



# CSG Invasive Pests Subgroup Activity Report – CYCAD 2008



## Subgroup Members

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## Introduction

The Invasive Pests Subgroup of the IUCN/SSC Cycad Specialist Group (CSG) was created in June 2005 to address the emerging threat to wild cycad populations from the artificial spread of insect pests and pathogens of cycads.

Over the past few years, an aggressive invasive pest of cycads, the cycad aulacaspis scale (CAS)—*Aulacaspis yasumatsui* Takagi (Hemiptera: Diaspididae)—has spread around the world as a result of human activity and commerce to the point where two species of cycads face imminent extinction in the wild. Given the conservation mission of the CSG, the focus of this subgroup as it relates to CAS will be on evaluating and mitigating its impact on wild cycad populations and cultivated cycad collections of conservation importance. The former is addressed here, while the latter is still in need of some work.

## Objectives

The initial objective of this subgroup, as outlined by the CSG Chair, was to gather facts and make recommendations to the CSG concerning CAS. A second and equally important objective is to monitor global discoveries/reports, status, and impacts of other invasive cycad pests.

## Cycad Aulacaspis Scale

### *CSG Report*

A report on CAS was submitted to the CSG Chair in September 2005 and was later updated in January 2006. The report was organized around the following specific tasks:

1. determine how to control current CAS outbreaks;
2. determine how to anticipate and, more importantly, stop the spread of CAS;
3. determine how to preserve the gene pool of species that are already affected or may become affected by CAS; and
4. undertake an analysis of the current distribution of CAS and identify high risk areas/species.

*Note:* The updated report is located on the CSG website at the following URL:

<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/CSG-Report-on-Cycad-Aulacaspis-Scale.pdf>

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### ***Pest Alerts***

Numerous pest alerts have been created and distributed for CAS. Below are just a few with either a state (within the U.S.), regional, national, or international scope; they are ordered chronologically.

- Originally created in August 2001, the CAS Pest Alert from the European & Mediterranean Plant Protection Organization (EPPO) was updated in March 2007.  
[http://www.eppo.org/QUARANTINE/Alert\\_List/insects/AULSYA.htm](http://www.eppo.org/QUARANTINE/Alert_List/insects/AULSYA.htm)
- Originally created in March 2003, the CAS Pest Alert from the Florida Department of Agriculture & Consumer Services (FDACS) Division of Plant Industry (DPI) was updated in April 2005.  
<http://www.doacs.state.fl.us/pi/enpp/ento/aulacaspis.html>
- A CAS Pest Alert was created for the CSG by William Tang and Jody Haynes in September 2005 and updated in January 2006. This alert was distributed worldwide via conservation organizations and governmental agencies, and it has been adopted by—and posted on the respective websites of—the University of Florida Department of Entomology, Nematology and Plant Pathology (September 2005) and the USDA Forest Service - Pacific Southwest Region (November 2006).  
<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/Cycad-Aulacaspis-Scale-Pest-Alert.pdf>
- In October 2005, the Nature Conservancy's (TNC) Global Invasive Species Team created a page for CAS on their Global Invasive Species Index website.  
<http://tncweeds.ucdavis.edu/products/gallery/aulya1.html>
- In February 2006, a CAS Regional Pest Alert was created by the U.S. Department of Agriculture (USDA) - Cooperative State Research, Education, and Extension Service (CSREES) Integrated Pest Management Centers, in cooperation with the National Plant Diagnostic Network and the USDA-Animal and Plant Health Inspection Service (APHIS).  
<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/USDA-IPM-Cycad-Scale-Pest-Alert.pdf>
- In May 2006, the Central Science Laboratory in York, UK, issued a pest alert on CAS for the UK Department for Environment, Food and Rural Affairs (DEFRA).  
<http://www.defra.gov.uk/planth/pestnote/2006/cycad.pdf>
- In September 2006, a CAS Pest Alert was issued by the Texas A&M University (TAMU) Cooperative Extension Service. [http://insects.tamu.edu/extension/publications/epubs/eee\\_00038.cfm](http://insects.tamu.edu/extension/publications/epubs/eee_00038.cfm)
- In October 2006, a CAS Pest Alert was issued by the University of Hawaii (UH) Cooperative Extension Service. <http://www.ctahr.hawaii.edu/oc/freepubs/pdf/IP-23.pdf>

### ***Quarantines & Restrictions***

- In October 2005, the Norway and New Zealand Ministries of Agriculture and Forestry (MAF) enacted rules to prohibit entry of all known hosts of CAS from Vietnam and Costa Rica because of their suspected presence in those countries.  
<http://www.inquit.com/StandardsDB/index.php?Ctry=Norway&-action=browse&-table=SPS&-cursor=9>  
<http://www.biosecurity.govt.nz/files/sps/transparency/notifications/nz1334-n.pdf>
- In September 2007, the Texas Department of Agriculture implemented a CAS quarantine for several Texas counties and for all plants of *Cycas*, *Dioon*, *Encephalartos*, *Macrozamia*, *Microcycas* and *Stangeria* coming into the state from Florida, Hawaii, or Puerto Rico.

