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MITIGATING THE POTENTIAL IMPACTS AND THREATS OF THE CACTUS MOTH, *CACTOBLASTIS CACTORUM* (LEPIDOPTERA: PYRALIDAE), TO NATIVE AND CULTIVATED CACTUS IN THE CARIBBEAN AND MEXICO

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ABSTRACT: The cactus moth, *Cactoblastis cactorum* has become the textbook example of successful biological weed control of invasive *Opuntia* species in many countries, including some Caribbean islands. However it has now turned, and is now threatening not only the lucrative cactus pear industry in Mexico, but also the rich diversity of all *Opuntia* species in most of the North America mainland. The moth is now present on most Caribbean islands as a consequence of either deliberate or accidental introductions by man or by means of natural spread. Although there is convincing evidence that *Cactoblastis* reached Florida through the nursery trade, there also exists the possibility of natural spread by means of cyclonic weather patterns. The different pathways that could result in the arrival of the moth in Mexico are analyzed. With few exceptions, little is known of the impacts of the cactus moth on the native *Opuntia* species in the Caribbean. The main target species, namely *Opuntia triacantha* and *O. dillenii* have become very scarce and may now need protection status. The long-term impact on non-target species is unknown but some species may have been drastically affected. Recently regional and international efforts have been launched to prevent the further spread of *Cactoblastis* to the species rich native *Opuntiae* flora of the southern United States and of Mexico. These include an intensive monitoring program of resident populations at the leading edge near the Florida/Alabama borders and monitoring of large cultivated plantations in Mexico, which are focal points for possible early invasions. An awareness campaign that sensitizes farmers and government officials to the insect and its damage is aimed at interception and early detection to allow eradication in the event of establishment in Mexico. Research also is underway in Florida to develop an SIT (Sterile Insect Technique) program to halt the westward spread of the moth and to create a biological barrier. The involvement and co-operation of plant health and quarantine personnel in these Caribbean islands has become crucial in the campaign to keep *Cactoblastis* out of Mexico.

KEY WORDS: endangered species, awareness campaign, early detection, quarantine, eradication, trade, cyclonic weather patterns, pathways of invasion

RÉSUMÉ. Le papillon de nuit du cactus, *Cactoblastis cactorum* qui est devenu l'exemple du manuel scolaire de contrôle de la mauvaise herbe biologique d'espèce prospère *Opuntia* envahissante dans plusieurs pays, y compris dans quelques îles antillaises, a maintenant apparu, et n'est maintenant pas seulement une menace à l'industrie de la poire du cactus lucrative au Mexique, mais aussi à la diversité riche de toute l'espèce *Opuntia* dans la plupart des terres d'Amérique du nord. Le papillon de nuit est maintenant présent sur la plupart des îles antillaises par suite d'introductions soit délibérées soit accidentelles par homme ou par les moyens de distribution naturelle. Bien qu'il y ait l'évidence persuasive que *Cactoblastis* a atteint la Floride à

travers le commerce de la crèche, là aussi existe la possibilité d'étendue naturelle au moyen de modèles du temps cycloniques. Avec peu d'exceptions, on connaît très peu sur des impacts du papillon de nuit du cactus sur l'espèce *Opuntia* autochtone et cultivé dans les Caraïbes. Les efforts régionaux et internationaux ont été lancés récemment pour prévenir l'étendue supplémentaire de *Cactoblastis* aux diversités riches d'*Opuntia* autochtones du Mexique et de tous les états du sud des États-Unis. Ceux-ci incluent un programme d'écoute intensif de populations résidentes à la pointe près du Florida/Alabama encadre et diriger de grandes plantations cultivées au Mexique qui est des points focaux pour les premières invasions possibles. Une campagne de la conscience qui sensibilise des fermiers et des fonctionnaires du gouvernement sur l'insecte et ses dégâts est visée sur l'interception et la découverte à temps pour autoriser l'éradication dans l'événement d'établissement au Mexique. La recherche va bientôt être en chemin en Floride pour développer un TIS (Technique d'Insecte Stérile) pour faite arrêter l'étendue vers l'ouest, et avec optimisme, pour la pointe à l'est et pour limiter des populations dans la péninsule de la Floride. Cette étendue vers d'évaluer les risques et étudier les voies d'invasion de certaines îles antillaises vers les terres mexicaines. La participation et coopération du personnel phytosanitaire dans ces îles antillaises sont devenues cruciales dans la campagne pour laisser *Cactoblastis* hors du Mexique.

