

2-14-2014

Ecology and Diversity of Cockroaches (Dictyoptera: Blattaria) from the Virgin Islands

Wenhua Lu

The Conservation Agency, Jamestown, RI, hq@theconservationagency.org

Barry D. Valentine

Sarasota, FL, bv@nwcs.com

Daniel E. Perez-Gelabert

Department of Entomology, National Museum of Natural History, Smithsonian Institution, P.O. Box 37012, Washington, DC 20013- 7012. USA, perezd@si.edu

Esteban Gutiérrez

Museo Nacional de Historia Natural, Havana, Cuba, byrsotria2002@yahoo.com

Follow this and additional works at: <http://digitalcommons.unl.edu/insectamundi>

Lu, Wenhua; Valentine, Barry D.; Perez-Gelabert, Daniel E.; and Gutiérrez, Esteban, "Ecology and Diversity of Cockroaches (Dictyoptera: Blattaria) from the Virgin Islands" (2014). *Insecta Mundi*. 854.

<http://digitalcommons.unl.edu/insectamundi/854>

This Article is brought to you for free and open access by the Center for Systematic Entomology, Gainesville, Florida at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Insecta Mundi by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

INSECTA MUNDI

A Journal of World Insect Systematics

0349

Ecology and Diversity of Cockroaches (Dictyoptera: Blattaria)
from the Virgin Islands

Wenhua Lu
The Conservation Agency
6 Swinburne Street
Jamestown, RI 02835, USA

Barry D. Valentine
5704 Lake Breeze Ct.
Sarasota, FL 34233, USA

Daniel E. Perez-Gelabert
Department of Entomology
United States National Museum of Natural History
Smithsonian Institution
P.O. Box 37012
Washington, DC 20013-7012, USA

Esteban Gutiérrez
Museo Nacional de Historia Natural
Obispo #61 esq. a Ofi cios, Plaza de Armas
Habana Vieja 10100
Havana, Cuba

Date of Issue: February 14, 2014

Wenhua Lu, Barry D. Valentine, Daniel E. Perez-Gelabert, and Esteban Gutiérrez
Ecology and Diversity of Cockroaches (Dictyoptera: Blattaria) from the Virgin Islands
Insecta Mundi 0349: 1–32

ZooBank Registered: urn:lsid:zoobank.org:pub:F1B10721-596C-4F0C-8C1C-9636E1E78C85

Published in 2014 by

Center for Systematic Entomology, Inc.

P. O. Box 141874

Gainesville, FL 32614-1874 USA

<http://centerforsystematicentomology.org/>

Insecta Mundi is a journal primarily devoted to insect systematics, but articles can be published on any non-marine arthropod. Topics considered for publication include systematics, taxonomy, nomenclature, checklists, faunal works, and natural history. **Insecta Mundi** will not consider works in the applied sciences (i.e. medical entomology, pest control research, etc.), and no longer publishes book reviews or editorials. **Insecta Mundi** publishes original research or discoveries in an inexpensive and timely manner, distributing them free via open access on the internet on the date of publication.

Insecta Mundi is referenced or abstracted by several sources including the Zoological Record, CAB Abstracts, etc. **Insecta Mundi** is published irregularly throughout the year, with completed manuscripts assigned an individual number. Manuscripts must be peer reviewed prior to submission, after which they are reviewed by the editorial board to ensure quality. One author of each submitted manuscript must be a current member of the Center for Systematic Entomology. Manuscript preparation guidelines are available at the CSE website.

Managing editor: Eugenio H. Nearn, e-mail: gino@nearns.com

Production editors: Michael C. Thomas, Paul E. Skelley, Brian Armitage, Ian Stocks, Eugenio H. Nearn

Editorial board: J. H. Frank, M. J. Paulsen

Subject editors: G.B. Edwards, Joe Eger, A. Rasmussen, Gary Steck, Ian Stocks, A. Van Pelt, Jennifer M. Zaspel, Nathan P. Lord, Adam Brunke

Spanish editors: Julieta Brambila, Angélico Asenjo

Website coordinator: Eugenio H. Nearn

Printed copies (ISSN 0749-6737) annually deposited in libraries:

CSIRO, Canberra, ACT, Australia

Museu de Zoologia, São Paulo, Brazil

Agriculture and Agrifood Canada, Ottawa, ON, Canada

The Natural History Museum, London, Great Britain

Muzeum i Instytut Zoologii PAN, Warsaw, Poland

National Taiwan University, Taipei, Taiwan

California Academy of Sciences, San Francisco, CA, USA

Florida Department of Agriculture and Consumer Services, Gainesville, FL, USA

Field Museum of Natural History, Chicago, IL, USA

National Museum of Natural History, Smithsonian Institution, Washington, DC, USA

Zoological Institute of Russian Academy of Sciences, Saint-Petersburg, Russia

Electronic copies (On-Line ISSN 1942-1354, CDROM ISSN 1942-1362) in PDF format:

Printed CD or DVD mailed to all members at end of year. Archived digitally by Portico.

Florida Virtual Campus: <http://purl.fcla.edu/fcla/insectamundi>

University of Nebraska-Lincoln, Digital Commons: <http://digitalcommons.unl.edu/insectamundi/>

Goethe-Universität, Frankfurt am Main: <http://edocs.ub.uni-frankfurt.de/volltexte/2010/14363/>

Author instructions available on the *Insecta Mundi* page at:

<http://centerforsystematicentomology.org/insectamundi/>

Copyright held by the author(s). This is an open access article distributed under the terms of the Creative Commons, Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original author(s) and source are credited. <http://creativecommons.org/licenses/by-nc/3.0/>

Ecology and Diversity of Cockroaches (Dictyoptera: Blattaria) from the Virgin Islands

Wenhua Lu

The Conservation Agency
6 Swinburne Street
Jamestown, RI 02835, USA
hq@theconservationagency.org

Barry D. Valentine

5704 Lake Breeze Ct.
Sarasota, FL 34233, USA
bv@nwcs.com

Daniel E. Perez-Gelabert

Department of Entomology
United States National Museum of Natural History
Smithsonian Institution
P.O. Box 37012
Washington, DC 20013-7012, USA
perezd@si.edu

Esteban Gutiérrez

Museo Nacional de Historia Natural
Obispo #61 esq. a Oficios, Plaza de Armas
Habana Vieja 10100
Havana, Cuba
byrsotria2002@yahoo.com

Abstract. The Virgin Islands (except St. Croix) are geologically part of the Puerto Rico Bank and biologically related to Puerto Rico, but their cockroaches (Dictyoptera: Blattaria) were not yet as well studied as those on Puerto Rico. To elucidate the number of species, life history, range distribution, and seasonal abundance of these cockroaches, we have conducted a quantitative study since June 2000 using a Malaise trap on Guana Island, British Virgin Islands, in addition to other conventional collecting methods. We found 21 species: *Blattella germanica* (Linnaeus), *Cariblatia antiguensis* (Saussure and Zehntner), *Cariblatia* sp. 2, *Cariblatia* sp. 3, *Colapteroblatta* sp. 1, *Eurycotis improcera* Rehn, *Eurycotis* sp. 2, *Euthlastoblatta facies* (Walker), *Hemiblabera brunneri* (Saussure), *Nyctibora lutzi* Rehn and Hebard, *Panchlora sagax* Rehn and Hebard, *Periplaneta americana* (Linnaeus), *P. australasiae* (Fabricius), *Plectoptera infulata* Rehn and Hebard, *P. rhabdota* Rehn and Hebard, *Plectoptera* sp. 3, *Pycnoscelus surinamensis* (Linnaeus), *Symploce pararuficollis* Roth, *S. ruficollis* (Fabricius), polyphagid sp. 1 (*Compsodes* sp. 1), and polyphagid sp. 2. Among them, nine are new records for the Virgin Islands and five for Guana Island. In addition, *Euthlastoblatta diaphana* (Fabricius), *Nyctibora noctivaga* Rehn, *Panchlora nivea* (Linnaeus), *P. viridis* (Fabricius), and *Rhyparobia maderae* (Fabricius) were recorded historically but were not rediscovered. As a result, the number of species is increased from 17 to 26 for the Virgin Islands, and from 10 to 15 for Guana Island. Overall, only five species are edificarian and likely introduced. Nymphs of polyphagid sp. 2 and *Euthlastoblatta facies* are reported for the first time as dwellers in termite runways. Only eight species came to the Malaise trap; their phenology illustrates close but not necessarily synchronic relationship with both the timing and amount of rainfall. Monthly abundance showed spring and fall highs and summer and winter lows. Yearly abundance reached lows when annual rainfall decreased below a threshold average of 2.0 mm per day. Seasonality and response to drought varied among species. This paper lays a foundation for further research on diversity of cockroaches from the Virgin Islands and their relationships with those from Puerto Rico.

Keywords. Blaberidae, Blattellidae, Blattidae, Polyphagidae, seasonality, termite, phenology, Guana

Introduction

Geologically and biologically the Virgin Islands (except St. Croix) are part of the Greater Puerto Rico Bank, which united these islands until about 10,000 years ago as continuous land. Thus their floras and faunas are expected to have much affinity with those of Puerto Rico (Heatwole et al. 1981). Politically these islands are divided into the British Virgin Islands (BVI) and U. S. Virgin Islands (USVI). There are two annual rainfall peaks in the Virgin Islands (Lazell 2005). Guana Island is a small, privately owned, BVI island located off the northeast end of Tortola at 18°28'N by 64°35'W (Fig. 1). Its rugged topography of 297 hectares features exceptionally well-preserved subtropical dry forest that covers most of the island from sea level to its highest elevation (Sugarloaf Peak at 246 m). Since 2000 we have been studying the ecology and diversity of Virgin Island cockroaches (Dictyoptera: Blattaria), using Guana Island as our base and research station. Our overall goals are to build a data matrix for further diversity study among an array of the Virgin Islands, to understand the biogeographic relationships of the cockroaches from these islands with those from Puerto Rico, and to provide a reference point for future studies on the impacts of climatic changes.

A synoptic study provides a list of cockroach species of Puerto Rico (Gutiérrez and Fisk 1998). In contrast, there is little information about the cockroaches of the Virgin Islands other than taxonomic species accounts scattered over >235 years. Fabricius (1787) described *Blatta ruficollis*, now in *Symploce*, from St. Thomas, which is the first species originally described from the Virgin Islands on the Greater Puerto Rico Bank. Shelford (1910) reported eight USVI species and others now synonyms: *Euthlastoblatta diaphana* (Fabricius), *Hemiblabera brunneri* (Saussure), *Periplaneta americana* (Linnaeus), *P. australasiae* (Fabricius), *Pycnoscelus surinamensis* (Linnaeus), *Panchlora nivea* (Linnaeus), and *Rhyparobia maderae* (Fabricius), but his *Nyctibora noctivaga* from Loango (now Lovango) Island near St. Thomas is dubious because the identification was based on an immature male (Rehn and Hebard 1927). Rehn (1930) described *Eurycotis improcera* from St. Croix, the second species originally from the Virgin Islands. Princis (1964) recorded *Panchlora viridis* (Fabricius) from St. John and St. Croix of USVI. Roth (1985) recorded *Blattella germanica* (Linnaeus) from “British West Indies.” This pest species is presumably present on the Virgin Islands because of its edificarian status: being found around human constructions. Miller (1994) recorded *P. surinamensis* as a “quarantine” pest on a shipment of potted plants being unloaded at Guana Island. Roth (1994) studied specimens taken by various collectors on Guana Island. Based on that material he described the third species originally from the Virgin Islands, *Symploce pararuficollis*, and added *Caribblatta antiguensis* (Saussure and Zehntner), *Euthlastoblatta facies* (Walker), *Panchlora sagax* Rehn and Hebard, and *Plectoptera rhabdota* Rehn and Hebard to the Virgin Islands list. As the result, there are three names of *Panchlora* green cockroaches recorded from the Virgin Islands. Seven of the eight species recorded by Roth were from Guana Island; *Hemiblabera brunneri* was from the island of Virgin Gorda. Recently Lazell (2005) provided a list of 10 cockroach species, adding the names *Eurycotis decipiens* (Kirby) and *Hemiblabera brunneri* (Saussure) to the fauna of Guana Island. However, the identification of *Eurycotis decipiens*, a cockroach species originally described from Trinidad (Kirby 1903), is now for the first time corrected to *E. improcera*, a species originally described from St. Croix (Rehn 1930). In all, 17 species were previously recorded from the Virgin Islands and 10 of these from Guana Island.

In this paper we report for the first time the increase of species diversity to 26 for the Virgin Islands and 15 for Guana Island. Changes in cockroach abundance and the impact of rainfall on abundance were studied with monthly samples from a Malaise trap over a period >12 years from June 2000 to October 2011. Our hypothesis was that the abundance changed not only among species, but also among years and different months of a year in response to rainfall. Habitats, multiple new island records, behaviors, life histories, and nymphal morphology of several species are provided for the first time. This study contributes new information on the ecology and fine mapping of cockroach distributions in the West Indies.

Materials and Methods

We collected cockroach specimens on Guana Island since 2000 every October, using a variety of collection methods such as sweeping or beating vegetation with an entomological net, looking under

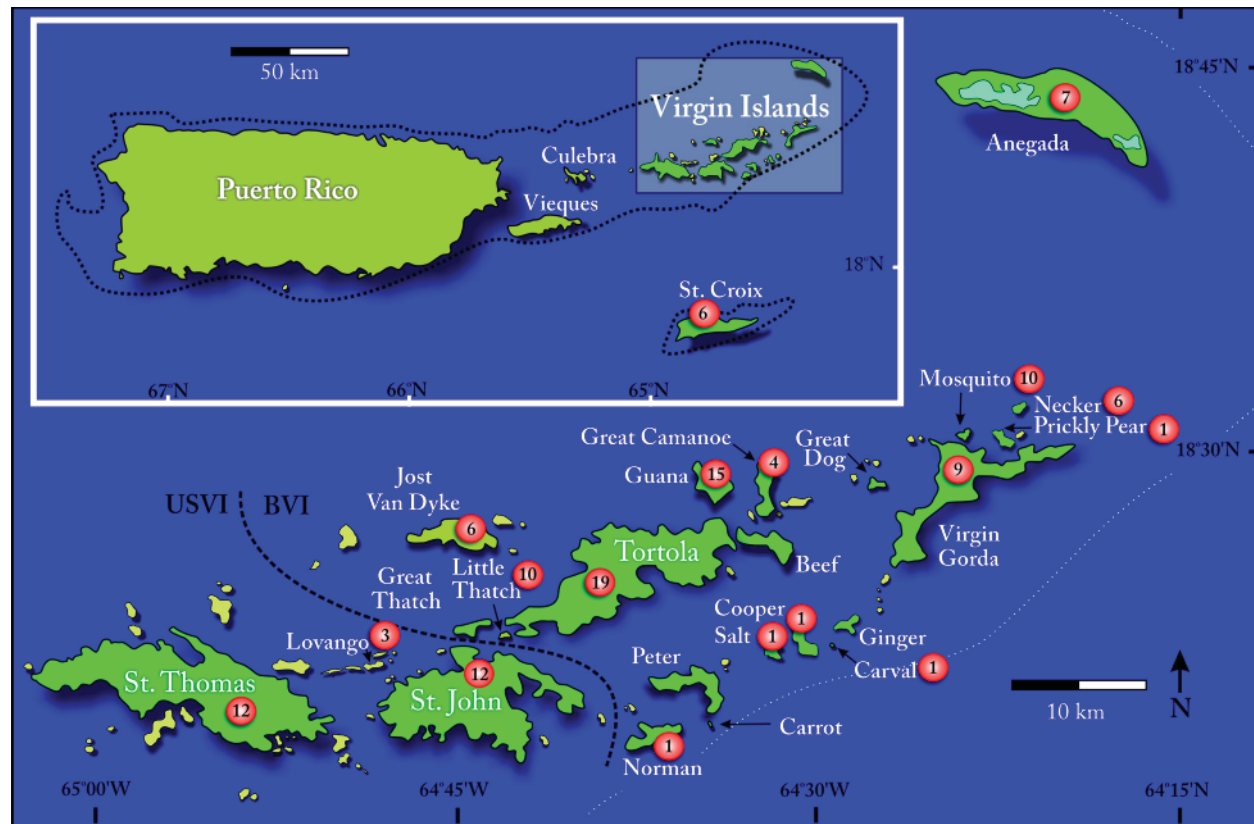


Figure 1. Maps of the Greater Puerto Rico Bank and the Virgin Islands with numbers of cockroaches recorded from the Virgin Islands historically and presently indicated for each sampled island.

detritus, logs, and rocks, at white (incandescent) or black (ultraviolet) lights, and at night with a headlamp, and covering the entire diversity of geography and habitats, in diurnal and nocturnal forays. Whenever possible, we also collected on other islands of BVI and USVI. In addition, a Malaise trap was set up in Quail Dove Ghut on Guana Island behind an orchard within a forest edge, at about 5 m above sea level on the leeward side. It provided monthly samples starting in June 2000. We sorted and counted the total number of individuals (nymphs and adults combined) by species, month, and year, and presented the average results of abundance changes across months or years. Four (VII/IX.2004, IV.2005, VII.2007) monthly samples were incomplete and replaced by respective monthly averages across years for computational ease. A resident scientist, Professor Liao Wei-Ping, and his assistants, maintained this trap and collected samples once a month except every October when we were present.

