United States Department of Agriculture

Marketing and Regulatory Programs

Animal and Plant Health Inspection Service

Coconut Rhinoceros Beetle Eradication Program on Guam

Environmental Assessment December 2011

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I. Introduction

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) is proposing to expand an integrated program to eradicate the coconut rhinoceros beetle (CRB), *Oryctes rhinoceros,* from Guam. APHIS has the responsibility for taking actions to exclude, eradicate, and/or control plant pests under the Plant Protection Act of 2000 (7 United States Code (U.S.C.) 7701 et seq.). This action is necessary to prevent further spread of CRB on Guam and eradicate CRB from the area.

As a Federal Government agency subject to compliance with the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321 et seq.), this environmental assessment (EA) has been prepared consistent with NEPA regulations promulgated by the Council on Environmental Quality (40 Code of Federal Regulations (CFR) parts 1500-1508), USDA (7 CFR part 1b), and APHIS' NEPA implementing procedures (7 CFR part 372) for the purpose of evaluating how the proposed action, if implemented, may affect the quality of the human environment.

APHIS has prepared a previous EA that is relevant to this current EA: Coconut Rhinoceros Beetle Eradication Program, Guam (USDA, APHIS, 2007), and is incorporated by reference into this document. This EA analyzed the use of an integrated eradication program using pheromone-baited traps to capture adults, various sanitation methods to eliminate infested and susceptible host material, and insecticides to kill larvae and adults in the Tumon Bay and Faifai Beach area of Guam.

A. Coconut Rhinoceros Beetle

CRB is one of the most damaging insects to coconut palms (*Cocos nucifera*). Although primarily found attacking coconut and oil palm, CRB has also occasionally been recorded on banana, sugarcane, papaya, sisal and pineapple (CPC, 2011). In Mauritius, the royal palm (*Roystonea regia*), the latanier palm (*Livistona chinensis*), the talipot palm (*Corypha umbraculifera*), and the raphia palm (*Raphia ruffia*) are attacked (Bedford, 1980).

1. Biology

CRB is a large (30-35 mm long and 14-21 mm breadth), black or reddish black beetle. It is stout and possesses a horn on its head which is larger in males.

Adult females lay 3 or 4 clutches of eggs that contain approximately 30 eggs per clutch, in logs or other concentrations of organic material such as rotting stumps and rubbish piles, over a period of 9 to 12 weeks (Hinckley, 1973). Eggs hatch in 8 to 12 days into whitish grubs (Bedford, 1980). Larvae may develop in the tops of dead standing coconut palms that have been killed by adult beetle attacks or lightning strike or other causes (Bedford, 1980). Coconut stumps and logs on the ground are also important breeding sites (Bedford, 1980). There are four larval stages lasting 12 to 165 days, and a pupal period lasting three to four months. Adults fly at night and bore down into the folded, emerging fronds, the adult can damage spadices and leaflets, resulting in loss in coconut production (Hinckley, 1973).

2. Damage

Adults are the injurious stage of the insect. CRB adults damage palms by boring into the center of the crown, where they injure the young, growing tissues and feed on the exuded sap. As they bore into the crown, they cut through the developing leaves. When the leaves grow out and unfold, the damage appears as V-shaped cuts in the fronds or holes through the midrib. If the growing tip is injured severe loss of tissue may cause decreased nut set. Also, the palm may die if the growing tip is destroyed or from a secondary infection (Hinckley, 1973). The CRB is one of the most damaging insects to coconut palms.

3. Distribution of CRB

CRB is native to Southern Asia and distributed throughout Asia and the Western Pacific including Sri Lanka, Upolu, Samoa, American Samoa, Republic of Palau, New Britain, West Irian, New Ireland, Pak Island and Manus Island (New Guinea), Fiji, Cocos (Keeling) Islands, Mauritius and Reunion (USDA, APHIS, 2007).

4. History of CRB in Guam

CRB was first detected on Guam on September 12, 2007. Delimiting surveys conducted at that time indicated that the infestation was limited to the Tumon Bay and Faifai Beach, an area of approximately 900 acres. Guam Department of Agriculture placed a quarantine on all properties within the Tumon area and later expanded the quarantine to greater than 5,830 acres. The current quarantine is 28,362 acres. See appendix A for a map of the quarantined area on Guam and appendix B for the number of CRB captured by the beginning of June in 2009, 2010, and 2011, demonstrating the expansion of the beetle on the island.

B. Purpose and Need

The purpose of the proposed action is to expand the CRB eradication program on Guam because of the high economic damage potential of this insect and the high probability of its spread to uninfested areas, such as other islands in Micronesia, Hawaii, and beyond (Smith and Moore, 2008). Recent evidence suggests that despite using traps and quarantines to limit its spread on Guam, the breeding range of this non-indigenous insect has grown. It has now spread into parts of Piti and into the Leo Palace or Manengon hills area (Ridgell, 2011). In addition, the insecticides that the program had been using in the Tumon Bay and Faifai Beach area have not been effective in controlling CRB and are not being used. Therefore, there is a need to add insecticides that are effective against CRB to the integrated eradication control program, and to increase the area of program activities, including the use of effective insecticides, beyond the Tumon Bay-Faifai Beach area.

II. Alternatives

This EA analyzes the potential environmental consequences associated with the proposed action to expand a program to eradicate CRB from Guam. Two alternatives are being considered: (1) no action by APHIS by maintaining the eradication program at the current level, and (2) the preferred alternative, to expand the eradication program by increasing the area of action and including effective insecticides.

A. No Action

Under the no action alternative, APHIS, in cooperation with the Guam Department of Agriculture, would continue to implement regulatory control (quarantine restrictions), delimitation, mass trapping, survey, CRB sinks, and sanitation throughout Guam. Including new, effective insecticides to control CRB would not be used and the eradication program would not be expanded to other infested areas of Guam beyond the Tumon Bay-Faifai Beach area.

Regulatory control consists of APHIS and the Guam Department of Agriculture establishing a quarantine. All host material from within the quarantine area is prohibited from moving outside the area, except under a limited permit issued by an Agriculture Officer. See appendix A for a map of the quarantine area.