RESUMEN. La palomilla del nopal, *Cactoblastis cactorum*, que en cierto momento en los libros de texto se convirtió en el exitoso ejemplo de control biológico de maleza para combatir las especies de *Opuntia* invasoras en muchos países, incluyendo algunas islas del Caribe, en la actualidad se ha convertido en una amenaza no sólo para la lucrativa industria del nopal de México, sino también para la rica diversidad de especies de *Opuntia* en la mayor parte de Norte América. Actualmente, la palomilla está presente en la mayoría de las islas caribeñas como consecuencia tanto de la introducción accidental o deliberada por parte del hombre como por medios de propagación naturales. A pesar de que existe evidencia convincente de que el *Cactoblastis* llegó a la Florida como consecuencia del comercio de plantas de vivero, también existe la posibilidad de la propagación natural inducida por los eventos meteorológicos como los ciclones. Salvo algunas excepciones, se desconoce el daño que la palomilla del nopal causa en las especies de *Opuntia* nativas y cultivadas en el Caribe. Recientemente, se han iniciado acciones regionales e internacionales para prevenir la propagación del *Cactoblastis* hacia la rica diversidad de las *Opuntia* nativas de México y de los estados del sur de Estados Unidos. Estas acciones incluyen un programa de vigilancia intensiva y permanente de las poblaciones de *Opuntia* cercanas al límite que separa a los estados de Florida y Alabama donde se encuentra el *Cactoblastis*, así como la vigilancia de enormes plantaciones en México que son los puntos focalizados de una posible invasión. Una campaña para que los productores y las autoridades gubernamentales tomen conciencia de la gravedad del problema y sus consecuencias negativas con el objeto de interceptar y detectar tempranamente esta plaga de manera que sea posible su erradicación en caso de que llegue a México. En la Florida está en marcha una investigación para el desarrollo de la TIE (Técnica del Insecto Estéril) para detener la propagación del insecto hacia el oeste y, contenerla en la península de la Florida. Es igualmente importante evaluar los riesgos y estudiar las vías de invasión desde algunas islas caribeñas hacia el territorio mexicano. La participación y cooperación del personal fitosanitario de estas islas del Caribe han sido cruciales en la campaña para mantener al *Cactoblastis* fuera de México.

INTRODUCTION

The cactus moth, *Cactoblastis cactorum* (Berg) (Pyralidae) was effectively used as a biological control agent of invasive *Opuntia* species in Australia, South Africa and other countries worldwide (Moran and Zimmermann 1984). These successes were the main reasons that lead to subsequent introductions of the cactus moth to the Caribbean in 1957 for the biological control of native invasive *Opuntia* species in Nevis, Antigua, Montserrat and the Cayman Islands (Simmonds and Bennett 1966). These projects were highly successful and heavily invaded areas were converted to productive pastures.

Subsequently the cactus moth also was introduced to other islands, or it has spread naturally on its own (Zimmermann et al. 1999; Zimmermann et al. 2001). It is now widespread in the Caribbean and occurs also in Cuba, Haiti, Dominican Republic, Puerto Rico, Jamaica, Guadeloupe, Virgin Islands, Granada, Dominica and St. Kitts. The cactus moth is still present on all these islands that were originally targeted for biological control despite the fact that the target host weeds, *Opuntia dillenii* Haw and *O. triacantha* (Willdenow), have become scarce. *C. cactorum* also feeds on other non-target *Opuntia* species and on some related *Consolea* species and some of these are severely affected by the insect, e.g. *Consolea (Opuntia) rubescens* Lem., *C. (Opuntia) spinosissima* (Mill.) Lemaire, *O. taylori* Britton & Rose, *O. tuna* (Linnaeus) P. Miller, *O. jamaicensis* Britton and *O. sanguinea* Proctor. The cactus moth was first detected in Florida in 1989 (Habeck and Bennett 1990) and has since spread northward and north-westward, crossing the border to Alabama in 2005 (Bloem et al. 2005 (in press); Hight et al. 2002). All six native *Opuntia* spp. in Florida are attacked and the existence of at least one species has been compromised by the insect (Stiling 2002). The drastic impact of the insect on invasive and non-invasive *Opuntia* spp. is an indication of what can be expected should the insect reach Mexico. This is an account of the impact of *C. cactorum* on the *Opuntia* spp. in the Caribbean, its threat to Mexico and possible action needed to prevent its further spread.

