

Research Note

FIRST REPORT OF A NEW INVASIVE MEALYBUG, THE HARRISIA CACTUS MEALYBUG HYPOGEOCOCCUS PUNGENS (HEMIPTERA: PSEUDOCOCCIDAE)^{1,2}

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This is the first report of the *Harrisia cactus* mealybug (HCM) in Puerto Rico including biological information, as well as results from a survey of dry forest columnar cacti in southern Puerto Rico conducted between April 2007 and January 2009. The survey had two objectives: (1) determination of the *H. pungens* geographical distribution and abundance; and (2) determination of susceptibility of native columnar cactus species to attack by this mealybug. We do not know when *H. pungens* (Granara de Willink) was introduced into Puerto Rico, but its first interception occurred in San Juan in 2000 on *Portulaca oleracea* L. (Portulacaceae) ornamentals (A. Ramírez, Unpublished). Initial sightings of *H. pungens* on cacti came late in 2005 from infested plants in Guánica. Now the mealybug appears well distributed in most dry districts of the island of Puerto Rico.

Pest importance. The *Harrisia cactus* mealybug, *Hypogeococcus pungens*, is a severe pest of columnar cacti worldwide (Figure 1A). The mealybug is native to Northern Argentina and Chile, westernmost Brazil, Paraguay and southern Peru (Williams and Granara de Willink, 1992; Ben-Dov, 1994; Claps and Haro, 2001). In native lands, *H. pungens* is primarily a pest of columnar cacti (Claps and Haro, 2001), but there are reports of other host plants, like *Portulaca* spp. (Portulacaceae), *Acalypha* (Euphorbiaceae) and *Althernanthera* spp. (Polygonaceae) (McFayden, 1979; Ben-Dov, 1994). This breadth in host plant preferences indicates a tendency towards polyphagy. Little is known about its biology or natural controls. McFayden (1979) found three nymphal instars in females and four in males, a common life history pattern in pseudococcids. Not so commonly observed in pseudococcids is ovi-larviposition, which occurs in this species and where gravid females lay eggs from which crawlers hatch only 20 minutes later. Neither diapause nor aestivation has been observed in this species, but its development has been shown to be slower through cooler winter months (McFayden, 1979).

In other parts of the world, *H. pungens* has been used as an effective biological control agent of cacti. In Australia and in South Africa, where cacti have become rangeland non-native invaders, the mealybug has been credited with clearing thousands of square

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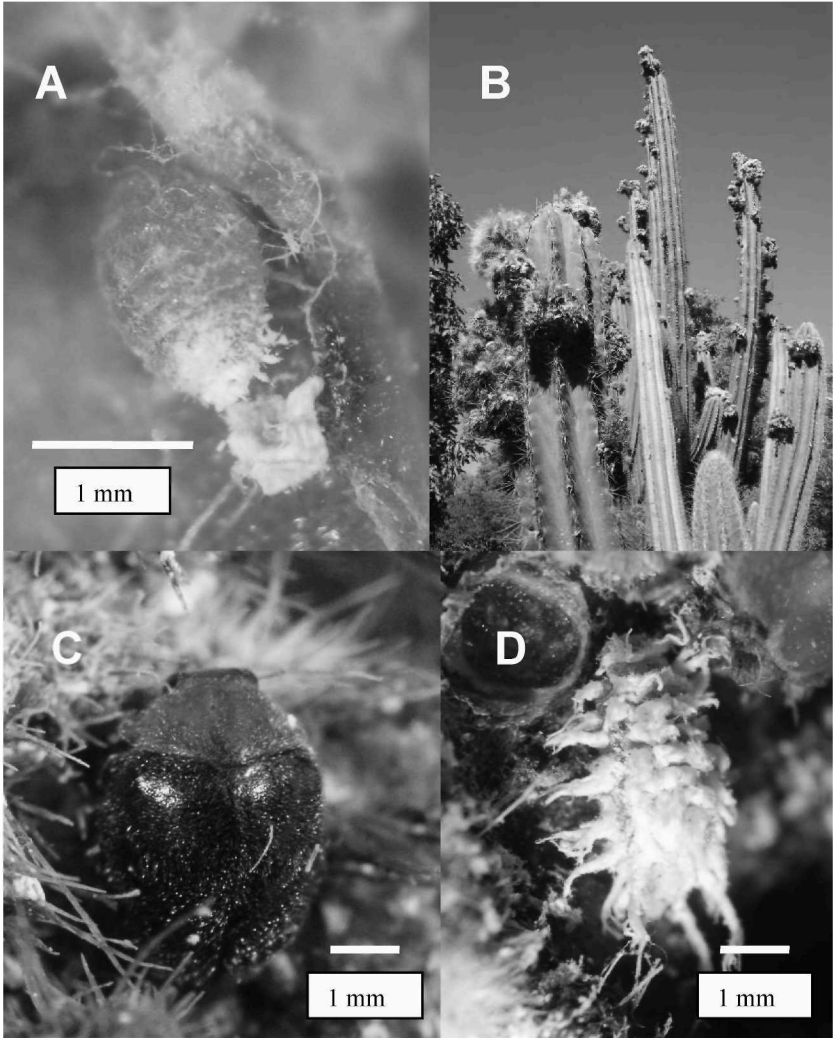