Delimitation and mass trapping strategies use the same methodology in trap design and location; only the trapping density differs. CRB bucket traps are made from five gallon buckets and fitted with a plastic vane. A commercially available lure containing a synthetic aggregation pheromone, ethyl 4-methyloctanoate, is suspended from the vane and attracts both sexes of the adult beetle. Traps are located in open areas where a higher percentage of beetles are captured rather than more densely vegetated areas. The traps are suspended from branches and existing aerial supports or placed on poles at a height of about 8 feet. Attracted beetles strike the vane and fall into the bucket. Once inside the bucket the beetle lacks enough space to escape. The traps are non-lethal and are checked and emptied once every one to two weeks. Collected beetles are placed in specimen jars and delivered to the University of Guam for sexing and recording. All traps are numbered for accountability and for database record reference.

Delimitation trap density is about 1 trap per 1,340 acres and covers a grid encompassing the entire island. Additional traps are placed at a density of 1 trap per acre in areas classified as having a high probability of material moved from the quarantine area. Mass trapping is aimed at reducing numbers or eliminating the adult beetles. Trap density for mass trapping is 1 trap per acre.

Reconnaissance surveys supplement delimitation trapping by visually identifying locations having feeding damage or the presence of grubs in dead palms and logs. Surveys are done on all of the area within the quarantine boundary, in areas where trap captures indicate the presence of CRB, and in areas where sightings of CRB or CRB damage is reported.

Infested sites are cleaned . Site cleaning consists of removing all ground or other debris within 10 meters of the flagging that marks an infested site. Dead palms and other dead trees are felled. Heavily infested live trees of low or no value are also felled because CRB uses the tops of these for larval breeding sites. Stumps are dug out or cut flat to protrude no more than six inches above the ground. Cleaning will result in a raked finish with only light litter (0-1 inch deep) remaining. Undeveloped lots may be cleared of over-story vegetation using equipment. All material is chipped on-site or loaded in such a way that material will not be blown or lost while in route to the processing site.

Green waste and other organic material collected from feeding and breeding sites and from landscape maintenance within the quarantine area is processed at the processing site. Debris is chipped or ground to within a maximum of ½-inch particle size in two dimensions. Chipping or grinding is accomplished within one day of delivery of the debris to the processing site. Chipped material is composted. The finished compost is made available for use only within the quarantine eradication area.

Recent evidence suggests that despite using these methods alone without effective insecticides to limit CRB spread on Guam, the breeding range of this non-indigenous insect has grown. It has now spread into parts of Piti and into the Leo Palace or Manengon hills area (Ridgell, 2011). In addition, the insecticides that the program had been using in the Tumon Bay and Faifai Beach area have not been effective in controlling CRB and are not being used. Therefore, there is a need to add insecticides that are effective against CRB to the integrated eradication control program, and to increase the area of their use beyond the Tumon Bay-Faifai Beach area.

B. Preferred Alternative

The expanded CRB eradication program (preferred alternative) is a cooperative effort among APHIS, the Guam Department of Agriculture (GDA) and the University of Guam (UOG). Under the preferred alternative, APHIS, GDA and UOG would continue the activities included in the no action alternative (regulatory control (quarantine restrictions), delimitation, mass trapping, survey, CRB sinks, and site cleaning) but would also add insecticide treatments using cypermethrin, pyriproxyfen, and the entomopathogen *Metarhizium majus* as tools to eradicate CRB from Guam.

Insecticide Treatments

Tree crowns: Using a lift or ladder, program personnel will ascend to the tree crown and remove all adults and immature beetles from any boreholes, frond bases, or other visible areas. Insecticide will be sprayed inside any boreholes and frond basal areas. The insecticide cypermethrin (demon®Max) will be used, applied at a maximum 0.1% emulsion concentration. Spraying will be followed by filling the boreholes with urethane foam. Nuts will be removed from trees prior to treatment of tree crowns and bore holes.

Stumps: Stumps of felled trees, to prevent beetle emergence from within or under the stump, will be treated with one of the following:

- cypermethrin (demon®Max) applied at a maximum 0.1% emulsion concentration
- pyriproxyfen, (NyGuard®) applied at a maximum 56 ml/50 gal water

Larval breeding sites: Larval breeding sites consist of piles of rotting or composting plant material from coconuts or mixed with other organic matter. These piles serve as attractive locations for beetles to lay their eggs. Eggs hatch and larvae live and feed in the debris pile. Larval breeding sites would be treated with one of the following insecticides:

- cypermethrin (demon® Max) applied at a maximum 0.1% emulsion concentration
- pyriproxyfen, (NyGuard®) applied at a maximum 56 ml/50 gal water

In addition to synthetic insecticides to control CRB larvae, the entomopathogen *Metarhizium majus*, applied as powdered spores, will be used in larval breeding sites, particularly in areas where cypermethrin and pyriproxyfen cannot be used. Studies have indicated that this fungus can be used for microbial control of CRB (Latch and Falloon, 1976; Gopal et al., 2006).

All insecticide treatments are applied with a backpack or power sprayer. Allowable application, protective equipment, exclusion, dosage, and entry restrictions will follow the label instruction of the insecticide specified. Only licensed applicators or persons working under the supervision of a licensed applicator shall apply insecticides. Areas will be retreated at specified intervals based upon the label directions, persistence of the insecticide, and environmental conditions. No application of insecticides will be made within 100 feet of streams, drainages, or the intertidal high water mark.

III. Affected Environment

This section of the EA presents the baseline conditions of socio-economic and environmental resources that could be impacted by CRB eradication activities. APHIS uses this information as the basis against which potential impacts of the program are evaluated.

