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Establishment of the sea grape flatid, *Petrusa epilepsis* (Hemiptera: Fulgoroidea: Flatidae), in Florida

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Abstract

The sea grape flatid, *Petrusa epilepsis* (Kirkaldy) (Hemiptera: Flatidae) is a polyphagous, widespread planthopper in the Caribbean that infests common ornamental plants, as well as some of agricultural importance. In 2015, *P. epilepsis* was found in Florida for the first time, and was confirmed to be established in 2017 by the detection of eggs and nymphs on various ornamental plants located at the University of Florida's Fort Lauderdale Research and Education Center in Davie, Florida, USA. In this study, 9 new host plants are reported with 1 representing a new host family (Araliaceae). Additionally, the presence of adults, eggs, and nymphs of various sizes suggests that there are overlapping generations. Molecular analysis reveals no genetic variation of the COI gene. This study records establishment of another invasive species that has the potential to become a pest due to the large number of ornamental plants that are grown in South Florida that could serve as hosts of *P. epilepsis* elsewhere in Florida and the Caribbean.

Keywords: invasive; planthopper; ornamental; pest

Resumen

El flátido de la uva del mar, *Petrusa epilepsis* (Kirkaldy) (Hemiptera: Flatidae) es un saltador de plantas polífago, con una amplia distribución en el Caribe que infesta plantas ornamentales comunes, así como algunas de importancia agrícola. En el 2015, *P. epilepsis* se encontró por primera vez en Florida y se confirmó que se estableció en el 2017 mediante la detección de huevos y ninfas en varias plantas ornamentales ubicadas en el Centro de Investigación y Educación de Fort Lauderdale de la Universidad de Florida en Davie, Florida. En este estudio, se informaron nueve nuevas plantas hospederas con una que representa una nueva familia de hospedadores (Araliaceae). Además, la presencia de adultos, huevos y ninfas de diversos tamaños sugiere que hay generaciones superpuestas. El análisis molecular no revela variación genética del gen COI. Este estudio registra el establecimiento de otra especie invasora que tiene el potencial de convertirse en una plaga debido a la gran cantidad de plantas ornamentales que se cultivan en el sur de la Florida que podrían servir como hospederos de *P. epilepsis* en otras partes de la Florida y el Caribe.

Palabras Clave: invasor; saltahojas; ornamental; parásito

The sea grape flatid, *Petrusa epilepsis* (Kirkaldy) (Hemiptera: Flatidae), is a common species of planthopper found throughout the Caribbean (Table 1) on a wide variety of host plants. This species is known from at least 37 host plants within 23 plant families (Table 2). On Guana Island (British Virgin Islands), *P. epilepsis* was found to be the most abundant planthopper sampled (Bartlett 2000). *Petrusa epilepsis* is not known to cause major economic losses. It is a common, minor pest of mostly ornamental plants, but also is found on crops of agricultural importance, such as coffee (*Coffea arabica* L.) (Rubiaceae) (Borkhataria et al. 2006) and mango (*Mangifera indica* L.) (Anacardiaceae) (S. H., unpublished). Feeding and subsequent honeydew accumulation from *P. epilepsis* has resulted in the growth of sooty mold on black mangroves (*Avicennia germinans* L.) Stearn

(Acanthaceae) in Puerto Rico (Nieves-Rivera et al. 2012). Additionally, *P. epilepsis* was documented on the palms *Cocos nucifera* and *Sabal causarum* (both Arecaceae) in Puerto Rico (Segarra-Carmona et al. 2013). The common name of *P. epilepsis* is derived from its noted abundance on sea grape (*Coccoloba uvifera* L.) Jacq. (Polygonaceae) in its native range. Despite being widespread and abundant throughout the Caribbean, little is known about the biology of *P. epilepsis*, with the primary source of information on biology and life history being covered by Otero (2017).

The first evidence of *P. epilepsis* in Florida occurred in Jun 2015 when it was found in Hollywood, Florida, USA, by Florida Department of Agriculture and Consumer Services, Division of Plant Industry. Adults and immatures were found on *Lantana involucrata* (L.)

