Don't Let Cacto Blast US !

A cooperative program to detect and contain of the South American Cactus moth, *Cactoblastis cactorum,* on the US Gulf Coast

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Cactoblastis cactorum larvae on outside of prickly pear cactus plant. Photos courtesy of Ignacio Baez

The South American cactus moth, *Cactoblastis cactorum,* proved to be a successful agent for the biological control of invasive prickly pear cactus, *Opuntia,* species in Australia in the 1920's and in other places where these cacti are not endemic. However, its introduction to the Caribbean in the 1950's and subsequent spread led to detection in the Florida Keys in 1989. This has been cause for concern by the research community, conservation groups, and the Mexican government. Since arriving in Florida, the cactus moth has moved along both coasts, with an increasing rate of approximately 100 miles per year along the Gulf Coast. It is now found on barrier islands in South Carolina and Alabama.

Since 2003, USDA, APHIS, Plant Protection and Quarantine (PPQ) has been cooperating with the Agriculture Research Service (ARS) to develop a strategic plan to improve detection methods and test the feasibility of using the sterile insect technique to establish a barrier along the US Gulf Coast to contain the cactus moth's spread westward. Beginning in 2006, Mexico's Secretería de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA), has matched funding for the research and control program in the United States.

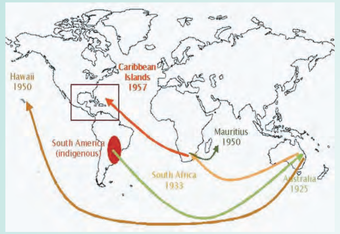
History of *Cactoblastis cactorum* Movement

A population of *Opuntia inermis* in Queensland, Australia prior to attack by *Cactoblastis cactorum.* Photograph taken in April, 1928.

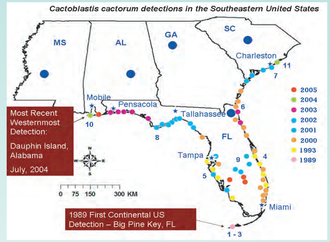
The same view 18 months after the introduction of *Cactoblastis cactorum.* Photo taken October, 1929.

C. cactorum's **origins are in South America (Argentina, Southern Brazil, Paraguay, and Uruguay). It as the most effective biological control agent tested in Australia in the 1920's to control several species of introduced prickly pear cactus.**

The success *C. cactorum* in Australia was renowned, influencing its use in other parts of the world, including South Africa in 1933, Hawaii in 1950, and the Caribbean island of Nevis in 1957. The insect now occurs throughout the Caribbean.

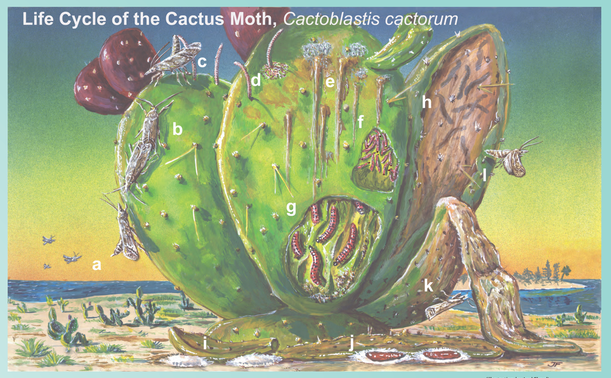


Spread of *C. cactorum* in the Continental US



C. cactorum **was first detected in the continental US in 1989 on Big Pine Key, Florida. Since that time, it has spread as far north as Bull Island, South Carolina by 2004 on the Atlantic Coast and as far west as Dauphin Island, Alabama on the Gulf Coast. The moth has not been detected inland except in peninsular Florida. At the 2004 rate of spread, 160 kilometers/year, *C. cactorum* was expected to reach Texas by 2007, barring artificial spread or long-distance dispersal by weather events. However, since 2004, it has not been detected west of Dauphin Island, Alabama.**

Life Cycle of the Cactus Moth, *Cactoblastis cactorum*



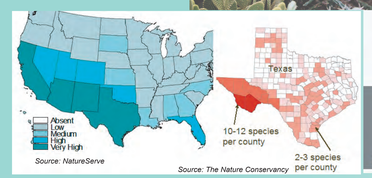
(illustration by Joel Floyd)

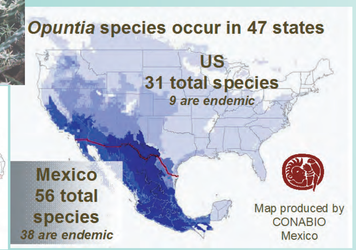
Life History

Before sunrise, the female moth begins to release sex pheromone signaling to males her readiness to mate. Males respond and (b) mating takes place for a short time.
(c) After an incubation period, the female deposits an egg stick averaging 70-90 eggs. Egg sticks, which resemble cactus spines, develop and d) hatch in 25- 30 days. Gregarious first instar larvae bore into the cactus pad. The external damage (e) is characterized by yellowing of plant tissue, with oozing of plant fluids and insect frass. (f) Shown here in cross-section, larvae feed, (g) develop internally, and eventually (h) hollow out the cactus pad. Mature larvae exit the cactus pad to (i) form cocoons and pupate (j) under debris on the ground at the base of the plant. After emergence (k), adult moths disperse (k) to new areas.