1. Demograhic Information

As of April 1, 2010, Guam's population totaled 159,358 (U.S. Census, 2010). In 2010, the municipalities of Mongmong-Toto-Maite, Chalan Pago-Ordot, and Mangilao showed the highest population increase since 2000 while the southern villages of Inarajan, Umatac, Agat and Merizo revealed a population decline. Demographic information from the 2010 census that will contain demographic, social, economic and housing characteristics will not be released until 2012. However, from the census taken in 2000, the population was 37.1 percent Chamorro, 26.3 percent Filipino, 11.3 percent other Pacific islander, 6.9 percent white, 6.3 percent other Asian, 2.3 percent other ethnic origin or race, and 9.8 percent mixed (U.S. Census, 2000). Median household income in 1999 was $39,317, and per capita income was $12,722 (U.S. Census, 2000). The economy in Guam is largely dependent on tourism as well as U.S. military spending due to the military presence on the island.

2. Ecological Resources

At the northern half of the island the area is typically flat limestone plateau with abrupt cliffs toward the ocean. The limestone soils in these areas are forested where they have not been cultivated or urbanized. The southern part of the island has rolling to mountainous terrain associated with deeply weathered volcanic soils. The volcanic soils on the southern half of Guam are covered primarily by grassland, with some ravine forest occurring in sheltered and leeward sites (Donnegan et al., 2002). Guam has more than 600 plant species on the island with 100 of those being trees. In total the forested area on Guam occupies approximately 63,830 acres, with limestone forest accounting for about 70 percent of that total (Donnegan et al., 2002). Guam is approximately 48 percent forested, with an additional 33 percent covered by grass and shrublands and has an estimated 1,162,494 coconut palms (*Cocos nucifera*) in its forests with a gross volume of 13,619,659 cubic feet (Donnegan et al., 2002).

Guam has a range of fish and wildlife resources that occupy its various terrestrial habitats as well as fresh and saltwater areas. The flora and fauna on Guam have been impacted by significant disturbance agents, including frequent tropical storms and typhoons, human-caused grassland and forest fires, introduction of domestic animals and invasive species, mass soil movements and erosion, historical military actions, and timber harvest. The introduction of invasive species such as the brown tree snake have been especially detrimental to the native bird and fruit bat fauna on the island. Guam is also home to several aquatic and terrestrial species that are protected under the Endangered Species Act. Several of these species occur on the Guam National Wildlife Refuge which is a 22,500 acre refuge overlain on military lands at the northern tip of Guam. Guam has also designated five marine preserves to protect coral reef habitats and associated marine animals. One of the preserves is located on the north eastern tip of the island, Pati Point, while three lay in close proximity to each other on the western side of the island (Tumon Bay, Piti Bomb Holes, Sasa Bay) and the fifth preserve, Achang Reef Flat, is on the southern tip of the island.

3. Environmental Quality

Guam has a wide diversity of freshwater and marine aquatic habitats. Assessment of the water quality in these habitats is variable based on the type of water body. Assessed wetlands are approximately 0.4 percent of the total on the island while approximately 37 percent of river/stream miles have been assessed for water quality (EPA, 2011a). Of the rivers and streams that have been assessed, approximately 34 percent are listed as impaired under Section 303(d) of the Clean Water Act (CWA) due primarily to turbidity. Other reasons for impairment include bacteria, dissolved oxygen, as well as some metals and other physical water quality parameters (ex. temperature). In bays/estuaries and shoreline areas, the impaired waterbodies relative to those that are not impaired is much greater than for rivers and streams. In bays and estuaries the major reason for impairment of those types of water bodies is the contamination of fish tissue with polychlorinated biphenyls (PCBs), while along shorelines, impairment is due to *Enterococcus* bacteria contamination (EPA, 2011a). Similar to bays and estuaries, the reason for impairment in wetland habitats is related to PCB contamination. Pesticides as a cause of impairment is only listed for bays and estuaries and is related to the organochlorine insecticides chlordane and dieldrin.

Air quality in Guam currently meets Environmental Protection Agency standards based on information from earlier this year with the exception of two areas that occur near power plants (EPA, 2011b). Available information shows that non-attainment of air quality standards due to sulfur dioxide levels occur in the Piti and the Tanguisson areas.

IV. Environmental Impacts

A. No Action

Environmental impacts from the no action alternative, including regulatory control (quarantine restrictions), delimitation, mass trapping, and sanitation as well as insecticides that are not being used (imidacloprid, carbaryl, chlorpyrifos, bifenthrin, and methyl bromide) but were proposed for use have been analyzed in the 2007 EA that was prepared for this program (USDA, APHIS, 2007). At that time, it was expected that the proposed components of the eradication program would be effective in controlling CRB. However, the proposed insecticides did not prove effective and site cleaning and trapping alone have not been successful in controlling CRB on Guam.

Impacts that could result from APHIS' implementation of the no action alternative relate primarily to economic and environmental effects related to the spread of CRB throughout Guam. Damage from CRB to local host plants would be substantial if a viable pest population were to spread and become established throughout Guam. Any host plant damage from the anticipated spread would soon be much greater than any impacts from the initial host plant removal contemplated under an integrated eradication program. Based on historical data from previous introductions of CRB in other areas the loss of palms could reach 50 percent. In the tourist area of Tumon, for example, a conservative estimate of loss of palms is 2,000 trees, and with an approximate replacement value of $2,500, could result in replacement costs of two and a half million dollars (Moore, 2009). Since tourism is a large part of the Guam economy the damage and loss of palms to resort, park, and residential shade and ornamental plants from CRB could result in reductions in private property values and loss of tourism. Economic impacts would also be anticipated if CRB becomes established in palm plantations on Guam, affecting production costs as well as diminishing yields through the loss of trees. Its establishment in Guam would also put other islands at risk from introduction of CRB where coconut is an important economic and subsistence crop for many Pacific island states (Smith and Moore, 2008). A permanent infestation could also lead to additional interstate and international quarantine restrictions affecting both Guam and the United States in general.

From an environmental perspective the loss of native palms would impact the diversity of forests in Guam and result in increased erosion on beaches where palms and other vegetation provide protection against erosion (Mimura and Nunn, 1998; Moore, 2009). In addition, a lack of increased APHIS efforts to control CRB damage would likely result in control efforts by other public and private entities, including landscapers and landowners. Most actions of these groups would be uncoordinated and spread of CRB is likely if an established population were not cooperatively managed. Individual efforts to limit plant damage would be expected to potentially involve use of insecticides with increasing frequency resulting in increased pesticide loading in the environment and risk to human health and the environment.