<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/Texas-CAS-Quarantine-Sep07.pdf>

### ***Environmental Assessments & Pest Risk Analyses***

- In June 2002, an environmental assessment was conducted on CAS by the Center for Plant Health Science and Technology, National Biological Control Institute, Plant Protection and Quarantine, U.S. Department of Agriculture.  
<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/EA-for-Cycad-Scale-Final-13-JUN-02.pdf>
- In November 2007, the European and Mediterranean Plant Protection Organization (EPPO) created an expert working group to perform a pest risk analysis (PRA) for CAS. Thomas Marler (University of Guam) participated in this PRA. Unfortunately, at the time of writing this report (29 November 2007), a summary of the outcomes of the PRA was not yet available.

### ***Online Databases***

- In 2006, Jody Haynes began to assemble what is now the largest clearinghouse of CAS-related information in the world. This CAS Information Page is located on the CSG website and is updated regularly. <http://www.iucn.org/themes/ssc/sgs/csg/pages/CAS.htm>
- Also in 2006, Jody Haynes worked with the IUCN/SSC Invasive Pests Specialist Group on their CAS entry in the Global Invasive Species Database.  
<http://www.issg.org/database/species/ecology.asp?si=814&fr=1&sts=sss>

### ***Notable Publications***

A plethora of articles has been written on CAS. Below are a few of the most recent and notable.

- The Cycad Society published a special supplemental issue of the *Cycad Newsletter* on CAS in December 2005. The following articles, which are all available on the CSG website, comprised this special issue:
  - The lead article by Jody Haynes was entitled “Cycad aulacaspis scale – A global perspective.”  
<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/TCS-Haynes.pdf>
  - Irene Terry and Thomas Marler’s article was entitled “Paradise lost? Tipping the scales against Guam’s *Cycas micronesica*.”  
<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/TCS-Terry-Marler.pdf>
  - Ron Cave’s article was entitled “Biological control of *Aulacaspis yasumatsui*.”  
<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/TCS-Cave.pdf>
  - Aubrey Moore, Thomas Marler, Ross Miller and R. Muniappan’s article was entitled “Biological control of cycad aulacaspis scale on Guam.”  
<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/TCS-Moore-etal.pdf>
  - Greg Holzman’s article was entitled “CAS control procedure.”  
<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/TCS-Holzman.pdf>
- In 2006, Jody Haynes worked with the Global Invasive Species Programme (GISP) on an article for their newsletter, the *GISPnews*. The newsletter was given out at the CBD COP-8 meeting in Brazil.  
<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/GISP-CAS-Article-January-2006.pdf>

- Also in 2006, R. Muniappan and C.A. Viraktamath published an article entitled “The Asian cycad scale *Aulacaspis yasumatsui*, a threat to native cycads in India” in *Current Science* 91(7):868-70.  
<http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/Muniappan-Viraktamath-2006.pdf>

### **Workshops & Symposia**

In April 2006, Jody Haynes organized and chaired an invited 2-hour session on CAS at the 5th National Integrated Pest Management Symposium in St. Louis, MO, USA. The following speakers gave presentations during this session:

- Jody Haynes, (formerly) Montgomery Botanical Center – “Cycad Aulacaspis Scale: Invasive Pest with Extinction Potential!”
- Amanda Hodges, University of Florida Department of Entomology & Nematology – “Field & Taxonomic Identification of Cycad Aulacaspis Scale”
- Ron Cave, University of Florida Indian River Research & Education Center – “Natural Enemies of Cycad Aulacaspis Scale”
- Christine Wiese, (formerly) Montgomery Botanical Center – “Development of an IPM Solution for *Aulacaspis yasumatsui* & Its Impact on Future Scale Control”
- Joe Chamberlin, Valent USA – “Integration of Safari® & Distance® IGR into a Management Program for Cycad Aulacaspis Scale”

*Note:* These presentations are available on the CAS Information Page located at the following URL:  
<http://www.iucn.org/themes/ssc/sgs/csg/pages/CAS.htm>

