BioOne COMPLETE

An Update on Mealybugs and Scale Insects (Hemiptera) on Native Epiphytic Orchids in South Florida, Including a New record for Pseudococcus microcirculus (Pseudococcidae)

Authors: Gutting, Amy, Zettler, Jennifer A., Zettler, Lawrence W., and Richardson, Larry W.

Source: Florida Entomologist, 98(2) : 401-404

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.098.0201

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

Research

An update on mealybugs and scale insects (Hemiptera) on native epiphytic orchids in South Florida, including a new record for *Pseudococcus microcirculus* (Pseudococcidae)

Amy Gutting[1], Jennifer A. Zettler[1,], Lawrence W. Zettler[2], and Larry W. Richardson[3]*

Abstract

We provide the first published record that populations of the orchid mealybug, *Pseudococcus microcirculus* McKenzie (Hemiptera: Pseudococcidae), occur on epiphytic orchids in both the Florida Panther National Wildlife Refuge and the Fakahatchee Swamp in the Big Cypress Basin eco-region of South Florida. In California, this mealybug has been a pest of orchids in greenhouses and was the target of state quarantine and eradication efforts in 1962. To date, no published records have documented *P. microcirculus* on orchids in either California's or Florida's natural habitats. In 2013, 322 epiphytic orchids were surveyed to document scale and mealybug levels. *Pseudococcus microcirculus* was found on 5 endangered epiphytic orchid taxa, and 8 (2.5%) individual plants harbored another greenhouse pest, Boisduval scale *Diaspis boisduvalii* Signoret (Hemiptera: Diaspididae), a species sometimes associated with orchids. How these invasive species were able to establish in these State-protected regions is unknown. With active orchid restoration efforts currently underway in these and other important orchid habitats, efforts should be made to prevent the further spread of these plant parasites.

Key Words: orchid mealybug; *Diaspis boisduvalii*; epiphytic orchids; *Prosthechea cochleata*; *Epidendrum* spp. Boisduval scale

Resumen

Se aporta el primer registro publicado de la presencia de poblaciones de la cochinilla de orquídeas, *Pseudococcus microcirculus* McKenzie (Hemiptera: Pseudococcidae) sobre orquídeas epífitas, tanto en el Refugio Nacional de Vida Silvestre Pantera de Florida (FPNWR en ingles) y el Pantano de Fakahatchee en la eco-región de Cuenca de Ciprés Grande del Sur de la Florida. En California, esta cochinilla ha sido una plaga de orquídeas en los invernaderos y fue el objetivo de los esfuerzos de cuarentena y erradicación del estado en el 1962. Hasta la fecha, no habian registros publicados que han documentado la presencia de *P. microcirculus* sobre orquídeas, ya sea en California o hábitats naturales de Florida. En el 2013, 322 orquídeas epífitas fueron muestreadas en la FPNWR para documentar el nivel de las escamas y cochinillas. Se encontró *Pseudococcus microcirculus* sobre cinco taxones de orquídeas epífitas en peligro de extinción y en ocho (2.5%) plantas individuales estaban una otra plaga común del invernadero, *Diaspis boisduvalii* Signoret (Hemiptera: Diaspididae), una especie de escama asociada con orquídeas. No se sabe cómo estas especies invasoras podian establecer en estas regiones protegidas por el estado. Con los esfuerzos activos de restauración de orquídeas ya en curso en estos y otros importantes hábitats de orquídeas, se deben hacer esfuerzos para prevenir la propagación de estos parásitos de plantas.

