

AN ANNOTATED LIST OF PLANTHOPPERS (HEMIPTERA: FULGOROIDEA) OF GUANA ISLAND (BRITISH WEST INDIES)¹

Charles R. Bartlett²

ABSTRACT: Twenty-seven species of planthoppers (Hemiptera: Fulgoroidea) are reported from Guana Island (British Virgin Islands), 26 for the first time. The full geographic range of each species is summarized. Local biogeography and *alpha* taxonomy needs for Guana species are discussed. Most planthoppers found on Guana (63%) are also known from Puerto Rico, but many species (59%) have never been reported from outside the Puerto Rican Bank.

Guana is a small privately owned island of 299 hectares situated north of Tortola in the Virgin Islands of the British West Indies. Guana Island is in unusually good ecological condition (Heatwole et al. 1981, Mayer and Chipley 1992), and consists principally of steeply hilly terrain, reaching an elevation of 246 m, covered principally by dry scrub woodland. The flora consists of over 300 species (Mayer and Chipley 1992). There is a small area of flat land with principally grassy vegetation plus a salt pond fringed with mangroves and *Sporobolus* grasses. Guana Island has been subject to a wide array of biological investigations (e.g., Mayer and Chipley 1992, Becker and Miller 1992, Evenhuis and Miller 1994, Roth 1994), although there are no previous studies on the auchenorrhynchos Homoptera. Geologically, Guana is a portion of the Puerto Rican Bank, which was connected to Puerto Rico by dry land during the Pleistocene glacial maxima (Heatwole and MacKenzie 1967, Lazell 1996). Puerto Rico became separated from the Virgin Islands approximately 8,000-10,000 years ago (Heatwole and MacKenzie 1967). The vegetation, climate and geology of the Puerto Rican Bank has been recently described by Heatwole et al. (1981). The planthoppers (Fulgoroidea) of Guana, therefore, are expected to be a relictual subset of the Puerto Rican fauna. The objective of this work is to document the planthoppers of Guana Island in a zoogeographic context.

The insects of Puerto Rico are relatively well known (reviewed by Maldonado Capriles 1996). Caldwell and Martorell (1951) provide keys to the fulgoroid fauna except Kinnaridae provided by Ramos (1957). Wolcott (1950), with additions summarized by Maldonado Capriles and Navarro (1967), lists the species of Puerto Rico, including some not treated by Caldwell and Martorell (1951) or Ramos (1957). The only fulgoroid species previously reported from Guana was the flatid *Melormenis basalis* (Walker, 1851) by Medler (1990).

¹ Received August 12, 1999. Accepted October 8, 1999.

² Department of Entomology and Applied Ecology, University of Delaware, Newark, DE 19717-1303.

All other fulgoroids are reported from Guana for the first time.

MATERIALS AND METHODS

Fulgoroids were surveyed during three collecting expeditions by the author (1993, with J. Cryan, 1994 and 1997) in cooperation with The Conservation Agency (Jamestown, Rhode Island). All surveys were conducted during October at times when The Conservation Agency was granted general access to the island for scientific research. Additional specimens from the Virgin Islands were obtained on loan from the Bernice P. Bishop Museum (BPBM, Honolulu, Hawaii) and M. Ivie (Montana State University). Collecting methods included sweeping or beating vegetation, visual inspection of plants, and malaise trapping.

For each species recorded, all specimens examined are reported and a summary of the entire geographic range is provided. The reported range of each species within the Caribbean islands is arranged geographically from west to east, with the Lesser Antilles divided into the Virgin Islands (VI), Leeward Islands (LI), and Windward Islands (WI) following Bent (1977). Synonymy is reported only for species with changes in nomenclature since Metcalf's Catalog of the Homoptera (Metcalf 1936, 1943, 1945, 1948, 1954a, 1954b, 1957, 1958), or for species reported under a different name by Caldwell and Martorell (1951). Junior synonyms are followed by the citation that resulted in the nomenclatural change. Voucher specimens of all species have been deposited primarily in the collection of North Carolina State University, Raleigh; with representative collections at the BPBM and the University of Delaware (Newark, Delaware).

A discovery curve (species accumulation curve) was calculated to evaluate the completeness of the survey and estimate the number of undetected planthopper species on Guana Island. The discovery curve was created by treating each specimen collected as an observation, and randomizing the sequence of observations with a SAS (SAS Institute 1989) program, and plotting observations by cumulative species. Total planthopper species richness was predicted using Chao's (1984) abundance based estimator of species richness, $S_{chao} = S_{obs} + \frac{F_1^2}{2F_2}$, where S_{obs} = number of observed species, F_1 =

number of species observed by exactly one specimen, F_2 = number of species observed by exactly two specimens. The variance was computed using the Chao (1987) estimator of standard deviation.

RESULTS

A total of 27 fulgoroid species (or subspecies) among nine fulgoroid families was found on Guana Island. All taxa are listed in Table 1; the five new

species will be described elsewhere. Chao's (1984) estimator of species richness (\pm standard deviation) calculates as 27.1 ± 0.142 , and the discovery curve (Figure 1) exhibits a clear leveling-off, suggesting that a high percentage of Guana Island planthopper species were detected.