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Table 1. Distribution of *Petrusa epilepsis* (Hemiptera: Flatidae) in the Caribbean, excluding Florida.

Location	Insect name in source	Reference
Antigua	<i>Ormenis marginata</i> (Brunnich)	Fennah 1941
Brazil	<i>Ormenis (Petrusa) marginata</i> (Brunn.), <i>Petrusa marginata</i> (Brunnich)	Stål 1869; Melichar 1902, 1923
Central America	<i>Ormenis (Petrusa) pygmaea</i> (Fabr.)	Melichar 1902, 1923
Cuba	<i>Petrusina marginata</i> (Brunnich)	Myers 1928
Dominica	<i>Petrusa pygmaea</i> (Fabr.), <i>Petrusa epilepsis</i> (Kirkaldy)	Stål 1869; FSCA ¹
Grenada	<i>Ormenis (Petrusa) marginata</i> (Brunn.), <i>Petrusina marginata</i> (Brunnich)	Melichar 1902, 1923
Guana Island	<i>Petrusa epilepsis</i> (Kirkaldy)	Bartlett 2000
Hispaniola	<i>Petrusa marginata</i> (Brunnich)	Caldwell 1950
Insulae Americanae Meridionalis (South American islands)	<i>Petrusa pygmaea</i> (Fabr.)	Stål 1869
Jost Van Dyke	<i>Petrusa marginata</i> (Brunnich)	Fennah 1949
Mona Island	<i>Petrusa marginata</i> (Brunnich)	Ramos 1946
Montserrat	<i>Ormenis marginata</i> (Brunnich)	Fennah 1941
Puerto Rico	<i>Ormenis pygmaea</i> F., <i>Petrusa epilepsis</i> (Kirkaldy)	Nieves-Riveira et al. 2012; Caldwell & Martorell 1951; Wolcott 1926, 1936; Leonard 1933; Borkhataria et al. 2012; Osborn 1929, 1935; FSCA
Puerto Rico – Caja de Muertos	<i>Petrusa marginata</i> (Brunnich)	Caldwell & Martorell 1951
St. Barthélemy	<i>Ormenis (Petrusa) pygmaea</i> (Fabr.), <i>Petrusa pygmaea</i> (Fabr.)	Stål 1869; Melichar 1902, 1923
St. Croix	<i>Ormenis (Petrusa) pygmaea</i> (Fabr.)	Melichar 1902, 1923; FSCA
St. Kitts		Fennah 1941
St. Thomas	<i>Petrusa marginata</i> (Brunnich)	Melichar 1902, 1923; Caldwell & Martorell 1951
Tortola	<i>Petrusa marginata</i> (Brunnich), <i>Petrusa epilepsis</i> (Kirkaldy)	Fennah 1949; FSCA
Virgin Gorda	<i>Petrusa marginata</i> (Brunnich)	Fennah 1949

¹Florida State Collection of Arthropods

(Verbenaceae) (Florida State Collection of Arthropods [FSCA] numbers E2015-2880, 3068), and adults and cast nymphal exoskeletons were found on *Forestiera segregata* (Jacq.) Krug & Urban (Oleaceae) (FSCA# E2015-3439). The insect was presumed to be established, since it was found on several plants of each species, but no further samples arrived at the Division of Plant Industry diagnostic bureau until fall 2017. No research has been conducted on *P. epilepsis* since its discovery in Florida, and information on host range, life history, genetic diversity, and distribution in Florida is lacking.

In this study, evidence of the establishment of *P. epilepsis* in the US is presented, along with notes and observations on host plants, damage, and life history of a population collected at the University of Florida, Fort Lauderdale Research and Education Center, Fort Lauderdale, Florida, USA. Additionally, an evaluation of the genetic diversity of the local population is provided.

