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Fortuitous Establishment of *Rhyzobius lophanthae* (Coleoptera: Coccinellidae) and *Aphytis lingnanensis* (Hymenoptera: Encyrtidae) in South Texas on the Cycad *Aulacaspis* Scale, *Aulacaspis yasumatsui* (Hemiptera: Diaspididae)

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The cycad aulacaspis scale, *Aulacaspis yasumatsui* Takagi, is currently found in China, Singapore, Hong Kong, Cayman Islands, Puerto Rico, U.S. Virgin Islands, Hawaii, and Florida (Germain and Hodges 2007). It was originally described from specimens collected on a *Cycas* sp., in Bangkok, Thailand, in 1972 (Takagi 1977). In recent years, finds have also been reported in California, Georgia, and Nevada (IUCN/SSC Cycad Specialist Group 2009). In 2006, severe outbreaks of cycad aulacaspis scale were reported in South Texas where sago palms, *Cycas revoluta* Thunb., adorn landscapes and are important ornamental plants for commercial nursery growers (Bográn et al. 2006). Of the more than 20 species of scale insects that occur on cycads in Florida, the most damaging species is cycad aulacaspis scale (Hodges et al. 2003).

In Thailand, this armored scale is considered a pest of cycads and is usually maintained in low densities by parasitoids (Tang et al. 1997). In 1998, two natural enemies of cycad aulacaspis scale, a predaceous beetle, *Cybocephalus nipponicus* Endroudy-Younga (misidentified as *Cybocephalus binotatus* Grouvelle - Smith and Cave 2006), and a parasitic wasp, *Coccobius fulvus* (Compere and Annecke), were released in Florida by the Tropical Research and Education Center, Homestead, FL. These natural enemies seem to control cycad aulacaspis scale effectively, but the scale undergoes outbreaks that are more severe when natural enemies are absent (Hodges et al. 2003).

The predator *Rhyzobius lophanthae* Blaisdell 1892 (Coleoptera: Coccinellidae) is a natural enemy of many species of diaspidid scale (Hodek 1973, Stathas 2000). Because of its prey specificity, high fecundity, adult longevity, absence of diapause, good mobility, rapid development (five to seven generations per year), and lack of parasitism, *R. lophanthae* is considered an important natural enemy of many species of armored scale (Smirnoff 1950, Rubstov 1952, Katsoyannos 1996). It is known for its effectiveness in integrated pest management of scale insects (Hodek 1973), via inundative releases (Katsoyannos 1996) and classical biological control programs in several countries including the USA (Yus 1973), Italy (Bouvier 1913, Smirnoff 1950), Argentina (Salvadores 1913), Bermuda (Bennet and Hughes 1959), Algeria, Tunisia, Morocco (Rungs 1950, Smirnoff 1950) and Georgia (Rubstov 1952). It is also reported from Greece, where it may have spread from neighboring countries (Argyriou and Katsoyannos 1977, Katsoyannos 1996). There are no records of this predator species being released in Texas. However, since October 2006, *R. lophanthae* has been found associated with

infestations of cycad aulacaspis scale in South Texas. On 9 July 2008, insects collected in South Texas were positively identified by Dr. Natalia J. Vandenberg (USDA / APHIS / PPQ / Systematic Entomology Laboratory, Beltsville, MD) as *Rhizobius lophanthae*. All developmental stages have been observed on sago palms, with larvae and adults being most prevalent. During visual inspections, adults were found feeding on cycad aulacaspis scale or *in copulo* on cycad foliage heavily infested by cycad aulacaspis scale. Adults were found on all parts of the plants; larvae were found mostly along the midrib (top and bottom) of the fronds. Few larvae were observed on the stem of the plants. Eggs were found mostly at the base of the frond where it meets the stem; a few times eggs were observed close to the midrib on the underside of a frond. Pupae were found along the bases of the fronds.

To determine the distribution and abundance of cycad aulacaspis scale in South Texas, Brownsville, Harlingen, McAllen, and the town of South Padre Island were surveyed between October 2006 and May 2009. Yellow sticky traps (6.4 x 7.6 cm) were placed on 10 mature sago palm trees (1 to 2 m in height) at each location and monitored monthly to determine the number of winged-males of cycad aulacaspis scale and seasonal variation between locations.

While monitoring populations of cycad aulacaspis scale in South Texas, large numbers of a parasitoid were observed on the yellow sticky traps at all locations. Infested fronds were collected and placed in plexi-glass emergence cages (40.6 x 45.7 x 61 cm). We found cycad aulacaspis scale being parasitized by a wasp identified by Dr. Gregory A. Evans (USDA / APHIS / PPQ / Systematic Entomology Laboratory, Beltsville, MD) as belonging to the *Aphytis lingnanensis* group. Interestingly, Woolley et al. (1994) reported *A. lingnanensis* attacking the California red scale, *Aonidiella aurantii* (Maskell) (Hemiptera: Diaspididae) in Texas. This is the first report of an *Aphytis* species attacking *A. yasumatsui*.

Several *Aphytis* species have been used successfully in biological control programs against armored scales (Rosen and DeBach 1990, Van Driesche and Bellows 1996). For several years, many scientists have searched for natural enemies of cycad aulacaspis scale, but to our knowledge an *Aphytis* species was not previously found. Species in the *A. lingnanensis* group are taxonomically similar and difficult to separate (G.A. Evans, personal communication). The insects in South Texas may be *A. lingnanensis* Compere, which attacks several species of scale and is widespread. DNA analysis may perhaps offer the best solution to identification of species.

Field data suggest that cycad aulacaspis scale populations are variable throughout the year and establishment and abundance of *A. lingnanensis* and *R. lophanthae* on cycad aulacaspis scale are contributing to this variability. These beneficial insects have not been released in South Texas and no one knows how they managed to colonize the area or if they changed hosts. However, we believe they fortuitously entered South Texas along with cycad aulacaspis scale on sago palms and proceeded to spread.

Since the initial discovery near Miami, cycad aulacaspis scale has become widely distributed in Florida (Hamon 2000). In 2006, cycad aulacaspis scale was detected in South Texas, making it a new state record and suggesting that it was an incipient infestation. Our data also indicate that *Aphytis lingnanensis* and *Rhizobius lophanthae* have become fortuitously established on cycad aulacaspis scale. Although abundance of cycad aulacaspis scale varies throughout the year, to date the scale has not reached problematic population levels in South Texas.

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