

***PSEUDOCOCCUS SACCHARICOLA* TAKAHASHI (HEMIPTERA:  
PSEUDOCOCCIDAE) IN THE BRITISH VIRGIN ISLANDS: FIRST  
WESTERN HEMISPHERE RECORDS, WITH RECORDS OF A CO-  
OCCURRING LADY BEETLE, *HYPERASPIS SCUTIFERA* (MULSANT)  
(COLEOPTERA: COCCINELLIDAE)**

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*Abstract.*—*Pseudococcus saccharicola* Takahashi was collected on Guana Island, and nearby Beef Island and Tortola, in the British Virgin Islands (BVI). The records are the first in the Western Hemisphere for this potentially important Old World pest of sugarcane and certain other graminoid crops. Host plants on Guana were *Chloris barbata* Sw. (swollen fingergrass), *C. radiata* (L.) (radiate fingergrass), *Cynodon dactylon* L. (bermudagrass), and *Saccharum officinarum* L. (sugarcane). A probable mealybug predator associated with colonies of *P. saccharicola* on all three islands was the hyperaspidine coccinellid *Hyperaspis scutifera* (Mulsant), previously recorded in the West Indies only from the Leeward Antilles (Curaçao). Both the mealybug and lady beetle are considered adventive in the BVI. Diagnoses and illustrations of both species are provided to facilitate their recognition. *Hyperaspis sanctaeritae* Dobzhansky, 1941, described from Arizona, USA, is proposed (by N.J.V.) as a junior synonym of *H. scutifera* (Mulsant 1850).

*Key Words:* Insecta, yellowish sugarcane mealybug, adventive species, insect detection, new records, new synonymy, West Indies

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Guana is a small (340 ha) volcanic island east of Puerto Rico and just north of Tortola, with a maximum elevation of 246 m. Guana's biota is remarkably diverse, the number of species in certain

groups of plants, reptiles, and mammals often substantially greater than would be predicted by species-area relationships (Lazell 2005). Among the Insecta, groups such as beetles (Valentine and Ivie 2005), butterflies (Becker and Miller 1992), dragonflies (Lazell 2005), planthoppers (Bartlett 2000),

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and termites (Lazell 2005) show greater-than-expected species richness. Many insect species on Guana are widely distributed in the Neotropics, some are strictly Antillean in distribution, whereas others are precinctive (endemic) to the Puerto Rico Bank or to Guana and a few nearby islands (Becker and Miller 2002, Lazell 2005). Recently, several insects new to science have been described from Guana (Slipinsky 1989, Scarbrough 1997, Norrbom 1998, Becker and Miller 2002), whereas other species have been recognized as undescribed (Bartlett 2000, Genaro and Franz 2008) but have yet to receive formal taxonomic descriptions.

Guana's impressive biotic diversity cannot be attributed solely to a greater collecting intensity compared to that on many other Caribbean islands. That numerous groups on Guana are unexpectedly speciose is attributable in part to the island's geological history as part of a landmass—"Greater Guania"—comprising a larger Puerto Rico and the Virgin Islands minus St. Croix. Speciation was favored by a pattern of continuity during glacial maxima, alternating, during interglacials, with island fragmentation (ca. 8,000 to 10,000 years ago) that created an archipelago as sea levels rose (Heatwole et al. 1981; Lazell 1996, 2005). Much of today's Guana Island was cleared for agriculture and horticulture in the eighteenth century, but steeper portions of the island were spared. Goats might never have been present, or at least have been absent since the 1930s (Proctor 2005). Sheep were introduced in the 1930s, but their effects on the island's vegetation apparently have been relatively small (Kraus 2002). Communities on Guana remain diverse (e.g., dry forest, dry lowland scrub and cactus, mangroves, mesic ravine forests), and the vegetation is better preserved than on most other dry islands (Becker and Miller 1992;

Collins et al. 1997; Kraus 2002; Lazell 1996, 2005); such conditions favor a diverse fauna of phytophagous insects (Proctor 2005). For additional information on the natural history and geology of Guana, readers are referred to the book by Lazell (2005).

