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A new species of the spittlebug genus *Clastoptera* Germar
(Hemiptera: Cercopoidea: Clastopteridae)
on Florida oaks

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A new species of the spittlebug genus *Clastoptera* Germar
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on Florida oaks

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Abstract. Over the past decade, a previously unrecorded spittlebug of the genus *Clastoptera* Germar (Hemiptera: Cercopoidea: Clastopteridae) has been observed in abundance on oaks (*Quercus* L. spp., Fagaceae) in several Florida counties. We describe this spittlebug as a new species, *Clastoptera querci* Thompson, Halbert and Rothschild, **new species**, provide information on its life history, host plants and distribution, and place it in the context of other members of the genus. *Clastoptera* spp. can transmit *Xylella fastidiosa* Wells et al., a bacterial pathogen that causes bacterial leaf scorch associated with oak decline. Thus *C. querci* should be monitored as a possible vector of *X. fastidiosa* in oaks.

Key words. *Quercus*, adventive, *Xylella*, bacterial leaf scorch.

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Introduction

Clastoptera Germar (Hemiptera: Cercopoidea: Clastopteridae) is a speciose spittlebug genus occurring in the New World, with approximately 85 described species, ranging from Canada to Argentina (Doering 1928; Metcalf and Wade 1962; Soulier-Perkins 2020). *Clastoptera* species are physically small (≤ 5.3 mm length), and almost all are wide-bodied (globose) in form. They are easy to determine to genus but difficult to determine to species because of commonalities in external form and coloration (Doering 1928). Male genitalia are comparatively simple and relatively uniform, while differences in internal female genitalia are useful in separating species (Doering 1928; Hamilton 2015) but require dissection.

Most *Clastoptera* species are Neotropical, and most are undescribed. The relatively well-collected Costa Rican fauna, for example, includes about a dozen described species and at least 40 additional undescribed morphospecies (VT and Carolina Godoy observations). Given such high local diversity and the apparently narrow geographical distributions of tropical species, there may be hundreds of species yet to be described. Most of the

relevant taxonomic work on North American *Clastoptera* is contained in Doering's (1928) classic monograph on the fauna of the United States and Canada, supplemented by several more recent species descriptions and minor taxonomic changes, including works on the Cuban and Puerto Rican faunas (Metcalf and Bruner 1944; Ramos 1957; Hamilton 1977, 1978, 2015; Wheeler and Kramer 1983; Nguyen et al. 2001).

Like all spittlebugs (Cercopoidea), *Clastoptera* species are xylem-feeding phytophages. Although often locally abundant, they generally have not been associated with serious damage to their host plants. There are three notable exceptions: in the southeastern USA *Clastoptera achatina* Germar is a minor but significant pest of pecans (*Carya illinoensis* (Wangenh.) K. Koch (Juglandaceae) (Teddars 1995); in Mexico, Central America and Brazil at least three *Clastoptera* species have damaged cacao (*Theobroma cacao* L. (Malvaceae)) plantations (Lozano 1980; Bicelli et al. 1989; López et al. 2013); and in Bermuda *Clastoptera undulata* Uhler has damaged trees of the genus *Casuarina* Rumph. ex L. (Casuarinaceae) (Dustan 1960; Bennett and Hughes 1963).

Beginning in 2012 the Florida Department of Agriculture and Consumer Services, Division of Plant Industry (DPI) received multiple reports of an abundant but unidentified spittlebug of the genus *Clastoptera* on oaks (*Quercus* spp., Fagaceae) in several Florida counties (Thompson and Halbert 2013). Close examination has confirmed that this species is new to science, and perhaps is newly introduced to the continental USA. Here we describe it as *Clastoptera querci* Thompson, Halbert and Rothschild, **new species**, and provide information on its life history, biology, and relationship to other *Clastoptera* species.

Materials and Methods

DPI records show 138 probable samples of the new *Clastoptera* sp. on oaks, collected by DPI inspectors and others. An additional nine samples came from other sources. We also have examined colonies on oaks to obtain immature stages for description (Fig. 1d, 2f). Our attempts to rear these insects in the greenhouse failed.

Measurements were taken in mm using a calibrated ocular micrometer in a Leica MZ16 stereomicroscope, which also was used in study of the specimens. Photomicrographs (Fig. 2a–i) were taken using this stereoscope in conjunction with a Canon EOS Rebel T6 digital camera using Canon EOS Utility software and processed as photomontage images using CombineZM software (exception: Fig. 2c was processed using a different system). Morphological terminology generally follows Fennah (1968).

This spittlebug has become numerous in Florida, resulting in many submissions to the laboratory at DPI. Routine submissions, especially in recent years, were not necessarily kept, but all were identified by authors on this paper, and the determinations were recorded in the DPI database. These data were used to compile biological information about seasonality, geographic range, host preferences, etc. Label data from the holotype, paratypes, and specimens examined to prepare the description are listed under material examined. Other records from the DPI database, used only for tabulating biological data, are presented in Appendix 1.

Acronyms for collections examined:

- AMNH** American Museum of Natural History, New York, NY, USA
- ASUT** Hasbrouck Insect Collection, Arizona State University, Tempe, AZ, USA
- CAS** California Academy of Sciences, San Francisco, CA, USA
- EMEC** Essig Museum of Entomology, Berkeley, CA, USA
- FMNH** Field Museum, Chicago, IL, USA
- FSCA** Florida State Collection of Arthropods, Gainesville, FL, USA
- MCZC** Museum of Comparative Zoology, Cambridge, MA, USA
- NCSU** North Carolina State University Insect Collection, Raleigh, NC, USA
- UCDC** Bohart Museum of Entomology, Davis, CA, USA
- USNM** US National Museum of Natural History, Washington, DC, USA
- VTRC** Vinton Thompson research collection, at AMNH, New York, NY, USA

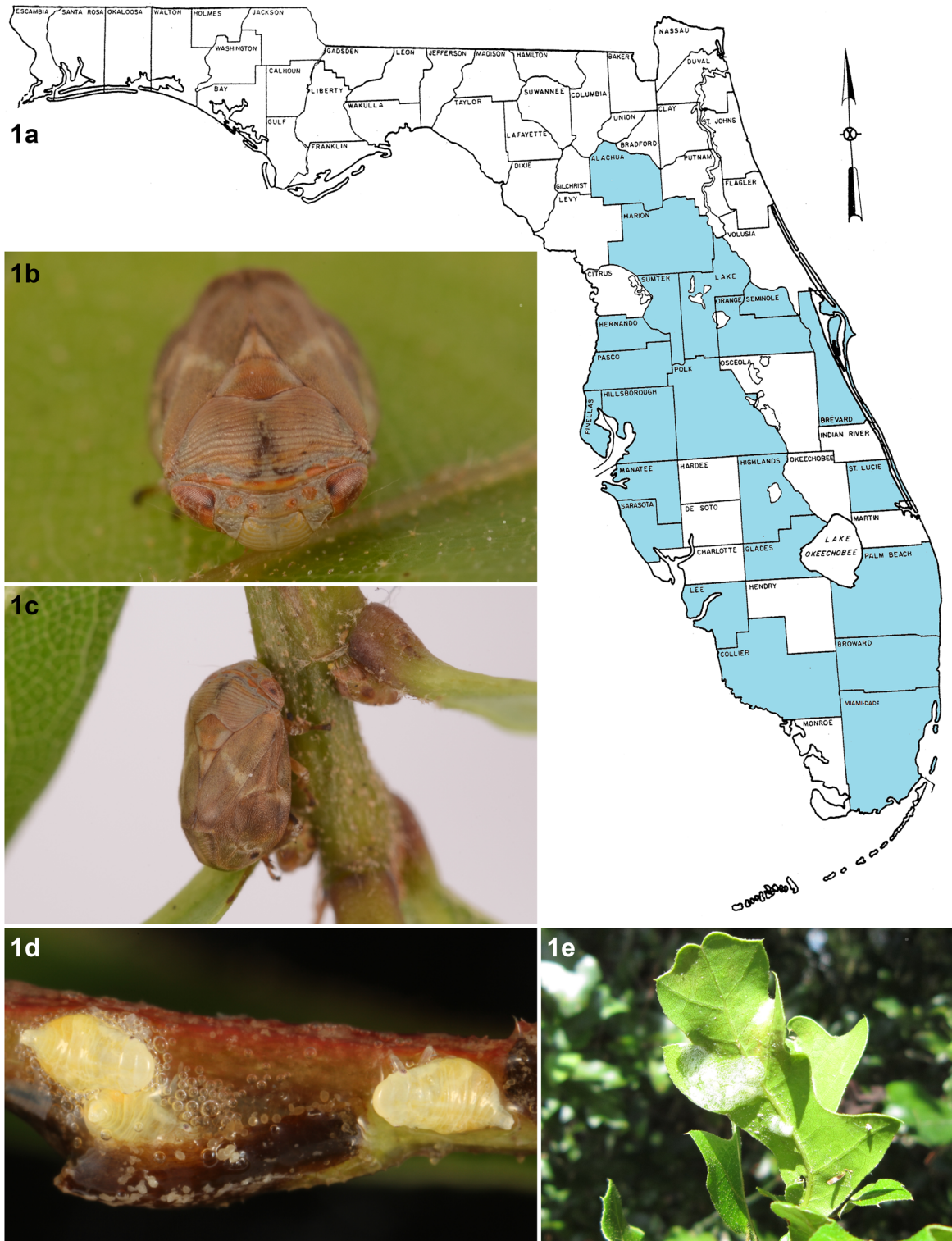


Figure 1. *Clastoptera querci* distribution map and photographs in natural settings. **a)** Counties in which specimens have been taken shaded in blue. The species is unknown outside Florida. **b)** Close-up of adult showing diagnostic red marking on vertex and front of pronotum. **c)** Adult on live oak. **d)** Early instar nymphs in spittles on oak twig. **e)** Spittle masses on oak leaves. Photographs 1b–d by Lyle Buss, University of Florida.