Palabras Clave: cochinillas de orquídeas; *Diaspis boisduvalii*; orquídeas epífitas; *Prosthechea cochleata*; *Epidendrum* spp. escama Boisduval

Both mealybugs (Hemiptera: Pseudococcidae) and armored scales (Hemiptera: Diaspididae) are regarded as serious phytophagous pests of orchids (Asparagales: Orchidaceae) grown in cultivation (Cullina 2004). By removing nutrients with their piercing-sucking mouthparts, these insects can reduce plant vigor and cause plant death (McKenzie 1967; Kosztarab 1990). Mealybugs, in particular, also secrete copious quantities of honeydew that serve as a food source for ants and sooty mold, the latter of which hinders photosynthesis by coating leaf surfaces (Wood et al. 1988). Scales and mealybugs are often difficult to detect due to their small size and habit of concealment beneath leaf sheaths and crevices. Moreover, the diminutive size of the immature motile stages (crawlers)

[1]Department of Biology, Armstrong State University, Savannah, GA 31419, USA
[2]Orchid Recovery Program, Department of Biology, Illinois College, Jacksonville, IL 62650, USA
[3]US Fish and Wildlife Service, Florida Panther and Ten Thousand Islands National Wildlife Refuge, Naples, FL 34114, USA
*Corresponding author; E-mail: jennifer.zettler@armstrong.edu

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

often leaves infestations of new plants undetected, resulting in the rapid spread of new colonies. For plants in cultivation, control of mealybug populations, in particular, often require the use of systemic insecticides, as contact pesticides may fail to reach mealybugs protected by their location on the plant, such as beneath tightly adhered leaf sheaths. Armored scales are even more difficult to control with chemical means because they are physically protected from contact applications by their cover, although Cating et al. (2010) found that the use of Silwet® L-77 plus petroleum oil can suppress scale populations on orchids in cultivation. The efficacy of systemic insecticides, which travel through the vascular system, is limited because armored scales feed by puncturing individual cells and not within the vascular system (Miller & Davidson 2005).

Other than the damage that mealybugs and scales cause to orchids in cultivation, these insects now pose a direct threat to rare native Florida orchids *in situ* as revealed by 2 recent studies (Ray et al. 2012; Zettler et al. 2012). Zettler et al. (2012) reported mealybugs (*Ferrisia* sp.) on inflorescences of the state-endangered ghost orchid, *Dendrophylax lindenii* (Lindl.) Benth. ex Rolfe, in Collier County in 2009 and Boisduval scale (*Diaspis boisduvalii* Signoret) on other epiphytic orchids in the Florida Panther National Wildlife Refuge in 2010. In 2011, Ray et al. (2012) documented that *D. boisduvalii* was more widespread and could be found in several orchid populations in both the Florida Panther National Wildlife Refuge and Fakahatchee Strand State Preserve. As an exotic species native to Neotropical regions (Balachowsky 1954; Espinosa et al. 2009), *D. boisduvalii* adds an additional burden to land managers already faced with the task of protecting native orchids from environmental degradation and poaching. During a return visit to the Fakahatchee Strand in 2012, we encountered another Neotropical greenhouse pest, the orchid mealybug, *Pseudococcus microcirculus* McKenzie (J.A. Zettler, unpublished data), on a leaf of a clamshell orchid, *Prosthechea cochleata* (L.) W. E. Higgins. This specimen was collected in close proximity to reintroduced cigar orchid seedlings (*Cyrtopodium punctatum* [L.] Lindl.) released as a part of a conservation program. Thus, the presence of both phytophagous pests (*D. boisduvalii* and *P. microcirculus*) in the most diverse orchid region in North America (Collier County, Florida) is of considerable concern.

In this paper, we provide an update on *D. boisduvalii* infestations at four sites within the Florida Panther National Wildlife Refuge in 2013, and we document the prevalence of *P. microcirculus* on native Florida epiphytic orchids. To our knowledge, this is the first published report that documents *P. microcirculus* on orchids *in situ*.

Materials and Methods

STUDY SITE

The Florida Panther National Wildlife Refuge, part of the Big Cypress Basin eco-region, borders the northern portion of the Fakahatchee Strand State Preserve, located in remote north-central Collier County, Florida. In June 2013, we surveyed epiphytic orchid populations at 2 sites (McBride's Pond and Cochran Lake) that were previously monitored for *D. boisduvalii* infestations (Ray et al. 2012). In this study, North Fritz and West Hinson Lake were added. These sites consist of strand swamps and sloughs dominated by bald cypress (*Taxodium distichum* [L.] Rich.; Pinales: Cupressaceae), pop ash (*Fraxinus caroliniana* Mill.; Lamiales: Oleaceae), and pond apple (*Annona glabra* L.; Magnoliales: Annonaceae) that serve as host trees for the epiphytic orchids. All 4 sites represent "islands" of orchid populations separated by pine flatwood or wet prairie habitats.