Specimens are deposited in the museum of Guana Island Wildlife Sanctuary (GIWS), the entomological collection of the University of Delaware, Newark, DE (UDCC), the Virgin Islands Insect Survey, Virgin Islands National Park, St. John, USVI (VIIS), the Entomological Museum of Montana State University, Bozeman, MT (MAIC), the U. S. National Museum of Natural History, Smithsonian Institution, Washington, DC (NMNH), and the American Museum of Natural History, New York, NY (AMNH), where specimens in VIIS collected on 18-27.VII.1972 from St. John at Lameshur Bay were collected at the Virgin Islands Environmental Resource Station by junior members of the New York Entomological Society under the direction of Alice Gray. A complete synoptic set of 700 specimens is in the private collection of B. D. Valentine (BDVC) and will be deposited in the Florida State Collection of Arthropods, Gainesville, FL. Specimens from St. John, USVI, at MAIC are a loan from BDVC. In the section for specimens examined, specimen labels for collectors are corrected as follows: Valentine-C = S. Valentine-Cooper, and Y.-P. Liao = W.-P. Liao. When a species is common on Guana Island, we did not save many hundreds of specimens; for those saved, we provide the number of specimens by sex or stage, sample months, collection methods, but often omit collection dates, years, or collectors.

Beating, sweeping, white light, or black (ultraviolet) light is shortened to beat, sweep, at light, or at UV, respectively, and only the first letter of directions is used in upper case, if given on the specimen labels. Some islands do not include the word “island” in their names (e.g., Anegada); for clarity, we have added “Is.” to these in our specimen records (e.g., Anegada Is.). This will avoid confusion with localities on islands. We followed Roth (1968, 1971) for terminology and McKittrick (1964) and Roth (2003) for higher taxonomic categories; an oothecum is the egg case of cockroaches; the forewing is termed tegmen (plural tegmina); the last visible tergite is the supra-anal plate; and the last visible sternite is the subgenital plate. Because synonyms for each taxon are completely treated in Princis (1963–1967, 1969), Roth (2003), and Beccaloni (2007), we only include references for original descriptions and for relevant geographical distributions. Most of the species descriptions were brief, reflecting trends of historic times; we provided additional detailed characteristics concurrent with modern taxonomy.

We obtained daily rainfall data from colleagues at the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautic and Space Administration (NASA). The NOAA Climate Prediction Center (CPC) (<http://www.cpc.ncep.noaa.gov/>) makes a “unified gauge” data product of global land precipitation (0.1 mm) in a spatial resolution of 0.5-degree latitude by longitude grid and a 1-day temporal resolution. Precipitation amounts and gauge counts for the pixel in the grid corresponding to the Virgin Islands (grid 18.0–18.5°N latitude by 64.5–65.0°W longitude) were extracted from each grid file. The dataset is based on precipitation gauges, but values represent an average over a large area rather than a point measurement. When there are multiple gauges, the rainfall amount should be essentially the average over those gauges located within the grid. Over the years the gauge count varies from 0 to 11 as old gauges fail or are taken offline or new gauges are installed. At least one gauge was periodically stationed on Beef Island, just southeast of Guana Island. We used daily rainfall from June 2000 to October 2011 averaged per month or averaged per year to look for correlation of rainfall with monthly and yearly fluctuations of cockroach abundance, respectively.

Results

Among >5,000 cockroach specimens taken we found 12 of the 17 species previously recorded. The five names known historically, but missing currently, are *Euthlastoblatta diaphana*, *Nyctibora noctivaga*, *Panchlora nivea*, *P. viridis*, and *Rhyparobia maderae*. In addition, we recorded nine species new to the Virgin Islands and five new to Guana Island (Table 1). The overall number of species recorded was thus increased from 17 to 26 in 14 genera and four families (Blaberidae 7 species, Blattellidae 13, Blattidae 4, and Polyphagidae 2) for the Virgin Islands; for Guana Island, the number of species was increased from 10 to 15. Only eight species were caught by the year-round Malaise trap on Guana Island: *Caribblatta antiguensis*, *Eurycotis improcera*, *Euthlastoblatta facies*, *Nyctibora lutzi*, *Panchlora sagax*, *Plectoptera rhabdota*, *Symploce pararuficollis*, and *S. ruficollis*. Among these, *E. improcera*, *N. lutzi*, and *P. sagax* were caught at very low frequency (<20 specimens over 12 years); *S. pararuficollis* was the most abundant (2,655), followed by *C. antiguensis* (1,366), *S. ruficollis* (190), *E. facies* (177), and *P. rhabdota* (83).

When compared among months, total Malaise trap captures of all species closely followed the timing of the spring rainfall (Fig. 2A, 3). The average number of individuals reached its spring high in June after the rainfall peak in April–May, then slid to its summer low, but regained a slow and steady fall–winter increase often until January after the rainfall peak in September–November, and finally decreased to its winter low from February to April. However, this monthly pattern of abundance synchrony with each rainy peak was species dependent. Only two species frequently captured in the Malaise trap showed the monthly pattern; *Euthlastoblatta facies*, *Plectoptera rhabdota*, and *Symploce ruficollis* showed only one abundance peak, in the summer (Table 2). Also, four species showed a delayed burst of abundance 1–2 months after the spring rainy peak; only *S. ruficollis* demonstrated tight synchrony with the spring rainfall peak (Table 2). Furthermore, four species reached their maxima in late spring or early summer (Table 2) when the rainfall amount was much less than the fall rainy peak (Fig. 2A); only *S. pararuficollis* showed close correlation with the amount of rainfall; its abundance reached maximum in the fall. Overall, the spring rainfall peak induced a delayed burst of abundance in late spring, and the fall rainfall peak only sustained a small increase of individuals from the summer low.

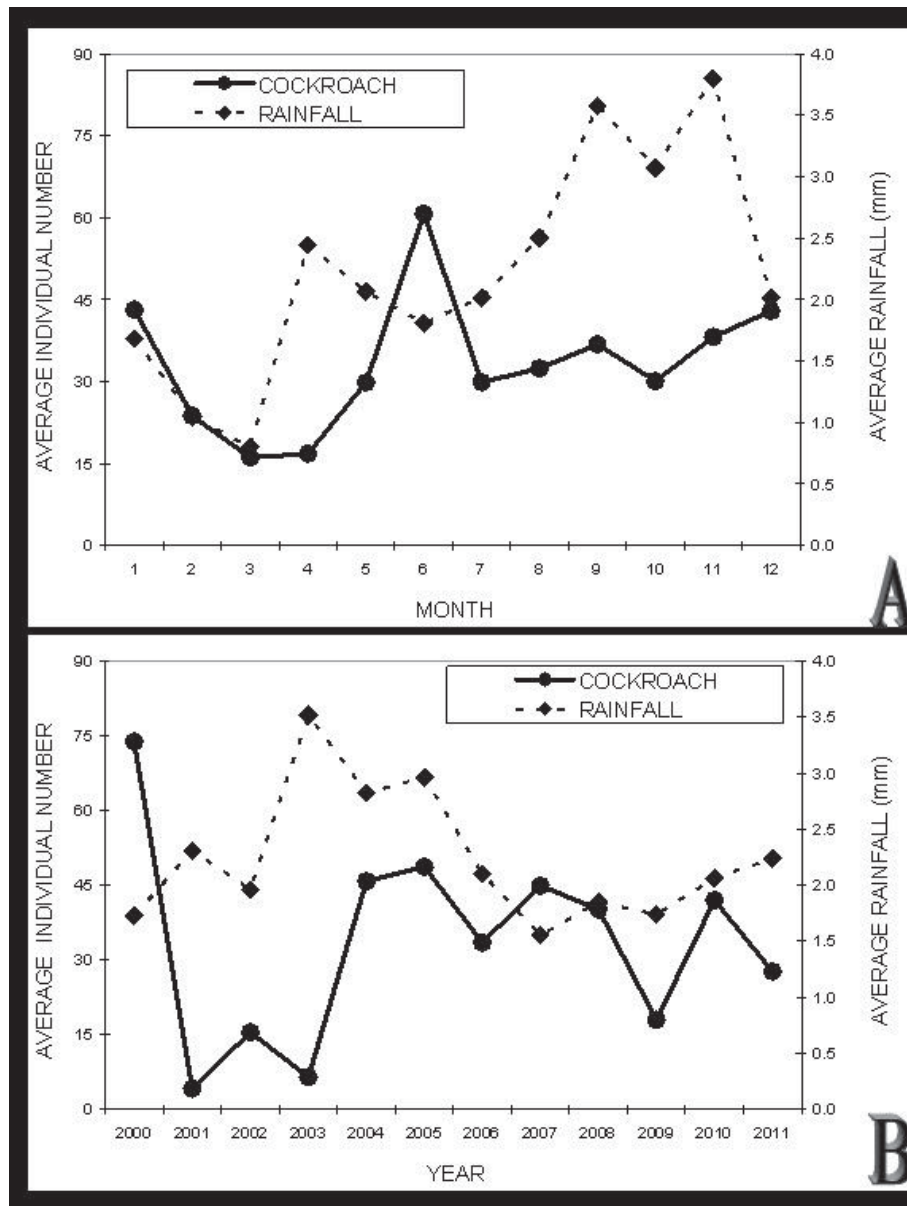


Figure 2. Relationship of rainfall (mm) with abundance of all cockroaches captured in a Malaise trap within a forest edge from June 2000 through October 2011 on Guana Island, British Virgin Islands (missing 4 samples of VII/IX.2004, IV.2005, and VII.2007; A: numbers of individuals per month averaged across years; B: numbers of individuals per year averaged across months).

When compared among years, total Malaise trap captures of all species closely followed the amount of annual rainfall (Fig. 2B, 3). There was a crash in the average number of individuals in 2001, 2003, and 2009, corresponding to decreased rainfall during each of the previous year(s): 2000, 2002, and 2007–2009 had a rainfall averages below 2.0 mm per day. This yearly pattern of low abundance in response to drought applied to all five species frequently captured in the Malaise trap (Table 3). However, high abundance occurred differently among species; *Euthlastoblatta facies* and *Plectoptera rhabdota* both reached maxima in 2010 after the 3-year period of low rainfall below 2.0 mm, while the other three species had high numbers in 2000 (Table 3), when annual rainfall of prior three years before our study was above 2.5 mm and averaged 3.1 mm. Overall, high annual rainfall coincided with high abundance, but a threshold below a daily average of 2.0 mm triggered abundance plunges in some and leaps in others.

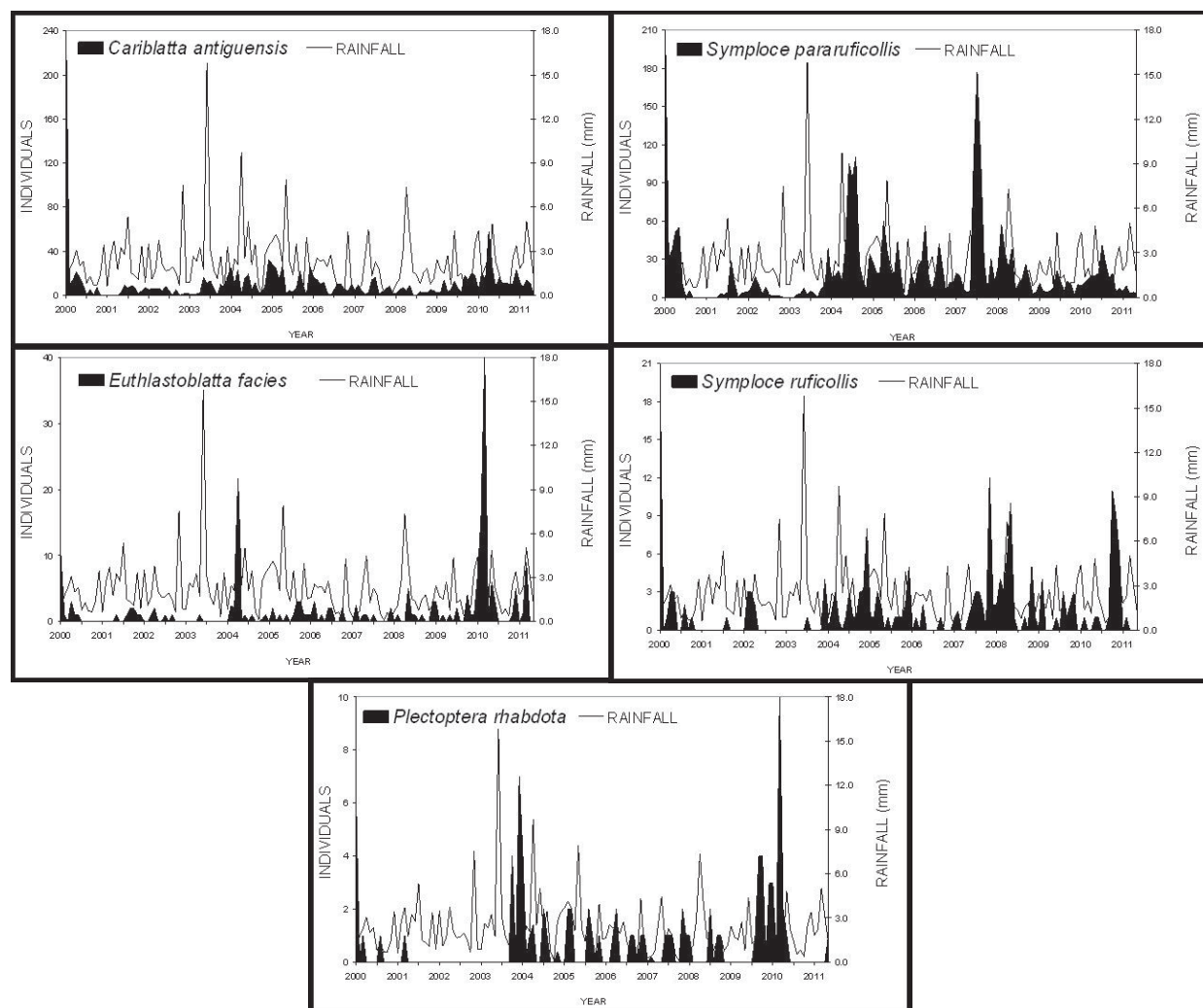


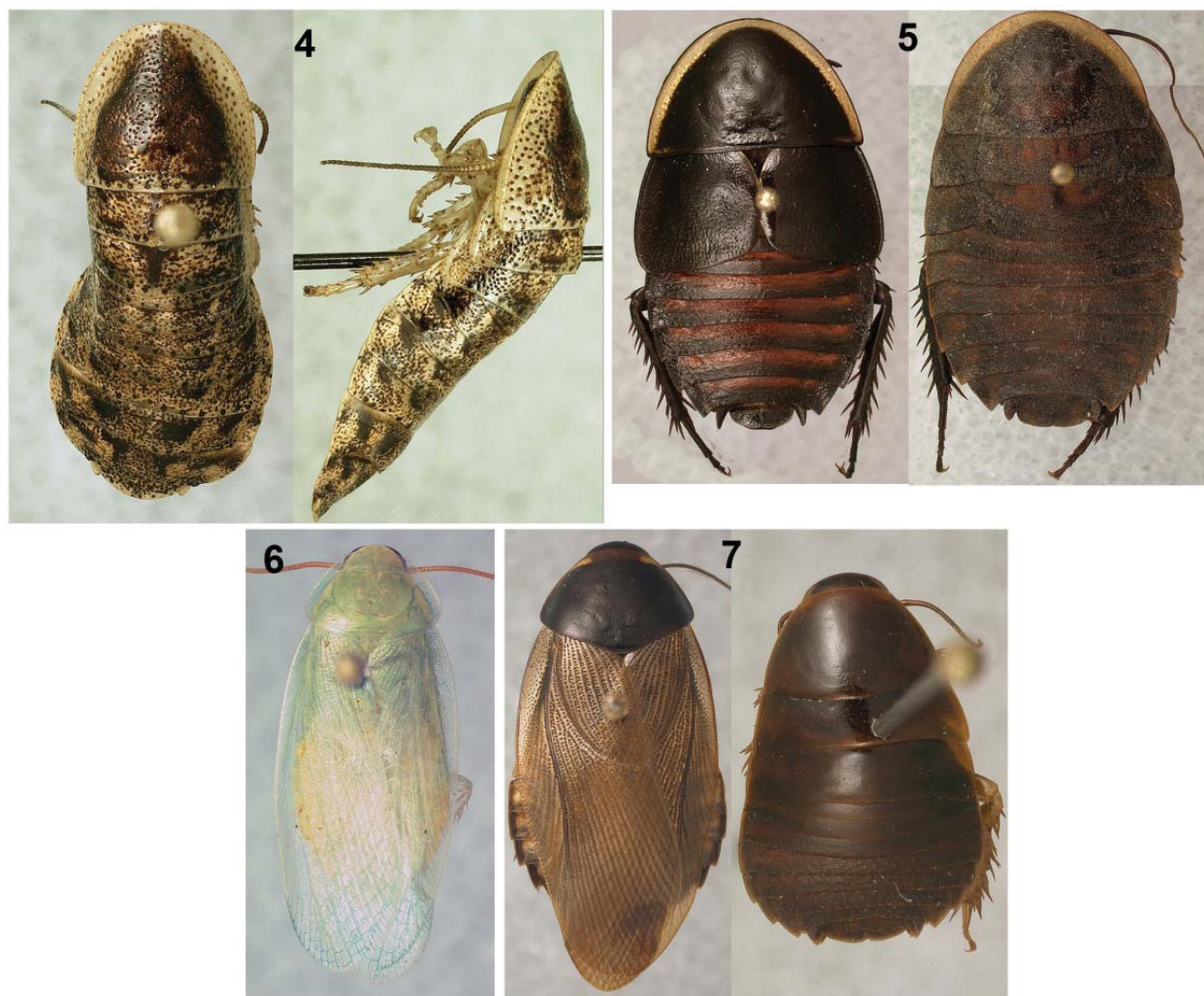
Figure 3. Relationship of average rainfall (mm) with monthly abundance in number of individuals of five cockroach species frequently captured in a Malaise trap within a forest edge from June 2000 through October 2011 on Guana Island, British Virgin Islands (missing 4 samples of VII/IX.2004, IV.2005, and VII.2007).