The insect fauna of Guana, like that of other Caribbean islands (Kairo et al. 2003, Peck 2006), also includes immigrant species, such as the red imported fire ant (*Solenopsis invicta* Buren) (Davis et al. 2001, Wetterer and Snelling 2006), that have become established as the result of human activities. Here, based on recent collecting in the British Virgin Islands (BVI)—mostly on Guana but also on nearby Beef Island and Tortola—we give the first Western Hemisphere records of the yellowish sugarcane mealybug, *Pseudococcus saccharicola* Takahashi. In addition, we give the first BVI records of a co-occurring coccinellid, *Hyperaspis scutifera* (Mulsant), known previously in the West Indies only from Curaçao. We provide diagnoses and illustrations for both species and discuss their distributional status in the BVI—that is, native or adventive.

#### MATERIALS AND METHODS

On 20 October 2008, one of us (A.G.W.) collected a mealybug on Guana by rolling back the dense turf of bermudagrass (*Cynodon dactylon* [L.] Pers.; Poaceae) from around rocks and walls of outbuildings and shaking the thick mats over a white enamel pan. In October 2009, mealybugs were found on bermudagrass at the same site and were collected from other Poaceae on Guana, as well as Tortola and Beef Island, by tapping shoots into a beating net placed at the base of grasses. Immature and mature females of the mealybug were preserved in 70% ethanol and later were identified as *Pseudococcus saccharicola* by G.A.E. Adult

coccinellids from bermudagrass turf and other grasses were point mounted and identified by N.J.V. The proposed synonymy of *Hyperaspis sanctaeritae* Dobzhansky, 1941 with *H. scutifera* (Mulsant 1850) is to be attributed to N.J.V. Voucher specimens of the mealybug are deposited in the National Museum of Natural History (USNM) Coccoidea Collection, Beltsville, MD; those of the coccinellid are in the USNM, Smithsonian Institution, Washington, DC.

#### RESULTS

##### *Pseudococcus saccharicola* Takahashi (Fig. 1)

Diagnosis.—*Pseudococcus saccharicola* can be distinguished from other *Pseudococcus* species by having 16 pairs of cerarii, with most cerarii (except those of the anal lobe) lacking auxiliary setae or containing 1 or 2 at most; circulus either present or absent; hind coxae and hind tibiae each with a few translucent pores, hind femora without translucent pores; discoidal pores absent next to eyes; and anal lobe cerarii on membranous areas. Most *Pseudococcus* species have 17 pairs of cerarii and 2 or more auxiliary setae surrounding the conical setae of each cerarius with anal lobe cerarii on heavily sclerotized areas. Among Neotropical species of *Pseudococcus* (Williams and Granara de Willink 1992), *P. saccharicola* is most similar to *P. sorghiellus* (Forbes), which in addition to having 17 pairs of cerarii, each containing several auxiliary setae, has short, stout legs with translucent pores on the hind coxa, femur, and tibia.

Distribution.—*Pseudococcus saccharicola* was described from Shinkwa, Taiwan (Takahashi 1928). It is widely distributed elsewhere in the Oriental Region: Andaman Islands, Bangladesh, India, Indonesia, Malaysia, Pakistan,

Philippines, Sri Lanka, and Thailand. The mealybug also is found in Papua New Guinea (Ben-Dov 1994, 2009; Williams 2004). Our records from the British Virgin Islands (Beef Island, Guana, and Tortola) are the first for the Western Hemisphere.

Bionomics.—*Old World*: Rao (1942) studied the life history and pest status of *P. saccharicola* on sugarcane (*Saccharum officinarum*) in India. In the Philippines, high densities (>100/hill) in rice (*Oryza sativa* L.) can cause wilting and plant death (Pathak and Khan 1994), but this mealybug tends to be prevalent only during droughts (Litsinger et al. 2009). Previously recorded host associations include numerous other grasses: *Arundo donax* L., *Echinochloa colona* (L.) Link, *E. crus-galli* (L.) Beauv., *E. glabrescens* Munro ex Hook. f., *Eleusine indica* (L.) Gaertn., *Eriochloa polystachya* Kunth, *Imperata conferta* (J. Presl) Ohwi, *Ischaemum rugosum* Salisb., *Leptochloa chinensis* (L.) Nees, *Panicum repens* L., *Paspalidium flavidum* (Retz.) A. Camus, *Paspalum conjugatum* Berg., *P. scrobiculatum* L., *Saccharum bengalense* Retz., *S. robustum* Brandes and Jesw. ex Grassl, *S. spontaneum* L., *Sorghum halepense* (L.) Pers., *Triticum aestivum* L., *Urochloa distachya* (L.) T. Q. Nguyen, and *U. mutica* (Forsk.) T. Q. Nguyen (Catindig et al. 1994, Galinato et al. 1999, Ben-Dov 2009). The sedge *Cyperus iria* L. is an “ovipositional” host (Galinato et al. 1999). In tests of the mealybug’s host range, nymphs survived on 17 of 24 graminoid species; rates were highest on rice, followed by *Echinochloa glabrescens* and *Panicum repens*. Life cycles were shortest on rice and *E. glabrescens*, followed by wheat (*T. aestivum*) and *Paspalidium flavidum* (Catindig et al. 1994). The mealybug feeds on the roots and lower (abaxial) leaf surfaces of host plants (Rao 1942, Ben-Dov 2009).