Materials and Methods

LOCALITY DATA, SAMPLING, AND IDENTIFICATION

This study was conducted at the Fort Lauderdale Research and Education Center, Davie, Broward County, Florida (26.050412°N, 80.141791°W), in the courtyard adjacent to the main administrative building. Initial samples collected were stored at -20 °C and then photographed using a Leica microscope (Leica Microsystems, Buffalo Grove, Illinois, USA) and LASCORE software (Leica Microsystems, Buffalo Grove, Illinois, USA). Male genitalia dissections were performed on representative males and identifications verified using Caldwell & Martorell (1951) and specimens from the Florida State Collection of Arthropods. The original find was confirmed by Dr.

Charles Bartlett, University of Delaware (Newark, Delaware, USA). Following a modified protocol from Bahder et al. (2015), only the terminal end of the abdomen was used for both molecular and morphological analysis. After verification of the species identity, a survey was conducted at the Fort Lauderdale Research and Education Center on 24 Jan 2018 around the area where *P. epilepsis* was first observed. Additionally, all specimens of sea grape and mango on the Fort Lauderdale Research and Education Center property were visually inspected and sampled with sweep nets to determine the host range and local distribution.

DNA BARCODE FOR MOLECULAR CHARACTERIZATION

In order to develop a barcode and template for molecular characterization of *P. epilepsis*, the 5' region of COI was selected and amplified using the primers LCO1490 (forward) and HCO2198 (reverse). Primer sequences are presented in Table 3. Reactions were performed in 25 µl reaction consisting of 5X Clear GoTaq Flexi Buffer (Promega, Madison, Wisconsin, USA), 25 mM MgCl₂, 200 µM dNTPs, 0.5 µM of each primer, 2% PVP-40, 1.5U GoTaq Flexi DNA polymerase (Promega, Madison, Wisconsin, USA), 2 µl of DNA template with the final volume prepared using Ultrapure (ThermoFisher Scientific, Waltham, Massachusetts, USA) sterile water. Thermal cycling conditions were as follows: initial denaturation at 95 °C for 2 min, followed by 35 cycles of denaturation at 95 °C for 30 sec, annealing at 50 °C for 30 sec, extension at 72 °C for 30 sec, followed by a final extension of 72 °C for 5 min. The amplicon was cloned using the TOPO TA Cloning Kit (ThermoFisher Scientific, Waltham, Massachusetts, USA) and the pCR®2.1 Vector (ThermoFisher Scientific, Waltham, Massachusetts, USA). After the cloned sequence was obtained, a total of 8 individuals were selected for molecular characterization and split based on color

Table 2. Host range of *Petrusa epilepsis* (Hemiptera: Flatidae) in the Caribbean, excluding Florida.

