterfront Park Rd (29.5562, -81.1800; 23-Dec-20); Flagler Beach; E Moody Rd (29.4754, -81.1825; 27-Mar-20)

Levy Co.: Chiefland; NW 19th Ave, leaf litter, 29.4967, -82.8723; 14-May-21)
Williston; SE 6th St (29.3876, -82.4393; 21-Jun-20); Morriston; by post office (29.2819, -82.4454; 21-Jun-20)

Marion Co.: Salt Springs; CR-19 (29.3572, -81.7358; 1-Apr-20); Ocala; NW 9th Ave (29.2704, -82.1996; 2-Apr-21); Ocala; Anthony Rd (29.2199, -82.1453; 10-Nov-19); Ocala; Paddock Mall (29.1568, -82.1711; 14-May-21); Santos; Santos trailhead (29.1050, -82.0949; 29-Apr-21); Ocala; The Island (29.0994, -82.0877; 10-Nov-19); Ocala; I-95N rest area (29.0936, -82.1823; 14-May-21); Ocala; I-95S rest area (29.0943, -82.1874; 2-Apr-21); Ocala; SW 134th St (29.0274, -82.1557; 7-May-21); Ocklawaha; by Little Lake Weir (29.0188, -81.9699; 29-Apr-21); Ocklawaha; by Lake Weir (29.0151, -81.9632; 29-Apr-21); Summerfield; Sunset Harbor Rd (29.0066, -82.0049; 10-Nov-19)

Volusia Co.: Ormond Beach; Fleming Ave (29.2642, -81.0653; 29-Dec-20); New Smyrna Beach; Letha Rd (29.0693, -80.9838; 29-Dec-20); New Smyrna Beach; Jungle Rd (29.0141, -80.9574; 29-Dec-20); Edgewater; Beacon Light Rd (28.8942, -80.8827; 18-Mar-20); Oak Hill; US-1 (28.8346, -80.8414; 18-Mar-20)

Lake Co.: Leesburg; Emeralda Island Rd (28.9501, -81.7862; 27-Apr-20)

Citrus Co.: Crystal River; Rock Crusher Rd (28.8793, -82.5397; 13-Nov-19); Lecanto; by hotel (28.8579, -82.4216; 13-Nov-19); Inverness; Wayside Park (28.8325, -82.3181; 13-Nov-19); Inverness; Knob Hill Rd (28.8254, -82.3179; 21-Jun-20)

+Sumter Co.: Lake Panasoffkee; N end CR-470 (28.8577, -82.1736; 13-Nov-19)
Sumterville; N of cemetery (28.7560, -82.0603; 15-Dec-19)

Seminole Co.; Geneva; Harrison Rd (28.7261, -81.0989, 31-Dec-21)

Brevard Co.: Titusville, Windover Way (28.5499, -80.8478; 2-Nov-20); Titusville, Challenger Parkway (28.5118, -80.8315; 2-Nov-20)

Eurhopalothrix floridana is now known from one county in Georgia (Camden) and 39 counties of Florida: Alachua, Bradford, Brevard, Broward, Citrus, Clay, Collier, Columbia, Dixie, Duval, Flagler, Franklin, Gilchrist, Gulf, Hamilton, Hernando, Highlands, Indian River, Jackson, Lake, Lee, Levy, Liberty, Marion, Miami-Dade, Monroe, Nassau, Orange, Osceola, Palm Beach, Pinellas, Putnam, St. Johns, St. Lucie, Seminole, Sumter, Taylor, Volusia, and Wakulla. Antweb lists *E. floridana* from a site in Suwannee State Park as in Suwannee County (antweb.org/specimen/ARTHARCH00048846), but the coordinates given are for a part of the park within Hamilton County.

Strikingly, JKW found *E. floridana* in leaf-litter

extractions only north of 28.5°N in 69 of 229 sites, including 64/154 sites between 28.5°N and 30.0°N, but just 5/75 sites between 30.0°N and 31.0°N (Fig. 3). JKW never collected *E. floridana* in the southern half of peninsular Florida (0/232 sites south of 28.5°N; Fig. 3).

We found an average of 29% of ant species were non-native in the northern extractions (>28.5°N) compared with 59% from in southern extractions (<28.5°N). In northern extractions, the percentage of non-native species did not differ between undisturbed and disturbed habitats (ANOVA, F-value = 0.26, p=0.78), whereas in southern extractions there was a higher percentage of native species in undisturbed (42%) versus in disturbed habitats (20%; ANOVA, F-value = 9.79, p<0.001). For northern extractions, we found no difference in percentage of non-native species in samples with *E. floridana* (76%) versus without *E. floridana* (70%; ANOVA, F-value = 0.90, p<0.34). In contrast, for southern extractions, samples with *E. floridana* present had fewer non-native species (39%) than those without *E. floridana* present (61%; ANOVA, F-value = 10.67, p<0.002).

