Special Issues Grant Proposal for Submission to the Western IPM Center

Development of Acoustic Methods for Detecting Coconut Rhinoceros Beetles on Guam

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Probable Duration: 6 months

Abstract

We request funding to test the feasibility of using acoustic methods to detect adult coconut rhinoceros beetles (CRB), *Oryctes rhinoceros,* boring into the crowns of coconut trees. These large scarab beetles kill palms when they bore onto the growing tip. Thousands of mature ornamental palms are at risk in the Tumon Bay tourist hotel district of Guam from a CRB infestation detected in September 2007. Acoustic detection may allow us to protect individual high-value trees by physical removal of beetles and/or by spot treatment with insecticide. Acoustic detection instrumentation may also be deployed as monitoring devices in an established eradication program.

Introduction

An infestation of the coconut rhinoceros beetle (CRB), *Oryctes rhinoceros*, was detected on Guam on September 11, 2007 in the Tumon Bay hotel district. This large scarab beetle is a major pest of coconut and other palms. CRB grubs feed in rotting coconut logs and associated debris. Adult beetles bore into the crowns of palm trees to feed on sap. If a beetle bores through the growing tip, the tree will die. After CRB invaded the Palau Islands during 1942, fifty percent of coconut trees were killed and some islands lost all of their coconut trees (Gressitt 1953). Coconuts are not a major agricultural crop on Guam. However, coconuts and other palms are very important in tourist hotel landscapes and they are a major component of Guam's forests. It currently costs about $1,000 to replace a mature coconut tree on hotel property, so the CRB infestation poses a significant economic threat to Guam's tourism industry.

Surveys indicate that the CRB infestation in Guam is limited to about 1,360 acres along the western coast, extending from Oka Point in the south to Tanguisson Beach in the north. An eradication project, funded by the Government of Guam and USDA-APHIS, is being managed under an incident command system. The project uses mass trapping with a commercially available synthetic aggregation pheromone to kill adults, coupled with removal of coconut logs and other breeding sites to kill immatures and prevent reinfestation. Recent observations indicate that mass trapping at a density of one trap per acre is insufficient to intercept all beetles before they bore into coconut tree crowns. When infestation of a palm is suspected, a tree climber is employed to inspect the crown, remove beetles, and apply insecticide. Due to resource

limitations, only a few palms per day can be protected in this way. We are also investigating the feasibility of using prophylactic trunk injections of systemic insecticides to protect high value palms.

Here, we propose a short-term project to evaluate the use of existing acoustic technology for rapid detection of adult rhino beetles in palm tree crowns and grubs in coconut logs and stumps. We are asking for financial support to fund a visit to Guam by Richard Mankin, a recognized expert in acoustic detection of insects.

CRB is an ideal candidate for acoustic detection. Adults and grubs of these large and powerful scarabs undoubtedly generate detectable feeding sounds. In addition pupae and adults communicate by stridulation (Darwin 1871, Gressitt 1953, Mini & Prabhu 1990). Moore (unpublished) has already recorded airborne stridulation sounds in the laboratory (Fig. 1) and these have been characterized by Mankin (unpublished), who has also recorded and analyzed stridulations from a close relative of this beetle in Australia, (Fig. 2). Our main objective is to see if we can use acoustic technology to detect adult rhino beetles in coconut palm crowns and immatures plus adults in dead coconut logs. Detection of CRB adults feeding in treetops seems feasible. According to Gressitt 1953, "In India, individuals are said to have developed the faculty of detecting adult feeding tin the crown of a palm by holding an ear against the trunk." More recently, sounds and vibrations from wood boring insects have been successfully detected using electronic instrumentation and identified using digital signal analysis (Mankin et al. 2008, Mankin et al. 2002).

Plan of Work

- Assess whether CRB can be detected by acoustic methods in coconut palms, dead coconut logs, and other breeding sites (Gressitt 1953) in the hotel district and western coast of Guam.
- Define the current benefits and limitations of the technique, and its potential role in IPM programs to eradicate CRB from Guam.
- Develop recommendations for future research needs and/or further CRB monitoring. Preliminary results will be presented in a public seminar at the University of Guam near the end of Dr. Mankin’s trip.