The distributions of these 26 cockroach species are summarized from 17 islands (Table 4): 19 on Tortola, 15 on Guana, 12 on St. John and St. Thomas, 10 on Little Thatch and Mosquito, and <10 on each of the other islands. *Hemiblabera brunneri* is most widespread (13 islands), followed by *Symploce ruficollis* (11), *Caribblatta antiguensis*, *Euthlastoblatta facies*, and *Pycnoscelus surinamensis* (10 each). These figures reflect present collecting success, not final diversity. The morphological diagnosis, habitat, behavior, new island records, and phenology for each species are given below.

Family Blaberidae

1. *Colapteroblatta* sp. 1 (Fig. 4), NEW RECORD

Diagnosis. Nymph 17 mm, relatively convex and elongate, pale yellowish brown and mottled dark brown; dorsum with dense, dark punctures, plus 5 very irregular longitudinal fields of brown markings, leaving margins of pronotum pale yellow-brown. Frons mostly dark ferruginous, vertex slightly darker with 3 pale, narrow, interocular stripes; antennomeres basally straw-colored, then progressively darker; pronotum disc convex, margin thickened and flared upward, with a large, irregular, mottled brown central area, and sides yellow with dark punctures; rest of dorsum irregularly spotted with dark brown,



Figures 4–7. Blaberidae. **4)** *Colapteroblatta* sp. 1 nymph from Tortola Island. **5)** *Hemiblabera brunneri* male adult from Guana Island and nymph from Little Thatch Island. **6)** *Panchlora sagax* from Guana Island. **7)** *Pycnoscelus surinamensis* from Guana Island (all specimens in BDVC).

forming 5 longitudinal series, of which the middle series is the least developed; venter pale straw and dark brown, with 2 darker mottled lateral fields that are wider posteriorly and connected across the last sternite; pale lateral margins continuous to cerci, then abruptly narrowed to a thin line; cerci very short, 1 segmented, straw-colored; legs pale with dark-tipped spines and scattered dark spots; posterior ridges of femora narrowly edged with dark brown.

Comments. In the most recent revision of the Antillean species of the genus *Colapteroblatta*, there is no mention of Virgin Islands (Gutiérrez 2012a). This only specimen was found in the wet zone of Sage Mountain on Tortola. Our species may be related with *C. portoricense* described from a tropical wet forest on Puerto Rico by Gutiérrez and Roth (1999), but we need adults for confirming the taxonomic status.

Specimen examined. BDVC—1 female nymph, BVI, Tortola Is., Sage Mt., 1600–1700 ft., 6.X.2001, B. & B. Valentine.

2. *Hemiblabera brunneri* (Saussure) (Fig. 5)

Blabera brunneri Saussure 1869: 113; Brazil.

Table 1. Species and capture methods as indicator of habitat and behavior of cockroaches recorded from the Virgin Islands and their presence on Guana Island and Puerto Rico, with GD for ground cover such as detritus, rocks, or logs, MT for Malaise trap, PT for pitfall traps, SB for sweeping or beating vegetation, UV for ultraviolet light trap, WL for white lights, - for requiring further study, * and ° for records new to the Virgin Islands and Guana, respectively.

Family	Species	Capture methods	Presence	
			Guana	Puerto Rico
Blaberidae	1* <i>Colapteroblatta</i> sp. 1	SB	no	-
	2 <i>Hemiblabera brunneri</i>	GD, MT, PT, SB, WL	yes	yes
	3 <i>Panchlora nivea</i>		no	yes
	4 <i>Panchlora sagax</i>	MT, SB, UV, WL	yes	yes
	5 <i>Panchlora viridis</i>		no	no
	6 <i>Rhyparobia maderae</i>		no	yes
	7 <i>Pycnoscelus surinamensis</i>	GD, SB, UV, WL	yes	yes
Blattellidae	8 <i>Blattella germanica</i>		no	yes
	9 <i>Caribblatta antiguensis</i>	MT, SB, UV, WL	yes	-
	10* <i>Caribblatta</i> sp. 2	WL	no	-
	11* <i>Caribblatta</i> sp. 3	SB	no	-
	12 <i>Euthlastoblatta diaphana</i>		no	yes
	13 <i>Euthlastoblatta facies</i>	MT, SB, UV, termite runway	yes	yes
	14* <i>Nyctibora lutzi</i>	GD, MT, UV, WL	°	yes
	15 <i>Nyctibora noctivaga</i>		no	no
	16* <i>Plectoptera infulata</i>	SB, WL	°	yes
	17 <i>Plectoptera rhabdota</i>	MT, SB, UV, WL	yes	yes
	18* <i>Plectoptera</i> sp. 3	SB	no	-
	19 <i>Symploce pararuficollis</i>	MT, SB, UV, WL	yes	yes
Blattidae	20 <i>Symploce ruficollis</i>	MT, SB, UV, WL	yes	yes
	21 <i>Eurycotis improcera</i>	MT, PT, SB, UV, WL	yes	no
	22* <i>Eurycotis</i> sp. 2	GD, SB	no	-
	23 <i>Periplaneta americana</i>	GD, UV, WL	yes	yes
	24 <i>Periplaneta australasiae</i>	GD, UV, WL	°	yes
Polyphagidae	25* <i>Polyphagid</i> sp. 1 (<i>Compsodes</i> sp. 1)	MT, UV, WL	°	-
	26* <i>Polyphagid</i> sp. 2	termite runway	°	-

Diagnosis. Brachypterous adults 21–37 mm, oval, with quadrate tegmina in both sexes; dorsum shiny, dark brown, with prominent yellowish pronotal margin reaching basal angles; head dark with 2 small, pale spots (ocelli) between antennal insertions and a larger reddish area on frons above clypeus; pronotum broader than long; tegmina unicolor or faintly paler laterally, with small punctures and vague wrinkles, without transverse discal grooves; anteroventral margin of fore femur with a row of stout proximal spines, followed by a row of short uniform spinules, and one larger terminal spine (Type B₁); supra-anal plate rectangular, with rounded angles and slight apical emargination in both sexes; tarsi almost black, variably 4 or 5 hind tarsomeres; abdominal segments dark red anteriorly, dark brown posteriorly; cerci short, flat, and rounded at tip.

Wingless adults and nymphs are very unlike the brachypterous adults; yellow pronotal margin narrow, dull, sometimes extending to meso- and metanotal margins; pronotum dull and rough with many small, flattened tubercles, which are progressively smaller and more acute on the rest of dorsum; head dark but genae and frons sometimes lighter, abdominal tergites transversely banded with light and dark brown, sometimes with a vague yellowish spot on each side. There are 10 instars based on anterior pronotal width corresponding to head width categories of 1.5, 3.0, 3.5, 4.0, 5.5, 6.0, 7.5, 9–10, 11.0–12.0, and 12.5–13.0 mm. We could not sex instars 1–3; the sex ratio of male and female adults and older nymphs is about 1:1. In addition, the posterior lateral margin of tegmina is longer than the sutural margin in females compared to males.

Table 2. Abundance changes across months of five cockroach species frequently captured in a Malaise trap within a forest edge on Guana Island, British Virgin Islands (missing 4 samples of VII/IX.2004, IV.2005, and VII.2007), with N = number of sample years from June 2000 through October 2011.

Month	Average numbers of cockroach individuals per month					N
	<i>Caribblatta</i> <i>antiguensis</i>	<i>Euthlastoblatta</i> <i>facies</i>	<i>Plectoptera</i> <i>rhabdota</i>	<i>Symploce</i> <i>pararuficollis</i>	<i>Symploce</i> <i>ruficollis</i>	
1	6.0	0.3	0.6	35.2	1.0	11
2	7.3	0.6	0.6	14.5	0.7	11
3	6.1	1.0	0.8	6.6	1.6	11
4	6.4	0.4	0.4	6.5	3.1	10
5	12.9	1.3	1.1	12.1	2.4	11
6	27.9	1.8	1.2	27.8	2.0	12
7	9.1	2.4	0.2	16.7	1.5	10
8	10.0	4.4	1.3	15.6	1.1	12
9	12.1	2.4	0.5	20.5	1.3	11
10	8.2	1.3	0.2	19.1	1.3	12
11	8.6	0.8	0.1	28.1	0.6	11
12	6.7	0.6	0.5	34.5	0.6	11

Comments. *Hemiblabera brunneri* is ovoviparous; a 27 mm female collected on Guana on 22 October 2004 gave live birth to 17 nymphs overnight, each about 7 mm long. It is a dimorphic species with both brachypterous and wingless adults. We found all sizes of individuals except the brachypterous form under rocks on Carval Rock, a very small island between Cooper and Ginger Islands with only herb-stage vegetation except for a few *Coccoloba uvifera* L. (Polygonaceae) shrubs (Lazell 2005), suggesting that it reproduces without winged adults. Furthermore, many wingless individuals are larger than brachypterous males. In early October 2008, nymphs and more than 20 both brachypterous and wingless adults were found coexisting in daytime under a coral rock in a low, sandy, wooded area next to the White Bay beach on Guana Island; that night they all disappeared, but many were found under the same rock the next day. This suggests it may be aggregative socially or nuptially. In daylight when disturbed, most dove into the sand and “swam” away. It is nocturnal and usually stays close to the ground, but was once found on branches >2 m above the ground. It can be found abundantly in suitable habitats on Guana Island (Table 1), from almost sea level to near the highest point.

Shelford (1910) first recorded this species from St. Thomas, Roth (1994) from Virgin Gorda, and Lazell (2005) from Guana Island; it is herein recorded for the first time on Anegada, Carval Rock, Little Thatch, Moskito, Necker, Norman, Prickly Pear, Salt, and Tortola of BVI, in addition to other previous records on St. John and St. Thomas of USVI, Culebra Island, Puerto Rico, and St. Vincent (Rehn and Hebard 1927, Princis 1963, Gutiérrez and Fisk 1998).

Specimens examined. **BDVC**—1 male, BVI, Anegada Is., airport vicinity, 22.X.2004, Valentines & Sibleys; 2 females/1 male, BVI, Anegada Is., SW coast, 20-21.X.2004, Valentines & Sibleys, at UV; 1 female, BVI, Guana Is., Grand Ghut, 13.X.2006, B. D. Valentine family, sweep; 2 females, BVI, Guana Is., 22-28.X.2001, 23-30.X.2002, B. & B. Valentine, at UV; 1 female/2 males, BVI, Guana Is., White Beach, 15.X.2007, W. Lu; 1 female/17 hatchlings, BVI, Guana Is., 22.X.2004, B. D. Valentine & S. C. Valentine-Cooper; 1 male, BVI, Guana Is., 22.X.2007, B. D. Valentine family; 2 females, BVI, Little Thatch Is., 25.X.2008, Valentine-Cooper & Lu; 3 adults, BVI, Little Thatch Is., 11.X.2010, E. Wright; 1 male, BVI, Moskito Is., 25.X.2007, W. Lu, sweep; 1 male/2 females, BVI, Moskito Is., 23.X.2008, Valentine-Cooper & Lu; 1 male/1 female, BVI, Moskito Is., 26.X.2009, W. Lu & S. Valentine-Cooper; 1 male, BVI, Prickly Pear Is., 23.X.2011, [K. Street, in Agave]; 1 female, BVI, Necker Is., 2-5.VI.2005, W. Lu; 1 female, BVI, Norman Is., 25.X.2002, T. Willard; 1 female/1 male, BVI, Salt Is., 12.X.2007, W. Lu, sweep; 1 female, BVI, Virgin Gorda Is., Oil Nut Bay, 12.X.2008, [B. S. Barker, mango tree litter]. **NMNH**—1 female, BVI, Tortola, Sopers Hole, 31.III.1958, J.F.G. Clarke. Wingless adults and nymphs examined: **BDVC**—3

Table 3. Abundance changes across years of five cockroach frequently captured in a Malaise trap within a forest edge on Guana Island, British Virgin Islands (missing 4 samples of VII/IX.2004, IV.2005, and VII.2007), with N = number of sample months from June 2000 through October 2011.

Year	Average numbers of cockroach individuals per year					N
	<i>Cariblatta antiguensis</i>	<i>Euthlastoblatta facies</i>	<i>Plectoptera rhabdota</i>	<i>Symploce pararuficollis</i>	<i>Symploce ruficollis</i>	
2000	29.2	1.6	0.9	39.1	3.0	7
2001	2.4	0.1	0.2	1.2	0.3	12
2002	5.6	0.9	0.0	8.2	0.8	12
2003	4.4	0.2	0.0	1.8	0.1	12
2004	11.4	2.2	1.6	29.5	1.1	10
2005	13.3	0.5	0.5	32.4	2.0	11
2006	10.2	1.5	0.6	20.1	1.1	12
2007	7.4	0.6	0.5	35.6	0.8	11
2008	3.8	0.8	0.6	31.2	3.8	12
2009	5.1	0.9	0.2	10.8	1.0	12
2010	18.1	6.5	2.3	14.1	1.0	12
2011	10.5	1.5	0.1	13.2	2.4	10

male/1 female nymphs, BVI, Anegada Is., airport vicinity, 22.X.2004, Valentines & Sibleys; 1 female/9 nymphs, BVI, Carval Rock Is., between Cooper & Ginger Is., 6.X.1999, W. Lu; 1 female nymph, BVI, Guana Is., 8-14.X.2001, B. & B. Valentine; 1 female nymph, BVI, Guana Is., 14.X.2007, W. Lu, sweep; 1 female nymph, BVI, Guana Is., 21.X.2007, B. D. Valentine family; 1 nymph, BVI, Guana Is., 24.IX.2005, B. D. Valentine & S. C. Valentine-Cooper; 3 male nymphs, BVI, Little Thatch Is., 18.X.2004, S. C. Valentine-Cooper, at light; 3 females/2 nymphs, BVI, Little Thatch Is., 25.X.2008, Valentine-Cooper & Lu; 1 male/1 nymph, BVI, Mosquito Is., 23.X.2008, Valentine-Cooper & Lu; 2 nymphs, BVI, Mosquito Is., 26.X.2009, W. Lu & S. Valentine-Cooper; 1 female, BVI, Virgin Gorda Is., Oil Nut Bay, 12.X.2008, [B. S. Barker, mango tree litter]. **MCZ**—9 nymphs, BVI, Carval Rock Is., between Cooper & Ginger Is., 6.X.1999, W. Lu. **NMNH**—1 male, BVI, Guana Is., 9-30.X.2000, W. Lu, Malaise trap; 1 female, BVI, Guana Is., nr Sugarloaf Mt. top, 806 ft., 7.X.2001, D. Perez. **VIIS**—1 female, USVI, St. John Is., 1970; 1 female, USVI, St. John Is., Lameshur Ranger Station, 23.XI.1958, C. F. Adams.

3. *Panchlora nivea* (Linnaeus)

Blatta nivea Linnaeus 1758: 423; Neotropical.

Comments. Among 49 known species in *Panchlora*, the major speciation occurred in Central and South America, with only two African and three West Indian species (Beccaloni 2007). The West Indian species are all likely adventives from Central and South America because of their establishment near edificarian environments (Gutiérrez 2013, pers. comm.). Shelford (1910) first reported this species from Loango (now Lovango) Island near St. Thomas, USVI; it is listed from Puerto Rico (Wolcott 1948), Antilles, West Indies, Central and South Americas (Princis 1964). It is one of the three green species in the genus recorded from the Virgin Islands; we have not yet found it and are not certain of its identity.

4. *Panchlora sagax* Rehn and Hebard (Fig. 6)

Panchlora sagax Rehn and Hebard 1927: 251; Dominica; Puerto Rico, Culebra Island.

Diagnosis. Adults 14–19 mm, flat, oval, with full tegmina in both sexes; when alive dorsum mostly pale green, with lateral submarginal borders of pronotum and costal cells of tegmina pale yellow; head with a reddish brown interocular band; venter and legs greenish yellow; ventro-posterior of hind femora without a minute spur; cerci tapering.

Table 4. Current (+) and historical (-) records of 26 cockroach names from the Virgin Islands. **1)** *Colapteroblatta* sp. 1. **2)** *Hemiblabea brunneri*. **3)** *Panchlora nivea*. **4)** *P. sagax*, **5:** *P. viridis*. **6)** *Pycnoscelus surinamensis*. **7)** *Rhyparobia maderae*. **8)** *Blattella germanica*. **9)** *Cariblatta antiguensis*. **10)** *Cariblatta* sp. 2. **11)** *Cariblatta* sp. 3. **12)** *Euthlastoblatta diaphana*. **13)** *E. facies*. **14)** *Nyctibora lutzi*. **15)** *N. noctivaga*. **16)** *Plectoptera infulata*. **17)** *P. rhabdota*. **18)** *Plectoptera* sp. 3. **19)** *Symploce pararuficollis*. **20)** *S. ruficollis*. **21)** *Eurycotis improcera*. **22)** *Eurycotis* sp. 2. **23)** *Periplaneta americana*. **24)** *P. australasiae*. **25)** Polyphagid sp. 1 (*Compsodes* sp. 1). **26)** Polyphagid sp. 2.

