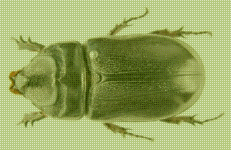
Early Detection Pest Risk Assessment

Coconut Rhinoceros Beetle



R5-FHP-2008-01
March 2008

INTRODUCTION

Coconut rhinoceros beetle (CRB, Coleoptera: Scarabaeidae), *Oryctes rhinoceros*, was detected on Guam on September 12, 2007. CRB is native to Southern Asia and now occurs throughout much of Asia and the Western Pacific. It was accidentally introduced and is now established on the Pacific Islands of Palau, Fiji and Samoa. It is a serious pest of coconut palm *Cocos nucifera*, betelnut *Areca catechu*, and *Pandanus* species. It is also known to attack banana, taro, pineapple and sugar cane.

Adult coconut rhinoceros beetle. Source: wiki page; see Moore 2007.

On Guam, adult beetles and larvae were initially collected from the Tumon Bay area; however, injured palms were found both at Tumon Bay (960 acres) and Faifai beach (15 acres). Detection and monitoring (see map, pg. 6) via ground surveys and attractive traps continue and the current eradication zone encompasses 1,360 acres. The quarantined area is much larger; Guam Department of Agriculture (GDA) initially quarantined an area of about 2,500 acres, but this has now been expanded to 5,830 acres, as CRB have been detected over a broader area.

Deformed palm fronds caused by adult CRB tunneling. Source: Ben Quichocho.

Adults are the injurious stage of the insect. They are generally night-time fliers and when they alight on a host, they chew down into the folded, emerging fronds of coconut palms to feed on sap. V-shaped cuts in the fronds and holes through the midrib are visible when the leaves grow out and unfold. If the growing tip is injured, the palm may be killed or severe loss of leaf tissue may cause decreased nut set. Feeding wounds may also serve as an infection pathway for pathogens or other pests. The effects of adult boring may be more severe on younger palms where spears are narrower. Mortality of young palms has already been observed on Guam. Oviposition and larval development typically occurs in decaying coconut logs or stumps.

Control measures have been developed for CRB and the current strategy on Guam is to implement an integrated eradication program using pheromone-baited, attractive traps to capture adults, various methods to eliminate infested and susceptible host material, and pesticides to kill larvae and adults. Pesticides may also be applied to uninfested trees as a preventive treatment. USDA-APHIS has completed an Environmental Assessment for the coconut rhinoceros beetle eradication program on Guam (EA Number: GU-08-1, http://www.guaminsects.net/uogces/kbwiki/images/d/dc/CRB_EA.pdf). The eradication program is a cooperative effort between USDA (APHIS and Forest Service), GDA and the University of Guam (UOG). This document follows the Forest Service Pest Risk Assessment (Kliejunas et al. 2001)

format and is intended to provide information regarding the current status of CRB on Guam, its potential to spread to uninfested locales, and the consequences of establishment. The high, moderate or low risk values are based on available biological information and the subjective judgment of the authors.

PEST ASSESSMENT OF THE COCONUT RHINOCEROS BEETLE

1. Probability of pest establishment: Breeding populations have been confirmed on Guam.

2. Spread potential: HIGH (reasonably certain)

If the eradication project is not successful, or is delayed in implementation, adult beetles will be numerous and the risk of accidental transport to other islands in Micronesia, Hawaii and beyond will be high. The most likely method of introduction onto Guam was by adult beetle(s) hitchhiking with construction material imported from Asia. Based on beetle distribution and numbers found, we estimate that it was present on Guam one to two years (three to six generations) before detection. It is interesting to note that a single CRB was caught in a seaport warehouse on Saipan, 150 miles to the north of Guam, in September 2006. We do not have any records of previous detections of this species in the Mariana Islands.

The biotic potential for the CRB is very high. Given that females lay an average of 90 eggs, CRB generation time is 4 months, and a one to one sex ratio, Gressitt (1953) estimated that a single gravid female could theoretically produce a progeny, assuming no mortality, of 16,995,293,890 by the end of two years. Typhoons have produced an abundance of dead coconut material suitable for breeding sites and larval food. Coconut palms killed by adult feeding will add to the supply of larval food, further facilitating population growth. In addition, CRB seems to be free of control by natural enemies on Guam. To date, no signs of predation, parasitism, or disease have been observed. Note that most vertebrate insectivores on Guam have been extirpated by the brown treesnake.

