

Cactus Moth Update



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The latest on:

- The spread of cactus moth hosts
- The search for cactus moth
- Cactus moth online training
- Cactus Moth Detection and Monitoring Network
- Cactus moth genetics
- Other cactus moth research

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New Cactus Populations Mapped

By Victor Maddox
Geosystems Research Institute

New host populations were identified in November and December 2009 primarily in conjunction with USDA-APHIS collaboration efforts. Prickly-pear species included *Opuntia engelmannii* Salm-Dyck ex Engelm. and *O. stricta* (Haw.) Haw. Although only 34 positive host reports were entered into the CMDMN database between October and 11 December 2009, there were 786 negative host reports (Figure 1) entered during the same period and included many from the north-western United States (Figure 2). More data continues to be entered and will eventually include western Oregon, northern California (Figure 1), and northern Nevada.

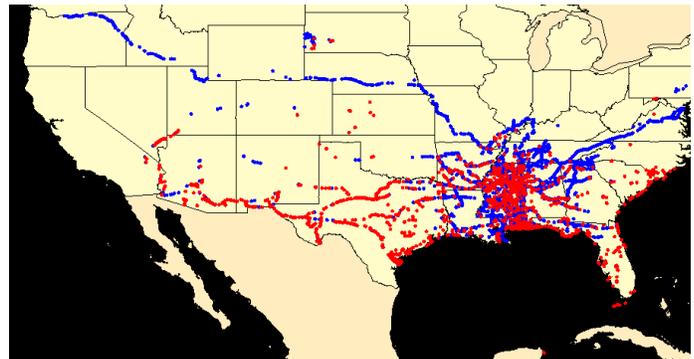


Fig. 2. Cactus Moth Detection and Monitoring Network (CMDMN) database map showing locations with (red) and without (blue) prickly pear cactus, the host of the cactus moth, as of 14 December 2009.

Surveys continue in southern Louisiana for host populations and new data is expected from volunteers in Arizona and Louisiana. This host data will also be entered into the Cactus

Moth Detection and Monitoring Network database.

Fig. 1. Negative data is collected and entered into the Cactus Moth Detection and Monitoring Network (CMDMN) to assist with host modeling efforts. This data may also help prevent duplicate survey efforts in areas like the one pictured in Northern California (Image by Victor Maddox, MSU-GRI).



“New information that is available on-line for the first time includes taxonomic history, phylogenetics relationships and evolution of host preferences for all pyralid genera associated with cactus.”

“Dissection of Male Cactus Moth Genitalia” – A Training Video

By Richard L. Brown
Department of Entomology

The identification of the cactus moth can be dependent upon making dissections of the male genitalia for distinguishing this species from related cactus moths. Proper methods for making dissections are known to many Lepidoptera specialists, but these have not been made widely known to others who are involved in making diagnostic identifications. A new video has been produced that covers the tools and reagents needed for making dissections and the detailed methods for cleaning, staining, and slide mounting the abdomen



Figure 1. The first on-line video for demonstrating method for making genitalia dissections of moths.

and genitalia. This video is available on You-Tube with a

search for “cactus moth” and is also available on DVD.

New Web Page on the Cactus Moth and Their Relatives

By Richard L. Brown
Department of Entomology

A new web site on cactus moths in North and South America has been developed by Thomas Simonsen and Richard L. Brown, with various other authors contributing selected pages.

Taxonomic and identification information, morphology, life history, larval hosts, and images are provided for 18 of the 21 genera associated with cactus.

New information that is available on-line for the first time includes taxonomic history, phylogenetics relationships and evolution of host preferences for all pyralid genera associated with cactus.

In addition, images of comparative morphology of *Cactoblastis* and *Melitara*, a synthesis of new information on life history and known hosts of *Cactoblastis*, a

link to the dissection video on You-Tube, a complete bibliography for *Cactoblastis* (with pdfs for some publications), and a compiled and categorized list of links to other sites.

The site can be accessed at : <http://mississippientomologicalmuseum.org.msstate.edu/Researchtaxapages/CactusMoths/Introduction.html>

Figure 1. One of 45 pages on the Web page for cactus moth.