Fig. 2. Bermudagrass, *Cynodon dactylon*, at desalination facility, Guana Island, BVI, where *Pseudococcus saccharicola* was discovered by rolling back the thatch from the cement wall to expose females of the mealybug.

*British Virgin Islands: Pseudococcus saccharicola* was common in mats of bermudagrass (Fig. 2) at the desalination facility on Guana (18°28.656'N, 64°34.601'W) in October of 2008 and 2009. Fieldwork on Guana in 2009 yielded records of the mealybug from other grasses in disturbed areas. Females were beaten from shoots of swollen fingergrass (*Chloris barbata*) at a construction site near the west end of North Beach (18°28.813'N, 64°34.519'W) and in a gravel pit near the beach's east end (18°28.777'N, 64°34.443'W). Foliar chlorosis occasionally was observed on *C. barbata* near mealybug colonies. Mealybugs also were beaten from leaves and stems of five sugarcane (*S. officinarum*) plants in the orchard on Guana (18°28.463'N, 64°34.406'W). Host grasses on Tortola along a bay near the island's east end (18°25'48.10"N, 64°33'51.73"W) were *C. barbata* and radiate fingergrass (*C. radiata* (L.) Sw.). *Chloris barbata* also was the host near the airport on Beef Island (18°26'48.33"N, 64°33'41.78"W).

Specimens examined.—BVI: Beef Island: near airport, 15 Oct. 2009, 4 ♀, ex *Chloris barbata*. Guana Island:

desalination facility, 20 Oct. 2008, 38 ♀ ex *Cynodon dactylon*; construction site, nr west end of North Bay, 13 Oct. 2009, 51 ♀, ex *Chloris barbata*; gravel pit, nr east end of North Bay, 17 Oct. 2009, 5 ♀, ex *C. barbata*; orchard, 16 Oct. 2009, 2 ♀, ex *S. officinarum*. Tortola: along bay nr east end, 15 Oct. 2009, 23 ♀ ex *C. barbata* & *C. radiata*.

*Hyperaspis scutifera* (Mulsant)

(Figs. 3, 4a–d, 5c, 6)

*Cleothera scutifera* Mulsant, 1850: 565.

*Hyperaspis scutifera*: Crotch 1874: 216;

Korschefsky 1931: 195; Blackwelder 1945: 448; Gordon and Canepari 2008: 303.

*Hyperaspis incompleta* Crotch, 1874:

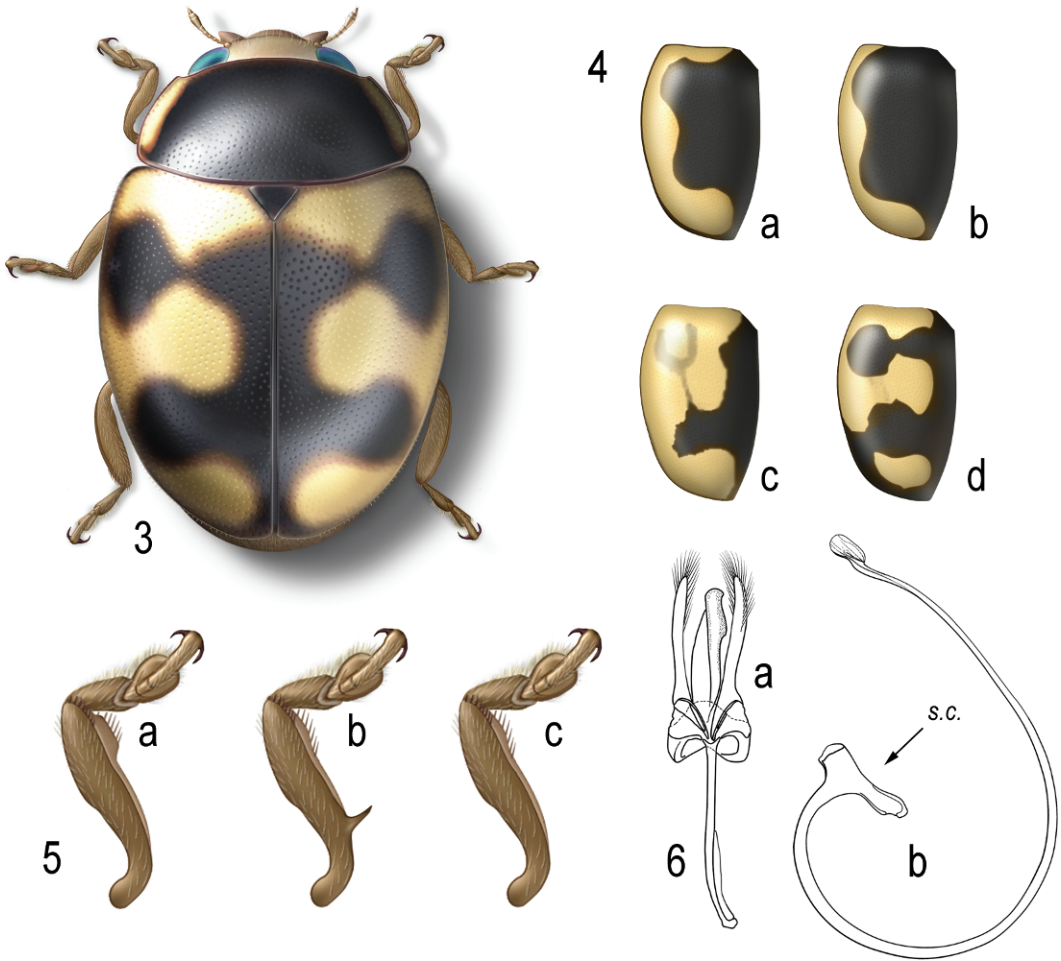
225; Korschefsky 1931: 190; Blackwelder 1945: 445; Gordon 1987: 28; Gordon and Canepari 2008: 303 (as synonym of *scutifera*) (lectotype designated).

*Hyperaspis sanctaeritae* Dobzhansky

1941: 60; Gordon 1985: 487. **New synonymy.**

The most reliable means of distinguishing the polymorphic *H. scutifera* from other species with similar elytral markings is through examination of the male genitalia. If the specimen is not dissected, or if only females are available, *H. scutifera* can be recognized by the general body form along with several details of external morphology (anterior tibia, antenna, prosternum, metapostcoxal line), none of which is definitive on its own.

Diagnosis.—Hyperaspidinae with body form oval, approximately 2.5 mm in length (range 2.0 to 2.8 mm). Dorsal surfaces glabrous except for clypeus and short fimbriolate margin of pronotum and elytron; dorsal color pattern ochre yellow and dark brownish black: head entirely black in female, yellow with black base in male; prono-



Figs. 3–6. *Hyperaspis scutifera*. 3, Male habitus of a representative specimen from Guana Island showing the “Curaçao” elytral color pattern. 4a–d, Dorsolateral view of left elytron showing a range of color patterns. 4a, “Scutifera” color pattern described by Mulsant (drawn from USNM specimens from Meta and Puerto Gaitan Colombia); 4b, Modified “scutifera” color pattern showing reduction of the anterior yellow border (drawn from the type series of *H. sanctaeritae*); 4c, “Incompleta” color pattern (redrawn from Gordon and Canepari 2008); 4d, “Curaçao” color pattern (drawn from a specimen collected on Guana Island). Figs. 5a–c, Right prothoracic leg showing variable morphologies of the tibia in the Hyperaspidinae. 5a, *Hyperaspis* sp. showing abrupt distal expansion of the ventral face of the tibia characteristic of certain species; 5b, *Brachiacantha* sp. showing sub-basal tibial spine; 5c, *Hyperaspis scutifera* showing unmodified tibia; Fig. 6a, b, Male genitalia of *Hyperaspis scutifera*. 6a, Ventral view of phallobase showing relative length of parameres (lateral setiferous structures) and basal lobe (asymmetrical median structure); 6b, Left lateral view of siphon (=penis), s.c.=siphonal capsule.