Island	Cockroach species																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Anegada		+				+			+										+	+			+	+		
Carval Rock		+																								
Cooper						+																				
Great Camanoe													+						+	+	+					
Guana		+		+		+			+				+	+		+	+		+	+	+		+	+	+	+
Jost van Dyke						+			+				+							+	+			+		
Little Thatch		+		+		+			+				+	+					+	+	+		+			
Moskito		+		+		+			+				+				+		+	+	+			+		
Necker		+		+					+				+				+			+						
Norman		+																								
Prickly Pear		+																								
Salt		+																								
St. Croix					-	+		-	+												+		-			
St. John		+		+	-			-	+				+	+			+		+	+	+		+			
St. Thomas		+	-			+	-	-				-	+		-		+			+			-	+		
Tortola	+	+		+		+		-	+	+	+		+	+		+	+	+	+	+	+	+	-	+		
Virgin Gorda		+		+		+		-	+				+							+	+		-			

Comments. *Panchlora sagax* is delicate, rather flat, and one of the three green species recorded from the Virgin Islands. Many specimens turn pale brown after death, especially if killed with alcohol or ethyl acetate. Males are generally shorter and narrower than females. We have not found the nymphs, which are reported to be brown (Gurney and Fisk 1987). Specimens from St John at VIIS were labeled as *P. nivea* but examination and comparison with Guana Island specimens indicate that they are all *P. sagax*, which differs from *P. nivea* in lacking the minute spur near the middle of the ventro-posterior margin of the hind femur.

This species is ovoviparous; a now faded brown female collected on 23.X.2008 from Moskito Island carries unborn nymphs, two of which are visible at the abdominal apex, and a green female collected on 26-28.X.2000 from Guana Island has an accidentally extruded brown egg mass. Nuptial aggregation may be normal in this species. In October 2001, approximately 30 individuals were attracted to a UV light; they formed a tight group on the trap sheet, all bodies in contact, and in simultaneous action when one moved. This aggregation phenomenon was observed for three consecutive days. Both sexes were present with males outnumbering females.

This is a common species on Guana Island, arboreal, and diurnal; we never found them under rocks or logs or active at night other than perching on vegetation or coming to lights (Table 1). We could only find individuals in the forest edge Malaise trap in July 2000, March 2003, May 2005, and September 2006 during the 12-year period.

Roth (1994) first recorded this species from Guana Island and checked identity for some of our specimens. It is herein recorded for the first time from St. John of USVI, Little Thatch, Moskito, Necker, Tortola, and Virgin Gorda of BVI, in addition to a previous record from Colombia (Princis 1964). It is probably of South American origin despite its Antillean type localities (Rehn and Hebard 1927).

Specimens examined. BDVC—3 females, BVI, Guana Is., Quail Dove Ghut, 9.V.-9.VI.2000, W.-P. Liao, Malaise trap; 6 females, BVI, Guana Is., 26-28/30.X.2000, 1-7/8-14.X.2001, 13.X.2005, B. & B. Valentine, at UV; 2 females, BVI, Guana Is., 23.IX./5.X.2005, B. D. Valentine & S. C. Valentine-Cooper, at UV; 1 female, BVI, Guana Is., 26.IX./1.X.2006, J. Cokendolpher, at UV; 3 males, BVI, Guana Is., 23.X.2004, 22.IX.2005, B. D. Valentine & S. C. Valentine-Cooper, at UV; 1 male, BVI, Guana Is., 9.X.2007, W. Lu; 3 males, BVI, Guana Is., 16.X.2006, 29.X.2007, B. D. Valentine family, at UV; 8 males, BVI, Guana Is., 26-29.X.2000, 1-7.X.2001, B. & B. Valentine, at UV; 1 adult, Jost Van Dyke, 8.X.2010, Lu & Valentine-Cooper; 1 male, Little Thatch Is., 18.X.2004, S. Valentine-Cooper, at light; 2 females [1 with young nymphs], BVI, Moskito Is., 23.X.2008, Valentine-Cooper & Lu; 1 female, BVI, Moskito

Is., 25X.2007, W. Lu, sweep; 1 male, BVI, Necker Is., 2-5.VI.2005, W. Lu; 2 females, BVI, Tortola Is., Paraquita Bay, 28.X.2001, Chalwell, VII-VIII.2003, both C. Petrovic, at light; 2 females, BVI, Virgin Gorda Is., SW coast, 14.X.2004, B. & S. Valentine, at UV. **MCZ**—11 adults, BVI, Guana Is. **UDCC**—1 female/7 males, BVI, Guana Is., 7.X.1994, 11.VIII.1997, 23.X.1997, C. R. Bartlett, beat/sweep/at UV; 1 male, BVI, Guana Is., 16.X.1993, C. Bartlett & J. Cryan; 10 adults, BVI, Guana Is., 21.X.1997, C. R. Bartlett. **VIIS**—1 adult (missing abdomen), USVI, St. John Is., Lameshur Bay, 18-27.VII.1968, A. Gray; 1 female, USVI, St. John Is., Lameshur Bay, 13.VII.1970, J. B. Hanzely; 2 females, USVI, St. John Is., Cruz Bay, A. E. Dammann; 1 male, USVI, St. John Is., VIII.1968, A. E. Dammann; 1 male/1 female, USVI, St. John Is., Chocolate Hole, 25.X.1968, A. E. Dammann.

5. *Panchlora viridis* (Fabricius)

Blatta viridis Fabricius 1775: 272; America.

Comments. This species is recorded from St. John and St. Croix of USVI, and is distributed from Trinidad to Cuba (Princis 1964, Bonfils 1969). It is one of the three green species in the genus recorded from the Virgin Islands; we have not yet found it and are not certain of its identity.

6. *Pycnoscelus surinamensis* (Linnaeus) (Fig. 7)

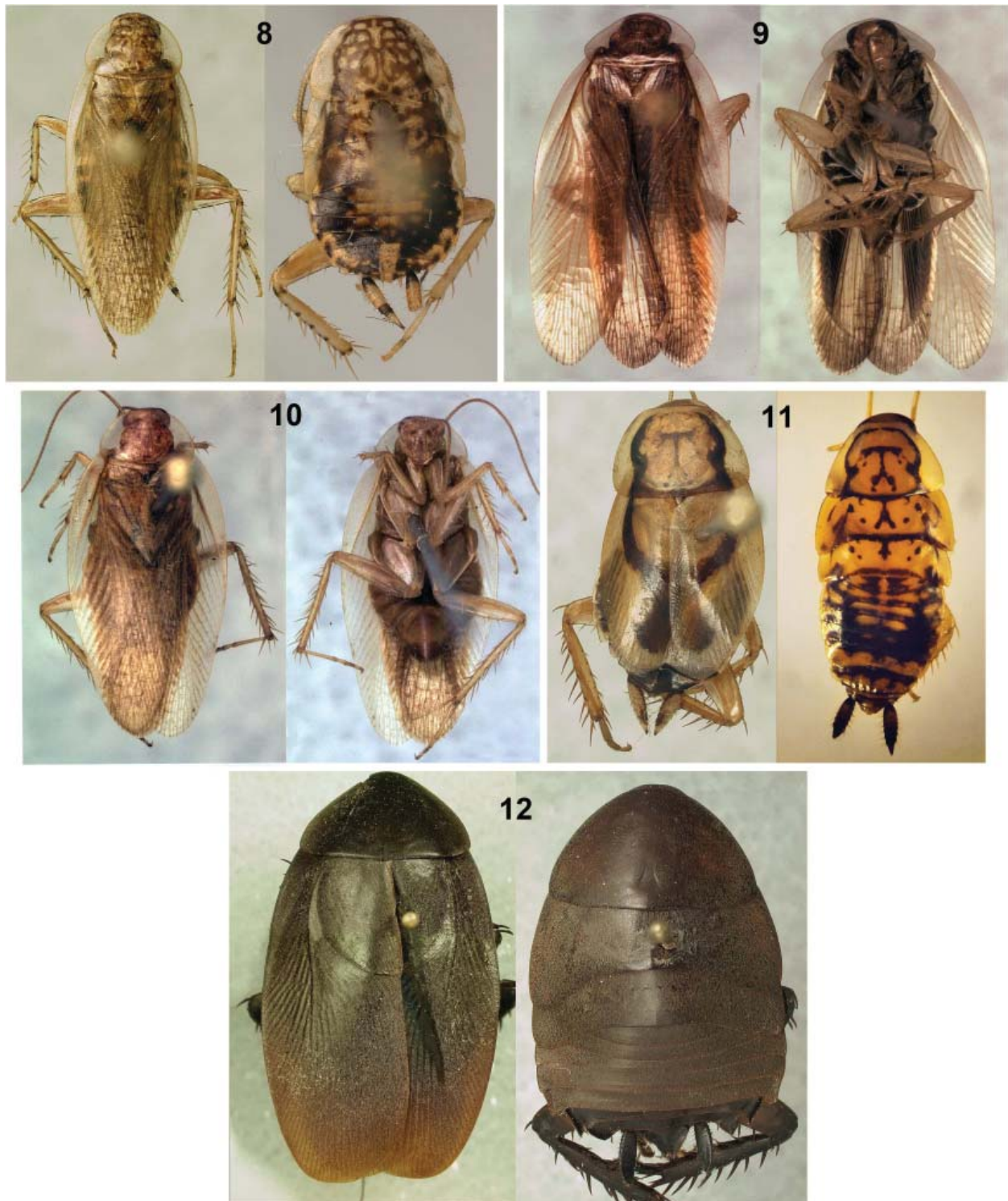
Blatta surinamensis Linnaeus 1758: 424; Surinam; circumtropical, of Asian origin.

Diagnosis. Adults 15–22 mm, oval, with full tegmina in both sexes, bicolored with black and pale brown; head dark brown; pronotum dark brown to almost black, with narrow yellowish (pale brown) anterior and lateral margins that are sometimes interrupted anteriorly; tegmina pale brown, contrasting with pronotum, with many basal punctures usually in double rows; abdominal apex not covered fully by tegmina in some. Nymphs reddish to dark brown to almost black, thorax and first 3 visible abdominal tergites smooth and shining, but segments 4–8 dull and very finely tuberculate, less evident in some very small individuals.

Comments. *Pycnoscelus surinamensis* adults appear to be all female, which is consistent with being parthenogenetic. It is common on Guana under debris, and a nocturnal ground-dweller (Table 1). Individuals are active and abundant at night in the pasture area, perhaps as scavengers on the donkey dung there. It is known throughout the Greater Antilles and tropical America (Princis 1964, 1967). It has more than 10 synonyms probably due to its edificarian circumtropical distribution.

Shelford (1910) first recorded this species from St. Thomas and Trinidad; Miller (1994) reported it in a shipment of plants being unloaded on Guana Island. It is herein recorded for the first time on Anegada, Cooper, Jost Van Dyke, Little Thatch, Mosquito, Tortola, and Virgin Gorda of BVI, in addition to other previous records on St. Croix of USVI (Rehn and Hebard 1927), Puerto Rico (Gutiérrez and Fisk 1998), and Hispaniola (Gutiérrez and Perez-Gelabert 2000).

Specimens examined. **BDVC**—1 nymph, BVI, Anegada Is., airport vicinity, 22.X.2004, Valentines & Sibleys; 4 nymphs, BVI, Cooper Is., 12.X.2007, W. Lu; 2 females, BVI, Guana Is., 22.IX/10.X.2005, B. D. Valentine & S. C. Valentine-Cooper, at UV; 5 females, BVI, Guana Is., 19/21.X.2006, 9/20.X.2007, B. D. Valentine family, at UV; 2 females, BVI, Guana Is., 15.X.2007, W. Lu; 1 female, BVI, Guana Is., 5-19.X.2005, B. D. & B. S. Valentine; 2 nymphs, BVI, Guana Is., 8/14.X.2001, B. D. Valentine family, at UV; 8 nymphs, BVI, Guana Is., 4/10-11.X.2005, B. D. Valentine & S. C. Valentine-Cooper; 1 nymph, BVI, Guana Is., 20.X.2007, B. D. Valentine family, at UV; 1 nymph, BVI, Guana Is., White Beach, 15.X.2007, W. Lu; 1 adult, Jost Van Dyke, 18-19.X.2010, W. Lu & S. C. Valentine-Cooper; 1 female, BVI, Little Thatch Is., 23.X.2005, W. Lu, sweep; 2 females, BVI, Mosquito Is., 23.X.2012, E. Hill; 1 female, BVI, Tortola Is., Chalwell, II.2003, C. Petrovic, at light; 2 females, BVI, Virgin Gorda Is., The Valley, 27.X.2003, J. Egelhoff; 1 female, BVI, Virgin Gorda Is., Oil Nut Bay, 12.X.2008, S. C. Valentine-Cooper [mango tree litter]. **NMNH**—1 female, BVI, Virgin Gorda Is., The Valley, 27.X.2003, J. Egelhoff.



Figures 8–12. Blattellidae. 8) *Cariblatta antiguensis* female adult from Tortola Island and nymph from Guana Island. 9) *Cariblatta* sp. 2 from Tortola Island. 10) *Cariblatta* sp. 3 from Tortola Island. 11) *Euthlastoblatta facies* adult and nymph from Guana Island. 12) *Nyctibora lutzi* adult and nymph from Guana Island (all specimens in BDVC).

7. *Rhyparobia maderae* (Fabricius)

Blatta maderae Fabricius 1781: 341–342; circumtropical, probably of African origin.

Comments. This species is reported from Loango (now Lovango) Island near St. Thomas of USVI (Shelford 1910), Puerto Rico (Wolcott 1948), West Indies, Central and South Americas (Princis 1964). It is large and usually associated with animal husbandry. We have not yet found it in the Virgin Islands.

Family Blattellidae

8. *Blattella germanica* (Linnaeus)

Blatta germanica Linnaeus 1767: 688; cosmopolitan.

Comments. Princis (1969) believes this species is probably of East Asian origin, and Roth (1985) agrees. Although no specimens collected, it is most likely a result of our target bias for natural habitats. In addition to these previous records on St. Croix, St. John, and St. Thomas, a local BVI pest control agent has also confirmed its presence in major edificarian habitats on Virgin Gorda and Tortola (J. Egelhoff 24.X.2011, pers. comm.).

9. *Cariblatia antiguensis* (Saussure and Zehntner) (Fig. 8)

Theganopteryx antiguensis Saussure and Zehntner 1893: 17; Antigua Island.

Diagnosis. Adults 9–11 mm, elongate and narrow, with full tegmina in both sexes; pale brown with light antennae; vertex with interocular pairs of brown spots, frons with an irregular brown area below these dark spots; pronotal disc with complex, symmetrical, dark markings plus a cluster of 5 small dark spots at base; legs pale, tibiae with a small black spot at base of each spine; costal cell of tegmina without a creamy-white stripe; 7–8 costal veins thickened, clubbed radiate dark gray; underside light with lateral black markings on each segment; basal and apical articles of cerci darker than intermediate; legs, especially tibiae, with a black spot at base of each spine.

Nymphs complexly mottled; tarsi yellow with tarsomeres 2–3 usually darker, cerci darker at base and apex. Oothecae dark brown, 3–3.5 mm long, kidney-shaped, with crowded, fine, longitudinal ridges that curve towards the hinge at both ends; egg chambers not visible externally; surface with sparse, short, truncate projections that become less numerous near the hinge; open edge with about 18–20 larger marginal tubercles. Older nymphs can be sorted according to head width categories of 0.5–0.6, 0.7–0.8, 0.9–1.0, 1.2–1.3, and 1.4–1.5 mm, suggesting more than five instars (adult 1.5–1.6 mm). The sex ratio is about 2 females to 1 male.

Comments. *Cariblatia antiguensis* is probably arboreal and nocturnal; individuals were active at night or perching on vegetation but never under ground cover such as detritus, rocks, or logs (Table 1). Oothecae were found in October with four adults from Guana Island and one adult from Mosquito Island. Nymphs were found in the forest edge Malaise trap in all months, suggesting multiple generations per year. The abundance pattern showed two highs; the fall increase was low in number as compared with the spring increase (Table 2). Abundance was particularly high in 2000 (237 individuals in June) (Fig. 3, Table 3), when annual rainfall of prior three years averaged above 3.1 mm. A spike of 15.8 mm heavy rainfall in November 2003 did not induce a striking abundance increase like that in 2000 (Fig. 3).

Roth (1994) first recorded this species from Guana Island where it is abundant. It is herein recorded for the first time on St. John of USVI, Anegada, Jost Van Dyke, Little Thatch, Mosquito, Necker, Tortola, and Virgin Gorda of BVI, in addition to other previous records on St. Croix of USVI, St. Barts, Antigua, and Trinidad (Rehn and Hebard 1927, Princis 1969), Dominica and St. Martin (Bonfils 1969), and Cuba (Gutiérrez 1995). It is not yet recorded from Hispaniola, but ranges from east and south of Puerto Rico, all the way to Trinidad; Puerto Rico should also have this species.

Specimens examined. **BDVC**—2 males, BVI, Anegada Is., 26-27.X.2009, W. Lu & S. Valentine-Cooper; 47 females/25 males/12 nymphs, BVI, Guana Is.; 5 adults/1 nymph, Jost Van Dyke, 18-19.X.2010, W. Lu & S. C. Valentine-Cooper; 1 nymph, BVI, Little Thatch Is., 13.X.2007, W. Lu, sweep; 1 adult, BVI, Little Thatch Is., 25.X.2008, Valentine-Cooper & Lu; 1 adult, BVI, Little Thatch Is., 11.X.2010, E. Wright; 2 females, BVI, Mosquito Is., 25.X.2007, S. C. Valentine-Cooper, sweep; 1 male, BVI, Necker Is., 2-5.VI.2005, W. Lu; 3 adults/1 nymph (1st instar), BVI, Necker Is., 16.X.2010, W. Lu; 2 females, BVI, Tortola Is., Sage Mt., 11.X.2007, W. Lu; 1 female, BVI, Tortola Is., Sage Mt., 1600-1700 ft., 6.X.2001, B. & B. Valentine; 2 males, BVI, Tortola Is., Chalwell, 1500 ft., 25-27.X.2001, C. Petrovic, at light; 1 male, BVI, Tortola Is., Sage Mt., 1600-1700 ft., 6.X.2001, B. & B. Valentine; 2 nymphs, BVI, Virgin Gorda, 23.X.2011, S. C. Valentine-Cooper. **MAIC**—5 adults, USVI, St. John Is., Great Cruz Bay, 15-23.VI.1996, B. & B. Valentine. **MCZ**—24 adults, BVI, Guana Is., B. & B. Valentine; 5 adults, USVI, St. John, Great Cruz Bay, 15-23.VI.1996, B. & B. Valentine. **UDCC**—6 females/2 males, BVI, Guana Is., 11.VIII.1997, 9.V-4.VI.2000, 27.X.1997, C. R. Bartlett, sweep/Malaise trap; 1 male, BVI, Little Thatch Is., 9.X.1994, C. R. Bartlett, sweep. **VIIS**—1 female, USVI, St. John Is., nr Lameshur Bay, 30.III.1970, L. Curry.