B. Preferred Alternative

Pyriproxyfen

Pyriproxyfen is part of a group of insecticides known as insect growth regulators that act as a juvenile hormone (JH) analog. Juvenile hormones are produced in insects naturally and are important in development, reproduction, and diapause. In this case, the JH analog is used as an insecticide to prevent larval insects from maturing to adults. Pyriproxyfen has several agricultural and non-agricultural uses in controlling a variety of insect pests. Its proposed use in the CRB program would be as applications to stumps or larval breeding sites using the formulation NyGuard® applied with a backpack sprayer.

1. Human Health Toxicity and Risk

Acute toxicity data for the pyriproxyfen active ingredient and the proposed formulation demonstrate very low toxicity from oral, dermal, or inhalation exposures. Median lethality values (LD/LC_{50}) for all three exposure pathways are greater than the highest test concentrations suggesting the formulation is practically non-toxic in acute exposures. Handling the formulated product can result in eye and skin irritation. In longer term studies pyriproxyfen has been shown to have low toxicity with no observable effect levels well above any exposures scenarios that could occur in the proposed program (EPA, 2009). Pyriproxyfen, and associated metabolites, are not considered to be carcinogenic or mutagenic based on available mammalian studies to support registration of the active ingredient (Bayoumi et al., 2003; EPA, 2009). Available mammalian toxicity data that has been submitted for registration of pyriproxyfen does not indicate any effects related to endocrine disruption. The greatest risk of exposure will be to workers during application. Applications will only be made by certified personnel following all label recommendations regarding worker safety. None of the treatments will be made to host plant material that would be consumed by humans; therefore, significant dietary exposure and risk is not anticipated. Exposure to pyriproxyfen from drinking water is also not anticipated due to the method of application, the environmental fate of the chemical, and the use of application buffers to protect surface water. The greatest possibility of exposure for the general public would be with the treatment of larval breeding sites and possible consumption of treated soil or host plant material after application. The risk from this type of exposure to the public is very low based on the available toxicity data and conservative assumptions regarding exposure.

2. Ecological Toxicity and Risk

Proposed pyriproxyfen applications are not expected to have adverse impacts to fish and wildlife based on the method of application, the low toxicity of the insecticide to most organisms, and program mitigations to reduce exposure and risk. Pyriproxyfen has low toxicity to wild mammals and birds, suggesting very little direct risk, and based on the mode of action of pyriproxyfen and the small areas of treatment, would not be expected to have adverse impacts for those terrestrial organisms that depend on insects as prey items. Pyriproxyfen will have some impacts to non-target terrestrial invertebrates but these impacts will be minimized by the small area of treatment and the selective nature of the insecticide. Available acute contact toxicity data for pollinators shows that pyriproxyfen is practically non-toxic to adult honeybees (EPA, 2011c). No toxicity has also been observed in adult bumblebees nor to male production and brood production. However, pyriproxyfen may impact larval bumblebee mortality at concentrations not anticipated from applications in this program (Mommaerts et al., 2006). Pyriproxyfen toxicity to aquatic organisms is variable with acute toxicity above water solubility (0.367 milligrams per liter) for most fish species, suggesting low acute risk to aquatic vertebrates (EPA, 2011c). Sublethal impacts in acute and chronic exposures can occur at concentrations in the low part per billion range for fish and in the part per trillion range for aquatic invertebrates (EPA, 2011c; Sihuincha et al., 2005; Matsumoto et al., 2008). Median lethal acute effects to aquatic invertebrates vary from the middle to upper part per billion range, depending on the test species (EPA, 2011c). Direct or indirect risk to aquatic organisms through loss of food items is expected to be low, based on the application method previously described that will reduce the likelihood of off-site drift and runoff, and the implementation of a 100-foot application buffer from aquatic areas.

3. Environmental Quality

Impacts to soil quality from pyriproxyfen applications are not expected, based on where treatments will occur and its fate in soil. Applications are directed primarily at stumps or small areas where larval host material occurs. Any contact with soil will be localized and not expected to persist, based on field dissipation half-lives ranging from 3.5 to 16.5 days and aerobic soil metabolism half-lives of less than two weeks (CA DPR, 2000). Pyriproxyfen is not anticipated to have impacts to air quality, based on the proposed method of application and environmental fate for the insecticide. Pyriproxyfen has a low vapor pressure suggesting that volatilization into the atmosphere from plants and soil will be minimal. Some material may be present in the atmosphere at the site of treatment during application but will quickly dissipate to the ground since applications are made using backpack sprayers using large, coarse droplets, reducing drift. Impacts to surface or ground water are also not anticipated due to the low solubility of pyriproxyfen in water as well as its preference to bind to soil and sediment, thus reducing the threat to surface and ground water. In addition, program operations require a 100-foot buffer from water bodies, further reducing the potential of program insecticides to impact water quality. This will also reduce the potential for volatilization from water into the atmosphere which is considered moderate for pyriproxyfen based on available fate data (CA DPR, 2000)

Cypermethrin

Cypermethrin is a pyrethroid insecticide that is a mixture of four diastereoisomers, each of which is present as a pair of enantiomers. Consistent with all pyrethroid insecticides, the mode of action is paralysis in affected organisms that occurs through effects to the axon of the nerve and subsequent paralysis (EPA, 2005). Cypermethrin has several agricultural and non-agricultural uses to control a variety of insect pests. Its proposed use in the CRB program is to treat bore holes, frond bases, stumps, and larval breeding sites using the formulation, demon®Max.