tum black with narrow yellowish border; elytron bicolored, variable, but falling within the range of patterns illustrated (Figs. 3, 4a–d). Legs yellow brown with tibiae darker brown. Ante-

rior tibia narrow, unmodified (Fig. 5c), lacking an abrupt distal expansion or sub-basal spine (compare Fig. 4a, b). Antenna composed of 10 articles. Metapostcoxal line extended nearly to

posterior margin of first abdominal ventrite and evenly recurved, fading before attaining anteriolateral margin, area inside of arc weakly alutaceous with sparse unevenly scattered punctures. Prosternum coarsely punctate; punctures contiguous or separated by less than  $\frac{1}{2}$  diameter of a puncture. Elytral epipleuron foveate to accommodate tibial apices. Male genitalia with phallobase (Fig. 6a) elongate; basal lobe sinuous on one side near apex, subequal in length to parameres; siphon (Fig. 6b) with basal capsule bearing truncate outer arm and longer digitiform inner arm.

Remarks.—The North and South American members of the tribe Hyperaspidini (Hyperaspidae) have been revised in separate monographs within the last 25 years (Gordon 1985, Gordon and Canepari 2008), but no one has tackled the Caribbean and Central American fauna. Gordon and Canepari (2008) synonymized *Hyperaspis incompleta* Crotch (described from Colombia) with *H. scutifera* Mulsant (described from Valencia, Venezuela), and tentatively included specimens from Curaçao as part of their species concept. Both the “scutifera” and “incompleta” color patterns are illustrated in the South American monograph (Gordon and Canepari 2008: 441) and reproduced here (Figs. 4a and c, respectively), but the “Curaçao” pattern (Figs. 3, 4d) was neither described nor illustrated in the aforementioned work. This made the identification of BVI material somewhat problematic. The USNM specimens of *H. scutifera*, identified by Gordon, include examples from Curaçao, and the color pattern matches that of our BVI specimens and the single USNM specimen examined from Tocayo, Venezuela. Individuals from both areas show only minor variations in this pattern, with a tendency toward confluence of adjacent dark maculae in more

heavily marked specimens. A few of the BVI specimens with the lightest markings have a slight separation of the rounded humeral spot from the transverse basal band. Male genitalia of BVI material were the same as those of USNM specimens from Colombia, Venezuela, and Curaçao. In composing a diagnosis for *H. scutifera*, N.J.V. also examined North American material and reviewed the corresponding North American monograph (Gordon 1985). Consequently, an additional synonym of *H. scutifera* was discovered: *Hyperaspis sanctaeritae* Dobzhansky, from Arizona. The type series of *H. sanctaeritae* has a modified “scutifera” pattern (Fig. 4b), with the yellow elytral border reduced in width, and absent along the anterior margin of the elytron (a pattern also exhibited in some of the material from Puerto Gaitan, Colombia). A comparison of the male genitalia showed no differences between the two nominal species.

Distribution.—Colombia, Venezuela, Curaçao, British Virgin Islands, USA (Arizona).

Type material.—of *scutifera*, Valencia, Venezuela (lectotype, female, designated Gordon and Canepari 2008), Deutsches Entomologisches Institut, Müncheberg, Germany; of *incompleta*, Colombia (holotype, female), Cambridge University Museum, Cambridge, England; of *sanctaeritae*, Santa Rita Mountains, Arizona (holotype and 2 paratypes, males), USNM.

Specimens examined.—BVI: Beef Island: near airport, 15 Oct. 2009, 1 adult, ex *Chloris barbata*. Guana Island: desalinization facility, 20 Oct. 2008, 42 adults & 12 Oct. 2009, 2 adults & 1 last-instar larva, ex *Cynodon dactylon*; construction site, nr west end of North Bay, 13 Oct. 2009, 2 adults, ex *C. barbata*; gravel pit, nr east end of North Bay, 17 Oct. 2009, 1 adult, ex *C. barbata*. Tortola: along bay nr island's

east end, 15 Oct. 2009, 1 adult, ex *C. radiata*.

Localities outside of BVI (total of 13 specimens examined): Colombia: Meta, Puerto Gaitan. Curaçao: Schottgatwee [=Schottgatweg]; Damacar [=Damacor]; Zapateer. Venezuela: Tocayo. USA: Arizona, Santa Rita Mountains.

Bionomics.—*South America*: Material from Gaitan, Colombia, was collected from the cassava mealybug, *Phenacoccus herreni* Cox and Williams, on cassava, *Manihot esculenta* Crantz (label data on USNM specimen).