Taxonomy

Clastoptera querci Thompson, Halbert and Rothschild, new species

(Fig. 1b–e and 2a–i)

Type locality. Largo, Pinellas County, Florida, USA

Diagnosis. Small (3–4 mm long), tan to brown, moderately globose; tegmina with non-descript dorsal pattern; ten characteristic reddish marks, 6 on anterior margin of pronotum, 4 on vertex (Fig. 1b, 2d); face without dark transverse striations, light yellow-tan band across lower postclypeus (Fig. 2c); small, well-defined dot-like bulla (apical callous) in first apical cell near tegminal costal margin (Fig. 2b). Dorsal basal portion of second valvula indented to shaft for about $\frac{1}{4}$ th total length (Fig. 2h).

Description

Head. Fig. 2c, d. Ocelli nearer anterior margin of vertex than pronotum, distance between ocelli about equal to distance between ocellus and eye, and about half median length of vertex; vertex base color tan, sometimes with greenish tint, small disc of reddish color around each ocellus; oval reddish marks in shallow pits between each ocellus and eye, intensity of these 4 reddish marks varying, sometimes to point of vanishing, and hue varying from red to red-orange to pink, apparently redder in living specimens (Fig. 1b); transverse light yellow-brown carina at anterior margin of vertex; tylus inconspicuous, barely visible in dorsal view beyond the vertex; postclypeus moderately inflated, base color tan, 8 pairs bilateral lightly pigmented transverse striations interrupted at midline with light yellow-brown band covering 3 ventral pairs, slight depression midline widening towards ventral side, scattered setae toward yellow-tan, pilose anteclypeus; lora almost white, pilose.

Pronotum. Fig. 2d. Maximum width between humeral angles about 1.90 mm, same as maximum width of head, eyes included; anterior margin convex; posterior margin deeply emarginated with bilateral convex rounded lobes; lateral margins strongly divergent, about as long as distance between posterior lobe tips where they intersect scutellar margins; humeral angles flaring sharply between eyes and tegmina; base color tan or yellow-tan, sometimes tinged with green, especially anteriorly, usually but not always with superimposed darker, grey-tan, bilaterally symmetrical patch covering much or most of pronotum except margins and humeral flares, this sometimes bisected at median into two patches (note: in the holotype this patch is asymmetrical, Fig. 2d); transverse wrinkles cover whole, about 13 at median, about 16 between tips of posterior lobes and anterior rim, some anastomosing; slight median longitudinal carina from about ridges 4 to 8; ridge between fourth and fifth wrinkles from anterior margin with band of dark yellow in center moving to next ridge back about $\frac{1}{3}$ distance toward lateral margins; anterior ridge margin thicker than others, yellow-tan with 6 reddish marks, outermost behind eyes, innermost pair behind ocelli, these last not meeting anterior margin, all 6 marks varying in size, distinctness, hue and intensity among individuals, as noted for reddish markings on vertex.

Scutellum. Fig. 2a. slightly more than 1.5 times length of pronotum, width about two thirds scutellum length, finely pilose, bilaterally creased for one quarter of width at just less than half length, tan base color; yellow-brown patch on anterior margin almost to creases, not including lateral margins; inner anterior section slightly depressed.

Tegmina. Fig. 2a, b. Length 2.5–3.5 mm; tan base color, finely pilose; color often darker brown on inflated area occupying most of distal portion of corium from claval suture to costal margin; narrow brown band from claval apex wing break down toward bulla, lighter color middle third costal margin, indistinct light diagonal line mid-scutellum rearward to inflation; bulla in basal portion first apical cell, shiny dark brown, raised, well-defined, about 0.2 mm diameter, white veins directly bordering basal side; appendix pale, hyaline, without pilae.

Legs. Fig. 2a, c. Tan, elongated light brown marks on first and second femora, darker marks on hind pair; 2 robust spines on hind tibia, distal larger; hind tibia with ring of 6 spines, first tarsomere ring 8 spines, second tarsomere ring 7 spines, all brown tipped with black.

Abdomen. Mottled tan-brown, pilose, posterior sternite edges with tan border.

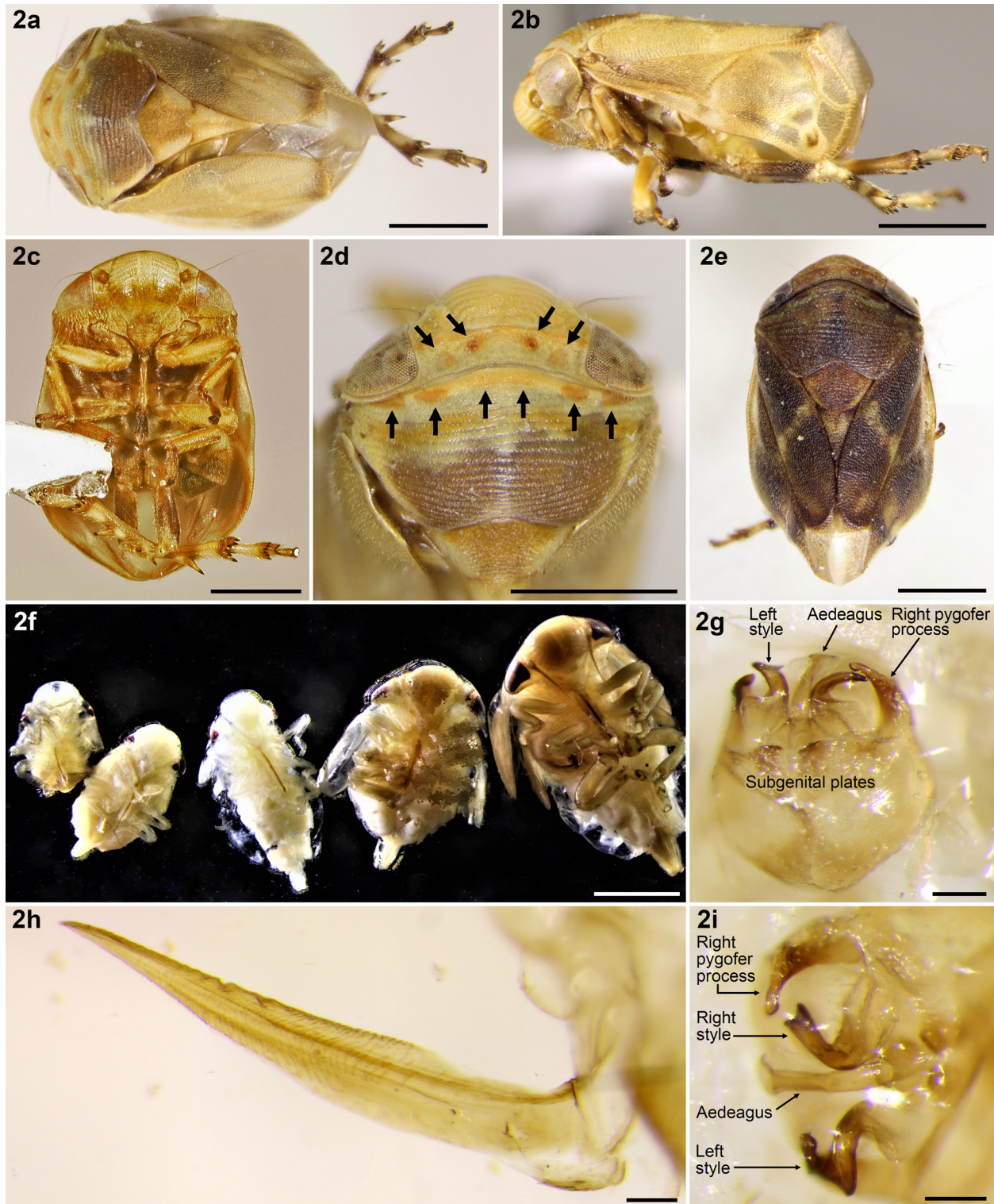


Figure 2. *Clastoptera querci* photomicrographs. **a)** Dorsal habitus. **b)** Lateral habitus. **c)** Ventral habitus. **d)** Close-up of pronotum and vertex, arrows point to diagnostic reddish marks. **e)** Dark color form. **f)** Left to right, nymphal instars 1 to 5, ventral view. **g)** Male genital capsule, ventral view. **h)** Female, left second valvula. **i)** Male genitalia close-up, ventral view. Figures 2a, b, d from holotype; 2e, g, h, i from paratypes. Scale bars for a–f = 1.0 mm, for g–i = 0.1 mm. Photograph 2c by Tony Dickens, FDACS/DPI.