Two types of portable acoustic detection instruments will be field- and laboratory-tested over a two-week period: a general-purpose Bruel and Kjaer accelerometer system and an AED-2000 system specifically designed for insect detection. Both systems have been used previously for detection of beetle larvae in trees (e.g., Mankin and Lapointe 2003). CRB are large and active; consequently, they are likely candidates for acoustic surveillance. We have identified already several areas with potentially infested sites where the instruments could be tested. In previous tests with similarly sized or smaller insects, experienced listeners with headphones and recorders have assessed presence or absence of infestation at approximately ten recording sites per hour with good reliability. The assessment can be double-checked using signal processing software (Mankin et al. 2000) that discriminates insect sounds from background noise by analysis of their spectral and temporal patterns.

One potential concern is that wind, traffic, or other extraneous noises could degrade the signals passing from the tops to the bases of the coconut trees, and reduce the detectability of the CRB below acceptable levels. Dr. Mankin's visit provides an opportunity to evaluate, at minimal cost, the feasibility of acoustic techniques, the desirability of future research, and the benefits or drawbacks of incorporating acoustic technology into the eradication program. It also provides and opportunity for Dr. Moore to obtain experience with the use of such equipment if it is determined to be of value. During the visit, we also will develop protocols for recording and digital signal analysis of pupal and adult stridulations and larval and adult feeding sounds recorded in the laboratory. A large number of adults and grubs which can be used for laboratory studies are already being reared.