Hosts

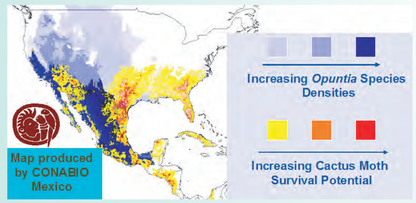
Opuntia species that are known hosts of *C. cactorum* include most prickly pear (Playyopuntia), however "cholla" *Opuntia* spp. (Cylindropuntia) are not preferred.





Prickly pear cacti occur in 47 states in the US and some species extend to Canada. The diversity of species increases westward and south to Mexico.

Survival Potential of *C. cactorum* in North America



A model that overlays *Opuntia* species densities over the survival potential of *C. cactorum* shows large areas on Texas, Arizona, and parts of Mexico as the most potentially impacted by C. cactorum if it became established there. The model needs further refinement.

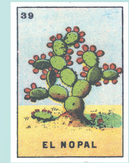
Potential US Impacts

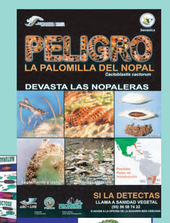
AGRICULTURE
- **Rangeland Grazing**
- **Nursery Plants and Landscaping**
- **Fruit and Pad Production**

CONSERVATION
- **Loss of Biodiversity**
  - **Species richness**
  - **Endangered Species impacted**
- **Habitat loss**
  - **Major plant component of desert ecosystems (Sonoran, Mojave, Chihuahuan)**
  - **Wildlife habitat**
- **Human impacts, values**
  - **Recreation, tourism**
  - **Hunting**
  - **Indigenous groups use for food, medicine**

Potential Impacts on Mexico

Fruit, pads (cladodes), and dye representing 2% of Mexico's total agricultural production
Cosmetics & other value added products
Forage
Biodiversity
Importance to subsistence farmers
Historical, cultural, and political significance





Establishing a National Detection Network

APHIS-PPQ, ARS, and US Geological Survey are working with Mississippi State University's Georesources Institute to set up a monitoring network for federal or state managed lands such as wildlife refuges, national parks and seashores, as well as lands managed by non-governmental organizations. These efforts will compliment state departments of agriculture surveys of nurseries and residential properties.

Partnerships between agencies for the detection network will be tied to the MSU Georesources Institute's database which will gather information on host plant distributions, which are not well known, and the results of monitoring sentinel plants managed land employees or volunteers.

Identification

The larvae of *C. cactorum* are very distinctive with black spots or bands on an orange to red body. However, native Lepidoptera (Pyralidae) species found on *Opuntia* are not well known, especially in the Western US. Adults are difficult to identify without dissection. Dr. Richard Brown, entomologist at MSU, is collaborating with Dr. Alma Solis, at the ARS Systematic Entomology Laboratory, to develop keys to the larvae likely encountered on Opuntia in the US.

Trap and Pheromone

A sex pheromone is being characterized by ARS laboratories in Florida, but is not yet fully defined for *C. cactorum.* An experimental lure is being used extensively by researchers and is quite effective at attracting males in the field.

Various trap designs tested show the pherocon 1C winged sticky trap to be most effective.

Control Strategy

Currently, the best hope for control of *C. cactorum* lies with the use of the sterile insect technique (SIT). There are effective insecticides if applied at the time when egg sticks or neonate larvae are present, but this method would only be appropriate in urban or agricultural situations. The candidate biological control agents that are known are not specific enough in their host preferences to be considered.

ARS and APHIS researchers in Florida and Georgia have made great strides in research since 2000 and the resulting technical developments make SIT a viable alternative for suppressing C. cactorum populations. The artificial diet developed is effecitve to make large scale artificial rearing possible and the irradiaion biology testing indicates that reared sterilized insects are as competitive as native moths.

Sterile Insect Technique Validation Study

Since 2005, ARS and APHIS, PPQ have conducted a large scale test at the leading edge of *C. cactorum*'s westward expansion on the US Gulf Coast.

Sterilized *C. cactorum* moths are released weekly by the tens of thousands in key areas on the islands. The concept of control is to overwhelm the native population with sterile individuals, thereby drastically reducing the probability of native female's mating with fertile, native males. The population is reduced with this technique in combination with removal of infected and uninfected host material from the area.

We are hopeful that SIT will help establish a suppression barrier at these islands, Santa Rosa Island of the Florida panhandle and on Dauphin Island, Alabama.

International Cooperation

Because of the importance of *Opuntia* to Mexico, their government's plant protection department (SAGARPA), and USDA are cooperating in funding research and control efforts for *C. cactorum* in the US, through the North American Plant Protection Organization (NAPPO). The International Atomic Energy Agency (IAEA), headquartered in Vienna Austria, has funded research and actively assisted in education efforts in both Mexico and the US.

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