STUDY PLANTS

Seven epiphytic orchid species were surveyed: *Prosthechea cochleata* (L.) W. E. Higgins var. *'triandra'* (Ames) W. E. Higgins (Florida clamshell orchid), *Epidendrum amphistomum* A. Richard (dingy-flowered star orchid), *Epidendrum nocturnum* Jacquin (night scented orchid), *Epidendrum rigidum* Jacquin (rigid epidendrum), *Encyclia tampensis* (Lindley) Small (Florida butterfly orchid), *Polystachya concreta* (Jacquin) Garay & Sweet (yellow helmet orchid), and *Harrisella porrecta* (Reichenbach f.) Fawcett & Rendle (jingle bell orchid). All but *E. tampensis* are listed as endangered on Florida's Regulated Plant Index (Coile and Garland 2003). At each site, we surveyed all orchids that were within 2 m of the ground for phytophagous pests. On each infested orchid, scales were removed with a scalpel by cutting or scraping a small (1 cm^2 section or less) sample of leaf and returned to the laboratory for processing. Mealybugs were concentrated near the roots of the orchids and collected by hand using soft-touch forceps. Restrictions on allowable plant damage prevented us from examining in detail the interior of the root structure. Vouchers of slide-mounted scales and mealybugs were identified by Ian Stocks at the Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, Florida, and deposited in the Florida State Collection of Arthropods slide collection.

Results

Of 322 orchids surveyed, *D. boisduvalii* occurred on 22.7%, *P. microcirculus* on 9.6%, and 8 (2.5%) had both mealybugs and scales (Table 1). Juvenile orchids were especially susceptible to infestation with 33.3% (18/54) of specimens surveyed having either scales or mealybugs. Of 7 orchid species surveyed, we recorded no scales or mealybugs for only *H. porrecta*, a leafless species. Mealybugs and scales were present at all 4 sites; however, which species were in association with a given host was not consistent. For example, no mealybugs or scales were found on either *E. nocturnum* or *E. rigidum* at North Fritz and West Hinson Lake, but at those sites other orchid species were infested (Table 1). Moreover, these orchid species at McBride's Pond and Cochran Lake had either or both *D. boisduvalii* and *P. microcirculus*. *Pseudococcus microcirculus* occurred on 15.2% of *P. cochleata* individuals, whereas *D. boisduvalii* occurred at the highest rates on *E. tampensis* (54.5%) and E. *amphistomum* (37.1%). At McBride's Pond, only 1 species (*P. concreta*) appeared free of scales, but 1 plant in that population did harbor mealybugs. Although *D. boisduvalii* was found on leaves, stems, and capsules of its host, these insects were most commonly observed clustered in protected areas near the leaf midrib or under the leaf sheath. Mealybugs were also concealed and were primarily found at the base of each plant hidden within the roots and beneath pseudobulb sheaths. In addition, mealybugs were nearly always associated with newly-formed leaf shoots (Fig. 1). For these plants, small groups of 2–20 mealybugs were typically located near the base of new leaf shoots. In rare instances, mealybugs were found on exposed surfaces such as inflorescences (Fig. 1).