Family	Species	Common Name	Reference
Anacardiaceae	<i>Mangifera indica</i> L.	mango	FSCA
Apocynaceae	<i>Trachelospermum jasminoides</i> (Lindl.) Lem.	star jasmine, jazmín estrellado	Otero 2017
Araceae	<i>Xanthosoma sagittifolium</i> (L.) Schott	elephant ear, yautia	Wolcott 1936
Bataceae	<i>Batis maritima</i> L.	salt wort, barilla	Caldwell & Martorell 1951
Boraginaceae	<i>Bourreria succulenta</i> Jacq.	strongbark, palo de vaca	Caldwell & Martorell 1951
Boraginaceae	<i>Cordia bellonis</i> Urb.	serpentine manjack	Otero 2017
Boraginaceae	<i>Cordia collococca</i> L.	clamay cherry, ateje colorado, red manjack	Otero 2017
Boraginaceae	<i>Cordia cylindrostachya</i> (Ruiz & Pav.) Roem. & Schult	black sage	Wolcott 1936
Boraginaceae	<i>Cordia polycephala</i> (Lam.) I. M. Johnst. (as <i>Cordia corymbosa</i>) (Desv.) G. Don	N/A	Osborn 1929, 1935; Wolcott 1936
Boraginaceae	<i>Cordia polycephala</i> (Lam.) I. M. Johnst.	basora prieta	Martorell 1976
Chrysobalanaceae	<i>Chrysobalanus icaco</i> L.	Coco plum, hicacao	Caldwell & Martorell 1951
Combretaceae	<i>Terminalia catappa</i> L.	tropical almond, almendra	Leonard 1933; Wolcott 1936
Euphorbiaceae	<i>Acalypha wilkesiana</i> Müll. Arg.	copperleaf, acalifa	Otero 2017
Fabaceae	<i>Phaseolus vulgaris</i> L.	common bean	Wolcott 1936
Lamiaceae	<i>Mentha x piperita</i> L.	peppermint, menta	Otero 2017
Lauraceae	<i>Nectandra turbacensis</i> (Kunth) Nees as <i>Nectandra sintenisii</i> Mez	laurel amarillo	Martorell 1976
Lauraceae	<i>Ocotea oblonga</i> (Meisn.) Mez as <i>Ocotea portoricensis</i> Mez	laurel de paloma, avispollo	Martorell 1976
Meliaceae	<i>Melia azedarach</i> L.	chinaberry, alelaila	Caldwell & Martorell 1951
Mimosaceae	<i>Inga vera</i> Willd.	river koko, guama	Martorell 1976
Myrtaceae	<i>Psidium guajava</i> L.	common guava, guayaba	Leonard 1933; Wolcott 1936
Myrtaceae	<i>Syzygium jambos</i> (L.) Alston	malabar plum, pomarrosa	Leonard 1933; Wolcott 1936
Nyctaginaceae	<i>Guapira fragrans</i> (Dum. Cours.) Little	black mampoo, corcho	Martorell 1976
Oleaceae	<i>Jasminum multiflorum</i> (Burm.f.) Andrews as <i>Jasminum pubescens</i> (Retz.) Willd.	downy jasmine	Wolcott 1936
Palmae	unspecified palms	palms	Segarra-Carmona et al. 2013
Piperaceae	<i>Piper medium</i> Jacq.	higuillo de limon	Wolcott 1936
Poaceae	<i>Panicum maximum</i> Jacq.	guinea grass	Myers 1928
Polygonaceae	<i>Coccoloba laurifolia</i> Jacq.	tie tongue	Ramos 1946
Polygonaceae	<i>Coccoloba uvifera</i> (L.) Jacq.	sea grape	Wolcott 1926, 1936; FSCA
Rubiaceae	<i>Coffea arabica</i> L.	coffee	Wolcott 1936; Borkkhataria et al. 2012
Rubiaceae	<i>Hillia</i> sp.	N/A	Otero 2017
Rutaceae	<i>Citrus aurantiifolia</i> (Christm.) Swingle	lime	Wolcott 1936
Rutaceae	<i>Citrus medica</i> L.	citron	Wolcott 1936
Rutaceae	<i>Citrus</i> sp.	citrus	FSCA
Rutaceae	<i>Murraya</i> sp.	orange jasmine	FSCA
Verbenaceae	<i>Avicennia germinans</i> (L.) L.	black mangrove	Nieves-Riveira et al. 2012
Verbenaceae	<i>Duranta erecta</i> L.	golden dewdrop, rain joe	Otero 2017
Verbenaceae	<i>Lantana camera</i> L.	white sage	Osborn 1929, 1935; Wolcott 1936; Fennah 1941; FSCA
Verbenaceae	<i>Phyla nodiflora</i> (L.) as <i>Lippia nodiflora</i> (L.) Michx.	capweed, frogfruit, yerba de mariposa	Caldwell & Martorell 1951
Verbenaceae	<i>Volkameria aculeata</i> L. as <i>Clerodendrum aculeatum</i> (L.) Schldtl.	haggar bush	Caldwell & Martorell 1951

morph so that 4 individuals of each color were sequenced. PCR products were run on a 1.5% agarose gel stained with GelRed® (Biotium, Fremont, California, USA). All successful reactions were purified using ExoSAP-IT™ PCR Product Cleanup Reagent (ThermoFisher Scientific,

Waltham, Massachusetts, USA) according to the manufacturer's instructions. Purified PCR product was quantified using a NanoDropLite spectrophotometer (ThermoFisher Scientific, Waltham, Massachusetts, USA) and sent for sequencing at Eurofins Scientific (Louisville,

Table 3. Primers used to obtain COI barcoding information for *Petrusa epilepsis* (Hemiptera: Flatidae) in Florida.