1. Human Health Toxicity and Risk

The technical active ingredient, cypermethrin, and the proposed formulation is moderately toxic in oral exposures but is considered practically non-toxic in dermal and inhalation exposures. The formulated material is severely irritating to the eye and moderately irritating to the skin. It is also considered a mild skin sensitizer. Cypermethrin is not considered mutagenic or teratogenic; however, it is considered a possible carcinogen based on results from a chronic mouse study where benign lung tumors were observed at the highest dose level. These levels are well above those expected in this program. Similar effects were not observed in other test species in chronic studies (EPA, 2007). There is data that demonstrate endocrine related impacts in vertebrates, but at residues that would not be expected to occur in this program. Jin et al. (2011) observed a decrease in testosterone levels in male mice dosed at 20 milligrams per kilogram of body weight (mg/kg). Wang et al. (2010) also observed effects to mice after maternal exposure during lactation to male offspring. Doses of 25 mg/kg resulted in reduced serum and testicular testosterone levels in male mice that returned to normal as they reached maturity; however, a reduction in testicular weights and tissue effects remained unchanged. These values are in the effect range for studies that have been submitted to support the registration of cypermethrin.

Similar to pyriproxyfen, exposure and risk will be the greatest for applicators. Adherence to personal protective equipment (PPE) recommendations will reduce risk to workers. Exposure to the general public in areas where they may frequent will be very low for cypermethrin treatments of boreholes and frond bases because the boreholes are plugged and the frond bases are well above the reach of the general public. The greatest chance for exposure to cypermethrin treatments would be through the ingestion of soil or plant material in cases where breeding sites are treated. No applications are made to parts of the plant that would be consumed as food; therefore, dietary exposure would be very low. Exposure to cypermethrin from drinking water is also not anticipated due to buffers from surface water and the extremely low probability of groundwater contamination based on the environmental fate for this insecticide. Risk to cypermethrin through the primary pathway of exposure, ingestion of soil, is very low based on the known toxicity and conservative assumptions regarding the amount of soil that would need to be consumed to reach an adverse effect.

2. Ecological Toxicity and Risk

Cypermethrin has low acute and chronic avian toxicity with reported acute median lethal doses and chronic no observable effect concentrations greater than the highest test concentration (EPA, 2005). Toxicity is high to most terrestrial invertebrates, including honey bees; however, the applications to boreholes and stumps as well as the small areas of treatment for larval sites will reduce exposure because flowers would not be expected to be treated. In addition, label language designed to protect foraging honeybees will provide additional protection from risk to cypermethrin exposure. Treatments could impact some soil borne terrestrial invertebrates; however, this will be minimized by the small treatment areas for the larval breeding sites and the affinity for the insecticide to bind to soil, reducing bioavailability (Hartnik and Styrishave, 2008). The localized impacts that could occur to some terrestrial invertebrates from treatment of larval breeding sites is not expected to pose an indirect risk to terrestrial vertebrates that depend on invertebrates for prey because they would forage over areas greater than the area of treatment.

Cypermethrin is considered highly toxic to aquatic invertebrates and vertebrates with reported median lethality values in the low parts per trillion to low parts per billion range, depending on the test species, although fish were slightly less sensitive when compared to aquatic invertebrates (Solomon et al., 2001; EPA, 2005). Acute and chronic risk to aquatic habitats is not anticipated based on the proposed method of application, environmental fate of cypermethrin, and proposed 100-foot application buffers from aquatic habitats.

3. Environmental Quality

Cypermethrin is not expected to cause adverse impacts to soil, water, or air quality due to the method of application, the environmental fate of the insecticide, and additional mitigation measures beyond those stated on the label. Cypermethrin breaks down in soil under aerobic and anaerobic conditions with half-lives of less than 65 days (EPA, 2005). Cypermethrin has very low water solubility and a high binding affinity to soil and sediment that would result in a very low probability of ground or surface water contamination. Cypermethrin that would move off-site as drift and enter surface water would dissipate quickly from the water column based on its low water solubility and affinity for sediment particles. The rapid partitioning of pyrethroid insecticides from water to sediments has been observed in field applications as well as laboratory data (Crossland, 1982). In the field, half-lives are less than a day under a variety of conditions (Agnihorti et al., 1986; Roessink et al., 2005; He et al., 2008). Surface water is further protected by adherence to label restrictions and the implementation of a 100-foot application buffer from water. Physical and chemical characteristics for cypermethrin preclude significant volatilization into the atmosphere. Cypermethrin may be present in the air as drift following an application to stumps or larval breeding sites; however, the directed hand application using large, coarse droplets will minimize the probability of any off-site drift during these types of applications. No drift is expected from the use of cypermethrin in treating bore holes that will be plugged immediately after treatment.

Metarhizium majus

Species of the genus *Metarhizium* are entomopathogenic fungi whose sporulating colonies are green in color. Species from this genus are used as biological control agents to manage various insect pests. Spores on the surface of the insect respond to chemical cues present there and germinate within 8 to 16 hours. The fungus then penetrates the insect's exoskeleton (insect's hard, outer covering) using a combination of mechanical pressure and a mixture of enzymes. Growing hyphae (long, branching filamentous cells of a fungus) usually reach the body cavity of the insect within 24 hours of germination, and the fungus grows and spreads rapidly through the insect. In a later stage of development, the insect is densely packed with fungal mycelia (masses of hyphae) and spores. The fungus kills its host by means of insect-specific toxic metabolites (destruxins), as well as tissue-disrupting enzymes. The infected insect typically dies within 7 to 14 days.

Metarhizium anisopliae var. *majus* (Tulloch, 1976; Driver et al. 2000) has been recently recognized as the species *Metarhizium majus* stat. nov. (Bischoff et al., 2009). *M. majus* is largely restricted to the genus *Oryctes* (Gillespie and Claydon, 1989; Rhombach et al., 1987; Ferron et al., 1972) and has been widely tested for the control of CRB (Ferron et al., 1975; Latch and Falloon, 1976; Marschall, 1978; Fernando et al., 1994-1995; Gopal et al., 2006). Larval, pupal, and adult CRBs are susceptible to *M. majus* (Latch, 1976). It has been collected from CRB larvae in Samoa, American Samoa, Tonga, Fiji, India, and Mauritius (Latch, 1976).

As early as 1913, *M. anisopliae* (now known as *M. majus*) was introduced into artificially produced CRB breeding sites in Samoa and has been used for field control of CRB in several countries (Latch and Falloon, 1976; Bedford, 1980). Swan (1974) summarized the literature on the CRB biological control work, including *M. anisopliae* (= *M. majus*) carried out in the Pacific Islands.