Male genitalia. Fig. 2g, i. Genital capsule about 0.40 mm across in posterior view; prominent pygofer processes curve ventrad and inward to almost meet tips of styles bending sharply dorsad and outward; styles laterally flattened, widening at ends in shallow bifurcation; pygofer processes sclerotized from point of sharp ventral bend to narrow rounded tip with slight end bulge; styles sclerotized from sharp bend to distal end; subgenital plates truncated, inconspicuous, protruding over anterior phallobase, posterior margins sclerotized; aedeagus curving dorsad, 0.24 mm long in ventral view from edge of phallobase, simple tube narrowing to shortly before gonopore, then widening to gonopore, flared flattened flange past gonopore.

Ovipositor. Fig. 2h. Inner (second) valvula 0.95 mm long, base color translucent tan; indented to shaft on basal portion of dorsal edge for about one quarter length, then feather shaped to distal end; small, inconspicuous setae on first two thirds of outer side of dorsal section above shaft, tip brownish, fine teeth lining the ventral section for about the apical half of its length (note: this second valvula is distinct in form from all 28 species illustrated in Doering 1928); outer (first) valvula distal section 0.75 mm long, scattered small setae on upper dorsal apical section.

Variant dark color form. Fig. 2e. Brown base color tegmina, pronotum, scutellum, vertex, postclypeus, legs and abdomen, sometimes obscuring but not completely masking distinctive red and dark yellow markings of vertex and pronotum; diagonal white tegminal line prominent; pronotum with dark brown longitudinal median line, this against brown background distinctive and diagnostic.

Measurements. In mm, mean \pm SD (range), 23 specimens measured. Body length (tip of tylus to tips of tegmina in dorsal view): ♂ 3.48 \pm 0.16 (3.18–3.68), ♀ 3.81 \pm 0.14 (3.51–4.05). Tegmen length (wing base to tip): ♂ 2.76 \pm 0.09 (2.60–2.90), ♀ 3.01 \pm 0.20 (3.65–3.50). Head width (maximum including eyes) = pronotum width (between humeral angles): ♂ 1.72 \pm 0.08 (1.60–1.80), ♀ 1.93 \pm 0.06 (1.85–2.07). Pronotum length (at median): ♂ 0.77 \pm 0.04 (0.70–0.83), ♀ 0.85 \pm 0.06 (0.75–1.00). Scutellum length (at median): ♂ 1.18 \pm 0.07 (1.10–1.28), ♀ 1.36 \pm 0.07 (1.25–1.48). Scutellum width (at widest point): ♂ 0.79 \pm 0.03 (0.73–0.83), ♀ 0.89 \pm 0.05 (0.80–0.95).

Material examined. Text within quotation marks is a verbatim transcription of pin label information, with the exception of the symbol “/”, which separates line breaks within labels on the same pin, and semicolons, which separate labels on the same pin (unless the semicolon is typed on the label). Semicolons following quotation marks separate specimens or groups of specimens with different information, each of which begins with a gender symbol and the number of specimens, if more than one. **Holotype** (♀, dissected, deposited at FSCA), with labels: “USA: FLORIDA Pinellas County / Largo 12615 102 Ave N / 27.8766, -82.80722 / 16-IX-2013 Mark Spearman / & Jason Spiller *Quercus vir- / giniana* FSCA# E2013-6887; CLASTOPTERIDAE / *Clastoptera* sp. / det. Susan E. Halbert 2013”; **Paratypes** (3 ♀, dissected), with same label information as holotype; (2 ♂, 1 dissected; 2 ♀) with labels “USA: FLORIDA Pinellas County / Largo 12520 Ulmerton Rd / 2-VIII-2013 Bob Albanese & / Mark Spearman *Quercus vir- / giniana* E2013-5599; CLASTOPTERIDAE / *Clastoptera* sp.” (Note: only 2 ♂ and 2 ♀ from this series were used for measurements. There are six additional paratypes from this series, 2 ♂ and 4 ♀.) Altogether, there are 13 paratypes, of which two will be deposited at AMNH, two will be deposited at the USNM, and two will be deposited at the Snow Entomological Museum. The rest will remain at the FSCA. **Additional material examined for description and measurements:** ♂ “USA: FLORIDA Alachua County / 3527 NW 52 Ave 28-VII-2014 / Steve Hildebrandt large #s in / dwelling FSCA# E2014-5181; CLASTOPTERIDAE / *Clastoptera* sp. / det. Susan E. Halbert 2014” (Note: There were three additional specimens in this series.); ♀ “USA: FLORIDA / Alachua County / Gainesville, / Kanapaha Park / 29.6176°, -82.4187°; 17 July 2014 / M.J. Rothschild / on *Quercus / virginiana*”; ♀ “USA: FLORIDA / Alachua County / Gainesville, / DPI grounds / 29.6352°, -82.3709° / 7 June 2018 / M.J. Rothschild on / *Quercus laurifolia*”; ♂ “USA: FLORIDA Broward Co / Davie 15110 SW 26 St / 24-VIII-2011 Antonio Demien / *Quercus* FSCA# E2011-5994; CERCOPIDAE / *Clastoptera undulata* Uhler / det. Susan E. Halbert 2011”; ♀ “USA, FL, Levy Co. Goethe S.F. / Gasline/Beehive Rds. 29.1608 / -82.5983 Flatwoods. MV/UVL / 19-VII-2014 J. Hayden, K. & M. / Schnepf, J. Bremer, K. Rogers”; ♀ “USA: FLORIDA Marion Co / Ocala Foxwood Farms Mobile / Homes Park NW 45 Ter. / 29.21030; -82.19701 / 9-IX-2013 Mark J. Rothschild / *Quercus virginiana* / FSCA# E2013-6580; CLASTOPTERIDAE / *Clastoptera* sp. / det. Susan E. Halbert 2013” (Note: there were two additional specimens in this series.); (2 ♀, same labels) “USA: FL, Miami-Dade / Co. Homestead, 21315 / SW 312 St., 17-VII-2015 / Jake Farnum leg.; *Quercus virginiana* / FSCA# E2015-4065”; ♂ “USA: FLORIDA Orange Co / Ocoee 6737 Lumberjack Ln / 12-IX-2012 Jesse Krok *Citrus x / paradisi* FSCA#

E2012-7060; CERCOPIDAE / *Clastoptera undulata* Uhler / det. Susan E. Halbert & / Mark J. Rothschild 2012”; **Dark forms:** ♀ dark form “USA: FLORIDA / Hernando Co. / US-41, 3.2km S of / Citrus Co. line; 28.6407°, -82.3376° / 21 March 2018 / M.J. Rothschild, on: / *Quercus laurifolia*”; ♀ dark form “USA: FLORIDA / Marion Co., Ocala / Tuscawilla Park / 29.1937°, -82.1314°; 11 June 2014 / M.J. Rothschild / on *Quercus / virginiana*”; ♀ dark form “USA: FLORIDA / Marion Co., Ocala, / Jervy Gantt Park / 29.1673°, -82.0921°; 1 March 2018 / M.J. Rothschild / on *Quercus / virginiana*”; ♀ dark form “USA: FLORIDA / Marion County / Ocala, Pine Oaks / Golf Course; 29.2101°, -82.1607° / 30 March 2019 / M.J. Rothschild. on: / *Quercus virginiana*”; ♀ dark form “USA: FLORIDA / Marion County, NW of / Ocala, NW 44th Ave. / 3.4km N of US-27; 29.2415°, -82.1922° / 31 March 2019 / M.J. Rothschild. on: / *Quercus laurifolia*”; ♀ dark form “USA: FLORIDA / Sumter Co., Oxford, / near Post Office / 28.9315°, -82.0381°; 28 March 2018 / M.J. Rothschild. / on: *Quercus / laurifolia*”. Altogether, there are 23 specimens in this category, of which two, including one dark form, will be deposited at the AMNH. Others will remain at the FSCA.

Nymphs. First through fifth instar nymphs preserved in ethanol are illustrated in Fig. 2f. Early instar living nymphs are illustrated in Fig. 1d. Except for eyes (dark red), stylets (brown) and partial greying or tanning of leg parts, wing pads and dorsal thorax in some fifth instar specimens, external parts are unpigmented white, including ocelli. In contrast to at least one other *Clastoptera* study (Kuenzi and Coppel 1985), head capsule width overlaps among adjacent instars, but instars are separable by a combination of body length, presence of ocelli, proportion of head to body, reach of stylets, presence of visible bacteriomes, and level of development of wing pads and leg spines (Table 1). First instar nymphs have off-yellow bacteriomes visible through the lateral sides of the abdomen just before it narrows towards the rear (see Moran et al. 2005 for illustrations of *Clastoptera* bacteriomes and an explanation of their biological significance). Later ethanol-preserved instars lack visible bacteriomes. The head and thorax of preserved fifth instar nymphs in ventral view present an uncanny likeness to Darth Vader in white. Nymphal observations are based on specimens collected from *Quercus virginiana* in the Largo, Florida type locality (supplemented by four first instars from Alachua Co. on *Quercus sp.* and two second instars from Miami-Dade Co. on *Q. virginiana*).