FIGURE 1. A) *H. pungens* female on *Pilosocereus royenii*; B) Infested *P. royenii*; C) Coccinellid *Cryptolaemus montrouzieri* Mulsant adult; and D) Mealybug destroyer larvae (Photos by A. Segarra).

miles of these plants (Tomley and McFayden, 1984; Moran and Zimmermann, 1991). In fact, invasive movements of this mealybug worldwide likely came from ornamental trade pathways involving secondary non-cactaceous hosts after their introduction as biological control agents in these two countries. Current distribution of this species in the Carib-

bean includes Florida (Halbert, 1996), Puerto Rico, and Barbados (A. Ramírez, Unpublished). This mealybug has also been intercepted at ports in southern Europe, but establishment has not been documented.

Surveys: Our distribution and abundance survey included observations of stands of *Pilosocereus royenii* (L.) Byles and Rowley (Royen's cactus, Cactaceae) in the southern municipalities of Cabo Rojo, San Germán, Lajas, Guánica, Guayanilla, Sabana Grande, Peñuelas, Ponce, Salinas, Aguirre, and Guayama. *Pilosocereus royenii* is the most common dry forest columnar cactus and has a typical multi-stem architecture. The number of clean and infested stems was determined for each individual. At least five mature individuals were observed per site. Presence of *H. pungens* was confirmed for every municipality. Highest infestations (i.e., percentage of stems infested) were found at Guánica (86%, n = 38 plants), Guayanilla (76%, n = 15) and Sabana Grande (64%, n = 28). Lowest infestations occurred in Salinas, Aguirre, and Guayama (>10%; n = 5 in each). Moderate infestation was observed in the other municipalities. On a survey trip to 'Caja de Muertos' Island (off the coast of Ponce) September 2007, we were unable to detect the pest. We estimate that *H. pungens* is currently distributed in an area of about 1,400 km² on the south coast, and the rate of new infestations suggests that *H. pungens* is spreading rapidly.

Predators: Our surveys have also identified four species of predators associated with mealybug infestations on *Pilosocereus royeri*. Three coccinellid species were identified. The most common was the mealybug destroyer, *Cryptolaemus montrouzieri* Mulsant (Figures 1C and D). This beetle was found feeding on *H. pungens* through this range. Also common was a little dark scymnine identified by the senior author as *Decadiomus hughesi* Gordon & Hilburn. This species had been previously collected from Puerto Rico by several collectors, but remained undescribed until 1990 (Gordon and Hilburn 1990) (i.e., USNM specimens collected by Harold Morrison 2-vii-1917 Maricao; R. G. Oakley 8-vii-1932 Peñuelas on eggplant; R. G. Oakley 20-iii-1933 Adjuntas on guava). In other countries, *D. hughesi* is associated with mealybugs. In all the places where our surveys were made, both coccinellids were observed. Another less common coccinellid found in our surveys was *Scymnillus bilucernarius* (Mulsant). This scymnine was collected in great numbers only at Lajas, and is also a new record for Puerto Rico. The chamaemyiid fly *Leucopis atrifacies* (=bella) Aldrich was also found associated with *H. pungens* only in the Guánica forest. This species is a well known mealybug predator (Wolcott, 1948).