Discussion

Past surveys of these orchid populations showed a trend to increasing scale levels despite differences in sample sizes. In 2011, 1,726 orchids were surveyed with an incidence of 39 with scales (2.3%) and no mealybugs being apparent (Ray et al. 2012). In 2012, 503 orchids were surveyed with an incidence of 39 with scales (7.7%; L.W. Zettler, unpublished data). In this study, we found that 22.7% of orchids had *D. boisduvalii*. Although other scale species were found at these sites in

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

Table 1. A compilation of Boisduval scale (*Diaspis boisduvalii*) and orchid mealybugs (*Pseudococcus microcirculus*) found on six orchid taxa at four sites surveyed in June 2013 in the Florida Panther National Wildlife Refuge (Collier, Co. Florida). The numbers in parentheses represent the percentage of individual plants infested.

Site	*Prosthechea cochleata*	*Epidendrum amphistomum*	*Epidendrum nocturnum*	*Epidendrum rigidum*	*Encyclia tampensis*	*Polystachya concreta*	Total
Cochran Lake							
Orchids surveyed	6	12	8	8	—	—	34
Mealybug	2	3	4	2	—	—	11 (32.3)
Scale	3	7	3	3	—	—	16 (47.0)
North Fritz							
Orchids surveyed	19	2	27	6	—	—	54
Mealybug	1	—	—	—	—	—	1 (1.8)
Scale	5	1	—	—	—	—	6 (11.1)
West Hinson Lake							
Orchids surveyed	12	29	5	1	5	—	52
Mealybug	3	3	—	—	—	—	6 (11.5)
Scale	3	15	—	—	4	—	22 (42.3)
McBride's Pond							
Orchids surveyed	81	54	23	1	17	6	182
Mealybug	12	—	—	—	—	1	13 (7.1)
Scale	5	13	2	1	8	—	29 (15.9)
Total							
Orchids surveyed	118	97	63	16	22	6	322
Mealybug	18 (15.2)	6 (6.2)	4 (6.3)	2 (12.5)	—	1 (16.7)	31 (9.6)
Scale	16 (13.5)	36 (37.1)	5 (7.9)	4 (25.0)	12 (54.5)	—	73 (22.7)

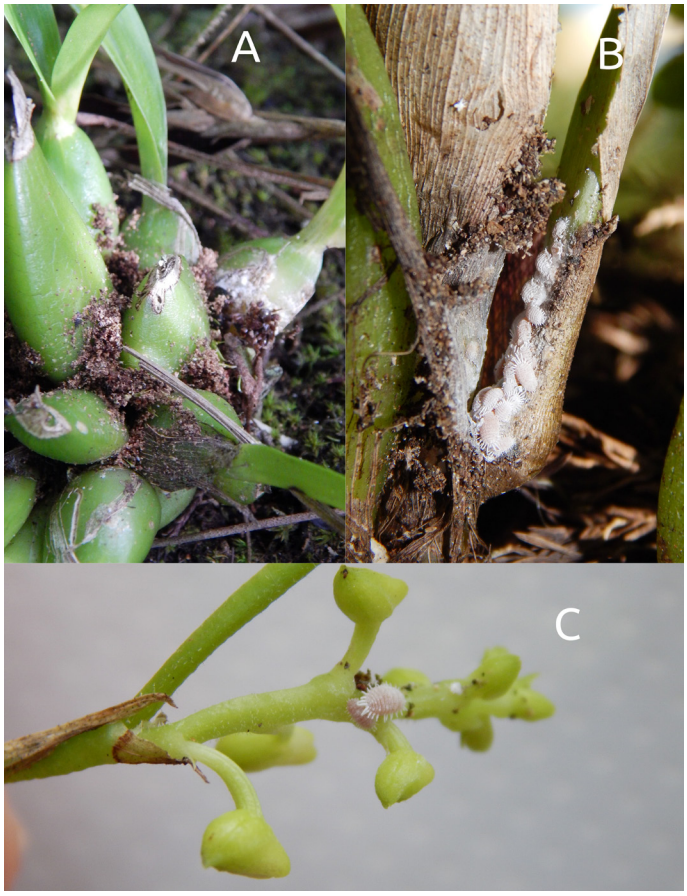


Fig. 1. (a) Debris deposited by ants around the base of *Prosthechea cochleata* where orchid mealybugs were concealed; (b) removal of an orchid leaf sheath on a new shoot reveals a large population of mealybugs on *P. cochleata*; and (c) 2 orchid mealybugs on the inflorescence of *Polystachya concreta*.