The taxonomy of the genus *Opuntia* in the Caribbean is problematic. In this account the dominant species in the Caribbean, namely, *O. dillenii* is recognized as an independent species following the descriptions by Anderson (2001), Howard and Touw (1982) and Hunt (1999), and supported by own observations. Also, the genera *Consolea* and *Nopalea* are recognized. The former are a unique group of tree-like opuntiae endemic to mainly the Caribbean and Florida.

THE EFFECT OF *CACTOBLASTIS CACTORUM* ON *OPUNTIAE* IN THE CARIBBEAN

Cactus pear is not commercially cultivated in the Caribbean. The only species that is utilized to some extent is *Nopalea (Opuntia) cochenillifera* (L.) Salm-Dyck which is an exotic species of Central American origin. This species is widely grown as an ornamental in gardens throughout the Caribbean. Young leaf pads of this species also are used in various dishes in some islands e.g. Antigua. At least two *Opuntia* species have become problematic as invaders in many islands, namely *O. triacantha* and *O. dillenii*. Their sudden increase could be attributed to their wide use as live fences and for the protection of fortresses during early colonial times. This went on for many years and the rapid spread was compounded further by large scale deforestation and overgrazing (Howard and Touw 1982). Simmonds and Bennett (1966) described large scale invasions by these two species, impeding access and utilization of the land for grazing. The spines, which become embedded in the flesh causing festering, caused serious injuries to livestock. Also Bennett and Habeck (1995) mention serious invasions on St. Kitts, Nevis, Antigua and Montserrat. Blanco and Vazquez (2001) mention that in Santiago de Cuba and Guantanamo 31,240 ha were invaded of which 23,060 ha had a cover of 25% and 534 ha were fully covered by *O. dillenii*. The remaining species (less than 30) are less common or scarce, and

some are even endangered. The genera, *Consolea* and *Nopalea*, previously classified in the genus *Opuntia*, are unique to the Caribbean and each deserves a special status.

The impact of the cactus moth after 30 to 40 years in the Caribbean has never been determined. Only the initial result after its release on invasive *Opuntia* spp. was recorded as highly effective (Simmonds and Bennett 1966; Julien and Griffiths 1999), i.e., to the extent that the target species became scarce. This was confirmed during a survey by the authors in 2005. The outcome of the biological program on the islands targeted for control is still highly praised by all farmers and agricultural officers interviewed during this recent survey. Very few plants of the once abundant *O. triacantha* and *O. dillenii* remain on Grand Cayman, Montserrat, St. Kitts and Antigua, and despite these low numbers the cactus moth is still present. One reason is that it is able to develop on alternative as well as on less suitable hosts which include *N. cochenillifera*, *Consolea rubescens*, *C. spinosissima*, *O. tuna*, *O. jamaicensis*, *O. taylori* and *Cylindropuntia caribaea* and probably others. The large and leathery cladodes of *C. rubescens* and *C. spinosissima* are unsuitable for the development of young neonate larva but the small seedlings and young regrowth underneath the large trees are highly susceptible to larval attack. The recruitment of *C. rubescens* and *C. spinosissima* is thus drastically curtailed which must have severe implications for the long-term survival of these species. It is not known what the impact of the cactus moth is on the other tree-like species in the rare genus *Consolea*.

The long-term impact of *C. cactorum* on *O. stricta* (a closely related and similar species to *O. dillenii*) has been well documented in the Kruger National Park in South Africa (Hoffmann et al 1998). Large mature flowering and fruiting plants usually collapse and the scattered isolated cladodes root and form many small plants that need up to three or more years to flower. The cactus moth by continuous attacks usually prevents these plants from reaching the flowering stage. The same was observed in Florida and is probably also true for the Caribbean. This could have severe consequences for the long-term survival of *O. dillenii* and *O. triacantha* in the Caribbean.

Observations on the impact of the cactus moth in the Caribbean also indicate clear host preferences within the genera *Opuntia* and *Consolea* species and that not all species are suitable hosts. Infected cladodes of *N. cochenillifera* are common and approximately 20% of the plants examined in more than 17 islands were infested. This has little impact on the mature plants as it quickly outgrows the damage caused by the feeding larvae. *C. cactorum* is unable to feed on the woody stems and the damage remains confined to the succulent terminal cladodes. Indeed most people are unaware of the damage caused by *C. cactorum* on their garden plants.

The smaller *Opuntia* species are most severely affected, and these include *O. triacantha*, *O. repens* and *O. taylori* and possibly others. Further studies are needed to evaluate the risk of the cactus moth to the long-term survival of these species.