10. *Caribblatta* sp. 2, NEW RECORD (Fig. 9)

Diagnosis. Female adult 11 mm, elongate and narrow, with full tegmina; pale brown with dark antennae (in contrast to Species 9, *C. antiguensis*); frons and vertex ferruginous, without prominent spots; pronotal central area variegate, brown, lacking dark spots as in *C. antiguensis*, but with a short, sub-basal, curved, dark, transverse bar; legs all pale, tibiae without black spots at base of spines; costal cell of tegmina with a strongly contrasting creamy-white stripe along its inner margin; 7–8 costal veins thickened, clubbed radiate white; underside mostly black, but lateral and posterior margins of each segment creamy white; cerci with base dark, tip pale, and a black, tapering, dorsal stripe on intervening articles; venter and legs without black spots.

Comments. This species is less spotted than *C. antiguensis*. It may be one of the six species known from Puerto Rico (Gutiérrez and Fisk 1998). A single female is known; new collecting efforts, especially for males, will better define its taxonomic status.

Specimen examined. **BDVC**—1 female, BVI, Tortola Is., Chalwell, X.2007, C. Petrovic, at light.

11. *Caribblatta* sp. 3, NEW RECORD (Fig. 10)

Diagnosis. Female adult 12 mm, elongate and narrow, with full tegmina; uniformly pale reddish-orange, with antennae of similar color; pronotum without spots or bars; costal cell of tegmina with inner margin pale like legs, but not white and therefore not as contrasting as in *Caribblatta* sp. 2 (Species 10); 7–8 costal veins thickened, clubbed radiate reddish; cerci entirely pale brown with each article weakly darker at base; underside mostly reddish brown, with lateral and posterior margins of each segment narrowly paler; venter and legs without black spots.

Comments. This species is slightly redder than its two congeners and superficially resembles *Symptloce ruficollis* (Species 20) in color and size. It is known from one apparently gravid female collected by sweeping roadside vegetation (C. Bartlett, pers. comm. 2009); new collecting efforts, especially for males, will better define its taxonomic status.

Specimen examined. **BDVC**—1 female, BVI, Tortola Is., 28.X.1997, C. R. Bartlett.

12. *Euthlastoblatta diaphana* (Fabricius) (Table 1)

Blatta diaphana Fabricius 1793: 11; West Indies.

Comments. Shelford (1910) first reported this species from St. Thomas, USVI, and Cuba; it is also recorded from Puerto Rico (Wolcott 1948), Lesser Antilles, Jamaica, Hispaniola, and Bermuda (Princis 1969). We have not yet found it and are not certain of its identity.

13. *Euthlastoblatta facies* (Walker) (Fig. 11)

Blatta facies Walker 1868: 102; locality not recorded.

Diagnosis. Adults 9–11 mm, oval, with full tegmina in both sexes; yellowish brown; head pale brown with a narrow dark band between eyes; pronotum pale brown with a dark brown central ‘T’ that is reduced to a transverse band or even absent in a few individuals, and a dark brown medial posterior margin connecting 2 sinuate stripes that are often weakly in touch anteriorly; tegmina almost or completely covering abdomen, pale brown, each with a prominent dark-brown ‘S’ marking that connects anteriorly with the dark sinuate stripe on pronotum; legs all pale; abdomen dark brown with pale lateral margins; cerci flattened, widest in middle, with lateral and ventral but not dorsal setae.

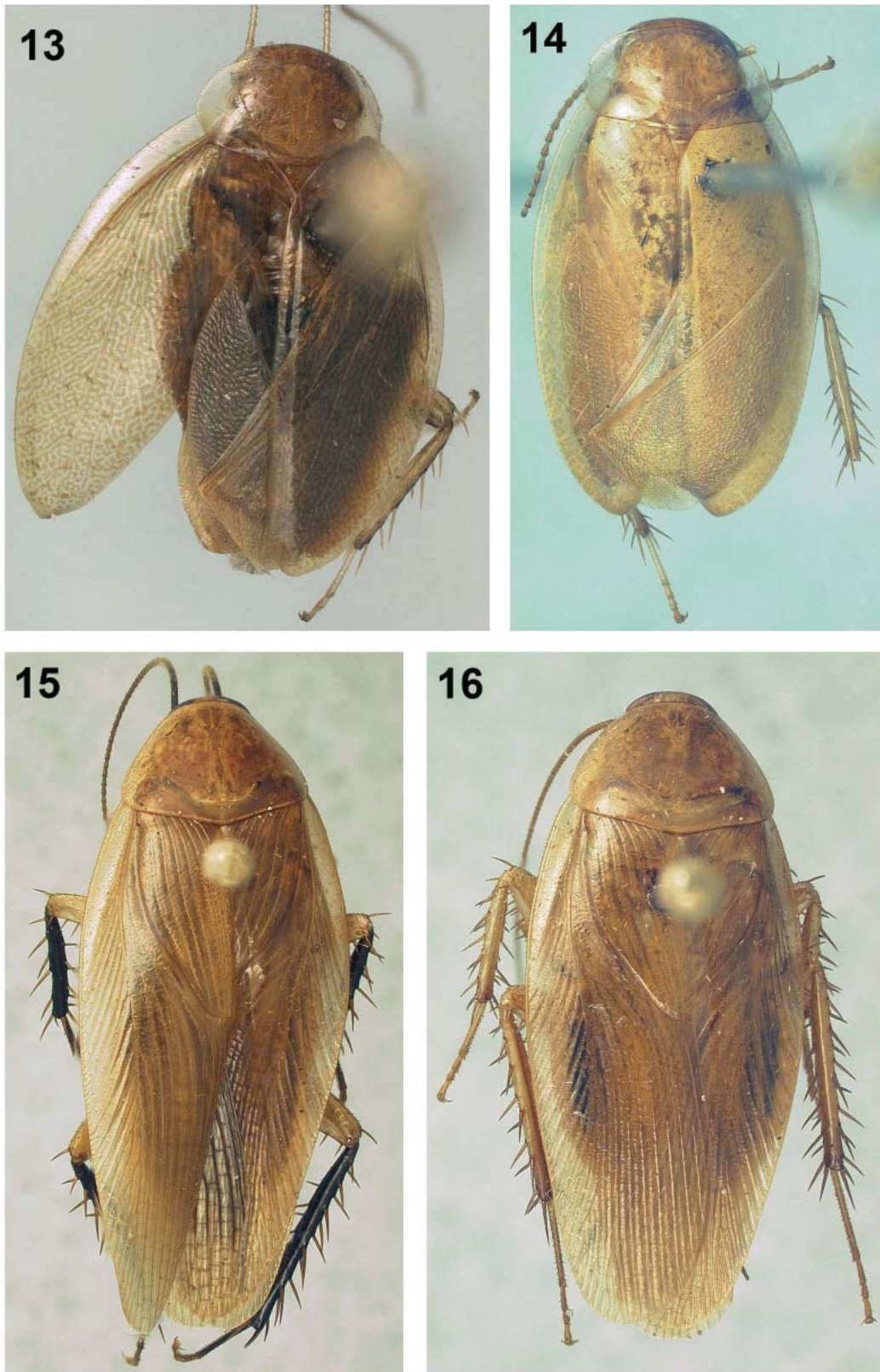
Nymphs similar to adults in having a central but much more distinct dark brown ‘T’ on pronotum; additionally, an inverted ‘Y’ on mesonotum and (less distinct) on metanotum; each notum with a dark brown posterior margin that connects two sinuate, lateral, dark brown stripes, more so on pronotum; like adults, head, thorax, and legs all pale, abdomen dark brown. The dark markings in first instars are grayish, vague, and suggestive. Nymphs can be sorted according to head width categories of 0.5–0.6, 0.7–0.8, 0.9–1.0, 1.1–1.3, 1.5–1.8, and 2.0–2.3 mm, suggesting six instars (adult 2.3–2.6 mm). A female caught in a Malaise trap during July 2011 carried an oothecum that had tufts of long hairs greater than the length of the abdomen. The sex ratio is about 1:1.

Comments. *Euthlastoblatta facies* is arboreal and nocturnal; individuals were very active at night on tree trunks and branches but never under ground cover (Table 1). At least some nymphs of this species are termite runway dwellers; in October 2008 Dr. Barbara Thorne discovered seven nymphs 3–7 mm long in arboreal tunnels of the termite *Nasutitermes acajutlae* (Holmgren).

The abundance pattern showed only one high in summer (Table 2), contrary to other species frequently captured in the forest edge Malaise trap. Abundance was particularly high in 2010 (40 individuals in August, all nymphs) (Fig. 3, Table 3), when annual rainfall of prior three years was below 2.0 mm (Fig. 2). Prolonged drought may have induced abundance increase, which was concurrent with the pattern of only one abundance peak each year (Table 2). However, a spike of 15.8 mm heavy rainfall in November 2003 was followed by a sizable abundance increase in November 2004 (Fig. 3).

A subsequent species, *E. absimilis* (Gurney 1937), was also described from Puerto Rico. According to Princis (1969), both *E. absimilis* and *E. diaphana* (Species 12) are distinct from, closely related to, and sympatric with *E. facies*, suggesting a possible Puerto Rican origin. Roth (1994) first recorded this species from Guana Island, where it is fairly common. It is herein recorded for the first time on St. John of USVI, Great Camanoe, Jost Van Dyke, Little Thatch, Mosquito, Necker, Tortola, and Virgin Gorda of BVI, in addition to other previous records on St. Thomas of USVI, Mona Island, Culebra Island, Puerto Rico, Dominica, and Barbados (Rehn 1932, Princis 1969).

Specimens examined. BDVC—1 nymph, BVI, Great Camanoe Is., 20.X.2008, S. C. Valentine-Cooper, at night; 2 males, BVI, Guana Is., 17–19.X.2000, 1–7.X.2001, B. & B. Valentine; 2 males, BVI, Guana Is., 25.X.2003, 30.IX.2005, B. D. Valentine & S. Valentine-Cooper, Malaise trap; 1 male, BVI, Guana Is., 14.X.2007, W. Lu, sweep; 1 male, BVI, Guana Is., 26.IX.2006, J. Cokendolpher, at UV; 2 females, BVI, Guana Is., Quail Dove Ghut, 17–23.X.2000, 22–28.X.2001, B. & B. Valentine, Malaise trap; 2 females, BVI, Guana Is., 26.IX/12.X.2006, B. D. Valentine family; 11 males, BVI, Guana Is., Quail Dove Ghut, X/XI.2001, XII.2002, VII/VIII/IX.2004, VII.2005, XI.2005, II/V/VI/VII/XI.2006, W.-P. Liao, Malaise trap; 1 female, BVI, Guana Is., 17.IX.2006, J. Cokendolpher, at UV; 9 nymphs, BVI, Guana Is., I–II, V, VII, IX, and X; 1 nymph, BVI, Guana Is., 26.X.2008, [B. Thorne, in runways of *Nasutitermes acajutlae* (Holmgren)]; 2 adults/1 nymph, Jost Van Dyke, 18–19.X.2010, W. Lu & S. C. Valentine-Cooper; 1 adult, BVI, Little Thatch Is., 11.X.2010, E. Wright; 2 nymphs, BVI, Mosquito Is., 25.X.2007, S. C. Valentine-Cooper & W. Lu; 1 adult/1 nymph, BVI, Mosquito Is., 23.X.2012, E. Hill; 1 nymph, BVI, Necker Is., 16.X.2006,



Figures 13–16. Blattellidae. **13)** *Plectoptera infulata* adult from Tortola Island. **14)** *Plectoptera rhabdota* adult from Guana Island. **15)** *Symploce pararuficollis* adult from Guana Island. **16)** *Symploce ruficollis* adult from Guana Island (all specimens in BDVC).

S. C. Valentine-Cooper; 1 nymph, BVI, Necker Is., 2-5.VI.2005, W. Lu; 2 adults/3 nymphs, BVI, Necker Is., 16.X.2010, W. Lu; 1 male, BVI, Tortola Is., Sage Mt., 1600-1700 ft., 6.X.2001, B. & B. Valentine. **MCZ**—5 adults, BVI, Guana Is., B. & B. Valentine. **NMNH**—2 specimens, BVI, Guana Is., 1-6.X.1999, 8.IX-8.X.2000, W. Lu, Malaise trap; 6 specimens, BVI, Guana Is., 9.V-9.VI.2000, 9.VIII-8.IX.2000, 8.IX-9.X.2000, II.2003, W. P. Liao, Malaise trap; 1 specimen, BVI, Guana Is., hotel area, 6-13.X.2001, D. E. Perez-Gelabert; 4 specimens, BVI, Necker Is., 25.X.2000, W. Lu. **UDCC**—1 nymph, BVI, Guana Is., 29.X.1997, C. R. Bartlett, beat/sweep; 1 male, BVI, Virgin Gorda Is., 11.X.1994, C. R. Bartlett. **VIIS**—1 adult, USVI, St. John Is., Lameshur Bay, 18-27.VII.1972, A. Gray.

14. *Nyctibora lutzi* Rehn and Hebard (Fig. 12), NEW RECORD

Nyctibora lutzi Rehn and Hebard 1927: 193; Puerto Rico.

Diagnosis. Adults 31–36 mm, with full tegmina in both sexes; broadly oval, dorsum entirely dark brown and densely covered with very short, fine, cinereous setae. Nymphs very dark reddish-brown to almost black, densely covered with similar setae which can be partially absent (especially on pronotum) due to abrasion. Adults and larger nymphs with one or more pairs of faint, glabrous, pronotal grooves, each pair convergent anteriorly; last tergite narrow and triangular with weak apical emargination; male supra-anal plate trilobate apically.

Comments. Among the cockroach species in the Virgin Islands, *Nyctibora lutzi* is readily recognized by its large size (>30 mm), densely and finely tomentose dorsum, full tegmina, and uniform dark brown color in both sexes. The pronotal widths of 11 nymphs suggest six instars. It is a nocturnal ground dweller (Table 1). On Guana Island in October 2008 adults were observed at night actively foraging and courting on the orchard flat. Nymphs were often found in rotten *Agave*; this habitat is similar to that in epiphytic bromeliads for the Dominican Republic species (Gutiérrez and Perez-Gelabert 2000). A female specimen collected in June 1996 from St. John carried an oothecum. Originally described from Puerto Rico, this is not a common species on Guana and is recorded for the first time on St. John of USVI, Guana, Little Thatch, and Tortola of BVI, in addition to a previous record on Puerto Rico (Gutiérrez and Fisk 1998).

Specimens examined. **BDVC**—1 male, BVI, Guana Is., 26.X.2004, B. D. Valentine & S. C. Valentine-Cooper; 7 nymphs, BVI, Guana Is., 10.X.2003, B. & B. Valentine; 2 nymphs, BVI, Guana Is., 11/13.X.2004, B. D. Valentine & S. C. Valentine-Cooper, at UV; 1 nymph, BVI, no other data; 1 female, BVI, Little Thatch Is., 19.X.2012, W. Lu; 2 males/1 female/1 nymph, BVI, Tortola Is., Lock Hill, 15.VI.2002, C. Petrovic, at light. **MCZ**—1 female [with oothecum], USVI, St. John, Great Cruz Bay, 15-23.VI.1996, B. & B. Valentine. **NMNH**—1 male, BVI, Guana Is., 27.IX.2003, W. Lu & S. Lazell; 1 female, BVI, Guana Is., 8.X.2003, W. Lu.

15. *Nyctibora noctivaga* Rehn

Nyctibora noctivaga Rehn 1902: 3; Nicaragua.

Comments. This species differs from *N. lutzi* (Species 14) mainly in the male supra-anal plate. Shelford (1910) first recorded it from “Loango Island” (Lovango Cay) near St. Thomas, USVI; Rehn and Hebard (1927) state that “the latter record, however, was based on an immature male individual, and in consequence the specific determination may be open to question.” We have not recognized any specimen of this taxon and question the record from the Virgin Islands until Lovango is revisited. It was recorded from Nicaragua; Panama; Jamaica; and Colombia, and considered adventive in Canada, USA, and Europe (Princis 1967).

16. *Plectoptera infulata* Rehn and Hebard (Fig. 13), NEW RECORD

Plectoptera infulata Rehn and Hebard 1927: 314; Puerto Rico, Vieques Island.

Diagnosis. Adults 6.5–7 mm, oval, with full tegmina in both sexes; pale yellowish brown; pronotum in 6 of 12 specimens with dull white, opaque, lateral margins (transparent in 6 others); tegmina with major veins opaque but not white, cells lacking any complex reticulum as in *P. rhabdota* (Species 17); interocular space with a dark band above a pale field (in one specimen this entire area is brown); abdomen and cerci paler than those of congeners.

Comments. A unique feature of this genus is the hindwing, which, at rest, is folded forward so that the wing apex rests above and near the wing base, thus explaining the generic name where ‘*plectos*’ means folded in Latin and ‘*ptera*’ wings. Another unique feature is that the tegmina meet in a straight line down the back, overlap less than other cockroaches. *Plectoptera infulata* is a new record and second species in the genus from the Virgin Islands. It is arboreal and probably diurnal (Table 1), not as common as *P. rhabdota* on Guana Island, suggesting a preference for wetter habitats. A female carried a partly visible oothecum in November 2001. It is herein recorded for the first time on Guana and Tortola of BVI in addition to a previous record from Puerto Rico (Princis 1965).