1. Human Health and Ecological Risk

Zimmerman (1993 and 2007) summarized the safety studies of *M. anisopliae* and concluded that it is safe with minimal risks to vertebrates, humans, and the environment. No toxicological or pathological symptoms were observed when the fungus was applied by different methods to birds, fish, mice, rats, guinea pigs, or rabbits. There have also been no harmful effects on honey bees, earthworms, freshwater invertebrates such as *Daphnia* sp. and Collembola. Acute oral and dermal LD_{50}s were reported as >2, 000 mg/kg (the maximum amount applied) to rats. Gopal et al. (2006) reported no toxicity of *M. majus* to *Eudrilus* sp. earthworms although 100 percent of CRB larvae were infected in the study. White mice and guinea pigs fed spores at a rate of 10 percent of their daily ration showed similar weight gains to control animals and no organ or tissue abnormalities were discovered at post mortem examination (Latch, 1976). No plant disease or toxicity effects of *M. anisopliae,* either on leaves or roots are known (Zimmerman, 2007).

C. Cumulative Effects

The selection of the preferred alternative described in this EA for the CRB eradication program is not anticipated to have a significant cumulative impact on human health or the environment. There will be an increase in insecticide loading in certain areas; however, it is anticipated that with a cooperative integrated approach, insecticide use would be less compared to permanent establishment of CRB on Guam that could occur under the no action alternative. Insecticide use would not be expected to have cumulative impacts to soil, air, or water quality beyond baseline conditions based on the proposed method of application, the environmental fate of pyriproxyfen and cypermethrin, and in the case of surface water, the use of a 100-foot application buffer for both insecticides. Both insecticides do have wide uses and may be used on Guam for other purposes; however, their use in areas where CRB detections would be likely to occur would be expected to be minimal. The use of the entomopathogenic fungus *M. majus* is also not anticipated to have significant cumulative impacts to human health or the environment based on its lack of toxicity to vertebrates and other non-target organisms. This fungus is specific to beetles in the *Oryctes* genus. Its anticipated use in the program will be only for larval breeding sites in areas where cypermethrin and pyriproxyfen can not be used; therefore, no cumulative impacts from the use of two control treatments would be anticipated.

D. Threatened and Endangered Species

Section 7 of the Endangered Species Act and its implementing regulations require Federal agencies to ensure their actions are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat.

APHIS has prepared a biological assessment (BA) that considers the effect of the proposed eradication program on federally listed threatened and endangered species in Guam. APHIS has determined that the program will have no effect on the little Mariana fruit bat, Guam Micronesian kingfisher, Guam rail, Guam bridled white-eye, Micronesian megapode, or nightingale reed-warbler. APHIS has also determined that with the implementation of certain protection measures, the proposed program may affect, but is not likely to adversely affect the Mariana fruit bat and its critical habitat, Mariana crow and its critical habitat, Mariana common moorhen, Mariana gray swiftlet, the critical habitat of the Guam Micronesian kingfisher, and green and hawksbill sea turtles. APHIS has requested concurrence with these determinations from the U.S. Fish and Wildlife Service.

E. Other Considerations

Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," focuses Federal attention on the environmental and human health conditions of minority and low-income communities, and promotes community access to public information and public participation in matters relating to human health and the environment. This EO requires Federal agencies to conduct their programs, policies, and activities that substantially affect human health or the environment in a manner so as not to exclude persons and populations from participation in or benefiting from such programs. It also enforces existing statutes to prevent minority and low-income communities from being subjected to disproportionately high or adverse human health or environmental effects. The human health and environmental risks from the preferred alternative are expected to be minimal and are not expected to have disproportionate adverse effects to any minority or low-income family.

EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks," acknowledges that children, as compared to adults, may suffer disproportionately from environmental health and safety risks because of developmental stage, greater metabolic activity levels, and behavior patterns. This EO requires each Federal agency to identify, assess, and address environmental health risks and safety risks that may disproportionately affect children. The program applications are made directly to trees, stumps, as well as small areas that are larval breeding sites in undeveloped lots, landscape areas surrounding hotels and businesses, and within public parks. Many of these sites would be in locations where children would not be expected to be present. In cases where applications could be made in public areas where children are present, the program applicators ensure that the general public is not in or around areas being treated to minimize exposure during application. The only possible exposure could occur from a child playing in the treated soil or on treated stumps. The available human health data and very conservative assumptions regarding ingestion of treated soil or host material suggests that risks to children in these types of scenarios would be extremely low in cases of exposure for each proposed program treatment. Therefore, it was determined that no disproportionate effects on children are anticipated as a consequence of implementing the preferred alternative.

Consistent with the National Historic Preservation Act of 1966, APHIS has examined the proposed action in light of its impacts to national historic properties. On October 24, 2011, a letter was prepared and sent to the State Historic Preservation Officer (SHPO). APHIS will continue to work with the SHPO to address potential questions or concerns regarding CRB eradication activities that could occur on properties protected by the National Historic and Preservation Act.

IV. Listing of Agencies and Persons Consulted

U.S. Department of Agriculture
Animal Plant Health Inspection Service
PPQ–Emergency and Domestic Programs
4700 River Road, Unit 26
Riverdale, MD 20737

U.S. Department of Agriculture
Animal Plant Health Inspection Service
PPQ–Environmental Compliance Team
4700 River Road, Unit 150
Riverdale, MD 20737

U.S. Department of Agriculture
Animal Plant Health Inspection Service
PPD–Environmental Services
4700 River Road, Unit 149
Riverdale, MD 20737