Primer Name	Sequence (5' → 3')	Reference
LCO1490 (Forward)	GGT CAA CAA ATC ATA AAG ATA TTG	Folmer et al. 1994
HCO2198 (Reverse)	TCA GGG TGA CCA AAA AAA TCA	Folmer et al. 1994

Kentucky, USA). Contiguous files were assembled using DNA Baser (Version 4.36) (Heraclio BioSoft SRL, Pitesti, Romania), aligned using MEGA7 (Kumar et al. 2016).

Results

INITIAL OBSERVATIONS

The first adult *P. epilepsis* was observed at the Fort Lauderdale Research and Education Center on a glass door in the courtyard of the administrative building at the center on 28 Aug 2017. The individual was collected and photographed (Fig. 1). Other adults of both color morphs were found feeding on 2 different host plants in the courtyard: firebush (*Hamelia patens* Jacq.) (Rubiaceae) (Fig. 2), and blue porterweed (*Stachytarpheta jamaicensis* L. Vahl) (Verbenaceae) (Fig. 3). On this initial sample date, only adults were observed; however, both color morphs that have been reported for this species were found (Fig. 1). Following this, the population was monitored on a weekly basis from 1 Sep to 15 Dec 2017. The adult counts per wk for each plant are presented in Table 4. On 27 Sep 2017, egg masses were first observed on both *H. patens* (Fig. 4) and *S. jamaicensis* (Fig. 4). Nymphs were first observed on 1 Oct 2017, and were present through mid-Dec. Two types of damage were observed on the host plants. On infested *H. patens*, a general reddening of the leaves was apparent, while an adjacent *H. patens* that was not infested with *P. epilepsis* lacked these symptoms (Fig. 5). The infested *S. jamaicensis*, which had noticeably more egg masses and more nymphs, had sooty mold due to honeydew produced by nymphs (Fig. 5).

HOST SURVEY

The survey conducted in Jan 2018 revealed that 7 different plant species were fed upon by *P. epilepsis* (Table 5). Additional records from the Florida State Collection of Arthropods bring the list to 9 host plants for *P. epilepsis* in Florida. Five of the 7 hosts identified in the survey appeared to be reproductive hosts due to the presence of egg masses and nymphs (Table 5). No individuals were identified outside of the courtyard where they were first observed, and they appear to be very restricted in range at the center. All hosts recorded in this survey represent new host records for *P. epilepsis* and 1 new family record (Araliaceae).

MOLECULAR CHARACTERIZATION

The sequence obtained for the COI gene after cloning was a 709 base pair (bp) region from the 5' end (Accession No. MH041629).

One record of *P. epilepsis* is present in GenBank (JN797344.1) for the COI gene; however the region available has an overlap of 96 base pairs with the product produced in this study, allowing for the sequences of other species that had a higher query coverage to come up after the BLAST search. The 96 bp overlap was 100% between the isolates. The closest match for the region sequenced in GenBank was from *Metcalfa pruinosa* (Say) (Hemiptera: Flatidae) (KX761467.1) with 87% identity and a query coverage of 68%. Based on the analysis performed, all 8 individuals had identical COI sequences. All isolates from this study have been deposited in GenBank (Accession Nos. MH041622–MH041628).