### **Guam Update (*Cycas micronesica*)**

- *Cycas micronesica* was described in 1994 but was not classified for inclusion in the IUCN Red List at that time. This species was then accidentally omitted from the 2003 update of the Red List, where it should have been listed as Near Threatened (NT). Based on its likely narrow distribution and the recent and rapid rate of decline due to CAS, the CSG Chair issued a provisional assessment of Endangered (EN) for this species in November 2005.
- In April 2006, the IUCN Red List authority accepted the status of EN for *Cycas micronesica*. The change from NT to EN was prompted largely by the devastating effects of CAS in Guam. The complete assessment of EN A3ce was added to the 2006 Red List update on 4 May.  
<http://www.iucnredlist.org/search/details.php/61316/all>
- February 2007: CAS got to the urban landscapes of Guam in late 2003 and made it to *Cycas micronesica* habitat within a year. I had been studying this species for several years on a USDA grant, so we had a lot of pre-CAS data. We have been following the population response in one habitat where we had an accurate census. The population along this transect in northwest Guam has declined from 686 individuals in early 2004 (before CAS reached this habitat) to 87 individuals in January 2007. So the carnage is much worse than I had predicted.

Current mortality is not necessarily a direct result of CAS. We recorded the introduction of the cycad blue butterfly (*Chilades pandava*) to Guam in 2005, and it spread throughout the island within months. Moreover, several pre-existing arthropod pests that were causing minor damage to the *Cycas micronesica* plants have ramped up their damage now that the cycad population is in such poor health. Many of the deaths that are occurring today are a result of epidemic longhorn beetle (*Dihammus*

*marianarum*) stem damage. Moreover, we have an exotic snail (*Satsuma mercatorius*) that has begun feeding on young leaflets and is an emerging threat. This newly learned feeding behavior by an herbivore may be the result of the compromised ability of the unhealthy cycad plants to adequately synthesize the chemicals that deter herbivory.

We really need more funds to document these “cascading” events. Not only are previously existing pests that were not a threat causing cycad mortality now that CAS has done its thing, but the plants themselves are screwed up in behavior. We have a lot of phenology data prior to 2003, revealing things like the key months that the cycad population synchronizes reproductive events. Of the females currently coning, very few have ovules that are developing into viable seeds. I think this is because the population-level synchrony has been altered by the CAS infestations.

We are tackling this from many angles; here are just a few:

1. With U.S. Forest Service funds we are protecting plants in habitat using chemical stem injections.
  2. With emergency National Science Foundation (NSF) funds Dr. Irene Terry and I are continuing to study pollination biology in case of Guam’s population extinction.
  3. With a grant from the Mauget Company we are looking at a high pressure injection system for chemical protection. Mucilage exudation from *Cycas micronesica* stems is so strong that low pressure injection protocols are not working. I am partnering with Anders Lindstrom at the Nong Nooch Tropical Botanical Garden in Thailand and Jack Fisher at the Fairchild Tropical Botanic Garden in Miami, FL, USA, to determine if the high pressure injection systems will cause unacceptable stem damage. We begin that study at Nong Nooch in April 2007.
  4. With U.S. Navy funds we are setting up an *ex-situ* germplasm collection on the island of Tinian. The *Cycas micronesica* endemic range includes Tinian, but all of the plants there were killed during the Japanese occupation several decades ago. So this project will re-establish the species there, and if all the plants on Guam die we will be able to repatriate Guam from Tinian in the future.
- March 2007: CAS has now jumped to the island of Rota. Members of my lab team confirmed this for the first time while they were scouting for cones to include in our pollination biology work. This is not surprising, as there are several direct flights from Guam to Rota daily. The only remaining islands on which substantial *Cycas micronesica* populations occur are Yap and Palau. This discovery points to the probability that it is only a matter of time before CAS makes it to both of these islands as well. I spent the past week in a *Cycas* habitat in northern Bata'an Province in Luzon, Philippines. Most of the plants I surveyed had minor CAS infestation. So there are enough natural enemies in the Philippines to keep it under control.

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### ***Taiwan Update (Cycas taitungensis)***

- *Cycas taitungensis* was classified as Vulnerable (V) in the 1997 and 2004 versions of the IUCN Red List. Based on its narrow distribution and the recent and rapid rate of decline due to CAS, the CSG Chair issued a provisional assessment of Endangered (EN) for this species in February 2006. Unfortunately, due to a lack of response from personnel in Taiwan, the conservation status could not be officially revised by the IUCN Red List authority for the 2006 update.