Of the 27 species, 17 (63%) are also known from Puerto Rico. The species that have **not** been recorded from Puerto Rico are *Bothriocera eborea* Fennah, 1943, *Colpoptera maculifrons flavifrons* Osborn, 1935, *Acanalonia depressa* Melichar, 1901, *Sayiana viequensis* Caldwell, 1951, *Flatoidinus spinosus* Caldwell, 1951, and five new species. *Colpoptera maculifrons*, however, is represented on Puerto Rico by the nominate form (*C. m. maculifrons* Muir, 1924) and two other subspecies (*C. m. maculata* Dozier, 1931, and *C. m. carinata* Dozier, 1936). Also, the Puerto Rican acanaloniid *Acanalonia brevifrons* Muir, 1924, is closely related to *A. depressa* (see **Discussion**). Of Guana Island's 27 species, 16 (59%, excluding *Neomegamelanus elongatus reductus*, see **Discussion**), have not been reported from outside the Puerto Rican Bank (Puerto Rico and the Virgin Islands).

Other than the aforementioned fulgoroid, no other Auchenorrhyncha has been previously reported from Guana Island. Among non-fulgoroid Auchenorrhyncha, a single treehopper species (*Deiroides inermis* Ramos, 1957), and a single cicada species (*Proarna hilaris* (Germar, 1834)) was found on Guana Island. There were no cercopids found during the present study on Guana Island.

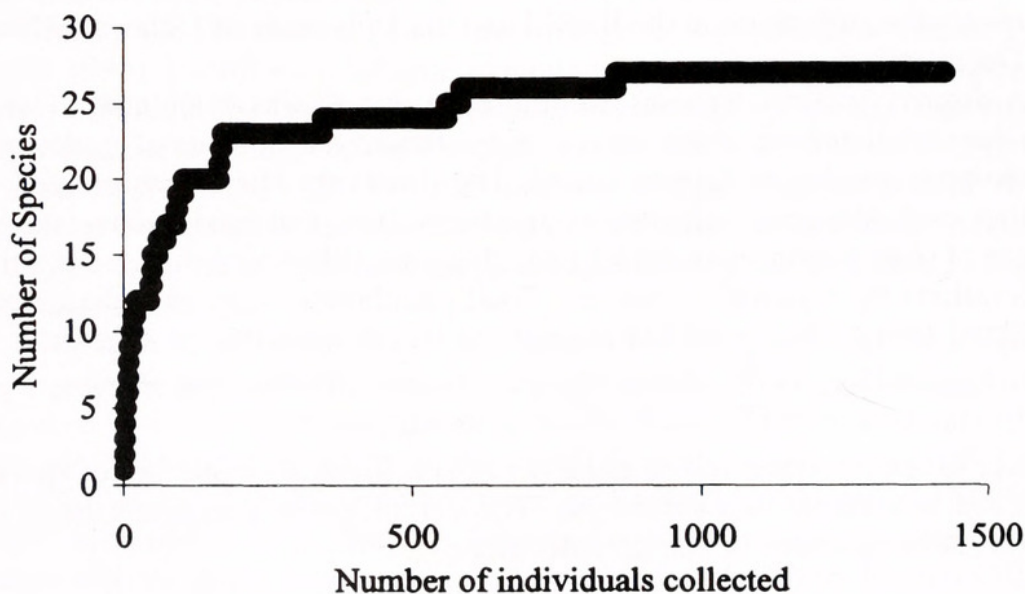


Fig. 1. Discovery curve for Guana Island planthopper species.

Table 1: Fulgoroids of Guana Island, British Virgin Islands.

| Species | Island: Specimens examined | Previously reported range (West to East; type locality in Bold) (VI = Virgin Is.; LI = Leeward Is.; WI = Windward Is. | References: |
|--|--|---|---|
| Cixiidae | | | |
| <i>Bothriocera eborea</i> Fennah, 1943 | Guana: 18 Tortola: 52 | VI: Tortola, Jost Van Dyke; LI: St. Kitts , Nevis, Montserrat; WI: Dominica, Martinique, St. Lucia, St. Vincent | Fennah 1943, 1945, 1949; Caldwell and Martorell 1951 |
| <i>Oliarus slossonae</i> Van Duzee, 1912 = <i>Oliarus borinquensis</i> Caldwell, 1951: Mead and Kramer : 1982: 424-426. | Guana: 86 Little Thatch: 1 Tortola: 2 Great Camanoe: 1 St. John: 2 | Cuba, Puerto Rico; VI: St. Thomas; USA: Florida (but not Mississippi or Texas, Mead and Kramer 1982) | Caldwell and Martorell 1951, Mead and Kramer 1982 |
| <i>Oliarus viequensis</i> Caldwell, 1951 | Guana: 2 (♀) Anegada: 3 | Hispaniola, Puerto Rico, Vieques ; VI: St. John; LI: Antigua; USA: FL | Caldwell and Martorell 1951, Mead and Kramer 1982 |
| <i>Pintalia alta</i> Osborn, 1935 | Guana: 83 Tortola: 258 Beef: 1 | Puerto Rico ; VI: St. Thomas | Caldwell and Martorell 1951 |
| Delphacidae | | | |
| <i>Neopunana carabbensis</i> (Caldwell, 1951) = <i>Punana carabbensis</i> Caldwell, 1951: Asche, 1983: 128 | Guana: 168 Tortola: 10 St. John: 5 Great Camanoe: 2 Frenchman's Cay: 2 Gt. St. James: 1 | Puerto Rico, Vieques; VI: St. Thomas | Caldwell and Martorell 1951 |
| <i>Neopunana</i> n. sp.1 | Guana: 2 | | |
| <i>Neopunana</i> n. sp.2 | Guana: 3 | | |
| <i>Neopunana</i> n. sp.3 | Guana: 3 | | |
| <i>Saccharosydne saccharivora</i> (Westwood, 1833) | Guana: 5 | Cuba, Jamaica, Hispaniola, Puerto Rico, Vieques; LI: Antigua, Guadeloupe; WI: St. Lucia, Barbados, Grenada , Trinidad; Venezuela, USA: Florida, Georgia, Hawaii; British Honduras, Venezuela | Anonymous 1833, Westwood 1833, Crawford 1914, Van Duzee 1917, Spooner 1920, Wolcott 1927, 1936, 1950; Caldwell and Martorell 1951, Box 1953, CIE 1956, Fennah 1959, Metcalfe 1969, Bruner et al. 1975 |