Discussion

This study provides the first evidence of the establishment of *P. epilepsis* in Florida. Additionally, it increases the known host range from 40 plant species in 23 families to 49 plant species in 24 families. This list represents confirmed feeding and reproductive hosts; however, the true range of reproductive hosts is unknown and needs further investigation. Future studies should focus on a survey of the urban environment to determine the distribution and host range of this species in South Florida. It is expected that in time the host range in Florida will increase. In addition, *P. epilepsis* is known to be a pest of ornamentals and some food crops in the Caribbean (Nieves-Rivera et al. 2012; Borkhataria et al. 2012), and may become a pest in Florida as well. After a better understanding of the distribution and host range of *P. epilepsis* in Florida is attained, applied studies for developing chemical and cultural practices to control populations will be undertaken. Due to the lack of information on the biology of this planthopper, it is unknown if natural enemies occur in Florida that could be used for biocontrol of this species. All damage recorded because of this species is limited to direct physical feeding, and the accumulation of honeydew and subsequent growth of sooty mold (Nieves-Rivera et al. 2012) for which the ornamental plant industry has a very low threshold. Until recently, no flatids were known to transmit plant pathogens (Wilson & O'Brien 1987); however, Donati et al. (2017) have shown that *M. pruinosa* Say can transmit *Pseudomonas syringae* pv. *actinidiae* van Hall (Pseudomonadaceae) to healthy kiwi (*Actinidia* spp.) plants. It is unknown if *P. epilepsis* is capable of transmitting plant pathogens, but due to its phloem-feeding behavior, it could play a role in transmission of known or unknown plant pathogens. Because it is polyphagous and newly established, this is an aspect of its biology that should be investigated further.



Fig. 1. *Petrusa epilepsis* collected at the University of Florida, Fort Lauderdale Research and Education Center in Davie, Florida; dark morph (left), light morph (right).



Fig. 2. *Petrusa epilepsis* feeding on stem of *Hamelia patens* (firebush).

Sources for distribution and early host records were obtained from Metcalf (1957). Records from South and Central America are poorly supported. The only record from Brazil is from Stål (1869), with no details given. The record from Brazil in Melichar (1902, 1923) references Stål. Similarly, "Insulae Americanae Meridionalis," South American islands, in Stål (1869) could refer to Caribbean islands, as does Melich-

ar's (1923) reference to Central America, where St. Croix, St. Thomas, and Barthélemy are specified. Metcalf (1957) says that Melichar (1923) records *P. epilepsis* in Colombia, but we could not find any reference to Colombia in Melichar (1923).

Whereas only 8 specimens were analyzed at the molecular level, the development of a barcode for this species provides information for

Table 4. Population data of *Petrusa epilepsis* (Hemiptera: Flatidae) collected from the *Hamelia patens* and *Stachytarpheta jamaicensis* in 2017.

Sample Date	<i>H. patens</i>			<i>S. jamaicensis</i>		
	Adults	Nymphs	Egg Masses	Adults	Nymphs	Egg Masses
28 Aug 2017	10	0	0	55	0	0
4 Sep 2017	4	0	0	56	0	0
10 Sep 2017	4	0	0	65	0	0
17 Sep 2017	8	0	0	63	0	0
25 Sep 2017	1	0	0	44	0	24
1 Oct 2017	1	2	3	39	6	19
9 Oct 2017	4	6	1	31	20	15
17 Oct 2017	0	10	0	20	35	10
24 Oct 2017	0	20	0	23	47	0
1 Nov 2017	0	23	0	16	66	0
9 Nov 2017	2	20	0	20	34	0
18 Nov 2017	10	20	0	20	30	0
26 Nov 2017	6	10	0	50	13	0
3 Dec 2017	10	2	0	50	10	0
10 Dec 2017	10	0	0	52	9	0



Fig. 3. *Petrusa epilepsis* feeding on inflorescence of *Stachytarpheta jamaicensis* (blue porterweed).



Fig. 4. Egg masses of *Petrusa epilepsis* on *Stachytarpheta jamaicensis* (blue porterweed) (A) and *Hamelia patens* (firebush) (B, C).



Fig. 5. Feeding damage of *Petrusa epilepsis* on *Stachytarpheta jamaicensis* (blue porterweed) (A) and *Hamelia patens* (firebush) (B).

Table 5. Host plants of *Petrusa epilepsis* (Hemiptera: Flatidae) recorded from first detection¹ and from the survey conducted in Jan 2018 at the University of Florida, Fort Lauderdale Research and Education Center, Davie, Florida².