Susceptibility: Our susceptibility survey also revealed moderate to severe infestations of several key columnar cacti. We conducted the qualitative survey at the Guánica Biosphere Reserve, where the severest attacks are currently found. We found that *Leptocereus quadricostatus* (Bello) Britt. & Rose (pitahaya), *Pilosocereus royenii* (Royen's cactus), *Melocactus in tortus* (Mill.) Urban, and the exotic *Cereus hexagonus* (L.) Mill. are all severely attacked. Severely attacked species, especially pitahaya and Royen's cactus, showed grossly distorted stems, marked diminution of flowering and fruiting, killed stems, and frequently death of whole individuals (Figure 1-B). The authors also found that the species *Stenocereus fimbriatus* (Lam.) Lourteig showed low damage levels, even when surrounded by heavily infested *P. royenii* individuals. No infestation could be confirmed on *Hylocereus trigonus* (Haw.) Safford, but one individual showed symptoms of distorted stems and gall-like growths similar to those caused by *H. pungens*. Species not surveyed included *Mammillaria nivosa* Link, *Harrisia portoricensis* Britton, and *Leptocereus grantianus* Britton. These species are reported only from the offshore islands of Mona, Desecheo and Culebra. Cacti of subfamily Opuntioideae were always found infestation free, thus confirming *H. pungens* preference for columnar Cactoideae. Opuntionideae sampled included *Consolea* sp., *Opuntia dillenii* (Ker-Gawl.) Haw., *O. cochenillifera* (L.) P. Mill., *Opuntia ficus-indica* (L.) P. Mill., and *O. repens* Bello. Earlier in 2009, the junior author, Adriana Jiménez, found and confirmed HCM attacking *Portu-*

laca oleracea L. occurring around Royen's cacti in the Guánica State Forest. This finding of HCM on a non cactus host plant can have important implications for biological control programs.

Ecological Significance: Dry forests in Puerto Rico are among the finest examples of a tropical dry forest anywhere in the world (Ewel and Whitmore, 1973). The best example of these is the Guánica Biosphere Reserve. Further, cacti are important members of dry forest flora in Puerto Rico. For example, *Pilosocereus royenii* is the most widely distributed tree at Cartegena Lagoon's La Tinaja tract (Weaver and Chinae 2003). Another native cactus, locally known as pitahaya, *Leptocereus quadricostatus*, ranks 20th among 58 tree species at La Tinaja. Similar distributions occur at the Guánica Biosphere Reserve, where Royen's cactus ranked seventh as a dominant tree species, and pitahaya ranked 26th (Murphy and Lugo, 1986). Perhaps a more telling illustration of the ecological importance of these trees in the Puerto Rican dry forest is their dominant abundance in seed rains. In a recent study of seed rains at the Cabo Rojo National Wildlife Refuge, Royen's cactus seeds were among the most commonly found, likely as a result of ornithochory (=bird-mediated transport) (Arias-García, 2006). There are 13 native and three endemic species of cactus in the Puerto Rican archipelago. Two columnar species are listed by the U.S. Fish & Wildlife Service as threatened or endangered: *Harrisia portoricensis* and *Leptocereus grantianus* (U.S. Fish & Wildlife Service, 2008).

Ecological relations of tropical dry forest cacti are also revealing of their importance. Tropical dry forest cacti are important food sources for endemic bats, birds, moths and other pollinators (Naranjo et al., 2003; Rivera-Marchand and Ackerman, 2006; Ruiz et al., 2000; Silvius, 1995; Schlumpberger et al., 2006). Given the fragile nature of dry forests, many critical trophic relationships exist between cactus and endangered animal species. For instance, one of the key consumers of *Stenocereus griseus* fruit on Margarita Island (Venezuela) is the endangered parrot *Amazona barbadensis* (Silvius, 1995). Similarly, Barnés (1946) and Post and Wiley (1976) found the endangered Puerto Rican yellow shouldered blackbird or 'Mariquita' (*Agelaius xanthomus*) feeding preferentially on Royen's cactus fruit, and also on Puerto Rican applecactus fruit (*Harrisia portoricensis* Britton).

The current severity of *H. pungens* attack on dominant cacti leads us to predict potential and long-lasting damage to columnar cactus populations, and to the organisms that depend on these plants for their survival. *Hypogeococcus pungens* introduction also represents potential negative impact on agricultural interests. Its presence may now preclude the establishment of viable commercial productions of dragon fruit or pitahaya, *Hylocereus undatus*, a potentially important fruit crop for dry areas in the Caribbean. The mealybug is also a potentially serious pest in the production of ornamentals, such as *Acalypha* spp. and *Portulaca* spp. Lastly, we predict that the eventual expansion of *H. pungens* range will soon include offshore islands, such as Mona, Desecheo, Vieques and Culebra, which now harbor the last remaining wild populations of endangered cacti (i.e., *Harrisia portoricensis* and *Leptocereus grantianus*). We believe that the introduction of *H. pungens* in Puerto Rico now poses a heightened extinction threat to these endemic cacti, and to the endemic organisms that depend on them.

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