| Species | Island: Specimens examined | Previously reported range (West to East; type locality in Bold) (VI = Virgin Is.; LI = Leeward Is.; WI = Windward Is. | References: |
|---|---|---|--|
| <i>Anchidelphax havanensis</i> (Crawford, 1914) = <i>Delphacodes havanensis</i> (Crawford, 1914): Fennah, 1965: 97 | Guana ♂ macropter: 4 ♀ brachypter: 8 ♀ macropter: 1 | Cuba , Jamaica, Puerto Rico,: Caja de Muertos, Vieques; VI: St. Thomas, St. Croix; WI: Martinique, St. Lucia, Barbados | Crawford 1914, Muir 1918, Osborn 1929, 1935; Wolcott 1936, 1950; Muir and Giffard 1924, Caldwell and Martorell 1951, Fennah 1959, 1965; Miskimen and Bond 1970 |
| <i>Neomegamelanus elongatus reductus</i> (Caldwell, 1951) = <i>Megamelanus elongatus reductus</i> (Caldwell, 1951): McDermott 1952: 50-52. | Guana: 13 | Puerto Rico, Vieques . | Caldwell and Martorell 1951 |
| <i>Toya venilia</i> (Fennah, 1959) = <i>Delphacodes venilia</i> Fennah, 1959: Fennah, 1965: 96 | Guana: 28 Necker: 14 | ?Puerto Rico, ?Vieques; LI: Montserrat | Fennah 1959, 1965 |
| Derbidae | | | |
| <i>Sayiana viequensis</i> Caldwell, 1951 | Guana: 24 Anegada: 1 | Vieques | Caldwell and Martorell 1951 |
| Achilidae | | | |
| <i>Catonia arida</i> Caldwell, 1951 | Guana: 139 Tortola: 1 Virgin Gorda: 1 Necker: 1 St. John: 1 | Puerto Rico , Caja de Muertos | Caldwell and Martorell 1951 |
| <i>Catonia cinerea</i> Osborn, 1935 | Guana: 64 Tortola: 6 Virgin Gorda: 1 | Puerto Rico , Caja de Muertos, Vieques; VI: St. Croix | Osborn 1935, Wolcott 1936, 1941, 1950; Caldwell and Martorell 1951 |
| <i>Catonia</i> sp. near <i>major</i> Fennah, 1950 | Guana: 27 Tortola: 2 | LI: Antigua | Fennah 1950 |
| Tropiduchidae | | | |
| <i>Tangella schaumii</i> (Stål, 1859) | Guana: 1 St. John: 1 | Puerto Rico, Caja de Muertos, Vieques; VI: St. Thomas, St. John , Jost Van Dyke | Stål 1859, Fennah 1949. Caldwell and Martorell 1951 |