References

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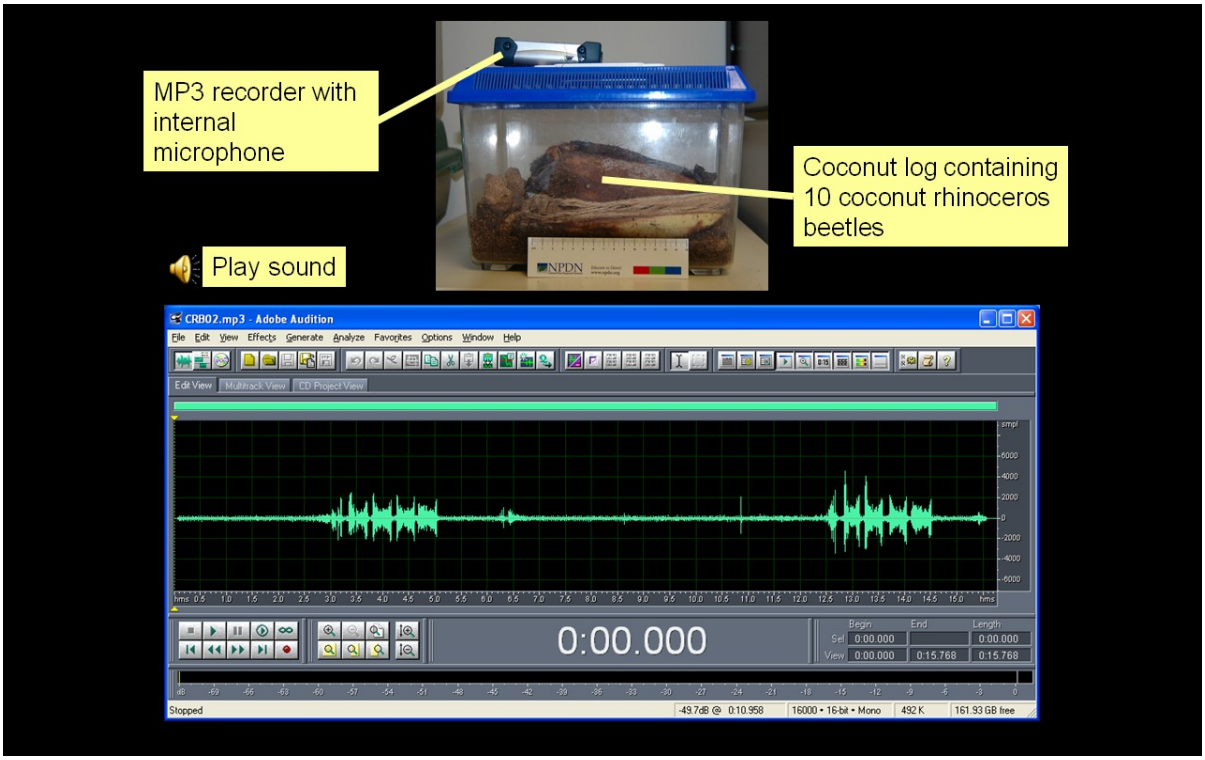
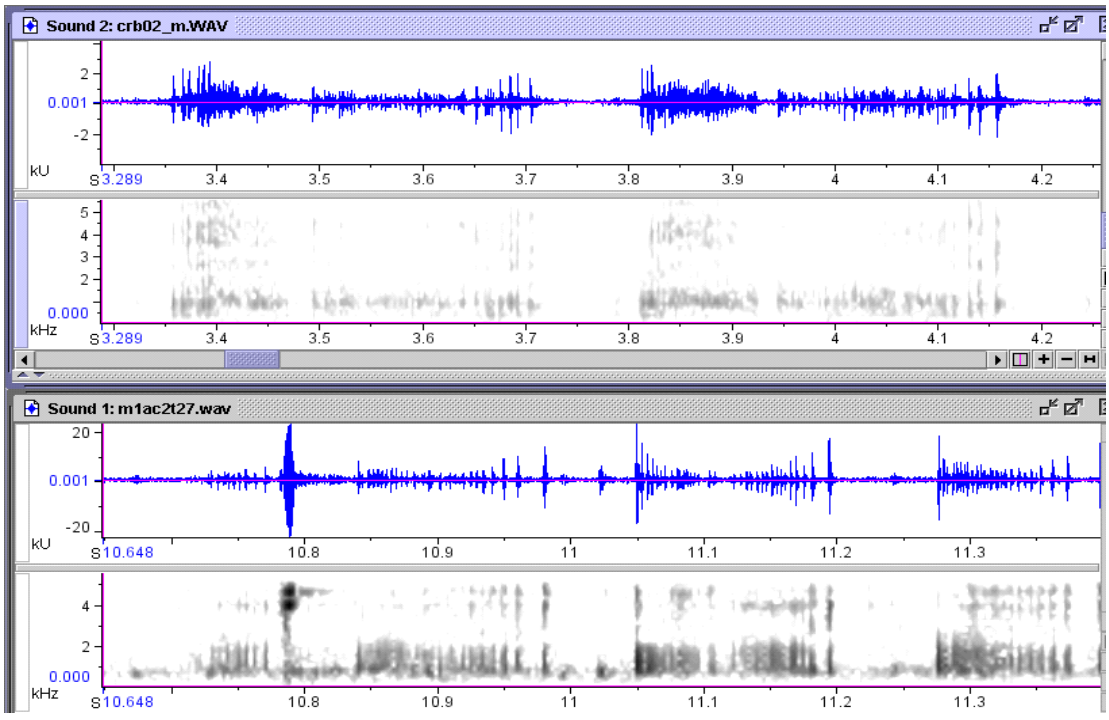


Figure 1. Laboratory recording of a stridulating coconut rhinoceros beetle.

Oryctes rhinoceros



Dasygnathus sp.

Figure 2. Oscillograms and spectrograms comparing stridulations produced by *Oryctes rhinoceros* and a related Australian Dynastinae, *Dasygnathus* sp.

Budget

Air Fare (Florida to Guam, return)	$2,300
Hotel, Per diem (14 days @ $150/day)	$2,100
Miscellaneous supplies	$ 100
	$4,500

Budget Narrative:

Air fare was the lowest price that could be obtained on travel and return between Gainesville and Guam.

Hotel is estimated at $115 per night and per diem at $35 per day.

Batteries, nails or stakes, marker flags, protective covers for instruments, etc. will be purchased as needed.