Some rare species are particularly threatened by *C. cactorum*. Anecdotal evidence describes the drastic decline of the rare *O. sanguinea* in Jamaica which was caused by the heavy feeding of an unknown insect, presumably *C. cactorum* (Oberli, pers. com.). Some species mentioned in the cactus literature have not recently been found and the cause of this could be either linked to *Cactoblastis* damage, by habitat destruction or to the taxonomic confusion within the *Opuntia* species complex in the Caribbean countries.

Much can be learned from the host-preferences and the impact of this insect on the native opuntiae in the Caribbean and this information can be extrapolated to give some idea on what to expect should it invade Mexico and the southern USA.

THE IMPORTANCE OF CACTUS PEAR TO MEXICO

The first awareness campaign informing the public on the risk of *C. cactorum* reaching Mexico was one of the subjects of a presentation "A New Insect Pest on Opuntiae Lying in Wait for Mexico" presented during the VIII National Congress and the VI International on knowledge and exploitation of prickly pear by the authors in September, 1999.

The highest diversity of species in the genus *Opuntia* is found in Mexico. In total 55 of the 83 *Opuntia* species recorded for Mexico, or 66%, are endemic. Many of these species are widely utilized by rural people and prickly pear cactus is deeply entrenched in the culture of the Mexican nation. Its national emblem, the flag, depicts an eagle perching on a cactus pear with a snake in its beak, based on a legend dating from the time when the ancient city of Tenochtitlan, now Mexico City, was founded. The site of the capital city's founding, which equates to the foundation of Mexican society, was marked by the first human sacrifice performed in the Valley of Mexico. The emblematic nopal germinated from the first heart torn from an enemy's breast, not that of an outsider, but Huitzilopochtli's own nephew. The divine sacrifice was sublimated in the form of this plant. In a carving of the Teocalli de la Guerra Sagrada, the monument commemorating the founding of Tenochtitlan, the nopal is seen sprouting from Cópil's heart turned to stone, which rises out of the lake. In its claw the eagle is clutching neither snake nor bird, but *nochtli* (tuna), and flowing from its beak *atlachinolli* (burnt water) -the name for war in its sacrificial dimension. The emblematic prickly-pear tree bore firm red fruits which were the hearts of the sacrificed victims. Fray Diego Duran called it the "tree of human hearts" (Dufétel 2002).

Cactus pear is widely used as a source for fodder, fruit, green vegetable and many byproducts are made from this valuable resource including shampoos, soaps, lotions, preserves and medicines. There are more than 20,500 growers that cultivate cactus pear in Mexico. Areas under cultivation include more than 150,000 ha for the exclusive use of cactus pear as fodder, 60,000 ha are cultivated for fruit production and about 10,500 ha are under intensive cultivation for the production of young leaf pads (nopalitos) for human consumption as a green vegetable. The wild growing prickly pears cover more than 3,000,000 ha and these are used mainly by the indigenous people in various ways. The spineless cactus pear, *O. ficus-indica* (L.) Miller, is the most common species cultivated in Mexico and this species has many cultivars, each one with unique characteristics. Prickly pear and its many products is very much part of the everyday diet of the Mexican people.

Of equal importance are the many native wild growing species that are crucial in maintaining ecological function in the various cactus-rich biomes of Mexico. There is no other country where cactus pear plays such an important role in the economy and in the culture of a nation. If the impact of the cactus moth on invading *Opuntia* species in other countries is a reliable indicator, then the effect in Mexico could be disastrous. Studies on climatic matching have indicated that *C. cactorum* is very likely to establish successfully in all cultivated and wild *Opuntia* populations in Mexico (Soberon et al. 2001).

POSSIBLE PATHWAYS OF INTRODUCTION OF *CACTOBLASTIS CACTORUM* INTO MEXICO

The possible pathways of invasion of *C. cactorum* from the Caribbean to Mexico could be the following:

- Natural dispersal and climatic events including tropical storms, trade winds and hurricanes.
- Trade and commerce.

- Tourism.
- Research.