Specimens examined. BDVC—1 male, BVI, Tortola Is., Chalwell, 470 m, VI-VII.2001, C. Petrovic, at light; male/1 female [with oothecum], BVI, Tortola Is., Chalwell, 470 m, XI.2001, C. Petrovic; 2 males, BVI, Tortola Is., Chalwell, 16-24.X.2003, 470 m, C. Petrovic, at light. NMNH—1 specimen, BVI, Tortola Is., Chalwell, 16/24.X.2003, C. Petrovic, at light. UDCC—1 female [with oothecum], BVI, Guana Is., 26.X.1997, C. R. Bartlett; 2 males, BVI, Tortola Is., Sage Mt., 14.X.1993, C. Bartlett & J. Cryan; 1 adult, BVI, Tortola Is., 28.X.1997, C. Bartlett.

17. *Plectoptera rhabdota* Rehn and Hebard (Fig. 14)

Plectoptera rhabdota Rehn and Hebard 1927: 305; Puerto Rico.

Diagnosis. Adults 5–6 mm, with full tegmina in both sexes; oval, smooth, pale brown; pronotum with transparent lateral margins (in some specimens cloudy); tegmina with major veins white to pale (transparent in some specimens), enclosing cells each with a darker, irregular area, forming a complex reticulum; interocular space with a dark band above a paler one; abdomen and cerci darker than those of congeners.

Nymphs can be sorted based on head width to at least five instars. Oothecum is approximately 2 mm long, roughly triangular in cross-section, with hinge side weakly convex, without external indications of egg chambers, bluntly rounded at one end, broadly and triangularly produced at the other; the open edge has 10 very short, acute, evenly-spaced marginal teeth, with the three central teeth smallest.

Comments. *Plectoptera rhabdota* is one of the smallest cockroaches in the Virgin Islands; the network of white veins and the intracellular pattern of the tegmina distinguish this from *P. infulata* (Species 16). It is arboreal and probably diurnal (Table 1). Five females collected in May 2006 and Octobers of 1997 and 2001 carried oothecae.

Like *Euthlastoblatta facies* (Species 13), the abundance pattern showed only one high from late spring to early summer. Abundance was particularly high in 2010 (Table 3) (10 individuals in August, 50% nymphs) when annual rainfall of prior three years was below 2.0 mm (Fig. 3, Table 3), also similar to that of *E. facies*. Prolonged drought may have induced abundance, which was concurrent with the pattern of only one abundance peak each year (Table 2). However, a spike of 15.8 mm heavy rainfall in November 2003 was followed by a sizable abundance increase in June 2004 (Fig. 3).

Originally described from Puerto Rico, this species was first recorded on Guana (Roth 1994). It is herein recorded for the first time on St. John of USVI, Mosquito, Necker, and Tortola of BVI, in addition to other previous records on St. Thomas of USVI (Princis 1965), Vieques Island, Puerto Rico, Dominica, Guadeloupe, and Marie Galante (Bonfils 1969).

Specimens examined. BDVC—1 nymph, BVI, Guana Is., 23.X.2007, B. D. Valentine family, sweep; 40 females, BVI, Guana Is., II-X, XII, at UV, at light, Malaise trap; 43 males, BVI, Guana Is., I-II, IV, VII-X, at UV, Malaise trap, sweep; 1 female, BVI, Mosquito Is., 23.X.2008, Valentine-Cooper & Lu;

1male/1 female, BVI, Necker Is., 16.X.2010, W. Lu; 2 females, BVI, Tortola Is., Sage Mt., 1600-1700 ft., 22.X.2000, 6.X.2001, B. & B. Valentine; 1 female, BVI, Tortola Is., Chalwell, IV.2006, C. Petrovic, at light; 1 female/1 nymph, BVI, Tortola Is., Sage Mt., 11.X.2007, W. Lu; 3 males, BVI, Tortola Is., Sage Mt., 11.X.2007, W. Lu; 2 males/1 gravid female, BVI, Tortola Is., Sage Mt., 1600-1700 ft., 6.X.2001, B. & B. Valentine. **NMNH**—3 specimens, BVI, Guana Is., 9.V-9.VI.2000, 9.VII-9.VIII.2000, V.2004, W. P. Liao, Malaise trap; 2 females, BVI, Guana Is., 9.VII-9.VIII.2000/VIII.2005, W. P. Liao, Malaise trap. **UDCC**—10 adults, BVI, Tortola Is., 28.X.1997, C. R. Bartlett. **VIIS**—2 adults, USVI, St. John Is., Lameshur Bay, 18-27.VII.1972, A. Gray.

18. *Plectoptera* sp. 3, NEW RECORD

Diagnosis. Female adult 4 mm, very small, pale brown, delicate, abnormally shriveled, not completely sclerotized, with full tegmina; pronotum transparent, minutely aspirate with scattered long setae; tegmina transparent, venation obsolete, cells lacking any complex reticulum as in *Plectoptera rhabdota* (Species 17), with widely scattered long setae; abdomen and cerci more uniformly brown than those of congeners.

Comments. This unique specimen is a newly emerged adult that has shrunk; it was found by sweeping and beating bushes along the roadside to Sage Mountain, Tortola (Table 1). It is different from but closely related to *Plectoptera dorsalis* (Burmeister 1838) described from Puerto Rico. This is the first record of a third *Plectoptera* species for the Virgin Islands; Roth (1994) reported but did not differentiate two undetermined species from Tortola. We also found other specimens different from this *Plectoptera* sp. 3, *P. infulata* (Species 16), and *P. rhabdota* (Species 17). The generic placement of this taxon is tentative; further study is required.

Specimen examined. **BDVC**—1 female, BVI, Tortola Is., Sage Mt. 14.X.1993, C. R. Bartlett & J. R. Cryan.

19. *Symploce pararuficollis* Roth (Fig. 15)

Symploce pararuficollis Roth 1994: 45; BVI: Guana Island.

Diagnosis. Adults 15–19 mm, elongate oval, with full tegmina in both sexes; reddish brown with tibiae dark brown to black in contrast to pale reddish femora; underside lighter, with 1 (rarely 2) lateral pair of black spots on each sternite, plus 1 ventral and 2–3 dorsal black spots on each coxa.

Comments. *Symploce pararuficollis* is the second species originally described from the Virgin Islands on the Greater Puerto Rico Bank. The black tibia distinguishes it from the following congener. It is probably arboreal and nocturnal; individuals were active on vegetation and never under ground cover at night (Table 1). The sex ratio is about 1:1. This is the most commonly seen and most numerous species on Guana Island. However, we collected few nymphs to distinguish *S. pararuficollis* from the congener (Species 20) other than the black tibiae. The nymphs are ground dwellers of leaf litter and probably diurnal because they were actively escaping from us when disturbed during the day. Surprisingly, the nymphs have not been found in the forest edge Malaise trap, suggesting that they are very much terrestrial and do not behaviorally climb, unlike their arboreal adults.

The abundance pattern showed two highs; the fall increase topped the spring increase, unlike other species frequently captured in the forest edge Malaise trap (Table 2). Abundance was particularly high in June 2000 (209 individuals), followed by November 2004 and December 2007 (Fig. 3, Table 3). In these three cases, annual rainfall was 1.7, 2.8, and 1.6 mm with that of prior three years averaging above 3.1, 2.6, and 2.6 mm, respectively. The annual rainfall was 3.5 mm with a spike of 15.8 mm in November 2003; it did not induce a striking abundance increase like that in 2000, but may have contributed to a delayed and sharp abundance increase in 2004.

Roth (1994) first described this species from Guana Island; it is herein recorded for the first time on St. John of USVI, Anegada, Great Camanoe, Little Thatch, Moskito, and Tortola of BVI, in addition

to a previous record on Puerto Rico (Gutiérrez and Fisk 1998, Gutiérrez 1999a). We have not found it on Necker, even though it occurs on Anegada, the easternmost island on the Puerto Rico Bank.

Specimens examined. **BDVC**—1 male, BVI, Anegada Is., 26/27.X.2009, W. Lu & S. Valentine-Cooper; 1 male/1female, BVI, Great Camanoe Is., 20.X.2008, Lu & S. C. Valentine-Cooper, at night; 20 females, BVI, Guana Is., I, III, IX-X, at UV, Malaise trap; 17 males, BVI, Guana Is., I, II, VIII-IX, Malaise trap; 1 adult, BVI, Little Thatch Is., 11.X.2010, E. Wright; 1 adult, BVI, Little Thatch Is., 11-12.X.2010, S. C. Valentine-Cooper; 1 nymph, BVI, Moskito Is., 23.X.2012, E. Hill; 1 female, BVI, Tortola Is., Chalwell, XI.2002, C. Petrovic, at light; 2 females, BVI, Tortola Is., Chalwell, XII.2009, C. Petrovic, Malaise trap. **MCZ**—6 adults, BVI, Guana Is., B. & B. Valentine; 5 adults, USVI, St. John, Great Cruz Bay, 15-23.VI.1996, B. & B. Valentine. **UDCC**—4 adults, BVI, Guana Is., 10.X.1994, 23/26.X.1997, C. R. Bartlett. **VIIS**—2 adults, USVI, St. John Is., Lameshur Bay, 18-27.VII.1972, A. Gray; 1 female, USVI, St. John Is., Trunk Bay, BS; 1 male, USVI, St. John Is., 26.I.1970.

20. *Symploce ruficollis* (Fabricius) (Fig. 16)

Blatta ruficollis Fabricius 1787: 226; “India.” USVI: St. Thomas Island (lectotype by Princis 1949: 362).

Diagnosis. Adults 12–14 mm, with full tegmina in both sexes; elongate oval, reddish brown with legs and venter lighter; venter with 1 lateral pair of black spots on each sternite, plus 1 and 3–4 dorsal black spots on each forecoxa, mesocoxa, and metacoxa, respectively.

Comments. *Symploce ruficollis* has the entire leg reddish in contrast to its congener *S. pararuficollis* (Species 19) who has contrasting black tibiae. It is probably arboreal and nocturnal; adult individuals were active on vegetation at night and never under ground cover (Table 1). The sex ratio is about 1:1. It is not as frequently seen or numerous as *S. pararuficollis* (Tables 2–3). Though a relatively common species on Guana Island, we collected few nymphs to distinguish *S. ruficollis* from the congener other than the tibia color.

The abundance pattern showed a spring high. This is the only species caught frequently in the Malaise trap, whose monthly abundance synchronized closely with the spring rainfall peak (Table 2); notably the abundance increase did not lag behind the spring rainfall peak. Abundance was particularly high in June 2000 (20 individuals), followed by May 2005, April and October 2008, and March-April 2011 (Fig. 3, Table 3). A spike of 15.8 mm heavy rainfall in November 2003 did not seem to impact abundance (Fig. 3).

Roth (1994) first recorded this species from Guana Island; it is herein recorded for the first time on Anegada, Great Camanoe, Jost Van Dyke, Little Thatch, Moskito, Tortola, and Virgin Gorda of BVI, in addition to other previous records on Guana and Necker of BVI, St. John and St. Thomas of USVI, Culebra Island, and Puerto Rico (Princis 1969, Roth 1994, Gutiérrez and Fisk 1998, Lazell 2005).

Specimens examined. **BDVC**—1 male/1 female, BVI, Anegada Is., 26/27.X.2009, W. Lu & S. Valentine-Cooper; 2 females, BVI, Great Camanoe Is., 20.X.2008, Lu & S. C. Valentine-Cooper; 19 males, BVI, Guana Is., III, IX-X, at UV, Malaise trap; 27 females, BVI, Guana Is., I, IX-X, at UV, Malaise trap; 3 adults, BVI, Little Thatch Is., 11.X.2010, E. Wright; 2 males, BVI, Moskito Is., 25.X.2007, W. Lu, sweep; 1 female, BVI, Moskito Is., 23.X.2008, Valentine-Cooper & Lu; 1 male, BVI, Necker Is., 2-5.VI.2005, W. Lu; 3 adults, BVI, Necker Is., 16.X.2010, W. Lu. **MCZ**—10 adults, USVI, St. John, Great Cruz Bay, 15-23.VI.1996, B. & B. Valentine; 10 adults, BVI, Guana Is., B. & B. Valentine. **NMNH**—3 adults, BVI, Anegada Is.; 4 adults, BVI, Jost Van Dyke Is.; 4 adults, BVI, Tortola Is.; 20 adults, BVI, Virgin Gorda Is. **UDCC**—1 adult, BVI, Guana Is., 23.X.1997, C. R. Bartlett. **VIIS**—2 adults, USVI, St. John Is., Lameshur Bay, 18-27.VII.1972, A. Gray; 1 male; USVI, St. John Is., Lameshur Ranger Station, 23XI.1958, C. F. Adams.

Family Blattidae

21. *Eurycotis improcera* Rehn (Fig. 17)

Eurycotis improcera Rehn 1930: 48; USVI: St. Croix.

Diagnosis. Adults 16–24 mm, brachypterous with quadrate tegmina in both sexes that barely overlap; oval, yellowish brown with dark brown pattern; dorsum shiny, tegmina densely and finely punctate; head yellowish with a distinct dark band across vertex between eyes and another across frons above clypeus, and an irregular, often weakly defined, dark area between antennal insertions; pronotum broader than long, with 2 large, elongate-oval, oblique, dark brown spots connected anteriorly, and sometimes weakly connected to a dark basal band, which does not reach lateral margins; tegmina with basal margins, suture, and transverse discal grooves variably dark brown; anteroventral margin of fore femur with a row of 13 progressively decreasing spines and 3 larger distal spines (Type A₃); basal and apical tarsomeres darker than intermediate; 4 or 5 hind tarsomeres (sometimes 4 on one leg and 5 on the other); abdomen dark brown with yellowish lateral margins, each segment slightly darker anteriorly than posteriorly; segment 7 broadly convex dorsally in female, last tergite triangular with apex broadly excavated in both sexes.

Nymphs have the same yellowish lateral margins of the abdomen but are duller and the number of segments with yellowish margins is variable, increasing with age, suggesting a random ontogenetic progression. Legs are darker in younger nymphs. The largest nymphs (~18 mm long) have no external indication of wing pads. An oothecum is twice as long as broad, 11 mm long, with 8 egg chambers on each side; each opening side (lip) has a submarginal, longitudinal ridge across the egg chambers, and 17 small, marginal teeth.

Comments. *Eurycotis improcera* is a common species on Guana Island and probably arboreal and nocturnal; individuals were active at night on tree branches at >2 m high, never under ground cover, but were caught in pitfall traps, probably during dispersal (Table 1). The sex ratio is about 1:1. Nymphs can be sorted according to head width categories of 2.0, 3.5, 4.0, 5.0–5.5, 6.5–7.0, 7.5–8.0, and 8.5–9.0 mm (adult 9.0–11 mm), suggesting seven instars. We observed active females carrying oothecae at night in Octobers of 2007, 2008, and 2009.

Originally described from St. Croix, *Eurycotis improcera* has three congeners from Puerto Rico (Gutiérrez 2004): *E. decipiens* (Kirby), *E. gurneyi* Gutiérrez, and *E. victori* Gutiérrez. The misidentification of *E. improcera* as *E. decipiens* from Guana Island (Lazell 2005) suggests morphological similarity of the two. It is herein recorded for the first time on St. John of USVI, Great Camanoe, Jost Van Dyke, Little Thatch, Moskito, Tortola, and Virgin Gorda of BVI, in addition to another previous record on St. Croix (Princis 1966).

Specimens examined. **AMNH**—1 male, USVI, St. John, Virgin Island National Park, 19-27.VII.1972, A. Gray. **BDVC**—1 nymph, BVI, Great Camanoe Is., 20.X.2008, S. C. Valentine-Cooper; 1 male, BVI, Guana Is., 22.X.2000, B. & B. Valentine; 1 male, BVI, Guana Is., N shore, 17-23.X.2007, B. D. Valentine family; 1 male, BVI, Guana Is., White Beach, 15.X.2007, W. Lu; 1 female [with oothecum], BVI, Guana Is., Pyramid, 22.X.2007, B. D. Valentine family, sweep; 1 female, BVI, Guana Is., 8.X.2004, B. D. & S. C. Valentine-Cooper, at UV; 1 female, BVI, Guana Is., 17-23.X.2000, B. & B. Valentine; 1 female, BVI, Guana Is., Palm Ghut, 18.X.2007, B. D. Valentine family; 4 female nymphs, BVI, Guana Is., Quail Dove Ghut, 9.VI-9.VII.2000, V/VIII.2003, VII.2006, W.-P. Liao, Malaise trap; 1 nymph, BVI, Guana Is., 16-22.X.2002, B. D. Valentine; 1 nymph, BVI, Guana Is., 5-19.X.2005, B. D. & B. S. Valentine; 2 nymphs, BVI, Guana Is., 16.X.2007, W. Lu; 1 nymph, BVI, Guana Is., 2.X.2009, D. M. Dennis & W. Lu; 1 female, BVI, Jost Van Dyke [as Pyke] Is., 19.X.2008, W. Lu; 1 female, BVI, Little Thatch Is., 25.X.2008, Valentine-Cooper & Lu; 1 adult, BVI, Little Thatch Is., 11.X.2010, E. Wright; 1 nymph, BVI, Moskito Is., 23.X.2012, E. Hill; 2 males, BVI, Tortola Is., Sage Mt., 750 m, 24.X.2002, B. & B. Valentine, beat; 1 female/1 male, BVI, Tortola Is., Chalwell, XI.2002/IV.2011, C. Petrovic, at light; 2 nymphs, BVI, Tortola Is., Sage Mt., 15.X.1999/28.X.2006, W. Lu; 1 nymph, BVI, Tortola Is., Sage Mt., 22/28.X.2009, S. Valentine-Cooper; 1 male, BVI, Virgin Gorda Is., SW coast, 14.X.2004, B. S. Valentine, at UV; 1 male nymph, BVI, Virgin Gorda Is., Oil Nut Bay, 12.X.2008, [B. S. Barker]. **MCZ**—2 adults, BVI, Guana Is., B. & B. Valentine. **NMNH**—2 males/1 female, BVI, Guana Is., hotel area, 6-13.X.2001,



Figures 17–20. Blattidae. **17)** *Eurycotis improcera* adult from Guana Island. **18)** *Eurycotis* sp. 1 adult from Tortola Island. **19)** *Periplaneta americana* adult from Guana Island. **20)** *Periplaneta australasiae* adult from Guana Island (all specimens in BDVC).