DISCUSSION

Eurhopalothrix floridana has widespread site records in Florida, spanning the entire length of the state from south to north and extending into Georgia (Fig. 2). In addition, *E. floridana* has been reported in the West Indies from Cuba (Baroni Urbani and de Andrade 2007), Dominican Republic (Longino 2013, Lubertazzi 2019), and Isla de Mona, Puerto Rico (Longino 2013) (Fig. 2). The fact that *E. floridana* has been reported from nature preserves in Cuba, the Dominican Republic, and Mona, suggests that this species is native to the Greater Antilles. The record of *E. floridana* from Isla de Mona, an isolated island that is entirely a nature preserve with no permanent human residents, is particularly strong evidence of native status there. In addition, *E. floridana* has close relatives in the Greater Antilles. In fact, Longino (pers. comm.) speculated that Baroni Urbani and de Andrade (2007) records of *E. floridana* in Cuba could be misidentifications of a very similar endemic Cuban species, *Eurhopalothrix mabuya* Longino, first described in 2013. Additional collection records of *E. floridana* from the West Indies would be useful. Records of *E. floridana* on several islands of the Greater Antilles strengthens the argument that this species may have spread on its own to nearby Florida.

Deyrup et al. (1997) wrote that *E. floridana* in Florida did not show any association with highly disturbed habitats. We were therefore surprised at how common this species was in highly disturbed sites in north-central Florida, yet never encountered *E. floridana* in similar disturbed habitat in South Florida. The collection of *E. floridana* at many disturbed sites in north-central Florida weakens the case for considering this a native species of Florida. Deyrup et al. (1997) found *E. floridana* in a wide range of forest habitats and concluded "this is apparently a woodland species that is not particular about drainage." Despite this broad habitat preference, *E. floridana* was nearly absent in leaf-litter samples collected in disturbed habitats (e.g., roadsides, agricultural lands, and recently harvested forests) in the southern half of Florida. One possible explanation for this pattern is that *E. floridana* may be excluded from this microhabitat in South Florida by the presence of one or more predators and/or competitors. Likely suspects are invasive tropical ant species, several of which are very common in South Florida, but rare or absent in North Florida, including *Pheidole megacephala* (Wetterer 2012), *Wasmannia auropunctata* (Wetterer 2013), and *Anochetus mayri* (Wetterer et al. 2018). This is supported through our co-occurrence analyses. We found that in disturbed habitats in southern where non-native species richness and abundance is highest, *E. floridana* tended to occur in undisturbed collections with fewer non-native species. In their northern range where there are fewer non-natives in disturbed areas, *E. floridana* occurred in both disturbed and undisturbed habitats.

Deyrup et al.'s (1997) primary evidence for considering *E. floridana* as exotic to Florida was that populations of *E. floridana* appeared to have only recently appeared and become common in north-central Florida. The present study supports this; this extremely distinctive species was found at a large portion of sites surveyed in north-central Florida (Fig. 3), including 10 of 17 extractions in Putnam County, the county where Van Pelt (1958) conducted his extensive leaf-litter ant surveys, but encountered

no *E. floridana*. It does not seem plausible that Van Pelt (1958) simply overlooked the presence of *E. floridana*.

Longino (2013) wrote of *E. floridana*: "the biogeographic history of this species, in Florida and elsewhere, remains enigmatic." We agree that there is still insufficient evidence to conclude with confidence whether or not *E. floridana* is native to Florida. Genetic analyses could address this question if specimens are found from additional sites in the Greater Antilles. If *E. floridana* specimens from Florida and Antillean populations show similarly high genetic diversity, this would suggest this species is native to both regions. If *E. floridana* specimens from Florida populations show low genetic diversity compared to populations in the Greater Antilles, this would suggest a founder effect and a relatively recent arrival of *E. floridana* in Florida. However, even if a founder effect is documented in Florida populations, it still may not be possible to determine whether the arrival of *E. floridana* in Florida was natural or through recent human commerce.