| Species | Island: Specimens examined | Previously reported range (West to East; type locality in Bold) (VI = Virgin Is.; LI = Leeward Is.; WI = Windward Is. | References: |
|--|---|---|---|
| <i>Tangia viridis</i> (Walker, 1851) = <i>Neurotmeta viridis</i> (Walker, 1851): Fennah, 1965: 100-101 | Guana: 97 St. Thomas: 1 St. John: 1 | Mona, Puerto Rico, Caja de Muertos, Vieques; VI: St. Thomas , Tortola, Virgin Gorda, St. Croix | Osborn 1935, Wolcott 1936, 1941, 1950; Fennah 1949, Caldwell and Martorell 1951, Miskimen and Bond 1970 |
| Flatidae | | | |
| <i>Flatoidinus spinosus</i> Caldwell, 1951 | Guana: 2 | VI: St. John , St. Thomas, Tortola | Caldwell and Martorell 1951 |
| <i>Melormenis basalis</i> (Walker, 1851) [nec. Caldwell, 1951] = <i>Melormenis antillarum</i> (Kirkaldy, 1909): Fennah, 1965: 107 | Guana: 55 Tortola: 8 Virgin Gorda: 2 Great Camanoe: 1 St. John: 2 | Mona, Puerto Rico, Caja de Muertos, Vieques; VI: St. Thomas, Jost Van Dyke, Tortola, Virgin Gorda, St. Croix; LI: Anguilla, St. Bartholomew, St. Kitts, Nevis, Montserrat, Antigua; Hawaii (type locality "West Indies" (Walker 1851), but stated as unknown by Fennah (1965)) | Melichar 1902, 1923; Beatty 1947, Wolcott 1923, 1941, 1950; Caldwell and Martorell 1951, Fennah 1949, 1965; Miskimen and Bond 1970; Asche 1997. |
| <i>Petrusa epilepsis</i> (Kirkaldy, 1906) = <i>Petrusa marginata</i> (Linne, 1767): Metcalf, 1957: 337-342. | Guana: 268 Tortola: 28 Anegada: 1 St. John: 6 St. Thomas: 1 Scrub: 5 | Cuba, Hispaniola, Mona, Puerto Rico, Caja de Muertos, Vieques; VI: St. Thomas, Jost Van Dyke, Tortola, Virgin Gorda, St. Croix; LI: St. Bartholomew, St. Kitts, Nevis, Montserrat, Antigua; WI: Grenada; Brazil, Columbia (type locality unknown) | Melichar 1902, 1923; Myers 1928; Wolcott 1923, 1936, 1941, 1950; Fennah 1941, 1949; Beatty 1947, Caldwell 1950, Caldwell and Martorell 1951, Miskimen and Bond 1970 |
| <i>Pseudoflatoides albus</i> Caldwell, 1951 | Guana: 17 Tortola: 6 Frenchman's Cay: 1 | Puerto Rico | Caldwell and Martorell 1951 |
| Issidae | | | |
| <i>Thionia argo</i> Fennah, 1949 | Guana: 92 Virgin Gorda: 4 St. John: 1 Scrub: 1 | Puerto Rico, Vieques Is., Culebrita; VI: St. Thomas, Jost Van Dyke , St. Croix | Fennah 1949, Caldwell and Martorell 1951 |

| Species | Island: Specimens examined | Previously reported range (West to East; type locality in Bold) (VI = Virgin Is.; LI = Leeward Is.; WI = Windward Is.) | References: |
|--|--|--|--|
| <i>Colpoptera maculifrons flavifrons</i> Osborn, 1935 | Guana: 3 Tortola: 3 | Mona; VI: St. Thomas, St. Croix ; LI: Antigua | Osborn 1935, Beatty 1947, Wolcott 1950, Miskimen and Bond 1970 |
| Acanaloniidae | | | |
| <i>Acanalonia depressa</i> Melichar, 1901 | Guana: 79 Tortola 2 Virgin Gorda: 1 Great Camanoe: 2 St. John: 1 Beef: 1 | VI: St. Thomas, St. John , Anegada, St. Croix | Melichar 1901, Caldwell and Martorell 1951 |
| Kinnaridae | | | |
| <i>Prosotropis</i> ♀ ♀ (poss. <i>marmorata</i> Fennah, 1942) | Guana: 2 St. John: 1 | | |
| <i>Quilessa fasciata</i> Fennah, 1945 | Guana: 131 Tortola: 1 Little Thatch: 1 Virgin Gorda: 3 Cas Cay (St. Thomas): 1 Anegada 10 | Puerto Rico | Ramos 1957 |

DISCUSSION

Although it is satisfying that Chao's (1984) estimator of species richness was only slightly higher than the observed species richness, it would be optimistic to claim that all species were detected. It should be noted that these data were not collected for the express purpose of estimating planthopper species richness, and that abundant species were not consistently collected at every encounter. Although additional planthopper species almost certainly occur, these data clearly suggest that a high percentage of species have been detected.

A variety of taxonomic problems were revealed in this study. One particular difficulty was with the forms related to *Acanalonia depressa*: *A. brevifrons* (type locality: Puerto Rico) and *A. impressa* Metcalf and Bruner, 1930 (type locality: Cuba). *Acanalonia impressa* appears to be an endemic Cuban form. Caldwell and Martorell (1951) and Fennah (1949) make conflicting statements as to the geographical limits of *A. brevifrons*. Caldwell and Martorell (1951) report *A. brevifrons* from St. Croix, St. Thomas, and tentatively Anegada, but

curiously do not report Puerto Rico (*A. brevifrons* was described from a single Puerto Rican male; Muir 1924) and do not report *A. depressa* in the Virgin Islands. Fennah (1949), however, reports *A. depressa* from Jost Van Dyke, St. Thomas and St. Croix, but limits *A. brevifrons* to Puerto Rico. The published morphological distinctions between *A. depressa* and *A. brevifrons* concern their relative size and subtle differences in the shape of the head and tegmina (Fennah 1949), but genitalic comparisons have never been made. Fennah (1949) suggested that *A. impressa* and *A. brevifrons* should be subspecies of *A. depressa*. The status of these species clearly requires reexamination.