D. E. Perez-Gelabert; 1 female, BVI, Guana Is., Quail Dove Ghut, I.2003, W.-P. Liao, Malaise trap; 1 male, BVI, Guana Is., 9.X.2002, W. Lu. **UDCC**—1 male, BVI, Guana Is., 8.X.1994, C. R. Bartlett.

22. *Eurycotis* sp. 2 (Fig. 18), NEW RECORD

Diagnosis. Adults 18–19 mm, with small, full, widely separated tegmina in both sexes that are rounded-triangular and barely surpass the mesonotal posterior margin, no transverse discal grooves, no hindwings; dorsum totally blackish brown, shiny, without punctures or wrinkles, with a fine, median, longitudinal carina on each notum, only visible at certain light angles; head dark without any marking; pronotum broader than long; anteroventral margin of fore femur with a row of 13 progressively decreasing spines and 3 larger distal spines (Type A₃); tarsomeres 1–5 each with a pale apical pad, that of 5 much smaller and partly hidden by 4; each pulvillus forming a ventral pad, which appears bilobed on metatarsi; abdominal segments slightly lighter anteriorly than posteriorly, supra-anal plate sub-trapezoidal with apical emargination and rounded angles.

Comments. *Eurycotis* sp. 2 may be a new species closely related to *E. gurneyi* Gutiérrez (1999b) described from Puerto Rico; further comparative study of both will determine its taxonomic status. It does not come to light and is a nocturnal ground-dweller (Table 1). We found them by sweeping dead vegetation, in rotten *Agave* in daytime, and at night active on the forest floor in the wet zone of Sage Mountain. This is the first report for the Virgin Islands; *E. improcera* (Species 21) was thought to be the only Virgin Islands species in the genus until the discovery of this species.

Specimens examined. **BDVC**—2 males/2 female nymphs, BVI, Tortola Is., Sage Mt., 11.X.2007/28.X.2008, W. Lu; 1 male nymph, BVI, Tortola Is., Sage Mt., 22/28.X.2009, S. Valentine-Cooper.

23. *Periplaneta americana* (Linnaeus) (Fig. 19)

Blatta americana Linnaeus 1758: 424; America.

Diagnosis. Adults 27–38 mm, with full tegmina in both sexes; elongate oval, reddish-brown; pronotum bicolored, disc with yellow encircling a large, irregular, central, reddish-brown area that is sometimes weakly divided into two; outer basal margin of tegmina without a contrasting yellow stripe; supra-anal plate sub-triangular, elongate, strongly bilobed, semi-transparent; cerci slender, almost as long as mid tarsi, apical 1/2 (female) or 1/3 (male) articles longer than broad. Nymphs are shades of brown without yellow spots or bands.

Comments. Cosmopolitan spread has produced multiple synonyms for *Periplaneta americana*. This edificarian pest is easily distinguished from another widespread congener *P. australasiae* (Species 24), by the tegmina color pattern. This is a common species on Guana Island; it is a nocturnal ground-dweller; individuals scurried around fallen tree trunks and rocks behind the hotel area (Table 1). Familiarity and abundance explain the fact that few specimens were collected for island records. Ledru (1810) first reported it from St. Thomas and St. Croix, and Lazell (2005) from Guana Island. A local BVI pest control agent has confirmed its presence in major edificarian habitats on Virgin Gorda and Tortola (J. Egelhoff, pers. comm. 24.X.2011). It is herein recorded for the first time on Anegada and Little Thatch of BVI, and St. John of USVI, in addition to other previous records on St. Croix, St. Thomas, Puerto Rico, and other Antillean islands (Shelford 1910, Princis 1966).

Specimens examined. **BDVC**—1 male, BVI, Anegada Is., airport vicinity, 20-21.X.2004, Valentines & Sibleys, at UV; 2 males, BVI, Guana Is., 8-9.X.2004, B. D. Valentine & S. C. Valentine-Cooper, at UV; 2 males, BVI, Guana Is., 6.X.2006/24.X.2007, B. D. Valentine family, at UV/under debris; 3 males/4 females, BVI, Guana Is., 1-7/15-21/22-28.X.2001, 9-15/23-30.X.2002, 8.X.2003, B. & B. Valentine, at UV; 2 males, BVI, Little Thatch Is., 23.X.2008, W. Lu. **MCZ**—5 adults, BVI, Guana Is., B. & B. Valentine. **NMNH**—1 male, BVI: Guana Is., hotel area, 6-13.X.2001, D. E. Perez-Gelabert. **UDCC**—1 male/1 female, BVI, Guana Is., 21/23.X.1997, C. R. Bartlett. **VIIS**—1 male, USVI, St. John Is., Lameshur Bay,



Figures 21–22. Polyphagidae. **21)** Polyphagid sp. 1 (*Compsodes* sp. 1) adult from Guana Island. **22)** Polyphagid sp. 2 nymph from Guana Island (all specimens in BDVC).

18-27.VII.1972, A. Gray; 1 male, USVI, St. John Is., Lameshur Bay, 7.VII.1968, R. Philibosian; 1 female, USVI, St. John Is., Lameshur Ranger Station, 15.XI.1958, C. F. Adams.

24. *Periplaneta australasiae* (Fabricius) (Fig. 20)

Blatta australasiae Fabricius 1775: 271; the Pacific and unknown regions (“nave e mare Pacifico et regionibus incognitis revertente”...).

Diagnosis. Adults 27–30 mm, with full tegmina in both sexes; elongate oval, dark brown; pronotum bicolored, disc with yellow encircling a large brown central area, which is sometimes weakly divided into two; outer basal margin of tegmina with a yellow costal edge; supra-anal plate of male rectangular, with a shallow emargination, opaque, reddish brown; supra-anal plate in female folded downward on each side, apically emarginate with apices rounded, dark brown; cerci flat, elongate spindle-like, almost as long as mid tarsi, articles broader than long except last one. Nymphs black, with 2 yellow transverse bands strikingly on pronotum and irregular lateral spots on rest of dorsum.

Comments. The likely tropical origin and spread around the world have created multiple synonyms for *Periplaneta australasiae*. This is an edificarian pest like its congener *P. americana* (Species 23), and probably arrived via cargo shipments from abroad. Because of its superficial resemblance to *P. americana* and collector bias, specimens were rarely collected. Its spread over the Virgin Islands should be interesting for geological, historical, and ecological aspects. Collecting efforts on other islands, especially those not inhabited, should be made. It can be easily distinguished from the widespread *P. americana* by the yellow costal edge of its tegmina. It is a nocturnal ground-dweller (Table 1); individuals were active at night in the orchard and in the hotel area, mingling with *P. americana*. Shelford (1910) reported this species from St. Thomas; it is common and herein recorded for the first time on Anegada, Guana, Jost Van Dyke, Mosquito, and Tortola of BVI, in addition to other previous records on St. Thomas, Puerto Rico, and other Antillean islands (Princis 1966).

Specimens examined. BDVC—1 nymph, BVI, Anegada Is., airport vicinity, 22.X.2004, Valentines & Sibleys; 1 male, BVI, Guana Is., 2003, W.-P. Liao; 1 adult (abdomen missing), BVI, Guana Is., 27.IX.2005, B. D. Valentine & S. C. Valentine-Cooper, at UV; 1 female/1 nymph, BVI, Guana Is., 14.X.2007, W. Lu, sweep; 1 female, BVI, Guana Is., 9-15.X.2002, B. & B. Valentine, at UV; 1 female, BVI, Guana Is., 26.IX.2005, B. D. Valentine & S. C. Valentine-Cooper; 1 nymph, Jost Van Dyke, 18-19.X.2010, W. Lu & S. C. Valentine-Cooper; 1 male/1 female, BVI, Moskito Is., 23.X.2008, Valentine-Cooper & Lu; 1 nymph, BVI, Tortola Is., Chalwell, 16-24.X.2003, C. Petrovic, at light.

Family Polyphagidae

25. Polyphagid sp. 1 (*Compsodes* sp. 1) (Fig. 21), NEW RECORD

Diagnosis. Male adults very small, delicate, 5 mm, elongate, with full tegmina; pale brown but head and pronotum slightly darker; pronotum and tegmina finely setose; anterior and lateral margins of pronotum pale; tegmina membranous with raised veins, cells minutely reticulate with larger setose punctures; venter and legs entirely paler; subgenital plate apically truncate; cerci as long as mid tarsi, with dense long setae, with intermediate articles thicker, apical articles sometimes darker.

Comments. Hebard (1917) described the genus *Compsodes*; the online catalogue (Beccaloni 2007) indicates that it contains four species and ranges from Panama to southern USA. *Compsodes* was first recorded from the Antilles based on five specimens taken in semi-dry forests in the Dominican Republic (Gutiérrez and Perez-Gelabert 2000) and was recently described as *Compsodes perezgelaberti* by Gutiérrez (2012b). Our species is different from the Dominican species and may be new. It is the first record of the genus for the Virgin Islands, and the second record for the Antillean region. It seems to be rare and comes to lights (Table 1). Roth (1994) recorded a possible polyphagid nymph from Guana Island, which may be this species.

Specimens examined. BDVC—1 male, BVI, Guana Is., 9-15.X.2002, B. & B. Valentine, at UV; 1 male, BVI, Guana Is., 17.X.2007, W. Lu, at light; 1 male, BVI, Guana Is., 2-7.X.2003, B. & B. Valentine, at UV. NMNH—1 specimen, BVI, Guana Is., 16-22.X.2002, B. & B. Valentine, sandpit Malaise trap.

26. Polyphagid sp. 2 (Fig. 22), NEW RECORD

Diagnosis. Nymph about 5 mm (abdomen somewhat down-curved), wingless, dorsum entirely shades of red, shining, with pronotum lightest and apical abdominal segments darkest, each segment darker anteriorly; dorsum finely and densely punctate, covered with short, pale, appressed setae that do not conceal the underlying derm, and a row of longer but sparse setae on each posterior abdominal tergite, most visible on segment 5; head pale, reddish-brown, with a darker transverse band between antennal insertions; clypeal apex and labrum much paler than frons; palpi almost white; antennae paler than head; venter mostly dark reddish, with many short, non-overlapping setae on abdominal segments; forecoxa and posterior apices of meso- and metacoxa bright creamy white; foreleg (1 missing) pale yellowish white; cerci short, widest in middle, segmentation obscure, with 5 or more articles; styli very small with perhaps 4 or 5 articles.

Comments. We tentatively place the single nymph in this family but need adults for further determination. It was collected on Guana Island in 2003 by Dr. Barbara Thorne, in an arboreal termite runway of *Nasutitermes corniger* (Motschulsky), identified then as *N. costalis* (Holmgren), which is now a junior synonym of *N. corniger*. She sent additional specimens in the same year to the late Dr. Louis M. Roth, but we have not been able to locate them. The termite is reported from more than 20 islands from Cuba to Trinidad; including Guana, Tortola, St Thomas, and St Croix (Collins et al. 1997) and more since then (Thorne and Haverty 2000). The cockroach may be host-specific and limited to islands with the same termite. In October 2008, Dr. Thorne revisited the Guana site, but found no additional specimens; she also checked colonies of the related and more common *Nasutitermes acajutlae* (Holmgren), and found only nymphs of *Euthlastoblatta facies* (Walker).

Specimen examined. BDVC—1 nymph, BVI, Guana Is., 4.X.2003, B. Thorne, gallery of *Nasutitermes costalis* (Holmgren).

Discussion

Most cockroaches of the Virgin Islands are definitively related to those of Puerto Rico. From Cretaceous times (100 million years ago) intermittently until the present interglacial, Puerto Rico and the Virgin Islands (except St. Croix) formed a single large land mass more than double the size of modern Puerto Rico. Beginning about 20,000 years ago, melting glaciers raised sea level, isolating the present islands. Many of the species shared with Puerto Rico were probably isolated on the Virgin Islands when these islands were separated by sea level rise in the late Pleistocene. Of the 14 genera identified, 10 genera have additional species on the other Antilles and the adjacent continental areas: *Eurycotis*, *Hemiblabera*, and *Symploce* are Antillean; *Caribblatta*, *Euthlastoblatta*, *Plectoptera*, and *Nyctibora* are also Antillean, but perhaps centered on the Puerto Rican Bank; *Colapteroblatta* is in the Antilles and northern South America; *Compsodes* has Central American relatives; and *Panchlora* is widespread neotropical. Of the 19 species identified to specific level, five are edificarian: *Blattella germanica*, *Periplaneta americana*, *P. australasiae*, *Pycnoscelus surinamensis*, and *Rhyparobia maderae*. The first three are thought to be introduced from the Old World and now have cosmopolitan distributions. *Pycnoscelus surinamensis* is largely a parthenogenetic species (Roth 1967, 1998) that has spread over the tropical and humid areas of the world. *Rhyparobia maderae* is the largest; its disappearance from the Virgin Islands may be coincident with the fading animal husbandry. Ten of the remaining 14 species are shared with Puerto Rico and two of them, *Panchlora nivea* and *Euthlastoblatta diaphana*, were previously reported but have not been rediscovered from the Virgin Islands. The extreme similarity of *P. nivea* to *P. sagax* and *E. diaphana* to *E. facies* suggests misidentifications or synonymy. Among the four that are not recorded from Puerto Rico, *Caribblatta antiguensis* may also be present on Puerto Rico as *Caribblatta plagia* Rehn and Hebard (1927); type comparison is necessary to confirm this. The remaining three species absent from Puerto Rico are *Panchlora viridis*, described from “America,” *Nyctibora noctivaga*, from Nicaragua, and *Eurycotis improcera*, from St. Croix. Although all three have a wide distributional range, we could not rediscover the first two species on the Virgin Islands and question their identities. For these four, as well as the seven unidentified species, we refrain from drawing biogeographic conclusions until there is a much-needed thorough comparison of cockroaches between Puerto Rico and the Virgin Islands.

Species diversity has more to do with altitude and habitat differences than just island size (Lazell 2005). Tortola is 5,494 hectares with a maximum BVI elevation of 521 m on Sage Mountain and a suggestion of a unique cloud forest; St. Thomas is 8,091 hectares and attains a maximum USVI elevation of 474 m at Crown Mountain — not a national park; St. John is 5,180 hectares with a height of 389 m on Bordeaux Mountain — lower than St. Thomas but in the USVI national park; and Guana is 297 hectares with a height of 246 m. The Virgin Islands have been extensively degraded by human activity; Sage Mountain on Tortola and Bordeaux Mountain on St. John were designated national parks not long ago. However, nearby Guana was only partially cleared a century ago (Lazell 2005) and has been protected for many years and recovering. Tortola is 18 times larger than Guana and twice the altitude, but is less well protected. Of the 21 species found, Tortola has 19 and Guana 15. Two Guana species are still unknown on Tortola (*Compsodes* sp. 1 and polyphagid sp. 2), but are expected because they are either common or associated with termites that are also abundant on Tortola. Six species on Tortola are not known from Guana where most collection efforts have been made (*Blattella germanica*, *Colapteroblatta* sp. 1, *Caribblatta* spp. 2–3, *Eurycotis* sp. 2, and *Plectoptera* sp. 3). Excluding the edificarian *B. germanica*, the three *Caribblatta* and *Plectoptera* species have full wings and appear arboreal, so flight ability cannot explain their absence on Guana Island. Lower altitude and drier forest on Guana suggest that habitat diversity may be the limiting factor. Though similar to Tortola in island size, St. John and St. Thomas may prove to have species numbers closer to Guana than to Tortola due to the lack of cloud forest. Furthermore, we have not found *Euthlastoblatta facies* on Necker despite extensive efforts, even though it occurs on Anegada, the easternmost island on the Puerto Rico Bank. Necker is a small island of 30 hectares (Lazell 2006), 1/130 the area of Anegada and slightly higher above sea level. The limited habitat of only a small patch of natural woods may explain the absence *E. facies* from

Necker. Anegada is a flat, elongate, limestone and sand bar of 3,872 hectares and its maximum 8.5 m height is a sand dune; it has seven widespread or edificarian species, which have full wings except the most abundant *Hemiblabera brunneri*, all shared with and probably derived from nearby islands.

Diverse collecting techniques, search image, effort, and natural tendency to concentrate on rarer species, all make estimates of abundance and island distribution imprecise. *Periplaneta* is a good example: we have a combined total of <30 specimens of the two common species on Guana (*P. americana* and *P. australasiae*); this contrasts with >20 specimens for each of the 10 native species. The absence of the edificarian *Periplaneta* from the Malaise trap may be explained by the trap location in a wooded area, away from edifices. This Malaise trap has been operated almost continuously for >12 years and has collected in excess of 5,000 cockroach specimens, but only eight species are represented and are all associated with wooded habitats. Two of these (*Symploce pararuficollis* and *Caribblatta antiguensis*) far outnumber the others and account for over 4,000 specimens. Total counts for the six remaining species range from <20 to <200 per species over 12 years. Even considering all collecting methods, five species in our collection are represented by single specimens. These are *Caribblatta* spp. 2 and 3 (Tortola), *Colapteroblatta* sp. 1 (Tortola), *Plectoptera* sp. 3 (Tortola), and polyphagid sp. 2 (Guana). Their rarity indicates strong habitat preferences; therefore, it is reasonable to expect their absence on smaller islands.