Cactus Moths and Their Relatives (Pyralidae: Phycitinae)
by Thomas J. Simonsen and Richard L. Brown

	List of Genera
Introduction	Cactus Feeders - <i>Opuntia</i>
Taxonomic History	<i>Cactoblastis</i>
Dissection	<i>Melitara</i>
Methodology	<i>Ozamia</i>
Identification Key to Genera	<i>Salambona</i>
Morphology	<i>Tucumanii</i>
Phylogenetic Relationships	Other Cactus Feeders - <i>Cylindropuntia</i> and other genera
Evolution of Host Preferences	<i>Aiberida</i>
List of Genera	<i>Amelafida</i>
References	<i>Cactoblastis</i>
Links	<i>Cahela</i>
Acknowledgments	<i>Echinocerata</i>
MEM Home	<i>Enemarga</i>
	<i>Nanaia</i>
	<i>Olyca</i>
	<i>Rumatha</i>
	<i>Sigelgalla</i>
	<i>Yosemita</i>
	Related Non-cactus Feeders
	<i>Baphala</i>
	<i>Leotilla</i>
	<i>Rhages</i>
	<i>Rastriolaetilla</i>
	<i>Zophodia</i>

Cactus Moth and Prickly Pear Cactus Models

By Gary Ervin
Geosystems Research Institute

Our proposed work for 2009-2010 encompasses three major areas of research – continued habitat modeling efforts based



Figure 1. Growth chamber experiment in APHIS-approved quarantine facility at Lyle Entomology Building, MSU.

on our large data set from the *C. cactorum* native range, continued genetic studies of *Opuntia* and cactophagous moths, and experimental studies of growth performance of *C. cactorum* and native US cactus moths on native southeastern US *Opuntia* species. The following is an update on progress towards our proposed deliverables for 2010.

A. Analyses of comparative growth chamber studies.

Growth chamber experiments are continuing, with both moth species (*C. cactorum* and *Melitara prodenialis*) nearing the ends of their life cycles. Preliminary analyses suggest differential performance of these

moths on the native Florida cacti (*O. humifusa* and *O. stricta*), and field studies conducted during 2009 demonstrated similar patterns of differential herbivory. These data are being used as the basis for an NSF grant proposal to be submitting in January 2010. That proposal aims to fund molecular genetic work to identify mechanisms of interaction between moths and host plants. The proposal submission will involve collaborative work with Dr. Travis Marsico of Arkansas State University; Marsico was a post-doc sponsored on this research.

B. Analyses of genetic data resulting from Argentina sampling trips.

We have submitted a manuscript based on genetic analyses of *C. cactorum* in its native range in Argentina, its invasive range in Florida, and for *Melitara prodenialis* across its native Floridian range. Those



Figure 2. Post-doc Travis Marsico “inoculating” cacti with neonate larvae for herbivory experiments. Dr. Marsico is now an Assistant Professor at Arkansas State University, in Jonesboro, AR.

results also will form the basis for continued collaborations with the USDA ARS scientists at Tifton and Buenos Aires, Argentina, as well as one or more subsequent journal manuscripts.

C. Calibration of environmental tolerance models for *Cactoblastis*, based on data collected in the two Argentina research trips.

We continue to integrate habitat modeling studies with results we have obtained to date from our genetic analyses (i.e., modeling habitat for specific genotypes). We have two manuscripts in development based on this habitat modeling work, and a third is in the planning stages. We also will be using these findings to help direct the collaborative work with USDA ARS scientists. Initial manuscript submission is targeted for January 2010; grant proposal submission is targeted for July 2010.

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Cactus Moth Detection and Monitoring Network Webpage Update

By Clifton Abbott
Geosystems Research Institute

Celebration time for the Cactus Moth Detection and Monitoring Network! Congratulations! The network has broken the 10,000 mark for pricklypear cactus reports while visual observation reports approach the 3,000 mark. The cactus reports are reporting negative reports as well as positive reports. Being able to say where the cacti are not is equally important for prediction models

to fine-tune their results. Volunteers are now monitoring 76 sentinel sites across the nation for the presence of the cactus moth.