Russell K. Campbell, Ph.D.
Territorial Entomologist & Administrator
Guam/USDA Plant Inspection Facility
Guam Department of Agriculture
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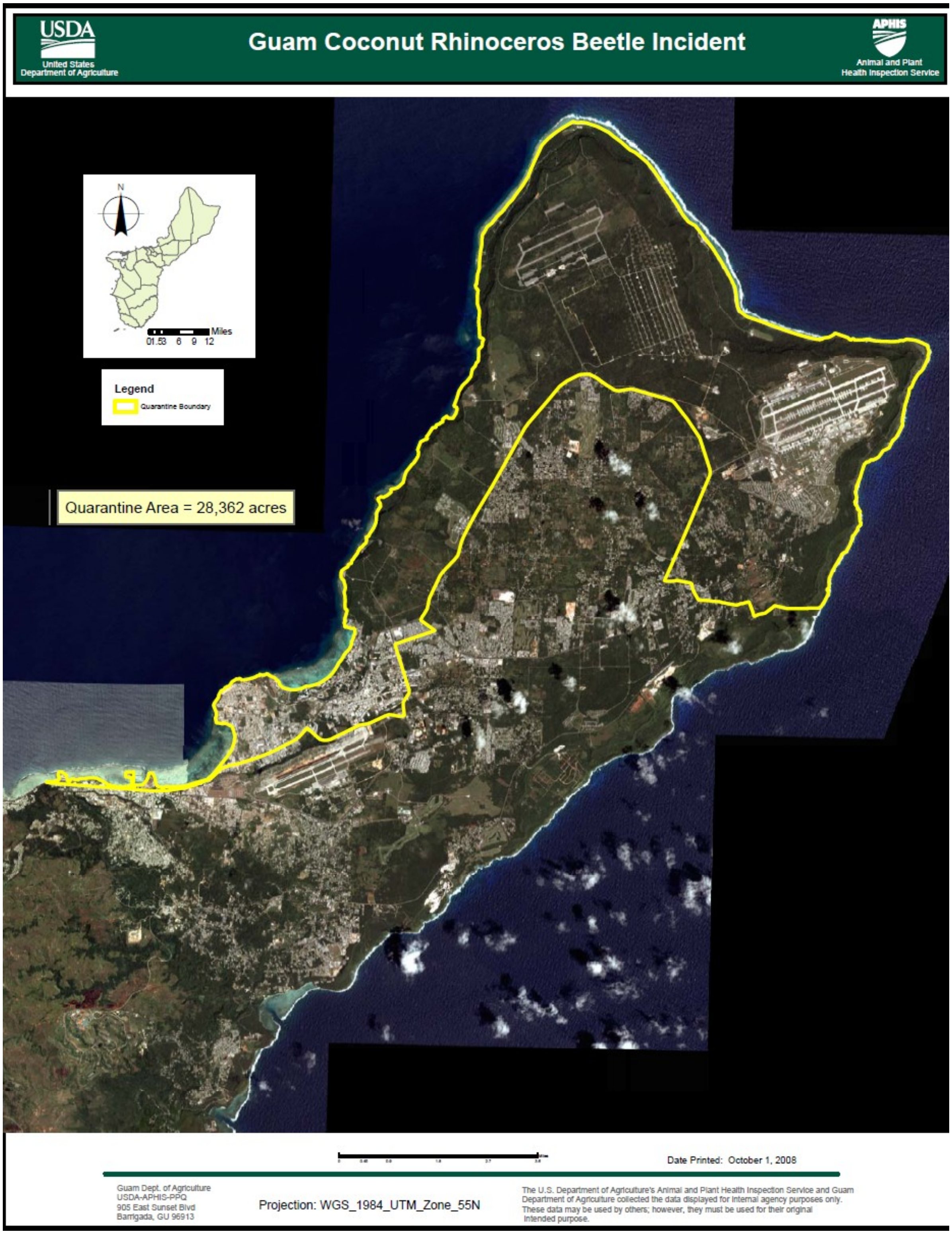
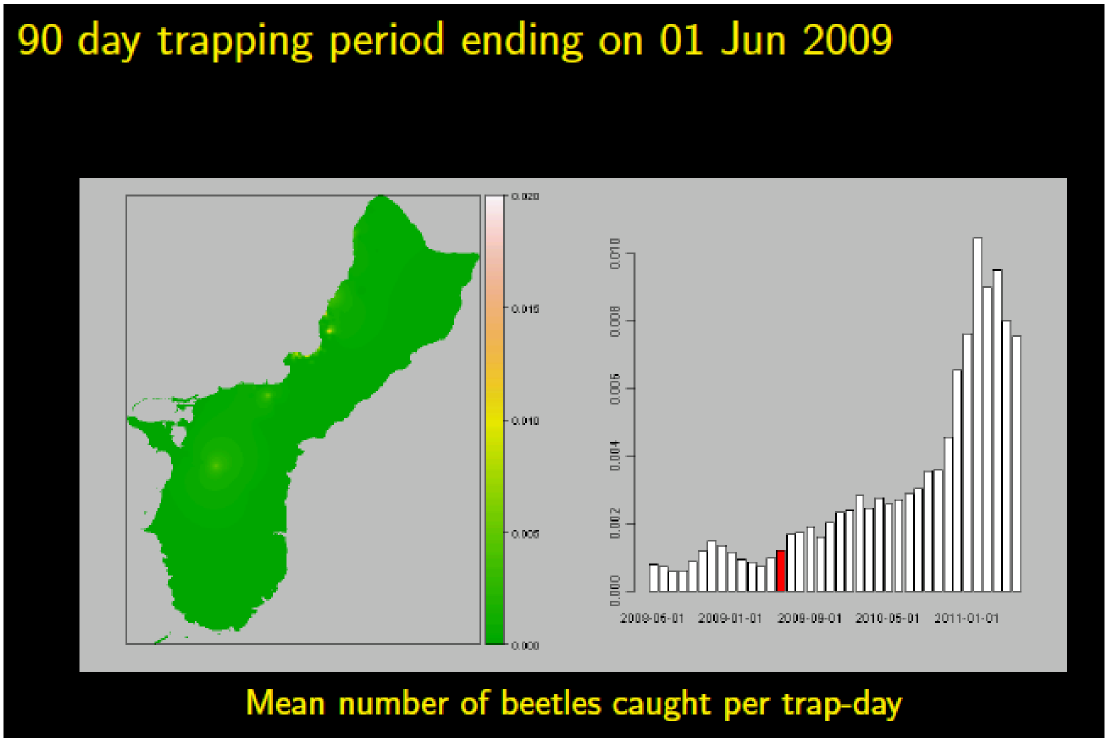
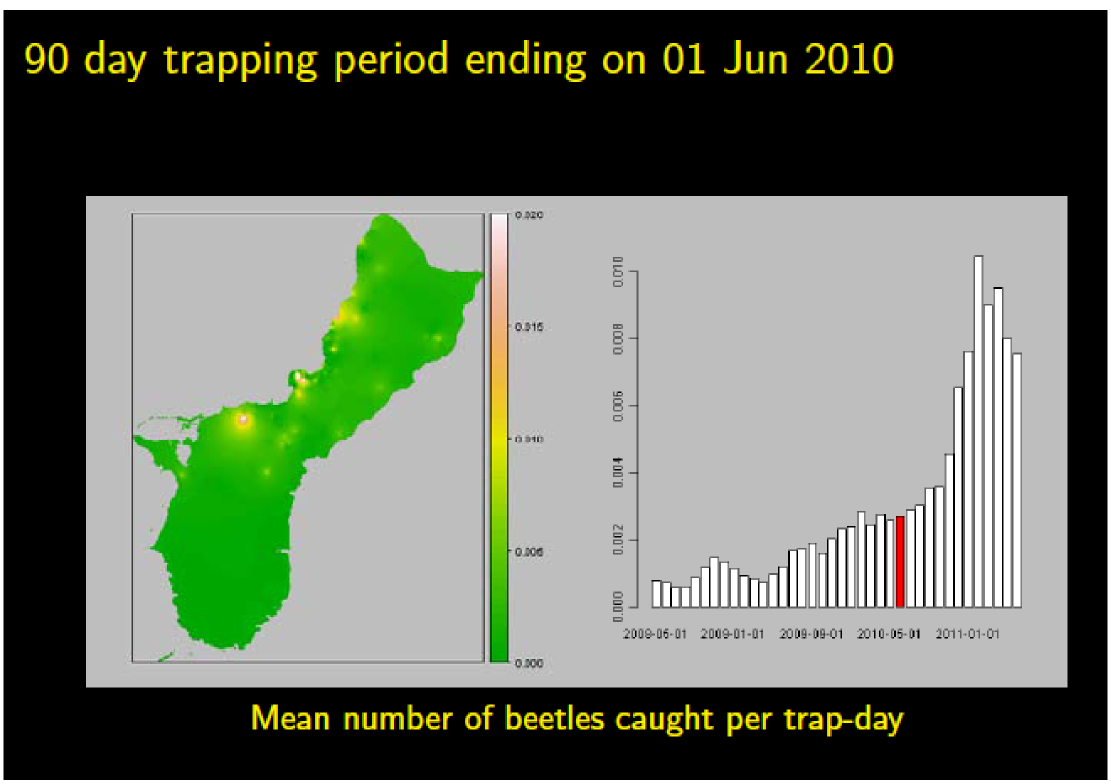
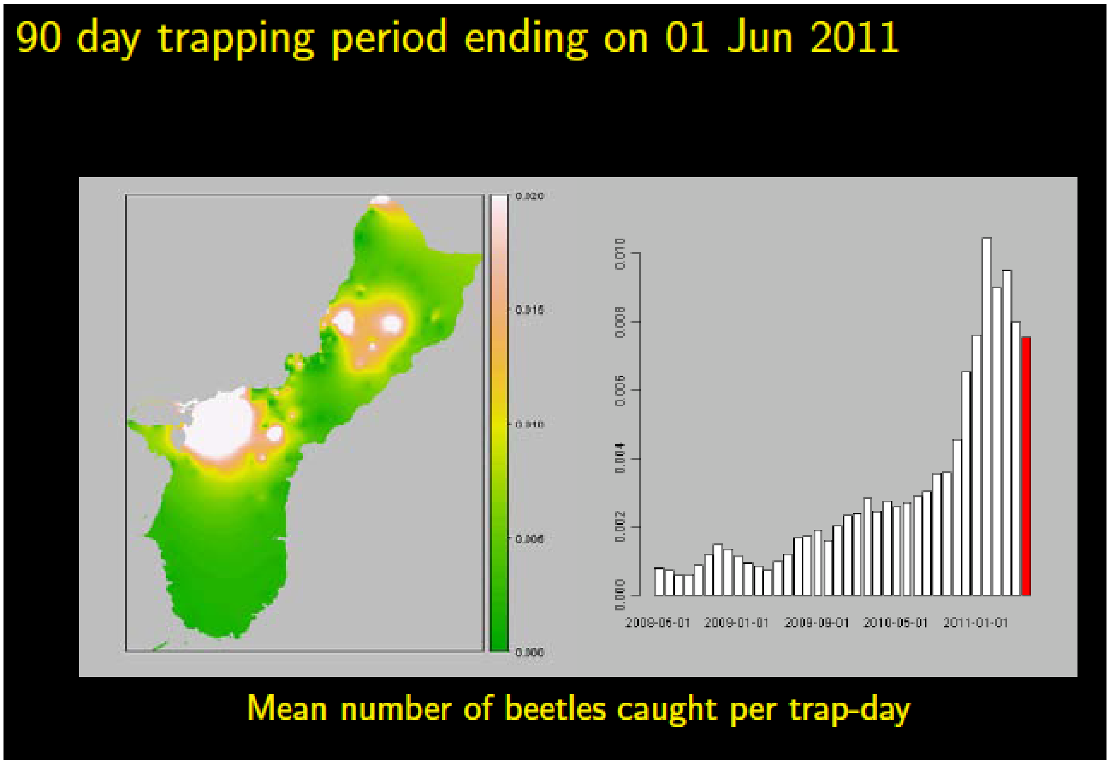
Appendix A. Quarantine boundary for CRB in Guam.



Appendix B. Number of CRB captured by the beginning of June in 2009, 2010, and 2011, demonstrating the expansion of the beetle on Guam (Moore, 2011).






90 day trapping period ending on 01 Jun 2011
0.020
0.015
0.010
0.005
0.000
0.010
0.008
0.006
0.004
0.002
0.000
2008-05-01
2009-01-01
2009-09-01
2010-05-01
2011-01-01
Mean number of beetles caught per trap-day