a previous study (Zettler et al. 2012), only *D. boisduvalii* and *P. microcirculus* were present in this study. Why fluctuations may occur from year to year is unknown but could be linked to a combination of biotic and abiotic factors. For example, Collier County, Florida, experienced a prolonged drought during 2009–2012, but the Naples area received above average rainfall in 2013 (www.nws.noaa.gov). Cockfield & Potter (1986) suggested that armored scale populations decrease when their host plants are water stressed. Thus, the increase in annual precipitation during 2013 might explain the higher incidence of scales in that year. In addition, their populations might be naturally cyclic because of natural biological control agents, as previously documented by Ray et al. (2012). Parasitoids tentatively assignable to Aphelinidae, Encyrtideae, and Signiphoridae were reared from *D. boisduvalii* colonies collected in 2012 and 2013 (Zettler & Zettler 2013; J. A. Zettler unpublished data).

The orchid mealybug, *P. microcirculus*, was described in 1960 from specimens collected from orchids from several nurseries in California (McKenzie 1960). In 1962, *P. microcirculus* became the target of eradication efforts in California, and nurseries with infestations were quarantined (McKenzie 1967). Miller et al. (2005) regarded *P. microcirculus* as only a minor threat to U.S. agriculture because the principle hosts are orchids. To date, no published records have documented *P. microcirculus* on orchids in a natural environment in either California or Florida. In an artificial setting (greenhouses), mealybugs typically remain hidden among roots and planting media and are apparent on the upper plant parts only when populations attain high densities (McKenzie 1967). On orchids, mealybugs typically congregate beneath the leaf sheaths, at the bases of leaf petioles, and occasionally on the underside of the leaves, affording these pests protection from predators and contact insecticides (McKenzie 1967). As a result, early eradication efforts were not successful, and *P. microcirculus* remains a pest in greenhouses in California (Johnson 2009). Given that *P. microcirculus* appears to exhibit the same cryptic feeding behavior on orchids in the natural setting, land managers charged with the task of controlling

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

this pest *in situ* may experience the same set of challenges currently faced by orchid growers.

Mealybugs feed on the phloem of their host and secrete honeydew waste that supports the growth of saprophytic fungi (sooty mold) capable of coating the leaves and reducing photosynthesis. Honeydew production also attracts ants whose tending might lead to increases in the mealybug populations (Daane et al. 2007). During our sampling, we found that the presence of ants or their debris was a reliable indicator that mealybugs were present (Fig. 1), and they could then be located by sorting through old leaf sheaths near new growth. Wheeler (1910) described an ant behavior in which foragers will cover the sticky substance with sand and other debris when they come into contact with a liquid that they cannot otherwise remove. Accordingly, researchers and land managers should look for signs of ant associations as a means of assessing the presence of mealybugs on orchids.

Over the next decade, plant conservationists plan to cultivate Florida's native epiphytic orchids from seed in vitro and reintroduce the greenhouse-grown seedlings into Collier County conservation lands. Considering that greenhouses are known to harbor scales, mealybugs, and other serious orchid pests (e.g., mites), the movement of seedlings from greenhouse to field sites has the potential to exacerbate the spread of orchid pests into natural areas unless preventative measures are devised. Greenhouse managers need to be diligent about inspecting and choosing pest-free sites where laboratory-grown orchids will be cultivated. We are currently characterizing the genetic structure of populations of orchid mealybugs found within the Big Cypress Basin eco-region with microsatellite markers, and we hope that this information might indicate how the spread of these populations can be prevented and controlled.

Acknowledgments

We thank Ian Stocks (Florida Department of Agriculture and Consumer Services, Gainesville) for his assistance in identifying mealybugs and scales and for reviewing the manuscript, Mike Owen (Fakahatchee Strand State Park) and Andy Stice (Illinois College) for their outstanding experience with navigating the sloughs of South Florida, and Gregory Evans (USDA, Beltsville, Maryland) for the identification of scale parasitoids. We would also like to warmly thank Bil Leidersdorf for his assistance in processing of specimens.