Host Family	Host Species	Common Name	Adult	Nymphs	Eggs	FSCA No.
Apocynaceae	<i>Calotropis gigantea</i> ²	giant milkweed	+	—	—	E2018-239
Araliaceae	<i>Polyscias guifoylei</i> ²	frosted aralia	+	+	+	E2018-252
Boraginaceae	<i>Cordia globosa</i> ²	bloodberry	+	—	—	E2018-241
Oleaceae	<i>Forestiera segregata</i> ¹	Florida swamp privet	+	+	+	E2015-3439
Verbenaceae	<i>Lantana involucrata</i> ¹	button sage	+	+	+	E2015-2880, 3068
Rubiaceae	<i>Hamelia patens</i> ²	firebush	+	+	+	E2018-244
Rubiaceae	<i>Pentas lanceolata</i> ²	star flower	+	+	+	E2018-240
Verbenaceae	<i>Stachytarpheta jamaicensis</i> ²	blue porterweed	+	+	+	E2018-251
Verbenaceae	<i>Aloysia gratissima</i> ²	whitebrush	+	+	+	E2018-248

future molecular studies to determine the genetic variability within the Florida population. A larger number of individuals from the Fort Lauderdale Research and Education Center needs to be analyzed, as well as individuals from other Florida localities, assuming it is established elsewhere. Additionally, further analysis of specimens from the Caribbean will provide information on genetic variation within its native range and could be used to determine the origin of this species. Since so few individuals were analyzed, it is unknown if there is a genetic basis for the color morphs or if the variants are due to environmental conditions. Regardless, the fact that both color morphs have identical sequences supports the morphological work done by Fennah (1941) indicating that they are the same species.

This study provides evidence of the establishment of a new invasive species in Florida and a baseline for studying its ecology and invasion biology. It also highlights that non-native species are continually being detected in Florida, emphasizing the importance of improved identification protocols.

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References Cited

- Bahder BW, Bollinger ML, Sudarshana MR, Zalom FG. 2015. Preparation of mealybugs (Hemiptera: Pseudococcidae) for genetic characterization and morphological examination. *Journal of Insect Science* 15: 104–110.
- Bartlett CR. 2000. An annotated list of planthoppers (Hemiptera: Fulgoroidea) of Guana Island (British West Indies). *Entomological News* 111: 120–132.
- Borkhataria RR, Collazo JA, Groom MJ. 2006. Additive effects of vertebrate predators on insects in a Puerto Rican coffee plantation. *Ecological Application* 16: 696–703.
- Borkhataria RR, Collazo JA, Groom MJ. 2012. Species abundance and potential biological control services in shade vs. sun coffee in Puerto Rico. *Agriculture, Ecosystems and Environment* 151: 1–5.
- Caldwell JS. 1950. Three new Antillean Fulgoroidea, with distributional notes on a few others (Homoptera). *American Museum Novitates* 1460: 1–4.
- Caldwell JS, Martorell LF. 1951. Review of the Auchenorynchous Homoptera of Puerto Rico. Part II. The Fulgoroidea except Kinnaridae. *The Journal of Agriculture of the University of Puerto Rico* 34: 133–269.
- Donati I, Mauri S, Buriani G, Cellini A, Spinelli F. 2017. Role of *Metcalfa pruinosa* as a vector for *Pseudomonas syringae* pv. *actinidiae*. *The Plant Pathology Journal* 33: 554–560.