Eggs. Unknown.

Etymology. The species name *querci* is from Latin *Quercus*, for oak, the host plant group.

Comparative notes

The known Florida *Clastoptera* fauna includes five other described species: *Clastoptera obtusa* (Say), *Clastoptera proteus* Fitch, *Clastoptera saint-cyri* Provancher, *Clastoptera undulata* Uhler and *Clastoptera xanthocephala* Germar (Osborn 1921; Porter 1955; Mead and Bennett 1987). *Clastoptera saint-cyri*, *C. proteus* and the two color forms of *C. xanthocephala* are black, black with prominent yellow markings, or uniform grey-tan and bear no resemblance to *C. querci*.

Table 1. Nymphal characteristics by instar.

Instar	No.	Body length (mm)		Head capsule width (mm)		Approximate ratio head length to body length	Approximate reach of stylets	Visible abdominal bacteriomes?	Ocelli present?	Wing pads?	Tibial conical spines?
		Mean	Range	Mean	Range						
1st	6	1.12	0.74–2.00	0.47	0.23–1.00	1/3	1/3 to all of abdomen	yes	no	no	no
2nd	4	2.09	1.90–2.25	0.88	0.80–1.00	1/4	1/2 of abdomen	no	no	no	no
3rd	5	2.70	2.30–2.70	1.00	1.00–1.00	1/3	past metacoxae	no	yes	visible	no
4th	6	3.10	2.60–3.30	1.40	1.30–1.50	1/6	past metacoxae	no	yes	membranous	hind legs
5th	11	3.54	3.30–4.00	1.50	1.40–1.60	1/6	metacoxae	no	yes	tracheated	all legs

Clastoptera undulata and *C. obtusa* resemble *C. querci* more closely, and all three species exhibit variation in dorsal color pattern, complicating separation. *Clastoptera obtusa* is largest, *C. undulata* smallest, with *C. querci* in between, but the size ranges overlap. However, in addition to the distinctive *C. querci* vertex-anterior pronotal markings (Fig. 1d, 2d), these species can be separated by facial pattern. In both *C. obtusa* (Hamilton 1982, fig. 71) and *C. undulata* the postclypeus has dark, medially interrupted transverse striations and a broad contrasting dark brown band towards the bottom. The striations are much fainter in *C. querci*, with only a light yellow-tan band towards the bottom of the postclypeus (Fig. 2c: obscured in some individuals of the dark form by the overall darker coloration). *Clastoptera querci* never has a contrasting dark brown band on the clypeus. These species also have different hosts: *C. undulata* occurs primarily on *Casuarina* spp. (Porter 1955; Mead and Bennett 1987), a group that attracts several *Clastoptera* species (Thompson 1999), while Florida *C. obtusa* occur primarily on *Alnus serrulata* (Aiton) Willd. (Mead and Bennett 1987).

There are three eastern USA *Clastoptera* species that have not been recorded yet in Florida but might be confused with *C. querci*:

The white nymphs of *Clastoptera testacea* Fitch live on white oaks (*Quercus* spp.) (Hanna 1970; VT observations) and superficially resemble nymphs of *C. querci*. However, *C. testacea* nymphs have red ocelli (VT observations), in contrast to the unpigmented ocelli in *C. querci*. They also have prominent red and yellow abdominal bacteriome structures (VT observations), whereas these structures are visible in *C. querci* only in the tiny first instar nymphs (Table 1). Adult *C. testacea* are sexually dimorphic and neither the black males nor the tan, relatively elongated females (Hamilton 1982, fig. 48 and 49) resemble *C. querci*.

Clastoptera laevigata Hamilton can be distinguished by the presence of four black marks on the vertex and six on the anterior pronotum (Wheeler and Kramer 1983; Hamilton 2015, fig. 1D); also, *C. laevigata* lives on *Celtis* spp. (Wheeler and Kramer 1983).

Clastoptera octonotata Hamilton has brown vertex and anterior pronotal markings and a broad white diagonal band across the clavus (Hamilton 2015, fig. 1C); it lives on *Vitis rotundifolia* Michaux (Hamilton 2015). Note: the Florida “*C. obtusa*” reported by Mead and Bennett (1987) to live on “wild grape” are more likely *C. octonotata*.

Life history and biology

DPI records include 138 probable samples (396 specimens) of *C. querci*, collected by DPI inspectors and others. There are 104 samples with some recorded host information. Forty-eight of those samples list *Quercus* (spp.) as the host. Of those 48, 30 were collected on the oaks, including all samples with nymphs, and 18 adult samples were from traps of various kinds. Fifty-six samples were reported from plants other than *Quercus*. Of these, 38 were from traps of various kinds. There were 18 samples of adults collected directly from plants other than *Quercus*. All were single adults except for a sample of three adults from *Citrus limon* (L.) Osbeck (lemon), and a sample of three adults from *Vaccinium* L. sp. Based on this information, it appears that *Quercus* is the only reproductive host, but adults might visit other plants. It is not known if adults found on other plants were feeding, resting, or in the case of trap catches, merely flying around in large numbers, accidentally being collected in a trap. Multi-Lure traps for fruit flies are bright yellow, which could have attracted the spittlebugs. An additional eight collections from oaks and one collection from a trap, which were not entered into the DPI database, are included among the specimens used for the description.

Records of submissions from the DPI database indicate a peak of both adults and nymphs between June and October, with highest numbers in August (Fig. 3). We do not have enough data to determine whether the slight increase in numbers of adults in December reflects a small second generation in the winter. A teneral adult collected in April suggests a winter or early spring generation, but no nymphs have been found yet at that time of year. The biological significance of the dark color form, including whether it might be genetically determined or a seasonal phenotype, is unknown.

Most of the specimens and collections from host plants for *C. querci* originate from oaks. Among these, a large majority of the ones for which the oak species is known come from *Quercus virginiana* Mill., the southern live oak, which appears to be the most common and widespread host. The full record of host records on oaks is as follows, including data from collections that are not from the DPI database:

Q. virginiana 181 specimens (20 collections)

Q. hemisphaerica Bartram ex Willd. 25 specimens (8 collections)

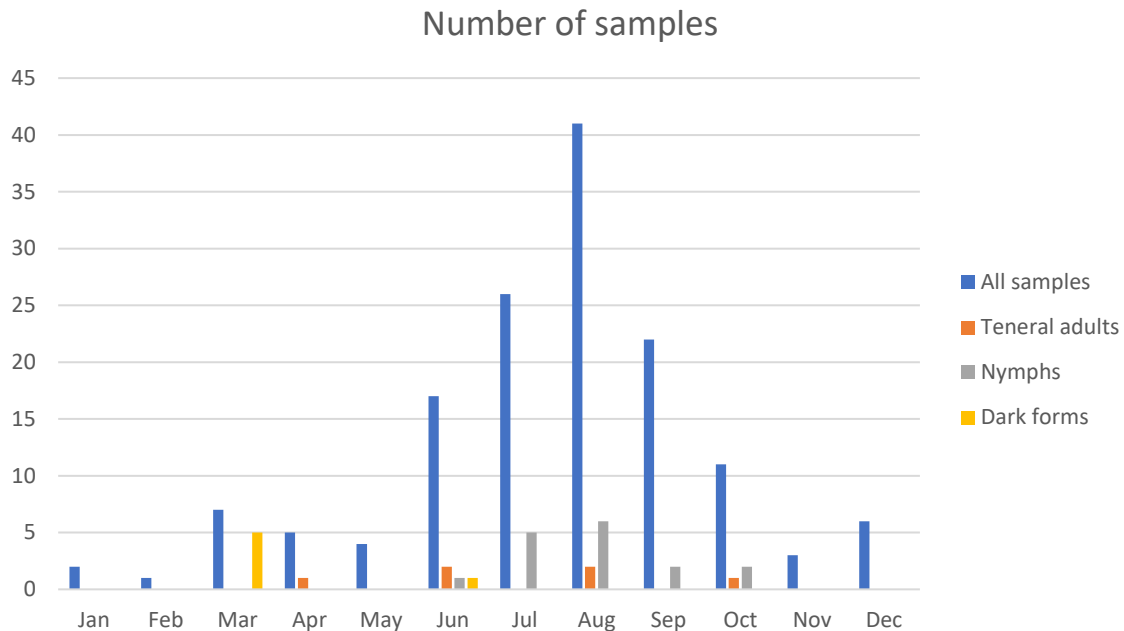


Figure 3. Seasonal distribution of collections of *C. querci*. Adults are present year around, peaking in August. Nymphs have been collected June through October. Blue shows all samples, regardless of life stage and color form. Orange indicates samples that include teneral (newly emerged) adults. Grey indicates samples that include nymphs. Yellow indicates samples that include dark color form adults.

