Biological Control of the Cycad Aulacaspis Scale, *Aulacaspis yasumatsui*

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4 Ecological impact of CAS - Moore

Ecological impact of CAS invasions is varies greatly with location, largely due to differences in characteristics of host plant host populations, climate, and presence of biological control agents.

When CAS arrived in Florida (1995) and Hawaii (1998), it became a pest of ornamental cycads which could be protected using a combination of pesticide applications and biological control. However, when CAS arrived in Guam (2003), it rapidly spread from ornamental cycads to the wild *Cycas micronesica* population, causing an uncontrolled island-wide outbreak. At that time, *C. micronesica* was the most abundant tree in Guam's forests Donnegon et al. 2004.

Cascading effects Haynes and T. E. Marler 2005

Effects on soil T. E. Marler and Calonje 2020

5 Natural enemies of CAS - Cave

6 Classical biological control

6.1 Florida - Cave

6.2 Hawaii - Wright

6.3 Guam - Moore

6.3.1 *Rhyzobius lophanthae*

About 100 adults of *Rhyzobius lophanthae* were field collected on Maui and imported to Guam during November 2004. This coccinelid was originally introduced to California from Australia in 1892 and to Hawaii from California in 1894. It was observed feeding voraciously on CAS shortly after arrival of this new pest in Hawaii. *R. lophanthae* was also previously introduced to Guam in 1925 and 1926, but there are no subsequent collection records prior to the recent importation.

The beetles from Maui were reared on scale-infested *C. micronesica* cuttings placed in a large screened camping tent set up in a laboratory. Adult offspring were collected for field release by aspirating them from the walls of the tent into plasic vials. Field releases were initiated on February 16 2005 at the Guam National Wildlife Refuge at Ritidian Point. The beetles established readily. By July 7 2005 high densities on adults were observed on cycads anywhere within a 1 lm radius of the release site. Establishment and dispersion of the beetles were monitored using yellow sticky traps deployed between June 2005 and May 2006. Unexpectedly, we were also able to monitor CAS crawlers and adult males using these traps (Fig. 1) (Moore 2017). Following establishment of *R. lophanthae* at Ritidian Point, laboratory-reared and field-collected beetles were released at about 30 other sites throughout Guam.

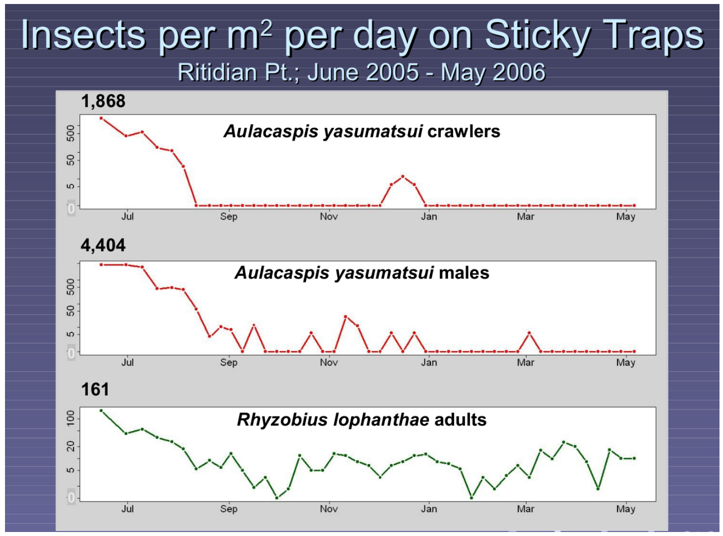

Figure 1: Caption goes here.

By about 2010, *R. lophanthae* larvae or adults could be found on almost every CAS-infested cycad on Guam, preventing CAS from killing mature cycads. By 2010, about 90% of wild cycads had been killed on Guam (REF). Unfortunately, the *C. micronesica* population is not recovering because almost all seeds and seedlings are being killed by CAS and other causes (REF). T. Marler, Miller, and Moore 2013 showed that *R. lophanthae* predation of CAS is significantly reduced close to the ground and suggest that this may account for failed biocontrol of CAS on seedlings. They also suggest:

> The causes of reduced scale predation by *R. lophanthae* near the ground are unknown, but a parasitoid biological control agent may not exhibit these same limitations. Furthermore, because a parasitoid would be much smaller than *R. lophanthae*, it would likely be better able to access scale infestations within cracks and crevices on *C. micronesica* and *C. revoluta* trees.

6.3.2 Other biological control agents

Ask Mark, Janis about Bernarr's report on fortuitous introduction of CAS parasitoids.

Ask Reddy about his report.

Ask Arnold Harra.

6.4 Elsewhere - Cave

7 Prospects for future action - Cave, Wright, and Moore

References

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Haynes, Jody and Thomas E. Marler (2005). *Exotic Invasive Pest Insect Critically Threatening Guam's Flora , Fauna and Island Ecosystem*. URL: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwibg5n2-vj0AhX5SGwGHbFJCL8QFnoECAUQAQ&url=http%3A%2F%2Fwww.montgomerybotanical.org%2Fmedia%2FCAS%2FHaynes-Marler-Guam-CAS-Overview.pdf&usg=AOvVaw1mtuqo4K8qYL0_hiJII35J.

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