Morphological and behavioral variation may partially explain abundance and island distribution. Of the eight species coming to the Malaise trap, *Caribblatta antiguensis*, *Euthlastoblatta facies*, *Plectoptera rhabdota*, *Symploce pararuficollis*, and *S. ruficollis* are commonly found perched on shrubs at night. These five species are relatively small, have full wings, and fly readily, so they can be expected in the Malaise trap frequently. On the other hand, *Eurycotis improcera* is relatively large, brachypterous, and arboreal. *Nyctibora lutzi* has full wings, but is a heavy cockroach and may not fly high and far; it is usually found on detritus close to or on the ground. Thus, they are infrequent visitors to the Malaise trap. *Panchlora sagax* has full wings and comes to electric lights and UV light traps in good numbers, but is surprisingly low in frequency in the Malaise trap. Ground level of the trap hints that this species is a canopy dweller. For an abundance estimate, use of UV light traps in combination with Malaise traps should be more informative for this species. The early abundance peak of *Symploce ruficollis* in April contrasts the latter abundance peaks of *S. pararuficollis* in June and December (Table 2), which suggests alternating ecologies of the congeners to avoid competition: when one is abundant the other is scarce. Each species has unique behavior and ecology; varied ecologies generate different abundance maxima and different slopes of abundance increase at different times; thus phenology varies among species.

Local weather also influences abundance and island distribution. The Virgin Islands in general have two rainy seasons, April-May and September-October-November. Total Malaise trap captures indicate that abundance fluctuated greatly among months and over years and differed in reference to these two rainy seasons (Fig. 2, 3). When looking at changes across months, the delayed burst of cockroach abundance after the spring rainfall and the small but steady increase during the fall rainfall (Fig. 2A) illustrate seasonality of abundance. Our cockroaches are mostly scavengers; vegetation boom in rainy seasons should provide them fresh palatable food sources. The spring rainy season is most important in affecting abundance for most species. When looking at changes over years, the ups and downs of cockroach abundances become perplexing, however. On one hand, the average numbers were tracking the annual rainfall (Fig. 2B); on the other hand, irregularity of fluctuation within a species (Fig. 3, Table 3) contradicts this yearly pattern of abundance and makes it difficult to predict. Of all five species frequently captured in the Malaise trap, the high abundance of three species (*Caribblatta antiguensis*, *Symploce pararuficollis*, and *S. ruficollis*) in June 2000 has not been surpassed in >12 years (Fig. 3). Neither the prior three years of heavy rainfall nor the low annual rainfall in 2000 can explain these high numbers of individuals, because these rainfall conditions are not essential to bursts of abundance. For example, in 2007 *S. pararuficollis* increased abruptly but *C. antiguensis* did not (Fig. 3, Table 3). If continuous drought for three years induced a sharp increase in *Plectoptera rhabdota* in 2010, then drought does not explain its leap in 2004 after a spike of heavy rainfall in 2003 (Fig. 3). We have observed a downward impact of a prior annual rainfall threshold below a daily average of 2.0 mm on abundance in some species and an upward affect of low annual rainfall consistently below that threshold in others. There may have been another rainfall threshold above a certain amount to trigger

a big spike in abundance, or timing of heavy rainfall in each spring and fall season may have affected abundance responses rapidly or be more extended into the next season. Also, seasonality is not obvious in the Virgin Islands because temperature does not fluctuate much in time and space due to latitude and low mountain ranges. Therefore, temperature is not regarded as a major factor affecting changes in cockroach abundance in the Virgin Islands. The lowest abundance of total Malaise trap captures coincided with the winter rainfall low, and could be the result of the combined affect of low moisture and temperature. Furthermore, use of the arithmetic average of the rainfall gauge measurements may be comparable to the “optimal interpolation” technique used to create a global data set. This technique merges satellite information with available gauge data over land and modifies the calculation of average values (Adler et al. 2003). The resultant rainfall data may be more pertinent in terms of climatic changes than just rain. Overall, complexity calls for evaluation of different climatic data sets and partition of data into crucial periods for further analysis of the effects of drought, heavy rainfall, and temperature.

Conclusions

Of the 26 cockroach species historically recorded or recently found during this long term research, nine are new records for the Virgin Islands and five are new for Guana Island. Excluding five edificarian species, more than half of these cockroaches are definitively present on Puerto Rico or related to those of the Greater Puerto Rico Bank. This close biogeographic relationship may increase with further taxonomic study of the Puerto Rican fauna. Most of these cockroaches are nocturnal but *Panchlora sagax* and perhaps the three *Plectoptera* species may be diurnal because we have not observed them actively moving around in the habitat at night. Nymphs of *Euthlastoblatta facies* and a polyphagid species have been taken in active termite nests. Phenology of five species frequently captured in the Malaise trap demonstrated distinct seasonality with abundance highs in spring and fall for two species, and with only one high in spring or early summer for three other species. The abundance increases were correlated closely, but not necessarily synchronic, with the spring and fall rainy peaks. An annual average rainfall below a threshold of 2.0 mm appears to impact abundance. Fluctuation over >12 years indicates further analysis of the relationship of cockroach abundance with rainfall is imperative.

Acknowledgments

We thank J. Lazell (The Conservation Agency, TCA) and S. E. Miller (Smithsonian Institution, NMNH) for providing the opportunity to study on Guana Island; also W.-P. Liao and his assistants for tending the Malaise trap samples; C. Petrovic, B. S. Valentine, and S. C. Valentine-Cooper for extensive collecting; L. Uccellini (NOAA) for being instrumental in getting the precipitation data; R. F. Adler, D. Bolvin, F. Einaudi, M. Jentoft-Nilsen, and E. Weiler (all NASA) for putting the precipitation data in a simple format; the staff and management of Guana Island for their hospitality and assistance; Idea Wild for supporting (EG) with equipment used in the present study, and G. Perry (Texas Tech University) and C. Nalepa (North Carolina State University) for reviews of the manuscript. This work was in part supported by NMNH through the Research Opportunity Funds program and by TCA through grants from the Falconwood Foundation.

Literature Cited

- Adler, R. F., G. J. Huffman, A. Chang, R. Ferraro, P. Xie, J. Janowiak, B. Rudolf, U. Schneider, S. Curtis, D. Bolvin, A. Gruber, J. Susskind, and P. Arkin. 2003. The version 2 global precipitation climatology project (GPCP) monthly precipitation analysis (1979-present). *Journal of Hydrometeorology* 4(6): 1147–1167.
- Beccaloni, G. W. 2007. Blattodea Species File Online. Version 1.2/3.5 (<http://Blattodea.SpeciesFile.org>) [accessed October 2011].
- Bonfils, J. 1969. Catalogue raisonné des insectes des Antilles Françaises. *Annales de Zoologie Ecologie Animale* 1(2): 107–120.
- Burmeister, H. 1838. *Handbuch der Entomologie II. Orthoptera*, p. 459–756. C. F. Enslin; Berlin. 751 p.

- Collins, M. S., M. I. Haverty, and B. L. Thorne. 1997.** The termites (Isoptera: Kalotermitidae, Rhinotermitidae, Termitidae) of the British Virgin Islands: distribution, moisture relations, and cuticular hydrocarbons. *Sociobiology* 30(1): 63–76.
- Fabricius, J. C. 1775.** *Systema Entomologiae, sistens insectorum classes, ordines, genera, species, adiectis synonymis, locis, descriptionibus, observationibus*, p. 271–273. *Officina Libraria Kortii*; Flensburg and Leipzig. 832 p.
- Fabricius, J. C. 1781.** *Species insectorum exhibentes eorum differentias specificas, synonyma auctorum, loca natalia, metamorphosin adiectis observationibus, descriptionibus*. I, p. 341–342. C. E. Bohnii; Hamburg and Cologne. 552 p.
- Fabricius, J. C. 1787.** *Classis II. Vlonata. 91. Blatta. Mantissa Insectorum*. I, p. 225–226. C. G. Proft; Copenhagen. 348 p.
- Fabricius, J. C. 1793.** *Entomologia systematica emendata et aucta. Secundum classes, ordines, genera, species adiectis synonymis, locis, observationibus, descriptionibus*. Tome II. C. G. Proft; Copenhagen. 519 p.
- Gurney, A.B. 1937.** Studies in certain genera of American Blattidae (Orthoptera). *Proceedings of the Entomological Society of Washington*. 39: 101–112.
- Gurney, A. B., and F. W. Fisk. 1987(1991).** Cockroaches (Blattaria, Dictyoptera). *In: J. R. Gorham (ed.). Insect and mite pests in food: an illustrated key*. United States Department of Agriculture Handbook 655, Volume I. 767 p.
- Gutiérrez, E. 1995.** Annotated checklist of Cuban cockroaches. *Transactions of the American Entomological Society* 121: 65–84.
- Gutiérrez, E. 1999a.** Estado actual del conocimiento de las cucarachas (Dictyoptera: Blattaria) de Puerto Rico. *Cocuyo* 9: 9–13.
- Gutiérrez, E. 1999b.** Two new species of the cockroach genus *Eurycotis* Stål (Dictyoptera: Blattidae: Polyzosteriinae) from Cuba and Puerto Rico (West Indies). *Proceedings of the Academy of Natural Sciences of Philadelphia* 149: 65–69.
- Gutiérrez, E. 2004.** Las cucarachas del género *Eurycotis* (Dictyoptera: Blattaria: Blattidae) en Puerto Rico, con la descripción de una nueva especie. *Solenodon* 4: 30–36.
- Gutiérrez, E. 2012a.** Las especies del género *Colapteroblatta* (Blattaria: Blaberidae: Epilamprinae) en las Antillas, con la descripción de una especie nueva de la República Dominicana. *Solenodon* 10: 38–51.
- Gutiérrez, E. 2012b.** Especie nueva del género de cucarachas *Compsodes* (Dictyoptera: Blattaria: Corydiidae) para la República Dominicana. *Solenodon* 10: 52–62.
- Gutiérrez, E., and F. W. Fisk. 1998.** Annotated checklist of Puerto Rican cockroaches. *Transactions of the American Entomological Society* 124: 333–354.
- Gutiérrez, E., and L. M. Roth. 1999.** A new species of the cockroach genus *Colapteroblatta* (Blattaria: Blaberidae, Epilamprinae) from Puerto Rico. *Transactions of the American Entomological Society* 125(4): 441–444.
- Gutiérrez, E., and D. E. Perez-Gelabert. 2000.** Annotated checklist of Hispaniolan cockroaches. *Transactions of the American Entomological Society* 126: 423–445.
- Heatwole, H., R. Levins, and M. D. Byer. 1981.** Biogeography of the Puerto Rican Bank. *Atoll Research Bulletin* 251: 1–55.
- Hebard, M. 1917.** The Blattidae of North America north of the Mexican boundary. *Memoirs of the American Entomological Society* 2: 1–284.
- Kirby, W. F. 1903.** Notes on Blattidae & c., with descriptions of new genera and species in the collection of the British Museum, South Kensington. No. III. *Annals and Magazine of Natural History* 12(7): 373–381.
- Lazell, J. 2005.** *Island: fact and theory in nature*. University of California Press; Berkeley, CA. 382 p.
- Lazell, J. 2006.** Natural Necker: thirty hectares of amazing biological diversity. *The Conservation Agency Occasional Paper* 3: 1–52.
- Ledru, A. P. 1810.** *Voyage aux îles de Ténériffe, la Trinité, Saint-Thomas, Sainte-Croix et Porto Ricco, exécuté par ordre du gouvernement français, depuis le 30 septembre 1796 jusqu'au 7 juin 1798, sous la direction du capitaine Baudin, pour faire des recherches et des collections relatives à l'histoire naturelle; contenant des observations sur le climat, le sol, la population, L'agriculture, les produc-*

- tions de ses îles, le caractère, les mœurs et le commerce de leurs habitants. Par André-Pierre Ledru. Ouvrage accompagné de notes et d'additions, par M. Sonnini. A. Bertrand; Paris. Tome 1, 315 p. (see p. 192); Tome 2, 324 p. (see p. 42).
- Linnaeus, C. 1758.** Systema Naturae per Regna tria Naturae secundum Classes, Ordines, Genera, Species, cum Characteribus, Differentiis, Synonymis, Locis (10th edition). Laurentii Salvii; Stockholm Sweden. 1384 p.
- Linnaeus, C. 1767.** Systema Naturae per Regna tria Naturae, secundum Classes, Ordines, Genera, Species, cum Characteribus, Differentiis, Synonymis, Locis (12th edition). Orthoptera 1(2): 688. Laurentii Salvii; Stockholm, Sweden. 1327 p.
- McKittrick, F. A. 1964.** Evolutionary studies of cockroaches. Cornell Experiment Station Memoir 389: 1–197.
- Miller, S. E. 1994.** Dispersal of plant pests into the Virgin Islands. Florida Entomologist 77: 520–521.
- Princis, K. 1949.** Kleine Beitrage zur Kenntnis der Blattarien und ihrer Verbreitung. II. Entomologische Meddelelser 25: 361–364.
- Princis, K. 1963.** Blattariae: Suborde [sic] Polyphagoidea: Fam.: Homoeogamiidae, Euthyrrhaphidae, Latindiidae, Anacompsidae, Atticolidae, Attaphilidae. Subordo Blaberoidea: Fam.: Blaberidae. Orthopterorum Catalogus 4: 77–172.
- Princis, K. 1964.** Blattariae: Subordo Blaberoidea: Fam.: Panchloridae, Gynopeltidae, Derocalymmiidae, Perisphaeriidae, Pycnoscelidae. Orthopterorum Catalogus 6: 175–281.
- Princis, K. 1965.** Blattariae: Subordo Blaberoidea: Fam.: Oxyhaloidae, Panesthiidae, Cryptocercidae, Chorisonauridae, Oulopterygidae, Diplopteridae, Anaplectidae, Archiblattidae, Nothoblattidae. Orthopterorum Catalogus 7: 285–393.
- Princis, K. 1966.** Blattariae: Subordo Blattoidea: Fam.: Blattidae, Nocticolidae. Orthopterorum Catalogus 8: 402–614.
- Princis, K. 1967.** Blattariae: Subordo Epilamproidea: Fam.: Nyctiboridae, Epilampridae. Orthopterorum Catalogus 11: 617–710.
- Princis, K. 1969.** Blattariae: Subordo Epilamproidea: Fam.: Blattellidae. Orthopterorum Catalogus 13: 713–1038.
- Rehn, J. A. G. 1902.** A contribution to the knowledge of the Orthoptera of Mexico and Central America. Transactions of the American Entomological Society 29: 1–7.
- Rehn, J. A. G. 1930.** New or little known Neotropical Blattidae (Orthoptera). Number 2. Transactions of the American Entomological Society 56: 19–71.
- Rehn, J. A. G. 1932.** New or little known Neotropical Blattidae (Orthoptera). Number 3. Transactions of the American Entomological Society 63: 103–137.
- Rehn, J. A. G., and M. Hebard. 1927.** The Orthoptera of the West Indies. Number 1. Blattidae. Bulletin of the American Museum of Natural History 54: 1–320.
- Roth, L. M. 1967.** Sexual isolation in parthenogenetic *Pycnoscelus surinamensis* and application of the name *Pycnoscelus indicus* to its bisexual relative (Dictyoptera: Blattaria: Blaberidae: Pycnoscelinae). Annals of the Entomological Society of America 60(4): 774–779.
- Roth, L. M. 1968.** Oviposition behavior and water changes in the oöthecae of *Lophoblatta brevis* (Blattaria: Blattellidae: Plectopterinae). Psyche 75: 99–106.
- Roth, L. M. 1971.** Additions to the oöthecae, uricose glands, ovarioles, and tergal glands of Blattaria. Annals of the Entomological Society of America 64(1): 127–141.
- Roth, L. M. 1985.** A taxonomic revision of the genus *Blattella* Caudell (Dictyoptera, Blattaria: Blattellidae). Entomologica Scandinavica 22: 5–221.
- Roth, L. M. 1994.** Cockroaches from Guana Island, British West Indies (Blattaria: Blattellidae: Blaberidae). Psyche 101: 45–52.
- Roth, L. M. 1998.** The cockroach genus *Pycnoscelus* Scudder, with a description of *Pycnoscelus femapterus*, sp. nov. (Blattaria: Blaberidae: Pycnoscelinae). Oriental Insects 32: 93–130.
- Roth, L. M. 2003.** Systematics and phylogeny of cockroaches (Dictyoptera: Blattaria). Oriental Insects 37: 1–186.
- de Saussure, H. 1869.** Mélanges orthoptérologiques. Mémoires de la Société de Physique et D'Histoire Naturelle de Genève 20: 227–326.

- de Saussure, H., and L. Zehntner. 1893–1899.** Insecta, Orthoptera. *Biologia Centrali-Americana*. I. R. H. Porter; London. 458 p.
- Shelford, R. 1910.** Blattidae. *Zoologische Jahrbücher Supplement* 11(2): 105–108.
- Thorne, B. L., and M. I. Haverty. 2000.** Nest growth and survivorship in three species of Neotropical *Nasutitermes* (Isoptera: Termitidae). *Environmental Entomology* 29: 256–264.
- Walker, F. 1868.** Catalogue of the specimens of Blattariae in the collection of the British Museum. The Natural History Museum; London. 239 p.
- Wolcott, G. N. 1948.** The insects of Puerto Rico. Orthoptera. Blattidae: Cockroaches. *Journal of the Agricultural University of Puerto Rico* 32(1): 37–46.

Received May 9, 2013; Accepted May 28, 2013.