- Q. shumardii* Buckley 40 specimens (1 collection)
- Q. nigra* L. 6 specimens (1 collection)
- Q. laevis* Walter 2 specimens (1 collection)
- Quercus* sp. (species not known) 23 specimens (6 collections)

In addition, the remains of a colony (skin and spittle) were found on *Quercus acutissima* Carruthers.

In the areas covered, *Quercus laurifolia* Michx. and *Q. hemisphaerica* both are present and difficult to distinguish. This accounts for the attribution of samples in some specimen records in Material Examined to *Q. laurifolia*. These are included above as coming from *Q. hemisphaerica*.

Distribution

Clastoptera querci is now widely distributed in Florida (Fig. 1a). It occurs coast to coast in Central and Southern Florida and reaches Alachua County in the north. It has not been collected in the Florida Panhandle or outside Florida. Counties in peninsular Florida without records probably reflect lack of collecting rather than lack of *C. querci*.

Discussion

Clastoptera querci is one of only two *Clastoptera* species known to live on oaks in both the nymphal and adult stages. The other is found in at Monteverde, Puntarenas, Costa Rica, where nymphs and adults of an undescribed *Clastoptera* species have been collected on *Quercus insignis* M. Martens and Galeotti (VT observations). This *Clastoptera* has black and yellow coloration and does not resemble *C. querci*.

Two other species of North American *Clastoptera* live on oaks in the nymphal stage. As noted above, *C. testacea* nymphs live on white oaks. Nymphs of the closely related southwestern USA species *Clastoptera osborni* Gillette and Baker live on *Quercus gambelii* Nuttall, but sleeved adults did not survive on this host (observations

of W. Cranshaw et. al., see Acknowledgments, species identification by VT). *Clastoptera osborni* adults, like those of *C. testacea*, live on pines (Doering 1928; VT observations) and, unlike *C. querci*, are uniformly tan and relatively elongated.

In addition, single adult specimens of an undescribed *Clastoptera* species from southern Arizona have been taken on a *Quercus* sp. and *Pinus edulis* Engelmann (among a series of nine specimens in the VTRC), suggesting that they might have a life history similar to that of *C. testacea* and *C. osborni*. This species shares the *C. querci* reddish marks on the vertex and anterior pronotum but differs in other pronotal markings, as well as facial pattern and shape of bulla. The nymphs are unknown. We note the existence of this species because it may be associated with oaks and might, on the basis of diagnostic markings, be confused with *C. querci*.

In summary, while there are other oak associated *Clastoptera* species, *C. querci* is unique among North American *Clastoptera* in passing its whole life cycle on oaks. Morphologically, it is also unique in the distinctive morphology of the second valvula of the ovipositor, differing from all other known North American *Clastoptera* species.

Clastoptera querci appears to be new to Florida and the continental USA. Examination of thousands of *Clastoptera* specimens in several collections (AMNH, ASUT, CAS, EMEC, FMNH, FSCA, MCZC, NCSU, UCDC, USNM, VTRC) revealed no historical specimens predating the recent outbreak. Either *C. querci* has existed in Florida for a long time, but at levels so low as to have eluded collection, or it is a recent introduction. Recent introduction is far more plausible, given the ample precedent for adventive insects in Florida. Notably, the spittlebug *C. undulata* first appeared in Florida in the 1950s, clearly introduced, possibly from Cuba, and occurring in profusion on trees of the introduced genus *Casuarina* (Porter 1955; Mead and Bennett 1987).

If introduced, *C. querci* must have come from somewhere in the Americas. Review of specimens from the Caribbean, Mexico, Central and South America in the collections enumerated above revealed only one potential match, a single undetermined female *Clastoptera* specimen labeled Taco Taco, Cuba and collected in 1922 by S. C. Bruner, J. Acuña and C. H. Ballou (NCSU collection). Although Bruner was coauthor of the only comprehensive work on the Cuban spittlebug fauna (Metcalf and Bruner 1944), this specimen does not correspond to any of the five *Clastoptera* species included in that review. Except for facial color pattern, it is indistinguishable in external morphology from the Florida *C. querci* specimens. It has darker and more prominent facial striations, and in place of a light yellow-tan lower postclypeal band, the lowest three striations coalesce into a brown band across the center of postclypeus. Otherwise, it is a close match, suggesting that it may be conspecific with *C. querci*, and, if so, that *C. querci* jumped from Cuba to Florida in recent history.

The specimen locality lends support to this hypothesis. Cuba has only one, relatively narrowly distributed, native oak, *Quercus sagraeana* Nuttall, a close relative of *Quercus virginiana* Miller (Gugger and Cavender-Bares 2013; Cavender-Bares et al. 2015; Eaton et al. 2015), the most common host of *C. querci* in Florida. Taco Taco lies about 10 km northeast of the edge of the ostensible continuous range of *Q. sagraeana* in western Cuba and a bit south of an array of small, non-contiguous *Q. sagraeana* patches (“cayos”) that extend further east (distribution maps in Samek 1973, fig. 13, 15 and related commentary on p. 31). A survey of *Q. sagraeana* in western Cuba could resolve this issue. If *C. querci* did originate in Cuba, Cuban oak populations could be a source of biological agents, should infestation levels or the potential to vector disease suggest a need for control.

The biggest vector threat from spittlebugs is transmission of *Xylella fastidiosa* Wells et al. This bacterium infects the xylem sap elements of plants and is transmitted by xylem feeding insects, a group limited to cicadas (Hemiptera: Cicadidae), sharpshooter leafhoppers (Hemiptera: Cicadellinae) and spittlebugs. It is a causative agent of Bacterial leaf scorch (BLS) of oaks, which has been associated with decline in *Q. virginiana* and other Florida oaks (McGovern and Hopkins 1994; Barnard et al. 1998; Barnard 2009). *Clastoptera brunnea* Ball and *C. achatina* have been demonstrated to transmit *X. fastidiosa* to grapes (Severin 1950) and pecans (Sanderlin and Melanson 2010), respectively. *Clastoptera obtusa* specimens collected in association with oaks in New Jersey have tested positive for *X. fastidiosa* (Zhang et al. 2011), although *C. obtusa* has not been directly demonstrated to acquire *X. fastidiosa* from or transmit it to oaks. These observations indicate that *Clastoptera* transmission of *X. fastidiosa* is more than a hypothetical possibility. *Clastoptera querci* should be monitored as a potential vector of *X. fastidiosa* in Florida oaks.

Xylella fastidiosa causes several other plant diseases, notably Pierce’s disease of grapevines in California, which is transmitted by sharpshooters, and Olive Quick Decline Syndrome in Italy, which is transmitted by the spittlebug *Philaenus spumarius* (L.) (Almeida and Nunney 2015; EFSA et al. 2019). The native US sharpshooter

Homalodisca vitripennis (Germar) has been demonstrated to transmit citrus variegated chlorosis (CVC), a destructive *X. fastidiosa*-caused disease of citrus in Brazil and Argentina (Damsteegt et al. 2006; EFSA et al. 2019). Our *C. querci* collections include two specimens from *Citrus reticulata* Blanco (mandarin orange), two from *Citrus × sinensis* (L.) Osbeck (sweet orange), and five from *Citrus limon*, suggesting at least the possibility of a role in transmission, were CVC to come to Florida (native *X. fastidiosa* strains do not damage citrus, EFSA et al. 2019). Although *C. querci* probably would play a minor role in transmission of the CVC pathogen in comparison to native sharpshooters, this provides another incentive to monitor *C. querci* as a potential vector.

Acknowledgments

We dedicate this paper to the memory of Dr. Charles W. O'Brien, longtime Florida entomologist, who passed away in retirement in Arizona in August 2019. Charlie worked at Florida Agricultural and Mechanical University for many years and was a world expert on the Curculionoidea. He and his wife, fulgoroid specialist Lois O'Brien, generously contributed the specimens of the undescribed oak-pine Arizona *Clastoptera* species referenced in this study.

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Appendix 1. *Clastoptera querci* specimen records in addition to those cited in Material examined (ordered by county, secondarily by FSCA number). Note: The sample year and sample number together make up the Florida State Collection of Arthropods sample number (FSCA#) (format E20xx-xxxx). Preserved specimens are deposited in the FSCA.