References Cited

Balachowsky AS. 1954. Les Cochenilles Palearctiques de la Tribudes Diaspidini. Memoires Scientifiques de l'Institut Pasteur, Paris, France.

Cating, RA, Hoy MA, AJ Palmateer. 2010. Silwet L-77 improves the efficacy of horticultural oils for control of Boisduval scale *Diaspis boisduvalii* (Hemiptera: Diaspididae) and the flat mite *Tenuipalpus pacificus* (Arachnida: Acari: Tenuipalpidae) on orchids. Florida Entomologist 93(1): 100-106.

Cockfield SD, Potter DA. 1986. Interaction of euonymus scale (Homoptera: Diaspididae) feeding damage and severe water stress on leaf abscission and growth of *Euonymus fortunei.* Oecologia 71(1): 41-46.

Coile NC, Garland MA. 2003. Notes on Florida's endangered and threatened plants. Florida Department of Agriculture and Consumer Services. Contribution No. 38, 4th edition.

Cullina W. 2004. Understanding Orchids: An Uncomplicated Guide to Growing the World's Most Exotic Plants. Houghton Mifflin Harcourt, Boston, Massachusetts, USA.

Daane KM, Sime KR, Fallon J, Cooper ML. 2007. Impacts of Argentine ants on mealybugs and their natural enemies in California's coastal vineyards. Ecological Entomology 32(6): 583-596.

Espinosa A, Bowman H, Hodges A, Hodges G. 2009. Boisduval scale, *Diaspis boisduvalii* Signoret (Insects: Hemiptera: Diaspididae). University of Florida IFAS Extension Document EENY-467 (IN838).

Johnson PJ. 2009 "Mealybugs on Orchids" https://www.aos.org/Default.aspx?id=511 (last accessed 12 May 2014).

Kosztarab M. 1990. Economic importance. pp. 307-311 *In* D. Rosen [ed], Armored Scale Insects, their Biology, Natural Enemies and Control. Elsevier, Amsterdam, The Netherlands.

McKenzie HL. 1960. Taxonomic study of California mealybugs with descriptions of new species. Hilgardia 29 (15): 681-770.

McKenzie HL. 1967. Mealybugs of California with Taxonomy, Biology, and Control of North American Species (Homoptera: Coccoidea: Pseudococcidae). University of California Press, Berkeley, California, USA.

Miller DR, Davidson JA. 2005. Armored Scale Insect Pests of Trees and Shrubs. Cornell University Press, Ithaca, New York, USA.

Miller DR, Miller GL, Hodges GS, Davidson JA. 2005. Introduced scale insects (Hemiptera: Coccoidea) of the United States and their impact on U.S. agriculture. Proceedings of the Entomological Society of Washington 107(1): 123-158.

Ray HA, McCormick JP, Stice AL, Stocks IC, Zettler LW. 2012. Occurrence of Boisduval scale, *Diaspis boisduvalii* (Hemiptera: Diaspididae), on native epiphytic orchids in Collier Co., Florida including Fakahatchee Strand State Preserve. Florida Entomologist 95(2): 312-318.

Wheeler WM. 1910. Ants: Their Structure, Development and Behavior. Columbia Biological Series, Number 9. Columbia University Press, New York, New York, USA.

Wood BW, Teders WL, Reilly CC. 1988. Sooty mold fungus on pecan foliage suppresses light penetration and net photosynthesis. HortScience 23(5): 851-853.

Zettler JA, Zettler LW, Richardson LW. 2012. Pestiferous scale insects on native orchids in South Florida: a new threat posed by introduced species. Southeastern Naturalist 11(1): 127-134.

Zettler LW, Zettler JA. 2013. Boisduval scale in the Fakahatchee: North America's orchid capital under siege. Orchids 82(1): 30-35.

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use