3. Consequences of pest establishment:

Economic Damage Potential: **HIGH (reasonably certain)**

CRB killed over 50% of the coconut palms on Palau after it was introduced in 1942 (Gressitt 1953). In 1968, CRB caused over one million dollars in damage to palms in South Pacific countries (Bedford 1980). The damage and losses to resort, park, and residential shade and ornamental plants on Guam will affect the esthetic appeal of important properties and tourist areas. Some losses in recreational use and revenue due to diminished scenic appeal are likely. Costs associated with hazard tree removal, tree replacement, and regulatory actions are expected to increase. Current cost of replacing a mature ornamental palm on Guam is $1,000. If CRB spreads to areas with palm plantations, great economic losses are anticipated. A permanent infestation could lead to additional interstate and international quarantine restrictions, affecting Guam, its trade partners, and other states in the U.S.

Coconut is an important economic and subsistence crop in many small Pacific island states. The livelihoods of rural people depend on this crop for food, shelter and for making value-added products such as coconut jewelry. Coconuts are exported green or brown, as desiccated coconut, as coconut oil or coconut cream, and are used in many Pacific culinary foods. For many Pacific island states, copra, the dry meat or kernel of the coconut, and its byproducts, are the only important exports. Copra is the main agriculture crop on the Marshall Islands.

***Environmental Damage Potential*: HIGH (reasonably certain)**

CRB outbreaks can expand and become self-perpetuating if attacks by the adult beetles become frequent enough to kill mature palms. Guam has more than 13 million coconut palms in its forests (Donnegan et al. 2004). Currently, the infestation is only impacting about 15 acres of native forest at Faifai Beach, however, based on CRB's invasiveness, injury to native host plants is expected to be substantial if populations are left untended. Movement of wood, debris, or infested host plants from the present quarantine area is likely to increase the rate of spread into native forests. The consequent changes in composition and age structure of palm forests could have long-term ecological effects for Guam.

Mortally wounded 4-5 year old palm. Injury caused by CRB. Source: A. Moore.

***Perceived Damage Potential*: HIGH (reasonably certain)**

An extremely high level of injury and mortality of cultivated and wild palms is anticipated. Cultivated trees are highly visible and their injury or mortality will be noticed, and may affect tourism, a major contributor to Guam's economy. Removal activities will be required in many locations. In addition, palms injured by adult feeding will add to the amount of host material for other life stages, compounding the problem. CRB invasion of native forests may be less noticeable but cause more harm to the ecology of Guam. invades the native forests, palm injury and mortality may largely go unnoticed by the general public. It is unknown whether trade will be affected; this will depend upon regulatory responses. However, it is very likely that trade with unifested zones will be regulated. The insect poses no direct threat to human health and is unlikely to cause public concern as a nuisance. An increase in hazard trees, however, is expected.

Injury caused by CRB. Source: Ernie Nelson.

4. Pest Risk Potential: HIGH

Effects of CRB on palms are likely to be severe; however, there may be some differences in host preferences, and mortality and injury levels between ornamental and native palms. Vertebrate insectivores and other natural enemies are not expected to control CRB populations in the foreseeable future. As CRB populations increase, the risk of accidental transport to other islands in Micronesia, Hawaii and beyond will be high. There is evidence that Guam and other Micronesian islands have been the source of several major insect pests introduced into Hawaii. If CRB escapes Guam, its impacts will be variable; primarily dependent upon the amount of host material available for reproductive sites and feeding, and the value of the palms.

CRB bucket traps developed by UOG. Source: wiki page; see Moore 2007.

5. Management Options

Regulatory control

Guam Department of Agriculture established a quarantine on October 5, 2007, through a "Declaration of Quarantine". Movement of all host material from within the quarantine area is prohibited except under a limited permit issued by GDA. Existing quarantine regulations are considered sufficient with regard to interstate movement (Berringer 2007).

Delimitation and mass trapping

Delimitation traps are being used to determine the boundaries of the current CRB infestation. Delimitation trap density is about 1 trap per 1,340 acres with traps located along roadsides throughout Guam. Mass trapping, at a density of 1 trap per acre, is aimed at reducing or eliminating adult beetles. Over 1,200 traps have been deployed to date, with a goal of ~ 1,500. Currently available traps are not as attractive as natural hosts; methods to improve lure/trap efficacy are being examined.