The delphacid *Neomegamelanus elongatus reductus* was described from Puerto Rico and Vieques Island by Caldwell (in Caldwell and Martorell 1951) as a Caribbean subspecies of the otherwise mainland *N. elongatus* (Ball, 1905) (found on the coastal eastern United States, Connecticut to Florida, McDermott 1952, Cummins et al. 1988). Other than geography, no useful morphological distinctions between these subspecies were presented. Comparison of chrotic and phallic features of *Neomegamelanus elongatus elongatus* and *N. elongatus reductus* suggests that there are not sufficient differences to justify subspecific status, although a detailed examination was beyond the scope of the present work. For the purposes of this study *Neomegamelanus elongatus reductus* was not considered a form unique to the Puerto Rican Bank.

Two species found on Guana had some notable differences from described forms. The kinnarid *Quilessa fasciata* lacked the diagnostic markings on the forewings noted by Ramos (1957), and had additional processes on the aedeagal complex. These differences are probably insufficient to consider this form a separate species, but may merit subspecific status. The achilid *Catonia* nr. *major* (from Antigua) showed color and genitalic differences compared to Fennah's (1950) description (this species is only recorded from the holotype), and probably represents a new species.

Zoogeographically, more than half of the species encountered on Guana Island are apparently endemic to the Puerto Rican Bank. Of the remaining species, three others are found also in the Leeward Islands (*Toya venilia*, *Catonia* nr. *major*, and *Colpoptera maculifrons flavifrons*), three were distributed widely within the Caribbean (*Bothriocera eborea*, *Melormenis basalis* and *Anchidelphax havanensis*; the former two largely restricted to the Lesser Antilles), one ranges to northern South America (*Petrusa epilepsis*), three range to the continental United States (*Oliarus slossonae*, *O. viequensis*, and *Neomegamelanus elongatus*), and one is found in both Central America and southeastern United States (*Saccharosydne saccharivora*). It appears odd that more species have an affiliation to North America than to Central America. Modern ideas concerning the origin of the Caribbean fauna (e.g., Rosen 1985, Liebherr 1988) suggest that biological affinities should be strongest with Central America. Ramos (1988: 68) also suggested that the Caribbean Auchel-

norrhyncha has "little or no affinity to North or South America." The eastern position of the Puerto Rican Bank (relative to the other Greater Antilles and Central America) and long period of time required for vicariance, however, would most certainly obscure biogeographic affinities at the species level.

The issid *Colpoptera maculifrons* Muir, 1924 has five subspecies (including the nominate form) that collectively occur throughout the Caribbean islands. The nominate form along with *C. m. carinata* Dozier and *C. m. maculata* Dozier are recorded from Puerto Rico, with the latter form also recorded from Mona Island (Dozier 1931, Caldwell and Martorell 1951). *Colpoptera maculifrons dominicana* Fennah, 1955, is known only from Hispaniola; *C. m. angustior* Fennah from the Leeward Islands (Antigua, Nevis, St. Kitts, Montserrat) and St. Croix; and *C. m. grenada* Fennah from Grenada (Windward Islands) (Fennah 1955).

The cixiid *Oliarus slossonae* was abundant on agave (*Agave missionum*, Agavaceae) on Guana, a host plant also reported for it on St. Thomas (Mead and Kramer 1982). Perhaps significantly, agave is not reported as a host elsewhere in its range (Mead and Kramer 1982), suggesting that *Oliarus slossonae* may represent a species complex.

The delphacid *Toya venilia* was common on Guana (and nearby islands, R. Denno, pers. comm.) in the grass *Sporobolus virginicus* (Poaceae) near a salt pond. Individuals of this species are commonly brachypterous, with an 85.7% (24 of 28) brachyptery rate among the Guana specimens examined in this study. *Toya venilia* was described from Montserrat (Leeward Islands), the only locality where this species has been unquestionably recorded in the past. Puerto Rican and Vieques Island records are based on Fennah's (1959: 262) assertion that "It appears to be this species which Caldwell and Martorell [1951: 183] have reported from Puerto Rico under the name *Delphacodes nigra*".

A total of 27 species and subspecies of planthoppers (including five new species) were recorded from Guana Island. Most planthoppers found on Guana also occur on Puerto Rico (17 of 27 species, 63%), mostly endemic to the Puerto Rican Bank (16 of 27 species, 59%). The relatively high degree of endemism observed is consistent with the high degree of endemism observed among Auchenorrhyncha in the Greater Antilles by Ramos (1988). It should be noted, however, that this observation is based on substantially incomplete information because many smaller Caribbean islands have no published reports of fulgoroids, and our knowledge of the planthoppers of Jamaica and Hispaniola is quite poor (Ramos 1988). Further surveys of Caribbean Fulgoroidea are needed to more confidently assess planthopper zoogeography.

ACKNOWLEDGMENTS

I am grateful to the Jarecki family, W. Lu and J. D. Lazell of The Conservation Agency, and the staff of Guana Island who made this research possible. I also thank M. A. Ivie (Montana

State University), K. Arakaki and S. Miller (Bernice P. Bishop Museum) for loans of specimens, and S. McKamey (United States National Museum), D. W. Tallamy, and J. A. Hough-Goldstein for valuable comments on the manuscript. Field work for this study was primarily supported by The Conservation Agency, with additional support from the Department of Entomology and Applied Ecology, University of Delaware.