Natural Dispersal. It has been suggested that climatic events and hurricanes could have played a role in the long-distance dispersal of the cactus moth to Florida and along the Florida coast (Johnson and Stiling 1998). Zimmermann et al. 2001 are of the opinion that the behaviour of the adult moth does not support such a theory and they placed more emphasis on long-term dispersal through human activities and interventions. *C. cactorum* has not been able to disperse naturally to some off-shore islands in the Caribbean, e.g. to Cayman Brac from Grand Cayman, which is part of the Cayman group of islands. The closest point from the Caribbean to Yucatan in Mexico is the Pinar del Rio region in Cuba. Fortunately *C. cactorum* is still absent from this region (Blanco et al 2004), and the likelihood of natural dispersal over the Yucatan channel remains, for the time being, small. A detailed study of the dispersal of the cactus moth throughout the Caribbean could reveal important information on the most likely pathway for introduction to Mexico.

Trade and Commerce as a Pathway. Pemberton (1995) provides evidence of 17 interceptions based on samples of cactus nursery plants infested with *Cactoblastis* to Miami that have originated from a nursery in the Dominican Republic between 1981 and 1993. Consignments destined for the United States for 1986 alone amounted to more than 350 000 plant specimens in 108 shipments. The chances for the moth to have reached Miami undetected during this period must have been high. A recent visit to this nursery in the Dominican Republic revealed three *Opuntia* species that are cultivated there for export, namely, *Opuntia pilifera* F.A.C.Weber, *O. leucotricha* DC and *N. cochenillifera*. *O. pilifera* plants were heavily infested with *Cactoblastis* larvae while the other two species were less affected. This nursery also exports cactus ornamentals to Europe. Specimens of *O. pilifera* were found in a nursery in Grand Cayman which originated from the nursery in the Dominican Republic via a wholesaler in Miami. Both the management of the nursery as well as the plant health inspectors in the Dominican Republic are now imposing strict screening procedures to prevent any further exportation of contaminated plants from this source.

Except for the above case, very few or no cactus nursery plants or plant products are exported from the Caribbean to the USA or Europe, and even less so to Mexico. The chances are very small that larvae or pupae of *C. cactorum* could reach *Cactoblastis*-free countries in containers or package material unless the containers have been in the close proximity of infested cactus plants. The almost total lack of trade with Mexico minimized the risk of introduction by means of this pathway.

Tourism as a Pathway. *Nopalea cochenillifera* is a popular garden plant with several uses and it is feasible that friends, family members and tourists could transport cladodes between countries. This is the likely pathway which contributed to the very wide distribution of this alien species in the Caribbean. There is, however, very limited tourism between Mexico and the Caribbean and the only direct flights between the Caribbean and Mexico are via Cuba. Effective inspection procedures in Cuba and in Mexico could reduce the risk of introduction of infested cladodes via this pathway to almost zero.

Research as a pathway. Research on the Cactaceae of Central America and the Caribbean will necessitate the exchange of plant material between countries. Botanical gardens usually have exchange programs in place and authorities issuing permits often rely on the scientific integrity of the researchers involved to prevent the introduction of unwanted plants, plant products or contaminants. Strict control by well trained plant health officers is nevertheless required to prevent any such unwanted introductions through the exchange of botanical specimens

earmarked for research because even scientists might be unaware of infested material and the threat of *Cactoblastis*.

The *Cactoblastis* populations in the Caribbean are considerably smaller compared to thirty years ago because of drastically diminishing host plants. This reduces the overall chances for dispersal by any means.

CONTROL METHODS

Several methods are being considered for the control of *C. cactorum* in Florida or in the event of its naturalization in Mexico. Considerable effort is focused on developing the Insect Sterile Technique (SIT) for the control or eradication of *Cactoblastis* (Carpenter et al. 2001). All requirements for the implementation of the SIT have been met and the testing of the synthetic pheromone is in its final stages (Bloem et al. 2003). An attempt will be made to establish an insect-free barrier along the leading edge of invasion at the border between Florida and Alabama. A memorandum of understanding between Mexico and the USA has been signed that would provide joint funding of over US \$1million for a broader bi-national implementation program to stop the spread of the insect in the USA.

Testing of new generation insecticides for the chemical control of the cactus moth also is in progress as a rapid response approach in the case of its detection in Mexico or elsewhere (Bloem et al. 2005 (in press)). Other control methods for the cactus moth in commercial cactus pear plantations in South Africa include orchard sanitation, as well as chemical and mechanical controls (Zimmermann et al 2004).

PREVENTION

Considerable funds have been allocated for a campaign to prevent the introduction of *C. cactorum* into Mexico. Emphasis is being placed on permanent monitoring and sampling procedures in cultivations that are most likely to receive the cactus moth in Mexico. More than 7,500 sample points have been monitored in Mexico covering more than 18,000 ha. Early detection is of crucial importance in preventing establishment of the moth beyond the point where eradication is possible. Effective sampling of *Cactoblastis* populations in Florida keeps track of the westward and northward spread of the insect. New legislation and regulations in Mexico and the USA have been promulgated that prohibit certain activities, e.g. the import or movement of cactus plant material from countries or states with *Cactoblastis* to yet unaffected areas.