Reconnaissance surveys and use of sentinel logs

Reconnaissance surveys to visually identify locations with feeding injury or grubs are used to supplement information obtained through trapping. In addition, sentinel logs may be strategically placed to monitor and capture CRB. If treated with insecticides, these logs can become part of an "attract and kill" system.

Sanitation

Sanitation targets the elimination of oviposition sites and larval food. CRB has established most successful where coconut logs or other larval feeding sites are numerous. It is estimated that about 10% of Guam's coconut palms are already damaged from other pests or typhoons; these plants are obvious host material for expanding populations of CRB. Sanitation is a slow methodical process and can be hampered by access, availability of effective treatment methods, and the ability to detect CRB-infested material. Efforts to improve sanitation techniques, reduce exposure of applicators to pesticides, and improve CRB detection (acoustic technology) are underway.

Individual tree protection

Injection of systemic insecticides is being evaluated for effectiveness in protecting high value palms, such as those in hotel landscapes. A disadvantage of this method is that as monocots, palms undergo no diametrical stem growth, thus do not heal holes drilled in the trunk (Howard, 2001). Soil/root drenches may be less damaging. Insecticide applications on high value tree boles may be an additional strategy to protect trees.

Additional control options

In many countries, the fungus *Metarhizium anisopliae* and the *Oryctes* virus are used to control CRB. Both of these are being investigated to determine their availability and feasibility on Guam.

6. Recommendations

- Support and implement the CRB integrated eradication program.
- Apprise cooperators of future CRB eradication needs on Guam for out-year budget planning
- Continue to communicate with nursery personnel, arborists, urban foresters, homeowners, land managers, etc., to increase awareness of CRB, inform of potential pathways to prevent further spread and provide training on how to recognize the signs and symptoms of CRB.
- Increase monitoring of CRB on uninfested islands that have host habitat and are likely receptors in the event of beetles being accidentally transported from Guam.
- Develop additional tools to supplement eradication efforts.
- Sufficiently monitor preventive pesticide treatments so that data can be used to determine their effective duration and assess efficacy against CRB.

7. Author Contact Information

Sheri L. Smith
Regional Entomologist
USDA Forest Service
Forest Health Protection
2550 Riverside Drive
Susanville, CA 96130
(530) 252-6667
ssmith@fs.fed.us

Dr. Aubrey Moore
Entomologist
College of Natural Resources and Applied Sciences
University of Guam
303 University Drive
Mangilao, Guam 96923
(671) 735-2086
amoore@guam.uog.edu

References:

Bedford, G.O. 1980. Biology, ecology, and control of palm rhinoceros beetles. Ann. Rev. Entomol. 25: 309-339.

Berringer, Dallas. 2007. Coconut rhinoceros beetle eradication program. Environmental Assessment. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Tamuning, Guam. 23 p.

Berringer, Dallas. 2008. Guam coconut rhinoceros beetle incident situation reports.

Donnegan, Joseph A.; Butler, Sarah L.; Grabowiecki, Walter; Hiserote, Bruce A.; Limtiaco, David. 2004. Guam's forest resources, 2002. Resour. Bull. PNW-RB-243. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 32 p.

Gressitt, J. L. 1953. The coconut rhinoceros beetle (*Oryctes rhinoceros*) with particular reference to the Palau Islands. Bulletin 212, Bernice P. Bishop Museum.

Howard, F. 2001. Insect pests of palms and their control. http://www.rsc.org/ej/PO/2001/b110547g.pdf

Kliejunas, J.T.; Tkacz, B.M.; Burdsall, H.H.; DeNitto, G.A.; Eglitis, A.; Haugen, D.A. and W.E. Wallner. 2001. Pest risk assessment of the importation into the United States of unprocessed Eucalyptus logs and chips from South America. Gen. Tech. Rep. FPL-GTR-124. Madison, WI. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 134 p.

Moore, Aubrey. 2007. Assessment of the rhinoceros beetle infestation on Guam. Document available at http://guaminsects.net/uogces/kbwiki/index.php?title=Oryctes_rhinoceros.