In the only detailed investigation of a *Eurhopalothrix* species, Wilson and Brown (1984) studied the biology of an Asian species, *Eurhopalothrix heliscata* Wilson and Brown, based on two colonies found nesting in rotten logs. Wilson and Brown (1984) studies the foraging behavior of *E. heliscata* in a colony brought back to the lab. Workers of *E. heliscata* are solitary hunters, apparently preying primarily on termites. Worker ants slowly approach potential prey with their mandibles spread open wide. When they contact their prey, the ants quickly clamp their mandibles onto one of the prey's appendages. While the prey struggles, often thrashing violently, the ants protect the distal parts of their antennae by tucking them completely under their flanged scape (first antennal segment) into deep antennal scrobes (grooves on the sides of the head). The ants then sting the prey and hang on until the prey is paralyzed by the venom after 5 or 10 minutes. Although *E. floridana* has a very similar morphology as *E. heliscata*, it is unknown whether *E. floridana* has similar habits. Now that *E. floridana* is common and easy to find in North-Central Florida (Fig. 3), local researchers have an excellent opportunity to learn more about this little-studied species, the only member of the *Basiceros* genus-group found in the continental US.

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Table 1. Earliest known records for *Eurhopalothrix floridana.* MCZ = Museum of Comparative Zoology. DBBC = DB Booher personal collection.

	Earliest record
Florida	1887 (Deyrup et al. 1997)
Cuba	2000 (Baroni Urbani and de Andrade 2007)
Dominican Republic	2002 (SP Cover; MCZ): Indigenous Eyes Ecological Park
Mona, Puerto Rico	2006 (JK Wetterer; MCZ): trail east of antenna
Georgia	2012 (DB Booher; DBBC): Crooked River State Park

Figure 1. *Eurhopalothrix floridana* worker from Archbold Biological Station, Florida (P.S. Ward; CASENT0006100, Photo by April Nobile, ©AntWeb.org, CC BY-SA 3.0).

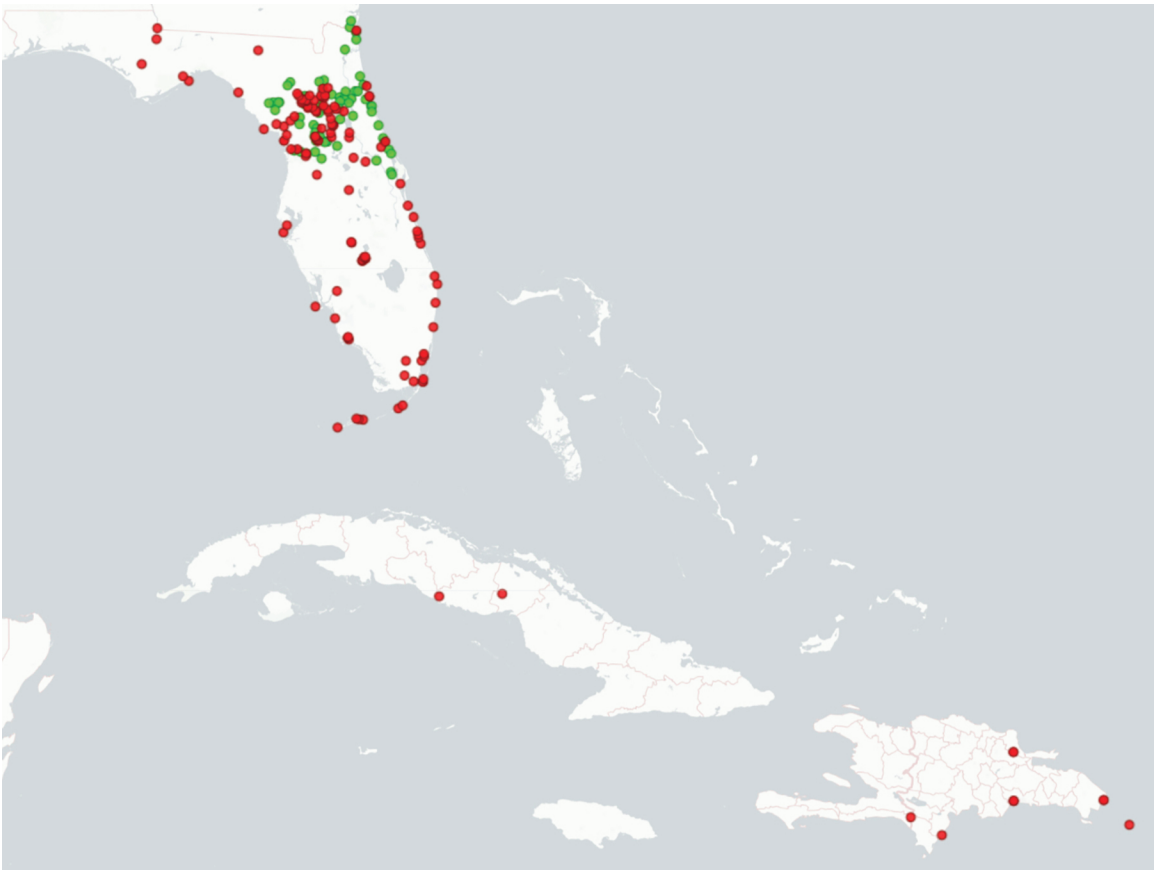

Figure 2. Geographic distribution of *E. floridana* records. Green = present study. Red = earlier records. Some red points overlay and may obscure more recent green points.