LITERATURE CITED

- Anonymous.** 1833. A notice of the ravages of the cane fly, a small winged insect, on the sugar canes of Grenada, including some facts on its habits. *Mag. Nat. Hist.* 6: 407-409.
- Asche, M.** 1983. Aufgliederung der Asiracinen - Gattung *Punana* Muir, 1913: *Equasystatus* gen. nov. aus Equador und *Neopunana* gen. nov. von den Karibischen Inseln (Homoptera Auchenorrhyncha Fulgoromorpha Delphacidae). *Marburger Entomol. Publ.* 1(8): 127-166.
- Asche, M.** 1997. A review of the systematics of Hawaiian planthoppers (Hemiptera: Fulgoroidea). *Pac. Sci.* 51(4): 366-376.
- Ball, E. D.** 1905. Some new Homoptera from the south and southwest. *Proc. Biol. Soc. Wash.* 18: 117-120.
- Beatty, H. A.** 1947. The insects of St. Croix, V.I. *J. Agric. Univ. P.R.* 28: 114-172.
- Becker, V. O. and S. E. Miller.** 1992. The butterflies of Guana Island, British Virgin Islands. *Bull. Allyn Mus.* 136: 1-9.
- Bent, R. M.** 1977. A modern secondary geography of the West Indies (second edition). Jamaica Publ. House, Kingston, Jamaica. 248 pp.
- Box, H. E.** 1953. List of sugar-cane insects. Commonwealth Instit. Entomol., London. 101 pp.
- Bruner, S. C., L. C. Scaramuzza, and A. R. Otero.** 1975. Catalogo de los insectos que atacan a las plantas economicas de Cuba. Academia de Ciencias de Cuba, Instituto de Zoologia. La Habana 2da. edición ampliada y revisada 1975. 394 pp.
- Caldwell, J. S.** 1950. Three new Antillean Fulgoroidea with distributional notes on a few others (Homoptera). *Am. Mus. Novit.* 1460: 1-4
- Caldwell, J. S., and L. F. Martorell.** 1951 [dated 1950]. Review of the Auchenorynchous [sic] Homoptera of Puerto Rico. Part II. The Fulgoroidea except Kinnaridae. *J. Agric. Univ. P.R.* 34(2): 133-269.
- Chao, A.** 1984. Non-parametric estimation of the number of classes in a population. *Scand. J. Stat.* 11: 265-270.
- Chao, A.** 1987. Estimating the population size for capture-recapture data with unequal catchability. *Biometrics* 43: 783-791.
- Commonwealth Institute of Entomology (CIE).** 1956. Distribution maps of insect pests. Map. No. 62. *Saccharosydne saccharivora* (Westw.). Queen's Gate, London.
- Crawford, D. L.** 1914. A contribution toward a monograph of the homopterous insects of the family Delphacidae of North and South America. *Proc. U.S. Natl. Mus.* 46: 557-640, plates 45-49.
- Cummins, J. D., S. W. Wilson, P. D. Calvert and J. H. Tsai.** 1988. *Neomegamelanus dorsalis* (Homoptera: Delphacidae): Descriptions of immatures. *J. N.Y. Entomol. Soc.* 96(3): 260-265.
- Dozier, H. L.** 1931. New and interesting West Indian Homoptera. *Am. Mus. Novit.* 510: 1-24.
- Dozier, H. L.** 1936. *Colpoptera carinata* sp. nov. Dozier. p. 99. In: G. N. Wolcott. "Insectae Borinquenses." A revision of "Insectae Portoricensis" *J. Agric. Univ. P.R.* 20(1): 1-600.
- Evenhuis, N. L. and S. E. Miller.** 1994. Bee flies of the British Virgin Islands (Diptera: Bombyliidae). *Fla. Entomol.* 77(3): 382-384.
- Fennah, R. G.** 1941. Notes on the flatid genus *Ormenis* in the British Lesser Antilles and Trinidad, with descriptions of new species (Homoptera: Fulgoroidea). *Proc. Entomol. Soc. Wash.* 43(9): 191-210.