AWARENESS AND TRAINING

Several workshops and meetings have been held to discuss strategies, research, prevention and control programs (Mahr et al. 2001). Special training programs are in place to educate plant health, quarantine and custom officials to identify *Cactoblastis* damage and to learn more about its biology. Mexican officials were trained in Florida and in South Africa on all aspects pertaining to the biology, identification and control of the insect.

Many pamphlets, brochures, posters, and books have been published and many radio interviews and programs on the subject have been broadcast as part of the general awareness campaign, mainly in Mexico. A comprehensive review on *C. cactorum* was recently published by the IAEA and FAO (Zimmermann et al. 2004). Awareness programs aimed at children have been introduced at school level and more than 20 newspaper articles on the threat of *Cactoblastis* to Mexico have been published in local newspapers since 2003. There are several websites where

up-to-date information on the latest developments regarding the spread of *Cactoblastis* and research progress can be found, e.g. in www.cactoblastis.org and www.aphis.usda.gov/ppq/ep/emerging_pests/cactoblastis/whitepaper.pdf

RESEARCH

Building on an ongoing USDA program on SIT for lepidopterans and specifically on a SIT project on *Cactoblastis* initiated in 2000 by Carpenter et al. (2001), the International Atomic Energy Agency (IAEA) instituted a research program on *Cactoblastis* in 2002 which involved the first studies on evaluating the SIT as a possible control method against this species, and which included mass-rearing methods, radiation levels and trapping methods (Bloem et al 2005; Bloem et al 2003; Carpenter et al 2001; Hight et al 2005).

Further funding was directed at identifying new insecticides for control and research on *Cactoblastis* in its natural habitat in Argentina. Considerable funds have recently been released for a joint Mexico/USA initiative aimed primarily in perfecting the SIT control method.

The Caribbean countries can provide valuable information on long-term impact studies of *Cactoblastis* on *Opuntia* populations, on observations regarding the dispersal of the insect, and host preferences within the more than 30 *Opuntia* spp. native to this region. Research on the biology and host-preferences of key natural enemies in Argentina also is underway.

Several Caribbean countries with a rich and endangered *Opuntia* flora may wish to control *C. cactorum* to reduce the threat to rare and endangered species. In this context Jamaica and Puerto Rico may qualify for control programs against *Cactoblastis* which may include biological control. Although this option is not favored for use in the USA because of possible non-target effects of introduced parasitoids, this may not apply to Caribbean islands which have a depauperate cactophagous Lepidopteran fauna, and any potential non-target effects are unlikely to have any effect on the environment. There are promising and relatively host-specific parasitoids available from Argentina (Pemberton and Cordo 2001). Research in biological control in the Caribbean may provide important information on the feasibility of using this method on the American mainland. The risk of possible non-target effects must be weighed against the risk of *Cactoblastis* damage.

CONCLUSIONS

Preventing the introduction or further spread of the cactus moth, *C. cactorum*, into Mexico and the USA is a joint effort of all the countries affected or threatened by the insect. Caribbean countries can provide much needed information that could assist Mexico in its efforts to prevent the introduction of *C. cactorum*. For example, the SIT can be best evaluated in small islands with a known *Cactoblastis* population. Information on the dispersal within the Caribbean and host-preferences of the cactus moth may indicate the chances of natural vs. deliberate introductions and on the expected impact on the native *Opuntia* populations in Mexico and the USA. Also, the potential of classical biological control of *Cactoblastis* can best be tested on some Caribbean islands whose governments desire to have their *Cactoblastis* populations controlled or even eradicated. Any quantitative data on the abundance of existing natural populations of *Cactoblastis* near Pina del Rio in Cuba can be used to calculate the risks of natural dispersal to the Yucatan region. Information on *Cactoblastis* impacts obtained elsewhere can also be used to predict the survival of some *Opuntia* spp. in the Caribbean that are most affected by the moth. The status of these scarce and threatened species also need to be evaluated as it may even become necessary to introduce special efforts to prevent the extinction of some of these species. Recent observations from the Caribbean indicate that the impact of the cactus

moth on cultivated and native *Opuntia* spp. in Mexico, and on the cactus-rich biomes of the southern USA could be severe.

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