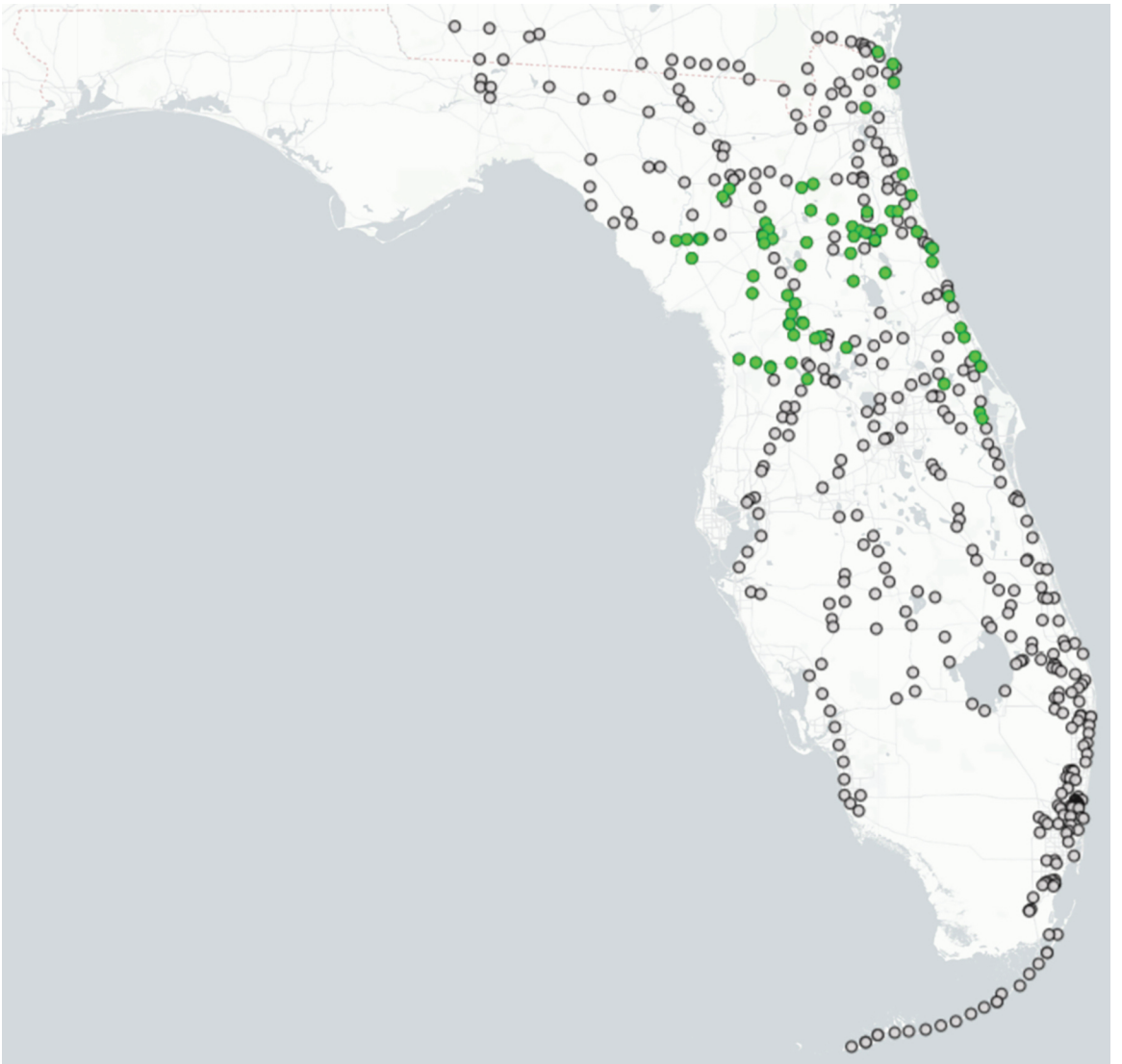

Figure 3. Leaf-litter extractions by JKW at 461 sites in 2018–2022 in Florida and southernmost Georgia. Green = *E. floridana* found. Grey = *E. floridana* not found.