- Fennah, R. G.** 1942. New or little-known West Indian Kinnaridae (Homoptera: Fulgoroidea). *Proc. Entomol. Soc. Wash.* 44(5): 99-110.
- Fennah, R. G.** 1943. New species of *Bothriocera* Burm. (Homoptera: Cixiidae) from the Lesser Antilles. *Psyche* 50: 9-17.
- Fennah, R. G.** 1945. The Cixiini of the Lesser Antilles (Homoptera: Fulgoroidea). *Proc. Biol. Soc. Wash.* 58: 133-146.
- Fennah, R. G.** 1949. On a small collection of Fulgoroidea (Homoptera) from the Virgin Islands. *Psyche* 56(2): 51-65.
- Fennah, R. G.** 1950. A generic revision of the Achilidae (Homoptera: Fulgoroidea) with descriptions of new species. *Bull. Br. Mus. (Nat. Hist.) Entomol.* 1(1): 1-170.
- Fennah, R. G.** 1955. Lanternflies of the family Issidae of the Lesser Antilles (Homoptera: Fulgoroidea). *Proc. U.S. Natl. Mus.* 105(3350): 24-47.
- Fennah, R. G.** 1959. Delphacidae from the Lesser Antilles (Homoptera: Fulgoroidea). *Bull. Br. Mus. (Nat. Hist.) Entomol.* 8(6): 245-265.
- Fennah, R. G.** 1965. New species of Fulgoroidea (Homoptera) from the West Indies. *Trans. R. Entomol. Soc. Lond.* 117(4): 95-126.
- Germar, E. F.** 1834. Observations sur plusieurs espèces du genre, *Cicada*, Latr. *Rev. Ent. Silbermann* 2: 49-82.
- Heatwole, H. and F. Mackenzie.** 1967. Herptogeography of Puerto Rico. IV. Paleogeography, faunal similarity and endemism. *Evolution* 21: 429-438.
- Heatwole, H., R. Levins, and M. D. Byer.** 1981. Biogeography of the Puerto Rican Bank. *Atoll Res. Bull.* 251: 1-55, plus 9 figures.
- Kirkaldy, G. W.** 1906. Two new Homoptera from Africa, and synonymical notes. *Can. Entomol.* 38: 154-156.
- Kirkaldy, G. W.** 1909. Hemiptera: new and old. - No. I. *Can. Entomol.* 41: 30-32.
- Lazel, J.** 1996. Guana Island: A natural history guide. The Conservation Agency Occ. Pap. 1: 1-20.
- Liebherr, J. K.** 1988. The Caribbean: fertile ground for zoogeography. Pp. 1-14. In: J. K. Liebherr (ed.). *Zoogeography of Caribbean insects*. Cornell Univ. Press, Ithaca, NY.
- Linne, C.** 1767. Hemiptera. Pp. 703-712. In: *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Editio duodecima, reformata. Tomus II. 824 pp.
- Maldonado Capriles, J.** 1996. The status of insect alpha taxonomy in Puerto Rico after the scientific survey. Pp. 201-216. In: J. C. Figueroa Colon (ed.). *The scientific survey of Puerto Rico and the Virgin Islands: An eighty-year reassessment of the islands' natural history*. Ann. N.Y. Acad. Sci., Vol. 776.
- Maldonado Capriles, J. and C. A. Navarro.** 1967. Additions and corrections to Wolcott's insects of Puerto Rico. *Caribb. J. Sci.* 7(1-2): 45-64.
- Mayer, G. C. and R. M. Chipley.** 1992. Turnover in the avifauna of Guana Island, British Virgin Islands. *J. Anim. Ecol.* 61: 561-566.
- McDermott, B. T.** 1952. A revision of the genus *Megamelanus* and its allies (Homoptera, Fulgoroidea, Delphacidae). *J. Kans. Entomol. Soc.* 25: 41-49.
- Mead, F. W. and J. P. Kramer.** 1982. Taxonomic study of the planthopper genus *Oliarus* in the United States (Homoptera: Fulgoroidea: Cixiidae). *Trans. Amer. Entomol. Soc.* 107: 381-569.
- Medler, J. T.** 1990. Types of Flatidae (Homoptera). XIV. Walker and Distant types in the British Museum (England, UK). *Orient. Insects* 24: 127-195.
- Melichar, L.** 1901. Monographie der Acanaloniiden und Flatiden (Homoptera). *Ann. K.K. Naturh. Hof.* 16: 178-258.
- Melichar, L.** 1902. Monographie der Acanaloniiden und Flatiden (Homoptera) (Fortsetzung.). *Ann. K. K. Naturh. Hof.* 17: 1-123.