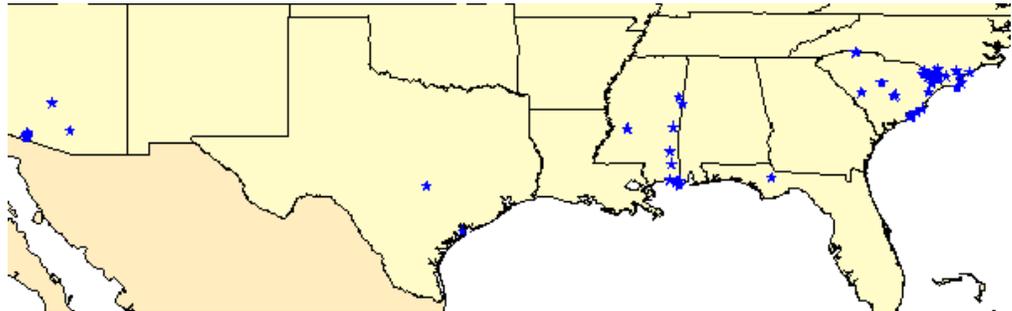
Recently, a problem has been detected with the process of requesting an account with the Cactus Moth Detection and Monitoring Network. This problem was detected with people from within the National Park Service network trying to request an account. It appears that the process is

being blocked from the NPS network. The problem is still being diagnosed, however, it appears to be limited to people from NPS.

Thank You to all of the volunteers who have worked to track the cactus moth and to limit the progression of the moth. If you would like to help with this effort, volunteer information can be found at http://www.gri.msstate.edu/cactus_moth.

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Fig. 1. Sentinel sites across the nation.



Cactus Moth Project Collaboration

Richard Brown and Thomas Simonsen, systematist at the Natural History Museum in London, have been cooperating during the past year to develop a web site for the cactus moth and all cactus feeding relatives. Dr. Simonsen worked with Dr. Brown at Mississippi State University during Dec. 6-10 to complete the web site.

Richard Brown and Sangmi Lee, Research Associate in the Mississippi Entomological Museum, collaborated on a comparative study of antennal sensilla of the cactus moth and the native *Melitara prodenialis* using the scanning electron microscope.

Richard Brown was an instructor in the Adult Lepidoptera Identification Training Work-

shop at University of California, Davis on March 24-26.

Richard Brown ran a Cactus Moth Identification Workshop at MSU on Aug. 18 to five USDA-APHIS personnel from AZ, CA, LA and TX. The workshop focused on identification methods using characteristics of the wings and body as well as genitalia. Participants took a test to qualify them to screen trap samples and identify cactus moths.

Richard Brown screened 548 pheromone traps from Alabama, Arizona, California, Louisiana, and Texas. Cactus moths were identified in traps from the Gulf Islands of Mississippi and in Terrebonne, Lafourche, and Jefferson Parishes, Louisi-

ana, the latter being significant range extensions.

Victor Maddox participated in a Cactus moth visual survey and eradication trip with USDA-APHIS on Mississippi barrier islands. 16-22 Nov. 2009.

Victor Maddox participated in the Cactus Moth Technical Working Group Meeting hosted by USDA, 1-3 Dec. 2009, in New Orleans, LA.

John Madsen presented to the Invasive Species Working Group, Update on the GRI Cactus Moth Detection Network. Invasive Species Working Group. Teleconference: National Biological Information Infrastructure, Invasive Species Information Node, April 2009.

Visual Surveys in Mississippi and Louisiana

By Victor Maddox
Geosystems Research Institute

During the week of November 16th, USDA-APHIS, USDA-ARS, and MSU-GRI conducted a cactus moth visual survey on Horn and Petit Bois Islands off the coast of Mississippi (Figure 1). Cactus moth was found on both islands, but the infestation did not appear to be heavy and most of the host populations were free of cactus moth. Another visual survey of the islands will be conducted in early 2010.

During the first week of December, USDA hosted a Cactus Moth Technical Working Group (TWG) meeting in New Orleans, Louisiana to address issues regarding the recent discovery of cactus moth in southern Louisiana and potential future strategies. The meeting was by invitation only, and attendees participating represented Barataria Terrebonne National Estuary Program, MSU-GRI, National Park Service (Arizona), SAGARPA



Figure 1. Cactus moth was identified and removed on eradication trips to Mississippi's Horn and Petit Bois Islands. Partial Horn Island survey team pictured while looking for cactus moth. Pictured are Randal St. Louis (Front)(USDA-APHIS), Maurice Duffel (Middle)(USDA-APHIS), and Victor Maddox (Back)(MSU-GRI) (Image by Kimberly Sargent, USDA-APHIS, Pensacola, FL).