Sample year	Sample no.	County	City	Address	Latitude	Longitude	Collection date	Collection method	Collectors	Plant genus	Plant species	Life stage/s	Preserved?	No. specimens
2013	6534	Alachua	Gainesville	1911 SW 34th St			4/Sep/2013	Hand catch	Mark Rothschild	<i>Quercus</i>	<i>hemisphaerica</i>	Adult	Pinned	1
2013	6871	Alachua	Gainesville	(none given)			20/Sep/2013	Hand catch	Mark Rothschild	<i>Ambrosia</i>	<i>artemisifolia</i>	Adult	Pinned	1
2014	791	Alachua	Gainesville	1911 SW 34th St			12/Feb/2014	Hand catch	Paul Skelley & Bill Grogan			Adult	Pinned	1
2019	3852	Alachua	Gainesville	SW 34th St			10/Jul/2019	Hand catch	Susan Halbert & Mark Rothschild	<i>Quercus</i>	<i>hemisphaerica</i>	Nymph	Alcohol	12
2019	4149	Alachua	Gainesville	Natural Area Dr			25/Jul/2019	Hand catch	Susan Halbert	<i>Quercus</i>	<i>hemisphaerica</i>	Nymph	Alcohol	3
2019	4363	Alachua	Gainesville	Natural Area Dr			2/Aug/2019	Hand catch	Susan Halbert	<i>Quercus</i>	sp.	Nymph	Alcohol (part)	15
2015	4525	Brevard	Merritt Island	560 S Plumosa St			31/Jul/2015	Hand catch	Glen Bupp & Anthony Gubler	<i>Quercus</i>	<i>virginiana</i>	Nymph	Alcohol	6
2017	3136	Brevard	Palm Bay	242 Alcantarra St NW			4/Aug/2017	Hand catch	Anthony Gubler	<i>Quercus</i>	<i>virginiana</i>	Nymph	No	20
2017	3827	Brevard	Melbourne	728 Bonnie Circle	28.083	-80.633	24/Sep/2017	Hand catch	Julie Nieuwenhuis			Adult	No	1
2019	2366	Brevard	Mims	1605 Arch Rd	28.639	-80.889	30/Apr/2019	Sweeping	Dawn Cermak			General adult	Pinned	1
2013	8394	Broward	Fort Lauderdale	1440 SW 41st Ave	26.102	-80.203	15/Nov/2013	Hand catch	Carlene Sargeant			Adult	Pinned	1
2013	9173	Broward	Sunrise	16001 W SR 84 (Markham Park)	26.129	-80.353	18/Dec/2013	Jackson ME trap	Antonio Demien	<i>Quercus</i>	sp.	Adult	Pinned	1
2014	5266	Broward	Plantation	1866 NW 94th Ave	26.149	-80.278	30/Jul/2014	Multi-lure trap	Jeffrey Muirhead	<i>Murroya</i>	<i>paniculata</i>	Adult	Pinned	1
2014	6260	Broward	Sunrise	1960 Sawgrass Circle			3/Sep/2014	Jackson ME trap	Olga Garcia	<i>Psidium</i>	<i>cattelianum</i>	Adult	Pinned	1
2014	6473	Broward	Plantation	7882 NW 7th Ct	26.132	-80.254	20/Sep/2014	Multi-lure trap	Jeffrey Muirhead	<i>Eugenia</i>	<i>uniflora</i>	Adult	No	1
2014	6631	Broward	Plantation	700 S Pine Island Rd	26.112	-80.260	16/Sep/2014	McPhail trap	Jeffrey Muirhead	<i>Swietenia</i>	<i>mahagoni</i>	Adult	Pinned	1
2014	6733	Broward	Miramar	Serman Circle			22/Sep/2014	Hand catch	Merlene Francois	<i>Quercus</i>	<i>virginiana</i>	Nymph	No	2
2015	2318	Broward	Plantation	8491 Gatehouse Rd	26.112	-80.262	4/May/2015	Multi-lure trap	Antonio Demien	<i>Bucida</i>	<i>buceras</i>	Adult	Pinned	1
2016	3231	Broward	Deerfield Beach	351 W Hillsboro Blvd			28/Jun/2016	Multi-lure trap	Keith Harris	<i>Mangifera</i>	<i>indica</i>	Adult	Pinned	1
2016	4716	Broward	Davie	11037 SW 40th Ct	26.071	-80.295	26/Sep/2016	Jackson trap	Rafael Martinez	<i>Tabebuia</i>	<i>impetiginosa</i>	Adult	No	1
2016	4857	Broward	Parkland	8637 NW 62nd PL	26.308	-80.242	4/Oct/2016	Hand catch	Lisa Charlton	<i>Manilkara</i>	<i>zapota</i>	Adult	No	1
2017	2619	Broward	Hollywood	N 63rd Ave & N 30th St	26.036	-80.215	28/Jun/2017	Hand catch	Justin Anto	<i>Quercus</i>	<i>virginiana</i>	Adult	Pinned	1
2017	2733	Broward	Davie	3501 SW 130th Ave	26.076	-80.322	30/Jun/2017	Hand catch	Justin Anto	<i>Quercus</i>	<i>virginiana</i>	Adult & Nymph	No	7
2017	3301	Broward	Fort Lauderdale	3161 W Sunrise Blvd			16/Aug/2017	Jackson Trap	George Louissaint	<i>Quercus</i>	sp.	Adult	No	1
2018	4400	Broward	Plantation	7067 W Broward Blvd	26.123	-80.242	16/Aug/2018	Hand catch	Jeffrey Muirhead	<i>Viburnum</i>	sp.	Adult	No	1
2018	4401	Broward	Weston	Town Center Blvd & Town Center Circle	26.098	-80.385	14/Aug/2018	Multi-lure trap	Antonio Demien	<i>Quercus</i>	sp.	Adult	No	1
2020	977	Broward	Parkland	7647 Old Thyme Ct	26.325	-80.254	9/Mar/2020	Hand catch	Lisa Charlton	<i>Quercus</i>	<i>virginiana</i>	Adult	Pinned	1
2013	6018	Collier	Naples	Buck Run Ct (Off CR951/Collier Blvd)			19/Aug/2013	Hand catch	Leonora Coleman	<i>Chrysobalanus</i>	<i>icaco</i>	Adult	Pinned	1
2013	7608	Collier	Naples	2170 Logan Blvd N	26.271	-81.721	16/Oct/2013	Hand catch	Scott Krueger	<i>Quercus</i>	<i>virginiana</i>	Nymph	Alcohol	14
2015	3958	Collier	Immokalee	2686 SR 29 N			2/Jul/2015	Suction Trap	Scott Croxton			Adult	Pinned	1