- **November 2005:** The predatory beetle, *Cybocephalus nipponicus* (sometimes referred to as *C. binotatus*), was imported from Thailand to the quarantine facility at the National Pingtung University on 6 September 2003. It was field released on 15 October 2005 in Taitung and on 15 November 2005 at Pingtung and Taichung.
- **July 2007:** The biocontrol program using *Cybocephalus nipponicus* is progressing well. Establishment of this beetle has reduced the scale population considerably. Some of the cycads that were badly damaged have begun flushing. If those trees can escape attack by a lycaenid pest, the trees will show a robust growth, which is quite different from what it was before. In addition, we also found the local *Cybocephalus favocaputu* beetle becoming more abundant. It has certainly helped control the scale. We are currently studying the tripartite interaction among cycad, scale and *Cybocephalus* as well as the interaction among the two *Cybocephalus* and the lycaenid.

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### ***Funding Awards***

At the 2005 CSG meeting in Xalapa, Mexico, CAS was identified as a critical issue for cycad conservation worldwide and was given priority status. The CSG Chair wrote a letter and funding plea in July 2005 that was sent out to various potential funding sources (see <http://www.iucn.org/themes/ssc/sgs/csg/publications/CAS/CSG-CAS-funding-plea-2005.pdf>). Although much more funding will be needed to adequately determine the global impacts of CAS, a few notable grants have been awarded over the past few years. Below is a brief summary of just a few of them.

- In 2005, Ronald Cave (University of Florida-IFAS) received funds from the USDA-APHIS to conduct exploration in Asia and screen any new natural enemies discovered. Cave and his colleague, R. Nguyen, began their exploration for CAS biocontrol organisms in China and Vietnam in spring 2006.
- Following their September 2005 board meeting in Santa Barbara, CA, USA, the board of directors of the Cycad Society (TCS) voted to donate \$2,500 toward CAS biocontrol research. In the supplement to the September/December 2005 issue of the *Cycad Newsletter*—which is dedicated solely to CAS—TCS also announced the establishment of a new CAS Fund and solicited donations from its members.
- In October 2005, Thomas Marler received a grant from the U.S. Navy to develop an *ex-situ* population-based conservation germplasm collection of *Cycas micronesica* on the island of Tinian.
- In November 2005, the Association of Zoological Horticulture approved a grant to Thomas Marler and Jody Haynes to establish a backup *ex-situ* germplasm collection of *Cycas micronesica* at Montgomery Botanical Center in Miami, FL, USA.
- The “Guam Update” section above provides additional information on CAS grants to Marler.

### **Other Pests**

CAS is obviously not the only invasive pest that affects cycads. Below is a brief summary of reports on some of the more important species.

- In January 2006, William Tang and Rolf Oberprieler assembled a pest alert for five additional invasive insect pests of cycads that are of special concern worldwide.  
<http://www.iucn.org/themes/ssc/sgs/csg/publications/PEST-ALERT-Insect-Pests-of-Cycads.pdf>
- In June 2007, the University of Florida announced the discovery of the poliaspis cycad scale (PCS), *Poliaspis cycadis* Comstock (Hemiptera: Diaspididae), on a plant of *Dioon* sp. at the University of Florida's Tropical Research & Education Center in Homestead, FL, USA. A special page has been created for this pest on the CSG website (see <http://www.iucn.org/themes/ssc/sgs/csg/pages/PCS.htm>). Nothing is yet known of the potential effects of this pest, but early indications suggest that it is not nearly as aggressive as CAS.
- Also in June 2007, a pest alert for PCS was issued by the Florida Department of Agriculture and Consumer Services (DOACS) Division of Plant Industry (DPI).  
[http://www.doacs.state.fl.us/pi/enpp/ento/poliapsis\\_cycadis.html](http://www.doacs.state.fl.us/pi/enpp/ento/poliapsis_cycadis.html)

### **Next Steps**

The Invasive Pests Subgroup will continue to monitor the spread of CAS and other important invasive pests of cycads and their impacts on plants in habitat. The subgroup will also continue to monitor reports of new potentially invasive cycad pests around the world and will work with appropriate conservation groups and governmental agencies to formulate press releases, pest alerts, and action plans as needed.

An important next step with regard to CAS will be to develop an assessment tool and then use the tool to evaluate various cycad collections of conservation importance around the world that occur in CAS-infested areas in an effort to determine the conservation, scientific, and economic impacts that CAS has had on them.

### **Decisions Required by CSG**

No decisions are required by CSG at this time.