- Fennah RG. 1941. Notes on the flatid genus *Ormenis* in the British Lesser Antilles and Trinidad, with descriptions of new species (Homoptera: Fulgoroidea). *Proceedings of the Entomological Society of Washington* 43: 193–210.
- Fennah RG. 1949. On a small collection of Fulgoroidea (Homoptera) from the Virgin Islands. *Psyche* 56: 51–65.
- Folmer O, Black M, Hoeh W, Lutz R, Vrijenhoek R. 1994. DNA primers for amplification of mitochondrial cytochrome *c* oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology* 3: 294–299.
- Kumar S, Stecher G, Tamura K. 2016. MEGA7: Molecular evolutionary genetics analysis version 7.0 for bigger datasets. *Molecular Biology and Evolution* 33: 1870–1874.
- Leonard MB. 1933. Notes on insect conditions in Puerto Rico for the fiscal year, July 1931 thru June 1932. *The Journal of the Department of Agriculture of Puerto Rico* 17: 97–137.
- Martorell LF. 1976. Annotated Food Plant Catalog of the Insects of Puerto Rico. University of Puerto Rico. Agricultural Experiment Station, Lajas Puerto Rico, USA.
- Melichar L. 1902. Monographie der Acanololiiden und Flatiden (Homoptera) (Fortsetzung). *Annalen des Naturhistorischen Museums in Wien* 17: 1–253.
- Melichar L. 1923. Homoptera Fam. Acanaloniidae, Flatidae et Ricaniidae. *Genera Insectorum*. Bruxelles 182: 1–185.
- Metcalf ZP. 1957. General Catalogue of the Homoptera. Fascicle IV, Fulgoroidea, Part 13, Flatidae and Hypochthonellidae. North Carolina State College, Raleigh, North Carolina, USA.
- Myers JG. 1928. Notes on Cuban Fulgoroid Homoptera, pp. 13–28 *In* Harvard Biological Laboratory and Botanical Garden in Cuba (Atkins Foundation) [eds.], *Studies on Cuban Insects*. Harvard University Press, Cambridge, Massachusetts, USA.
- Nieves-Rivera ÁM, Tattar TA, Williams EH. 2012. Sooty mould-plant hopper association on leaves of the black mangrove *Avicennia germinans* (L.) Stearn in southwestern Puerto Rico. *Arboricultural Journal* 26: 141–155.
- Osborn H. 1929. Notes on Porto Rican Homoptera. *The Journal of the Department of Agriculture of Puerto Rico* 13: 81–112.
- Osborn H. 1935. Insects of Porto Rico and the Virgin Islands, Homoptera (excepting the Sternorhynchi). *Scientific Survey of Porto Rico and the Virgin Islands, Volume XIV - Part 2*: 111–260.
- Otero M. 2017. Revisión del género *Petrusa* Stål (Hemiptera: Flatidae) en Puerto Rico con notas sobre sus hospederos y biología. Universidad de Puerto Rico, Recinto Universitario de Mayagüez. Mayagüez, Puerto Rico. Master's Thesis.
- Ramos JA. 1946. The insects of Mona Island (West Indies). *The Journal of Agriculture of the University of Puerto Rico* 30: 1–74.
- Segarra-Carmona A, Franqui RA, Otero-Arocho M. 2013. Survey of palm-associated Fulgoroidea in Puerto Rico. *The Journal of Agriculture of the University of Puerto Rico* 97: 107–117.
- Stål C. 1869. Hemiptera Fabriciana. *Fabricianska Hemipterarter, efter de I Köpenhamn och Kiel förvarde typexemplaren granskade och beskrifne* 2. *Kongliga Svenska Vetenskaps-Akademiens Handlingar* 8: 1–130. P.A. Norsted & Söner, Stockholm, Sweden.
- Wilson SW, O'Brien LB. 1987. A survey of planthopper pests of economically important plants (Homoptera: Fulgoroidea), pp. 343–360 *In* Wilson MR, Nault LR [eds.], *Proceedings of the Second International Workshop on Leafhoppers and Planthoppers of Economic Importance*, 28 Jul–1 Aug 1986, Provo, Utah, USA.
- Wolcott GN. 1926. Notes on the insects of the sea-grape, *Coccoloba uvifera* (L.) Jacq. in Porto Rico and adjacent countries. *Bulletin of Entomological Research* 27: 49–52.
- Wolcott GN. 1936. *Insectae Borinquenses*. A revised annotated check-list of the insects of Puerto Rico, with a host-plant index by José Otero. *The Journal of Agriculture of the University of Puerto Rico* 20: 1–600.