Sample year	Sample no.	County	City	Address	Latitude	Longitude	Collection date	Collection method	Collectors	Plant genus	Plant species	Life stage/s	Preserved?	No. specimens
2017	3371	Collier	Immokalee	2685 SR 29 N			21/Aug/2017	Suction Trap	Monica Triana	<i>Psidium</i>	<i>cattleianum</i>	Adult	No	1
2019	534	Collier	Naples	2863 Tiburon Blvd E			30/Jun/2019	Jackson Trap	Mary Graham	<i>Schinus</i>	<i>terebinthifolia</i>	Adult	No	1
2019	4941	Collier	Naples	6291 Napa Woods Way	26.210	-81.734	4/Sep/2019	Hand catch	Scott Krueger	<i>Quercus</i>	sp.	Adult	No	1
2014	6642	Glades	Moore Heaven	346 Trevino Ln			29/Aug/2014	Multi-lure trap	Roberto Delcid			Adult	Pinned	1
2013	7589	Hernando	Brooksville	24059 Childs Rd			15/Oct/2013	Hand catch	Training Class 85	<i>Persea</i>	<i>americana</i>	Adult	Pinned	1
2014	6819	Hillbonds	Avon Park	2305 W Cavalier Rd	27.626	-81.539	25/Sep/2014	Multi-lure trap	Gary Moore	<i>Quercus</i>	sp.	Adult	Pinned	1
2013	6204	Hillsborough	Tampa	Post Office			19/Aug/2013	Multi-lure trap	Michael Dina	<i>Quercus</i>	sp.	Adult	Pinned	1
2013	6487	Hillsborough	Dover	5240 W Trapnell Rd			30/Jul/2013	Multi-lure trap	Rebecca Freeman	<i>Quercus</i>	sp.	Adult	Pinned	1
2013	6659	Hillsborough	Tampa	4623 Hesperides St N			2/Sep/2013	Multi-lure trap	Michael Dina	<i>Quercus</i>	sp.	Adult	Pinned	1
2014	1566	Hillsborough	Plant City	5404 Buckshot Rd			17/Dec/2013	Multi-lure trap	Rebecca Freeman	<i>Quercus</i>	sp.	Adult	Pinned	1
2014	3637	Hillsborough	Tampa	12310 Nebraska Ave			23/May/2014	Trap	Travis Streeter	<i>Quercus</i>	sp.	Adult	Pinned	1
2014	4594	Hillsborough	Citrus Park	9520 Exposition Dr			30/Jun/2014	Hand catch	Jason Spiller	<i>Quercus</i>	<i>nigra</i>	Nymph	Alcohol	6
2014	7434	Hillsborough	Gibsonton	11807 Autumn Creek Dr	27.827	-82.326	16/Oct/2014	Jackson Trap	Hillary Barton	<i>Quercus</i>	<i>virginiana</i>	Adult	No	2
2015	4974	Hillsborough	Tampa	2528 Chapel Way	28.039	-82.487	25/Aug/2015	Multi-lure trap	Patricia Barker	<i>Citrus</i>	<i>aurantium</i>	Adult	No	1
2015	6772	Hillsborough	Sun City	4910 US 41 S			18/Dec/2015	Hand catch	Susan Youngblood	<i>Cupressus</i>	<i>sempervirens</i>	Adult	No	1
2016	4424	Hillsborough	Tampa	10406 Carroll Cove Pl	28.046	-82.484	14/Sep/2016	Multi-lure trap	Patricia Barker			Adult	No	1
2016	4787	Hillsborough	Thonotosassa	14302 Morris Bridge Rd	28.123	-82.314	21/Jul/2016	Malaise trap	Eric Leveen, Enger German Ramirez, Eric Dougherty & Douglas Restom Gaskill			Adult	No	1
2017	520	Hillsborough	Tampa	2916 Kingswood Dr	27.970	-82.369	30/Jun/2017	Multi-lure trap	Patricia Barker	<i>Citrus</i>	<i>reticulata</i>	Adult	No	1
2017	2211	Hillsborough	Tampa	6010 N Tampa Ave			31/May/2017	Multi-lure trap	Michael Dina	<i>Citrus</i>	<i>sinensis</i>	Adult	Pinned	1
2017	2853	Hillsborough	Tampa	8424 Camden St	28.028	-82.515	11/Jul/2017	Multi-lure trap	Patricia Barker	<i>Quercus</i>	sp.	Adult	No	1
2017	4128	Hillsborough	Tampa	705 E Comanche Ave			27/Oct/2017	Hand catch	Travis Streeter	<i>Quercus</i>	<i>laevis</i>	Teneral adult, Nymph	No	3
2019	4577	Hillsborough	Dover	2245 Jaudon Rd	27.978	-82.240	6/Aug/2019	Multi-lure trap	Michael Dina	<i>Cinnamomum</i>	<i>camphora</i>	Adult	No	1
2019	5108	Hillsborough	Riverview	12017 Timberhill Dr	27.864	-82.296	10/Sep/2019	Multi-lure trap	Jeremiah Ortiz	<i>Quercus</i>	sp.	Adult	Pinned	1
2019	5380	Hillsborough	Riverview	10115 Bloomingdale Ave	27.894	82.336	3/Sep/2019	Multi-lure trap	Roberto Duenas			Adult	No	1
2014	6349	Lake	Clermont	11240 Mandarin Dr			10/Sep/2014	Hand catch	Anthony Puppelo	<i>Quercus</i>	sp.	Adult	Pinned	2
2015	1916	Lake	Umatilla	40144 Fletcher Rd			17/Apr/2015	Hand catch	James McGhee	<i>Citrus</i>	<i>reticulata</i>	Adult	Pinned	1
2015	3811	Lake	Groveland	Florida Boys Ranch Rd & Hwy 33			8/Jul/2015	Hand catch	Michael Dornberg, Kyle Schnepp & Susan Halbert	<i>Quercus</i>	sp.	Adult	Pinned	1
2017	3912	Lake	Eustis	34729 Marshall Rd			12/Oct/2017	Hand catch	Mary Sellers, Harry Morrison & Nora Marquez	<i>Quercus</i>	<i>hemisphaerica</i>	Nymph	No	5
2018	3591	Lake	Groveland	8507 SR 33	28.471	-81.834	29/Jun/2018	Hand catch	Abby Bartlett	<i>Tabebuia</i>	<i>chrysantha</i>	Adult	No	1
2019	4103	Lake	Clermont	11801 Montevista Rd	28.519	-81.807	25/Jul/2019	Hand catch	Abby Bartlett	<i>Quercus</i>	<i>shumardii</i>	Nymph	Alcohol	40
2012	1584	Lee	Estero	10501 FCGU Blvd			8/Mar/2012	Hand catch	Reuben Sibert	<i>Quercus</i>	sp.	Adult	No	1
2014	4112	Lee	Cape Coral	219 NW 4th Terr	26.661	-81.980	11/Jun/2014	Multi-lure trap	Amy Cook	<i>Eriobotrya</i>	<i>japonica</i>	Adult	Pinned	1
2015	2116	Lee	LeHigh Acres	11963 Lake Vista Circle			8/Apr/2015	Hand catch	Roberto Delcid	<i>Viburnum</i>	sp.	Adult	No	1
2016	1543	Lee	Fort Myers	3666 Pearl St	26.657	-81.839	11/Apr/2016	Multi-lure trap	Michael Weiss	<i>Mangifera</i>	<i>indica</i>	Adult	No	1
2016	3857	Lee	Fort Myers	3893 Palm Beach Blvd	26.665	-81.834	12/Aug/2016	Jackson TML trap	Michael Weiss	<i>Mangifera</i>	<i>indica</i>	Adult	No	1

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2014	4523	Levy	Dunnellon	Gasline & Beehive Rd (junction of)	29.161	-82.598	28/Jun/2014	Black Light	James Hayden	<i>Quercus</i>	<i>acutissima</i>	Adult	Pinned	1
2013	5985	Manatee	Palma Sola	Montezuma Dr & SR 64			20/Aug/2013	Hand catch	Jason Sharp			Skin & spittle	No	1
2013	6139	Manatee	Bradenton	1155 Encure RV Park	27.506	-82.487	20/Aug/2013	Multi-lure trap	Robin Duniwin	<i>Citrus</i>	<i>sinensis</i>	Adult	Pinned	1
2013	5590	Marion	Ocala	2333 NE 19th Ave	29.211	-82.112	8/Aug/2013	Hand catch	Shelly Wayte	<i>Quercus</i>	sp.	Nymph	No	4
2019	4867	Marion	Umatilla	17255 SE Hwy 452	28.581	-82.775	4/Sep/2019	Hand catch	Tavia Gordon & Kelly Douglas	<i>Vaccinium</i>	sp.	Adult	Pinned	3
2014	5850	Miami-Dade	Miami	10360 SW 118th St			20/Aug/2014	Hand catch	Olga Garcia	<i>Quercus</i>	<i>virginiana</i>	Adult	Pinned	1
2014	6096	Miami-Dade	Miami	13601 Old Cutler Rd	25.643	-80.295	26/Aug/2014	Hand catch	Andrew Derksen	<i>Quercus</i>	<i>virginiana</i>	Adult	Pinned	1
2014	6102	Miami-Dade	Doral	NW 99th Ave (NW corner)			29/Aug/2014	Hand catch	Olga Garcia	<i>Quercus</i>	<i>virginiana</i>	Nymph	Alcohol	8
2014	6114	Miami-Dade	Miami	10360 SW 118th St			27/Aug/2014	Hand catch	Olga Garcia			Adult	Pinned	1
2014	6185	Miami-Dade	Hialeah Gardens	7230 NW 77th St			22/Aug/2014	Multi-lure trap	Gloria Gonzalez	<i>Quercus</i>	sp.	Adult	Pinned	1
2015	1793	Miami-Dade	Miami	10360 SW 118th St			10/Apr/2015	Hand catch	Olga Garcia			Adult	Pinned	1
2015	3782	Miami-Dade	Doral	6370 - 76 NW 97th Ave			7/Jul/2015	Multi-lure trap	Olga Garcia	<i>Chrysophyl- lum</i>	<i>oliviforme</i>	Adult	Pinned	1
2015	3834	Miami-Dade	North Miami Beach	4000 NE 169th St			8/Jul/2015	Beating	Olga Garcia	<i>Coccoloba</i>	<i>uvifera</i>	Adult	Pinned	1
2015	4101	Miami-Dade	Miami	220 NW 130th Ave			20/Jul/2015	Multi-lure trap	Olga Garcia	<i>Dimocarpus</i>	<i>longan</i>	Adult	No	1
2015	4111	Miami-Dade	Miami	12304 NW 8th Terr			20/Jul/2015	Multi-lure trap	Olga Garcia	<i>Calophyllum</i>	sp.	Adult	No	2
2015	6665	Miami-Dade	Miami	1211 SW 126th Pl			14/Dec/2015	Jackson TML trap	Sergio Delgado	<i>Eugenia</i>	<i>uniflora</i>	Adult	No	1
2018	4206	Miami-Dade	Homestead	16401 SW 281st St	25.508	-80.457	2/Aug/2018	Jackson TML trap	David Perendree	<i>Senna</i>	<i>surattensis</i>	Adult	No	1
2012	6473	Orange	Ocoee	6604 Pineknott Ct	28.607	-81.508	20/Aug/2012	Jackson CUE Trap	Jesse Krok	<i>Quercus</i>	sp.	Adult	No	1
2013	6224	Orange	Orlando	1615 Crocker Ave			23/Aug/2013	Multi-lure trap	Terrance McDermott			Adult	Pinned	1
2013	6373	Orange	Orlando	1702 Honboroug Dr			27/Aug/2013	Hand catch	Luis Russe	<i>Persea</i>	<i>americana</i>	Adult	No	1
2013	6511	Orange	Orlando	3300 Escondido Dr	28.447	-81.341	4/Sep/2013	Jackson TML trap	Ricardo Lopez	<i>Viburnum</i>	<i>odoratissimum</i>	Adult	Pinned	1
2013	7195	Orange	Orlando	6159 Sandpine Estates Blvd			26/Sep/2013	Jackson Trap	Luis Russe	<i>Errobotrya</i>	<i>japonica</i>	Adult	No	1
2013	8173	Orange	Apopka	2725 Binion Rd			21/Oct/2013	Reared	Lance Osborne	<i>Quercus</i>	sp.	Adult	Pinned	1
2014	5467	Orange	Orlando	3869 Wunderlakes Dr			6/Aug/2014	Jackson Trap	Luis Russe	<i>Citrus</i>	<i>x paradisi</i>	Adult	No	1
2018	4046	Orange	Apopka	1425 Green Ridge Dr	28.667	-81.483	24/Jul/2018	Jackson TML trap	Rafael Hernandez			Adult	No	2
2018	5866	Orange	Orlando	6729 Nightwind Circle	28.630	-81.482	5/Nov/2018	Jackson ME Trap	Rafael Hernandez			Adult	No	1
2013	6155	Palm Beach	Greenacres	4822 Waverly Woods Terr	26.606	-80.129	22/Aug/2013	Jackson TML trap	Jim Pernsteiner			Adult	Pinned	1
2014	7600	Palm Beach	West Palm Beach	Palomino Dr & SR 7 (Corner of)			29/Oct/2014	Jackson Trap	Thomas Foos	<i>Chrysobala- nus</i>	<i>icaco</i>	Adult	No	1
2015	1731	Palm Beach	Jupiter	11729 Cottonwood	26.850	-80.098	14/Dec/2014	Multi-lure trap	Thomas Wilson	<i>Psidium</i>	<i>cattleanum</i>	Adult	Pinned	1
2015	3820	Palm Beach	Boca Raton	5734 NW 32nd Terr			29/Jun/2015	Multi-lure trap	Eduardo Solis	<i>Calophyllum</i>	<i>inophyllum</i>	Adult	Pinned	1
2016	4619	Palm Beach	Delray Beach	5901 Broken Sound Pkwy			7/Sep/2016	Multi-lure trap	Juan Ochoa	<i>Schinus</i>	<i>terebinthifolia</i>	Adult	No	1
2016	5909	Palm Beach	Boca Raton	21684 Marigot Dr	26.353	-80.236	22/Dec/2016	Jackson TML trap	Carlene Sargeant			Adult	No	1
2018	3151	Palm Beach	Royal Palm Beach	12781 52nd Rd N			4/Jun/2018	Hand catch	Matthew Miller			Adult	No	1
2019	2685	Palm Beach	Wellington	4828 Exerter Estate Ln	26.610	-80.211	30/Nov/2018	Multi-lure trap	Mark Aubry	<i>Quercus</i>	sp.	Adult	No	1
2017	3312	Pasco	New Port Richey	8250 Pala Ct			15/Aug/2017	Hand catch	Karen Destefano	<i>Quercus</i>	sp.	Adult	Pinned	1