*British Virgin Islands*: *Hyperaspis scutifera* was collected consistently with the mealybug *P. saccharicola*. Adults were most numerous (>40) in mealybug-infested mats of bermudagrass at the desalinization facility on Guana in October 2008. Adults were found in smaller numbers at the same site the following October. A last-instar larva beaten from bermudagrass mats at this site on 12 October 2009 and held in an 8-dram plastic vial yielded an adult of *H. scutifera* by early November. The hyperaspidine was collected on Guana in 2009 at two additional sites from mealybug-infested *Chloris barbata*: near North Bay at the east end (1 adult) and west end (2 adults). An adult also was collected with the yellowish sugarcane mealybug on *C. barbata* near the airport on Beef Island and another adult from mealybug-infested *C. radiata* on Tortola.

#### DISCUSSION

We consider the mealybug *P. saccharicola* to be adventive on Guana. Miller (1994) documented the arrival on Guana of insect-infested ornamental plants from southern Florida nurseries. The yellowish sugarcane mealybug might have arrived with infested plant material originating in Asia. Even though *P. saccharicola* has been col-

lected only in the British Virgin Islands, it initially might have entered and become established elsewhere in the Caribbean, where its populations have remained undetected. Not only are quarantine procedures and specific legislation that would limit the introduction of potentially invasive species into the Caribbean generally lacking or insufficient, but in many regions knowledge of established adventive species is inadequate or anecdotal (Kairo et al. 2003).

*Pseudococcus saccharicola*, although found on ornamental sugarcane plants on Guana, is unlikely to become an agricultural pest on this private island where no graminoid crops are grown. It could, however, pose a threat to sugarcane and certain other cultivated grasses on other islands of the West Indies. Moreover, Old World pests, such as the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) (Kairo et al. 2000, Chong et al. 2008), often are detected in Florida soon after they become established in the Caribbean. Sugarcane, an important crop in Florida (Hall 1988), and other grass hosts of *P. saccharicola* known to occur in Florida thus warrant monitoring for the possible presence of this mealybug. It has been listed among exotic mealybug species not known to occur in the United States that, if established, could threaten U.S. agriculture (Miller et al. 2002).

The range of the coccinellid *H. scutifera* is poorly known and might be more extensive than the relatively few published records would indicate. We consider it adventive rather than native in the British Virgin Islands, following recommendations to regard as adventive those species for which evidence is insufficient to resolve distributional status (Whitehead and Wheeler 1990, Carlton 1996). *Hyperaspis scutifera* might have entered the BVI with shipments of plant material. It



might also have become established in the BVI through active or passive aerial dispersal from South America or, having been attracted to ship lights (Holzapfel and Harrell 1968, Roque-Albelo et al. 2008), arrived with a cruise ship docking at Tortola (or another Caribbean island).

*Hyperaspis scutifera* was the most abundant coccinellid in mealybug-infested mats of bermudagrass at the desalinization facility on Guana. Also present was the scymnine *Diomus roseicollis* (Mulsant), a widespread Caribbean species previously recorded from Guana (Valentine and Ivie 2005, Peck 2006). It preys on mealybugs and other homopterans (Peck 2009).

The consistent occurrence of *H. scutifera* with *P. saccharicola* on grasses, high density observed on mealybug-infested bermudagrass, collection of a larva from a mealybug colony on bermudagrass, and records of predation on mealybugs by other *Hyperaspis* species (Gordon 1985, Vandenberg 2002, Hodek and Honěk 2009) suggest that this coccinellid feeds on *P. saccharicola* in the British Virgin Islands. Adventive lady beetles that are generalist predators, such as *Harmonia axyridis* (Pallas), can disrupt communities by displacing native coccinellids (Evans 2004). *Harmonia axyridis* sometimes also damages commercial fruits and becomes a nuisance when adults invade buildings and houses during autumn and winter (Koch 2003, Koch et al. 2004, Roy and Wajnberg 2008). *Hyperaspis scutifera*, however, is a presumed specialized predator of scale insects. It might compete with other small coccidiphagous lady beetles, but any adverse environmental effects on Guana (or elsewhere in the West Indies) probably would be minimal. Even if the establishment of *H. scutifera* should affect the abundance and distribution of native hyperaspidine and scymnine coccinell-

ids in the Caribbean, such changes likely would go undetected (Wheeler and Hoebeke 2009).

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