(Mexico), Southeastern Louisiana University, Texas A&M University, The Nature Conservancy, USDA-APHIS, USDA-ARS, and USDA-PPQ. The first day included an on-site inspection of the infested area in the Louisiana marsh (Figure 2). The remainder of the meeting was a facilitated, roundtable meeting, where

after two intense days of discussion the group generated 5 strategic plans. Each plan represented a different level of activity intensity and addressed the positive and negative sides of each plan. These plans will be utilized by USDA for near-future decision-making in regard to cactus moth.

Figure 2. Technical Working Group inspecting *Opuntia engelmannii* Salm-Dyck ex Engelm. for cactus moth in southern Louisiana during a meeting in New Orleans to discuss potential USDA cactus moth strategic plans. MSU-GRI was one of several groups that participated at the meeting. Two of the three survey boats are pictured (Image by Victor Maddox, MSU-GRI).



**Cactus Moth
was found on
both Horn and
Petit Bois
Islands off the
coast of
Mississippi.**

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Publications October—December 2009

Publications

Simpson, A., Jarnevich, C., Madsen, J. D., Westbrooks, R., Fournier, C., Mehrhoff, L., Browne, M., Graham, J., & Sellers, E. (2009). Invasive species information networks: collaboration at multiple levels for prevention, early detection, and rapid response to invasive alien species. *Biodiversity*. 10(2), 5-13.

Publications accepted

Marsico, T.D., J.W. Burt, E.K. Espelend, G.W. Gilchrist, M.A. Jamieson, L. Lindström, G.K. Roderick, S. Swope, M. Szűcs, and N.D. Tsutsui. 2010. Underutilized resources for studying the evolution of invasive species during their introduction, establishment, and lag phases. *Evolutionary Applications*, In press.

Manuscripts submitted

Ervin, G. N. *In review*. Indian fig cactus (*Opuntia ficus-indica* (L.) Miller) in the Americas: An uncertain history. Submitted to *Ethnobotanical Research & Applications*.

Marsico, T. D., L. E. Wallace, G. N. Ervin, C. P. Brooks, J. E. McClure, and M. E. Welch. *In review*. Geographic patterns of genetic diversity reveal a ge-

netic bottleneck and multiple introductions for invasive populations of *Cactoblastis cactorum* (Berg). Submitted to *Biological Invasions*.

Presentations

Cannon, J. B., & Ervin, G. N. (2009). Soil texture effects on *Opuntia pusilla* morphology. Mississippi State University Undergraduate Research Symposium. Mississippi State University.

Madsen, J. D., Brown, R. L., Ervin, G. N., Maddox, V. L., & Abbott, C. F. (2009). Update on the GRI Cactus Moth Detection Network. Invasive Species Working Group. Teleconference: National Biological Information Infrastructure, Invasive Species Information Node.

Maddox, V. L., Abbott, C. F., Madsen, J. D., & Westbrooks, R. (2009). New Developments with the Cactus Moth (*Cactoblastis cactorum* Berg.) Detection and Monitoring Network Efforts. 36th Natural Areas Conference. Vancouver, WA..

Professional Presentations

Ervin, G. N., Marsico, T. D., & Brooks, C. P. (2009). Reassessing expectations for *Cactoblastis*

cactorum (Berg) spread in North America. Research Collaboration Workshop. USDA ARS Crop Protection and Management Research Laboratory, Tifton, GA.

Marsico, T. D., & Ervin, G. N. (2009). Chew 'em up and spit 'em out: Prickly pear defenses elicited from native but not invasive moths. Research Collaboration Workshop. USDA ARS Crop Protection and Management Research Laboratory, Tifton, GA.

Madsen, J. D., Brown, R. L., Ervin, G. N., Maddox, V. L., & Abbott, C. F. (2009). Update on the GRI Cactus Moth Detection Network. Invasive Species Working Group. Teleconference: National Biological Information Infrastructure, Invasive Species Information Node.

Awards

The 2008 Editor's Choice Award for the Outstanding Paper of the Year in the *Annals of the Entomological Society* was presented to Thomas Simonsen, Richard Brown, and Felix Sperling for the article "Tracing an Invasion: Phylogeography of *Cactoblastis cactorum* (Lepidoptera: Pyralidae) in the United States based on mitochondrial DNA.

www.gri.msstate.edu/cactus_moth