- Melichar, L.** 1923. Homoptera, fam. Acanaloniidae, Flatidae et Ricaniidae. *Genera Insectorum* 182: 1-185.
- Metcalf, Z. P.** 1936. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 2, Cixiidae. Smith College, Northhampton, MA. 269 pp.
- Metcalf, Z. P.** 1943. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 3, Araeopidae (Delphacidae). Smith College, Northhampton, MA. 552 pp.
- Metcalf, Z. P.** 1945. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 4, Derbidae. Smith College, Northhampton, MA. 212 pp.
- Metcalf, Z. P.** 1948. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 10 Achilidae. Smith College, Northhampton, MA. 85 pp.
- Metcalf, Z. P.** 1954a. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 11 Tropiduchidae. N.C. State Univ., Raleigh. viii + 176 pp.
- Metcalf, Z. P.** 1954b. General Catalogue of the Hemiptera. Fascicle IV, Fulgoroidea, Part 14 Acanaloniidae. N.C. State Univ., Raleigh. vii + 64 pp.
- Metcalf, Z. P.** 1957. General Catalogue of the Homoptera. Fascicle IV, Fulgoroidea, Part 13, Flatidae and Hypochthonellidae. N.C. State College, Raleigh. viii + 565 pp.
- Metcalf, Z. P.** 1958. General Catalogue of the Homoptera. Fascicle IV, Fulgoroidea, Part 15, Issidae. Waverly Press Inc., Baltimore, MD. vii + 561 pp.
- Metcalf, Z. P. and S. C. Bruner.** 1930. Cuban Fulgorina. 1. The families Tropiduchidae and Acanaloniidae. *Psyche* 37(4): 395-424.
- Metcalf, J. R.** 1969. Studies on the biology of the sugar cane pest *Saccharosydne saccharivora* (Westw.) (Hom.: Delphacidae). *Bull. Entomol. Res.* 59: 393-408.
- Miskimen, G. W. and R. M. Bond.** 1970. The Insects of St. Croix, United States Virgin Islands. *Sci. Survey Porto Rico Virgin Islands* 13(1): 1-114.
- Muir, F. A. G.** 1918. Homopterous Notes II. *Proc. Hawaii. Entomol. Soc.* 3: 414-429.
- Muir, F. A. G.** 1924. New and Little Known Fulgorids from the West Indies (Homoptera). *Proc. Hawaii. Entomol. Soc.* 5(3): 461-472.
- Muir, F. A. G. and W. M. Giffard.** 1924. Studies in North American Delphacidae. *Bull. Exp. Stn. Hawaii. Sugar Planters' Assoc., Entomol. Ser.* 15: 1-53.
- Myers, J. G.** 1928. Notes on Cuban Fulgoroid Homoptera. *Studies on Cuban Insects* 1: 13-28.
- Osborn, H.** 1929. Notes on Porto Rican Homoptera. *J. Dept. Agric. Porto Rico* 13(3): 81-112.
- Osborn, H.** 1935. Insects of Porto Rico and the Virgin Islands. Homoptera (excepting the Sternorhynchi). *Sci. Survey Porto Rico Virgin Islands* 14(2): 111-260.
- Ramos, J. A.** 1957. A review of the auchenorrhynchos Homoptera of Puerto Rico. *J. Agric. Univ. P.R.* 41(1): 38-117.
- Ramos, J.A.** 1988. Zoogeography of the auchenorrhynchos Homoptera of the Greater Antilles (Hemiptera). pp. 61-70. In: J.K. Liebherr (ed.). *Zoogeography of Caribbean insects*. Cornell Univ. Press, Ithaca, NY.
- Rosen, D. E.** 1985. Geological hierarchies and biogeographic congruence in the Caribbean. *Ann. Mo. Bot. Gard.* 72: 636-659.
- Roth, L. M.** 1994. Cockroaches from Guana Island, British West Indies (Blattaria: Blattellidae: Blaberidae). *Psyche* 101: 45-52.
- SAS Institute.** 1989. SAS user's guide: Statistics. SAS Institute, Cary, NC.
- Spooner, C. S.** 1920. Some notes on the occurrence of Delphacinae (Hemip. Homop.). *Entomol. News* 31: 44-46.
- Stål, C.** 1859. Novae quaedam Fulgorinorum formae speciesque insigniores. *Berlin. Entomol. Z.* 3: 313-327.
- Van Duzee, E. P.** 1912. Hemipterological gleanings. *Bull. Buffalo Soc. Nat. Sci.* 10: 477-512.
- Van Duzee, E. P.** 1917. Catalogue of the Hemiptera of America North of Mexico (excepting the Aphididae, Coccidae and Aleurodidae). *Tech. Bull. Univ. Calif. Agric. Exp. Stn. Univ. Calif. Press, Berkeley*, Vol. 2, pp. i-xiv, 1-902.

- Walker, F.** 1851. List of the specimens of Homopterous insects in the collection of the British Museum. 2: 261-636.
- Westwood, J. O.** 1833. Additional observations upon the insect which infests the sugar canes in Grenada. Mag. Nat. Hist. 6: 409-413.
- Wolcott, G. N.** 1927. Entomologie d'Haiti. Service Technique du Department de l'Agriculture et de l'Enseignement Professionnel. Port-Au-Prince, Haiti. 440 pp.
- Wolcott, G. N.** 1936. Insectae Borinquenses. A revised annotated checklist of the insects of Puerto Rico. J. Agric. Univ. P.R. 20(1): 1-600.
- Wolcott, G. N.** 1941. A supplement to "Insectae Boringuenses". J. Agric. Univ. P.R. 25(2): 33-158.
- Wolcott, G. N.** 1950 [dated 1948]. The insects of Puerto Rico. J. Agric. Univ. P.R. 32(1): 1-224.



Bartlett, Charles R. 2000. "An Annotated List Of Planthoppers (Hemiptera : Fulgoroidea) Of Guana Island (British West Indies)." *Entomological news* 111, 120–132.

View This Item Online: <https://www.biodiversitylibrary.org/item/21125>

Permalink: <https://www.biodiversitylibrary.org/partpdf/15158>

Holding Institution

Smithsonian Libraries and Archives

Sponsored by

Smithsonian

Copyright & Reuse

Copyright Status: In copyright. Digitized with the permission of the rights holder.

Rights Holder: American Entomological Society

License: <http://creativecommons.org/licenses/by-nc-sa/3.0/>

Rights: <https://biodiversitylibrary.org/permissions>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.