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2013	5225	Pinellas	Largo	12520 Ulmerton Rd	27.896	-82.791	25/Jul/2013	Hand catch	Bob Albanese	<i>Quercus</i>	<i>virginiana</i>	Nymph	Alcohol	65
2014	4276	Pinellas	Largo	11101 Ulmerton Rd	27.896	-82.791	17/Jun/2014	Sweeping	William Salway	<i>Myrica</i>	<i>cerifera</i>	Adult	Pinned	1
2015	3235	Pinellas	St Petersburg	13920 58th St N Ste 1011			16/Jun/2015	Hand catch	Thomas Lastrapes			General adult	Pinned	1
2016	4788	Pinellas	St Petersburg	1101 Country Club Way S	27.736	-82.662	21/Jul/2016	malaise trap	Katherine Okins, Phelicia Perez, Lindsay Wheeler, Enger German Ramirez, Douglas Restom Gaskill & Chris Pearce			Adult	No	2
2013	6375	Polk	Lakeland	1810 Sir Henry Trl	28.139	-81.920	26/Aug/2013	Multi-lure trap	David Nick Szanyi	<i>Quercus</i>	sp.	Adult	Pinned	1
2013	7438	Polk	Winter Haven	3027 Lake Alfred Rd			3/Oct/2013	Suction Trap	Peggy Sieburth			Adult	Pinned	1
2014	6063	Polk	Winter Haven	3027 Lake Alfred Rd			22/Aug/2014	Suction Trap	Peggy Sieburth			Adult	Pinned	1
2014	6234	Polk	Winter Haven	3027 Lake Alfred Rd			29/Aug/2014	Suction Trap	Peggy Sieburth			Adult	No	2
2014	6592	Polk	Winter Haven	3027 Lake Alfred Rd			11/Sept/2014	Suction Trap	Peggy Sieburth			Adult	No	1
2015	4799	Polk	Winter Haven	3027 Lake Alfred Rd			13/Aug/2015	Suction Trap	Peggy Sieburth			Adult	Pinned	1
2018	3690	Polk	Winter Haven	3027 Lake Alfred Rd			5/Jul/2018	Suction Trap	Kenneth Branch & Robinson Lawrence			Adult	Pinned	1
2018	4317	Polk	Winter Haven	3027 Lake Alfred Rd			2/Aug/2018	Suction Trap	Kenneth Branch & Robinson Lawrence			Adult	No	1
2019	3679	Polk	Lakeland	4938 Hidden Hills Dr			10/Jun/2019	Hand catch	Adriana Diaz	<i>Citrus</i>	<i>limon</i>	General adult	No	1
2019	4500	Polk	Winter Haven	460 Lake Daisy Dr			12/Aug/2019	Hand catch	Rolando Figueroa-Vargas	<i>Citrus</i>	<i>sinensis</i>	General adult	No	1
2019	5181	Polk	Lakeland	Paula Ct			20/Aug/2019	Hand catch	Rolando Figueroa-Vargas	<i>Citrus</i>	<i>sinensis</i>	General adult	No	1
2019	5933	Polk	Lakeland	4337 Dasiy Ln	28.098	-82.006	22/Oct/2019	Multi-lure trap	Loretta Spano	<i>Eriobotrya</i>	<i>japonica</i>	Adult	No	1
2016	3518	Sarasota	Sarasota	2341 Seattle Slew Dr	27.312	-82.443	19/Jul/2016	Multi-lure trap	Susan Graham	<i>Mangifera</i>	<i>indica</i>	Adult	Pinned	1
2018	3375	Sarasota	Sarasota	3805 Malec Circle	27.281	-82.493	12/Jun/2018	Hand catch	Prem Kumar	<i>Citrus</i>	<i>limon</i>	Adult	No	1
2019	3167	Sarasota	North Port	4845 Italy Ave	27.061	-82.108	24/May/2019	Hand catch	Juan Amador	<i>Citrus</i>	<i>reticulata</i>	Adult	No	1
2014	4604	Seminole	Casselberry	2264 King Henrys Ct	28.617	-81.316	1/Jul/2014	Jackson Trap	Carmelo Torres	<i>Citrus</i>	<i>x paradisi</i>	Adult	Pinned	1
2018	4255	Seminole	Oviedo	6032 Twin Lakes Dr	28.613	-81.250	30/Jul/2018	Jackson TML trap	Luis Torres	<i>Citrus</i>	<i>sinensis</i>	Adult	No	1
2019	4899	Seminole	Longwood	1364 Marcy Dr	28.716	-81.369	27/Aug/2019	Jackson TML trap	Carmelo Torres	<i>Acer</i>	sp.	Adult	No	1
2018	3386	St Lucie	Fort Pierce	7445 Commercial Circle	27.473	-80.407	19/Jun/2018	Multi-lure trap	Jennifer Patterson	<i>Quercus</i>	sp.	Adult	Pinned	1
2018	4793	St Lucie	Fort Pierce	1902 S 8th St			6/Aug/2018	Hand catch	Danielle Hutchinson	<i>Citrus</i>	<i>limon</i>	Adult	No	3
2018	5189	St Lucie	Port St Lucie	1961 SE Westmoreland Blvd			27/Sep/2018	Hand catch	Jeanie Frechette & Teresa Ortelli	<i>Quercus</i>	<i>virginiana</i>	Spittle & dam-age	No	1
2013	5886	Volusia	Deltona	310 Fairbairn Dr	28.886	-81.270	12/Aug/2013	Jackson TML trap	Eugene Monaghan	<i>Citrus</i>	<i>x paradisi</i>	Adult	Pinned	1
2013	8105	Volusia	De Land	(none given)			22/Oct/2013	Hand catch	Gary Leibe	<i>Quercus</i>	<i>virginiana</i>	Adult	Pinned	3
2015	4311	Volusia	Deltona	161 Landmark St	28.881	-81.278	21/Jul/2015	Multi-lure trap	Eugene Monaghan	<i>Citrus</i>	<i>sinensis</i>	Adult	No	1
2018	4601	Volusia	Deltona	1342 Vachaca St	28.936	-81.238	20/Aug/2018	Multi-lure trap	Eugene Monaghan			Adult	No	1
2019	3509	Volusia	De Land	321 Nowell Loop (E of)	28.982	-81.285	10/Jun/2019	Jackson CUE Trap	Diane McColl	<i>Quercus</i>	sp.	Adult	No	3
2019	4629	Volusia	De Land	2185 E Dale Circle	28.982	-81.312	5/Aug/2019	Jackson ME Trap	Diane McColl	<i>Quercus</i>	sp.	Adult	No	1